HUDSON RIVER ECOLOGICAL STUDY IN THE AREA OF INDIAN POINT
1977 ANNUAL REPORT

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SECTION I

INTRODUCTION

The 1977 Indian Point ecological study and impingement monitoring program conducted by Texas Instruments Incorporated (TI) for Consolidated Edison Company of New York Incorporated (Con Edison) and for the Power Authority of the State of New York (PASNY) represents the eighth in a series of ecological studies initiated in 1969 to determine the impact of the Indian Point nuclear generating station on the Hudson River aquatic biota in the nearfield (RM 39-46). Since 1972, TI has continued to monitor impingement at the Indian Point generating station and fish populations in the Indian Point nearfield region.

The major objectives of the Indian Point report series (TI 1972, 1973, 1974b, 1975b, 1976c, 1977d) have been to: 1) report on fish collections from the intake screens at Indian Point and examine plant operating and river conditions that may influence impingement; 2) evaluate the biological significance of fish impingement at Indian Point; 3) identify the species composition of the fish in the Indian Point nearfield and analyze the relative abundance and movements of selected fish species; 4) describe the biological characteristics of striped bass, white perch, and Atlantic tomcod in the Indian Point nearfield; 5) describe movements, survival, and food habits of recaptured hatchery-reared striped bass; and 6) study the population dynamics of the isopod Cyathura polita (1973 and 1974 only).

This report presents data from 1977 field efforts, and with the accumulation of data on impingement and relative abundance of fishes in the nearfield and the estuary (through other estuarine studies, e.g. TI 1979a), the report focuses on these principal objectives:

- to determine the patterns and magnitudes of impingement and the factors that affect them,
- to determine the relationship of nearfield fish abundance and distribution to that in the Hudson River estuary, and
- to evaluate the hatchery program as a potential mitigative measure for the effects of power plant operations on striped bass.

Section II, Summary and Conclusions, provides a concise summary and review of the results of these objectives. It summarizes the principal findings of each section and relates those findings to the principal objectives and the operation of the Indian Point station.

Section III, Field and Laboratory Procedures, describes the Hudson River estuary study area and summarizes the methods and materials used to collect the data. The methods include the Impingement Monitoring Program, the Standard Stations Program, the Long River Fisheries Survey, and the Biocharacteristics Program.

Section IV, Impingement Patterns and Factors Affecting Impingement, discusses patterns and magnitudes of impingement with emphasis on eight selected species (striped bass, white perch, Atlantic tomcod, blueback herring, American shad, alewife, bay anchovy, and hogchoker). This section examines variables such as physicochemical factors and nearfield fish abundance to determine their influence on impingement and to suggest methods for mitigating such influence. The point of origin of tagged or fin-clipped striped bass, white perch, and Atlantic tomcod that were impinged is examined to ascertain the range of influence of the Indian Point generating station. The length/weight relationships of Atlantic tomcod in impingement and nearfield collections are compared to determine the condition of impinged individuals relative to individuals collected in the nearfield.

In Section V, Fishes and Water Quality of Indian Point and Adjacent Regions, the question of the relationship of nearfield fish abundance to that of the estuary is examined using fisheries, biocharacteristics, and physicochemical data in an effort to determine whether data from standard stations in the Indian Point nearfield are representative of the rest of the estuary. The species composition and relative abundance of fish are compared, and the possible role that various physicochemical factors play in determining nearfield abundance is studied.

Section VI, Striped Bass Hatchery Program - Selected Aspects, discusses the hatchery program proposed to mitigate losses of striped bass due to entrainment and impingement, with regard to data on the movements, length, weight, age, sexual maturity, and diet of hatchery-reared fish--information useful in assessing the potential success of the hatchery stocking program.

A glossary of common technical terms with definitions specific to this study follows. More specific terms are defined in the text, particularly in Section III (Field and Laboratory Procedures).

GLOSSARY

AGE COMPOSITION

The quantitative makeup of a group or population of fish based on age classes (e.g. age 1, 2, 3, etc.); usually expressed as the percentage of individuals of a given age in the population.

ANADROMOUS

Fish which spend most of their life cycle in a marine environment but return to rivers or streams to spawn.

BIOLOGICAL CHARACTERISTICS (BIOCHARACTERISTICS)

Attributes of a population, which are determined by the interaction of their genetic-based characteristics with a particular environment; examples include sex ratios, age composition, fecundity, and age at maturity.

CATCH PER AREA (CATCH-PER-AREA SWEPT, CATCH PER VOLUME)

The number or weight of fish taken by sampling a defined area or volume, e.g., catch per 1000 m^3.

CATCH PER EFFORT (C/f)

The catch of fish in numbers or in weight taken by using a specified gear for a defined amount of time or amount of gear deployment, e.g., catch per tow.

CONDUCTIVITY (SPECIFIC CONDUCTANCE)

A measure of the total concentration of the solutes in water and a measure of a solution's capacity to conduct an electric current. Since conductivity increases 2 to 3 percent each degree Centigrade, it is reported at a standard temperature of $25^{\circ}C$ in $\mu S/cm$ (micro Siemens per centimeter).

DIVERSE

An adjective referring to number of taxonomic groups (usually species) found in an area under discussion.

DISSOLVED OXYGEN

Oxygen dissolved in water through photosynthesis and diffusion of atmospheric oxygen and expressed in milligrams per liter (mg/l).

ENTRAINMENT

In this report, the passage of small organisms through a power plant's intake screen and condenser cooling system along with cooling water withdrawn from the Hudson River.

ESTUARY

A semi-enclosed coastal body of water which has free access to the sea and whose water is measurably diluted below the salinity of open ocean water by freshwater tributaries and surface drainage. For the Hudson River system, the estuary is the portion downstream from the Troy Dam at RM 153.

EURYHALINE

An organism tolerant of wide changes in salinity, a characteristic of many estuarine species and certain stages in the life history of other species.

EXPLOITATION RATE

That fraction of the population that is caught (impinged); it is estimated by dividing the number of marked fish impinged by the total number of marked fish.

EXPOSURE

The presence of a population within the vicinity of a power plant. See VULNERABILITY.

FINCLIP

A method for marking fish by excising (cutting a piece out of or completely removing) one or more of the fins; this method is used on fish that are too small to tag effectively.

GEAR AVOIDANCE

The behavior of a fish which enables it to escape capture by fishing gear.

ICHTHYOPLANKTON

The early life stages of fish (eggs, larvae) which have little or no swimming ability and drift passively with currents.

IMPINGEMENT

The entrapment of fish and other organisms by structures designed to screen cooling water prior to its passage through the condensers.

INDIAN POINT REGION

Area of the Hudson River estuary, RM 39-46, in the vicinity of the Indian Point generating station. See NEARFIELD.

JUVENILE

The lifestage beginning when fish have acquired the full complement of adult fin characteristics and extending to age I (December 31) of the year spawned. This lifestage is also referred to as young-of-the-year.

KEY SPECIES

In this report, they are striped bass (Morone saxatilis), white perch (Morone americana), and Atlantic tomcod (Microgadus tomcod).

LENGTH-FREQUENCY

Percentage of a sample or a population of organisms within a given length interval.

MICRODISTRIBUTION

Patterns in abundance of an organism over a small area, often divided into vertical or lateral differences.

NEARFIELD

Area of the Hudson River estuary, RM 39-46, in the vicinity of the Indian Point generating station. See INDIAN POINT REGION.

NRC

Nuclear Regulatory Commission

NYU

New York University

pH

The pH of a solution is a measure of its hydrogen ion activity - its acidity or alkalinity. Neutral pH is 7, with increasing acidity from pH 7 to pH 1 and increasing alkalinity from pH 7 to pH 14.

POPULATION CHARACTERISTICS

See BIOLOGICAL CHARACTERISTICS.

POPULATION

The organisms of a given species collectively inhabiting an area or region.

POPULATION DYNAMICS

Study of population phenomena in a community with special reference to density, competition, available food, and physical and chemical changes in the environment (Pennak 1964).

POST YOLK-SAC LARVAE

The stage from initial development of a complete and functional digestive system (regardless of degree of yolk and/or retention) until transformation to the juvenile lifestage (having a full complement of fin rays).

RELATIVE ABUNDANCE

A measure of the number of organisms in a given year relative to other years or in a given area relative to other areas. This may differ from absolute abundance due to effects of sampling gear, sampling area, and certain biological factors.

SALT FRONT

The leading edge of the mass of seawater intruding into the estuary. Salt front is defined as the point associated with a conductivity of 0.3 μS/cm (micro Siemens per centimeter) or equivalent to a salinity of about 0.1 $^{o}/oo$ (parts per thousand).

SPECIES COMPOSITION

A description of the types of species found in an area.

STANDARD STATIONS

Standard sampling areas in the nearfield region of the Indian Point generating station (see Section III).

STRATUM (STRATA pl.)

A cross sectional area of the river. As used in this report, strata are shoal (depth $\leq$20 feet), bottom (depth within 10 feet of river bottom, but not in shoal), and channel (area other than shoal or bottom).

TIDAL AMPLITUDE

The magnitude of displacement of the tidal wave from its mean value (Stickney 1972).

TURBIDITY

The opacity of water caused by the presence of suspended particulate matter (such as clay, silt, microorganisms, and organic and inorganic detritus).

VULNERABILITY

A measure of the potential susceptibility of a population of organisms to either entrainment or impingement by power plants. The term is used to refer to the presence of a population within the nearfield of a power plant (the EXPOSURE) which may be a measure of potential entrainment and impingement.

YEAR CLASS

A cohort of fish spawned or hatched during a given calendar year.

YEAR CLASS ABUNDANCE

The number or relative number of fish of a given species spawned or hatched during a given calendar year.

YEAR CLASS STRENGTH

A year class abundance relative to other years. See RELATIVE ABUNDANCE.

YEARLING

The age classification of fish during the calendar year following the year in which they were spawned.

YOLK-SAC LARVAE

The transitional stage from hatching through development of a complete and functional digestive system.

YOUNG-OF-THE-YEAR

See JUVENILE.

SECTION II
SUMMARY AND CONCLUSIONS

The 1977 Indian Point Annual Report presents the results of ecological and impingement monitoring studies conducted by Texas Instruments Incorporated in the vicinity of the Indian Point generating station during 1977. The major objectives of these studies were:

- to evaluate the pattern and magnitude of impingement and the factors influencing impingement, including nearfield abundance,,
- to evaluate the relationship of nearfield fish abundance and distribution to that in the Hudson River estuary, and
- to evaluate the hatchery program as a potential mitigative measure for the effects of power plant operation on striped bass.

Impingement magnitude and related environmental parameters were monitored daily throughout 1977 at Indian Point Units No. 2 and No. 3. Although Unit No. 1 was not in commercial operation during 1977, impingement occurring during special tests and at other times when circulators were operating was recorded, but this information is not discussed in this report. Abundance and distribution of fish in the Indian Point and adjacent regions were monitored on a weekly or biweekly basis, depending on the month (season), from April through December 1977. Emphasis in this report was placed on explaining periodic veriations in impingement rates and on comparing numbers of impinged fish with the distribution and abundance of these populations in the estuary. Nearfield species composition, abundance and biological characteristics of selected species, and water quality near Indian Point were compared to similar data from other river regions to determine whether nearfield sampling yielded results representative of the rest of the estuary. Similar data from previous studies were used as appropriate to broaden the data base for evaluations.

A hatchery program designed to investigate the biological and economic feasibility of artificially hatching, rearing, and stocking young-of-the-year striped bass as a potential mitigative measure to the effects of power plant operation was conducted from 1973 to 1975. During that period more than 300,000 fingerling striped bass were marked and released in the estuary. Their presence in the Hudson River was monitored throughout 1977.

A. IMPINGEMENT

During 1977, a total of 2,896,232 fish representing 72 species were collected by impingement sampling at Indian Point. The total biomass collected was 15,454 kg. This represented a 3.5-fold increase over numbers impinged during 1975 and 1976 and an increase in number of species collected when compared to 50 species in 1975 and 59 species in 1976. With the exception of the spot (Leiostomus xanthurus), all of the additional species impinged during 1977 were collected infrequently. Fifteen species have accounted for 99% of the total number collected each year since 1975, and four of those (white perch, Atlantic tomcod, lueback herring, and bay anchovy) accounted for more than 90% of the individuals collected. Impingement collection increases observed during 1977 were related to a 1.5-fold increase in cooling water circulator flow and to increased abundance of fish through the estuary.

The Hudson River estuary serves as a spawning and/or nursery ground for many resident and anadromous species, the young of which composed a major portion of impingement collections. Impingement was due in part to their inability to avoid the intake screens and in part to the age structure of the fish populations (i.e., the predominance of young individuals) in the river.

The species composition of impingement collections changed throughout the year as a function of each species' seasonal abundance. White perch and striped bass were impinged predominantly during late fall and winter (and also early spring for white perch). Atlantic tomcod and hogchoker were impinged primarily during summer. Bay anchovy and the three clupeid species (alewife, blueback herring, and American shad) were most abundant and impinged in greatest numbers during late summer and fall. Application of a Relative Catch Index to compare and interpret catch-effort trends across different sampling gear confirmed that the observed seasonal impingement patterns of each species closely paralleled their seasonal abundance patterns in the Indian Point region. Relative Catch Indices also indicated that no one gear best portrayed impingement trends for all species. For example, an unlined bottom trawl appeared most useful for indicating impingement patterns of white perch, Atlantic tomcod, and blueback herring; the lined bottom trawl was most useful for bay anchovy and alewife; and the beach seine for American shad. River collections did not reflect impingement patterns for striped bass or hogchoker.

Collection efficiency of impinged fish has routinely been less than 100% as a result of fish loss due to factors such as predation, tidal or river currents, disintegration, entanglement in submerged structures, air curtain operation, and screen wash procedures. Various tests conducted at Indian Point since 1974 were continued during 1977 to estimate the percentage of impinged fish actually collected. The best estimate of Unit No. 2 collection efficiency was 29.0% based on nine tests conducted in 1977 and three earlier tests. The best estimate for Unit No. 3 collection efficiency was 71.1% based on 11 tests conducted at Unit No. 3 during 1977 and seven tests from earlier years. The differences in collection efficiency between units No. 2 and No. 3 were presumably related to differences in intake design. Unit No. 2 has both fixed and traveling screens, whereas Unit No. 3 has only traveling screens. Washing procedures for the fixed screens apparently result in a loss of impinged fish, which in turn results in a lower collection efficiency at Unit No. 2. Recovery rates of dyed test fish from three release times within each 24-hour test period were not significantly different, indicating that duration on the intake screens did not appreciably affect collection efficiency.

Mean monthly impingement rates for Unit No. 2 were compared to those of Unit No. 3 using 1977 data. Impingement rates were calculated only for days meeting specific criteria chosen to insure precise matching of daily fish impingement and plant water volume intake and only for days on which both units operated simultaneously. For all species combined and for each of the four major species examined (white perch, Atlantic tomcod, blueback herring, and striped bass), impingement rates at Unit No. 2 were generally higher from fall through winter and into spring, while those at Unit No. 3 were generally higher from late spring through summer. Differences in impingement rates between the two units may result from a variety of factors such as location of the intake relative to the discharge, bottom morphometry adjacent to each intake, water currents, or variations in intake design.

Seasonal variations in impingement were most affected by changes in air and water temperature and by salt front position and resulting conductivity changes. For example, impingement peaks of white perch during the winter and bay anchovy during the summer occurred coincidently with intrusions of saltwater into the Indian Point region. Conductivity was also related to the impingement of hogchoker and blueback herring. Water and/or air temperature appeared to be related to striped bass, white perch, Atlantic tomcod, American shad, alewife, and bay anchovy impingement. Other factors such as precipitation, tidal amplitude, multiple screen washes, and unit interaction (the effect of the operation of one unit on the impingement rates at the other unit) were found to be important, but played a lesser role in affecting impingement rates at Indian Point.

Estimates of the distances that marked fish traveled prior to impingement (range of influence) at the Indian Point station were generally similar to those described for previous years and included most of the lower and middle estuary (area from river mile 12 through about 76). The exploitation rates estimated from the 1977 impingement recaptures of striped bass, white perch, and Atlantic tomcod were low, generally less than 1% per month for the peak impingement periods. Moreover, impinged Atlantic tomcod were significantly ($\alpha = 0.05$) lighter at a given length than were tomcod randomly collected from the estuarine population, suggesting that fish in poorer condition may be more susceptible to impingement.

B. FISH ABUNDANCE

In general, the most abundant species in the Indian Point impingement samples were also the most abundant species collected during nearfield river sampling. Fifty-three species of fish were common to both impingement and nearfield samples collected from 1975 to 1977. Four species collected by nearfield sampling were not collected by impingement, and 26 species impinged were not collected by nearfield sampling. Impingement sampling was more effective than nearfield sampling for collecting uncommon or seasonal species, primarily because of its much more intensive (daily) effort. In general, those species common to the shore zone appeared less frequently in impingement collections; thus, fish in the shore zone appear to be less vulnerable to impingement than fish inhabiting the offshore bottom area.

Fifteen species collected by riverwide sampling were absent from impingement and standard station collections in the nearfield; two species (rainbow trout and white hake) were collected only in the Indian Point nearfield. In nearfield sampling, as with impingement, a small number of species composed a large percentage of the total number of fish collected.

The number of species collected and the relative abundance among those species were similar for each station sampled within a similar habitat. The largest number of species were encountered in the shore zone stations and included many freshwater species not collected in the offshore habitats. The number of species in the shore zone was highest during summer when many of the typically offshore species moved into the shore zone. A total of 45 species were encountered in the shore zone, primarily due to the presence of more freshwater species, especially members of the cyprinid and centrarchid families that were not collected offshore.

Populations in the offshore pelagic zone, represented by the fewest number of species, included predominantly pelagic euryhaline species; only anadromous clupeids (American shad, blueback herring, and alewife), bay anchovy, and young-of-the-year bluefish were commonly collected in this zone. The offshore bottom zone was dominated by offshore and typically demersal species such as Atlantic tomcod, white catfish, and hogchoker.

The distribution of common species among the nearfield standard stations showed patterns similar to those observed in previous years. There was no significant difference ($\alpha = 0.05$) in the abundance of individual species among stations in the offshore pelagic zone, which demonstrates that this habitat is relatively uniform. Among the offshore bottom stations, white perch, Atlantic tomcod, hogchoker, and American eel were significantly more abundant at deeper stations than at shallow ones, presumably due to the preference of these species for the higher salinities at the deeper stations. Blueback herring and bay anchovy were most abundant at one of the shallow, offshore stations.

Abundance patterns among shore zone stations showed that striped bass, American shad, and bluefish were more abundant at the open, unvegetated stations. White perch, banded killifish, spottail shiner, American eel, alewife, and tessellated darter were more abundant in sheltered, vegetated stations, probably because these sites offer protection from predators and are resistant to sudden changes in salinity. Bay anchovy were most abundant at downriver shore zone stations where salinity was usually high.

Abundance indices based on beach seine catches at the standard stations were representative of yearly trends in riverwide abundance for juvenile striped bass, white perch, American shad, blueback herring, and bay anchovy. Additionally, standard station bottom trawl abundance indices were representative of riverwide abundance for hogchoker. Standard station abundance was not indicative of riverwide abundance for Atlantic tomcod and alewife.

Length-frequency distributions for striped bass and white perch from beach seines in the Indian Point region were representative of distributions for striped bass and white perch from beach seines in other regions combined. However, significant differences ($\alpha = 0.025$) were detected between length-frequency distributions for Atlantic tomcod from bottom trawls in the Indian Point region and distributions for tomcod from bottom trawls in other regions combined.

C. WATER QUALITY

Salinity within the Indian Point region was dependent on the recurring movements of the salt front into and out of this region. Salt front location was influenced by freshwater flow, tidal amplitude, and local river morphometry. During periods of low freshwater flow (winter and summer), the salt front was generally upriver from Indian Point, and during periods of high freshwater flow, the salt front was generally downriver from Indian Point. Water temperature, dissolved oxygen, turbidity, and salinity each showed a well defined seasonal pattern; however, salinity was the only one exhibiting longitudinal variation.

D. STRIPED BASS HATCHERY PROGRAM

The first sexually mature, hatchery-reared striped bass were collected during 1977. Five of six three-year old males collected during the spring spawning run were mature, indicating that hatchery-reared striped bass survived to contribute to the spawning population. The recaptured hatchery fish were similar in length, weight, percent maturity, and stomach contents to wild striped bass of the same age. Thus, it appears that a hatchery program is a viable approach that could be used to mitigate the effects of power plant operation on the striped bass population in the Hudson River estuary.

E. CONCLUSIONS

Increased impingement collections at Indian Point Units No. 2 and No. 3 during 1977 over 1975-76 impingement levels were related to both the 1.5-fold increase in cooling water circulated and the increased abundance of the 15 species which composed 99% of the total number of fish collected. Seasonal variations in numbers and species of fish impinged were most influenced by each species' life history and seasonal abundance and changes in air temperature, water temperature, and position of the salt front.

Year-round nearfield sampling in the vicinity of Indian Point represented trends in riverwide yearly relative abundance for most of the fish species dominant in impingement collections. Nearfield beach seine catches collected from 1 April to 31 December reflected yearly trends in riverwide abundance for five species (striped bass, white perch, American shad, blueback herring, and bay anchovy). Nearfield bottom trawl catches collected from 1 April to 31 December reflected yearly abundance trends in riverwide abundance for two of three species, alewife and hogchoker. Nearfield abundance for the third species, Atlantic tomcod, was not representative of riverwide abundance because of gear differences between nearfield and riverwide sampling.

The major findings presented in this report provide insight into the problem of fish impingement at the Indian Point generating station and suggest some potential mitigative techniques. For example, the recovery of sexually mature, hatchery-reared striped bass during 1977 suggests that a hatchery program is a viable approach to mitigate the effects of Indian Point and other generating stations on the Hudson River striped bass population.

SECTION III

FIELD AND LABORATORY PROCEDURES

A. THE HUDSON RIVER ESTUARY STUDY AREAS

The Hudson River estuary is the tidal region of the Hudson River, extending 246 km (153 mi) northward from the Battery on Manhattan Island to the Troy Dam near Albany, New York (Figure III-1). Although the estuary has extreme depths of about 53 m, it is typically shallower, with depths of 10 to 20 m being most common. Distinct relationships exist between longitudinal depth, width, and cross-sectional area profiles. In general, the width and cross sectional area decrease as the depth increases, a phenomenon directly attributable to the presence or absence of mountainous terrain. The deepest region of the estuary is near West Point, New York, where the river cuts through the Hudson Highlands region and is confined to a deep, narrow gorge. The Hudson River has a slightly inclined river basin, with the channel bottom approximately at sea level in the Albany area. There is a gradual descent of the channel bottom from Albany to the continental shelf, with deep holes located in the Highlands region.

Water temperatures in the estuary generally follow the seasonal air temperatures, which generally range between -4°C to -11°C in January and 26°C to 30°C in July. During the winter, ice may completely cover the estuary as far south as Peekskill, although it is broken up by shipping and tidal action. Maximum summer water temperature is approximately 25°C, with higher temperatures occurring only in shore areas.

Within the New York state area, stream flows (as evidenced by stream discharges) tend to exhibit a bimodal pattern with respect to time (Section V). Discharges into the Hudson River estuary follow the same pattern: summer flows are low, followed by higher discharges in November and December; a midwinter depression is followed by a second period of high flow during March, April, and May, apparently related to combined spring thaws and higher precipitation.

Freshwater flow into the estuary is partially controlled by the Troy Dam and other flood control and water supply reservoirs in the Hudson

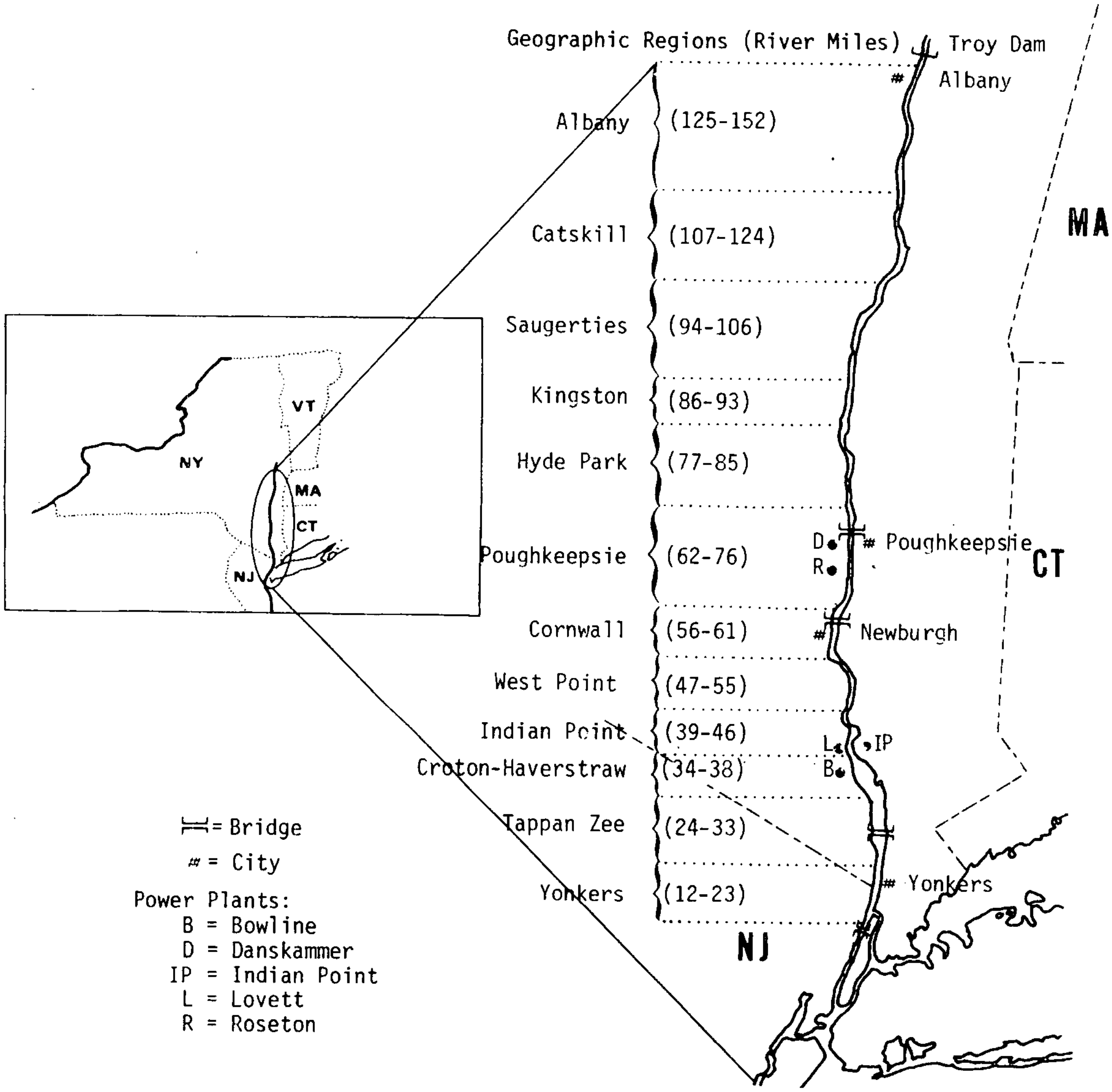


Figure III-1. Location of the 12 Geographic Regions (with river mile boundaries) Used during 1977 Field Sampling Programs in Hudson River Estuary

drainage basin. Approximately 60% of the net flow of the Hudson estuary passes the Green Island gauge below the Troy Dam. The drainage basin below Troy contributes the remainder, principally from the tributaries in the southeastern Catskill Mountains. The average flow at Green Island is 354 m^3/sec (12,500 ft^3/sec); the mean freshwater flow at New York City amounts to about 580 m^3/sec (20,480 ft^3/sec). Even extraordinarily high flows of fresh water are damped out by tidal influence and the increasing cross section of the channel within 30 to 50 km below Albany (Darmer 1969). The oscillating tidal flow of the Hudson is typically from 10 to 100 times the freshwater flow. It ranges from about 5,670 to 8,500 m^3/sec (300,140 ft^3/sec), but exceptional tidal flows may be greater than 14,000 m^3/sec (494,200 ft^3/sec) (Busby 1966). As a consequence, the net flow of the Hudson drainage is usually masked by the tidal flows superimposed on it. Even the estuary's largest tidal flow can be suppressed by unusual weather conditions. Strong wind from the north or south can push water into or out of the estuary, obscuring the true tidal regime (Busby 1966).

The salt front, that area where salinity equals 0.1 part per thousand (^{o}/oo) or 0.3 mS/cm, typically extends no farther upstream than Newburgh (RM 62 [KM 100]) and reaches that point only occasionally during the year (TI 1976b). Salinities greater than 1.0 ^{o}/oo rarely occur above Cornwall, New York (RM 57 [KM 92]). At Indian Point (RM 42 [KM 68]), however, the salinity regularly ranges up to 7 to 9 ^{o}/oo during low freshwater flows; conversely, the water is fresh during periods of high net flow. Salinity is usually above 1 or 2 ^{o}/oo below the Tappan Zee Bridge at Tarrytown, New York (RM 28 [KM 45]), with only occasional elimination of salt water from the region by flood conditions (Darmer 1969). Usual ocean salinity is about 35 ^{o}/oo.

Mixing of fresh water and salt water by tidal action in the lower estuary is influenced by shallow areas that border the channel or deeper areas. The channel water attains higher velocities and responds earlier to tidal and freshwater discharge currents than water in shoal areas. The result of reduced circulation and delay in mixing is less variable salinity in bay areas. Saltwater intrusion into bay areas is delayed by the tendency for denser, more saline water to follow deeper areas of the channel during intrusion. As tidal mixing increases, the intruded salt water is diluted by freshwater flows and simultaneously introduced into shallower areas by upper-level circulation patterns. Flushing of backwater bay areas is less abrupt than channel flushing due to reduced circulation of tidal and freshwater flows through these areas (TI 1976b).

Variables having the greatest influence on the intensity of salt intrusion are freshwater flow, tidal mixing, and river morphometry (see Section V.E). Secondary influences are imposed by meteorological conditions (wind, relative humidity, and air temperature) interacting with water temperatures. Freshwater flows dilute the intruding salt water, and tidal activity (indicated by amplitudes) mixes fresh and saline water. Rapid changes in the contour of the river basin, especially the presence of sill structures, tend to increase mixing by intensifying turbulence.

B. FIELD AND LABORATORY METHODS

Field and laboratory procedures, schedules for each task, and use of the data collected for this report (Table III-1) are described below.

1. Impingement Monitoring

a. Collections and Processing

Daily collections were made of fish impinged on the intake screens at Indian Point in 1977. Unit No. 1 was not in commercial operation during 1977, but was used on a limited basis for experimental purposes. The procedures employed and results obtained in special studies at Unit No. 1 have been previously reported (TI 1978a; TI 1978c) and will not be discussed in this report.

The intake screens at Units No. 2 and No. 3 were routinely washed to remove fish and debris during regular wash periods scheduled once daily between 0800 and 1200. Occasionally, heavy debris loading or fixed screen malfunction required more frequent or even continuous screen washing. On those occasions, fish were collected and counted whenever possible using the same basic procedures as in routine sampling.

Fish collected from intake screens were identified and sorted, and the total weight and number of each species were determined and recorded. Striped bass, white perch, and Atlantic tomcod in each sample were individually counted except for young-of-the-year tomcod when their total daily count exceeded 100 during the period from 1 April to 15 November (the time of first tomcod tag or finclip release of the year). During that period, the total number of young-of-the-year tomcod collected was estimated by determining the weight of a subsample of 100 individuals and relating the resultant ratio of number/weight to the weight of the total collection. The

Table III-1

Schedule of Field Tasks during 1977 and Application of Data to Indian Point Annual Report

Task	J	F	M	A	M	J	J	A	S	O	N	D	Data Collected	Data Uses (Indian Point Annual)
Standard Station Fisheries Surveys				—	—	—	—	—	—	—	—	—	Numbers and size of juveniles and adult fish in shoals, channel, and shore zone	Species composition, relative abundance, biological characteristics
Mark-Recapture	—	—	—	—	—	—	—	—	—	—	—	—	Mark release and recovery data on striped bass, white perch, and Atlantic tomcod collected by all programs	Distribution of origin of impinged fish
Beach Seine				—	—	—	—	—	—	—	—	—	Numbers of juvenile and adult fish in shore zone	Species composition, relative abundance, biological characteristics
Interregional Trawl				—	—	—	—	—	—	—	—	—	Numbers of juvenile and adult fish in shoals and channel	(Species composition, relative abundance, biological characteristics — shared with Beach Seine)
Adult Striped Bass Program			—	—	—	—							Numbers, size, sex, mark-recovery, fecundity, and maturity	Recovery of hatchery-reared individuals
Water Quality Program	—	—	—	—	—	—	—	—	—	—	—	—	Temperature, dissolved oxygen, conductivity, pH, and turbidity	Regional comparisons; factors affecting impingement, species composition
Impingement Monitoring	—	—	—	—	—	—	—	—	—	—	—	—	Numbers, size, and age of fish collected	Annual and seasonal patterns, relative abundance, species composition

total weight of each additional species was measured, and the total number was counted if the collection sample was smaller than 100 or was estimated from a subsample, as for young tomcod, if the collection sample was greater than 100. For six species (white perch, striped bass, Atlantic tomcod, blueback herring, alewife, and American shad), the weight and number were reported for four length classes:

Length Class 1 = 0 mm to X mm
Length Class 2 = X + 1 mm to 150 mm
Length Class 3 = 151 mm to 250 mm
Length Class 4 = 251 mm and over

where X, the division value, was a variable length used to separate young-of-the-year from older fish. The value of X was empirically determined for each species by examining the size distribution of the population. Length class (LC) 1 therefore contained fish from the current year class, i.e. young-of-the-year between the current spawning season and 31 December, then yearlings from 1 January until the following spawning season. The date arbitrarily chosen for the spawning season was one month before the first appearance of young-of-the-year in collections. The division value (X) was revised to a smaller number at the start of each spawning season, thus causing any yearlings collected thereafter to be counted in LC 2. The date on which the X value was revised was 1 June for all but the winter-breeding Atlantic tomcod, where the revision occurred on 1 April. Between 1 January and the following spawning season, all LC 1 fish were termed yearlings. Upon separation of each of the six species into four length classes, the total number and weight of fish in each length class were determined. Individual lengths and weights were determined from biweekly subsamples of 25 fish per length class for each of the three key species, white perch, Atlantic tomcod, and striped bass.

b. Power Plant and Environmental Variables

To provide a basis for computing impingement rates and analyzing the factors affecting impingement rates at Units No. 2 and No. 3, cooling water circulator flow rates and the duration of circulator pump operation were monitored along with fish collections. Frequency of pump start-ups and shutdowns was also monitored along with water temperature, conductivity, and dissolved oxygen values which were recorded daily at the intake of each unit and in the common discharge. Water quality measurements were taken 2 ft below the surface at each of the following locations:

Unit No. 1 - from the pier;

Unit No. 2 - at the south end of the intake near screen No. 21; and

Unit No. 3 - along the metal seawall at the south end of the intake near screen No. 31.

An additional set of readings was taken 3 ft above the bottom at Unit No. 2. Conductivity was measured with a YSI Model 33 salinity-conductivity-turbidity meter, and temperature and dissolved oxygen were measured with a YSI Model 54 or 57 oxygen meter. Variables related to plant operation were obtained directly from plant engineers.

c. Determination of Impingement Rate

The most useful way of expressing impingement rate is to relate the number of fish collected to the volume of water pumped. Ideally, the rate reflects all fish impinged divided by the total volume of water pumped during a time period. Factors such as ice floes, trash loading (usually caused by heavy rain), equipment failure, and plant maintenance sometimes precluded determination of an accurate impingement rate. When plant operators were forced to perform unscheduled screen washes (e.g., to prevent screen collapse from trash loading), it was sometimes impossible to relate fish collected on the following wash to the volume from which they were actually impinged because the exact time of unscheduled washes was often not available.

To circumvent such problems, TI screened the data to select days on which fish counts could be accurately matched to the volume of water from which those fish were impinged. The "selected" impingement rates discussed in this report are based on these selected days. For purposes of comparison, selected rates have been computed from 1975, 1976, and 1977 impingement data. Appendix A contains comparisons of these selected rates with rates of total fish collected per total volume of water passing through the plant. The percentage of total collection and the percentage of days of plant operation included in each selected rate are also indicated.

d. Collection Efficiency Tests

Tests were performed in 1977 to estimate the percentage of fish that were impinged but not collected during the impingement monitoring process. It is known that losses occurred as a result of scavenging by fish and birds, river flow, and tidal activity, as well as entrapment in the submerged structures associated with the intake screens.

In the tests, dead white perch or striped bass dyed various colors were released at three depths in front of intake screens No. 22 and 26 (Unit No. 2) and No. 32 and 36 (Unit No. 3). The units were not tested simultaneously. Each test was composed of three releases of 30 fish at each of two screens, for a total of 180 fish per test. A different color of dye was utilized in each release to examine the effect of impingement duration on fish loss. The first fish were released immediately after the morning screen wash (approximately 0900 hr). Subsequent releases were made at 1600 hr and on the following day at 0600 hr. When unscheduled washes interrupted a test, releases ceased but collections continued. Recovery of dyed fish began with the next scheduled wash at about 0800 and continued during all screen washes on succeeding days. Fish were released at three depths (9 ft, 15 ft, and 21 ft below the surface) at both Unit No. 2 and Unit No. 3. Because previous studies had indicated greater impingement near the surface (TI 1975d), 18 of the 30 fish in each release were released at the 9 ft depth, and six fish were released at both the 15 ft and 21 ft depths.

At Unit No. 3, the three release locations (depths) were located in a vertical line 5 ft in front of the traveling screen. At Unit No. 2, the three positions were located on a diagonal 2 ft in front of the fixed screen. The diagonal passed from an upper corner of the screen, through the center, to the opposite lower corner. For each test release the slope of the diagonal was switched to the corners opposite those used on the previous release.

2. Standard Stations Program

The Standard Stations Program sampled juvenile and older fishes in the nearfield of the Indian Point generating station. The 1977 sampling contributed to a data base extending back to 1969 that can be examined for trends in species composition, relative abundance, distribution, and biological characteristics. Sampling in 1977 involved 14 fixed stations (Figure III-2) between RM 39-43 [KM 62-69].

Beginning in April and continuing through December, seven shore zone stations (Table III-2) were sampled weekly with a 100 ft (30.5 m) beach seine approximately 2 hr before a low tide (see TI 1978a for gear specifications and deployment procedures). Seven offshore stations (Table III-3) were sampled twice weekly, first using a 44.3 ft (13.4 m) bottom trawl with a fine mesh liner, and second using a trawl without a liner. From July through December, each offshore trawl station was also sampled biweekly with a 49.2 ft (15.0 m) surface trawl (TI 1979a). The entire catch from each sample was kept on ice for laboratory processing.

Each sample was sorted by species into four length classes as defined in Section B.1.a. The number in each length class was recorded for each species. A random subsample (maximum of 20 fish) from each length class for each species was measured and weighed. Scales were removed from these subsampled striped bass and white perch for age determination. Sex determination was attempted on all subsampled white perch greater than 150 mm total length (TL). Striped bass were aged as part of the Biocharacteristics Program described below. During May, June, and July, gonads were removed from all subsampled white perch of at least 100 mm TL to determine age at maturity. Atlantic tomcod from two standard station bottom trawl samples per week, collected on different days, were processed for biological characteristics. Total lengths and weights were recorded for up to 80 young-of-the-year and 40 adult Atlantic tomcod per sample. Quality control was maintained on the identification and total count of each species using a continuous sampling plan, CSP-1 (Dodge 1977).

3. Long River Fisheries Sampling

a. Beach Seine Survey and Related Mark/Recapture Survey

The Beach Seine Survey produced data on density, distribution, and length of juvenile and adult fishes in the shore zone of the estuary and provided a major portion of the mark/recapture effort. From April through June and September through December of each year, the estuary from RM 12 (KM 19)

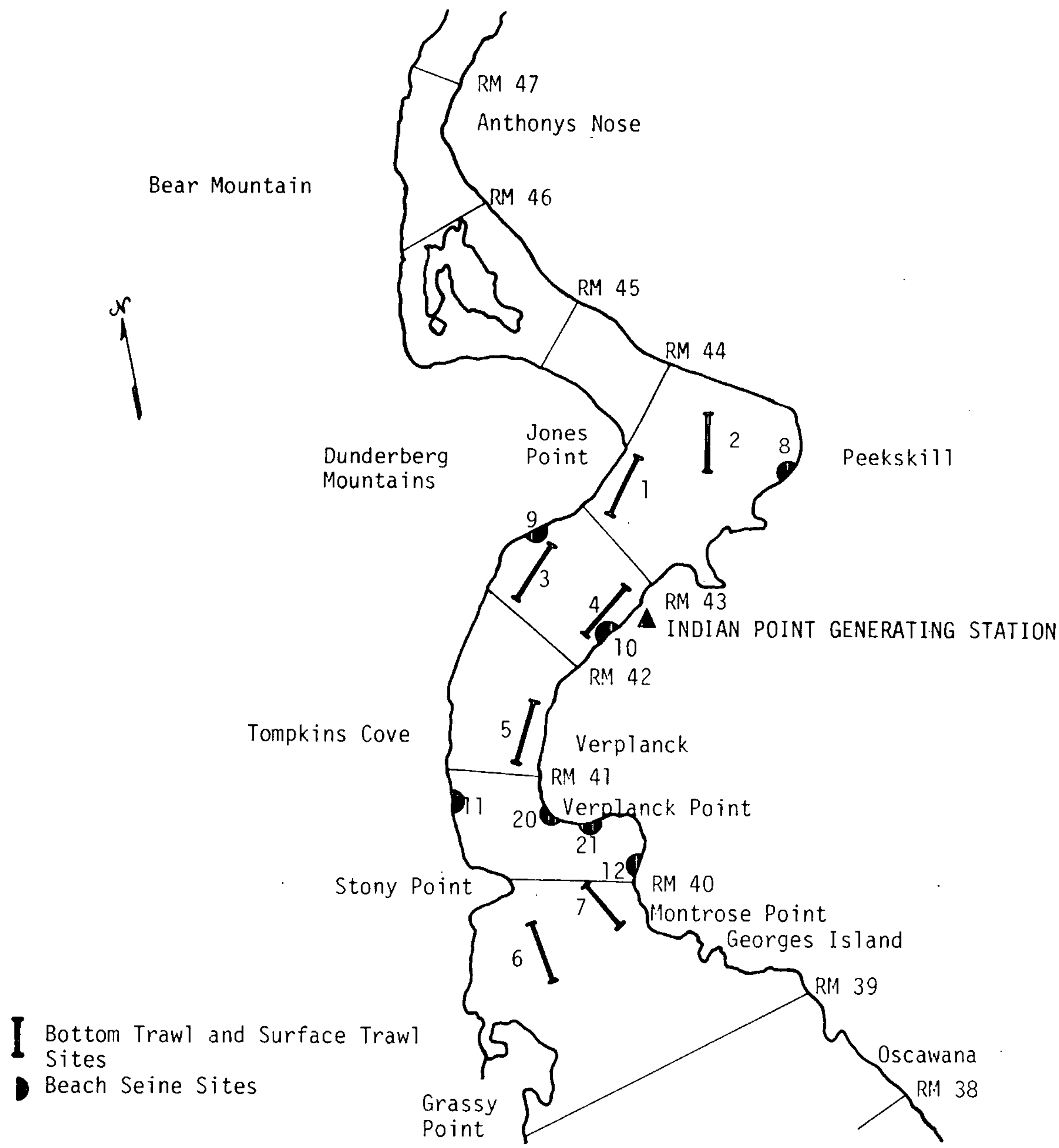


Figure III-2. Indian Pcint Standard Station Beach Seine, Bottom Trawl, and Surface Trawl Sites, Hudson River Estuary, RM 39-43 (KM 62-69), 1977

Table III-2

Location and Description of Standard Stations Beach Seine Sites near Indian Point in Hudson River Estuary. (Sites were sampled once each week from April through December.)

Station	Location	Description
8	In Peekskill Bay (RM 43, east side) immediately south of public launching ramp	Mud bottom, beach covered with accumulation of glass; maximum depth 1.5 m; heavy aquatic vegetation during summer; far from channel
9	South of Jones Pt. (RM 42, west side) near former reserve fleet headquarters	Mudbottom with medium-size rocks; maximum depth 1.5 m; heavy aquatic vegetation during summer; far from channel
10	100 m south of Indian Point discharge canal (RM 42, east side)	Sand/gravel beach, changing to mud bottom with increasing depth; maximum depth 2 m; little vegetation; close to channel
11	35 m south of Trap Rock Corp. barge mooring area (RM 40, west side)	Sand bottom; beach sloping steeply to 2.5 m; little vegetation; close to channel
12	Greens Cove (RM 40, east side) 100 m south of Cortlandt Yacht Club	Brick and rock beach, changing to mud with increasing depth; maximum depth 2 m; very dense vegetation in summer; far from channel
20	Verplanck Point (RM 40, east side) 10 m south of wharf	Sand beach, with an accumulation of detritus on bottom as depth increases; maximum depth 2 m; little vegetation; close to channel
21	South of Verplanck Point (RM 40, east side) near trailer park	Sand/gravel bottom; maximum depth 2 m; far from channel

Table III-3

Location and Depth of Standard Station Trawl Sites near Indian Point in Hudson River Estuary. (These were sampled in alternate weeks as part of interregional bottom trawl survey; bottom trawls were used from April through December, while surface trawls were used in same weeks from July through December.)

Station	Location	Depth (m)
1	RM 43 west side, off Jones Pt.	9
2	RM 43 east side, in Peekskill Bay	5
3	RM 42 west side, south of Jones Pt.	6
4	RM 42 east side, in front of Indian Pt. power plants	15
5	RM 41 east side, south of overhead power cables	14
6	RM 39 west side, south of Stony Pt.	14
7	RM 39 east side, between Verplanck Pt. and Montrose Pt.	5

to RM 153 (KM 245) was sampled biweekly using 100-ft beach seines; on alternate weeks, the Yonkers through Cornwall regions were sampled (RM 12-61). During July and August of each year, all regions (RM 12-153) were sampled weekly.

Approximately 100 samples were collected during daytime each week from nearly 300 available beaches. Sample sites were allocated by dividing each of the 12 river regions into 3-mile sections and randomly selecting sites in each section. Sites were chosen daily, with none being sampled more than once per day, but some could have been sampled two or more times per week.

The 100-ft seine was deployed by setting it perpendicular to the shore and then towing it to the beach to form a semicircular impoundment (TI 1979a). The ends of the net were pulled onto the beach, concentrating the catch in the middle (bunt) of the net (TI 1978b).

The sample processing procedures varied slightly from year to year between 1975 and 1977. In 1975, all fish were identified and separated into age classes. White perch, striped bass, American shad, blueback herring, and alewife were separated into young-of-the-year, yearling, and older than yearling age classes; all other species were separated into only two age classes, either young-of-the-year or yearling and older fish. The fish were separated into their respective age groups according to predetermined, maximum length values (divisions) for respective age groups. These values were updated as necessary to allow for growth. All young-of-the-year fish collected in 1975 were preserved and returned to the laboratory except during fall marking periods when young-of-the-year striped bass and white perch were checked for clipped fins. All probable recaptures were returned to the laboratory for verification, while unmarked fish were finclipped and released. Young-of-the-year fish returned to the lab were separated and the number of individuals of each species counted. Total lengths were recorded for randomly selected subsamples of white perch and striped bass (during non-marking periods) and alewife, blueback herring, American shad, Atlantic tomcod, spottail shiner, tessellated darter, banded killifish, and bay anchovy. If a sample contained an extremely large number of one species, a subsampling technique was used to estimate the total number. During the

1975 fall marking period, up to 25 young-of-the-year striped bass and white perch were randomly selected from each sample and the total length of each recorded before being marked and released.

In 1976, all fish were identified and separated into one of four length groups as described for impingement samples. A biweekly subsample of 20 lengths and weights was taken for each length group of white perch, striped bass, and Atlantic tomcod collected within each of the 12 geographic regions. An additional 40 lengths were determined within the young-of-the-year age group of each of the three species. The biweekly length/weight subsamples were taken on weeks which coincided with interregional bottom trawl sampling. Collections of young-of-the-year fish in 1976, except for white perch and striped bass during marking periods, were preserved and returned to the lab where all species were separated and the number of individuals of each species counted; small samples were processed in the field. Length and weight subsamples were taken for Atlantic tomcod as described above. Only sufficient young-of-the-year striped bass and white perch to fill the length/weight quota were returned to the lab for processing. As in 1975, all white perch, striped bass, and adult tomcod probable recaptures were returned to the lab for verification during 1976.

In 1977, sample processing procedures including length/weight subsampling were the same as in 1976 for the Croton-Haverstraw, West Point, and Cornwall regions. Length/weight subsampling was performed on fish collected in the Indian Point region as part of the Standard Stations Program (see Section III.B.2). No length/weight subsampling was performed on white perch, striped bass, or Atlantic tomcod collected from other regions. Quality control inspections were preformed utilizing standard process control techniques in 1976 (Duncan 1974) and 1977 (Dodge 1977).

Marking procedures were identical from 1975 through 1977. Young-of-the-year white perch and striped bass were finclipped from September through mid-December (fall marking period). Yearling striped bass and white perch were finclipped from April through June (spring marking period) and tagged during the fall marking period. Yearling and older fish were tagged with a Floy fingerling tag or a nylon internal anchor tag, depending on the total length of the fish. In the process of collecting white perch and striped bass, any yearling or older Atlantic tomcod collected were examined for finclips or tags and released; adults of other species were counted and released.

b. Interregional Bottom Trawl Survey

The Interregional Bottom Trawl Survey (previously termed the Axial Trawl Survey) provided data on the relative abundance, distribution, and population characteristics of juvenile and older fishes inhabiting the offshore bottom strata of the river. It also provided a deep water recapture effort for marked fish. On alternate weeks from April through November, 32 fixed stations (Figure III-3) from RM 27 to RM 62 (KM 43 to KM 100) were sampled with an otter-type bottom trawl equipped with a fine mesh cod end cover (TI 1979a). Catches were sorted by species and length group, as was done for standard stations.

Samples were processed and subjected to quality control as described for the Beach Seine Survey (Section III.B.3), with the exception that length/weight samples were taken for all regions sampled in 1977. Also, when available, two samples of Atlantic tomcod per sampling period were returned to the lab. Randomly selected subsamples were taken from these two samples and were processed for biological characteristics using methods identical to those with which standard station bottom trawl samples were processed. In 1976 and 1977, these samples were subjected to quality control examination based on a lot-by-lot zero fraction defective technique (Duncan 1974) and a continuous sampling plan, CSP-1 (Dodge 1977) respectively. No fish were marked from the trawl catches.

4. Biocharacteristics Program--Selected Aspects

Recaptured hatchery-reared striped bass were compared with wild fish for length, weight, percent mature, and stomach contents. Nearly all the wild fish examined were obtained from the sampling program designed to assess the status of the adult striped bass population (described in TI 1979a). Data on length, weight, percent mature, and stomach contents for wild striped bass were combined from the 1976 and 1977 adult striped bass programs to create larger sample sizes for statistical comparison with 1977

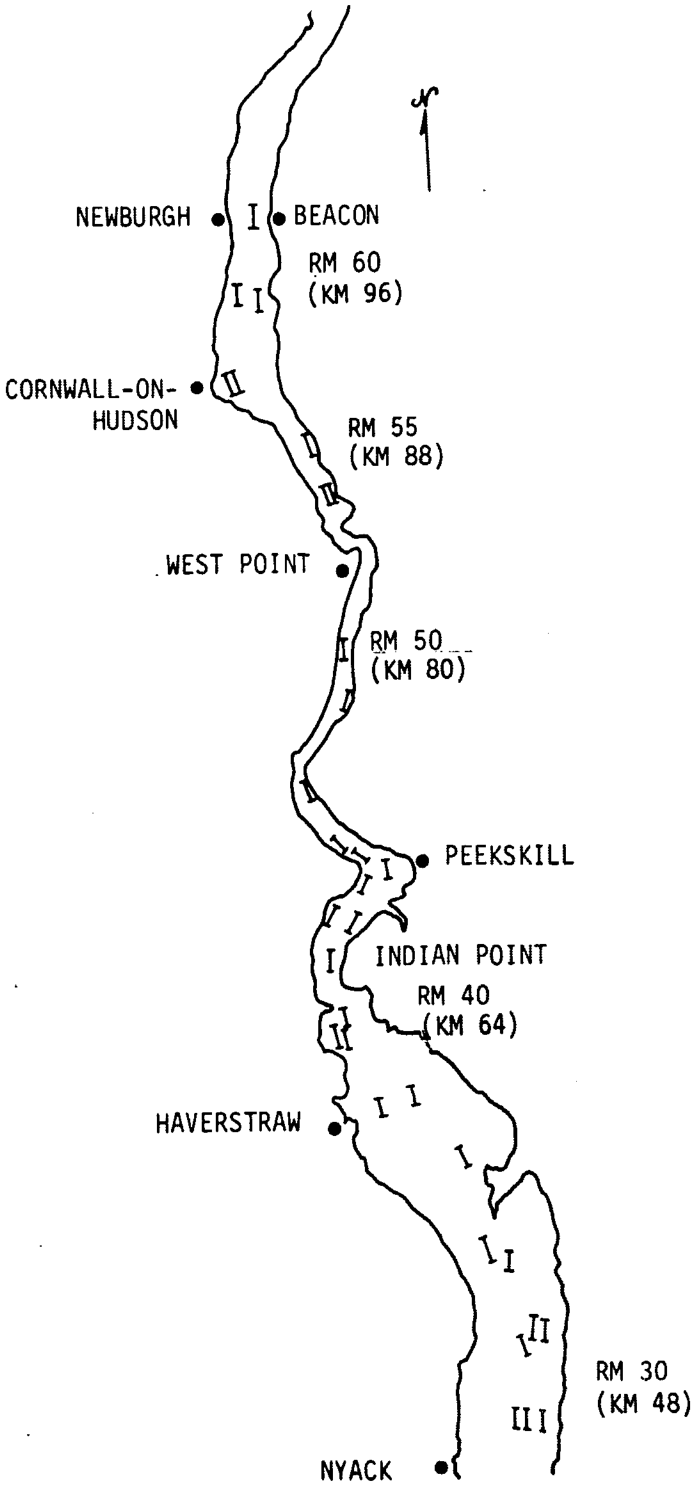


Figure III-3. Interregional Bottom Trawl Survey Sampling Sites during 1977, Hudson River Estuary, RM 27-62 (KM 43-100) hatchery-reared fish. Hatchery-reared striped bass were collected in 1977 by a variety of sampling efforts (gill nets, haul seines, box traps, beach seines, bottom trawls, commercial fishermen, Indian Point impingement, and other environmental contractors). The 1976 diet data on stomach contents were derived from fish captured in beach seines only. In 1977, hatchery fish were collected in gill nets; wild striped bass were caught in beach seines. Two- and three-year-old striped bass processed in the laboratory for length, weight, sex, and percent mature were subjected to quality control procedures using a continuous sampling plan (CSP-1) described by Dodge (1977). Age analyses and diet were subject to lot-by-lot quality control (Duncan 1974).

a. Length and Weight

Length and weight are good measures of the overall condition of released hatchery-reared fish. Data on the length and weight of two- and three-year-old wild striped bass collected in the adult striped bass program conducted from March through June of 1976 and 1977 were combined and grouped by age and sex for length/weight comparisons with hatchery-reared striped bass. Since no size difference exists between the two sexes of wild male and female striped bass at age 2 (TI 1979a), age 2 fish of both sexes were combined to increase the sample sizes. Only male hatchery-reared fish were collected in 1977, so the comparison was made with male wild fish. A two-tailed Student's t-test (Hultquist 1969) was used to test for differences in length and weight of wild and hatchery fish.

b. Sexual Maturity

Visual examination and a body weight/gonad weight ratio (McFadden and Lawler 1977) were used to determine the maturity of two- and three-year-old wild striped bass captured in the adult striped bass program during 1976 and 1977 and comparable age hatchery-reared striped bass recaptured during 1977. Prior to 1977, no maturation analysis was performed on age 2 hatchery-reared recaptures (6 fish). After classifying fish as mature or immature based on size and color of gonads, a body weight/gonad weight ratio was calculated and used to determine the state of maturation of fish that were classified and those fish which could not be visually classified as mature or immature. During the spring, wild males and females with body weight/gonad weight ratios of less than 235 and less than 70, respectively, were considered mature and ready to spawn (McFadden and Lawler 1977). Striped bass were aged by the scale method (Mansueti 1961). The proportions of mature wild and hatchery-reared striped bass were compared by age and sex using a test for equality of two percentages (Sokal and Rohlf 1969).

c. Stomach Contents

The stomach contents of hatchery-reared striped bass captured in 1976 and 1977 were examined to note the types of food organisms consumed. Twenty-nine hatchery-reared striped bass were available for stomach analysis in 1977; three were available in 1976. Stomach contents of hatchery-reared recaptures were compared to those of wild striped bass of similar lengths collected during daylight in the same location and during the same months to determine whether hatchery-reared and wild fish had similar feeding habits. Comparisons of hatchery-reared and wild striped bass diet during 1974 and 1975 were presented in another report (TI 1977d). Striped bass analyzed in this study were captured in beach seines during May and June 1976 and June 1977 and in gill nets during June 1977. All wild fish were collected in standard stations beach seines between RM 39 and 46 (Indian Point region) during 1976 and 1977, while hatchery-reared fish were collected in beach seines between RM 35 and 43 during 1976 and in gill nets at RM's 34, 40, and 67 during 1977. Striped bass were preserved with 10% formalin in the field. To facilitate preservation of stomach contents, 10% formalin was also injected into the stomachs in the field.

The stomach contents were placed in a petri dish, sorted under a dissecting microscope, identified, and counted. The number of identifiable dismembered organisms was estimated by counting the number of heads or portions of animals judged to constitute 50% or more of the original animal. If there were large numbers (>250) of small organisms, total count estimates were made by subsampling in a petri dish with a grid superimposed on the bottom. Items such as filamentous algae, animal remains, plant remains, detritus, and occasionally fish remains were not counted but were noted as being present or absent.

The percent frequency of each countable food item was calculated for each striped bass as follows:

$$f_{ij} = \frac{m_{ij}}{m_j} \times 100\% \qquad \text{(III-1)}$$

where

f_{ij} = percent frequency of food item i in stomach j

m_{ij} = number of organisms of food item i in stomach j

m_j = total number of organisms counted in stomach j

The mean percent frequency of each countable food item observed on a monthly basis for hatchery-reared and wild striped bass for four length groups (1-75 mm, 76-125 mm, 126-200 mm, and 201mm+) and for all length groups combined was then obtained using the formula:

$$\bar{f}_i = \frac{1}{n} \sum_{j=1}^{n} f_{ij} \qquad \text{(III-2)}$$

where

$\bar{f}_i$ = mean percent frequency of food item i for all stomachs

f_{ij} = percent frequency of food item i in stomach j

n = total number of stomachs with at least one countable food item

Trends in food habits of hatchery-reared and wild striped bass were obtained by ranking all food items consumed according to mean percent frequency. The top ranked food items were then compared among different length groups for hatchery-reared and wild striped bass.

5. Water Quality Tasks

Water quality data (water temperature, dissolved oxygen, pH, conductivity, and turbidity) were collected concurrently with or subsequent to each impingement, standard stations, and fisheries sample. The instruments used to measure water quality parameters, as well as other details, are described in Table III-4. All instruments and thermometers were calibrated prior to daily sampling and checked for accuracy periodically during the sampling day.

At the completion of each standard station surface and bottom trawl sample and each interregional bottom trawl sample, all water quality variables except turbidity were measured in the field; a water sample was collected at the surface for subsequent laboratory measurement of turbidity. In beach seine surveys of the Standard Stations and Long River Sampling Programs, surface water temperature and dissolved oxygen concentration were measured in situ. A water sample was collected at each shore zone site and delivered to the laboratory for determination of pH, conductivity, and turbidity.

Water temperature, dissolved oxygen concentration, and conductivity were measured daily at Unit No. 2 intakes and in the discharge canal. Measurements were also taken daily at Units No. 1 and No. 3 whenever the circulator pumps for these units were in operation (see Section III.B.6).

Table III-4

Physicochemical Measurements Taken per Biological Sample, Sample Depth*, Field or Laboratory Determination**, and Instrumentation Used To Determine Sample Values***, 1974 through 1977

Year	Task	Sample Depth	Physicochemical Measurements Taken/Biological Sample: Water Temperature	pH	D.O.	Conductivity	Turbidity
1974	Standard Station Beach Seine	S	F(6)	L(4)	--†	L(5)	L(2)
	Standard Station Trawl and Inter-regional Bottom Trawl	3 m	F(1)	F(1)	F(1)	F(1)	L(2)
1975	Standard Station Beach Seine	S	F(3)	L(4)	F(3)	L(5)	L(2)
	Standard Station Trawl and Inter-regional Bottom Trawl	S,M,B,	F(1)	F(1)	F(1)	F(1)	L(2)
1976	Standard Station Beach Seine	S	F(3)	L(7)	F(3)	L(5)	L(2)
	Standard Station Trawl and Inter-regional Bottom Trawl	S,M,B,	F(1)	F(1)	F(1)	F(1)	L(2)
1977	Standard Station Surface and Bottom Trawl, and Inter-regional Bottom Trawl	S,M,B	F(1)	F(1)	F(1)	L(11)	L(8)
	Standard Station Beach Seine	S	F(9)	L(10)	F(9)	L(11)	L(8)
	Impingement Units I & III (when operating)	S	F(9)	--	F(9)	F(12)	--
	Unit II	S,B	F(9)	--	F(9)	F(12)	--

*S = Surface
M = Middle
B = Bottom
3m = Three-meter depth intervals (surface to bottom) switched to S, M, B midyear. Measurements were made only at the surface, middle, and bottom depths and only surface samples were analyzed for turbidity starting 1 September 1974. During surface trawling efforts, physicochemical data were usually collected only at the surface.

**F = Field Determination
L = Laboratory Determination

***(1) Hydrolab Surveyor Model 6D in situ Water Quality Analyzer
Reserve Equipment:
a) YSI Model 57 Dissolved Oxygen Meter (Temperature and D.O.)
b) YSI Model 33 S-C-T Meter (Conductivity)
No in situ pH measurement was taken when reserve equipment was used.
(2) Hach Model 2100-A Turbidimeter
(3) YSI Model 57 or 54 Dissolved Oxygen Meter
(4) Sargent-Welch Model PBL pH Meter
(5) YSI Model 31 Conductivity Bridge
(6) Mercury thermometer
(7) Sargent-Welch Model PBL or LSX pH Meter
(8) Hach Model 2100-A or Ecolab 104 Turbidimeter
(9) YSI Model 57 Dissolved Oxygen Meter
(10) Sargent-Welch Model LSX pH Meter
(11) YSI Model 31 or Model 33 Conductivity Bridge
(12) YSI Model 33 S-C-T Meter

†Indicates no physicochemical measurement taken.

Note: Temperature and conductivity measurements which were not taken in situ because of meter problems were determined from a sample collected at the surface. Water temperature was determined with a mercury, alcohol, or dial thermometer and the sample bottle was capped and returned to the Verplanck lab for analysis.

SECTION IV

IMPINGEMENT PATTERNS AND FACTORS AFFECTING IMPINGEMENT

A. INTRODUCTION

Environmental variables, fish abundance in the river, and number of fish impinged at Indian Point Units No. 2 and No. 3 were monitored throughout 1977 with emphasis on explaining periodic variations in impingement and on comparing and contrasting impinged fish with river fish populations. Of particular interest were 1) seasonal patterns in impingement, 2) age and species composition of both impinged and river fish, 3) extent of the river from which fish may move and subsequently be impinged at Indian Point (range of influence), 4) variations in river abundance compared to magnitude of impingement collections, 5) physicochemical factors affecting impingement, 6) relative condition of fish selected from the river versus impinged fish, and 7) differences in impingement rates between Unit No. 2 and Unit No. 3. These aspects of the 1977 impingement program are discussed in this section along with data from previous years where needed. Routine data from daily impingement collections are presented for reference in Appendix A.1 and A.2.

B. DESCRIPTION OF INDIAN POINT GENERATING STATION

The Indian Point facility withdraws cooling water from the Hudson River near Peekskill, New York (RM 42 [KM 67]). The nuclear plant consists of three individual generating units (Figure IV-1) having a combined water pumping capacity of 7700 m^3/min (2,058,000 gal/min). Unit No. 1 has two condenser circulating water pumps, each with a capacity of 530 m^3/min (140,000 gal/min); Units No. 2 and No. 3 each have six 530 m^3/min circulator pumps. The circulating pumps operate at 60% capacity when ambient river temperature is below 4.4^{o}C (40^{o}F) and at 100% the remainder of the year (mid-April through mid-December). Service pumps with much lower capacities are also associated with each unit. Units No. 1 and No. 2 have fixed screens at the river's edge and traveling screens within the intake forebays. Unit No. 3 has traveling screens at the river's edge but does not have fixed screens. Details of the plant and associated intake structures have been presented previously (TI 1975b, Con Ed 1977).

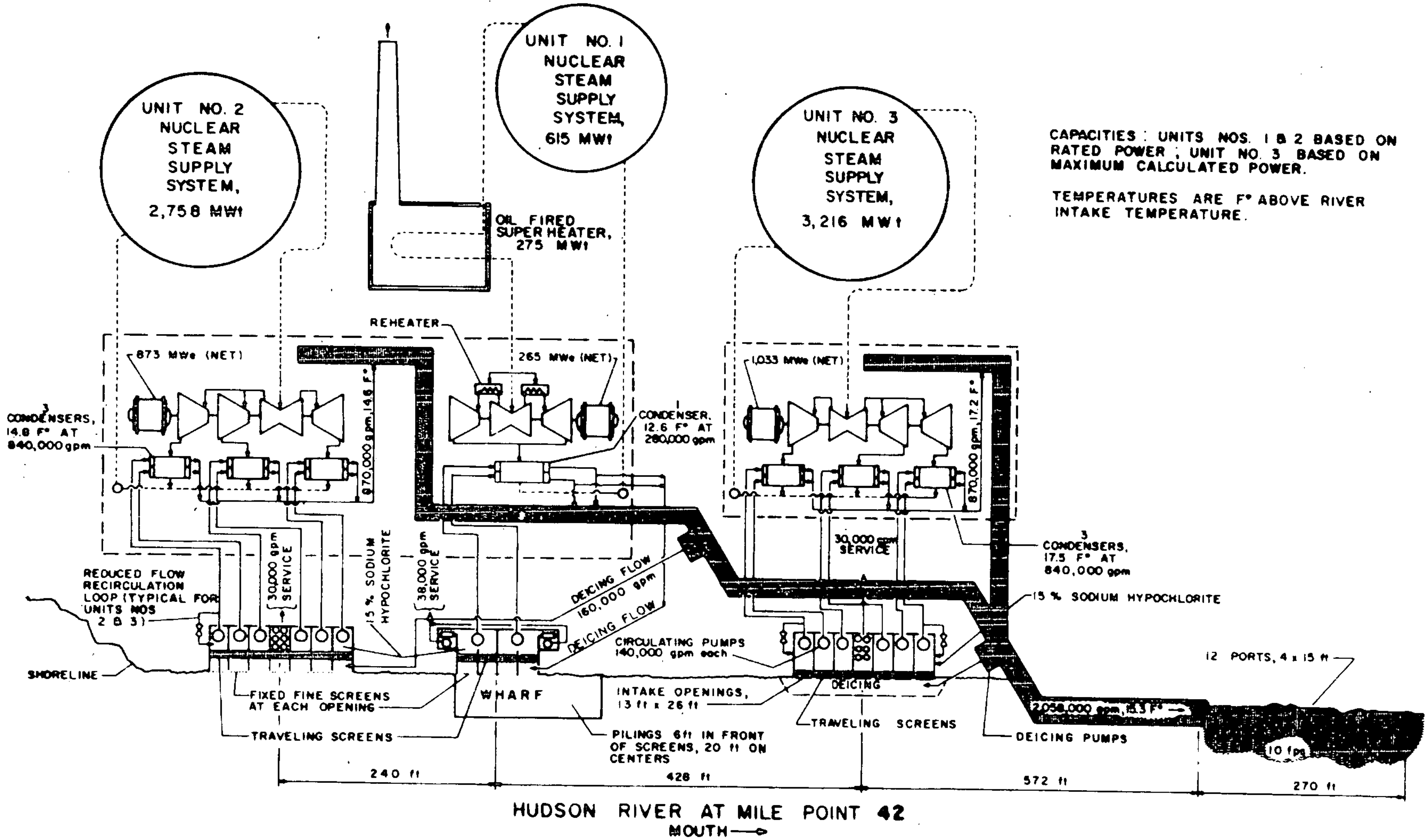


Figure IV-1. Indian Point Plant Layout. (Courtesy of Consolidated Edison Company of New York.)

C. PATTERNS AND MAGNITUDE OF IMPINGEMENT AND THE RELATION TO NEARFIELD ABUNDANCE

1. Species Composition

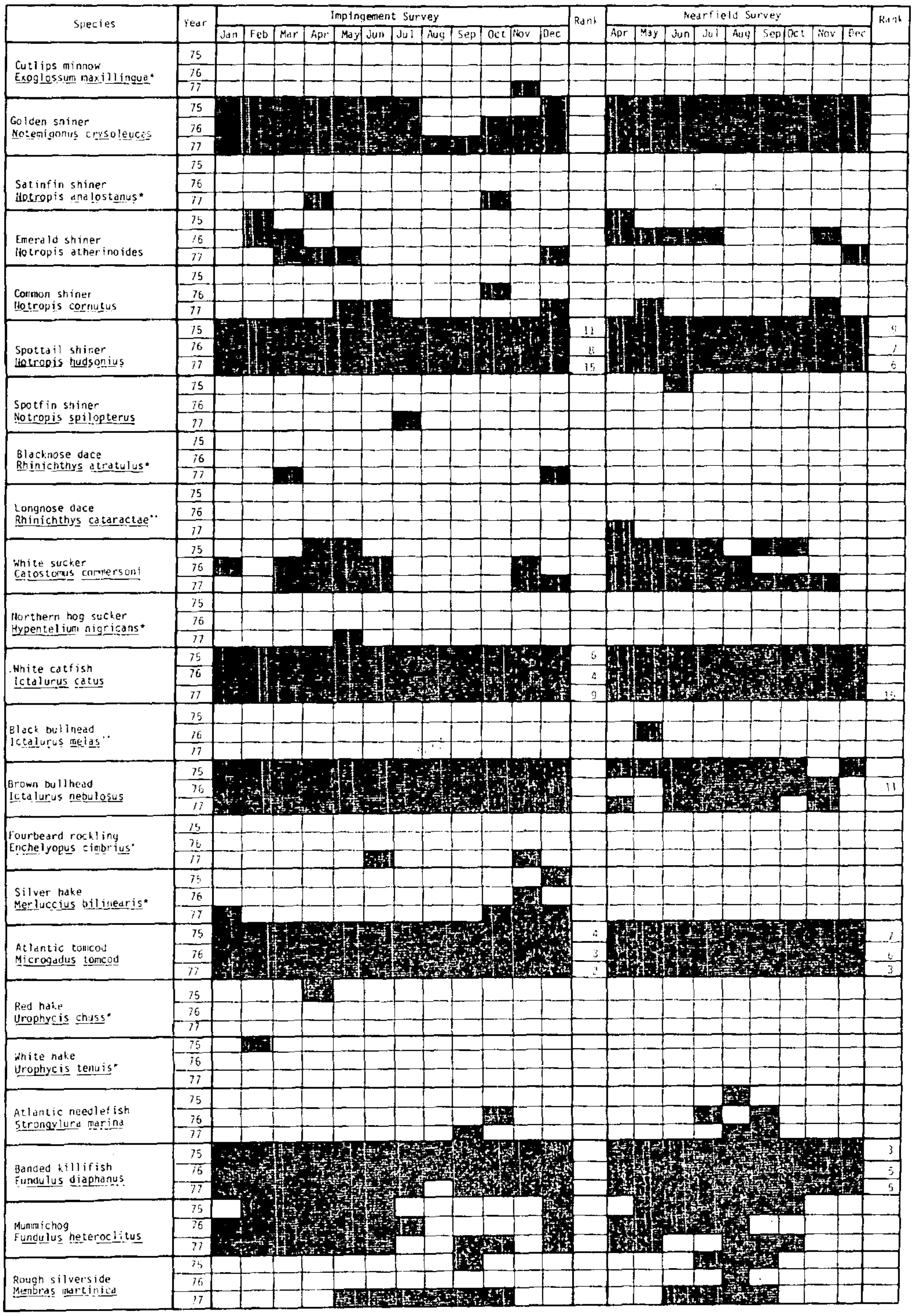
a. Species Composition of Impingement Collections

During 1977, a total of 2,896,232 fish representing 72 species (Table IV-1) was collected by impingement sampling at the Indian Point generating station. An increase in the number of species collected during 1977, from 50 in 1975 and 59 in 1976, was presumably due to an increase in the volume of water circulated during 1977 (Table IV-2). The species present in 1977 impingement collections that were not present in 1975 or 1976 were uncommon to the Indian Point area and were generally collected in low numbers. The only new species to appear in relatively large numbers was the spot (Leiostomus xanthurus). In 1977, spot was the eleventh most abundant species impinged, while in 1976 it was fifteenth, and in 1975 it was not present. Fifteen species composed 99% of the total number collected each year and four species (white perch, Atlantic tomcod, blueback herring, and bay anchovy) composed 90% of the collections (Table IV-3). The remaining species collected were impinged in relatively low numbers. Numbers of all species and weights of predominant species impinged can be found in Appendix A. Relative positions of the top four impinged species have shifted each year since 1975. White perch have consistently been impinged in greatest numbers, but ranks of the other species have varied. Tomcod ranking increased from fourth in 1975 to third in 1976 and to second in 1977.

The total number of white perch, blueback herring, and bay anchovy collected has increased each year since 1975. A reduction in the number of tomcod impinged from 1975 to 1976 was followed by a marked increase from 1976 to 1977. Each of the 15 species impinged in greatest numbers was more numerous in 1977 than in 1976. Species showing the greatest increase in numbers impinged from 1976 to 1977 were Atlantic tomcod (22x), alewife (17x), bluefish (14x), weakfish (14x), bay anchovy (12x), spot (11x), and rainbow smelt (9x). The general 3.5-fold increase in numbers impinged from 1976 to 1977 was disproportionately greater than the concurrent 1.5-fold increase in volume circulated by the plant. Neither the volume circulated nor the overall number of fish impinged changed appreciably from 1975 to 1976.

Table IV-1

Monthly Presence/Absence of Fishes Collected by Impingement and Nearfield Sampling from 1975 through 1977 with Ranking of 15 Most Abundant Species Collected Each Year by Each Type of Sampling. (Common species were collected by both types of sampling; incidental species were sometimes collected by only one type of sampling.)



Species	Year	Impingement Survey Rank	Nearfield Survey Rank
Cutlips minnow *Exoglossum maxillingua**	75		
	76		
	77		
Golden shiner *Notemigonus crysoleucas*	75		
	76		
	77		
Satinfin shiner *Notropis analostanus**	75		
	76		
	77		
Emerald shiner *Notropis atherinoides*	75		
	76		
	77		
Common shiner *Notropis cornutus*	75		
	76		
	77		
Spottail shiner *Notropis hudsonius*	75	11	9
	76	8	7
	77	15	6
Spotfin shiner *Notropis spilopterus*	75		
	76		
	77		
Blacknose dace *Rhinichthys atratulus**	75		
	76		
	77		
Longnose dace *Rhinichthys cataractae***	75		
	76		
	77		
White sucker *Catostomus commersoni*	75		
	76		
	77		
Northern hog sucker *Hypentelium nigricans**	75		
	76		
	77		
White catfish *Ictalurus catus*	75	6	
	76	4	
	77	9	15
Black bullhead *Ictalurus melas***	75		
	76		
	77		
Brown bullhead *Ictalurus nebulosus*	75		
	76		11
	77		
Fourbeard rockling *Enchelyopus cimbrius**	75		
	76		
	77		
Silver hake *Merluccius bilinearis**	75		
	76		
	77		
Atlantic tomcod *Microgadus tomcod*	75	4	7
	76	3	6
	77	2	3
Red hake *Urophycis chuss**	75		
	76		
	77		
White hake *Urophycis tenuis**	75		
	76		
	77		
Atlantic needlefish *Strongylura marina*	75		
	76		
	77		
Banded killifish *Fundulus diaphanus*	75		3
	76		5
	77		5
Mummichog *Fundulus heteroclitus*	75		
	76		
	77		
Rough silverside *Membras martinica*	75		
	76		
	77		

Impingement Survey months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. Nearfield Survey months: Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.

* Species not present in nearfield collections

** Species not present in impingement collections

■ At least one individual collected-Species present

□ No individuals collected-Species absent

Table IV-1 (Contd)

Species	Year	Impingement Survey Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Rank	Nearfield Survey Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Rank
Sea lamprey *Petromyzon marinus*	75												■										■	
	76	■	■										■											
	77		■	■			■						■											
Shortnose sturgeon *Acipenser brevirostrum*	75						■													■				
	76		■													■								
	77	■	■		■	■				■														
Atlantic sturgeon *Acipenser oxyrhynchus*	75	■			■	■	■	■	■	■	■	■	■			■	■	■		■	■			
	76	■	■	■	■		■	■	■	■	■	■	■		■	■	■	■	■	■				
	77	■	■	■	■	■	■	■	■	■	■	■	■			■	■	■	■	■				
American eel *Anguilla rostrata*	75	■	■	■	■	■	■	■	■	■	■	■	■	15	■	■	■	■	■	■	■	■	■	13
	76	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	14
	77	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	15
Blueback herring *Alosa aestivalis*	75	■	■	■	■	■	■	■	■	■	■	■	■	7	■	■	■	■	■	■	■	■	■	1
	76	■		■	■	■	■	■	■	■	■	■	■	2	■	■	■	■	■	■	■	■		1
	77	■			■	■	■	■	■	■	■	■	■	3		■	■	■	■	■	■	■	■	1
Alewife *Alosa pseudoharengus*	75	■	■	■	■	■	■	■	■	■	■	■	■	10	■	■	■	■	■	■	■	■	■	6
	76	■	■		■	■	■	■	■	■	■	■	■	10	■	■	■	■	■	■	■	■		8
	77	■		■	■	■	■	■	■	■	■	■	■	5	■	■	■	■	■	■	■	■	■	9
American shad *Alosa sapidissima*	75	■	■	■	■			■	■	■	■	■	■	13	■	■	■	■	■	■	■	■		8
	76	■		■		■	■	■	■	■	■	■	■	9		■	■	■	■	■	■	■		4
	77	■			■	■	■	■	■	■	■	■	■	12		■	■	■	■	■	■	■		8
Atlantic menhaden *Brevoortia tyrannus*	75		■		■		■	■	■	■		■						■	■	■				
	76						■	■	■	■	■	■				■	■	■	■	■	■			14
	77						■	■	■	■	■	■					■	■	■	■				
Gizzard shad *Dorosoma cepedianum*	75	■	■	■		■					■	■	■	14							■	■	■	
	76	■	■	■	■	■					■	■	■	12	■	■			■			■	■	
	77	■	■	■				■	■	■	■	■	■	14	■						■	■	■	
Bay anchovy *Anchoa mitchilli*	75	■	■	■		■	■	■	■	■	■	■	■	3			■	■	■	■	■	■	■	2
	76				■	■	■	■	■	■	■	■		6	■	■	■	■	■	■	■	■		2
	77	■				■	■	■	■	■	■	■	■	4		■	■	■	■	■	■	■		2
Rainbow trout *Salmo gairdneri**	75																							
	76							■																
	77																							
Brown trout *Salmo trutta*	75																							
	76							■																
	77											■						■						
Brook trout *Salvelinus fontinalis**	75																							
	76						■																	
	77																							
Rainbow smelt *Osmerus mordax*	75	■	■	■	■	■	■	■	■	■	■	■	■	8	■	■	■	■	■	■	■	■	■	
	76	■	■	■	■	■	■	■	■	■	■	■	■	11	■	■	■	■	■	■	■	■	■	12
	77	■	■	■	■	■	■	■	■	■	■	■	■	7	■	■	■	■	■	■	■	■	■	13
Central mudminnow *Umbra limi**	75																							
	76																							
	77			■	■																			
Eastern mudminnow *Umbra pygmaea**	75			■	■																			
	76																							
	77			■		■							■											
Redfin pickerel *Esox americanus americanus*	75																■							
	76																							
	77			■	■																			
Northern pike *Esox lucius**	75																							
	76																							
	77						■																	
Chain pickerel *Esox niger**	75																							
	76				■																			
	77																							
Goldfish *Carassius auratus*	75	■	■	■	■	■	■	■					■		■	■	■	■	■	■	■			
	76	■	■	■		■	■				■	■	■		■	■	■	■	■	■	■	■	■	
	77	■	■	■	■	■	■	■	■	■	■	■	■		■		■	■	■	■	■	■		
Carp *Cyprinus carpio*	75	■		■												■	■		■	■	■			
	76				■							■			■	■	■			■	■			
	77			■									■		■	■	■	■	■	■	■	■		

* Species not present in nearfield collections

** Species not present in impingement collections

■ At least one individual collected-Species present

☐ No individuals collected-Species absent

Table IV-1 (Contd)

Species	Year	Impingement Survey Rank	Nearfield Survey Rank
Tidewater silverside *Menidia beryllina*	75		
	76		
	77		
Atlantic silverside *Menidia menidia*	75		
	76		
	77		
Fourspine stickleback *Apeltes quadracus*	75		15
	76		17
	77		
Brook stickleback *Culaea inconstans*	75		
	76		
	77		
Threespine stickleback *Gasterosteus aculeatus**	75		
	76		
	77		
Northern pipefish *Syngnathus fuscus*	75		
	76		
	77		
White perch *Morone americana*	75	1	4
	76	1	3
	77	1	4
White bass *Morone chrysops*	75		
	76		
	77		
Striped bass *Morone saxatilis*	75	9	10
	76	7	11
	77	6	7
Rockbass *Ambloplites rupestris*	75		
	76		
	77		
Redbreast sunfish *Lepomis auritus*	75		
	76		
	77		
Green sunfish *Lepomis cyanellus***	75		
	76		
	77		
Pumpkinseed *Lepomis gibbosus*	75		12
	76	13	13
	77		14
Bluegill *Lepomis macrochirus*	75		
	76		
	77		
Smallmouth bass *Micropterus dolomieui**	75		
	76		
	77		
Largemouth bass *Micropterus salmoides*	75		
	76		
	77		
White crappie *Pomoxis annularis*	75		
	76		
	77		
Black crappie *Pomoxis nigromaculatus*	75		
	76		
	77		
Tessellated darter *Etheostoma olmstedi*	75		11
	76		10
	77		12
Yellow perch *Perca flavescens*	75		
	76		
	77		
Bluefish *Pomatomus saltatrix*	75	12	14
	76	14	15
	77	10	11
Crevalle jack *Caranx hippos*	75		
	76		
	77		

Impingement Survey months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. Nearfield Survey months: Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec.

* Species not present in nearfield collections

** Species not present in impingement collections

■ At least one individual collected-Species present

☐ No individuals collected-Species absent

Table IV-1 (Contd)

Species	Year	Impingement Survey Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Rank	Nearfield Survey Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Rank
Lookdown *Selene vomer**	75																							
	76																							
	77								■	■														
Atlantic moonfish *Vomer setapinnis***	75																		■					
	76																							
	77																							
Scup *Stenotomus chrysops**	75																							
	76																							
	77							■	■	■														
Weakfish *Cynoscion regalis*	75								■	■				7				■	■	■				
	76							■	■	■	■								■	■				
	77						■	■	■	■	■	■		13				■	■	■				
Spot *Leiostomus xanthurus*	75																							
	76							■	■	■	■	■	■	15					■	■	■			
	77							■	■	■	■	■	■	11					■	■	■	■		
Atlantic croaker *Micropogon undulatus*	75																							
	76											■	■								■	■		
	77												■											
Tautog *Tautoga onitis**	75																							
	76																							
	77						■																	
Striped mullet *Mugil cephalus**	75																							
	76											■												
	77																					■		
White mullet *Mugil curema*	75																							
	76											■												
	77																							
Butterfish *Peprilus triacanthus**	75							■	■															
	76							■																
	77						■	■	■			■												
Northern searobin *Prionotus carolinus**	75																							
	76																							
	77								■	■														
Striped searobin *Prionotus evolans**	75																							
	76																							
	77										■	■												
Grubby *Myoxocephalus aenaeus**	75																							
	76		■																					
	77	■																						
Summer flounder *Paralichthys dentatus**	75																							
	76										■													
	77						■	■	■	■														
Winter flounder *Pseudopleuronectes americanus*	75		■	■					■	■														
	76	■							■	■	■													
	77	■	■	■	■		■	■	■	■	■	■	■					■						
Hogchoker *Trinectes maculatus*	75	■			■	■	■	■	■	■	■	■	■	5	■	■	■	■	■	■	■	■	■	5
	76	■		■	■	■	■	■	■	■	■	■	■	5	■	■	■	■	■	■	■	■	■	9
	77	■		■	■	■	■	■	■	■	■	■	■	9	■	■	■	■	■	■	■	■	■	10
Northern puffer *Sphoeroides maculatus**	75																							
	76	■																						
	77									■														

* Species not present in nearfield collections

** Species not present in impingement collections

■ At least one individual collected-Species present

☐ No individuals collected-Species absent

Table IV-2

Number of Species Collected by Impingement Sampling and by Nearfield Sampling from 1975 through 1977 with Corresponding Amounts of Effort. (Number of species collected was proportional to effort.)

	Impingement		Nearfield		Common to Impingement and Nearfield
Year	Number of Species	Volume Circulated ($m^3 \times 10^6$)	Number of Species	Number of Samples	Number of Species
1975	50	1273	47	600	39
1976	58	1384	43	606	40
1977	72	2158	48	619	47
1975-77	79	4815	57	1825	53

b. Comparison of Nearfield and Impingement Species Composition

Fifty-three species of fish were common to both impingement and nearfield samples collected from 1975 to 1977 (Table IV-2). Four species collected by nearfield sampling were not collected by impingement, and 26 species were present in impingement samples but not collected by nearfield sampling (Table IV-1). Species that were collected by only one of the two types of sampling were incidental and were never collected in large numbers. Impingement sampling was a more intensive effort than nearfield sampling. Impingement samples were collected every day of the year, whereas nearfield stations were sampled once a week or once every 2 weeks from April through December. Therefore impingement sampling would perhaps be expected to collect a greater variety of species.

In general, the most abundant species in impingement samples were also the most abundant species collected during nearfield sampling. As with impingement, a small number of species composed a large percentage of the total number of fish collected by nearfield sampling. White perch was the species impinged in greatest abundance each year from 1975 to 1977, but in nearfield samples white perch ranked fourth in 1975 and 1977 and third in 1976. With the exception of tomcod box-trapping, nearfield sampling was not conducted from January through March, the time of high white perch impingement. Thus, absence of comparable field sampling during this period accounts for the difference in the ranking of white perch between the two

Table IV-3

Abundance of 15 Predominant Species in 1975 through 1977 Impingement Collections* at Indian Point Generating Station Listed in Order of Decreasing Contribution to 1977 Collections. (Four species account for 90% of total number collected.)

Species	1975 Number	1975 Percent Total	1976 Number	1976 Percent Total	1977 Number	1977 Percent Total	1975-1977 Number	1975-1977 Percent Total	Cumulative Percentage
White perch	299325	43.0	440641	54.0	1094592	37.8	1834558	41.6	41.6
Atlantic tomcod	78627	11.3	34236	4.2	747702	25.8	860565	19.5	61.1
Blueback herring	155707	22.3	258303	31.6	637519	22.0	1051529	23.9	85.0
Bay anchovy	96058	13.8	12142	1.5	146879	5.1	255079	5.8	90.8
Alewife	4243	0.6	3549	0.4	58592	2.0	66384	1.5	92.3
Striped Bass	5977	0.9	6130	0.8	27677	1.0	39784	0.9	93.2
Rainbow smelt	7790	1.1	3049	0.4	26988	0.9	37827	0.9	94.0
Hogchoker	18839	2.7	14795	1.8	25472	0.9	59106	1.3	95.4
White catfish	10171	1.5	18767	2.3	24755	0.9	53693	1.2	96.6
Bluefish	1616	0.2	1525	0.2	21403	0.7	24544	0.6	97.1
Unid. Clupeid**	108	0.1	179	0.1	19743	0.7	20030	0.5	97.6
Spot	0	0.0	1471	0.2	16267	0.6	17738	0.4	98.0
American shad	1148	0.2	4223	0.5	12704	0.4	18075	0.4	98.4
Weakfish	8969	1.3	556	0.1	7587	0.3	17112	0.4	98.8
Gizzard shad	921	0.1	2777	0.3	6636	0.2	10334	0.2	99.0
Spottail shiner	3949	0.6	5154	0.6	5308	0.2	14411	0.3	99.4
Other species combined	3266	0.5	8633	1.1	16408	0.6	28307	0.6	100.0
All species	696714	100.0	816130	100.0	2896232	100.0	4409076	100.0	

*Units No. 1, No. 2, and No. 3 combined for 1975 and 1976, Units No. 2 and No. 3 for 1977.
**Unidentifiable clupeids were primarily blueback herring and alewives.

types of sampling. Blueback herring was the most abundant species in nearfield samples each year from 1975 to 1977 and was the second most abundant species in impingement collections in 1975 and 1976; in 1977, blueback herring was third in abundance in impingement samples. The number of species collected in nearfield samples and the nearfield sampling effort remained consistent from 1975 to 1977 (Table IV-2).

Species which inhabit the shore zone appeared to be less vulnerable to impingement than pelagic species. Banded killifish and tessellated darter (inshore species) were abundant in nearfield samples but were not impinged in large numbers. Beach seine collections accounted for nearly all banded killifish and tessellated darter taken in nearfield sampling. Weakfish, a species collected solely by bottom trawl, was relatively more abundant in impingement than in nearfield samples. White perch, the species of greatest abundance in impingement, was also abundant in trawl catches (Section IV.C.2.d), further suggesting that species in the off-shore, deep-water habitat were more vulnerable to impingement than inshore fishes.

c. Age Composition

Routine sampling of both impinged fish and Hudson River fish included an estimation of size composition of the key species (white perch, Atlantic tomcod, and striped bass) and the three clupeid species (alewife, blueback herring, and American shad). Most fish impinged at Indian Point in recent years have been small and less than 12 months old, due in part to the ability of larger fish to swim away from the intake screens and in part to the age structure of the fish population. This latter consideration is particularly true of anadromous species such as the clupeids for which most individuals leave the estuary as juveniles and are therefore vulnerable only during their first four to six months of life. Field samples also consisted primarily of young fish. Sixty-five percent of the white perch taken in standard stations beach seines and bottom trawls and 89% of the striped bass taken in standard stations beach seines in 1976 were less than 12 months old (TI 1977d). Although young fish were common in field collections, they were proportionately more abundant in impingement collections. Ninety-five percent of the white perch impinged at Indian Point during 1976 were less than 12 months old; in 1977, 86% were less than 12 months old (Table IV-4).

Table IV-4

Percent Age Composition of Impinged White Perch Collected at Indian Point Units No. 1, No. 2, and No. 3 Combined, 1976 and 1977. [The majority of white perch impinged (95% in 1976 and 86% in 1977)* were less than 12 months old.]

	Percentage of Monthly 1976 Collections				Percentage of Monthly 1977 Collections			
Month	Young-of the-Year	Yearling	Older than Yearling	No. in Collection	Young-of the-Year	Yearling	Older than Yearling	No. in Collection
Jan	0.0	96.8	3.2	91536	0.0	89.8	10.2	387729
Feb	0.0	95.9	4.1	29795	0.0	90.2	9.8	168034
Mar	0.0	91.1	8.9	18454	0.0	82.6	17.4	89354
Apr	0.0	97.5	2.5	3231	0.0	49.8	50.2	74799
May	0.0	94.4	5.6	5161	0.0	89.5	10.5	47914
Jun	0.0	20.0	80.0	1652	49.2	7.7	43.1	13414
Jul	13.0	14.3	72.8	1056	32.7	20.5	46.7	3467
Aug	64.8	6.2	29.1	2949	84.3	2.5	13.2	15743
Sep	75.5	3.1	21.3	3593	54.3	17.9	27.8	7684
Oct	94.1	2.7	3.1	53763	91.2	3.0	5.8	51822
Nov	96.7	2.0	1.5	86372	91.7	4.7	3.5	142195
Dec	96.1	1.4	2.5	143079	92.1	3.5	5.4	92437
Total	62.7	33.6	3.8	440641	26.3	61.1	12.6	1094592

*Obtained by summing total counts of young-of-the-year from June through December and yearlings from January through May.

For striped bass the percentages of fish less than 12 months old were 94% in 1976 and 97% in 1977 (Table IV-5). The predominance of young fish was also reflected in the low average weights of impinged striped bass (7.80 g in 1976 and 1977 combined) and white perch (7.31 g in 1976 and 1977 combined) (Table IV-6).

Young-of-the-year white perch and striped bass were each first impinged during July in 1976 and during June in 1977. In both years, actual numbers as well as proportions of young-of-the-year in the impingement collections increased through October and remained high through December (Tables IV-4 and IV-5). Since spawning typically occurs in May or June and young-of-the-year fish become yearlings on 1 January each year, there are no young-of-the-year white perch or striped bass between January and May. Therefore, yearlings dominated the January to May white perch and striped bass impingement collections. Few fish older than yearlings were impinged, particularly in the case of striped bass. After May, young-of-the-year began to reach impingeable size concurrent with a reduction in absolute numbers of yearlings impinged. Thus, the proportion of yearling white perch and striped bass impinged from June through December was reduced. The increase in proportions of impinged fish older than yearlings during April through July resulted from decreases in numbers of yearlings collected rather than from increases in collections of older fish.

Like white perch and striped bass, the majority of Atlantic tomcod impinged at Indian Point were young. Atlantic tomcod spawn during the winter, mature during the year, and spawn the following winter at one year of age. The mature fish then migrate downriver and, except for an occasional stray, do not reappear in the area of Indian Point. Less than 2% of the tomcod impinged during 1976 and 1977 were older than 12 months. Most of the tomcod impinged at Indian Point were young fish that apparently spent the summer in the Indian Point and Croton Haverstraw regions. The mean weight of Atlantic tomcod impinged during 1976 and 1977 was 3.40 g (Table IV-6). An upriver spawning migration during the fall results in a low winter population near Indian Point, and consequently low numbers of mature tomcod were impinged at Indian Point. Of the total tomcod collected during 1976 and 1977, only 2.4% were collected from October through April, the period when most maturing and mature tomcod were present in the river.

Table IV-5

Percent Age Composition of Impinged Striped Bass Collected at Indian Point Units No. 1, No. 2, and No. 3 Combined, 1976 and 1977. [The majority of striped bass impinged (94% in 1976 and 97% in 1977)* were less than 12 months old.]

Month	Percentage of Monthly 1976 Collections				Percentage of Monthly 1977 Collections			
	Young-of the-Year	Yearling	Older than Yearling	No. in Collection	Young-of the-Year	Yearling	Older than Yearling	No. in Collection
Jan	0.0	98.3	1.7	1818	0.0	96.5	3.5	4625
Feb	0.0	96.6	3.4	116	0.0	88.5	11.5	1687
Mar	0.0	100.0	0.0	113	0.0	83.8	16.2	884
Apr	0.0	100.0	0.0	27	0.0	60.5	39.5	43
May	0.0	90.2	9.8	92	0.0	72.1	27.9	136
Jun	0.0	76.2	23.8	42	30.6	42.7	26.8	157
Jul	74.3	17.1	8.6	70	94.8	0.3	4.9	1233
Aug	82.0	6.9	11.6	233	99.4	0.1	0.5	5875
Sep	91.9	4.3	3.9	540	98.1	0.0	1.9	3029
Oct	94.9	3.8	1.3	1989	99.6	0.2	0.2	3941
Nov	92.4	6.1	1.4	554	99.6	0.2	0.2	3332
Dec	97.0	2.8	0.2	536	99.5	0.0	0.5	2735
Total	59.7	38.0	2.3	6130	72.2	25.0	2.8	27677

*Obtained by summing total counts of young-of-the-year from June through December and yearlings from January through May.

Table IV-6

Total Numbers of Individuals and Weights (g) of Impinged Striped Bass, White Perch, and Atlantic Tomcod Collected at Indian Point Units No. 1, No. 2, and No. 3, 1976 and 1977

	Species		
Year	Striped Bass	White Perch	Atlantic Tomcod
1976			
Total Weight (g)	72857	2512729	395775
Number of Individuals	6130	440641	34236
Mean Weight (g)	11.89	5.70	11.56
1977			
Total Weight (g)	190830	8702432	2259633
Number of Individuals	27677	1094592	747704
Mean Weight (g)	6.89	7.95	3.02
1976-1977			
Total Weight (g)	263687	11215161	2655408
Number of Individuals	33807	1535233	781940
Mean Weight (g)	7.80	7.31	3.40

Of the alewife, blueback herring, and American shad collected from Indian Point intake screens during 1976 and 1977, 99.8% were collected between June and December, and of those, 99.4% were less than 12 months old (Table IV-7). During the period January through May, the proportion of older fish in impingement collections increased (47.3% were less than 12 months old) but numbers were extremely low. Mean weights for the three species during the latter half of the year, when predominantly young fish were present, were 1.6 g for blueback herring, 2.6 g for alewife, and 3.5 g for American shad (Table IV-7). For the period January through May, when weight data included all ages, the mean weight for the three species combined was still only 107.1 g. The extremely high proportions of young fish among the clupeids impinged are related to their anadromous nature. Adult fish enter the estuary to spawn during the spring, after which most immediately emigrate. The estuary is utilized as a nursery area by the young clupeids until late fall when they also emigrate. A few blueback herring and alewives, especially alewives, may remain in the river throughout the year and become susceptible to impingement. Low numbers of clupeids impinged during the first half of each year are a function of both reduced abundance and, as they grow, an increased ability to avoid intakes.

Table IV-7

Percentage of Clupeids Less than 12 Months Old in Combined 1976 and 1977 Impingement Collections at Indian Point Units No. 2 and No. 3. (Percentage of young fish in collections was high from June through December, lower from January through May.)

	Jun-Dec			Jan-May		
Species	Percent of Sample	Sample Size	Mean Weight (g)	Percent of Sample	Sample Size	Mean Weight (g)
Blueback herring	99.6	894356	1.6	61.4	1448	73.7
Alewife	97.5	61317	2.6	21.8	817	165.8
American shad	98.5	16900	3.5	71.4	14	195.9
Combined	99.4	972573	1.7	47.3	2279	107.1

2. Seasonal and Yearly Impingement Patterns

a. Introduction

Each species impinged exhibits its own distinct pattern of distribution, movement, and behavior which results in its being susceptible to impingement. Temporal variations in size of impingement collections during 1975, 1976, and 1977 reflected this fact. Analysis of seasonal impingement patterns and comparison of those patterns with important environmental factors and population abundance estimates are required to evaluate fluctuations in impingement rates.

Simple counts of fish collected from intake screens provide a rough estimate of impingement trends. However, impingement patterns derived from simple counts can be confounded by the extent of plant operation. Variations in the amount of plant operation can be accounted for by relating the number of fish impinged to the volume of water circulated (i.e., impingement rate).

When evaluating impingement numbers or rates, it must be considered that the efficiency of collecting impinged fish is less than 100%. Impinged fish may be lost prior to collection as a result of several factors such as scavenging by fish and birds, loss to tidal or river currents, disintegration of fragile species, or entanglement in submerged structures associated with the intakes. Collection efficiency adjustment factors can be applied to actual counts of fish collected for estimating total mortality due to impingement. Application of such factors results in increased numbers and rates throughout the year but does not alter temporal patterns of impingement, which is the primary subject matter of this report. Therefore, the numbers and rates of impinged fish discussed herein, unless otherwise noted, are actual counts of fish taken in routine daily impingement monitoring.

b. Impingement Collection Efficiency

Various tests have been conducted at Indian Point since 1974 to estimate the percentage of impinged fish actually collected. Tests were continued during 1977 in accordance with the methods described in Section III.B.1.d. The basic procedure was to release dyed test fish (dead) in front of the intake screens and record numbers recovered during subsequent routine daily impingement collections. Many of the early tests of collection efficiency at Unit No. 2 were made during the operation of an air curtain (TI 1976a), the use of which was discontinued after March 1976. Air curtain use resulted in lower collection efficiency than present operation without air curtains (McFadden et al. 1978); therefore, the following discussion is restricted to tests made in the absence of an air curtain.

Nine tests were conducted at Unit No. 2 during 1977 (each with operating circulators at 100% flow capacity) in which a total of 1500 fish were released on the fixed screens and 224 were eventually recovered, yielding a total recovery rate of 14.9%. The percentage of test fish recovered during these nine tests (Table IV-8) ranged from 5.0 to 29.4%.

Several collection efficiency tests were conducted during 1974 and 1975 under conditions similar to those existing in 1977 (i.e., air curtain off). Two tests conducted during 1974 produced recovery rates of 74.5% and 37.0%. A total of 400 fish were released in each of those tests. In a single test conducted in 1975, 200 fish were released and 46 were recovered for a recovery rate of 23.0%. No tests were conducted at Unit No. 2 during 1976. Based on the nine tests during 1977 and the three earlier tests in which a total of 2500 fish were released and 716 recovered, the current best

Table IV-8

Numbers and Percentage of Fish Recovered in Collection Efficiency Tests at Indian Point Unit No. 2, 1977

Test No.	Date	Number Released	Number Recovered	Percent Recovered
1	5/23	180	36	20.0
2	5/29	180	18	10.0
3	6/03	120	22	18.3
4	6/11	120	17	14.2
5	6/15	180	9	5.0
6	6/18	180	53	29.4
7	6/22	180	23	12.8
8	6/25	180	30	16.7
9	6/29	180	16	8.9
Total		1500	224	14.9

estimate of Unit No. 2 collection efficiency is 29.0% when the air curtain is not operating. From this can be derived an adjustment factor of 3.5 which, when multiplied by the actual numbers of fish collected (Appendix A), will yield an estimate of the total numbers of fish impinged at Unit No. 2 during 1977.

Eleven tests were conducted at Unit No. 3 in 1977. The first was conducted while each operating circulator at the unit was operating in the reduced flow mode employed during winter (60% of capacity). In that test, 72.2% of the released fish were recovered. Ten additional tests were conducted at the normal 100% flow rate. The average recovery rate of test fish in those ten tests was 68.6% with a range of 58.3% to 85.0% (Table IV-9). During 1976, a total of 550 fish were released and 435 recovered in seven collection efficiency tests conducted at Unit No. 3. Recovery rates ranged from 75 to 86% with an average of approximately 80% (TI 1977d). Our current best estimate of the collection efficiency at Unit No. 3 is 71.2% based on all 18 tests conducted during 1976 and 1977. The resultant adjustment factor of 1.4, when multiplied by actual numbers of fish collected (Appendix A), will yield an estimate of the total number of fish impinged at Unit No. 3 during 1977.

Table IV-9

Numbers and Percentage of Fish Recovered in Collection Efficiency Tests at Indian Point Unit No. 3, 1977

Test No.	Date	Number Released	Number Recovered	Percent Recovered
1*	3/31	180	130	72.2
2	4/13	179	112	62.6
3	6/15	180	127	70.6
4	6/22	180	143	79.4
5	7/6	180	128	71.1
6	7/16	180	111	61.7
7	7/20	180	105	58.3
8	8/3	180	117	65.0
9	8/6	180	153	85.0
10	9/14	180	120	66.7
11	9/21	120	77	64.2
Total		1919	1323	68.9

*Circulators operating at 60% flow capacity, all other tests conducted at 100% flow capacity.

Each collection efficiency test at Units No. 2 and No. 3 involved the release of fish at three separate times within 24 hours to test the effect of impingement duration. A different color of dye for each of the three releases allowed the fish to be separated during recovery. Recovery rates among the three release times (Table IV-10) were not significantly different ($\alpha = 0.05$). Thus, within the 24-hour test period, duration on the intake screens did not affect collection efficiency.

Test fish have been recovered as long as ten days after release, although the majority were usually collected within the first two or three days. At Unit No. 3, 87% of the total number of fish eventually recovered from all tests appeared in the first collection, while at Unit No. 2 the figure was 47%. The test fish collected on the first and second screen washes combined at Unit No. 2 constituted a mean of 84% of the total number

Table IV-10

Release-Specific Recovery Rates of Test Fish in Collection Efficiency Tests Conducted at Indian Point Units No. 2 and No. 3 during 1977

Unit No. 2

Release	Number Released	Number Recovered	Percent Recovered
1	540	78	14.4
2	540	74	13.7
3	420	72	17.1
Total	1500	224	14.9

Unit No. 3

Release	Number Released	Number Recovered	Percent Recovered
1	660	464	70.3
2	660	411	62.3
3	599	448	74.8
Total	1919	1323	68.9

eventually recovered, a value similar to that of Unit No. 3. Thus, many fish impinged at Unit No. 2 on a given day were apparently not collected until the second or even the third screen wash thereafter.

The Unit No. 2 fixed screen wash procedure entailed individually raising each screen while a high pressure spray from behind the screen washed fish and debris off the screen and into the river. Each screen was raised to the point where only a few feet of screen remained in the water and was then immediately lowered back into position, being washed again on its way down. It is probable that many fish washed from the screens had not yet reached the forebay by the time the screens were back in position, thus possibly accounting for the delayed return of collection efficiency test fish noted above. This problem did not occur at Unit No. 3 because it has no fixed screens. High returns of test fish were observed on the first collection period at Unit No. 3 because test fish were released immediately in front of the traveling screens and had only to be impinged and remain on the screen until it was rotated and washed. Fish have been observed to fall off the traveling screens at both units as the screens clear the water during rotation. Occurrences such as this contributed to the less than 100% efficiency at Unit No. 3.

Circulating water pumps, when shut off, can produce a backwash of sufficient force to wash impinged fish from the screens into the river. With this in mind, collection efficiency data were examined to determine whether any of the circulators had been shut off briefly during any efficiency tests. It was found that circulator operation during tests 3, 7, and 8 at Unit No. 2 and tests 2 and 4 at Unit No. 3 (all tests at 100% flow) had been interrupted at least once. However, the results of those tests were not significantly different (chi-square test, $\alpha = 0.05$) from the other tests. At Unit No. 2, the average efficiency of the three interrupted tests was 15.6% compared to 14.6% for uninterrupted tests. At Unit No. 3, the average efficiency of two interrupted tests was 71.0% compared to 68.5% for uninterrupted tests. Since impingement collections from each screen were not kept separate but were combined for all screens within a unit, the lack of an obvious difference (i.e., lower efficiency in tests with interrupted circulator operation) indicates that most or all fish lost from one screen were collected on adjacent screens and not lost to the river. However, only five tests do not provide sufficient data from which to draw conclusions applicable to the impingement study program.

c. Impingement Rates

1) Selected versus Unselected Impingement Rates

The relationship of the number of fish impinged to the volume of water circulated during the fish collection period (impingement rate) is often confounded by conditions of plant operation and fish collection which limit the precision of matching numbers of fish to appropriate volumes circulated (Section III.B.1.c). Variation introduced into monthly or yearly impingement rates by such problems is of minor consequence in evaluating long-range impact of a plant on the environment. For such use, it is appropriate and economical to simply disregard slight fish-to-volume mismatches and to compute rates by dividing total estimated numbers impinged by total estimated volume circulated. Rates calculated in such a manner are hereafter referred to as "unselected rates."

To evaluate within-plant variation on a day-to-day basis, exact computation of daily rates is critical. Failure to precisely match fish counts to volume circulated would superimpose this source of variation upon whatever natural variation exists (i.e., due to biological or physico-chemical factors), thus possibly masking any real effect of these factors on impingement rates. Various factors (Section III.B.1.c) occasionally prevented precise daily impingement rate computation. Therefore, impingement rates were calculated only for days meeting specific criteria (Appendix A.3) chosen to insure precise matching of daily fish impingement and plant water volume intake, hence the term "selected" impingement rates. Once developed, the selection system was also applied to 1975 and 1976 impingement data. Selected rates for the three years were compared with previous estimates of impingement rates for those years (Appendix A.4). Agreement in the two rate estimates, as well as agreement between the percent of days and the percent of catch included in the selected rates, demonstrates that the selection process was accurate and not biased toward either large or small sample sizes (Table IV-11).

2) Trends in Impingement of Predominant Species

Mean monthly selected impingement rates (No. impinged/10^6 m^3 of water circulated) for all species combined and Units No. 2 and No. 3 combined were often an order of magnitude higher during 1977 than during either 1975 or 1976. Rates tended to be lowest during 1976 and intermediate during 1975 (Figure IV-2). Higher impingement rates in 1977 were apparently related to increased abundance of fish in the river (Section IV.C.2.d). Seasonal variation in magnitude of impingement rates within each year resulted from complex patterns of behavior, movement, and distribution of each species. High impingement rates depicted in Figure IV-2 resulted from the impingement of combinations of a few predominant species. Each of the species impinged in greatest numbers exhibited relatively well defined and

Table IV-11

Comparison between Average Selected and Unselected Impingement Rates (No. fish/$10^6 m^3$ of water circulated) for Eight Species Impinged at Indian Point Units No. 2 and No. 3 during 1975 through 1977. (Selected and unselected impingement rates, as well as percent of days included and percent of catch selected, agree closely.)

Species	Unit	Percent of Days Included	Unselected Rate	Selected Rate	Percent of Catch Selected	Percent of Days Included	Unselected Rate	Selected Rate	Percent of Catch Selected	Percent of Days Included	Unselected Rate	Selected Rate	Percent of Catch Selected
White perch	2	82.1	229.40	239.68	82.1	65.7	613.16	792.67	74.1	58.5	843.76	739.05	50.1
	3	–*	–	–	–	67.3	180.77	248.43	78.0	62.0	207.43	166.77	52.2
Striped bass	2	82.1	4.39	4.62	82.7	65.7	8.18	9.97	69.9	58.5	17.20	14.03	46.7
	3	–	–	–	–	67.3	2.71	3.42	71.7	62.0	8.92	10.90	79.4
Atlantic tomcod	2	82.1	68.42	70.42	80.8	65.7	26.31	27.11	59.1	58.5	265.79	412.39	88.8
	3	–	–	–	–	67.3	25.38	29.13	65.1	62.0	418.11	571.78	88.9
Blueback herring	2	82.1	138.99	159.56	90.2	65.7	286.13	270.72	54.2	58.5	569.61	557.27	56.0
	3	–	–	–	–	67.3	145.35	215.37	84.1	62-0	51.21	75.25	95.5
Alewife	2	82.1	3.68	3.99	85.2	65.7	1.52	1.15	43.3	58.5	15.60	16.50	60.5
	3	–	–	–	–	67.3	3.28	5.29	74.2	62.0	37.39	52.05	90.5
American shad	2	82.1	1.01	1.08	84.5	65.7	2.49	2.46	56.7	58.5	3.82	4.02	34.8
	3	–	–	–	–	67.3	3.53	4.28	63.8	62.0	7.71	10.92	92.0
Bay anchovy	2	82.1	85.63	84.51	77.5	65.7	7.32	8.34	65.3	58.6	60.11	78.77	78.4
	3	–	–	–	–	67.3	9.98	9.93	56.5	62.0	77.42	102.41	86.0
Hogchoker	2	82.1	16.73	17.16	80.6	65.7	6.46	5.36	47.5	58.5	11.97	13.03	62.3
	3	–	–	–	–	67.3	13.60	13.48	56.2	62.0	11.65	14.59	81.4

*Indicates unit not in operation.

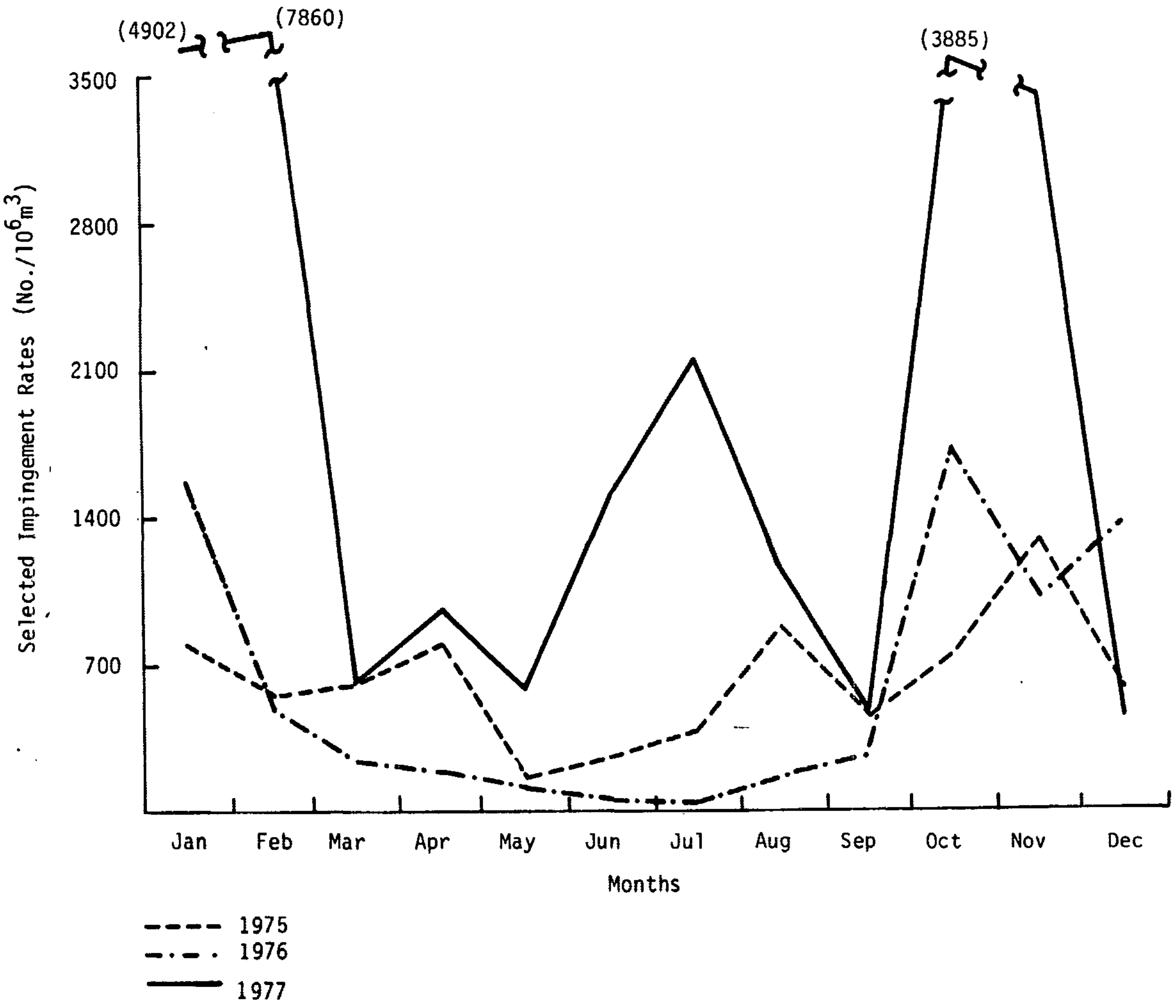


Figure IV-2. Monthly Mean of Selected Daily Impingement Rates (No./10^6m^3) of All Species Combined Impinged at Indian Point Units No. 2 and No. 3 during 1975, 1976, and 1977. (Rates were high during 1977 although patterns were generally consistent with previous years; see Appendix Table A-23 for volumes associated with rates.)

remarkably consistent periods of maximum impingement each year. For the three clupeids and the bay anchovy, those periods overlapped during late summer and fall (Figure IV-3). White perch and striped bass impingement extended through a greater portion of the year, especially fall and winter (and also early spring for white perch), while tomcod and hogchoker were impinged in greatest numbers during the summer (Figure IV-4).

3) Comparison of Impingement Rates at Units No. 2 and No. 3

Selected daily impingement rates for January through October 1977 were used to compare impingement of white perch, striped bass, Atlantic tomcod, blueback herring, and all species combined between Indian Point Units No. 2 and No. 3. Previous attempts to use mean monthly impingement rates to address the question of whether Unit No. 2 impinged fish at rates different from Unit No. 3 have always been confounded by the influence of nonsimultaneous operation. The present availability of daily impingement rates made it possible to compare rates between units utilizing days on which both units operated simultaneously and at similar flow rates. Data collected on days of simultaneous operation were used to compute a single impingement rate for the two units combined each month. No comparative analyses were possible for November or December 1977 because the fixed screens at Unit No. 2 collapsed, causing an adjustment of the washing schedule at that unit. The proportion of the monthly impingement rate attributable to each unit was calculated for the four key species: white perch (Figure IV-5), Atlantic tomcod (Figure IV-6), striped bass (Figure IV-7), blueback herring (Figure IV-8), and all species combined (Figure IV-9). Rates based on actual collections and rates adjusted for collection efficiency have been presented because differences in collection efficiency exist between the two units (Section IV.2.b) that could significantly affect conclusions regarding differential impingement. Adjustments were made based on the best estimates of collection efficiency presently available (29% at Unit No. 2 and 71% at Unit No. 3).

The primary result of making collection efficiency adjustments (3.5x for Unit No. 2 and 1.4x for Unit No. 3) was to increase the proportion of impingement by Unit No. 2 so that in most months it exceeded 50% of the monthly combined unit rate. In other words, considering adjusted rates for

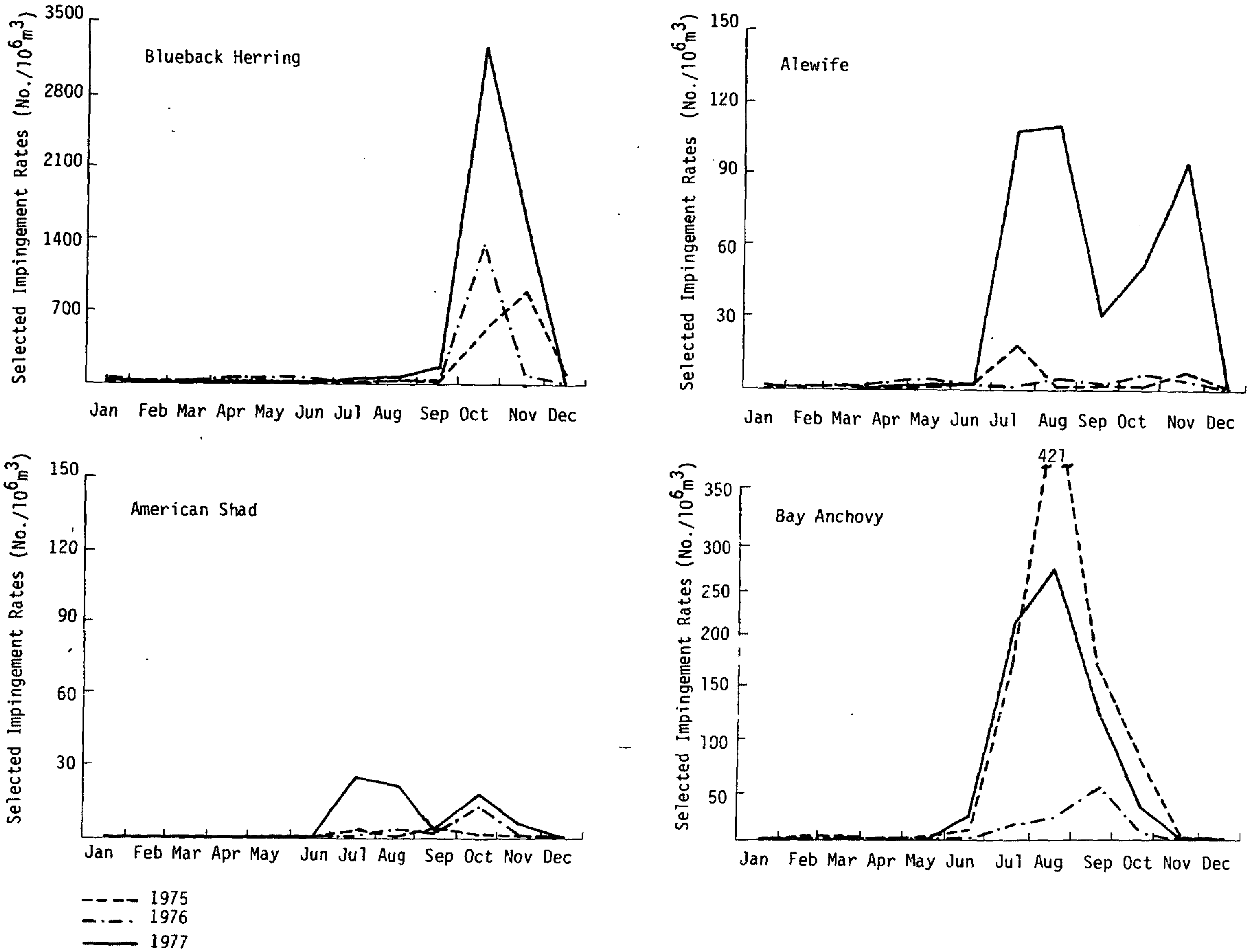


Figure IV-3. Monthly Mean of Selected Daily Impingement Rates (No./10^6m^3) of Blueback Herring, Alewife, American Shad, and Bay Anchovy Impinged at Indian Point Units No. 2 and No. 3 during 1975, 1976, and 1977.

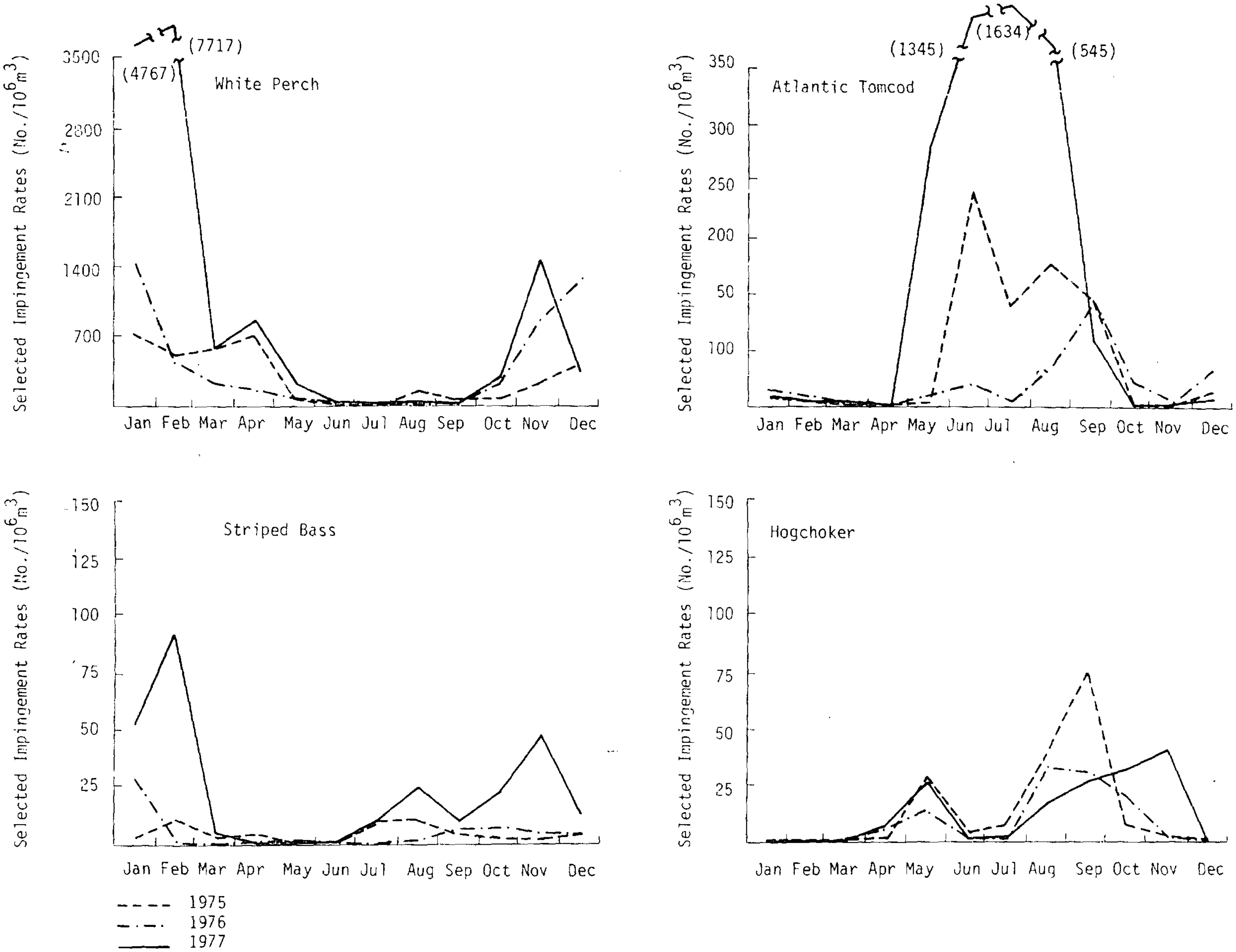


Figure IV-4. Monthly Mean of Selected Daily Impingement Rates (No./$10^6 m^3$) of White Perch, Atlantic Tomcod, Striped Bass, and Hogchoker Impinged at Indian Point Units No. 2 and No. 3 during 1975, 1976, and 1977

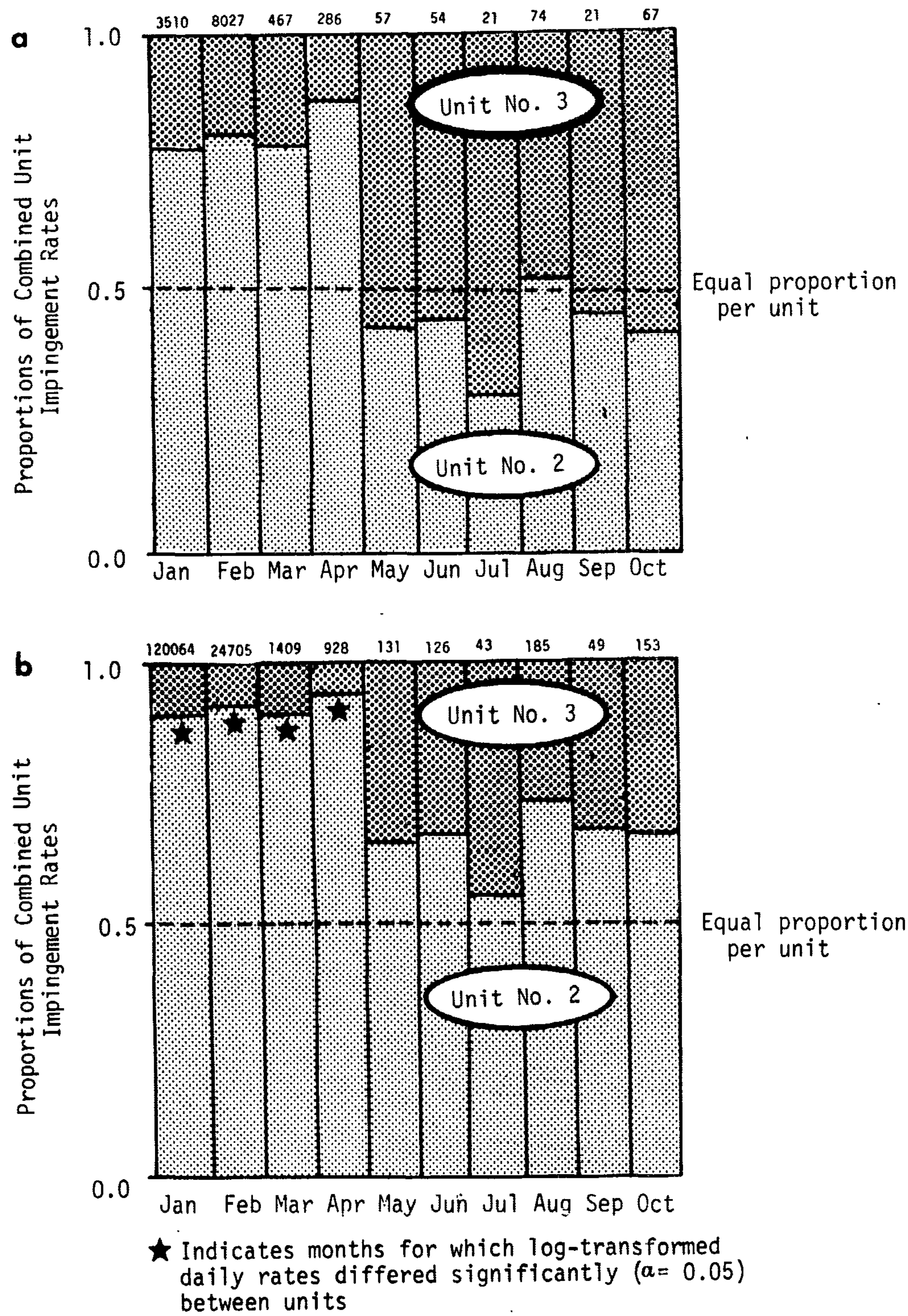


Figure IV-5. Unit No. 2 versus Unit No. 3 Impingement Rates of White Perch at Indian Point during 1977. Proportions of combined unit rate (presented at top of each figure as No./$10^6 m^3$) attributable to each individual unit (a, based on actual collections; b, rate at each unit adjusted for less than 100% collection efficiency.)

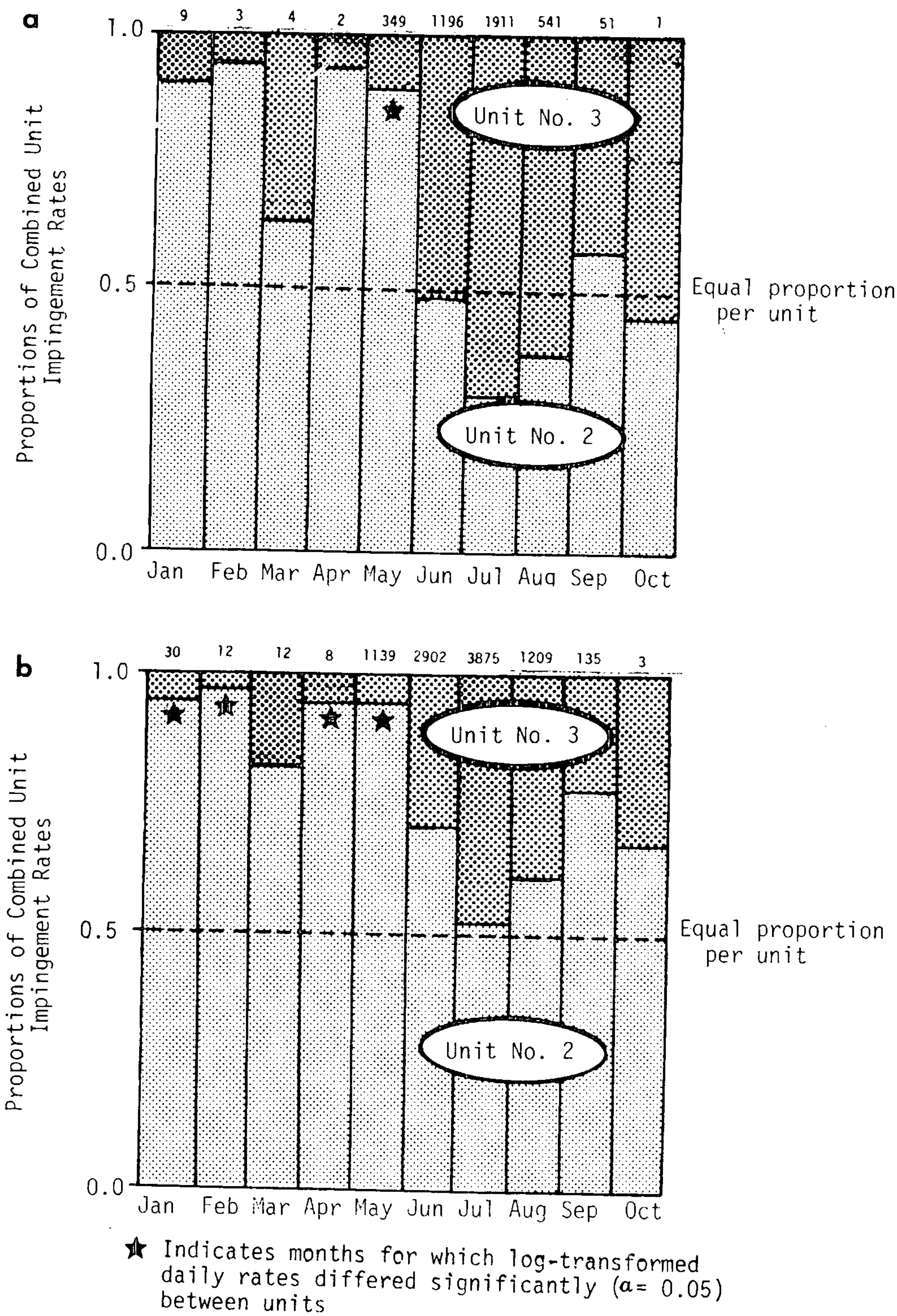


Figure IV-6. Unit No. 2 versus Unit No. 3 Impingement Rates of Atlantic Tomcod at Indian Point during 1977. Proportions of combined unit rate (presented at top of each figure as No./$10^6 m^3$) attributable to each individual unit (a, based on actual collections; b, rate at each unit adjusted for less than 100% collection efficiency.)

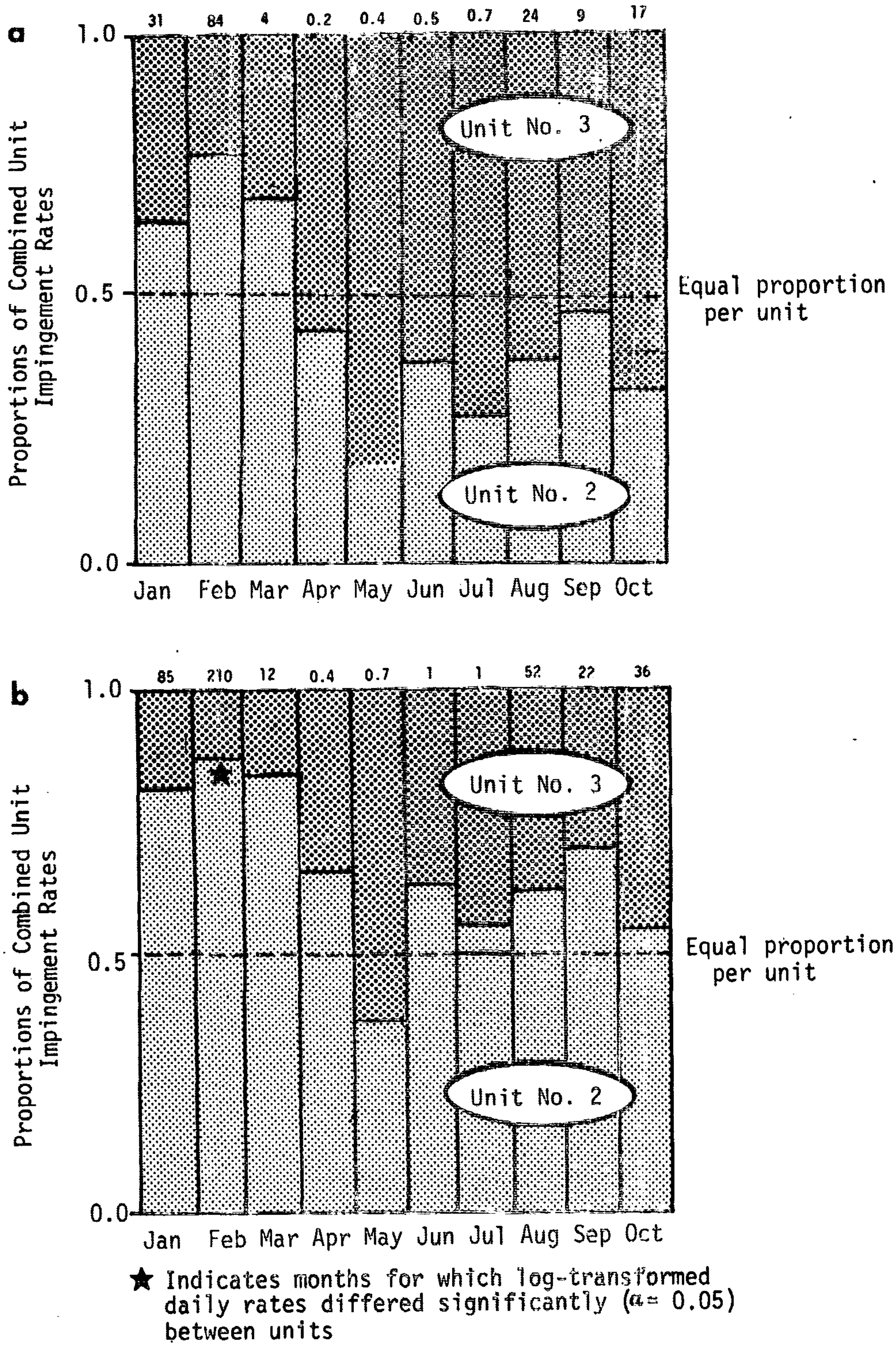
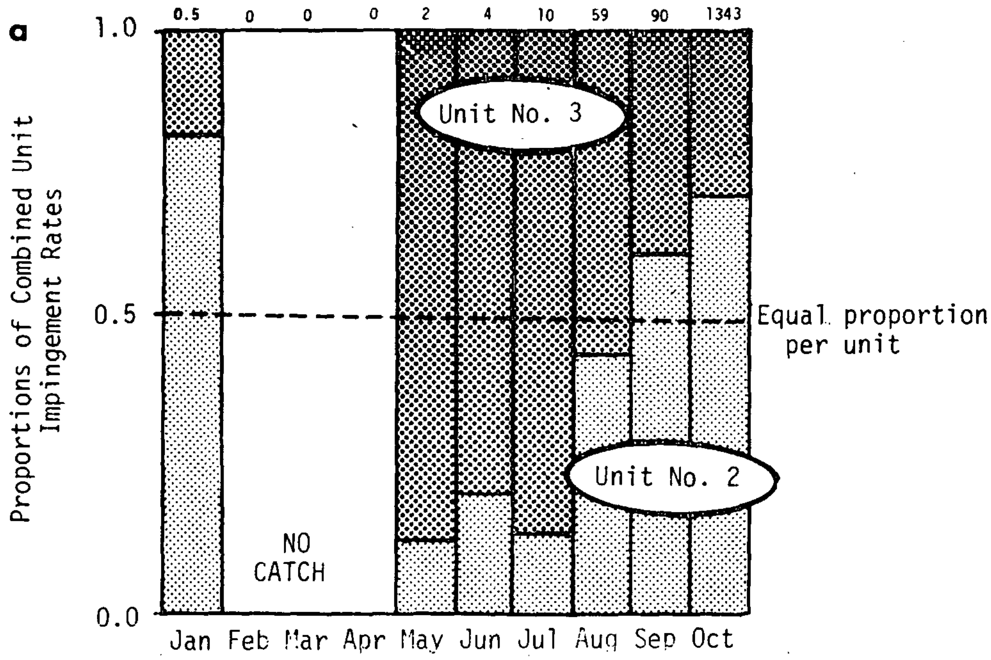


Figure IV-7. Unit No. 2 versus Unit No. 3 Impingement Rates of Striped Bass at Indian Point during 1977. Proportions of combined unit rate (presented at top of each figure as No./$10^6 m^3$) attributable to each individual unit (a, based on actual collections; b, rate at each unit adjusted for less than 100% collection efficiency.)



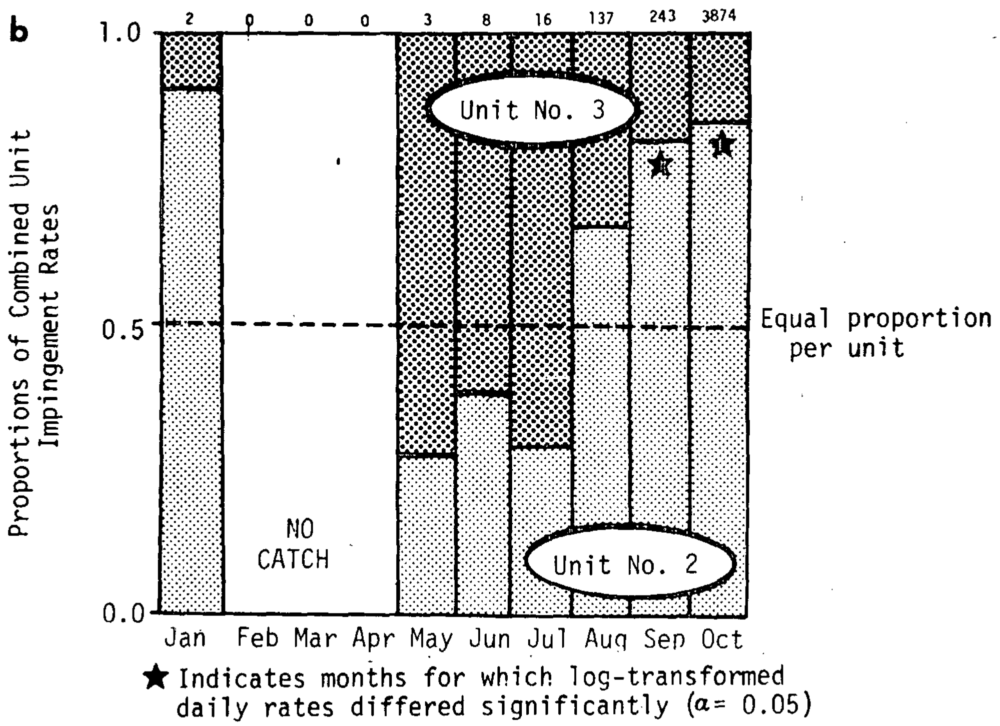


Figure IV-8. Unit No. 2 versus Unit No. 3 Impingement Rates of Blueback Herring at Indian Point during 1977. Proportions of combined unit rate (presented at top of each figure as No./$10^6 m^3$) attributable to each individual unit (a, based on actual collections; b, rate at each unit adjusted for less than 100% collection efficiency.)

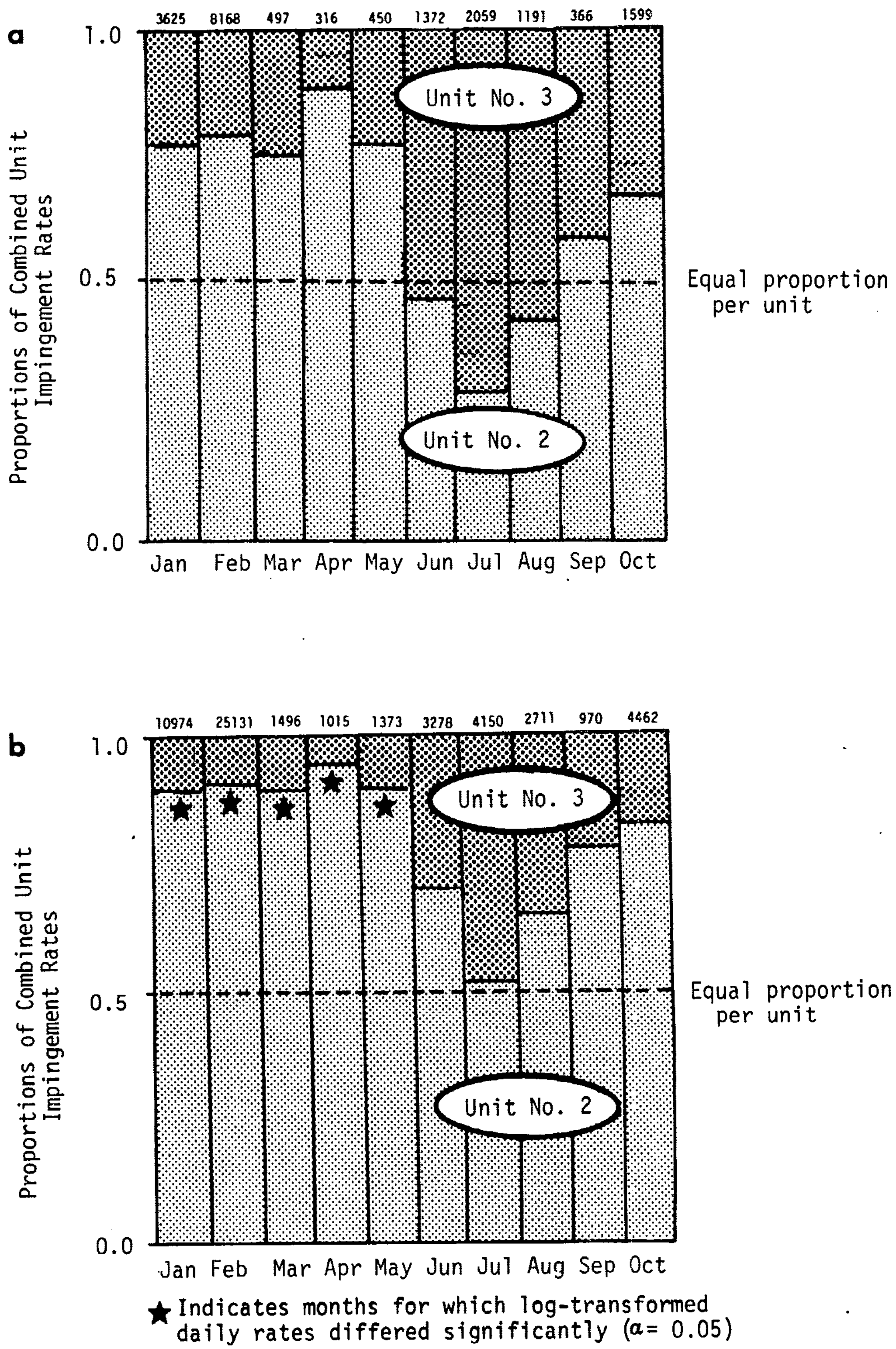


Figure IV-9. Unit No. 2 versus Unit No. 3 Impingement Rates of All Species Combined at Indian Point during 1977. Proportions of combined unit rate (presented at top of each figure as No./10^6m^3) attributable to each individual unit (a, based on actual collections; b, rate at each unit adjusted for less than 100% collection efficiency.)

rates for each of the species examined, Unit No. 2 impinged fish at a greater rate than Unit No. 3 during every month except May, June, and July for blueback herring and except May for striped bass.

Both adjusted and unadjusted impingement rates were analyzed using a two-way analysis of variance for unequal numbers of replicates (Winer 1971). Transformed impingement rates ($\log_{10}$ [X + 1]) were used in the analysis in order to meet the assumptions of homogeneity of variance. A significant interaction of month and unit was observed for each species for both adjusted and unadjusted rates. This indicated that rates differed between the two units but that neither unit had consistently higher rates than the other. A posteriori tests were performed to establish, within each month, which unit impinged fish at a greater rate. Tukey's HSD test (Kirk 1968) was used to make these comparisons. The months for which significant differences between units are found are denoted in Figures IV-5 through IV-9.

Regardless of whether adjusted or unadjusted rates were considered, seasonal differences in impingement rates between the two units were apparent for each species examined and for all species combined. The general pattern observed was that Unit No. 2 tended to impinge fish at equal or greater rates than Unit No. 3 during much of the year. Notable exceptions occurred during July and August for Atlantic tomcod and during May, June, and July for blueback herring when there was a considerable increase in the proportion of fish impinged at Unit No. 3 compared to the rest of the year. In the case of tomcod, the shift to greater impingement at Unit No. 3 during summer coincided with the primary period of tomcod impingement. Thus, although there were only two months during which Unit No. 3 impinged tomcod at rates greater than Unit No. 2 and although Unit No. 3 pumped only 12% more water (Table IV-12), a total of 477,524 tomcod were collected from Unit No. 3 compared to only 270,178 collected from Unit No. 2. Contrary to the situation with tomcod, the greater summer impingement rates for blueback herring at Unit No. 3 did not coincide with the period of maximum herring abundance; therefore, only 58,501 were collected at Unit No. 3 compared to 579,019 collected at Unit No. 2. White perch impingement rates at Unit No. 2 significantly exceeded those at Unit No. 3 during the winter months when

Table IV-12

Comparison between Indian Point Units No. 2 and No. 3 with Regard to Water Volume Circulated* and Numbers of Atlantic Tomcod, Blueback Herring, and White Perch Impinged during 1977

Species	Unit No. 2	Unit No. 3
Atlantic tomcod	270,178	477,524
Blueback herring	579,019	58,501
White perch	857,682	236,910

*Water volume circulated during 1977 totaled $1016.5 \times 10^6 m^3$ at Unit No. 2 and $1142.1 \times 10^6 m^3$ at Unit No. 3.

perch were in greatest abundance. This resulted in a white perch collection of 857,682 from Unit No. 2 compared to 236,910 from Unit No. 3.

d. Relative Catch Index for Comparison of Impingement Rates to Collection Rates of Other Sampling Gears

It is difficult to compare impingement rates with collection rates for fisheries sampling gear because of habitat restriction and the inherent selectivity of the gear used. A Relative Catch Index (RCI) was therefore developed to permit comparisons of C/f data among fishing gear and impingement collections. The index, which is simply the proportion of the year's mean catch that was caught each month, adjusts C/f values on a gear by gear basis allowing direct comparison on the same scale; however, cognizance of gear selectivity must still be maintained with respect to fish size, species collected, and habitat sampled.

The Relative Catch Index was calculated as follows for each gear:

$$RCI_i = \frac{x_i}{\bar{x}} \qquad \text{(IV-1)}$$

where

RCI_i = RCI for the i^{th} time period

x_i = C/f for the i^{th} time period

$\bar{x} = \frac{1}{n} \Sigma x_i$ = Mean C/f over n periods

RCI values can be determined for any appropriate time period(s). The values obtained for each gear are comparable on the same scale relative to the mean C/f value for each gear and respective time period. For example, a monthly RCI value of 2.0 indicates that collections in that month were twice as great as the average C/f for all months considered; a value of 0.5 represents a monthly C/f rate half as great as the average, and so on. The index allows comparison, on a proportional basis, of impingement rates to catch rates for fisheries gear used to monitor nearfield river abundance; it also permits evaluation of which gear best portrays variations in impingement rates for key species.

RCI's were calculated from fisheries C/f data within RM 39-46 because of their proximity to Indian Point. Only those gear for which sampling extended from April through December 1977 were used in the comparison since no nearfield sampling other than tomcod box trap sampling was conducted during January through March 1977. Surface trawl data covering only six months and interregional trawl data covering only nine months were excluded; likewise, impingement data for January through March 1977 were excluded for RCI computation to maintain comparability.

A comparison of RCI and C/f data is presented in Figure IV-10. In this example, it was necessary to adjust scales to several different orders of magnitude for various gear when using C/f values. The adjustments were arbitrarily selected to fit the graph and could confuse comparison of proportional changes in abundance among gear. RCI curves, however, are all on a single scale allowing ready comparison of seasonal variation in proportional abundance as measured by each gear.

Examination of 1977 collection data confirms that in general the numbers of fish impinged increased with increasing fish abundance in the Indian Point region. There was remarkably good agreement for most species between monthly impingement peaks and monthly abundance peaks in the river. November impingement collections were probably not representative of impingement for that month because 1) Unit No. 3 did not operate and 2) the selection process (Section IV.C.2.a) eliminated all but six days at Unit No. 2 due to the collapse of several fixed screens.

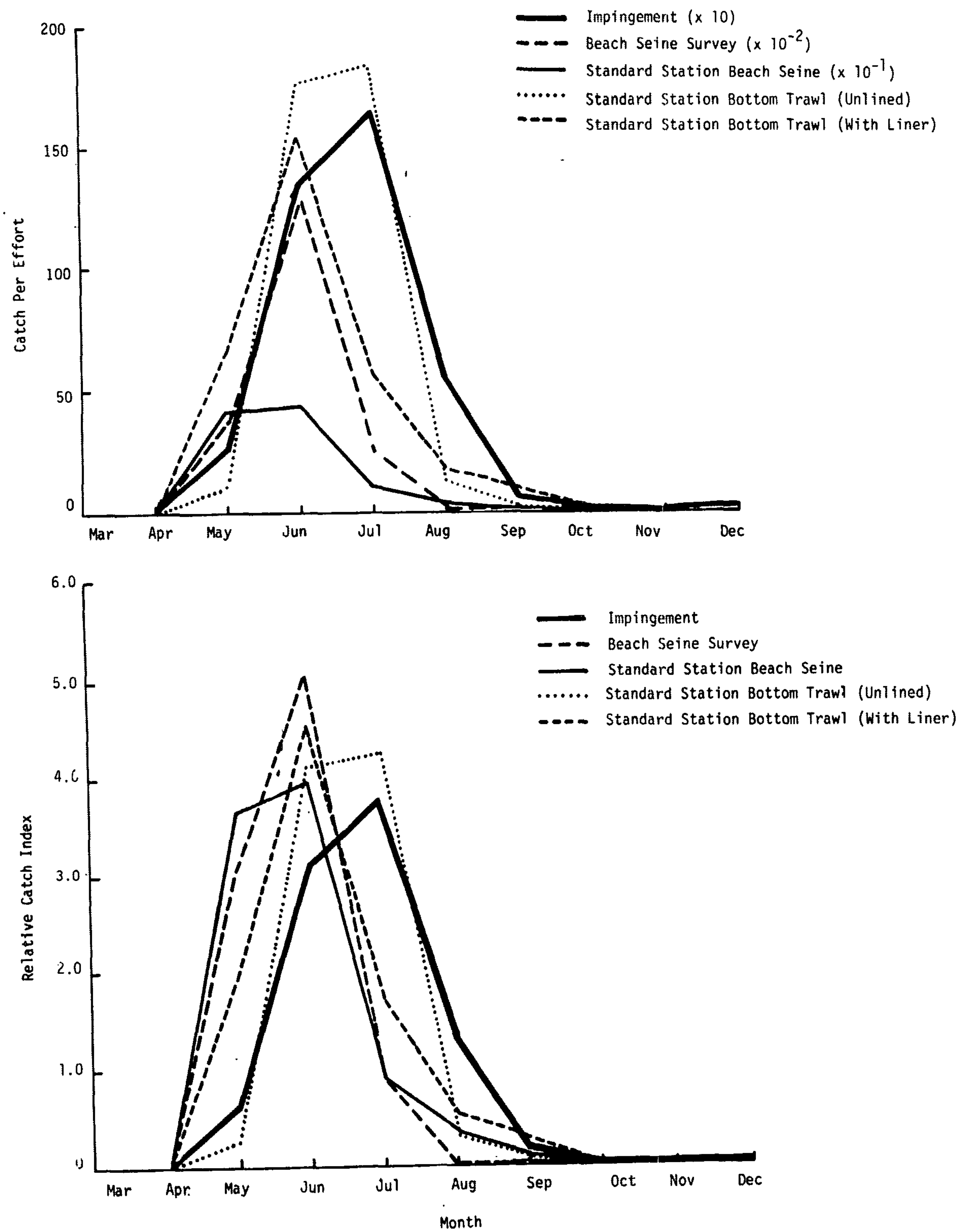


Figure IV-10. Comparison of 1977 Catch per Effort (C/f) and Relative Catch Index (RCI) for Atlantic Tomcod in Indian Point Region (RM 39-46) of Hudson River Estuary

White perch impingement clearly showed a direct relationship to trawl collections, especially the unlined standard station bottom trawl (Figure IV-11a). This was probably due to a size selectivity comparable to impingement selectivity; fish small enough to pass through the unlined trawl were more likely subject to entrainment rather than impingement. Beach seine collections of white perch were a poor indicator of impingement vulnerability.

Impingement trends depicted by RCI values corresponded well with river abundance trends for most other species examined. Only striped bass and hogchoker river collections did not clearly reflect impingement magnitudes (Figures IV-11b and IV-11c). Collections of Atlantic tomcod from impingement and the unlined standard station bottom trawl showed similar patterns (Figure IV-11d), while bay anchovy impingement peaks were reflected in both lined and unlined standard station bottom trawls (Figure IV-12a). Patterns of clupeid abundance in the Indian Point vicinity clearly mirrored impingement patterns; blueback herring collections for all river gear and impingement peaked in October (Figure IV-12b), and bimodal peaks in impingement for alewife and American shad corresponded to river abundances during summer and fall (Figures IV-12c and IV-12d). Clupeid RCI values from impingement were most similar to RCI values for alewife collected in the lined bottom trawl, blueback herring collected in the unlined bottom trawl, and American shad collected in beach seines.

Because of their size, behavior, abundance, and time spent in the estuary, young-of-the-year fish are more susceptible than older individuals to impingement. The gear evaluated in the above comparisons were selective for this segment of the river populations, and good agreement with impingement trends was anticipated. While collections in the river may not be useful for predicting day-to-day impingement variations, since various gear sample different portions of the river populations on any given day, these gear are sensitive tools for monitoring monthly trends in population vulnerability to impingement at Indian Point.

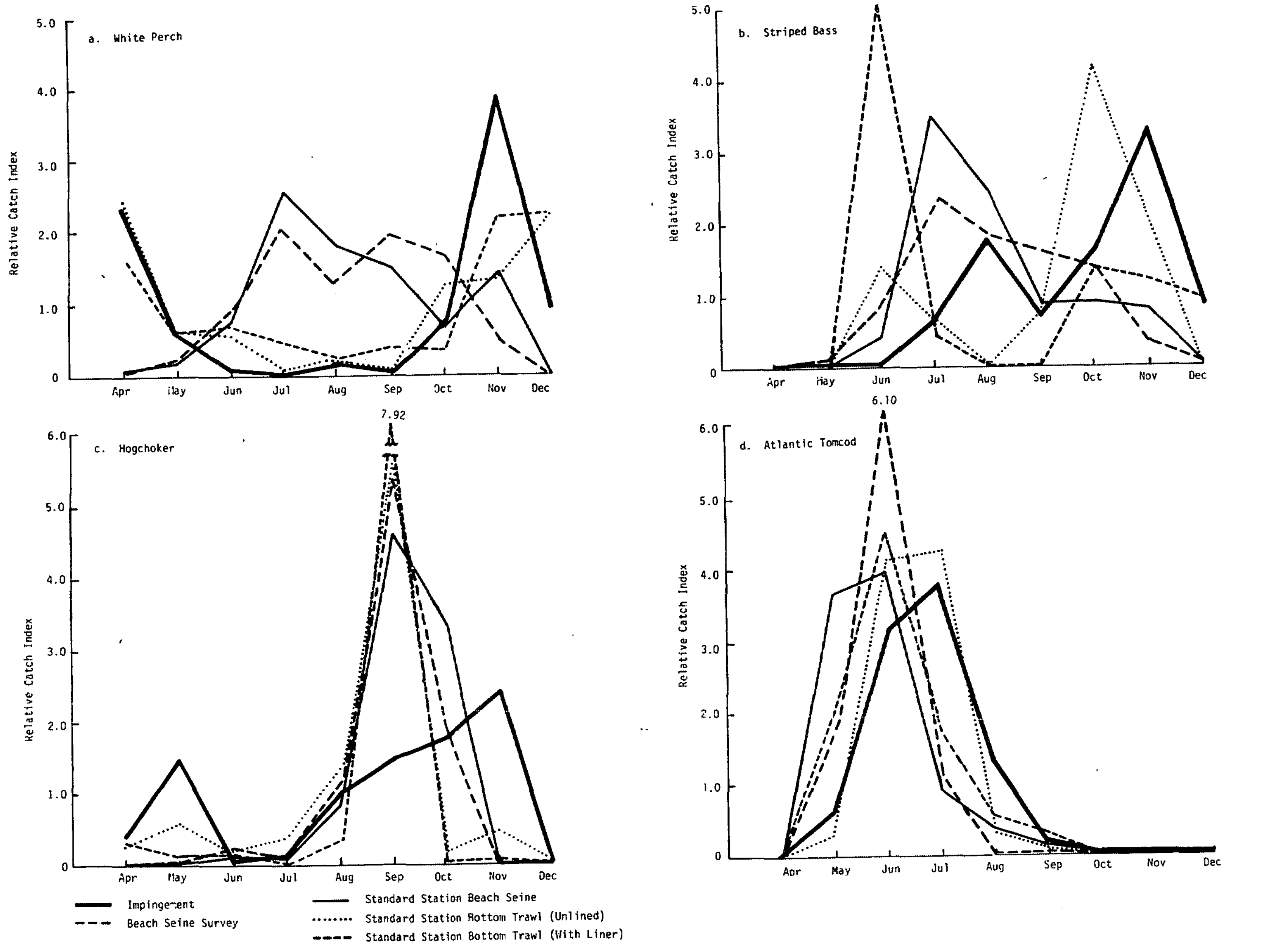


Figure IV-11. Monthly Variation in 1977 Indian Point Impingement Rates of White Perch, Striped Bass, Hogchoker, and Atlantic Tomcod Compared to Monthly Variation in River Abundance of Those Species in Indian Point Region (RM 39-46) of Hudson River Estuary

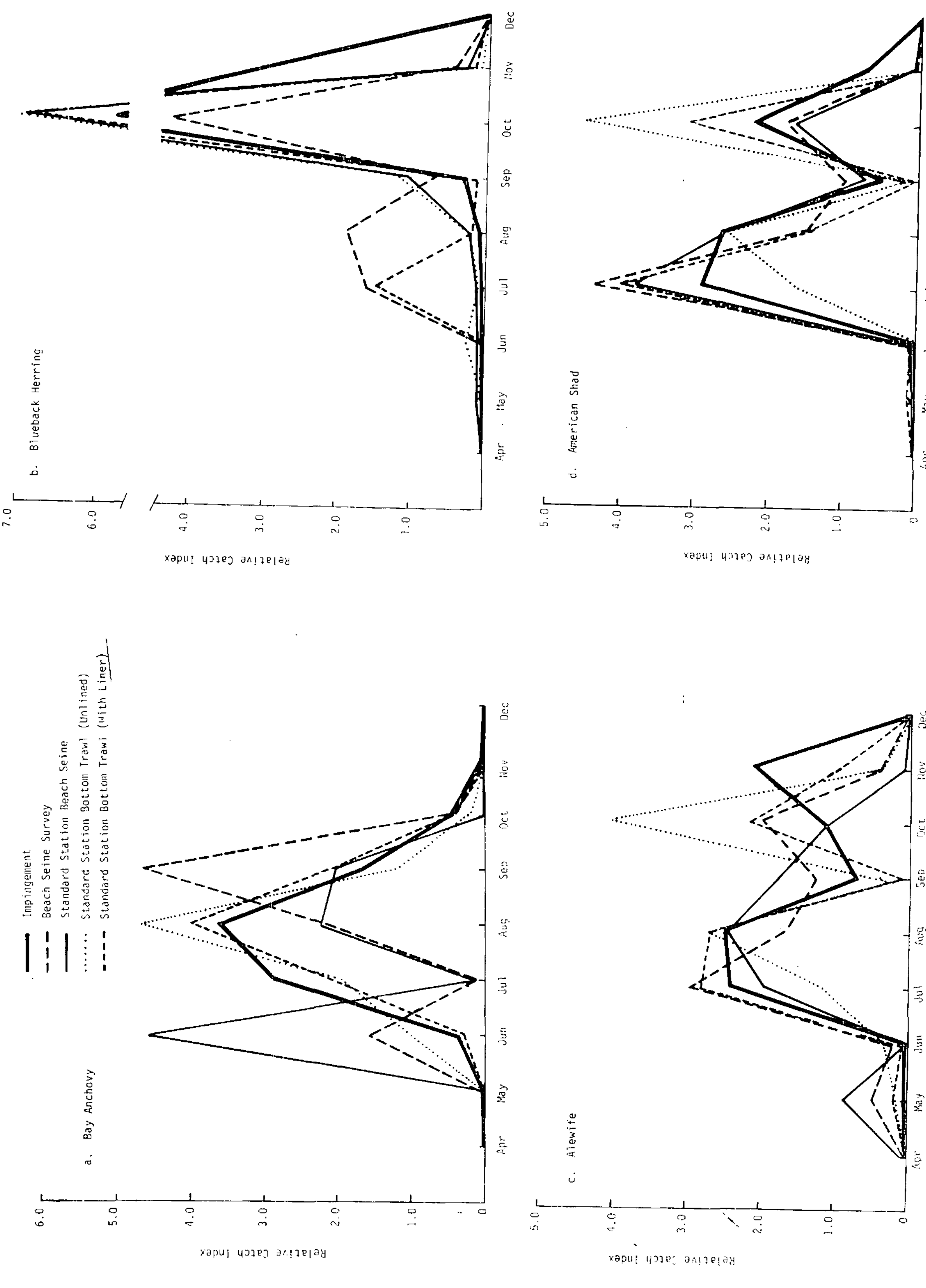


Figure IV-12. Monthly Variation in 1977 Indian Point Impingement Rates of Bay Anchovy, Blueback Herring, Alewife, and American Shad Compared to Monthly Variations in River Abundance of Those Species in the Indian Point Region (RM 39-46) of Hudson River Estuary

e. Assessment of Power Plant and Environmental Factors Affecting Impingement at Indian Point

1) Analytical Procedures

Power plant and environmental parameters, selected on the basis of previous studies (TI 1974a, 1975d, 1976a, 1977d), were examined to investigate causes of temporal variation in impingement rates (Section IV. C.2) for key fish species and total collections. Impingement rates for each species were examined during the primary impingement period(s) for that species. Physicochemical variables and periods examined for each species used in the analyses are defined in Table IV-13. Intake screens were generally washed daily between 8:00 A.M. and 12:00 noon; therefore, daily impingement rates were computed on the basis of fish accumulated during the period from noon to noon each day. Weather and water quality values used were matched as closely as possible to the impingement collection period. The "daily" means of all measurements available from the Indian Point region (RM 39-46) were used as the nominal values in describing the relationship between impingement and the independent variables. Precipitation and air temperature data for four local cities, Carmel, Yorktown Heights, West Point, and Glenham (obtained from the National Climatic Center, Ashville, N.C.), were treated similarly to generate nominal values for these variables.

A stepwise regression analysis procedure (Draper and Smith 1966) was used strictly in an exploratory manner to identify important relationships. Since none of the independent variables could be experimentally controlled during this study, multiple correlation would have normally been considered to be the correct analytical method (Sokal and Rohlf 1969). However, the interpretation of the correlations among 15 variables involves a large number of comparisons of correlation coefficients, especially in the absence of specific a priori causal hypotheses. The probability of making a Type I error increases as the number of comparisons increases. The use of regression when the independent variables are not experimentally controlled results in heterogeneity of error and underestimates of functional relationships decreasing the power of tests of significance (Sokal and Rohlf 1969). On the other hand, stepwise regression offers a systematic method for screening a large number of variables which reduces the number of comparisons and the probability of Type I error.

Table IV-13

Definition of Variables Used in Stepwise Regression Impingement Models, Indian Point Units No. 2 and No. 3, 1977

Independent Variables	Definition
WT	Water temperature
WT2	Water temperature squared
DWT	Water temperature change from previous day
MXAT	Average maximum daily air temperature
MNAT	Average minimum daily air temperature
SF	Salt front position relative to Indian Point
SF2	Salt front position squared
COND	Conductivity
COND2	Conductivity squared
DCOND	Conductivity change from previous day
AMP	Tidal amplitude
PPT	Mean daily precipitation
WASH	Single versus multiple screen washes
U	Unit operation interference

Dependent Variables*	Primary Impingement Period
White perch	January through April, August, November, and December
Striped bass	January through December
Atlantic tomcod	May through September
Blueback herring	September through November
Alewife	July through November
American shad	July through October
Hogchoker	August through November, May
Bay anchovy	June through October
All species combined	January through December

*Expressed as number of fish impinged/10^6 m^3 water circulated based on selected impingement rates (see Section IV.C.2.c) with no adjustment made for collection efficiency.

Since nominal values, representing the average response over an area much larger than the immediate vicinity of the power plant, were used in this study, it was unlikely that precise functional relationships would be revealed. Therefore, stepwise regression was used instead of multiple correlation in order to minimize the number of comparisons. It must be emphasized that use of stepwise regression in this case will reveal only the major functional relationships and the analysis must be considered exploratory rather than definitive. The stepwise procedure started with a simple correlation matrix and entered into regression the variable most highly correlated with daily impingement rates of the species in question, i.e., selected the single-variable model (i.e., regression) which produced the largest R^2 statistic. At each subsequent step, an additional variable--one whose partial correlation with impingement rates was highest--was added to the previous step's model. After each variable was added, the procedure reexamined all variables included in the model. Any variable not producing a partial F statistic at the specified significance level for being retained was then deleted from the model. The significance level for entry of a variable was 0.50 while the significance level for removal of a variable was 0.10. The final regression model resulting from the stepwise procedure for each species included those variables which "best" explained the observed variations in daily impingement rates, i.e., those variables which, when included in the model, were each still sufficiently significant to generate F values with probabilities less than 0.10.

Some of the factors thought to influence impingement were represented by "dummy" variables, i.e., variables which indicated only the presence or absence of a condition such as single versus multiple screen washes and unit operation interface. Additionally, the squares of some of the continuous variables (e.g., water temperature and conductivity) were included in the analyses to identify nonlinear relationships. Before being squared, these variables were adjusted by subtracting the mean value of each parameter from each daily value of the parameter over the time period considered such that the squared values approximated even functions of the data.

2) Factors Affecting Impingement

Comparison of river abundances to impingement collections (Section IV.C.2.d) illustrated that fish abundance in the Indian Point region is a key variable in estimating impingement rates, an observation also made by Haven and Ginn (1978) in their development of a regression model for predicting impingement. The effects of physicochemical factors of the environment on impingement rates are in turn inextricably associated with daily and seasonal behavioral patterns of the fishes (Haven and Ginn 1978, Lifton and Storr 1978). Season is the main factor affecting presence and location of fishes in the Hudson River and, therefore, the availability of fish vulnerable to impingement.

Stepwise regression analyses revealed that water temperature, air temperature, and conductivity are also strongly associated with variations in impingement at Indian Point. Other variables, such as salt front position, unit interaction, and tidal amplitude, appeared consistently in the stepwise regression models but accounted for smaller portions of the variability in impingement, thus suggesting lesser roles in affecting impingement rates. Remaining variables (Table IV-13) appeared in some models and accounted for differing portions of the variability in impingement. The results of the analyses are summarized in Tables IV-14 through IV-22. The occurrence of several low R^2 (coefficient of determination) values may indicate that nonlinear relationships or interactions of independent variables governed impingement or that measurement errors generated a significant amount of variance heterogeneity. Meaningful interpretation of models with R^2 values less than 0.3 was not considered possible.

Changes in water temperature explained much of the variation in impingement rates for several species through four distinct types of functional relationships (Figure IV-13). At Unit No. 3, impingement of bay anchovy, a species abundant in the Indian Point region during the summer, was directly associated with temperature (Table IV-15, Figure IV-13a). White perch impingement rates at Unit No. 2 varied inversely with temperature (Table IV-14, Figure IV-13b), a relationship indicative of movements between shallow and deep water habitats in response to seasonal rise and fall of river temperature. Large impingement collections of white perch

Table IV-14

Stepwise Regression Models for White Perch Impingement Rates as Functions of Plant/Environmental Parameters, January through April, August, November, and December 1977

Indian Point Unit No. 2

$R^2 = 0.3968$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	4151071829.83	1383690609.94	14.03	0.0001
Error	64	6311173519.04	98612086.23		
Total	67	10462245348.87			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	17509.36				
WT	-1160.76	197.61	3402526266.17	34.50	0.0001
COND	2.71	0.70	1476210445.08	14.97	0.0003
AMP	-3272.61	1327.59	599226373.56	6.08	0.0164

Interpretation*:
1. As water temperature increased, impingement decreased.
2. As conductivity increased, impingement increased.
3. As tidal amplitude increased, impingement decreased.

*With all other variables in the model held constant.

Indian Point Unit No. 3

$R^2 = 0.5680$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	20357326.60	5089331.65	19.72	0.0001
Error	60	15483103.49	258051.72		
Total	64	35840430.09			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	790.29				
MNAT	-48.62	8.11	9267532.64	35.91	0.0001
SF	19.93	5.44	3456926.96	13.40	0.0005
PPT	1023.11	161.03	10416507.80	40.37	0.0001
U	-324.60	183.87	804168.17	3.12	0.0826

Interpretation*:
1. As minimum daily air temperature increased, impingement decreased.
2. As the salt front moved upriver from Indian Point, impingement increased.
3. As precipitation increased, impingement increased.
4. Concurrent operations at Unit No. 2 decreased impingement.

*With all other variables in the model held constant.

Table IV-15

Stepwise Regression Models for Bay Anchovy Impingement Rates as Functions of Plant/Environmental Parameters, June through October 1977

Indian Point Unit No. 2

R^2 = 0.6386

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	6	13094391.39	2182398.57	20.32	0.0001
Error	69	7409216.57	107379.95		
Total	75	20503607.96			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	1990.52				
WT	199.41	20.08	10585159.99	98.58	0.0001
WT2	9.27	2.14	2009083.90	18.71	0.0001
DCOND	-0.08	0.04	465388.34	4.33	0.0411
MXAT	-60.59	11.21	3137159.06	29.22	0.0001
SF	-13.50	4.34	1037758.45	9.66	0.0027
SF2	-0.41	0.18	559538.45	5.21	0.0255

Interpretation*:

1. and 2. As water temperature increased, impingement increased; impingement was more sensitive to increases at higher water temperatures than at lower water temperatures
3. As differences in conductivity from day to day increased, impingement decreased.
4. As maximum daily air temperature increased, impingement decreased.
5. and 6. Impingement reached a maximum as the salt front approached RM 26; thus impingement decreased as the salt front moved upriver from Indian Point.

*With all other variables in the model held constant.

Indian Point Unit No. 3

R^2 = 0.3386

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	6	1617211.64	269535.27	7.94	0.001
Error	93	3158552.60	33962.93		
Total	99	4775764.24			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	558.91				
WT	59.68	11.58	901506.02	26.54	0.0001
MNAT	-29.40	6.72	650010.69	19.14	0.0001
SF	-4.37	2.19	135125.72	3.98	0.0490
AMP	44.79	21.39	148971.61	4.39	0.0389
WASH	-210.02	77.60	248774.84	7.32	0.0081
U	-141.77	47.73	299614.89	8.82	0.0038

Interpretation*:

1. As water temperature increased, impingement increased.
2. As minimum daily air temperature increased, impingement decreased.
3. As the salt front moved upriver from Indian Point, impingement decreased.
4. As tidal amplitude increased, impingement increased.
5. Decreased impingement was associated with mulitple washes.
6. Concurrent operations at Unit No. 2 decreased impingement.

*With all other variables in the model held constant.

Table IV-16

Stepwise Regression Models for Striped Bass Impingement Rates as Functions of Plant/Environmental Parameters, January through December 1977

Indian Point Unit No. 2

$R^2 = 0.5324$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	6	755273.02	125878.84	26.38	0.0001
Error	139	663284.34	4771.83		
Total	145	1418557.37			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	249.20				
WT2	0.72	0.12	186267.42	39.03	0.0001
DWT	7.45	4.15	15382.96	3.22	0.0748
MXAT	-4.12	0.56	255245.77	53.49	0.0001
SF2	-0.07	0.02	59527.82	12.47	0.0006
AMP	-11.28	6.21	15733.60	3.30	0.0716
U	-127.10	21.37	168867.81	35.39	0.0001

Interpretation*:

1. As water temperature increased or decreased from the mean (approximately 14°C) for the year, impingement increased.
2. As differences in water temperature from day to day increased, impingement increased.
3. As maximum daily air temperature increased, impingement decreased.
4. Impingement reached a maximum when the salt front was in the Indian Point region and decreased as the salt front moved away from the Indian Point region.
5. As tidal amplitude increased, impingement decreased.
6. Concurrent operations at Unit No. 3 decreased impingement.

*With all other variables in the model held constant.

Indian Point Unit No. 3

$R^2 = 0.1506$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	13219.05	4406.35	9.28	0.0001
Error	157	74564.76	474.93		
Total	160	87783.81			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	-12.63				
WT2	0.11	0.03	7456.15	15.70	0.0001
DCOND	-0.00	0.00	1344.17	2.83	0.0945
AMP	6.02	2.02	4202.70	8.85	0.0034

R^2 value too low for meaningful interpretation

Table IV-17

Stepwise Regression Models for Hogchoker Impingement Rates as Functions of Plant/Environmental Parameters, May and August through November 1977

Indian Point Unit No. 2

$R^2 = 0.1909$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	115051.15	57525.57	8.61	0.0004
Error	73	487721.97	6681.12		
Total	75	602773.12			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	248.14				
MXAT	-9.93	2.64	94259.14	14.11	0.0003
MNAT	5.64	2.93	24741.44	3.70	0.0582

R^2 value too low for meaningful interpretation

Indian Point Unit No. 3

$R^2 = 0.4797$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	5	55183.70	11036.74	14.20	0.0001
Error	77	59854.71	777.33		
Total	82	115038.42			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	31.17				
COND2	0.00	0.00	37321.27	48.01	0.0001
SF	-0.74	0.27	5698.01	7.33	0.0083
SF2	-0.05	0.01	7886.50	10.15	0.0021
PPT	39.57	12.08	8341.22	10.73	0.0016
U	-13.21	10.12	2520.24	3.24	0.0757

Interpretation*:

1. Impingement reached a minimum as conductivity approached the mean (approximately 2939 µS/cm) for the time period examined.
2. and 3. Impingement reached a maximum as the salt front reached RM 35; thus impingement decreased as the salt front moved upriver from Indian Point.
4. As precipitation increased, impingement increased.
5. Concurrent operations at Unit No. 2 decreased impingement.

*With all other variables in the model held constant.

Table IV-18

Stepwise Regression Models for Alewife Impingement Rates as Functions of Plant/Environmental Parameters, July through November 1977

Indian Point Unit No. 2

R^2 = 0.6746

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	990611.58	495305.79	60.11	0.0001
Error	58	477910.09	8239.83		
Total	60	1468521.67			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	-2.76				
WT2	4.81	0.49	794734.63	96.45	0.0001
SF	-2.89	0.74	125668.26	15.25	0.0002

Interpretation*:
1. Impingement increased as the water temperature increased or decreased from the mean water temperature (approximately 20°C) for the July through November period.
2. As the salt front moved upriver from Indian Point, impingement decreased.

*With all other variables in the model held constant.

Indian Point Unit No. 3

R^2 = 0.2033

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	512874.16	170958.05	6.64	0.0005
Error	78	2009368.16	25761.13		
Total	81	2522242.32			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	6.16				
AMP	66.96	19.74	296518.47	11.51	0.0011
PPT	-130.31	64.24	106001.23	4.11	0.0459
U	-88.05	39.53	127782.61	4.96	0.0288

R^2 value too low for meaningful interpretation

Table IV-19

Stepwise Regression Models for All Species Impingement Rates as Functions of Plant/Environmental Parameters, January through December 1977

Indian Point Unit No. 2

$R^2 = 0.3588$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	5792642611.69	1930880870.56	26.49	0.0001
Error	142	10349362854.98	72882837.01		
Total	145	16142005466.67			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	27691.38				
MXAT	-476.36	66.87	3698912508.74	50.75	0.0001
SF2	-6.11	2.51	430596635.73	5.91	0.0163
U	-10426.80	2329.82	1459766619.21	20.03	0.0001

Interpretation*:
1. As maximum daily air temperature increased, impingement decreased.
2. As the salt front moved away from Indian Point impingement decreased; i.e., impingement peaked when the salt front was in the Indian Point region.
3. Concurrent operations at Unit No. 3 decreased impingement.

*With all other variables in the model held constant.

Indian Point Unit No. 3

$R^2 = 0.2663$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	7	95182197.84	13597456.83	7.94	0.0001
Error	153	262169395.93	1713525.46		
Total	160	357351593.77			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	1516.99				
WT	76.83	22.93	19243535.98	11.23	0.0010
WT2	4.48	1.91	9407538.49	5.49	0.0204
MXAT	-38.37	20.86	5797784.29	3.38	0.0678
SF2	-1.47	0.47	16634851.61	9.71	0.0022
AMP	282.59	121.52	9266600.13	5.41	0.0214
PPT	578.70	317.11	5706687.19	3.33	0.0700
U	-853.84	259.63	18524742.84	10.81	0.0013

R^2 value too low for meaningful interpretation

Table IV-20

Stepwise Regression Models for Blueback Herring Impingement Rates as Functions of Plant/Environmental Parameters, September through November 1977

Indian Point Unit No. 2

$R^2 = 0.4911$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	1871814794.17	623938264.72	13.51	0.0001
Error	42	1939239184.09	46172361.53		
Total	45	3811053978.27			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	3087.30				
COND	-1.02	0.31	491678061.94	10.65	0.0022
AMP	3072.94	1031.33	409914879.11	8.88	0.0048
U	-6263.58	2544.45	279793506.83	6.06	0.0180

Interpretation*:
1. As conductivity increased, impingement decreased.
2. As tidal amplitude increased impingement increased.
3. Concurrent operations at Unit No. 3 decreased impingement.

*With all other variables in the model held constant.

Indian Point Unit No. 3

$R^2 = 0.6064$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	8528169.02	4264084.51	24.65	0.0001
Error	32	5536273.15	173008.54		
Total	34	14064442.18			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	487.80				
COND	-0.22	0.04	6291351.06	36.36	0.0001
COND2	0.00	0.00	1979704.76	11.44	0.0019

Interpretation*:
1. and 2. Impingement reached a minimum as conductivity approached the the mean (approximately 7692 μS/cm) for September through November.

*With all other variables in the model held constant.

Table IV-21

Stepwise Regression Models for Atlantic Tomcod Impingement Rates as Functions of Plant/Environmental Parameters, May through September 1977

Indian Point Unit No. 2

R^2 = 0.3210

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	189421284.69	63140428.23	11.03	0.0001
Error	70	400674384.45	5723919.78		
Total	73	590095669.14			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	9222.84				
MXAT	-342.88	91.78	79889134.40	13.96	0.0004
MNAT	219.83	102.48	26335135.11	4.60	0.0354
WASH	-3688.65	673.27	171809391.30	30.02	0.0001

Interpretation*:
1. As maximum daily air temperature increased, impingement decreased.
2. As minimum daily air temperature increased, impingement increased.
3. Decreased impingement was associted with multiple screen washes.

*With all other variables in the model held constant.

Indian Point Unit No. 3

R^2 = 0.2565

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	5	55833282.86	11166656.57	7.38	0.0001
Error	107	161856332.64	1512676.01		
Total	112	217689615.50			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	463.46				
COND2	-0.00	0.00	7773419.85	5.14	0.0254
SF	37.34	12.19	14191672.04	9.38	0.0028
SF2	-1.31	0.64	6409869.01	4.24	0.0420
AMP	428.74	145.74	13091019.25	8.65	0.0040
U	-755.70	275.70	11365484.19	7.51	0.0072

R^2 value too low for meaningful interpretation

Table IV-22

Stepwise Regression Models for American Shad Impingement Rates as Functions of Plant/Environmental Parameters, July through October 1977

Indian Point Unit No. 2

$R^2 = 0.3443$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	71339.47	17834.87	6.56	0.0003
Error	50	135850.51	2717.01		
Total	54	207189.98			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	-5.60				
WT	-11.07	2.92	39051.49	14.37	0.0004
COND2	-0.00	0.00	24308.75	8.95	0.0043
SF	1.64	0.82	10740.32	3.95	0.0523
AMP	18.72	7.12	18758.53	6.90	0.0114

Interpretation*:
1. As water temperature increased, impingement decreased.
2. Impingement reached a maximum as conductivity approached the mean value (approximately 4638 μS/cm) for the July through October period.
3. As the salt front moved upriver from Indian Point, impingement increased.
4. As tidal amplitude increased, impingement increased.

*With all other variables in the model held constant.

Indian Point Unit No. 3

$R^2 = 0.1846$

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	13479.31	6739.65	8.94	0.0003
Error	79	59525.00	753.48		
Total	81	73004.31			

	B Value	Std Error	Type II SS	F	Prob>F
Intercept	19.83				
AMP	7.71	3.34	4021.60	5.34	0.0235
U	-22.98	6.76	8706.02	11.55	0.0011

R^2 value too low for meaningful interpretation

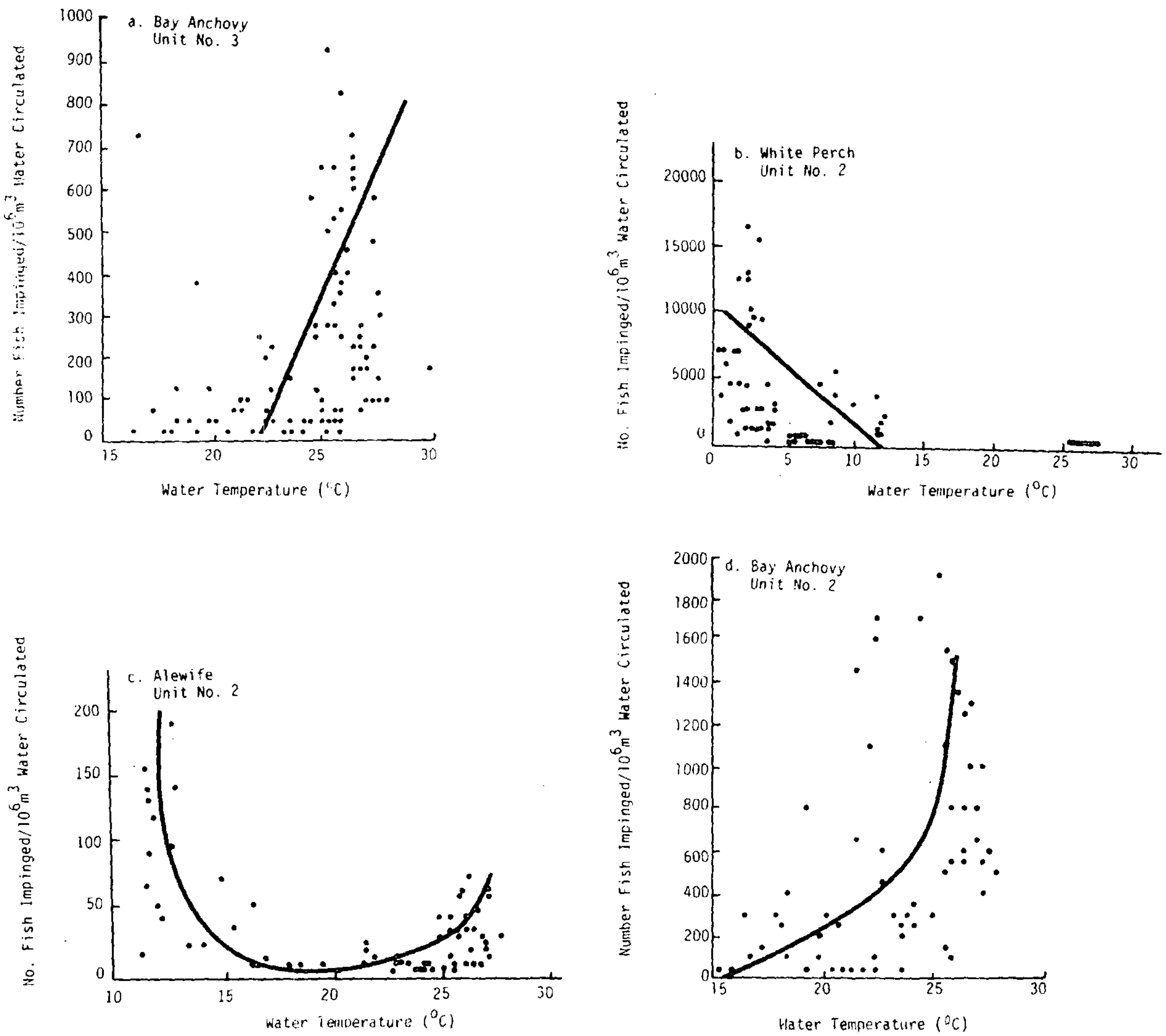


Figure IV-13. Relationship of Water Temperature to Impingement Rates for a. Bay Anchovy, b. White Perch, and c. Alewife at Indian Point Unit No. 2 and d. Bay Anchovy at Indian Point Unit No. 3, 1977 occurred during late fall, winter, and early spring when they were offshore, while collections were low in the summer when they were offshore, while collections were low in the summer when young white perch were concentrated in the shore zone, presumably beyond the influence of the intakes (Section V.B).

A nonlinear relationship between impingement and water temperature existed for alewife at Unit No. 2 (Table IV-18, Figure IV-13c). Impingement was lowest at the approximate mean water temperature (20°C) for the time period examined (Table IV-13) and increased at both higher and lower water temperatures. The relationship between temperatures and impingement rates for bay anchovy at Unit No. 2 had both linear and nonlinear components (Figure IV-13d). Impingement of bay anchovy at Unit No. 2 increased with increasing temperatures, but the rate of increase was greater at higher water temperatures than at lower water temperatures (Figure IV-13d).

The association between impingement and either minimum or maximum daily air temperature was more consistent, as impingement of white perch at Unit No. 2 (Table IV-14), bay anchovy at both units (Table IV-15), striped bass at Unit No. 2 (Table IV-16), and all species combined at both units (Table IV-19) decreased with increasing air temperatures. Increased impingement for Atlantic tomcod, however, was associated with both decreasing maximum daily air temperature and increasing minimum daily air temperature at Unit No. 2 (Table IV-21), a relationship that is probably spurious.

Conductivity changes also explained large portions of the variability in impingement rates for several species. Increased impingement rates for white perch at Unit No. 2 (Table IV-13) and decreased rates for blueback herring at Unit No. 2 (Table IV-20) were associated with increased conductivity. Additionally, nonlinear relationships between impingement and conductivity similar to those between impingement and water temperatures existed for three species. Impingement of American shad at Unit No. 2 reached a maximum as conductivity approached the mean value (4638 μS/cm) for the July through October period examined (Table IV-22). Conversely, impingement of hogchoker at Unit No. 3 (Table IV-17) and blueback herring at Unit No. 3 (Table IV-20) reached minima as conductivity approached the mean values (2939 and 7692 μS/cm) for the time periods examined (Table IV-13).

Large collections of impinged fish at Indian Point are often associated with salt front intrusions into the Indian Point region (TI 1975b, 1976c, 1977d). As used in this analysis, salt front position was predicted from a model based primarily on tidal amplitude and freshwater flow (Section V.E.2). There was good correlation between predicted salt front position and empirical conductivity values (averaged over the Indian Point region) for all daily samples used in each model (r values from 0.67 to 0.88). Impingement rates for all species combined peaked when the salt front was near Indian Point and decreased as it advanced farther up or downriver (Table IV-19). As observed in past studies (TI 1975b, 1976c, 1977d), increased abundance of fishes in the vicinity of the plant during 1977 was associated with salt front intrusion and contributed to increased impingement rates. Linear relationships between impingement rate and salt front position were evident for white perch at Unit No. 3 (Table IV-14), bay anchovy at Unit No. 3 (Table IV-15), alewife at Unit No. 2 (Table IV-18), and American shad at Unit No. 2 (Table IV-22). Both linear and nonlinear relationships occurred for bay anchovy at Unit No. 2 (Table IV-15) and hogchoker at Unit No. 3 (Table IV-17), while a nonlinear association was observed for striped bass at Unit No. 2 (Table IV-16). Generally, changes in salt front position accounted for less of the variability in impingement than did changes in water temperature, air temperature, or conductivity.

The effect of operation of one unit on the impingement collections at the other unit was consistently important in explaining some of the variations in impingement rates at Indian Point. Concurrent operations at Unit No. 3 resulted in decreased collections at Unit No. 2 for striped bass (Table IV-16), all species combined (Table IV-19), and blueback herring (Table IV-20). Similarly, concurrent operations at Unit No. 2 resulted in decreased collections at Unit No. 3 for white perch (Table IV-14), bay anchovy (Table IV-15), and hogchoker (Table IV-17). These decreases in impingement at either unit during concurrent operations of both units indicated that the two units compete for some portion of the total number of fish of the above species subject to impingement.

Changes in impingement rates were consistently associated with changes in tidal amplitude. Tidal amplitude is the magnitude of displacement of the tidal wave from its mean value, or one-half of the tidal wave height (Stickney 1972). As tidal amplitude increased, impingement increased for bay anchovy at Unit No. 3 (Table IV-15), blueback herring at Unit No. 2 (Table IV-20), and American shad at Unit No. 2 (Table IV-22), but decreased for white perch at Unit No. 2 (Table IV-14) and striped bass at Unit No. 2 (Table IV-16).

Multiple (more than one per day) screen washes, necessitated by high debris loading, were associated with decreased impingement of bay anchovy at Unit No. 3 (Table IV-15) and Atlantic tomcod at Unit No. 2 (Table IV-21). Multiple screen washings are necessary predominantly in the late fall when bay anchovy are leaving the estuary (McFadden et al. 1978) and Atlantic tomcod are in the lower estuary (TI 1979a). Increased precipitation corresponded with increased impingement of white perch at Unit No. 3 (Table IV-14) and hogchoker at Unit No. 3 (Table IV-17). Precipitation or an associated physical factor such as low barometric pressure may cause changes in behavior patterns that affect vulnerability to impingement.

In summary, fish impingement at Indian Point was characterized by marked seasonal peaks that were partly related to migratory activities and to the nursery function of the estuary. Seasonal and probably diurnal variations in impingement were strongly related to changes in air and water temperature and conductivity. Other variables that were important in explaining impingement variations included salt front position, unit interaction, and tidal amplitude. Multiple screen washes and precipitation also explained portions of the variability in impingement.

D. RANGE OF INFLUENCE OF INDIAN POINT GENERATING STATION

1. Introduction and Methods

The mark-recapture program, in addition to providing estimates of population size, can also be used to assess the range of movements for fish that are impinged and to estimate the exploitation rate of the power plant.

Estimates of impingement exploitation rate are possible when the numbers of fish actually released are combined with the recapture data (Ricker 1975). Exploitation rate is estimated by the formula:

$$\hat{\mu} = \frac{R}{M} \qquad \text{(IV-2)}$$

where

$\hat{\mu}$ = estimate of the exploitation rate (μ)

R = number of marked fish impinged

M = number of fish marked

Approximate* 95% confidence limits for μ can be calculated by assuming that R is a Poisson-distributed variable with a mean equal to the observed number of recaptures. Thus, upper and lower bounds for R are found from published tables (Ricker 1975). This method is preferred over other techniques (i.e. normal approximation) when the number of recaptures or values of $\hat{\mu}$ are small (Ricker 1975, Seber 1973).

The estimated exploitation rate ($\hat{\mu}$) can then be used with the total mortality rate (A) to obtain an estimate of the conditional impingement mortality rate (m) which is used to determine impingement impact (TI 1975a):

$$m = 1 - e^{-F} \quad \text{= conditional impingement mortality rate} \qquad \text{(IV-3)}$$

where

$$F = \frac{\hat{\mu} Z}{A} \quad \text{= instantaneous rate of fishing (impingement) mortality} \qquad \text{(IV-4)}$$

and

$$Z = -\ell n\,(1-A) \quad \text{= instantaneous total mortality rate} \qquad \text{(IV-5)}$$

when impingement and natural mortality occur simultaneously (Ricker 1975).

The reliability of the method is controlled by the number of fish actually recaptured. For a truly unbiased estimate of exploitation rate, the expected number of recaptures (i.e. the true exploitation rate multiplied by the number of fish marked) should exceed ten (Chapman 1951). Failure to meet this criterion may result in errors up to an order of magnitude from the true value.

*The calculations for confidence intervals are based on the assumption that R is distributed as a Poisson variable, the exact distribution being unknown. Thus, confidence limits based on this assumption can only be considered approximate.

The method assumes that fish marked within any temporal or spatial stratum are distributed randomly throughout the population at the time of exploitation. This assumption is even more critical than random distribution of marks in population estimates since, in this case, the recapture effort (impingement) is done entirely at one location. If the marked fish released in several spatial strata are to be combined to calculate exploitation for the entire population, the fraction of the population in each stratum that is marked must be the same for all strata. Otherwise the combined exploitation rate, total number of marked fish recovered divided by the total number marked, will be biased toward those strata which have the highest numbers of fish marked.

If the assumptions of proportional distribution of marked fish in numbers sufficient to produce adequate numbers of recaptures are met, then two further steps must be taken to produce usable exploitation rates. The numbers of fish marked must be adjusted for marking-related mortality, unless it is inconsequential, and the number of fish recaptured must be adjusted for impingement collection efficiency.

Finclips and tags have been used to mark striped bass and white perch since 1972 and Atlantic tomcod since 1974. Although various finclip combinations have been used to denote the location (river region) and time (month or biweekly period) of marking (TI 1979a), fish marked with tags provide a more exact account of release location (river mile) and time (date). However, since the number of fish marked in a region generally decreases as distance from the Indian Point generating station increases (TI 1977d, TI 1979a), recaptured fish from the more distant areas may under-represent the actual numbers of fish that travel long distances before being impinged. Thus, this analysis can establish the regions from which fish may eventually move and become vulnerable to impingement, but conclusions concerning regions from which fish will not become vulnerable must be made with caution. Release and recapture data for each marked fish recaptured during 1977 can be found in Appendix A.5.

2. Results and Discussion

a. Striped Bass

All marked striped bass recovered at the Indian Point generating station in 1977 were of the 1977 year class (Table IV-23). The observed exploitation rates were higher for fish marked between RM 39 and 76 than for the other regions; however, the 95% confidence limits for exploitation rates were very wide. The total calculated exploitation rates were 0.1% (i.e., $\hat{\mu} = 0.001$) for fish marked in September, 0.1% for fish marked in October, and 0.0% for fish marked in November.

The estimated exploitation rate ($\hat{\mu}$) is unusable for calculating conditional impingement mortality of the 1977 year class because of violation of the assumption of proportional marking across all strata and because 1) impingement in August 1977 cannot be considered since the fish had not been marked at that time, 2) impingement occurring after 1977 has also been excluded, and 3) the actual number of fish recaptured (six) was too small to obtain an unbiased estimate. In light of these problems, estimates of exploitation rates could be in error by an order of magnitude; thus, further refinement by adjusting for marking mortality and collection efficiency would not be justified. Even though the observed exploitation rates may be severely biased, the total number of young-of-the-year striped bass impinged, less than 20,000 (Table IV-5), suggests that Indian Point impingement exploitation of the species was relatively low.

Thus, the data are principally useful for showing the area from which fish may move and eventually be impinged. This area extended at least from the Yonkers region (RM 12-23) through the Poughkeepsie region (RM 62-76). This range is wider than exhibited by fish captured in 1976 (TI 1977d) and indicates that striped bass may move into the Indian Point region from both upstream and downstream.

b. White Perch

Marked white perch impinged at Indian Point during 1977 represented many different year classes. White perch of the 1976 and 1977 year classes, marked with finclips, indicated that fish from all five mark-recapture

Table IV-23

Indian Point Generating Station Impingement Exploitation Rates for Young-of-the-Year Striped Bass Marked and Recaptured during 1977

Release Region	R	M	$\hat{\mu}$	μ_L	μ_U
September					
RM 12- 23	1	1272	*	0.000	0.004
24- 38	0	3190	0.000	0.000	0.001
39- 46	4	1042	0.004	0.001	0.010
47- 76	1	583	0.002	0.000	0.010
77-152	0	99	0.000	0.000	0.037
Total	6	6186	0.001	0.000	0.002
October					
RM 12- 23	0	1421	0.000	0.000	0.003
24- 38	1	3274	0.000	0.000	0.002
39- 46	4	1709	0.002	0.001	0.006
47- 76	0	364	0.000	0.000	0.010
77-152	0	20	0.000	0.000	0.185
Total	5	6788	0.001	0.000	0.002
November					
RM 12- 23	0	868	0.000	0.000	0.004
24- 38	0	1884	0.000	0.000	0.002
39- 46	0	925	0.000	0.000	0.004
47- 76	0	100	0.000	0.000	0.037
77-152	0	2	0.000	0.000	1.850
Total	0	3779	0.000	0.000	0.001

R = Number of marked fish recovered from impingement at Indian Point

M = Number of fish marked

$\hat{\mu}$ = Estimate of exploitation rate (μ)

μ_L = Lower 95% confidence bound for μ

μ_U = Upper 95% confidence bound for μ

* = Greater than 0.0 but less than 0.001

regions were susceptible to impingement at Indian Point (Tables IV-24 and IV-25). This was similar to the zones of influence determined from analysis of 1976 recaptures (TI 1977d). Regional exploitation rates did not decline directly as distance from the Indian Point generating station increased; however, the exploitation rates were generally less precise in the uppermost and lowermost regions. This decrease in precision was caused by the smaller numbers of fish marked in these regions. The width of the confidence intervals is inversely related to M and R.

The observed total exploitation rates for fish marked in different months ranged from 0.2% (October 1976) to 0.9% (November 1976 and April-June 1977) for the 1976 year class and 0.6% (October 1977) to 0.9% (November 1977) for the 1977 year class. While all these estimates of exploitation rates contain enough recaptures to eliminate the bias inherent in the single region estimates, the rates are essentially a mean weighted by the number of fish marked in each region. Thus, to accurately describe the exploitation rate for the whole population, the fraction of the regional population that is marked must be the same for all regions. During the marking periods, the uppermost and lowermost regions were sampled less frequently, and thus in comparison to fish in the closer regions, adequate numbers of the many white perch in these regions were not marked (Table IV-26). This assumption that fish in all regions have an equal probability of being marked is more critical in this analysis than in population estimates since the recapture sampling effort occurs at a fixed location and cannot be applied proportionally to the entire population (see TI 1979a for discussion of mark-recapture population estimates). As a result, the calculated exploitation rates do not accurately represent exploitation on the entire population but are simply reflective of those regions in which most fish were marked. Thus, further refinement to produce estimates of conditional mortality rates would not be warranted.

Tagged white perch showed a range of influence in 1977 similar to that exhibited in 1976 (TI 1977d). White perch ≤150 mm (total length) had moved into the Indian Point region from at least as far away as RM's 13 and 99 (Figure IV-14). Since fish that had been marked during the latter half of 1977 showed only limited movements, fish that had been at large over the winter and spring had apparently moved farther than recent releases.

Table IV-24

Indian Point Generating Station 1977 Impingement Exploitation Rates for 1976 Year Class of White Perch

September

Release Region	R	M	$\hat{\mu}$	μ_L	μ_U
RM 12- 23	0	42	0.000	0.000	0.088
24- 38	24	8617	0.003	0.002	0.004
39- 46	13	4668	0.003	0.001	0.005
47- 76	6	2161	0.003	0.001	0.006
77-152	0	471	0.000	0.000	0.008
Total	43	15959	0.003	0.002	0.004

October

Release Region	R	M	$\hat{\mu}$	μ_L	μ_U
RM 12- 23	0	40	0.000	0.000	0.092
24- 38	7	3239	0.002	0.001	0.004
39- 46	6	3065	0.002	0.001	0.004
47- 76	5	537	0.009	0.003	0.022
77-152	0	214	0.000	0.000	0.017
Total	18	7095	0.002	0.002	0.004

November

Release Region	R	M	$\hat{\mu}$	μ_L	μ_U
RM 12- 23	6	59	0.102	0.037	0.222
24- 38	2	269	0.007	*	0.027
39- 46	10	1795	0.006	0.003	0.010
47- 76	0	38	0.000	0.000	0.097
77-152	1	14	0.071	0.007	0.400
Total	19	2175	0.009	0.005	0.014

April - June

Release Region	R	M	$\hat{\mu}$	μ_L	μ_U
RM 12- 23	16	69	0.232	0.133	0.377
24- 38	12	4167	0.003	0.001	0.005
39- 46	21	1117	0.019	0.012	0.029
47- 76	5	354	0.014	0.005	0.033
77-152	0	323	0.000	0.000	0.011
Total	54	6030	0.009	0.007	0.012

R = Number of marked fish recovered from impingement at Indian Point
M = Number of fish marked
$\hat{\mu}$ = Estimate of exploitation rate (μ)
μ_L = Lower 95% confidence bound for u
μ_U = Upper 95% confidence bound for u
* = Greater than 0.0 but less than 0.001

Table IV-25

Indian Point Generating Station 1977 Impingement Exploitation Rates for 1977 Year Class of White Perch

Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
			September			
RM	12- 23	0	24	0.000	0.000	0.154
	24- 38	9	1200	0.008	0.003	0.014
	39- 46	19	1824	0.010	0.006	0.016
	47- 76	10	1959	0.005	0.002	0.009
	77-152	2	280	0.007	0.001	0.026
	Total	40	5287	0.008	0.005	0.010
			October			
Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
RM	12- 23	1	266	0.004	0.000	0.021
	24- 38	6	2696	0.002	0.001	0.005
	39- 46	33	2953	0.011	0.008	0.016
	47- 76	6	1044	0.006	0.002	0.012
	77-152	0	125	0.000	0.000	0.030
	Total	46	7084	0.006	0.005	0.009
			November			
Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
RM	12- 23	0	323	0.000	0.000	0.011
	24- 38	5	2708	0.002	0.001	0.004
	39- 46	29	1284	0.023	0.015	0.032
	47- 76	11	563	0.020	0.010	0.035
	77-152	0	43	0.000	0.000	0.086
	Total	45	4921	0.009	0.007	0.012

R = Number of marked fish recovered from impingement at Indian Point

M = Number of fish marked

$\hat{\mu}$ = Estimate of exploitation rate (μ)

μ_L = Lower 95% confidence bound for μ

μ_U = Upper 95% confidence bound for μ

Table IV-26

Percent of Mean Monthly Shore Zone Standing Crops (Based on Beach Seine CPUA Extrapolation) and Percent of Finclipped Young-of-the-Year White Perch Released within Each of Five Mark-Recapture Regions during Fall of 1976. (Marked fish are under represented in regions more distant from Indian Point.)

		Marking Region					
Marking Period		RM 12-23	24-38	39-46	47-76	77-152	Total
September	Standing Crop	0.2	36.4	8.1	8.9	46.4	100.0
	Finclips	*	54.0	29.2	13.5	3.0	99.7
October	Standing Crop	2.1	33.8	4.2	9.7	50.2	100.0
	Finclips	0.6	45.6	43.2	7.6	3.0	100.0
November	Standing Crop	19.7	37.5	5.6	17.8	19.3	99.9
	Finclips	2.7	12.4	82.5	1.7	0.6	99.9

*Less than 0.1

Calculated exploitation rates for these tagged white perch generally declined as distance from Indian Point (RM 42) increased (Table IV-27). Exploitation was higher for fish marked during April through June 1977 (1.0%) than for fish marked either in 1976 or later in 1977. This may be due to the mortality suffered by the fish marked in 1976, which would have reduced the number available to be caught, and the shorter period of vulnerability for fish marked in the September through December period. Regional exploitation rates for the spring releases ranged from 0.4% to 1.4%.

Results for white perch >150 mm were similar, although a few recaptured fish had traveled a few miles farther (Figure IV-15) than the smaller tagged fish. The range of influence extended at least from RM's 13 to 121. Fish released in the first half of 1977 (April-June) showed a pattern similar to those released throughout 1976, but fish released in the latter half of 1977 again showed more restricted movements. These findings agree with previous studies which indicated that white perch move more actively during the winter and spring than they do during the fall (TI 1979a).

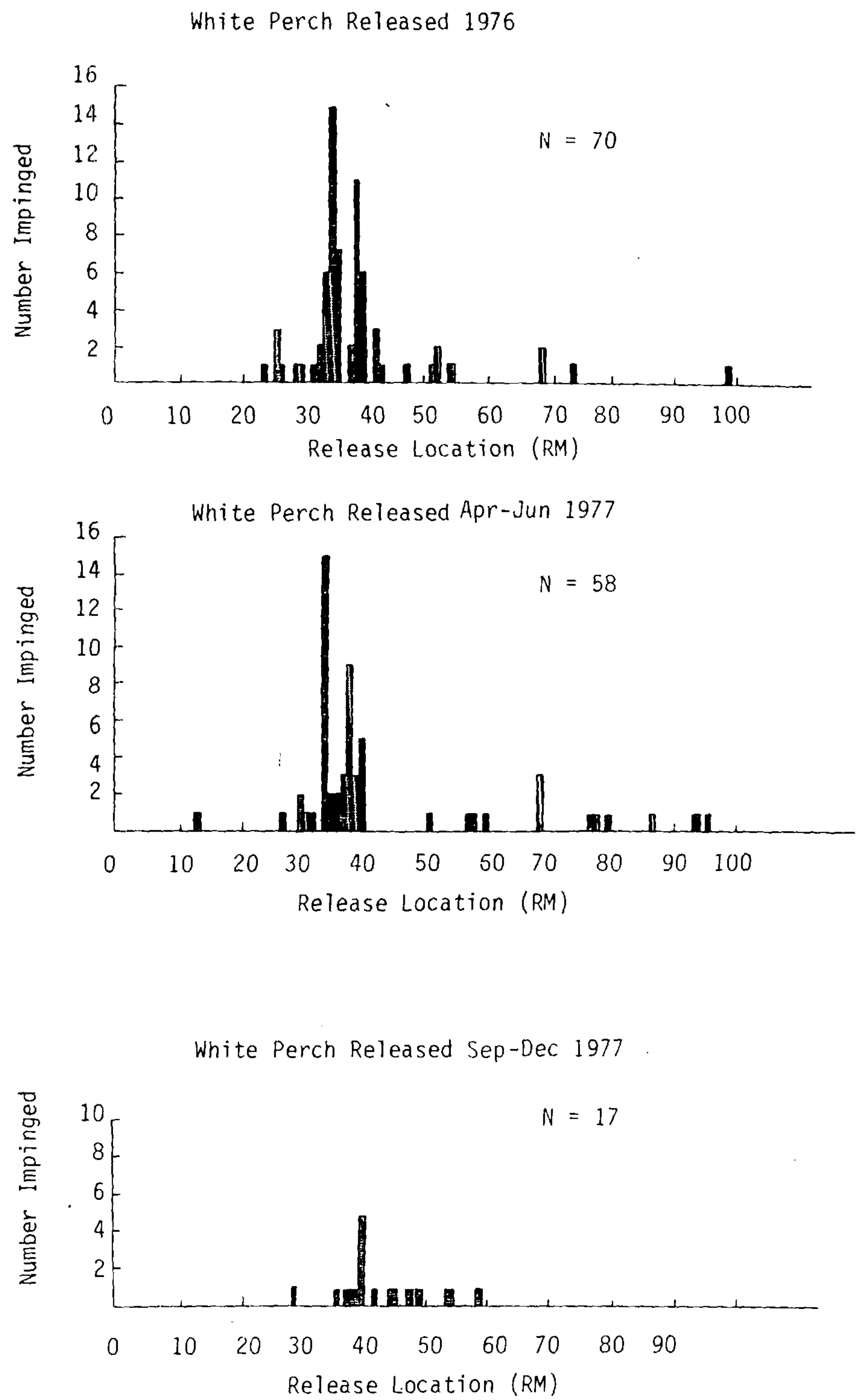


Figure IV-14. Release Locations of Tagged White Perch ≤150 mm (total length) Captured by Impingement at Indian Point Generating Station (RM 42) during 1977. (Impinged fish traveled from at least as far as RM 13 and 99.)

Table IV-27

Indian Point Impingement Exploitation Rates for Tagged White Perch <150 mm (total length) during 1977. (Exploitation declined as distance from Indian Point increased.)

Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
1976						
RM	12- 23	0	100	0.000	0.000	0.037
	24- 38	40	7445	0.005	0.004	0.007
	39- 46	21	3267	0.006	0.004	0.010
	47- 76	8	2004	0.004	0.002	0.008
	77-152	1	2422	0.0004	0.000	0.002
	Total	70	15238	0.004	0.004	0.006
Apr-Jun 1977						
Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
RM	12- 23	1	177	0.006	0.001	0.032
	24- 38	37	2611	0.014	0.010	0.020
	39- 46	8	785	0.010	0.004	0.020
	47- 76	6	814	0.007	0.003	0.016
	77-152	6	1323	0.004	0.002	0.010
	Total	58	5710	0.010	0.008	0.013
Sep-Dec 1977						
Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
RM	12- 23	0	66	0.000	0.000	0.056
	24- 38	3	3033	0.001	0.0002	0.003
	39- 46	9	1230	0.007	0.003	0.014
	47- 76	5	607	0.008	0.003	0.019
	77-152	0	137	0.000	0.000	0.027
	Total	17	5073	0.003	0.002	0.005

R = Number of marked fish recovered from impingement at Indian Point
M = Number of fish marked
$\hat{\mu}$ = Estimate of exploitation rate (μ)
μ_L = Lower 95% confidence bound for μ
μ_U = Upper 95% confidence bound for μ

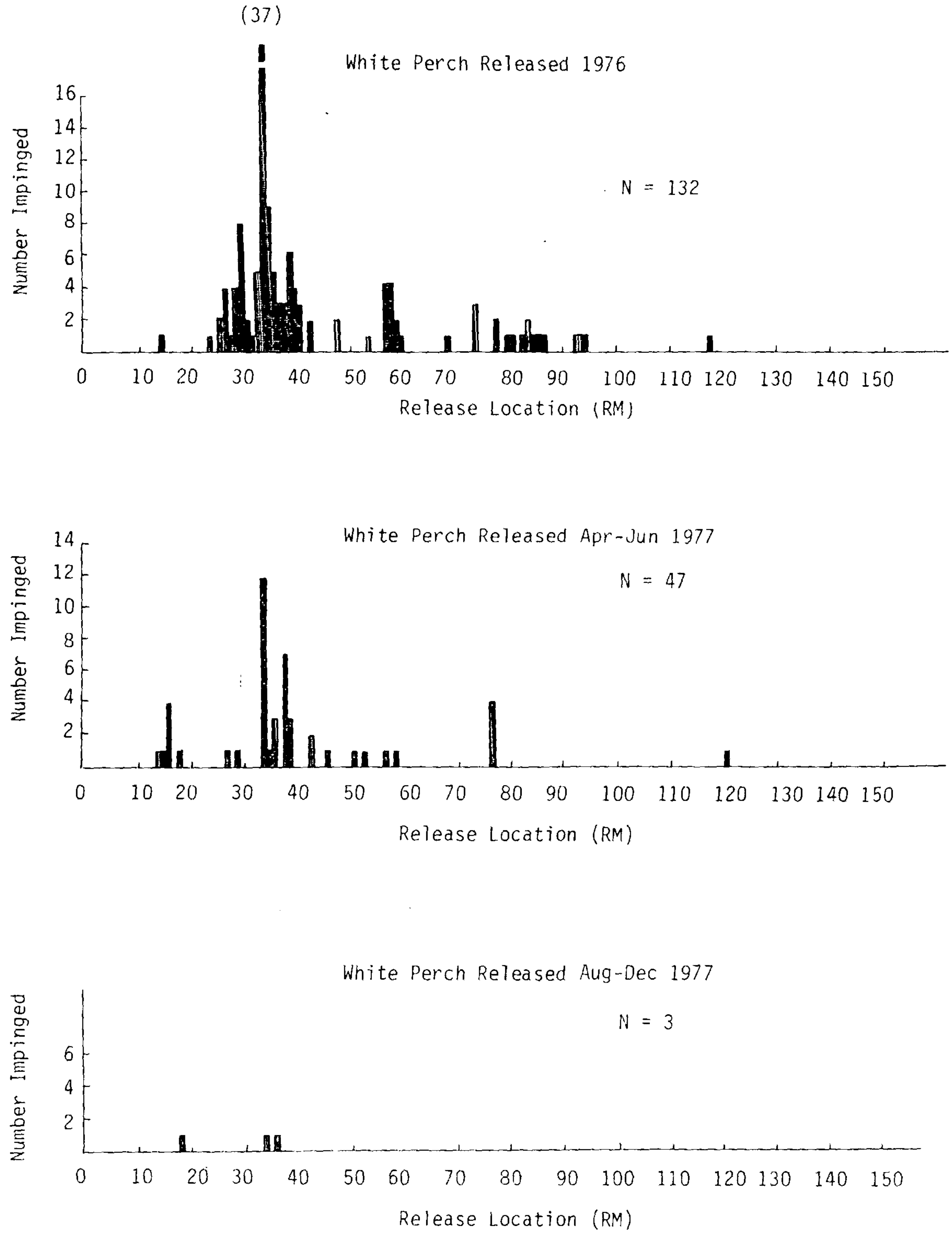


Figure IV-15. Release Locations of Tagged White Perch >150 mm (total length) Recaptured by Impingement at Indian Point Generating Station (RM 42) during 1977. (Impinged fish traveled from at least as far as RM 13 and 121.)

Exploitation of the larger (>150 mm) tagged fish was also highest for fish released in the spring (Table IV-28). Exploitation rates were similar across all regions, and total exploitation rate was 0.9%. Fish released in 1976 suffered only a 0.7% exploitation during 1977. Fish marked in the fall, which were exposed to impingement for a shorter period, were exploited at a rate of 0.1% during 1977.

These exploitation rates for tagged white perch were also biased by small numbers of recaptures and non-proportional distribution of marked fish. Large numbers of older white perch were also found in the uppermost marking region (TI 1979a); thus, calculated exploitation rates are not reflective of exploitation on the entire population. Perhaps the most significant conclusion to be drawn from these analyses is that white perch from all regions of the Hudson River may move into the Indian Point region and become impinged; thus, the Indian Point plant is not exploiting a localized population.

c. Atlantic Tomcod

Atlantic tomcod impinged at Indian Point in 1977 consisted of fish from both the 1976-1977 and 1977-1978 spawning runs. Tomcod migrate from the lower Hudson River estuary to spawn during winter (December-February), usually upriver from the Indian Point plant (TI 1977d). Since they are not caught in great numbers in box traps before they reach the spawning area, most fish are marked upstream from the power plant, and thus fish recovered through impingement exhibit downriver movement (TI 1977d). Nineteen tagged and ten finclipped Atlantic tomcod from the 1976-1977 spawning run recaptured at Indian Point had moved downstream, while only one had moved upstream (Table IV-29, Figure IV-16). Atlantic tomcod are better suited to calculating exploitation rates from mark-recapture methods than are striped bass and white perch. The concentration of the population upriver from the Indian Point generating station, where they can be marked, and the subsequent movement back past the plant greatly decreased the problem of proportional distribution of marks. However, since most tomcod were marked upriver from Indian Point, any calculated exploitation rate would essentially represent only the exploitation which occurs during the downstream migration.

Table IV-28

Indian Point Impingement Exploitation Rates for Tagged White Perch ≥150 mm (total length) during 1977

Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
1976						
RM	12- 23	1	662	0.002	0.000	0.008
	24- 38	85	11558	0.007	0.006	0.009
	39- 46	15	1902	0.008	0.004	0.013
	47- 76	18	2846	0.006	0.004	0.010
	77-152	13	2849	0.005	0.002	0.008
	Total	132	19817	0.007	0.006	0.008
Apr-Jun 1977						
RM	12- 23	7	688	0.010	0.004	0.021
	24- 38	25	2444	0.010	0.007	0.015
	39- 46	6	639	0.009	0.003	0.020
	47- 76	4	657	0.006	0.002	0.016
	77-152	5	536	0.009	0.003	0.022
	Total	47	4964	0.009	0.007	0.013
Sep-Dec 1977						
RM	12- 23	1	634	0.002	*	0.009
	24- 38	2	4083	0.001	*	0.002
	39- 46	0	637	0.000	0.000	0.006
	47- 76	0	188	0.000	0.000	0.020
	77-152	0	73	0.000	0.000	0.051
	Total	3	5605	0.001	0.000	0.002

R = Number of marked fish recovered from impingement at Indian Point

M = Number of fish marked

$\hat{\mu}$ = Estimate of exploitation rate (μ)

μ_L = Lower 95% confidence bound for μ

μ_U = Upper 95% confidence bound for μ

* = Greater than 0.0 but less than 0.001

Table IV-29

Indian Point Impingement Exploitation Rates for Marked (tagged and finclipped) Atlantic Tomcod during 1977

			Spawning Season 1976-1977			
Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
RM	12-38	1	4040	*	*	0.001
	39-46	0	308	0.000	0.000	0.012
	47-61	19	42644	*	*	0.001
	62-77	10	13946	0.001	*	*
	Total	30	60938	0.001	*	0.001
			Nov-Dec 1977			
Release Region		R	M	$\hat{\mu}$	μ_L	μ_U
RM	12-38	0	2615	0.000	0.000	0.001
	39-46	0	23	0.000	0.000	0.161
	47-61	1	2561	*	*	0.002
	62-77	0	807	0.000	0.000	0.005
	Total	1	6006	*	*	0.001

R = Number of marked fish recovered from impingement at Indian Point

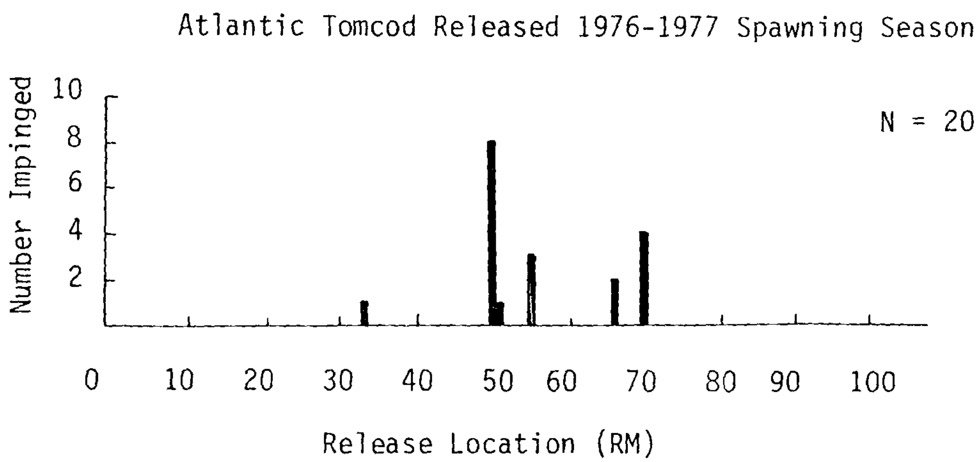
M = Number of fish marked

$\hat{\mu}$ = Estimate of exploitation rate (μ)

μ_L = Lower 95% confidence bound for μ

μ_U = Upper 95% confidence bound for μ

* = Greater than 0.0 but less than 0.001



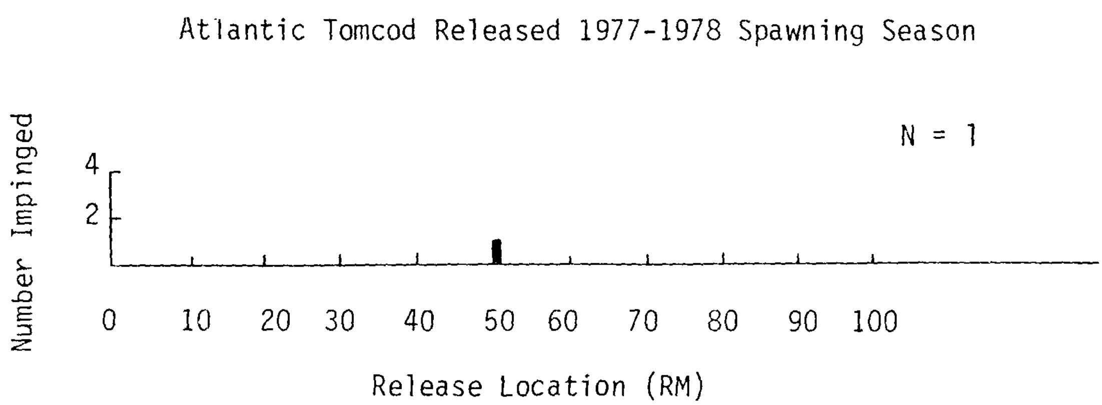


Figure IV-16. Release Locations of Tagged Atlantic Tomcod Recaptured by Impingement at Indian Point Generating Station (RM 42) during 1977. (Most recaptured fish had been released upstream from Indian Point.)

The 1976-1977 spawning run was very large (TI 1979a), and 56,590 tomcod were marked with tags and finclips upriver from the Indian Point region (RM 39-46). Since survival of marked Atlantic tomcod is excellent, no adjustment for marking mortality is necessary (TI 1979a). Twenty-nine of the marked fish were subsequently recovered in impingement collections at Indian Point for an observed exploitation rate of 0.1% for the downstream migration (Table IV-29). Collection efficiencies at Units No. 2 and No. 3 (Tables IV-7, IV-8) indicated that only 33% of adult Atlantic tomcod impinged from November 1976 through June 1977 were collected; thus, actual estimated exploitation of the downstream migrants was 0.15%.

E. LENGTH/WEIGHT RELATIONSHIPS OF FISH CAUGHT IN RIVER AND IMPINGEMENT COLLECTIONS

1. Introduction

Previous studies in which length/weight relationships have been used to assess differences in condition between impinged fish and fish taken from river samples have been inconclusive (TI 1976a, 1977d). Several factors can influence the weight of impinged fish, thereby disguising real differences in condition and confounding interpretation of results. For example, between the time of impingement and collection, fish weight may change due to extrusion of gonadal products, digestion or regurgitation of food, increased metabolic expenditure, or osmotically induced changes in body water content. An effort was made to overcome some of these factors by selecting impinged tomcod, judged by appearance to have been recently impinged, for length/weight comparison with tomcod collected by bottom trawls. No comparable data were available for other species.

2. Methods

Atlantic tomcod were selected from Indian Point impingement samples on 12 occasions during 1975 through 1977 to estimate the condition factor using the length/weight relationship. Tomcod showing no outward signs of physical damage were subsampled from the total impingement collection. From each group obtained, a maximum of 81 young-of-the-year tomcod were randomly selected for the determination of lengths and weights. The length/weight relationship of each impinged sample was compared to that of a river sample of tomcod collected within 24 hours of the impingement sample. Each river sample consisted of a maximum of 81 young-of-the-year tomcod randomly selected from a bottom trawl sample taken in the Indian Point or West Point regions of the estuary.

Levene's test for homogeneity of variance (Brown and Forsythe 1974) was performed on $\log_{10}$ transformed length and weight data from both trawl and impingement samples (Table IV-30). Data from paired impingement and trawl samples which satisfied the assumption of homogeneity of variance were tested for commonality of lines and slopes by analysis of variance (Sokal and Rohlf 1969).

3. Results and Discussion

Analysis of the length/weight relationships of Atlantic tomcod impinged at Indian Point and those collected in bottom trawls indicated that impinged fish generally weighed less at a specific length than fish taken from bottom trawls. Of the nine paired samples having homogeneous variance, five tested by ANOVA did not have common lines ($p < 0.05$) (Table IV-30). The y-intercept in four of the five pairs was lower for impinged tomcod, indicating they weighed less at a specific length than fish caught in bottom trawls. This was further supported when the weights of tomcod were calculated at two arbitrary total lengths (75 mm and 125 mm) using the regression equations for these five pairs of samples (Table IV-31). In four of the five pairs of samples, impinged tomcod weights ranged from 11.5 to 22.8% (at 75 mm) and 6.4 to 23.6% (at 125 mm) less than fish caught in bottom trawls.

Although several factors may influence weight of impinged fish, osmotic loss or gain of water during impingement is the most likely cause of weight change. The direction of change is dependent upon the direction of the difference between solute concentration of the river and solute concentration of the body fluids of the fish. When the solute concentration of the body fluids exceeds that of the environment, water is taken into the fish across permeable membranes, such as those of the gills. Conversely, when the solute concentration of the water exceeds that of the body fluids, water is lost across these surfaces. Under ordinary circumstances, a

Table IV-30

Length/Weight Regression Equation and ANOVA for Common Line and Slope of Atlantic Tomcod Bottom Trawl and Impingement Samples, 1975 through 1977. [Note that only 4 pairs of samples had common lines ($p > 0.05$).]

SOURCE	DATE	SAMPLE SIZE	MEAN LENGTH (mm) (Log_{10})	MEAN WEIGHT (g) (Log_{10})	REGRESSION† EQUATION	LINE F	LINE d.f.	LINE p‡	SLOPE F	SLOPE d.f.	SLOPE p‡
Bottom Trawl	6-19-75	50	1.79	0.29	y = -5.279 + 3.110x	*			*		
Impingement	6-20-75	40	1.83	0.40	y = -4.052 + 2.430x						
Impingement	8-12-75	44	1.93	0.67	y = -5.441 + 3.171x	1.723	2	0.1829	2.256	1	0.1357
Bottom Trawl	8-14-75	80	1.90	0.58	y = -5.135 + 3.014x						
Impingement	12-08-75	48	2.17	1.44	y = -6.053 + 3.456x	*			*		
Bottom Trawl	12-09-75	54	2.19	1.51	y = -4.278 + 2.648x						
Bottom Trawl	8-03-76	80	1.97	0.81	y = -4.994 + 2.945x	0.268	2	0.7657	0.011	1	0.9148
Impingement	8-04-76	63	1.96	0.77	y = -5.021 + 2.957x						
Impingement	8-11-76	55	1.94	0.75	y = -5.042 + 2.979x	0.079	2	0.9241	0.004	1	0.9524
Bottom Trawl	8-11-76	80	1.89	0.60	y = -5.033 + 2.973x						
Bottom Trawl	8-25-76	81	1.98	0.85	y = -5.373 + 3.139x	3.785	2	0.0248	0.562	1	0.4547
Impingement	8-26-76	81	1.97	0.83	y = -5.225 + 3.070x						
Bottom Trawl	11-23-76	19	2.12	1.36	y = -4.507 + 2.762x	11.569	2	0.00007	1.317	1	0.2566
Impingement	11-29-76	35	2.18	1.48	y = -5.102 + 3.020x						
Impingement	6-10-77	80	1.79	0.26	y = -5.242 + 3.063x	22.438	2	<0.00001	9.354	1	0.0026
Bottom Trawl	6-14-77	80	1.81	0.33	y = -5.738 + 3.355x						
Bottom Trawl	6-28-77	80	1.83	0.43	y = -5.391 + 3.173x	72.296	2	<0.00001	0.004	1	0.9486
Impingement	6-30-77	50	1.84	C.36	y = -5.485 + 3.183x						
Bottom Trawl	7-26-77	80	1.86	0.49	y = -4.905 + 2.908x	*			*		
Impingement	7-26-77	80	1.89	0.55	y = -5.450 - 3.171x						
Impingement	8-15-77	80	1.89	0.47	y = -5.678 + 3.260x	103.408	2	<0.00001	7.626	1	0.0064
Bottom Trawl	8-15-77	80	1.85	0.47	y = -4.975 + 2.938x						
Impingement	9-08-77	80	1.92	0.59	y = -5.526 + 3.192x	1.456	2	0.2378	0.003	1	0.9577
Bottom Trawl	9-08-77	29	1.89	0.50	y = -5.557 + 3.199x						

†$y = \log_{10}$ weight; $x = \log_{10}$ length

‡Probability of rejection of null hypothesis when it is true

*Nonhomogeneous variances as determined by Levene's Test

Table IV-31

Differences in Calculated Weight (g) of Atlantic Tomcod Caught in Bottom Trawls and Collected by Impingement at Two Arbitrary Lengths Based on Equations for Lines which Were Not Common. (Note that weights of impinged tomcod were usually less than fish caught in bottom trawls.)

Date of Samples	At 75 mm Length: Weight of Fish Caught in Bottom Trawl	At 75 mm Length: Difference from Weight of Impinged Fish*	At 75 mm Length: Percent Difference in Weight	At 125 mm Length: Weight of Fish Caught in Bottom Trawl	At 125 mm Length: Difference from Weight of Impinged Fish*	At 125 mm Length: Percent Difference in Weight
25/26 Aug 1976	3.26	+0.14	4.3	16.19	+0.13	0.8
23/29 Nov 1976	4.70	-1.07	22.8	19.27	-2.30	11.9
14/10 Jun 1977	3.58	-0.41	11.5	19.85	-4.68	23.6
28/30 Jun 1977	3.62	-0.58	16.0	18.30	-2.87	15.7
15/15 Aug 1977	3.42	-0.70	20.5	15.34	-0.98	6.4

*(-)Indicates impingement weights < river weights.
(+)Indicates impingement weights > river weights.

variety of physiological mechanisms interact to maintain a constant relationship between body water and solute level. The gills, kidneys, and gut are all actively involved in maintaining homeostasis, but maintenance of salt and water balance requires an expenditure of energy.

Studies have demonstrated that when fish are exposed to stress, such as forced sustained swimming or an environment with a low oxygen content, the rate of water flux (influx or efflux) increases (Stevens 1972, Kirk 1974). This increased flux is due primarily to an increased rate of ventilatory movement of water across the permeable gill surfaces (Evans 1969) as the fish attempt to meet increased demands for oxygen. Frequently, the homeostatic mechanisms cannot immediately mitigate the increased uptake or loss of water and a change in weight occurs until the imbalance can be corrected. As fish attempt to avoid or escape impingement, increased water fluxes are to be expected. Since the maintenance of salt and water balance requires an expenditure of energy, the imbalance worsens as the fish approach exhaustion.

The osmotic concentration of solutes in the body fluids of freshwater fishes is typically equivalent to a solution of approximately 0.7% sodium chloride (Prosser and Brown 1973). The salinity of the Hudson River near Indian Point varies throughout the year (Section V.E), but it rarely approaches a salinity of 0.7%. On each of the dates on which tomcod were sampled for this study, the salinity at the Indian Point intakes was less than 0.7% (Table IV-32). Under these conditions, it is likely that the weight of impinged fish increased as a result of increased water uptake. Therefore, on those occasions when the predicted weight of impinged Atlantic tomcod was found to be less at a given length than that of fish taken from the river, the actual difference was probably even greater than reported. On those occasions when the predicted weights of Atlantic tomcod from impingement and the river did not differ, impinged fish may have weighed less prior to being impinged, but the weight of those impinged fish increased by osmotic water uptake. Therefore, although results of this study are equivocal, the data suggest that Atlantic tomcod impinged at Indian Point weighed less at a given length than fish taken by bottom trawl from the river, and that impinged tomcod were in poorer condition than the general population.

Table IV-32

Salinity* at Intakes of Indian Point Generating Station on Days upon which Atlantic Tomcod were Selected from Impingement Collections for Length/Weight Comparisons with Fish Caught in Bottom Trawls

Date	Percent Salinity
6-20-75	0.010
8-12-75	0.114
12-08-75	0.010
8-04-76	0.097
8-11-76	0.019
8-26-76	0.303
11-29-76	0.012
6-10-77	0.058
6-30-77	0.206
7-26-77	0.227
8-15-77	0.471
9-08-77	0.336

* Converted from measured intake conductivities using equation V-2 in Section V.E.2.b.

SECTION V

FISHES AND WATER QUALITY OF INDIAN POINT AND ADJACENT REGIONS

A. INTRODUCTION

The objective of this section is to determine the relationship of data collected during nearfield sampling to that collected during riverwide sampling. As earlier results have emphasized (TI 1979a), information on the ecological effects of the Indian Point generating station on the nearfield fish populations must be viewed in light of the riverwide distribution and abundance of each species. Species composition, abundance and biological characteristics of selected species, and water quality in the nearfield are compared to similar data from other river regions in order to determine whether the nearfield is representative of the rest of the estuary.

B. RIVERWIDE AND NEARFIELD SPECIES COMPOSITION

1. Comparisons of Riverwide and Nearfield Species Composition

Due to its complex physical and chemical structure, the Hudson River estuary provides a broad range of habitats supporting a diverse fish fauna. The salt front moves up the channel of the estuary, leaving pockets of fresh water in the shore zone (TI 1976b); thus, both freshwater and marine species may be found in the same region during the same time. Marine species such as the bluefish are seasonal visitors; freshwater species such as the banded killifish are year-long residents. Anadromous species (e.g. American shad) use the estuary as a spawning and nursery area.

Ninety-nine species of fish were collected in the estuary between RM 12 and RM 152 during sampling conducted by Texas Instruments from 1975 through 1977 (Appendix Table B-1). Several marine species, euryhaline species, and freshwater species were collected frequently throughout the year or during part of a year. The number of species occurring within the estuary was further increased by the occasional presence of marine species, such as the lookdown (Selene vomer), that are not common in the North Atlantic and freshwater species that are collected infrequently, such as the brook trout (Salvelinus fontinalis) which enters the estuary from tributaries.

The Indian Point nearfield lies within the section of the estuary that has the most diverse assemblage of fish species (McFadden 1977). Of the 99 species collected in riverwide sampling from 1975 through 1977, 84 were collected by impingement sampling at the Indian Point generating station and by nearfield standard station sampling (Table IV-1). Fifteen species collected by riverwide sampling were absent from impingement and standard station collections. Freshwater minnows (silvery minnow, bridle shiner, bluntnose minnow, fathead minnow, creek chub, and fallfish) and saltwater species (conger eel, Atlantic herring, and striped killifish) are examples of species collected by riverwide sampling but not by nearfield or impingement sampling during 1975 through 1977. A few species (northern searobin, grubby, and white hake) were found infrequently in the nearfield during 1975-1977 but were not encountered elsewhere. All species that commonly occurred in the estuary, except the silvery minnow which was collected in the upper part of the estuary, were present in the nearfield.

2. Species Composition within the Nearfield during 1977

The Indian Point nearfield (RM 39-43) was sampled with 100 ft beach seines, a bottom trawl, and a surface trawl (Section III). These gears sampled three habitat types: the shore zone, the offshore bottom zone, and the offshore pelagic zone, respectively. Although no species was restricted to one zone, many species were collected predominantly by one gear; for example, Atlantic tomcod and hogchoker by bottom trawl, banded killifish by beach seine, and blueback herring by surface trawl. The offshore pelagic zone held the fewest number of species, 15 (Appendix Table B-2). Only anadromous clupeids (American shad, blueback herring, alewife), bay anchovy, and young-of-the-year bluefish were commonly collected in this zone. Twenty-two species were collected in the offshore bottom zone (Appendix Table B-3). The species collected included those common in the offshore pelagic zone, such as anadramous clupeids, bay anchovy, and bluefish, and typically demersal fishes, such as Atlantic tomcod, white catfish, and hogchoker. White perch, striped bass, American eel, Atlantic menhaden, and rainbow smelt were also common in the offshore bottom zone. The shore zone contained the largest number of species, 45 (Appendix Table B-4). Atlantic sturgeon, weakfish, and brown trout were the only species collected during nearfield sampling that were not present in the shore zone. Twenty-four species were collected only in the shore zone. Species that were common only in the shore zone were banded killifish, four-spine stickleback, golden shiner, spottail shiner, striped bass, pumpkinseed, and tessellated darter.

The number of species and types of species were generally consistent among stations of the same zone, while major differences in abundance and types of species existed among zones. The greater number of species in the shore zone was due to the presence of more freshwater species, primarily members of the families Cyprinidae (minnows and carps) and Centrarchidae (sunfishes) that were not collected offshore. The offshore pelagic and bottom species assemblages were composed of mostly euryhaline species, probably due to the rapid changes in salinity in the deep water habitat (TI 1976b).

3. Distribution of Selected Species among Sampling Stations

While the species composition among sampling stations of a particular zone was consistent, there were differences in the distribution of some species among the sampling stations of the shore zone and offshore bottom zone. Sampling stations in the offshore pelagic zone were less variable with respect to depth, bottom type, and vegetation than those in the other zones; thus, there was less difference in the distributions of species among these stations than of the shore zone or offshore bottom zone stations. The shore zone varied from sheltered bays with dense aquatic vegetation to sandy beaches which dropped steeply to the river channel. Sampling stations were categorized as being located far from the main river channel and containing large amounts of vegetation or as being close to the channel and relatively free of aquatic plants (Table III-2). "Far" and "close" were determined by inspection of river charts, with an effort to keep the classification consistent with that of previous reports (TI 1976c). Stations 8, 9, and 12 were of the former type, while 10 and 11 were of the latter; stations 20 and 21 were intermediate with respect to vegetation and proximity to the channel. The offshore bottom zone varies considerably in depth. Stations 2, 3, and 7 were classified as shallow ($\leq$20 ft), stations 1, 4, 5, and 6 are deep (>20 ft) [Table III-3]. A Friedman Rank Sums test and the multiple comparisons approach to a posteriori comparisons of the Friedman test (Hollander and Wolfe 1973) were used to evaluate the distribution of selected species among the sampling stations during 1976 and 1977.

Analysis of data from 1972 through 1977 found that, in the shore-zone, striped bass, bluefish, blueback herring, and bay anchovy were generally more abundant at stations nearest the channel where little vegetation occurred. American shad exhibited a homogeneous distribution. White perch, spottail shiner, pumpkinseed, alewife, banded killifish, and tesselated darter were more abundant at stations farther from the channel where aquatic macrophytes were dense during summer. In the offshore bottom zone, white perch, Atlantic tomcod, and hogchoker were more abundant at deeper stations than shallower ones. The results for 1976 and 1977 were similar and are discussed in the succeeding paragraphs.

Many species of fish exhibited preferences for one type of station over another. Striped bass, American shad, and bluefish were more abundant at the open, unvegetated shore zone sites (Appendix Table B-6). White perch, banded killifish, spottail shiner, American eel, alewife, and tessellated darter preferred the sheltered vegetated sites. Blueback herring were not significantly more abundant at sites of one type than the other. Bay anchovy distribution appeared to be related to salinity, since bay anchovy were more abundant at the shore zone sites farther downriver where conductivities were usually higher (Appendix Table B-5). Bay anchovy were abundant in the Indian Point area from May to October, the time of highest salinity. Banded killifish, tessellated darter, alewife, and spottail shiner may have been more abundant at the sheltered shore zone sites because the vegetation afforded them protection from predators. Although food availability may be an important factor in explaining the preference of some species for sheltered shore zone sites over more open ones, little data exist on the differences in food availability between the two habitat types, precluding such evaluation. Also, the sheltered bays far from the channel do not undergo sudden changes of salinity (TI 1976b) which the freshwater species might not have been able to tolerate.

Among the offshore bottom stations, white perch, Atlantic tomcod, hogchoker, and American eel were significantly more abundant ($\alpha = 0.05$) at deep stations than at shallow ones (Appendix Table B-7 and B-8). Although Atlantic tomcod and hogchoker are both bottom dwelling species, this does not explain their apparent preference for deep water. The higher abundance of Atlantic tomcod at the deeper stations was probably the result of their preference for more saline water (TI 1979a). A distinct stratification of salinity (with highest values at the bottom of the deepest stations) existed when conductivity values were over 1.0 mS/cm (Figure V-1). Increased salinity may also have been the main factor determining the distribution of hogchokers. They exhibit a downstream movement to more saline water when they spawn (TI 1976c). The reason for the greater abundance of white perch and American eel at the deeper stations is not apparent. Blueback herring and bay anchovy, which are pelagic species, were more abundant at shallow stations than at deep ones and would not be expected to be found in abundance at the deep stations of the offshore bottom zone.

There were no significant differences in the distribution of American shad, blueback herring, alewife, or bay anchovy among the offshore pelagic zone stations (Appendix Table B-9). This reflects the greater uniformity (i.e., the offshore pelagic zone is more uniform in the sense that there are no depth, bottom type, or vegetation differences as for the offshore bottom and shore zones) of the sampling stations in the offshore pelagic zone.

C. PATTERNS OF ABUNDANCE IN STANDARD STATIONS VERSUS RIVERWIDE SAMPLING

1. Introduction

Many species of fish present in the Hudson River estuary undergo extensive movements. Some of these movements are in response to changes in physical and chemical factors such as salt front position, while others represent seasonal migrations. Much of the movement occurs through the Indian Point region. One of the purposes of the Standard Stations Program is to determine relative abundance in the vicinity of the Indian Point generating station (Section III.B.2). Because of the extensive movement of some species through this region, standard station sampling may also reflect riverwide relative abundance for several species. The objective of this section is to determine how well abundance indices based on standard station sampling represent patterns of abundance in larger areas of the river for juveniles (young-of-the-year) of eight of the species commonly impinged (Section IV.C.2) at the Indian Point generating station. Two types of comparisons were used to make this determination: Data Set I, which was developed by TI from subsets of beach seine and bottom trawl data collected in several studies from 1965 through 1977 and compared data collected in the vicinity of Indian Point to data collected riverwide (Appendix B.4); and Data Set II, which compared data from the current TI Standard Stations Program and the Long River (riverwide) Fisheries Survey (see Section III.C.3) from 1975 through 1977.

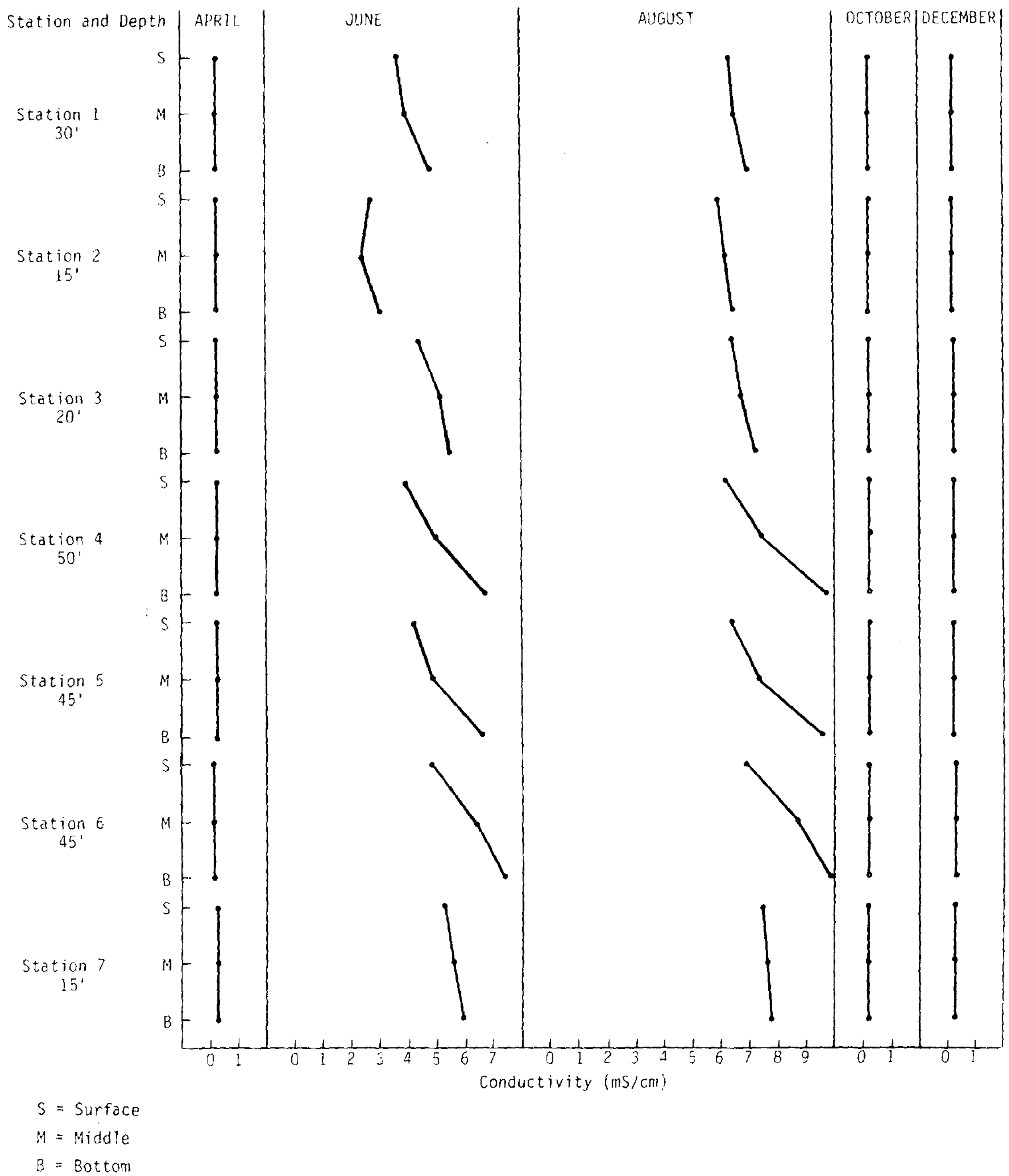


Figure V-1. Vertical Profile of Conductivity in Indian Point Nearfield during 1977. (Stratification of salinity occurs during summer months when the salt front is above Indian Point and is more pronounced at deeper stations.)

2. Methods

a. Data Set I

Correlation analysis was used to determine how well annual abundance indices based on standard station sampling represent patterns of annual abundance in larger areas of the river for juveniles of the four species (striped bass, white perch, American shad, and Atlantic tomcod) for which a long series of abundance indices (8 years of bottom trawl and 12 years of beach seine abundance indices) has been calculated. Comparisons were made between standard station and riverwide catch-per-area (CPA) values based on beach seine sampling from 1965 through 1977 for the first three species and catch-per-effort (C/f) values for the demersal Atlantic tomcod based on bottom trawl samples from 1969 to 1977. A more detailed description of the data subsets used to develop Data Set I (including contractor, years, sampling areas, months sampled, and types of gear employed for each species) appears in Appendix B-4. For each of the four species, a Spearman Rank Correlation test (Siegel 1956) was used to test the association between standard station and riverwide abundance indices.

b. Data Set II

A comparable long series of juvenile abundance indices was not available for the four other species of interest (blueback herring, alewife, bay anchovy, and hogchoker). Therefore, instead of a rank correlation analysis, a two-way analysis of variance (ANOVA) (Sokal and Rohlf 1969) was used to compare standard station C/f and riverwide C/f values for these four species. Data from the 3-year period 1975 through 1977 were included to maintain consistency with the focus of this report. A data base consisting of only 3 years can be sensitive to occasional yearly anomalies in the distribution patterns of fish. Thus, the results of these ANOVA tests should be interpreted carefully.

Selected time periods and river regions, based upon the geographic and temporal distribution of each species, were used to calculate biweekly C/f values (Table V-1). The time periods and regions varied from species to species and were selected through an evaluation of a species' life history relative to the yearly sampling designs. These biweekly C/f values were then used as replicates in the ANOVA and were computed as the sum of the biweekly collections for each species divided by the total number of biweekly samples for combined standard stations and combined selected regions, respectively (Table V-1). Transformed C/f values, $\log_e [(C/f) + 1]$, were used in the ANOVA.

Table V-1

Species, Gear, Time Period, Long River Regions, and Standard Station Sites* Used To Generate Riverwide and Standard Station Abundance Indices for Data Set II from 1975 through 1977

Species (Juveniles)	Gear	Time Period	Long River Regions**	Standard Station Sites
Blueback Herring	Beach seine	Mid-Jul through Oct	1 through 12	8, 9, 10, 11, 12, 20, 21
Alewife	Bottom trawl†	Mid-Jul through Sep	2 through 6	1, 2, 3, 4, 5, 6, 7
Bay anchovy	Beach seine	Jul through Nov	1 through 5	8, 9, 10, 11, 12, 20, 21
Hogchoker	Bottom trawl	Aug through Dec	2 through 6	1, 2, 3, 4, 5, 6, 7

*See Figure III-2 for location of Standard Stations Sites

**Region 1 = Yonkers; Region 2 = Tappan Zee; Region 3 = Croton-Haverstraw; Region 4 = Indian Point; Region 5 = West Point; Region 6 = Cornwall; Region 7 = Poughkeepsie; Region 8 = Hyde Park; Region 9 = Kingston; Region 10 = Saugerties; Region 11 = Catskill; Region 12 = Albany

†Although riverwide beach seine data indicate that juvenile alewife are concentrated in the upper estuary in the summer and migrate downstream in early fall (McFadden et al. 1978), bottom trawl data (which was only collected in the lower and middle portions of the estuary) were used in this analysis because there is evidence that alewife are offshore during the day and migrate inshore only at night (Raytheon 1971, Dovel 1979). Beach seine sampling during 1975 through 1977 was done only during the day and would probably not yield accurate estimates of juvenile alewife abundance.

3. Results and Discussion

a. Data Set I - Correlation Analysis

The standard station abundance index based on beach seine catches was representative of riverwide trends in abundance for juvenile striped bass, white perch, and American shad. There was a significant correlation between standard station and riverwide abundance indices over the 12-year period (Figures V-2, V-3, and V-4) for each of the three species.

Standard station abundance indices for juvenile Atlantic tomcod, however, were not correlated with either the Croton-Haverstraw/Indian Point index or the other riverwide index, both of which showed similar trends for the relative abundance of juvenile Atlantic tomcod (Figure V-5). This result is both surprising and curious. The Croton-Haverstraw/Indian Point

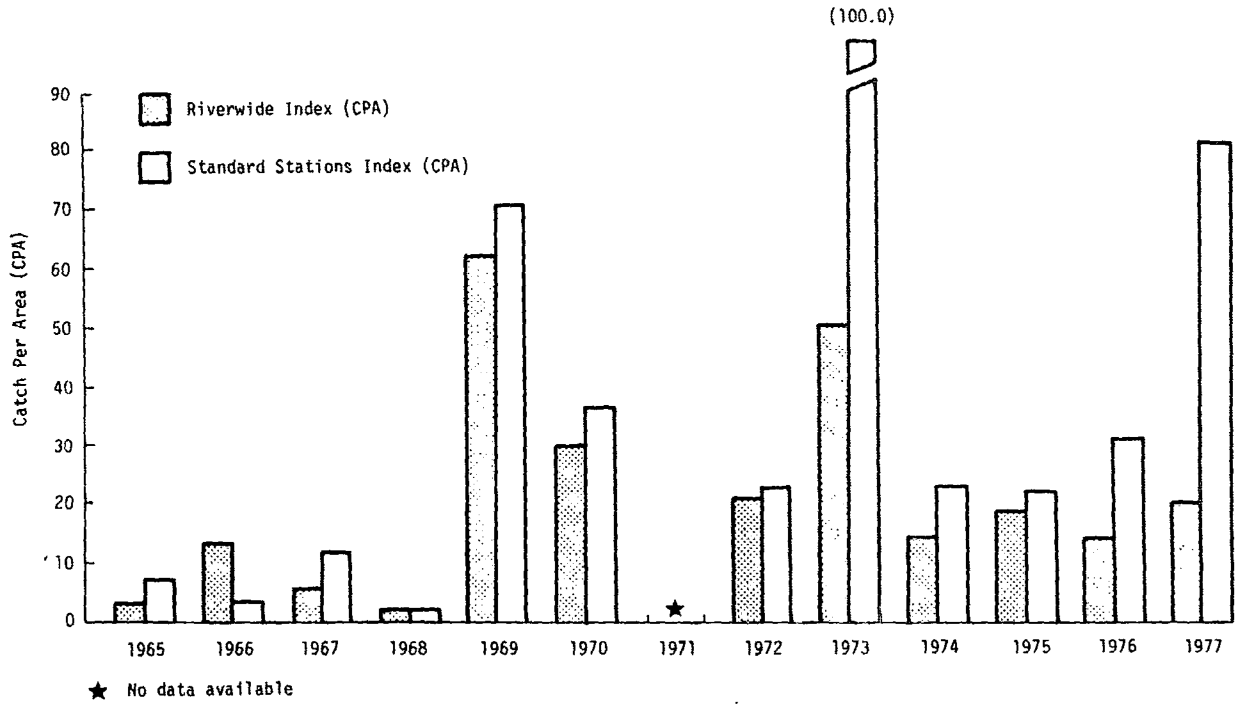


Figure V-2. Comparison of Riverwide and Standard Station Juvenile Striped Bass Abundance Indices from 1965 through 1977 Based on Beach Seine Sampling. [The riverwide and standard station abundance indices were significantly correlated (r_s = 0.85, $p<0.001$).]

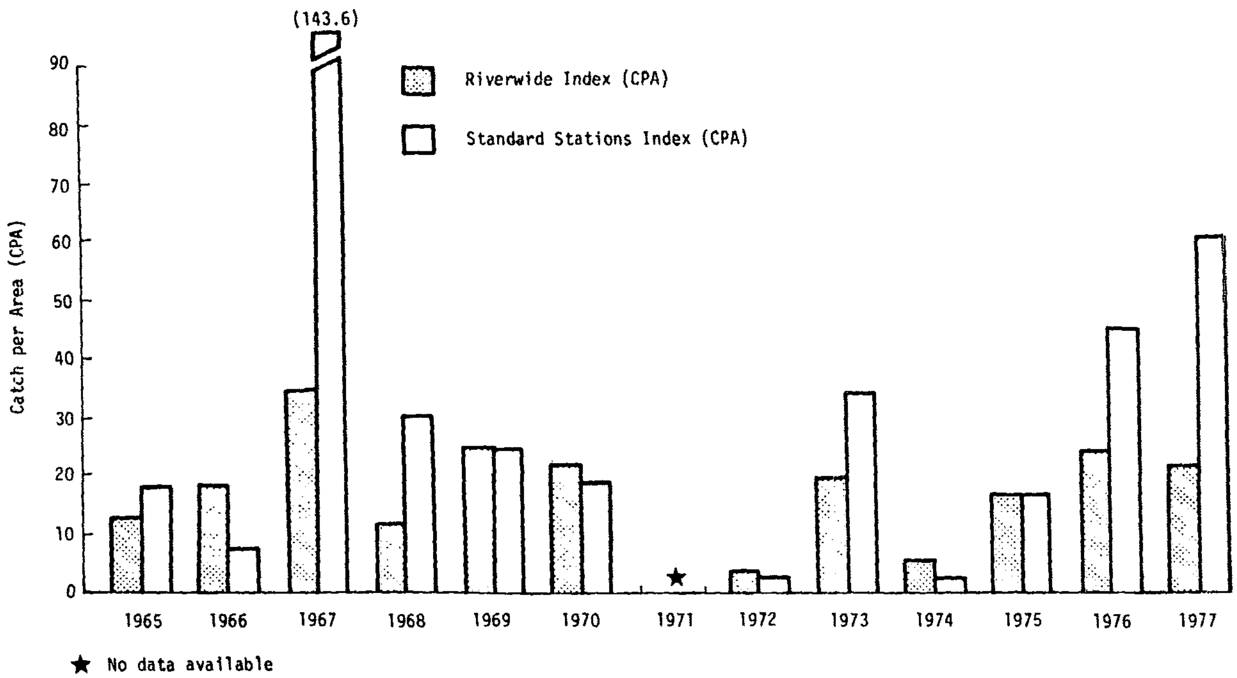


Figure V-3. Comparison of Riverwide and Standard Station Juvenile White Perch Abundance Indices from 1965 through 1977 Based on Beach Seine Sampling. [The riverwide and standard station abundance indices were significantly correlated (r_s = 0.741, $0.01>p>0.001$).]

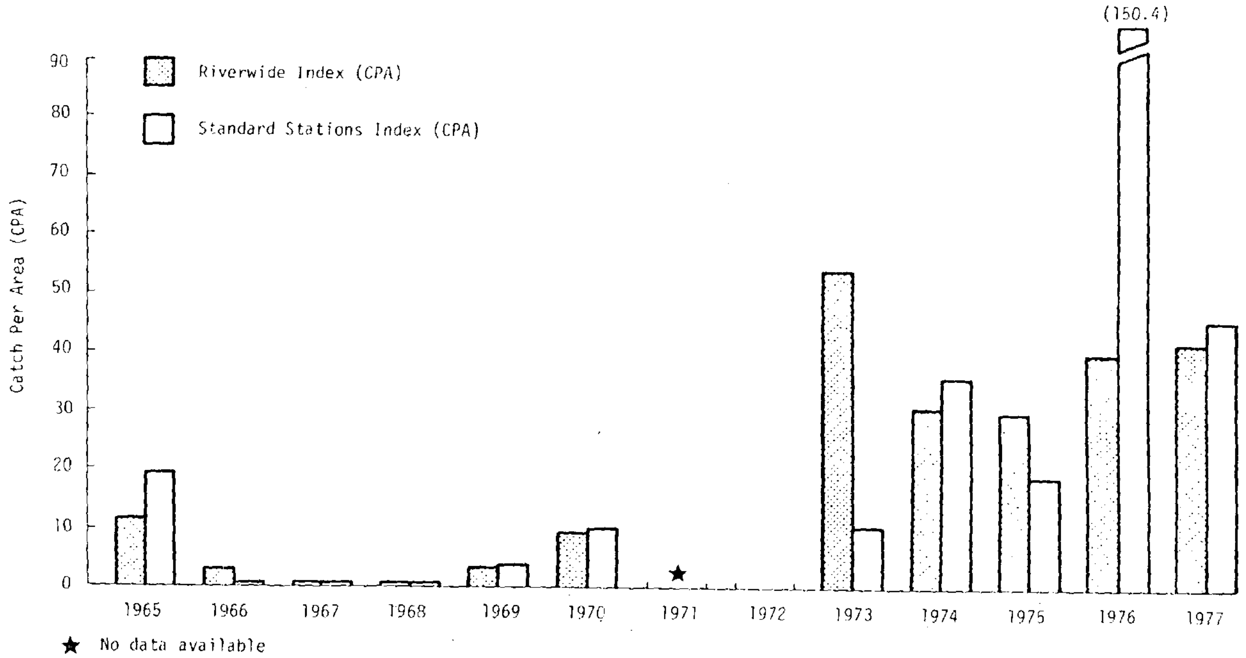


Figure V-4. Comparison of Riverwide and Standard Station Juvenile American Shad Abundance Indices from 1965 through 1977 Based on Beach Seine Sampling. [The riverwide and standard station abundance indices were significantly correlated (r_s = 0.860, p<0.001).]

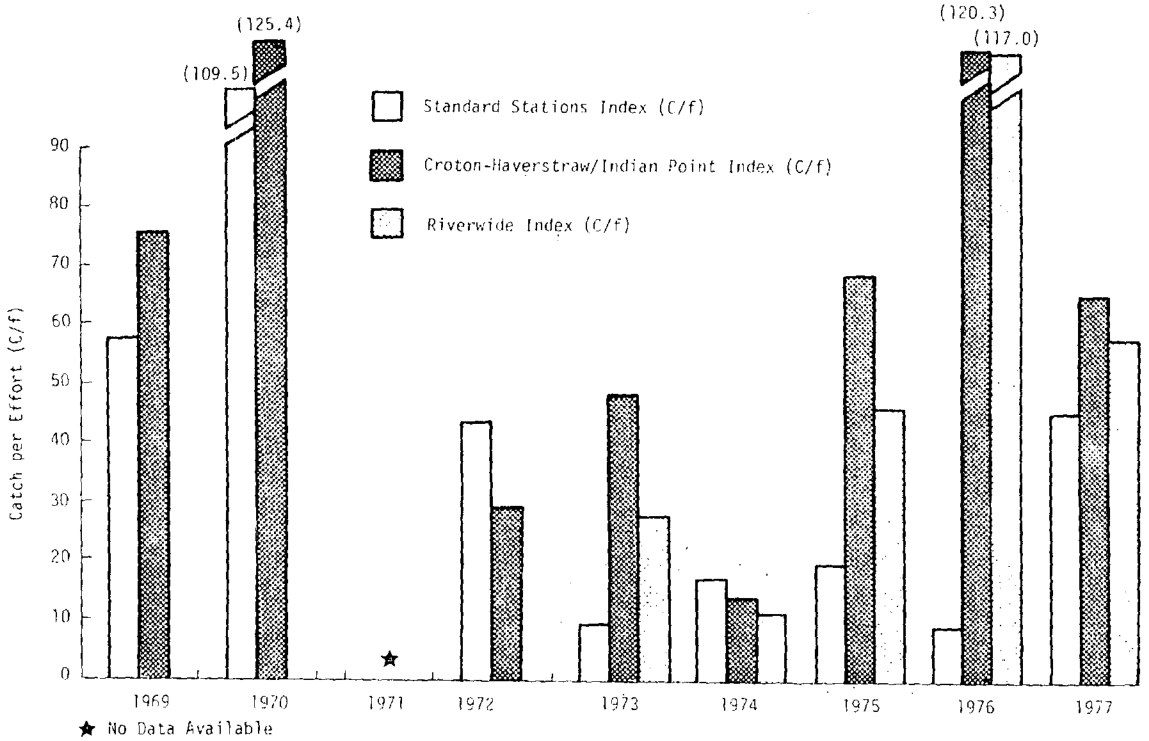


Figure V-5. Comparison of Riverwide and Standard Station Juvenile Atlantic Tomcod Abundance Indices from 1969 through 1977 Based on Bottom Trawl Sampling. [In 1976, there was a pronounced difference between standard station and riverwide abundance indices; the two riverwide abundance indices were almost identical (8-year index: r_s = 0.33, p>0.05; 5-year index: r_s = -0.10, p>0.05).]

(CH-IP) index was primarily a measure of catches from the Indian Point region, because catches of juvenile tomcod in the Croton-Haverstraw region were negligible (Appendix Figure B-6). Interregional trawl catch data from 1975 through 1977 indicated that juvenile Atlantic tomcod were abundant in the Tappan Zee, Indian Point, and West Point regions (Appendix Figure B-6). During 1975 and 1977, regional abundance was highest in the Indian Point region. Therefore, the lack of correlation between the standard stations index and the other two indices (CH-IP and riverwide) must be related to differences between the Standard Stations Program and the Interregional Trawl Survey.

An examination of the types of trawls used each year (Table V-2) reveals differences that may be important. Prior to 1973, the same trawling gear was used each year. In 1973, a separate Standard Stations Program and Interregional Trawl Survey were initiated and each survey used a slightly different bottom trawl. Specifically, the interregional trawl had larger doors than the standard stations trawl (Table V-2). The size of the doors affects the spread of the trawl mouth; in general, larger doors counteract net drag more effectively and increase the extension of the trawl. This difference in door size probably accounts for the differences in catch observed between the two surveys during 1973 (Figure V-5).

In 1974, both trawls were modified. A fine mesh liner was added to the standard stations trawl to increase the catches of small fish (40-100 mm) (TI 1973). However, decreasing the mesh size and filtration area increases the drag of the trawl net (Leakey 1974) and exacerbates the problem associated with the smaller door size on the standard stations trawl. Conversely, a fine mesh cover was added to the interregional trawl, which should increase the net drag but not decrease filtration area.

A comparison of total catches at stations sampled by both surveys (Table V-3) suggests that the gear modifications decreased the efficiency of the standard stations trawl (compared to the interregional trawl) in collecting juvenile Atlantic tomcod, particularly in 1976, a year of high tomcod abundance (Figure V-5). The differences in catches for the two trawls probably resulted from the increased back pressure and subsequent pressure wave effect caused by the fine mesh liner (TI 1973) in the standard stations gear.

Table V-2

Major Features of Bottom Trawls Used from 1969 through 1977

Year	Survey	Dimensions of Doors (inches)	Stretch Mesh Sizes of Cod End Components: Cod End (inches)	Liner (inches)	Cover (inches)
1969	*	36 x 17	1.25	0.25	none
1970	*	36 x 17	1.25	0.25	none
1972	*	30 x 16	1.50	none	none
1973	SS	30 x 16	1.50	none	none
	IRT	48 x 30	1.50	none	none
1974 through 1977	SS	30 x 16	1.50	0.50	none
	IRT	48 x 30	1.50	none	0.50

*One type of trawl was used in each year.

SS = standard stations survey
IRT = interregional trawl survey

Table V-3

Total Catches of Juvenile Atlantic Tomcod at Stations Common* to Standard Stations and Interregional Trawl (IRT) Sampling, 1973 through 1977. (IRT catches are adjusted†; IRT trawls consistently catch more fish.)

Year	Standard Stations Trawl Catch (Number of Tows)	Interregional Trawl Catch (Number of Tows)
1973	62(14)	455.8(14)
1974	481(14)	435.8(10)
1975	510(14)	977.8(12)
1976	257(14)	7134.7(14)
1977	1282(14)	1729.3(14)

*Standard trawl station 4 = interregional trawl station 42-3

standard trawl station 5 = interregional trawl station 41-2

†IRT catches multiplied by 1.54 to standardize tow speeds and tow durations (TI 1979b:Appendix A.II.C)

Thus, the lack of correlation between catches of juvenile Atlantic tomcod in the two surveys is more probably due to gear differences than to differences in the abundance of juvenile tomcod between the Indian Point area and the riverwide areas. If the same bottom trawl had been used in standard stations and riverwide sampling, the trends in standard stations abundance indices for juvenile Atlantic tomcod should have been representative of the trends in riverwide abundance.

b. Data Set II - Analysis of Variance

Standard station C/f values for each species could differ from riverwide values for each species either temporally (i.e., the two indices could show different patterns in abundance across years) or by magnitude (i.e., within a particular year, the two indices could be significantly different). The test of the interaction term (Index x Year) in the ANOVA evaluated differences in the temporal pattern of abundance; i.e., a significant interaction indicates that the response across years for standard station C/f data was not the same as that for the riverwide C/f data. The tests of the main effect (Index) for the difference between the standard station and riverwide C/f values evaluated the significance of the average difference in magnitude of these values.

Neither the test of the interaction nor the test of the main effect was significant ($\alpha = 0.05$) for the four species tested from Data Set II (Appendix Tables B-13 through B-16). For blueback herring, alewife, bay anchovy, and hogchoker, standard station data yielded the same inferences as riverwide data concerning the yearly patterns and magnitude of abundance from 1975 through 1977.

4. Conclusions

Abundance indices based on data from the Standard Stations Program provided a representative measure of the 12-year trend in riverwide abundance for juvenile striped bass, white perch, and American shad but not for juvenile Atlantic tomcod. The lack of correlation between the standard station and riverwide indices for juvenile tomcod is likely due to differences in the trawls used in standard stations and riverwide sampling rather than differences in Atlantic tomcod abundance between the Indian Point region and the remainder of the estuary. Standard station abundance indices were also representative of the 3-year trend in riverwide abundance for juvenile blueback herring, alewife, bay anchovy, and hogchoker; however, because the results for these species were based on only 3 years of data, they should be viewed with caution.

D. COMPARISON OF LENGTH-FREQUENCY DISTRIBUTIONS BETWEEN INDIAN POINT AND ADJACENT REGIONS, 1976 AND 1977

1. Introduction

The range of juvenile striped bass, white perch, and Atlantic tomcod originating in the Hudson River extends from the waters off Long Island (TI 1977e) through the entire Hudson River estuary to the Troy Dam (RM 152, km 243) (TI 1975d). Within this range, sampling for the three species is regularly conducted throughout the estuary (RM 12-152, km 19-243) and also concentrated in the Indian Point nearfield area (RM 39-43, km 62-69). Data on the length of fish are derived from beach seine and interregional bottom trawl sampling within and outside the Indian Point nearfield area. The objective of this section is to determine whether the length-frequency distributions for juvenile striped bass, white perch, and Atlantic tomcod collected within the Indian Point region (RM 39-46, km 62-74) are similar to the length-frequency distributions based upon data collected from larger segments of the estuary.

2. Methods

For each of the three species, length-frequency distributions for juveniles collected in the Indian Point region were paired by species, gear type, and weekly interval with those for the other regions combined. Paired distributions with large sample sizes ($n \geq 40$) (Siegel 1956) were selected for analysis. As a result, only July or August data were compared (Table V-4). The Kolmogorov-Smirnov two-sample test (Siegel 1956) was used to compare length-frequency distributions (using total length in 1 mm intervals) between the Indian Point region and other regions for 1976 and 1977. To avoid a Type I error, the standard α level for significance ($\alpha = 0.05$) was distributed or divided among the total number of comparisons made for each species (Appendix Table B-24).

Table V-4

Summary of Input Data to Length-Frequency Distribution Analyses

Species	Gear	Time Period	Length-Frequency Distributions Tested*
Striped Bass	Beach Seine	8-14 Aug 1976	IP vs YK,TZ,CH,WP through AL (combined)
		31 Jul-6 Aug 1977	IP vs CH,WP,CW (combined)
White Perch	Beach Seine	8-14 Aug 1976	IP vs YK,TZ,CH,WP through AL (combined)
		31 Jul-6 Aug 1977	IP vs CH,WP,CW (combined)
	Bottom Trawl	8-14 Aug 1976	IP vs TZ,CH,WP,CW (combined)
Atlantic tomcod	Bottom Trawl	11-17 Jul 1976	IP vs TZ,CH,WP,CW (combined)
		3-9 Jul 1977	IP vs TZ,CH,WP,CW (combined)

*YK = Yonkers region, RM 12-23 (km 19-37)
TZ = Tappan Zee region, RM 24-33 (km 38-53)
CH = Croton-Haverstraw region, RM 34-38 (km 54-61)
IP = Indian Point region, RM 39-46 (km 62-74)
WP = West Point region, RM 47-55 (km 75-88)
CW = Cornwall region, RM 56-61 (km 89-98)
PK = Poughkeepsie region, RM 62-76 (km 99-122)
AL = Albany region, RM 125-152 (km 200-243)

Fish collected in the Indian Point region were measured fresh, whereas fish collected from other regions were measured after a period of preservation in 10% formalin. The preservation of fish in formalin can cause some shrinkage. Stobo (1972) found a maximum shrinkage of 1.35% for yellow perch; Clutter and Whitesel (1956) measured a 1.6% shrinkage for salmon (Oncorhynchus nerka) smolts; and Parker (1963) reported a 3-4% shrinkage for several species of salmon (Oncorhynchus spp.). Because the amount of shrinkage appears to be relatively small and data on actual shrinkage for the three species used in this study were not available, the lengths were analyzed without any attempt to adjust for shrinkage due to preservation.

3. Results and Discussion

For all three species, length-frequency distributions for fish collected in the Indian Point region generally had a greater proportion of small fish than those of the adjacent regions combined (Appendix Tables B-21 through B-23). Statistical tests of differences between these distributions are conservative (observed differences were probably smaller than actual differences) since any shrinkage (due to preservation) of fish collected outside the Indian Point regions would increase the proportion of small fish there and narrow the measured differences between the length-frequency distributions within and outside the Indian Point region.

The length-frequency distribution for juvenile striped bass collected in the Indian Point region was not significantly different ($\alpha = 0.025$) from that for juvenile striped bass collected in the other regions combined in either 1976 or 1977 (Appendix Table B-24), nor was a significant difference ($\alpha = 0.01$) detected between the length-frequency distribution for juvenile white perch collected in the Indian Point region and juvenile white perch collected in the other regions combined (Appendix Table B-24). Hence, for both Morone species, the length frequency for juveniles collected in the Indian Point region is representative of the other regions combined.

Another Hudson River study reported that the mean lengths of juvenile white perch collected in the vicinity of the Bowline generating station (RM 38, km 59; Croton-Haverstraw region) were greater than the mean lengths of juvenile white perch collected in the vicinity of the Roseton plant (RM 65, km 104; Poughkeepsie region) (Orange and Rockland 1977). Additionally, Wallace (1971) reported similar spatial differences in growth for juvenile white perch along the Delaware River.

The length-frequency distribution for juvenile Atlantic tomcod collected in the Indian Point region was significantly different ($\alpha = 0.025$) from that for juvenile tomcod collected in the other regions combined in both 1976 and 1977 (Figures V-6 and 7; Appendix Table B-24). However, the difference observed in 1976 was probably the result of a comparatively small sample from the Indian Point region (175 fish versus 1,262 fish from the other regions combined; Figure V-6). In 1977, a larger sample was collected in the Indian Point region (1,445 fish versus 1,232 fish from the other regions combined) and the length-frequency distribution for Indian Point contained a larger proportion of smaller fish than did that for the other regions combined (Figure V-7). The reason for this difference is not known.

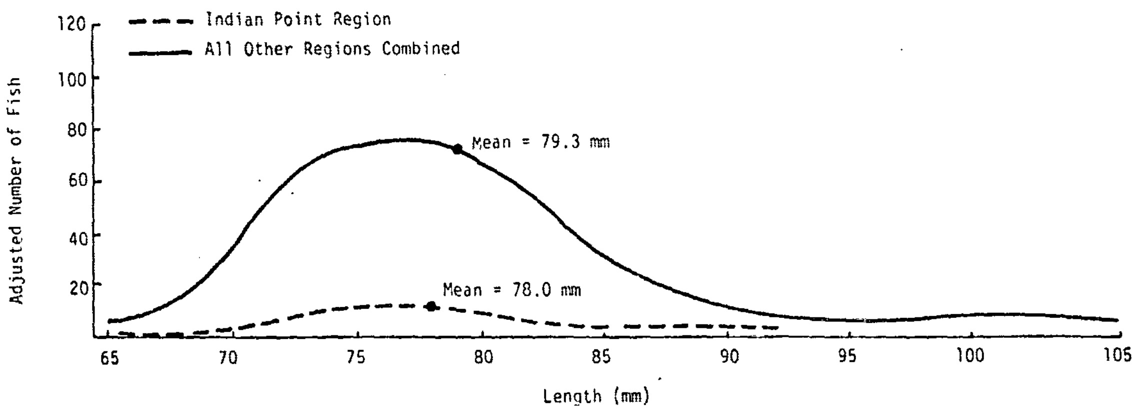


Figure V-6. Length-Frequency Distributions for Juvenile Atlantic Tomcod Collected by Bottom Trawls in Indian Point Region and Other Regions (TZ, CH, WP, and CW) Combined, July 11 through July 17, 1976. (Curves were fitted visually to length-frequency histograms in Appendix Figure B-7.)

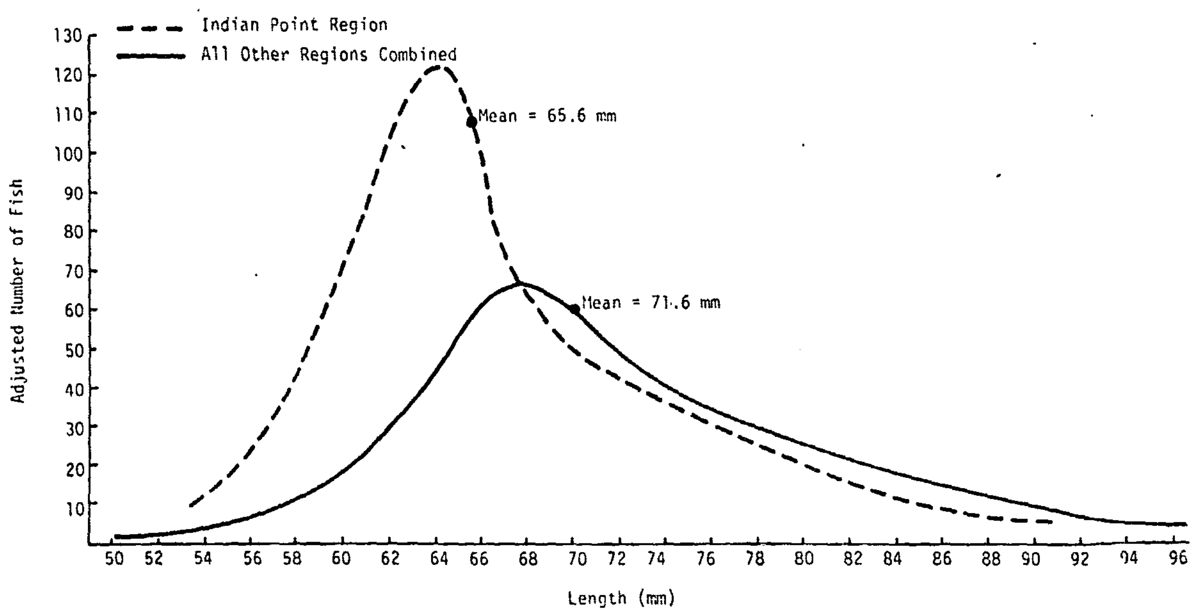


Figure V-7. Length-Frequency Distributions for Juvenile Atlantic Tomcod Collected by Bottom Trawls in Indian Point Region and Other Regions (TZ, CH, WP, and CW) Combined, July 3 through July 9, 1977. (Curves were fitted visually to length-frequency histograms in Appendix Figure B-8.)

4. Conclusions

Sampling fish within the Indian Point region is a reliable method of monitoring the length-frequency distribution of the juvenile striped bass and white perch populations in the Hudson River estuary during August. It is not a reliable method for juvenile Atlantic tomcod during July.

E. PHYSICOCHEMICAL COMPONENTS OF THE ESTUARY IN THE INDIAN POINT AND ADJACENT REGIONS

1. Introduction

To develop an understanding of factors that influence impingement (Section IV.C.2.c) and the relation of water chemistry in the nearfield to that of the rest of the estuary, this section compares the physicochemical components (conductivity, temperature, pH, dissolved oxygen, and turbidity) at Indian Point with adjacent regions. Details on conductivity and a summary of previously reported patterns for other factors (TI 1976b) are also included in this section.

2. The Salt Front

a. Introduction

One of the most fundamental physicochemical characteristics of an estuary is the salinity distribution, which is influenced by tidal currents, freshwater discharge and associated currents, and basin morphometry. The intrusion of saline (and therefore denser) waters from the ocean is a primary cause of density-induced circulation. This circulation, in turn, influences energy and mass transport in the estuary (Lauff 1967).

Salinity increases in "sectors" (Howells 1972) from the northern boundary of the Hudson estuary at Troy to the Battery. During average years, the salt front (defined as a salinity of 0.1 $^{o}/oo$) is restricted to the central part of the estuary (Section I). The salt front partitions a freshwater northern region from a saline southern region and leads to the coexistence of a tidal freshwater river and a typical mid-Atlantic estuarine system. Within a given year, the apparent boundary between these communities fluctuates as the salt front moves upstream and downstream. Since the Haverstraw Bay-Indian Point regions are centrally located in the estuary, they experience a wide range of salinities (0.01-15.7 $^o/oo$) caused by the movement of the salt front.

b. The Salt Front Model

Although there have been 24 salt intrusion surveys and collections of salinity data since 1929 (Abood 1977, TI 1976b), the complexity of the Hudson River estuary makes obtaining a good model between tidal currents, freshwater discharge, and salinity difficult. Because of cyclic variations of the tidal current, the salinity at a given location is a function of time and must be sampled consistently over many time intervals. The same is true for river morphometry, which changes mixing patterns and captures denser saline water in deep holes. Additionally, salinity changes in the shoal areas (less than 20 feet deep) lag behind changes in the channel; for instance, it may take hours or days for the salinity in some shoal areas to drop after the salt front has receded south in the main channel. Models (TI 1976b, Abood 1977) of salt front position avoid this problem by predicting the river mile position of the leading edge of the salt wedge (i.e. the salt front) in the channel and do not attempt to describe local conditions in the shoals.

The model used to estimate salt front position is based on a regression of freshwater flow and tidal amplitude; salt front is defined as 0.3 mS/cm conductance, which is equivalent to 0.1 $^o/oo$ salinity (equation V-2) (TI 1976b). Daily estimates of longitudinal position (Figures V-8 through V-10) were calculated as follows (TI 1976b):

$$M_s = -17.33\ (\ell n\ U_5) + 25.59/A_4 + 78.17 \qquad \text{(V-1)}$$

where

M_s = salt front intrusion distance (miles above Battery Park) as position of 0.3 mS/cm isopleth at midchannel

U_5 = freshwater discharge (10^3 ft^3/sec) at Green Island 5 days before date of salt front determination

A_4 = tidal amplitude (ft) at Indian Point 4 days before date of salt front determination

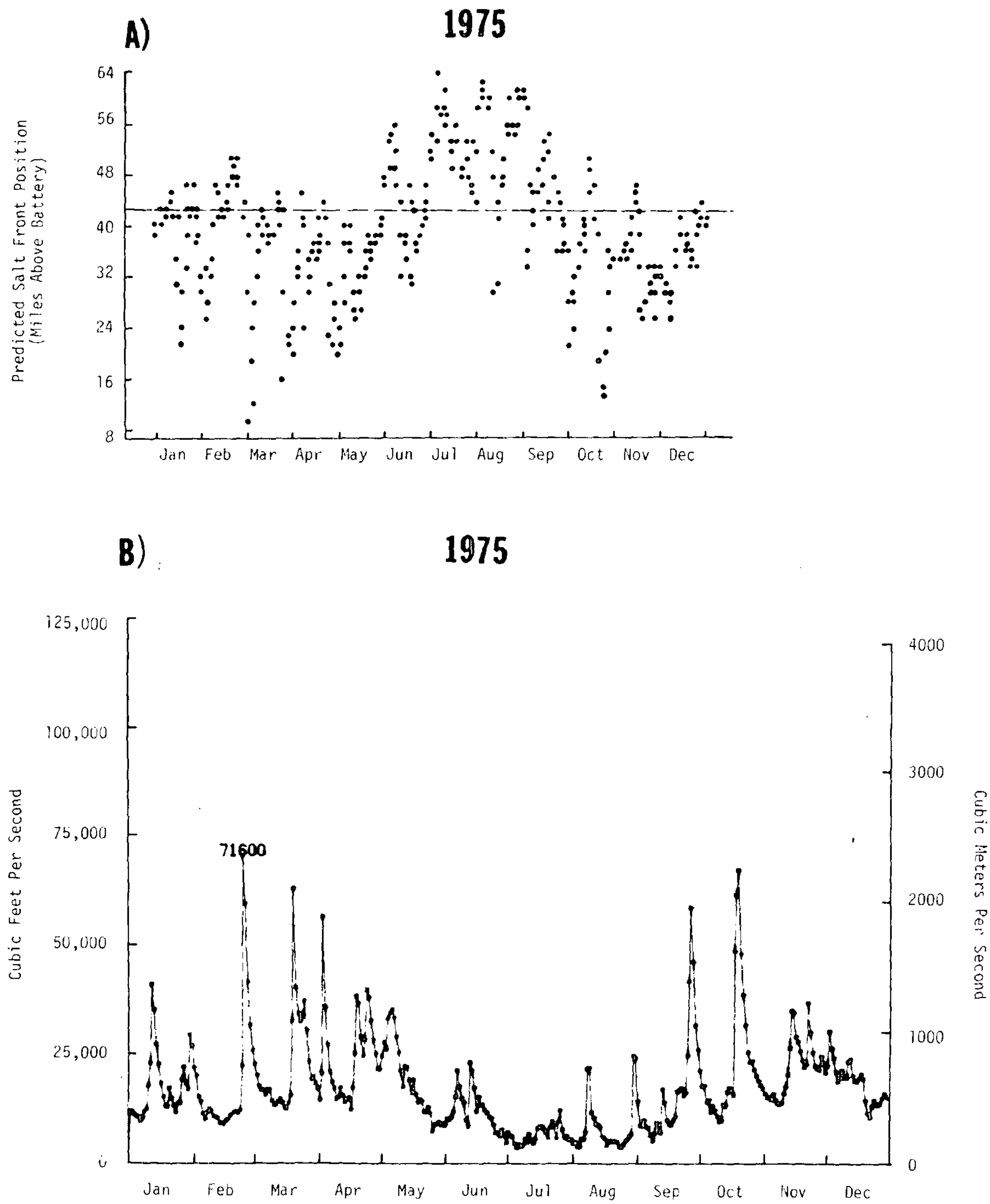


Figure V-8. Estimate of Salt Front (Salinity = 0.1 $^{o}/oo$) Position (A) and Daily Freshwater Discharge (B), 1975, in Hudson River Estuary. [In times of low flow (summer and winter), the salt front intruded past the Indian Point generating station at RM 42 (dotted line).]

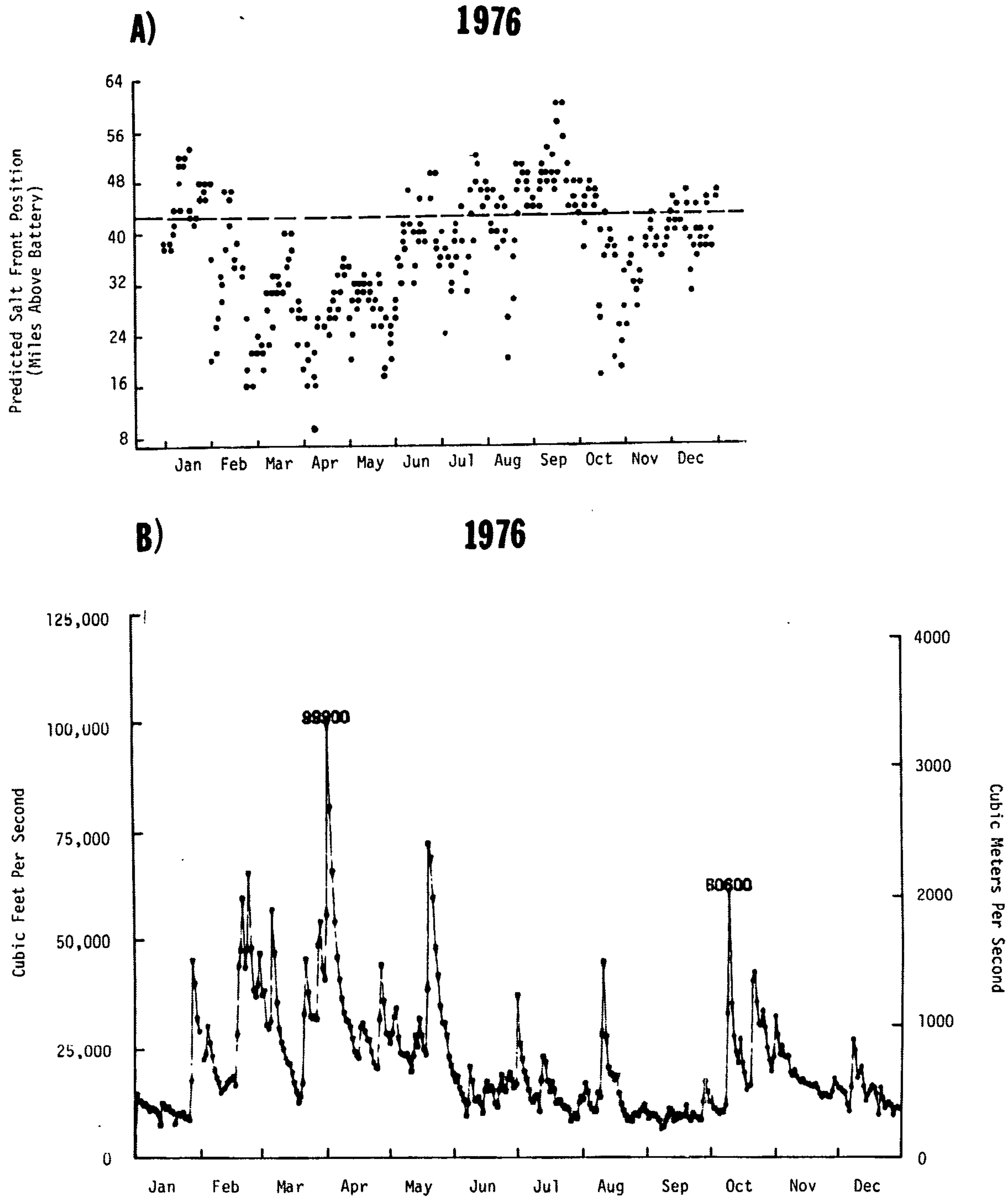
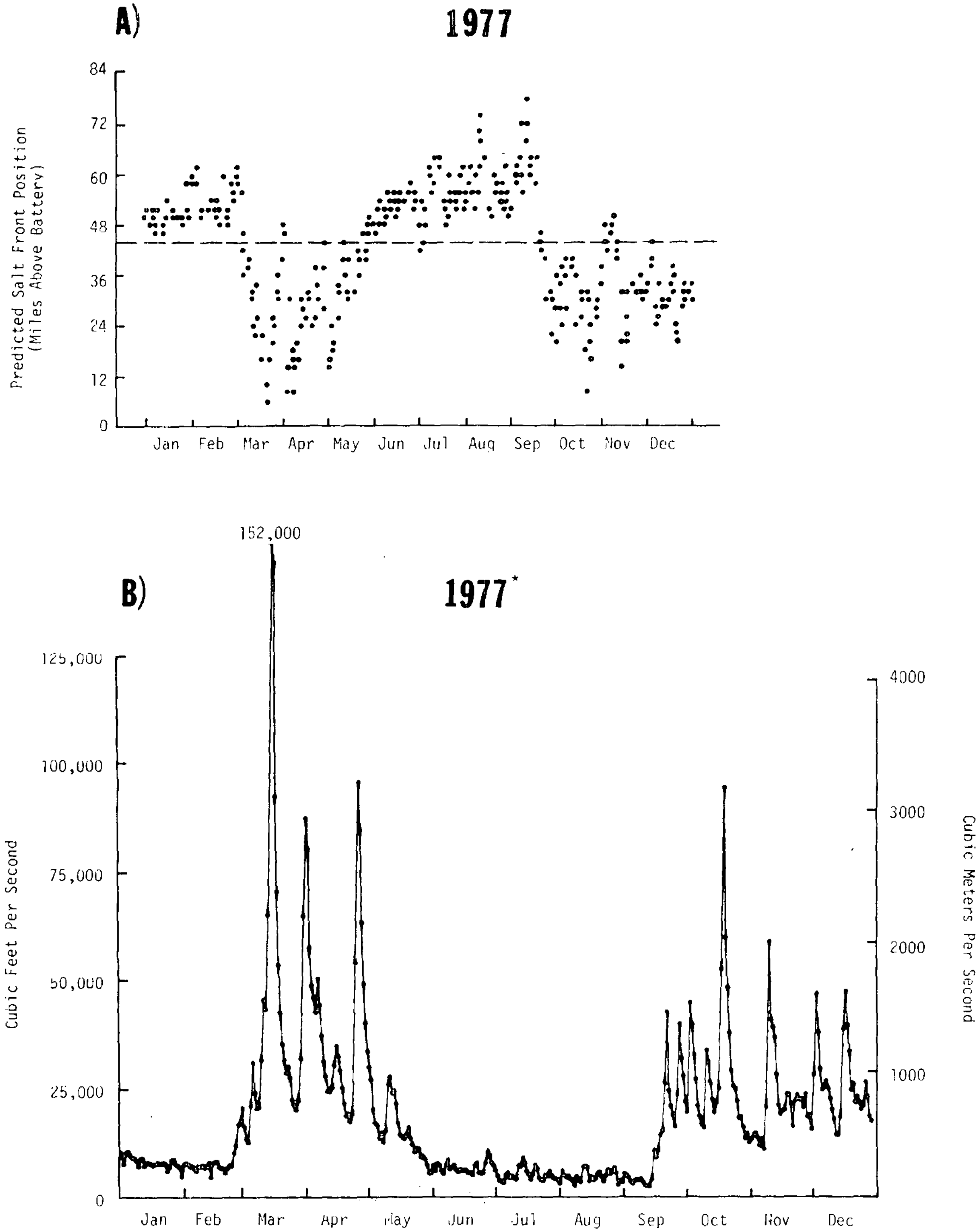


Figure V-9. Estimate of Salt Front (Salinity = 0.1 ^{o}/oo) Position (A) and Daily Freshwater Discharge (B), 1976, in Hudson River Estuary. [In times of low flow (summer and winter), the salt front intruded past the Indian Point generating station at RM 42 (dotted line).]



* Provisional data; i.e., these data were obtained directly from the USGS office and are considered provisional until potential changes are made and final data are published in the USGS Publications series.

Figure V-10. Estimate of Salt Front (Salinity = 0.1 ^{o}/oo) Position (A) and Daily Freshwater Discharge (B), 1977, in Hudson River Estuary. [In times of low flow (summer and winter), the salt front intruded past the Indian Point generating station at RM 42 (dotted line).]

Freshwater discharge data, in cubic feet per second (ft^3/sec), for the Hudson River Basin, Hudson River at Green Island, N.Y., were taken from Water Resources Data for New York publications, United States Department of the Interior, U.S. Geological Survey (USGS 1975, 1976, 1977). Tidal amplitudes for the Hudson River were derived from yearly tide tables for the Battery in New York City, published by the National Oceanic and Atmospheric Administration (NOAA 1975, 1976, 1977). Time and height of tides at Indian Point were calculated using adjustments published by NOAA; tidal amplitude is the difference between the mean of the high and the mean of the low tides within a 24-hr period (TI 1976b).

Conductivity can be converted to salinity by:

$$S = -100 \ln \left(1 - \frac{C_{25}}{178.5}\right) \qquad \text{(V-2)}$$

where

S = salinity (^{o}/oo)
C_{25} = conductivity (mS/cm @ 25^{o}C)

As is apparent from equation V-1 the largest intrusion of the salt front coincides with periods of low freshwater flow during the winter and summer. During these times the salt front is generally north (upriver) of the Indian Point generating station, although it may pass through the Indian Point region occasionally. During periods of high freshwater flow, the salt front is located south of this area. These patterns were observed from 1975 through 1977. On the average, freshwater discharge from 1975 through 1977 was greater than the 11-year mean (USGS 1966-1976; Figure V-11); 1976 and 1977 were particularly wet years, and all three were wetter than average in the fall. Thus, the salt front was generally farther south in 1975 through 1977 than in drier years.

As mentioned above, the validity of any salt front model is based on its ability to estimate salt front position in the main channel. A comparison between the calculated position (from equation V-1) and data from a study designed to observe salt front position shows the TI model and a second model to be predictive, at the worst case, within 10 miles of the actual location of the salt front (Table V-5). Water samples taken at the

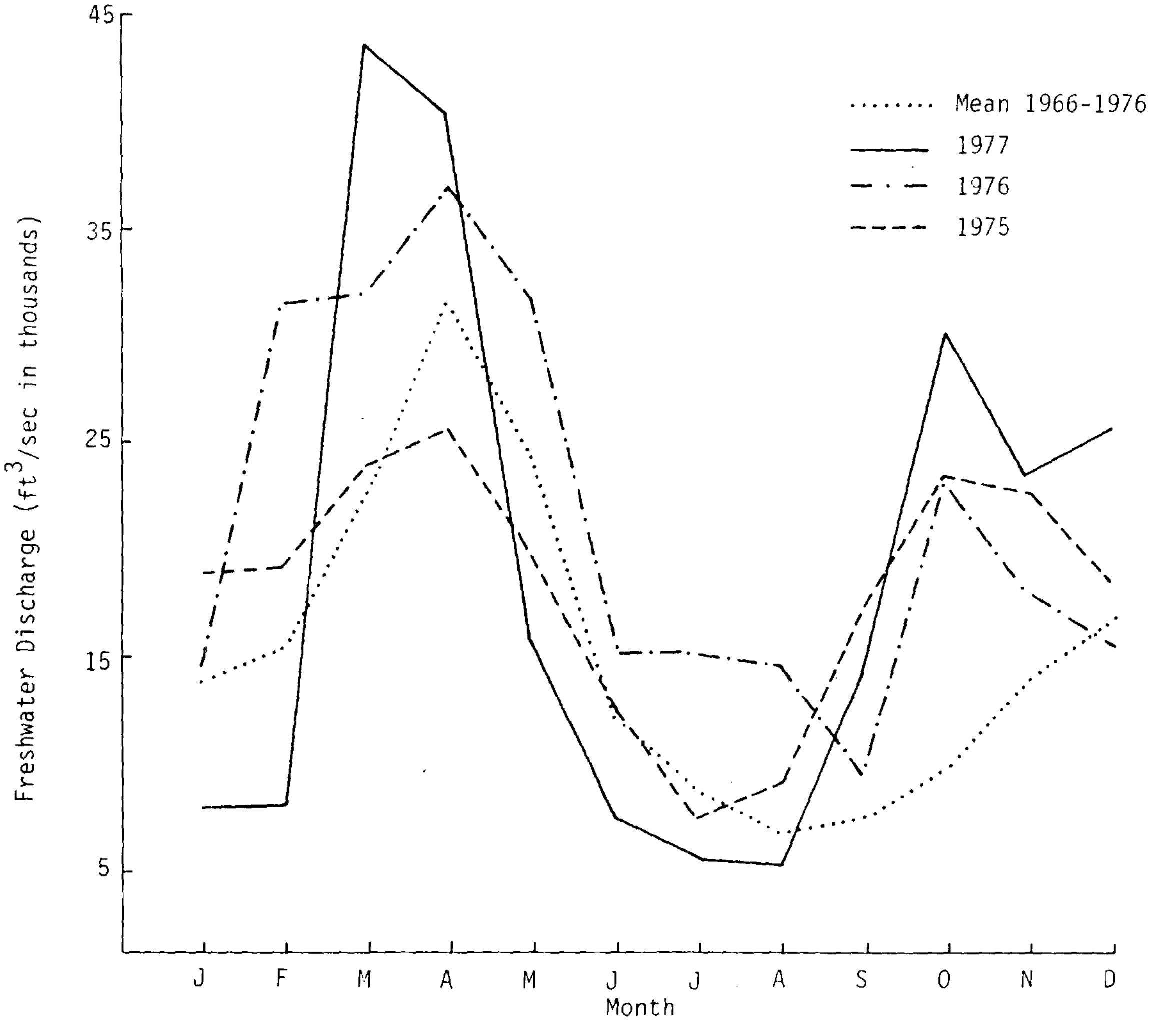


Figure V-11. Comparison of Freshwater Discharge in Hudson River, 1975 through 1977, to 11-Year Average Discharge. (1976 and 1977 were particularly wet years; all three were wet in the fall.)

Indian Point generating station showed large conductivity change within a week of the period when equation V-1 predicted that the salt front would move upriver and downriver past the plant (Figure V-12).

c. Salinity in the Indian Point Region

The salinity distribution in the Indian Point region (RM 39-46) is complex; not only is it influenced by freshwater flow and tidal amplitude, but also by river morphometry. A sharp increase in river depth, coupled with the presence of sill-like structures in RM 35-45, lead to tide-induced mixing. The extent to which mixing occurs is also partly determined by tidal

Table V-5

Comparison of Salt Front Position as Calculated by Present TI Model Compared to Position Predicted by QLM Model and Positions Observed in Field by Simpson et al. (1973). (Predicted values compared to observed positions agree within 5 miles, while differences up to 10 miles occur between models.)

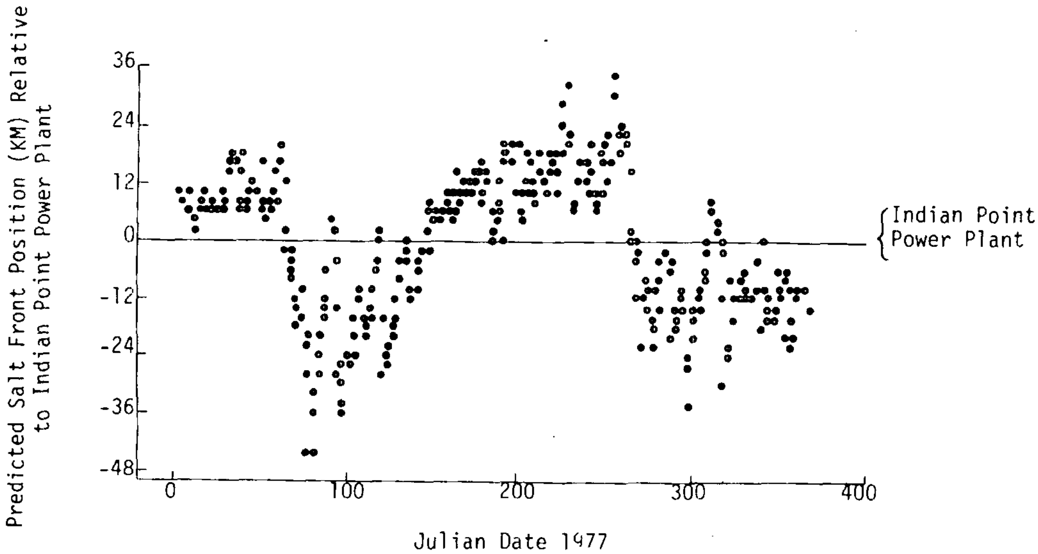
Date	QLM*	Simpson et al.**	Present TI Model	RM Difference
Jan 1, 1966	RM 52		RM 42	10
Jan 10, 1966	RM 47		RM 42	5
Feb 15, 1966	RM 53		RM 50	3
Mar 1, 1966	RM 42		RM 44	-2
Mar 31, 1966	RM 33		RM 32	1
Apr 6, 1966	RM 35		RM 35	0
Jun 28, 1972		RM 14	RM 17	-3
Jul 3, 1972		RM 18	RM 19	-1
Jul 10, 1972		RM 18	RM 20	-2
Jul 18, 1972		RM 29	RM 29	0
Jul 23, 1972		RM 46	RM 41	5

*QLM 1973 (now LMS) calculated at 0.10 o/oo (0.3 mS/cm).

**Simpson et al. (1973) observed at 1.0 o/oo.

amplitude: when tidal amplitude is low, there is insufficient energy available to mix salt with fresh water, so a gravitational flow of salt water moves upriver past Indian Point as it fills these deep areas (Figure V-13).

The Indian Point region is generally an area of partial stratification. In areas to the south, flow tends to be stratified. As the salt front encounters the first deep hole of the river near Stony Point (RM 40), strong vertical mixing occurs. Curiously, areas only 1 mile north of RM 40 show strong vertical gradients. Since saline water cannot "unmix" after going through the deep hole, Simpson et al. (1973) conclude that a substantial portion of the flow must go around the deepest part of the channel, thereby maintaining a vertical gradient. Thus, the water mass entrained by the Indian Point generating station may come either from "mixed" water that passes through the hole near Stony Point or stratified water that passes around the hole. The presence of several water masses in the Indian Point region may produce complicated, but unknown, changes in fish distribution and impingement patterns as they interact near the Indian Point generating station.



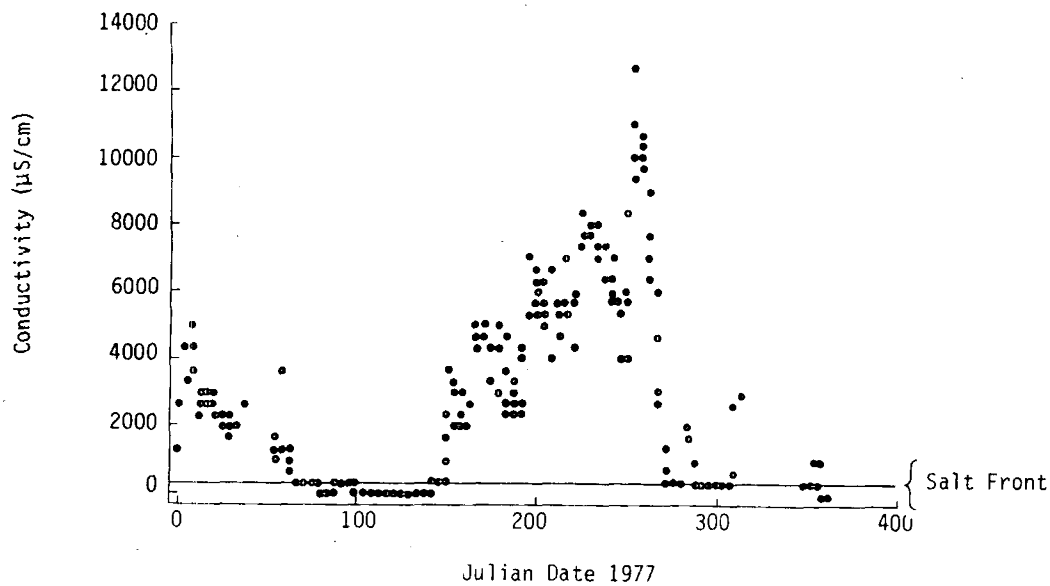


Figure V-12. Comparison of Conductivity at Indian Point Generating Station with Predicted Salt Front Position. (At times when the salt front was predicted to be above Indian Point, conductivities were greater than 0.3 µS/cm.)

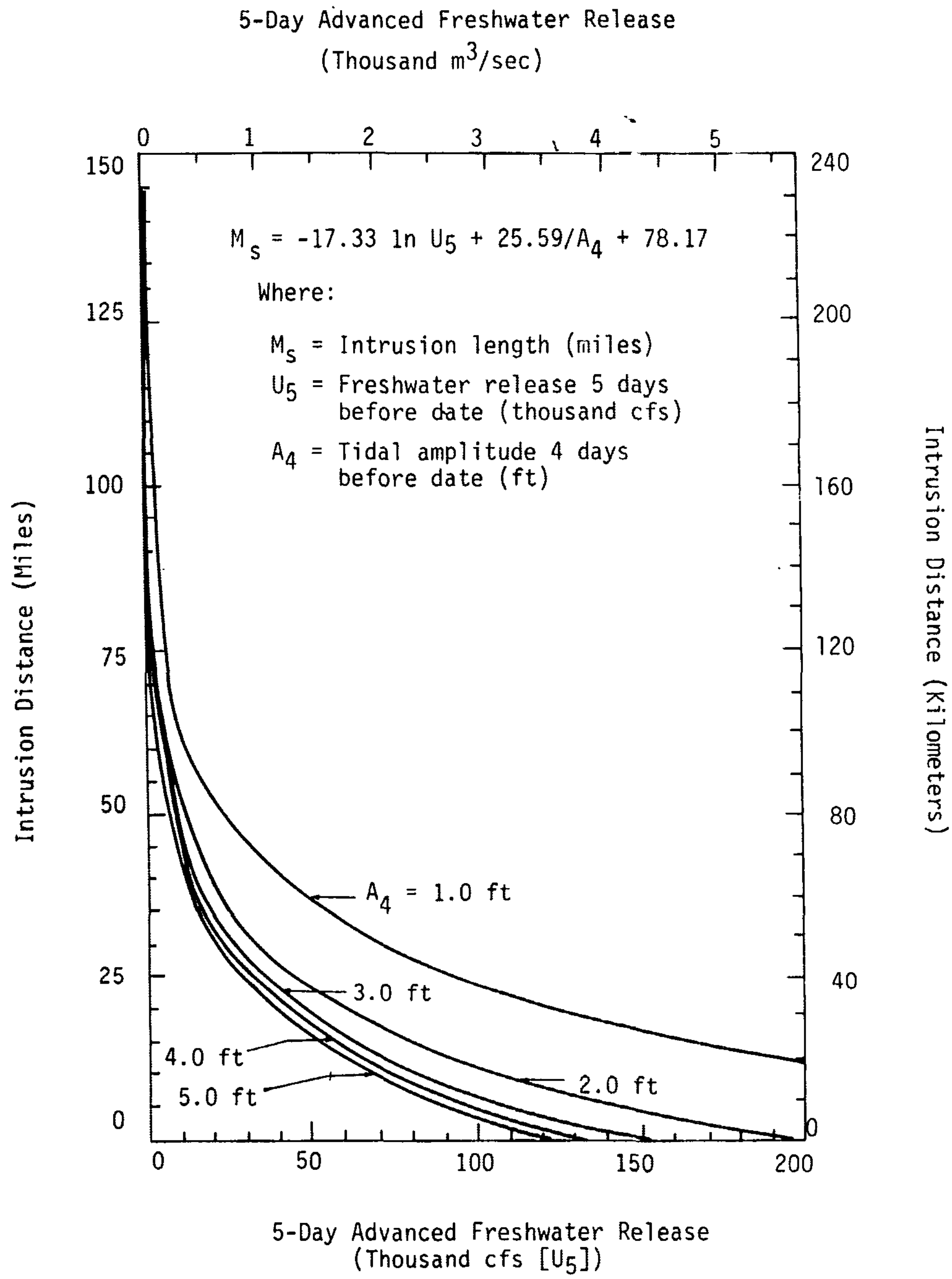


Figure V-13. Relationships of Intrusion Distance to Freshwater Release for Specified Tidal Amplitudes. (At low tidal amplitude, there is little energy available to mix salt with fresh water and a gravitational flow of salt water moves upriver.)

In summary, the general location of the salt front in the Indian Point region is determined by freshwater flow and tidal amplitude. The Indian Point region is centered in an area of large conductivity changes (0.017-26.0 mS/cm). During periods of high freshwater flow (in the spring and fall), the salt front is generally located south (downriver) of the Indian Point generating station, while during low freshwater flow, it is to the north. Except during periods of low tidal amplitude, saline water is mixed with fresh water near Indian Point by tidal mixing at a series of deep areas, starting near Stony Point (RM 40). Part of the stratified water mass bypasses these deeper areas so that several water masses may be entrained at Indian Point generating station intakes. Thus, because of its central location in the estuary and the presence of complex local currents, it is extremely difficult to describe local salinity distribution at times when the salt front moves through this area.

3. Other Physicochemical Components

a. Water Temperature

The annual cycle of river temperature is related to 1) seasonal changes in air temperature and 2) freshwater discharge. The second factor is only important in times of high (greater than about 20,000 ft^3/sec) water discharge. Freshwater flows above Green Island come from higher (and cooler) elevations, where channels are shallower, flows are more turbulent, and contact with the atmosphere is more complete than for the estuarine portion of the Hudson (TI 1976b). Therefore, high freshwater discharge decreases downstream temperature. During spring and early summer, shortly after the beginning of each major increase in freshwater discharge, the rate at which temperature had been increasing downstream is retarded; on occasion, downstream temperatures are even reduced. In the fall, increased freshwater discharge results in a more rapid rate of cooling downstream. The temporal thermal changes at Indian Point can be described as follows (TI 1976b):

$$T_c = 11.89971 \cos\left(\frac{2}{365.25} t_i\right) - 0.04625 \bar{U}_5 + 13.29842 \qquad \text{(V-3)}$$

where

T_c = temperature (°C)

t_i = time (days) of projected temperature measured from August 6 of any year

$\bar{U}_5$ = 5-day mean freshwater discharge (10^3 ft^3/sec) at Green Island centered 5 days prior to t_i

b. Dissolved Oxygen

Dissolved oxygen (D.O.) concentrations in the Hudson estuary follow the physical principle that the solubility of oxygen in water is inversely related to temperature. Freshwater discharge influences temperature, which, in turn, influences D.O. (TI 1976b).

Dissolved oxygen concentrations at localized areas in the Hudson River estuary may show some degree of depletion due to high detrital loads; however, few instances of depletion have been observed at Indian Point since 1972 (TI 1976b). Temporal variation in dissolved oxygen concentrations at Indian Point can be described as follows (TI 1976b):

$$D.O. = 2.469 \cos\left(\frac{2\pi}{365.25} t_i\right) - 0.101\ T_c - 0.017\ \bar{U}_5 + 11.025 \qquad \text{(V-4)}$$

where

D.O. = dissolved oxygen concentration (mg/l) near Indian Point at time t_i

t_i = time (days) measured from February 12 of a given year

T_c = temperature at Indian Point (°C) at time t_i

$\bar{U}_5$ = 5-day mean freshwater discharge (10^3 ft^3sec) at Green Island centered 5 days prior to t_i

c. Turbidity

The main component of turbidity in the Hudson River estuary is silt, which is transported by terrestrial runoff. Turbidity concentrations are highest during periods of heaviest runoff, particularly that associated with seasonally reduced watershed ground cover (TI 1976b). Additional silt is suspended through erosional processes within the estuary itself. No longitudinal variations in turbidity are discernible (TI 1976b). Temporal variation is described as follows (TI 1976b):

$$\overline{T}_f = 0.490\ \overline{U}_b + 0.689 \qquad (V-5)$$

where

$\overline{T}_f$ = mean biweekly turbidity (FTU)

$\overline{U}_b$ = mean biweekly discharge (10^3 ft^3/sec) at Green Island from previous 2 weeks

d. Hydrogen Ion Concentration (pH)

The hydrogen ion concentration of most aquatic systems is strongly influenced by the quantity of free CO_2 (including H_2CO_3). Since the solubility of CO_2 decreases as salinity increases, free CO_2 tends to be lower in saline water than in most fresh water. Also, because of an additional buffering base, principally borates and silicates, seawater contains greater buffering capacity than does fresh water. Thus, seawater exhibits a higher and more stable pH than does most fresh water. As a consequence, one would expect higher and less variable pH in the lower reaches of the Hudson River estuary than in the regions not influenced by salt intrusion. Variations in biological activity leading to production or removal of CO_2 should also influence pH readings, particularly in the less buffered upper river regions. Upon examination, pH data collected in the Hudson River estuary since 1966 have shown no temporal or spatial patterns (TI 1976b). This lack of variation may result from a predominance of dissolved calcium and magnesium carbonates (limestones) in runoff water, relatively low primary production rates, and relatively high turbulence.

SECTION VI

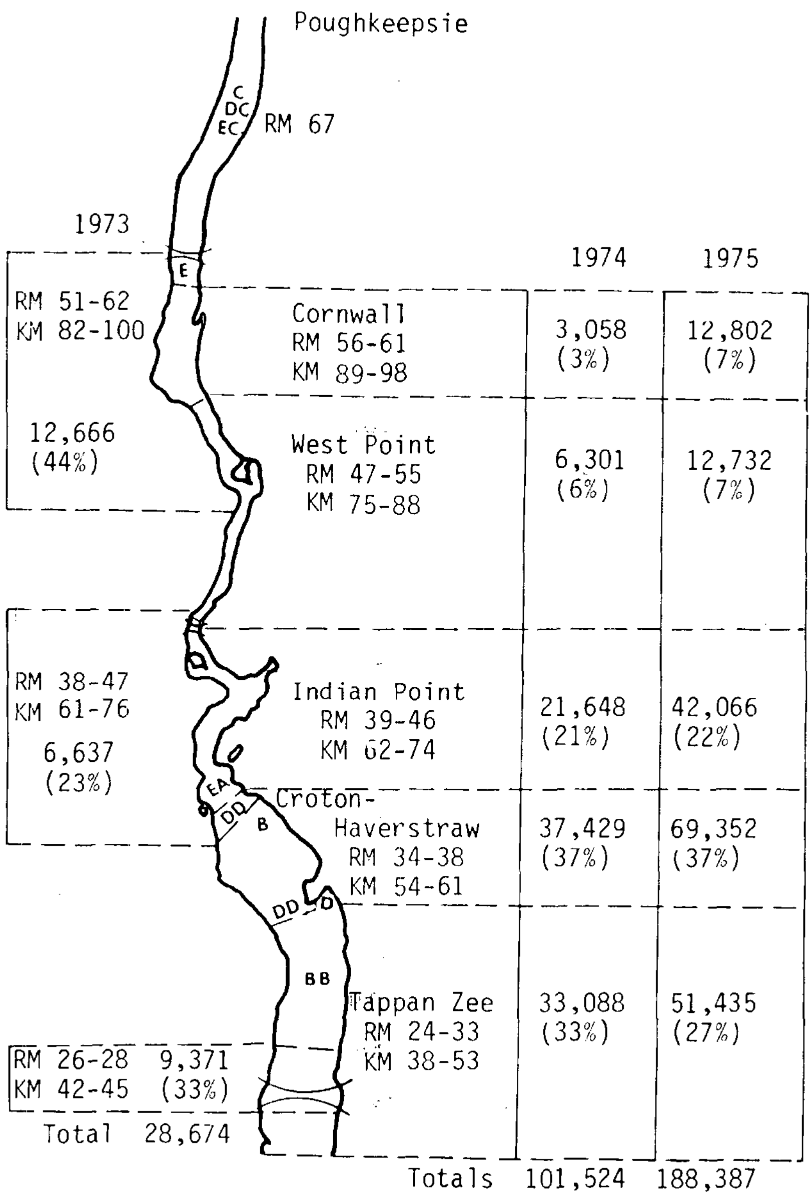
STRIPED BASS HATCHERY PROGRAM--SELECTED ASPECTS

A. INTRODUCTION

From 1973 to 1975, TI investigated the feasibility of artificially hatching, rearing, and stocking young-of-the-year striped bass. The hatchery program was designed to mitigate losses to the wild striped bass stock due to power plant operation on the Hudson River. Such a study was stipulated as a condition of the license issued in 1970 by the Federal Power Commission to Consolidated Edison Company of New York, Inc. to construct and operate a pumped storage hydroelectric plant at Cornwall, New York. During the 3 years (1973-1975) that stockable-size fingerlings (75-125 mm) were reared, a total of more than 319,000 striped bass were released into the Hudson River between RM 24 and 62 (KM 39-100). These hatchery-reared striped bass were finclipped and had magnetic nose tags inserted to permit positive identification if recaptured. Short-term (3-9 mo) survival of hatchery-reared striped bass has already been shown to be similar to that of wild fish (TI 1977b). Earlier reports (TI 1974c, 1975c, 1977b, 1977d) have detailed the methodology and initial results. The present goal is to confirm that long-term survival occurs and to determine that hatchery-reared striped bass participate in the spring spawning run. Data from 1977 on movements, size, and percent mature and data from 1976 and 1977 on feeding habits of recaptured hatchery-reared fish are presented in this section and compared with similar 1976 and 1977 data for wild striped bass.

B. BIOLOGICAL CHARACTERISTICS AND MOVEMENT

Recaptures of hatchery-reared striped bass to date indicate that the fish have survived for several years and are maturing. Of the 281 striped bass recaptured during 1976 (265) and 1977 (16), 12 had been released during 1974 and 269 during 1975. No 1973 released fish were recaptured, which was expected since few were released (Figure VI-1) and tag retention appeared to be poor (TI 1974c). More hatchery-reared fish are expected to be recaptured in 1978 and 1979 since a larger proportion will be mature and return to the area sampled by the TI adult striped bass program.



A = Hatchery-reared striped bass released between RM 24-38
B = Hatchery-reared striped bass released between RM 34-38
C = Hatchery-reared striped bass released between RM 39-46
D = Hatchery-reared striped bass released between RM 24-67 (1974)
E = Hatchery-reared striped bass released between RM 24-67 (1975)

Figure VI-1. Point of Recapture of Hatchery-Reared Fish Collected in 1977 and Distribution of Hatchery-Reared Striped Bass Fingerlings Stocked in Hudson River during 1973, 1974, and 1975. (Letters in the river denote the release region of each recaptured fish.)

1. Length and Weight

Two- and three-year-old recaptured hatchery-reared striped bass did not differ significantly (t-test, p>0.05) in length or weight from wild fish (Table VI-1). Although Age III wild male fish appeared to be longer (34 mm) and heavier (172 g) than hatchery-reared counterparts, the numbers of hatchery-reared fish were limited and the differences were not statistically significant. The two recaptured hatchery-reared striped bass that were collected by gill nets were the two largest hatchery-reared fish collected (Appendix Table C-1).

2. Sexual Maturity

The percentages of mature two- and three-year-old hatchery-reared and wild striped bass were not statistically different (p>0.05). Five of six of the Age 3 male hatchery-reared fish (Table VI-2 and Appendix Table C-1) were mature, while less than half (35 of 82 fish) of the three-year-old wild male fish were mature. No two-year-old hatchery-reared male fish (0 of 6) were mature while 13% (4 of 31) of wild male fish were mature. No hatchery-reared (0 of 3) or wild (0 of 25) Age 2 female striped bass were mature. Males generally mature earlier than females (McFadden and Lawler 1977). The presence of mature hatchery-reared striped bass among wild striped bass during the prespawning and spawning periods provides evidence that hatchery-reared striped bass will contribute to the Hudson River spawning stock.

3. Diet of Wild and Hatchery-Reared Striped Bass

During 1976, hatchery-reared and wild striped bass had similar frequencies of stomachs with food (75.9% and 79.6%, respectively), indicating that their feeding rates and schedules were approximately the same (Appendix Tables C-2 and C-3). Wild striped bass [73-128 mm total length (TL)] collected in 1977 had 10.3% empty stomachs. Only three hatchery-reared striped bass had their stomach contents preserved and were available for analysis in 1977; two fish (TL = 400 and 433 mm) had empty stomachs and one (TL = 260 mm) contained only detritus. Because hatchery-reared striped bass collected in 1977 contained no countable food items, comparisons with wild striped bass diet were not possible. The major food items consumed by wild striped bass in 1977 are presented in Appendix Tables C-4 and C-5.

Table VI-1

Mean Total Length (mm) and Weight (g) of Two- and Three-Year-Old Striped Bass Collected in Hudson River Estuary during March through June 1976 and 1977. (Note similarity in size of hatchery-reared and wild fish.)

	Length			Weight		
	Mean Total Length (mm)	Standard Error	Number Examined	Mean Weight (g)	Standard Error	Number Examined
Age 2						
Wild	239	2.61	122	177	6.62	74
Hatchery	236	9.59	9	159	16.65	9
Age 3 Males*						
Wild	378	3.26	325	590	17.74	223
Hatchery	344	25.56	6	418	80.24	6

*No three-year-old female hatchery fish were collected in 1977.

Table VI-2

Maturity of Hatchery-Reared and Wild Striped Bass Collected from March through June 1976 and 1977. (Note percentages of mature wild and hatchery-reared striped bass.)

Age		Wild		Hatchery-Reared	
		Number	Percent Mature	Number*	Percent Mature
2	Females	25	0	3	0
2	Males	31	13	6	0
3	Males	82	43	6	83

*One hatchery-reared fish was not sexed and therefore not used for growth or maturity.

Wild and hatchery-reared striped bass consumed a variety of prey organisms during May and June 1976 (Table VI-3, Appendix Tables C-2 and C-3), feeding primarily on small invertebrates. Wild striped bass 76-125 mm TL ate Gammarus, chironomid pupae and copepods, while the only hatchery-reared fish of that size consumed chironomid pupae (Table VI-3) and amphipods (uncountable remains). Hatchery-reared fish 126-200 mm TL consumed Gammarus as well as immature aquatic dipterans and copepods. Only one wild striped bass was available for analysis in this length group, and it had eaten chironomid larvae, other immature aquatic dipterans, and one American eel.

Most hatchery-reared fish available for analysis in 1976 were in the larger length group (126-200 mm) since the last hatchery-reared fish were released during 1975 (TI 1977b). This uneven (1 wild versus 16 hatchery-reared) distribution of sample sizes within length-group divisions precluded statistical comparisons between the diets of hatchery-reared and wild striped bass. However, when fish from all length groups were combined, it appeared that hatchery-reared and wild striped bass were both feeding primarily on Gammarus, immature aquatic dipterans, and copepods. Previous studies comparing stomach contents of hatchery-reared and wild striped bass during 1974 and 1975 indicated that their diets were similar (TI 1977d). Striped bass appear to be nonselective feeders (TI 1979a), preying upon food organisms which are easily accessible. As striped bass increase in size, they prey upon larger invertebrates and rely less on smaller organisms such as copepods. During June 1977, wild striped bass preyed primarily on copepods and Gammarus. Unlike wild fish collected in 1976, these fish ate other striped bass (mean percent frequency = 3.86). Two striped bass examined (TL = 94 and 118 mm) had eaten four and two striped bass, respectively. Previous incidences of cannibalism in the Hudson River have been documented in other TI reports (TI 1977d, TI 1979a).

4. Movements of Hatchery-Reared Striped Bass

Most wild striped bass appear to emigrate from the river before Age 1 (TI 1977a) and, since few (16) hatchery-reared two- and three-year-olds were recaptured, it appears the hatchery-reared and wild fish emigrate similarly. A higher mortality for hatchery-reared striped bass than for

Table VI-3

Comparison of Percent Frequency of Major Countable Food Items in Wild and Hatchery-Reared Striped Bass Collected from the Hudson River, RM 35-46, May-June, 1976. (Although sample sizes vary among length groups, diets of wild and hatchery-reared striped bass appear to be similar.)

Wild Striped Bass				Hatchery-Reared Striped Bass			
Length Group (mm)	Sample Size*	Food Item	Mean Percent Frequency	Length Group (mm)	Sample Size*	Food Item	Mean Percent Frequency
76-125	24	*Gammarus*	31.68	76-125	1	Chironomidae (P)	100.0
		Chironomidae (P)	15.12				
		Cyclopoida	12.56				
		Calanoida	11.17				
		Leptodora	8.55				
		Fish eggs (Unid.)	5.83				
		Polypedilum (L)	3.25				
		Sida	1.99				
126-200	1	Chironomidae (L)	50.00	126-200	16	*Gammarus*	55.27
		Tanytarsus (L)	25.00			Diptera (P)	16.50
		American eel	12.50			Chironomidae (L)	9.93
		Ceratopogonidae (L)	12.50			Cyclopoida	5.19
						Tanytarsus (L)	4.11
						Polypedilum (L)	3.13
						Chironomidae (P)	2.96
						Araneida	1.25
All	25	*Gammarus*	30.41	All	17	*Gammarus*	52.02
		Chironomidae (P)	14.51			Diptera (P)	15.53
		Cyclopoida	12.06			Chironomidae (L)	9.35
		Calanoida	10.82			Chironomidae (P)	8.67
		Leptodora	8.21			Cyclopoida	4.88
		Fish eggs (Unid.)	5.60			Tanytarsus (L)	3.87
		Chironomidae (L)	3.13			*Polypedilum* (L)	2.94
		Polypedilum (L)	3.12			Araneida	1.18

(Unid.) = Unidentified
(P) = Pupae
(L) = Larvae

*Number of fish containing at least one countable food item.

wild is not a likely cause for so few returns since survival of hatchery-reared fish was at least as good as that of wild fish for the first 3 to 9 months after stocking (TI 1977b). Tag return data demonstrated a movement out of the river for wild fish (TI 1979a). Since hatchery-reared fish did not have external tags like wild fish, recaptures from outside the Hudson River are unlikely; hatchery-reared fish were finclipped and had magnetic nose tags inserted when stocked and could only be identified by trained personnel with the proper equipment. The hatchery-reared fish were recaptured over most of the river sampled by the adult striped bass program (RM 26-69). Hatchery-reared recaptures appear to have been interspersed within schools of wild fish since four hatchery-reared fish were collected with 75 wild two- and three-year-old striped bass by a commercial fisherman in two sets (1 hour each) of a drift gill net.

C. CONCLUSIONS

Hatchery-reared and wild striped bass are similar with regard to length, weight, diet, and age at maturity. Earlier studies have shown that survival of hatchery-reared fish was at least as good as that of wild fish for the first 3 to 9 months after stocking (TI 1977b). This similarity is to be expected, since hatchery-reared striped bass have been produced each year from adults collected from the river and therefore hatchery fish share a common gene pool with wild fish. These findings support the position that the stocking program provides a viable alternative to cooling towers for mitigation of striped bass losses resulting from power plant operation on the Hudson River.

SECTION VII

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APPENDIX A

IMPINGEMENT PATTERNS AND FACTORS AFFECTING IMPINGEMENT

Note: Impingement numbers and weights in this report are totaled on a midnight-to-midnight basis, whereas 401 reports (for New York State DEC certification) present totals on a scheduled wash to scheduled wash basis. Thus, total numbers in the two documents do not agree. Also, minor differences in total counts among tables in Appendix A are the result of slightly different methods of extrapolation and rounding used in the computer-generated tables.

APPENDIX A.1

Total Counts of Each Species Impinged

Table A-1

Total Monthly Count of Each Species Collected from Intake Screens of Indian Point Unit No. 2 during 1977

SPECIES NAME	JAN.	FEB.†	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY TOTALS
ALEWIFE*	17	0	0	0	32	103	2	24	53	17	23	3	274
BAY ANCHOVY	1	0	0	0	50	2321	126	28468	23484	3984	21	2	58456
AMERICAN SHAD*	4	0	0	0	0	4	0	0	7	40	11	1	67
BLUEFISH	0	0	0	0	4	3823	243	37	27	2	0	0	4136
BLUEGILL	3	1	13	4	3	1	1	0	2	78	610	228	944
BROWN BULLHEAD	2	2	8	3	1	0	1	0	3	51	9	45	125
PUMPKINSEED	275	78	382	63	13	20	1	4	7	313	108	320	1584
BLACK CRAPPIE	3	0	3	4	0	2	0	0	0	1	12	35	60
CARP	0	0	0	0	0	0	0	0	0	0	0	5	5
AMERICAN EEL	62	14	32	63	43	239	24	126	104	179	115	158	1159
GOLDFISH	15	12	24	19	0	0	0	0	1	2	22	36	131
GOLDEN SHINER	7	7	14	11	1	1	1	0	0	1	4	47	94
HOGCHOKER	0	0	1	7	965	176	6	1012	2789	4688	2511	11	12165
TESSELLATED DARTER	1	0	5	54	24	6	1	0	0	5	23	22	141
BANDED KILLIFISH	65	11	78	14	1	15	1	0	9	18	18	30	260
EMERALD SHINER	0	0	3	4	0	0	0	0	0	0	0	2	9
LARGEMOUTH BASS	2	0	4	2	0	0	0	0	2	19	25	39	93
MUMMICHOG	16	1	19	1	1	1	0	0	1	3	0	1	44
ATLANTIC MENHADEN	0	0	0	0	0	56	1	4	21	1	3	0	86
BLUEBACK HERRING*	14	0	0	0	29	219	22	45	177	56	0	0	562
WHITE SUCKER	0	0	1	0	3	0	0	0	0	0	1	1	6
ATLANTIC SILVERSIDE	0	0	0	0	1	0	0	0	2	4	5	0	12
RAINBOW SMELT	2809	490	526	490	1038	1724	108	129	879	4687	1091	653	14623
SHORTNOSE STURGEON	1	1	0	2	1	0	0	0	0	0	0	0	5
SPOTTAIL SHINER	690	257	537	730	123	41	1	12	5	14	290	791	3491
ATLANTIC STURGEON	6	1	5	17	0	3	0	3	3	1	3	2	44
STRIPED BASS	3496	1262	590	3	12	59	3	1850	1428	3167	3332	2284	17486
4-SPINE STICKLEBACK	0	0	0	0	0	1	0	0	0	0	0	0	1
ATLANTIC TOMCOD	585	219	410	195	45944	165364	11536	34689	8257	442	508	2030	270178
UNIDENTIFIED	0	0	0	0	0	3	0	0	0	2	0	0	5
WHITE CATFISH	632	138	444	203	613	284	4	29	53	2773	7738	2857	15768
WHITE PERCH	322643	139973	68772	35602	3946	5580	142	6527	3537	49015	142195	79750	857682
YELLOW PERCH	22	7	47	78	26	0	0	0	0	5	32	172	389
SATINFIN SHINER	0	0	0	0	0	0	0	0	0	2	0	0	2
NORTHERN PIPEFISH	0	0	0	0	0	7	0	107	174	2	0	0	290
REDBREAST SUNFISH	0	0	0	3	0	0	0	1	3	1	0	4	12
CREVALLE JACK	0	0	0	0	0	0	0	2	3	1	0	0	6
WEAKFISH	0	0	0	0	0	5	0	1847	2236	90	208	0	4387
COMMON SHINER	0	0	0	0	1	0	0	0	0	0	0	2	3
LOOKDOWN	0	0	0	0	0	0	0	2	10	0	0	0	12
CLUPEID, UNIDENT	0	0	0	0	0	2	66	720	973	12333	315	0	14410
CLUPEID LARVAE	0	0	0	0	0	7	0	0	0	0	0	0	7
MORONE LARVAE	0	0	0	0	0	0	14	0	0	0	0	0	14
MORONE UNIDENTIFIED	0	0	0	0	0	0	0	0	0	26	0	1	27
REDFIN PICKEREL	0	0	2	1	0	0	0	0	0	0	0	0	3
4-BEARDED ROCKLING	0	0	0	0	0	0	0	0	0	0	2	0	2
SPOT	0	0	0	0	0	0	0	1421	1527	1202	534	3	4686
BROOK STICKLEBACK	0	0	1	0	0	0	0	0	0	0	0	12	13
NORTHERN PORGY	0	0	0	0	0	0	0	0	3	0	0	0	3
WINTER FLOUNDER	2	1	0	0	0	0	0	9	17	1	3	0	33
TIDEWATER SILVERSIDE	0	0	0	0	0	1	0	0	0	0	0	0	1
SEA LAMPREY	0	1	0	0	0	1	0	0	0	0	0	3	5
GIZZARD SHAD	266	12	1	0	0	0	0	0	1	428	2461	2259	5428
SILVER HAKE	0	0	0	0	0	0	0	0	0	1	8	6	15
3-SPINE STICKLEBACK	29	20	11	2	0	2	0	0	0	0	1	0	65
BROWN TROUT	0	0	0	0	0	0	0	0	0	0	1	0	1
BUTTERFISH	0	0	0	0	0	0	0	0	0	0	2	0	2
WHITE CRAPPIE	1	0	0	0	0	0	0	0	0	6	12	10	29
NORTHERN PIKE	0	0	0	0	0	1	0	0	0	0	0	0	1
BLACKNOSE DACE	0	0	0	0	0	0	0	0	0	0	0	1	1
CUTLIPS MINNOW	0	0	0	0	0	0	0	0	0	0	7	0	7
YOY BLUEBACK HERRING	0	0	0	0	0	0	0	4507	37643	494162	42086	60	578457
YOY AMERICAN SHAD	0	0	0	0	0	0	0	701	339	2479	302	3	3824
YOY ALEWIFE	0	0	0	0	0	0	0	2580	2153	7404	3461	7	15606
CENTRARCHID UNIDENT	13	5	61	30	6	2	0	1	13	1193	1321	398	3043
OTHERS	3	0	6	8	2	2	0	3	27	212	254	93	610
COL. TOTALS:	331685	142513	72000	37613	52882	180076	12304	84860	85972	589110	209688	92387	1891087

*Counts exclude young-of-the-year (YOY) individuals which are provided separately at the bottom of the table.

†Oil from a spill at Con Hook (RM 49) in early February fouled screens at Unit No. 2 from February 10 through 20; estimates of impingement counts, totaling approximately 53,765 fish, for those days are not included in the February counts.

Table A-2

Total Monthly Count of Each Species Collected from Intake Screens of Indian Point Unit No. 3 during 1977

SPECIES NAME	JAN.	FEB.†	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	YEARLY TOTALS
ALEWIFE*	11	0	8	72	313	339	256	181	109	16	0	1	1306
BAY ANCHOVY	0	0	0	0	33	4028	33227	36755	12145	2231	0	3	88422
AMERICAN SHAD*	5	0	0	1	2	14	56	7	9	54	0	0	148
BLUEFISH	0	0	0	0	0	9155	6850	1051	210	0	0	0	17266
BLUEGILL	13	2	25	21	48	3	1	5	8	18	0	48	192
BROWN BULLHEAD	1	0	12	11	7	1	3	1	1	0	0	7	44
PUMPKINSEED	121	29	369	149	279	50	80	79	39	43	0	127	1365
BLACK CRAPPIE	0	0	12	20	10	0	0	0	0	0	0	14	56
CARP	0	0	1	0	0	0	0	0	0	0	0	2	3
AMERICAN EEL	86	15	24	344	324	269	179	299	95	25	0	8	1668
GOLDFISH	7	1	46	20	10	1	1	1	0	0	0	25	112
GOLDEN SHINER	1	2	18	13	10	2	4	3	4	1	0	63	121
HOGCHOKER	2	0	3	880	4395	150	400	2933	4022	519	0	2	13307
TESSELLATED DARTER	0	0	1	244	119	2	7	2	1	0	0	1	377
BANDED KILLIFISH	6	5	40	8	4	7	1	0	0	0	0	6	77
EMERALD SHINER	0	0	2	2	1	0	0	0	0	0	0	0	5
LARGEMOUTH BASS	3	1	2	0	0	0	0	0	2	6	0	15	29
MUMMICHOG	3	2	5	1	1	1	0	0	0	1	0	0	14
ATLANTIC MENHADEN	0	0	0	0	0	259	56	122	79	3	0	0	519
BLUEBACK HERRING*	14	0	0	43	541	864	605	366	409	121	0	1	2964
WHITE SUCKER	0	0	2	1	3	1	0	0	0	0	0	0	7
ATLANTIC SILVERSIDE	0	0	0	0	0	0	0	2	1	0	0	0	3
RAINBOW SMELT	385	64	161	1698	2266	4681	2016	181	380	373	0	159	12365
SMALLMOUTH BASS	0	0	0	0	0	0	0	0	1	0	0	0	1
SHORTNOSE STURGEON	0	0	0	0	0	0	0	0	1	0	0	0	1
SPOTTAIL SHINER	98	18	204	468	589	29	106	79	4	0	0	222	1817
ATLANTIC STURGEON	0	0	18	85	14	12	18	1	5	0	0	0	153
STRIPED BASS	1129	425	294	40	124	98	1230	4025	1601	774	0	451	10191
4-SPINE STICKLEBACK	1	0	0	1	0	0	0	0	0	0	0	0	2
ATLANTIC TOMCOD	69	23	165	95	7739	142748	230639	86962	8744	35	0	307	477524
UNIDENTIFIED	0	0	0	0	0	2	0	0	0	0	0	0	2
WHITE CATFISH	237	84	338	2674	4259	192	25	44	96	120	0	920	8988
WHITE PERCH	65086	28061	20582	39197	43968	7834	3325	9216	4147	2807	0	12687	236910
YELLOW PERCH	3	1	18	65	125	7	1	1	0	0	0	26	247
SATINFIN SHINER	0	0	0	1	0	0	0	0	0	0	0	0	1
ROCK BASS	0	0	1	1	0	0	0	0	0	0	0	0	2
NORTHERN PIPEFISH	0	0	0	0	2	8	0	18	30	2	0	0	60
REDBREAST SUNFISH	0	0	3	1	5	1	4	2	2	0	0	2	17
ATLANTIC NEEDLEFISH	0	0	0	0	0	0	0	0	1	0	0	0	1
CREVALLE JACK	0	0	0	0	0	3	1	10	7	0	0	0	21
WEAKFISH	0	0	0	0	0	3	171	1830	1195	0	0	0	3200
COMMON SHINER	0	0	0	0	1	1	0	0	0	0	0	1	3
LOOKDOWN	0	0	0	0	0	0	0	1	14	0	0	0	15
CLUPEID, UNIDENT	0	0	0	0	0	0	2873	1323	383	753	0	0	5333
MORONE LARVAE	0	0	0	0	0	0	326	0	0	0	0	0	326
NORTHERN HOGSUCKER	0	0	0	0	1	0	0	0	0	0	0	0	1
MORONE UNIDENTIFIED	0	0	0	0	0	0	16	0	0	0	0	0	16
TAUTOG	0	0	0	0	0	1	0	0	0	0	0	0	1
4-BEARDED ROCKLING	0	0	0	0	0	3	0	0	0	0	0	0	3
SPOT	0	0	0	0	0	0	167	7750	3008	655	0	0	11581
NORTHERN PORGY	0	0	0	0	0	0	2	2	8	0	0	0	12
WINTER FLOUNDER	1	0	1	3	0	3	2	16	4	0	0	1	31
TIDEWATER SILVERSIDE	0	0	0	0	1	0	0	1	0	0	0	0	2
SEA LAMPREY	0	0	1	0	0	0	0	0	0	0	0	0	1
GIZZARD SHAD	237	17	7	0	0	0	2	2	4	0	0	939	1208
SILVER HAKE	2	0	0	0	0	0	0	0	0	0	0	4	6
3-SPINE STICKLEBACK	3	5	12	0	0	0	0	0	0	0	0	1	21
BUTTERFISH	0	0	0	0	0	1	2	1	0	0	0	0	4
WHITE CRAPPIE	0	0	1	3	1	0	0	0	0	0	0	1	6
NORTHERN PIKE	0	0	0	0	0	1	0	0	0	0	0	0	1
NORTHERN PUFFER	0	0	0	0	0	0	0	0	1	0	0	0	1
BLACKNOSE DACE	0	0	1	0	0	0	0	0	0	0	0	0	1
YOY BLUEBACK HERRING	3	0	0	0	1	0	5331	6989	18211	24998	0	4	55537
YOY AMERICAN SHAD	0	0	0	0	0	0	3555	3895	750	461	0	4	8665
YOY ALEWIFE	0	0	0	0	1	0	15528	20217	4622	1037	0	1	41406
CENTRARCHID UNIDENT	3	0	39	28	81	1	0	0	6	49	0	33	240
SPOTFIN SHINER	0	0	0	0	0	0	1153	0	0	0	0	0	1153
OTHERS	3	0	3	4	5	2	3	19	4	0	0	24	67
COL. TOTALS:	67533	28755	22416	46194	65283	170777	308222	184394	60363	35103	0	16109	1005148

*Counts exclude young-of-the-year (YOY) individuals which are provided separately at the bottom of the table.

†Oil from a spill at Con Hook (RM 49) in early February fouled screens at Unit No. 3 from February 7 through 22; estimates of impingement counts, totaling approximately 63,628 fish, are not included in the February counts.

APPENDIX A.2

Numbers and Weights of Major Impinged Species

Total counts and total weights of ten species predominant in impingement collections are presented in the following tables. Totals are summarized by week, month, season, and year. Weeks were defined as calendar weeks extending from Sunday through Saturday with only Saturday, January 1, 1977, included in week 1. This accounts for the presence of 53 weeks in the year. The values for all species combined represent all species impinged including the following ten listed separately in these tables:

1. White perch (WP)
2. Striped bass (SB)
3. Atlantic tomcod (TC)
4. Blueback herring (BH)
5. Alewife (AL)
6. Bay anchovy (BA)
7. Bluefish (BF)
8. Hogchoker (HC)
9. Rainbow smelt (RS)
10. White catfish (WC)

Table A-3

Total Count† of Ten Major Species and All Species Combined Collected from Indian Point Unit No. 2 Intake Screens during 1977 (summarized by week, month, season, and year)

PERIOD	ALL SPECIES COMBINED	WP	SB	TC	BH	AL	BA	BF	HC	RS	WC
WEEK											
1	13089	12749	49	51	0	0	0	0	0	145	31
2	83603	80848	482	193	7	1	1	0	0	1395	206
3	64866	62769	585	153	6	2	0	0	0	814	155
4	70162	68567	857	113	1	2	0	0	0	281	98
5	94212	92106	1450	69	0	12	0	0	0	164	132
6	16548	16209	189	13	0	0	0	0	0	26	20
7	9743	9571	102	9	0	0	0	0	0	14	13
8	0	0	0	0	0	0	0	0	0	0	0
9	117976	116005	998	170	0	0	0	0	0	425	92
10	34832	33607	339	186	0	0	0	0	0	233	124
11	30918	30013	251	87	0	0	0	0	0	137	238
12	4766	4247	31	99	0	0	0	0	1	65	52
13	2373	1891	7	54	0	0	0	0	0	26	32
14	3974	3520	9	33	0	0	0	0	0	139	29
15	13181	12267	0	125	0	0	0	0	5	118	81
16	23563	22621	2	54	0	0	0	0	2	332	114
17	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	16921	2043	3	13596	12	13	0	0	469	544	121
22	28794	1068	6	26686	12	13	3	0	440	344	157
23	46777	2062	31	42897	75	38	135	176	115	631	492
24	59594	2769	16	53510	66	31	1285	1217	62	490	53
25	11314	737	2	8831	21	14	622	818	16	134	38
26	53190	669	11	50257	40	16	256	1251	36	491	34
27	23734	259	4	22496	38	12	128	513	5	187	4
28	4933	61	1	4567	6	0	67	93	4	50	2
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	26	1	0	18	4	0	2	1	0	0	0
33	13498	1952	443	4102	918	586	4668	19	251	9	6
34	31659	1693	391	19816	1136	326	6249	7	364	59	10
35	27444	2195	582	8016	1455	859	12268	4	255	37	10
36	19286	1024	579	4523	2512	1168	7635	11	211	31	5
37	12208	453	283	2484	2011	1146	4365	5	259	6	12
38	8052	374	242	1088	1530	223	2650	2	1075	9	7
39	15501	643	153	1800	2199	216	8407	10	888	77	8
40	60529	2179	673	1107	46697	305	6083	5	560	939	39
41	62356	1548	332	19	55269	110	2334	0	715	713	55
42	200420	15835	1129	239	167732	1293	1141	2	2552	2059	424
43	147163	14282	589	47	125698	1594	131	0	630	912	675
44	142269	14811	816	116	113333	4137	3	0	672	760	1314
45	75164	22283	994	93	44819	2162	4	0	688	473	2415
46	72171	52949	1303	158	10884	875	18	0	1503	511	2662
47	31770	24988	624	95	1545	498	0	0	282	99	1680
48	25530	22827	268	51	563	135	0	0	62	66	743
49	33645	29192	503	194	418	82	0	0	37	56	826
50	22787	19388	642	308	8	2	0	0	5	64	501
51	27773	23748	578	1223	2	2	0	0	0	70	1137
52	16728	14018	536	324	0	1	2	0	1	442	613
53	16033	14641	401	105	0	0	0	0	0	47	310
MONTH											
1	331684	322643	3496	585	14	17	1	0	0	2808	632
2	142513	139973	1262	219	0	0	0	0	0	490	138
3	72000	68772	590	410	0	0	0	0	1	526	444
4	37614	35602	3	195	0	0	0	0	7	490	203
5	52884	3946	12	45944	29	32	50	4	965	1039	613
6	180070	5580	59	165361	219	103	2320	3821	176	1724	284
7	12303	142	3	11535	22	2	126	243	6	108	4
8	84859	6527	1850	34689	4550	2604	28469	37	1012	129	29
9	85975	3537	1428	8257	37821	2207	23485	27	2789	879	53
10	589108	49015	3167	442	494219	7416	3983	2	4688	4687	2775
11	209683	142195	3332	508	42083	3483	21	0	2510	1091	7738
12	92387	79750	2284	2030	60	10	2	0	11	653	2857
SEASON											
WINTER	546197	531388	5348	1214	14	17	1	0	1	3824	1214
SPRING	270568	45128	74	211500	248	135	2370	3825	1148	3253	1100
SUMMER	183137	10206	3281	54481	42393	4813	52080	307	3807	1116	86
FALL	891178	270960	8783	2980	536362	10909	4006	2	7209	6431	13370
YEAR	1891080	857682	17486	270175	579017	15874	58457	4134	12165	14624	15770

†Estimates (≈ 53,765 fish) of impingement counts during the February oil spill are not included.

Table A-4

Total Count† of Ten Major Species and All Species Combined Collected from Indian Point Unit No. 3 Intake Screens during 1977
(summarized by week, month, season, and year)

PERIOD	ALL SPECIES COMBINED	WP	SB	TC	BH	AL	BA	BF	HC	RS	WC
WEEK											
1	3058	3011	8	4	0	0	0	0	0	6	4
2	19346	18466	338	28	13	1	0	0	1	170	121
3	22878	22188	298	17	4	5	0	0	0	132	70
4	10439	10065	207	8	0	4	0	0	0	41	28
5	10710	10326	229	9	0	1	0	0	1	33	14
6	2755	2567	127	10	0	0	0	0	0	9	4
7	177	171	4	1	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	25083	24609	312	7	0	0	0	0	0	50	58
10	9037	8681	160	12	0	0	0	0	1	26	65
11	7248	6820	122	32	0	0	0	0	0	40	133
12	3499	3025	23	102	0	0	0	0	0	39	63
13	3168	2644	11	23	0	7	0	0	2	32	82
14	1687	1476	9	6	0	2	0	0	0	41	31
15	797	649	2	10	0	4	0	0	1	11	38
16	6586	5764	1	22	0	8	0	0	15	284	198
17	18749	15485	15	55	4	15	0	0	281	914	1341
18	19683	16979	22	6	39	44	0	0	583	481	1084
19	25413	19882	34	113	193	71	0	0	1801	736	1933
20	24814	18724	36	1928	140	107	0	0	1152	519	1499
21	6045	2571	29	1573	97	62	0	0	819	433	291
22	4348	1304	15	1718	69	48	4	0	530	381	205
23	21379	3555	55	16039	171	61	50	69	120	731	422
24	40652	2877	27	33126	247	98	1788	1430	76	769	59
25	20145	1148	3	14863	127	53	1442	1083	21	1229	22
26	53149	1057	11	45681	219	108	635	3387	23	1824	15
27	66762	945	21	59999	294	84	277	4277	9	695	5
28	65817	882	13	52208	515	1274	3818	3160	23	1149	12
29	8384	249	9	2510	196	801	3202	823	9	59	2
30	81018	255	61	64561	961	2743	10062	765	54	251	4
31	116707	1340	1004	81521	3703	9237	15081	682	260	163	4
32	42139	1859	556	21526	1340	6654	6349	842	425	103	7
33	15541	1035	599	3734	883	2725	4328	133	460	5	13
34	79808	2848	1493	47087	4057	4382	12190	197	927	42	5
35	44435	3080	1045	15521	1148	5863	12766	129	888	39	18
36	21954	1131	628	8310	1025	3909	4140	100	516	29	3
37	5654	315	116	1252	444	1134	1463	13	196	9	5
38	5814	366	126	1154	608	157	940	22	1829	1	7
39	10211	741	180	1220	1209	510	4025	72	1204	46	14
40	36039	2811	1173	1206	21465	1693	3747	81	611	374	82
41	27137	2271	615	19	18757	827	2072	0	406	303	104
42	775	51	3	0	568	19	37	0	63	9	3
43	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
51	2472	2034	62	0	3	0	1	0	1	3	190
52	6678	4744	217	153	2	1	2	0	1	139	449
53	6959	5909	172	154	0	1	0	0	0	17	281
MONTH											
1	67533	65086	1129	69	17	11	0	0	2	385	237
2	28755	28061	425	23	0	0	0	0	0	64	84
3	22416	20582	294	165	0	8	0	0	3	161	338
4	46196	39197	40	95	43	72	0	0	880	1699	2675
5	65283	43968	124	7738	542	314	33	0	4397	2267	4257
6	170778	7834	98	142748	864	339	4028	9155	150	4682	192
7	308217	3325	1230	230640	5935	15782	33226	6850	400	2016	25
8	184393	9216	4025	86963	7357	20400	36753	1050	2933	181	44
9	60367	4147	1601	8745	18620	4731	12145	210	4023	380	96
10	35102	2807	774	35	25118	1054	2231	0	519	373	120
11	0	0	0	0	0	0	0	0	0	0	0
12	16109	12687	451	307	5	2	3	0	2	159	920
SEASON											
WINTER	118704	113729	1848	257	17	19	0	0	5	610	659
SPRING	282257	90999	262	150581	1449	725	4061	9155	5427	8648	7124
SUMMER	552977	16688	6856	326348	31912	40913	82124	8110	7356	2577	165
FALL	51211	15494	1225	342	25123	1056	2234	0	521	532	1040
YEAR	1005149	236910	10191	477528	58501	42713	88419	17265	13309	12367	8988

†Estimates (≈62,628 fish) of impingement counts during the February oil spill are not included.

Table A-5

Total Count† of Ten Major Species and All Species Combined Collected from Indian Point Units No. 2 and No. 3 Intake Screens during 1977 (summarized by week, month, season, and year)

PERIOD	ALL SPECIES COMBINED	WP	SB	TC	BH	AL	BA	BF	HC	RS	WC
WEEK											
1	16147	15760	57	55	0	0	0	0	0	151	35
2	102954	99314	820	221	20	2	1	0	1	1565	327
3	87744	84957	883	170	10	7	0	0	0	946	225
4	80601	78632	1064	121	1	6	0	0	0	322	126
5	104922	102432	1679	78	0	13	0	0	1	197	146
6	19303	18776	316	23	0	0	0	0	0	35	24
7	9920	9742	106	10	0	0	0	0	0	14	13
8	0	0	0	0	0	0	0	0	0	0	0
9	143059	140614	1310	177	0	0	0	0	0	475	150
10	43869	42288	499	198	0	0	0	0	1	259	189
11	38166	36833	373	119	0	0	0	0	0	177	371
12	8265	7272	54	201	0	0	0	0	1	104	115
13	5541	4535	18	77	0	7	0	0	2	58	114
14	5661	4996	18	39	0	2	0	0	0	180	60
15	13978	12916	2	135	0	4	0	0	6	129	119
16	30149	28385	3	76	0	8	0	0	17	616	312
17	18749	15485	15	55	4	15	0	0	281	914	1341
18	19683	16979	22	6	39	44	0	0	583	481	1084
19	25413	19882	34	113	193	71	0	0	1801	736	1933
20	24814	18724	36	1928	140	107	0	0	1152	519	1499
21	22966	4614	32	15169	109	75	0	0	1288	977	412
22	33142	2372	21	28404	81	61	7	0	970	725	362
23	68156	5617	86	58936	246	99	185	245	235	1362	914
24	100246	5646	43	86636	313	129	3073	2647	138	1259	112
25	31459	1885	5	23694	148	67	2064	1901	37	1363	60
26	106339	1726	22	95938	259	124	891	4638	59	2315	49
27	90496	1204	25	82495	332	96	405	4790	14	882	9
28	70750	943	14	56775	521	1274	3885	3253	27	1199	14
29	8384	249	9	2510	196	801	3202	823	9	59	2
30	81018	255	61	64561	961	2743	10062	765	54	251	4
31	116707	1340	1004	81521	3703	9237	15081	682	260	163	4
32	42165	1360	556	21544	1344	6654	6351	843	425	103	7
33	29039	2987	1042	7836	1801	3311	8996	152	711	14	19
34	111467	4541	1884	66903	5193	4708	18439	204	1291	101	15
35	71879	5275	1627	23537	2603	6722	25034	133	1143	76	28
36	41240	2155	1207	12833	3537	5077	11775	111	727	60	8
37	17862	768	399	3736	2455	2280	5828	18	455	15	17
38	13866	740	368	2242	2138	380	3590	24	2904	10	14
39	25712	1384	333	3020	3408	726	12432	82	2092	123	22
40	96568	4990	1846	2313	68162	1998	9830	86	1171	1313	121
41	89493	3819	947	38	74026	937	4406	0	1121	1016	159
42	201195	15886	1132	239	168300	1312	1178	2	2615	2068	427
43	147163	14282	589	47	125698	1594	131	0	630	912	675
44	142269	14811	816	116	113333	4137	3	0	672	760	1314
45	75164	22283	994	93	44819	2162	4	0	688	473	2415
46	72171	52949	1303	158	10884	875	18	0	1503	511	2662
47	31770	24988	624	95	1545	498	0	0	282	99	1680
48	25530	22827	268	51	563	135	0	0	62	66	743
49	33645	29192	503	194	418	82	0	0	37	56	826
50	22787	19388	642	308	8	2	0	0	5	64	501
51	30245	25782	640	1223	5	2	1	0	1	73	1327
52	23406	18762	753	477	2	2	4	0	2	581	1062
53	22992	20550	573	259	0	1	0	0	0	64	591
MONTH											
1	399217	387729	4625	654	31	28	1	0	2	3193	869
2	171268	168034	1687	242	0	0	0	0	0	554	222
3	94416	89354	884	575	0	8	0	0	4	687	782
4	83810	74799	43	290	43	72	0	0	887	2189	2878
5	118167	47914	136	53682	571	346	83	4	5362	3306	4870
6	350843	13414	157	308109	1083	442	6348	12976	326	6406	476
7	320520	3467	1233	242175	5957	15784	33352	7093	406	2124	29
8	269252	15743	5875	121652	11907	23004	65222	1087	3945	310	73
9	146342	7684	3029	17002	56441	6938	35630	237	6812	1259	149
10	624210	51822	3941	477	519337	8470	6214	2	5207	5060	2895
11	209683	142195	3332	508	42083	3483	21	0	2510	1091	7738
12	108496	92437	2735	2337	65	12	5	0	13	812	3777
SEASON											
WINTER	664901	645117	7196	1471	31	36	1	0	6	4434	1873
SPRING	552825	136127	336	362081	1697	860	6431	12980	6575	11901	8224
SUMMER	736114	26894	10137	380829	74305	45726	134204	8417	11163	3693	251
FALL	942389	286454	10008	3322	561485	11965	6240	2	7730	6963	14410
YEAR	2896229	1094592	27677	747703	637518	58587	146876	21399	25474	26991	24758

†Estimates (≈116,393 fish) of impingement counts during the February oil spill are not included.

Table A-6

Total Weights (g)† of Ten Major Species and All Species Combined Collected from Indian Point Unit No. 2 Intake Screens during 1977 (summarized by week, month, season, and year)

PERIOD	ALL SPECIES COMBINED	WP	SB	TC	BH	AL	BA	BF	HC	RS	WC
WEEK											
1	57013	53982	232	907	0	0	0	0	0	225	690
2	436510	408433	2448	3321	45	3	1	0	0	2127	7352
3	553386	521511	3639	2830	22	31	0	0	0	1444	7007
4	462036	438429	6268	1886	5	11	0	0	0	488	2213
5	647610	617259	12766	1414	0	328	0	0	0	293	3853
6	79573	72738	1550	197	0	0	0	0	0	71	1084
7	103904	99595	1932	136	0	0	0	0	0	26	804
8	0	0	0	0	0	0	0	0	0	0	0
9	762225	728207	15456	2847	0	0	0	0	0	1009	4040
10	148246	127358	3997	3762	0	0	0	0	0	707	5561
11	206455	192047	2903	1521	0	0	0	0	0	1075	3266
12	78693	63829	340	1600	0	0	0	0	22	1228	3004
13	69129	59289	639	981	0	0	0	0	0	367	482
14	97102	88081	107	621	0	0	0	0	0	517	959
15	338120	317794	0	2599	0	0	0	0	66	503	1465
16	517918	506639	13	1316	0	0	0	0	23	1007	1124
17	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	37912	9902	18	9172	1348	2341	0	0	8660	2106	884
22	45790	10185	36	21190	1127	2002	6	0	6030	1446	771
23	88232	29620	580	41255	2466	2762	315	218	1789	3020	3347
24	142963	42694	146	79232	3532	2298	4100	1750	647	2149	477
25	50964	19354	167	17912	1329	670	1866	1394	294	573	602
26	151334	21846	394	111080	1761	809	864	3062	375	2031	582
27	74880	8898	83	55653	867	794	380	1649	100	436	230
28	14953	2016	7	11423	340	0	121	333	94	164	10
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	111	2	0	88	5	0	4	12	0	0	0
33	59466	5680	1156	22242	1113	1292	12061	220	8407	10	143
34	132029	7657	1689	63273	1644	814	17681	231	9230	126	1501
35	99488	9802	1276	27828	2214	2113	32898	79	6235	98	1241
36	70597	10168	1316	13652	3320	2450	20780	302	4770	28	368
37	59402	8819	1461	13292	2928	2646	11122	177	5978	27	1016
38	54922	6233	1802	4685	2483	670	6311	82	23609	7	694
39	81487	11881	867	7774	3526	1035	19465	687	20226	290	577
40	160001	18798	2882	4827	71416	1050	13144	261	7827	1444	2343
41	118872	10096	1119	81	79895	293	3597	0	5976	648	1455
42	449387	89566	5417	1450	242777	4607	1266	51	51064	2981	5763
43	329060	88252	2556	476	194468	4865	104	0	11028	950	6950
44	341905	129440	4391	1605	147708	11896	3	0	10340	841	12666
45	271545	153364	4831	1731	60165	6135	6	0	10626	1228	19231
46	434888	342653	5917	2172	15101	3106	32	0	18256	1736	21580
47	229004	186188	5411	2114	2588	1506	0	0	3016	333	12300
48	166417	144853	1428	1100	946	387	0	0	904	433	6392
49	281666	242035	3150	4404	804	287	0	0	580	246	6650
50	200762	153963	3887	6852	13	9	0	0	117	192	5126
51	252783	174014	3708	33427	4	8	0	0	0	222	12549
52	149449	104437	3116	11681	0	87	2	0	31	1340	8048
53	131113	106138	2072	4285	0	0	0	0	0	511	4183
MONTH											
1	2180752	2060021	25836	10435	72	373	1	0	0	4591	21761
2	954486	907257	19091	3683	0	0	0	0	0	1200	7934
3	541050	481737	7340	7620	0	0	0	0	22	3615	10510
4	881632	846176	23	4200	0	0	0	0	89	1681	2699
5	104707	29250	80	36390	2616	4536	126	12	15573	4165	3687
6	464314	111089	1315	280991	9475	7081	7231	7522	2283	7335	3065
7	38007	4176	36	29536	679	59	295	872	133	425	151
8	332720	27725	5092	121256	6339	6003	76905	723	27032	251	3016
9	350696	48898	7125	36357	58025	6021	55906	1328	58624	1622	3083
10	1324378	339349	14970	3889	710477	22483	5626	51	79922	5776	30831
11	1248654	978826	18741	9486	58161	10591	37	0	32391	3659	61900
12	817906	609241	13524	58051	116	158	2	0	251	2383	31946
SEASON											
WINTER	3676288	3449015	52267	21738	72	373	1	0	22	9406	40205
SPRING	1450653	986515	1418	321581	12091	11617	7357	7534	17945	13181	9451
SUMMER	721423	80799	12253	187149	65043	12083	133106	2923	85789	2298	6250
FALL	3390938	1927416	47235	71426	768754	33232	5665	51	112564	11818	124677
YEAR	9239302	6443745	113173	601894	845960	57305	146129	10508	216320	36703	180583

†Estimates of impingement weights during the February oil spill are not included.

Table A-7

Total Weights (g)† of Ten Major Species and All Species Combined Collected from Indian Point Unit No. 3 Intake Screens during 1977 (summarized by week, month, season, and year)

PERIOD	ALL SPECIES COMBINED	WP	SB	TC	BH	AL	BA	BF	HC	RS	WC
WEEK											
1	12932	10655	40	83	0	0	0	0	0	11	20
2	121146	103311	1717	610	56	4	0	0	28	268	3636
3	184070	160594	2688	383	10	77	0	0	0	224	2608
4	71003	58299	931	126	0	33	0	0	0	69	175
5	62638	52030	1072	161	0	12	0	0	30	55	146
6	29004	22372	598	147	0	0	0	0	0	20	71
7	2698	2591	53	20	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	123214	112646	5162	93	0	0	0	0	0	104	1396
10	43691	35524	2077	239	0	0	0	0	17	94	1034
11	53109	41944	1624	505	0	0	0	0	0	697	1788
12	61531	42875	189	1662	0	0	0	0	0	788	3883
13	121659	98217	128	419	0	1900	0	0	58	691	4099
14	65357	49441	433	110	0	583	0	0	0	384	1017
15	43475	34045	8	215	0	1195	0	0	10	93	1251
16	100297	84904	105	546	0	1951	0	0	373	851	1519
17	218643	164426	1319	1308	779	3533	0	0	6151	2365	9162
18	165390	100004	969	134	8301	10455	0	0	13200	1391	8466
19	245935	109513	534	456	37549	16481	0	0	43870	2187	10638
20	195969	100716	1697	1444	16311	20165	0	0	27240	1966	8388
21	83061	26121	1667	1237	12587	12480	0	0	16402	1965	2183
22	63273	24927	182	1579	9275	8243	19	0	9917	1862	1756
23	179376	122485	1092	23175	11237	6815	197	91	1878	4206	3025
24	190509	84950	901	54391	13898	9136	6633	2271	1059	4209	1231
25	128216	51788	878	33996	8729	3754	5790	2274	283	7473	1001
26	212765	46321	824	105214	12045	6403	2741	9405	452	10373	1086
27	263193	41594	1442	166243	11110	6631	1065	16174	199	3865	175
28	240708	27008	1479	145100	7320	5138	14054	15284	706	7166	1044
29	72153	13616	865	30021	1899	2688	11966	5143	108	194	96
30	357697	15320	1193	275851	2846	8461	37829	7138	858	355	1388
31	497118	30120	2800	347827	7520	24363	49259	11818	7274	210	301
32	238077	32282	2148	108205	4236	19679	23121	10735	14541	273	1010
33	136961	30082	2521	21774	1788	7514	13167	2553	16645	26	2821
34	473475	31542	5829	205454	6685	13286	42718	7669	26439	119	382
35	274522	40797	3854	66865	3188	16441	40356	5418	23167	144	2576
36	131167	21705	2847	30252	3047	11002	13814	4899	12356	129	109
37	46395	12341	1288	5930	1674	3058	4618	642	5140	30	406
38	82069	12186	3913	6493	2035	887	2776	1242	41949	7	262
39	104225	22378	1741	5586	3484	2661	12900	4720	29232	287	1382
40	246446	64705	12243	5291	40818	7190	11422	4936	15182	1915	3777
41	120978	38488	3279	158	34420	3435	2577	0	5572	1242	3427
42	4794	862	15	0	896	102	27	0	1663	38	52
43	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
51	17750	11701	406	0	5	0	1	0	2	25	1322
52	67434	34680	1977	3479	93	21	7	0	9	468	5669
53	60844	36581	929	4957	0	5	0	0	0	116	5359
MONTH											
1	460449	389805	6676	1404	66	126	0	0	58	632	6585
2	156857	139317	6692	396	0	0	0	0	0	133	1892
3	319126	249624	3344	2707	0	2230	0	0	75	2510	11282
4	543425	395132	2401	2254	9080	17387	0	0	19734	4830	20512
5	660696	317465	4175	7974	78866	60227	145	0	98876	9007	25239
6	799082	279346	4303	309566	48121	27239	15786	25118	2339	26775	4149
7	1316990	102920	7382	894966	26037	48361	117233	46694	10716	10322	3080
8	1152091	141695	16054	393248	16511	58272	122289	28242	85782	580	6682
9	508470	113605	19282	36540	39698	17566	38635	12358	96182	1966	5553
10	151753	46816	4036	248	45364	4348	2961	0	8237	1591	3813
11	0	0	0	0	0	0	0	0	0	0	0
12	146028	82962	3312	8436	98	26	8	0	11	609	12350
SEASON											
WINTER	936432	778746	16712	4507	66	2356	0	0	133	3275	19759
SPRING	2003203	991943	10879	319794	136067	104853	15931	25118	120949	40612	49900
SUMMER	2977551	358220	42718	1324754	82246	124199	278157	87294	192680	12868	15315
FALL	297781	129778	7348	8684	45462	4374	2969	0	8248	2200	16163
YEAR	6214967	2258687	77657	1657739	263841	235782	297057	112412	322010	58955	101137

†Estimates of impingement weights during the February oil spill are not included.

Table A-8

Total Weights (g)† of Ten Major Species and All Species Combined Collected from Indian Point Units No. 2 and No. 3 Intake Screens during 1977
(summarized by week, month, season, and year)

PERIOD	ALL SPECIES COMBINED	WP	SB	TC	BH	AL	BA	BF	HC	RS	WC
WEEK											
1	69945	64637	272	990	0	0	0	0	0	236	710
2	557656	511744	4165	3931	101	7	1	0	28	2395	10988
3	737456	682105	6327	3213	32	108	0	0	0	1668	9615
4	533039	496728	7199	2012	5	44	0	0	0	557	2388
5	710248	669289	13838	1575	0	340	0	0	30	348	3999
6	108577	95110	2148	344	0	0	0	0	0	91	1155
7	106602	102186	1985	156	0	0	0	0	0	26	804
8	0	0	0	0	0	0	0	0	0	0	0
9	885439	840853	20618	2940	0	0	0	0	0	1113	5436
10	191937	162882	6074	4001	0	0	0	0	17	801	6595
11	259564	233991	4527	2026	0	0	0	0	0	1772	5054
12	140224	106704	529	3262	0	0	0	0	22	2016	6887
13	190788	157506	767	1400	0	1900	0	0	58	1058	4581
14	162459	137522	540	731	0	583	0	0	0	901	1976
15	381595	351839	8	2814	0	1195	0	0	76	596	2716
16	618215	591543	118	1862	0	1951	0	0	396	1858	2643
17	218643	164426	1319	1308	779	3533	0	0	6151	2365	9162
18	165390	100004	969	134	8301	10455	0	0	13200	1391	8466
19	245935	109513	534	456	37549	16481	0	0	43870	2187	10638
20	195969	100716	1697	1444	16311	20165	0	0	27240	1966	8386
21	120973	36023	1685	10409	13935	14821	0	0	25062	4071	3067
22	109063	35112	218	22769	10402	10245	25	0	15947	3308	2527
23	267608	152105	1672	64430	13705	9577	512	309	3667	7226	6372
24	333472	127644	1047	133623	17430	11434	10733	4021	1706	6358	1708
25	179180	71142	1045	51908	10058	4424	7656	3668	577	8046	1603
26	364099	68167	1218	216294	13806	7212	3605	12467	827	12404	1668
27	338073	50492	1525	221896	11977	7425	1445	17823	299	4301	405
28	255661	29024	1486	156523	7660	5138	14175	15617	800	7330	1054
29	72153	13616	865	30021	1899	2688	11966	5143	108	194	96
30	357697	15320	1193	275851	2846	8461	37829	7138	858	355	1388
31	497118	30120	2800	347827	7520	24363	49259	11818	7274	210	301
32	238188	32234	2148	108293	4241	19679	23125	10747	14541	273	1010
33	196427	35762	3677	44016	2901	8806	25278	2773	25052	36	2964
34	605504	39199	7518	268727	8329	14100	60399	7900	35669	245	1833
35	374010	50599	5130	94693	5402	18554	73254	5497	29402	242	3817
36	201764	31873	4163	43904	6367	13452	34594	5201	17126	157	477
37	105797	21160	2749	19222	4602	5704	15740	819	11118	57	1422
38	136991	18419	5715	11178	4518	1557	9087	1324	65558	14	956
39	185712	34259	2608	13360	7010	3696	32365	5407	49458	577	1959
40	406447	83503	15125	10118	112234	8240	24566	5197	23009	3359	6120
41	239850	48584	4398	239	114315	3728	6174	0	11548	1890	4882
42	454181	90428	5432	1450	243673	4709	1293	51	52727	3019	5815
43	329060	88252	2556	476	194468	4865	104	0	11028	950	6950
44	341905	129440	4391	1605	147708	11896	3	0	10340	841	12666
45	271545	153364	4831	1731	60165	6135	6	0	10626	1228	19231
46	434888	342653	5917	2172	15101	3106	32	0	18256	1736	21580
47	229004	186188	5411	2114	2538	1506	0	0	3016	333	12300
48	166417	144853	1423	1100	946	387	0	0	904	433	6392
49	281666	242035	3150	4404	804	287	0	0	580	246	6650
50	200762	153963	3887	6852	13	9	0	0	117	192	5126
51	270533	185715	4114	33427	9	8	1	0	2	247	13871
52	216883	139117	5093	15160	93	108	9	0	40	1808	13717
53	191957	142719	3001	9242	0	5	0	0	0	627	9542
MONTH											
1	2641201	2449826	32512	11839	138	499	1	0	58	5223	28346
2	1111343	1046574	25783	4079	0	0	0	0	0	1333	9826
3	860176	731361	10684	10327	0	2230	0	0	97	6125	21792
4	1425057	1241308	2424	6454	9080	17387	0	0	19823	6511	23211
5	765403	346715	4255	44364	81482	64763	271	12	114449	13172	28926
6	1263396	390435	5618	590557	57596	34320	23017	32640	4622	34110	7214
7	1354997	107096	7418	924502	26716	48420	117528	47566	10849	10747	3231
8	1484811	169420	21146	514504	22850	64275	199194	28965	112814	831	9698
9	859166	162503	26407	72897	97723	23587	94541	13686	154806	3588	8636
10	1476131	386165	19006	4137	755841	26831	8587	51	88159	7367	34644
11	1248654	978826	18741	9486	58161	10591	37	0	32391	3659	61900
12	963934	692203	16836	66487	214	184	10	0	262	2992	44296
SEASON											
WINTER	4612720	4227761	68979	26245	138	2729	1	0	155	12681	59964
SPRING	3453856	1978458	12297	641375	148158	116470	23288	32652	138894	53793	59351
SUMMER	3698974	439019	54971	1511903	147289	136282	411263	90217	278469	15166	21565
FALL	3688719	2057194	54583	80110	814216	37606	8634	51	120812	14018	140840
YEAR	15454269	8702432	190830	2259633	1109801	293087	443186	122920	538330	95658	281720

†Estimates of impingement weights during the February oil spill are not included.

APPENDIX A.3

Selected Impingement Rates

The need for accurate daily impingement rates prompted a selection process whereby impingement data were sorted such that any days thought to include incomplete data, or data otherwise capable of introducing spurious variation, were eliminated. Data collected on the "selected" days remaining were used to compute impingement rates. The criteria used for selection of appropriate days are described below and the impingement rates are presented in the following tables. Note that Tables A-12 through A-14 represent impingement rates computed from weights of impinged fish whereas all other tables of selected impingement rates presented herein were based on number impinged.

Selection Criteria

Continuous Circulator Operation

Each circulator at a unit was required to have operated continuously throughout each collection day (which extended from 1201 Noon to 1200 Noon). This was to eliminate the possibility of fish loss as a result of the backwash which occurs when a circulator is shut off.

Duration of Collection Period

Each screen at a unit was required to have been washed at least once on the previous collection day. The two purposes of this requirement were 1) to insure that each daily impingement rate represented only that day so that comparison could be made to daily variation in physicochemical parameters, and 2) to prevent erroneously low rates that would result if collection efficiency decreased with long periods (greater than one day) of impingement.

Unscheduled Washes

It was occasionally necessary for plant operators to conduct unscheduled screen washes (i.e., in addition to the routine morning screen wash) primarily to relieve pressure caused by heavy debris build-up on the intake screens. Routine collection procedures were followed whenever possible during such washes. However, the emergency nature of unscheduled washes often led to collections by nonroutine personnel and occasionally to missed collections. Therefore, in the interest of computing rates with the least number of inconsistencies, it was deemed advisable to eliminate analysis of any collection day on which an unscheduled wash had occurred for a particular unit.

Abnormal Collection

All days for which collections were coded as abnormal were excluded from the computation of selected impingement rates. A collection of impinged fish was coded as abnormal by the operating TI technician on any day for which equipment malfunction or actual loss or miscount of fish might cause that day not to represent the normal operating regime of the unit in question. During November and December 1977, collections at Unit No. 2 were coded as abnormal because some of the fixed screens had collapsed, making the collection nonrepresentative of normal Unit No. 2 operation.

Table A-9

Mean Selected Impingement Rates (based on number collected/$10^6 m^3$ water circulated) of Predominant Species and All Species Combined in Indian Point Unit No. 2 Impingement Collections during 1977 (summarized by week, month, season, and year)

PERIOD	ALL_SPP	WP	SB	TC	BH	AL	BA	AS	HC
WEEK									
1	9028	8794	34	35	0	0	0	0	0
2	6660	6452	37	15	1	0	0	0	0
3	5411	5234	50	14	1	0	0	0	0
4	5329	5210	66	8	0	0	0	0	0
5	5779	5633	91	8	0	0	0	0	0
6	6703	6551	110	2	0	0	0	0	0
7	1562	1525	20	4	0	0	0	0	0
8	.*	.	.	.	.	.	.	.	.
9	13863	13688	95	11	0	0	0	0	0
10	1172	1102	13	13	0	0	0	0	0
11	1732	1675	15	6	0	0	0	0	0
12	582	531	5	12	0	0	0	0	0
13	168	134	1	5	0	0	0	0	0
14	248	220	1	2	0	0	0	0	0
15	1018	945	0	5	0	0	0	0	0
16	4208	4037	0	8	0	0	0	0	0
17	.	.	.	.	.	.	.	.	.
18	.	.	.	.	.	.	.	.	.
19	.	.	.	.	.	.	.	.	.
20	.	.	.	.	.	.	.	.	.
21	534	66	0	427	0	0	0	0	15
22	898	33	0	833	0	0	0	0	14
23	1620	67	1	1491	2	1	5	0	4
24	1859	86	1	1670	2	1	40	0	2
25	390	24	0	308	1	1	21	0	1
26	1901	23	0	1798	1	1	12	0	1
27	976	12	0	921	2	1	6	0	0
28	1668	21	0	1544	2	0	23	0	1
29	.	.	.	.	.	.	.	.	.
30	.	.	.	.	.	.	.	.	.
31	.	.	.	.	.	.	.	.	.
32	23	1	0	16	4	0	2	0	0
33	591	88	19	188	42	25	197	5	10
34	1658	96	18	1058	62	11	301	11	20
35	892	77	18	284	49	24	369	7	9
36	628	36	21	145	58	42	265	5	7
37	415	15	10	85	69	40	147	3	8
38	247	11	7	34	45	7	82	2	33
39	490	20	5	55	79	6	255	2	34
40	1529	58	17	59	1042	10	246	3	18
41	1917	52	11	1	1699	4	71	1	19
42	5885	415	22	8	4935	32	38	57	86
43	7313	556	27	2	6492	51	11	31	21
44	4646	474	33	3	3682	127	0	11	25
45	3002	699	45	3	1968	102	0	7	24
46	4207	2793	49	11	942	52	1	3	68
47	.	.	.	.	.	.	.	.	.
48	.	.	.	.	.	.	.	.	.
49	.	.	.	.	.	.	.	.	.
50	.	.	.	.	.	.	.	.	.
51	.	.	.	.	.	.	.	.	.
52	.	.	.	.	.	.	.	.	.
53	.	.	.	.	.	.	.	.	.
MONTH									
JAN	5642	5485	56	12	0	0	0	0	0
FEB	9370	9212	99	7	0	0	0	0	0
MAR	795	749	7	7	0	0	0	0	0
APR	2149	2045	0	6	0	0	0	0	0
MAY	681	51	0	591	0	0	1	0	12
JUN	1397	44	0	1282	2	1	19	0	1
JUL	1564	20	0	1463	3	0	16	0	1
AUG	868	73	18	366	49	25	274	7	10
SEP	451	20	9	63	103	17	174	2	23
OCT	4391	326	23	3	3742	50	33	18	30
NOV	3427	1466	48	6	1560	94	1	6	41
DEC	.	.	.	.	.	.	.	.	.
SEASON									
WIN	4061	3951	40	9	0	0	0	0	0
SPR	1256	332	0	860	1	1	10	0	5
SUM	714	44	13	292	72	20	209	4	16
FAL	4169	589	28	3	3239	61	25	15	32
YR	2412	1411	20	321	500	14	62	3	10

*Dot (·) indicates that no days during specific period met selection criteria.

Table A-10

Mean Selected Impingement Rates (based on number collected/$10^6 m^3$ water circulated) of Predominant Species and All Species Combined in Indian Point Unit No. 3 Impingement Collections during 1977 (summarized by week, month, season, and year)

PERIOD	ALL_SPP	WP	SB	TC	BH	AL	BA	AS	HC
WEEK									
1	1670	1644	4	2	0	0	0	0	0
2	944	893	18	2	0	0	0	0	0
3	1922	1867	27	2	0	0	0	0	0
4	.*	.	.	.	.	.	.	.	.
5	.	.	.	.	.	.	.	.	.
6	.	.	.	.	.	.	.	.	.
7	.	.	.	.	.	.	.	.	.
8	.	.	.	.	.	.	.	.	.
9	4047	3976	44	1	0	0	0	0	0
10	521	501	11	0	0	0	0	0	0
11	487	457	7	3	0	0	0	0	0
12	258	234	2	8	0	0	0	0	0
13	101	90	0	1	0	0	0	0	0
14	88	77	0	0	0	0	0	0	0
15	36	29	0	0	0	0	0	0	0
16	100	94	0	0	0	0	0	0	0
17	623	523	1	1	0	0	0	0	10
18	573	495	1	0	1	1	0	0	18
19	709	542	1	1	3	1	0	0	63
20	957	725	1	85	5	4	0	0	38
21	199	84	1	52	3	2	0	0	27
22	135	41	0	54	2	2	0	0	17
23	524	108	1	360	5	2	2	0	5
24	1443	96	1	1183	8	3	65	0	3
25	839	39	0	636	5	2	58	0	1
26	2118	32	0	1857	6	4	31	0	1
27	2439	31	1	2200	11	3	10	0	0
28	2076	29	0	1643	16	39	120	37	1
29	326	9	0	103	6	28	125	8	0
30	2523	8	2	2010	30	86	314	21	2
31	3532	37	40	2556	117	305	357	39	8
32	1311	58	17	670	42	207	198	38	13
33	484	32	19	116	27	85	135	10	14
34	2489	89	47	1469	126	137	380	52	29
35	1386	96	33	484	36	183	398	22	23
36	699	35	20	271	34	125	128	12	15
37	176	10	4	39	14	35	46	2	6
38	199	13	4	31	22	6	30	4	73
39	247	19	3	28	40	10	80	3	40
40	1152	83	35	17	769	53	73	14	18
41	1045	86	23	1	694	34	106	16	16
42	295	14	1	0	196	6	18	0	47
43	.	.	.	.	.	.	.	.	.
44	.	.	.	.	.	.	.	.	.
45	.	.	.	.	.	.	.	.	.
46	.	.	.	.	.	.	.	.	.
47	.	.	.	.	.	.	.	.	.
48	.	.	.	.	.	.	.	.	.
49	.	.	.	.	.	.	.	.	.
50	.	.	.	.	.	.	.	.	.
51	310	251	7	0	1	0	0	1	0
52	365	258	11	9	0	0	0	0	0
53	660	584	17	7	0	0	0	0	0
MONTH									
JAN	1467	1418	20	2	0	0	0	0	0
FEB	4047	3976	44	1	0	0	0	0	0
MAR	290	270	4	3	0	0	0	0	0
APR	367	315	0	0	0	1	0	0	9
MAY	397	245	1	68	3	2	0	0	28
JUN	1511	59	1	1277	7	3	40	0	1
JUL	2200	23	9	1681	39	108	210	25	3
AUG	1322	66	29	627	53	145	263	28	21
SEP	431	28	10	60	152	36	70	5	31
OCT	948	74	20	1	652	29	80	13	22
NOV	.	.	.	.	.	.	.	.	.
DEC	448	355	13	8	0	0	0	0	0
SEASON									
WIN	920	888	12	2	0	0	0	0	0
SPR	793	195	1	489	4	2	14	0	13
SUM	1328	40	17	792	79	99	185	20	18
FAL	698	214	16	4	326	15	40	7	11
YR	1039	221	11	507	72	46	92	10	13

*Dot (·) indicates that no days during specific period met selection criteria.

Table A-11

Mean Selected Impingement Rates (based on number collected/$10^6 m^3$ water circulated) of Predominant Species and All Species Combined in Indian Point Units No. 2 and No. 3 Impingement Collections during 1977 (summarized by week, month, season, and year)

PERIOD	ALL_SPP	WP	SB	TC	BH	AL	BA	AS	HC
WEEK									
1	4921	4803	17	17	0	0	0	0	0
2	4435	4289	28	10	0	0	0	0	0
3	5071	4910	47	11	0	0	0	0	0
4	5329	5210	66	8	0	0	0	0	0
5	5779	5633	91	8	0	0	0	0	0
6	6703	6551	110	2	0	0	0	0	0
7	1562	1525	20	4	0	0	0	0	0
8	.*	.	.	.	.	.	.	.	.
9	10340	10198	80	9	0	0	0	0	0
10	869	823	12	7	0	0	0	0	0
11	1421	1373	13	5	0	0	0	0	0
12	369	328	2	10	0	0	0	0	0
13	157	128	1	4	0	0	0	0	0
14	161	142	1	1	0	0	0	0	0
15	667	620	0	2	0	0	0	0	0
16	2828	2726	0	5	0	0	0	0	0
17	623	523	1	1	0	0	0	0	10
18	573	495	1	0	1	1	0	0	18
19	709	542	1	1	3	1	0	0	63
20	957	725	1	85	5	4	0	0	38
21	398	73	0	275	2	1	0	0	20
22	516	37	0	442	1	1	0	0	15
23	1395	83	1	1252	4	2	3	0	4
24	1716	89	1	1500	5	2	48	0	3
25	560	28	0	430	2	1	36	0	1
26	2079	28	0	1893	4	3	19	0	1
27	1576	19	0	1442	6	2	7	0	0
28	2043	29	0	1617	16	39	120	37	1
29	326	9	0	103	6	28	125	8	0
30	2523	8	2	2010	30	86	314	21	2
31	3532	37	40	2556	117	305	357	39	8
32	1294	57	17	662	41	204	195	38	13
33	504	48	18	136	30	63	154	8	12
34	2171	88	38	1289	95	104	346	41	26
35	1173	88	29	383	39	123	390	18	19
36	695	35	20	229	48	94	193	9	13
37	271	12	6	57	37	36	88	2	7
38	225	12	6	31	35	6	62	2	47
39	365	19	4	44	53	9	172	3	32
40	1247	72	26	36	819	39	143	10	19
41	1444	72	17	1	1171	18	76	9	18
42	4392	305	17	5	3672	26	32	41	77
43	7313	556	27	2	6492	51	11	31	21
44	4646	474	33	3	3682	127	0	11	25
45	3002	699	45	3	1968	102	0	7	24
46	4207	2793	49	11	942	52	1	3	68
47	.	.	.	.	.	.	.	.	.
48	.	.	.	.	.	.	.	.	.
49	.	.	.	.	.	.	.	.	.
50	.	.	.	.	.	.	.	.	.
51	310	251	7	0	1	0	0	1	0
52	365	258	11	9	0	0	0	0	0
53	660	584	17	7	0	0	0	0	0
MONTH									
JAN	4902	4767	52	9	0	0	0	0	0
FEB	7860	7717	92	6	0	0	0	0	0
MAR	618	581	6	5	0	0	0	0	0
APR	967	893	0	2	0	1	0	0	8
MAY	568	231	1	260	2	1	0	0	25
JUN	1509	49	1	1345	4	2	26	0	1
JUL	2148	23	9	1634	39	108	210	25	3
AUG	1179	66	25	545	49	110	266	23	17
SEP	484	27	10	67	153	31	124	4	26
OCT	3885	305	24	2	3264	52	34	19	30
NOV	3427	1466	48	6	1560	94	1	6	41
DEC	448	355	13	8	0	0	0	0	0
SEASON									
WIN	3387	3293	37	7	0	0	0	0	0
SPR	1035	320	1	625	2	1	10	0	12
SUM	1240	39	15	716	81	83	200	17	15
FAL	2908	501	25	4	2136	45	20	12	24
YR	1932	929	18	421	355	36	77	8	12

*Dot (·) indicates that no days during specific period met selection criteria.

Table A-12

Mean Selected Impingement Rates (based on weight [g] collected/$10^6 m^3$ water circulated) of Predominant Species and All Species Combined in Indian Point Unit No. 2 Impingement Collections during 1977 (summarized by week, month, season, and year)

PERIOD	ALL_SPP	WP	SB	TC	BH	AL	BA	AS	HC
WEEK									
1	39325	37234	160	626	0	0	0	0	0
2	34358	31967	194	241	1	0	0	0	0
3	47023	44366	320	252	2	3	0	2	0
4	35700	34035	496	132	0	1	0	0	0
5	34390	32000	816	221	0	1	0	0	0
6	47335	43061	2457	33	0	0	0	0	0
7	10419	10226	83	59	0	0	0	0	0
8	·*	·	·	·	·	·	·	·	·
9	88844	85883	1425	196	0	0	0	0	0
10	9726	8288	169	251	0	0	0	0	0
11	12581	11610	157	98	0	0	0	0	0
12	7185	5926	48	188	0	0	0	0	2
13	5108	4348	70	79	0	0	0	0	0
14	6060	5497	7	39	0	0	0	0	0
15	26231	25024	0	94	0	0	0	0	5
16	88656	86629	1	204	0	0	0	0	6
17	·	·	·	·	·	·	·	·	·
18	·	·	·	·	·	·	·	·	·
19	·	·	·	·	·	·	·	·	·
20	·	·	·	·	·	·	·	·	·
21	1197	317	1	289	42	73	0	0	270
22	1429	318	1	661	35	62	0	0	188
23	2852	873	19	1410	78	90	11	0	61
24	4461	1332	5	2472	110	72	128	2	20
25	1701	637	6	623	48	24	63	0	10
26	5258	704	15	3974	67	20	40	0	12
27	3079	372	4	2286	40	33	18	0	4
28	5057	682	2	3863	115	0	41	0	32
29	·	·	·	·	·	·	·	·	·
30	·	·	·	·	·	·	·	·	·
31	·	·	·	·	·	·	·	·	·
32	98	2	0	78	4	0	4	0	0
33	2603	255	48	1035	53	55	505	9	332
34	6682	376	79	3279	95	25	839	22	416
35	3336	337	36	1003	76	59	993	13	212
36	2214	303	46	440	78	88	720	12	163
37	1960	276	50	465	96	94	375	6	181
38	1691	196	54	143	74	21	196	4	716
39	2670	374	32	250	121	22	575	10	807
40	4482	542	51	243	1584	34	533	15	275
41	3732	350	36	3	2450	10	109	7	181
42	12152	2131	98	43	6774	106	44	262	1633
43	15245	3319	120	15	10129	154	8	133	326
44	11231	4084	178	47	4876	361	0	56	342
45	9749	4828	219	61	2646	286	0	32	411
46	22530	17247	196	180	1267	165	2	17	931
47	·	·	·	·	·	·	·	·	·
48	·	·	·	·	·	·	·	·	·
49	·	·	·	·	·	·	·	·	·
50	·	·	·	·	·	·	·	·	·
51	·	·	·	·	·	·	·	·	·
52	·	·	·	·	·	·	·	·	·
53	·	·	·	·	·	·	·	·	·
MONTH									
JAN	36130	33928	404	212	1	1	0	0	0
FEB	64958	61541	1984	127	0	0	0	0	0
MAR	8213	7261	85	120	0	0	0	0	1
APR	47087	45633	1	132	0	0	0	0	4
MAY	1348	377	1	468	34	58	2	0	200
JUN	3489	836	10	2113	76	57	61	0	18
JUL	4813	545	6	3716	84	11	39	0	15
AUG	3407	289	49	1292	69	56	736	13	268
SEP	2280	323	46	295	155	45	408	8	510
OCT	9498	2271	106	25	5381	147	47	83	465
NOV	14419	9312	216	105	2131	270	1	28	628
DEC	·	·	·	·	·	·	·	·	·
SEASON									
WIN	27977	26149	473	162	0	0	0	0	0
SPR	8974	7076	6	1259	51	49	32	0	79
SUM	2960	322	45	973	111	43	534	10	367
FAL	10634	3895	131	43	4631	176	36	71	502
YR	13504	10714	179	665	732	53	155	13	193

*Dot (·) indicates that no days during specific period met selection criteria.

Table A-13

Mean Selected Impingement Rates (based on weight [g] collected/$10^6 m^3$ water circulated) of Predominant Species and All Species Combined in Indian Point Unit No. 3 Impingement Collections during 1977 (summarized by week, month, season, and year)

PERIOD	ALL_SPP	WP	SB	TC	BH	AL	BA	AS	HC
WEEK									
1	7062	5818	22	45	0	0	0	0	0
2	7653	6645	82	38	3	0	0	2	4
3	14955	13462	210	48	0	0	0	0	0
4	·*	·	·	·	·	·	·	·	·
5	·	·	·	·	·	·	·	·	·
6	·	·	·	·	·	·	·	·	·
7	·	·	·	·	·	·	·	·	·
8	·	·	·	·	·	·	·	·	·
9	20040	18369	819	7	0	0	0	0	0
10	2481	2104	79	1	0	0	0	0	3
11	3707	2947	110	51	0	0	0	0	0
12	3528	2651	15	128	0	0	0	0	0
13	4196	3408	3	16	0	90	0	0	0
14	3399	2571	23	6	0	30	0	0	0
15	3293	3066	2	9	0	82	0	0	0
16	1397	1161	0	0	0	0	0	0	6
17	5886	4350	85	26	54	127	0	0	245
18	4901	3063	9	5	261	326	0	0	388
19	6546	3217	17	11	479	259	0	0	1453
20	7089	3864	59	65	490	708	0	1	876
21	2756	861	60	41	411	428	0	0	539
22	1963	769	6	49	289	256	1	1	310
23	5536	4022	30	522	272	193	6	4	75
24	6285	2655	30	1945	432	301	241	7	36
25	4560	1655	36	1451	314	100	231	0	5
26	7922	1438	37	4233	418	271	133	3	15
27	9391	1350	44	6115	387	213	38	1	4
28	7673	901	46	4568	238	163	441	46	24
29	2735	508	34	1124	69	104	464	9	4
30	11135	477	37	8584	89	264	1179	39	27
31	15416	1010	99	10959	216	818	1219	110	239
32	7415	1006	67	3368	132	612	720	90	453
33	4274	939	79	679	56	234	411	22	519
34	14774	984	182	6411	209	415	1333	138	825
35	8566	1273	120	2086	99	513	1259	56	723
36	4005	644	95	986	100	357	430	34	357
37	1448	385	40	185	52	95	144	5	160
38	3051	416	158	175	70	37	94	15	1703
39	2917	644	49	138	109	61	244	9	980
40	7433	1832	401	87	1432	225	229	78	471
41	4480	1440	123	6	1269	139	117	84	220
42	2521	217	3	0	310	21	11	0	1255
43	·	·	·	·	·	·	·	·	·
44	·	·	·	·	·	·	·	·	·
45	·	·	·	·	·	·	·	·	·
46	·	·	·	·	·	·	·	·	·
47	·	·	·	·	·	·	·	·	·
48	·	·	·	·	·	·	·	·	·
49	·	·	·	·	·	·	·	·	·
50	·	·	·	·	·	·	·	·	·
51	2322	1527	44	0	2	0	0	3	0
52	3730	1888	111	205	6	1	0	0	1
53	4772	3372	85	220	0	1	0	0	0
MONTH									
JAN	10698	9448	128	43	1	0	0	1	2
FEB	20040	18369	819	7	0	0	0	0	0
MAR	3436	2680	49	44	0	13	0	0	1
APR	4088	2935	22	10	105	162	0	0	192
MAY	4099	2089	31	70	373	374	1	0	591
JUN	6563	2058	35	2814	361	211	155	4	17
JUL	9442	774	55	6423	190	343	765	48	73
AUG	8234	1002	115	2840	118	416	876	71	606
SEP	3611	772	146	247	313	130	224	22	745
OCT	4207	1214	103	6	1170	119	92	75	427
NOV	·	·	·	·	·	·	·	·	·
DEC	3902	2297	96	189	4	1	0	0	0
SEASON									
WIN	6798	5830	133	41	0	8	0	0	1
SPR	4988	2282	30	1049	304	264	57	1	287
SUM	7179	856	105	3193	203	303	636	48	476
FAL	4055	1756	99	98	537	60	46	37	214
YR	6109	2066	85	1768	248	225	306	26	325

*Dot (·) indicates that no days during specific period met selection criteria.

Table A-14

Mean Selected Impingement Rates (based on weight [g] collected/$10^6 m^3$ water circulated) of Predominant Species and All Species Combined in Indian Point Units No. 2 and No. 3 Impingement Collections during 1977 (summarized by week, month, season, and year)

PERIOD	ALL_SPP	WP	SB	TC	BH	AL	BA	AS	HC
WEEK									
1	21317	19700	83	302	0	0	0	0	0
2	24179	22308	143	162	1	0	0	0	2
3	43741	41232	318	208	2	3	0	2	0
4	35700	34035	496	132	0	1	0	0	0
5	34390	32001	816	221	0	1	0	0	0
6	47335	43061	2457	33	0	0	0	0	0
7	10419	10226	83	59	0	0	0	0	0
8	.*	.	.	.	.	.	.	.	.
9	64494	61732	1301	150	0	0	0	0	0
10	6315	5414	127	133	0	0	0	0	1
11	10331	9507	153	83	0	0	0	0	0
12	6637	5320	22	162	0	0	0	0	2
13	4330	4111	39	69	0	12	0	0	0
14	4608	3901	15	21	0	17	0	0	0
15	17974	17323	1	48	0	27	0	0	3
16	59403	58243	1	146	0	0	0	0	7
17	5836	4350	85	26	54	127	0	0	245
18	4901	3063	9	5	261	326	0	0	388
19	6546	3217	18	11	479	259	0	0	1453
20	7089	3864	59	65	490	708	0	1	876
21	1892	553	27	191	202	228	0	0	395
22	1697	545	3	354	162	159	0	0	249
23	4153	2181	24	1223	159	147	9	1	64
24	5281	1897	15	2279	253	179	168	4	31
25	2310	1024	18	936	155	57	132	0	7
26	6758	1082	24	4225	245	167	76	2	14
27	5801	804	26	3884	217	115	25	0	4
28	7585	939	46	4506	230	159	437	46	26
29	2735	508	34	1124	69	104	464	9	4
30	11135	477	37	8584	89	264	1179	39	27
31	15416	1010	99	10959	216	818	1219	110	239
32	7299	982	63	3325	128	602	711	90	441
33	3572	687	69	778	51	169	435	17	434
34	12525	840	146	5322	168	319	1162	108	720
35	6325	864	94	1583	85	342	1164	43	501
36	3317	499	68	760	95	256	584	27	299
37	1629	336	42	296	71	90	238	5	161
38	2131	269	88	147	69	24	152	8	1055
39	2702	490	40	197	110	42	434	11	771
40	6337	1316	322	160	1433	158	356	50	414
41	4107	944	80	4	1836	71	101	50	196
42	9723	1639	72	30	5048	87	35	187	1586
43	15245	3319	120	15	10129	154	8	133	326
44	11231	4084	178	47	4876	361	0	56	342
45	9749	4828	219	61	2646	286	0	32	411
46	22530	17247	196	180	1268	165	2	17	931
47	.	.	.	.	.	.	.	.	.
48	.	.	.	.	.	.	.	.	.
49	.	.	.	.	.	.	.	.	.
50	.	.	.	.	.	.	.	.	.
51	2322	1527	44	0	1	0	0	3	0
52	3730	1888	111	205	6	1	0	0	1
53	4772	3372	85	220	0	1	0	0	0
MONTH									
JAN	32109	30078	380	170	1	1	0	1	0
FEB	54523	51191	1931	107	0	0	0	0	0
MAR	6662	5747	74	92	0	5	0	0	1
APR	17655	16357	19	47	92	134	0	0	169
MAY	3469	1662	21	213	263	277	1	0	526
JUN	4834	1328	20	2470	197	132	94	2	18
JUL	9231	762	53	6284	175	334	763	48	73
AUG	6755	774	92	2386	102	314	835	57	490
SEP	3171	594	116	279	290	103	329	13	594
OCT	9011	2303	114	23	4744	159	45	92	503
NOV	14419	9312	216	105	2131	270	1	28	628
DEC	3902	2297	96	189	4	1	0	0	0
SEASON									
WIN	23700	21999	436	128	0	2	0	0	0
SPR	7446	5093	20	1062	195	185	38	1	239
SUM	6293	709	83	2864	188	248	641	41	393
FAL	8521	3408	126	79	3084	135	26	58	390
YR	10923	7156	156	1335	589	158	240	24	264

*Dot (·) indicates that no days during specific period met selection criteria.

APPENDIX A.4

Comparison between Selected and Unselected Impingement Rates

Selected impingement rates developed for this report are compared with more traditional unselected rates in the following tables. Both types of rate are valid estimates of impingement, but each has limitations (see Section IV.C.2.c). In most cases, the two rate estimates provide similar values although occasional discrepancies occur. The greatest discrepancies appear to be related to months when only a few days were acceptable for selected rate computation. However, the differences under these conditions occurred in both directions; i.e., selected rates were higher than unselected rates on some occasions and lower on others.

Values presented in Tables A-15 through A-21 were calculated as follows:

$$\text{Percent of Days Included} = \frac{\text{total number of days per unit(s) meeting selection criteria}}{\text{total number of days of unit(s) operation}}$$

$$\text{Unselected Rate} = \frac{\text{total number of fish collected per unit(s) on all days of unit operation}}{\text{total volume of water circulated (including service water) per unit(s)}}$$

$$\text{Selected Rate} = \frac{\text{sum of the selected daily rates}}{\text{total number of days meeting selection criteria}}$$

$$\text{Percent of Catch Selected} = \frac{\text{total number of fish collected per unit(s) on selected days of unit operation}}{\text{total number of fish collected per unit(s) on all days of unit operation}}$$

Table A-15

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Unit No. 2 during 1977. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also indicated.)*

Month	Percent of Days Included	WHITE PERCH Unselected Rate	WHITE PERCH Selected Rate	WHITE PERCH Percent of Catch Selected	STRIPED BASS Unselected Rate	STRIPED BASS Selected Rate	STRIPED BASS Percent of Catch Selected	ATLANTIC TOMCOD Unselected Rate	ATLANTIC TOMCOD Selected Rate	ATLANTIC TOMCOD Percent of Catch Selected	BLUEBACK HERRING Unselected Rate	BLUEBACK HERRING Selected Rate	BLUEBACK HERRING Percent of Catch Selected
Jan	77.4	5487.12	5485.00	64.5	59.46	55.89	59.5	9.95	11.55	76.8	0.24	0.26	37.9
Feb	26.9	2477.40	9212.50	67.5	22.34	98.70	54.4	3.88	7.17	45.0	0.00	0.00	0.0
Mar	74.2	957.83	748.60	50.0	8.22	6.61	48.6	5.71	6.96	69.6	0.00	0.00	0.0
Apr	53.8	892.28	2044.50	58.5	0.08	0.16	66.7	4.89	5.73	35.9	0.00	0.00	0.0
May	100.0	44.79	51.36	100.0	0.14	0.15	100.0	521.50	590.80	100.0	0.33	0.38	100.0
Jun	83.3	41.86	44.24	90.4	0.44	0.45	86.4	1240.52	1281.50	88.2	1.64	1.72	89.5
Jul	100.0	10.92	19.90	100.0	0.23	0.40	100.0	887.31	1462.97	100.0	1.69	3.43	100.0
Aug	80.8	61.11	72.89	82.6	17.32	18.44	79.1	324.80	365.52	83.8	42.60	48.62	83.3
Sep	73.3	25.10	20.36	60.9	10.13	9.17	65.4	58.60	62.85	77.2	268.42	102.94	27.9
Oct	64.5	397.53	326.10	48.8	25.68	22.70	51.8	3.58	2.70	47.1	4008.26	3742.00	55.9
Nov	20.0	1490.51	1465.93	22.8	34.93	47.60	30.9	5.32	6.15	26.8	440.30	1560.17	78.3
Dec	0.0	899.10	·**	0.0	25.75	·	0.0	22.89	·	0.0	0.68	·	0.0
Average	58.5	843.76	739.05	50.1	17.20	14.03	46.7	265.79	412.39	88.8	569.61	557.27	56.0

Month	Percent of Days Included	ALEWIFE Unselected Rate	ALEWIFE Selected Rate	ALEWIFE Percent of Catch Selected	AMERICAN SHAD Unselected Rate	AMERICAN SHAD Selected Rate	AMERICAN SHAD Percent of Catch Selected	BAY ANCHOVY Unselected Rate	BAY ANCHOVY Selected Rate	BAY ANCHOVY Percent of Catch Selected	HOGCHOKER Unselected Rate	HOGCHOKER Selected Rate	HOGCHOKER Percent of Catch Selected
Jan	77.4	0.29	0.10	23.5	0.07	0.10	100.0	0.02	0.03	100.0	0.00	0.00	0.0
Feb	26.9	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0
Mar	74.2	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.01	0.02	100.0
Apr	53.8	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.18	0.31	57.1
May	100.0	0.36	0.39	100.0	0.00	0.00	0.0	0.57	0.64	100.0	10.95	12.38	100.0
Jun	83.3	0.77	0.83	89.3	0.03	0.02	75.0	17.41	19.44	95.9	1.32	1.40	91.5
Jul	100.0	0.15	0.30	100.0	0.00	0.00	0.0	9.69	16.10	100.0	0.46	0.77	100.0
Aug	80.8	24.38	24.55	99.8	6.56	6.81	75.3	266.55	274.17	80.6	9.48	10.40	82.3
Sep	73.3	15.66	17.46	80.1	2.46	2.44	71.3	166.67	173.71	75.0	19.79	23.40	84.9
Oct	64.5	60.14	50.37	47.7	20.43	18.18	57.3	32.31	32.56	72.5	38.02	29.94	50.4
Nov	20.0	36.51	94.47	59.7	3.28	6.22	38.6	0.22	0.53	57.1	26.32	40.65	35.6
Dec	0.0	0.11	·	0.0	0.04	·	0.0	0.02	·	0.0	0.12	·	0.0
Average	58.5	15.60	16.50	60.5	3.82	4.02	34.8	60.11	78.77	78.4	11.97	13.03	62.3

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

**Dot (·) indicates that no days during the month met selection criteria.

Table A-16

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Unit No. 3 during 1977. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also included.)*

Month	Percent of Days Included	WHITE PERCH Unselected Rate	WHITE PERCH Selected Rate	WHITE PERCH Percent of Catch Selected	STRIPED BASS Unselected Rate	STRIPED BASS Selected Rate	STRIPED BASS Percent of Catch Selected	ATLANTIC TOMCOD Unselected Rate	ATLANTIC TOMCOD Selected Rate	ATLANTIC TOMCOD Percent of Catch Selected	BLUEBACK HERRING Unselected Rate	BLUEBACK HERRING Selected Rate	BLUEBACK HERRING Percent of Catch Selected
Jan	22.6	891.59	1417.81	28.8	15.46	20.14	24.0	0.94	1.78	34.8	0.23	0.13	11.8
Feb	7.1	439.14	3975.80	60.8	6.65	44.35	44.3	0.36	0.50	8.7	0.00	0.00	0.0
Mar	51.6	250.08	269.90	48.4	3.57	4.02	48.3	2.00	2.78	73.3	0.00	0.00	0.0
Apr	48.3	390.02	314.52	49.9	0.40	0.42	65.0	0.94	0.45	26.3	0.43	0.49	74.4
May	74.2	315.18	245.43	57.6	0.89	0.76	64.5	55.47	67.90	91.9	3.88	3.03	58.5
Jun	70.0	57.73	58.76	70.4	0.72	0.60	59.2	1051.94	1276.80	82.5	6.37	6.76	71.4
Jul	87.1	23.78	23.03	81.9	8.80	9.17	82.3	1649.78	1680.60	89.3	42.45	39.28	80.2
Aug	96.8	63.12	65.83	98.1	27.57	28.76	98.2	595.64	626.80	99.0	50.39	52.84	98.6
Sep	86.7	29.41	27.96	80.0	11.35	10.46	77.6	62.02	59.81	81.2	132.06	151.69	96.9
Oct	90.9	52.27	73.58	98.9	14.41	19.76	99.7	0.65	0.77	100.0	467.75	651.78	98.9
Nov	0.0	-----†	-----	0.0	-----	-----	0.0	-----	-----	0.0	-----	-----	0.0
Dec	58.8	190.21	355.13	76.6	6.76	12.60	76.3	4.60	7.60	67.8	0.07	0.15	80.0
Average	62.0	207.43	166.77	52.2	8.92	10.90	79.4	418.11	571.78	88.9	51.21	75.25	95.5

Month	Percent of Days Included	ALEWIFE Unselected Rate	ALEWIFE Selected Rate	ALEWIFE Percent of Catch Selected	AMERICAN SHAD Unselected Rate	AMERICAN SHAD Selected Rate	AMERICAN SHAD Percent of Catch Selected	BAY ANCHOVY Unselected Rate	BAY ANCHOVY Selected Rate	BAY ANCHOVY Percent of Catch Selected	HOGCHOKER Unselected Rate	HOGCHOKER Selected Rate	HOGCHOKER Percent of Catch Selected
Jan	22.6	0.15	0.00	0.0	0.07	0.14	40.0	-----	0.00	0.0	0.03	0.06	50.0
Feb	7.1	----	----	0.0	----	0.00	0.0	-----	0.00	0.0	----	0.00	0.0
Mar	51.6	0.10	0.05	25.0	----	0.00	0.0	-----	0.00	0.0	0.04	0.03	33.3
Apr	48.3	0.72	0.64	55.6	0.01	0.00	0.0	-----	0.00	0.0	8.76	8.51	62.6
May	74.2	2.25	2.02	67.2	0.01	0.02	100.0	0.24	0.31	100.0	31.50	27.67	65.5
Jun	70.0	2.50	2.74	74.6	0.10	0.11	78.6	29.68	39.70	94.1	1.10	1.24	78.0
Jul	87.1	112.89	107.97	81.9	25.82	25.48	85.8	237.68	210.11	77.2	2.86	2.67	76.5
Aug	96.8	139.73	144.95	97.7	26.73	28.04	98.9	251.75	262.91	98.3	20.09	20.54	96.4
Sep	86.7	33.55	35.77	89.9	5.38	5.34	83.7	86.13	70.05	67.8	28.52	30.64	90.6
Oct	90.9	19.63	29.18	99.0	9.59	13.48	98.6	41.54	80.32	99.3	9.66	22.05	99.0
Nov	0.0	-----	-----	0.0	----	-----	0.0	-----	-----	0.0	----	----	0.0
Dec	58.8	0.03	0.08	100.0	0.06	0.07	50.0	0.04	0.07	66.7	0.03	0.04	50.0
Average	62.0	37.39	52.05	90.5	7.71	10.92	92.0	77.42	102.41	86.0	11.65	14.59	81.4

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

†Unit did not operate during month.

Table A-17

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Units No. 2 and No. 3 during 1976. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also indicated.)*

Month	Percent of Days Included	WHITE PERCH Unselected Rate	WHITE PERCH Selected Rate	WHITE PERCH Percent of Catch Selected	STRIPED BASS Unselected Rate	STRIPED BASS Selected Rate	STRIPED BASS Percent of Catch Selected	ATLANTIC TOMCOD Unselected Rate	ATLANTIC TOMCOD Selected Rate	ATLANTIC TOMCOD Percent of Catch Selected	BLUEBACK HERRING Unselected Rate	BLUEBACK HERRING Selected Rate	BLUEBACK HERRING Percent of Catch Selected
Jan	50.0	2941.80	4767.00	58.5	35.09	51.77	50.8	4.96	9.22	72.3	0.24	0.18	41.9
Feb	16.7	1395.63	7716.80	66.0	14.01	92.44	51.7	2.01	6.07	40.1	0.00	0.00	0.0
Mar	62.9	579.84	581.40	50.2	5.74	5.94	49.1	3.73	5.33	71.6	0.00	0.00	0.0
Apr	50.0	532.76	892.70	54.0	0.31	0.41	65.1	2.06	1.95	32.8	0.31	0.43	74.4
May	83.3	210.52	231.40	61.1	0.60	0.56	67.6	235.86	260.10	98.8	2.51	2.13	60.6
Jun	76.7	49.87	48.80	78.7	0.58	0.53	69.4	1145.40	1345.00	85.5	4.03	3.83	75.1
Jul	88.2	22.69	22.55	82.6	8.07	9.16	82.3	1584.91	1634.50	89.8	38.98	38.95	80.2
Aug	89.5	62.27	65.99	91.7	23.24	25.46	92.2	481.21	545.40	94.6	47.10	48.85	92.8
Sep	80.0	27.26	26.64	70.0	10.74	10.32	71.5	60.30	67.10	79.2	200.20	153.14	50.3
Oct	71.4	294.44	304.53	50.8	22.39	23.61	60.7	2.71	2.44	51.2	2950.78	3263.90	57.8
Nov	20.0	1490.51	1465.92	22.6	34.82	47.60	31.4	5.32	6.14	26.6	441.14	1560.16	81.5
Dec	20.8	594.83	355.14	10.5	17.60	12.60	12.6	15.04	7.59	8.9	0.42	0.14	6.2
Average	60.3	464.20	418.24	51.2	11.89	12.27	58.8	316.49	501.74	90.2	273.91	287.05	59.6

Month	Percent of Days Included	ALEWIFE Unselected Rate	ALEWIFE Selected Rate	ALEWIFE Percent of Catch Selected	AMERICAN SHAD Unselected Rate	AMERICAN SHAD Selected Rate	AMERICAN SHAD Percent of Catch Selected	BAY ANCHOVY Unselected Rate	BAY ANCHOVY Selected Rate	BAY ANCHOVY Percent of Catch Selected	HOGCHOKER Unselected Rate	HOGCHOKER Selected Rate	HOGCHOKER Percent of Catch Selected
Jan	50.0	0.21	0.10	14.3	0.07	0.12	66.7	0.01	0.03	100.0	0.02	0.02	50.0
Feb	16.7	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0
Mar	62.9	0.05	0.02	25.0	0.00	0.00	0.0	0.00	0.00	0.0	0.02	0.03	50.0
Apr	50.0	0.51	0.54	55.6	0.01	0.00	0.0	0.00	0.00	0.0	6.32	7.56	62.6
May	83.3	1.52	1.49	70.2	0.01	0.01	100.0	0.36	0.38	100.0	23.54	25.20	71.6
Jun	76.7	1.64	1.74	78.0	0.07	0.06	77.8	23.59	26.22	94.7	1.21	1.39	85.3
Jul	88.2	103.31	107.82	81.9	23.62	25.48	85.7	218.28	209.97	77.3	2.66	2.69	76.8
Aug	89.5	90.98	110.39	95.7	18.21	23.17	95.1	258.00	265.57	90.5	15.60	16.80	92.6
Sep	80.0	24.60	31.00	86.6	3.92	4.45	79.7	126.38	123.90	72.4	24.16	25.64	88.1
Oct	71.4	48.14	51.77	54.0	17.23	19.24	63.5	35.31	34.12	82.7	29.58	30.06	55.3
Nov	20.0	36.42	94.47	59.6	3.28	6.23	43.8	0.22	0.55	57.1	26.32	40.64	35.6
Dec	20.8	0.08	0.07	16.7	0.05	0.07	25.0	0.03	0.07	40.0	0.08	0.04	7.7
Average	60.3	25.18	36.43	82.3	5.44	7.89	82.5	63.12	92.02	83.0	10.95	13.90	72.3

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

Table A-18

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Unit No. 2 during 1976. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also indicated.)*

		WHITE PERCH			STRIPED BASS			ATLANTIC TOMCOD			BLUEBACK HERRING		
Month	Percent of Days Included	Unselected Rate	Selected Rate	Percent of Catch Selected	Unselected Rate	Selected Rate	Percent of Catch Selected	Unselected Rate	Selected Rate	Percent of Catch Selected	Unselected Rate	Selected Rate	Percent of Catch Selected
Jan	71.0	1145.63	1453.30	85.6	22.75	29.88	88.5	16.36	16.10	70.2	0.26	0.29	85.7
Feb	62.1	359.69	524.44	88.8	1.38	1.49	62.5	8.63	9.86	66.7	0.00	0.00	0.0
Mar	67.7	225.32	233.81	68.9	1.38	1.24	60.2	3.16	- 2.15	44.8	0.01	0.02	100.0
Apr	100.0	10.00	36.97	100.0	0.23	1.27	100.0	----	0.00	0.0	0.00	0.00	0.0
May	0.0	------†	-----	0.0	----	----	0.0	----	-----	0.0	-----	-----	0.0
Jun	57.1	5.74	5.78	24.3	0.08	0.00	0.0	29.38	90.62	77.6	0.46	1.00	50.0
Jul	0.0	------	-----	0.0	----	----	0.0	-----	-----	0.0	-----	-----	0.0
Aug	0.0	------	-----	0.0	----	----	0.0	----	-----	0.0	-----	-----	0.0
Sep	61.5	38.20	53.69	64.1	5.36	8.80	78.0	48.64	72.84	74.7	11.73	20.19	75.9
Oct	58.1	359.08	348.82	50.4	10.52	8.14	41.6	26.36	33.44	58.8	1218.60	1242.70	53.7
Nov	100.0	178.12	209.85	100.0	2.04	2.46	100.0	0.28	0.34	100.0	78.58	90.73	100.0
Dec	55.0	2019.06	3415.90	69.2	7.95	12.17	63.7	100.84	121.31	50.1	0.08	0.18	100.0
Average	65.7	613.16	792.67	74.1	8.18	9.97	69.9	26.31	27.11	59.1	286.13	270.72	54.2

		ALEWIFE			AMERICAN SHAD			BAY ANCHOVY			HOGCHOKER		
Month	Percent of Days Included	Unselected Rate	Selected Rate	Percent of Catch Selected	Unselected Rate	Selected Rate	Percent of Catch Selected	Unselected Rate	Selected Rate	Percent of Catch Selected	Unselected Rate	Selected Rate	Percent of Catch Selected
Jan	71.0	0.36	0.52	93.1	0.01	0.00	0.0	0.00	0.00	0.0	0.01	0.00	0.0
Feb	62.1	0.01	0.02	100.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0
Mar	67.7	0.00	0.00	0.0	0.01	.02	100.0	0.00	0.00	0.0	0.05	0.05	75.0
Apr	100.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0
May	0.0	----	---	0.0	----	----	0.0	----	-----	0.0	-----	-----	0.0
Jun	57.1	0.23	0.38	33.3	0.00	0.00	0.0	0.23	0.90	100.0	0.39	0.62	40.0
Jul	0.0	----	---	0.0	----	----	0.0	----	-----	0.0	-----	-----	0.0
Aug	0.0	----	---	0.0	----	----	0.0	----	-----	0.0	-----	-----	0.0
Sep	61.5	0.46	0.60	64.3	0.59	1.00	68.4	50.59	109.72	86.9	8.42	15.02	80.0
Oct	58.1	5.71	4.42	36.5	10.48	10.77	56.4	16.30	12.93	45.2	25.05	21.04	43.9
Nov	100.0	2.27	2.68	100.0	0.28	0.33	100.0	0.11	0.14	100.0	1.36	1.59	100.0
Dec	55.0	0.04	0.10	100.0	0.06	0.07	66.7	0.00	0.00	0.0	0.02	0.00	0.0
Average	65.7	1.52	1.15	43.3	2.49	2.46	56.7	7.32	8.34	65.3	6.46	5.36	47.5

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

†Unit did not operate during month.

Table A-19

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Unit No. 3 during 1976. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also included.)*

Month	Percent of Days Included	WHITE PERCH Unselected Rate	WHITE PERCH Selected Rate	WHITE PERCH Percent of Catch Selected	STRIPED BASS Unselected Rate	STRIPED BASS Selected Rate	STRIPED BASS Percent of Catch Selected	ATLANTIC TOMCOD Unselected Rate	ATLANTIC TOMCOD Selected Rate	ATLANTIC TOMCOD Percent of Catch Selected	BLUEBACK HERRING Unselected Rate	BLUEBACK HERRING Selected Rate	BLUEBACK HERRING Percent of Catch Selected
Jan	0.0	-----†	-----	0.0	----	----	0.0	----	----	0.0	----	----	0.0
Feb	50.0	90.92	345.20	60.6	0.39	1.50	58.3	0.20	0.13	16.7	0.00	0.00	0.0
Mar	0.0	-----	-----	0.0	----	----	0.0	----	----	0.0	----	----	0.0
Apr	33.3	59.37	231.92	61.2	0.48	1.75	57.7	0.17	0.32	33.3	1.32	5.45	71.6
May	67.7	60.08	73.00	78.0	1.07	1.47	83.7	10.63	9.53	26.1	8.24	11.61	78.1
Jun	73.3	16.84	18.46	76.6	0.44	0.48	78.0	14.66	15.26	73.5	6.46	7.17	76.4
Jul	51.6	9.87	12.10	50.4	0.65	0.22	15.7	19.79	6.17	16.2	0.83	1.44	69.7
Aug	64.5	25.81	32.59	64.6	2.06	2.49	60.9	36.37	39.34	57.2	6.40	8.46	69.5
Sep	70.0	27.95	22.46	69.9	4.57	4.06	83.9	126.24	99.77	77.1	11.62	7.48	52.0
Oct	74.2	145.91	147.28	74.9	8.22	7.21	64.8	21.24	19.85	75.4	1086.95	1205.40	84.4
Nov	80.0	845.51	965.60	85.4	5.28	5.60	86.9	7.01	7.48	83.9	89.91	82.57	88.0
Dec	74.2	533.04	468.50	68.7	1.73	1.70	66.4	5.86	6.14	79.7	0.04	0.07	100.0
Average	67.3	180.77	248.43	78.0	2.71	3.42	71.7	25.38	29.13	65.1	145.35	215.37	84.1

Month	Percent of Days Included	ALEWIFE Unselected Rate	ALEWIFE Selected Rate	ALEWIFE Percent of Catch Selected	AMERICAN SHAD Unselected Rate	AMERICAN SHAD Selected Rate	AMERICAN SHAD Percent of Catch Selected	BAY ANCHOVY Unselected Rate	BAY ANCHOVY Selected Rate	BAY ANCHOVY Percent of Catch Selected	HOGCHOKER Unselected Rate	HOGCHOKER Selected Rate	HOGCHOKER Percent of Catch Selected
Jan	0.0	----	----	0.0	----	----	0.0	----	----	0.0	-----	----	0.0
Feb	50.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0
Mar	0.0	----	----	0.0	----	----	0.0	----	----	0.0	-----	----	0.0
Apr	33.3	1.23	5.30	66.7	0.00	0.00	0.0	1.51	2.06	67.9	2.68	10.22	55.7
May	67.7	3.24	4.47	81.3	0.05	0.03	50.0	0.80	0.73	31.9	10.99	12.78	82.0
Jun	73.3	1.78	1.97	77.8	0.18	0.18	76.5	0.91	0.91	75.3	1.75	1.99	78.0
Jul	51.6	1.99	1.07	20.2	1.60	0.76	19.9	25.31	14.46	27.7	6.23	1.08	7.8
Aug	64.5	3.32	4.04	63.0	2.64	3.44	66.9	21.14	24.79	61.9	31.40	32.64	54.6
Sep	70.0	3.31	2.66	77.0	4.06	2.96	70.5	30.35	24.85	76.6	52.01	29.21	52.9
Oct	74.2	8.50	9.12	78.0	19.47	18.73	71.8	8.44	7.28	74.6	17.84	15.31	65.0
Nov	80.0	5.98	5.81	91.0	2.08	1.81	82.5	0.02	0.02	50.0	2.81	2.93	87.3
Dec	74.2	0.23	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.04	0.07	100.0
Average	67.3	3.28	5.29	74.2	3.53	4.28	68.8	9.98	9.93	56.5	13.60	13.48	56.2

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

†Unit did not operate during month.

Table A-20

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Units No. 2 and No. 3 during 1976. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also indicated.)*

Month	Percent of Days Included	WHITE PERCH Unselected Rate	WHITE PERCH Selected Rate	WHITE PERCH Percent of Catch Selected	STRIPED BASS Unselected Rate	STRIPED BASS Selected Rate	STRIPED BASS Percent of Catch Selected	ATLANTIC TOMCOD Unselected Rate	ATLANTIC TOMCOD Selected Rate	ATLANTIC TOMCOD Percent of Catch Selected	BLUEBACK HERRING Unselected Rate	BLUEBACK HERRING Selected Rate	BLUEBACK HERRING Percent of Catch Selected
Jan	71.0	1145.63	1453.40	85.6	22.75	29.89	88.5	16.36	16.10	70.2	0.26	0.29	85.7
Feb	60.0	281.88	463.18	86.2	1.10	1.44	62.1	6.19	9.37	66.2	0.00	0.00	0.0
Mar	67.7	171.82	233.80	68.9	1.05	1.25	60.2	2.41	2.14	44.8	0.01	0.02	100.0
Apr	46.7	55.71	148.35	60.8	0.46	1.56	59.2	0.16	0.19	33.3	1.22	3.12	67.6
May	67.7	60.08	73.00	78.7	1.07	1.48	83.7	10.63	9.54	26.1	8.24	11.62	78.1
Jun	70.3	15.50	17.82	74.3	0.39	0.43	76.2	16.44	21.74	74.3	5.73	6.57	76.1
Jul	51.6	9.87	12.10	50.4	0.65	0.22	15.7	19.79	6.17	16.2	0.83	1.44	69.7
Aug	64.5	25.81	32.59	64.6	2.06	2.48	60.9	36.37	39.33	57.1	6.40	8.47	69.5
Sep	67.4	30.90	34.40	67.9	4.80	6.02	82.0	103.94	107.30	76.7	11.65	11.67	58.8
Oct	66.1	253.60	215.97	57.2	9.38	7.43	51.6	23.82	26.74	66.0	1153.46	1350.10	67.9
Nov	85.0	743.99	855.90	85.9	4.79	4.82	87.7	5.99	6.22	84.0	88.18	72.42	89.2
Dec	66.7	1140.96	1268.10	69.1	4.27	4.36	64.4	44.71	36.08	52.4	0.06	0.09	100.0
Average	66.7	318.36	439.05	75.4	4.43	5.72	70.6	18.40	28.42	84.5	186.60	234.76	68.8

Month	Percent of Days Included	ALEWIFE Unselected Rate	ALEWIFE Selected Rate	ALEWIFE Percent of Catch Selected	AMERICAN SHAD Unselected Rate	AMERICAN SHAD Selected Rate	AMERICAN SHAD Percent of Catch Selected	BAY ANCHOVY Unselected Rate	BAY ANCHOVY Selected Rate	BAY ANCHOVY Percent of Catch Selected	HOGCHOKER Unselected Rate	HOGCHOKER Selected Rate	HOGCHOKER Percent of Catch Selected
Jan	71.0	0.36	0.52	93.1	0.01	0.00	0.0	0.00	0.00	0.0	0.01	0.00	0.0
Feb	60.0	0.01	0.01	100.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0
Mar	67.7	0.00	0.00	0.0	0.01	0.02	100.0	0.00	0.00	0.0	0.04	0.05	75.0
Apr	46.7	1.14	3.04	66.7	0.00	0.00	0.0	1.40	3.45	67.9	2.48	5.84	54.2
May	67.7	3.24	4.48	81.3	0.05	0.03	50.0	0.80	0.73	31.9	10.99	12.78	82.3
Jun	70.3	1.59	1.82	77.0	0.16	0.16	76.5	0.82	0.95	76.1	1.58	1.87	76.9
Jul	51.6	1.99	1.07	20.2	1.60	0.76	19.9	25.31	14.46	27.6	6.23	1.06	7.8
Aug	64.5	3.32	4.04	63.0	2.64	3.43	66.9	21.14	24.79	61.8	31.40	32.64	54.5
Sep	67.4	2.49	2.44	76.4	3.06	2.85	70.3	36.16	54.94	80.6	39.48	29.52	54.5
Oct	66.1	7.09	7.00	60.8	14.93	14.63	66.1	12.41	9.43	55.0	21.48	19.12	52.4
Nov	85.0	5.42	4.36	91.9	1.81	1.27	83.7	0.03	0.04	75.0	2.59	2.62	88.0
Dec	66.7	0.15	0.02	10.5	0.02	0.02	66.7	0.00	0.00	0.0	0.03	0.05	75.0
Average	66.7	2.56	3.19	68.1	3.04	3.65	65.5	8.70	9.38	58.9	10.68	10.63	54.4

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

Table A-21

Comparison between Selected and Unselected Impingement Rates (No. fish collected/$10^6 m^3$ water circulated) for Eight Species Impinged at Indian Point Unit No. 2 during 1975. (Corresponding percentages of days within each month as well as percentages of total catch/species included in each selected rate are also indicated.)*

Month	Percent of Days Included	WHITE PERCH Unselected Rate	WHITE PERCH Selected Rate	WHITE PERCH Percent of Catch Selected	STRIPED BASS Unselected Rate	STRIPED BASS Selected Rate	STRIPED BASS Percent of Catch Selected	ATLANTIC TOMCOD Unselected Rate	ATLANTIC TOMCOD Selected Rate	ATLANTIC TOMCOD Percent of Catch Selected	BLUEBACK HERRING Unselected Rate	BLUEBACK HERRING Selected Rate	BLUEBACK HERRING Percent of Catch Selected
Jan	87.1	632.10	753.70	89.3	3.21	3.60	96.3	8.51	8.21	86.6	0.04	0.02	50.0
Feb	92.8	482.07	521.00	98.8	10.79	11.72	99.5	5.14	5.57	94.6	0.21	0.22	100.0
Mar	80.6	442.49	567.50	67.3	1.93	3.24	81.4	0.75	0.78	95.6	0.16	0.14	100.0
Apr	79.3	804.58	718.90	84.9	5.23	5.15	90.5	0.90	0.82	88.0	2.19	1.69	70.3
May	71.0	105.18	97.00	51.7	0.50	0.63	74.2	5.87	5.56	66.8	2.07	1.67	48.8
Jun	90.0	13.19	13.51	90.9	0.24	0.24	91.2	204.32	220.41	95.5	1.07	1.11	92.6
Jul	82.1	13.34	13.60	86.3	9.79	9.86	83.8	115.43	101.85	70.1	9.74	11.11	93.9
Aug	76.2	138.31	168.59	86.4	9.65	10.93	78.9	127.80	143.07	80.0	10.32	12.87	89.5
Sep	86.7	90.90	79.18	78.3	4.90	4.55	83.6	138.37	110.89	72.1	5.40	5.55	81.8
Oct	80.6	90.84	84.71	98.5	2.79	2.62	98.2	3.59	2.99	99.6	600.74	547.50	99.5
Nov	80.0	254.98	260.95	83.1	1.88	1.93	82.5	3.16	2.94	92.4	892.47	915.30	89.2
Dec	77.4	402.00	437.90	73.0	3.28	3.26	65.8	14.78	15.65	67.8	95.52	123.47	85.0
Average	82.1	229.40	239.68	82.1	4.39	4.62	82.7	68.42	70.42	80.8	138.99	159.56	90.2

Month	Percent of Days Included	ALEWIFE Unselected Rate	ALEWIFE Selected Rate	ALEWIFE Percent of Catch Selected	AMERICAN SHAD Unselected Rate	AMERICAN SHAD Selected Rate	AMERICAN SHAD Percent of Catch Selected	BAY ANCHOVY Unselected Rate	BAY ANCHOVY Selected Rate	BAY ANCHOVY Percent of Catch Selected	HOGCHOKER Unselected Rate	HOGCHOKER Selected Rate	HOGCHOKER Percent of Catch Selected
Jan	87.1	0.04	0.04	100.0	0.06	0.07	100.0	0.00	0.00	0.0	0.02	0.02	100.0
Feb	92.8	0.66	0.70	100.0	0.04	0.04	100.0	0.06	0.06	100.0	0.00	0.00	0.0
Mar	80.6	0.03	0.04	100.0	0.00	0.00	0.0	0.03	0.09	100.0	0.00	0.00	0.0
Apr	79.3	0.07	0.08	83.3	0.00	0.00	0.0	0.00	0.00	0.0	0.57	0.24	39.6
May	71.0	0.65	0.68	74.0	0.00	0.00	0.0	0.08	0.12	100.0	20.75	28.50	94.6
Jun	90.0	2.55	2.79	96.6	0.00	0.00	0.0	11.25	12.12	95.4	4.26	4.36	90.5
Jul	82.1	17.80	19.50	90.6	3.44	3.22	75.1	188.38	176.69	85.1	7.96	7.92	84.6
Aug	76.2	1.36	1.53	78.6	0.64	0.77	90.3	393.96	421.01	81.2	34.71	38.58	79.2
Sep	86.7	1.51	1.20	74.5	1.53	4.40	93.0	192.25	171.59	82.5	84.77	74.63	77.5
Oct	80.6	2.27	1.90	99.4	2.82	2.35	99.6	97.52	83.06	100.0	6.55	6.27	98.8
Nov	80.0	6.78	7.11	84.4	1.79	1.96	89.8	0.02	0.03	100.0	2.71	2.69	80.4
Dec	77.4	0.82	1.05	93.3	0.09	0.09	72.7	0.26	0.25	79.3	0.74	0.80	82.6
Average	82.1	3.68	3.99	85.2	1.01	1.08	84.5	85.63	84.51	77.5	16.73	17.16	80.6

*See legend on title page of Appendix A.4 for methods used to calculate values presented.

Table A-22

Total Monthly Discharge (x $10^6 m^3$ water circulated) at Indian Point Units No. 2 and No. 3, Service Water Included, 1976-1977
(Values represent unselected volumes)

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Unit 2	50.4	51.6	30.5	84.1	118.9	138.8	131.7	97.3	121.6	78.8	105.5	109.7
1975	Unit 3	-*	-	-	-	-	-	-	-	-	-	-	-
	Combined	50.4	51.6	30.5	84.1	118.9	138.8	131.7	97.3	121.6	78.8	105.5	109.7
	Unit 2	79.9	75.1	81.9	4.3	-	12.9	-	-	32.3	107.1	17.6	51.3
1976	Unit 3	-	30.6	25.5	53.7	85.9	93.7	107.0	113.1	80.1	104.9	98.1	74.1
	Combined	79.9	105.7	107.4	58.0	85.9	106.6	107.0	113.1	112.4	212.0	115.7	125.4
	Unit 2	58.8	56.5	71.8	39.9	88.1	133.3	13.0	106.8	140.9	123.3	95.4	88.7
1977	Unit 3	73.0	63.9	82.3	100.5	139.5	135.7	139.8	146.0	141.0	53.7	-	66.7
	Combined	131.8	120.4	154.1	140.4	227.6	269.0	152.8	252.8	281.9	176.0	95.4	155.4

*Unit did not operate during month.

Table A-23

Total Monthly Discharge (x $10^6 m^3$ water circulated) for Selected Days at Indian Point Units No. 2 and No. 3, Service Water Excluded, 1976-1977

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Unit 2	43.0	46.9	23.4	61.4	79.8	122.7	99.0	66.8	99.9	68.3	85.4	82.1
1975	Unit 3	-*	-	-	-	-	-	-	-	-	-	-	-
	Combined	43.0	46.9	23.4	61.4	79.8	122.7	99.0	66.8	99.9	68.3	85.4	82.1
	Unit 2	54.4	42.9	54.2	1.2	-	3.3	-	-	18.2	55.4	14.6	21.2
1976	Unit 3	-	5.4	●**	8.2	54.9	65.1	45.2	59.3	56.9	73.4	75.9	47.3
	Combined	54.4	48.3	54.2	9.4	54.9	68.4	45.2	59.3	75.1	128.8	90.5	68.5
	Unit 2	38.1	9.1	46.5	13.2	77.4	112.2	9.1	77.6	100.5	76.2	22.0	●
1977	Unit 3	13.7	4.3	40.4	50.0	104.5	92.9	120.7	137.4	118.3	33.2	-	27.0
	Combined	51.8	13.4	86.9	63.2	181.9	205.1	129.8	215.0	218.8	109.4	22.0	27.0

* Unit did not operate during month.

** Dot (●) indicates that no days during the month met selection criteria.

APPENDIX A.5

Recaptures of Marked Fish

Definitions of species codes and tag type codes appearing in this section are as follows:

SPECIES 30	:	Striped Bass
SPECIES 32	:	Atlantic Tomcod
SPECIES 35	:	White Perch
TAG TYPE 5	:	Floy Fingerling Tag
TAG TYPE 6	:	Carlin Tag
TAG TYPE 9	:	Dennison Internal Anchor Tag
TAG TYPE 26	:	Floy Fingerling Tag and 1st Dorsal Finclip
TAG TYPE 29	:	Dennison Internal Anchor Tag and 1st Dorsal Finclip
TAG TYPE 30	:	Dennison Internal Anchor Tag and 1st Dorsal Finclip
MR	:	Multiple recapture (i.e., the fish was recaptured more than once; indicated by double asterisks [**] in MR column)
SPECIES	:	Species Code
TT	:	Tag Type
TAG_NO	:	Tag Number
RL_DATE	:	Release Date (month, day, year)
RL_MONTH	:	Release Month
RL_RM	:	Release River Mile
RL_SITE	:	Release Site
RL_LENG	:	Release Total Length (mm)
RL_GR	:	Release Gear (Sampling Device)
RC_DATE	:	Recovery Date (month, day, year)
RC_MONTH	:	Recovery Month
RC_RM	:	Recovery River Mile
RC_SITE	:	Recovery Site
RC_LENG	:	Recovery Total Length (mm)
DAYS	:	Days at Large
DSTNC	:	Distance in Miles (Rel. - Rec.)
RC_GR	:	Recovery Gear (Sampling Device)
DESC	:	Recovery Gear Description

Table A-24

Striped Bass, White Perch, and Atlantic Tomcod Marked and Released from 1974 through 1977 and Recaptured during 1977 (summarized by species, month of recapture, tag type, and date of recapture)*

			RELEASE								RECOVERY				
SPECIES=30 RC_MONTH=1															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	30414	43076	40	WEST	234	14	12177	0			265	40	98	SPORTS FISHERMAN
SPECIES=30 RC_MONTH=2															
	5	40117	92476	57	WEST	175	12	22377	3	WEST		151	54	98	SPORTS FISHERMAN
SPECIES=30 RC_MONTH=3															
	5	44240	102576	42	EAST	213	14	31277	3	WEST		137	39	98	SPORTS FISHERMAN
SPECIES=30 RC_MONTH=6															
	5	37400	90776	60	EAST	176	5	60877	38	EAST	190	273	22	5	BOX TRAP
	5	30625	61576	37	WEST	238	12	61877	.			368	.	98	SPORTS FISHERMAN
	5	46939	110976	42	EAST	169	14	61877	75			220	-33	98	SPORTS FISHERMAN
	5	30077	102275	33	EAST	202	14	62677	5	EAST		612	28	98	SPORTS FISHERMAN
SPECIES=30 RC_MONTH=7															
	5	40585	92776	60	EAST	218	5	70177	152	WEST		276	-92	98	SPORTS FISHERMAN
	5	39381	92076	60	EAST	217	5	72777	60	EAST	233	309	0	5	BOX TRAP
	5	46932	110976	42	EAST	218	14	72777	65	WEST	218	259	-23	96	DANSKAMMER
SPECIES=30 RC_MONTH=9															
	26	57021	90677	34	EAST	131	14	92277	34	EAST	185	16	0	14	200' BEACH SEINE
	26	53554	91477	60	EAST	208	5	92377	60	EAST	193	9	0	5	BOX TRAP
	26	56338	90677	35	EAST	160	12	92677	35	EAST	168	20	0	53	500' BEACH SEINE

*See legend on title page of Appendix A.5 for definitions of abbreviations.

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=32 RC_MONTH=1

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	6	27230	122176	56	WEST	126	36	10277	42	EAST		11	14	99	INDIAN POINT
	6	20870	120876	51	WEST	202	36	10377	51	WEST	202	25	0	36	BOX TRAP
	6	21466	121676	51	EAST	234	36	10377	51	EAST	234	17	0	36	BOX TRAP
**	6	21598	121576	76	EAST	138	36	10377	67	EAST	136	18	9	36	BOX TRAP
	6	21955	121676	51	WEST	177	36	10377	50	WEST		17	1	98	SPORTS FISHERMAN
	6	22497	121376	51	EAST	223	36	10377	51	EAST	222	20	0	36	BOX TRAP
	6	22980	121676	51	EAST	210	36	10377	51	WEST	208	17	0	36	BOX TRAP
	6	23165	121376	51	WEST	216	36	10377	51	EAST	215	20	0	36	BOX TRAP
	6	23239	121376	51	WEST	168	36	10377	51	EAST	166	20	0	36	BOX TRAP
	6	24074	121776	51	WEST	158	36	10377	51	EAST	158	16	0	36	BOX TRAP
	6	24612	121776	51	WEST	196	36	10377	51	EAST	196	16	0	36	BOX TRAP
	6	26668	121676	51	WEST	135	36	10377	51	WEST	139	17	0	36	BOX TRAP
	6	27053	122176	56	WEST	253	36	10377	51	EAST	252	12	5	36	BOX TRAP
	6	28024	123076	67	EAST	159	36	10377	67	EAST	158	3	0	36	BOX TRAP
	6	28498	122076	52	WEST	115	36	10377	42	EAST	111	13	10	99	INDIAN POINT
	6	28589	122776	67	EAST	166	36	10377	67	EAST	163	6	0	36	BOX TRAP
	6	29512	122176	51	WEST	161	36	10377	51	EAST	160	12	0	36	BOX TRAP
	6	29684	122176	67	EAST	145	36	10377	76	EAST	144	12	-9	36	BOX TRAP
	6	29936	122076	76	EAST	215	36	10377	67	EAST	214	13	9	36	BOX TRAP
	6	34666	123076	51	EAST	163	36	10377	51	EAST	160	3	0	36	BOX TRAP
	6	35814	122876	56	WEST	162	36	10377	51	WEST	164	5	5	36	BOX TRAP
	6	19685	121076	51	EAST	205	36	10477	51	EAST	208	24	0	36	BOX TRAP
	6	22947	121676	51	EAST	216	36	10477	51	WEST	215	18	0	36	BOX TRAP
	6	25366	121576	71	WEST	119	36	10477	66	WEST	116	19	5	96	DANSKAMMER
	6	26867	121576	51	EAST	226	36	10477	52	WEST	232	19	-1	36	BOX TRAP
	6	28221	122276	67	EAST	155	36	10477	66	WEST	151	12	1	96	DANSKAMMER
	6	28569	122776	67	EAST	147	36	10477	65	WEST	143	7	2	91	ROSETON
	6	29517	122176	51	WEST	136	36	10477	51	EAST	137	13	0	36	BOX TRAP
	6	30698	122176	51	EAST	187	36	10477	51	EAST	189	13	0	36	BOX TRAP
	6	32701	10377	51	WEST	247	36	10477	51	WEST	244	1	0	36	BOX TRAP
	6	35490	10377	51	EAST	150	36	10477	51	EAST	150	1	0	36	BOX TRAP
	6	35574	10377	51	EAST	134	36	10477	51	EAST	132	1	0	36	BOX TRAP
	6	35629	10377	51	EAST	149	36	10477	51	EAST	149	1	0	36	BOX TRAP
	6	35640	10377	51	EAST	137	36	10477	51	EAST	139	1	0	36	BOX TRAP
	6	38219	123076	51	WEST	134	36	10477	52	WEST	132	4	-1	36	BOX TRAP
	6	38909	10377	51	WEST	150	36	10477	51	WEST	149	1	0	36	BOX TRAP
	6	39992	10377	51	EAST	170	36	10477	51	EAST	171	1	0	36	BOX TRAP
	6	10116	122375	51	EAST	188	36	10577	66	WEST	254	378	-15	96	DANSKAMMER
	6	19571	121076	51	EAST	154	36	10577	51	EAST	151	25	0	36	BOX TRAP
	6	26926	122076	71	WEST	127	36	10577	66	WEST	127	15	5	96	DANSKAMMER
	6	33868	10377	76	EAST	168	36	10577	76	EAST	165	2	0	36	BOX TRAP
	6	35522	10377	51	EAST	162	36	10577	51	EAST	162	2	0	36	BOX TRAP
	6	35608	10377	51	EAST	151	36	10577	51	WEST	150	2	0	36	BOX TRAP
	6	39288	10477	51	EAST	152	36	10577	51	EAST	149	1	0	36	BOX TRAP

Table A-24 (contd)

			RELEASE							RECOVERY					
SPECIES=32 RC_MONTH=1															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	6	40315	10477	76	EAST	232	36	10577	76	EAST	232	1	0	36	BOX TRAP
	6	19312	112476	27	EAST	142	36	10677	36	EAST	146	42	-9	36	BOX TRAP
	6	23230	121376	51	WEST	154	36	10677	51	EAST	154	23	0	36	BOX TRAP
	6	23607	122976	60	EAST	168	36	10677	51	EAST	166	7	9	36	BOX TRAP
	6	31006	121776	51	EAST	253	36	10677	52	WEST	253	19	-1	36	BOX TRAP
	6	32157	123076	36	EAST	160	36	10677	36	EAST	158	6	0	36	BOX TRAP
	6	32381	10377	51	WEST	180	36	10677	51	EAST	179	3	0	36	BOX TRAP
	6	35643	10377	51	EAST	114	36	10677	51	EAST	116	3	0	36	BOX TRAP
	6	37384	122976	51	EAST	226	36	10677	51	EAST	224	7	0	36	BOX TRAP
	6	39375	10477	51	EAST	167	36	10677	51	EAST	166	2	0	36	BOX TRAP
	6	21822	121676	51	WEST	126	36	10777	51	EAST	126	21	0	36	BOX TRAP
	6	22176	120976	71	WEST	150	36	10777	51	EAST	146	28	20	36	BOX TRAP
	6	23219	121376	51	WEST	136	36	10777	51	EAST	135	24	0	36	BOX TRAP
	6	23416	121476	51	EAST	176	36	10777	51	EAST	175	23	0	36	BOX TRAP
	6	23952	121676	51	EAST	125	36	10777	51	EAST	126	21	0	36	BOX TRAP
	6	25736	122076	76	EAST	139	36	10777	51	EAST	140	17	25	36	BOX TRAP
	6	28331	122076	51	WEST	148	36	10777	51	WEST	148	17	0	36	BOX TRAP
	6	37071	122976	51	EAST	139	36	10777	42	EAST	134	8	9	99	INDIAN POINT
	6	37426	122976	51	EAST	157	36	10777	51	EAST	155	8	0	36	BOX TRAP
	6	39177	10477	51	EAST	142	36	10777	51	EAST	143	3	0	36	BOX TRAP
**	6	39441	10477	51	EAST	203	36	10777	51	EAST	201	3	0	36	BOX TRAP
	6	29150	122776	36	EAST	152	36	11077	36	EAST	151	13	0	36	BOX TRAP
	6	30572	123076	36	EAST	145	36	11077	36	EAST	139	10	0	36	BOX TRAP
	6	38734	123076	36	EAST	176	36	11077	36	EAST	175	10	0	36	BOX TRAP
**	6	39441	10477	51	EAST	203	36	11077	51	EAST	200	6	0	36	BOX TRAP
	6	39938	10377	51	EAST	283	36	11077	36	EAST	286	7	15	36	BOX TRAP
	6	23010	121376	51	WEST	148	36	11177	51	WEST	149	28	0	36	BOX TRAP
	6	24779	121776	67	EAST	179	36	11177	65	WEST	175	24	2	96	DANSKAMMER
	6	28270	122276	67	EAST	158	36	11177	66	WEST	155	19	1	96	DANSKAMMER
	6	28552	122776	67	EAST	150	36	11177	66	WEST	148	14	1	96	DANSKAMMER
	6	28692	122276	67	EAST	148	36	11177	66	WEST	143	19	1	96	DANSKAMMER
	6	30346	122776	71	WEST	116	36	11177	65	WEST	113	14	6	91	ROSETON
	6	30365	122776	71	WEST	142	36	11177	65	WEST	141	14	6	96	DANSKAMMER
	6	30481	122776	71	WEST	148	36	11177	65	WEST	147	14	6	96	DANSKAMMER
	6	31089	121776	51	EAST	137	36	11177	51	WEST	137	24	0	36	BOX TRAP
	6	32833	10377	51	EAST	153	36	11177	51	EAST	150	8	0	36	BOX TRAP
	6	39789	10477	51	EAST	145	36	11177	51	EAST	143	7	0	36	BOX TRAP
	6	24031	121776	51	WEST	177	36	11277	65	WEST	170	25	-14	91	ROSETON
	6	29132	122776	36	EAST	232	36	11277	51	EAST	230	15	-15	36	BOX TRAP
	6	30967	122176	51	EAST	148	36	11277	51	EAST	149	21	0	36	BOX TRAP
	6	35552	10377	51	EAST	255	36	11277	51	EAST	250	9	0	36	BOX TRAP
	6	35828	122876	56	WEST	147	36	11277	51	WEST	146	14	5	36	BOX TRAP
	6	37076	122976	51	EAST	133	36	11277	51	EAST	135	13	0	36	BOX TRAP
	6	39970	10377	51	EAST	135	36	11377	37	WEST	132	10	14	94	OTHER

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=32 RC_MONTH=1

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	6	40625	11177	67	EAST	154	36	11377	71	WEST	155	2	-4	36	BOX TRAP
	6	25500	121676	51	EAST	122	36	11477	42	EAST	116	28	9	99	INDIAN POINT
	6	37173	122976	51	EAST	141	36	11477	51	EAST	140	15	0	36	BOX TRAP
	6	19125	120276	52	WEST	151	36	11577	37	WEST	207	43	15	94	OTHER
	6	24157	121676	56	WEST	150	36	11577	37	WEST	147	29	19	94	OTHER
	6	35974	122876	56	WEST	125	36	11577	42	EAST	122	17	14	99	INDIAN POINT
	6	26005	121676	52	WEST	158	36	11777	51	EAST	156	31	1	36	BOX TRAP
	6	36153	10777	51	WEST	162	36	11777	51	WEST	158	10	0	36	BOX TRAP
**	6	43927	11377	36	EAST	161	36	11777	36	EAST	159	4	0	36	BOX TRAP
	6	33988	10377	76	EAST	146	36	11877	65	WEST	140	15	11	91	ROSETON
	6	39860	11777	51	WEST	149	36	11877	51	WEST	149	1	0	36	BOX TRAP
	6	27840	122776	71	WEST	141	36	11977	65	WEST	137	22	6	91	ROSETON
	6	29205	122776	67	EAST	155	36	11977	65	WEST	149	22	2	91	ROSETON
	6	31504	122076	51	EAST	161	36	11977	52	WEST	164	29	-1	36	BOX TRAP
	6	37216	122976	51	EAST	145	36	11977	51	EAST	146	20	0	36	BOX TRAP
	6	28908	122076	52	WEST	161	36	12077	51	EAST	160	30	1	36	BOX TRAP
	6	30595	123076	36	EAST	141	36	12077	51	EAST	140	20	-15	36	BOX TRAP
**	6	38153	123076	51	WEST	146	36	12077	51	EAST	143	20	0	36	BOX TRAP
	6	38530	10477	51	EAST	148	36	12077	51	EAST	146	16	0	36	BOX TRAP
	6	41527	10477	51	WEST	231	36	12077	51	EAST	228	16	0	36	BOX TRAP
**	6	38153	123076	51	WEST	146	36	12177	51	EAST	144	21	0	36	BOX TRAP
	6	38339	123076	51	WEST	166	36	12177	51	EAST	165	21	0	36	BOX TRAP
	6	20401	120876	36	EAST	148	36	12277	37	WEST	149	44	-1	97	BOWLINE
	6	30587	123076	36	EAST	142	36	12277	37	WEST	142	22	-1	97	BOWLINE
	6	21769	120976	51	EAST	201	36	12477	51	EAST	192	45	0	36	BOX TRAP
	6	36259	10477	36	EAST	160	36	12477	36	EAST	148	20	0	36	BOX TRAP
	6	23542	122976	71	WEST	143	36	12577	65	WEST	139	26	6	91	ROSETON
	6	24300	121676	56	WEST	216	36	12577	65	WEST	209	39	-9	91	ROSETON
	6	28050	123076	67	EAST	137	36	12577	66	WEST	134	25	1	96	DANSKAMMER
	6	34425	123076	67	EAST	157	36	12577	66	WEST	153	25	1	96	DANSKAMMER
	6	36708	122976	51	WEST	210	36	12577	65	WEST	205	26	-14	91	ROSETON
	6	38389	123076	51	EAST	173	36	12577	66	WEST	175	25	-15	94	OTHER
	6	40066	10477	67	EAST	193	36	12577	66	WEST	192	21	1	94	OTHER
	6	41942	12477	76	EAST	118	36	12577	76	EAST	119	1	0	36	BOX TRAP
	6	41946	12477	76	EAST	165	36	12577	76	EAST	163	1	0	36	BOX TRAP
	6	41948	12477	76	EAST	158	36	12577	76	EAST	159	1	0	36	BOX TRAP
	6	33752	12577	71	WEST	128	36	12677	72	WEST	125	1	-1	36	BOX TRAP
	6	32297	123076	36	EAST	121	36	12777	27	EAST	121	27	9	36	BOX TRAP
	6	36572	122976	51	WEST	150	36	12777	51	EAST	146	28	0	36	BOX TRAP
	6	37709	12677	51	EAST	141	36	12777	51	EAST	139	1	0	36	BOX TRAP
	6	37726	12677	51	EAST	135	36	13177	51	EAST	133	5	0	36	BOX TRAP
	6	40944	12077	60	EAST	151	36	13177	51	EAST	149	11	9	36	BOX TRAP

Table A-24 (contd)

RELEASE / RECOVERY

SPECIES=32 RC_MONTH=2

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	6	25866	122076	76	EAST	159	36	20177	66	WEST	153	42	10	96	DANSKAMMER
	6	33798	12877	76	EAST	137	36	20177	71	WEST	138	4	5	36	BOX TRAP
	6	40865	13177	51	EAST	126	36	20177	51	EAST	122	1	0	36	BOX TRAP
	6	41913	12177	52	WEST	157	36	20177	51	EAST	157	11	1	36	BOX TRAP
	6	33307	20177	51	EAST	142	36	20277	51	EAST	140	1	0	36	BOX TRAP
	6	33707	10577	51	WEST	173	36	20277	51	EAST	143	28	0	36	BOX TRAP
	6	42972	20277	51	EAST	137	36	20377	51	EAST	137	1	0	36	BOX TRAP
	6	41146	11977	71	WEST	159	36	20777	51	EAST	157	19	20	36	BOX TRAP
	6	42375	11377	76	EAST	154	36	20877	66	WEST	149	26	10	96	DANSKAMMER
	6	28770	122176	67	EAST	244	36	20977	65	WEST	230	49	2	91	ROSETON
	6	33598	20177	51	EAST	141	36	20977	51	EAST	140	8	0	36	BOX TRAP
	6	38583	10477	51	EAST	147	36	20977	37	WEST	144	36	14	97	BOWLINE
	6	42839	20777	51	EAST	160	36	20977	51	EAST	158	2	0	36	BOX TRAP
	6	42877	20877	71	WEST	133	36	21077	71	WEST	132	2	0	36	BOX TRAP
	6	42884	20877	71	WEST	147	36	21077	65	WEST	146	2	6	91	ROSETON
	6	36325	123076	43	EAST	120	36	21277	37	WEST	119	43	6	97	BOWLINE
	6	24278	121676	56	WEST	146	36	21477	37	WEST	142	59	19	97	BOWLINE
	6	26690	121676	51	WEST	177	36	21477	37	WEST	178	59	14	97	BOWLINE
	6	33767	12577	76	EAST	165	36	21577	66	WEST	166	21	10	96	DANSKAMMER
	6	18023	12676	51	EAST	164	36	21677	51	EAST		386	0	88	88
	6	21898	121676	51	WEST	137	36	21677	37	WEST	133	61	14	97	BOWLINE
	6	6859	121775	51	EAST	163	36	22177	42	EAST		431	9	99	INDIAN POINT
	6	36411	12077	71	WEST	117	36	22277	42	EAST	115	33	29	99	INDIAN POINT
	6	42038	10577	67	EAST	195	36	22277	66	WEST	190	48	1	96	DANSKAMMER
	6	35819	122876	56	WEST	121	36	22377	42	EAST		56	14	99	INDIAN POINT
	6	43047	20977	51	EAST	133	36	22377	42	EAST	133	14	9	99	INDIAN POINT

SPECIES=32 RC_MONTH=3

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	6	29040	122876	67	EAST	283	36	30177	66	WEST	270	62	1	94	OTHER
	6	33751	12577	71	WEST	221	36	30277	42	EAST	213	36	29	99	INDIAN POINT
	6	36042	122876	56	WEST	268	36	30377	17	EAST		64	39	98	SPORTS FISHERMAN
	6	17685	12876	51	EAST	150	36	30677	3	WEST		402	48	98	SPORTS FISHERMAN
	6	27987	122776	71	WEST	240	36	31177	3	WEST		73	68	98	SPORTS FISHERMAN
	6	42660	11177	51	EAST	177	36	31277	19	EAST		60	32	98	SPORTS FISHERMAN
	6	43400	20277	51	EAST	114	36	31277	37	WEST	113	38	14	97	BOWLINE
	6	43998	20977	41	EAST	125	0	31677	37	WEST	123	35	4	97	BOWLINE
	6	29171	122776	36	EAST	182	36	31977	37	WEST	176	81	-1	97	BOWLINE
	6	34291	122876	51	EAST	134	36	31977	37	WEST	133	80	14	97	BOWLINE
	6	33919	10377	76	EAST	208	36	32077	19	EAST		76	57	98	SPORTS FISHERMAN
	6	27086	122176	56	WEST	270	36	32977	0			97	56	98	SPORTS FISHERMAN
	6	31387	121776	51	EAST	245	36	32977	0			101	51	98	SPORTS FISHERMAN
	6	35239	10377	51	EAST	226	36	33077	13	WEST		86	38	98	SPORTS FISHERMAN
	6	36575	122976	51	WEST	187	36	33077	0			90	51	98	SPORTS FISHERMAN

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
			RELEASE								RECOVERY				
							SPECIES=32		RC_MONTH=4						
	6	30855	122176	51	EAST	261	36	40477	11	EAST		103	40	98	SPORTS FISHERMAN
	6	33451	12477	52	WEST	240	36	40777	.			73	.	98	SPORTS FISHERMAN
	6	38080	123076	51	WEST	190	36	40977	0			99	51	98	SPORTS FISHERMAN
	6	27811	122776	71	WEST	262	36	41477	13	WEST		107	58	98	SPORTS FISHERMAN
	6	29420	122176	76	EAST	139	36	41477	31	WEST		113	45	98	SPORTS FISHERMAN
	6	32525	10777	51	EAST	136	36	41777	26	WEST		100	25	93	COMMERCIAL FISHERMAN
	6	38376	123076	51	EAST	145	36	41777	.			107	.	98	SPORTS FISHERMAN
	6	43751	11477	52	WEST	137	36	41777	26	WEST		93	26	93	COMMERCIAL FISHERMAN
	6	33339	20177	71	WEST	132	36	41977	27	WEST		77	44	93	COMMERCIAL FISHERMAN
	6	36445	12077	52	WEST	142	36	41977	27	WEST		89	25	93	COMMERCIAL FISHERMAN
	6	41679	13177	67	EAST	157	36	41977	27	WEST		78	40	93	COMMERCIAL FISHERMAN
	6	32325	10377	51	WEST	185	36	42177	.			108	.	98	SPORTS FISHERMAN
	6	37429	122976	51	EAST	122	36	42477	27	WEST		115	24	93	COMMERCIAL FISHERMAN
	6	25788	122076	76	EAST	153	36	42777	3	WEST		127	73	98	SPORTS FISHERMAN
	6	39804	11777	71	WEST	153	36	42877	10	WEST		101	61	98	SPORTS FISHERMAN
	6	34259	122876	51	EAST	184	36	43077	.			122	.	98	SPORTS FISHERMAN
							SPECIES=32		RC_MONTH=5						
	6	40479	10477	60	EAST	164	36	50777	.			123	.	98	SPORTS FISHERMAN
	6	24208	121676	56	WEST	200	36	51477	27	WEST		148	29	98	SPORTS FISHERMAN
	6	32649	10677	76	EAST	189	36	51877	.			132	.	98	SPORTS FISHERMAN
	6	42619	11077	51	EAST	196	36	53077	13	EAST		140	38	98	SPORTS FISHERMAN
							SPECIES=32		RC_MONTH=6						
	6	41450	10477	51	WEST	134	36	60777	38	CNTR		154	13	93	COMMERCIAL FISHERMAN
	6	42056	10577	67	EAST	149	36	60977	27	WEST	150	155	40	54	54
	6	33162	21477	51	EAST	109	36	61177	42	EAST	135	117	9	99	INDIAN POINT
	6	35392	10377	51	EAST	241	36	61177	1	WEST		159	50	98	SPORTS FISHERMAN
							SPECIES=32		RC_MONTH=7						
	6	37291	122976	51	EAST	252	36	70277	0			184	51	98	SPORTS FISHERMAN
	6	34257	122876	51	EAST	130	36	70877	42	EAST	160	191	9	99	INDIAN POINT
	6	43758	11477	52	WEST	158	36	71377	3	WEST		180	49	98	SPORTS FISHERMAN
	6	37011	122976	51	EAST	154	36	71777	42	EAST	171	199	9	99	INDIAN POINT
	6	23566	122976	71	WEST	150	36	72177	42	EAST	175	203	29	99	INDIAN POINT
	6	37396	122976	51	EAST	130	36	72177	40	EAST		203	11	98	SPORTS FISHERMAN
	6	40199	10477	67	EAST	190	36	72377	42	EAST	205	200	25	99	INDIAN POINT
	6	42922	20277	51	EAST	130	36	72377	42	EAST	151	171	9	99	INDIAN POINT
	6	34674	123076	51	EAST	142	36	72477	42	EAST	165	205	9	99	INDIAN POINT
	6	19944	120776	34	EAST	139	36	72577	42	EAST	162	229	-8	99	INDIAN POINT
	6	33177	21477	51	EAST	118	36	72877	39	EAST		164	12	98	SPORTS FISHERMAN
	6	33399	20177	71	WEST	125	36	72877	42	EAST	155	177	29	99	INDIAN POINT
	6	41670	13177	67	EAST	125	36	72877	42	EAST	157	178	25	99	INDIAN POINT

Table A-24 (contd)

			RELEASE						RECOVERY						
SPECIES=32 RC_MONTH=8															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	6	40488	10477	60	EAST	137	36	80677	14	WEST		214	46	98	SPORTS FISHERMAN
	6	36504	122976	51	WEST	178	36	81477	.			227	.	98	SPORTS FISHERMAN
	6	33502	12077	51	EAST	129	36	81677	42	EAST	166	208	9	99	INDIAN POINT
SPECIES=32 RC_MONTH=10															
	6	37306	122976	51	EAST	173	36	102377	.			297	.	98	SPORTS FISHERMAN
SPECIES=32 RC_MONTH=12															
	6	44925	121977	51	WEST	227	36	122177	51	EAST	230	2	0	36	BOX TRAP
	6	45511	121977	25	EAST	170	36	122177	25	EAST	171	2	0	36	BOX TRAP
	6	51405	121277	71	WEST	164	36	122177	71	WEST	162	9	0	36	BOX TRAP
	6	51703	121477	25	EAST	160	36	122177	25	EAST	161	7	0	36	BOX TRAP
	6	45471	121977	25	EAST	174	36	122777	51	EAST	175	8	-26	36	BOX TRAP
	6	45475	121977	25	EAST	185	36	122777	25	EAST	186	8	0	36	BOX TRAP
	6	52296	121577	51	EAST	255	36	122777	51	EAST	246	12	0	36	BOX TRAP
	6	45918	122277	27	EAST	174	36	122877	25	EAST	172	6	2	36	BOX TRAP
	6	45997	122277	27	EAST	166	36	122877	27	EAST	163	6	0	36	BOX TRAP
	6	47178	122777	25	EAST	174	36	122877	27	EAST	175	1	-2	36	BOX TRAP
	6	47285	122777	25	EAST	157	36	122877	25	EAST	156	1	0	36	BOX TRAP
	6	51203	122777	51	EAST	188	36	122877	51	EAST	182	1	0	36	BOX TRAP
	6	44692	122977	51	EAST	207	36	122977	51	EAST	206	0	0	36	BOX TRAP
	6	45910	122277	25	EAST	149	36	122977	25	EAST	148	7	0	36	BOX TRAP
	6	46850	122277	51	EAST	196	36	122977	51	EAST	193	7	0	36	BOX TRAP
	6	45089	122977	68	WEST	261	36	123077	71	WEST	257	1	-3	36	BOX TRAP
	6	47445	122777	51	EAST	157	36	123077	51	EAST	159	3	0	36	BOX TRAP
	6	51276	122777	51	EAST	183	36	123077	51	EAST	183	3	0	36	BOX TRAP
	6	44910	121977	51	WEST	151	36	123177	42	EAST	151	12	9	99	INDIAN POINT

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
RELEASE								RECOVERY							
SPECIES=35 RC_MONTH=1															
	5	46746	102876	38	WEST	113	14	10077	42	EAST	111	63	-4	99	INDIAN POINT
	5	43791	101276	34	EAST	128	53	10177	42	EAST	130	80	-8	99	INDIAN POINT
	5	42818	101376	35	EAST	116	14	10577	41	WEST	113	83	-6	95	LOVETT
	5	41542	92776	39	EAST	110	12	10677	42	EAST	103	100	-3	99	INDIAN POINT
	5	45250	100576	35	EAST	112	53	10677	42	EAST	114	92	-7	99	INDIAN POINT
	5	46344	100876	40	EAST	140	14	10677	42	EAST	138	89	-2	99	INDIAN POINT
	5	37654	91376	39	EAST	126	5	10777	42	EAST		115	-3	99	INDIAN POINT
	5	29327	111975	34	EAST	140	14	11077	42	EAST	141	417	-8	99	INDIAN POINT
	5	39700	91576	35	EAST	125	14	11077	42	EAST	121	116	-7	99	INDIAN POINT
	5	43657	101876	40	EAST	122	14	11077	42	EAST	124	83	-2	99	INDIAN POINT
	5	44822	100676	39	EAST	122	14	11077	42	EAST	121	95	-3	99	INDIAN POINT
	5	45921	101176	39	WEST	123	12	11077	37	WEST		90	2	97	BOWLINE
	5	32721	52776	74	WEST	140	27	11377	42	EAST	137	230	32	99	INDIAN POINT
	5	30595	51776	34	EAST	138	12	11477	42	EAST	138	241	-8	99	INDIAN POINT
	5	38981	91476	34	EAST	119	53	11477	42	EAST	119	121	-8	99	INDIAN POINT
	5	37980	90976	99	EAST	106	12	11577	42	EAST	108	127	57	99	INDIAN POINT
	5	38622	91476	36	WEST	115	14	11577	42	EAST	116	122	-6	99	INDIAN POINT
	5	40378	101276	52	EAST	139	12	11577	42	EAST	129	94	10	99	INDIAN POINT
	5	44786	100676	39	EAST	124	14	11577	42	EAST	126	100	-3	99	INDIAN POINT
	5	37100	91376	42	WEST	112	12	11677	42	EAST	114	124	0	99	INDIAN POINT
	5	37578	91076	36	WEST	104	53	11677	42	EAST	109	127	-6	99	INDIAN POINT
	5	39252	91676	35	WEST	116	14	11677	42	EAST	116	121	-7	99	INDIAN POINT
	5	42400	92976	35	EAST	110	53	11677	42	EAST	110	108	-7	99	INDIAN POINT
	5	43507	101976	40	EAST	105	14	11677	42	EAST	105	88	-2	99	INDIAN POINT
	5	44381	100576	35	EAST	127	53	11777	42	EAST	124	103	-7	99	INDIAN POINT
	5	31663	51376	69	EAST	147	14	11877	42	EAST	150	249	27	99	INDIAN POINT
	5	38130	90976	33	EAST	104	53	11977	42	EAST	104	131	-9	99	INDIAN POINT
	5	39757	91676	34	EAST	112	14	12077	42	EAST	110	125	-8	99	INDIAN POINT
	5	42850	101376	35	EAST	117	14	12177	42	EAST	112	99	-7	99	INDIAN POINT
	5	47703	110176	30	WEST	102	12	12177	42	EAST	101	80	-12	99	INDIAN POINT
	5	38093	91376	36	WEST	112	14	12277	42	EAST	106	130	-6	99	INDIAN POINT
	5	44199	101476	43	EAST	122	14	12377	42	EAST	118	100	1	99	INDIAN POINT
	5	36481	100176	26	EAST	118	12	12477	42	EAST	121	114	-16	99	INDIAN POINT
	5	39425	91776	32	EAST	113	53	12477	42	EAST	111	128	-10	99	INDIAN POINT
	5	44724	100676	39	EAST	127	14	12477	42	EAST	114	109	-3	99	INDIAN POINT
	5	30227	102275	34	EAST	137	14	12577	42	EAST	139	460	-8	99	INDIAN POINT
	5	37065	92176	38	EAST	115	12	12577	42	EAST	113	125	-4	99	INDIAN POINT
	5	37329	91076	39	EAST	141	12	12577	42	EAST	143	136	-3	99	INDIAN POINT
	5	41727	92876	39	EAST	103	14	12577	42	EAST	103	118	-3	99	INDIAN POINT
	5	42413	92976	35	EAST	121	53	12577	42	EAST	120	117	-7	99	INDIAN POINT
	5	43349	100476	36	EAST	128	14	12577	42	EAST	131	112	-6	99	INDIAN POINT
	5	45504	101576	34	EAST	122	12	12577	42	EAST	122	101	-8	99	INDIAN POINT
	5	46159	100776	36	EAST	117	14	12577	42	EAST	116	109	-6	99	INDIAN POINT
	5	41313	92176	24	WEST	131	14	12777	42	EAST	128	127	-18	99	INDIAN POINT

Table A-24 (contd)

			RELEASE					RECOVERY							
							SPECIES=35	RC_MONTH=1							
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	44325	100576	35	EAST	120	53	12777	42	EAST	121	113	-7	99	INDIAN POINT
	5	29353	112075	39	EAST	122	14	13177	37	WEST	125	437	2	97	BOWLINE
	5	43162	112276	52	EAST	122	12	13177	42	EAST	123	69	10	99	INDIAN POINT
	9	60846	52876	57	WEST	157	14	10077	42	EAST	155	216	15	99	INDIAN POINT
	9	63868	91676	34	EAST	189	12	10077	42	EAST	182	105	-8	99	INDIAN POINT
	9	67538	92476	35	EAST	209	53	10077	42	EAST	202	97	-7	99	INDIAN POINT
	9	68899	102176	34	EAST	156	64	10177	42	EAST	154	71	-8	99	INDIAN POINT
	9	75496	101876	27	WEST	168	12	10177	42	EAST	162	74	-15	99	INDIAN POINT
	9	53508	112075	28	WEST	156	64	10377	42	EAST	155	409	-14	99	INDIAN POINT
	9	68034	92076	34	EAST	154	12	10377	42	EAST	151	104	-8	99	INDIAN POINT
	9	75371	100576	34	EAST	184	14	10377	42	EAST	184	89	-8	99	INDIAN POINT
	9	84110	102576	34	EAST	175	14	10377	42	EAST	171	69	-8	99	INDIAN POINT
	9	68978	90976	32	WEST	162	64	10477	42	EAST	160	116	-10	99	INDIAN POINT
	9	70710	92176	118	WEST	157	12	10477	42	EAST	155	104	76	99	INDIAN POINT
	9	70750	92876	39	EAST	176	14	10477	42	EAST	173	97	-3	99	INDIAN POINT
	9	75192	100576	34	EAST	174	14	10477	42	EAST	168	90	-8	99	INDIAN POINT
	9	76674	110276	34	EAST	152	14	10477	42	EAST	151	62	-8	99	INDIAN POINT
	9	83817	101576	33	EAST	176	53	10477	42	EAST	174	80	-9	99	INDIAN POINT
	9	76700	110276	34	EAST	187	14	10577	37	WEST	186	63	-3	94	OTHER
	9	50901	110575	33	EAST	171	14	10677	42	EAST	168	427	-9	99	INDIAN POINT
	9	73273	92876	27	WEST	180	14	10677	42	EAST	179	99	-15	99	INDIAN POINT
	9	74378	112976	30	WEST	216	64	10677	42	EAST	213	37	-12	99	INDIAN POINT
	9	75227	100576	34	EAST	181	14	10677	42	EAST	182	92	-8	99	INDIAN POINT
	9	44985	110375	38	WEST	158	12	10777	42	EAST	158	430	-4	99	INDIAN POINT
	9	62719	52876	57	WEST	158	14	10777	42	EAST	154	223	15	99	INDIAN POINT
	9	67712	91676	33	EAST	191	14	10777	42	EAST	191	112	-9	99	INDIAN POINT
	9	74458	101976	40	EAST	157	14	10777	42	EAST	150	79	-2	99	INDIAN POINT
	9	85016	112976	30	WEST	171	64	10777	42	EAST	165	38	-12	99	INDIAN POINT
	9	42669	111175	15	WEST	174	12	10877	42	EAST	175	423	-27	99	INDIAN POINT
	9	52578	111875	33	EAST	175	14	10877	42	EAST	176	416	-9	99	INDIAN POINT
	9	59274	51476	58	EAST	155	14	10877	42	EAST	153	238	16	99	INDIAN POINT
	9	62198	52676	58	WEST	166	12	10877	42	EAST	163	226	16	99	INDIAN POINT
	9	66856	91376	34	EAST	192	14	10877	42	EAST	191	116	-8	99	INDIAN POINT
	9	56128	42276	59	EAST	158	12	10977	42	EAST	155	261	17	99	INDIAN POINT
	9	57882	50576	40	WEST	172	12	10977	42	EAST	167	248	-2	99	INDIAN POINT
	9	72412	92976	39	EAST	153	12	11077	42	EAST	154	102	-3	99	INDIAN POINT
	9	72650	92976	34	EAST	191	12	11077	42	EAST	184	102	-8	99	INDIAN POINT
	9	74077	101876	37	EAST	175	14	11077	42	EAST	176	83	-5	99	INDIAN POINT
	9	62083	52776	74	WEST	150	27	11177	42	EAST	151	228	32	99	INDIAN POINT
	9	62927	52976	84	WEST	172	14	11177	42	EAST	170	226	42	99	INDIAN POINT
	9	71710	92876	29	WEST	153	14	11177	42	EAST	150	104	-13	99	INDIAN POINT
	9	83840	101576	33	EAST	170	53	11177	42	EAST	170	87	-9	99	INDIAN POINT
	9	56228	40876	69	EAST	167	12	11277	42	EAST	165	278	27	99	INDIAN POINT
	9	73591	102976	38	EAST	196	14	11277	37	WEST	187	74	1	94	OTHER

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	RELEASE							RECOVERY							
	SPECIES=35 RC_MONTH=1														
	9	74025	101876	37	EAST	195	14	11277	42	EAST	198	85	-5	99	INDIAN POINT
	9	48539	101475	61	EAST	181	12	11377	42	EAST	177	456	19	99	INDIAN POINT
	9	56114	41476	30	WEST	158	12	11377	37	WEST	159	273	-7	94	OTHER
	9	62091	52776	74	WEST	171	27	11377	42	EAST	168	230	32	99	INDIAN POINT
	9	62454	52976	78	EAST	166	12	11377	42	EAST	162	228	36	99	INDIAN POINT
	9	63207	52976	87	WEST	151	14	11377	42	EAST	151	228	45	99	INDIAN POINT
	9	72777	92776	40	EAST	154	14	11377	42	EAST	151	107	-2	99	INDIAN POINT
	9	42550	100775	33	EAST	190	14	11477	42	EAST	189	464	-9	99	INDIAN POINT
	9	44761	111275	36	EAST	164	12	11477	42	EAST	161	428	-6	99	INDIAN POINT
	9	50198	102875	57	WEST	172	12	11477	42	EAST	155	443	15	99	INDIAN POINT
	9	57617	52476	36	EAST	168	5	11477	42	EAST	155	234	-6	99	INDIAN POINT
	9	65239	61776	36	EAST	160	14	11477	42	EAST	157	210	-6	99	INDIAN POINT
	9	74110	101976	34	EAST	152	14	11477	42	EAST	150	86	-8	99	INDIAN POINT
	9	76809	101276	40	WEST	191	14	11477	37	WEST	188	93	3	94	OTHER
	9	76843	101176	34	EAST	178	14	11477	42	EAST	177	94	-8	99	INDIAN POINT
	9	85342	120176	30	WEST	155	64	11477	37	WEST	150	43	-7	94	OTHER
	9	65413	91376	36	WEST	163	14	11577	42	EAST	157	123	-6	99	INDIAN POINT
	9	69578	100776	29	WEST	155	64	11577	42	EAST	154	99	-13	99	INDIAN POINT
	9	63197	91676	57	WEST	175	5	11677	42	EAST	175	121	15	99	INDIAN POINT
	9	63818	90276	37	WEST	152	14	11677	42	EAST	152	135	-5	99	INDIAN POINT
	9	65309	92076	57	WEST	176	5	11677	42	EAST	200	117	15	99	INDIAN POINT
	9	53952	112075	28	WEST	194	64	11777	42	EAST	193	423	-14	99	INDIAN POINT
	9	60870	52576	59	EAST	163	14	11877	42	EAST	162	237	17	99	INDIAN POINT
	9	66666	90276	34	EAST	176	12	11877	42	EAST	170	137	-8	99	INDIAN POINT
	9	75554	100576	35	EAST	155	53	11877	42	EAST	158	104	-7	99	INDIAN POINT
	9	76958	101976	34	EAST	191	14	11877	42	EAST	186	90	-8	99	INDIAN POINT
	9	62472	52976	81	EAST	155	12	11977	42	EAST	150	234	39	99	INDIAN POINT
	9	67203	111276	34	EAST	187	14	11977	37	WEST	188	67	-3	97	BOWLINE
	9	66869	92176	41	EAST	176	0	12077	42	EAST	168	120	-1	99	INDIAN POINT
	9	72499	100876	34	EAST	185	14	12077	42	EAST	184	103	-8	99	INDIAN POINT
	9	76670	102976	34	EAST	184	14	12077	42	EAST	178	82	-8	99	INDIAN POINT
	9	40178	90875	39	EAST	154	12	12177	42	EAST	152	500	-3	99	INDIAN POINT
	9	63980	60276	54	EAST	169	14	12177	42	EAST	164	232	12	99	INDIAN POINT
	9	66827	90776	34	EAST	175	14	12177	42	EAST	172	135	-8	99	INDIAN POINT
	9	67204	111276	34	EAST	193	14	12177	42	EAST	190	69	-8	99	INDIAN POINT
	9	72932	92376	34	EAST	182	14	12177	42	EAST	177	119	-8	99	INDIAN POINT
	9	42255	100975	40	EAST	182	5	12277	42	EAST	177	470	-2	99	INDIAN POINT
	9	61895	52676	86	WEST	182	14	12277	42	EAST	180	240	44	99	INDIAN POINT
	9	69694	91476	48	EAST	165	12	12277	42	EAST	155	129	6	99	INDIAN POINT
	9	73596	102976	34	EAST	186	14	12277	42	EAST	185	84	-8	99	INDIAN POINT
	9	68251	91076	43	EAST	178	12	12377	42	EAST	179	134	1	99	INDIAN POINT
	9	84607	111576	39	EAST	177	64	12377	42	EAST	173	68	-3	99	INDIAN POINT
	9	40290	110575	34	EAST	173	14	12477	42	EAST	167	445	-8	99	INDIAN POINT
	9	52864	121875	35	CNTR	180	64	12477	42	EAST	174	402	-7	99	INDIAN POINT

Table A-24 (contd)

RELEASE / RECOVERY

SPECIES=35 RC_MONTH=1

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	9	62462	52976	78	EAST	152	12	12477	42	EAST	151	239	36	99	INDIAN POINT
	9	65195	61476	34	EAST	166	14	12477	42	EAST	157	223	-8	99	INDIAN POINT
	9	67103	90776	43	EAST	154	12	12477	42	EAST	150	138	1	99	INDIAN POINT
	9	72011	92776	34	EAST	209	12	12477	42	EAST	205	118	-8	99	INDIAN POINT
	9	16708	43074	57	WEST	150	12	12577	42	EAST	153	1000	15	99	INDIAN POINT
	9	48482	101475	33	EAST	150	14	12577	42	EAST	145	468	-9	99	INDIAN POINT
	9	59428	90876	41	EAST	180	0	12577	42	EAST	175	138	-1	99	INDIAN POINT
	9	60533	50576	95	EAST	155	12	12577	42	EAST	158	264	53	99	INDIAN POINT
	9	62846	60776	34	EAST	170	12	12577	42	EAST	167	231	-8	99	INDIAN POINT
	9	70506	92776	34	EAST	173	12	12577	42	EAST	179	119	-8	99	INDIAN POINT
	9	71469	101176	34	EAST	156	14	12577	42	EAST	153	105	-8	99	INDIAN POINT
	9	72005	92776	35	EAST	167	12	12577	42	EAST	169	119	-7	99	INDIAN POINT
	9	76889	101476	38	EAST	159	14	12577	42	EAST	162	102	-4	99	INDIAN POINT
	9	53237	111375	37	CNTR	162	64	12677	41	WEST	161	439	-4	95	LOVETT
	9	60882	52876	57	WEST	167	14	12677	37	WEST	164	242	20	97	BOWLINE
	9	84325	111676	34	EAST	165	64	12677	42	EAST	165	70	-8	99	INDIAN POINT
	9	44444	102375	35	EAST	190	53	12777	42	EAST	192	461	-7	99	INDIAN POINT
	9	46316	103075	53	EAST	159	14	12777	42	EAST	158	454	11	99	INDIAN POINT
	9	58990	42176	41	WEST	170	5	12877	42	EAST	172	281	-1	99	INDIAN POINT
	9	68760	91076	29	WEST	174	64	12877	42	EAST	180	139	-13	99	INDIAN POINT
	9	72558	92876	15	WEST	172	12	12877	42	EAST	180	121	-27	99	INDIAN POINT
	9	54662	120275	30	CNTR	167	64	12977	37	WEST	166	423	-7	97	BOWLINE

Table A-24 (contd)

			RELEASE						RECOVERY						
SPECIES=35 RC_MONTH=2															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	38023	90976	33	EAST	107	53	20277	42	EAST	108	145	-9	99	INDIAN POINT
	5	41743	92876	39	EAST	112	14	20777	42	EAST		131	-3	99	INDIAN POINT
	5	44154	100576	29	WEST	119	12	20777	37	WEST		124	-8	97	BOWLINE
	5	37252	90776	26	WEST	118	12	20877	42	EAST	113	153	-16	99	INDIAN POINT
	5	26861	110775	34	EAST	129	14	20977	37	WEST	135	459	-3	97	BOWLINE
	5	43456	101476	43	EAST	122	14	21977	37	WEST		127	6	97	BOWLINE
	5	44149	100576	29	WEST	121	12	22177	42	EAST	118	138	-13	99	INDIAN POINT
	5	40980	92376	42	EAST	114	14	22277	42	EAST	114	151	0	99	INDIAN POINT
	5	43398	100476	36	EAST	108	14	22277	42	EAST	113	140	-6	99	INDIAN POINT
	5	45019	100576	35	EAST	109	53	22277	42	EAST	109	139	-7	99	INDIAN POINT
	5	38534	91476	34	EAST	111	53	22377	42	EAST	111	161	-8	99	INDIAN POINT
	5	39886	92076	39	WEST	109	14	22377	42	EAST	113	155	-3	99	INDIAN POINT
	5	40085	92276	27	WEST	104	12	22377	42	EAST	104	153	-15	99	INDIAN POINT
	5	45163	100576	35	EAST	112	53	22377	42	EAST	122	140	-7	99	INDIAN POINT
	5	45266	100576	35	EAST	124	53	22377	41	WEST		140	-6	95	LOVETT
	5	41766	92776	54	EAST	108	12	22477	42	EAST	103	149	12	99	INDIAN POINT
	5	41856	110376	40	EAST	113	14	22477	42	EAST	113	112	-2	99	INDIAN POINT
	5	44083	93076	35	WEST	102	53	22477	42	EAST	106	146	-7	99	INDIAN POINT
	5	44588	101876	26	EAST	127	12	22477	42	EAST	126	128	-16	99	INDIAN POINT
	5	45877	111076	40	WEST	130	14	22477	42	EAST	123	105	-2	99	INDIAN POINT
	5	45922	101176	39	WEST	113	12	22477	42	EAST	113	135	-3	99	INDIAN POINT
	5	41488	92276	36	WEST	120	14	22577	42	EAST	122	155	-6	99	INDIAN POINT
	5	45078	100576	35	EAST	121	53	22577	42	EAST	123	142	-7	99	INDIAN POINT
	5	47377	101576	35	EAST	119	53	22577	42	EAST	122	132	-7	99	INDIAN POINT
	5	39407	92076	40	WEST	108	5	22677	42	EAST	105	158	-2	99	INDIAN POINT
	9	61629	52776	80	WEST	158	14	20877	42	EAST	152	256	38	99	INDIAN POINT
	9	41897	103075	36	EAST	154	14	20977	37	WEST	156	467	-1	97	BOWLINE
	9	36783	60575	57	WEST	175	5	21277	37	WEST	183	617	20	97	BOWLINE
	9	53888	112075	28	WEST	178	64	21677	41	WEST	175	453	-13	95	LOVETT
	9	71018	100476	36	EAST	154	14	22077	42	EAST		138	-6	99	INDIAN POINT
	9	46296	101475	39	EAST	153	14	22177	42	EAST	151	495	-3	99	INDIAN POINT
	9	74026	101876	37	EAST	235	14	22177	37	WEST	226	125	0	97	BOWLINE
	9	65011	90276	26	WEST	185	12	22377	42	EAST	184	173	-16	99	INDIAN POINT
	9	66565	90276	38	EAST	162	14	22377	42	EAST	162	173	-4	99	INDIAN POINT
	9	67176	91376	29	WEST	189	12	22377	41	WEST	185	162	-12	95	LOVETT
	9	70681	92476	34	EAST	164	53	22377	42	EAST	162	151	-8	99	INDIAN POINT
	9	75710	100776	34	EAST	202	53	22377	37	WEST	202	138	-3	97	BOWLINE
	9	63327	52976	83	WEST	177	14	22477	42	EAST	178	270	41	99	INDIAN POINT
	9	72713	102876	48	WEST	156	12	22477	42	EAST	151	118	6	99	INDIAN POINT
	9	73524	100876	34	EAST	181	14	22577	42	EAST	175	139	-8	99	INDIAN POINT
	9	75502	100576	35	EAST	188	53	22677	42	EAST	183	143	-7	99	INDIAN POINT
	9	60164	51176	49	WEST	220	12	22877	37	WEST	217	292	12	97	BOWLINE

Table A-24 (contd)

					RELEASE						RECOVERY				
SPECIES=35 RC_MONTH=3															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	40194	92876	51	EAST	117	12	30177	42	EAST	113	153	9	99	INDIAN POINT
	5	45045	100576	35	EAST	120	53	30477	42	EAST	123	149	-7	99	INDIAN POINT
	5	39248	91676	35	WEST	114	14	31177	42	EAST	117	175	-7	99	INDIAN POINT
	5	40283	92976	40	EAST	105	12	31677	41	WEST		167	-1	95	LOVETT
	5	25533	90475	34	EAST	134	12	32877	35	EAST		570	-1	88	88
	9	46399	101575	36	WEST	169	14	30477	42	EAST	173	505	-6	99	INDIAN POINT
	9	66366	92476	35	EAST	214	53	32977	35	EAST	216	185	0	61	900' HAUL SEINE
**	9	83855	101576	35	EAST	197	53	32977	35	EAST	197	164	0	61	900' HAUL SEINE

Table A-24 (contd)

					RELEASE						RECOVERY				
							SPECIES=35	RC_MONTH=4							
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	41815	110276	40	WEST	128	14	41677	37	CNTR		164	3	98	SPORTS FISHERMAN
	5	36652	90276	37	WEST	141	14	42177	14	WEST	140	230	23	14	200' BEACH SEINE
**	5	38881	92176	41	EAST	135	0	42177	32	EAST	131	211	9	38	38
**	5	38881	92176	41	EAST	135	0	42177	32	EAST	129	211	9	38	38
	5	40626	92876	29	WEST	121	14	42277	29	WEST	120	205	0	12	100' BEACH SEINE
	5	42773	92976	23	EAST	134	12	42777	24	EAST	139	209	-1	14	200' BEACH SEINE
	5	37918	90976	99	EAST	149	12	42977	99	EAST		231	0	98	SPORTS FISHERMAN
	9	62959	52976	84	WEST	158	14	41077	42	EAST	154	315	42	99	INDIAN POINT
	9	58242	42376	39	EAST	186	5	41277	14	WEST	185	353	25	12	100' BEACH SEINE
	9	59754	90976	33	EAST	193	53	41277	33	EAST		214	0	98	SPORTS FISHERMAN
	9	66809	90276	60	EAST	152	5	41277	42	EAST	147	221	18	99	INDIAN POINT
	9	72177	110276	30	WEST	172	64	41477	31	WEST		162	-1	98	SPORTS FISHERMAN
	9	71248	92376	38	EAST	181	64	41677	37	CNTR		204	1	98	SPORTS FISHERMAN
	9	71715	92876	29	WEST	191	14	41677	37	CNTR		199	-8	98	SPORTS FISHERMAN
	9	75705	100776	36	WEST	150	53	41677	37	CNTR		190	-1	98	SPORTS FISHERMAN
	9	85097	113076	30	WEST	187	64	41677	37	CNTR		136	-7	98	SPORTS FISHERMAN
	9	68536	91576	22	EAST	183	12	41777	18	EAST		213	4	98	SPORTS FISHERMAN
	9	72449	100476	38	EAST	178	5	41777	26	WEST		194	12	93	COMMERCIAL FISHERMAN
	9	76201	111776	32	EAST	198	12	41977	32	EAST	197	152	0	12	100' BEACH SEINE
	9	68319	100576	35	EAST	160	53	42077	35	EAST		196	0	87	87
	9	68377	100576	35	EAST	170	53	42077	35	EAST		196	0	87	87
	9	75535	100576	35	EAST	157	53	42077	35	EAST	155	196	0	61	900' HAUL SEINE
	9	75570	100576	35	EAST	175	53	42077	35	EAST		196	0	87	87
	9	85830	41277	14	WEST	185	12	42177	14	WEST	184	9	0	14	200' BEACH SEINE
	9	86972	42077	15	WEST	220	12	42177	16	WEST	219	1	-1	14	200' BEACH SEINE
	9	69883	92776	34	EAST	180	14	42277	34	EAST	180	206	0	12	100' BEACH SEINE
	9	71311	92276	34	EAST	179	14	42277	34	EAST	176	211	0	12	100' BEACH SEINE
	9	75514	100576	35	EAST	153	53	42277	35	EAST		198	0	87	87
**	9	83855	101576	35	EAST	197	53	42277	35	EAST		188	0	87	87
**	9	86916	41877	34	EAST	174	12	42277	34	EAST	174	4	0	12	100' BEACH SEINE
	9	86924	41877	34	EAST	167	12	42277	34	EAST	165	4	0	12	100' BEACH SEINE
**	9	67553	92476	35	EAST	204	53	42577	35	EAST		212	0	87	87
	9	67714	91676	33	EAST	180	14	42577	34	EAST	180	220	-1	14	200' BEACH SEINE
	9	84113	102576	34	EAST	180	14	42577	34	EAST	185	181	0	14	200' BEACH SEINE
	9	86902	41877	27	WEST	161	12	42777	27	WEST	160	9	0	14	200' BEACH SEINE
	9	85790	40577	15	WEST	195	12	42877	10	WEST		23	5	98	SPORTS FISHERMAN
	9	85858	40777	26	WEST	175	12	42877	14	WEST	188	21	12	12	100' BEACH SEINE
	9	86666	42177	14	WEST	179	14	42877	14	WEST	178	7	0	12	100' BEACH SEINE
	9	86914	41877	34	EAST	173	12	42877	34	EAST	169	10	0	12	100' BEACH SEINE
	9	87322	42177	16	WEST	210	14	42877	16	WEST	209	7	0	12	100' BEACH SEINE
	9	86742	41977	16	WEST	175	12	42977	26	WEST	185	10	-10	12	100' BEACH SEINE

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
			RELEASE							RECOVERY					
							SPECIES=35	RC_MONTH=5							
	5	49949	42777	94	WEST	104	12	50377	42	EAST	109	6	52	99	INDIAN POINT
	5	30658	42276	69	EAST	142	12	50477	42	EAST	139	376	27	99	INDIAN POINT
	5	27762	102775	53	WEST	122	12	50577	49	WEST	132	555	4	12	100' BEACH SEINE
	5	31404	60876	42	WEST	137	12	50577	42	EAST	140	330	0	99	INDIAN POINT
	5	49589	42777	96	WEST	115	12	50677	42	EAST	120	9	54	99	INDIAN POINT
	5	37090	92276	47	WEST	122	12	50877	42	EAST	121	227	5	99	INDIAN POINT
	5	35129	90776	34	EAST	130	14	50977	33	EAST	129	243	1	14	200' BEACH SEINE
	5	49967	42877	78	WEST	149	12	51077	66	WEST	147	12	12	96	DANSKAMMER
	5	41954	101176	58	WEST	119	12	51177	58	WEST	117	211	0	12	100' BEACH SEINE
	5	38787	92076	34	EAST	117	12	51277	34	EAST	119	233	0	14	200' BEACH SEINE
	5	37665	91376	39	EAST	147	5	51777	38	EAST	149	245	1	5	BOX TRAP
**	5	40490	92776	34	EAST	128	14	51777	34	EAST	126	231	0	14	200' BEACH SEINE
	5	39940	92176	34	EAST	118	14	52377	34	EAST	119	243	0	12	100' BEACH SEINE
**	5	40490	92776	34	EAST	128	14	52377	34	EAST	124	237	0	12	100' BEACH SEINE
	5	40425	92476	34	EAST	123	53	52477	34	EAST	120	241	0	14	200' BEACH SEINE
	5	26435	110375	36	WEST	122	12	52577	36	WEST	132	568	0	14	200' BEACH SEINE
	5	35551	91476	36	WEST	110	12	52577	36	WEST	115	252	0	14	200' BEACH SEINE
**	5	44071	93076	35	WEST	119	53	52577	36	WEST	119	236	-1	14	200' BEACH SEINE
	5	50045	51777	35	WEST	130	14	52577	35	WEST	129	8	0	14	200' BEACH SEINE
	5	49299	51877	60	WEST	134	12	52677	42	EAST	127	8	18	99	INDIAN POINT
	5	49172	51177	87	WEST	130	12	52977	42	EAST	123	18	45	99	INDIAN POINT
	5	30007	102075	39	EAST	137	14	53177	42	EAST	140	588	-3	99	INDIAN POINT
	5	48919	50277	13	WEST	116	12	53177	42	EAST	121	29	-29	99	INDIAN POINT
	5	50249	51277	34	EAST	128	14	53177	34	EAST	122	19	0	5	BOX TRAP
	5	50955	52477	34	EAST	110	5	53177	42	EAST	103	7	-8	99	INDIAN POINT
	5	51019	52477	34	EAST	115	14	53177	42	EAST	110	7	-8	99	INDIAN POINT
	5	51050	52577	36	EAST	122	14	53177	42	EAST	120	6	-6	99	INDIAN POINT
	9	84839	110476	30	WEST	155	64	50077	39			176	-9	93	COMMERCIAL FISHERMAN
	9	95206	62477	34	EAST	206	5	50077	.			55	.	98	SPORTS FISHERMAN
	9	86660	42177	14	WEST	217	14	50177	14	WEST		10	0	98	SPORTS FISHERMAN
	9	86680	42177	14	WEST	185	14	50477	66	WEST	182	13	-52	96	DANSKAMMER
	9	70672	92776	39	EAST	165	14	50577	39	EAST	167	219	0	87	87
	9	70678	92476	34	EAST	178	53	50577	39	EAST	165	222	-5	87	87
	9	86456	41577	33	EAST	165	5	50877	17	EAST		23	16	98	SPORTS FISHERMAN
**	9	86916	41877	34	EAST	174	12	50977	34	EAST	170	21	0	14	200' BEACH SEINE
	9	86920	41877	34	EAST	183	12	50977	34	EAST	182	21	0	14	200' BEACH SEINE
	9	86922	41877	34	EAST	162	12	50977	34	EAST	159	21	0	14	200' BEACH SEINE
	9	87021	42277	34	EAST	197	12	50977	34	EAST	196	17	0	14	200' BEACH SEINE
	9	71377	92276	34	EAST	192	14	51077	34	EAST	185	229	0	14	200' BEACH SEINE
	9	86311	42077	28	EAST	163	12	51077	29	EAST		20	-1	98	SPORTS FISHERMAN
	9	86392	42877	18	EAST	171	12	51077	18	EAST	171	12	0	12	100' BEACH SEINE
	9	87045	42277	34	EAST	172	12	51077	34	EAST	170	18	0	14	200' BEACH SEINE
	9	87054	42277	34	EAST	177	12	51077	34	EAST	175	18	0	14	200' BEACH SEINE
	9	58801	42676	38	EAST	167	5	51177	39	EAST	164	379	-1	5	BOX TRAP

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=35 RC_MONTH=5

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	9	86875	50577	39	EAST	164	5	51177	39	EAST	164	6	0	5	BOX TRAP
	9	71327	92276	34	EAST	185	14	51277	34	EAST	184	231	0	14	200' BEACH SEINE
	9	74584	102276	12	WEST	203	12	51577	12	WEST		204	0	98	SPORTS FISHERMAN
	9	88007	50577	27	WEST	163	12	51577	27	WEST		10	0	98	SPORTS FISHERMAN
	9	85973	51077	18	EAST	196	12	51777	18	EAST		7	0	98	SPORTS FISHERMAN
	9	70741	92376	76	EAST	157	12	51877	37	CNTR		236	39	98	SPORTS FISHERMAN
	9	85853	40577	36	WEST	185	14	51877	37	CNTR		43	-1	98	SPORTS FISHERMAN
	9	74544	110376	40	EAST	170	14	52177	99	WEST		198	-59	98	SPORTS FISHERMAN
	9	85720	40477	15	WEST	184	12	52177	57	WEST		47	-42	98	SPORTS FISHERMAN
	9	65842	60976	76	WEST	150	14	52377	57	WEST	151	347	19	12	100' BEACH SEINE
	9	88899	60677	58	EAST	170	12	52477	34	EAST	170	13	24	5	BOX TRAP
	9	73799	101376	36	WEST	172	14	52677	37	WEST	174	224	-1	97	BOWLINE
	9	87698	42877	78	WEST	172	12	52677	78	WEST	169	28	0	12	100' BEACH SEINE
	9	72083	92776	34	EAST	170	12	52877	33	EAST		242	1	98	SPORTS FISHERMAN
	9	85883	41477	34	EAST	227	14	52877	12	WEST		44	22	98	SPORTS FISHERMAN
	9	65622	92376	15	EAST	179	12	53177	66	WEST	174	249	-51	96	DANSKAMMER
	9	69071	100676	28	WEST	180	64	53177	42	EAST	181	236	-14	99	INDIAN POINT

Table A-24 (contd)

			RELEASE								RECOVERY				
							SPECIES=35	RC_MONTH=6							
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	38906	91376	40	EAST	146	14	60077	40	WEST		259	0	98	SPORTS FISHERMAN
	5	35500	91376	38	WEST	115	12	60177	37	WEST	116	260	1	90	L.M.S.
	5	49201	52577	58	WEST	128	12	60177	41	WEST		7	17	95	LOVETT
	5	50590	52577	34	EAST	123	12	60177	41	WEST		7	-7	95	LOVETT
	5	51511	52677	34	EAST	109	14	60177	42	EAST		6	-8	99	INDIAN POINT
	5	34439	90276	32	EAST	118	12	60277	32	EAST	120	272	0	12	100' BEACH SEINE
	5	39800	91676	34	EAST	140	14	60277	34	EAST	137	258	0	14	200' BEACH SEINE
	5	41877	110476	34	EAST	118	14	60277	34	EAST	121	209	0	14	200' BEACH SEINE
	5	49252	42277	29	WEST	127	12	60277	29	WEST	130	41	0	12	100' BEACH SEINE
	5	50235	51177	39	EAST	125	5	60277	42	EAST		22	-3	99	INDIAN POINT
	5	51494	52577	34	EAST	132	14	60277	42	EAST		8	-8	99	INDIAN POINT
	5	51510	52677	34	EAST	125	14	60277	42	EAST		7	-8	99	INDIAN POINT
	5	50793	52677	80	WEST	149	12	60377	42	EAST	138	8	38	99	INDIAN POINT
	5	51147	52677	78	WEST	133	12	60577	42	EAST		10	36	99	INDIAN POINT
	5	33404	52576	57	WEST	136	14	60677	57	WEST	138	376	0	12	100' BEACH SEINE
	5	43862	93076	57	WEST	108	14	60677	57	WEST	111	248	0	12	100' BEACH SEINE
	5	50956	52477	34	EAST	126	5	60677	34	EAST	104	13	0	5	BOX TRAP
	5	47104	102076	40	EAST	113	14	60877	40	EAST	113	230	0	14	200' BEACH SEINE
	5	50085	51977	36	WEST	125	14	60877	42	EAST		20	-6	99	INDIAN POINT
	5	50095	52077	38	EAST	116	5	60877	38	EAST	104	19	0	5	BOX TRAP
	5	50246	51177	39	EAST	149	5	60877	38	EAST	143	28	1	5	BOX TRAP
	5	50282	60177	51	EAST	147	12	60877	51	EAST	145	7	0	12	100' BEACH SEINE
	5	51459	52577	34	EAST	134	14	61077	42	EAST		16	-8	99	INDIAN POINT
	5	52430	53177	38	EAST	120	5	61077	39	EAST	121	10	-1	5	BOX TRAP
	5	52527	60277	39	EAST	125	5	61077	39	EAST	124	8	0	5	BOX TRAP
	5	52944	60977	40	WEST	118	14	61077	42	EAST	119	1	-2	99	INDIAN POINT
	5	52260	60377	37	EAST	136	12	61177	42	EAST		8	-5	99	INDIAN POINT
	5	47814	102576	40	WEST	120	5	61277	37	WEST	117	229	3	97	BOWLINE
	5	50373	52677	30	WEST	121	12	61277	42	EAST		17	-12	99	INDIAN POINT
	5	52258	60377	37	EAST	123	12	61277	42	EAST		9	-5	99	INDIAN POINT
	5	52903	60977	40	WEST	116	14	61277	42	EAST		3	-2	99	INDIAN POINT
	5	34602	83176	53	WEST	115	12	61377	53	WEST	121	285	0	12	100' BEACH SEINE
	5	50078	51977	36	EAST	127	14	61377	37	EAST	129	25	-1	12	100' BEACH SEINE
	5	40150	92776	35	EAST	110	12	61477	35	EAST	118	259	0	14	200' BEACH SEINE
**	5	40452	92476	34	EAST	147	53	61477	34	EAST	149	262	0	14	200' BEACH SEINE
	5	45254	100576	35	EAST	129	53	61477	35	EAST	129	251	0	12	100' BEACH SEINE
	5	49752	52777	35	EAST	123	14	61477	36	EAST	119	18	-1	14	200' BEACH SEINE
	5	51965	61377	34	EAST	145	5	61477	32	EAST		1	2	88	88
**	5	39272	91676	33	EAST	124	14	61577	34	EAST	132	271	-1	14	200' BEACH SEINE
	5	34232	61676	34	EAST	142	12	61677	34	EAST	147	364	0	5	BOX TRAP
	5	49663	42777	27	WEST	131	14	61677	27	WEST	129	50	0	14	200' BEACH SEINE
	5	50005	51677	36	EAST	142	14	61677	36	EAST	139	31	0	14	200' BEACH SEINE
	5	51703	61377	27	WEST	142	12	61677	27	WEST	140	3	0	14	200' BEACH SEINE
	5	52415	53177	34	EAST	136	5	61677	34	EAST	129	16	0	5	BOX TRAP

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=35 RC_MONTH=6

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
**	5	40452	92476	34	EAST	147	53	61777	34	EAST	150	265	0	14	200' BEACH SEINE
	5	50910	52077	34	EAST	138	12	61777	34	EAST	144	28	0	14	200' BEACH SEINE
	5	51668	60877	34	EAST	114	5	61777	42	EAST		9	-8	99	INDIAN POINT
	5	51994	61477	34	EAST	125	14	61777	34	EAST	120	3	0	14	200' BEACH SEINE
	5	53897	60977	69	WEST	108	12	61777	42	EAST		8	27	99	INDIAN POINT
	5	51933	60877	38	EAST	148	5	61877	42	EAST		10	-4	99	INDIAN POINT
	5	52940	60977	40	WEST	137	14	61977	42	EAST		10	-2	99	INDIAN POINT
	5	37960	91376	43	EAST	147	12	62077	43	EAST	146	279	0	12	100' BEACH SEINE
	5	53877	60977	69	WEST	112	12	62077	42	EAST		11	27	99	INDIAN POINT
	5	35565	91476	29	WEST	120	12	62177	29	WEST	134	279	0	12	100' BEACH SEINE
	5	36711	90276	39	EAST	148	14	62177	57	WEST	146	291	-18	12	100' BEACH SEINE
**	5	39272	91676	33	EAST	124	14	62177	34	EAST	131	277	-1	14	200' BEACH SEINE
	5	40445	92476	34	EAST	130	53	62177	34	EAST	140	269	0	14	200' BEACH SEINE
	5	40447	92476	34	EAST	122	53	62177	34	EAST	131	269	0	14	200' BEACH SEINE
	5	40481	92776	34	EAST	131	14	62177	34	EAST	136	266	0	14	200' BEACH SEINE
	5	40487	92776	34	EAST	130	14	62177	34	EAST	130	266	0	14	200' BEACH SEINE
	5	49617	41977	33	EAST	122	14	62177	34	EAST	125	63	-1	14	200' BEACH SEINE
	5	50926	52377	34	EAST	121	12	62177	34	EAST	121	29	0	12	100' BEACH SEINE
	5	52046	61577	34	EAST	137	14	62177	34	EAST	139	6	0	14	200' BEACH SEINE
	5	52056	61577	34	EAST	136	14	62177	34	EAST	134	6	0	14	200' BEACH SEINE
	5	52061	61577	34	EAST	141	14	62177	34	EAST	136	6	0	14	200' BEACH SEINE
	5	52065	61577	34	EAST	137	14	62177	34	EAST	133	6	0	14	200' BEACH SEINE
	5	52066	61577	34	EAST	124	14	62177	34	EAST	120	6	0	14	200' BEACH SEINE
	5	52080	61577	34	EAST	130	14	62177	34	EAST	130	6	0	14	200' BEACH SEINE
	5	52091	61677	34	EAST	132	14	62177	34	EAST	129	5	0	14	200' BEACH SEINE
	5	29645	111075	40	WEST	147	12	62277	40	WEST	155	589	0	14	200' BEACH SEINE
	5	34484	90276	26	WEST	123	12	62277	26	WEST	137	292	0	14	200' BEACH SEINE
	5	36048	90976	99	EAST	123	12	62277	99	EAST	123	285	0	12	100' BEACH SEINE
	5	37920	90976	99	EAST	114	12	62277	99	EAST	119	285	0	12	100' BEACH SEINE
	5	37971	91376	43	EAST	141	12	62277	43	EAST	143	281	0	12	100' BEACH SEINE
**	5	44071	93076	35	WEST	119	53	62277	36	WEST	120	264	-1	14	200' BEACH SEINE
	5	45801	102576	36	WEST	117	12	62277	36	WEST	119	239	0	14	200' BEACH SEINE
	5	45962	101576	43	EAST	138	12	62277	43	EAST	137	249	0	12	100' BEACH SEINE
	5	47506	101976	35	WEST	112	12	62277	35	WEST	117	245	0	14	200' BEACH SEINE
	5	47702	110176	35	WEST	118	12	62277	35	WEST	123	232	0	14	200' BEACH SEINE
	5	49664	42777	27	WEST	120	14	62277	27	WEST	129	56	0	14	200' BEACH SEINE
	5	49670	42777	27	WEST	149	14	62277	27	WEST	149	56	0	14	200' BEACH SEINE
	5	49756	61477	38	WEST	133	14	62277	36	WEST	132	8	2	14	200' BEACH SEINE
	5	50315	61477	34	EAST	119	12	62277	42	EAST		8	-8	99	INDIAN POINT
	5	50391	61477	36	WEST	130	12	62277	36	WEST	132	8	0	14	200' BEACH SEINE
	5	51785	61677	27	WEST	129	14	62277	26	WEST	125	6	1	14	200' BEACH SEINE
	5	51791	61677	27	WEST	123	14	62277	27	WEST	118	6	0	14	200' BEACH SEINE
	5	51792	61677	27	WEST	118	14	62277	27	WEST	114	6	0	14	200' BEACH SEINE
	5	51793	61677	27	WEST	132	14	62277	27	WEST	128	6	0	14	200' BEACH SEINE

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
			RELEASE							RECOVERY					
							SPECIES=35	RC_MONTH=6							
	5	51876	61677	27	WEST	140	14	62277	27	WEST	133	6	0	14	200' BEACH SEINE
	5	51887	61677	27	WEST	140	14	62277	27	WEST	131	6	0	14	200' BEACH SEINE
	5	51888	61677	27	WEST	132	14	62277	27	WEST	131	6	0	14	200' BEACH SEINE
	5	51894	61677	27	WEST	132	14	62277	27	WEST	125	6	0	14	200' BEACH SEINE
	5	52153	62077	38	EAST	127	5	62277	42	EAST		2	-4	99	INDIAN POINT
	5	52462	60177	40	WEST	104	14	62277	40	WEST	105	21	0	14	200' BEACH SEINE
	5	53089	60777	77	EAST	145	14	62277	42	EAST		15	35	99	INDIAN POINT
**	5	38743	91476	39	EAST	149	12	62377	39	EAST	136	281	0	12	100' BEACH SEINE
	5	40758	92276	39	EAST	120	14	62377	38	EAST	122	273	1	5	BOX TRAP
	5	46002	100776	36	WEST	120	53	62377	36	WEST	132	258	0	14	200' BEACH SEINE
	5	49270	42977	29	WEST	125	12	62377	29	WEST	125	55	0	14	200' BEACH SEINE
	5	49276	42977	29	WEST	115	12	62377	29	WEST	120	55	0	14	200' BEACH SEINE
	5	49395	61677	39	EAST	119	5	62377	39	EAST	115	7	0	5	BOX TRAP
	5	50245	51177	39	EAST	146	5	62377	39	EAST	149	43	0	5	BOX TRAP
	5	51263	51177	39	EAST	145	12	62377	38	EAST	141	43	1	5	BOX TRAP
	5	51781	61577	29	WEST	126	14	62377	29	WEST	123	8	0	14	200' BEACH SEINE
	5	51783	61577	29	WEST	114	14	62377	29	WEST	110	8	0	14	200' BEACH SEINE
	5	52427	53177	33	EAST	115	5	62377	38	EAST	115	23	0	5	BOX TRAP
	5	42921	92776	40	EAST	144	14	62477	40	EAST	150	269	0	14	200' BEACH SEINE
	5	49072	42077	26	WEST	111	12	62477	43	EAST	114	65	-17	14	200' BEACH SEINE
	5	54557	62377	39	EAST	140	5	62577	42	EAST	135	2	-3	99	INDIAN POINT
	5	50196	62377	51	EAST	118	12	62677	42	EAST	117	3	9	99	INDIAN POINT
	5	54299	62277	40	WEST	117	14	62677	37	WEST		4	3	97	BOWLINE
	5	54608	62177	57	WEST	124	12	62677	42	EAST	120	5	15	99	INDIAN POINT
**	5	38743	91476	39	EAST	149	12	62777	39	EAST	136	285	0	12	100' BEACH SEINE
	5	50206	51077	34	EAST	118	14	62777	34	EAST	127	48	0	5	BOX TRAP
	5	54413	62477	40	EAST	115	14	62777	42	EAST		3	-2	99	INDIAN POINT
	5	55565	62277	27	WEST	117	14	62777	42	EAST	119	5	-15	99	INDIAN POINT
	5	35142	90776	34	EAST	128	14	62877	34	EAST	135	293	0	14	200' BEACH SEINE
	5	35176	90776	34	EAST	130	14	62877	34	EAST	133	293	0	5	BOX TRAP
	5	37710	91576	40	WEST	108	14	62877	39	EAST	118	285	1	12	100' BEACH SEINE
	5	41872	110476	34	EAST	128	14	62877	34	EAST	131	235	0	14	200' BEACH SEINE
	5	41883	110476	34	EAST	128	14	62877	34	EAST	134	235	0	14	200' BEACH SEINE
	5	51294	62077	43	EAST	109	12	62877	43	EAST	106	8	0	12	100' BEACH SEINE
	5	51865	62077	32	WEST	130	14	62877	42	EAST		8	-10	99	INDIAN POINT
	5	54261	62177	34	EAST	120	14	62877	42	EAST		7	-8	99	INDIAN POINT
	5	55431	62477	40	WEST	128	14	62877	39	EAST	124	4	1	12	100' BEACH SEINE
	5	51779	61577	29	WEST	123	14	62977	29	WEST	124	14	0	14	200' BEACH SEINE
	5	55847	62477	34	EAST	137	5	62977	42	EAST		5	-8	99	INDIAN POINT
	5	49350	61677	34	EAST	147	5	63077	42	EAST		14	-8	99	INDIAN POINT
	5	51916	60877	38	EAST	124	5	63077	42	EAST		22	-4	99	INDIAN POINT
	5	54874	62777	38	EAST	134	5	63077	42	EAST		3	-4	99	INDIAN POINT
	9	46940	103075	51	EAST	158	14	60177	37	WEST	159	579	14	90	L.M.S.
	9	86516	41877	39	EAST	186	5	60177	40	WEST		44	-1	94	OTHER

Table A-24 (contd)

RELEASE / RECOVERY

SPECIES=35 RC_MONTH=6

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	9	88853	52577	36	WEST	166	14	60177	42	EAST		7	-6	99	INDIAN POINT
	9	70402	91676	34	EAST	184	14	60277	34	EAST	176	258	0	14	200' BEACH SEINE
	9	70753	92876	39	EAST	189	14	60277	42	EAST	188	246	-3	99	INDIAN POINT
	9	72067	92776	34	EAST	185	12	60277	34	EAST	184	247	0	14	200' BEACH SEINE
	9	76208	112376	39	EAST	176	12	60277	39	EAST	179	190	0	5	BOX TRAP
	9	86485	42077	26	WEST	205	12	60277	30	WEST	197	43	-4	12	100' BEACH SEINE
	9	61966	52476	74	WEST	161	12	60377	42	EAST	163	374	32	99	INDIAN POINT
	9	75458	101876	27	WEST	171	12	60477	42	EAST	170	228	-15	99	INDIAN POINT
	9	64518	60876	58	WEST	162	12	60677	37	WEST	162	362	21	97	BOWLINE
	9	72578	100576	34	EAST	170	14	60677	37	WEST	170	243	-3	97	BOWLINE
	9	77302	102176	39	WEST	185	64	60677	48	EAST	181	227	-9	12	100' BEACH SEINE
	9	87751	51077	34	EAST	161	14	60677	34	EAST	160	27	0	5	BOX TRAP
	9	87761	51077	34	EAST	184	14	60677	42	EAST		27	-8	99	INDIAN POINT
	9	87848	51277	34	EAST	169	14	60677	34	EAST	166	25	0	5	BOX TRAP
	9	70742	92376	76	EAST	155	12	60777	77	EAST	155	256	-1	14	200' BEACH SEINE
	9	86928	41977	39	EAST	169	12	60777	39	EAST	163	49	0	12	100' BEACH SEINE
**	9	63839	90276	39	EAST	184	14	60877	38	EAST	182	278	1	5	BOX TRAP
	9	73300	92876	27	WEST	180	14	60877	42	EAST	175	252	-15	99	INDIAN POINT
	9	72340	92776	34	EAST	197	14	60977	41	WEST	195	254	-7	95	LOVETT
	9	83662	111976	39	EAST	170	14	61077	96	WEST		202	-57	98	SPORTS FISHERMAN
	9	85759	51077	121	CNTR	189	12	61077	42	EAST		31	79	99	INDIAN POINT
	9	87825	51177	39	EAST	157	5	61077	39	EAST	155	30	0	5	BOX TRAP
	9	92523	60677	34	EAST	153	5	61077	42	EAST	152	4	-8	99	INDIAN POINT
	9	87376	51977	41	EAST	179	12	61277	43	EAST		24	-2	98	SPORTS FISHERMAN
	9	88984	60877	38	EAST	164	5	61277	42	EAST		4	-4	99	INDIAN POINT
	9	93297	60877	77	WEST	152	14	61377	42	EAST		5	35	99	INDIAN POINT
	9	70301	91676	34	EAST	169	14	61477	34	EAST	165	270	0	12	100' BEACH SEINE
	9	70440	91676	34	EAST	171	14	61477	34	EAST	171	270	0	12	100' BEACH SEINE
	9	70455	92076	34	EAST	167	14	61477	35	EAST	164	266	-1	14	200' BEACH SEINE
	9	92759	61077	39	EAST	162	5	61477	39	WEST	160	4	0	1	BOTTOM TRAWL
	9	93288	60877	77	WEST	177	14	61477	42	EAST	175	6	35	99	INDIAN POINT
	9	71802	92976	29	WEST	178	53	61577	29	WEST	178	258	0	14	200' BEACH SEINE
	9	76662	102976	34	EAST	193	14	61577	34	EAST	190	228	0	14	200' BEACH SEINE
**	9	87472	42777	27	WEST	180	14	61677	27	WEST	180	50	0	14	200' BEACH SEINE
**	9	87492	42777	27	WEST	160	14	61677	27	WEST	164	50	0	14	200' BEACH SEINE
**	9	87497	42777	27	WEST	175	14	61677	27	WEST	174	50	0	14	200' BEACH SEINE
	9	88926	60777	27	WEST	202	12	61677	27	WEST	200	9	0	14	200' BEACH SEINE
**	9	88928	60777	27	WEST	165	12	61677	27	WEST	163	9	0	14	200' BEACH SEINE
	9	89034	53177	34	EAST	174	5	61677	42	EAST	170	16	-8	99	INDIAN POINT
	9	92625	60977	76	EAST	156	12	61677	46		151	7	30	65	1 M TUCKER TRAWL
	9	88149	60377	43	EAST	181	12	61777	43	EAST	177	14	0	14	200' BEACH SEINE
	9	88990	60877	38	EAST	157	5	61877	42	EAST		10	-4	99	INDIAN POINT
	9	67481	92776	43	EAST	178	12	62077	43	EAST	175	265	0	12	100' BEACH SEINE
	9	71061	100576	34	EAST	156	53	62077	34	EAST	162	257	0	14	200' BEACH SEINE

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
RELEASE								RECOVERY							
SPECIES=35 RC_MONTH=6															
**	9	72502	92776	43	EAST	161	12	62077	43	EAST	162	265	0	12	100' BEACH SEINE
	9	83660	110476	34	EAST	171	14	62077	34	EAST	168	227	0	14	200' BEACH SEINE
	9	86098	52577	34	EAST	152	12	62077	34	EAST	146	26	0	12	100' BEACH SEINE
	9	87829	51177	39	EAST	171	5	62077	39	EAST	165	40	0	5	BOX TRAP
	9	76643	102976	34	EAST	159	14	62177	34	EAST	162	234	0	14	200' BEACH SEINE
	9	76665	102976	34	EAST	163	14	62177	34	EAST	161	234	0	14	200' BEACH SEINE
	9	76671	102976	34	EAST	160	14	62177	34	EAST	157	234	0	14	200' BEACH SEINE
	9	86219	61677	34	EAST	187	5	62177	42	EAST	183	5	-8	99	INDIAN POINT
	9	87274	42177	15	WEST	189	14	62177	57	WEST	182	61	-42	12	100' BEACH SEINE
	9	94026	61577	34	EAST	172	14	62177	34	EAST	166	6	0	14	200' BEACH SEINE
	9	94030	61577	34	EAST	171	14	62177	34	EAST	169	6	0	14	200' BEACH SEINE
**	9	72502	92776	43	EAST	161	12	62277	43	EAST	159	267	0	12	100' BEACH SEINE
	9	72517	92876	16	WEST	190	12	62277	16	WEST	190	266	0	12	100' BEACH SEINE
	9	86042	61377	43	EAST	177	12	62277	43	EAST	180	9	0	12	100' BEACH SEINE
	9	87368	61477	38	WEST	157	14	62277	36	WEST	157	8	2	14	200' BEACH SEINE
	9	87448	61677	27	WEST	160	14	62277	27	WEST	161	6	0	14	200' BEACH SEINE
	9	87450	61677	27	WEST	170	14	62277	27	WEST	172	6	0	14	200' BEACH SEINE
	9	87487	42777	26	WEST	194	14	62277	27	WEST	195	56	-1	14	200' BEACH SEINE
**	9	87492	42777	27	WEST	160	14	62277	27	WEST	168	56	0	14	200' BEACH SEINE
**	9	87497	42777	27	WEST	175	14	62277	27	WEST	174	56	0	14	200' BEACH SEINE
	9	88003	50577	27	WEST	167	12	62277	27	WEST	168	48	0	14	200' BEACH SEINE
	9	88510	61677	27	WEST	204	14	62277	27	WEST	204	6	0	14	200' BEACH SEINE
	9	88513	61677	27	WEST	159	14	62277	27	WEST	162	6	0	14	200' BEACH SEINE
**	9	88928	60777	27	WEST	165	12	62277	27	WEST	167	15	0	14	200' BEACH SEINE
**	9	67553	92476	35	EAST	204	53	62377	42	EAST	204	271	-7	99	INDIAN POINT
	9	68306	100576	35	EAST	186	53	62377	35	EAST	175	260	0	14	200' BEACH SEINE
	9	75577	100576	35	EAST	178	53	62377	35	EAST	177	260	0	14	200' BEACH SEINE
	9	87808	51177	38	EAST	159	5	62377	38	EAST	156	43	0	5	BOX TRAP
	9	88078	51777	38	EAST	157	5	62377	38	EAST	152	37	0	5	BOX TRAP
	9	85981	62077	43	EAST	164	12	62477	43	EAST	167	4	0	14	200' BEACH SEINE
	9	85990	62077	43	EAST	162	12	62477	43	EAST	159	4	0	14	200' BEACH SEINE
	9	85995	62077	43	EAST	155	12	62477	43	EAST	156	4	0	14	200' BEACH SEINE
	9	88529	61677	36	WEST	184	14	62477	42	EAST	177	8	-6	99	INDIAN POINT
	9	89027	53177	34	EAST	233	5	62477	33	EAST		24	1	98	SPORTS FISHERMAN
	9	89094	60177	40	WEST	181	14	62477	40	WEST	183	23	0	14	200' BEACH SEINE
	9	92356	60677	34	EAST	180	5	62477	42	EAST	175	18	-8	99	INDIAN POINT
	9	92522	60677	34	EAST	192	5	62477	42	EAST	188	18	-8	99	INDIAN POINT
	9	94053	61777	40	WEST	171	14	62477	40	WEST	167	7	0	14	200' BEACH SEINE
	9	93961	61377	34	EAST	176	5	62577	42	EAST		12	-8	99	INDIAN POINT
	9	88258	61677	34	EAST	184	5	62677	42	EAST		10	-8	99	INDIAN POINT
	9	93970	61377	34	EAST	165	5	62677	30	WEST		13	4	98	SPORTS FISHERMAN
	9	87889	52077	38	EAST	160	5	62777	38	EAST	157	38	0	5	BOX TRAP
	9	61157	51976	58	EAST	157	5	62877	42	EAST	164	404	16	99	INDIAN POINT
	9	70467	92076	34	EAST	187	14	62877	34	EAST	182	280	0	14	200' BEACH SEINE

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=35 RC_MONTH=6

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	9	86488	42177	16	WEST	202	12	62877	42	EAST	205	68	-26	99	INDIAN POINT
	9	87440	61577	29	WEST	177	14	62877	29	WEST	176	13	0	12	100' BEACH SEINE
	9	92289	62077	27	WEST	171	12	62877	26	WEST	171	8	1	12	100' BEACH SEINE
	9	93996	61577	34	EAST	165	14	62877	34	EAST	164	13	0	5	BOX TRAP
	9	94168	62377	39	EAST	169	5	62877	38	EAST	166	5	1	14	200' BEACH SEINE
**	9	63839	90276	39	EAST	184	14	62977	42	EAST	180	299	-3	99	INDIAN POINT
	9	87429	61577	30	WEST	170	14	62977	66	WEST	167	14	-36	96	DANSKAMMER
	9	87743	50577	39	EAST	166	5	62977	42	EAST	165	55	-3	99	INDIAN POINT
	9	87772	51077	34	EAST	160	14	63077	34	EAST	155	51	0	5	BOX TRAP
	9	87846	51277	34	EAST	159	14	63077	34	EAST	156	49	0	5	BOX TRAP
	9	92785	61477	39	EAST	158	12	63077	39	EAST	159	16	0	12	100' BEACH SEINE

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=35 RC_MONTH=7

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	5	36614	90276	39	EAST	142	14	70177	42	EAST	140	301	-3	99	INDIAN POINT
	5	51502	52677	34	EAST	120	14	70277	42	EAST		37	-8	99	INDIAN POINT
	5	54859	62777	38	EAST	146	5	70377	42	EAST		6	-4	99	INDIAN POINT
	5	55740	62377	38	EAST	129	5	70377	42	EAST		10	-4	99	INDIAN POINT
	5	45961	101576	46	EAST	167	12	70577	12			262	34	98	SPORTS FISHERMAN
	5	50900	52077	38	EAST	121	5	70577	34	EAST	128	46	4	5	BOX TRAP
	5	51714	61377	34	EAST	130	12	70577	34	EAST	132	22	0	12	100' BEACH SEINE
	5	49118	52377	54	EAST	118	12	70677	54	EAST	122	44	0	12	100' BEACH SEINE
	5	51785	61677	27	WEST	129	14	70677	27	WEST	130	20	0	14	200' BEACH SEINE
	5	56677	70177	36	WEST	117	14	70977	42	EAST		8	-6	99	INDIAN POINT
	5	43862	93076	57	WEST	108	14	71177	57	WEST	120	283	0	12	100' BEACH SEINE
	5	49127	52377	53	EAST	132	12	71177	53	EAST	132	49	0	12	100' BEACH SEINE
	5	50137	61677	58	EAST	127	12	71177	58	EAST	123	25	0	12	100' BEACH SEINE
	5	51320	50577	47	WEST	122	12	71177	43	EAST	124	67	4	12	100' BEACH SEINE
	5	54822	62777	38	EAST	143	5	71177	42	EAST		14	-4	99	INDIAN POINT
	5	55913	62777	39	EAST	148	12	71177	39	EAST	151	14	0	12	100' BEACH SEINE
	5	53821	60877	85	WEST	135	12	71377	65	WEST	142	35	20	96	DANSKAMMER
**	5	51951	61377	38	EAST	119	5	72077	38	EAST	133	37	0	5	BOX TRAP
	5	52195	62177	34	EAST	146	14	72077	42	EAST		29	-8	99	INDIAN POINT
	5	56663	63077	34	EAST	133	5	72077	42	EAST		20	-8	99	INDIAN POINT
	5	43261	100176	42	WEST	130	12	72177	42	WEST	130	292	0	12	100' BEACH SEINE
	5	50521	52677	30	WEST	127	12	72677	30	WEST	145	61	0	12	100' BEACH SEINE
	5	50956	52477	34	EAST	126	5	72777	34	EAST	116	64	0	5	BOX TRAP
	5	44521	101376	43	EAST	135	12	72877	39	EAST		287	4	98	SPORTS FISHERMAN
	9	87424	61677	36	WEST	171	14	70177	42	EAST		15	-6	99	INDIAN POINT
	9	94479	62377	38	EAST	166	5	70177	42	EAST		8	-4	99	INDIAN POINT
	9	70281	91676	34	EAST	190	14	70277	42	EAST	190	288	-8	99	INDIAN POINT
	9	76142	100676	34	EAST	184	14	70377	42	EAST		269	-8	99	INDIAN POINT
	9	88373	62777	38	EAST	159	5	70377	42	EAST		6	-4	99	INDIAN POINT
	9	92175	61377	38	EAST	175	5	70377	42	EAST	161	20	-4	99	INDIAN POINT
	9	93893	62377	59	EAST	154	12	70377	42	EAST		10	17	99	INDIAN POINT
	9	94248	62377	38	EAST	165	5	70377	42	EAST		10	-4	99	INDIAN POINT
	9	87831	51177	39	EAST	152	5	70477	42	EAST	155	54	-3	99	INDIAN POINT
	9	88302	62177	57	WEST	171	12	70477	42	EAST	171	13	15	99	INDIAN POINT
	9	94616	62777	38	EAST	161	5	70477	42	EAST		7	-4	99	INDIAN POINT
	9	87809	51177	38	EAST	152	5	70577	38	EAST	151	55	0	5	BOX TRAP
	9	95312	62877	26	WEST	174	12	70577	27	WEST	173	7	-1	12	100' BEACH SEINE
	9	87322	42177	16	WEST	187	14	70877	42	EAST	206	78	-26	99	INDIAN POINT
	9	87876	52077	39	EAST	175	5	70877	39	EAST	167	49	0	5	BOX TRAP
	9	88327	61677	38	EAST	170	5	70877	38	EAST	173	22	0	5	BOX TRAP
	9	72147	110176	26	WEST	167	64	71077	42	EAST	163	250	-16	99	INDIAN POINT
	9	85620	41577	39	EAST	187	12	71177	39	EAST		87	0	98	SPORTS FISHERMAN
	9	88612	52577	94	WEST	174	12	71177	38	EAST	167	47	56	5	BOX TRAP
	9	76962	101976	34	EAST	194	14	71277	42	EAST	192	265	-8	99	INDIAN POINT

Table A-24 (contd)

			RELEASE							RECOVERY					
SPECIES=35 RC_MONTH=7															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	9	66812	90276	60	EAST	162	5	71577	60	EAST	161	315	0	5	BOX TRAP
	9	69781	92976	34	EAST	187	12	71577	38	EAST	182	288	-4	5	BOX TRAP
	9	88801	52377	35	EAST	176	12	71577	34	EAST	174	53	1	5	BOX TRAP
	9	88925	60777	27	WEST	185	12	71777	42	EAST	180	40	-15	99	INDIAN POINT
	9	94115	62277	35	WEST	169	14	71777	42	EAST	169	25	-7	99	INDIAN POINT
	9	86800	42777	16	WEST	180	12	71877	42	EAST	174	82	-26	99	INDIAN POINT
	9	65354	92176	24	WEST	178	14	71977	42	EAST	176	300	-18	99	INDIAN POINT
	9	86097	52477	39	EAST	176	12	72077	39	EAST	167	57	0	5	BOX TRAP
	9	67531	92476	35	EAST	207	53	72177	42	EAST	201	299	-7	99	INDIAN POINT
	9	86405	51677	46	EAST	169	12	72177	42	EAST	162	66	4	99	INDIAN POINT
	9	86709	41977	14	WEST	205	12	72177	41	WEST	209	93	-27	95	LOVETT
	9	87217	42177	16	WEST	188	14	72177	42	EAST	188	91	-26	99	INDIAN POINT
	9	93286	60877	77	WEST	182	14	72377	42	EAST	179	45	35	99	INDIAN POINT
	9	70471	92076	34	EAST	161	14	72677	42	EAST	157	308	-8	99	INDIAN POINT
	9	92221	62077	35	EAST	156	12	72677	35	EAST	158	36	0	12	100' BEACH SEINE
	9	70499	92176	34	EAST	180	14	72877	42	EAST	180	309	-8	99	INDIAN POINT
	9	73720	92476	33	EAST	185	53	73077	42	EAST	182	308	-9	99	INDIAN POINT
	9	71326	92276	34	EAST	166	14	73177	42	EAST	165	311	-8	99	INDIAN POINT
	9	86011	61477	34	EAST	165	12	73177	42	EAST	163	47	-8	99	INDIAN POINT
	29	12597	53074	42	EAST	173	5	70177	0	EAST		1127	42	88	88

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
			RELEASE							RECOVERY					
						SPECIES=35		RC_MONTH=8							
	5	49042	41477	31	WEST	118	14	80177	42	EAST	118	109	-11	99	INDIAN POINT
	5	50869	53177	34	EAST	117	12	80477	42	EAST	138	65	-8	99	INDIAN POINT
	5	51651	60777	30	WEST	123	12	80777	42	EAST	122	61	-12	99	INDIAN POINT
	5	47343	101576	33	EAST	139	53	80877	33	EAST	159	296	0	14	200' BEACH SEINE
	5	55468	62777	30	WEST	126	12	80877	30	WEST	137	42	0	14	200' BEACH SEINE
	5	55945	62877	32	WEST	150	12	80977	32	WEST	152	42	0	12	100' BEACH SEINE
	5	45254	100576	35	EAST	129	53	81577	35	EAST	141	313	0	14	200' BEACH SEINE
	5	51398	51677	36	EAST	122	14	81577	36	EAST	138	91	0	14	200' BEACH SEINE
	5	52122	61677	36	EAST	126	14	81577	36	EAST	145	60	0	14	200' BEACH SEINE
	5	37337	91076	40	EAST	143	12	81977	38	EAST	149	342	2	5	BOX TRAP
	5	45202	100576	35	EAST	139	53	82277	29	WEST	152	320	6	14	200' BEACH SEINE
	5	40788	92276	39	EAST	143	14	82477	38	EAST	152	335	1	5	BOX TRAP
	5	50532	52677	25	EAST	122	12	82877	0			94	25	98	SPORTS FISHERMAN
**	5	51951	61377	38	EAST	119	5	82977	42	EAST	130	77	-4	99	INDIAN POINT
	5	51727	61377	37	EAST	115	12	83077	36	EAST	136	78	1	12	100' BEACH SEINE
	5	51768	62077	27	WEST	144	12	83077	27	WEST	151	71	0	12	100' BEACH SEINE
	5	41768	92776	54	EAST	111	12	83177	56	WEST		337	-2	98	SPORTS FISHERMAN
	5	53376	63077	37	WEST	130	12	83177	42	EAST	129	62	-5	99	INDIAN POINT
	5	56625	63077	39	EAST	115	5	83177	39	EAST	131	62	0	12	100' BEACH SEINE
	9	70440	91676	34	EAST	171	14	80177	42	EAST	170	318	-8	99	INDIAN POINT
	9	86184	41477	15	WEST	222	12	80177	42	EAST	196	109	-27	99	INDIAN POINT
	9	92109	60877	38	EAST	168	5	80177	38	EAST	167	54	0	5	BOX TRAP
	9	92950	60777	46	EAST	168	12	80277	42	EAST	168	56	4	12	100' BEACH SEINE
	9	87268	42177	15	WEST	175	14	80377	30	WEST	173	104	-15	14	200' BEACH SEINE
	9	67514	92476	35	EAST	202	53	80477	42	EAST	201	313	-7	99	INDIAN POINT
	9	73190	100176	38	WEST	189	12	80477	42	EAST	177	306	-4	99	INDIAN POINT
	9	88252	61477	34	EAST	198	12	80477	42	EAST	193	51	-8	99	INDIAN POINT
	9	84279	110476	30	CNTR	230	64	80577	42	EAST	227	273	-12	99	INDIAN POINT
	9	57765	51276	58	EAST	186	14	80677	42	EAST	183	450	16	99	INDIAN POINT
	9	73604	92976	29	WEST	185	53	80677	42	EAST	183	310	-13	99	INDIAN POINT
	9	86585	41977	34	EAST	167	14	80777	42	EAST	165	110	-8	99	INDIAN POINT
	9	66379	92376	35	EAST	164	14	80877	42	EAST	167	318	-7	99	INDIAN POINT
	9	70245	91676	34	EAST	168	14	80877	42	EAST	164	325	-8	99	INDIAN POINT
	9	71806	92976	29	WEST	175	53	80877	37	WEST		312	-8	98	SPORTS FISHERMAN
	9	84556	110476	31	WEST	170	64	80877	42	EAST	167	276	-11	99	INDIAN POINT
	9	87153	50977	53	WEST	154	12	80977	42	EAST	151	92	11	99	INDIAN POINT
	9	87747	50577	39	EAST	164	5	81077	39	EAST	160	97	0	5	BOX TRAP
	9	88357	62777	34	EAST	198	5	81177	42	EAST	195	45	-8	99	INDIAN POINT
	9	84216	110376	30	WEST	230	64	81277	42	EAST	227	281	-12	99	INDIAN POINT
	9	85020	112976	30	WEST	180	64	81277	42	EAST	172	255	-12	99	INDIAN POINT
	9	67509	92476	35	EAST	199	53	81477	42	EAST	191	323	-7	99	INDIAN POINT
	9	84289	110476	30	CNTR	182	64	81477	42	EAST	168	282	-12	99	INDIAN POINT
	9	88815	52477	39	EAST	180	5	81577	42	EAST	177	83	-3	99	INDIAN POINT
	9	84145	102576	40	WEST	158	14	81677	36	WEST	156	294	4	12	100' BEACH SEINE

Table A-24 (contd)

					RELEASE						RECOVERY				
							SPECIES=35	RC_MONTH=8							
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	9	84598	110476	31	WEST	185	64	81677	42	EAST	181	284	-11	99	INDIAN POINT
	9	86393	42877	18	EAST	195	12	81777	42	EAST	184	111	-24	99	INDIAN POINT
	9	88119	60177	51	EAST	181	12	81777	42	EAST	180	77	9	99	INDIAN POINT
	9	93038	60777	77	EAST	157	14	81777	42	EAST		71	35	99	INDIAN POINT
	9	72866	92476	33	EAST	179	53	82077	42	EAST	176	329	-9	99	INDIAN POINT
	9	73838	92276	34	EAST	168	14	82277	42	EAST	167	333	-8	99	INDIAN POINT
	9	87197	51377	39	EAST	171	12	82277	39	EAST	182	101	0	12	100' BEACH SEINE
	9	88546	62077	30	WEST	170	14	82277	29	WEST	170	63	1	14	200' BEACH SEINE
	9	72131	110176	24	WEST	185	64	82477	38	EAST	183	295	-14	5	BOX TRAP
	9	75479	101876	27	WEST	173	12	82577	26	WEST	172	310	1	14	200' BEACH SEINE
	9	92880	62477	43	EAST	167	14	82577	42	EAST	162	62	1	99	INDIAN POINT
	9	83954	110276	30	WEST	180	64	82677	42	EAST	170	296	-12	99	INDIAN POINT
	9	86798	42777	18	EAST	160	12	82677	18	EAST	159	121	0	14	200' BEACH SEINE
	9	88314	62177	60	EAST	153	12	82977	61	EAST	154	69	-1	12	100' BEACH SEINE

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
			RELEASE							RECOVERY					
							SPECIES=35		RC_MONTH=9						
	5	54005	90677	27	WEST	110	12	90677	26	EAST	110	0	1	14	200' BEACH SEINE
	5	43669	101876	40	EAST	145	14	90877	40	EAST	155	324	0	14	200' BEACH SEINE
**	5	54002	90677	27	WEST	120	12	90877	26	WEST	117	2	1	12	100' BEACH SEINE
	5	50241	51177	39	EAST	121	5	91277	39	EAST	135	124	0	12	100' BEACH SEINE
	5	50243	51177	39	EAST	128	5	91277	39	EAST	144	124	0	12	100' BEACH SEINE
	5	51396	51677	36	EAST	133	14	91277	36	EAST	154	119	0	12	100' BEACH SEINE
	5	52528	60277	39	EAST	123	5	91277	39	EAST	139	102	0	12	100' BEACH SEINE
	5	55391	91277	39	EAST		12	91377	39	EAST	137	1	0	14	200' BEACH SEINE
	5	56560	90677	39	EAST	120	12	91377	39	EAST	118	7	0	14	200' BEACH SEINE
	5	43699	101976	40	EAST	126	14	91477	40	EAST	134	329	0	14	200' BEACH SEINE
	5	54418	62477	40	EAST	132	14	91477	40	EAST	140	82	0	14	200' BEACH SEINE
	5	51767	62077	27	WEST	137	12	91577	27	WEST	150	87	0	12	100' BEACH SEINE
	5	51890	61677	27	WEST	140	14	91577	27	WEST	149	91	0	12	100' BEACH SEINE
	5	51765	61677	40	WEST	132	12	91677	40	WEST	138	92	0	53	500' BEACH SEINE
	5	55499	63077	43	WEST	130	12	91977	48	WEST	141	81	-5	12	100' BEACH SEINE
	5	41187	92776	39	EAST	115	14	92077	39	EAST	137	357	0	14	200' BEACH SEINE
	5	54002	90677	27	WEST	120	12	92077	26	WEST	115	14	1	12	100' BEACH SEINE
	5	50237	51177	39	EAST	120	5	92277	39	EAST	142	134	0	14	200' BEACH SEINE
	5	52035	61477	35	EAST	131	14	92277	35	EAST	149	100	0	14	200' BEACH SEINE
	5	56497	91577	35	EAST	112	12	92277	35	EAST	110	7	0	14	200' BEACH SEINE
	5	57917	92077	36	WEST	122	14	92277	35	EAST	120	2	1	14	200' BEACH SEINE
	5	42490	92976	35	EAST	112	53	92677	35	EAST	148	361	0	53	500' BEACH SEINE
	5	45501	101576	34	EAST	119	12	92677	35	EAST	143	345	-1	53	500' BEACH SEINE
	5	51015	52477	34	EAST	110	14	92677	42	EAST	136	125	-8	99	INDIAN POINT
	5	59043	92377	35	EAST	130	14	92677	35	EAST	125	3	0	53	500' BEACH SEINE
**	5	54537	62277	40	WEST	133	14	92777	40	WEST	137	97	0	14	200' BEACH SEINE
	5	54255	62277	35	WEST	141	14	92877	42	EAST	143	98	-7	99	INDIAN POINT
	5	56689	70177	36	WEST	123	14	93077	42	EAST	127	91	-6	99	INDIAN POINT
	9	95333	62977	53	EAST	158	12	90277	53	EAST	157	65	0	14	200' BEACH SEINE
	9	95794	62377	29	WEST	175	14	90577	42	EAST	173	74	-13	99	INDIAN POINT
	9	86035	52677	26	WEST	174	12	90677	26	EAST	171	103	0	14	200' BEACH SEINE
	9	67137	91376	29	WEST	172	12	90777	29	WEST		358	0	98	SPORTS FISHERMAN
	9	73625	92976	29	WEST	162	53	90777	36	WEST		342	-7	98	SPORTS FISHERMAN
	9	83857	101576	35	EAST	228	53	90877	33	EAST		327	2	98	SPORTS FISHERMAN
	9	84130	102576	34	EAST	168	14	90877	34	EAST	169	317	0	14	200' BEACH SEINE
	9	72270	92776	40	WEST	163	14	91277	42	EAST	150	349	-2	99	INDIAN POINT
	9	87837	51177	39	EAST	160	5	91277	39	EAST	162	124	0	12	100' BEACH SEINE
	9	86142	41277	32	EAST	182	12	91477	32	EAST	162	155	0	12	100' BEACH SEINE
	9	84072	111876	36	EAST	194	64	91877	42	EAST	193	303	-6	99	INDIAN POINT
	9	58332	50676	85	EAST	177	12	92077	42	EAST	153	501	43	99	INDIAN POINT
	9	70451	92076	34	EAST	163	14	92277	35	EAST	166	366	-1	14	200' BEACH SEINE
	9	87875	51977	36	WEST	192	14	92277	35	WEST	195	126	1	53	500' BEACH SEINE
	9	83963	110276	30	WEST	196	64	92577	42	EAST	194	326	-12	99	INDIAN POINT
	9	58126	42176	94	WEST	157	12	92677	42	EAST		522	52	99	INDIAN POINT

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
RELEASE								RECOVERY							
SPECIES=35 RC_MONTH=9															
	9	70455	92076	34	EAST	167	14	92877	35	EAST	170	372	-1	14	200' BEACH SEINE
	9	86671	42177	14	WEST	151	14	93077	42	EAST	161	162	-28	99	INDIAN POINT
	26	56410	90777	38	WEST	122	12	90777	38	WEST	123	0	0	14	200' BEACH SEINE
**	26	56411	90777	38	WEST	114	12	90777	38	WEST	115	0	0	14	200' BEACH SEINE
	26	56539	90677	43	EAST	110	12	90777	42	EAST	113	1	1	99	INDIAN POINT
	26	56334	90677	26	WEST	143	12	90877	26	WEST	137	2	0	12	100' BEACH SEINE
	26	57171	90877	40	EAST	110	14	91077	42	EAST		2	-2	99	INDIAN POINT
	26	56459	91277	36	EAST	112	12	91277	36	EAST	114	0	0	12	100' BEACH SEINE
	26	56464	91277	36	EAST	123	12	91277	36	EAST	125	0	0	12	100' BEACH SEINE
**	26	53477	90877	29	WEST	104	12	91477	29	WEST	102	6	0	12	100' BEACH SEINE
	26	54096	91277	53	EAST	117	12	91577	53	EAST	115	3	0	12	100' BEACH SEINE
	26	56418	90777	36	WEST	122	12	91977	55	EAST	121	12	-19	14	200' BEACH SEINE
	26	56702	91377	39	EAST	103	14	91977	39	EAST	112	6	0	14	200' BEACH SEINE
	26	57290	91277	35	WEST	112	12	91977	35	WEST	113	7	0	12	100' BEACH SEINE
	26	53475	90877	29	WEST	130	12	92077	29	WEST	128	12	0	12	100' BEACH SEINE
	26	56424	90977	36	EAST	148	12	92077	36	WEST	148	11	0	14	200' BEACH SEINE
	26	56478	91477	30	WEST	128	12	92077	30	WEST	131	6	0	12	100' BEACH SEINE
	26	53470	90877	29	WEST	117	12	92177	29	WEST	118	13	0	12	100' BEACH SEINE
**	26	53477	90877	29	WEST	104	12	92177	29	WEST	104	13	0	12	100' BEACH SEINE
	26	56727	91377	39	EAST	138	14	92177	39	EAST	135	8	0	12	100' BEACH SEINE
	26	57109	90777	38	WEST	115	14	92177	38	WEST	110	14	0	14	200' BEACH SEINE
	26	57131	90777	38	WEST	116	14	92177	38	WEST	117	14	0	14	200' BEACH SEINE
	26	57132	90777	38	WEST	121	14	92177	38	WEST	113	14	0	14	200' BEACH SEINE
	26	49810	92077	39	EAST	122	14	92277	39	EAST	120	2	0	14	200' BEACH SEINE
	26	53513	91277	26	WEST	166	12	92277	26	WEST	109	10	0	12	100' BEACH SEINE
	26	56983	92077	36	WEST	142	14	92277	35	EAST	138	2	1	14	200' BEACH SEINE
**	26	57066	90777	36	WEST	116	14	92277	35	WEST	117	15	1	53	500' BEACH SEINE
	26	54112	92077	56	WEST	135	14	92377	42	EAST		3	14	99	INDIAN POINT
	26	54986	91977	35	EAST	122	12	92377	35	EAST	117	4	0	14	200' BEACH SEINE
	26	56496	91577	35	EAST	103	12	92377	35	EAST	115	8	0	14	200' BEACH SEINE
	26	58379	91977	55	EAST	144	14	92377	42	EAST		4	13	99	INDIAN POINT
	26	58751	92277	35	EAST	111	14	92377	35	EAST	117	1	0	14	200' BEACH SEINE
	26	58799	92277	35	EAST	123	14	92377	35	EAST	121	1	0	14	200' BEACH SEINE
	26	49858	91977	59	EAST	138	14	92477	42	EAST		5	17	99	INDIAN POINT
	26	53575	91977	58	WEST	113	12	92577	42	EAST		6	16	99	INDIAN POINT
	26	58538	91977	48	WEST	145	12	92677	42	EAST		7	6	99	INDIAN POINT
	26	56827	91477	40	EAST	113	14	92777	40	EAST	110	13	0	12	100' BEACH SEINE
	26	57092	90777	36	WEST	121	14	92777	35	WEST	116	20	1	53	500' BEACH SEINE
	26	55376	91277	36	EAST	110	12	92877	36	EAST	110	16	0	12	100' BEACH SEINE
	26	57871	92077	36	WEST	112	14	92877	36	EAST	115	8	0	12	100' BEACH SEINE
	26	57893	92077	36	WEST	132	14	92877	36	EAST	123	8	0	12	100' BEACH SEINE
	26	55363	91277	36	EAST	101	12	93077	36	EAST	111	18	0	12	100' BEACH SEINE
	30	96309	90677	26	EAST	155	14	90977	26	WEST	145	3	0	14	200' BEACH SEINE
	30	96326	90677	26	EAST	177	14	90977	26	WEST	175	3	0	14	200' BEACH SEINE

Table A-24 (contd)

			RELEASE								RECOVERY				
SPECIES=35 RC_MONTH=9															
MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	30	95965	91277	39	EAST	175	12	92077	39	EAST	167	8	0	14	200' BEACH SEINE
	30	86257	91477	26	WEST	167	12	92177	26	WEST	174	7	0	12	100' BEACH SEINE
	30	97460	92077	36	WEST	158	14	92277	35	EAST	148	2	1	14	200' BEACH SEINE
	30	97480	92077	36	WEST	170	14	92277	35	EAST	160	2	1	14	200' BEACH SEINE
	30	98134	92277	35	EAST	155	14	92677	35	EAST	152	4	0	53	500' BEACH SEINE
	30	95683	92377	35	EAST	158	14	92877	36	EAST	151	5	-1	12	100' BEACH SEINE
	30	94596	91477	32	EAST	189	12	93077	32	EAST	189	16	0	12	100' BEACH SEINE
	30	96332	90677	26	EAST	183	14	93077	26	WEST	182	24	0	12	100' BEACH SEINE

Table A-24 (contd)

RELEASE — RECOVERY

SPECIES=35 RC_MONTH=10

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
**	5	40158	92776	35	EAST	127	12	100477	35	EAST	148	371	0	14	200' BEACH SEINE
	5	51724	61377	37	EAST	122	12	100477	37	EAST	140	113	0	14	200' BEACH SEINE
	5	55455	62377	32	WEST	137	14	100477	32	WEST	153	103	0	12	100' BEACH SEINE
**	5	35562	91476	29	WEST	115	12	100777	29	WEST	125	387	0	14	200' BEACH SEINE
	5	53654	100777	36	WEST	140	14	101177	35	WEST	140	4	1	14	200' BEACH SEINE
	5	37981	90976	99	EAST	115	12	101277	99	EAST	127	397	0	12	100' BEACH SEINE
	5	52364	60877	40	EAST	122	14	101277	42	EAST	130	126	-2	99	INDIAN POINT
	5	53607	100377	26	WEST	123	14	101377	26	WEST	121	10	0	14	200' BEACH SEINE
	5	56648	70177	36	WEST	130	14	101677	37	WEST		107	-1	97	BOWLINE
**	5	53604	100377	26	WEST	124	14	101877	26	WEST	117	15	0	14	200' BEACH SEINE
	5	53606	100377	26	WEST	147	14	101877	26	WEST	144	15	0	14	200' BEACH SEINE
**	5	54537	62277	40	WEST	133	14	102077	40	WEST	136	120	0	14	200' BEACH SEINE
	5	40200	92776	40	WEST	140	14	102477	40	WEST	143	391	0	14	200' BEACH SEINE
	5	55435	62477	40	WEST	134	14	102477	40	WEST	143	122	0	14	200' BEACH SEINE
**	5	53604	100377	26	WEST	124	14	102577	26	WEST	118	22	0	14	200' BEACH SEINE
**	5	54002	90677	27	WEST	120	12	102577	26	WEST	122	49	1	14	200' BEACH SEINE
	9	68352	100576	35	EAST	162	53	100477	35	EAST	159	363	0	14	200' BEACH SEINE
	9	88110	51277	35	EAST	151	14	100477	35	EAST	156	145	0	14	200' BEACH SEINE
	9	94082	61677	35	EAST	167	14	100477	35	EAST	171	110	0	14	200' BEACH SEINE
	9	70860	100176	46	WEST	170	12	100677	46	WEST	172	369	0	12	100' BEACH SEINE
	9	87770	51077	34	EAST	169	14	100677	34	EAST	170	149	0	12	100' BEACH SEINE
	9	83665	111976	39	EAST	153	14	101077	42	EAST	152	324	-3	99	INDIAN POINT
	9	97079	100777	18	WEST	180	14	101377	19	WEST	183	6	-1	14	200' BEACH SEINE
	9	87056	42277	34	EAST	153	12	101777	34	EAST	157	178	0	12	100' BEACH SEINE
	9	99620	101377	26	WEST	159	14	101877	26	WEST	159	5	0	12	100' BEACH SEINE
	9	74523	110476	34	EAST	152	14	101977	38	EAST	164	348	-4	5	BOX TRAP
	9	87054	42277	34	EAST	177	12	102477	34	EAST	179	185	0	12	100' BEACH SEINE
	9	76618	102976	34	EAST	172	14	102577	33	EAST	173	360	1	53	500' BEACH SEINE
	9	99615	101377	26	WEST	192	14	102577	26	WEST	192	12	0	14	200' BEACH SEINE
	9	75864	101476	32	WEST	172	12	103177	32	WEST	172	381	0	12	100' BEACH SEINE
	26	53485	90877	29	WEST	127	12	100377	29	WEST	127	25	0	14	200' BEACH SEINE
	26	56413	90777	38	WEST	110	12	100377	38	WEST	113	26	0	14	200' BEACH SEINE
	26	56331	90677	26	WEST	149	12	100477	26	WEST	151	28	0	12	100' BEACH SEINE
	26	56453	90977	38	WEST	102	12	100477	37	WEST	104	25	1	97	BOWLINE
**	26	57066	90777	36	WEST	116	14	100577	35	WEST	116	28	1	53	500' BEACH SEINE
**	26	57066	90777	36	WEST	116	14	100577	35	WEST	116	28	1	12	100' BEACH SEINE
	26	57144	90877	38	WEST	148	14	100577	38	WEST	151	27	0	14	200' BEACH SEINE
	26	60084	92777	26	WEST	104	12	100577	26	WEST	104	8	0	12	100' BEACH SEINE
	26	55376	91277	36	EAST	110	12	101177	37	EAST	114	29	-1	14	200' BEACH SEINE
	26	58536	92077	46	WEST	112	12	101177	42	EAST		21	4	99	INDIAN POINT
	26	53463	90877	30	WEST	139	12	101277	30	WEST	139	34	0	14	200' BEACH SEINE
	26	60086	92877	23	EAST	136	12	101277	23	EAST	134	14	0	14	200' BEACH SEINE
	26	53510	91277	26	WEST	124	12	101377	26	WEST	125	31	0	14	200' BEACH SEINE
	26	56794	91377	40	WEST	105	14	101477	40	WEST	103	31	0	14	200' BEACH SEINE

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
	RELEASE							RECOVERY							
	SPECIES=35							RC_MONTH=10							
	26	54031	90877	34	EAST	129	14	101777	34	EAST	128	39	0	12	100' BEACH SEINE
	26	56759	91377	36	WEST	137	14	101777	36	WEST	139	34	0	14	200' BEACH SEINE
	26	59900	92277	35	WEST	122	12	101777	35	WEST	128	25	0	53	500' BEACH SEINE
**	26	54062	90877	34	EAST	126	14	101877	33	EAST	128	40	1	53	500' BEACH SEINE
	26	53538	91477	38	EAST	126	5	101977	38	EAST	129	35	0	5	BOX TRAP
	26	55376	91277	36	EAST	110	12	102177	35	WEST	102	39	1	12	100' BEACH SEINE
	26	56780	91377	36	WEST	112	14	102177	36	WEST	114	38	0	12	100' BEACH SEINE
	26	53494	90877	26	WEST	147	12	102577	26	WEST	147	47	0	14	200' BEACH SEINE
	26	55302	90977	26	WEST	128	14	102577	26	WEST	131	46	0	14	200' BEACH SEINE
	26	56915	91577	26	WEST	120	12	102577	26	WEST	124	40	0	14	200' BEACH SEINE
	30	94374	92177	38	WEST	156	14	100077	36			9	2	94	OTHER
	30	97729	92277	25	EAST	162	12	100377	25	EAST	163	11	0	14	200' BEACH SEINE
	30	96033	90677	26	WEST	164	12	100477	26	WEST	161	28	0	12	100' BEACH SEINE
	30	98015	92977	59	EAST	158	14	100477	37	WEST	151	5	22	97	BOWLINE
	30	95721	92877	15	WEST	241	12	100777	18	WEST	240	9	-3	14	200' BEACH SEINE
	30	95713	92877	16	WEST	207	12	101277	16	WEST	207	14	0	14	200' BEACH SEINE
	30	97186	91377	23	EAST	165	12	101277	23	EAST	166	29	0	14	200' BEACH SEINE
	30	98155	92277	18	EAST	158	14	101277	18	EAST	159	20	0	12	100' BEACH SEINE
	30	97711	92277	26	WEST	172	12	101377	26	WEST	179	21	0	14	200' BEACH SEINE
	30	97716	92277	26	WEST	177	12	102577	26	WEST	184	33	0	14	200' BEACH SEINE
	30	97724	92277	26	WEST	160	12	102577	26	WEST	162	33	0	14	200' BEACH SEINE

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
			RELEASE							RECOVERY					
						SPECIES=35		RC_MONTH=11							
	5	45075	100576	35	EAST	130	53	110177	35	EAST	152	391	0	53	500' BEACH SEINE
	5	59100	110277	42	EAST	110	14	110377	42	EAST	112	1	0	99	INDIAN POINT
	5	59900	92277	35	WEST	122	12	110377	35	WEST	124	42	0	53	500' BEACH SEINE
	5	51593	60377	35	EAST	111	12	110477	42	EAST	139	154	-7	99	INDIAN POINT
	5	50125	61677	58	WEST	129	12	110777	42	EAST	135	144	16	99	INDIAN POINT
	5	57799	102077	57	WEST	110	12	110977	16	WEST	109	20	41	12	100' BEACH SEINE
	5	58487	110277	38	WEST	119	14	110977	30	WEST	118	7	8	14	200' BEACH SEINE
	5	61243	102477	40	WEST	113	14	110977	42	EAST	110	16	-2	99	INDIAN POINT
	5	58429	110177	40	EAST	110	14	111277	42	EAST	110	11	-2	99	INDIAN POINT
	5	52044	61577	34	EAST	128	14	111477	32	EAST	153	152	2	64	EPIBENTHIC SLED
	5	58236	110377	26	WEST	112	14	111477	26	WEST	115	11	0	14	200' BEACH SEINE
	5	59793	103177	30	WEST	129	14	111477	30	WEST	130	14	0	14	200' BEACH SEINE
	5	59155	110477	39	EAST	127	53	111577	39	EAST	124	11	0	14	200' BEACH SEINE
	5	61646	110377	12	WEST	105	14	111577	37	WEST	104	12	-25	97	BOWLINE
**	5	35562	91476	29	WEST	115	12	111777	30	WEST	124	428	-1	14	200' BEACH SEINE
	5	50385	61477	29	WEST	122	12	111777	29	WEST	138	156	0	14	200' BEACH SEINE
	5	59993	100777	29	WEST	124	14	111777	30	WEST	121	41	-1	14	200' BEACH SEINE
	5	58258	110977	30	WEST	127	14	111877	30	WEST	127	9	0	12	100' BEACH SEINE
**	5	40158	92776	35	EAST	127	12	112177	35	EAST	150	419	0	14	200' BEACH SEINE
	5	59801	101777	36	EAST	103	12	112177	36	EAST	104	35	0	14	200' BEACH SEINE
	5	58237	110377	26	WEST	145	14	112277	26	WEST	140	19	0	14	200' BEACH SEINE
	5	59794	103177	30	WEST	131	14	112277	30	WEST	128	22	0	14	200' BEACH SEINE
	5	54824	62777	38	EAST	120	5	112577	42	EAST	127	151	-4	99	INDIAN POINT
	5	61638	110177	36	EAST	107	14	113077	36	EAST	107	29	0	14	200' BEACH SEINE
	9	84161	110376	34	EAST	198	14	110277	34	EAST	200	363	0	12	100' BEACH SEINE
	9	75900	110276	26	WEST	171	12	110377	26	WEST	178	365	0	12	100' BEACH SEINE
	9	85992	62077	43	EAST	159	12	110577	42	EAST	161	138	1	99	INDIAN POINT
	9	100421	110177	18	WEST	153	64	111077	42	EAST	151	9	-24	99	INDIAN POINT
	9	99510	100377	26	WEST	154	14	111777	26	WEST	156	45	0	14	200' BEACH SEINE
	9	75702	100776	36	WEST	153	53	111877	36	WEST	155	406	0	12	100' BEACH SEINE
	9	98053	100477	26	WEST	170	12	112277	26	WEST	165	49	0	14	200' BEACH SEINE
	9	98060	100477	26	WEST	158	12	112277	26	WEST	157	49	0	14	200' BEACH SEINE
	9	98073	100477	26	WEST	196	12	112277	26	WEST	192	49	0	14	200' BEACH SEINE
	9	88024	50677	57	WEST	174	14	112877	27	WEST	175	206	30	12	100' BEACH SEINE
	26	55354	91277	36	EAST	125	12	110177	36	EAST	126	50	0	14	200' BEACH SEINE
	26	56765	91377	36	WEST	123	14	110177	36	WEST	124	49	0	14	200' BEACH SEINE
**	26	54062	90877	34	EAST	126	14	110277	34	EAST	123	55	0	14	200' BEACH SEINE
	26	57254	91277	36	WEST	115	12	110277	36	WEST	106	51	0	12	100' BEACH SEINE
	26	55083	91577	53	EAST	114	12	110377	53	EAST	118	49	0	12	100' BEACH SEINE
	26	50480	92077	36	WEST	123	14	110677	42	EAST	119	47	-6	99	INDIAN POINT
	26	57121	90777	33	WEST	112	14	111677	42	EAST	110	70	-4	99	INDIAN POINT
	26	56895	91577	29	WEST	149	12	111777	30	WEST	149	63	-1	14	200' BEACH SEINE
	26	57253	91277	35	WEST	127	12	111877	35	WEST	129	67	0	12	100' BEACH SEINE
	26	56842	91477	40	EAST	146	14	111977	42	EAST	147	66	-2	99	INDIAN POINT

Table A-24 (contd)

MR	TT	TAG_NO	RL_DATE	RL_RM	RL_SITE	RL_LENG	RL_GR	RC_DATE	RC_RM	RC_SITE	RC_LENG	DAYS	DSTNC	RC_GR	DESC
RELEASE								RECOVERY							
SPECIES=35 RC_MONTH=11															
**	26	56411	90777	38	WEST	114	12	112177	38	WEST	115	75	0	14	200' BEACH SEINE
	26	56479	91477	30	WEST	127	12	112277	30	WEST	131	69	0	14	200' BEACH SEINE
	26	49809	92077	39	EAST	121	14	112977	42	EAST	118	70	-3	99	INDIAN POINT
SPECIES=35 RC_MONTH=12															
	5	58447	110177	40	WEST	108	14	120377	42	EAST	108	32	-2	99	INDIAN POINT
**	5	35562	91476	29	WEST	115	12	120677	29	WEST	124	447	0	14	200' BEACH SEINE
	5	54578	62377	39	EAST	115	5	121477	42	EAST	127	174	-3	99	INDIAN POINT
	5	61665	111777	29	WEST	123	14	122377	42	EAST	123	36	-13	99	INDIAN POINT
	9	66563	90276	38	EAST	153	14	120177	38	EAST	158	454	0	12	100' BEACH SEINE
	9	94907	90677	34	EAST	194	12	121577	42	EAST	195	100	-8	99	INDIAN POINT
	9	99277	103177	34	EAST	151	14	122277	37	WEST		52	-3	94	OTHER
	26	57224	91477	26	WEST	144	12	120577	29	CNTR	148	82	-3	1	BOTTOM TRAWL
	30	96438	90777	36	WEST	151	14	122677	42	EAST	153	110	-6	99	INDIAN POINT

APPENDIX B

FISHES OF INDIAN POINT

Appendix B.1

Species Composition of the Hudson River Estuary (RM 12 to 152) during 1975, 1976, and 1977)

Table B-1

Fishes Collected from April through December during 1975, 1976, and 1977 by All Texas Instruments Field Sampling in the Hudson River Estuary (RM 12 to 152). (A total of 84 species were collected during 1975, 85 during 1976, and 79 during 1977.)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Silver lamprey *Ichthyomyzon unicuspis*	75									
	76									
	77								■	
Sea lamprey *Petromyzon marinus*	75				■					■
	76									
	77									■
Shortnose sturgeon *Acipenser brevirostrum*	75	■					■			■
	76	■	■	■	■		■			
	77		■	■	■	■	■		■	■
Atlantic sturgeon *Acipenser oxyrhynchus*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	
American eel *Anguilla rostrata*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Conger eel *Conger oceanicus*	75									
	76	■								
	77									
Blueback herring *Alosa aestivalis*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	
	77	■	■	■	■	■	■	■	■	■
Hickory shad *Alosa mediocris*	75							■		
	76									
	77									
Alewife *Alosa pseudoharengus*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
American shad *Alosa sapidissima*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	
Atlantic menhaden *Brevoortia tyrannus*	75		■	■	■	■	■	■	■	
	76	■	■	■	■	■	■	■	■	
	77	■	■	■	■	■	■	■		
Atlantic herring *Clupea harengus harengus*	75	■	■							
	76	■	■							
	77									
Gizzard shad *Dorosoma cepedianum*	75				■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■		■			■	■	■	■

■ At least one individual collected-species present.

(blank) No individuals collected-species absent.

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Striped anchovy *Anchoa hepsetus*	75						■			
	76									
	77									
Bay anchovy *Anchoa mitchilli*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Brown trout *Salmo trutta*	75									
	76	■		■						
	77	■			■					
Brook trout *Salvelinus fontinalis*	75									
	76									
	77		■							
Rainbow smelt *Osmerus mordax*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Central mudminnow *Umbra limi*	75									
	76	■								
	77									
Eastern mudminnow *Umbra pygmaea*	75	■								
	76									
	77									■
Redfin pickeral *Esox americanus americanus*	75		■	■	■	■	■			■
	76			■	■	■	■			
	77			■	■			■		
Northern pike *Esox lucius*	75						■			
	76			■						
	77				■					
Chain pickerel *Esox niger*	75	■	■	■	■	■	■	■	■	■
	76		■	■	■		■	■		
	77	■		■			■			
Goldfish *Carassius auratus*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Carp *Cyprinus carpio*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Cutlips minnow *Exoglossum maxillingua*	75	■			■		■	■		
	76	■		■			■			
	77							■		

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Silvery minnow *Hybognathus nuchalis*	75				■	■	■	■		
	76	■	■	■	■	■	■			
	77				■	■				
Golden shiner *Notemigonus crysoleucas*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Satinfin shiner *Notropis analostanus*	75		■		■	■			■	
	76					■				
	77					■				
Emerald shiner *Notropis atherinoides*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Bridle shiner *Notropis bifrenatus*	75									
	76		■			■				
	77									
Common shiner *Notropis cornutus*	75	■			■			■	■	
	76				■	■				
	77		■		■	■			■	
Spottail shiner *Notropis hudsonius*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Spotfin shiner *Notropis spilopterus*	75		■	■	■	■	■	■	■	
	76	■	■	■	■	■	■	■	■	
	77	■	■	■	■	■	■		■	
Bluntnose minnow *Pimephales notatus*	75				■	■	■		■	
	76	■	■	■	■			■		
	77				■	■				
Fathead minnow *Pimephales promelas*	75			■		■				
	76		■							
	77				■					
Blacknose dace *Rhinichthys atratulus*	75			■				■		
	76	■	■	■		■				
	77	■	■	■	■				■	■
Longnose dace *Rhinichthys cataractae*	75			■						
	76	■								
	77	■								
Creek chub *Semotilus atromaculatus*	75	■	■							
	76	■							■	
	77	■				■			■	

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fallfish *Semotilus corporalis*	75		■		■	■				
	76	■	■	■	■	■				
	77				■		■			
White sucker *Catostomus commersoni*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Northern hogsucker *Hypentelium nigricans*	75									
	76					■				
	77				■	■			■	
White catfish *Ictalurus catus*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Black bullhead *Ictalurus melas*	75									
	76		■							
	77			■						
Yellow bullhead *Ictalurus natalis*	75					■				
	76									
	77									
Brown bullhead *Ictalurus nebulosus*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Trout-perch *Perocopsis omiscomaycus*	75					■				
	76				■	■				
	77				■			■	■	
Fourbeard rockling *Enchelyopus cimbrius*	75		■							
	76									
	77									
Silver hake *Merluccius bilinearis*	75						■			■
	76	■								■
	77								■	
Atlantic tomcod *Microgadus tomcod*	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Red hake *Urophycis chuss*	75									
	76		■							
	77									■
Atlantic needlefish *Strongylura marina*	75		■	■	■	■	■	■		
	76				■	■	■			
	77				■	■	■			

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Banded killifish *Fundulus diaphanus*	75	▒	▒	▒	▒	▒	▒	▒	▒	▒
	76	▒	▒	▒	▒	▒	▒	▒	▒	▒
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒
Mummichog *Fundulus heteroclitus*	75	▒	▒	▒	▒	▒	▒	▒	▒	▒
	76	▒	▒	▒	▒	▒	▒	▒	▒	▒
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒
Striped killifish *Fundulus majalis*	75									
	76	▒								
	77									
Rough silverside *Membras martinica*	75			▒	▒	▒	▒	▒		
	76		▒	▒	▒	▒	▒	▒	▒	
	77	▒	▒	▒	▒	▒	▒	▒		
Tidewater silverside *Menidia beryllina*	75		▒	▒	▒	▒	▒	▒	▒	▒
	76		▒	▒	▒	▒	▒	▒	▒	▒
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒
Atlantic silverside *Menidia menidia*	75	▒	▒	▒	▒	▒	▒	▒	▒	▒
	76		▒	▒	▒	▒	▒	▒	▒	
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒
Fourspine stickleback *Apeltes quadracus*	75	▒	▒	▒	▒	▒	▒	▒	▒	▒
	76	▒	▒	▒	▒	▒	▒	▒	▒	▒
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒
Brook stickleback *Culaea inconstans*	75	▒	▒							
	76	▒								
	77	▒		▒			▒			
Threespine stickleback *Gasterosteus aculeatus*	75	▒	▒			▒		▒		
	76	▒	▒					▒		
	77		▒		▒					
Northern pipefish *Syngnathus fuscus*	75	▒	▒	▒	▒	▒	▒	▒	▒	
	76	▒	▒	▒	▒	▒	▒	▒		
	77		▒	▒	▒	▒	▒	▒	▒	
White perch *Morone americana*	75	▒	▒	▒	▒	▒	▒	▒	▒	▒
	76	▒	▒	▒	▒	▒	▒	▒	▒	▒
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒
White bass *Morone chrysops*	75								▒	
	76									
	77						▒	▒	▒	▒
Striped bass *Morone saxatilis*	75	▒	▒	▒	▒	▒	▒	▒	▒	▒
	76	▒	▒	▒	▒	▒	▒	▒	▒	▒
	77	▒	▒	▒	▒	▒	▒	▒	▒	▒

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rock bass Ambloplites rupestris	75	■	■		■	■	■	■	■	■
	76		■	■	■	■	■	■	■	■
	77			■	■	■	■	■	■	■
Redbreas sunfish Lepomis auritus	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Green sunfish Lepomis cyanellus	75		■			■				
	76									
	77	■		■		■				
Pumpkinseed Lepomis gibbosus	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Warmouth Lepomis gulosus	75									
	76						■			
	77									
Bluegill Lempomis macrochirus	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Smallmouth bass Micropterus dolomieui	75			■	■	■	■	■		■
	76		■	■	■	■	■	■	■	
	77				■	■		■	■	
Largemouth bass Micropterus salmoides	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
White crappie Pomoxis annularis	75						■		■	■
	76			■	■	■	■		■	
	77		■	■	■	■		■	■	
Black crappie Pomoxis nigromaculatus	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Tessellated darter Etheostoma olmstedi	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Yellow perch Perca flavescens	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Log perch Percina caprodes	75									
	76		■	■			■			
	77			■						

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bluefish *Pomatomus saltatrix*	75		■	■	■	■	■	■	■	
	76			■	■	■	■	■		
	77		■	■	■	■	■	■		
Crevalle jack *Caranx hippos*	75				■	■	■	■		
	76					■	■	■		
	77					■	■	■		
Lookdown *Selene vomer*	75						■			
	76				■		■			
	77						■			
Atlantic moonfish *Vomer setapinnis*	75						■			
	76							■		
	77									
Scup *Stenotomus chrysops*	75		■							
	76				■					
	77									
Weakfish *Cynoscion regalis*	75		■		■	■	■	■		
	76				■	■	■	■	■	
	77				■	■	■	■		
Spot *Leiostomus xanthurus*	75				■					
	76			■	■	■	■	■		
	77				■	■	■	■	■	
Northern kingfish *Menticirrhus saxatilis*	75					■	■			
	76						■			
	77									
Atlantic croaker *Micropogon undulatus*	75									
	76						■	■	■	■
	77							■	■	■
Tautog *Tautoga onitis*	75				■					
	76									
	77									
Striped mullet *Mugil cephalus*	75		■							
	76		■					■		
	77				■	■	■			
White mullet *Mugil curema*	75				■			■	■	
	76				■					
	77							■		
Naked goby *Gobiosoma bosci*	75									
	76							■		
	77									

Table B-1 (contd)

Species	Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seaboard goby <u>Gobiosoma</u> <u>ginsburgi</u>	75									
	76						■	■		
	77									
Atlantic mackerel <u>Scomber</u> <u>scombrus</u>	75									
	76									
	77			■						
Butterfish <u>Peprilus</u> <u>triacanthus</u>	75		■			■				
	76			■			■	■		
	77									
Striped searobin <u>Prionotus</u> <u>evolans</u>	75					■				
	76									
	77									
Summer flounder <u>Paralichthys</u> <u>dentatus</u>	75		■	■		■	■			
	76		■	■	■	■	■	■		
	77			■	■	■	■		■	
Windowpane flounder <u>Scophthalmus</u> <u>aquosus</u>	75	■								
	76									
	77									
Winter flounder <u>Pseudopleuronectes</u> <u>americanus</u>	75		■	■	■	■	■	■	■	
	76	■	■	■	■	■	■	■	■	
	77	■	■	■	■	■	■	■	■	
Hogchoker <u>Trinectes</u> <u>maculatus</u>	75	■	■	■	■	■	■	■	■	■
	76	■	■	■	■	■	■	■	■	■
	77	■	■	■	■	■	■	■	■	■
Northern puffer <u>Sphoeroides</u> <u>maculatus</u>	75					■				
	76									
	77					■				

Appendix B.2

Species Composition of Nearfield, Offshore Pelagic, Offshore Bottom, and Shore Zones and Monthly Mean Conductivity Values at 14 Nearfoeld Sampling Stations

Table B-2

Species Collected by Surface Trawl at Each of Seven Standard Stations Trawl Sites during 1977, Indian Point Area, Hudson River Estuary

	Station						
Species*	1	2	3	4	5	6	7
Alewife E	+	+	+	+	+	+	+
American eel E					+		+
American shad E	+	+	+	+	+	+	+
Atlantic menhaden M							+
Bay anchovy E	+	+	+	+	+	+	+
Blueback herring E	+	+	+	+	+	+	+
Bluefish M	+	+	+	+	+	+	+
Brown trout F		+					
Gizzard shad E	+	+		+	+		+
Hogchoker E	+						+
Rainbow smelt E						+	+
Rough silverside M	+				+	+	+
Striped bass E		+		+	+		+
White bass F					+		
White perch E	+	+					
Number/Station	9	9	5	7	10	7	12

*Of a total of 15 species collected at all stations, 2 were fresh-water (F), 10 were euryhaline (E), and 3 were marine (M) species.

Table B-3

Species Collected by Bottom Trawl* at Each of Seven Standard Stations Trawl Sites during 1977, Indian Point Area, Hudson River Estuary

	Station						
Species**	1	2	3	4	5	6	7
Alewife E	+	+	+	+	+	+	+
American eel E	+		+	+	+	+	+
American shad E	+	+	+	+	+	+	+
Atlantic menhaden M	+	+	+	+	+	+	+
Atlantic sturgeon E				+	+	+	
Atlantic tomcod E	+	+	+	+	+	+	+
Bay anchovy E	+	+	+	+	+	+	+
Blueback herring E	+	+	+	+	+	+	+
Bluefish M	+	+	+	+	+	+	+
Gizzard shad E	+			+			+
Golden shiner F		+	+				
Hogchoker E	+	+	+	+	+	+	+
Pumpkinseed F				+			
Rainbow smelt F	+	+	+	+	+	+	+
Spot M				+	+	+	
Spottail shiner F	+	+	+			+	+
Striped bass E	+	+	+	+	+	+	+
Tessellated darter F				+			
Weakfish M	+			+	+	+	+
White bass F				+			
White catfish E	+	+	+	+	+	+	+
White perch E	+	+	+	+	+	+	+
Number/Station	16	14	15	20	16	17	16

*Includes bottom trawl with and without liner.

**Of a total of 22 species collected at all stations, 5 were freshwater (F), 13 were euryhaline (E), and 4 were marine (M) species.

Table B-4

Species Collected by Beach Seine at Each of Seven Standard Stations Seine Sites during 1977, Indian Point Area, Hudson River Estuary

Species*	Station 8	9	10	11	12	20	21
Alewife E	+	+	+	+	+	+	+
American eel E	+	+	+	+	+	+	+
American shad E	+	+	+	+	+	+	+
Atlantic menhaden M		+		+	+	+	+
Atlantic needlefish M	+	+	+				+
Atlantic silverside M	+	+	+		+	+	+
Atlantic tomcod E	+	+	+	+	+	+	+
Banded killifish F	+	+	+	+	+	+	+
Bay anchovy E	+	+	+	+	+	+	+
Black crappie F	+		+				+
Blueback herring E	+	+	+	+	+	+	+
Bluefish M	+	+	+	+	+	+	+
Bluegill F	+	+	+	+	+		
Brook stickleback F		+					
Brown bullhead F	+	+	+	+	+		+
Carp F	+	+	+		+	+	+
Common shiner F	+						
Crevalle jack M			+	+			
Emerald shiner F			+				
Fourspine stickleback E	+	+	+		+	+	+
Gizzard shad E	+	+	+	+	+	+	+
Golden shiner F	+	+	+	+	+	+	+
Goldfish F	+	+	+		+		
Hogchoker E	+	+	+	+	+	+	+

Table B-4 (contd)

Species	Station 8	9	10	11	12	20	21
Largemouth bass F	+	+	+		+		
Longnose dace F	+						
Mummichog E	+	+			+		
Northern pipefish M	+	+		+	+	+	
Pumpkinseed F	+	+	+	+	+	+	+
Rainbow smelt E	+	+		+	+	+	+
Redbreast sunfish F	+	+	+	+	+		
Rockbass F	+				+		
Rough silverside M	+		+	+	+	+	+
Spot M	+		+	+	+	+	+
Spottail shiner F	+	+	+	+	+	+	+
Striped bass E	+	+	+	+	+	+	+
Tessellated darter F	+	+	+	+	+	+	+
Tidewater silverside E	+		+	+			+
White bass F			+		+		+
White catfish E	+	+	+	+	+		
White crappie F	+						
White perch E	+	+	+	+	+	+	+
White sucker F	+	+	+	+	+		
Winter flounder M							+
Yellow perch F	+	+	+		+	+	+
Number/Station	39	33	35	28	35	25	30

*Of a total of 45 species collected at all stations, 21 were freshwater (F), 15 were euryhaline (E), and 9 were marine (M) species.

Table B-5

Mean Monthly* Conductivities (µS/cm) at 14 Standard Stations during April through December 1977, Indian Point Nearfield Area, Hudson River Estuary

		Month								
Station	Gear	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Bottom and Surface Trawl	175	765	4140	6150	6561	6333	210	164	178
2		179	500	3025	5606	6183	5425	214	165	175
3		180	856	5003	6236	6806	6381	210	163	178
4		178	852	5210	6967	7803	6833	208	175	187
5		177	1004	5240	7203	7767	7406	210	160	179
6		176	1234	6157	7675	8522	8300	215	175	200
7		176	1080	5633	6967	7556	7261	220	176	253
8	Beach Seine	177	175	2673	4143	5265	4641	316	1191	208
9		163	155	4390	5985	6901	6422	642	1838	219
10		164	156	3566	4989	6225	5519	327	1601	232
11		174	159	4392	6032	7003	6178	581	1912	206
12		191	168	5042	6717	7705	6832	797	2255	284
20		165	158	5330	6835	8164	7186	919	2942	388
21		192	163	5323	7341	8020	7052	943	2748	302

*Computed as the monthly mean of all available conductivity values by station for all depths combined.

Appendix B.3

Results of Friedman Nonparametric Two-Way ANOVA and
Multiple Comparisons Test on the Distribution
of Selected Species in the Nearfield Area

Table B-6

Results of Friedman Nonparametric Two-Way ANOVA and Multiple Comparisons Test for Selected Species Collected by Beach Seine during Nearfield Sampling, 1976 and 1977

Species	S´ Value‡ 1976	S´ Value‡ 1977	Multiple Comparison Test† 1976							1977						
Striped bass, young-of-the-year	34.52*	12.62*	12	8	9	21	11	20	10	12	8	9	20	21	10	11
yearling and older	37.64*	26.79*	12	8	9	21	20	11	10	12	8	9	11	21	10	20
White perch, young-of-the-year	30.24*	16.62*	11	21	8	20	10	12	9	11	8	21	20	10	12	9
yearling and older	9.68	56.86*								20	11	9	21	8	12	10
American shad	11.13	19.44*								20	8	12	10	21	9	11
Blueback herring	13.02*	20.65*	9	8	12	10	11	21	20	8	12	10	21	9	11	20
Alewife	12.93*	12.17	11	21	9	8	20	10	12	11	21	10	8	12	20	9
Spottail shiner	25.68*	29.95*	10	11	20	8	21	12	9	11	20	21	10	9	12	8
Bay anchovy	26.22*	34.25*	9	8	10	11	21	12	20	8	9	10	12	11	21	20
Bluefish	33.63*	20.24*	8	12	10	20	9	21	11	20	8	9	12	10	21	11
Banded killifish	74.61*	73.66*	11	10	20	21	8	12	9	20	11	21	10	12	9	8
Tessellated darter	44.04*	36.64*	11	10	21	20	9	12	8	11	20	21	12	9	10	8
American eel	37.61*	28.19*	11	10	21	12	8	20	9	11	10	21	8	12	20	9

† Stations are in order of increasing abundance, underlining indicates no significant differences ($p<0.05$).

‡ S´ = Value of Friedman Test statistic after adjusting for ties (i.e., the C/f was the same at two or more stations).

* Significant at $\alpha = 0.05$.

Table B-7

Results of Friedman Nonparametric Two-Way ANOVA and Multiple Comparisons Test for Selected Species Collected by Bottom Trawl without Liner during Nearfield Sampling, 1976 and 1977

Species	S´ Value‡		Multiple Comparison Test†													
	1976	1977	1976							1977						
White perch, young-of-the-year	30.34*	21.86*	3**	2	7	5	1	4	6	3	7	2	6	1	5	4
yearling and older	33.80*	47.04*	2	3	7	5	4	1	6	7	2	3	1	5	4	6
Atlantic tomcod	51.01*	53.59*	2	7	3	4	1	6	5	2	3	7	1	5	6	4
Hogchoker	36.99*	29.14*	2	3	7	5	4	6	1	2	3	7	1	4	5	6
American eel	27.17*	33.06*	2	3	7	1	4	6	5	3	7	2	1	5	4	6
Blueback herring	29.07*	16.75*	3	6	4	1	5	2	7	6	5	1	4	7	3	2
Bay anchovy	8.79	12.86*								4	5	2	6	1	3	7

† Stations are in order of increasing abundance, underlining indicates no significant differences ($p<0.05$).

‡ S´ = value of Friedman Test statistic after adjusting for ties.

* Significant at $\alpha = 0.05$.

** Stations 2, 3, and 7 are shallow; 1, 4, 5, and 6 are deep.

Table B-8

Results of Friedman Nonparametric Two-Way ANOVA and Multiple Comparisons Test for Selected Species Collected by Bottom Trawl with Liner during Nearfield Sampling, 1976 and 1977

Species	S´ Value‡ 1976	S´ Value‡ 1977	Multiple Comparison Test† 1976							Multiple Comparison Test† 1977						
White perch, young-of-the-year	29.48*	25.21*	2**	3	7	1	5	6	4	2	7	3	1	5	6	4
yearling and older	46.02*	59.83*	2	3	7	1	5	4	6	2	3	7	1	5	4	6
Atlantic tomcod	62.46*	54.02*	2	3	1	7	4	6	5	2	7	3	1	4	6	5
Hogchoker	35.07*	45.38*	2	7	3	6	1	4	5	2	3	7	1	4	5	6
Blueback herring	25.42*	29.89*	6	1	3	5	4	7	2	6	5	1	4	3	7	2
Bay anchovy	17.48*	11.00	5	3	6	1	4	2	7							
American eel	37.32*	43.56*	2	3	7	1	4	6	5	2	7	3	1	4	5	6

† Stations are in order of increasing abundance, underlining indicates no significant differences ($p<0.05$).

‡ S´ = value of Friedman Test statistic after adjusting for ties (i.e., the C/f was the same at two or more stations).

* Significant at $\alpha = 0.05$.deep.

** Stations 2, 3, and 7 are shallow; 1, 4, 5, and 6 are deep.

Table B-9

Results of Friedman Nonparametric Two-Way ANOVA for Selected Species Collected by Surface Trawl during Nearfield Sampling, 1976 and 1977

Species	S′ Value‡ 1976	1977
American shad	8.72	11.08
Blueback herring	6.75	3.33
Alewife	8.69	9.19
Bay anchovy	6.72	6.11

All not significant at $\alpha = 0.05$.

‡S′ = value of Friedman Test statistic after adjusting for ties (i.e., the C/f was the same at two or more stations).

Appendix B.4

Data Used To Develop Data Set I

The standard stations catch per area (CPA) values for striped bass, white perch, and American shad were based on 12 years of beach seine data collected by New York University (NYU) (1965-1969), Raytheon (1969-1970), and TI (1972-1977) from similar but not identical stations in the vicinity of Indian Point (Table B-10). CPA was used instead of C/f because three types of seines (50-ft, 75-ft, and 100-ft) and different methods of deployment were used over the years. CPA values represent catch per 10,000 ft^2. The time periods used to generate CPA values for each species are shown in Table B-10. Maps showing the location of the standard station sites by year are shown in Figures B-1 through B-4. A detailed description of the contractors, years sampled, areas sampled, and types of gear was given in previous TI reports (see TI 1975b, 1977c).

The riverwide CPA values for striped bass, white perch, and American shad were also based on 12 years of beach seine data collected by NYU, Raytheon, and TI, but from larger portions of the river. A comparison of the portion of the river sampled from which riverwide CPA values were derived in each year is shown in Table B-11 and Figures B-1 and B-2. Time periods coincided with those used for standard stations CPA's.

The standard station C/f values for juvenile Atlantic tomcod were based on 8 years of bottom trawl data collected by Raytheon (1969-1970) and TI (1972-1977). The stations and time periods used to calculate the C/f values are shown in Table B-12 and Figure B-5. Certain assumptions and catch correction factors (TI 1977c) were applied to provide the necessary comparability of these bottom trawl data for analysis since the types of trawls used were not identical over all the years.

Two sets of riverwide C/f values were developed for Atlantic tomcod. From 1973 through 1977, bottom trawl samples were collected from the Tappan Zee through Cornwall regions. In 1969, 1970, and 1972, bottom trawl sampling was primarily restricted to the Croton-Haverstraw and Indian Point regions. Therefore, one set of C/f values was generated from 1969 to 1977 based solely on samples taken in the Croton-Haverstraw and Indian Point regions. A second set represents C/f values for 1973 to 1977 only and was based on samples taken from the Tappan Zee through the Cornwall regions.

Table B-10

Data Sets Used To Generate the 12-Year Standard Station Abundance Indices for Juvenile White Perch, Striped Bass, and American Shad

Contractor	Year	Stations	Time Period for White Perch	Time Period for Striped Bass	Time Period for American Shad
NYU	1965	IIW1	Jul through Aug	Mid-Jul through Aug	Jul through Aug
NYU	1966	IIE1, IIW1	Jul through Aug	Mid-Jul through Aug	Jul through Aug
NYU	1967	IIW1	Jul through Aug	Mid-Jul through Aug	Jul through Aug
NYU	1968	IIE1, IIW1	Jul through Aug	Mid-Jul through Aug	Jul through Aug
NYU, RAY	1969	IIE1, IIW1, 34, 35, 36, 38	Jul through Aug	Mid-Jul through Aug	Jul through Aug
RAY	1970	34, 35, 36, 38	Jul through Aug	Mid-Jul through Aug	Jul through Aug
TI	1972-77	8, 9, 10, 11	Mid-Jul through Aug	Mid-Jul through Aug	Jul through Aug

NYU = New York University

RAY = Raytheon

TI = Texas Instruments

Table B-11

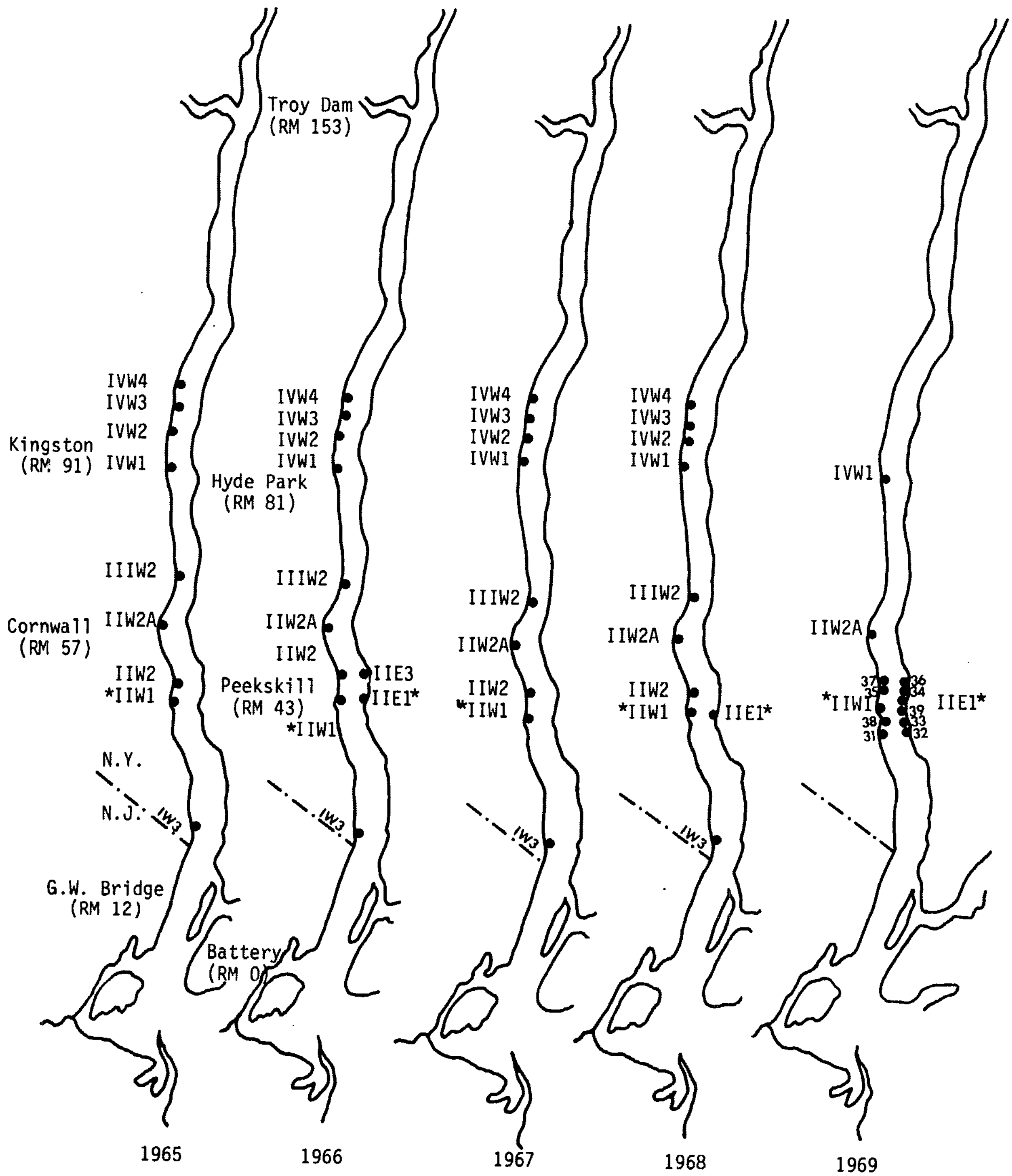
Data Sets Used To Generate 12-Year Riverwide Abundance Indices for Juvenile Striped Bass, White Perch, and American Shad

Contractor	Year	Portion of River Sampled (river miles)
NYU	1965	27 through 87
NYU	1966	27 through 105
NYU	1967	27 through 96
NYU	1968	27 through 105
NYU, RAY	1969	35 through 87
RAY	1970	35 through 47
TI	1972	32 through 43
TI	1973 through 1977	12 through 153

Table B-12

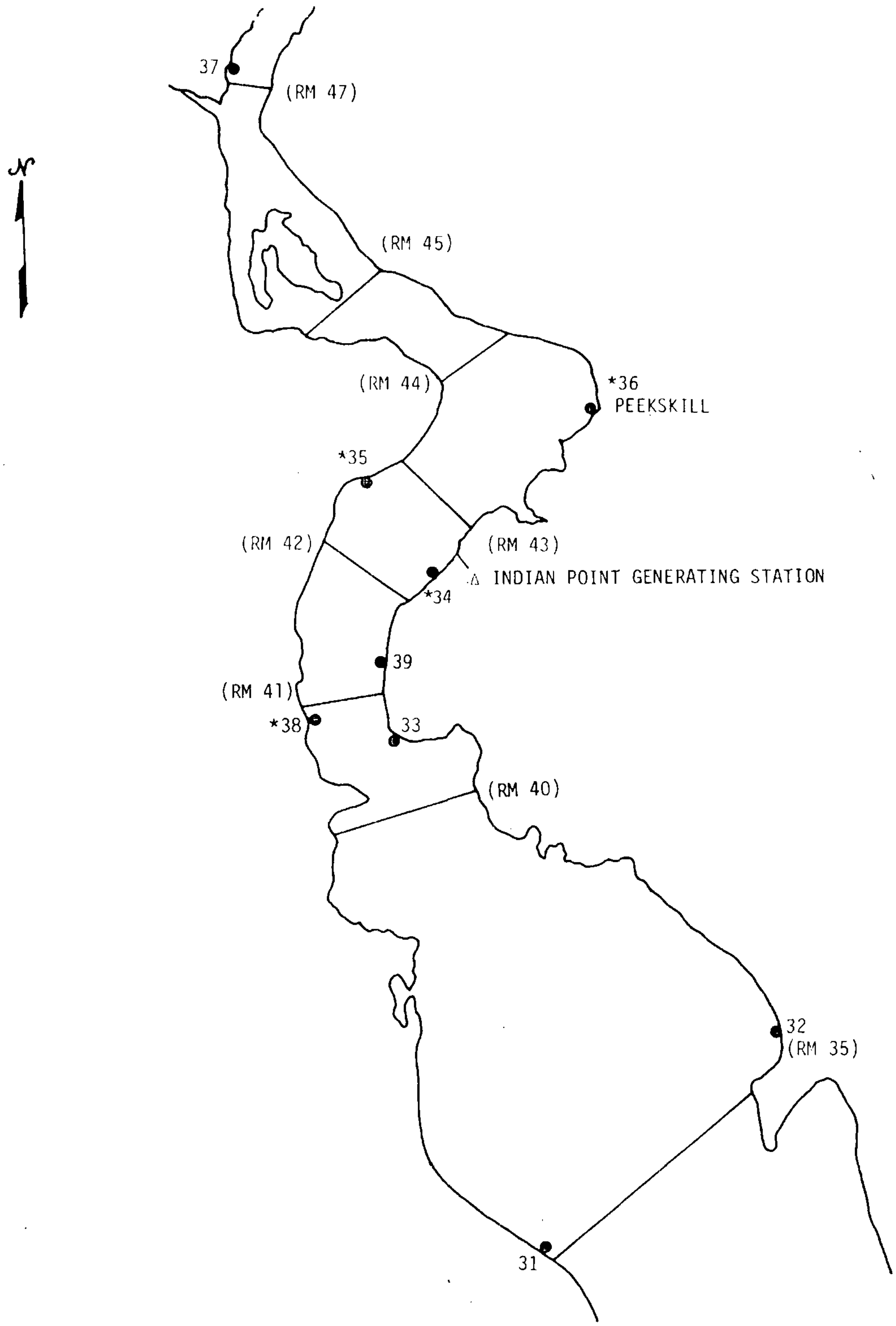
Data Sets Used To Generate 8-Year Standard Station Abundance Indices for Juvenile Atlantic Tomcod

Contractor	Year	Stations	Time Period
Ray	1969	12, 10, 16, 9	Jul through Sep
Ray	1970	12, 10, 16, 9	Jul through Sep
TI	1972 through 1977	2, 4, 5, 7	Jul through Sep



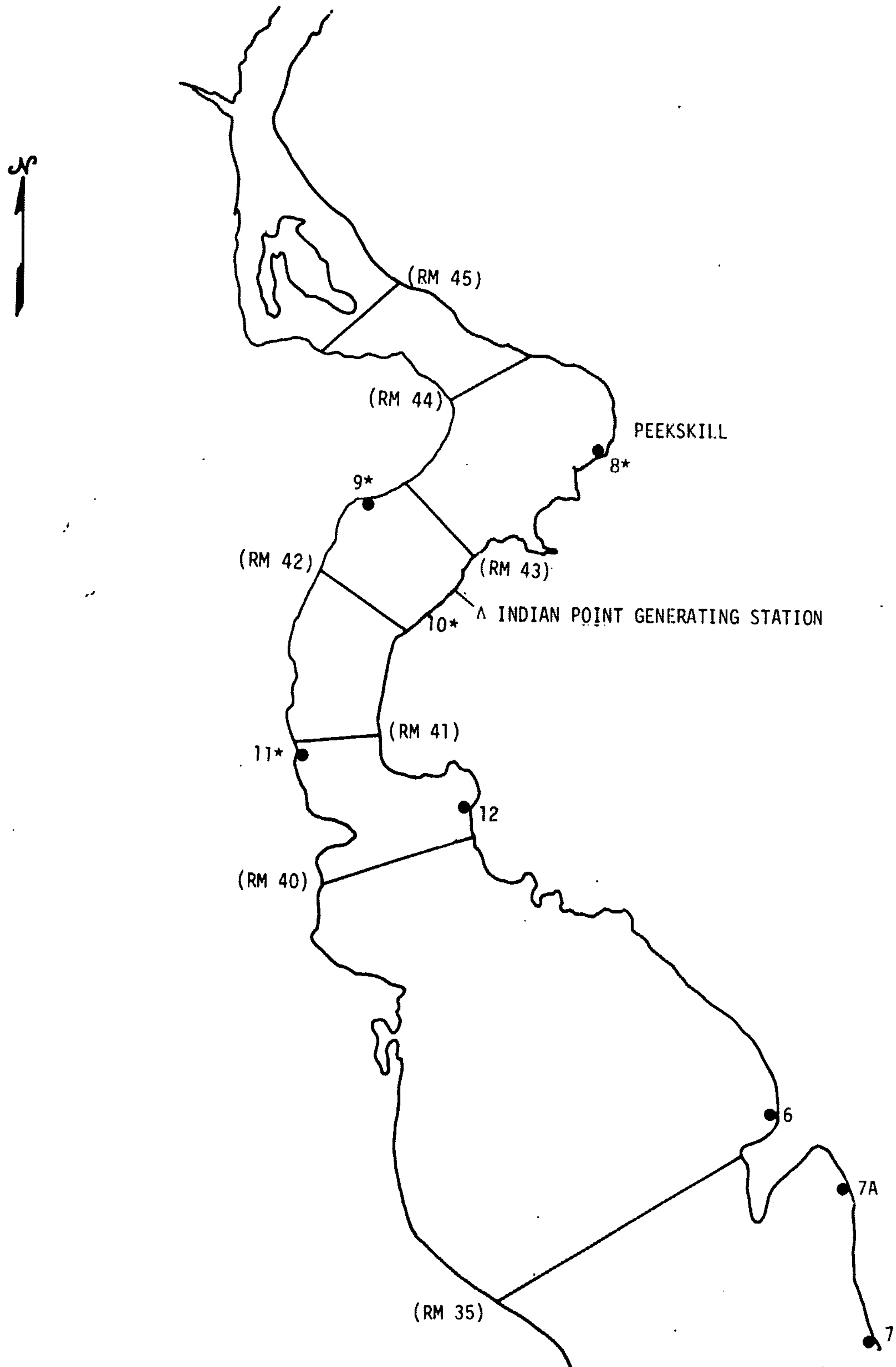
*Standard station sites

Figure B-1. NYU and Raytheon Standard Stations and Riverwide Beach Seine Sites Sampled from 1965 through 1969. (Raytheon sampled during 1969 at Stations 31-39 only.)



*Standard station sites

Figure B-2. Raytheon Standard Stations and Riverwide Beach Seine Sites Sampled during 1970



*Standard station sites

Figure B-3. TI Standard Stations and Riverwide Beach Seine Sites Sampled during 1972

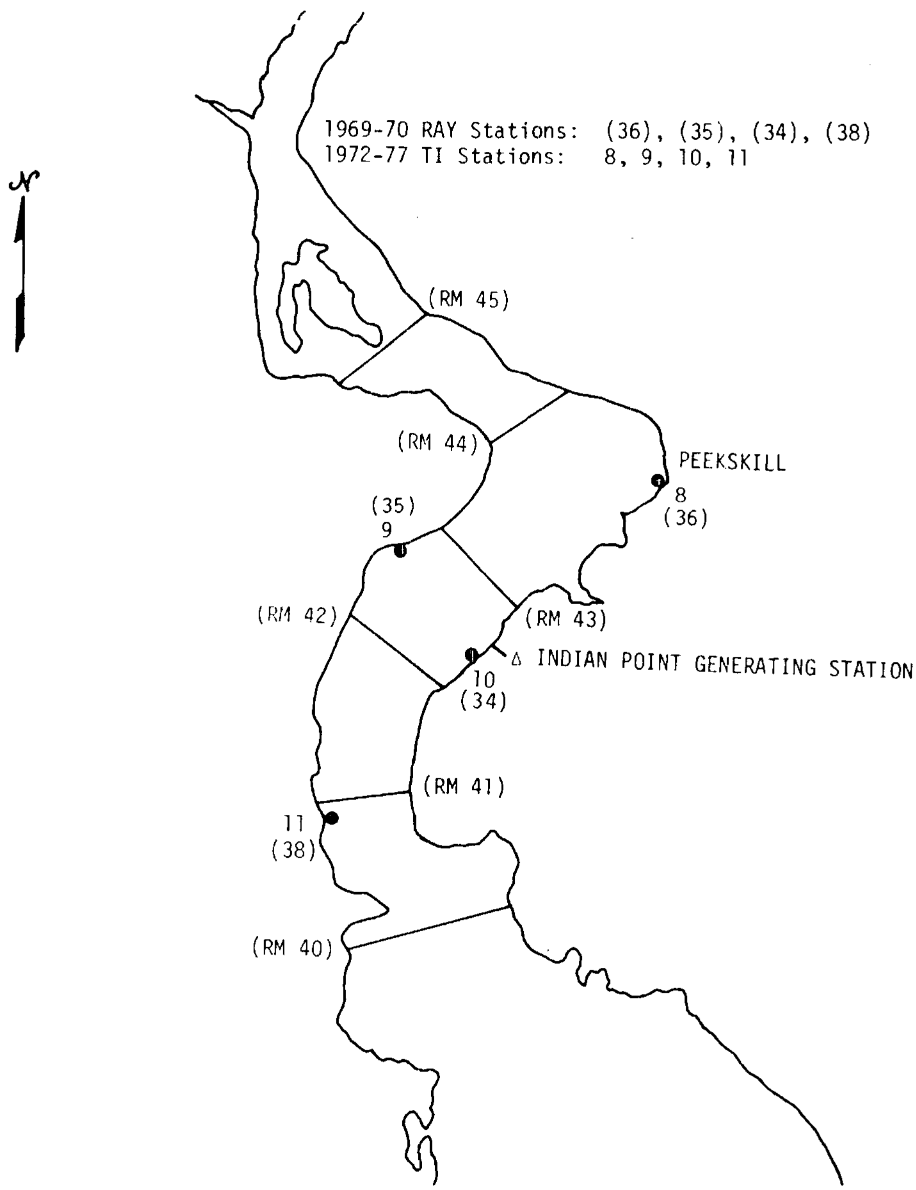


Figure B-4. Indian Point Area of the Hudson River Showing Four Comparable Sampling Stations Used To Estimate Standard Station Abundance Indices (CPA) for Juvenile Striped Bass, White Perch, and American Shad in 1969, 1970, and 1972 through 1977

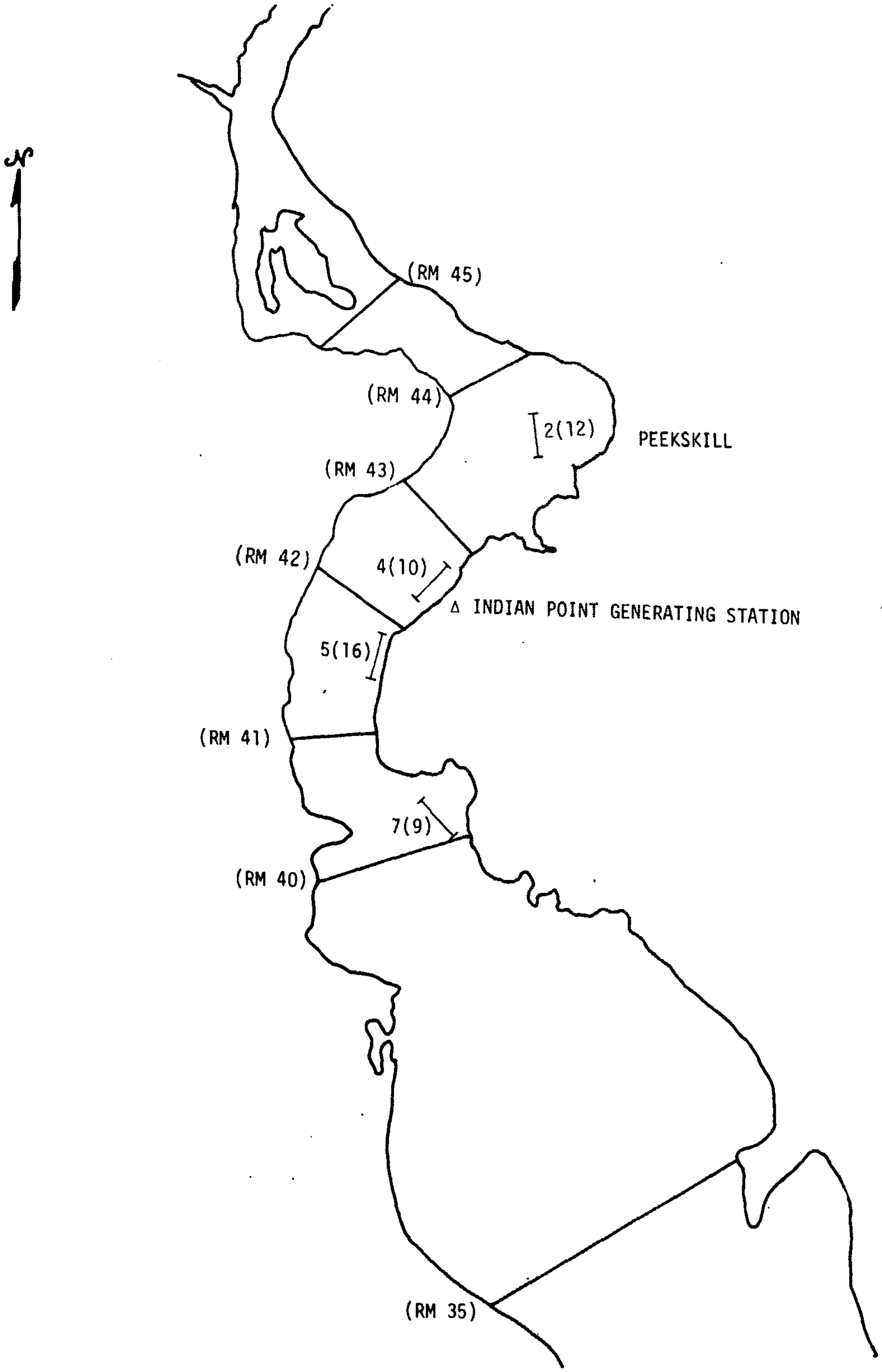


Figure B-5. Texas Instruments (2, 4, 5, and 7) and Raytheon (9, 10, 12, and 16) Bottom Trawl Stations Used in Calculating the 8-Year (1969-1977) Standard Station Abundance Indices (C/f) for Juvenile Atlantic Tomcod

Appendix B.5

Supplementary Data for Section V.C.3

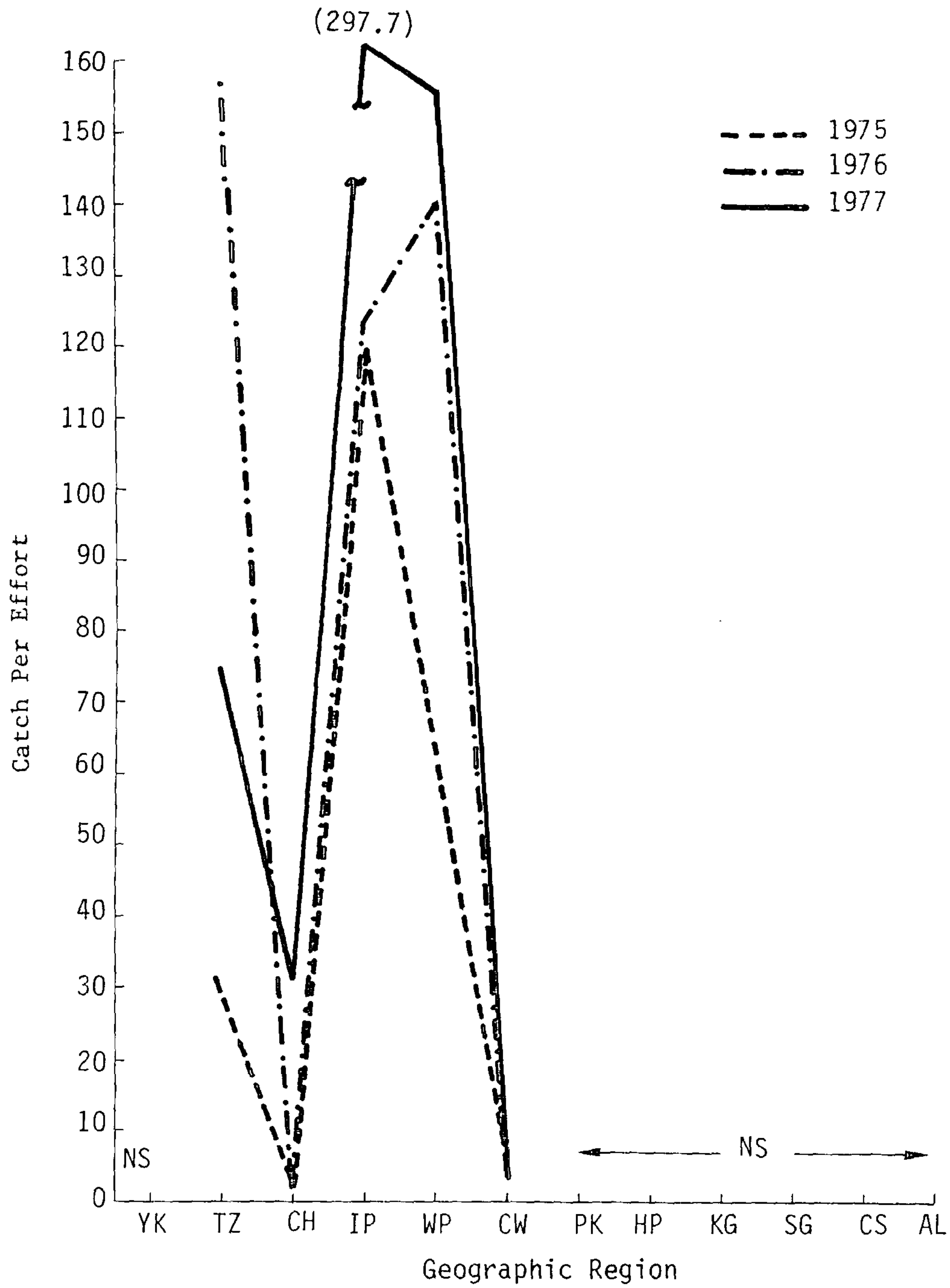


Figure B-6. Geographic Distribution of Juvenile Atlantic Tomcod from June through August 1975 through 1977, Based on Bottom Trawl Catches. (Juvenile tomcod were concentrated in Indian Point, West Point, and Tappan Zee regions.)

Table B-13

Results of Two-Way ANOVA for Standard Station and Riverwide Transformed C/f Values for Juvenile Blueback Herring, 1975 through 1977

Source of Variation	df	SS	MS	F	P
Index (Fixed)	1	21.177	21.177	6.587	0.10<p<0.25
Years (Random)	2	18.794	9.397	5.713	0.005<p<0.01*
Index x Years	2	6.431	3.215	1.955	0.10<p<0.25
Error	42	69.083	1.644		

* Significant ($\alpha = 0.05$)

Table B-14

Results of Two-Way ANOVA for Standard Station and Riverwide Transformed C/f Values for Juvenile Alewife, 1975 through 1977

Source of Variation	df	SS	MS	F	P
Index (Fixed)	1	1.013	1.013	5.855	0.10<p<0.25
Years (Random)	2	8.308	4.154	3.430	0.025<p<0.05*
Index x Years	2	0.347	0.173	0.143	p>0.75
Error	59	71.449	1.211		

* Significant ($\alpha = 0.05$)

Table B-15

Results of Two-Way ANOVA for Standard Station and Riverwide Transformed C/f Values for Juvenile Bay Anchovy, 1975 through 1977

Source of Variation	df	SS	MS	F	P
Index (Fixed)	1	5.266	5.266	5.761	$0.10<p<0.25$
Years (Random)	2	1.445	0.722	0.276	$p>0.75$
Index x Years	2	1.828	0.914	0.350	$0.50<p<0.75$
Error	35	91.358	2.610		

Table B-16

Results of Two-Way ANOVA for Standard Station and Riverwide Transformed C/f Values for Juvenile Hogchoker, 1975 through 1977

Source of Variation	df	SS	MS	F	P
Index (Fixed)	1	0.801	0.801	2.584	$0.10<p<0.25$
Years (Random)	2	4.752	2.376	4.543	$0.01<p<0.25$*
Index x Years	2	0.620	0.310	0.593	$0.50<p<0.75$
Error	57	29.811	0.523		

* Significant (α= 0.05)

Table B-17

Catch/Effort (C/f) Data Used in Two-Way ANOVA for Juvenile Blueback Herring

Bi-Weekly Period	Standard Stations C/f	Riverwide C/f
1975		
13 Jul - 26 Jul	0.33	25.52
27 Jul - 09 Aug	39.31	112.51
10 Aug - 23 Aug	0.62	69.66
24 Aug - 06 Sep	0.00	28.11
07 Sep - 20 Sep	0.00	44.05
21 Sep - 04 Oct	3.85	64.55
05 Oct - 18 Oct	67.14	154.26
19 Oct - 01 Nov	166.71	117.75
1976		
11 Jul - 24 Jul	41.86	43.57
25 Jul - 07 Aug	10.21	124.56
08 Aug - 21 Aug	231.43	206.15
22 Aug - 04 Sep	77.77	141.22
05 Sep - 18 Sep	35.86	88.56
19 Sep - 02 Oct	66.77	74.12
03 Oct - 16 Oct	23.79	79.89
17 Oct - 30 Oct	210.93	53.76
1977		
10 Jul - 23 Jul	12.38	182.16
24 Jul - 06 Aug	12.00	231.87
07 Aug - 20 Aug	23.64	234.59
21 Aug - 03 Sep	17.08	155.53
04 Sep - 17 Sep	3.07	118.32
18 Sep - 01 Oct	207.00	126.82
02 Oct - 15 Oct	706.79	209.07
16 Oct - 29 Oct	437.43	94.19

Table B-18

Catch/Effort (C/f) Data Used in Two-Way ANOVA for Juvenile Alewife

Bi-Weekly Period	Standard Stations C/f	Riverwide C/f
1975		
29 Jun - 12 Jul	0.00	NS
13 Jul - 26 Jul	0.17	0.77
27 Jul - 09 Aug	0.57	4.01
10 Aug - 23 Aug	0.57	1.27
24 Aug - 06 Sep	0.71	0.60
07 Sep - 20 Sep	1.17	1.36
21 Sep - 04 Oct	28.67	1.70
05 Oct - 18 Oct	24.29	57.44
19 Oct - 01 Nov	24.86	36.62
02 Nov - 15 Nov	6.67	47.10
16 Nov - 29 Nov	6.00	10.24
1976		
27 Jun - 10 Jul	0.14	0.00
11 Jul - 24 Jul	1.43	10.15
25 Jul - 07 Aug	6.00	1.06
08 Aug - 21 Aug	2.43	2.02
22 Aug - 04 Sep	0.29	1.20
05 Sep - 18 Sep	1.57	1.11
19 Sep - 02 Oct	0.71	2.02
03 Oct - 16 Oct	1.86	0.62
17 Oct - 30 Oct	8.86	13.61
31 Oct - 13 Nov	2.71	6.49
14 Nov - 27 Nov	0.00	0.34
1977		
26 Jun - 09 Jul	0.00	1.49
10 Jul - 23 Jul	15.14	11.59
24 Jul - 06 Aug	12.29	10.07
07 Aug - 20 Aug	4.86	4.86
21 Aug - 03 Sep	24.71	4.27
04 Sep - 17 Sep	0.43	1.54
18 Sep - 01 Oct	0.57	4.57
02 Oct - 15 Oct	4.86	22.36
16 Oct - 29 Oct	18.71	15.34
30 Oct - 12 Nov	13.57	20.10
13 Nov - 26 Nov	2.43	0.48

NS = No Sample

Table B-19

Catch/Effort (C/f) Data Used in Two-Way ANOVA for Juvenile Bay Anchovy

Bi-Weekly Period	Standard Stations C/f	Riverwide C/f
1975		
29 Jun - 12 Jul	0.00	0.01
13 Jul - 26 Jul	0.00	5.64
27 Jul - 09 Aug	56.08	10.45
10 Aug - 23 Aug	10.15	45.96
24 Aug - 06 Sep	2.77	14.85
07 Sep - 20 Sep	2.14	53.08
21 Sep - 04 Oct	0.31	84.92
1976		
27 Jun - 10 Jul	0.00	0.04
11 Jul - 24 Jul	0.00	0.02
25 Jul - 07 Aug	6.29	1.74
08 Aug - 21 Aug	36.14	17.63
22 Aug - 04 Sep	31.00	61.20
05 Sep - 18 Sep	7.50	28.56
19 Sep - 02 Oct	2.85	17.28
1977		
26 Jun - 09 Jul	0.00	0.13
10 Jul - 23 Jul	0.08	1.24
24 Jul - 06 Aug	5.57	8.22
07 Aug - 20 Aug	4.64	17.17
21 Aug - 03 Sep	59.85	116.87
04 Sep - 17 Sep	13.07	36.05
18 Sep - 01 Oct	61.93	79.50

Table B-20

Catch/Effort (C/f) Data Used in Two-Way ANOVA for Juvenile Hogchoker

Bi-Weekly Period	Standard Stations C/f	Riverwide C/f
1975		
27 Jul - 09 Aug	0.00	0.00
10 Aug - 23 Aug	0.43	1.96
24 Aug - 06 Sep	0.14	1.21
07 Sep - 20 Sep	1.67	0.36
21 Sep - 04 Oct	4.83	3.71
05 Oct - 18 Oct	0.14	1.33
19 Oct - 01 Nov	9.14	0.36
02 Nov - 15 Nov	0.67	0.65
16 Nov - 29 Nov	0.17	0.15
30 Nov - 13 Dec	0.17	0.00
14 Dec - 27 Dec	0.00	1.92
1976		
25 Jul - 07 Aug	0.00	0.00
08 Aug - 21 Aug	0.00	0.00
22 Aug - 04 Sep	0.00	0.05
05 Sep - 18 Sep	0.00	0.05
19 Sep - 02 Oct	0.00	0.00
03 Oct - 16 Oct	0.00	3.99
17 Oct - 30 Oct	0.00	0.00
31 Oct - 13 Nov	0.00	0.05
14 Nov - 27 Nov	0.00	0.00
28 Nov - 11 Dec	0.00	0.05
12 Dec - 25 Dec	NS	NS
1977		
24 Jul - 06 Aug	0.00	0.00
07 Aug - 20 Aug	0.00	0.00
21 Aug - 03 Sep	0.00	0.35
04 Sep - 17 Sep	11.71	4.57
18 Sep - 01 Oct	13.14	2.07
02 Oct - 15 Oct	0.14	14.71
16 Oct - 29 Oct	0.00	1.20
30 Oct - 12 Nov	0.00	6.39
13 Nov - 26 Nov	0.00	1.63
27 Nov - 10 Dec	0.00	0.08
11 Dec - 24 Dec	0.00	NS

NS = No Sample

Appendix B.6

Supplementary Data for Section V.D.

Cumulative length-frequency distributions (expressed as decimal equivalents) for samples compared using Kolmogorov-Smirnov two-sample test (Siegel 1956). The Indian Point region is defined as RM 39-46 and "Other Regions" as the remainder of the river from which data were acquired (see Table V-4). The largest difference (D) between each pair of cumulative distributions is enclosed in a box.

Table B-21

Cumulative Length-Frequency Distributions for Juvenile White Perch*

White Perch

Length (mm)	Beach Seine 8/8 - 8/14/76 Region IP	Beach Seine 8/8 - 8/14/76 Region Other	Beach Seine 8/8 - 8/14/76 Largest D	Beach Seine 7/31 - 8/6/77 Region IP	Beach Seine 7/31 - 8/6/77 Region Other	Beach Seine 7/31 - 8/6/77 Largest D	Bottom Trawl 8/8 - 8/14/76 Region IP	Bottom Trawl 8/8 - 8/14/76 Region Other	Bottom Trawl 8/8 - 8/14/76 Largest D
16								.008	.008
17								.008	.008
18								.008	.008
19							.018	.008	.010
20							.018	.008	.010
21							.018	.008	.010
22							.037	.015	.022
23							.037	.015	.022
24							.037	.015	.022
25		.002	.002	.012		.012	.055	.015	.040
26		.005	.005	.012		.012	.055	.023	.032
27		.012	.012	.012		.012	.055	.036	.019
28	.017	.017	.000	.024	.007	.017	.055	.051	.004
29	.017	.032	.015	.060	.007	.053	.090	.066	.024
30	.052	.055	.003	.060	.021	.039	.124	.095	.029
31	.052	.067	.015	.072	.034	.038	.158	.110	.048
32	.052	.087	.035	.084	.048	.036	.177	.145	.032
33	.052	.097	.045	.096	.069	.027	.177	.151	.026
34	.086	.112	.026	.108	.076	.032	.195	.166	.029
35	.121	.139	.018	.145	.083	.062	.232	.180	.052
36	.121	.159	.038	.157	.097	.060	.269	.187	.082
37	.155	.187	.032	.157	.097	.060	.337	.229	.108
38	.259	.216	.043	.157	.117	.040	.369	.258	.111
39	.310	.246	.064	.169	.131	.038	.369	.273	.095
40	.345	.289	.056	.181	.166	.015	.406	.338	.068
41	.379	.331	.048	.229	.179	.050	.443	.373	.070
42	.414	.383	.031	.265	.200	.065	.474	.401	.073
43	.448	.433	.015	.301	.228	.073	.564	.444	.120
44	.483	.483	.000	.337	.269	.068	.564	.473	.091
45	.552	.515	.037	.386	.324	.062	.627	.523	.104
46	.586	.545	.041	.446	.345	.101	.659	.558	.101
47	.621	.594	.027	.494	.386	.108	.675	.620	.055
48	.724	.637	.087	.590	.469	.121	.725	.683	.042
49	.759	.701	.058	.663	.510	.153	.789	.697	.042
50	.862	.766	.096	.795	.614	.181	.836	.738	.104
51	.897	.801	.096	.855	.655	.200	.870	.773	.097
52	.948	.843	.105	.865	.697	.170	.905	.850	.055
53	.948	.878	.070	.904	.738	.166	.921	.885	.036
54	.948	.913	.035	.928	.786	.141	.952	.893	.059
55	.966	.943	.023	.952	.834	.117	.952	.926	.026
56	1.000	.968	.032	.976	.855	.121	.968	.959	.009
57	1.000	.973	.027	.988	.897	.091	1.000	.960	.040
58	1.000	.985	.015	.988	.931	.057	1.000	.979	.022
59	1.000	.992	.008	.988	.952	.036	1.000	.980	.020
60	1.000	1.000	.000	.988	.979	.090	1.000	1.000	.000
61				.988	.979	.009			
62				.988	.993	.005			
63				.988	.993	.005			
64				.988	.993	.005			
65				1.000	1.000	.000			
Total Sample Size	58	402		83	145		63	200	

*See title page of Appendix B.6 for explanation.

Table B-22

Cumulative Length-Frequency Distributions for Juvenile Striped Bass*

Striped Bass						
	Beach Seine 8/8 - 8/14/76			Beach Seine 7/31 - 8/6/77		
	Region		Largest	Region		Largest
Length (mm)	IP	Other	D	IP	Other	D
21						
22				.009		.009
23				.019		.019
24				.028		.028
25				.028		.028
26				.028		.028
27				.028		.028
28				.028		.028
29				.028		.028
30				.028		.028
31				.028		.028
32				.028		.028
33				.028		.028
34				.028		.028
35				.028		.028
36				.028		.028
37				.038		.038
38		.003	.003	.038		.038
39		.003	.003	.047	.006	.041
40	.013	.003	.010	.057	.006	.051
41	.013	.014	.001	.057	.013	.044
42	.026	.024	.002	.057	.019	.038
43	.038	.028	.010	.094	.019	.075
44	.064	.035	.029	.094	.032	.062
45	.064	.045	.019	.104	.045	.059
46	.090	.062	.028	.142	.071	.071
47	.128	.069	.059	.170	.115	.055
48	.154	.080	.074	.198	.122	.075
49	.192	.094	.098	.198	.147	.051
50	.244	.125	.119	.245	.218	.027
51	.269	.142	.127	.283	.250	.033
52	.282	.181	.101	.340	.288	.052
53	.282	.208	.074	.377	.327	.050
54	.372	.250	.122	.396	.385	.011
55	.410	.274	.136	.434	.429	.005
56	.423	.319	.104	.481	.474	.007
57	.499	.378	.071	.491	.513	.022
58	.474	.444	.030	.519	.545	.026
59	.487	.483	.004	.528	.558	.030
60	.577	.517	.060	.557	.596	.039
61	.590	.569	.021	.604	.647	.043
62	.603	.625	.022	.651	.679	.028
63	.641	.660	.019	.679	.756	.077
64	.692	.688	.004	.726	.776	.050
65	.756	.729	.027	.755	.808	.053
66	.821	.774	.047	.802	.827	.025
67	.859	.812	.047	.821	.833	.012
68	.859	.833	.026	.821	.840	.019
69	.872	.847	.025	.849	.865	.016
70	.885	.896	.011	.868	.872	.004
71	.910	.920	.010	.896	.891	.005
72	.936	.948	.012	.906	.917	.011
73	.936	.951	.015	.906	.923	.017
74	.962	.965	.003	.906	.923	.017
75	.962	.976	.014	.915	.929	.014
76	.962	.983	.021	.934	.942	.008
77	.962	.993	.031	.943	.955	.012
78	.962	.993	.031	.943	.962	.019
79	.962	.996	.034	.953	.968	.015
80	.962	.996	.034	.953	.968	.015
81	1.000	1.000	.000	.962	.974	.012
82				.981	.974	.007
83				.981	.981	.000
84				.981	.981	.000
85				.981	.987	.006
86				.981	.987	.006
87				.981	1.000	.019
88				.981	1.000	.019
89				.991	1.000	.009
90				1.000	1.000	.000
Total Sample Size	78	288	---	106	156	---

*See title page of Appendix B.6 for explanation.

Table B-23

Cumulative Length-Frequency Distributions for Juvenile Atlantic Tomcod*

Atlantic Tomcod

Length (mm)	Bottom Trawl 7/11 - 7/17/76 Region IP	Bottom Trawl 7/11 - 7/17/76 Region Other	Bottom Trawl 7/11 - 7/17/76 Largest D	Bottom Trawl 7/3 - 7/9/77 Region IP	Bottom Trawl 7/3 - 7/9/77 Region Other	Bottom Trawl 7/3 - 7/9/77 Largest D
50				.000	.008	.008
51				.000	.012	.012
52				.000	.016	.016
53				.000	.019	.019
54				.013	.024	.011
55				.026	.032	.006
56				.078	.051	.027
57				.029	.067	.062
58				.181	.094	.087
59				.206	.098	.108
60				.280	.106	.174
61				.343	.149	.194
62				.393	.187	.206
63				.456	.219	.237
64				.581	.262	.319
65	.000	.009	.009	.631	.311	.320
66	.017	.018	.001	.656	.350	.306
67	.034	.036	.002	.706	.419	.287
68	.051	.046	.005	.755	.458	.297
69	.051	.055	.004	.804	.500	.304
70	.102	.099	.003	.840	.546	.294
71	.153	.125	.028	.853	.589	.264
72	.204	.214	.010	.853	.593	.260
73	.324	.240	.084	.865	.631	.234
74	.375	.285	.090	.876	.639	.237
75	.432	.365	.067	.890	.643	.247
76	.500	.420	.080	.890	.658	.232
77	.540	.483	.057	.890	.686	.204
78	.659	.527	.132	.890	.686	.204
79	.693	.580	.113	.926	.717	.209
80	.693	.633	.060	.951	.766	.185
81	.744	.678	.066	.963	.786	.177
82	.813	.713	.100	.975	.824	.151
83	.813	.793	.020	.975	.839	.136
84	.847	.802	.045	.975	.866	.109
85	.847	.847	.000	.975	.889	.086
86	.847	.866	.019	.975	.889	.086
87	.864	.875	.011	.987	.923	.064
88	.881	.883	.002	.987	.958	.029
89	.898	.884	.014	1.000	.969	.031
90	.915	.893	.022	1.000	.984	.016
91	.966	.902	.064	1.000	.988	.012
92	.966	.920	.046	1.000	.988	.012
93	.966	.920	.046	1.000	.988	.012
94	.966	.920	.046	1.000	.988	.012
95	.966	.920	.046	1.000	.988	.012
96	.966	.929	.037	1.000	1.000	.000
97	.966	.947	.019	1.000	1.000	.000
98	1.000	.965	.035			
99	1.000	1.000	.000			
100						
Total Sample Size	170	1264	---	1441	1229	---

*See title page of Appendix B.6 for explanation.

Table B-24

Kolmogorov-Smirnov Values from Comparisons of Length-Frequency Distributions of Juvenile Striped Bass, White Perch, and Atlantic Tomcod Captured in Indian Point and Adjacent Regions during 1976 and 1977

Species	Gear	Week	Distributed α*	D-Value**	Critical Value***	Result	Area(s) with Largest D-Value†	
							Indian Point	Other Regions Combined
Striped Bass	Beach Seine	8-14 Aug 76	0.025	0.136	0.190	NS	X	
		31 Jul - 6 Aug 77	0.025	0.077	0.186	NS		X
White Perch	Beach Seine	8-14 Aug 76	0.010	0.105	0.229	NS	X	
		31 Jul - 6 Aug 77	0.010	0.200	0.224	NS	X	
	Bottom Trawl	8-14 Aug 76	0.010	0.120	0.236	NS	X	
Atlantic Tomcod	Bottom Trawl	11-17 Jul 76	0.025	0.138	0.121	‡	X	
		3-9 Jul 77	0.025	0.320	0.057	‡	X	

*Because two or more tests are made, α=0.05 is distributed over all the tests, i.e., the α for each of two tests is 0.025 and for each of three tests is 0.01 (no equation for the critical value at α=0.0167 is available).
**D-Value is maximum absolute difference between cumulative proportions.
***Critical value is calculated from sample data. If D value exceeds critical value the distributions are significantly different at distributed α.
†Largest value at length of maximum D-value; see Appendix Tables B-21 through B-23.
‡Significant difference at distributed α.
NS = No significant difference at distributed α.

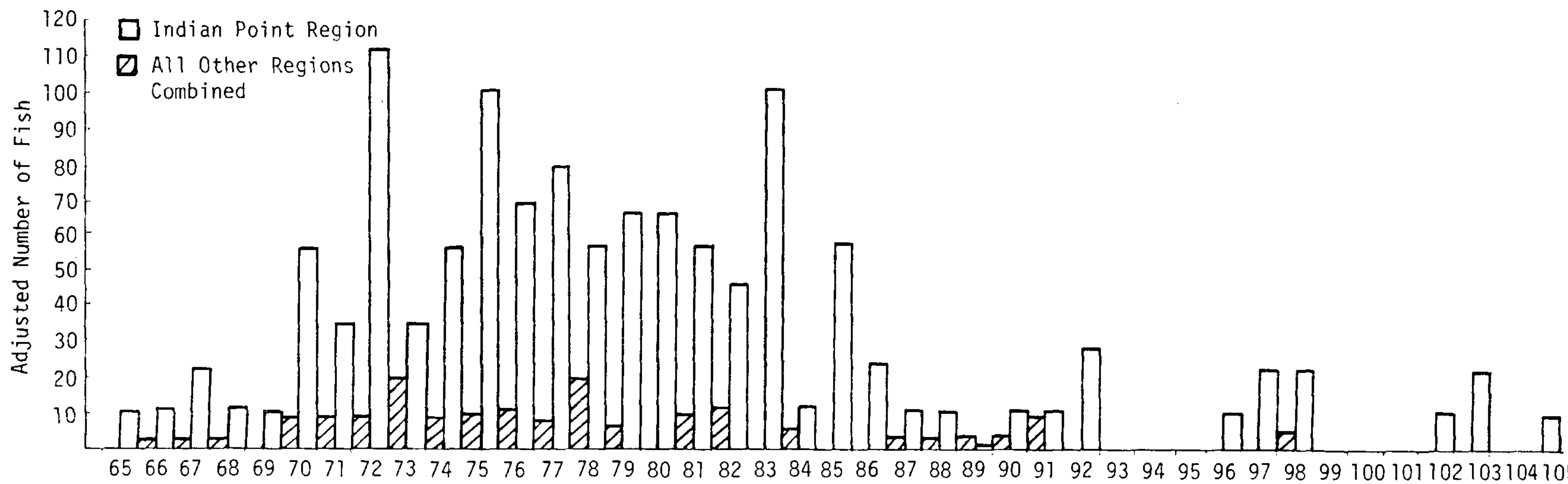


Figure B-7. Length-Frequency Histograms for Juvenile Atlantic Tomcod Collected by Bottom Trawls in Indian Point and Other Regions (TZ, CH, WP, and CW) Combined, July 11 through July 17, 1977

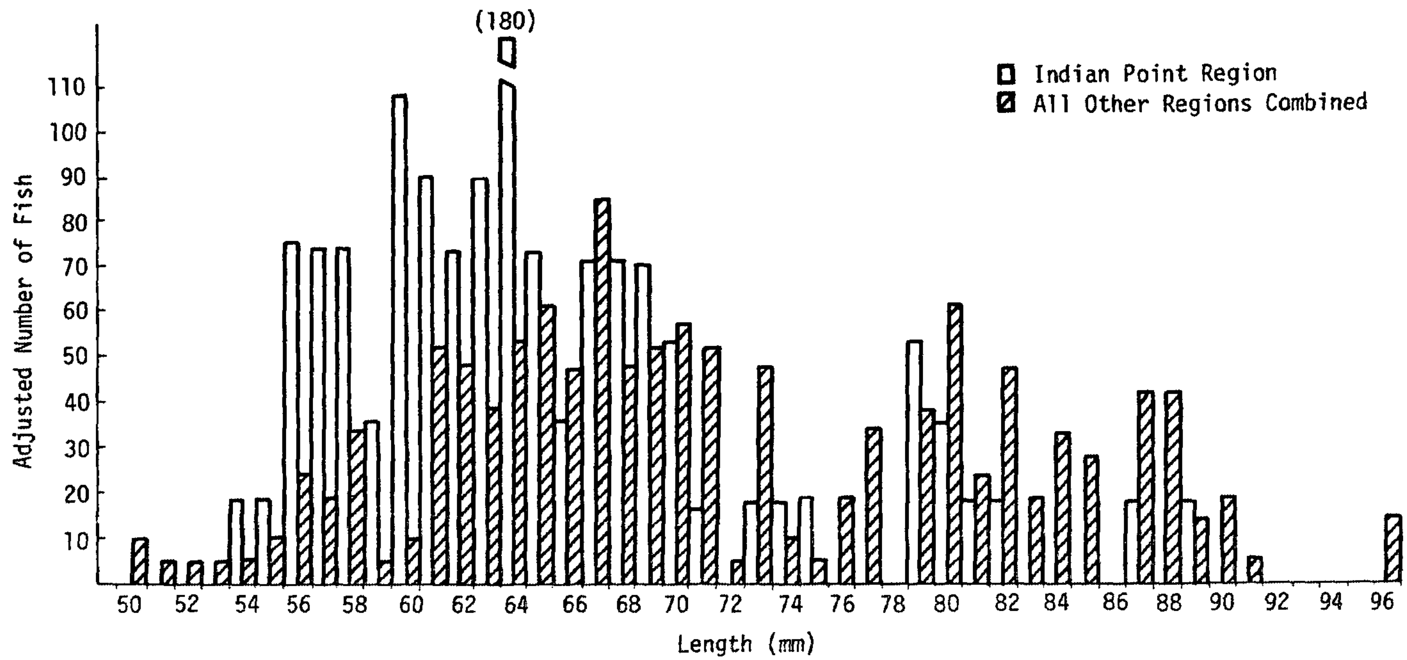


Figure B-8. Length-Frequency Histograms for Juvenile Atlantic Tomcod Collected by Bottom Trawls in Indian Point and Other Regions (TZ, CH, WP, and CW) Combined, July 3 through July 9, 1977

APPENDIX C

STRIPED BASS HATCHERY PROGRAM

Table C-1

1977 Recaptured Hatchery-Reared Striped Bass

Date and Region of Stocking	Recapture Date	River Mile	Site*	Gear	Age (Years)	Sex	Sexual Condition	Total Length (mm)	Weight (g)	Gonad Wt (g)	Body Wt/ Gonad Wt Ratio
Fall 1974	May 26, 1977	40	1	Haul Seine	3	Male	Ripe	312	291	NA	NA
Fall 1974	Apr 20, 1977	35	3	Haul Seine	3	Male	Developing	334	380	8.00	47.5
Fall 1974	May 4, 1977	35	3	Haul Seine	3	Male	Immature	325	357	NA	NA
Fall 1974	Apr 28, 1977	40	1	Gill Net	3	Male	Ripe	400	655	19.80	33.1
Fall 1974	May 5, 1977	34	3	Gill Net	3	Male	Developing	433	652	20.20	32.2
Fall 1974	May 19, 1977	67	3	Commercial Fishermen	3	Male	Developing	260	171	1.90	90.0
IP Sep 12-26, 1975**	Jun 29, 1977	69	3	Commercial Fishermen	2	Female	Immature	256	178	0.64	278.1
IP Sep 12-26, 1975	Jun 29, 1977	69	3	Commercial Fishermen	2	Female	Immature	235	164	0.29	565.5
IP Sep 12-26, 1975	Jun 30, 1977	67	3	Commercial Fishermen	2	Male	Undetermined	270	198	NA	NA
Sep 1975	Jun 30, 1977	67	3	Commercial Fishermen	2	NA	Undetermined	285	229	NA	NA
Sep 1975	Apr 20, 1977	42	3	Beach Seine	2	Male	Immature	199	92	0.04	2300.0
CH Oct 1-12, 1975	May 23, 1977	31	1	Bottom Trawl	2	Male	Immature	207	100	0.03	3333.3
CH Sep 27-30, 1975	May 23, 1977	31	1	Bottom Trawl	2	Female	Immature	220	187	0.15	1246.7
CH Sep 27-30, 1975	Jun 1, 1977	37	1	Other Contractor Gear	2	Male	Immature	242	173	0.12	1441.7
CH/TZ Oct 10-11, 1975	Mar 6, 1977	42	3	Impingement	2	Male	Immature	215	104	0.09	1155.6
Sep 1975	Aug 28, 1977	60	3	Box Trap	2	Male	Immature	282	237	0.14	1692.9

NA = Not Available

*Recapture location where:

1 = west side of river
3 = east side of river

**IP = Indian Point region, RM 39-46 (KM 62-74)
CH = Croton-Haverstraw region, RM 34-38 (KM 54-61)
TZ = Tappan-Zee region, RM 24-33 (KM 38-53)

Table C-2

Food Items of Wild Striped Bass (89-183 mm in total length) Collected in Beach Seines from RM 39 through 46 of Hudson River during May and June 1976

Total Number of Stomachs Examined = 49 Empty Stomachs = 10

Number of Stomachs in which at Least One Countable Food Item was Present = 25

Food Item*	# Stomachs Containing Food Item	Count For Food Item	Mean Count	S.E.** For Count	Mean Percent Frequency	S.E. For Percent Frequency
American Eel	1	1	0.04	0.04	0.50	0.50
Fish Eggs (Unid.)	2	100	4.00	2.77	5.60	3.94
Chironomidae (L)	3	7	0.28	0.18	3.13	2.13
Chironomidae (P)	8	13	0.52	0.17	14.51	6.56
Ceratopogonidae (L)	2	3	0.12	0.09	0.59	0.50
Collembola	1	1	0.04	0.04	0.67	0.67
Polypedilum (L)	3	13	0.52	0.31	3.12	2.51
Diptera (P)	2	6	0.24	0.18	1.05	0.75
Tanytarsus (L)	1	2	0.08	0.08	1.00	1.00
Araneida	1	1	0.04	0.04	1.00	1.00
Gammarus	14	109	4.36	1.48	30.41	7.86
Chirodotea	3	3	0.12	0.07	1.21	1.01
Cyathura polita	1	1	0.04	0.04	0.05	0.05
Leptocheirus	1	1	0.04	0.04	0.17	0.17
Copepoda (Unid.)	1	120	4.80	4.80	1.77	1.77
Harpacticoida	1	2	0.08	0.08	0.33	0.33
Cyclopoida	7	96	3.84	2.48	12.06	4.96
Calanoida	6	121	4.84	3.59	10.82	4.33
Leptodora	3	70	2.80	1.83	8.21	5.11
Chydoridae	1	5	0.20	0.20	0.83	0.83
Sida	1	11	0.44	0.44	1.91	1.91
Cladocera (Unid.)	1	1	0.04	0.04	0.17	0.17
Nematoda	3	4	0.16	0.09	0.89	0.60

Number of Occurrences of Uncountable Food Items

Food Item	Number
Fish Remains	9
Diptera Remains	5
Adult Insect Remains	1
Amphipoda Remains	14
Copepoda Remains	4
Cladocera Remains	2
Filamentous Algae	1
Animal Remains	15
Plant Remains	11
Detritus	22
Invertebrate Eggs (Unid.)	13

*(Unid.) = Unidentified
(L) = Larvae
(P) = Pupae

**S.E. = Standard Error

Table C-3

Food Items of Hatchery-Reared Striped Bass (122-171 mm in total length) Collected in Beach Seines from RM 35 through 43 of Hudson River during May and June 1976

Total Number of Stomachs Examined = 29 Empty Stomach = 7

Number of Stomachs in which at Least One Countable Food Item was Present = 17

Food Item*	# Stomachs Containing Food Item	Count For Food Item	Mean Count	S.E.** For Count	Mean Percent Frequency	S.E. For Percent Frequency
American Eel	2	3	0.18	0.13	0.43	0.37
Chironomidae (L)	5	18	1.06	0.82	9.35	5.72
Chironomidae (P)	2	12	0.71	0.55	8.67	6.35
Homoptera (Unid.)	1	1	0.06	0.06	0.12	0.12
Polypedilum (L)	1	1	0.06	0.06	2.94	2.94
Diptera (P)	6	11	0.65	0.35	15.53	7.72
Tanytarsus (L)	2	4	0.24	0.18	3.87	3.03
Araneida	1	1	0.06	0.06	1.18	1.18
Diplopoda	1	1	0.06	0.06	0.12	0.12
Gammarus	11	400	23.53	11.41	52.02	11.48
Leptocheirus	1	1	0.06	0.06	0.13	0.13
Copepoda (Unid.)	1	2	0.12	0.12	0.65	0.65
Harpacticoida	1	1	0.06	0.06	0.12	0.12
Cyclopoida	2	15	0.88	0.82	4.88	4.57

Number of Occurrences of Uncountable Food Items

Food Item	Number
Fish Remains	9
Diptera Remains	2
Adult Insect Remains	3
Amphipoda Remains	10
Animal Remains	7
Plant Remains	6
Detritus	12
Invertebrate Eggs (Unid.)	1

*(Unid.) = Unidentified
(L) = Larvae
(P) = Pupae

**S.E. = Standard Error

Table C-4

Food Items of Wild Striped Bass (73-128 mm in total length) Collected in Beach Seines from RM 39 through 46 of Hudson River during June 1977

Total Number of Stomachs Examined = 39 Empty Stomachs = 4

Number of Stomachs in which at Least One Countable Food Item was Present = 23

Food Item*	# Stomachs Containing Food Item	Count For Food Item	Mean Count	S.E.** For Count	Mean Percent Frequency	S.E. For Percent Frequency
Striped bass	2	6	0.26	0.19	3.86	3.01
Fish Remains	1	1	0.04	0.04	0.03	0.03
Fish Eggs (Unid.)	1	2	0.09	0.09	1.24	1.24
Chironomidae (L)	4	4	0.17	0.08	0.66	0.50
Chironomidae (P)	2	2	0.09	0.06	0.03	0.03
Ceratopogonidae (L)	1	1	0.04	0.04	< 0.01	< 0.01
Diptera (L)	1	1	0.04	0.04	< 0.01	< 0.01
Diptera (P)	2	2	0.09	0.06	0.62	0.62
Hydracarina	1	1	0.04	0.04	< 0.01	< 0.01
Gammarus	5	53	2.30	1.37	7.86	5.42
Cyathura	2	3	0.13	0.10	2.33	1.61
Neomysis	4	10	0.43	0.27	4.17	3.10
Leptocheirus	1	2	0.09	0.09	0.72	0.72
Copepoda (Unid.)	16	28586	1242.87	307.96	69.40	9.79
Harpacticoida	1	1	0.04	0.04	0.72	0.72
Cyclopoida	2	2	0.09	0.06	2.90	2.26
Calanoida	2	4	0.17	0.14	5.43	3.84

Number of Occurrences of Uncountable Food Items

Food Item	Number
Fish Remains	16
Diptera Remains	2
Neomysis Remains	2
Amphipoda Remains	4
Copepoda Remains	14
Cladocera Remains	1
Animal Remains	1
Plant Remains	17
Detritus	27
Invertebrate Eggs (Unid.)	14

*(Unid.) = Unidentified
(L) = Larvae
(P) = Pupae

**S.E. = Standard Error

Table C-5

Major Countable Food Items of Wild Striped Bass by Mean Percent Frequency, June 1977*

Length Group (mm)	Sample Size**	Food Item†	Mean Percent Frequency
1-75	3	Copepoda (Unid.)	99.97
		Gammarus	0.03
76-125	20	Copepoda (Unid.)	64.82
		Gammarus	9.03
		Calanoida	6.25
		Neomysis	4.80
		Striped bass	4.44
		Cyclopoida	3.33
		Cyathura polita	2.68
		Fish eggs (Unid.)	1.43
126-200	0		
All	23	Copepoda (Unid.)	69.40
		Gammarus	7.86
		Calanoida	5.43
		Neomysis	4.17
		Striped bass	3.86
		Cyclopoida	2.90
		Cyathura polita	2.33
		Fish eggs (Unid.)	1.24

*No hatchery-reared striped bass available for this analysis.

**Number of fish containing at least one countable food item.

†(Unid.) = Unidentified.