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SEMIANNUAL PROGRESS REPORT FOR HUDSON RIVER ECOLOGICAL STUDY IN THE AREA OF INDIAN POINT 1 JANUARY — 30 JUNE 1974

APRIL 1975

Prepared for

UNITED EDISON COMPANY

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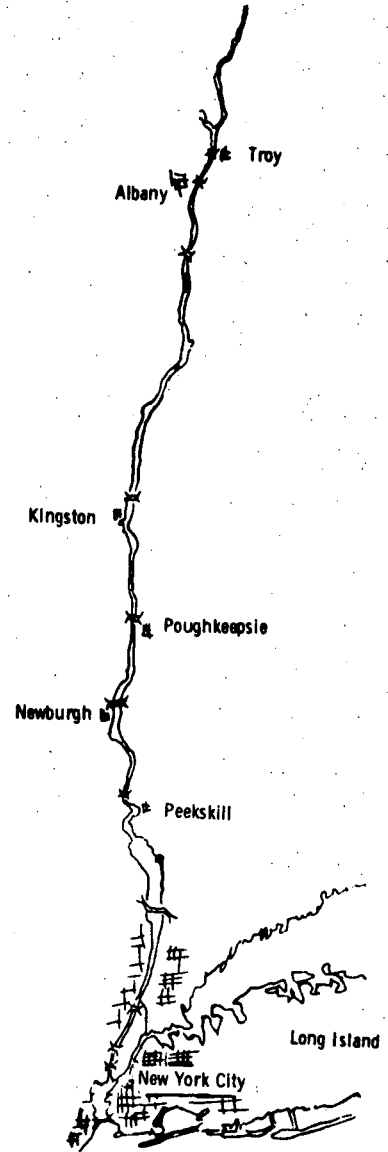
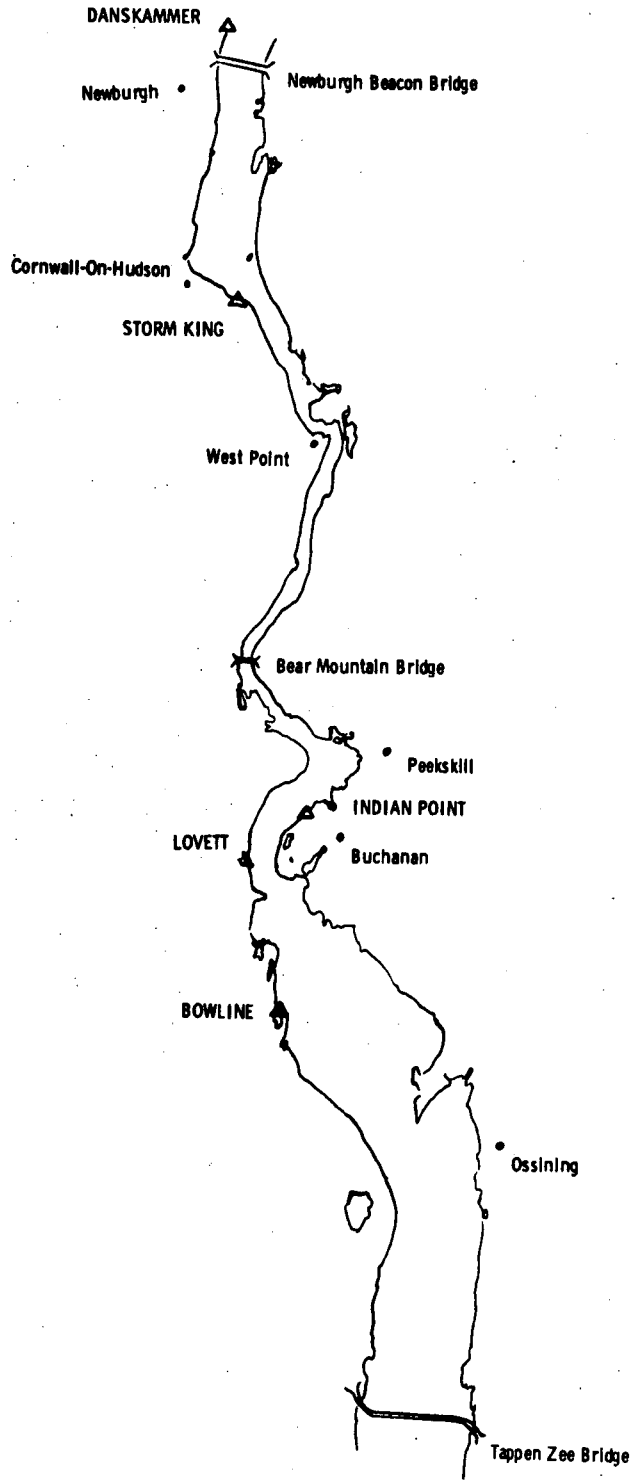


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FOR
HUDSON RIVER ECOLOGICAL STUDY
IN THE AREA OF INDIAN POINT
1 JANUARY-30 JUNE 1974

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Prepared for
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
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TEXAS INSTRUMENTS INCORPORATED
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Hudson River Estuary



FOREWORD

This semiannual report, which has been prepared for Consolidated Edison Company, Inc. (Con Ed), by the Ecological Services Group of Texas Instruments Incorporated (TI), summarizes the progress and status of TI's Hudson River ecological study in the area of Indian Point for the period 1 January 1974 through 30 June 1974.



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SECTION I INTRODUCTION

A. OVERVIEW

In June 1969, Consolidated Edison Company of New York, Inc., began an intensive study of the Hudson River estuary in the area of the Indian Point nuclear generating plant to assess the ecological impact of this facility. The contract for the initial baseline survey, from June 1969 through October 1970, was awarded to Raytheon Company and included monitoring of the river's chemical and physical parameters, identification of various life forms, and evaluation of the relative abundance of major aquatic species (Raytheon, 1971).

In 1972, the scope of work was expanded to permit direct empirical assessment and mathematical modeling of actual plant impact on the Hudson River estuary from Haverstraw Bay to the Newburgh-Beacon Bridge. This expanded program was conducted through the integrated efforts of three contractors: Texas Instruments Incorporated (TI), New York University (NYU), and Lawler, Matusky and Skelly Engineers (LMS). Individual study responsibilities are as follows:

- TI: plant-operation effects on screenable organisms and impact of thermal and chemical effluents on fish and benthos
- NYU: plant-operation effects on non-screenable organisms
- LMS: development and use of a mathematical model to predict entrainment and impingement effects on striped bass populations
- TI: integration of the results of these studies

In 1973, the Indian Point study was expanded to include the area south to the George Washington Bridge.



B. PROGRAM OBJECTIVES

The major objectives and supportive tasks relating to TI's 1974 Hudson River ecological study in the area of Indian Point are as follows:

Objective I: Examine the population dynamics of white perch, striped bass, Atlantic tomcod, and the benthic invertebrate *Cyathura polita*

Task 1: Continue mark/recapture efforts to estimate the population density of key fish species (white perch, striped bass, and Atlantic tomcod) in the Hudson River estuary

Task 2: Investigate the biological characteristics of white perch, striped bass, and Atlantic tomcod

Task 3: Conduct nearfield fisheries sampling to determine species composition and abundance and to provide specimens for biological-characteristics studies

Task 4: Obtain vital statistics and determine thermal and chemical effluent effects on the benthic invertebrate *Cyathura polita*

Objective II: Monitor impingement for impact assessment and test modified intake designs to reduce mortality

Objective III: Analyze water quality in conjunction with studies of relative abundance and spatial distribution of fish and benthos to assess interactions

Objective IV: Conduct physiological/behavioral and bioassay studies of fish and benthos to determine the effects of chemical and thermal effluents



SECTION II PROGRAM STATUS

A. POPULATION-DYNAMICS STUDIES

1. Mark/Recapture Study

Mark/recapture studies on Hudson River white perch and striped bass were initiated in 1972 and are continuing to estimate population sizes as a first step in evaluating the impact of the Indian Point nuclear generating plant Units 1, 2, and 3 on these species. In 1974, the mark/recapture program was expanded to include Atlantic tomcod.

Population-size estimates based on mark/recapture techniques can be compared to catch per unit effort and standing-crop estimates for white perch, striped bass, and Atlantic tomcod and will permit estimates of exploitation rates resulting from impingement at the plant intakes. In addition, the use of regional marks (fin clips) for young-of-the-year and numbered tags for older individuals will provide an estimate of the spatial or regional segment of the population (Table II-1) subject to impingement, the movement of portions of the populations into and out of these regions, and consequently the geographical extent of plant influence.

a. White Perch and Striped Bass

Yearling and older white perch and striped bass were fin-clipped or tagged from 1 April through 10 June 1974. Tagging operations were suspended during the remainder of June and July due to high mortality rates resulting from increased water temperatures [exceeding 21°C (70°F)]. A summary of white perch and striped bass mark/recapture information for January through June 1974 is presented in Table II-2. Tagging operations are scheduled to resume during late August or early September when water temperatures and subsequent tagging mortalities decline.



Table II-1
1974 Mark/Recapture Regions

Region	River Mile	Kilometer
Manhattan-Yonkers*	0- 23	0- 38.3
Tappan Zee-Croton-Haverstraw*	24- 38	38.4- 62.8
Indian Point	39- 46	62.9- 75.1
West Point-Cornwall	47- 61	74.2-123.1
Upper Hudson	62-152	123.2-244.8

*The Manhattan-Yonkers and Tappan Zee-Croton Haverstraw regions combined during the spring 1974 mark/recapture program.

Table II-2
Number of White Perch and Striped Bass Marked
and Recaptured, January-June 1974

	White Perch		Striped Bass	
	No. Marked	No. Recaptured	No. Marked	No. Recaptured
Fin-Clipped	4,432	648	799	23
Floy-Tagged	1,979	4	79*	0
Dennison-Tagged	5,444	29	34	2
Total	11,855	681	912	25

*Includes 38 hatchery juveniles released from physiology experiments.



b. Atlantic Tomcod

Atlantic tomcod, which enter the Hudson River estuary during winter months to spawn, were captured, marked, and released in January and February 1974. Of the 7135 specimens marked with a fin clip and released, 29 were recaptured during the January-February period. Mark/recapture efforts for this species are to be resumed in November and December 1974 when mature fish again migrate into the estuary to spawn. These efforts will allow a more precise estimate of the population size of Atlantic tomcod within the estuary, as well as in the Indian Point area, which will be presented in the 1974 multiplant annual report.

2. Biological-Characteristics Study

Biological characteristics of white perch, striped bass, and Atlantic tomcod are being studied to assess population parameters such as age structure, condition, and age-specific mortality, natality, growth rate, and reproduction. Analyses of these data, in conjunction with dietary overlap and predation, can indicate alteration in the status of fish stocks attributable to long-term power-plant impact and provide the data necessary to detect potential compensatory mechanisms.

a. Sampling Program

For use in the biological-characteristics studies, Atlantic tomcod were collected from December 1973 through February 1974, while white perch and striped bass were collected beginning in March 1974. Total numbers of white perch, striped bass, and Atlantic tomcod collected and analyzed as of July 18 are presented in Table II-3.

b. Catch Curve Analysis

In fisheries investigations, it is sometimes possible to estimate survival and mortality rates for fish populations from the age composition



Table II-3

Number of Fish Collected and Workup Completed from 1974
Biological-Characteristics Sampling (through 18 July 1974)

Task	Total Collected	Total Completed	Remarks
Aging			
Standard stations			
SB	144 (juveniles)	83	Complete through 13 June 1974
WP	544	415	
Tagged fish			
SB	38	8	
Other			
SB (spawners)	272	27	85 white perch for catch curve analysis remain
SB (juveniles)	11	11	
WP	253	168	
TC (adults)	879	477	
TC (young-of-the-year)	61	61	
Otoliths			
SB	136	0	Currently developing technique of age inter- pretation
Stomach Analysis			
Monthly analysis			
SB and WP	200	50	Currently working on April 1974 stomachs
TC	136	0	
Post yolk-sac larvae			
SB and WP	240	0	Currently being assem- bled by Ichthyoplankton group
Fecundity			
SB (females)	118	55	
SB (males)	132	132	
WP (males and females)	200	0	
TC (males and females)	879	87 females 271 males	
Length/Weight			
(For impingement com- parison)			
WP (river)	54	54	Future samples to be collected approximately 3 times per month
WP (screens)	209	209	
TC (river)	412	412	
TC (screens)	-	-	On file in data center
Abbreviations: SB = striped bass WP = white perch TC = tomcod			



of the catch. When age-frequency distribution is plotted for the population, the resulting graphical representation is called a catch curve. During April 1974, white perch collected at standard-station beach-seine sites were subsampled for age determination so that a catch curve could be constructed for the spring season. A second white perch catch curve analysis is planned for October 1974.

c. Growth

Scale samples of 414 white perch (all ages) and 83 juvenile striped bass from specimens collected at standard-station beach-seine and bottom-trawl sites were analyzed to determine growth histories by a back-calculation method. Studies to determine time of annulus formation by determining percent of fish forming annuli per month for each group are also being conducted.

Comparability and assessment of the annulus method vs the otolith (or earstone) method for age determination of striped bass were begun in spring 1974. Both scales and otoliths were taken from 136 adult striped bass to aid in scale validation. White perch otoliths will be taken during August and September to minimize scale aging problems resulting from misinterpretations of annulus formation.

d. Fecundity

The relationship of fecundity to length, weight, and age is presently being studied for striped bass, white perch, and Atlantic tomcod collected in 1973 and 1974. Of the approximately 272 striped bass (96 males and 176 females) collected during spring 1974, all males and 56 females have been analyzed to date for state of maturity and fecundity. A relationship between fecundity and length of Atlantic tomcod was derived from examination of specimens collected in December 1973.



e. Effects of Preservation

Preliminary investigations have shown significant differences between the length/weight relationship of preserved (10% formalin) and fresh or unpreserved white perch; consequently, a direct comparison of river fish with impinged fish is not practical since river fish are preserved prior to weighing but impinged fish are weighed while fresh. Present corrective procedures involve analysis of fish sampled in the vicinity of the intake screens concurrently with impingement sampling. Analysis of specimens will employ the use of wet weights from unpreserved fish collected at the Indian Point intake screens and in the river.

3. Nearfield Fishery Sampling

The nearfield fishery program, which includes standard-station beach-seine, bottom-trawl, and surface-trawl sampling, provides input to several tasks related to Indian Point study objectives. Fishery efforts provide white perch, striped bass, and Atlantic tomcod mark/recapture data as well as species composition, abundance, and distributional data for fish which occur in the Indian Point area. Additionally, these efforts supply specimens for laboratory biological-characteristics analyses and for physiology, behavioral, and bioassay experiments.

The description and status of the 1974 Indian Point nearfield fisheries operations are summarized in Table II-4.

a. Standard-Station Beach-Seine Sampling

Standard-station beach-seine sampling in the area of Indian Point began in mid-March 1974 and will continue into winter. In June, two new beach-seine sites were added to allow greater comparison with the existing data base. One of the additional sites was sampled by Raytheon (1971) and is located at Verplanck Point on the east shore (river mile 40),



Table II-4

Description and Status of Fisheries Operations Field Programs for 1974 as of 30 June 1974

Program Description	Study Area			Sampling Schedule		Status
	Region	RM	No. of Sites	Frequency	Period	
Standard-station beach seines (same as 1973)	West Point, Cornwall	52-60	6	Weekly	3/15-4/17/74	Complete
Standard-station beach seines (same as 1973)	Indian Point	40-44	5	Weekly	3/7-6/1/74	Complete
Standard-station beach seines (same as 1973-two stations added).	Indian Point	40-44	7	Weekly	6/2-12/31/74	Ongoing
Standard-station bottom trawls (same as 1973)	Cornwall	56-58	5	Biweekly	4/10/74	Complete
Standard-station bottom trawls (same as 1973)	Indian Point	39-44	7	Biweekly	4/9-12/31/74	Ongoing
Standard-station bottom trawls (same as 1973-with cod-end liner)	Indian Point	39-44	7	Biweekly	6/21-12/31/74	Ongoing
Standard-station surface trawls (same as 1973)	Indian Point	39-44	7	Biweekly	7/19-12/31/74	Ongoing

II-7

services group



while the second site is located approximately 0.33 mi (0.5 km) downriver on the east shore; the bottom substrate at both sites is sand-gravel.

Standard-station beach-seine samples were collected also in the vicinity of Cornwall and West Point (RM 52-59) from mid-March to mid-April 1974 at the sites surveyed in 1973 in conjunction with nearfield sampling in the area of the proposed Cornwall pumped-storage plant. Sampling at these sites was discontinued after mid-April and confined to the Indian Point area.

b. Standard-Station Bottom-Trawl Sampling

Bottom trawling at seven standard stations in the Indian Point area began in mid-April 1974 and will continue on a biweekly basis until winter. Since late June, biweekly sampling at these stations has been conducted also with a bottom trawl with a cod-end liner [0.25-in. (6.3-mm) mesh] to provide catch data which can be compared with that collected by Raytheon (1971). Trawling with and without the cod-end liner is conducted on consecutive days at similar tidal stages so that gear comparability and efficiency estimates can be made.

Standard-station bottom-trawl samples were collected also in the vicinity of the proposed Cornwall pumped-storage plant during mid-April but were discontinued thereafter and confined to the Indian Point area.

c. Standard-Station Surface-Trawl Sampling

Surface-trawl collections at the seven Indian Point standard-station trawl sites began on 19 July 1974 and will continue on a biweekly basis until winter.



4. Benthic Invertebrate Studies

Benthic invertebrate studies are being conducted in the vicinity of the Indian Point plant to assess the effects of the plant's thermal and chemical effluents on organisms living on or within the bottom substrate. Analyses of these data will provide information on community composition, diversity, biomass, and relative abundance of benthic organisms. Naturally occurring variations in community structure, community variations between a test area at the site and a control area beyond the influence of plant operations, and population dynamics of the estuarine isopod *Cyathura polita* in the test and control areas will also be evaluated.

Indian Point benthic-studies methodology for 1974 is the same as that implemented in 1973; e.g., samples are taken in control and test areas in triplicate on a monthly schedule. Population-dynamics studies of the isopod *Cyathura polita* are also continuing. Epibenthic sled (0.5 m² net opening) sampling in the test and control areas has been substituted for biological dredge sampling to provide a better data base for assessing plant effects on near-bottom invertebrates.

To date, benthic sampling and sample processing are progressing on schedule.

B. IMPINGEMENT STUDIES

Since June 1972, TI has conducted impingement studies at the Unit-1 screens that include monitoring and recording of fish impingement, river physical/chemical variables in the vicinity of the plant, and selected plant variables. Analyses of these data will be directed toward assessing the biological impact of impingement on fish populations of the Hudson River and determining the factors which influence impingement. In addition, methods of reducing impingement are being evaluated.



Impingement monitoring at the Indian Point plant is continuing on schedule. Fish avoidance induced by a bubbler system or air curtain is also being investigated. An initial evaluation of the use of sonar to estimate the numbers of fish present in the screen area has been completed and will be presented in a separate report.

The relationship of fish impingement to tidal movements and saltwater intrusion is being examined and will be presented in the 1974 annual report on fish impingement.

C. WATER-QUALITY STUDIES

Chemical and physical parameters in the Hudson River estuary, including pH, dissolved oxygen, turbidity, temperature, and conductivity, are being monitored to determine factors which affect variations in species composition, abundance, and distribution in the estuary, specifically in the area of the Indian Point power plant. These parameters are being measured *in situ* in conjunction with fisheries and benthic collections and to support data for the behavior/physiology studies.

Since salt intrusion, of all the variables measured, changes most rapidly over the widest range, this factor will be analyzed comprehensively. Analysis of conductivity data will be directed toward an evaluation of the influence of salt intrusion and salt-front fluctuations in the Indian Point region on fish impingement.

Tidal studies have been conducted in the area of the power plant to determine the existence and extent of plant/tide interactions throughout the tidal cycle and to provide information relating to the influence of river morphometry on plant intake flow.



D. PHYSIOLOGY AND BEHAVIOR STUDIES

The behavior and physiology program integrates field and laboratory investigations to evaluate the biological impact of the Indian Point thermal discharge and to define the effects of elevated temperatures on Hudson River organisms. Laboratory experiments are conducted under conditions which simulate those of the Hudson River environment. Seasons, for experimental purposes, are defined by the ambient water temperatures of the river and lag behind the calendar seasons due to the high specific heat of the river water mass. Results of the physiology/behavior and bioassay experiments will be presented in the 1974 Indian Point annual report.

1. Thermal Experiments

Thermal experiments on white perch, striped bass, and Atlantic tomcod are continuing on schedule. Specific experiments relating to the potential of the thermal plume to act as a barrier to migrating species (avoidance) and studies which define lethal temperature tolerance and thermal preference of key species have been completed.

2. Respirometry Experiments

Thermal discharges can affect the population dynamics of fish and other aquatic organisms in that the rate of energy consumption increases as temperature increases: as temperature increases above a critical level, maintenance energy requirements increase so rapidly that little or no surplus energy is available for other physiological processes. Respiration experiments were initiated during 1973 to determine the temperature above which maintenance requirements may limit other physiological processes such as reproduction or growth. These experiments are continuing on schedule and will be completed by 1 January 1975.



3. Bioassay Experiments

Bioassay experiments are being conducted to assess the effects of cooling-tower blowdown and plant chemical discharges on young-of-the-year white perch and striped bass. These studies are continuing on schedule and are slated for completion in September 1974.



SECTION III
LITERATURE CITED

Raytheon. 1971. Indian Point ecology survey. Final report for Consolidated Edison, 7: 1-7.