HR Library #11530

Sampling Design Synopses
Hudson River Ecological Studies
(1971-1983)

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(1971-1983)

Office of Environmental Affairs
Consolidated Edison Company of New York, Inc.

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I. Introduction

This document provides the basic sampling design features for most of the ecological study programs managed by Con Edison. These programs have typically been funded by a consortium of utilities with interests in generating stations on the estuarine portion of the Hudson River. Each program's sampling design generally underwent a yearly review to institute changes required to fulfill various biological, statistical and/or regulatory agency objectives.

The specific programs included here and the years during which they were performed are:

- Indian Point Impingement (1979-1983)
- Indian Point Entrainment Abundance (1971-1983)
- Riverwide Ichthyoplankton, Fall Shoals and Beach Seine Surveys (1973-1983)
- Atlantic Tomcod Stock Assessment (1976-1984)

Also included are several efforts (interregional trawls, try trawls and adult striped bass stock assessment) which were discontinued after the Settlement Agreement of 1980. For ease of identification, the various programs have been divided into riverwide and Indian Point nearfield studies, Sections II and III, respectively.

This review of study programs does not include all of the studies which have been sponsored by Con Edison. Not included are the following:

- Indian Point Impingement (1969-1978). These studies are summarized in TI (1980c)
- Indian Point Nearfield Fisheries Surveys (1969-1980). A compilation of these studies through 1978 is included in TI (1980c). Nearfield studies conducted in 1979 and 1980 are described in TI (1980d) and Con Edison (1982), respectively.
- Indian Point Entrainment Survival Studies. The results of these studies are presented in (EA 1978; 1979, 1980, 1981, and 1982).

Table I-1
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1973

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Weekly, April 29 - August 18 18 surveys (RM 17-140)	Day and night sampling See table I-2 for description of gear and sampling design for 1973 and 1974	Densities of eggs, larvae and early juveniles Water quality (DO, temp., conductivity) collected with each sample	Texas Instruments, Inc. conducted surveys and analyzed lab samples, data reported in TI (1975)

Table I-2
Comparison of 1973 and 1974 Ichthyoplankton Sampling Programs

Area of Change	Sampling Season 1973	1974
Sample design	Sampling occurred every 8 km until Morone eggs or larvae were collected. Sampling then was concentrated in immediate area to define limits of Morone abundance.	Sampling occurred on a stratified random basis. Sites were selected within a region and stratum from a random number table. Numbers of samples per region and stratum were proportional to river volume within each region and stratum.
Sampling time period	Around the clock	Each individual river survey was conducted during dayling or nighttime hours.
Sampling gear	1-m^2 epibenthic sled 1-m^2 Tucker trawl 2-m^2 Tucker trawl	1-m^2 epibenthic sled 1-m^2 Tucker trawl
Plankton nets	Each gear was equipped with three nets. Samples were collected consecutively. Mesh sizes increased throughout the sampling season from 500- through 505-μ, 1000-, 1800-, and 3000-μ consecutively.	Each gear was equipped with a single 505-μ mesh net. Mesh size was not changed during the season.

Source: TI (1975)

Table I-3
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1974

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Weekly, April 23 - August 15 23 surveys (RM14-140)	See Table I-2 for sampling design Approximately 100-175 samples per survey	Same as 1973	Texas Instruments, Inc., conducted surveys and analyzed lab samples, data reported in TI (1975)

Table I-4
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1975

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Atlantic Tomcod Survey: 3 surveys of approximately 80 samples/survey conducted between mid-March and mid-April (RM 14-76) Long River Survey: Weekly mid-April to mid-August 15 surveys with approximately 175 samples/survey, RM 14-140	Sampling was during day until 2 weeks after eggs of Morone sp. appeared after which night sampling was conducted Sampling design basically unchanged between 1975 and 1981. See Table I-5 which gives details on sample allocation for 1975-1981	Same as 1973	Texas Instruments, Inc. conducted surveys and analyzed lab samples, data reported in TI (1978)

Table I-5
Long River Ichthyoplankton Sample Allocations
1975-1981

The following steps were used in determining number of samples per region in ichthyoplankton surveys:

A. Three samples (out of the total required per survey) are assigned to each of the strata/region combinations: (for example, on the Atlantic tomcod surveys, this will allocate 54 out of 100 samples.)

	Region	RM	Shoals (20' River Depth)	Channel (20' River Depth)	Channel Bottom
1	Yonkers (YK)	14-23	Tucker Trawl & Sled	Tucker Trawl	--
2	Tappan Zee (TZ)	24-33	Tucker Trawl & Sled		Sled
3	Croton-Harverstraw (CH)	34-38	Tucker Trawl & Sled		
4	Indian Point (IP)	39-46	Tucker Trawl & Sled		
5	Cornwall (CW)	47-55	--		
6	Poughkeepsie (PK)	56-61	Tucker Trawl & Sled		
7	Hyde Park (HP)	62-76	--		
8	Kingston (KG)	77-85	--		
9	Sugerties (SG)	86-93	--		
10	Catskill (CS)	94-106	--		
11	Albany (AL)	107-124	--		
12		125-140	--		

-- = Strata does not occur in region

B. The remainder of the samples (46 samples in the example in Step A) are allocated based on standing crop estimates in the peak periods of occurrency of particular life stages in prior years (most recent three years of data were used where available).

1. Peak periods of post yolk-sac larvae (predominant life stage of Atlantic tomcod during sampling period of mid-March through mid-April)
   1975: 4/7-9 1976: 3/22-25 1977: 3/21-26

2. For these periods, divide the strata standing crop within each region by the total river standing crop to obtain the following proportions.

	1975			1976			1977		
Region	S	B	C	S	B	C	S	B	C
YK	.0217	-	.5869	.0535	-	.7566	.0015	-	.4206
TZ	.0434	.3043	.0456	.1440	.0282	.0066	.0926	.0497	.4132
CH	.0013	.0046	.0016	.0016	.0019	.0031	.0034	.0023	.0033
IP	.0011	.0020	.0003	.0011	.0004	0	.0009	.0022	.0042
WP	-	0	0	-	.0012	.0016	-	.0009	.0040
CW	0	.0003	0	.0001	0	0	0	.0003	.0003
PK	-	0	0	-	0	0	-	.0001	.0004

Table I-5 (Continued)

3. Multiply each proportion by the remaining 46 samples and then obtian the mean sample number by strata for 1975 through 1977.

	1975			1976			1977			Mean 1975-1977		
Region	S	B	C	S	B	C	S	B	C	S	B	C
YK	1	-	27	3	-	35	0	-	19	1	-	27
TZ	2	14	2	7	1	0	5	3	19	5	6	7
CH	0	0	0	0	0	0	0	0	0	0	0	0
IP	0	0	0	0	0	0	0	0	0	0	0	0
WP	-	0	0	-	0	0	-	0	0	0	0	0
CW	0	0	0	0	0	0	0	0	0	0	0	0
PK	-	0	0	-	0	0	-	0	0	0	0	0

4. Add the mean number of samples in Step 3 to the 3 samples per strata (Step A) for the final allocation per survey.

5. Sample allocation for ichthyoplankton surveys conducted on the entire river (14-140) used standing crop estimates for eggs, yolk-sac and post yolk-sac larvae. The number of surveys conducted using a particular life stage allocation depended on the duration of the period of the peak occurrence of a particualr life stage. For example, in 1981 out of 10 surveys conducted between early May and early July, surveys 1-4 were based on eggs, surveys 5-7 on yolk-sac and surveys 8-10 on post yolk-sac distributions.

Source: TI 1978 and 1979 Standard Operating Procedures

Table I-6
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1976

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Atlantic Tomcod Survey: biweekly, 23 February through 8 April 5 surveys (RM 14-76)	100 samples/survey collected per Atlantic tomcod survey and 200 samples/survey collected per long river survey	Length measurements of striped bass larvae included in lab analysis; all life stages except eggs represented in length measurements	Texas Instruments, Inc. conducted surveys and analyzed lab samples, data reported in TI (1979)
Long River Survey: Weekly, April 19 through August 23, 15 long river surveys (RM 14-140)			

Table I-7
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1977

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Atlantic tomcod Survey: Biweekly, February 21 through April 17; 4 surveys (RM 14-73) Long River Survey: Weekly, April 18 through August 12, 15 surveys (RM 14-140)	Only 157 out of 200 samples collected in long river surveys analyzed in lab. Samples chosen for analysis by multiplying number of samples in each stratum and region by 0.785 (157/200)	Same as 1976	Texas Instrumente, Inc. conducted surveys and Lawler, Matusky & Skelly Engineers (LMS) analyzed lab data, data reported in TI (1980a)

Table I-8
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1978

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Atlantic Tomcod Survey:	Same as 1978	Same as 1978	Texas Instruments, Inc. conducted surveys, LMS analyzed lab samples, data reported in TI (1980b)
biweekly, March 28 through April 14, 2 Surveys (RM 14-76)			
Long River Survey:			
Weekly, April 17 through August 18, 15 surveys (RM 14-140)			

Table I-9
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Atlantic Tomcod Survey: Biweekly March 19 through April 6, 2 surveys (RM 14-76) Long River Survey: April 16 through August 17, 15 surveys (RM 14-140)	Same as 1978	Same as 1978	Texas Instruments, Inc. conducted surveys, LMS analyzed lab samples. TI (1981)

Table I-10
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Atlantic Tomcod Survey:	Same as 1979	Same as 1979	Texas Instruments, Inc. conducted surveys, LMS analyzed lab samples, data reported in Battelle (1983)
Biweekly, between March 17 and May 2, 4 surveys (RM 14-76)			
Long River Survey:			
Weekly, between May 5 and July 4, 9 surveys (RM 14-140)			

Table I-11
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1981

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Long River Survey: Weekly, May 4 through July 9, 10 surveys (RM 14-140)	Atlantic tomcod survey, early March through early May, discontinued; Long River Survey remained the same as 1980, except that sampling period reduced to concentrate on peak abundance of striped bass, white perch and clupeids	Same as 1980	LMS conducted surveys and Ecological Analysts, Inc. (EAI) analyzed lab samples, data reported in Battelle (1983)

Table I-12
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1982

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Long River Survey: Weekly, May 10 through July 9 (RM 14-140) 9 surveys (RM 14-140) (1st survey in May was missed)	Stratified random sampling design modified and use of prior 3 years standing crop data discontinued; (see table I-5 which describes sampling design used for 1975-1981) Allocation of samples was: Surveys 1-3 194/week Surveys 4-6 186/week Surveys 7-10 187/week All samples analyzed in lab Water quality collection at fixed sites (12-16 per region, 164 samples per survey) as compared to being taken with each sample. Design provides more useful water quality information, provides a better indication of salt front location from survey to survey	Lengths of a maximum of 30 larval or juvenile striped bass, white perch* and American shad* recorded per sample	EAI conducted surveys; LMS analyzed lab samples Report not yet drafted

* Added in 1982

Table I-13
Utilities Hudson River Monitoring Program
Long River Ichthyoplankton Survey
Year: 1983

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Long River Survey: Weekly, May 2 through July 8, 10 surveys (RM 14-140)	Same as 1982	Same as 1982	EAI conducted surveys; LMS analyzed lab samples Report not yet drafted

Table BS-1
Utilities Hudson River Monitoring Program
Beach Seine Survey
Year: 1973

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Weekly, early April - mid-December (RM 12 - 66) Weekly, early April - September and biweekly October - December (RM 66 - 153) Approximately 100 beaches out of 300 available beaches sampled per survey	Stratified Random Design based both on amount of shoreline in region and previous week's catches of striped bass and white perch Day sampling (some selected beaches sampled at night) Gear: 100 ft. (30.5m) beach seine primary gear; set perpendicular to shore one end held on shore and towed clock-wise to shore forming a rough semicircle. 50 ft. (15m) seines also used, set parallel to shore in water less than 3 ft. deep and both ends walked to shore.	See Table BS-3 for field and lab procedures	Texas Instruments Inc. collected data; data reported in (TI 1975)

Table BS-2
Utilities Hudson River Studies
Beach Seine Survey
Year: 1974

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Same as 1973	No 50 ft. (15m) beach seine sampling	See Table BS-3 for field and lab procedures and comparisons between 1973 and 1974	Texas Instruments Inc. collected data; data reported in (TI 1975)

Table BS-3
Comparison of 1973 and 1974 Beach-Seine Survey Sampling Programs

Area of Change	Sampling Season 1973	1974
Nighttime sampling location	George Washington Bridge [RM 12 (19 km)] to Marlboro [RM 69 (110 km)]	Indian Point region [RM 39-46 (63-75km)] and Cornwall [RM 56-62 (90-99 km)]
Nighttime sampling season	Irregular intervals, August through December	Weekly August through December
Gear	50 ft. (15.2-m) beach seine 100 ft. (30.5-m) beach seine	100-ft. (30.5-m) beach seine
Field procedures	Did not differentiate yearling striped bass, white perch, American shad, alewife, and blueback herring from Age-II and older specimens.	Differentiated yearling striped bass, white perch, American shad, alewife, and blueback herring from Age-II and older specimens
	Water-quality samples collected at most (but not all) sample sites	Water-quality samples col- at all sample sites
	Examined striped bass and white perch for fin clips or tags	Examined striped bass, white perch, and Atlantic tomcod for fin clips or tags
Laboratory procedures	Alewife and blueback herring identified to species	Alewife and blueback herring < 30 mm in total length identified as Alosa sp.

Source: (TI 1975)

Table BS-4
Utilities Hudson River Studies
Beach Seine Survey
Year: 1975

Sampling Frequency	Sampling Design/Changes	Type of Data Collected	Contractor & Reference
Weekly, early April - December (RM 12 - 75) Biweekly early April - June and September - December and weekly July and August (RM 76 - 153) 100 samples per survey	Beach sites chosen by dividing river into 3 mi. sections and one site/section randomly chosen so that no site was sampled more than once during the same day; however, some sites sampled more than once/week. The remainder of approximately 100 samples per survey were apportioned based on the prior week's catches of juvenile striped bass and white perch.	Length/weight on subsamples of striped bass, white perch and Atlantic tomcod	Texax Instruments, Inc. collected data; data reported in (TI 1978)

Table BS-5
Utilities Hudson River Studies
Beach Seine Survey
Years: 1976 - 1978

Sampling Frequency	Sampling Design/Changes	Type of Data Collected	Contractor & Reference
Weekly, early Arpil - December (RM 12 - 61) Biweekly, early April - June and September - December, and weekly July - August (RM 62 - 153) 100 samples per survey	Same as 1975	Same as 1975	Texas Instruments, Inc. collected data; 1976 data reported in (TI 1979), 1977 data reported in (TI 1980a), and 1978 data reported in (TI 1980b)

Table BS-6
Utilities Hudson River Studies
Beach Seine Survey
Years: 1979 - 1980

Sampling Frequency	Sampling Design	Types of Data Collected	Contractor & Reference
Biweekly, April - June and September - December (RM 12-153) Weekly, July - August; (RM 12-76) 100 samples per survey On alternate weeks in April - June, 100 samples collected between RM 12-76 (this sampling was designed primarily to recapture striped bass and white perch fin-clipped in previous fall)	Random allocation based on amount of shorezone in each region, with a minimum of 5 beaches/region (change from 1973-1978 where 30 - 40 samples were allocated to 3-4 mi sections and the remainder apportioned according to the prior weeks catches of juvenile striped bass and white perch) See table BS-7 for sample allocations	Length/weight of sub-samples of young-of-the-year of the following species (in addition to length/ weight data for striped bass, white perch and Atlantic tomcod): American shad blueback herring alewife bay anchovy white catfish spottail shiner weakfish Atlantic sturgeon shortnose sturgeon	Texas Instruments, Inc. collected data; 1979 data reported in (TI 1981), 1980 data reported in Battelle (1983)

Table BS-7
Beach Seine Survey Site Sampling Allocations
1979 - 1980

Downriver Region	RM	Number of Beaches Samples Per Region: Full River Sampling Week	Number of Beaches Samples Per Region: Downriver Sampling Week
Yonkers	12-23	5	7
Tappan Zee	24-33	24	39
Croton-Haverstraw	34-38	14	23
Indian Point	39-46	5	8
West Point	47-55	5	6
Cornwall	56-61	6	10
Poughkeepsie	62-76	5	7
Upriver Region			
Hyde Park	77-85	5	--
Kingston	86-93	5	--
Saugerties	94-106	9	--
Catskill	107-124	10	--
Albany	125-152	7	--
Total		100	100

Source: TI 1979 Standard Operating Procedures, p FS 111-2

Table BS-8
Utilities Hudson River Studies
Beach Seine Survey
Year: 1981

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, August - October (RM 12 - 153) 6 Surveys	Sampling period reduced to concentrate on peak occurrence of juvenile striped bass, white perch and clupeid species.	Same as 1980	Lawler, Matusky & Skelly Engineers collected data; data reported in Battelle (1983)

Table BS-9
Utilities Hudson River Studies
Beach Seine Survey
Year: 1982

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, mid-August (August 16th) mid- October, RM 12 - 153 5 Surveys 1st beach seine survey scheduled for the 1st week in August was missed	Same as 1981	Only length data collected on selected species of YOY (see Table BS-6); weight measurements discontinued.	Lawler, Matusky & Skelly Engineers collected data; report not yet drafted

Table BS-10
Utilities Hudson River Studies
Beach Seine Survey
Year: 1983

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, August 1 through October 15 (October 15) RM 12 - 153 6 surveys	Same as 1981-82	Same as 1982	Ecological Analysts, Inc. collected data; no report drafted

Table FS-1
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1973

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly in August, and biweekly October through December (RM 12-70)	Epibenthic sled with 3000um mesh used; sampling conducted at night to evaluate shoal areas (5-20 feet deep) as nursery grounds and to obtain recaptures for Mark/Recapture program.	Density of juvenile fish; water quality (DO, temp,) conductivity collected with each sample	Texas Instruments, Inc. collected data; data reported in TI (1973)

Table FS-2
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1974

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, mid-August through December (RM 12-70) 100 samples per day	Allocation of samples based on distribution of juvenile striped bass and white perch in 1973 in bottom and shoals strata (majority of samples were in shoal areas); selection of sampling sites same as long river ichthyoplankton program, (see Table I-2) except that no mid-water, or Tucker trawl samples, taken.	Same as 1973	Texas Instruments, Inc. collected data; data reported in TI (1977)

Table FS-3
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1975

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, mid-August through December (RM 14-76) 100 samples per survey	Stratified random design (in shoal and bottom strata) based on distribution of juvenile striped bass and white perch during 1974	Same as 1974	Texas Instruments, Inc. collected data; data reported in TI (1978)

Table FS-4
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1976

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, mid-August through December 100 samples/survey.	Stratified random design in shoal and bottom strata based on juvenile distribution of striped bass and white perch in 1975.	Same as 1975	Texas Instruments, Inc. collected data; data reported in TI (1979)

Table FS-5
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1977

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, August 15 through December 6 (RM 14-76) 9 surveys 100 Samples/survey	Same as 1976	Same as 1976	Texas Instruments, Inc. collected data; data reported in TI (1980a)

Table FS-6
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1978

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, August 21 through December 14 (RM 14-76) 9 surveys 100 samples/survey	Same as 1977	Same as 1977	Texas Instruments, Inc. collected data; data reported in TI (1980b)

Table FS-7
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, July 9 through December 13 (RM 12-140) 12 Surveys 200 samples/survey	No of samples per survey increased to 200 from 100; 100 sled samples (bottom and shoals) retained in RM 14-76 for comparability with 1974-1978: For the additional 100 samples: a: 50 channel samples collected with tucker trawl with a minimum of 3/region (=36) and 14 allocated based on juvenile striped bass and white perch patterns in Yonkers through Catskills Regions. b: 50 bottom samples collected with epibenthic sled in Hyde Park - Albany regions in proportion to combined shoals and bottom strata volumes. See Table FS-8 for number of site per region and strata.	lenght/weight data added from the following juvenile species: striped bass white perch Atlantic tomcod spottail shiner American shad blueback herring alewife rainbow smelt shortnose sturgeon Atlantic sturgeon	Texas Instruments, Inc. collected data; data reported in TI (1981)

Table FS-8
Sample Allocation for Fall Shoal Survey, 1979-1983

	Shoal	Bottom	Channel	
Sampling Region	Epibenthic Sled	Epibenthic Sled	Tucker Trawl	Total
Yonkers	7	*	5	12
Tappan Zee	30	8	8	46
Croton-Harverstraw	16	8	3	27
Indian Point	6	5	3	14
West Point	**	5	3	8
Cornwall	5	5	3	13
Poughkeepsie	**	5	3	8
Hyde Park	**	6	4	10
Kingston	**	9	6	15
Saugerties	**	12	6	18
Catskill	**	15	6	21
Albany	**	8	**	8
Total	64	86	50	200

* Not sampled due to obstructions
** Stratum too limited to sample

Table FS-9
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, mid-July through December (RM 14-140) 12 surveys	Same as 1979	Same as 1979	Texas Insturments, Inc. collected data; data reported in Battelle (1983)

Table FS-10
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1981

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, August-October (RM 14-140) 7 surveys	After Settlement Agreement, the duration reduced to concentrate on period of peak striped bass, white perch and clupeid juvenile abundance No changes were made in the basic study design (see Table FS-8)	Same as 1980	Lawler, Matusky & Skelly Engineers collected data; data reported in Battelle (1983)

Table FS-11
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1982

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, mid-August (August 12) through mid-October (RM 14-140) 6 surveys	Water quality collections taken at fixed sites, 12-16 per region(164 samples per survey) as compared to being taken with each sample as in prior year; this design provides a better indication of salt front location from survey to survey. (Same design as water quality collections for the Long River Ichthyoplankton Survey, see Table I-12)	Weight measurements for selected species discontinued (see Table FS-7 for list of species)	Lawler, Matusky & Skelly Engineers collected data; no report drafted (as of 5/84)

Table FS-12
Utilities Hudson River Studies
Fall Shoals Survey
Year: 1983

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, early August 7 through October 21 RM 14-140 6 surveys	Same as 1982	Same as 1982	Ecological Analysts, Inc. collected data; report not yet drafted (as of 5/84)

Table IRT-1
Utilities Hudson River Monitoring Program
Interregional Bottom Trawl Survey
Year: 1973

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, April - December	Interregional bottom trawl survey was designed to collect data on juvenile and adult species composition, abundance and distribution. It also supplied a deep-water effort for white perch and striped bass mark/-recapture programs. 32 fixed stations, primarily in channel areas, between RM 27-62. Bottom trawl used (towed against current for 5 minutes at 1.3m/sec). Dimensions: Foot rope = 30.5 ft. total length = 44.3 ft. cod end mesh = 1.3 in. stretch	Juvenile and adult fish, water temperature was the only water quality parameter recorded.	Texas Instruments, Inc. collected data; data reported in TI (1975)

Table IRT-2
Utilities Hudson River Monitoring Program
Interregional Bottom Trawl Survey
Year: 1974

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
biweekly, April - December.	7 shoal and channel stations between RM12 and RM 27 added. Gear modified to include a cod end cover of 0.25in. mesh over the existing cod end. This was done to collect juveniles more effectively. Both cod end liners were tied off and catch data for each were recorded. The interregional trawl (IRT) continued to have this "double cod end" through 1980.	Upper length limits for yearling used to differentiate age I and age II striped bass, white perch and clupeid species.	Texas Instruments, Inc. collected data; data reported in TI (1975)

Table IRT-3
Utilities Hudson River Monitoring Program
Interregional Bottom Trawl Survey
Year: 1975

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, April - December	The 7 stations between RM 12-27 were dropped.	Same as 1974	Texas Instruments, Inc. collected data; data reported in TI (1978)

Table IRT-4
Utilities Hudson River Monitoring Program
Interregional Bottom Trawl Survey
Year: 1976 - 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, April - December (RM 27-62)	Same as 1975	The following water quality parameters were added at each sampling site: pH, DO, conductivity and turbidity. IRT's began being used between April - December for collection of Atlantic tomcod biocharacteristics samples.	Texas Instruments, Inc. collected data; data reported in TI (1979), TI (1980a) and TI (1980b)

Table IRT-5
Utilities Hudson River Monitoring Program
Interregional Bottom Trawl Survey
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Biweekly, April - December (RM 27-62	Same as 1979	pH and turbidity measurements discontinued.	Texas Instruments, Inc. collecred data; data reported in Battelle (1983)

Table MR-1
Utilities Hudson River Monitoring Program
Mark/Recapture Studies
Year: 1973

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
April through mid-June and mid-August through December. No marking was conducted from mid-June through mid-August because higher water temperatures increased marking stress.	Marking gear Beach seine survey with 100 ft beach seines was primary gear. The following supplemental gear were used: - Boxtraps with one 50 ft lead and two 20 ft wings - 200 ft beach seines - 3 and 4 in. bar mesh gill nets Types of marks used: greater than 150mm - internal anchor tag 100-150mm - fingerling tag less than 100mm - finclips (for fall juvenile marks) Recapture gear all gear used in the monitoring program were used to obtain recapture data (e.g. beach seines, interregional trawls, etc.)	Movements of juvenile and older striped bass and white perch. Data used for mark/recapture population estimates	Texas Instruments, Inc. collected data; data reported in TI (1975)

Table MR-2
Utilities Hudson River Monitoring Program
Mark/Recapture Studies*
Year: 1974

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Same as 1973	Fingerling tag applied to striped bass 100-250mm instead of only through 150mm (as in 1973)	Same as 1973	Texas Instruments, Inc. collected data; data reported in TI (1975)

* Note: in 1974-1975 (winter) mark/recapture studies began for adult Atlantic tomcod (See Tables AT-1 - AT-7)

Table MR-3
Utilities Hudson River Monitoring Program
Mark/Recapture Studies
Year: 1975

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
April - December (no fish marked in July and August to avoid poor marking survival)	500 ft seines were used to obtain markable striped bass and white perch.	Same as 1973	Texas Instruments, Inc. collected data; data reported in TI (1978)

Table MR-4
Utilities Hudson River Monitoring Program
Mark/Recapture Studies*
Year: 1976 - 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
For 1976-1979, marking periods were generally similar with no marking occuring in July - August.	Marking for striped bass and white perch juveniles using fall shoals epibenthic sled samples (1976-1979). 14-day survival tests were initiated for all species marked and the type of mark (e.g. finclips, fingerling tags, etc.).	Same as 1973	Texas Instruments, Inc. collected data; data reported in TI (1979), TI (1980a) and TI (1980b)

* Note: In 1976 mark/recapture studies for adult striped bass began (see tables SA-1 through SA-5)

Table MR-5
Utilities Hudson River Monitoring Program
Mark/Recapture Studies
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Same as 1973-1979	All marking for striped bass and white perch juveniles in the fall using finclips discontinued; only yearling striped bass were still marked in all marking gear	Same as 1973	Texas Instruments, Inc. collected data; data reported in Battelle (1983)

Table AT-1
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Year: 1974-1975 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
January - February (RM 36-96) Boxtraps sampled daily Monday through Friday	Utilities began a mark/-recapture program to determine the size of the Atlantic tomcod population using boxtraps withough wings or leads boxtrap dimension = 3x3x6 ft mesh size = 0.375 in. traps set paralled to shore (off of bulkheads, piers, etc.) in 6-10 ft. limited number of fish marked with Carlin tags Impingement collections at Indian Point between January and March were the primary source of recaptured Atlantic tomcod (winter of 1974-1975 through winter of 1981-1982).	Enumeration using 8 length categories. The following biocharacteristics data collected: length, weight, sex, age, and fecundity. (including mean egg diameter/female) Water chemistry data collected with each sample: Temperature, conductivity.	Texas Instruments, Inc. collected data; data reported in TI (1975)

Table AT-2
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Year: 1975-1976 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Mid-November through mid-March RM 27-80 19 boxtrap sampling sites	Majority of fish marked with Carlin tags. For large catches, a certain number of fish were fin-clipped using clip combination specific to date and river regions.	Same as 1974-1975	Texas Instruments, Inc. collected the data; data reported in TI (1978)

Table AT-3
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Year: 1976-1977 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
December-March RM 24-78 14 boxtrap sites	Same as 1975-1976	Same as 1974-1975	Texas Instruments, Inc. collected data; data reported in TI (1979)

Table AT-4
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Years: 1977-1978 (winter)
through 1980-1981 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
December through mid-March 20-21 boxtrap sites RM 18-84	14-day survival studies conducted for tagged and fin-clipped Atlantic tomcod between the winters of 1977-78 and 1979-80. Tests were discontinued in 1980-1981 because of consistently high survival. No tagged fish were recaptured in 1980-1981.	Mean egg diameter per female recorded beginning in 1977-1978.	Texas Instruments, Inc. collected data; data reported in TI (1980a) TI (1980b) TI (1981) and EA (1983)

Table AT-5
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Year: 1981-1982 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Mid-December through early February (daily collections, Monday-Friday for 8 weeks) 13 boxtrap sites RM 18-77	Use of Carlin tags discontinued. All fish collected in boxtraps north of RM 46 were finclipped, with single or double finclip combinations specific to one week intervals (mid-December through early February)	Same as 1980-1981	Ecological Analysts, Inc. collected data; data reported in EA (1983)

Table AT-6
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Year: 1982-1983 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
December through mid-March RM 3-76 19 boxtrap sites (sampled daily, Monday through Friday, for 13 weeks)	Bottom trawling to collect marked fish conducted between January through mid-March in the lower Hudson (RM 0-40). Approximately 20-25 samples/week collected. Most trawl samples taken between RM 0-11. bottom trawl dimensions: head rope = 22.5 ft. foot/rope = 19.5 ft. total length = 17.0 ft. body mesh = 3.0 in. (strecth) cod end mesh = 1.5 in. (strecth) trawl gear equipped with metal doors, floats and rollers/disks (on foot rope) to reduce hangdowns.	Same as 1981-1982	Normandeau Associates, Inc. collected the data; data reported in NAI (1974)

Table AT-7
Utilities Hudson River Monitoring Program
Atlantic Tomcod Stock Assessment
Year: 1983-1984 (winter)

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
December through mid-March 17 boxtrap sites (RM 18-76) sampled daily Monday through Friday, for 12 weeks.	Boxtrap at RM 3 discontinued because it caught no fish. Bottom trawling conducted between RM 0-11 from January 2 through March 27. Approximately 20-25 samples per week collected. All fish collected in boxtraps above Croton-Harverstraw (RM 38) were finclipped. Separate marks applied to fish collected in 4 regions (Croton-Harverstraw, Indian Point, West Point, Cornwall-Poughkeepsie) for 4 marking periods (28 November - 18 December, 19 Deccember - 8 January, 9 January - 29 January, 30 January - 6 March).	Included biocharacteristics (length, weight, age, sexual maturity) from one trawl sample per week. Individual egg measurements recorded (random subsamples of 25 eggs/-gonad).	Normandeau Associates, Inc. collected data and is preparing report (as of 5/84)

Table SA-1
Utilities Hudson River Monitoring Program
Adult Striped Bass Stock Assessment
Year: 1976

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
March - June	A comprehensive adult striped bass stock assessment program was begun to estimate population size and record movement patterns. Two clusters of anchored 300 ft. gill nets (4, 4.5, 5 and 6 in. stretch) were positioned to maximize catch of migrating population between RM 27 and RM 60. Catches of four commercial fishermen who used stake and anchored gill nets of varying mesh sizes between RM 27 and RM 67 were obtained by TI field crews to obtain data on the commercial fishery which was closed in 1976.	Length, weight, sex, age, fecundity and stomach content analyses. Water quality (temp, DO, pH, turbidity) taken with each gill net collection.	Texas Instruments, Inc. collected data; data reported in TI (1979)

Table SA-2
Utilities Hudson River Monitoring Program
Adult Striped Bass Stock Assessment
Year: 1977 - 1978

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
March - June	Haul seine sampling at night conducted at selected beaches. Haul seine dimensions: length = 900 ft. wings = 240 ft. (short) 560 ft. (long) (with 3 and 4 in. stretch mesh) bag = 100 ft. mesh = 1 2/3 in. stretch Gill net sizes modified, the 4.5 in. nets were replaced by 7 in. nets (the four sizes used were 4, 5, 6, and 7 in.). In 1978, the simulated commercial fishery included 3 fishermen between RM 12 and RM 38.	Fecundity analysis (number eggs/female) also included egg diameter measurements.	Texas Instruments, Inc. collected data; data reported in TI (1908a)

Table SA-3
Utilities Hudson River Monitoring Program
Adult Striped Bass Stock Assessment
Year: 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
March - June	A large bottom trawl was used from mid-May through June. Bottom trawl dimensions: head rope = 50 ft. bottom rope = 70 ft. total length = 44 ft. body/wing mesh = 4 in. stretch cod end mesh = 1 3/4 in. stretch Four commercial fishermen between RM 12 and RM 52 used for simulated commercial fishery.	Same as 1978	Texas Instruments, Inc. collected data; data reported in TI (1981)

Table SA-4
Utilities Hudson River Monitoring Program
Adult Striped Bass Stock Assessment
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor Reference
March - June	Otter trawl modified to include roller and discs on foot rope to reduce net hangdowns. Cod end mesh increased to 3.5 in. stretch mesh. Otter trawl sampling conducted from March through June. Simulated commercial fishery discontinued.	Same as 1979	Texas Instruments, Inc. collected data; data reported in Battelle (1983)

Table SA-5
Utilities Hudson River Monitoring Program
Adult Striped Bass Stock Assessment
Year: 1981

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
April (3 weeks)	4, 5, 6 and 7 in. gill nets in two clusters. No large trawl sampling. Sampling ceased in late April after Indian Point Environmental Technical Specification (ETSR) deleted all biological monitoring.	A total of 319 fish released. No biocharacteristics data collected. Approximately 10% tag return	Lawler, Matusky and Skelly Engineers collected data; data never summarized or included in Con Edison data base

Table TT-1
Utilities Hudson River Monitoring Program
Try Trawl Survey
Year: 1978

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Weekly, September through December For first three weeks of month, 50 samples/week collected between RM 12-46 and in last week of month 50 samples collected between RM 47-152.	In 1978, try trawl used mainly as a recapture gear. Samples allocated to each region according to its surface area. Sampling sites within a region were chosen by crew leader, the tows (10-15 min at 1.5m/sec) were made in areas 10-30 ft. deep. This gear was designed to catch juvenile and older fish in the offshore zone which could not be effectively sampled by the interregional trawl or epibenthic sled. Try trawl dimension: head rope = 12 ft. foot rope = 12 ft. total length = 20 ft. body mesh = 1.3 in stretch cod end mesh = 0.25 in stretch	Juvenile and older fish water temperature (the only water quality parameter measured).	Texas Instruments, Inc. collected data; data reported in TI (1980b)

Table TT-2
Utilities Hudson River Monitoring Program
Try Trawl Survey
Year: 1979 - 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
April through mid-December 100 samples collected over a two week period between RM 12 and RM 152 (2 surveys per month) A riverwide try trawl survey was begun in 1979 because 1978 results demonstrated that the gear provided valuable abundance and distribution information.	Allocation of number of samples per region based on shoal volumes of each region. A minimum of 5 samples were assigned to each region. The following numbers of samples were collected in each region:	Try trawl used to obtain samples for white perch sex, age and fecundity analyses.	Texas Instruments, Inc. collected data; data reported in TI (1981) and Battelle (1983)

Region	Number of Samples
Albany	11
Catskill	8
Saugerties	5
Kingston	5
Hyde Park	5
Poughkeepsie	5
Cornwall	5
West Point	5
Indian Point	5
Croton-Harverstraw	12
Tappan Zee	28
Yonkers	6
Total	100

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1971

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/week from end of April through mid-July; 1 day/month from end of July through December, 7 samples collected per "day" from noon to midnight; 5 minute collection per sample	0.5m, 571μm mesh, hoop net; all nets equipped with TSK flowmeters; samples collected at D1, D2; sampled at 3 depths (surface, mid-depth, bottom) except for D2(?)	all ichthyoplankton densities; most abundant reported	Report: Hudson River Ecosystem Studies Effects of Entrainment by the Indian Point Power Plant on Biota of the Hudson River Estuary - Progress Report 1971-1972, in September 1973 by NYU; samples collected by NYU; lab analysis by NYU; report and data analyses by NYU; data converted to SAS by Con Edison (S&IP)
STANDARD STATIONS PROGRAM; 1 day/month in March and April, 1 day/week May through July, 2 days/month in August, 1 day/month in September through December; 2 samples/day, one in the daytime, one during the night; 10 minute collection per sample	0.5m, 571μm mesh, hoop net; all nets equipped with small vane GO flowmeters; samples collected at 7 standard stations in the Indian Point vicinity; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton densities; most abundant species reported	"

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1972

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/week from January through December; 2 samples collected per "day", one during the day and one at night; daytime sampling was discontinued after August 24; 5 minute collection per sample	0.5m, 571μm mesh, hoop net; samples collected at I1, D2, D2; sampled at 3 depths (surface, mid-depth, bottom) except for D2(?); all nets equipped w/TSK flowmeters; sampling rigs (bar racks) were installed in May-June at the various sampling locations	all ichthyoplankton densities; primarily striped bass reported	Report: Hudson River Ecosystem Studies Effects of Entrainment by the Indian Point Power Plant on Biota of the Hudson River Estuary, Progress Report for 1971-1972 (Sept-1973) by NYU; samples collected by NYU; lab analysis by NYU; report and data analysis by NYU; data converted to SAS by Con Edison (S&IP)
STANDARD STATIONS PROGRAM; 1 day/month in March and April, 1 day/week in May through July, 2 days/month in August, 1 day/month in September through December; 2 samples/day, one in the day and 1 during the night; 10 minute collection per sample	0.5m, 571μm mesh, hoop net; all nets equipped with small vane GO flowmeters; samples collected at 7 standard stations in the Indian Point vicinity; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton densities; most abundant species reported	"

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1973

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/week from May 8 through July 24, 1 day/2 weeks from end of July through December; 12 samples collected per 24 hour day; 50 minute collection per sample	0.5m, 571μm mesh, hoop net; all nets equipped with TSK flowmeters; samples collected at D1, D2 and limited sampling at DP (the discharge port); sampled at 3 depths (surface, mid-depth, bottom) except for D2(?) and DP	all ichthyoplankton densities; only striped bass reported; striped bass length frequency data presented	Report: Hudson River Ecosystem Studies Effects of Entrainment by the Indian Point Power Plant on Biota of the Hudson River Estuary-Progress Report for 1973 (September 1974) by NYU; samples collected by NYU; lab analysis by NYU; report and data analysis by NYU; data converted to SAS by Con Edison (S&IP)
STANDARD STATIONS PROGRAM: sampling the same as above except sampling commenced on May 29; sampling was concurrent with in-plant sampling	0.5m, 571μm mesh, hoop net; all nets equipped with small vane GO flowmeters; 3 depths (surface, mid-depth, bottom) sampled; samples collected at 4 stations (transects) in the immediate vicinity of the IP intakes	all ichthyoplankton densities; most abundant species reported; striped bass length frequency data presented	Data also reported in Hudson River Ecosystem Studies Effects of Entrainment by the Indian Point Power Plant on the Biota of the Hudson River - Addenda to: The 1973 Report by NYU in August 1976

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1974

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/week from end of April through mid-July, 1 day/week from end of July through December; 7 samples collected per "day" from noon to midnight; 5 minute collection per sample	0.5m, 571µm mesh, hoop net; all nets equipped with velocity reduction cones with no flowmeters; samples collected at I1, I2, and DP (the discharge port); sampled at 3 depths (surface, mid-depth, bottom) except for D2(?) and DP	all ichthyoplankton densities; only striped bass reported	Report: Hudson River Ecosystem Studies Effects of Entrainment by the Indian Point Power Plant on Biota of the Hudson River Estuary Progress Report for 1974 (February 1976) by NYU; samples collected by NYU; report and data analysis by NYU;data converted to SAS by Con Edison (S&IP)
STANDARD STATIONS PROGRAM; 1 day/month in March and April, 1 day/week May through July, 2 days/month in August, 1 day/month in September through December; 2 samples/day, 1 in daytime, 1 during the night; 10 minute collection per sample	0.5m, 571µm mesh, hoop net; all nets equipped with small vane GO flowmeters; samples collected at 7 standard stations in the vicinity of Indian Point; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton densities; most abundant species reported	"

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1975

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/week from end of April through mid-July, 1 day/month from end July through December; 7 samples collected per "day" from noon to midnight; 5 minute collection per sample	0.5m, 571μm mesh, hoop net; all nets equipped with velocity reduction cones, no flowmeters; samples collected at I2, I3, D1, D2 and DP (the discharge port); sampled at 3 depths (surface, mid-depth, bottom) except for D2(?) and DP	all ichthyoplankton densities, only striped bass reported	Report: Hudson River Ecosystem Studies Effects Entrainment by the Indian Point Power Plant on Biota of the Hudson River Estuary-Progress Report for 1975 (April 1977) by NYU; sampling by NYU; laboratory analysis by NYU; report and data analyses by NYU; data converted to SAS by Con Edison (S&IP)
STANDARD STATION PROGRAM; 1 day/month in March and April, 1 day/week May through July, 2 days/month in August, 1 day/month in September through December; 2 samples/day, 1 in daytime and 1 during the night; 10 minute collection per sample	0.5m, 571μm mesh, hoop net; all nets equipped with small vane GO flowmeters; samples collected at 7 standard stations; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton densities, most abundant species reported	"

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1976

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/month in April, 1 day/week in May through July, 1 day/month August through December, 10 minute samples (?); 7 samples per "day" from noon to midnight	0.5m, 571µm mesh, hoop net with large vane GO flowmeters for intake samples, small vane GO flowmeter for discharge samples; I2 sampled with rigid frame in intake; I3 sampled by nets suspended from lines from a boat moored near Unit 3 intake; D2 was only discharge station sampled(?); 3 depths (surface, mid-depth, bottom) sampled except D2 where only surface sampled(?)	all ichthyoplankton in laboratory (?); only striped bass reported	NYU collected samples, performed laboratory analyses and presented the results in report entitled: Hudson River Ecosystem Studies Effects of Entrainment by the Indian Point on Biota in the Hudson River Estuary-Progress Report for 1976 (July 1978)
STANDARD STATIONS PROGRAM; same as above except 10 minutes sampled; 2 sample/day; 1 at night and 1 during the day	0.5m, 571µm mesh, hoop net small vane GO flowmeter; 3 depths (surface, mid-depth, bottom) sampled; 7 standard stations in the IP vicinity	all ichthyoplankton density; only most abundant taxa reported	"

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1977

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/week in May through July, 1 day/week in August through December; 7 samples collected per "day" which ran from noon to midnight; 5 minute collection per sample	0.5m, 571µm mesh, hoop net; TSK flowmeter at intake stations; GO flowmeter at discharge stations; 3 depths (surface, mid-depth, bottom) sampled; I2, I3, D1, D2 sampled depending upon station operation	all ichthyoplankton density in lab analyses and data tape; only striped bass length and density presented in the report	NYU collected samples; LMS performed lab analyses and prepared data tape; EA wrote report; Report: Indian Point Generating Station Entrainment and Nearfield Studies- 1977 Annual Report (December 1980)
STANDARD STATIONS PROGRAM; river schedule the same as net program above except (a) 10 minute samples (b) one additional sampling day in late April (c) two samples/day, 1 at night and 1 during the day	0.5m, 571µm mesh, hoop net; GO flowmeters; 3 depths (surface, mid-depth, bottom) sampled; 7 standard stations sampled in the vicinity of the IP station	all ichthyoplankton density in lab analyses and data tape; striped bass, white perch, Alosa, and bay anchovy presented in the report	"
TRANSECT PROGRAM; same as net program above except sampling occurred in May through July only and samples were of 10 minute duration	0.5m, 571µm mesh, hoop net; GO flowmeters; 3 depths sampled (surface, mid-depth, bottom); 3 stations sampled in the immediate vicinity of the intakes	all ichthyoplankton density in lab analyses and data tape; only striped bass length and density presented in the report	"
PUMP-NET COMPARISONS; sampled on 31 May, 17 June, and 1 July; 15 minute sample; 7 samples per day from noon to midnight	0.5m, 571µm mesh, hoop net; w/GO and TSK flowmeters; 3 and 4 inch pumps; sampled at mid-depth at D1	all ichthyoplankton densities	Ecological Analysts collected the samples, and performed lab analyses; Report by EA: Indian Point Generating Station Entrainment Survival Studies, 1977 Annual Report (August 1978)

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1978

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
NET PROGRAM; 1 day/month in March and April, 1 day/week in May through July, 1 day/month in August through December; 7 samples collected from noon to midnight, 5 minutes collection per sample	0.5m, 571µm mesh, hoop net; TSK flowmeters; at I2, I3, and D1 (after June 1); 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton density in lab analyses and in data tape only striped bass density and length in the report	Ecological Analysts sampling and data analyses; LMS performed laboratory analyses; Report: Indian Point Generating Station Entrainment and Nearfield Studies-1978 Annual Report (May 1980)
STANDARD STATIONS PROGRAM; schedule same as net program above except 10 minute samples; 2 samples/day; 1 night and 1 day	0.5m, 571µm mesh, hoop net, GO flowmeter; 7 standard station in the IP vicinity; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton density in lab analysis; most ichthyoplankton density reported, only striped bass length reported	"
TRANSECT PROGRAM; same as net program above except 10 minute samples concurrent with in-plant net samples; May through July	0.5m, 571µm mesh, hoop net, GO flowmeter; 3 stations in the immediate IP vicinity; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton density in lab analyses; only striped bass density and length data reported	"
PUMP-NET COMPARISONS; 1 night/week; June through mid-July; 10 to 18 samples per night; 15 minutes collection per sample	concurrent sampling with 6-inch pump and 0.5m, 571µm mesh, hoop net; sampled at mid-depth at D1; volume for net estimated with Cushing electromagnetic current meter; volume for pump estimated with a sparling flowmeter	all ichthyoplankton densities and lengths	Ecological Analysts collected the samples, performed the lab analyses, and wrote the report; Report: Indian Point Generating Station Entrainment Survival and Related Studies-1978 Annual Report (September 1979)

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
AUTOSAM PROGRAM; 2 hour samples; 148 out of 120 minutes; 7 samples collected each day from noon to midnight, 1 day/week from 2 May through 14 June	3 inch pump into 500μm mesh net, at D1, at mid-depth; Note: this was the first time a pump sampling device was used as the principle sampling device at IP	striped bass length and density.	Ecological Analysts - sampling and data analyses; LMS - lab analyses; Report: Indian Point Generating Station Entrainment and Nearfield Studies-1979 Annual Report (May 1981) by EA
NET PROGRAM; 7 samples collected from noon to midnight; 5 minute collection per sample; 1 day/month in March and April, 1 day/week in May through July, 1 day/month in August through December	0.5m, 571μm mesh, hoop net; TSK flowmeter; at I2, I3 and D1; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton(?); just striped bass length and density reported	"
STANDARD STATIONS PROGRAM; same as net program above except 10 minute samples; 1 sample during day and 1 sample during night	0.5m, 571μm mesh, hoop net; GO flowmeters; 7 standard stations in the IP vicinity; 3 depths (surface, mid-depth, bottom) sampled	all ichthyoplankton density; just striped bass length	"
TRANSECT PROGRAM; concurrent with net program above in May through July; 10 minute collection per sample	0.5m, 571μm mesh, hoop net; GO flowmeters; 3 stations in the immediate vicinity of the IP intakes; 3 depths sampled (surface, mid-depth, bottom); 3 boats used	striped bass length and density	"

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
AUTOSAM PROGRAM; three hour samples, 90 out of 180 minutes; 24 hour/day, 1 day/week in March, April, May; 2 days/week in early June; 3 days/week in remainder of June and throughout July	sampled at D2 with 3 inch pump at 1.0m^3/min; mid-depth; 500µm mesh collection device; Note: net abundance sampling was discontinued this year	density and length data on all eggs, ysl, pysl, and juvenile ichthyoplankton	Sampling and lab analysis by EA, Report: 1980 Indian Point Annual by Con Edison in April 1982

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1981

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
AUTOSAM PROGRAM, 3 hour samples, 90 out of 180 minutes; 24 hours/day, 2 days/week; 6 May through 30 August	sampled with 3 inch pump at D2 at .8m^3/min; sampled at mid-depth; 500µm mesh collection device, Note: change in primary sampling location from D2 to D2	density and length of eggs, ysl, pysl and juveniles of all ichthyoplankton	sampling and lab analysis by EA; Report: 1981 Indian Point Annual by Con Edison in August 1982
GEAR COMPARISON: one hour samples; 36 out of 60 minutes; 6 samples/night, 2 - 4 nights/week; 1 July through 21 August	comparison of 3 gears at D1: 0.5m 500µm mesh hoop net; 1.0m^2 1600µm mesh net; 15cm high volume pump; sampled at 3 depths (surface, mid-depth, bottom); primary purpose was to determine most appropriate gear for sampling juvenile fish	density and length data on all ichthyoplankton $\geq$ 12mm	sampling and lab analysis by Normandeau Associates, Report: Gear Comparability Study for Entrainment Sampling of Juvenile Fish at the Indian Point Station, 1981 by Normandeau and Con Edison in June 1982

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1982

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference

No studies were conducted

Utilities Sponsored Hudson River Studies
Survey: Indian Point Entrainment Abundance - Ichthyoplankton
Year: 1983

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
AUTOSAM PROGRAM; 3 hour samples, 24 hours/day, 7 days/week; 3 May through 14 August	sample at D2 with 3 inch pump samples collected at mid-depth; pumping rate of $1m^3$/min	densities and length data for all ichthyoplankton	Ecological Analysts; performed field sampling, laboratory analysis, and data analysis; draft report March 1984
JUVENILE NET SAMPLING; 3 hour samples, 144 minutes out of every 180 minutes; 24 hours/day, 3 randomly selected days per week, 15 June through 13 August	sample at D2 with 0.5m, 500μm mesh net; net was moved from bottom to surface to simulate an oblique tow	density and length data for all ichthyoplankton $\geq$12mm in length (primarily juveniles)	"
SPECIAL STUDY; to obtain estimate of sampling variance, 3 hour samples, 24 hours/week, 17 June through 9 July	simultaneous sampling at D2 with 3 pumps (one pump being the pump mentioned above in AUTOSAM program); pumping rate of $1m^3$/min; samples collected at mid-depth	densities and length data for all ichthyoplankton	"

Table IP-1
Utilities Hudson River Monitoring Program
Indian Point Impingement Studies
Year: 1979

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Intake screens at Units 2 and 3 washed daily between 0630-1200. Unit 1 not operational; however, when screens were washed samples were collected and processed as for Units 2 and 3.	Collection Efficiency: Dyed and taged dead fish released immediately after screen wash at 3 depths in front of fixed screens 22 and 26 (Unit 2) and travelling screens 32 and 36 (Unit 3). Fish were again released at 1600 and 0600 on the following day. Recovery was made in all subsequent screen washes. Eight releases were made on: 15 January 19, 26 April 5, 10, 24 May 20 September 20 December	All fish separated by species and enumerated by length class; total weight of each species also recorded. Surface water sample taken after each sample at Unit 1 dock, Unit 2 intake screen No. 21, Unit 3 Intake screen No. 31 and in dishcarge canal. The following parameters were measured: water temperature, DO and conductivity	Texas Instruments, Inc. TI (1980d)

Table IP-2
Utilities Hudson River Monitoring Program
Indian Point Impingement Studies
Year: 1980

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
daily sampling at Unit 2 and 3 between 0630 and 1200 hrs.	Collection Efficiency: Efficiency tests increased in 1980. Three tests (on alternate days) at each unit each week. Sixty (60) tagged dead fish were apportioned over all operating circulators and released at mid-depth in front of fixed screens (Unit 2) or travelling screens (Unit 3) Recovery of fish occurred in all screen washes	Same as 1979	Texas Instruments, Inc. Con Edison (1982)

Table IP-3
Utilities Hudson River Monitoring Program
Indian Point Impingement Studies
Year: 1981

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
daily sampling at Units 2 and 3 between January 1 and June 30, 1981. From July 1 through December 31, 1981, samples collected on randomly selected days at Units 2 and 3. Contractor personnel removed fish and debris on all days not selected as samples.	Stratified random sampling design developed in 1981. Samples allocated to the following seasonal periods (Strata) No. of Days Unit 2 Unit 3 1/1 - 3/31 30 27 4/1 - 6/30 10 18 7/1 - 9/30 11 31 10/1 - 12/31 59 34 No collection efficiency tests in 1981.	Water quality data collected only on selected sampling days.	Normandeau Associates, Inc. (Jan - Mar) LMS (Apr - Dec) Con Edison (1984)

Table IP-4
Utilities Hudson River Monitoring Program
Indian Point Impingement Studies
Year: 1982

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Samples collected and analyzed on randomly selected days (see Table IP-3 for sample allocation) No collections made at Unit 2 in November and December. Collections made at Unit 3 from January - March and late October - early November. During the remainder of year no water circulated at Unit 3.	Same allocation of samples per seasonal strata used in 1982 as 1981. Allocations are the same for 1981-1984 (sampling designs to be evaluated in 1984, allocations may change as a result) Collection Efficiency: Collection efficiency tests at Unit 2 only (April 19 - May 14). Tests conducted on Monday, Wednesday and Friday and 60 dead (tagged) fish apportioned over all operating circulators used and released at mid-depth in front of fixed screens. Tests were conducted in order to obtain additional efficiency data when intake temperatures were between 5 and 15 degrees C.	discharge water quality samples discontinued	Ecological Analysts, Inc. Con Edison (1983)

Table IP-5
Utilities Hudson River Monitoring Program
Indian Point Impingement Studies
Year: 1983

Sampling Frequency	Sampling Design/Changes	Types of Data Collected	Contractor & Reference
Samples collected and analyzed on randomly selected days (see Table IP-3 for sample allocation). On all other days, contractor collected fish and debris. No collections at Unit 2 (October 4 - October 24) - outage. No collections made at Unit 3 except for occasional collections between June 5 and July 9.	No collection efficiency tests. Blue crab impingement recorded on all selected and "non sample" days. (Requested by NYSDEC)	Individual blue crab carapace width, weight and sex recorded. All live specimens released, live/dead information recorded.	EAI (Jan-March) NAI (Apr-Dec) Report being prepared by NAI (due June 1984).

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