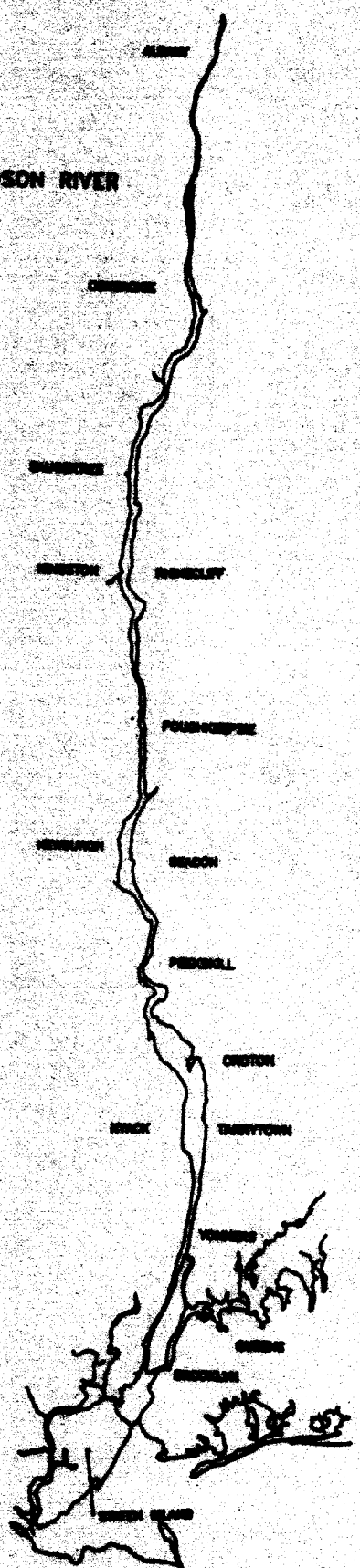


HUDSON RIVER



1997 YEAR CLASS REPORT

for the
**Hudson River Estuary
Monitoring Program**

Prepared for and Jointly Funded by

**Central Hudson Gas and Electric Corporation
Consolidated Edison Company of New York, Inc.
New York Power Authority
Niagara Mohawk Power Corporation
Southern Energy New York**

Prepared by

ASA

**1997 Year Class Report
for the Hudson River Estuary
Monitoring Program**

Prepared by

**Applied Science Associates
New Hampton, New York**

Prepared for

**Central Hudson Gas & Electric Corporation
Newburgh, New York**

Jointly Funded by

**Central Hudson Gas and Electric Corporation
Consolidated Edison Company of New York, Inc.
New York Power Authority
Niagara Mohawk Power Corporation
Southern Energy New York**

January 2001

CONTENTS

	<u>Page</u>
LIST OF FIGURES.....	iii
LIST OF TABLES.....	xi
1. INTRODUCTION.....	1-1
2. MATERIALS AND METHODS.....	2-1
2.1 Sampling Design.....	2-1
2.2 Longitudinal River Ichthyoplankton Survey.....	2-4
2.2.1 Field Methods.....	2-4
2.2.2 Laboratory Methods.....	2-8
2.3 Fall Shoals Survey.....	2-19
2.3.1 Field Methods.....	2-19
2.3.2 Laboratory Methods.....	2-23
2.4 Beach Seine Survey.....	2-24
2.4.1 Field Methods.....	2-24
2.4.2 Laboratory Methods.....	2-24
2.5 Analytical Methods.....	2-27
2.5.1 Physical/Chemical Parameters.....	2-27
2.5.2 Spatiotemporal Distribution Indices.....	2-28
3. PHYSICAL/CHEMICAL PARAMETERS.....	3-1
3.1 Green Island Dam Flows.....	3-1
3.2 Poughkeepsie Waterworks Temperatures.....	3-1
3.3 Hudson River Surveys.....	3-1
3.3.1 Spatiotemporal Pattern in Temperature.....	3-1
3.3.2 Spatiotemporal Pattern in Salinity.....	3-5
3.3.3 Spatiotemporal Pattern in Dissolved Oxygen.....	3-5

CONTENTS (Continued)

	<u>Page</u>
4. SPATIOTEMPORAL DISTRIBUTION OF SELECTED SPECIES OF HUDSON RIVER ESTUARY FISHES	4-1
4.1 Fish Community	4-1
4.1.1 General Description of the Fish Community	4-1
4.1.2 Species Occurrence Through Time	4-2
4.1.3 Species Collected in 1997	4-8
4.2 Striped Bass	4-12
4.3 White Perch	4-23
4.4 Atlantic Tomcod	4-29
4.5 Bay Anchovy	4-34
4.6 American Shad	4-49
4.7 River Herrings	4-54
4.8 Alewife	4-61
4.9 Blueback Herring	4-68
4.10 Gizzard Shad	4-77
4.11 Rainbow Smelt	4-77
4.12 Hogchoker	4-85
4.13 Spottail Shiner	4-85
4.14 Atlantic Sturgeon	4-91
4.15 Shortnose Sturgeon	4-97
4.16 White Catfish	4-101
4.17 Weakfish	4-106
4.18 Bluefish	4-110
REFERENCES	R-1
APPENDIX A: QUALITY CONTROL REPORT FOR THE 1997 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM AND 1997 FALL JUVENILE SURVEY	
APPENDIX B: PHYSICAL/CHEMICAL PARAMETERS	
APPENDIX C: NUMBERS OF FISH COLLECTED IN THE LONG RIVER (1988-1997), FALL SHOALS (1985-1997), AND BEACH SEINE (1985-1997) SURVEYS	
APPENDIX D: DENSITY AND STANDING CROP ESTIMATES	
APPENDIX E: LENGTH FREQUENCY DISTRIBUTION	
APPENDIX F: SUMMARY OF ATLANTIC TOMCOD FOOD HABITS STUDY	

LIST OF FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
2-1	Location of 13 geographic regions (with river mile boundaries) sampled during the 1997 biological monitoring program in the Hudson River estuary.	2-2
2-2	Cross sections of the Hudson River estuary showing locations and typical proportional relationships of the shoal, bottom, and channel strata.	2-3
2-3	Completed sampling schedule for 1997.	2-7
2-4	Design and dimensions of 1.0-m ² Tucker trawl.	2-10
2-5	Design and dimensions of 1.0-m ² Tucker trawl mounted on an epibenthic sled.	2-11
2-6	Conceptual diagram of the splitting process.	2-16
2-7	Inspection plan for evaluation of splitting precision.	2-17
2-8	Design and dimensions of the 3.0-m beam trawl.	2-21
3-1	Hudson River daily average flow rate in 1997 and monthly average flow rates from 1947 to 1997, Green Island, New York.	3-2
3-2	Seasonal variations in water temperature from 1951 to 1997 as measured at Poughkeepsie Waterworks.	3-3
3-3	Seasonal variations in water temperature from the Hudson River surveys, 1974-1997.	3-4
3-4	Seasonal variations in salinity from the 1997 Long River/Fall Shoals surveys, average weekly values.	3-6
3-5	Seasonal variations in dissolved oxygen from the Hudson River surveys, 1974-1997.	3-8
4-1	Spatiotemporal distribution of eggs and yolk sac larval striped bass in the Hudson River estuary based on the 1997 Long River Survey.	4-14
4-2	Spatiotemporal distribution of post yolk sac larval and young-of-year striped bass in the Hudson River estuary based on the 1997 Long River Survey.	4-15
4-3	Spatiotemporal distribution of young-of-year striped bass in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-16

LIST OF FIGURES (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
4-4	Spatiotemporal distribution of yearling striped bass in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-17
4-5	Spatiotemporal distribution of older-than-yearling striped bass in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-18
4-6	Temporal distribution indices for striped bass collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-19
4-7	Geographical distribution indices for striped bass collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-20
4-8	Geographical distribution indices for striped bass collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-21
4-9	Weekly length statistics for young-of-year striped bass in the Hudson River estuary, 1997.	4-22
4-10	Spatiotemporal distribution of eggs and yolk sac larval white perch in the Hudson River estuary based on the 1997 Long River Survey.	4-24
4-11	Spatiotemporal distribution of post yolk sac larval and young-of-year white perch in the Hudson River estuary based on the 1997 Long River Survey.	4-25
4-12	Spatiotemporal distribution of young-of-year white perch in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-26
4-13	Spatiotemporal distribution of yearling white perch in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-27
4-14	Spatiotemporal distribution of older-than-yearling white perch in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-28
4-15	Temporal distribution indices for white perch collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-30
4-16	Geographical distribution indices for white perch collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-31
4-17	Geographical distribution indices for white perch collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-32
4-18	Weekly length statistics for young-of-year white perch in the Hudson River estuary, 1997.	4-33

LIST OF FIGURES (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
4-19	Spatiotemporal distribution of yolk sac larval, post yolk sac larval, and young-of-year Atlantic tomcod in the Hudson River estuary based on the 1997 Long River Survey.	4-35
4-20	Spatiotemporal distribution of young-of-year Atlantic tomcod in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-36
4-21	Spatiotemporal distribution of yearling and older Atlantic tomcod in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-37
4-22	Temporal distribution indices for Atlantic tomcod collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-38
4-23	Geographical distribution indices for Atlantic tomcod collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-39
4-24	Geographical distribution indices for Atlantic tomcod collected during Fall Shoals surveys of the Hudson River estuary, 1979-1997.	4-40
4-25	Weekly length statistics for young-of-year Atlantic tomcod in the Hudson River estuary, 1997.	4-41
4-26	Spatiotemporal distribution of eggs and yolk sac larval bay anchovy in the Hudson River estuary based on the 1997 Long River Survey.	4-43
4-27	Spatiotemporal distribution of post yolk sac larval and young-of-year bay anchovy in the Hudson River estuary based on the 1997 Long River Survey.	4-44
4-28	Spatiotemporal distribution of young-of-year bay anchovy in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-45
4-29	Spatiotemporal distribution of yearling and older bay anchovy in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-46
4-30	Temporal distribution indices for bay anchovy collected during Long River surveys of the Hudson River estuary, 1988-1997.	4-47
4-31	Geographical distribution indices for bay anchovy collected during Long River surveys of the Hudson River estuary, 1988-1997.	4-48
4-32	Geographical distribution indices for bay anchovy collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-50

LIST OF FIGURES (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
4-33	Weekly length statistics for young-of-year bay anchovy in the Hudson River estuary, 1997.	4-51
4-34	Spatiotemporal distribution of eggs and yolk sac larval American shad in the Hudson River estuary based on the 1997 Long River Survey.	4-52
4-35	Spatiotemporal distribution of post yolk sac larval and young-of-year American shad in the Hudson River estuary based on the 1997 Long River Survey.	4-53
4-36	Spatiotemporal distribution of young-of-year American shad in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-55
4-37	Spatiotemporal distribution of yearling and older American shad in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-56
4-38	Temporal distribution indices for American shad collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-57
4-39	Geographical distribution indices for American shad collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-58
4-40	Geographical distribution indices for American shad collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-59
4-41	Weekly length statistics for young-of-year American shad in the Hudson River estuary, 1997.	4-60
4-42	Spatiotemporal distribution of eggs and yolk sac larval <i>Alosa</i> spp. in the Hudson River estuary based on the 1997 Long River Survey.	4-62
4-43	Spatiotemporal distribution of post yolk sac larval and young-of-year <i>Alosa</i> spp. in the Hudson River estuary based on the 1997 Long River Survey.	4-63
4-44	Spatiotemporal distribution of young-of-year <i>Alosa</i> spp. in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-64
4-45	Temporal distribution indices for <i>Alosa</i> spp. collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-65
4-46	Geographical distribution indices for <i>Alosa</i> spp. collected during Long River surveys of the Hudson River estuary, 1974-1997.	4-66
4-47	Geographical distribution indices for <i>Alosa</i> spp. collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-67

LIST OF FIGURES (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
4-48	Spatiotemporal distribution of young-of-year alewife in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-69
4-49	Spatiotemporal distribution of yearling and older alewife in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-70
4-50	Geographical distribution indices for alewife collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-71
4-51	Weekly length statistics for young-of-year alewife in the Hudson River estuary, 1997.	4-72
4-52	Spatiotemporal distribution of young-of-year blueback herring in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-73
4-53	Spatiotemporal distribution of yearling and older blueback herring in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-74
4-54	Geographical distribution indices for blueback herring collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-75
4-55	Weekly length statistics for young-of-year blueback herring in the Hudson River estuary, 1997.	4-76
4-56	Spatiotemporal distribution of young-of-year gizzard shad in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-78
4-57	Spatiotemporal distribution of yearling and older gizzard shad in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-79
4-58	Geographical distribution indices for gizzard shad collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-80
4-59	Temporal distribution indices for rainbow smelt collected during Long River surveys of the Hudson River estuary, 1974-1996.	4-82
4-60	Geographical distribution indices for rainbow smelt collected during Long River surveys of the Hudson River estuary, 1974-1996.	4-83
4-61	Geographical distribution indices for rainbow smelt collected during Fall Shoals surveys of the Hudson River estuary, 1979-1996.	4-84

LIST OF FIGURES (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
4-62	Spatiotemporal distribution of eggs and yolk sac larval hogchoker in the Hudson River estuary based on the 1997 Long River Survey.	4-86
4-63	Spatiotemporal distribution of post yolk sac larval and young-of-year hogchoker in the Hudson River estuary based on the 1997 Long River Survey.	4-87
4-64	Spatiotemporal distribution of young-of-year hogchoker in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-88
4-65	Spatiotemporal distribution of yearling and older hogchoker in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-89
4-66	Geographical distribution indices for hogchoker collected during Fall Shoals surveys of the Hudson River estuary, 1979-1997.	4-90
4-67	Spatiotemporal distribution of young-of-year spottail shiner in the Hudson River estuary based on the 1997 Fall Shoals and Beach Seine surveys.	4-92
4-68	Spatiotemporal distribution of yearling and older spottail shiner in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-93
4-69	Geographical distribution indices for spottail shiner collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-94
4-70	Weekly length statistics for young-of-year spottail shiner in the Hudson River estuary, 1997.	4-95
4-71	Spatiotemporal distribution of yearling and older Atlantic sturgeon in the Hudson River estuary based on the 1997 Long River and Fall Shoals surveys.	4-99
4-72	Spatiotemporal distribution of yearling and older shortnose sturgeon in the Hudson River estuary based on the 1997 Long River and Fall Shoals surveys.	4-103
4-73	Spatiotemporal distribution of young-of-year white catfish in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-104
4-74	Spatiotemporal distribution of yearling and older white catfish in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-105
4-75	Geographical distribution indices for white catfish collected during Fall Shoals surveys of the Hudson River estuary, 1979-1997.	4-107
4-76	Weekly length statistics for young-of-year white catfish in the Hudson River estuary, 1997.	4-108

LIST OF FIGURES (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
4-77	Spatiotemporal distribution of young-of-year weakfish in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-109
4-78	Geographical distribution indices for weakfish collected during Fall Shoals surveys of the Hudson River estuary, 1979-1997.	4-111
4-79	Weekly length statistics for young-of-year weakfish in the Hudson River estuary, 1997.	4-112
4-80	Spatiotemporal distribution of young-of-year bluefish in the Hudson River estuary based on the 1997 Long River, Fall Shoals, and Beach Seine surveys.	4-114
4-81	Geographical distribution indices for bluefish collected during Beach Seine surveys of the Hudson River estuary, 1974-1997.	4-115

LIST OF TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1-1	Fish species treated in depth in the 1997 Year Class Report.	1-2
2-1	Strata sampled within the 13 geographic regions of the Hudson River estuary during 1997.	2-5
2-2	Summary of 1997 Hudson River surveys.	2-6
2-3	Summary of 1997 sample collection information by river region and stratum for the Longitudinal River Ichthyoplankton Survey.	2-9
2-4	Specifications of sampling gear used during the 1997 Longitudinal River Ichthyoplankton Survey.	2-12
2-5	Water quality sampling locations during the 1997 Longitudinal River Ichthyoplankton and Fall Shoals surveys.	2-13
2-6	Summary of 1997 sample analysis information by river region and stratum for the Longitudinal River Ichthyoplankton Survey.	2-15
2-7	Summary of 1997 sample collection by river region and stratum for the Fall Shoals Survey.	2-20
2-8	Specifications of sampling gear used during the 1997 Fall Shoals Survey.	2-22
2-9	Specifications of sampling gear used during the 1997 Beach Seine Survey.	2-25
2-10	Summary of 1997 sample collection by river region for the Beach Seine Survey.	2-26
2-11	Stratum and region volumes (m ³) and surface areas (m ²) used in analysis of 1997 Hudson River estuary data.	2-31
4-1	Species composition of fish collected during Hudson River studies from 1974 to 1997.	4-3
4-2	Species composition of fish collected in each of the Hudson River surveys during 1997.	4-9
4-3	Collections of Atlantic sturgeon during the 1997 Hudson River surveys.	4-98
4-4	Collections of shortnose sturgeon during the 1997 Hudson River surveys.	4-102

CHAPTER 1

INTRODUCTION

Since 1973, an annual Year Class Report has been prepared for five utilities (collectively referred to as the "Utilities"): Central Hudson Gas and Electric Corporation; Consolidated Edison Company of New York, Inc.; New York Power Authority; Niagara Mohawk Power Corporation; and Orange and Rockland Utilities, Inc (which has been replaced by Southern Energy New York). The main purpose of the reports has been to present and analyze data on the distribution and abundance of early life stages of selected fish species based on surveys conducted throughout the Hudson River estuary. The content and scope of these reports have varied over time from estimating the environmental impact of five Hudson River generating stations to focusing on indices of year class strength to describing the spatiotemporal distribution of selected fish species. Since the early 1990's, the annual Year Class Report has been standardized to describe the physical/chemical parameter patterns in the Hudson River estuary and the spatiotemporal distribution of 16 selected species of fish. These 16 species were identified by the New York State Department of Environmental Conservation (NYSDEC) of interest for discharge permitting purposes.

The present report adds to the historical database by describing the results of the Longitudinal River Ichthyoplankton Survey, the Fall Shoals Survey, and the Beach Seine Survey for 1997. The 1997 Year Class Report presents basic abundance and distribution data with the following objectives:

- Describe the patterns and variability of environmental parameters that may have affected fish distribution and abundance in the Hudson River estuary in 1997.
- Describe the distribution and abundance of 16 selected species of fish (Table 1-1) in the Hudson River estuary in 1997.
- Describe the fish community of the Hudson River estuary in 1997.
- Describe patterns in growth for the 1997 year class of key species.
- In an appendix section, summarize the results of the Atlantic tomcod food habit study.

This report is organized into four chapters with supporting appendixes. Data collection and analysis methods are described in Chapter 2. Physical and chemical parameters are described in Chapter 3, and spatiotemporal distribution of selected fish species and fish community analysis are presented in Chapter 4. Detailed data tables supporting report analyses are contained within the appendix section as follows: Appendix A - Quality Control Report for the 1997 Hudson River Ichthyoplankton Laboratory Program and 1997 Fall Juvenile Survey; Appendix B - Physical/Chemical Parameters; Appendix C - Numbers of Fish Collected in the Long River (1988-1997), Fall Shoals (1985-1997), and Beach Seine (1985-1997) Surveys; Appendix D - Density and Standing Crop Estimates; Appendix E - Length Frequency Distribution; and Appendix F - Atlantic tomcod Food Habit Study.

TABLE 1-1 FISH SPECIES TREATED IN DEPTH IN THE 1997 YEAR CLASS REPORT

<u>Common Name</u>	<u>Scientific Name^a</u>
Alewife	<i>Alosa pseudoharengus</i>
American shad	<i>Alosa sapidissima</i>
Atlantic sturgeon	<i>Acipenser oxyrinchus</i>
Atlantic tomcod	<i>Microgadus tomcod</i>
Bay anchovy	<i>Anchoa mitchilli</i>
Blueback herring	<i>Alosa aestivalis</i>
Bluefish	<i>Pomatomus saltatrix</i>
Gizzard shad	<i>Dorosoma cepedianum</i>
Hogchoker	<i>Trinectes maculatus</i>
Rainbow smelt	<i>Osmerus mordax</i>
Shortnose sturgeon	<i>Acipenser brevirostrum</i>
Spottail shiner	<i>Notropis hudsonius</i>
Striped bass	<i>Morone saxatilis</i>
Weakfish	<i>Cynoscion regalis</i>
White catfish	<i>Ameiurus catus</i>
White perch	<i>Morone americana</i>

a. Names recognized by American Fisheries Society (Robins et al. 1991).

CHAPTER 2

MATERIALS AND METHODS

2.1 SAMPLING DESIGN

Several fishery techniques were employed in three separate sampling surveys to obtain comprehensive information on the abundance and distribution of selected larval, juvenile or young-of-year (YOY), and adult fish species in the Hudson River estuary. Temporally, the monitoring program covered spring through fall, the period of greatest biological activity in north temperate waters. Survey-specific techniques were employed to adequately sample all habitats and permit the determination of spatial distribution patterns. The three surveys followed the same general design and employed gear similar to that of previous Hudson River monitoring programs.

The three sampling surveys that made up the overall monitoring program and their objectives were:

1. **Longitudinal River Ichthyoplankton Survey (LRS or Long River Survey)**—The entire length of the Hudson River estuary, from River Mile (RM) 1 at the Battery in Manhattan to RM 152 at the Federal Dam in Troy, was sampled to provide ichthyoplankton data that would allow calculations of standing crop, temporal, and geographic indices and growth rates for selected Hudson River fish species. The primary species were Atlantic tomcod (*Microgadus tomcod*), American shad (*Alosa sapidissima*), striped bass (*Morone saxatilis*), white perch (*M. americana*) and bay anchovy (*Anchoa mitchilli*). LRS sampling was concentrated during the spring, summer, and early fall when eggs and larvae of the primary species were usually abundant.
2. **Fall Shoals Survey (FSS or Fall Juvenile Survey)**—Samples were collected every other week from the Battery to the Troy Dam in mid-summer and fall. The objective was to provide data on YOY fish that would allow calculation of standing crop, temporal, and geographic indices for selected Hudson River fish species. The target species were Atlantic tomcod, American shad, striped bass, and white perch.
3. **Beach Seine Survey (BSS)**—Beach seine samples were collected in alternate weeks with the FSS at stations from the George Washington Bridge (RM 12) to the Troy Dam. The objective was to obtain distribution and relative abundance information on YOY American shad, Atlantic tomcod, striped bass, and white perch while they were concentrated primarily in the shallow, near-shore region. The survey was conducted from mid-June through October, when YOY of these species were utilizing the shorezone nursery.

Sampling for all surveys was conducted according to a stratified random design in which the Hudson River estuary from the Battery (RM 1) to the Federal Dam at Troy (RM 152) was divided into 13 regions (Figure 2-1). Each region was further divided into "strata" on the basis of river depth. The strata based on river depth are graphically presented in Figure 2-2 and defined below.

- **Shore**—That portion of the Hudson River estuary extending from the shore to a depth of 10 ft (the stratum defined only for BSS).
- **Shoal**—That portion of the Hudson River estuary extending from the shore to a depth of 20 ft at mean low tide.

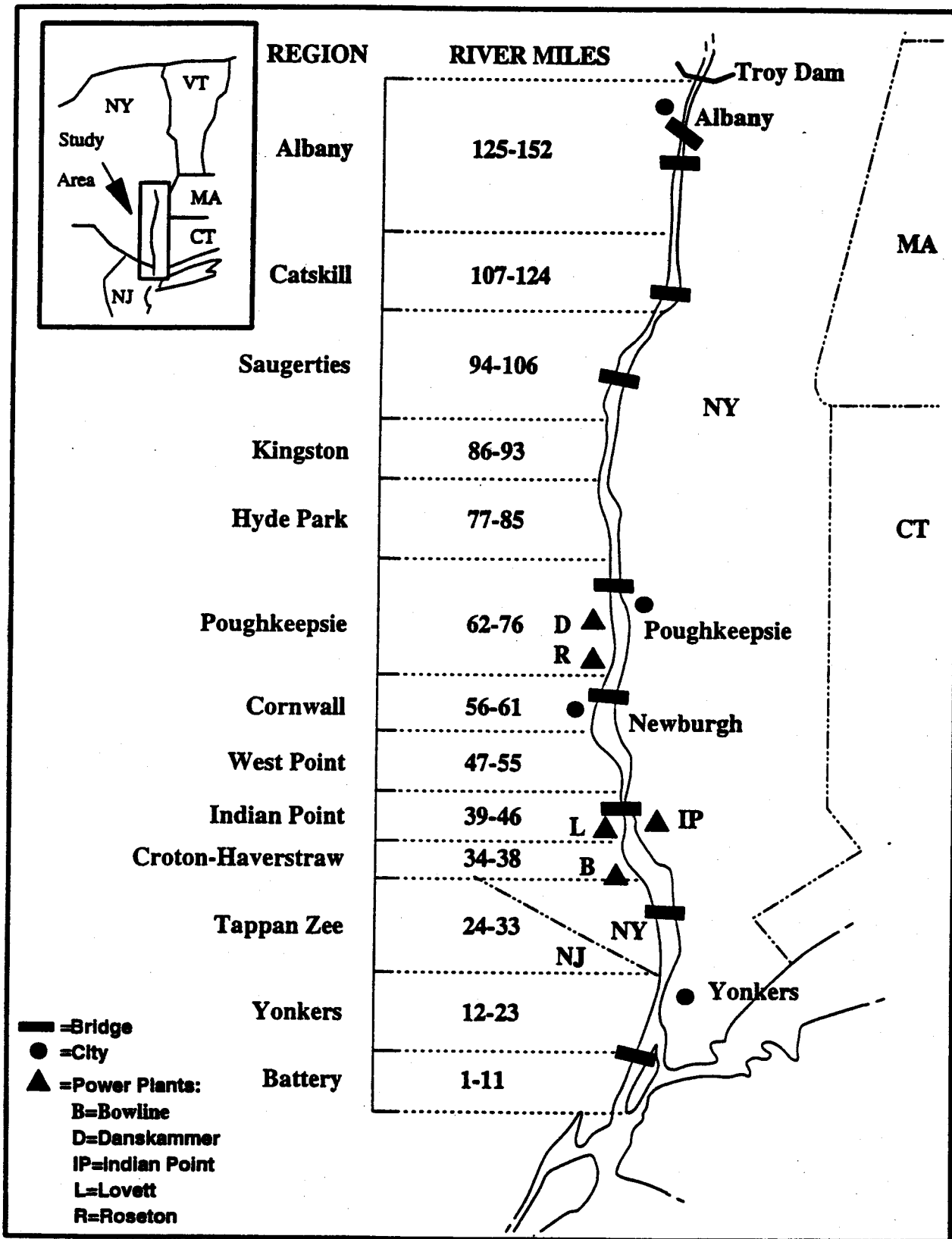


Figure 2-1. Location of 13 geographic regions (with river mile boundaries) sampled during the 1997 biological monitoring program in the Hudson River estuary.

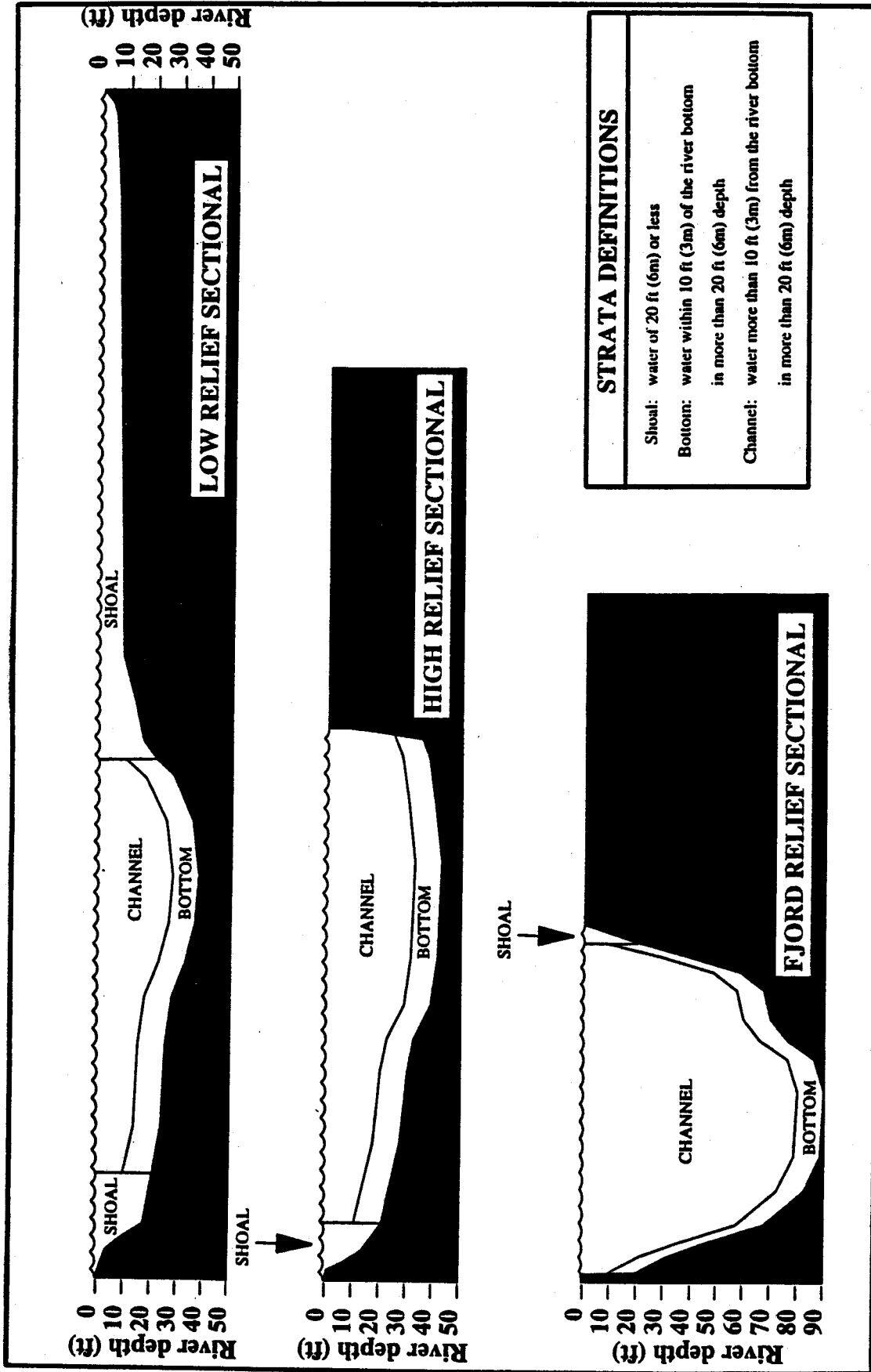


Figure 2-2. Cross sections of the Hudson River estuary showing locations and typical proportional relationships of the shoal, bottom, and channel strata.

- **Bottom**—That portion of the Hudson River estuary extending from the bottom to 10 ft above the bottom where river depth is greater than 20 ft at mean low tide.
- **Channel**—That portion of the Hudson River estuary not considered bottom where river depth is greater than 20 ft at mean low tide.

The proportional relationships of the shoal, bottom, and channel strata vary over the length of the Hudson River estuary. Presented in Figure 2-2 are three types of cross-sectional views. The low relief sectional is characteristic of the Tappan Zee and Croton-Haverstraw regions, the high relief sectional is exemplified by the Yonkers and Poughkeepsie regions, and the fjord relief sectional represents the West Point region.

A minimum of two samples was assigned to each stratum in most regions for the LRS. However, no samples were scheduled in the Poughkeepsie through Albany regions during the first 3 sampling weeks of the LRS (3 March - 6 April) nor in the Hyde Park through Albany regions during the final 7 sampling weeks of the LRS (14 July - 10 October) because few organisms of the target species were expected in these regions during these weeks. A minimum of three samples was assigned to each stratum in each region for the FSS except no channel samples were scheduled during the final 3 sampling weeks (27 October - 23 November). A minimum of three samples was also taken in each region for the BSS. The strata actually sampled in each region during the 1997 survey period are given in Table 2-1. Shoal strata samples were not assigned in upriver regions nor were shoal or shore strata samples assigned in the Battery region.

A general summary of the three sampling surveys for the annual monitoring program is presented in Table 2-2. The field and laboratory methods used for each survey are described in detail in the following sections.

2.2 LONGITUDINAL RIVER ICHTHYOPLANKTON SURVEY

2.2.1 Field Methods

The 1997 LRS covered 31 weeks from 10 March to 9 October (Table 2-2 and Figure 2-3). For the first 4 weeks, sampling was conducted biweekly between RM 1 and RM 61 with all samples collected during the day. For 13 consecutive weeks beginning the week of 7 April, sampling encompassed RM 1 - RM 152 and all samples were collected at night. Beginning the week of 14 July and ending the week of 6 October, sampling was conducted biweekly between RM 1 and RM 76 with all samples collected at night. Between 19 May and 30 June, approximately 20 additional trawl (channel strata) samples were collected per week. The samples were preserved so that aging of striped bass larvae using daily otolith rings could be conducted.

The allocation of sampling effort among river regions and strata was temporally adjusted in response to the projected presence and distribution of target species and life stages. The 1997 LRS sampling program was scheduled as 6 separate multiweek efforts. The first, which covered March, sampled biweekly, was directed toward the collection of Atlantic tomcod post yolk-sac larvae (PYSL). The second effort which covered the first 3 weeks of April was directed toward the collection of American shad eggs. The third effort covered the first 3 weeks of May and was designed to collect eggs of *Morone* spp. and American shad. The fourth effort encompassed the next 3 weeks from the middle of May through the beginning of June and targeted *Morone* spp. and American shad yolk-sac larvae (YSL). The fifth effort consisted of 4 weeks extending from early June through the first week in July. This sampling effort was designed to collect *Morone* spp. and American shad PYSL. The LRS sampling program concluded with a 13-week

TABLE 2-1 STRATA SAMPLED WITHIN THE 13 GEOGRAPHIC REGIONS OF THE HUDSON RIVER ESTUARY DURING 1997

<u>Region</u>	<u>Abbreviation</u>	<u>River Miles</u>	<u>River Kilometers</u>	<u>1997 Survey</u>			
				<u>Shore</u>	<u>Shoal</u>	<u>Channel</u>	<u>Bottom</u>
Battery	BT	1-11	1-19	--	--	X	X
Yonkers	YK	12-23	19-39	X	X	X	X
Tappan Zee	TZ	24-33	39-55	X	X	X	X
Croton-Haverstraw	CH	34-38	55-63	X	X	X	X
Indian Point	IP	39-46	63-76	X	X	X	X
West Point	WP	47-55	76-90	X	--	X	X
Cornwall	CW	56-61	90-100	X	X	X	X
Poughkeepsie	PK	62-76	100-124	X	--	X	X
Hyde Park	HP	77-85	124-138	X	--	X	X
Kingston	KG	86-93	138-151	X	--	X	X
Saugerties	SG	94-106	151-172	X	--	X	X
Catskill	CS	107-124	172-201	X	--	X	X
Albany	AL	125-152	201-246	X	--	X	X

NOTE: Dashes (--) indicate no sampling scheduled.

TABLE 2-2. SUMMARY OF 1997 HUDSON RIVER SURVEYS

Program Phase	Sampling Schedule		Number of Sampling Runs	Sampling Frequency	Strata Sampled	Sample Number		Sampling Gear
	Start Week	End Week				Collection	Lab Analysis	
Longitudinal River Ichthyoplankton Survey	10 MAR	6 OCT	22	Weekly/ Biweekly	Shoal	566	566	1.0-m ² net on epibenthic sled or 1.0-m ² Tucker trawl
					Channel	1,650 ^a	1,650	1.0-m ² Tucker trawl
					Bottom	1,351	1,351	1.0-m ² net on epibenthic sled
Fall Shoals Survey	7 JUL	24 NOV	11	Biweekly	Shoal	427	414 ^b	3.0-m beam trawl
					Channel	648	650	or 1.0-m ² Tucker trawl
					Bottom	1,055	951 ^b	1.0-m ² Tucker trawl
Beach Seine Survey	16 JUN	20 OCT	10	Biweekly	Shore	1,000	1,000	3.0-m beam trawl
								30.5-m beach seine

^a Includes 141 samples collected for striped bass otolith analysis.

^b River Run 11 was terminated after 30 samples were collected due to boat engine failure.