NOAA Technical Memorandum NMFS-NE-121

Habitat Use and Requirements of Important Fish Species Inhabiting the Hudson River Estuary: Availability of Information

U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts

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Habitat Use and Requirements of Important Fish Species Inhabiting the Hudson River Estuary: Availability of Information

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[a]Robins, C.R. (chair); Bailey, R.M.; Bond, C.E.; Brooker, J.R.; Lachner, E.A.; Lea, R.N.; Scott, W.B. 1991. Common and scientific names of fishes from the United States and Canada. 5th ed. *Amer. Fish. Soc. Spec. Publ.* 20; 183 p.

[b]Turgeon, D.D. (chair); Quinn, J.F., Jr.; Bogan, A.E.; Coan, E.V.; Hochberg, F.G.; Lyons, W.G.; Mikkelsen, P.M.; Neves, R.J.; Roper, C.F.E.; Rosenberg, G.; Roth, B.; Scheltema, A.; Thompson, F.G.; Vecchione, M.; Williams, J.D. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd ed. *Amer. Fish. Soc. Spec. Publ.* 26; 526 p.

[c]Williams, A.B. (chair); Abele, L.G.; Felder, D.L.; Hobbs, H.H., Jr.; Manning, R.B.; McLaughlin, P.A.; Pérez Farfante, I. 1989. Common and scientific names of aquatic invertebrates from the United States and Canada: decapod crustaceans. *Amer. Fish. Soc. Spec. Publ.* 17; 77 p.

[d]Rice, D.W. 1998. Marine mammals of the world: systematics and distribution. *Soc. Mar. Mammal. Spec. Publ.* 4; 231 p.

[e]Cooper, J.A.; Chapleau, F. 1998. Monophyly and interrelationships of the family Pleuronectidae (Pleuronectiformes), with a revised classification. *Fish. Bull. (U.S.)* 96:686-726.

[f]McEachran, J.D.; Dunn, K.A. 1998. Phylogenetic analysis of skates, a morphologically conservative clade of elasmobranchs (Chondrichthyes: Rajidae). *Copeia* 1998(2):271-290.

[g]ISO [International Organization for Standardization]. 1981. ISO standards handbook 3: statistical methods. 2nd ed. Geneva, Switzerland: ISO; 449 p.

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Acronyms

GIS = geographical information system
NEFSC = Northeast Fisheries Science Center
SUNY = State University of New York
TL = total length

EXECUTIVE SUMMARY

The objective of our project was to determine the extent and availability of information that is adequate for: 1) assessing basic habitat requirements of selected fishery resources of the Hudson River estuary; 2) relating those requirements to habitat availability in that estuary; and 3) developing priorities for projects that will enhance, restore, or maintain productivity of those resources. We used a three-step process to determine if sufficient information is available on habitat requirements of selected fish species. First, we selected 11 fish species that are considered important and representative of the fish community in the Hudson River estuary. Second, we examined alternative definitions of habitat and selected one for evaluating the role of habitat in the life history strategies of the 11 species. Third, we assessed the availability of information necessary to evaluate habitat requirements and use in the Hudson River estuary for each of the 11 species.

We assembled a list of close to 1,000 publications up to 1995 containing information that may be relevant to habitat requirements and use by the selected fish species inhabiting the Hudson River estuary, then sorted those publications by species and life stage. To determine the amount of information that would likely be available for a full-scale study of habitat use by the 11 selected species, we made two evaluations of the collected publications: 1) the availability of published information on site-specific **distribution** within the Hudson River estuary of each life stage (*i.e.*, spawning, egg, larva, juvenile, subadult, and adult) for each selected species; and 2) the availability of published information on **habitat requirements** of each life stage for each selected species. We evaluated the two types of information separately because evaluations of habitat requirements and use usually begin by locating the organisms within the water body, then determining why they are there; locational information is usually much easier to obtain, as was apparent in our study.

We conclude that the available information is insufficient to conduct a full-scale, detailed study of the importance of Hudson River habitats to the selected fish species. Although our evaluation of the available information suggests that little would be gained from a full-scale study, we do not recommend total abandonment of the project; our review of the literature revealed a wealth of information on a number of areas related to the natural history of the Hudson River estuary and the alteration of the estuary through human activities.

We suggest that the next step towards identifying important habitats for Hudson River fishes would be to begin assembling the data on life stage distributions and habitats of the Hudson River estuary into a geographic-based information system (GIS). By using GIS, gaps in the information base will become more clear, and priorities for collection of additional information will become more evident. Because of the immensity of this task, no single governmental or nongovernmental organization should be expected to undertake such a project for the Hudson watershed singlehandedly -- a cooperative effort among federal, state, and local agencies is needed where all parties contribute and all parties benefit.

INTRODUCTION

Since 1963, the Hudson River estuary has been the focus of one of the most ambitious environmental research and assessment programs ever performed (Barnthouse *et al.* 1988), and nowhere has the conflict between society and the environment been so intense (Smith 1988). The estuary supports major commercial and recreational fisheries, serves as a major transportation corridor, and is surrounded by one of the most densely populated metropolitan areas in North America (Figure 1). In spite of efforts by government agencies and nongovernment organizations to protect the fishery resources of the river, threats -- including sediment-laden contaminants, municipal and industrial water withdrawals and discharges, channel dredging, and nonpoint-source runoff -- continue in this estuarine habitat.

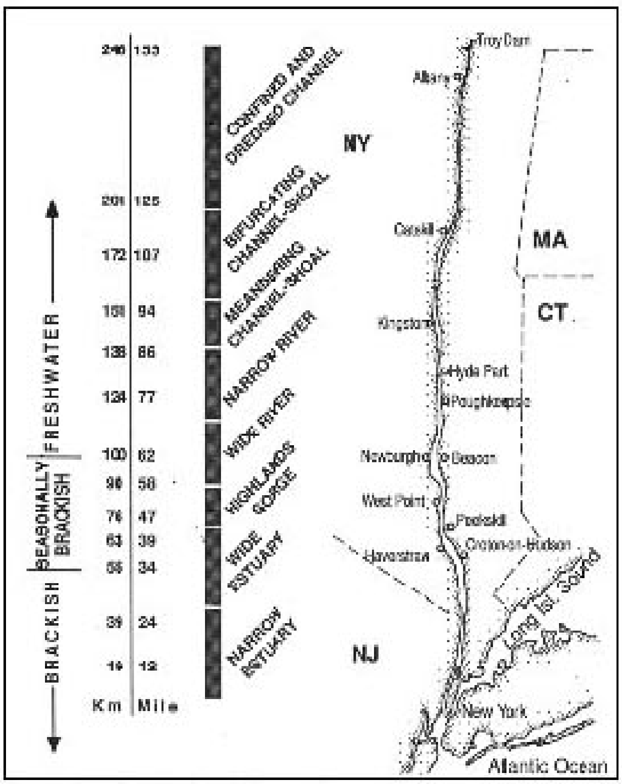

Figure 1. Geographical, geomorphological, and salinity characteristics of the Hudson River estuary. (From Haley (1999).)

Before major programs are initiated to protect, enhance, and restore the fishery resources of the Hudson River estuary through habitat improvements, an understanding is needed of the relationship between habitat characteristics of the estuary and basic habitat requirements of the fishery resources, as recommended in the "Habitat Research Plan of the National Marine Fisheries Service" (Thayer *et al.* 1996). Information used to gain that understanding also needs to be in a form that is useful in determining: 1) the types of habitat restoration projects that are feasible, and 2) the short-term and long-term benefits of these projects. However, establishing baseline habitat requirements for fishery resources of the Hudson River estuary is not as straightforward as it may seem. In some instances, the habitat requirements of a prey species may be the important factor in productivity of a fishery resource; for example, productivity of bluefish may depend on the abundance of bay anchovy in the estuary. Furthermore, the amount of available habitat may be limited more by the abundance of competitor species than by the spatial scale of the habitat itself. Thus, determining linkages between habitat characteristics and fishery resource productivity requires an appreciation for, and understanding of, the complexities of interactions among members of the fish community, specifically among predators, competitors, and prey during all life stages present in the system.

By 1981, an estimated $40-50 million had been spent on basic fisheries research in the Hudson River (Smith 1988), and $3-4 million has been spent per year since then on research and monitoring by the Hudson River utilities and the Hudson River Foundation. Because of these enormous expenditures, a dogma exists within the environmental community that sufficient data now exist for informed management of the Hudson River resources and their habitats. This is simply not the case, as evidenced in recent criticism of the draft environmental impact statement prepared by the Hudson River utilities (ESSA Technologies, Ltd., and Deriso 1994).

Much of the information gathered on Hudson River fishes has been specifically for evaluating impacts of power plant operations (see Barnthouse *et al.* 1984). Habitat-related studies in the Hudson River estuary have been chiefly site-specific or species-specific, such as the work being performed by the State University of New York (SUNY) at Stony Brook on the effects of cadmium-contaminated sediments on the aquatic fauna at Foundry Cove (Knutson *et al.* 1987), or by the Institute for Ecosystem Studies on the invasion and subsequent distribution of zebra mussels in the upper estuary (Strayer *et al.* 1994). No program has been undertaken to define habitat use and habitat requirements of Hudson River fishes on an estuary-wide basis; this is a fundamental void that needs to be filled for development of remedial actions and restoration plans for habitats.

The objective of our project was to determine the extent and availability of information that is adequate for: 1) assessing basic habitat requirements of selected fishery resources of the Hudson River estuary; 2) relating those requirements to habitat availability in that estuary; and 3) developing priorities for projects that will enhance, restore, or maintain productivity of those resources.

METHODS

Two approaches could be used, either independently or jointly, as first-order approximations to understand the linkage between habitat requirements and the well-being of fishery resources. One approach would be to determine the minimum habitat requirements necessary to support selected fishery resources, and then to map areas where any one or a combination of these factors would exclude use by the selected resources. A tool to accomplish this task would be a geographic-based information system (GIS). A second approach would be to determine the historical extent of habitat use in the estuary by selected fishery resources, compare to the current extent, and determine what factors might be causing any differences. Both approaches are data hungry, requiring an extensive amount of information from field collections and controlled laboratory experiments. The extent to which the data exist and are available will determine success of either approach in assessing habitat requirements and, ultimately, in setting priorities for habitat restoration projects in the estuary.

We used a three-step process to determine if sufficient information is available on habitat requirements of selected fish species. First, we selected 11 fish species that are considered important and representative of the fish community in the Hudson River estuary. Second, we examined alternative definitions of habitat and selected one for evaluating the role of habitat in the life history strategies of those 11 species. Third, we assessed the availability of information necessary to evaluate habitat requirements and use in the Hudson River estuary for each of the 11 species.

SELECTION OF SPECIES

The Hudson River estuary extends for 243 km from the Battery on Manhattan Island north to the Troy Dam (Cooper *et al.* 1988), and is tidal over its entire length, with the greatest tidal amplitudes occurring at both ends. The magnitude of tidal flow within the estuary is 10-100 times greater than the freshwater inflows, causing a reversal in the current pattern twice each day (Busby 1966, cited in Cooper *et al.* 1988). The estuary is generally considered freshwater (<0.3‰) above river kilometer (Rkm) 80 to 100, which may extend to Rkm 40 during high inflow periods (spring and fall). The oligohaline zone (0.3-5‰) extends from Rkm 80 to 40, but may reach Rkm 19, and the mesohaline zone (5-18‰) generally occurs from Rkm 45 into New York Harbor (Cooper *et al.* 1988; Haley 1999).

A total of 140 species of fish have been collected within the Hudson River estuary, a listing of which by river region can be found in Beebe and Savidge (1988, Table 6). Of the 140 species, 50 have been found in all three salinity zones of the estuary, and two species have been found only in the polyhaline zone (Yonkers and Tappan Zee sampling regions, Figure 2). The 140 fish species also embody a variety of life history strategies, which can largely be described by four patterns: **anadromous** (spawning and nursery areas in freshwater, oligohaline, and/or mesohaline zones of the Hudson River estuary,

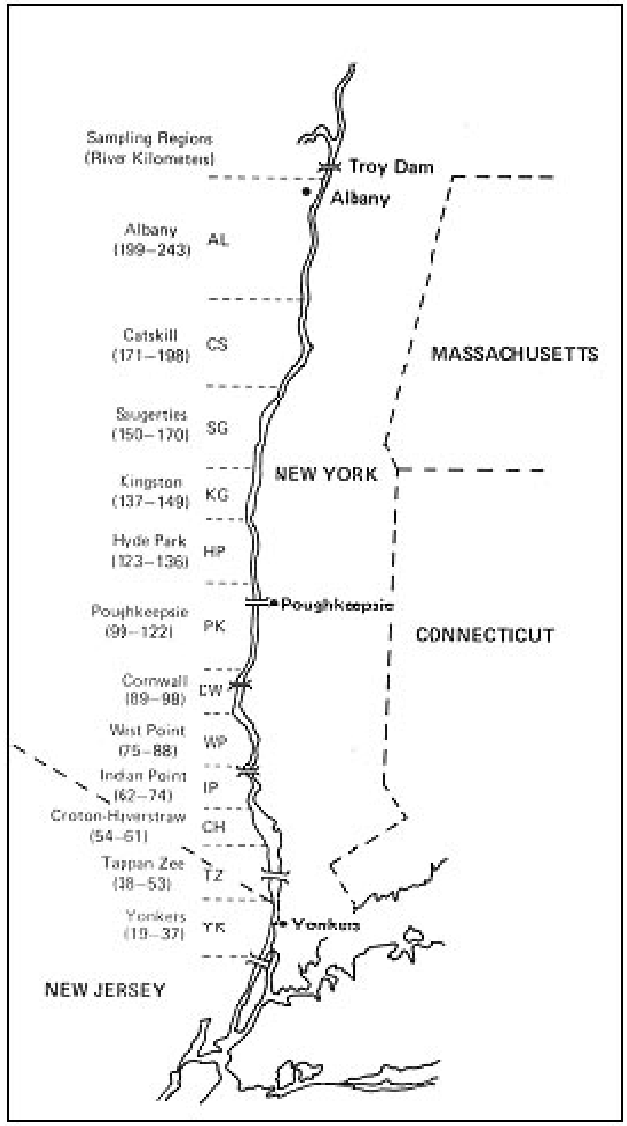

Figure 2. Sampling regions used by the Hudson River utility companies for their ichthyoplankton survey programs. (From Boreman and Klauda (1988).)

most of adult life in the marine environment); **freshwater-oligohaline nonmigratory** (entire life cycle in freshwater and/or oligohaline zones); **euryhaline nonmigratory** (entire life cycle within the Hudson River, but across all salinity zones); and **oceanic/coastal spawners** (spawning in highest salinity zone of the Hudson River estuary and surrounding coastal waters, early life stages enter lower salinity zones of the estuary). Anadromous can be further subdivided into the group of species that spawns in the **tributaries** -- if not also the river proper -- of the Hudson River estuary, and the group that spawns exclusively in the **river** proper. We chose 11 fish species that represent the four life history strategies (Table 1), and that are also important to the Hudson River estuary economically or ecologically. Synopses of the life histories of the 11 selected species are presented in Appendix A.

Table 1. Fish species selected for assessing the availability of information on habitat use and preference in the Hudson River estuary

Life History Strategy	Species
Anadromous:	
Tributary spawners	Alewife (*Alosa pseudoharengus*)
	Blueback herring (*A. aestivalis*)
River spawners	Striped bass (*Morone saxatilis*)
	American shad (*A. sapidissima*)
	Atlantic sturgeon (*Acipenser oxyrhynchus*)
Freshwater-oligohaline nonmigratory	Largemouth bass (*Micropterus salmoides*)
Euryhaline nonmigratory	Shortnose sturgeon (*A. brevirostrum*)
	Atlantic tomcod (*Microgadus tomcod*)
	White perch (*Morone americana*)
Oceanic/coastal spawners	Bluefish (*Pomatomus saltatrix*)
	Bay anchovy (*Anchoa mitchilli*)

HABITAT DEFINITION

The term "habitat" needs to be defined before assessing the availability of information related to habitat use by important fish species inhabiting the Hudson River estuary. We thoroughly reviewed definitions of habitat that have appeared in the literature (Odum 1971; Partridge 1978; Pimm and Rosenzweig 1981; Rosenzweig 1981, 1991; Van Horne 1983; Boesch and Turner 1984; Rosenzweig and Abramsky 1985; Bell and Westoby 1986; Brown and Rosenzweig 1986; Bell *et al.* 1987; CBLRFT 1987; Morris 1987a,b; McIvor and Odum 1988; Govoni *et al.* 1989; Sogard and Able 1991; Peters and Cross 1992; Hoss and Thayer 1993; Able and Kaiser 1994). We subsequently settled on one that seems to be most appropriate for Hudson River estuary fishes: Habitat is that part of the environment required for the survival (*i.e.*, survival to successful reproduction) of individuals of a species, consisting of biological and nonbiological parameters which differ among species, as well as among life stages within a species, and which are affected either seasonally or change as a result of other environmental factors.

ASSESSMENT OF INFORMATION AVAILABILITY

Given our working definition of habitat, we assembled information that might be used to determine the importance of habitats in the Hudson River estuary to the 11 selected fish species. We surveyed the published and unpublished (gray) literature ("publications") available through agencies and organizations involved with research on Hudson River resources. We also contacted a number of investigators and organizations that might possess unpublished information, such as databases and specimen collections, that also might be relevant (Appendix B).

We used a software package for database retrieval called FileMaker Pro Unlimited® (available in Windows and MacIntosh versions from FileMaker, Inc., 5201 Patrick Henry Dr., P.O. Box 58168, Santa Clara, CA 95054-8168) to organize the publications in a manner that allowed us to search those publications. The publications could be searched by the following: author, year, title, report type, publisher, geography, fish species, and/or keyword(s). This database is available for public access and use. See Appendix C ("Users Guide to the Database") of this report for the several formats of the database which have been prepared for public access and use.

RESULTS

We assembled a list of close to 1,000 publications containing information that may be relevant to habitat requirements and use by the selected fish species inhabiting the Hudson River estuary (Appendix D), then sorted those publications by species and life stage. Approximately 120 of the publications are available from us in hard copy. Unpublished materials are also available through personal, agency, and nongovernmental organization contacts. (See the "Remarks" column in Appendix B.)

To determine the amount of information that would likely be available for a full-scale study of habitat use by the 11 selected species, we made two evaluations of the collected publications: 1) the availability of published information on site-specific **distribution** within the Hudson

Table 2. Evaluation of the relative availability of published information on the life stage **distributions** of 11 fish species inhabiting the Hudson River estuary, based on the publications listed in Appendix D. (Key: A = information available for Hudson River population; Al = information available for Hudson River population, but limited; N = information available from neighboring system; Ua = information unavailable, but attainable within 3 yr; Uu = information unavailable and unattainable within 3 yr; and X = not applicable for Hudson River population.)

	Life History Stage					
Species	**Spawning**	**Egg**	**Larva**	**Juvenile**	**Subadult**	**Adult**
Alewife	Al,N	A	A	Al	X	Al,N
American shad	Al,N	A	A	Al	X	Al,N
Atlantic sturgeon	Al	Ua	Ua	Al	X	Al
Atlantic tomcod	Al,N	A	A	A	Al	Al,N
Bay anchovy	Al,N	Al,N	Al,N	Al,N	Al	Al,N
Blueback herring	Al,N	A	A	Al	X	Al,N
Bluefish	X	X	X	Al	Al	Al
Largemouth bass	A	A	A	Ua	Ua	Al?
Shortnose sturgeon	Al,N	Ua	Ua	Al	Al,N	Al,N
Striped bass	A	A	A	Al	Al	Al
White perch	Al	Al	A	Al	Al	Al

River estuary of each life stage (*i.e.*, spawning, egg, larva, juvenile, subadult, adult) for each selected species (Table 2); and 2) the availability of published information on **habitat requirements** of each life stage for each selected species (Table 3). Habitat requirements information includes tolerances and preferences for environmental parameters (salinity, temperature, turbidity, depth, vegetation, bottom type, etc.) and trophic inter-relationships. We evaluated the two types of information separately because evaluations of habitat requirements usually begin by locating the organisms within the water body, then determining why they are there; locational information is usually much easier to obtain, as was apparent in our study. For each life stage of each species, we noted whether information on distribution or habitat requirements is: 1) available for the Hudson River population (**A** in Tables 2 and 3); 2) available for the Hudson River population, but limited either geographically or temporally (**Al**); 3) not available for the Hudson River population, but available for a population of the species in a neighboring system (**N**); 4) unavailable, but attainable within 3 yr assuming adequate funding (**Ua**); 5) unavailable and would not be attainable within 3 yr even if funding were adequate (**Uu**); or 6) inapplicable because the life stage is not present in the Hudson River estuary (**X**). The evaluations contained in Tables 2 and 3 are based on our judgments; others may draw different conclusions after reviewing the publications contained in the database.

The most complete information on distribution of the 11 selected species in the Hudson River estuary is for the planktonic life stages (egg and larva) of alewife, American shad, Atlantic tomcod, blueback herring, and striped bass. This result is not surprising, since all 11 selected species, except the largemouth bass, have been targeted for collection in the riverwide surveys conducted by the utility companies as part of their impact assessment programs. Although the utilities' surveys covered the entire estuary over a number of years, the spatial resolution of the data is limited to the 12 regions designated by the survey design (Figure 2). Their surveys also varied in coverage of depth zones.

The distribution of spawners, eggs, and larvae of the largemouth bass has been well documented in a special study of the species conducted by David Green and his coworkers (*e.g.*, see Nack and Cook 1987; Hopkins and Green 1988; Green *et al.* 1988, 1989; Nack *et al.* 1993). Information on the distributions of other life stages of largemouth bass and on Hudson River populations of the

Table 3. Evaluation of the relative availability of published information on the life stage **habitat requirements** of 11 fish species inhabiting the Hudson River estuary, based on the publications listed in Appendix D. (Key: A = information available for Hudson River population; Al = information available for Hudson River population, but limited; N = information available from neighboring system; Ua = information unavailable, but attainable within 3 yr; Uu = information unavailable and unattainable within 3 yr; and X = not applicable for Hudson River population.)

	Life History Stage					
Species	**Spawning**	**Egg**	**Larva**	**Juvenile**	**Subadult**	**Adult**
Alewife	Ua,N	Ua	Ua	Ua	X	Ua
American shad	Ua,N	Ua,N	Ua,N	Ua,N	X	Ua,N
Atlantic sturgeon	Ua	Ua	Ua	Ua	X	Ua
Atlantic tomcod	Ua	Al	Al	Al	Ua	Al
Bay anchovy	Ua,N	Ua,N	Ua,N	Ua,N	Ua,N	Ua,N
Blueback herring	Ua,N	Ua	Ua	Ua	X	Ua
Bluefish	X	X	X	Al	Ua	Ua
Largemouth bass	Al	Al	Al	Al	Ua	Al
Shortnose sturgeon	Ua	Ua	Ua	Ua	Ua	Ua
Striped bass	N	N	N	N	N	N
White perch	Al,N	N	N	N	Ua,N	Ua,N

other species is also generally available, although limited geographically or temporally.

Information on habitat requirements for the 11 selected species is much more limited than information on their distributions. For striped bass, white perch, bay anchovy, and American shad, substantial information exists on habitat requirements in neighboring systems, primarily Chesapeake Bay, that may be transferrable to the Hudson River estuary. Transferring habitat requirements information among estuarine systems, however, may not withstand the scrutiny of litigation. Generally, information on habitat requirements is unavailable for most species, but attainable within the short-term (3 yr or so) if sufficient funding is available to test the species' preference or tolerance for key habitat variables. The variables may include, depending on the species and life stage, water temperature, salinity, conductivity, sediment type, vegetation or other shelter, and turbidity. We are assuming that the individual life stages need to be tested under controlled conditions, and recognize that techniques for rearing and maintaining the fish for purposes of experimentation have not yet been developed for all life stages.

CONCLUSIONS AND RECOMMENDATIONS

Based on our assembly of close to 1,000 publications, and on our contacts with a number of individuals, agencies, and nongovernmental organizations involved with collection of information on Hudson River fishes, we conclude that the available information is insufficient to conduct a full-scale, detailed study of the importance of Hudson River habitats to the selected fish species. If a full-scale study proceeds, the following findings are likely:

1. Distributions will be available for the egg through juvenile life stages of most of the 11 species, but the spatial resolution of the distributions will not be adequate for evaluating use of specific areas within the estuary.

2. Few studies have been conducted on the distributions of subadult and adult life stages within and adjacent to the estuary, in and out of spawning season. The distributions will have to be based on

anecdotal information from recreational and commercial harvesters, and on results of studies presently being planned or conducted on striped bass, American shad, the sturgeons, and bay anchovy.

3. Specific habitat requirements related to key environmental variables will be largely unknown for the Hudson River populations of the 11 species. Studies in other systems (Chesapeake Bay, Delaware River, and Connecticut River) may provide some information, but transferability of the information from the neighboring systems to the Hudson River estuary will be suspect. Efforts should be made to compare extant data among these systems to determine transferability.

4. Tributaries to the Hudson River estuary probably serve a more important role in the life history of the eleven fish species than previously thought.

5. Most life stages of the eleven fish species are probably not associated with a specific habitat, such as cobble bottom or mussel bed, but are at the mercy of freshwater discharge and tidally-driven circulation in the estuary. For planktonic life stages, such as eggs and larvae of striped bass, salinity, temperature patterns, and turbidity may be more important to survival than substrate or vegetation.

Although our evaluation of the available information suggests that little would be gained from a full-scale study, we do not recommend total abandonment of the project. Our review of the literature revealed a wealth of information on a number of areas related to the natural history of the Hudson River estuary and on the alteration of the estuary through human activities; some of the information has already been synthesized in literature reviews and atlases. However, such syntheses have limited utility. Experience has shown that the efforts of the U.S. Fish and Wildlife Service and NOAA related to coastal wetlands mapping and estuarine inventories do not meet needs when attempts are made to use their information on a site-by-site basis, which is where both agencies expend most of their resource-advising efforts. This concern is especially critical as federal and state agencies move towards ecosystem-level management of aquatic and terrestrial systems.

We suggest that the next step towards identifying important habitats for Hudson River fishes would be to begin assembling data on life stage distributions and habitats of the Hudson River estuary into a GIS. By using GIS, gaps in the information base will become more clear, and priorities for collection of additional information will become more evident. The GIS approach retains flexibility in its use and analysis, addresses the needs of ecosystem-level management, and takes advantage of new and developing technologies as recommended in the "Habitat Research Plan of the National Marine Fisheries Service" (Thayer *et al.* 1996). Giles and Nielsen (1992) give examples of how GIS can be used in watershed research and management:

- bibliographic references to site-specific conditions and ecological phenomena
- standard reports, texts, and tables for various reports and purposes
- ongoing research and development projects
- factual information (such as that provided by the Fish and Wildlife Information System)
- numerical datasets (*e.g.*, daily precipitation)
- models (statistical, mathematical)
- records of materials collections (plants, fish, wildlife, soil, water, etc.)
- map databases that link all of the above

For a system as large and complex as the Hudson River estuary, both in terms of its physical attributes and the resource management system that oversees it, more than the current piecemeal approach to identifying resource distributions and habitat use is necessary. A GIS for the Hudson River estuary should contain the following dataset layers at a minimum:

- fish, wildlife, and plant distributions and abundances
- harvesting profiles (location, type, and density of effort, catch, and access)
- water body characteristics (depth and current profiles, physical and chemical features, wetted perimeter, locations and types of blockages, and hydrologic features)
- sources and fates of environmental contaminants
- sediment characteristics and substrate types for the main channel and its tributaries
- town zoning plans and bylaws
- density distribution of human population
- locations of parks, open space, and other recreational areas
- daily records of the amount and chemical composition of precipitation
- snow accumulation and chemical composition
- climatic information such as temperature, photoperiod, cloud cover, and barometric pressure
- upland characteristics such as soil and bedrock types and properties, slope, and land-use cover

Because of the immensity of this task, no single governmental or nongovernmental organization should be expected to undertake such a project for the Hudson watershed single-handedly -- a cooperative effort among federal, state, and local agencies is needed where all parties contribute and all parties benefit.

Concurrent with development of the GIS database, we recommend initiation of studies on life stages of the selected fish species that would be expected to associate with key habitat variables such as bottom type, vegetation, structures, circulation patterns (eddies, plumes, etc.), and geomorphological characteristics (wetlands, tributaries, etc.). Information generated from these studies would be immediately useful in planning habitat restoration programs. We recommend placing initial focus of the studies on the juvenile, post-planktonic life stages of the 11 selected species, examining the importance of shore zones, shelter created by vegetation or structure, and tributaries and their outfalls. We speculate that it is the juvenile life stage that is probably the least tolerant of habitat alteration and loss in the Hudson River estuary.

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REFERENCES CITED

Able, K.W.; Kaiser, S.C. 1994. Synthesis of summer flounder habitat parameters. *NOAA Coastal Ocean Program Decision Anal. Ser.* 1; 68 p.

Bain, M.B.; Boreman, J.; Nack, S.; Haley, N. 1995. Techniques for evaluating the population status of Atlantic sturgeon. Proposal *to*: New York Sea Grant Institute, Albany, NY; 27 p.

Barnthouse, L.W.; Boreman, J.; Christensen, S.W.; Goodyear, C.P.; Van Winkle, W.; Vaughan, D.S. 1984. Population biology in the courtroom: the Hudson River controversy. *BioScience* 34(1):14-19.

Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S. 1988. Introduction to the monograph. *In:* Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S.; Kendall, R.L., eds. Science, law, and Hudson River power plants: a case study in environmental impact assessment. *Am. Fish. Soc. Monogr.* 4:1-8.

Beebe, C.A.; Savidge I.R. 1988. Historical perspective on fish species composition and distribution in the Hudson River estuary. *In:* Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S.; Kendall, R.L., eds. Science, law, and Hudson River power plants: a case study in environmental impact assessment. *Am. Fish. Soc. Monogr.* 4:25-35.

Bell, J.D.; Westoby, M. 1986. Variations in seagrass height and density over a wide spatial scale: effects on fish and decapods. *J. Exp. Mar. Biol. Ecol.* 104:275-295.

Bell, J.D.; Westoby, M.; Steefe, A.S. 1987. Fish settling in seagrass: do they discriminate between beds of different leaf density? *J. Exp. Mar. Biol. Ecol.* 111:133-144.

Bigelow, H.B.; Schroeder, W.C. 1953. Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish. Bull.* 53; 577 p.

Boesch, D.F.; Turner, R.E. 1984. Dependence of fishery species on salt marshes: the role of food and refuge. *Estuaries* 7:460-468.

Boreman, J. 1981. Life histories of seven fish species that inhabit the Hudson River estuary. *Northeast Fish. Sci. Cent. Ref. Doc.* 81-34; 97 p.

Boreman, J.; Fletcher, R.I. 1993. Modelling egg deposition patterns. *Bull. Hudson River Monit. Program Tech. Work. Group* 1(1):1-8.

Boreman, J.; Klauda, R.J. 1988. Distributions of early life stages of striped bass in the Hudson River estuary, 1974-1979. *In:* Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S.; Kendall, R.L., eds. Science, law, and Hudson River power plants: a case study in environmental impact assessment. *Am. Fish. Soc. Monogr.* 4:53-58.

Boyce Thompson Institute for Plant Research. 1977. An atlas of the biological resources of the Hudson River estuary. Yonkers, NY: Boyce Thompson Institute for Plant Research, Estuarine Study Group.

Boyle, R.H. 1968. Notes on the fishes of the lower Hudson River. *Underwater Nat.* 5(2):32-33,40.

Breder, C.M., Jr.; Rosen, D.E. 1966. Modes of reproduction in fishes. Garden City, NY: Natural History Press; 941 p.

Brown, J.S.; Rosenzweig, M.L. 1986. Habitat selection in slowly regenerating environments. *J. Theor. Biol.* 123:151-171.

Busby, W. 1966. Flow, quality, and salinity in the Hudson River estuary. *In:* Hudson River ecology. Albany, NY: Hudson River Valley Commission of New York; p. 135-145.

Carlson, D.M. 1992. Importance of wintering refugia to the largemouth bass fishery in the Hudson River estuary. *J. Freshwater Ecol.* 7:173-180.

CBLRTF [Chesapeake Bay Living Resources Task Force]. 1987. Habitat requirements for Chesapeake Bay living resources. Annapolis, MD: Chesapeake Bay Program; 63 p.

Cooper, J.C.; Cantelmo, F.R.; Newton, C.E. 1988. Overview of the Hudson River estuary. *In:* Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S.; Kendall, R.L., eds. Science, law, and Hudson River power plants: a case study in environmental impact assessment. *Am. Fish. Soc. Monogr.* 4:11-24.

Dadswell, M.J.; Taubert, B.D.; Squires, T.S.; Marchette, D.; Buckley, J. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* LeSueur 1818. *NOAA Tech. Rep. NMFS* 14; 45 p.

Dew, C.B. 1995. The nonrandom size distribution and size-selective transport of age-0 Atlantic tomcod (*Microgadus* *tomcod*) in the lower Hudson River estuary. *Can. J. Fish. Aquat. Sci.* 52:2353-2366.

Dew, C.B.; Hecht, J.H. 1994. Hatching, estuarine transport, and distribution of larval and early juvenile Atlantic tomcod, *Microgadus tomcod*, in the Hudson River. *Estuaries* 17:472-488.

Dovel, W.L. 1981. Ichthyoplankton of the lower Hudson estuary. *N.Y. Fish Game J.* 28:21-39.

Englert, T.L.; Sugarman, D. 1988. Patterns of movement of striped bass and white perch larvae in the Hudson River estuary. *In:* Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 148-169.

ESSA Technologies, Ltd.; Deriso, R.B. 1994. A critical review of the SPDES Draft Environmental Impact Statement. Report *to:* New York State Department of Environmental Conservation, Albany, NY; 70 p.

Giles, R.H., Jr.; Nielsen, L.A. 1992. The uses of geographic information systems. *In:* Stroud, R.H., ed. Fisheries management and watershed development. *Am. Fish. Soc. Symp.* 13:81-94.

Govoni, J.J.; Hoss, D.E.; Colby, D.R. 1989. The spatial distribution of larval fishes about the Mississippi plume. *Limnol. Oceanogr.* 34:178-187.

Green, D.M.; Nack, S.B.; Bunnell, D.; Forney, J.L. 1989. Identification of black bass spawning and nursery habitats in the Hudson River estuary. Final report *to:* Hudson River Foundation, New York, NY; 52 p.

Green, D.M.; Nack, S.B.; Forney, J.L. 1988. Identification of black bass spawning and nursery habitats in the Hudson River estuary. Final report *to:* Hudson River Foundation, New York, NY; 49 p.

Haley, N.J. 1999. Habitat characteristics and resource use patterns of sympatric sturgeons in the Hudson River estuary. [M.S. thesis]. Amherst, MA: Univ. of Massachusetts; 124 p.

Hardy, J.D. 1978. *Morone americana* (Gmelin), white perch. *U.S. Fish Wildl. Serv. FWS-OBS*-78/12(3):71-85.

Hildebrand, S.F. 1963. Family Clupeidae. In: Fishes of the western North Atlantic. Part 3. Soft-rayed bony fishes. *Sears Found. Mar. Res. Mem.* 1:257-385,397-442,452-454. New Haven, CT: Sears Foundation for Marine Research, Yale Univ.

Hildebrand, S.F.; Schroeder, W.C. 1928. Fishes of Chesapeake Bay. *Bull. U.S. Bur. Fish.* 43(pt.1); 366 p.

Hoff, T.B.; Klauda, R.J.; Young, J.R. 1988. Contribution to the biology of shortnose sturgeon in the Hudson River. *In:* Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 171-189.

Hopkins, D.; Green, D.M. 1988. Evaluation of potential sources of recruitment of largemouth bass to the Hudson River. Section VIII *in:* Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1988. New York, NY: Hudson River Foundation; 26 p.

Hoss, D.E.; Thayer, G.W. 1993. The importance of habitat to the early life history of estuarine dependent fishes. *In:* Fuiman, L.A. Water quality and the early life stages of fishes. *Am. Fish. Soc. Symp.* 14:147-158.

Kendall, A.W., Jr.; Walford, L.A. 1979. Sources and distribution of bluefish, *Pomatomus saltatrix*, larvae and juveniles off the East Coast of the United States. *Fish. Bull. (Wash., D.C.)* 77:213-227.

Klauda, R.J.; Fischer, S.A; Hall, L.W., Jr.; Sullivan, J.A. 1991. Alewife and blueback herring. *In:* Funderburk, S.L.; Mihursky; J.A.; Jordan, S.J.; Riley, D., eds. Habitat requirements for Chesapeake Bay living resources. Annapolis, MD: Chesapeake Bay Program Living Resources Subcommittee.

Klauda, R.J.; McLaren, J.B.; Schmidt, R.E.; Dey, W.P. 1988. Life history of the white perch in the Hudson River. *In:* Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S.; Kendall, R.L., eds. Science, law, and Hudson River power plants: a case study in environmental impact assessment. *Am. Fish. Soc. Monogr.* 4:69-88.

Klauda, R.J.; Moos, R.E.; Schmidt, R.E. 1988. Life history of the Atlantic tomcod, Microgadus tomcod, in the Hudson River estuary, with emphasis on spatio-temporal distribution and movements. *In:* Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 219-251.

Knutson, A.B.; Klerks, P.L.; Levinton, J.S. 1987. The fate of metal contaminated sediments in Foundry Cove, New York. *Environ. Pollut.* 45:291-304.

Leim, A.H.; Scott, W.B. 1966. Fishes of the Atlantic coast of Canada. *Fish. Res. Board Can. Bull.* 155; 483 p.

Lippson, A.J.; Moran, R.L. 1974. Manual for identification of early developmental stages of fishes of the Potomac estuary. *Md. Dept. Nat. Resour. Power Plant Siting Program Rep.* PPSP-MP-13; 282 p.

Loesch, J.G. 1968. A contribution to the life history of *Alosa aestivalis*. [M.S. thesis]. Storrs, CT: Univ. of Connecticut; 31 p.

Loesch, J.G. 1969. A study of the blueback herring, *Alosa aestivalis* (Mitchill) in Connecticut waters. [Ph.D. dissertation]. Storrs, CT: Univ. of Connecticut; 78 p.

Marks, R.E.; Conover, D.O. 1993. Ontogenic shift in the diet of young-of-the-year bluefish (*Pomatomus saltatrix*) during the oceanic phase of the early life history. *Fish. Bull. (Wash., D.C.)*: 91:97-106.

McFadden, J.T.; Texas Instruments; Lawler, Matusky & Skelly Engineers. 1978. Influence of the proposed Cornwall pumped storage project and steam electric generating plants on the Hudson River estuary, with emphasis on striped bass and other fish populations. Revised. Report *to:* Consolidated Edison Company of New York, New York, NY; p. 7.1-7.227.

McIvor, C.C.; Odum, W.E. 1988. Food, predation risk, and microhabitat selection in a marsh fish assemblage. *Ecology* 69:1341-1351.

McLaren, J.B.; Cooper, J.C.; Hoff, T.B.; Lander, V. 1981. Movements of Hudson River striped bass. *Trans. Am. Fish. Soc.* 110:158-167.

McLaren, J.B.; Peck, T.H.; Dey, W.P.; Gardinier, M. 1988. Biology of the Atlantic tomcod in the Hudson River estuary. *In*: Barnthouse, L.W.; Klauda, R.J.; Vaughn, D.S.; Kendall, R.L., eds. Science, law, and Hudson River power plants: a case study in environmental impact assessment. *Am. Fish. Soc. Monogr.* 4:102-112.

Miller, K.D.; Kramer, R.H. 1971. Spawning and early life history of largemouth bass (*Micropterus salmoides*) in Lake Powell. *In:* Hall, G.E., ed. Reservoir fisheries and limnology. *Am. Fish. Soc. Spec. Publ.* 8:78-83.

Morris, D.W. 1987a. Ecological scale and habitat use. *Ecology* 68:362-369.

Morris, D.W. 1987b. Tests of density-dependent habitat selection in a patchy environment. *Ecol. Monogr.* 57:269-281.

Nack, S.B.; Bunnell, D.; Green, D.M.; Forney, J.L. 1993. Spawning and nursery habitats of largemouth bass in the tidal Hudson River. *Trans. Am. Fish. Soc.* 122:208-216.

Nack, S.B.; Cook, W. 1987. Characterization of spawning and nursery habitats of largemouth bass (*Micropterus salmoides*) in the Stockport component of the Hudson River National Estuarine Research Reserve. Section IV *in:* Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1988. New York, NY: Hudson River Foundation; 24 p.

Norden, C.R. 1967. Age, growth, and fecundity of the alewife, *Alosa pseudoharengus* (Wilson), in Lake Michigan. *Trans. Am. Fish. Soc.* 96:387-393.

Odum, E.P. 1971. Fundamentals of ecology. Philadelphia, PA: W.B. Saunders; 544 p.

Partridge, L. 1978. Habitat selection. *In:* Krebs, J.R.; Davies, N.B., eds. Behavioural ecology: an evolutionary approach. Sunderland, MA: Sinauer Associates; p. 351-376.

Peters, D.S.; Cross, F.A. 1992. What is coastal fish habitat? *In:* Stroud, R.H., ed. Stemming the tide of coastal fish habitat loss: proceedings of the Symposium on Conservation of Coastal Fish Habitat, Baltimore, Md. *Mar. Recreat. Fish.* 14:17-22. Available *from:* National Coalition for Marine Conservation, Savannah, GA.

Pimm, S.L.; Rosenzweig, M.L. 1981. Competitors and habitat use. *Oikos* 37:1-6.

Richards, S.W. 1959. Pelagic fish eggs and larvae of Long Island Sound. *Bull. Bingham Oceanogr. Coll. Yale Univ.* 17:95-124.

Rosenzweig, M.L. 1981. A theory of habitat selection. *Ecology* 62:327-335.

Rosenzweig, M.L. 1991. Habitat selection and population interactions: the search for mechanism. *Am. Nat.* 137:S5-S28.

Rosenzweig, M.L.; Abramsky, Z. 1985. Detecting density-dependent habitat selection. *Am. Nat.* 126:405-417.

Ross, R.M.; Backman, T.W.H.; Bennett, R.M. 1993. Evaluation of habitat suitability index models for riverine life stages of American shad, with proposed models for premigratory juveniles. *U.S. Fish Wildl. Serv. Biol. Rep.* 14; 26 p.

Sargent, W.; Boreman, J. 1984. Bluefish: biology and management along the Atlantic coast. *Northeast Fish. Sci. Cent. Target. Info.* 1984 Apr. 25; 6 p.

Schmidt, R.E.; Klauda, R.J.; Bartels, J.M. 1988. Distributions and movements of the early life stages of three species of *Alosa* in the Hudson River, with comments on mechanisms to reduce interspecific competition. *In:* Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 193-215.

Schmidt, R.E.; Limburg, K.; Stillman, T. 1994. An estimate of the significance of tributary spawning of alewife (*Alosa pseudoharengus*) to the Hudson River estuary. *In*: Schmidt, R.E.; Stillman, T., eds. Drift of early life stages of fishes in Stockport Creek and significance of the phenomenon to the Hudson River estuary. New York, NY: Hudson River Foundation; p.23-35.

Schmidt, R.E.; Stillman, T. 1994. Larval fish export from Stockport Creek, a major tributary of the Hudson River estuary. *In*: Schmidt, R.E.; Stillman, T., eds. Drift of early life stages of fishes in Stockport Creek and significance of the phenomenon to the Hudson River estuary. New York, NY: Hudson River Foundation; p.3-22.

Scott, W.B.; Crossman, E.J. 1973. Freshwater fishes of Canada. *Fish. Res. Board. Can. Bull.* 184; 980 p.

Smith, C.L. 1988. Introduction. *In:* Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 1-4.

Smith, T.I.J.; Collins, M.R.; Kennedy, E. 1993. Identification of critical habitat requirements of shortnose sturgeon in South Carolina. Final report. Washington, DC: U.S. Fish and Wildlife Serv.; 102 p.

Sogard, S.M.; Able, K.W. 1991. A comparison of eelgrass, sea lettuce, macroalgae, and marsh creeks as habitats for epibenthic fishes and decapods. *Estuarine Coastal Shelf Sci.* 33:501-519.

Stevenson, R.A., Jr. 1958. A biology of the anchovies, *Anchoa mitchilli mitchilli* Cuvier and Valenciennes 1848 and *Anchoa hepsetus hepsetus* Linnaeus 1758. [M.S. thesis]. Newark, DE: Univ. of Delaware; 56 p.

Strayer, D.L.; Hunter, D.C.; Smith, L.C.; Borg, C.K. 1994. Distribution, abundance, and roles of freshwater clams (Bivalvia, Unionidae) in the freshwater tidal Hudson River. *Freshwater Biol.* 31:239-248.

Texas Instruments, Inc. 1976a. Hudson River ecological study in the area of Indian Point: thermal effects report. Report *to:* Consolidated Edison Company of New York, New York, NY.

Texas Instruments, Inc. 1976b. Predation by bluefish in the Hudson River. Report *to:* Consolidated Edison Company of New York, New York, NY; 23 p.

Thayer, G.W.; Thomas, J.P.; Koski, K.V. 1996. The habitat research plan of the National Marine Fisheries Service. *Fisheries (Bethesda)* 21(3):6-10.

Van Horne, B. 1983. Density as a misleading indicator of habitat quality. *J. Wildl. Manage.* 47:893-901.

Von Geldern, C.E., Jr. 1971. Abundance and distribution of fingerling largemouth bass, *Micropterus salmoides*, as determined by electrofishing at Lake Nacimiento, California. *Calif. Fish Game* 57:228-245.

Woodhead, P.M.J. 1991. The fish community of New York Harbor: spatial and temporal distributions of major species. *In:* Proceedings of the Conference on the Impacts of New York Harbor Development on Aquatic Resources, 1987. New York, NY: Hudson River Foundation; p. 103-122.

Woodhead, P.M.J.; Rohlf, F.J.; O'Hare, M.A. 1992. The structure of the fish community and distribution of major species in the lower Hudson estuary and New York Harbor. Final report *to:* Hudson River Foundation, New York, NY; 178 p.

APPENDIX A

Life History Synopses for Selected Fish Species Inhabiting the Hudson River Estuary

Understanding habitat requirements of the selected fish species in the Hudson River estuary requires an understanding of the distribution and environmental limitations for each life stage found in the estuary. A synopsis of the life history of each selected species reveals that a variety of habitats and regions of the Hudson River estuary are utilized; it also reveals some disagreement in the literature, as well as a general lack of information on specific habitat requirements for all life stages. Included in this appendix are 11 complementary figures (Figures A1-A11) for the 11 selected species which schematically present spatial distribution by life stage. References cited in this appendix are listed in the "References Cited" section of this document.

ATLANTIC STURGEON

The Atlantic sturgeon, *Acipenser oxyrhynchus*, is an anadromous species of the Hudson River. The following account of life history is summarized from Bain *et al.* (1995). Adult Atlantic sturgeon live along the Atlantic coastline for approximately 10 yr before migrating into coastal rivers. Males enter the Hudson River in early April, before the females. Atlantic sturgeon do not spawn annually, with 2-5 yr between spawning events. Spawning occurs well upstream from the salt front; larvae are known to be intolerant of euryhaline environments.

Eggs are demersal and adhesive. The larvae remain close to the river bottom for some time. Juveniles are fairly evenly distributed in the Hudson River during summer, with their highest concentration between Kingston and Haverstraw Bay (Rkm 140 and 63, respectively). After summer, when water temperatures fall below 20°C, juveniles are found in high numbers between the Bear Mountain Bridge and the George Washington Bridge (Rkm 74 and 19, respectively). This tighter distribution is thought to represent an overwintering area for juvenile Atlantic sturgeon. Juveniles move back upstream in early spring, and do not migrate out of the Hudson River until 2-6 yr of age. Adults spend approximately 10 yr at sea before maturation and subsequent inland migration. Males and females mature at different ages, approximately 12 and 15 yr of age, respectively.

SHORTNOSE STURGEON

The shortnose sturgeon, *A. brevirostrum*, is considered to be a nonmigratory, euryhaline fish. In the Hudson and other large rivers, adult shortnose sturgeon overwinter in deep polyhaline water downstream from the spawning grounds to which they will travel in the following spring when water temperatures reach 8-9°C (Dadswell *et al.* 1984). In the Hudson River, spawning occurs in April and May between Coxsackie and Troy (Dadswell *et al.* 1984; Hoff *et al.* 1988). Detailed information on spawning habitat is available for shortnose sturgeon of the Savannah River, South Carolina (Smith *et al.* 1993), which may or may not apply to those of the Hudson River. Adults are thought to move downstream in May and June, after spawning (Hoff *et al.* 1988).

Eggs of the shortnose sturgeon are demersal and adhesive (Dadswell *et al.* 1984). Larvae and juveniles are probably benthic, remaining in deep water where currents are strong (Dadswell *et al.* 1984; Hoff *et al.* 1988). As a result, little is known about the early life stages. In addition, identification of young specimens (eggs, larvae, and juveniles) is extremely difficult because of overall similarity to young Atlantic sturgeon (Hoff *et al.* 1988). Some workers (*i.e.*, Hoff *et al.* 1988) believe that the larvae disperse downstream during summer, whereas others (*i.e.*, Dadswell *et al.* 1984) believe that young shortnose sturgeon remain above the salt front until they reach 45 cm total length (TL). Upon attaining adult size (45-50 cm TL), shortnose sturgeon move downriver in fall, and back upriver in spring (Dadswell *et al.* 1984).

Sexual maturation is thought to be at 3-4 yr of age for males, and probably 6-8 yr of age for females, in the Hudson River (Dadswell *et al.* 1984). The age of maturation for females is based on age at first spawning. It is unknown how frequently shortnose sturgeon in the Hudson River spawn; in Canada, females spawn every 3 yr, and males every other year (Dadswell *et al.* 1984).

ALEWIFE

The alewife, *Alosa pseudoharengus*, is an anadromous species of the Hudson River (Schmidt and Stillman 1994). Adult alewife spend most of the year in coastal Atlantic waters, migrating into the Hudson River (and other estuaries) to spawn. Alewife probably return to their natal river to spawn (Klauda *et al.* 1991). Alewife usually enter the Hudson River in early spring, prior to mid-May (Schmidt *et al.* 1988).

Spawning usually occurs in freshwater tributaries, in relatively shallow water with a slow current (Schmidt *et al.* 1988); in fact, the alewife is the only anadromous fish species commonly found in freshwater tributaries of the Hudson River (Schmidt and Stillman 1994). Eggs and larvae are not morphologically distinguishable from those of blueback herring (*A. aestivalis*), and for this reason, the two species are typically referred to as "river herring"

(Dovel 1981; Schmidt *et al.* 1994). The role of blueback herring in tributaries is still unclear; however, because adult alewife are frequently sampled from freshwater tributaries during the spawning season, it has been assumed that most, if not all, of the eggs and larvae found in the freshwater tributaries are alewife (Schmidt *et al.* 1994). This contradicts earlier findings in which alewife eggs and larvae were presumed to be present in the main river channel (Boreman 1981). In addition to the differences in spawning location, larvae and eggs can also be distinguished by their temporal distribution, because alewife spawn about a month earlier than blueback herring (Hildebrand and Schroeder 1928; Schmidt *et al.* 1988).

Eggs are essentially pelagic, somewhat adhesive, and demersal in still water (Hildebrand 1963; Norden 1967; Lippson and Moran 1974; Klauda *et al.* 1991). In the Chesapeake Bay area, alewife larvae and juveniles may move further upstream to avoid intrusion of saltwater (Klauda *et al.* 1991). Larvae and juveniles remain in the freshwater tributaries of the Hudson River until June. At this time, juvenile alewife move out of the nursery areas of the tributaries and make their way downstream to the lower Hudson River and into the Atlantic Ocean (Schmidt *et al.* 1988), although capture of yearlings suggests some may overwinter in the estuary during the first year of life.

Alewife feed primarily on amphipods, mysids, copepods, small fish, and fish eggs (Leim and Scott 1966).

BLUEBACK HERRING

The blueback herring, *A. aestivalis*, is an anadromous fish of the Hudson River (Klauda *et al.* 1991). Adults remain in coastal waters of the Atlantic Ocean and migrate upriver to spawn, as do alewife. Blueback herring usually spawn later in the spring than alewife, and in different habitat (Schmidt *et al.* 1988). Blueback herring prefer to spawn in relatively deep freshwater with swift currents on hard substrates of either gravel or sand (Schmidt *et al.* 1988; Klauda *et al.* 1991). It has been noted that this habitat preference is mainly seen in northern populations where blueback herring are sympatric with alewife, and, conversely, southeastern blueback herring spawn in lentic as well as lotic water (Klauda *et al.* 1991). It has been observed that blueback herring do not move as far upstream in tributaries as alewife (Loesch 1968, 1969), and recent studies in the Hudson River suggest that blueback herring spawn mainly in the main channel of the estuary, whereas alewife spawn more in tributaries (Schmidt *et al.* 1994). The single peak, seen in late May, in the temporal distribution of "river herring" eggs in the main channel (Boreman 1981) may therefore represent eggs of blueback herring.

Eggs of the blueback herring are pelagic, somewhat adhesive, and demersal in still water (Hildebrand 1963; Norden 1967; Lippson and Moran 1974; Klauda *et al.* 1991). "River herring" larvae found in the main channel of the Hudson River estuary are thought to be blueback herring; larvae probably remain in nearshore habitat (Schmidt *et al.* 1994). Juveniles move downriver in July, later than alewife (Boreman 1981; Schmidt *et al.* 1988).

Food of blueback herring consists mainly of plankton, copepods, pelagic shrimp, and early life stages of small fishes (Scott and Crossman 1973).

AMERICAN SHAD

The American shad, *A. sapidissima*, is a highly migratory species of the Hudson River, and is often cited as a classic example of an anadromous fish. Adults move into the Hudson River from Atlantic waters in early spring, usually beginning in March or April (Boreman 1981), depending on the water temperature of the river, which must be 12°C or above before the shad begin their run (Bigelow and Schroeder 1953). Adult American shad do not eat when running or spawning, and will not do so until they begin the postspawning downriver migration to the Atlantic, eating along the way (Bigelow and Schroeder 1953). Spawning occurs mainly at night (Bigelow and Schroeder 1953; Ross *et al.* 1993), in shallow freshwater of moderate current (Schmidt *et al.* 1988), and on various substrates (Bigelow and Schroeder 1953).

Eggs are demersal and nonadhesive (Bigelow and Schroeder 1953), and hatch after 2-17 days, depending on water temperature (Boreman 1981). Bigelow and Schroeder (1953) report that eggs raised in water at 12°C hatch between 12 and 15 days. Eggs are found in the spawning areas (Boreman 1981), and are not associated with any particular habitat type (Ross *et al.* 1993). In a 1974 study, egg abundance peaked in May (Boreman 1981); yolksac larval abundance has also been reported to peak in May (Schmidt *et al.* 1988). Yolksac larvae absorb their yolk in 4-5 days in water at 17°C (Boreman 1981). Larvae are reported to frequent riffle pools where water is of moderate depth and variable velocity and direction (Ross *et al.* 1993). Both feeding and yolksac larvae are planktonic; dispersal therefore occurs by passive transport (Boreman 1981; Schmidt *et al.* 1988). Juveniles are found downriver from the spawning grounds (Boreman 1981) beginning in June, with peak abundance in July (Schmidt *et al.* 1988). Juvenile habitat preference in the Hudson River seems to be positively correlated with depth, turbidity, and current velocity, possibly as an effect of food distribution (Ross *et al.* 1993). Most juveniles complete their migration from freshwater into the Atlantic by late fall or early winter (Bigelow and Schroeder 1953; Boreman 1981; Schmidt *et al.* 1988).

Adult American shad overwinter in the deep water of the Atlantic and Gulf of Maine (Boreman 1981). They move closer to their natal river in the spring, due to their strong homing ability (Boreman 1981). Adult American shad are euryhaline, but only enter freshwater to spawn (Bigelow and Schroeder 1953).

ATLANTIC TOMCOD

The Atlantic tomcod, *Microgadus tomcod*, is a euryhaline fish of the Hudson River estuary. It is not considered to be migratory *per se*, but does show significant, seasonal, upriver/downriver movement within the estuary. Spawning of Atlantic tomcod takes place under ice, mainly from December to January (Bigelow and Schroeder 1953; Boreman 1981; Klauda, Moos, and Schmidt 1988; McLaren *et al.* 1988; Dew and Hecht 1994). The winter spawning occurs upriver mainly in fresh and possibly in brackish water (Boreman 1981; Klauda, Moos, and Schmidt 1988; Dew and Hecht 1994).

Eggs are demersal (Bigelow and Schroeder 1953; Boreman 1981; Klauda, Moos, and Schmidt 1988). The state of adhesion or nonadhesion of eggs is unknown, due to the difficulty of winter collection; conflicting opinions range from nonadhesive (Boreman 1981), to probably adhesive (Klauda, Moos, and Schmidt 1988), to adhesive (Bigelow and Schroeder 1953). Hatching occurs in freshwater (Dew and Hecht 1994) after 24-60 days in February and March (Klauda, Moos, and Schmidt 1988; Dew and Hecht 1994). Yolksac larvae reach peak abundance in mid-March, and post-yolksac larvae reach peak abundance in mid-April (Klauda, Moos, and Schmidt 1988). The yolksac larval period is approximately 4 wk, and the feeding larval period is approximately 6 wk (Boreman 1981). Larvae disperse downriver to Rkm 19-53 by mid-May (Klauda, Moos, and Schmidt 1988). The lower Hudson River is considered to be a nursery area for young Atlantic tomcod (McLaren *et al.* 1988). Juveniles are thought to peak in mid-May, mainly in the Tappan Zee and Yonkers regions (Klauda, Moos, and Schmidt 1988), although earlier reports show that juveniles did not appear until early August (Boreman 1981). They move upriver in mid-spring (Dew 1995), possibly to remain in brackish water as the salt front moves upriver (Klauda, Moos, and Schmidt 1988).

In the Hudson River, males and females both sexually mature between 11 and 12 mo, during their first fall (Boreman 1981; Klauda, Moos, and Schmidt 1988; McLaren *et al.* 1988). Adult Atlantic tomcod therefore spawn in their first year. Atlantic tomcod are not thought to move out of the Hudson River estuary during their life span, although they are found frequently in mouths of estuaries when not spawning (Bigelow and Schroeder 1953).

BAY ANCHOVY

The bay anchovy, *Anchoa mitchilli*, is a coastal species which enters the lower Hudson River in April as adults (Woodhead *et al.* 1992). Adults are present in the lower estuary in high numbers in the summer, and are absent from the estuary in the winter (Woodhead *et al.* 1992). Egg collections suggest spawning occurs in the lowest regions of the Hudson River and probably out into coastal waters (Boreman 1981). Spawning is typically in water less than 20 m deep (Richards 1959); spawning activity in the lower Hudson River occurs from early June to mid-August and perhaps beyond, as suggested by a study of anchovy spawning in nearby Long Island Sound (Richards 1959). Since the minimum age at maturity is 2.5 mo at a size between 30 and 40 mm (Stevenson 1958), it is likely that bay anchovies spawn in their first year of life.

Eggs are pelagic (Klauda *et al.* 1991) and hatch in about 24 hr; yolksacs are absorbed in another 24 hr (Boreman 1981). Anchovy eggs have been collected in the Hudson River estuary up to Rkm 88 (Boreman 1981). The distribution of young anchovy shifts upriver as development progresses through summer. Post-yolksac larvae metamorphose in August and September (Woodhead *et al.* 1992). Juveniles in Chesapeake Bay prefer freshwater habitats (Klauda *et al.* 1991); this may also be the case for juveniles in the Hudson River as suggested by the upriver shift in distribution mentioned earlier. In the Hudson River, juvenile anchovy emigrate to sea in the fall; few remain in the estuary after November (Woodhead 1991).

Although no tagging studies have been conducted on Hudson River bay anchovy, studies elsewhere suggest that oceanic movements are limited to inshore-offshore migrations (Hildebrand 1963). Bay anchovy feed on detrital material and small planktonic animals in the Hudson River estuary (Boyce Thompson Institute for Plant Research 1977).

BLUEFISH

Bluefish (*Pomatomus saltatrix*) are ocean spawners; larval and early juvenile development also occurs offshore. Bluefish first appear in estuaries as juveniles and, in the Northeast, usually arrive in the lower Hudson in late summer and fall (Boyle 1968). The distribution of larvae offshore is fairly well studied (Kendall and Walford 1979), but that of early juveniles is less known. Very little information is available on habitat requirements, food habits, or multispecies interactions in the oceanic phase. Juvenile bluefish generally appear in nearshore coastal waters in two waves, one in spring and another in summer, suggesting two spawning periods or a protracted spawning season offshore (Sargent and Boreman 1984).

In estuaries, juvenile bluefish are piscivorous, feeding on a wide variety of prey items (Marks and Conover 1993). Juvenile bluefish in the Hudson River feed on bay anchovy, white perch, American shad, river herring, and striped bass (Texas Instruments 1976b; Juanes *et al.* 1993).

LARGEMOUTH BASS

The largemouth bass, *Micropterus salmoides*, is a freshwater-oligohaline, nonmigratory species inhabiting the Hudson River. When preparing to spawn, adult largemouth bass select appropriate sites in which to construct nests and to fertilize and deposit eggs. In the Hudson River, spawning and nesting habitat typically consists of protected coves and bays, and almost never exposed shoreline (Nack *et al.* 1993). Miller and Kramer (1971) found high mortality rates for eggs and larvae due to exposure to wind-induced waves, which explains why largemouth bass seem to prefer lentic habitat. Also, while specific effects of tidal action on developing eggs are unknown, stable water levels are associated with high recruitment (Von Geldern 1971). Nesting in coves and bays may slightly mitigate effects of tidal action. Temperature may be an important environmental cue for the timing of spawning because the early season nests seem to be in areas of warmer water (Nack *et al.* 1993).

Eggs are adhesive, sticking to one another in a mass and to the substrate upon which they are laid, such as gravel or roots (Breder and Rosen 1966). Male largemouth bass guard the nests, even after the eggs have hatched (Breder and Rosen 1966). Larvae and juveniles use the area around nesting sites as nursery habitat (Green *et al.* 1988; Green *et al.* 1989; Nack *et al.* 1993). Presumably, these preadult life stages remain in the tributaries where they would be protected from waves, unstable water levels, as well as some predators.

Adult largemouth bass also prefer lentic water in protected areas, especially in winter (Carlson 1992). Largemouth bass are believed to seek shelter from tide-affected areas in winter when their metabolic rates are low (Carlson 1992). Largemouth bass tend to leave overwintering sites when water temperature rises to 10°C (Nack *et al.* 1993).

STRIPED BASS

Striped bass (*Morone saxatilis*) spawn in the fresh-brackish reach of the Hudson River, concentrating between Rkm 54 and 88, from early May through June (Boreman 1981). Striped bass eggs are semibuoyant (Hardy 1978). The yolksac larval stage runs 3-6 days, and the feeding (post-yolksac) larval stage may last 4 wk (Boreman and Fletcher 1993). The distribution of the early life stages in the river has been well documented (*e.g.*, see Boreman and Klauda 1988), showing that the fish distribute both upriver and downriver as they develop. Timing of movement of juveniles out of estuarine nursery areas varies among stocks; in the Hudson River, age 0 fish move out of the river to estuaries in Long Island Sound and New Jersey. By age 1, these fish are participating in coastal migrations. Temperature is usually implicated in triggering migrations, but further studies relating movement and environmental conditions or prey availability seem warranted. Coastal movement of striped bass tagged in the Hudson River is extensive, but concentrated between Cape May and Cape Cod (McLaren *et al.* 1981).

Food habits studies conducted in the estuary (Texas Instruments, Inc. 1976a) suggest that age-0 striped bass feed primarily on harpacticoid, calanoid, and cyclopoid copepods, *Gammarus* spp., and chironomid larvae, progressing to fish as they age. Striped bass greater than 75 mm feed on bay anchovies, and striped bass greater than 116 mm feed on clupeids, Atlantic tomcod, mummichogs, *Morone* spp., and banded killifish. White perch, bluefish, Atlantic tomcod, largemouth bass, and smallmouth bass have been reported as potential predators on striped bass larvae (McFadden *et al.* 1978).

WHITE PERCH

In the Hudson River, the white perch, *M. americana*, is a nonmigratory euryhaline species which is widely distributed throughout the river. Spawning occurs from April to June (Bigelow and Schroeder 1953; Klauda, McLaren, *et al.* 1988) or July (Boreman 1981), with peak egg deposition in mid-May to early June in the upper Hudson (Klauda, McLaren, *et al.* 1988). Spawning takes place mainly in freshwater (Englert and Sugarman 1988; Klauda, McLaren, *et al.* 1988) in a variety of protected habitats, such as shallow flats, embayments, and tidal creeks (Klauda, McLaren, *et al.* 1988).

Eggs are demersal and adhesive (Bigelow and Schroeder 1953), and hatch after only 1.5-2 days (Boreman 1981). Yolksac larvae are found in the same areas as the eggs, probably as a result of the short duration of the larval stages (3-5 days) (Klauda, McLaren, *et al.* 1988). Feeding larvae are more widely distributed due to their higher mobility, and disperse downriver in July (Klauda, McLaren, *et al.* 1988). This finding on post-yolksac larval distribution conflicts with earlier sampling data from the 1970s which indicated that both egg and larval stages are widely distributed in the Hudson, with larval stages found between Rkm 39 and 201 (Boreman 1981). Juveniles first appear in June, dispersing downriver and into the shorezone during the end of summer; juveniles were mainly found close to shore in October, but then moved into deeper water by December (Klauda, McLaren, *et al.* 1988).

Adult white perch sexually mature at age 4 in males, and age 5 in females (Klauda, McLaren, *et al.* 1988). There is no known habitat preference for adults; they are widely distributed in the Hudson River in both brackish and freshwater habitats (Klauda, McLaren, *et al.* 1988), but remain in the river for their entire life span (Boreman 1981).

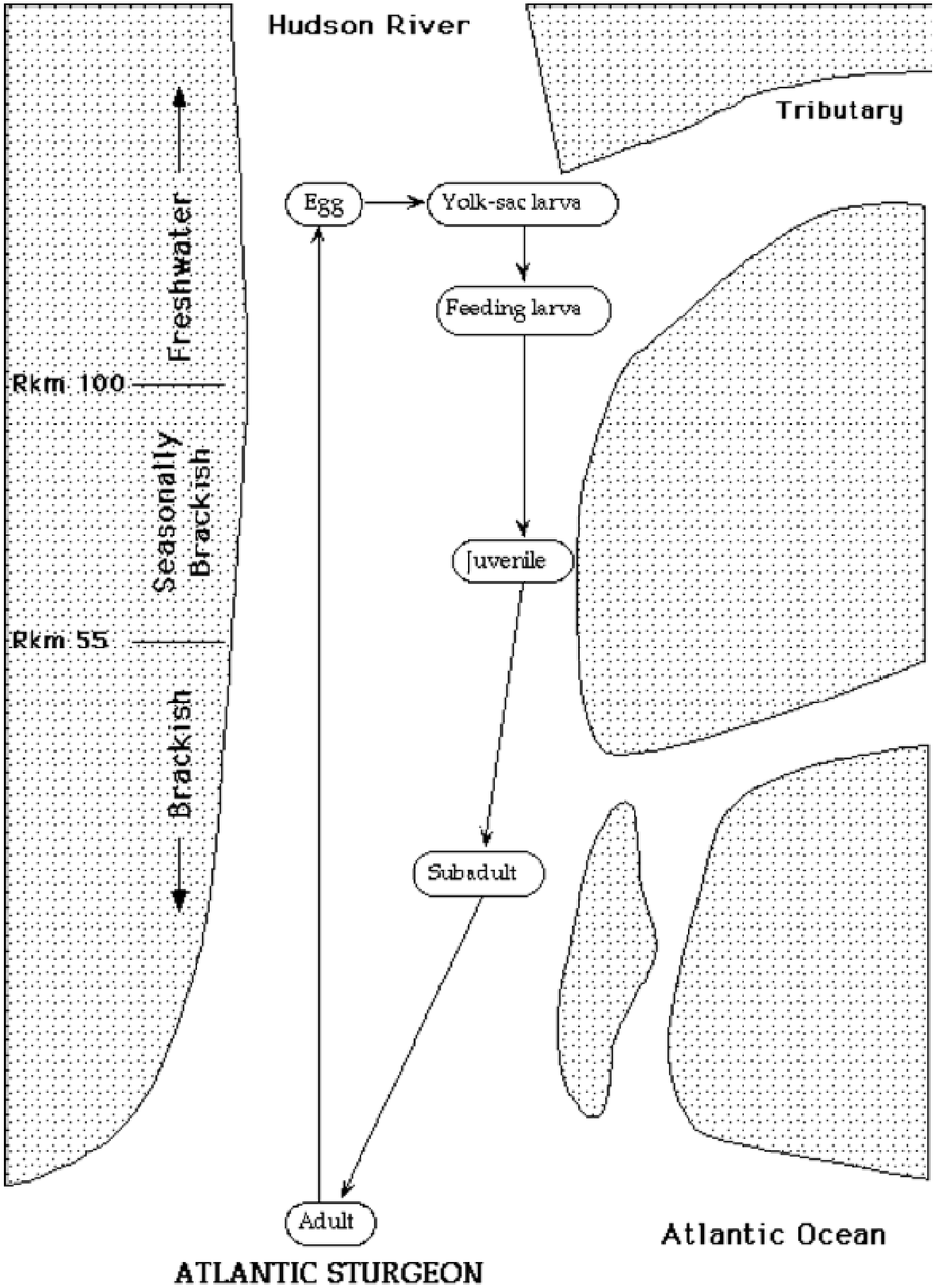

Figure A-1. Spatial representation of the life history of the Atlantic sturgeon in the Hudson River estuary

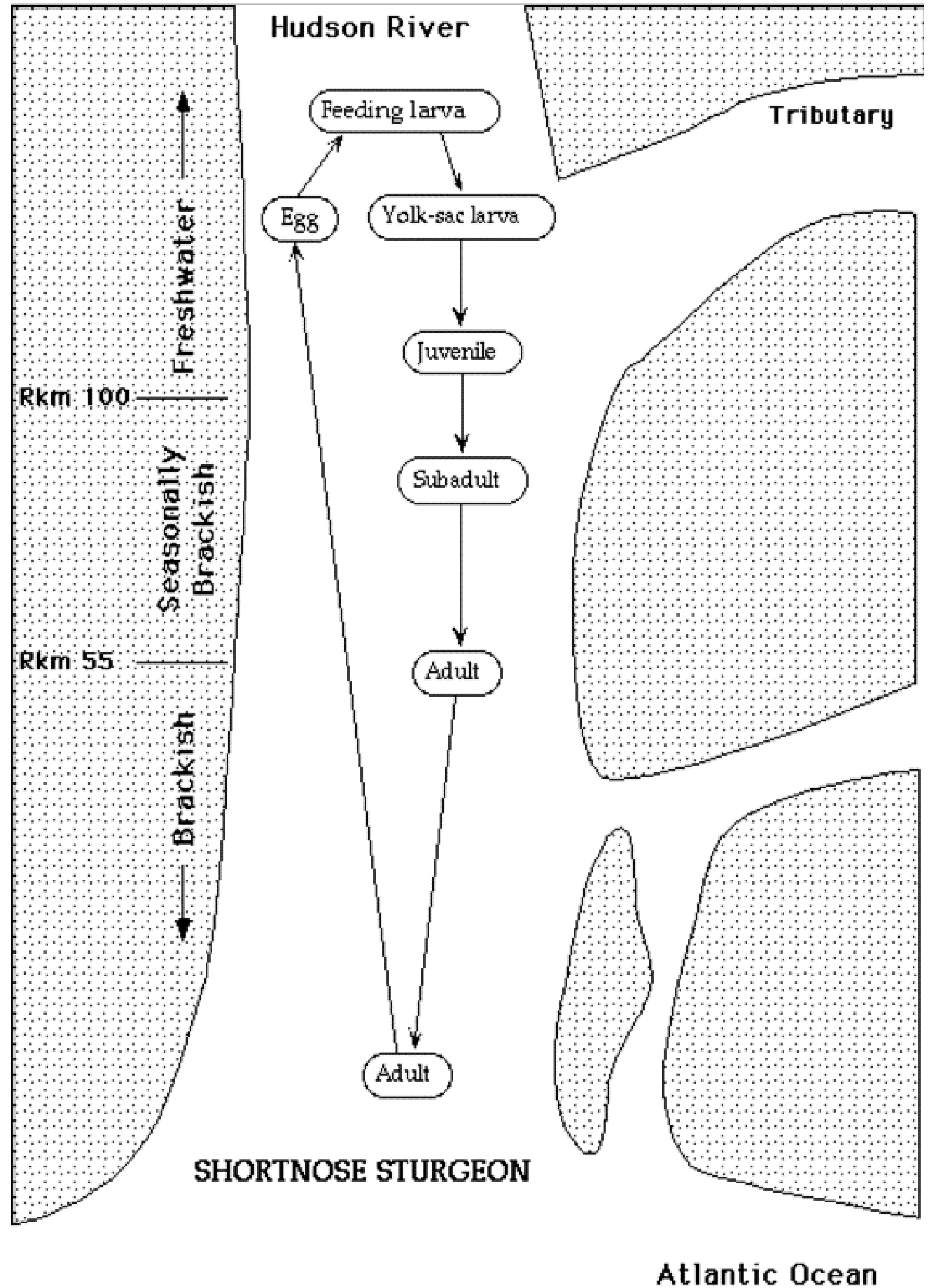

Figure A-2. Spatial representation of the life history of the shortnose sturgeon in the Hudson River estuary

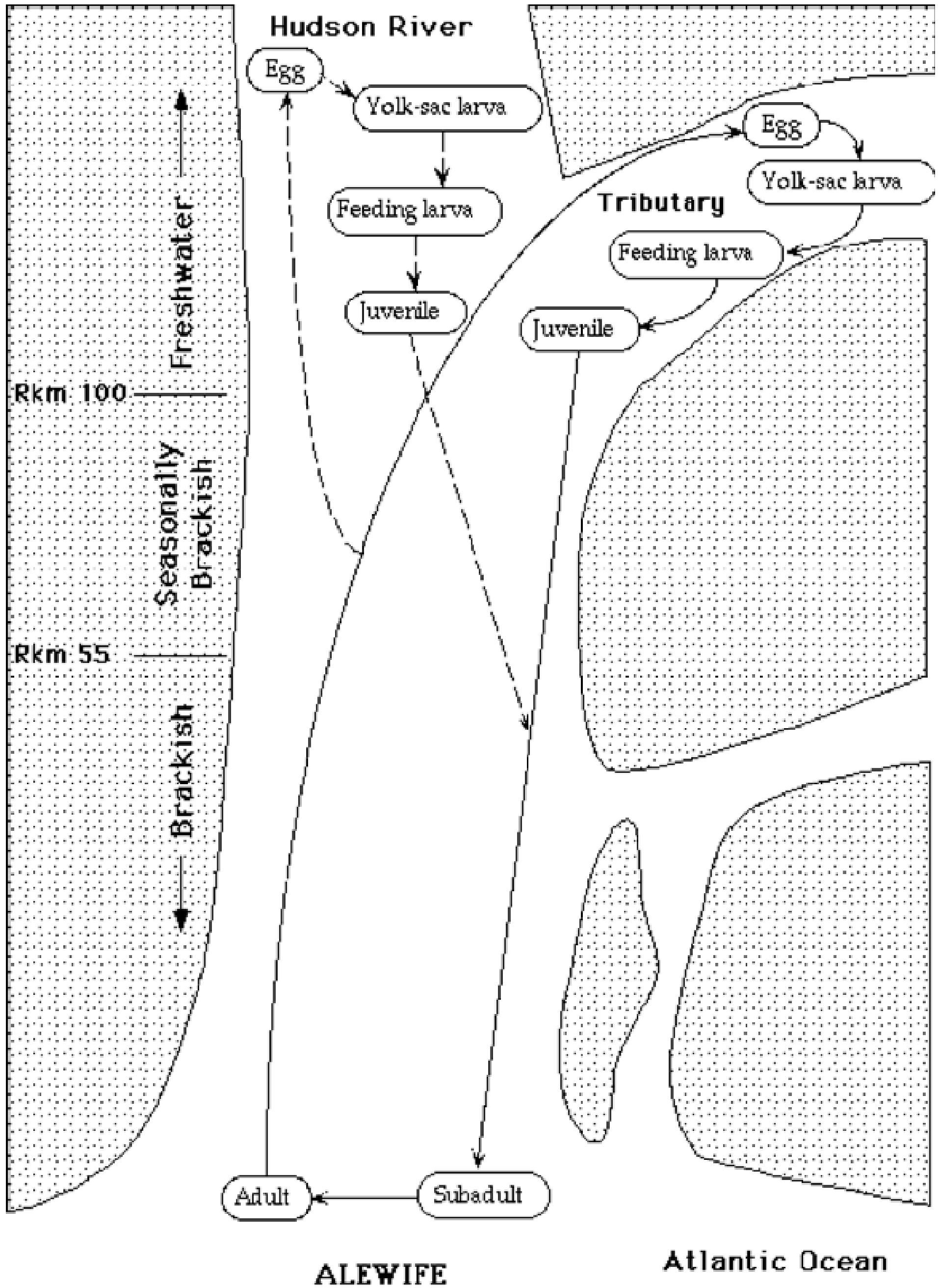

Figure A-3. Spatial representation of the life history of the alewife in the Hudson River estuary

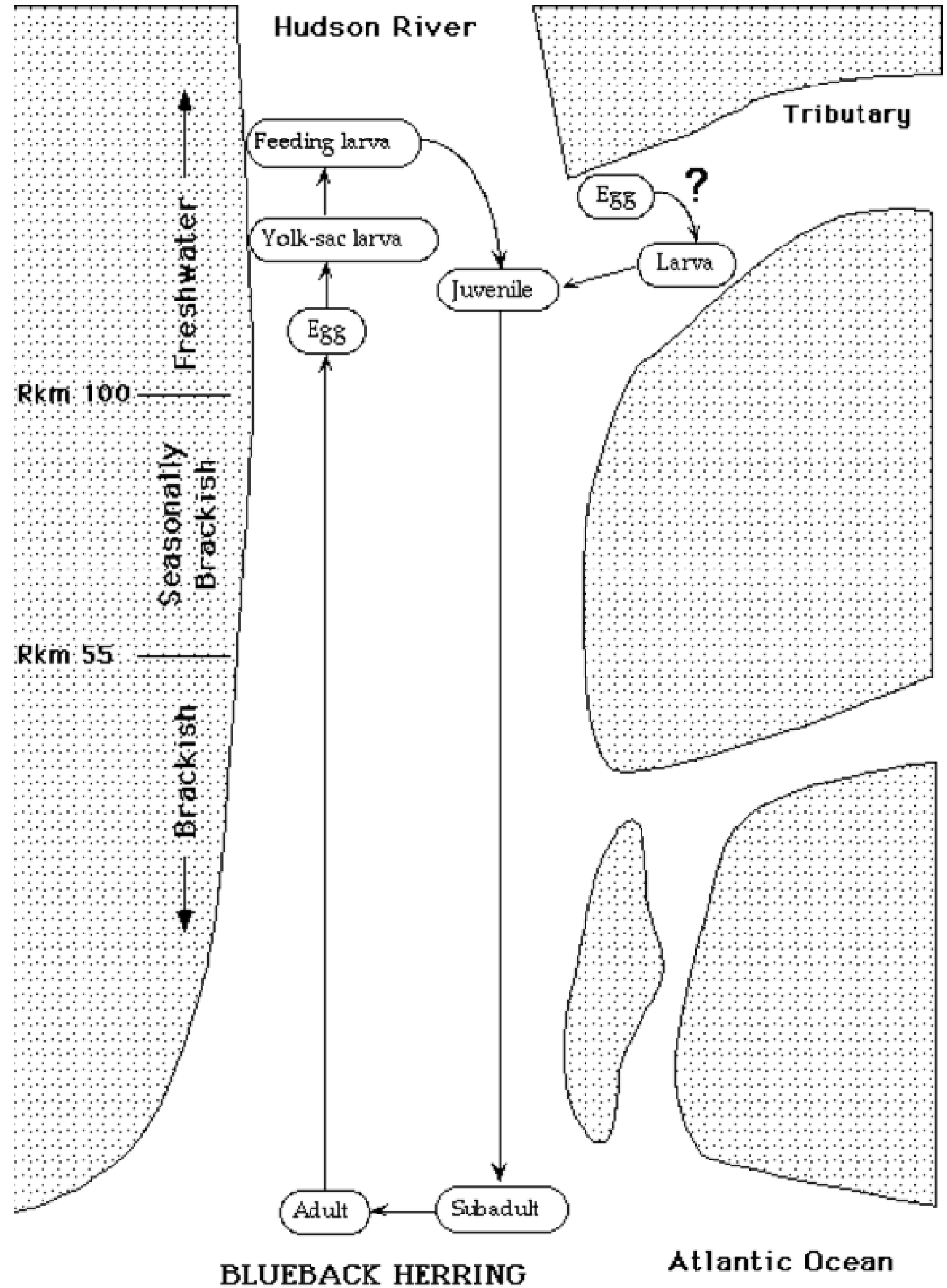

Figure A-4. Spatial representation of the life history of the blueback herring in the Hudson River estuary

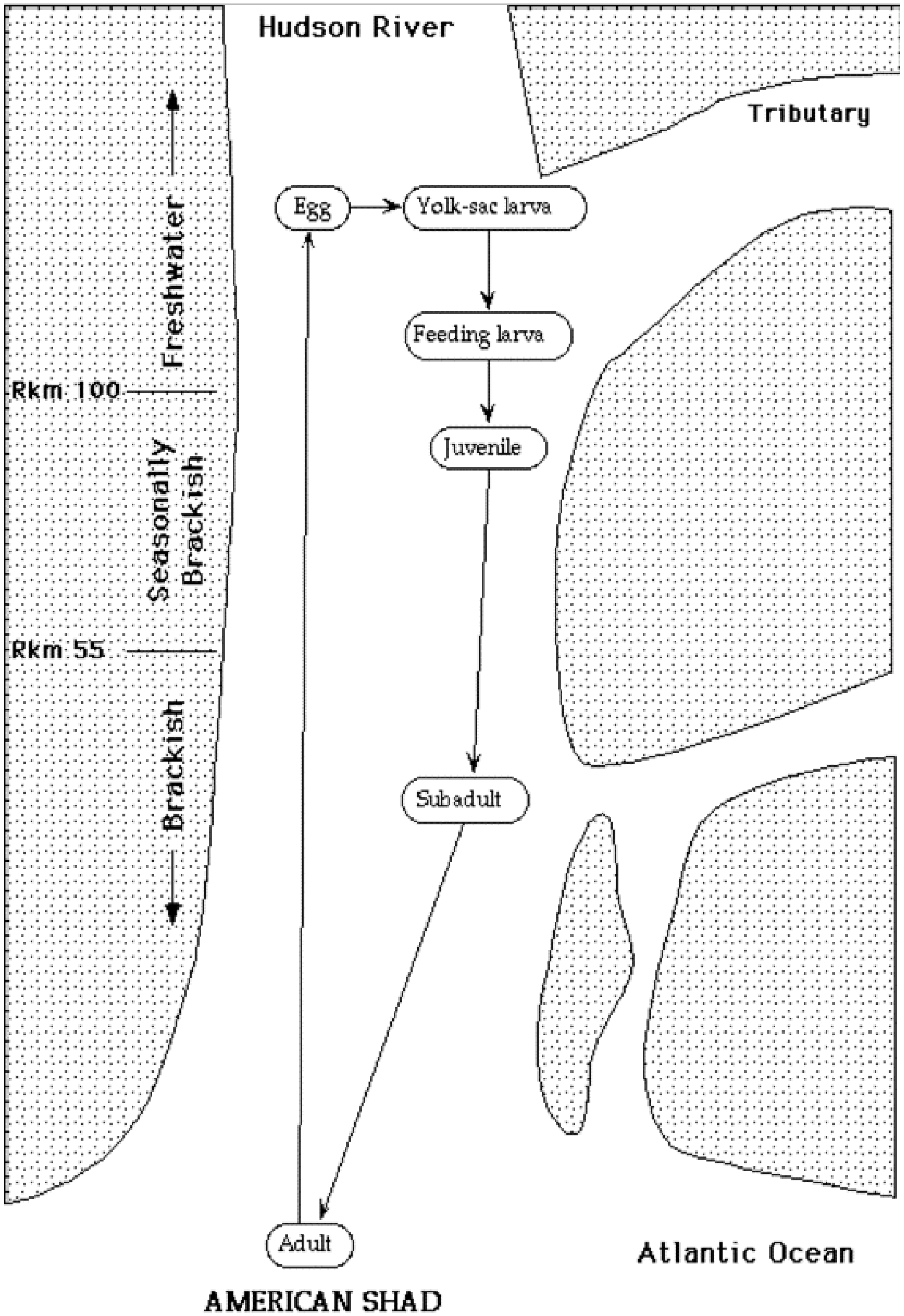

Figure A-5. Spatial representation of the life history of the American shad in the Hudson River estuary

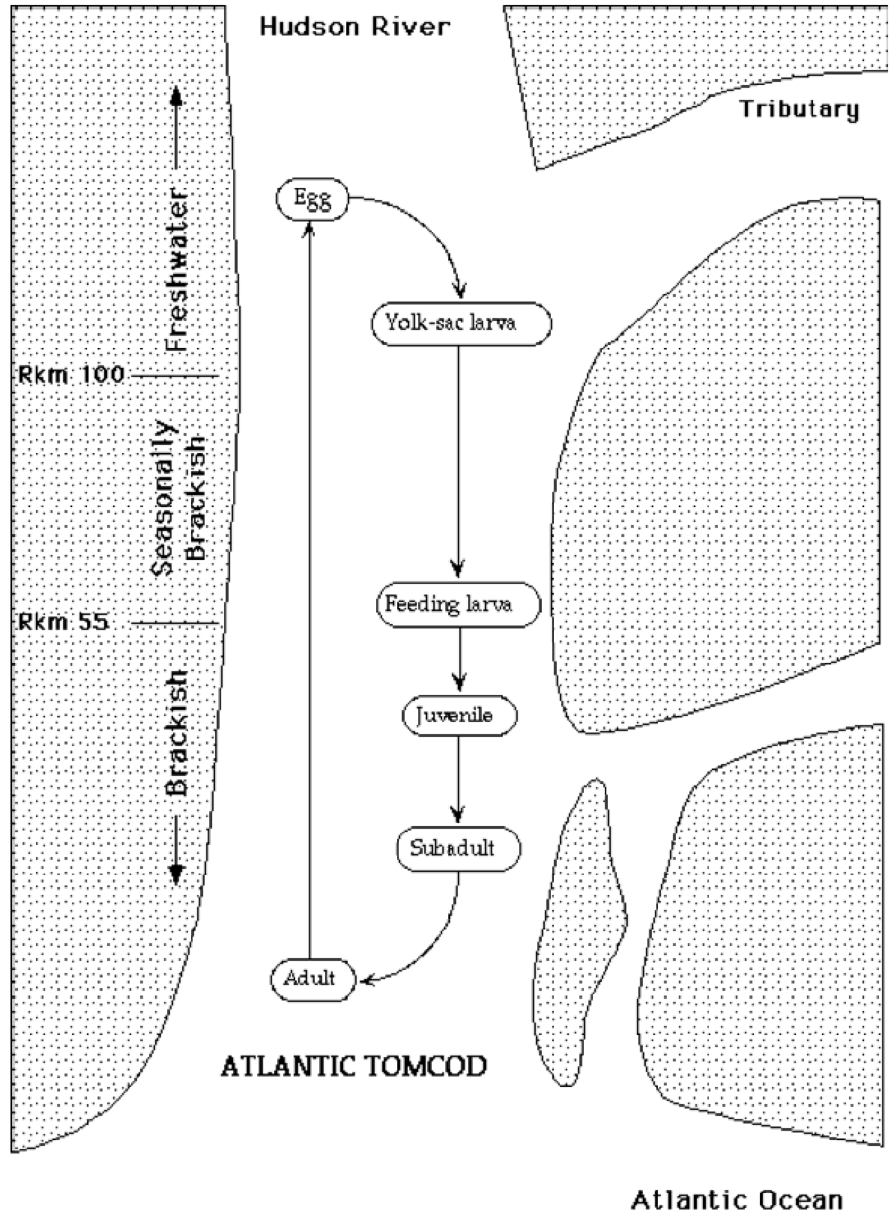

Figure A-6. Spatial representation of the life history of the Atlantic tomcod in the Hudson River estuary

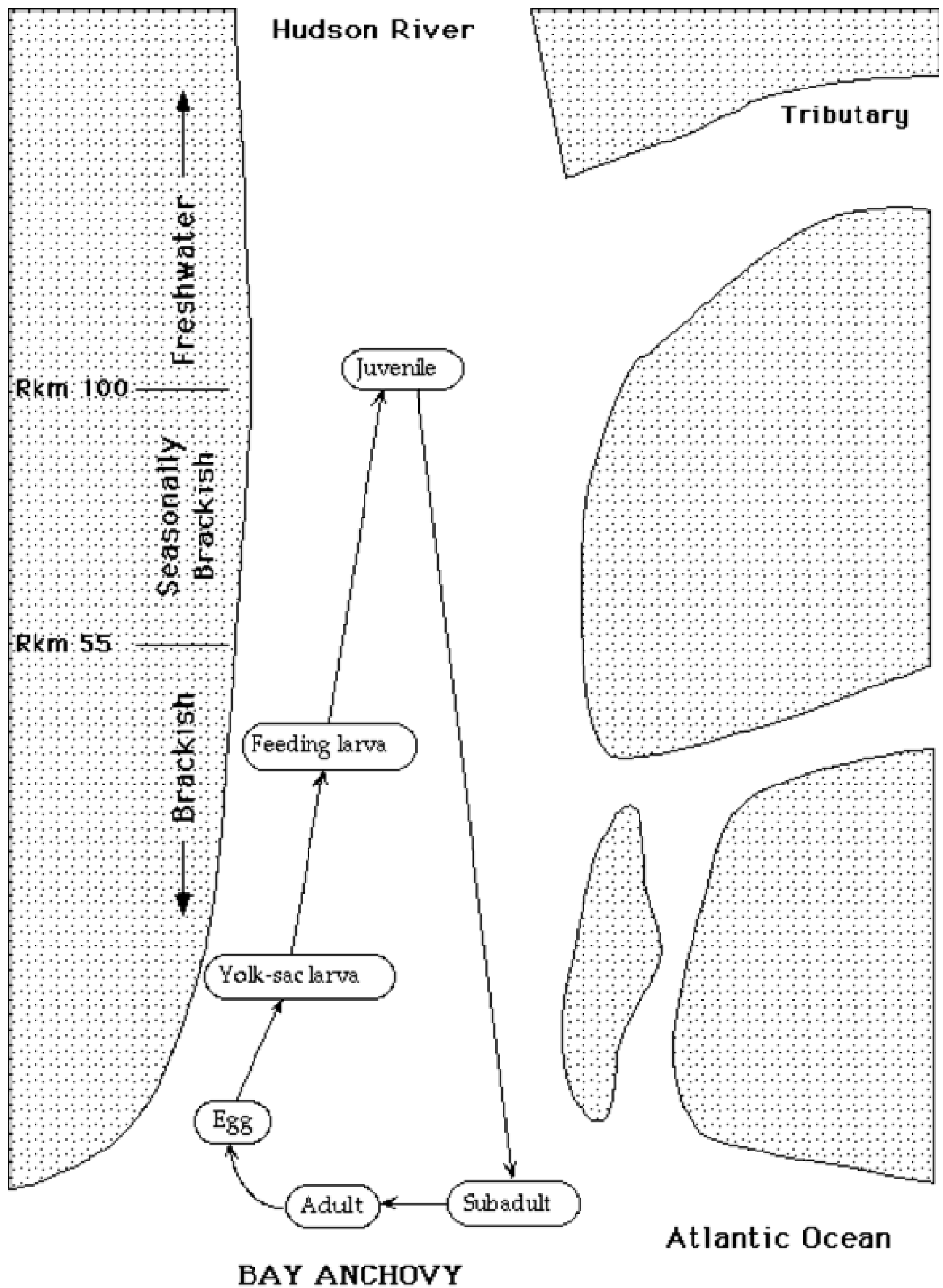

Figure A-7. Spatial representation of the life history of the bay anchovy in the Hudson River estuary

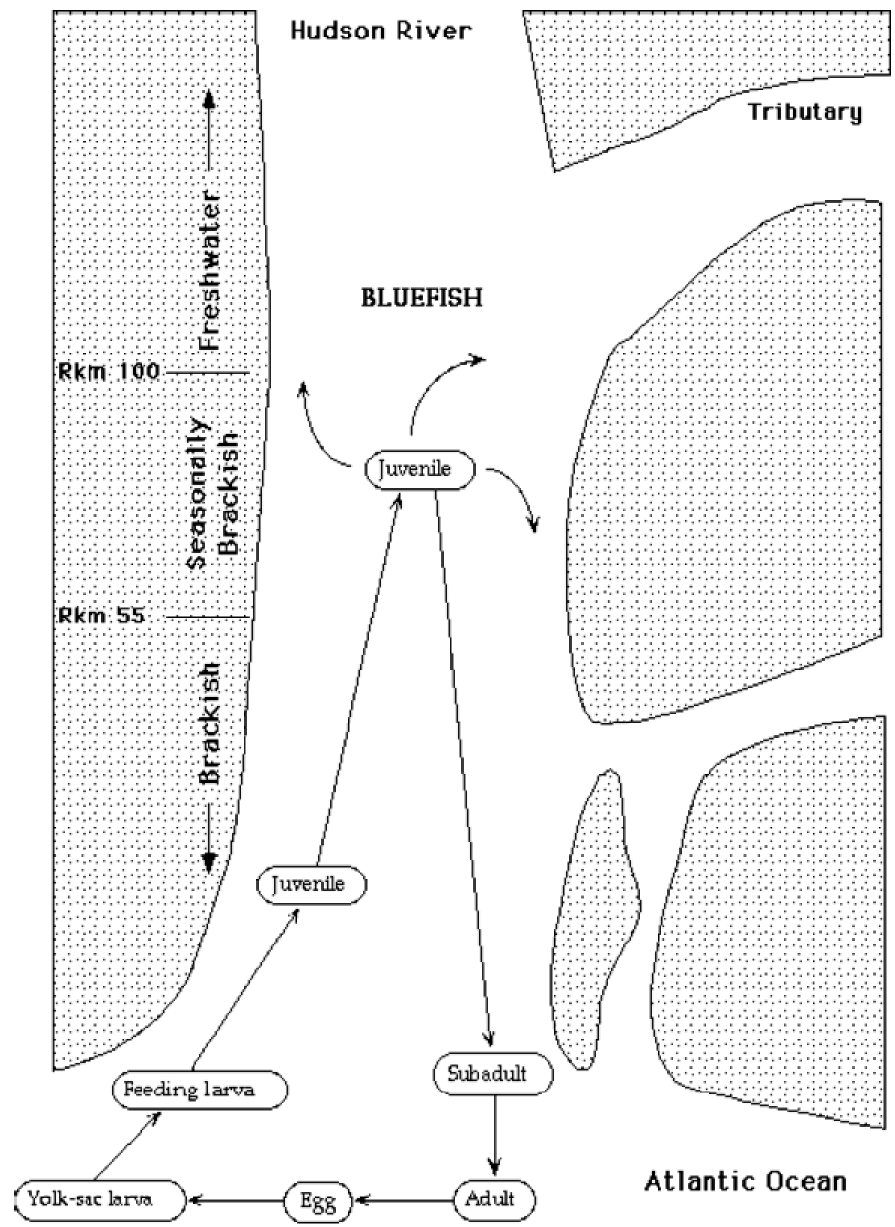

Figure A-8. Spatial representation of the life history of the bluefish in the Hudson River estuary

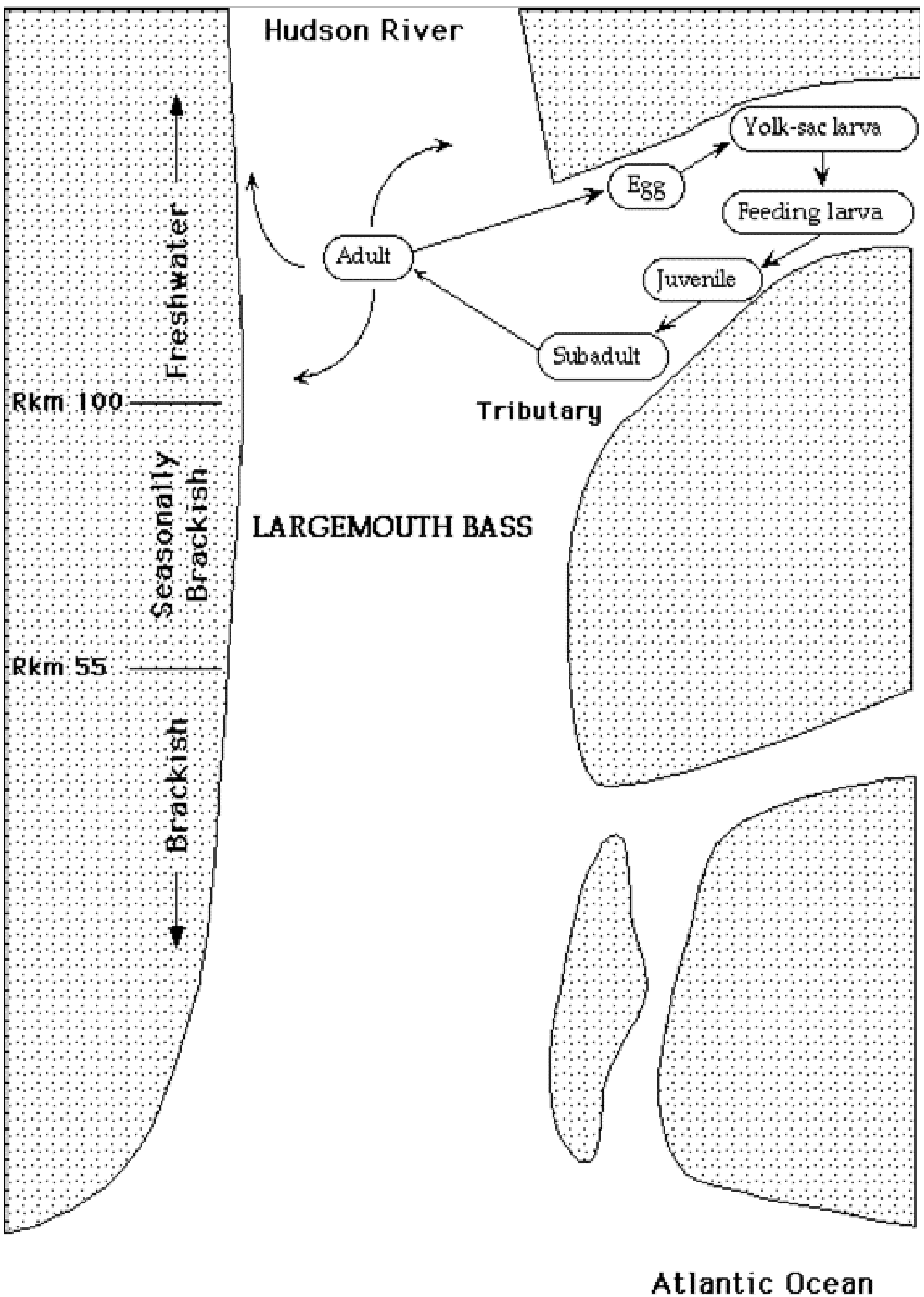

Figure A-9. Spatial representation of the life history of the largemouth bass in the Hudson River estuary

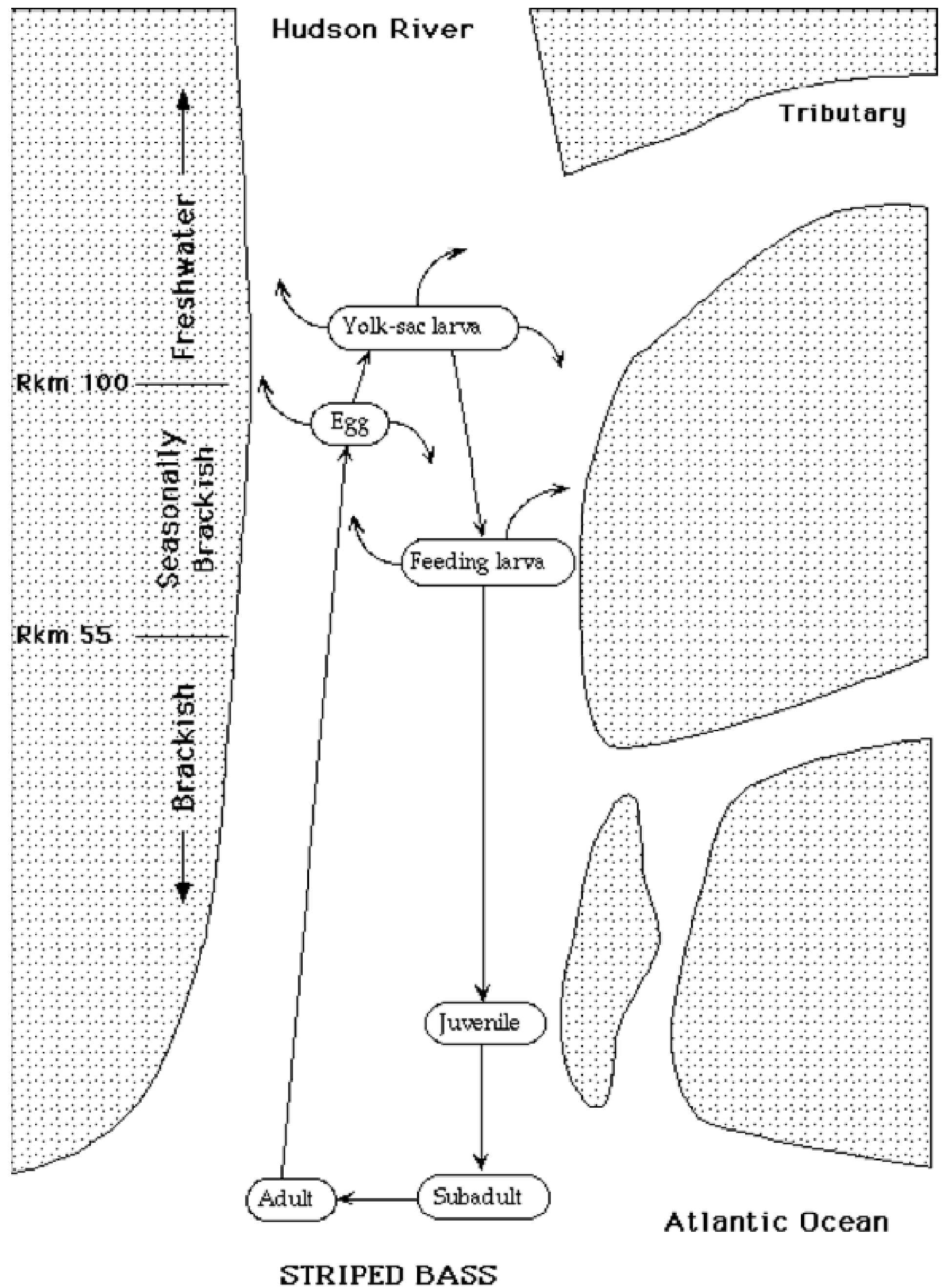

Figure A-10. Spatial representation of the life history of the striped bass in the Hudson River estuary

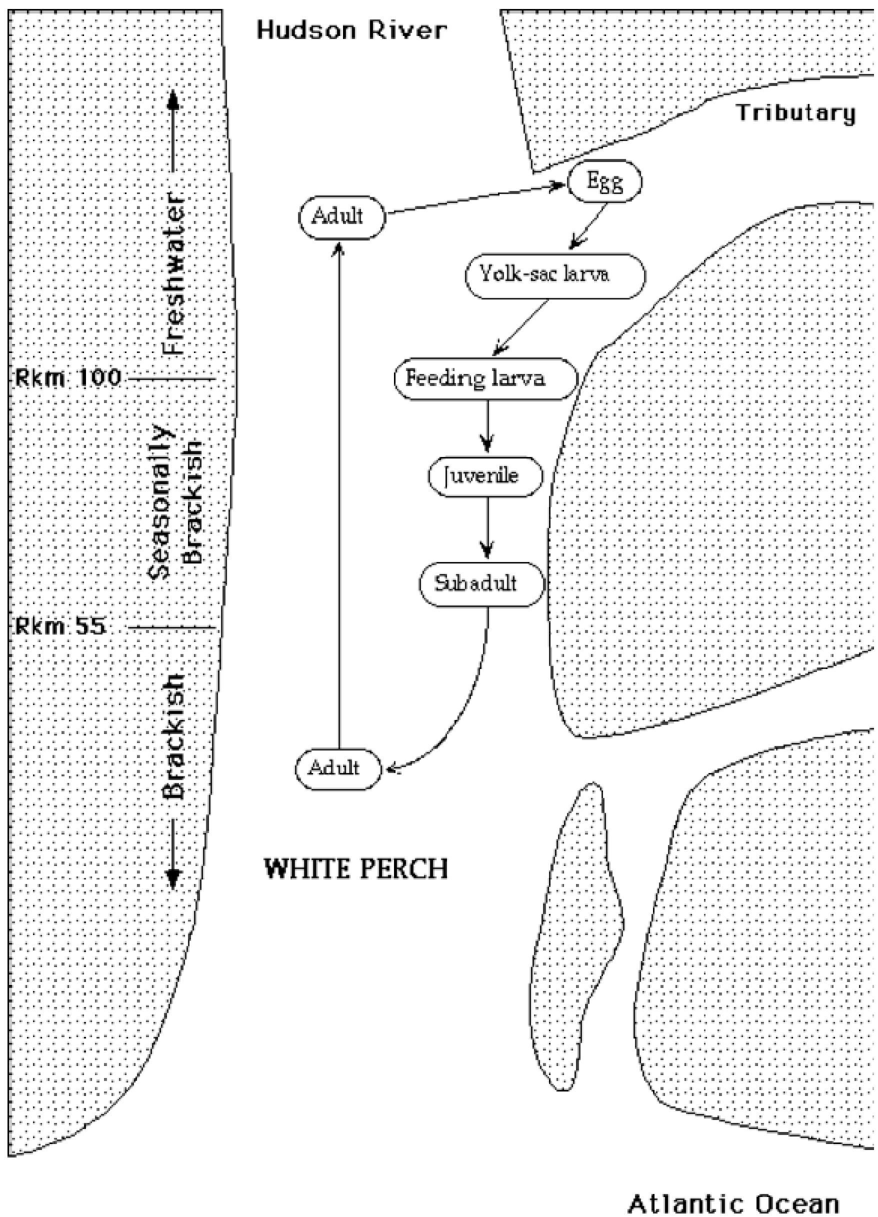

Figure A-11. Spatial representation of the life history of the white perch in the Hudson River estuary

APPENDIX B

List of Agencies, Organizations, and Individuals Contacted to Determine the Extent of Unpublished Information Related to Habitat Use by the Selected Fish Species Inhabiting the Hudson River Estuary

AGENCIES AND ORGANIZATIONS

American Museum of Natural History
Bard College
Central Hudson Gas and Electric
Consolidated Edison Co.
Cornell University
Hudson River Foundation
Hudson River National Estuarine Research Reserve
Hudson River Sloop *Clearwater*
Hudson Riverkeeper
Hudsonia, Ltd.
Institute of Ecosystem Studies
Lawler, Matusky and Skelly Engineers
Maryland Department of Natural Resources
National Marine Fisheries Service
New York State Museum
New York Power Authority
New York State Department of Environmental Conservation
New York State Department of State
Orange and Rockland Utilities
Rutgers University
Scenic Hudson, Inc.
Simon's Rock College
State University of New York at Stony Brook
The River Project
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
University of Maryland Chesapeake Biological Laboratory
University of Massachusetts
University of South Alabama

INDIVIDUALS

Name & Mailing Address at Time of Contact	Remarks
Kenneth Able Marine Field Station Institute of Marine and Coastal Sciences Rutgers University 800 Great Bay Blvd. Tuckerton, NJ 08087	Research on striped bass in the Hudson River
Mark B. Bain Department of Natural Resources Cornell University Ithaca, NY 14853-3001	Research on shortnose sturgeon in the Hudson River

Barbara Brown
Department of Ichthyology
American Museum of Natural History
Central Park West & 79th St.
New York, NY 10024

Detailed information available on cataloged specimens from the Hudson River; all 11 species represented by most life stages

Jeffrey A. Buckel
Marine Science Research Center
State University of New York at Stony Brook
Stony Brook, NY 11794

Research on bluefish in the Hudson River

Gregory L. Capobianco
Coastal Program
New York State Department of State
162 Washington Ave., 4th Fl.
Albany, NY 12231

Head of Significant Habitat Unit; has worked on Hudson River significant habitat

John Catena
Northeast Regional Operations Office
National Marine Fisheries Service
1 Blackburn Dr.
Gloucester, MA 01930

David Conover
Marine Science Research Center
State University of New York at Stony Brook
Stony Brook, NY 11794

Research on bluefish in the Hudson River

James Cowan
Department of Marine Science
University of South Alabama
Mobile, AL 36688

Research on bay anchovy in Chesapeake Bay

John Cronin
P.O. Box 130
Garrison, NY 10524

Hudson Riverkeeper

Robert A. Daniels
Biological Survey Laboratory
New York State Museum
145 Jordan Rd.
Troy, NY 12180

Information available on cataloged specimens from the Hudson River; all 11 species represented, mainly young-of-the-year and adult stages

Cathy Drew
The River Project
67 Vestry St.
New York, NY 10013

Executive Director

Dennis Dunning
New York Power Authority
123 Main St.
White Plains, NY 10601

Research on striped bass in the Hudson River

Fran Dunwell
New York State Department
of Environmental Conservation
21 S. Putt Corners Rd.
New Paltz, NY 12561-1696

Information on the Hudson River as it pertains to New York State government

David M. Green
Biological Field Station
Cornell University
900 Shakelton Point Rd.
Bridgeport, NY 13030

Research on largemouth bass in the Hudson River

Thomas Halavik
Coastal Ecosystems Project
U.S. Fish and Wildlife Service
Shoreline Plaza, Rt. 1A
P.O. Box 307
Charlestown, RI 02813

Senior biologist heading study on "Significant Habitat and Habitat Complexes of the New York Bight Watershed"

Len Houston
Environmental Analysis Branch
New York District
U.S. Army Corps of Engineers
26 Federal Plaza
New York, NY 10278

This office is putting together, along with the New York State Department of Environmental Conservation, a restoration plan for the Hudson River

Francis Juanes
Department of Forestry and Wildlife
University of Massachusetts
Amherst, MA 01003

Research on bluefish in the Hudson River; recruitment and feeding, in particular

Andrew W. Kahnle
Hudson River Fisheries Unit
New York State Department of Environmental Conservation
61 Yankee Folly Rd.
New Paltz, NY 12561

Hudson River fisheries for the New York State Department of Environmental Conservation; New York state sturgeon regulations, 1992; research on American shad and striped bass in the Hudson River

Eric Kiviatt
Hudsonia, Ltd.
Bard College Field Station
Annandale, NY 12504

Research on natural and social science aspects of Hudson River management

Ronald J. Klauda
Research & Monitoring Division
Tidewater Administration - Chesapeake Bay
Maryland Department of Natural Resources
580 Taylor Ave., B2
Annapolis, MD 21401

Research on striped bass, white perch, shortnose sturgeon, American shad, Atlantic tomcod, and alewife in the Hudson River

Tom Lake
Hudson River Almanac
New York State Department of Environmental Conservation
3 Steinhaus Ln.
Wappinger Falls, NY 12590

Cara Lee
Scenic Hudson, Inc.
9 Vassar St.
Poughkeepsie, NY 17601

Environmental Director; also Director of Hudson River Improvement Fund

Karin Limburg Institute of Ecosystem Studies Box AB Millbrook, NY 12545	Research on alewife, blueback herring,American shad, and general fish ecology in the Hudson River
Wayne Mancroni Central Hudson Gas and Electric 284 South Ave. Poughkeepsie, NY 12602	
Kim McKown Marine Resources New York State Department of Environmental Conservation 205 Belle Meade Rd. East Setauket, NY 11733	Research on striped bass in the Hudson River; sturgeon regulations with Andrew W. Kahnle
Andrew Milliken Coastal Ecosystems Project U.S. Fish and Wildlife Service Shoreline Plaza, Rt. 1A P.O. Box 307 Charlestown, RI 02813	
William Neider Hudson River National Estuarine Research Reserve Bard College Field Station Annandale, NY 12504	Research coordinator for the reserve
Michael Pace Institute of Ecosystem Studies Box AB Millbrook, NY 12545	Research on striped bass in the Hudson River
William D. Sasken Orange and Rockland Utilities 1 Blue Hill Plaza Pearl River, NY 10965	
Robert Schmidt Simon's Rock College Great Barrington, MA 01230	Research on alewife and blueback herring in the Hudson River with particular knowledge of freshwater tributary habitat
David H. Secor Chesapeake Biological Laboratory University of Maryland P.O. Box 38 Solomons, MD 20688	Research on striped bass and Atlantic sturgeon in the Hudson River
C. Lavett Smith Department of Ichthyology/Herpetology American Museum of Natural History Central Park West & 79th St. New York, NY 10024	Editor of several books on Hudson River fishes

Nancy Steinberg Hudson River Foundation 40 West 20th St. New York, NY 10011	Research on young-of-the-year bluefish in the Hudson River;head of library at the Hudson River Foundation
Dennis Suzskowski Hudson River Foundation 40 West 20th St. New York, NY 10011	
John Waldman Hudson River Foundation 40 West 20th St. New York, NY 10011	Research on striped bass and Atlantic sturgeon in the Hudson River
Alan Wells Lawler, Matusky and Skelly Engineers 1 Blue Hill Plaza P.O. Box 1509 Pearl River, NY 10965	
John Young Consolidated Edison Co. 4 Irving Place New York, NY 10003	

APPENDIX C

User's Guide to the Database

ABOUT THE DATABASE

Literature references, representing mostly published papers and unpublished reports, for 11 fish species which are considered important and representative of the fish community of the Hudson River estuary, have been assembled into a database. The 11 fish species are: Atlantic sturgeon, *Acipenser oxyrhynchus*; shortnose sturgeon, *A. brevirostrum*; American shad, *Alosa sapidissima*; alewife, *A. pseudoharengus*; blueback herring, *A. aestivalis*; bay anchovy, *Anchoa mitchilli*; bluefish, *Pomatomus saltatrix*; Atlantic tomcod, *Microgadus tomcod*; striped bass, *Morone saxatilis*; white perch, *M. americana*; and largemouth bass, *Micropterus salmoides*. The record of each literature reference in the database includes 18 fields, among which are fields for "fish species," "geography," and "(other) keywords" (Table C-1). The 62 "other keywords" which were most often used in the database to describe the habitat use and requirements of the 11 species are listed in Table C-2.

DATABASE ACCESS AND USE

The database currently exists in three formats to enable public access and use, and will eventually exist in a fourth format for such purposes. The first format of the database is an annotated bibliography of the literature references which is presented in a paper printing of this report. Each entry in that bibliography is annotated with keywords on fish species, geography, and "other" keywords. That annotated bibliography is Appendix D ("List of Published and Unpublished Works Containing Information That May Be Relevant to Habitat Requirements and Use by the Selected Fish Species Inhabiting the Hudson River Estuary") of this report.

The second format of the database is the same annotated bibliography as presented in the paper printing, but is one which has been electronically posted. The electronic posting is part of the HTML and PDF publishing of this report on the Northeast Fisheries Science Center's (NEFSC's) Internet webpage on "Reports and Publications" (*http://www.nefsc.nmfs.gov/nefsc/publications/*). The HTML version can be searched with the search engine associated with the user's Internet access software (*e.g.*, Netscape Navigator, Microsoft Internet Explorer).

The third format of the database is one prepared with FileMaker® database software (FileMaker, Inc., 5201 Patrick Henry Dr., P.O. Box 58168, Santa Clara, CA 95054-8168). To access and use this format, one must have either FileMaker 4 or 5 software installed on his/her computer, and must request the actual data to be sent as an e-mail attachment from the NEFSC's Editorial Office (*Jon.Gibson@noaa.gov*). The FileMaker database contains complete instructions -- through its "Help" menu -- for the user, and permits searches on either single or multiple items (*i.e.*, fish species, "other" keywords, and authors).

The fourth format of the database, which will not be available until several years after the first three formats have been prepared, will be the tagging of the annotated bibliography with XML. The XML-tagged bibliography will be part of an XML-based system for searching and retrieving a wide array of information from an extensive collection of NEFSC-produced scientific works.

Table C-1. Fields associated with records in the database on habitat use and requirements of important fish species inhabiting the Hudson River estuary

Field Name	**Content**
Author:	Name(s) of the author(s) of the particular document.
Year:	Year of publication, or year of completion if unpublished.
Title:	Title of the particular document.
Type:	Type of document, *i.e.*, whether it is a journal article, thesis, etc. For example, since bibliographic format differs for a book by one or more authors, as opposed to an edited book which contains several papers by different authors, this field allows the database program to identify the different types of books (*i.e.*, “Book Type I” and “Book Type II”) so that the program can set up the proper bibliographic output.
Title of Type:	Title of the type of document, only where the title of the type of document differs from the title of the document itself; *i.e.*, for journal articles, this would include the title of the journal where an article is published.
Volume:	Volume number, when applicable.
Pages:	Either the page numbers, or number of pages, for the particular document, when known.
Editors:	Editors for the document, when applicable.
Publisher:	Publisher for the particular document, when applicable.
Geography:	One or more items pertaining to the locality (or localities) discussed in, or pertinent to, the document.
Fish Species:	Fish species discussed in the document, especially for those 11 species of particular interest. In papers discussing fish species other than the 11, not all species are necessarily included in this field. In most cases, the genus and species, as well as the common name, are entered for each fish.
Hardcopy Y or N:	Whether a hardcopy of the document was on hand when the database was created. The papers with “Yes” written in this field are now in a small library under the care of John Boreman. (See new affiliation and e-mail address noted earlier.)
Hardcopy #:	Number assigned to the hardcopy, for easy reference.
Notes:	Originally intended to contain notes on papers that were read. Mostly, this field has been left blank.
Source:	From what paper, person, or place the document was originally found.
Output:	Bibliographic format for the document.
Keywords:	Keywords for the document. For papers for which a hardcopy is available, keywords are taken from both the text and title. For papers for which a hardcopy is not available, keywords are taken from only the title.

Table C-2. Keywords most often used in the database on habitat use and requirements of important fish species inhabiting the Hudson River estuary

abundance
adult
age
anadrom (for "anadromy" or "anadromous")
behavior
benthos
biology
chemistry
community
contamin (for "contaminant" or "contamination")
development
dissolved oxygen
distribution
ecology
ecosystem
egg
embryo
entrain
environment
estuary
feeding
fisher (for "fishery" or "fisheries")
food
freshwater
growth
habitat
history
impinge
juvenile (also, see "young")
larva (for "yolksac and post-yolksac/feeding larva"; also, see "young")
life history
loading
management
mark (for "mark and recapture")
marsh
migration
mortality
movement
nursery
nutrient
otolith
PCB (polychlorinated biphenyl)
physiology
plankton
pollut (for "pollution" or "pollutant")
population
power (for "power plant")
predat (for "predation" or "predator")
recruitment
reproduc (for "reproduce" or "reproduction")
salinity
season
sediment
spawn
stock
temperature
tide (or "tidal")
toxic
turbidity
vegetation
wastewater
young (for "young" and "young-of-the-year"; also, see "larva" and "juvenile")

APPENDIX D

List of Published and Unpublished Works Containing Information That May Be Relevant to Habitat Requirements and Use by the Selected Fish Species Inhabiting the Hudson River Estuary

*Editor's Note: To insure consistency between the content of the following bibliography and the content of the FileMaker database created by this report's authors, none of the bibliographic data (*i.e., *author(s), date, title, and publishing information) in this bibliography have been edited by this series' editorial staff. Some formatting and styling have been performed for the sake of consistency among issues in the* NOAA Technical Memorandum NMFS-NE *series.*

Able, K.W.; Kaiser, S.C. 1994. Synthesis of summer flounder habitat parameters. *NOAA Coastal Ocean Program Decision Anal. Ser.* 1. Silver Spring, MD: NOAA Coastal Ocean Office; 167 p. Keywords: North America habitat, egg, larva, juvenile, adult summer flounder.

Abood, K.A. 1974. Circulation in the Hudson River estuary. *Annals NY Acad. Sci.* 250:39-111. Keywords: Hudson River, water circulation.

Abood, K.A. 1977. Evaluation of circulation in partially stratified estuaries as typified by the Hudson River. [Ph.D. dissertation.] New Brunswick, NJ: Rutgers University. Keywords: Hudson River, New York, evaluation, circulation, stratification, estuary.

Abood, K.A.; Apicella, G.A.; Wells, A.W. 1992. General evaluation of Hudson River freshwater flow trends. *In*: C.L. Smith, ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 3-28. Keywords: Hudson River, freshwater.

Abood, K.A.; Konrad, K.A.; Shirk, J.; McCroddy, P. 1973. Effects of power plants on physical and chemical water quality parameters with specific attention to temperature, dissolved oxygen, and chlorine distributions. *In*: Proceedings of 3rd Symposium of Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, effects, power plants, water quality, chemistry, temperature, dissolved oxygen, chlorine.

Abood, K.A.; Maikish, E.A.; Kimmel, R.R. 1976. Field and analytical investigations of ambient temperature distribution in the Hudson River: *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, temperature distribution.

Adams, A.G. 1981. The Hudson: a guidebook to the river. Albany, NY: State University of New York Press; 424 p. Keywords: Hudson River, New York, guidebook, reference.

Adams, P.B. 1980. Life history patterns in marine fishes and their consequences for fisheries management. *Fish. Bull. (U.S.)* 78:1-12. Keywords: life history, fisheries, marine fishes, management.

Adams, S.M. 1976. The ecology of eelgrass, *Zostera marina* (L.), fish communities: I. Structural analysis. *J. Exp. Mar. Biol. Ecol.* 22:269-291. Keywords: ecology, eelgrass, fish community, habitat, vegetation.

Adams, S.M. 1976. The ecology of eelgrass, *Zostera marina* (L.), fish communities: II. Functional analysis. *J. Exp. Mar. Biol. Ecol.* 22:293-311. Keywords: ecology, eelgrass, fish community, function, habitat, vegetation.

Adams, S.M.; DeAngelis, D.L. 1987. Indirect effects of early bass-shad interactions on predator population structure and food web dynamics. *In*: Kerfoot, W.C.; Sih, A., eds. Predation: direct and indirect impacts on aquatic communities. Hanover, NH: University Press of New England; p. 103-117. Keywords: interactions, predation, predator, prey, population structure, food web, adult, largemouth bass, American shad.

Albrecht, A.B. 1964. Some observations on factors associated with survival of striped bass eggs and larvae. *Calif. Fish Game J.* 50:100-113. Keywords: observations, factors, survival, eggs, larvae, striped bass.

Allen, D.M.; Barker, D.L. 1990. Interannual variations in larval fish recruitment to estuarine epibenthic habitats. *Mar. Ecol. Prog. Ser.* 65:113-125. Keywords: interannual, variations, larvae, fish recruitment, metamorphosis, estuary, epibenthic habitats.

Alperin, I.M. 1966. Dispersal, migration, and origins of striped bass from Great South Bay, Long Island. *NY Fish Game J.* 13:79-112. Keywords: Long Island, Great South Bay, dispersal, migration, adult, striped bass.

Alperin, I.M. 1966. Occurrence of yearling striped bass along the south shore of Long Island. *NY Fish Game J.* 13:113-120. Keywords: Long Island, Atlantic Ocean, population, yearling, young, striped bass.

Alsop, R.G.; Forney, J.L. 1962. Growth and food of white perch in Oneida Lake. *NY Fish Game J.* 9:133-136. Keywords: Oneida Lake, New York, growth, food, feeding, adult, white perch.

Ammerman, J.W. 1989. Microbial breakdown of organic phosphates in the Hudson River, 1 August, 1987 - 31 July, 1988. [Final report.] New York, NY: Hudson River Foundation; 30 p. Keywords: Hudson River, New York, microbe, microbial breakdown, organic, phosphates.

Ammerman, J.W. 1991. Role of ecto-phosphohydrolases in phosphorus regeneration in estuarine and coastal ecosystems. *In*: Chrost, R.J., ed. Microbial enzymes in aquatic environments. New York, NY: Springer-Verlag; p. 164-185. Keywords: ecto-Phosphohydrolases, phosphorus, estuary, coastal, ecosystem.

Anderson, A.B.; Schmidt, R.E. 1989. A survey of larval and juvenile fish populations in water-chestnut (*Trapa natans*) beds in Tivoli South Bay, a Hudson River tidal marsh. *In*: Blair, E.A.; Waldman, J.R., eds. Polgar Fellowship reports of the Hudson River National Estuarine Research Reserve Program, 1988, Section VII. New York, NY: Hudson River Foundation; 34 p. Keywords: Tivoli South Bay, Hudson River, survey, fish, larvae, juvenile, populations, water-chestnut beds, tidal marsh, habitat.

Anderson, E.D. 1980. A preliminary assessment of the bluefish (*Pomatomus saltatrix*) along the Atlantic coast of the United States. *NOAA/NMFS Woods Hole Lab. Ref. Doc*. 80-30; 29 p. Keywords: Atlantic Coast, Atlantic Ocean, preliminary assessment, survey, population, adult, bluefish.

Anderson, H.G. 1970. Annotated list of parasites of the bluefish. *Bur. Sport Fish. Wildl. Tech. Pap.*. 54; 15 p. Keywords: annotated list, parasites, adult, bluefish.

Anderson, R.D. 1978. Feeding and spawning of bluefish. *Sea Frontiers* 24:335-339. Keywords: food, feeding, spawning, adult, bluefish.

Anonymous. 1994. Scientific publications about the Hudson River National Research Reserve and environments. Unpublished; 13 p. Keywords: Hudson River, publications, references, estuary, environment.

Armstrong, R.W.; Sloan, R.J. 1980. Trends in levels of several known chemical contaminants in fish from New York State waters. *DEC Bur. Environ. Protect. Wildl. Tech. Rep.* 80-2, v. iii; 77 p. Keywords: New York, Hudson River, estuary, lakes, bays, sounds, rivers, trends, chemical, contaminants, fish.

Armstrong, R.W.; Sloan, R.J. 1981. PCB patterns in Hudson River fish: I. Resident/freshwater species. *In*: Proceedings of Hudson River Environmental Society. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, PCB patterns, fishery, freshwater species.

Armstrong, R.W.; Sloan, R.J. 1988. PCB patterns in Hudson River fish: I. Resident freshwater species. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 304-324. Keywords: Hudson River, PCBs.

Ashizawa, D.; Cole, J.J. 1994. Long-term temperature trends of the Hudson River: a study of the historical data. *Estuaries* 17(1B):166-171. Keywords: Hudson River, temperature, history.

Atkinson, C.E. 1951. Feeding habits of adult shad (*Alosa sapidissima*) in fresh water. *Ecology* 32:556-557. Keywords: feeding, food, adult, American shad.

Taub, S. 1990. Fishery management plan for Atlantic sturgeon. *Atl. States Mar. Fish. Comm. Fish. Manage. Rep.* 17; 73 p. Keywords: fishery, management, Atlantic sturgeon.

AuClair, R.P. 1956. The white perch, *Morone americana* (Gmelin) [in] Sebasticook Lake, Maine. [M.S. thesis.] Orono, ME: University of Maine; 84 p. Keywords: Maine, Sebasticook Lake, adult, white perch.

AuClair, R.P. 1960. White perch in Maine. Augusta, ME: Department of Inland Fisheries and Game. Keywords: Maine, adult, white perch.

Auld, A.H.; Schubel, J.R. 1978. Effects of suspended sediment on fish eggs and larvae: a laboratory assessment. *Estuar. Coastal Mar. Sci*. 6:153-164. Keywords: suspended sediment, fish eggs, eggs, laboratory experiment.

Austin, H.K.; Findlay, S. 1987. The contribution of bacteria to benthic processes in the Hudson River estuary. *In*: Blair, E.A.; Cooper, J.C., eds. Polgar Fellowship reports of the Hudson River National Estuarine Research Reserve Program, 1986, Section V. New York, NY: Hudson River Foundation; 48 p. Keywords: Hudson River, benthos, bacteria.

Austin, H.K.; Findlay, S. 1989. Benthic bacterial biomass and production in the Hudson River estuary. *Microbial Ecol.* 18:105-116. Keywords: Hudson River, benthos, bacteria.

Austin, M.P. 1987. Models for the analysis of species? Response to environmental gradients. *Vegetatio* 69:35-45. Keywords: model, species, environment, gradient.

Ayres, R.U.; Ayres, L.W.; McCurley, J.; Small, M.; Tarr, J.A.; Widgery, R.C. 1985. An historical reconstruction of major pollutant levels in the Hudson-Raritan basin 1880-1980. Pittsburgh, PA: Variflex Corp. Keywords: Hudson River, Raritan River, New York, New Jersey, basin, history, pollutants, pollution, 1880, 1980, 1880-1980.

Ayres, R.U.; Ayres, L.W.; McCurley, J.; Small, M.; Tarr, J.A.; Widgery, R.C. 1988. An historical reconstruction of major pollutant levels in the Hudson-Raritan Basin: 1880-1980 (3 volumes). *NOAA Tech. Memo. NOS OMA* 43. Keywords: Hudson River, New York, Raritan River, New Jersey, Hudson - Raritan Basin, estuary, history, reconstruction, pollutants, pollutant levels, 1880-1980.

Ayres, R.U.; Rod, S.R. 1986. Patterns of pollution in the Hudson River. *Environment* 28:14-20, 39-43. Keywords: Hudson River, Raritan Bay, pollution, wastewater, contaminants, loadings.

Bain, M.B.; Bain, J.L. 1982. Habitat suitability index model: coastal stocks of striped bass. *U.S. Fish Wildl. Serv. Rep. FWS/OBS* 82/10.1; 47 p. Keywords: model, habitat, coastal, stocks, adult, striped bass.

Bain, M.B.; Boreman, J.; Nack, S.; Haley, N. 1995. Techniques for evaluating the population status of Atlantic sturgeon. [Proposal.] Stony Brook, NY: New York Sea Grant Institute; 27 p. Keywords: Hudson River, habitat, distribution, juvenile, adult, sampling, mark and recapture, Atlantic sturgeon.

Barclay, B. 1993. Hudson River angler survey. [Final report.] New York, NY: Hudson River Foundation; 66 p. Keywords: Hudson River, sport fishery, angler.

Barger, L.E. [year unknown.] Age and growth of the bluefish, *Pomatomus saltatrix* (Linnaeus), from the northern Gulf of Mexico and the southeastern United States. *NOAA/*

NMFS Panama City Lab. Rep.; 10 p. Keywords: northern Gulf of Mexico, Gulf of Mexico, southeastern United States, age, growth, adult, young, bluefish.

Barnthouse, L.W.; Boreman, J.; Christensen, S.W.; Goodyear, C.P.; Van Winkle, W.; Vaughan, D.S. 1984. Population biology in the courtroom: the Hudson River controversy. *BioScience* 34:14-19. Keywords: Hudson River, population biology, courtroom, controversy.

Barnthouse, L.W.; Klauda, R.J.; Klauda, R.L. 1988. Assessing ecological impacts of power plants: Lessons from the Hudson River case. *Am. Fish. Soc. Monogr*. 4. Keywords: Hudson River, New York, ecology, impacts, power plants.

Barnthouse, L.W.; Klauda, R.J.; Vaughan, D.S. 1988. What we didn't learn about the Hudson River, why, and what it means for environmental assessment. *Am. Fish. Soc. Monogr*. 4:1-8. Keywords: Hudson River, New York, environmental assessment.

Barnthouse, L.W.; Van Winkle, W. 1988. Analysis of impingement impacts on Hudson River fish populations. *Am. Fish. Soc. Monogr*. 4:182-190. Keywords: Hudson River, New York, impingement, power plant, fish population.

Barnthouse, L.W.; Van Winkle, W.; Vaughan, D.S. 1983. Impingement losses of white perch at Hudson River power plants: magnitude and biological significance. *Environ. Manage*. 7:355-364. Keywords: Hudson River, New York, impingement, mortality, power plants, biology, egg, larva, juvenile, white perch.

Bason, W.H. 1971. Ecology and early life history of striped bass, *Morone saxatilis*, in the Delaware estuary. Middletown, DE: Ichthyological Associates. *Ichthyol. Assoc. Bull*. 4:112. Keywords: Delaware, Delaware River, Delaware Bay, Delaware estuary, estuary, ecology, early life history, striped bass.

Battelle Marine Research Laboratory. 1983. 1980 and 1981 year class report for the Hudson River Estuary Monitoring Program. [Report.] New York, NY: Consolidated Edison Co.; 350 p. Keywords: Hudson River, New York, 1980, 1981, year class report, estuary, monitoring program, adult, striped bass, white perch, Atlantic tomcod.

Bath, D.W.; O'Connor, J.M. 1982. The biology of white perch, *Morone americana*, in the Hudson River estuary. *Fish. Bull. (U.S.)* 80:599-610. Keywords: Hudson River, New York, estuary, biology, adult, white perch.

Bath, D.W.; Beebe, C.A.; Ryder, R.H.; Hecht, J.H. 1976. A list of common and scientific names of fishes in the Hudson River. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society; 6 p. Keywords: Hudson River, New York, fishes, names, common, scientific.

Bath, D.W.; O'Connor, J.M. 1981. Development and identification of larval Atlantic sturgeon (*Acipenser oxyrhynchus*) and shortnose sturgeon (*Acipenser brevirostrum*) from the Hudson River estuary, New York. *Copeia* 1981:711-717. Keywords: Hudson River, development, identification, estuary, larvae, Atlantic sturgeon, shortnose sturgeon.

Bayless, J.D. 1972. Artificial propagation and hybridization of striped bass, *Morone saxatilis* (Walbaum). Columbia, SC: South Carolina Marine Resources Dept.; 135 p. Keywords: propagation, hybridization, adult, striped bass.

Beaven, M.; Mihursky, J. 1980. Food and feeding habits of larval striped bass: an analysis of larval striped bass stomachs from 1976 Potomac estuary collections. *Chesapeake Biol. Lab. Ref. No. [UMCEES]* 79-45-CBL; 27 p. Keywords: Potomac River, estuary, feeding, habits, behavior, larvae, stomachs, analysis, 1976, striped bass.

Beebe, C.A.; Savidge, I.R. 1988. Historical perspective on fish species composition and distribution in the Hudson River estuary. *Am. Fish. Soc. Monogr*. 4:25-36. Keywords: Hudson River, distribution.

Bell, J.D.; Westoby, M. 1986. Variations in seagrass height and density over a wide spatial scale: effects on fish and decapods. *J. Exp. Mar. Biol. Ecol*. 104:275-295. Keywords: seagrass, fish community, habitat, decapods.

Bell, J.D.; Westoby, M.; Steefe, A.S. 1987. Fish settling in seagrass: do they discriminate between beds of different leaf density? *J. Exp. Mar. Biol. Ecol*. 111:133-144. Keywords: seagrass, fish habitat.

Belton, T.; Roundy, R. 1985. A study of toxic hazards for urban subsistence and recreational fishermen. [Final report.] New York, NY: Hudson River Foundation; 48 p. Keywords: Hudson River, toxic, PCBs, pesticides, fish tissue analysis, fishermen, adult, striped bass, white perch, bluefish.

Belton, T.; Ruppel, B.E.; Lockwood, K.; Boriek. M. 1983. PCBs in selected finfish caught within New Jersey waters, 1981-1982 (with limited chlordane data). Trenton, NJ: New Jersey Department of Environmental Protection; 36 p. Keywords: New Jersey, adult, PCB, bluefish, striped bass.

Bennett, G.W. 1974. Ecology and management of largemouth bass, *Micropterus salmoides*. Overharvest and management of largemouth bass in small impoundments. *Am. Fish. Soc. Spec. Pub*. No. 3. Keywords: ecology, management, adult, largemouth bass.

Benz, G.W.; Jacobs, R.P. 1986. Practical field methods of sexing largemouth bass. *Prog. Fish-Cult*. 48:221-225. Keywords: field methods, sexing, adult, largemouth bass.

Berg, D.L.; Levinton, J.S. 1985. The biology of the Hudson-Raritan estuary with special emphasis on fishes. *NOAA Tech. Memo. NOS OMA* 16; 170 p. Keywords: Hudson River, New York, Raritan River, New Jersey, estuary, biology, fishes.

Berggren, T.J.; Lieberman, J.T. 1978. Relative contribution of Hudson, Chesapeake and Roanoke striped bass, *Morone saxatilis*, stocks to the Atlantic coast fishery. *Fish. Bull. (U.S.)* 76:335-345. Keywords: Hudson River, Chesapeake Bay, Roanoke River, Atlantic Ocean, contribution, stocks, population, fishery, Atlantic coast, adult, striped bass.

Bero, A.S.; Gibbs, R.J. 1990. Mechanisms of pollutant transport in the Hudson estuary. *Sci. Total Environ*. 97/98:9-22. Keywords: Hudson River, pollutant transport, sediment, PCB, pesticides, trace metals.

Bigelow, H.B.; Schroeder, W.C. 1953. Alewife. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):101-106. Keywords: Gulf of Maine, distribution, biology, growth, adult, spawning, food, fishery, alewife.

Bigelow, H.B.; Schroeder, W.C. 1953. American shad. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):108-112. Keywords: Gulf of Maine, adult, distribution, food, spawning, reproduction, egg, larva, growth, fishery, American shad.

Bigelow, H.B.; Schroeder, W.C. 1953. Bay anchovy. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):118-119. Keywords: Gulf of Maine, adult, distribution, bay anchovy.

Bigelow, H.B.; Schroeder, W.C. 1953. Blueback herring. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):106-107. Keywords: Gulf of Maine, adult, distribution, spawning, blueback herring.

Bigelow, H.B.; Schroeder, W.C. 1953. Bluefish. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):383-389. Keywords: Gulf of Maine, adult, behavior, spawning, egg, larva, juvenile, distribution, fishery, bluefish.

Bigelow, H.B.; Schroeder, W.C. 1953. Short-nose sturgeon. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):84-85. Keywords: Gulf of Maine, Maine, distribution, spawning, adult, short-nose sturgeon.

Bigelow, H.B.; Schroeder, W.C. 1953. Striped bass. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):389-405. Keywords: Gulf of Maine, Maine, biology, adult, behavior, food, migration, spawning, egg, larva, growth, fishery, population, abundance, striped bass.

Bigelow, H.B.; Schroeder, W.C. 1953. Tomcod. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):196-199. Keywords: Gulf of Maine, adult, spawning, egg, larva, food, behavior, distribution, fishery, Atlantic tomcod.

Bigelow, H.B.; Schroeder, W.C. 1953. White perch. *In*: Fishes of the Gulf of Maine. *U.S. Fish Wildl. Serv. Fish Bull*. 74(53):405-407. Keywords: Gulf of Maine, adult, distribution, spawning, egg, larva, fishery, white perch.

Blackford, C.M. 1916. The shad: a national problem. *Trans. Am. Fish. Soc*. 46:14-May. Keywords: adult, American shad.

Blair, B.; Neider, W.C. 1993. Mapping the Hudson River National Estuarine Reserve: Creating tools for tidal wetlands research, management, and education. [Final report.] New York, NY: Hudson River Foundation; 6 p. Keywords: Hudson River, wetland, tidal, tide, research, management, education.

Boesch, D.F.; Turner, R.E. 1984. Dependence of fishery species on salt marshes: the role of food and refuge. *Estuaries* 7:460-468. Keywords: marsh habitat, food, refuge.

Bohne, C.; Schmidt, R.E. 1989. Larval fish flux between a freshwater tidal marsh and the Hudson River estuary. *In*: Blair, E.A.; Waldman, J.R., eds. Polgar Fellowship reports of the Hudson River National Estuarine Research Reserve Program, Section VII. New York, NY: Hudson River Foundation; 22 p. Keywords: Hudson River, larvae, movement, marsh habitat, freshwater.

Bokuniewicz, H.J.; Ellsworth, J.M. 1986. Sediment budget for the Hudson River system. *Northeast Geol*. 8:156-163. Keywords: Hudson River, New York, sedimentation, sediment, geology.

Bokuniewicz, H.J.; Ullman, D. 1995. Turbidity distribution in the Hudson River estuary. Stony Brook, NY: Marine Science Research Center, *Spec. Sci. Rep*. 109 (Reference 95-02); 42 p. Keywords: Hudson River, turbidity.

Bonn, E.W.; Bailey, W.M.; Bayless, J.D.; Erickson, K.E.; Stevens, R.E., editors. 1976. Guidelines for striped bass culture. Bethesda, MD: American Fisheries Society (Southern Division); 103 p. Keywords: guidelines, culture, eggs, striped bass.

Booth, R.A. 1967. A description of the larval stages of the tomcod, *Microgadus tomcod*, with comments on its spawning ecology. [M.S. thesis.] Storrs, CT: University of Connecticut; 53 p. Keywords: larval stages, larvae, spawning, ecology, tomcod.

Bopp, R.F. 1979. The geochemistry of polychlorinated biphenyls in the Hudson River. [Ph.D. dissertation.] New York, NY: Columbia University. Keywords: Hudson River, New York, geochemistry, PCBs.

Bopp, R.F.; Simpson, H.J. 1984. Persistent chlorinated hydrocarbon contaminants in the New York Harbor complex. [Final report.] New York, NY: Hudson River Foundation. Keywords: Hudson River, New York Harbor, contaminants, loadings.

Bopp, R.F.; Simpson, H.J. 1988. Sources and trends of persistent contaminants in the New York Harbor complex. [Final report.] New York, NY: Hudson River Foundation; 54 p. Keywords: Hudson River, contaminants, sediments, radionuclides, PCBs, chlorinated hydrocarbon pesticides, trace metals, cadmium.

Bopp, R.F.; Simpson, H.J. 1989. Contamination of the Hudson River - the sediment record. *In*: National Research Council, ed. Contaminated marine sediments assessment and remediation. Washington, DC: National Academy Press; p. 401-416. Keywords: Hudson River, New York, contaminant, sediment, pollution.

Bopp, R.F.; Simpson, H.J.; Chillrud, S.N.; Robinson, D.W. 1993. Sediment-derived chronologies of persistent contaminants in Jamaica Bay, New York. *Estuaries* 16:608-616. Keywords: Jamaica Bay, New York, sediment, contaminants.

Bopp, R.F.; Simpson, H.J.; Deck, B.L. 1985. Release of polychlorinated biphenyls from contaminated Hudson River sediments. [Final report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, release, polychlorinated biphenyls, PCB, contamination, sediments.

Bopp, R.F.; Simpson, H.J.; Olsen, C.R.; Kostyk, N. 1981. Polychlorinated biphenyls in the sediments of the tidal Hudson River, New York. *Environ. Sci. Technol*. 15:210-216. Keywords: Hudson River, New York, polychlorinated biphenyls, PCBs, sediments, tide.

Bopp, R.F.; Simpson, H.J.; Olsen, C.R.; Trier, R.M.; Kostyk, N. 1982. Chlorinated hydrocarbons and radionuclide chronologies in sediments of the Hudson River and estuary. *NY Environ. Sci. Technol*. 16:666-676. Keywords: Hudson River, New York, estuary, chlorinated hydrocarbons, radionuclide, chronologies, sediments.

Boreman, J. 1979. Spatial distributions of entrainable life stages of six Hudson River fish populations. *In*: Boreman, J., *et al*. Entrainment impact estimates for six fish populations inhabiting the Hudson River estuary. Testimony submitted during the EPA, Region II, adjunctory hearing in the matter of NPDES permits for Bowline Point, Indian Point, and Roseton generating stations. Exhibit EPA-200; Chapter III. Keywords: Hudson River, entrainment, distribution.

Boreman, J. 1981. American shad stocks along the Atlantic Coast. *NOAA NMFS Woods Hole Lab. Ref. Doc*. 81-40. Keywords: Atlantic Coast, population, stocks, adult, American shad.

Boreman, J. 1981. Life histories of seven fish species that inhabit the Hudson River estuary. *NOAA NMFS Woods Hole Lab. Ref. Doc*. 81-34; 97 p. Keywords: Hudson River, Long River, spawning, egg, larvae, juvenile, adult, trophic relationships, ecology, striped bass, white perch, blueback herring, alewife, American shad, Atlantic tomcod, bay anchovy.

Boreman, J. 1982. River herring stocks along the Atlantic coast. *NOAA NMFS Woods Hole Lab. Ref. Doc.* 81-35; 23 p. Keywords: Atlantic coast, life history, spawning, eggs, larvae, juvenile, adults, trophic relationships, fishery, survey, river herring, blueback herring, alewife.

Boreman, J. 1983. Simulation of striped bass egg and larva development based on temperature. *Trans. Am. Fish. Soc*. 112:286-292. Keywords: simulation, egg, larva, development, temperature, striped bass.

Boreman, J. 1983. Status of bluefish along the Atlantic coast, 1982. *NOAA NMFS Woods Hole Lab. Ref. Doc.* 83-28; 35 p. Keywords: Atlantic coast, fishery, stock, spawning, migration, age, growth, trophic relationships, survey, abundance, recruitment, mortality, adult, bluefish.

Boreman, J. 1992. Impact of added mortality on the reproductive potential of shortnose sturgeon in the lower Connecticut River. [Report.] Gloucester, MA: NMFS Northeast Regional Office; 14 p. Keywords: Connecticut River, mortality, reproduction, population, eggs, adult, shortnose sturgeon.

Boreman, J.; Austin, H.M. 1985. Production and harvest of anadromous striped bass stocks along the Atlantic coast. *Trans. Am. Fish. Soc*. 114:3-7. Keywords: Atlantic Ocean, coast, fishery, production, harvest, anadromous, adult, striped bass.

Boreman, J.; Barnthouse, L.W.; Vaughan, D.S.; Goodyear, C.P.; Christensen, S.W.; Kumar, K.D.; Kirk, B.L.; Van Winkle, W. 1982. The impact of entrainment and impingement of fish populations in the Hudson River estuary: Vol. I. Entrainment impact estimates for six fish populations inhabiting the Hudson River estuary. *Environ. Sci. Div. Publ. No*. 1790. [ORNL/NUREG/TM-385/V1]. Keywords: Hudson River, New York, estuary, impact, entrainment, impingement, fish populations, estimates, habitat.

Boreman, J.; Fletcher, R.I. 1993. Modeling egg deposition patterns. Bulletin of the Technical Working Group, Hudson River Monitoring Program 1(1):1-8. Keywords: Hudson River, eggs, model, striped bass.

Boreman, J.; Goodyear, C.P. 1988. Estimates of entrainment mortality for striped bass and other fish species inhabiting the Hudson River estuary. *Am. Fish. Soc. Monogr*. 4:152-160. Keywords: Hudson River, New York, estuary, estimates, entrainment, mortality, fish, species, egg, larva, juvenile, striped bass.

Boreman, J.; Goodyear, C.P.; Christensen, S.W. 1978. An empirical transport model for evaluating entrainment of aquatic organisms by power plants. *U.S. Fish Wildl. Serv. FWS/OBS*-78/90. Keywords: model, transport model, empirical data, evaluation, entrainment, aquatic organisms, power plants.

Boreman, J.; Klauda, R.J. 1988. Distributions of early life stages of striped bass in the Hudson River estuary, 1974-1979. *Am. Fish. Soc. Monogr*. 4:53-58. Keywords: Hudson River, egg, larva, juvenile, distribution, striped bass.

Boreman, J.; Lewis, R.R. 1987. Atlantic coastal migrations of striped bass. *Am. Fish. Soc. Symp*. 1:331-339. Keywords: Atlantic Ocean, migration, adult, striped bass.

Boreman, J.; Overholtz, W.J.; Sissenwine, M.P. 1984. A preliminary analysis of the effects of fishing on shortnose sturgeon. *NOAA NMFS Woods Hole Lab. Ref. Doc*. 84-17; 22 p. Keywords: Saint John River, Hudson River, Pee Dee River, fishery, growth, mortality, adult, shortnose sturgeon.

Bowden, K.F. 1980. Physical factors: salinity, temperature, circulation, and mixing processes. *In*: Olausson, E.; Cato, I., eds. Chemistry and biogeochemistry of estuaries. New York, NY: John Wiley & Sons; p. 37-70. Keywords: salinity, temperature, circulation, estuary.

Bower, P.M.; Simpson, H.J.; Williams, S.C.; Li, Y.H. 1978. Heavy metals in the sediments of Foundry Cove, Cold Spring, NY. *Environ. Sci. Technol.* 12:683-687. Keywords: Foundry Cove, Cold Spring Harbor, Long Island Sound, New York, heavy metals, metals, sediments.

Boyce Thompson Institute. 1977. An atlas of the biological resources of the Hudson River estuary. Yonkers, NY: Boyce Thompson Institute of Plant Research, Estuarine Study Group. Keywords: Hudson River, biology, environment, estuary, bay anchovy.

Boyle, R.H. 1968. Notes on the fishes of the lower Hudson River. *Underwater Nat.* 5(2):32-33, 40. Keywords: Hudson River, bluefish.

Boynton, W.R.; Kemp, W.M.; Keefe, C.W. 1982. A comparative analysis of nutrients and other factors influencing estuarine phytoplankton production. *In*: Kennedy, V.S., ed. Estuarine comparisons. New York, NY: Academic Press; p. 69-90. Keywords: nutrients, estuary, phytoplankton.

Boynton, W.R.; Polgar, T.T.; Zion, H.H. 1981. Importance of juvenile striped bass food habits in Potomac estuary.

Trans. Am. Fish. Soc. 110:56-63. Keywords: Potomac River, estuary, food habits, feeding, juveniles, striped bass.

Bozeman, E.L.; Jr.; Dean, J.M. 1980. The abundance of estuarine larval and juvenile fish in a South Carolina intertidal creek. *Estuaries* 3:89-97. Keywords: South Carolina, estuary, larvae, juveniles, intertidal habitat.

Bradford, A.D.; Miller, J.G.; Buss, K. 1966. Bioassays on eggs and larval stages of American shad, *Alosa sapidissima*. *In*: Carlson, F.T., ed. Suitability of the Susquehanna River for the restoration of shad. Washington, DC: Maryland Board of Natural Resources, New York Conservation Department, and Pennsylvania Fish Commission; p. 52-60. Keywords: Susquehanna River, restoration, bioassays, eggs, larvae, stages, American shad.

Brandt, R.E. 1987. Current status of American shad, alewife, and blueback herring in New York waters. [Report.] Washington, DC: Atlantic States Marine Fisheries Commission; 82 p. Keywords: stocks, fishery, population, American shad, alewife, blueback herring.

Brandt, S.B.; Mason, D.M.; Patrick, E.V. 1992. Spatially-explicit models of striped bass growth potential in Chesapeake Bay. *Fisheries* 17:23-31, 34-35. Keywords: Chesapeake Bay, model, growth, adult, striped bass.

Breder, C.M.; Jr.; Rosen, D.E. 1966. Modes of reproduction in fishes. Garden City, NY: Natural History Press; 941 p. Keywords: reproduction, largemouth bass.

Breteler, R.J. 1973. Chemical pollutants of the Hudson-Raritan estuary: proceedings of a workshop. Battelle New England Marine Research Laboratory. Keywords: Hudson River, New York, Raritan River, New Jersey, Hudson-Raritan estuary, estuary, chemical, pollutant.

Breteler, R.J.; editor. 1973. Chemical pollution of the Hudson-Raritan estuary. *NOAA Tech. Memo. NOS OMA*-7. Keywords: Hudson River, New York, Raritan River, New Jersey, estuary, chemical, pollution.

Bridgewater, R.; Schmidt, R. 1994. Diets of larval white perch and striped bass in the Kingston Region of the Hudson River estuary with comments on the significance of the Bosmina bloom. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1993. New York, NY: Hudson River Foundation. Keywords: Hudson River, New York, estuary, food habits, feeding, larvae, behavior, striped bass, white perch.

Brosnan, T.M.; Stokes, T.L.; Jr.; Forndran, A.B. 1987. Water quality monitoring and trends in New York Harbor. *In*: Proceedings of the Oceans 87 Conference: Coastal and Estuary Pollution 5. Halifax, Nova Scotia: IEEE; p. 1598-1603. Keywords: New York Harbor, Hudson River, estuary, pollution, water quality, monitoring.

Brown, B. 1993. A classification system of marine and estuarine habitats in Maine: an ecosystem approach to habitats: Part I. Benthic habitats. Augusta, ME: Maine Natural Areas Program, Department of Economic and Community Development. Keywords: Maine, classification, system, marine, estuary, habitats, ecosystem.

Brown, J.S.; Rosensweig, M.L. 1986. Habitat selection in slowly regenerating environments. *J. Theoretical Biol*. 123:151-171. Keywords: habitat selection.

Brown, M.P.; Werner, M.B.; Sloan, R.J.; Simpson, K.W. 1985. Polychlorinated biphenyls in the Hudson River. *Environ. Sci. Technol*. 19:656-661. Keywords: Hudson River, New York, polychlorinated biphenyls, PCBs.

Buckel, J.A.; Steinberg, N.D.; Conover, D.O. 1995. Effects of temperature, salinity, and fish size on growth and consumption of juvenile bluefish. *J. Fish Biol*. 47:696-706. Keywords: Hudson River, temperature, salinity, size, growth, predation, juvenile, bluefish.

Buckley, E. 1984. Partition coefficients and the modeling of PCB congeners in the environment. Ithaca, NY: Cornell University; 33 p. Keywords: PCB, ecosystem, submerged aquatic vegetation, emergent aquatic vegetation.

Buckley, E.H. 1971. Maintenance of a functional environment in the lower portion of the Hudson River estuary: an appraisal for the estuary. Yonkers, NY: Boyce Thompson Institute for Plant Research, Inc. Reprint No. 2233. Keywords: Hudson River, environment, maintenance, management.

Buckley, E.H.; Ristich, S.S. 1976. Distribution of rooted vegetation in the brackish marshes and shallows of the Hudson River estuary. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society; Paper 20. Keywords: Hudson River, vegetation, plant, brackish, marsh habitat.

Bulkey, R.B. 1975. Chemical and physical effects on centrarchid basses. *In*: Clepper, H., ed. Black bass biology and management. Washington, DC: Sport Fishing Institute; p. 286-294. Keywords: physiology, chemistry, biology, management, centrarchid bass, adult, largemouth bass.

Burbridge, R.G. 1974. Distribution, growth, selective feeding, and energy transformations of young-of-the-year blueback herring, *Alosa aestivalis* (Mitchill), in James River, Virginia. *Trans. Am. Fish. Soc*. 103:297-311. Keywords: James River, Virginia, distribution, growth, selective feeding, feeding, energy transformations, energy, young-of-the-year, blueback herring.

Burdick, G.E. 1954. An analysis of the factors, including pollution, having possible influence on the abundance of shad in the Hudson River. *NY Fish Game J*. 1:188-205. Keywords: Hudson River, abundance, adult, American shad.

Burns, R.W. 1974. Seasonal abundance and diversity of larval fishes in a high-marsh tidal creek. [M.S. thesis.] Columbia, SC: University of South Carolina; 54 p. Keywords: seasonal, abundance, diversity, larvae, marshes, tidal creek, habitat, tides.

Busby, W. 1966. Flow, quality, and salinity in the Hudson River estuary. *In*: Hudson River ecology. Albany, NY: Hudson River Valley Commission; p. 135-145. Keywords: Hudson River, New York, flow, quality, salinity, estuary.

Busch, W.D.N.; Davies, D.H.; Nepszy, S.J. 1977. Establishment of white perch, *Morone americana*, in Lake Erie. *J. Fish. Res. Board Can*. 34:1039-1041. Keywords: Lake Erie, New York, introduced species, adult, white perch.

Busch, W.N.; Heinrich, J.W. 1982. Growth and maturity of white perch in Lake Ontario. *NY Fish Game J*. 29:206-208. Keywords: Lake Ontario, New York, growth, maturity, adult, white perch.

Butler, P.A. 1966. The problem of pesticides in estuaries. *Am. Fish. Soc. Spec. Publ*. 3:110-115. Keywords: pesticides, pollution, estuary.

Campbell, M.; Dexter, B.L. 1987. Identification, distribution and abundance patterns of aquatic algae and herbivores in marshlands of the Hudson River National Estuarine Research Reserve (Stockport Flats component). *In*: Blair, E.A.; Cooper, J.C., eds. Polgar Fellowship reports of the Hudson River National Estuarine Research Reserve Program, 1986, Section V. New York, NY: Hudson River Foundation; 35 p. Keywords: Hudson River, Stockport Flats, algae, marsh habitat.

Cannon, T.C.; Jinks, S.M.; King, L.R.; Lauer, G.J. 1978. Survival of entrained ichthyoplankton and macroinvertebrates at Hudson River power plants. *In*: Jensen, L.D., ed. Fourth National Workshop on Entrainment and Impingement. Melville, NY: EA Communications. Keywords: Hudson River, New York, survival, entrainment, ichthyoplankton, macroinvertebrates, power plants.

Carey, K. M. and R. H. Waines. 1987. Preliminary report on the geology, hydrology and related historical aspects of the Tivoli Bays and Stockport Flats. *In*: Blair, E.A.; Cooper, J.C., eds. Polgar Fellowship reports of the Hudson River National Estuarine Research Reserve Program, 1986, Section VIII; 91 p. Keywords: Hudson River, Stockport Flats, Tivoli Bays, geology, hydrology, history.

Carline, R.F.; Machung, J.F.; Genito, D. 1995. Impediments to fish passage and habitat suitability for anadromous fish in Pennsylvania tributaries to the Susquehanna River. [Final report.] Harrisburg, PA: Pennsylvania Fish and Boat Commission; 62 p. Keywords: Pennsylvania, Susquehanna River, anadromy, migration, habitat, alewife, blueback herring.

Carlson, D.M. 1986. Fish and their habitats in the upper Hudson estuary. [Unclassified report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, habitat.

Carlson, D.M. 1990. Assessment of the largemouth bass population and fishery in the Hudson River estuary. Albany, NY: Fisheries Bureau, New York State Department of Environmental Conservation. Keywords: Hudson River, estuary, assessment, population, fishery, adult, largemouth bass.

Carlson, D.M. 1992. Importance of wintering refugia to the largemouth bass fishery in the Hudson River estuary. *J. Freshwater Ecol*. 7:173-180. Keywords: Upper Hudson River estuary, New York, Wappinger Creek, Rondout Creek, Esopus Creek, Catskill Creek, Coxsackie Bay, mark and recapture, overwintering, refugia, habitat, abundance, adult, largemouth bass.

Carlson, D.M.; Simpson, K.W. 1987. Gut content of juvenile shortnose sturgeon in the upper Hudson estuary. *Copeia* 1987:796-802. Keywords: Hudson River, juvenile, shortnose sturgeon.

Carlson, F.T., editor. 1968. Suitability of the Susquehanna River for the restoration of shad. Washington, DC: U.S. Department of the Interior, Maryland Board of Natural Resources, New York Conservation Department, and Pennsylvania Fish Commission; 60 p. Keywords: Susquehanna River, suitability, restoration, adult, American shad.

Carlson, F.T.; McCann, J.A. 1969. Hudson River fisheries investigations. 1965-1968: Evaluations of a proposed pumped storage project at Cornwall, NY in relation to fish in the Hudson River. Keywords: Hudson River Policy Committee, Cornwall, Hudson River, New York, fishery, 1965-1968, pumped storage.

Carscadden, J.E. 1975. Studies on the American shad (*Alosa sapidissima*) in the St. John River and Miramichi River, New Brunswick with special reference to homing and r-K selection. [Ph.D. dissertation.] Montreal, QB: McGill University. Keywords: St. John River, Miramichi River, New Brunswick, Canada, homing, migration, r-K selection, adult, American shad.

Central Hudson Gas and Electric, Inc.; Lawler, Matusky and Skelly Engineers, Inc. 1977. Annual Progress Report 1976. Pearl River, NY: LMS Engineers. Keywords: Hudson River, lower, entrainment, impingement, estuary, abundance, distribution, plankton, ichthyoplankton, fish, chemical characteristics, physical characteristics, egg, larva, juvenile, adult, striped bass.

Cerrato, R.M. 1994. The spatial and temporal structure of the benthos in the lower bay of New York Harbor. [Final report.] New York, NY: Hudson River Foundation; 10 p. Keywords: Hudson River, New York Harbor, New York, benthos, distribution.

Cerrato, R.M.; Bokuniewicz, H.J.; Wiggins, M.H. 1989. A spatial and seasonal study of the benthic fauna of the lower bay of the New York Harbor. Stony Brook, NY: SUNY Marine Sciences Research Center, *Spec. Rep. No*. 84; 325 p. Keywords: New York Harbor, Hudson River, estuary, spatial, seasonal, benthos, fauna, lower bay.

Chambers, J.R.; Musick, J.A.; Davis, J. 1976. Methods of distinguishing larval alewife from blueback herring. *Chesapeake Sci.* 17:93-100. Keywords: methods, larva, species identification, alewife, blueback herring.

Chapoton, R.B.; Sykes, J.E. 1961. Atlantic coast migration of large striped bass as evidenced by fisheries and tagging. *Trans. Am. Fish. Soc*. 90:13-20. Keywords: Atlantic coast, migration, adult, striped bass.

Cheney, A.N. 1896. Shad of the Hudson River. *Ann. Rept. Comm. Fish, Game, Forests NY* 1896:125-134. Keywords: Hudson River, adult, American shad.

Chesapeake Bay Living Resources Task Force. 1987. Habitat requirements for Chesapeake Bay living resources. [Report.] Annapolis, MD: Maryland Department of Natural Resources, Chesapeake Bay Program; 63 p. Keywords: Chesapeake Bay, Maryland, habitat, ecosystem, target species, adult, striped bass, blueback herring, American shad, white perch, bay anchovy.

Chiarella, L.A.; Conover, D.O. 1990. Spawning season and first-year growth of adult bluefish from the New York Bight. *Trans. Am. Fish. Soc*. 119:455-462. Keywords: New York Bight, New York, spawning, season, first-year growth, young-of-the-year, adult, bluefish.

Chittenden, M.E., Jr. 1969. Life history and ecology of the American shad, *Alosa sapidissima*, in the Delaware River. [Ph.D. dissertation.] New Brunswick, NJ: Rutgers University; 459 p. Keywords: Delaware River, life history, history, ecology, adult, American shad.

Chittenden, M.E., Jr. 1972. Responses of young American shad, *Alosa sapidissima*, to low temperatures. *Trans. Am. Fish. Soc*. 101:680-685. Keywords: responses, young, temperature, American shad.

Chittenden, M.E., Jr. 1976. Present and historical spawning grounds and nurseries of American shad, *Alosa sapidissima*, in the Delaware River. *Fish. Bull. (U.S.)* 74:343-352. Keywords: Delaware River, spawning, nursery, adult, American shad.

Chittenden, M.E., Jr. 1976. Weight loss, mortality, feeding, and duration of residence of adult American shad, *Alosa sapidissima*, in fresh water. *Fish. Bull. (U.S.)* 74:151-157. Keywords: weight loss, mortality, feeding, residence, adult, fresh water, American shad.

Chittenden, M.E., Jr.; Westman, J.R. 1967. Highlights of the life history of the American shad in the Delaware River: Public hearing on water quality standards for the Delaware River at Trenton, N.J., January 26, 1967. W. Trenton, NJ: Delaware River Basin Commission; 9 p. Keywords: Delaware River, life history, adult, American shad.

Christensen, S.W.; Englert, T.L. 1988. Historical development of entrainment models for Hudson River striped bass. *Am. Fish. Soc. Monogr*. 4:133-142. Keywords: Hudson River, New York, history, development, models, entrainment, egg, larva, juvenile, striped bass.

Christensen, S.W.; Van Winkle, W.; Barnthouse, L.W.; Vaughan, D.S. 1981. Science and the law: Confluence and conflict on the Hudson River. *EIA Review* 1-2:63-90. Keywords: Hudson River, New York, science, law, confluence, conflict.

Christie, R.W.; Walker, P.T.; Eversole, A.G.; Curtis, T.A. 1981. Distribution of spawning blueback herring on the West Branch of Cooper River and the Santee River, South Carolina. *Proc. Ann. Conf. SE Assoc. Fish Wildl. Agencies* 35:632-640. Keywords: South Carolina, Cooper River, Santee River, spawning, distribution, adult, blueback herring.

Cianci, J.M. 1969. Larval development of the alewife, *Alosa pseudoharengus* Wilson, and the glut herring, *Alosa aestivalis* Mitchill. [M.S. thesis.] Storrs, CT: University of Connecticut; 62 p. Keywords: larvae, development, alewife, glut herring, blueback herring.

Clark, J.F.; Simpson, H.J.; Bopp, R.F.; Deck, B. 1992. Geochemistry and loading history of phosphate and silicate in the Hudson estuary. *Estuar. Coast. Shelf Sci*. 34:213-233. Keywords: Hudson River, nutrients, loading, wastewater, phosphate, silicate.

Clark, J.F.; Simpson, H.J.; Bopp, R.F.; Deck, B.L. 1993. Dissolved oxygen utilization and distribution in the lower Hudson River estuary since the late 1970s. Publisher unknown; 22 p. Keywords: Hudson River, dissolved oxygen.

Clark, J.R. 1968. Seasonal movements of striped bass contingents of Long Island Sound and New York Bight. *Trans. Am. Fish. Soc*. 97:320-343. Keywords: Long Island Sound, New York Bight, season, movements, adult, striped bass.

Coastal Environmental Services, Inc. 1990. Hudson River stock assessment outage evaluation and benefit-cost programs: progress meeting, 17 November, 1989. [Report.] White Plains, NY: New York Power Authority; 68 p. Keywords: Hudson River, power plant, population, striped bass, white perch, Atlantic tomcod.

Coastal Environmental Services, Inc. 1992. Hudson River stock assessment for American shad, Atlantic tomcod, and white perch. [Report.] White Plains, NY: New York Power Authority; 200 p. Keywords: Hudson River, stock, population, power plant, adult, American shad, Atlantic tomcod, white perch.

Coastal Environmental Services, Inc. 1994. Distribution patterns of eight key species of Hudson River fish by life stage: Vol. I. Summaries of sampling effort for studies conducted from 1974-1987, tables of dates sampled and gear deployed. [Report.] New York, NY: Hudson River Foundation; 500 p. Keywords: Hudson River, distribution, sampling, life stage, American shad, striped bass, white perch, Atlantic tomcod, largemouth bass, shortnose sturgeon.

Coastal Environmental Services, Inc. 1994. Distribution patterns of eight key species of Hudson River fish by life stage: Vol. II. Summaries of sampling effort for studies conducted from 1974-1987, maps of sampling location. [Report.] New York, NY: Hudson River Foundation; 400 p. Keywords: Hudson River, life stage, life history, distribution, sampling, American shad, striped bass, white perch, Atlantic tomcod, largemouth bass, shortnose sturgeon.

Coastal Environmental Services, Inc. 1994. Distribution patterns of eight key species of Hudson River fish by life stage: Vol. III. Summaries of patterns of presence-absence. [Report.] New York, NY: Hudson River Foundation; 75 p. Keywords: Hudson River, life stage, life history, distribution, sampling, American shad, striped bass, white perch, Atlantic tomcod, largemouth bass, shortnose sturgeon.

Coastal Environmental Services, Inc. 1994. Distribution patterns of eight key species of Hudson River fish by life stage: Vol. IV. Summaries of patterns of relative abundance.

[Report.] New York, NY: Hudson River Foundation; 50 p. Keywords: Hudson River, life stage, life history, distribution, sampling, abundance, American shad, striped bass, white perch, Atlantic tomcod, largemouth bass, shortnose sturgeon.

Coch, N.H. 1986. Sediment characteristics and facies distributions in the Hudson system. *Northeastern Geol.* 8:109-129. Keywords: Hudson River, New York, sediment, distribution, pollution.

Cochran, J.K.; Hirschberg, D.J. 1994. Benthic contaminant accumulation and mixing rate studies in the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 64 p. Keywords: Hudson River, sediments, loading, contaminants.

Cole, B.E.; Cloern, J.E. 1987. An empirical model for estimating phytoplankton productivity in estuaries. *Mar. Ecol. Prog. Ser*. 36:299-305. Keywords: model, phytoplankton productivity, estuary.

Cole, J.J.; Caraco, N.F.; Peierls, B. 1992. Can phytoplankton maintain a positive carbon balance in a turbid, freshwater, tidal estuary? *Limnol. Oceanogr*. 37:1608-1617. Keywords: phytoplankton, carbon balance, estuary, tide, freshwater, turbidity.

Cole, J.J.; Caraco, N.M.; Peierls, B.L. 1988. Phytoplankton primary production in the mid-Hudson. [Final report.] New York, NY: Hudson River Foundation; 35 p. Keywords: Hudson River, phytoplankton, temperature, oxygen, conductivity, DIC, light, suspended weight, phosphorus, chlorophyll, photosynthesis, production, respiration.

Cole, J.J.; Findlay, S.; Pace, M.L. 1988. Basic ecosystem processes in the Hudson River: A report on the conference at the Institute of Ecosystem Studies, October 10 and 11, 1988. Millbrook, NY: Institute of Ecosystem Studies. Keywords: Hudson River, New York, ecosystem, processes, ecology.

Connell, J.H.; Sousa, W.N. 1983. On the evidence needed to judge ecological stability or persistence. *Am. Nat*. 121:789-824. Keywords: ecology, stability, persistence.

Connolly, J.P.; Winfield, R.P.; Blasland, J.R. 1984. Application of a food chain model of PCB accumulation to the striped bass of the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 35 p. Keywords: Hudson River, PCB, food chain, model, adult, striped bass.

Conover, N.R. 1958. Investigations of the white perch, *Morone americana* (Gmelin), in Albemarle Sound and the lower Roanoke River, North Carolina. [M.S. thesis.] Raleigh, NC: North Carolina State College; 58 p. Albemarle Sound, Roanoke River, adult, white perch.

Conservation and Utilization Division. 1993. Status of the fishery resources off the northeastern United States for 1993. *NOAA Tech. Mem. NMFS-F/NEC*-101; 140 p. Keywords: northeastern United States, Atlantic Ocean, Gulf of Maine, status, fishery, resources, fishes, 1993.

Cooper, J.C.; Cantelmo, F.R.; Newton, C.F. 1988. Overview of the Hudson River estuary. *Am. Fish. Soc. Monogr*. 4:11-24. Keywords: Hudson River, hydrology, water chemistry, temperature, dissolved oxygen, nutrients, contaminants, turbidity, pH, alkalinity, salinity.

Cooper, J.C.; Polgar, T.T. 1981. Recognition of year-class dominance in striped bass management. *Trans. Am. Fish. Soc*. 110:180-187. Keywords: recognition, year-class dominance, management, young-of-the-year, striped bass.

Cooper, R.A. 1961. Early life history and spawning migration of the alewife, *Alosa pseudoharengus*. [M.S. thesis.] Narragansett, RI: University of Rhode Island; 58 p. Keywords: early life history, life history, spawning migration, alewife, early life history, spawning, migration, adult, egg, larva, young, alewife.

Correll, D.L. 1978. Estuarine productivity. *BioScience* 28:646-650. Keywords: estuary, productivity.

Coutant, C.C. 1985. Striped bass, temperature, and dissolved oxygen: a speculative hypothesis for environmental risk. *Trans. Am. Fish. Soc*. 114:31-61. Keywords: temperature, dissolved oxygen, adult, striped bass.

Coutant, C.C. 1986. Thermal niches of striped bass. *Sci. Am*. 254:98-104. Keywords: habitat, thermal, temperature, adult, striped bass.

Cox, P. 1921. Histories of new food fishes. V. The tomcod. *Bull. Biol. Board Can*., Vol. 5. Keywords: history, fishery, fishes, adult, Atlantic tomcod.

Crance, J.H. 1986. Habitat suitability index models and instream flow suitability curves: shortnose sturgeon. *U.S. Fish Wildl. Serv. Biol. Rep.* 82(10.129); 31 p. Keywords: habitat, index model, flow, suitability, adult, shortnose sturgeon.

Crecco, V.A.; Blake, M.M. 1983. Feeding ecology of coexisting larvae of American shad and blueback herring in the Connecticut River. *Trans. Am. Fish. Soc*. 112:498-507. Keywords: Connecticut River, feeding ecology, feeding, ecology, coexisting larvae, larvae, American shad, blueback herring.

Crecco, V.A.; Savoy, T.F. 1984. Effects of fluctuations in hydrographic conditions on year-class strength of American shad (*Alosa sapidissima*) in the Connecticut River. *Can. J. Fish. Aquat. Sci*. 41:1216-1223. Keywords: Connecticut River, hydrography, year-class strength, young-of-the-year, American shad.

Crecco, V.A.; Savoy, T.F.; Whitworth, W. 1986. Effects of density-dependent and climatic factors on American shad (*Alosa sapidissima*) recruitment: a predictive approach. *Can. J. Fish. Aquat. Sci*. 43:457-463. Keywords: density-dependent, climate, recruitment, larva, juvenile, adult, American shad.

Crocker, R.A. 1965. Planktonic fish eggs and larvae of Sandy Hook estuary. *Chesapeake Sci*. 6:92-95. Keywords: Sandy Hook estuary, plankton, ichthyoplankton, fish eggs, fish larvae.

Cronin, L.E.; Daiber, J.C.; Hulburt, E.M. 1962. Quantitative seasonal aspects of zooplankton in the Delaware River estuary. *Chesapeake Sci.* 3:63-93. Keywords: Delaware River, Chesapeake Bay, seasonal, zooplankton, estuary.

Curran, H.W.; Ries, D.T. 1937. A biological survey of the lower Hudson watershed. Albany, NY: New York State

Conservation Department. Keywords: Lower Hudson Watershed, Hudson River, New York, biology, survey.

Curran, H.W.; Ries, D.T. 1937. Fisheries investigations in the lower Hudson River, a biological survey of the lower Hudson watershed: Supplement to the 26th Annual Report for 1936. Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, lower Hudson River, fishery, biological survey.

Dadswell, M.J. 1975. Biology of the shortnose sturgeon (*Acipenser brevirostrum*) in the St. John estuary, New Brunswick, Canada. Baseline survey and living resources potential study of the St. John estuary: Vol. III. Fish and Fisheries. St. Andrews, NB: Huntsman Marine Laboratory; 75 p. Keywords: St. John River, New Brunswick, Canada, survey, resources, estuary, adult, shortnose sturgeon.

Dadswell, M.J. 1976. Biology of the shortnose sturgeon (*Acipenser brevirostrum*) in the St. John estuary, New Brunswick, Canada. Trans. Atlantic Chapter Can. Soc. Environ. Bio. Annual Meeting 1975; p. 20-72. Keywords: St. John River, New Brunswick, Canada, survey, resources, biology, estuary, adult, shortnose sturgeon.

Dadswell, M.J. 1979. Biology and population characteristics of shortnose sturgeon *Acipenser brevirostrum* Lesueur 1818 (Osteichthyes: Acipenseridae), in the Saint John River estuary, New Brunswick, Canada. *Can. J. Zool*. 57:2187-2210. Keywords: Saint John River, Saint John River estuary, New Brunswick, Canada, biology, population, adult, shortnose sturgeon.

Dadswell, M.J. 1979. Testimony on the shortnose sturgeon and Atlantic sturgeon on behalf of National Marine Fisheries Service. Washington, DC: U.S. Environmental Protection Agency; 19 p. Keywords: testimony, adult, shortnose sturgeon, Atlantic sturgeon.

Dadswell, M.J. 1981. Synopsis of biological data on shortnose sturgeon (*Acipenser brevirostrum*) Lesueur, 1818. *In*: Shortnose sturgeon recovery plan. [Draft.] Silver Spring, MD: Natl. Mar. Fish. Serv.; 75 p. Keywords: biology, synopsis, recovery plan, adult, shortnose sturgeon.

Dadswell, M.J.; Melvin, G.D.; Williams, P.J.; Themelis, D.E. 1987. Influences of origin, life history, and chance on the Atlantic coast migration of American shad. *Am. Fish. Soc. Symp*. 1:313-330. Keywords: Atlantic coast, life history, migration, adult, American shad.

Dadswell, M.J.; Taubert, B.D.; Squires, T.S.; Marchette, D.; Buckley, J. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum* Lesueur 1818. *NOAA Tech. Rep. NMFS* 14; 45 p. Keywords: Hudson River, Canada, east coast, US, morphology, life history, habitat, reproduction, embryo, larva, juvenile, adult, feeding, food, growth, age, behavior, fishery, management, shortnose sturgeon.

Dando, P.R. 1984. Reproduction in estuarine fish. *In*: Potts, G.W.; Woonton, R.H., eds. Fish reproduction, strategies and tactics. New York, NY: Academic Press; p. 155-170. Keywords: reproduction, estuarine fish.

Daniel, D.A. 1967. A laboratory study to define the relationship between survival of young striped bass (*Morone saxatilis*) and their food supply. Calif. Dept. of Fish and Game, Anadromous Fisheries Branch, *Admin. Rep. No*. 76-1; 13 p. Keywords: laboratory study, young, food supply, feeding, striped bass.

Daniels, R.A. 1986. List of Hudson River fish species in the New York State Museum. [Report.] New York, NY: Hudson River Foundation; 8 p. Keywords: Hudson River, fish species, museum specimens.

Daniels, R.A. 1995. Nearshore fish assemblage of the tidal Hudson River. *In*: LaRoe, E.T.; Farris, G.S.; Puckett, C.E.; Doran, P.D.; Mac, M.J., eds. Our living resources: a report to the nation on the distribution, abundance, and health of U.S. plants, animals, and ecosystems. Publisher unknown; p. 260-263. Keywords: Hudson River, nearshore, fish community, tidal, tide.

Daniels, R.A.; Lawrence, T. 1991. Stability of fish assemblages in the lower Hudson River. [Final report.] New York, NY: Hudson River Foundation; 39 p. Keywords: Hudson River, fish community, stability.

Darmer, K.I. 1969. Hydrologic characteristics of the Hudson River estuary. *In*: Howell, G.P.; Lauer, G.J., eds. Hudson River Ecology: Proceedings of the 2nd Symposium on Hudson River Ecology. Albany, NY: New York State Department of Environmental Conservation; p. 40-55. Keywords: Hudson River, New York, hydrology.

Darmer, K.I. 1987. Overview of Hudson River hydrology. [Final report.] New York, NY: Hudson River Foundation; 174 p. Keywords: Hudson River, hydrology, acid precipitation, contaminants, loadings.

Davies, W.P. 1970. The effects of temperature, pH and total dissolved solids on the survival of immature striped bass, *Morone saxatilis* (Walbaum). [Ph.D. dissertation.] Raleigh, NC: North Carolina State University; 100 p. Keywords: effects, temperature, pH, dissolved solids, survival, young, immature, striped bass.

Davis, J. 1973. Spawning sites and nurseries of fishes of the genus Alosa in Virginia. *In*: Pacheco, A.L., ed. Proceedings of a workshop on egg, larval, and juvenile stages of fish in Atlantic Coast estuaries. *NOAA/NMFS Sandy Hook Tech. Series Rep.* 1; p. 140-141. Keywords: Atlantic Coast, Atlantic Coast estuary, Virginia, spawning sites, nursery, fishes, egg, larval, juvenile, stages.

Davis, J.R.; Cheek, R.P. 1966. Distribution, food habits, and growth of young clupeids, Cape Fear River system, North Carolina. *In*: Proceedings, 20th Annual Conference, S.E. Assoc. Game Fish Comm.; p. 250-260. Keywords: Clupeidae, distribution, food, growth.

Davis, W.S. 1957. Ova production of American shad in Atlantic coast rivers. *Bur. Sport Fish. Wildl., Resource Publ.* 67; 51 p. Keywords: Atlantic coast, egg, ova, ova production, adult, American shad.

Deck, B.L. 1981. Nitrogen dynamics and nitrogenous biochemical oxygen demand in the Hudson estuary. [Final report.] New York, NY: Hudson River Foundation. Keywords: Hudson River, New York, estuary, nitrogen, oxygen.

Deck, B.L. 1981. Nutrient-element distributions in the Hudson River estuary. [Ph.D. dissertation.] New York, NY: Columbia University; 396 p. Keywords: Hudson River, nutrients, loadings.

Dery, L. 1979. Alewife, *Alosa pseudoharengus*, age-length keys from spring and fall bottom trawl surveys, 1973 to spring 1978, covering the U.S. continental shelf from Cape Hatteras, NC, to Nova Scotia. *NOAA NMFS Woods Hole Lab. Ref. Doc*. 79-45. Keywords: United States, continental shelf, Cape Hatteras, North Carolina, Nova Scotia, Atlantic Ocean, age-length keys, season, spring, fall, trawl, survey, adult, alewife.

Deuel, D.G. [year unknown.] Migration of bluefish *Pomatomus saltatrix* in Atlantic coast waters. *NOAA/NMFS/NEFC Sandy Hook Lab. Rep*.; 37 p. Keywords: Atlantic coast, migration, coastal waters, adult, bluefish.

Deuel, D.G. 1964. Evidence of spawning of tagged bluefish. *Underwater Nat*. 2:24. Keywords: spawning, tagging, mark and recapture, adult, bluefish.

Deuel, D.G.; Clark, J.R.; Mansueti, A.J. 1966. Description of embryonic and early larval stages of bluefish, *Pomatomus saltatrix*. *Trans. Am. Fish. Soc*. 95:264-271. Keywords: embryology, development, egg, embryo, larva, stages, bluefish.

Dew, C.B. 1981. Biological characteristics of commercially caught Hudson River striped bass. *In*: Rachlin, J.W.; Tauber, G., eds. Hudson River Ecology, 5th Symposium. New Paltz, NY: Hudson River Environmental Society; p. 82-102. Keywords: Hudson River, New York, biology, commercial fisheries, catch, adult, striped bass.

Dew, C.B. 1988. Biological characteristics of commercially caught Hudson River striped bass, 1973-1975. *Trans. Am. Fish. Soc*. Keywords: Hudson River, Tappan Zee region, spawning, gill-net, fishery, adult, striped bass.

Dew, C.B. 1988. Stomach contents of commercially caught Hudson River striped bass, *Morone saxatilis* 1973-1975. *Fish. Bull. (U.S.)*. 86(2):397-401. Keywords: Hudson River, food, feeding, gut content analysis, fishery, adult, striped bass.

Dew, C.B. 1991. Early life history and population dynamics of Atlantic tomcod (*Microgadus tomcod*) in the Hudson River estuary, New York. [Ph.D. dissertation.] New York, NY: City University of New York; 369 p. Keywords: Hudson River, New York, life history, population dynamics, estuary, adult, Atlantic tomcod.

Dew, C.B. 1995. The nonrandom size distribution and size-selective transport of age-0 Atlantic tomcod (*Microgadus tomcod*) in the lower Hudson River estuary. *Can. J. Fish. Aquat. Sci*. 52:2353-2366. Keywords: Hudson River, size, distribution, movement, transport, age-0, egg, larva, juvenile, Atlantic tomcod.

Dew, C.B.; Hecht, J.H. 1976. Ecology and population dynamics of Atlantic tomcod (*Microgadus tomcod*) in the Hudson River estuary. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, ecology, population, adult, Atlantic tomcod.

Dew, C.B.; Hecht, J.H. 1976. Observations on the population dynamics of the Atlantic tomcod (*Microgadus tomcod*) in the Hudson River estuary. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society; 8 p. Keywords: Hudson River, population dynamics, estuary, adult, Atlantic tomcod.

Dew, C.B.; Hecht, J.H. 1994. Hatching, estuarine transport, and distribution of larval and early juvenile Atlantic tomcod, *Microgadus tomcod*, in the Hudson River. *Estuaries* 17:472-488. Keywords: Hudson River, hatching, transport, distribution, larvae, juveniles, Atlantic tomcod.

Dew, C.B.; Hecht, J.H. 1994. Recruitment, growth, mortality, and biomass production of larval and early juvenile Atlantic tomcod in the Hudson River estuary. *Trans. Am. Fish. Soc*. 123:681-702. Keywords: Hudson River, growth, spawning, mortality, larva, juvenile, recruitment, metamorphosis, Atlantic tomcod.

Dexter, B.L. 1995. Project Riverwatch: water quality studies in tributary/shoreline environments of the lower Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 26 p. Keywords: lower Hudson River, tributary, shoreline, environment, water quality.

Dey, W.P. 1981. Mortality and growth of young-of-the-year striped bass in the Hudson River estuary. *Trans. Am. Fish. Soc*. 110:151-157. Keywords: Hudson River, New York, estuary, mortality, growth, young-of-the-year, striped bass.

Dey, W.P.; Baumann, P.C. 1978. Community dynamics of shore zone fish populations in the Hudson River estuary: 108th Annual American Fisheries Society Meeting, Kingston, RI. Keywords: American Fisheries Society, Hudson River, New York, fish community, dynamics, shore zone, population, estuary.

Dey, W.P.; Peck, T.H.; Smith, C.E.; Kreamer, G.L. 1993. Epizoology of hepatic neoplasia in Atlantic tomcod (*Microgadus tomcod*) from the Hudson River estuary. *Can. J. Fish. Aquat. Sci*. 50:1897-1907. Keywords: Hudson River, New York, estuary, epizoology, hepatic neoplasia, adult, Atlantic tomcod.

Diaz, R.J.; Boesch, D.F. 1984. The macrobenthos of the Hudson-Raritan estuary. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology; Ch. VI. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, Raritan River, New Jersey, macrobenthos, estuary.

DiLorenzo, J.L.; Huang, P.; Ram, R.V.; Najarian, T.O. 1990. Water quality screening analysis of small tidal embayments bordering the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 65 p. Keywords: Hudson River, water quality, tidal, pollution, loading, hydrodynamic, management.

Dodson, J. J. and W. C. Leggett. 1973. Behavior of adult American shad (*Alosa sapidissima*) homing to the Connecticut River from the Long Island Sound. *J. Fish. Res. Board Can*. 30:1847-1860. Keywords: Connecticut River, Long Island Sound, adults, homing behavior, migration, American shad.

Domermuth, R.B.; Reed, R.J. 1980. Food of juvenile American shad, *Alosa sapidissima*, juvenile blueback herring, *Alosa* *aestivalis* and pumpkinseed, *Lepomis gibbosus*, in the Connecticut River below Holyoke Dam, Massachusetts. *Estuaries* 3:65-68. Keywords: Connecticut River, food, feeding, diet, juvenile, pumpkinseed, estuary, American shad, blueback herring.

Doroshev, S.I. 1970. Biological features of the eggs, larvae, and young of the striped bass (*Roccus saxatilis*) in connection with the problem of its acclimatization in the USSR. *J. Ichthyol*. 10:235-247. Keywords: USSR, Russia, biology, eggs, larvae, juvenile, young, acclimatization, striped bass.

Doroshov, S.I.; Moberg, G.P. 1993. Reproductive conditions of the Atlantic sturgeon (*Acipenser oxyrhynchus*) stock in the Hudson River. [Final report.] New York, NY: Hudson River Foundation; 52 p. Keywords: reproduction, adult, Atlantic sturgeon.

Doroshov, S.I.; Van Eenennaam, J.P.; Moberg, G.P.; Watson, J.G. 1994. Reproductive conditions of the Atlantic sturgeon (*Acipenser oxyrhynchus*) stock in the Hudson River. [Report for Year 2.] New York, NY: Hudson River Foundation; 65 p. Keywords: Hudson River, reproduction, adult, Atlantic sturgeon.

Dovel, W.L. 1976. Performance report for the biology and management of shortnose and Atlantic sturgeons of the Hudson River. [Report; Oct. 1, 1975 to March 31, 1976.] Albany, NY: New York State Department of Environmental Conservation; 12 p. Keywords: Hudson River, New York, performance report, biology, management, adult, shortnose sturgeon, Atlantic sturgeon.

Dovel, W.L. 1977. An atlas of the biological resource of the Hudson estuary. Yonkers, NY: Boyce Thompson Institute for Plant Research. Keywords: Hudson River, New York, estuary, atlas, biological resources, biology.

Dovel, W.L. 1977. Performance report for the biology and management of shortnose and Atlantic sturgeons of the Hudson River. [Report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, performance report, biology, management, adult, shortnose sturgeon, Atlantic sturgeon.

Dovel, W.L. 1978. Performance report for the biology and management of shortnose and Atlantic sturgeons of the Hudson River. [Report, April 1, 1977 - March 31, 1978.] Albany, NY: New York State Department of Environmental Conservation; 154 p. Keywords: Hudson River, New York, performance report, biology, management, adult, shortnose sturgeon, Atlantic sturgeon.

Dovel, W.L. 1978. Performance report for the biology and management of shortnose and Atlantic sturgeons of the Hudson River. [Draft final report.] Albany, NY: New York State Department of Environmental Conservation; 181 p. Keywords: Hudson River, New York, performance report, biology, management, adult, shortnose sturgeon, Atlantic sturgeon.

Dovel, W.L. 1979. Atlantic and shortnose sturgeons in the Hudson River estuary: Testimony report for the U.S. EPA. The Oceanic Society; 26 p. Keywords: Hudson River, New York, testimony report, biology, management, adult, shortnose sturgeon, Atlantic sturgeon.

Dovel, W.L. 1979. The biology and management of shortnose and Atlantic sturgeon of the Hudson River. [Report.] Albany, NY: New York State Department of Environmental Conservation; 68 p. Keywords: Hudson River, biology, management, adult, shortnose sturgeon, Atlantic sturgeon.

Dovel, W.L. 1979. The endangered shortnose sturgeon of the Hudson River: Its life history and vulnerability to the activities of man. [Periodic progress report No. 1.] Washington, DC: Federal Energy Regulatory Commission; 10 p. Keywords: Hudson River, New York, vulnerability, life history, endangered species, biology, management, shortnose sturgeon.

Dovel, W.L. 1980. The endangered shortnose sturgeon of the Hudson River: Its life history and vulnerability to the activities of man. [Periodic progress report No. 5.] Washington, DC: Federal Energy Regulatory Commission; 5 p. Keywords: Hudson River, New York, life history, vulnerability, endangered species, biology, management, shortnose sturgeon.

Dovel, W.L. 1981. Ichthyoplankton of the lower Hudson estuary, New York. *NY Fish Game J*. 28:21-39. Keywords: Hudson River, New York, estuary, ichthyoplankton, adult, striped bass, Atlantic sturgeon.

Dovel, W.L. 1981. The endangered shortnose sturgeon of the Hudson River: Its life history and vulnerability to the activities of man. [Final report.] Washington, DC: Federal Energy Regulatory Commission; 32 p. Keywords: Hudson River, life history, vulnerability, adult, shortnose sturgeon.

Dovel, W.L. 1990. Movements of immature striped bass in the Hudson River estuary, New York. [Report.] Lancaster, PA: Wyatt Group; 48 p. Keywords: Hudson River, habitat, estuary, seasonal movement, immature adult, development, striped bass.

Dovel, W.L.; Berggren, T.J. 1983. Atlantic sturgeon of the Hudson River estuary, New York. *NY Fish Game J.* 30:140-172. Keywords: Hudson River, adult, Atlantic sturgeon.

Dovel, W.L.; Pekovitch, A.K.; Berggren, T.J. 1992. Biology of the shortnose sturgeon (*Acipenser brevirostrum* Lesueur, 1818) in the Hudson River estuary, New York. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press. Keywords: Hudson River, biology, adult, shortnose sturgeon.

Drill, S.; Schmidt, R.E. 1988. The composition of the summer zooplankton community in Tivoli Bays, Hudson River, New York. *In*: Waldman, J.R.; Blair, E.A., eds. Polgar Fellowship reports of the Hudson River National Estuarine Research Reserve Program, 1986, Section II. New York, NY: Hudson River Foundation; 24 p. Keywords: Hudson River, Tivoli Bays, zooplankton, community, ecology, season.

Durbin, A.G. 1976. The role of fish migration in two coastal ecosystems: the Atlantic menhaden (*Brevoortia tyrannus*) in Narragansett Bay and the alewife (*Alosa pseudoharengus*) in Rhode Island ponds. [Ph.D. dissertation.] Kingston, RI: University of Rhode Island. Keywords: Narragansett Bay, Rhode Island, ponds, role, fish migration, migration, coastal ecosystems, Atlantic menhaden, adult, alewife.

Dustman, E.H.; Stickel, L.F.; Blus, L.J.; Reichel, W.L.; Wiemeyer, S.N. 1971. The occurrence and significance of polychlorinated biphenyls in the environment. *In*: Transactions, 36th North American Wildlife and Natural Resources Conference; 1971 March 7-10; Portland, OR. Washington, DC: Wildlife Management Institute; p. 118-133. Keywords: PCB, environment, ecosystem, biology, chemistry.

Ecological Analysts Science and Technology, Inc. 1978. Hudson thermal effects studies for representative species. [Final report.] Poughkeepsie, NY: Central Hudson Gas and Electric Corporation; New York, NY: Consolidated Edison Company; Pearl River, NY: Orange and Rockland Utilities. Keywords: Hudson River, New York, thermal, temperature, species.

Ecological Analysts Science and Technology, Inc. 1978. Thermal effects literature review for Hudson River representative important species. [Report.] Poughkeepsie, NY: Central Hudson Gas and Electric Corporation; New York, NY: Consolidated Edison Company; Pearl River, NY: Orange and Rockland Utilities; 127 p. Keywords: Hudson River, New York, thermal effects, temperature, literature, fish, species.

Ecological Analysts Science and Technology, Inc. 1979. Effects of heat shock on predation of striped bass larvae by yearling white perch. [Report.] 49 p. Keywords: temperature, heat shock, predation, adult, striped bass, white perch.

Ecological Analysts Science and Technology, Inc. 1983. Stock characteristics of the Hudson River Atlantic tomcod population during the 1980-1981 and 1981-1982 spawning seasons. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, power plant, age, egg, larva, juvenile, adult, spawning, population, fishery, entrainment, impingement, Atlantic tomcod.

Ecological Analysts Science and Technology, Inc. 1984. Abundance and stock characteristics of the Atlantic tomcod population in the Hudson River, Winter 1982-1983. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, power plant, age, egg, larva, juvenile, adult, spawning, population, fishery, entrainment, impingement, Atlantic tomcod.

Ecological Analysts Science and Technology, Inc. 1984. Abundance and stock characteristics of the Atlantic tomcod population in the Hudson River, Winter 1983-1984. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, power plant, age, egg, larva, juvenile, adult, spawning, population, fishery, entrainment, impingement, Atlantic tomcod.

Ecological Analysts Science and Technology, Inc. 1986. A study of the occurrence of liver cancer in Atlantic tomcod (*Microgadus tomcod*) from the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 57 p. Keywords: Hudson River, liver, cancer, adult, Atlantic tomcod.

Ecological Analysts Science and Technology, Inc. 1990. 1988 year class report for the Hudson River monitoring Program. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, estuary, impingement, entrainment, egg, larva, juvenile, adult, striped bass.

Edsall, T.A. 1970. The effects of temperature on the rate of development and survival of alewife eggs and larvae. *Trans. Am. Fish. Soc.* 99:376-380. Keywords: eggs, larvae, development, survival, temperature effects, alewife.

Edwards, E.A.; Gebhart, G.; Maughan, O.E. 1983. Habitat suitability information: smallmouth bass. *U.S. Fish Wildl. Serv. FWS/OBS*-82/10.36; 47 p. Keywords: habitat suitability, smallmouth bass.

Edwards, S.J.; Hutchison, J.B., Jr. 1980. Effectiveness of a barrier set in reducing white perch (*Morone americana*) and striped bass (*Morone saxatilis*) impingement. *Environ. Sci. Tech.* 14:210-213. Keywords: barrier, impingement, power plant, juvenile, adult, white perch, striped bass.

Eldridge, M.B.; King, J.; Eng, D.; Bowers, M.J. 1977. Role of the oil globule in survival and growth of striped bass (*Morone saxatilis*) larvae. *In*: Proceedings, 57th Annual Conference, Western Assoc. State Game and Fish Commissioners; p. 303-313. Keywords: oil globule, survival, growth, larvae, striped bass.

Eldridge, M.B.; Whipple, J.A.; Bowers, M.J. 1982. Bioenergetics and growth of striped bass, *Morone saxatilis*, embryos and larvae. *Fish. Bull. (U.S.)* 80:461-474. Keywords: bioenergetics, growth, embryos, larvae, striped bass.

Eldridge, M.B.; Whipple, J.A.; Eng, D.; Bowers, M.J.; Jarvis, B.M. 1981. Effects of food and feeding factors on laboratory-reared striped bass (*Morone saxatilis*) larvae. *Trans. Am. Fish. Soc.* 110:111-120. Keywords: food, feeding, laboratory-reared, survival, growth, larvae, striped bass.

Elzinga, C.L. 1989. Freshwater tidal wetlands, Hudson River: vegetation, description, investigation, and preservation. [M.S. thesis.] Madison, WI: University of Wisconsin; 171 p. Keywords: Hudson River, New York, freshwater tidal wetlands, vegetation, preservation.

Englert, T.L.; Aydin, F.N. 1975. An intra-tidal population model of young-of-the-year striped bass in the Hudson River. *In*: Proceedings of the AICA International Symposium on Advances in Computer Methods for Partial Differential Equations; p. 273. Keywords: Hudson River, New York, computer methods, intra-tidal, tides, population, model, young-of-the-year, striped bass.

Englert, T.L.; Sugarman, D. 1988. Patterns of movement of striped bass and white perch larvae in the Hudson River estuary. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 148-169. Keywords: Hudson River, movement, distribution, larvae, striped bass, white perch.

Environmental Information Systems. 1985. Users guide to the Hudson River database: Vol. II. Long River

Ichthyoplankton Survey. [Final report.] New York, NY: Hudson River Foundation. Keywords: Long River, ichthyoplankton.

Environmental Information Systems. 1987. Users guide to the Hudson River database: Vol. II. Descriptions of major surveys/programs. [Final report.] New York, NY: Hudson River Foundation. Keywords: Hudson River, survey.

Eraslan, A.H.; Van Winkle, W.; Sharp, R.D.; Christensen, S.W.; Goodyear, C.P.; Rush, R.M.; Fulkerson, W. 1976. A computer simulation model for the striped bass young-of-the-year population in the Hudson River. Oak Ridge, TN: Oak Ridge National Laboratory, Environmental Sciences Division Publication 766 [ORNL/NUREG-8]. Keywords: Hudson River, New York, computer simulation, model, young-of-the-year, population, striped bass.

ESSA Technologies, Ltd. and Deriso. 1994. A critical review of the SPDES Draft Environmental Impact Statement. [Report.] Albany, NY: New York State Department of Environmental Conservation; 70 p. Keywords: Hudson River, environment.

Esser, S.C. 1983. Long-term changes in some fishes of the Hudson-Raritan estuary. *In*: Mayer, G.F., ed. Ecological stress and the New York Bight. Columbia, SC: Estuarine Research Federation; p. 299-314. Keywords: Hudson River, Raritan River, New York, fishes, estuary.

Fabrizio, M.C. 1987. Contribution of Chesapeake Bay and Hudson River stocks of striped bass to Rhode Island coastal waters as estimated by isoelectric focusing of eye lens protein. *Trans. Am. Fish. Soc*. 116:588-593. Keywords: Hudson River, Chesapeake Bay, Rhode Island, distribution, migration, adult, striped bass.

Feldman, A.E. 1973. A microfaunal and microfloral population investigation of the Hudson River in the vicinity of Roseton, NY. *In*: Proceedings of 3rd Symposium of Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, Roseton, microfaunal, microfloral, population, investigation.

Festa, P.J. 1990. Summary of Hudson River black bass tournament reports 1989. Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, tournament, black bass, sport fishery.

Fewlass, L. 1980. Life history and management of the largemouth bass in the Upper Chesapeake Bay. [Study II.] Annapolis, MD: Maryland Department of Natural Resources. Keywords: Upper Chesapeake Bay, Chesapeake Bay, life history, management, young, adult, largemouth bass.

Fewlass, L. 1985. A study of the largemouth bass inhabiting Potomac River tidal waters. [Report.] Annapolis, MD: Maryland Department of Natural Resources; 10 p. Keywords: Potomac River, tidal waters, adult, largemouth bass.

Fewlass, L. 1985. A study of the largemouth bass inhabiting Wicomico River tidal waters. [Report.] Annapolis, MD: Maryland Department of Natural Resources; 6 p. Keywords: Wicomico River, tidal waters, adult, largemouth bass.

Findlay, S. 1988. Significance of the detritus food web in the Tivoli Bays. [Final report.] Silver Spring, MD: NOAA Marine and Estuarine Management Division; 36 p. Keywords: Hudson River, Tivoli Bays, detritus, food web.

Findlay, S.; Pace, M.L.; Lints, D.; Cole, J.J.; Caraco, N.F.; Peierls, B. 1991. Weak coupling of bacterial and algal production in heterotrophic ecosystem: the Hudson River estuary. *Limnol. Oceanogr*. 36:268-278. Keywords: Hudson River, New York, estuary, weak coupling, bacteria, algae, production, heterotrophic, ecosystem.

Findlay, S.; Howe, K.; Austin, H.K. 1990. Comparison of detritus dynamics in two tidal freshwater wetlands. *Ecol*. 71:288-295. Keywords: Hudson River, detritus, tidal, freshwater, wetland.

Findlay, S.; Pace, M.L. 1994. Synthesis of information on the lower food web of the tidal freshwater Hudson River. [Final report.] New York, NY: Hudson River Foundation; 20 p. Keywords: Hudson River, phytoplankton, zooplankton, bacteria, distribution, freshwater.

Findlay, S.; Pace, M.L.; Lints, D. 1991. Scales of variability and transport of suspended sediment, particulate, and dissolved organic carbon in the tidal, freshwater Hudson River. *Biogeochemistry* 12:149-169. Keywords: Hudson River, New York, transport, organic carbon, sediment, particulate, tides, freshwater, estuary.

Findlay, S.; Pace, M.L; Fischer, D. 1996. Spatial and temporal variability in the lower food web of the tidal freshwater Hudson River. *Estuaries* 19:866-873. Keywords: lower Hudson River, food web, tidal, tide, freshwater, ecology.

Findlay, S.; Schoeberl, K.; Wagner, B. 1989. Abundance, composition, and dynamics of the invertebrate fauna of a tidal freshwater wetland. *J. N. Am. Benthol. Soc*. 8:140-148. Keywords: Hudson River, invertebrates, community, tidal, freshwater, wetland.

Fishler, K.G. 1959. Contributions of the Hudson and Connecticut Rivers to New York-New Jersey shad catch of 1956. *U.S. Fish Wildl. Serv. Fish. Bull*. 60:161-174. Keywords: Hudson River, New York, Connecticut River, New Jersey, fishery, catch, 1956, adult, American shad.

Fleming, A.K.; et al. 1976. The environmental impact of PL 92-500 on the Hudson River estuary. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, environmental impact, PL 92-500, estuary.

Flemming, J.; Anderson, W.; Motyer, J.; Dadswell, M.J. [year unknown.] Utilization of an intertidal mudflat by tomcod (*Microgadus tomcod*) and smooth flounder (*Liopsetta putnami*) and their impact on benthic prey organisms, Peck's Cove, Cumberland Basin, New Brunswick. [Report.] Keywords: Peck's Cove, Cumberland Basin, New Brunswick, intertidal mudflat, tide, smooth flounder, impact, prey, benthos, adult, Atlantic tomcod.

Floyd, K.B.; Hoyt, R.D.; Timbrook, S. 1984. Chronology of appearance and habitat partitioning by stream larval fishes. *Trans. Am. Fish. Soc*. 113:217-223. Keywords: chronology, appearance, habitat partitioning, stream larval fishes, stream, larvae.

Fortin, R.; Leveille, M.; Laramee, P.; Mailhot, Y. 1990. Reproduction and year-class strength of the Atlantic tomcod (*Microgadus tomcod*) in the Sainte-Anne River at La Perade, Quebec. *Can. J. Zool*. 68:1350-1359. Keywords: Sainte-Anne River, La Perade, Quebec, reproduction, year-class strength, young-of-the-year, Atlantic tomcod.

Foster, F.J. 1919. White perch notes and methods of propagation. *Trans. Am. Fish. Soc*. 48:160-165. Keywords: propagation, reproduction, adult, white perch.

Fox, L.E. 1991. Phosphorus chemistry in the tidal Hudson estuary. *Geochim. Cosmochim. Acta* 55:1529-1538. Keywords: Hudson River, New York, tidal zone, tide, estuary, phosphorus chemistry, chemistry.

Freadman, M.A. 1979. Swimming energetics of striped bass (*Morone saxatilis*) and bluefish (*Pomatomus saltatrix*): gill ventilation and swimming metabolism. *J. Exp. Biol*. 83:217-230. Keywords: swimming, energetics, gill ventilation, swimming metabolism, physiology, adult, striped bass, bluefish.

Fredin, R.A. 1954. Causes of fluctuations in abundance of Connecticut River shad. *U.S. Fish Wildl. Serv. Fish. Bull*. 54:247-259. Keywords: Connecticut River, abundance, adult, American shad.

Fredrick, S.W.; Heffner, R.L.; Packard, A.T.; Eldridge, T.M.; Eldridge, J.C.; Schumacher, J.G.; Eichorn, K.; Currie, J.; Richards, J.N.; Boody, O.C., IV. 1976. Notes on phytoplankton distribution in the Hudson River estuary. *In*: Boesch, D.F., ed. Proceedings of the 4th Symposium on Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, phytoplankton, distribution, estuary.

Friedland, K.D.; Garman, G.C.; Bejda, A.J.; Studholme, A.L.; Olla, B. 1988. Interannual variation in diet and condition in juvenile bluefish during estuarine residency. *Trans. Am. Fish. Soc*. 117:474-479. Keywords: diet variation, food, feeding, juvenile, estuary, bluefish.

Fritzsche, R.A.; Johnson, G.D. 1980. Early osteological development of white perch and striped bass with emphasis on identification of their larvae. *Trans. Am. Fish. Soc*. 109:387-406. Keywords: osteology, development, morphology, identification, larvae, white perch, striped bass.

Funderburk, S.L.; Jordan, S.J.; Mihursky, J.A.; Riley, D., editors. 1991. Habitat requirements for Chesapeake Bay living resources, Second Edition. Annapolis, MD: Chesapeake Bay Program. Keywords: Chesapeake Bay, habitat, bay anchovy, alewife, blueback herring, American shad, white perch, striped bass.

Gallagher, R.P.; Conner, J.B. 1983. Comparison of two ichthyoplankton sampling gears with notes on microdistribution of fish larvae in a large river. *Trans. Am. Fish. Soc*. 112:280-285. Keywords: comparison, ichthyoplankton, sampling gears, microdistribution, fish larvae, river.

Gandarillas, E.F.; Brinkhuis, B.H. 1981. Benthic faunal assemblages in the lower bay of New York Harbor. Stony Brook, NY: SUNY Marine Sciences Research Center; 129 p. Keywords: Hudson River, New York Harbor, New York, benthic fauna, benthos, lower bay.

Gardinier, M.N.; Hoff, T.B. 1982. Diet of striped bass (*Morone saxatilis*) in the Hudson River estuary. *NY Fish Game J*. 29:152-165. Keywords: New York, Hudson River, diet, estuary, food, feeding, adult, striped bass.

Garside, C.; Malone, T.C.; Roels, O.A.; Sharfstein, B.A. 1976. An evaluation of sewage derived nutrients and their influence on the Hudson River estuary and the New York Bight. *Estuar. Coastal Mar. Sci*. 4:281-289. Keywords: Hudson River, New York Bight, bight, estuary, sewage, nutrients.

Garvey, E.A. 1989. The geochemistry of inorganic carbon in the Hudson estuary. [Ph.D. dissertation.] New York, NY: Columbia Univ.; 559 p. Keywords: Hudson River, New York, estuary, geochemistry, inorganic carbon, carbon.

Garvine, R.W. 1985. A simple model of estuarine subtidal fluctuations forced by local and remote wind stress. *J. Geophys. Res*. 90:945-948. Keywords: model, estuary, subtidal fluctuations, wind.

Gibbons, J.W.; Hook, J.T.; Forney, D.L. 1972. Winter responses of largemouth bass to heated effluent from a nuclear reactor. *Prog. Fish-Cult*. 34:88-90. Keywords: winter response, season, nuclear reactor, temperature effects, adult, largemouth bass.

Gibbs, R.J. 1993. The transport of toxic substances in the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation. Keywords: Hudson River, toxic, transport.

Giese, G.L.; Barr, J.W. 1967. The Hudson River estuary, a preliminary investigation of flow and water characteristics. Albany, NY: New York State Water Commission; Bulletin 61. Keywords: Hudson River, New York, estuary, flow, water.

Giesel, J.T. 1976. Reproductive strategies as adaptations to life in temporarily heterogenous environments. *Ann. Rev. Ecol. Syst*. 7:57-79. Keywords: reproduction, adaptations, heterogenous environment.

Giles, R.H., Jr.; Neilsen, L.A. 1992. The uses of geographic information systems in fisheries. *In*: Stroud, R.H., ed. Fisheries management and watershed development. *Am. Fish. Soc. Symp*. 13:81-94. Keywords: GIS, geographic information system, fisheries, management.

Ginn, T.C. 1977. An ecological investigation of Hudson River macrozooplankton in the vicinity of a nuclear power plant. [Ph.D. dissertation.] New York, NY: New York University. Keywords: Hudson River, New York, ecology, investigation, macrozooplankton, nuclear power plant.

Gladden, J.B.; Cantelmo, F.R.; Croom, J.M.; Shapot, R. 1988. Evaluation of the Hudson River ecosystem in relation to the dynamics of fish populations. *Am. Fish. Soc. Monogr*. 4:37-52. Keywords: Hudson River, fish community, ecosystem, food chain, invertebrates, wastewater, marshes, nutrients, loadings.

Goldman, J.C. 1978. Combined toxicity effects of chlorine, ammonia, and temperature on marine plankton. [Progress report, Nov. 1976-Jan. 1978.] Washington DC: Department of Energy; 6 p. Keywords: toxicity, chlorine, ammonia, temperature, plankton.

Goodyear, C.P. 1985. Relationship between reported commercial landings and abundance of young striped bass in Chesapeake Bay, Maryland. *Trans. Am. Fish. Soc.* 114:92-96. Keywords: Chesapeake Bay, juveniles, abundance, commercial fishery, striped bass.

Gould, K.; Findlay, S. 1991. Changes in interstitial water chemistry along a salinity gradient. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1990, Section II. New York, NY: Hudson River Foundation; 33 p. Keywords: Hudson River, water chemistry, salinity.

Grabe, S.A. 1978. Food and feeding habits of juvenile Atlantic tomcod, *Microgadus tomcod*, from Haverstraw Bay, Hudson River. *Fish. Bull. (U.S.)* 76:89-94. Keywords: Hudson River, Haverstraw Bay, juvenile, food, feeding, behavior, Atlantic tomcod.

Grabe, S.A. 1980. Food of age 1 and 2 Atlantic tomcod, *Microgadus tomcod*, from Haverstraw Bay, Hudson River, NY. *Fish. Bull. (U.S.)* 76:89-94. Keywords: Haverstraw Bay, Hudson River, New York, food, juvenile, age 1, age 2, young, Atlantic tomcod.

Grabe, S.A.; Schmidt, R.E. 1978. Overlap and diet variations in feeding habits of *Alosa sapidissima* juveniles from the lower Hudson River estuary. *Prepared for*: Annual meeting, American Fisheries Society, NY Chapter, Marcy, NY. Keywords: Hudson River, New York, Lower Hudson River, estuary, diet, feeding habits, food, juveniles, American shad.

Grant, G.C. 1962. Predation by bluefish on young Atlantic menhaden in Indian River, Delaware. *Chesapeake Sci.* 3:45-47. Keywords: Indian River, Delaware, predation, predator, prey, food, feeding, young, Atlantic menhaden, adult, bluefish.

Grant, G.C. 1974. The age composition of striped bass catches in Virginia rivers 1967-1971, and a description of the fishery. *Fish. Bull. (U.S.)* 72:193-199. Keywords: Virginia, rivers, age composition, population, catches, fishes, fishery, adult, striped bass.

Grant, G.C.; Olney, J.E. 1982. Assessment of larval striped bass, *Morone saxatilis* (Walbaum), stocks in Maryland and Virginia waters: Part II. Assessment of spawning activity in major Virginia Rivers. [Final report, segment 2.] Gloucester, MA: National Marine Fisheries Service; 42 p. Keywords: Maryland, Virginia, stocks, spawning, rivers, larval, assessment, report, striped bass.

Greeley, J.R. 1935. Annotated list of fishes occurring in the watershed. A Biological Survey of the Mohawk-Hudson Watershed: Supplement to the 24th Annual Report for 1934. Albany, NY: New York State Department of Environmental Conservation; p. 63-101. Keywords: Mohawk River, Hudson River, New York, biology, biological survey, watershed.

Greeley, J.R. 1937. Fishes of the area with an annotated list. *In*: Moore, E., ed. A biological survey of the lower Hudson watershed. [Supplemental to 26th Annual Report.] Albany, NY: State of New York Conservation Department; p. 45-103. Keywords: New York Conservation Department, Hudson River.

Green, D.M. 1982. Population dynamics and management of largemouth bass (*Micropterus salmoides*) and chain pickerel (*Esox niger*) in Dryden Lake, New York. [Ph.D. dissertation.] Ithaca, NY: Cornell University; 149 p. Keywords: Dryden Lake, New York, population dynamics, management, chain pickerel, adult, largemouth bass.

Green, D.M.; Heidinger, R.C. 1994. Longevity record for largemouth bass. *N. Am. J. Fish. Manage.* 14:464-465. Keywords: longevity, age, aging techniques, otolith.

Green, D.M.; Jackson, J. 1991. Characterizations of angler activity on the Hudson River estuary. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1990, Section VII. New York, NY: Hudson River Foundation; 52 p. Keywords: Hudson River, fishermen.

Green, D.M.; Landsberger, S.E.; Nack, S.B.; Bunnell, D.; Forney, J.L. 1993. Abundance and winter distribution of Hudson River black bass. [Final report.] New York, NY: Hudson River Foundation; 49 p. Keywords: Hudson River, abundance, distribution, season, adult, largemouth bass.

Green, D.M.; Nack, S.B.; Bunnell, D.; Forney, J.L. 1989. Identification of black bass spawning and nursery habitats in the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 52 p. Keywords: Hudson River, black bass, spawning, nursery, habitat, eggs, nests, fishery, young-of-the-year, adult, largemouth bass.

Green, D.M.; Nack, S.B.; Forney, J.L. 1988. Identification of black bass spawning and nursery habitats in the Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 34 p. Keywords: Hudson River, black bass, spawning, nursery, habitat, eggs, nests, fishery, young-of-the-year, adult, largemouth bass.

Green, D.M.; Schonhoff, B.J., III; Youngs, W.D. 1984. Population dynamics of largemouth and smallmouth bass in New York waters. Albany, NY: New York State Department of Environmental Conservation; 286 p. Keywords: waters, New York, population, smallmouth bass, adult, largemouth bass.

Green, D.M.; Schonhoff, B.J., III; Youngs, W.D. 1986. The New York State bass study, 1977-1980: use of angler collected data to determine population dynamics. Albany, NY: New York State Department of Environmental Conservation; 142 p. Keywords: fishery, angler, population, smallmouth bass, adult, largemouth bass.

Green, D.M.; Schonhoff, B.J., III; Youngs, W.D. 1988. Evaluation of hooking mortality of smallmouth and largemouth bass. *In*: Barnhart, R.H.; Roelofs, T.D., eds. Catch and Release Fishing, A Decade of Experience. National Sports Fishing Symposium. Arcata, CA: Humboldt State University. Keywords: mortality, smallmouth bass, adult, fishery, largemouth bass.

Green, D.M.; Stang, D.L.; Klindt, R.M.; Chiotti, T.L.; Miller, W.W. 1995. Redistribution of black bass resulting from competitive fishing and potential influence on mortality. [Report.] New York, NY: Hudson River Foundation; 32 p. Keywords: distribution, fishery, mortality, largemouth bass.

Greig, R.A.; McGrath, R. 1977. Trace metals in sediments of Raritan Bay. *Mar. Pollut. Bull*. 8:188-192. Keywords: Raritan Bay, metals, sediments, pollution, contaminant.

Grove, T.L.; Berggren, T.J.; Powers, D.A. 1976. The use of innate tags to segregate spawning stocks of striped bass, *Morone saxatilis*. *In*: Wiley, M., ed. Estuarine processes. New York, NY: Academic Press; p. 166-176. Keywords: tags, mark, spawning, stocks, adult, striped bass.

Hackney, P.A.; Webb, J.C. 1978. A method for determining growth and mortality rates of ichthyoplankton. *In*: Jensen, L.E., ed. Fourth National Workshop on Entrainment and Impingement. Melville, NY: EA Communications; p. 115-124. Keywords: growth, mortality, ichthyoplankton.

Hatrack, R.L. 1983. Estuarine fishes. *In*: Ketchup, B.H., ed. Estuaries and enclosed seas: ecosystems of the world 26. New York, NY: Elsevier; p. 183-207. Keywords: estuary, fishes.

Haley, N.J. 1999. Habitat characteristics and resource use patterns of sympatric sturgeons in the Hudson River estuary. [M.S. thesis.] Amherst, MA: University of Massachusetts; 124 p. Keywords: habitat, estuary, salinity, Atlantic sturgeon, shortnose sturgeon.

Hall, J.W.; Smith, T.I.J.; Lamprecht, S.D. 1991. Movements and habitats of shortnose sturgeon, *Acipenser brevirostrum*, in the Savannah River. *Copeia* 1991:695-702. Keywords: Savannah River, movements, habitat, adult, shortnose sturgeon.

Hall, L.W., Jr.; Fischer, S.A.; Killen, W.D.; Zeigenfuss, M.C.; Anderson, R.D.; Klauda, R.J. 1993. Assessing the relationship between critical acidic conditions in Maryland coastal plain streams and predicted mortality of early life stages of migratory fish. *Aquat. Toxicol*. 26:239-272. Keywords: Maryland, habitat, mortality, acid, egg, larva, white perch, blueback herring, alewife.

Hamer, P.E. 1959. Age and growth studies of the bluefish (*Pomatomus saltatrix* Linnaeus) of the New York Bight. [M.S. thesis.] New Brunswick, NJ: Rutgers University. Keywords: New York Bight, New York, age, growth, adult, young, bluefish.

Hamilton, A.; Schmidt, R.E. 1993. Significance of the fishes collected by gill net in the Tivoli South Bay ecosystem. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the 1992 Tibor T. Polgar Fellowship Program, Section IX. New York, NY: Hudson River Foundation; 16 p. Keywords: Hudson River, Tivoli South Bay, tidal, freshwater, marsh habitat, water-chestnut beds, fish sampling, gill net, adult, largemouth bass.

Hammond, D.E. 1975. Dissolved gases and kinetic processes in the Hudson River estuary. [Ph.D. dissertation.] New York, NY: Columbia University. Keywords: Hudson River, nutrients, loadings.

Hankin, N.; Schmidt, R.E. 1992. Standing crop of fishes in water celery beds in the tidal Hudson River estuary. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1991. New York, NY: Hudson River Foundation; 21 p. Keywords: Hudson River, estuary, tidal, tide, population, sampling, water celery bed, adult, white perch, alewife, blueback herring.

Hardy, J.D. 1978. *Morone americana* (Gmelin), white perch. *In*: Development of fishes of the Mid-Atlantic Bight. *U.S. Fish Wildl. Serv. FWS/OBS*-78/12, v. 3:71-85. Keywords: adult, white perch.

Hardy, J.D. 1978. *Morone saxatilis*, striped bass. *In*: Development of fishes of the Mid-Atlantic Bight. *U.S. Fish. Wildl. Serv. FWS/OBS*-78/12, v. 3:86-105. Keywords: adult, striped bass.

Hardy, J.D., Jr.; Hudson, L.L. 1975. Descriptions of the eggs and juveniles of the Atlantic tomcod, *Microgadus tomcod*. *Chesapeake Biol. Lab. Ref*. 75-11; 14 p. Keywords: eggs, juveniles, Atlantic tomcod.

Hare, J. [year unknown.] Processes involved in the survival and subsequent recruitment of bluefish early life history stages (*Pomatomus saltatrix*). New York, NY: Hudson River Foundation. Keywords: recruitment, survival, life history, larvae, larval transport, estuary, bluefish.

Harper, J.L.; Jarman, R. 1972. Investigation of striped bass, *Roccus saxatilis* (Walbaum), culture in Oklahoma. *In*: Proceedings, 25th Annual Conference of Southeastern Assoc. Game and Fish Comm. 1971; 510-512. Keywords: Oklahoma, adult, striped bass.

Hart, J.; Wirgin, I. 1994. Characterization of mitochondrial DNA genotypes in Atlantic sturgeon (*Acipenser oxyrhynchus*) from the Hudson River: the extent of spatial and temporal heterogeneity. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1993. New York, NY: Hudson River Foundation. Keywords: Hudson River, New York, estuary, mitochondria, DNA, genotypes, spatial heterogeneity, temporal heterogeneity, heterogeneity, adult, Atlantic sturgeon.

Hassler, W.W.; Trent, W.L.: Florence, B.J. 1966. The status and abundance of the striped bass in the Roanoke River, North Carolina, for 1965. [Report.] Raleigh, NC: North Carolina Dept. of Conservation and Development of Commercial Sport Fishing; 52 p. Keywords: Roanoke River, North Carolina, status, abundance, adult, striped bass.

Hattala, K.; Kahnle, A.; Liebig, P. 1993. Annual assessment of the striped bass spawning stock in the Hudson River estuary. *In*: Abstracts, Striped Bass Study Workshop, 1993. Washington, DC: Atlantic States Marine Fisheries Commission. Keywords: Hudson River, spawning, adult, striped bass.

Hatton, S.R. 1941. Feeding habits of the striped bass and shad. *Calif. Conservationist* 6:11-22. Keywords: feeding, food, behavior, adult, striped bass, American shad.

Haynes, J.M.; Frisch, N.J. 1993. Illustrated Guide to Hudson River Fishes. New York, NY: Hudson River Foundation; 114 p. Keywords: Hudson River, key to species, species identification, adult, Atlantic sturgeon, shortnose sturgeon, alewife, blueback herring, American shad, Atlantic tomcod, bay anchovy, bluefish, striped bass, white perch, largemouth bass.

Hazen, R.E.; Kneip, T.J. 1980. Biogeochemical cycling of cadmium in a marsh ecosystem. *In*: Nriagu, J.O., ed. Cadmium in the environment: Part I. Ecological cycling. New York, NY: John Wiley & Sons; p. 399-424. Keywords: Biogeochemical cycling, chemistry, cadmium, marsh, ecosystem.

Heffner, R.L. 1973. Phytoplankton community dynamics in the Hudson River estuary between mile points 39 and 77. *In*: Proceedings of 3rd Symposium of Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, estuary, phytoplankton, community dynamics.

Heidinger, R.C. 1975. Life history and biology of the largemouth bass. *In*: Stroud, R.H.; Clepper, H., eds. Black bass biology and management. Washington, DC: Sports Fishing Institute; p. 11-20. Keywords: life history, management, biology, adult, largemouth bass.

Heidinger, R.C. 1976. Synopsis of biological data on the largemouth bass (*Micropterus salmoides*). *FAO Fish. Syn.* 115; 85 p. Keywords: biology, data, adult, largemouth bass.

Heimbuch, D.G.; Dunning, D.J.; Young, J.R. 1992. Post-yolk-sac larvae abundance as an index of year class strength of striped bass in the Hudson River. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p 376-391. Keywords: Hudson River, post-yolk-sac larvae, larvae abundance, index, year class strength, striped bass.

Heinle, D.R.; Flemer, D.A.; Ustach, J.F. 1977. Contribution of tidal marshlands to mid-Atlantic estuarine food chains. *In*: Estuarine process: Vol. II. Circulation, sediments, and transfer of material in the estuary. New York, NY: Academic Press, Inc.; p. 309-320. Keywords: Atlantic Ocean, estuary, tidal marsh, tide, food chain.

Henderson, P.A. 1987. The vertical and transverse distribution of larval herring in the Blackwater River estuary, Essex. *J. Fish Biol*. 31:281-290. Keywords: Blackwater River, vertical, transverse, distribution, larvae, blueback herring.

Hetling, L.; Bureau of Water Research. 1978. Summary of Hudson River PCB study results. Albany, NY: New York State Department of Environmental Conservation Technical Paper 51; 88 p. Keywords: Hudson River, PCBs, sediment, water quality, adult, striped bass.

Hetling, L.J. 1976. An analysis of past, present and future Hudson River wastewater loadings. *In*: Hudson River Ecology, 4th Symposium. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, wastewater, loadings.

Hetling, L.J.; Horn, E.; Tofflemire, T.J. 1978. Summary of Hudson River PCB study results. Albany, NY: NY: New York State Department of Environmental Conservation Technical Paper 52; 88 p. Keywords: Hudson River, New York, PCB, contaminant, study results.

Hetling, L.J.; Tofflemire, T.J.; Horn, E.G.; Thomas, R.; Mt. Plaesant, R. 1979. The Hudson River PCB problem: Management alternatives. *Ann. NY Acad. Sci*. 320:630-650. Keywords: Hudson River, New York, PCB, contaminant, pollution, management, alternatives.

Hildebrand, S.F. 1943. A review of the American anchovies (Family Engraulidae). *Bull. Bingham Oceanogr. Coll. Yale Univ*. 8:1-165. Keywords: anchovy.

Hildebrand, S.F. 1963. Family Clupeidae. *In*: Fishes of the western North Atlantic. *Sears Found. Mar. Res. Mem*. 1, Part 1; p. 227-238; 397-442; 452-454. Keywords: Clupeidae.

Hildebrand, S.F. 1963. Family Engraulidae. *In*: Fishes of the western North Atlantic. *Sears Found. Mar. Res. Mem*. 1, Part 1; p. 152-249. Keywords: anchovy.

Hildebrand, S.F.; Cable, L.E. 1930. Development and life history of fourteen fishes at Beaufort, NC. *U.S. Fish Wildl. Serv. Fish. Bull*. 46:383-488. Keywords: Beaufort, North Carolina, development, life history.

Hildebrand, S.F.; Schroeder, W.C. 1928. Fishes of Chesapeake Bay. *U.S. Fish. Wildl. Serv. Fish. Bull*. 42(1926):77-85. Keywords: Chesapeake Bay.

Himchak, P.; Carlson, J.; Tilton, R.; Andrews, W.D. 1984. Inventory of the fishery resources of the Hudson River from Bayonne to Piermont. [Final report.] Trenton, NJ: New Jersey Department of Environmental Protection; 142 p. Keywords: Hudson River, Bayonne, Piermont, New York, inventory, fishes, fishery resources.

Hinton, D.E.; Klaunig, J.E.; Lipsky, M.M. 1978. PCB-induced alterations in teleost liver: a model for environmental disease in fish. *Mar. Fish. Rev*. 40:47-50. Keywords: PCB, toxic, teleost liver, model, environment, disease.

Hirschberg, D.J.; Bokuniewicz, H.J. 1991. Measurements of water temperature, salinity, and suspended sediment concentrations along the axis of the Hudson River estuary 1980-1981. Stony Brook, NY: SUNY Marine Sciences Research Center Special Data Report No. 11. Keywords: Hudson River, New York, estuary, water temperature, salinity, suspended sediments, 1980, 1981.

Hirschberg, D.J.; Chin, P.; Feng, H.; Cochran, J.K. 1996. Dynamics of sediment and contaminant transport in the Hudson River estuary: evidence from sediment distributions of naturally occurring radionuclides. *Estuaries* 19:175-193. Keywords: Hudson River, sediment, contaminant, radionuclide.

Hjorth, D.A. 1988. Feeding selection of larval striped bass and white perch in the Peekskill region of the Hudson River. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 171-179. Keywords: Hudson River, Peekskill, predation, prey selection, food, feeding, larvae, striped bass, white perch.

Hoagman, W.J.; Merriner, J.V.; St. Pierre, R.; Wilson, W.L. 1973. Biology and management of river herring and shad in Virginia. [Completion report.] Gloucester Pt., VA: Virginia Institute of Marine Science. Keywords: Virginia, biology, management, adult, blueback herring, American shad.

Hoff, J.G. 1979. Annotated bibliography and subject index on the shortnose sturgeon, *Acipenser brevirostrum*. *NOAA Tech. Rep. NMFS SSRF*-731; 16 p. Keywords: bibliography, index, adult, shortnose sturgeon.

Hoff, J.G. 1980. Review of the present status of the stocks of the Atlantic sturgeon, *Acipenser oxyrhynchus*, Mitchill. Gloucester, MA: National Marine Fisheries Service; 136 p. Keywords: stocks, population, status, review, adult, Atlantic sturgeon.

Hoff, T.B.; McLaren, B.; Cooper, J.C. 1988. Stock characteristics of Hudson River striped bass. *Am. Fish. Soc. Monogr.* 4:59-68. Keywords: Hudson River, stock, population, adult, striped bass.

Hoff, T.B.; Klauda, R.J. 1979. Data on shortnose sturgeon (*Acipenser brevirostrum*) collected incidentally from 1969 through 1977 in sampling programs conducted for the Hudson River Ecological Study. *Prepared for*: workshop of shortnose sturgeon recovery team, Danvers, MA. Buchanan, NY: Texas Instruments; 31 p. Keywords: Hudson River, New York, ecology, sampling, distribution, catch, estuary, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, adult, shortnose sturgeon.

Hoff, T.B.; Klauda, R.J. 1979. Distribution and some life history aspects of shortnose sturgeon (*Acipenser brevirostrum*) in Lower Hudson River estuary. *Prepared for*: workshop of shortnose sturgeon recovery team, Danvers, MA. Buchanan, NY: Texas Instruments; 31 p. Keywords: Hudson River, New York, life history, ecology, sampling, distribution, catch, estuary, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, adult, shortnose sturgeon.

Hoff, T.B.; Klauda, R.J.; Belding, B.S. 1977. Data on incidental catch and distribution of shortnose sturgeon (*Acipenser brevirostrum*) in the Hudson River estuary, 1969 through 1977. [Report.] Buchanan, NY: Texas Instruments; 21 p. Keywords: Hudson River, New York, distribution, catch, estuary, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, adult, shortnose sturgeon.

Hoff, T.B.; Klauda, R.J.; Belding, B.S. 1977. Incidental catch and distribution of shortnose sturgeon and Atlantic sturgeon in the Hudson River estuary, 1969 through 1977. *Prepared for*: workshop of shortnose sturgeon recovery team, Philadelphia, PA. Keywords: Hudson River, New York, distribution, catch, estuary, workshop, recovery team, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, adult, shortnose sturgeon, Atlantic sturgeon.

Hoff, T.B.; Klauda, R.J.; Young, J.R. 1988. Contribution to the biology of shortnose sturgeon in the Hudson River. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 171-179. Keywords: Hudson River, distribution, larva, juvenile, adult, shortnose sturgeon, Atlantic sturgeon.

Hogan, T.M.; Williams, B.S. 1976. Occurrence of the gill parasite, *Ergasilus labracis*, on striped bass, white perch and tomcod in the Hudson River. *NY Fish Game J.* 23:97. Keywords: Hudson River, New York, gill parasite, adult, striped bass, white perch, Atlantic tomcod.

Holland, L.E. 1986. Effects of barge traffic on distribution and survival of ichthyoplankton and small fishes in the upper Mississippi River. *Trans. Am. Fish. Soc.* 115:162-165. Keywords: Upper Mississippi River, Mississippi River, barge traffic, river traffic, distribution, survival, ichthyoplankton, small fish.

Hollis, E.H. 1948. The homing tendency of shad. *Science* 108(2804):332-333. Keywords: homing, migration, shad.

Hollis, E.H. 1952. Variations in the feeding habits of the striped bass, *Roccus saxatilis* (Walbaum), in Chesapeake Bay. *Bull. Bingham Oceanogr. Coll. Yale Univ.* 14:111-131. Keywords: Chesapeake Bay, food, feeding habits, adult, striped bass.

Hollis, E.H. 1967. Investigation of striped bass in Maryland. [Report.] Annapolis, MD: Maryland Department of Game and Inland Fish; 96 p. Keywords: Maryland, adult, striped bass.

Holsapple, J.G.; Foster, L.E. 1975. Reproduction of white perch in the lower Hudson River. *NY Fish Game J.* 22:122-127. Keywords: Hudson River, New York, lower Hudson River, reproduction, adult, white perch.

Hopkins, D.; Green, D.M. 1989. Evaluation of potential sources of recruitment of largemouth bass to the Hudson River. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1988, Section VIII. New York, NY: Hudson River Foundation; 28 p. Keywords: Hudson River, New York, recruitment, estuary, juvenile, adult, largemouth bass.

Horn, E.G.; Hetling, L.J.; Tofflemire, T.J. 1979. The problem of PCBs in the Hudson River system. *Ann. NY Acad. Sci.* 320:591-609. Keywords: Hudson River, New York, estuary, river, bay, contaminant, pollution, PCB.

Hoss D.E.; Coston, L.C.; Schaaf, W.E. 1974. Effects of sea water extracts of sediments from Charleston Harbor, SC, on larval estuarine fishes. *Estuar. Coast. Mar. Sci.* 2:323-328. Keywords: Charleston Harbor, South Carolina, sea water, sediment, larvae, estuary, estuarine fishes.

Hoss, D.E.; Hettler, W.F.; Coston, L.C. 1974. Effects of thermal shock on larval estuarine fish: ecological implications with respect to entrainment in power plant cooling systems. *In*: Blaxter, J.H.S., ed. The early life history of fish: proceedings of an international symposium, Dunstaffnage Marine Research Laboratory, Oban, Scotland, 1973. New York, NY: Springer-Verlag; p. 357-371. Keywords: temperature, thermal shock, larvae, estuary, estuarine fish, ecology, entrainment, power plant, cooling systems, life history.

Hoss, D.E.; Thayer, G.W. 1993. The importance of habitat to the early life history of estuarine dependent fishes. *Am. Fish. Soc. Symp.* 14:147-158. Keywords: habitat, early life history, estuary.

Houser, A.; Rainwater, W.C. 1975. Relation of physical and biological variables to black bass crops. *In*: Stroud, R.H.;

Clepper, H., eds. Black bass biology and management. Washington, DC: Sports Fishing Institute. Keywords: physical factors, biology, black bass, crops, population, adult, largemouth bass.

Howarth, R.W.; Fruci, J.R.; Sherman, D. 1991. Inputs of sediment and carbon to an estuarine ecosystem: Influence of land use. *Ecol. Applications* 1:27-39. Keywords: sediment, carbon, ecosystem, estuary, ecology.

Howarth, R.W.; Marino, R.; Garritt, R.; Sherman. D. 1992. Ecosystem respiration and organic carbon processing in a large, tidally influenced river: the Hudson River. *Biogeochemistry* 16:83-102. Keywords: Hudson River, New York, ecosystem, respiration, organic carbon, tidal, tide.

Howe, A.B. 1971. Biological investigations of the Atlantic tomcod, *Microgadus tomcod* (Walbaum), in the Weweantic River estuary, Massachusetts, 1967. [M.S. thesis.] Amherst, MA: University of Massachusetts; 82 p. Keywords: Weweantic River, Massachusetts, adult, Atlantic tomcod.

Howells, G.; Weaver, S. 1969. Studies on phytoplankton at Indian Point. *In*: Hudson River Ecology, Proceedings of symposium at Sterling Forest, NY. Keywords: Hudson River, New York, Indian Point, phytoplankton.

Howells, G.P. 1972. The estuary of the Hudson River, United States of America. *Proc. R. Soc. Lond. B Biol. Sci.* 180:521-534. Keywords: Hudson River, New York, estuary.

Hoyt, R.D., editor. 1991. Larval fish recruitment and research in the Americas: 13th Annual Larval Fish Conference; Merida, Mexico; May 1989. *NOAA Tech. Rep. NMFS* 95; 137 p. Keywords: recruitment, feeding larva, juvenile, distribution, migration.

Hudson River Environmental Society, Inc. 1994. Who's doing what: a guide to Hudson River research, monitoring, informational programs: Report from conference at Marist College, New York, March 1994. New Paltz, NY: Hudson River Environmental Society. Keywords: ###

Hudson River Estuary Management Program. 1994. Hudson River estuary management plan: final generic environmental impact statement. Albany, NY: New York State Department of Environmental Conservation; 156 p. Keywords: Hudson River, habitat management.

Hudson River Valley Greenway Council. 1991. A Hudson River Greenway: A Report to Governor Cuomo and the New York State Legislature. Albany, NY: New York State Office of General Service. Keywords: Hudson River.

Huff, J.A. 1975. Life history of Gulf of Mexico sturgeon, *Acipenser oxyrhynchus desotoi* in Suwanee River, Florida. *Florida Marine Resources Publication* 16; 32 p. Keywords: Suwanee River, Florida, life history, sturgeon subspecies, Gulf of Mexico sturgeon.

Humphries, E.T. 1971. Culture of striped bass (*Morone saxatilis*, Walbaum) fingerlings in Virginia. [Ph.D. dissertation.] Blacksburg, VA: Virginia Polytechnic Inst. and State University; 77 p. Keywords: Virginia, culture, fingerlings, young, striped bass.

Humphries, E.T.; Cummings, K.B. 1973. An evaluation of striped bass fingerling culture. *Trans. Am. Fish. Soc.* 102:13-20. Keywords: evaluation, young, fingerlings, culture, fish, ecology, striped bass.

Hunkins, K. 1981. Salt dispersion in the Hudson estuary. *J. Phys. Oceanogr*. 11:729-738. Keywords: Hudson River, New York, estuary, salinity, salt dispersion.

Hutchinson, B.P. 1971. The effects of fish predation on the zooplankton of ten Adirondack lakes with particular reference to the alewife (*Alosa pseudoharengus*). *Trans. Am. Fish. Soc*. 100:325-335. Keywords: Adirondack Park, Adirondack Lakes, New York, fish predation, zooplankton, lake, adult, alewife.

Hutchison, J.B., Jr. 1988. Technical descriptions of Hudson River electricity generating stations. *Am. Fish. Soc. Monogr*. 4:113-120. Keywords: Hudson River, New York, power plants.

Hydroscience, Inc. 1979. Analysis of the fate of PCBs in the ecosystem of the Hudson River: Report to the New York State Department of Environmental Conservation. Westwood, NJ: Hydroscience, Inc. Keywords: Hudson River, New York, analysis, PCBs, ecosystem.

Ishibashi, N. 1974. Feeding, starvation, and weight changes of early fish larvae. *In*: Blaxter, J.H.S., ed. The early life history of fish. New York, NY: Springer-Verlag; 339-344. Keywords: feeding, starvation, weight, larvae, life history.

Jackson, L.F. 1992. Reproduction in the white perch (*Morone americana*): the annual gametogenic cycle. [M.S. thesis.] Raleigh, NC: North Carolina State University. Keywords: reproduction, annual cycle, gametogenic cycle, adult, white perch.

Jacobs, R.P.; Crecco, V.A. 1980. Age and growth of larval and juvenile American shad (*Alosa sapidissima*) utilizing daily growth increments of otoliths. *Prepared for*: 36th Annual Northeast Fish and Wildlife Conference, Ellenville, NY. Keywords: larvae, juvenile, age, growth, otolith, American shad.

Jessop, B.M. 1985. Influence of mesh composition, velocity, and run time on the catch and length composition of juvenile alewives (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) collected by pushnet. *Can. J. Fish. Aquat. Sci*. 42:1928-1939. Keywords: fishery, catch, length, juvenile, pushnet, adult, alewife, blueback herring.

Johnson, H.B.; Stevens, H.W.; Hassler, W.W. 1979. Cooperative management program for Albemarle Sound-Roanoke River striped bass. [Annual progress report.] Morehead City, NC: North Carolina Department of Natural. Resources. Keywords: Albemarle Sound, Roanoke River, management, adult, striped bass.

Johnson, R.K.; Koo, T.S.Y. 1975. Production and distribution of striped bass (*Morone saxatilis*) eggs in Chesapeake and Delaware Canal. *Chesapeake Sci.* 16:39-55. Keywords: Chesapeake Canal, Delaware Canal, Delaware River, canal, production, distribution, eggs, striped bass.

Jones, E. M. 1972 Characteristics of black bass in northeastern United States *Am. Fish Cult*. 3:27-29. Keywords: Northeastern United States, characteristics, largemouth bass.

Jones, J.B. 1992. Environmental impact of trawling on the seabed: a review. *NZ J. Mar. Freshwater Res*. 26:59-67. Keywords: environmental, impact, trawling, seabed, review.

Juanes, F. 1992. The advantages of advection: recruitment, piscivory, growth and consumption of young-of-the-year bluefish (*Pomatomus saltatrix*). [Ph.D. dissertation.] Stony Brook, NY: State University of New York. Keywords: advection, recruitment, piscivory, growth, consumption, young-of-the-year, bluefish.

Juanes, F.; Buckel, J.A.; Conover, D.O. 1994. Accelerating the onset of piscivory: intersection of predator and prey phonologies. *J. Fish Biol*. 45(Sup. A):41-54. Keywords: Great South Bay, Hudson River, piscivory, predator, prey, feeding, phenology, adult, bluefish.

Juanes, F.; Conover, D.O. 1994. Piscivory and prey size selection in young-of-the-year bluefish: predator preference or size dependent capture success? *Mar. Ecol. Prog. Ser*. 114:59-69. Keywords: piscivory, prey, predator, young-of-the-year, size dependent, food, feeding, bluefish.

Juanes, F.; Conover, D.O. 1994. Rapid growth, high feeding rates, and early piscivory in young-of-the-year bluefish (*Pomatomus saltatrix*). *Can. J. Fish. Aquat. Sci*. 51:1752-1661. Keywords: Great South Bay, Long Island, growth, feeding rate, piscivory, predation, young-of-the-year, bluefish.

Juanes, F.; Marks, R.E.; McKown, K.; Conover, D.O. 1993. Predation by age-0 bluefish on age-0 anadromous fishes in the Hudson River estuary. *Trans. Am. Fish. Soc*. 122:348-356. Keywords: Hudson River, predation, predator, piscivory, age-0, anadromy, anadromous, adult, bluefish, Atlantic tomcod, bay anchovy.

Kahnle, A.; Hattala, K.; McKown, K. 1992. Proposed New York State Atlantic sturgeon regulations. Stony Brook, NY: New York State Department of Environmental Conservation; 21 p. Keywords: management, adult, Atlantic sturgeon.

Katz, H.M. 1978. Circadian rhythms in juvenile American shad, *Alosa sapidissima*. *J. Fish Biol*. 12:609-614. Keywords: circadian rhythms, biological clock, juvenile, American shad.

Keast, A.; Eadie, J. 1985. Growth depensation in year-0 largemouth bass: the influence of diet. *Trans. Am. Fish. Soc*. 114:204-213. Keywords: growth, year-0, young, food, diet, largemouth bass.

Keiser, R.K., Jr.; Klauda, R.J. 1987. Users guide to the Hudson River database, Volume I – Overview. [Final report.] New York, NY: Hudson River Foundation; 114 p. Keywords: Hudson River, database, hydrography, survey, environment.

Kellog, R.L.; Salermo, J.J.; Latimer, D.L. 1978. Effects of acute and chronic thermal exposure on the eggs of three Hudson River anadromous fishes. *In*: Thorpe, J.H.; Gibbons, J.W., eds. Energy and environmental stress in aquatic systems. Washington, DC: U.S. Department of Energy Technical Information Service. Keywords: Hudson River, New York, thermal exposure, temperature, anadromous fish, eggs, estuary.

Kelly, K. 1994. Fish habitat: who's minding the store? *National Fisherman* October:14-16, 72. Keywords: habitat management, NOAA, NMFS.

Kendall, A.W., Jr.; Walford, L.A. 1979. Sources and distribution of bluefish, *Pomatomus saltatrix*, larvae and juveniles off the east coast of the United States. *Fish. Bull. (U.S.)* 77:213-227. Keywords: Atlantic Ocean, United States, east coast, source, distribution, larva, juvenile, bluefish.

Kernehan, R.J.; Headrick, M.R.; Smith, R.E. 1981. Early life history of striped bass in the Chesapeake and Delaware Canal and vicinity. *Trans. Am. Fish. Soc*. 110:137-150. Keywords: Chesapeake Bay, Chesapeake Canal, Delaware River, Delaware Canal, early life history, egg, larva, striped bass.

Ketchum, B.H. 1969. Eutrophication in estuaries. *In*: Eutrophication: Causes, Consequences, Correctives: Proceedings of the Symposium. Washington, DC: National Academy of Sciences; p. 262-267. Keywords: estuary, eutrophication.

Kim, W.S. 1993. Zooplankton community effects on the phytoplankton community in Long Island bays. [Ph.D. dissertation.] Stony Brook, NY: SUNY Marine Sciences Research Center; 242 p. Keywords: Long Island Sound, New York, zooplankton, phytoplankton, community.

King, L.R.; Hutchison, J.B., Jr.; Huggins, T.G. 1978. Impingement survival studies on white perch, striped bass, and Atlantic tomcod at three Hudson River power plants. *In*: Jensen, L.D., ed. 4th National Workshop on Entrainment and Impingement. Melville, NY: EA Communications. Keywords: Hudson River, New York, impingement, survival, power plants, juvenile, egg, larva, juvenile, adult, striped bass, white perch, Atlantic tomcod.

Kinsey, D. 1980. Endangered and threatened species of New Jersey. [Report.] Trenton, NJ: New Jersey Department of Environmental Protection; 40 p. Keywords: New Jersey, adult, habitat, conservation, shortnose sturgeon.

Kissil, G.W. 1974. Spawning of the anadromous alewife, *Alosa pseudoharengus*, in Bride Lake, Connecticut. *Trans. Am. Fish. Soc*. 103:312-317. Keywords: Bride Lake, Connecticut, spawning, anadromous, adult, alewife.

Kiviat, E. 1973. A freshwater tidal marsh on the Hudson Tivoli North Bay. *In*: Proceedings of 3rd Symposium of Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, Tivoli North Bay, New York, freshwater, tidal marsh, tide.

Kiviat, E. 1979. Hudson estuary shore zone: ecology and management. [M.S. thesis.] New Paltz, NY: State University of New York; 159 p. Keywords: Hudson River, New York, estuary, shore zone, ecology, management.

Kiviat, E.; Stevens, G. 1995. Manual for identifying biodiversity resources in the Hudson River Valley Greenway corridor. [Final report.] New York, NY: Hudson River Foundation; 53 p. Keywords: Hudson River, biodiversity.

Klauda, R.; Dey, W.P.; Hoff, T.P.; McLaren, J.B.; Ross, Q.E. 1980. Biology of juvenile Hudson River striped bass. *Mar. Rec. Fish*. 5:101-123. Keywords: Hudson River, New York, biology, juvenile, striped bass.

Klauda, R.J. 1994. Lethal and critical effects thresholds for American shad eggs and larvae exposed to acid and aluminum in the laboratory, with speculation on the potential role of habitat acidification on stock status in Maryland. *In*: Cooper, J.E.; Eades, R.T.; Klauda, R.J.; Loesch, J.G., editors. Proceedings of the Anadromous *Alosa* Symposium. Bethesda, MD: American Fisheries Society; p. 7-39. Keywords: Maryland, egg, larva, habitat, acid, aluminum, stock, American shad.

Klauda, R.J.; Barnthouse, L.W.; Vaughan, D.S. 1988. What we learned about the Hudson River: journey toward an elusive destination. *Am. Fish. Soc. Monogr*. 4:316-328. Keywords: Hudson River, New York.

Klauda, R.J.; Fischer, S.J.; Hall, L.W.; Jr.; Sullivan, J.A. 1991. Alewife and blueback herring. *In*: Funderburk, S.L; Mihursky, J.A.; Jordan, S.J.; Riley, D., eds. Habitat requirements for Chesapeake Bay living resources. Annapolis, MD: Chesapeake Bay Program Living Resources Subcommittee. Keywords: Chesapeake Bay, anadromous, egg, habitat, juvenile, larva, life history, spawning, alewife, blueback herring.

Klauda, R.J.; McLaren, J.B.; Schmidt, R.E.; Dey, W.P. 1988. Life history of white perch in the Hudson River estuary. *Am. Fish. Soc. Monogr*. 4:69-88. Keywords: Hudson River, distribution, egg, larvae, juvenile, adult, fecundity, mortality, abundance, white perch.

Klauda, R.J.; Moos, R.E.; Schmidt, R.E. 1988. Life history of the Atlantic tomcod, *Microgadus tomcod*, in the Hudson River estuary, with emphasis on spatio-temporal distribution and movements. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 219-251. Keywords: Hudson River, larva, juvenile, adult, movement, distribution, Atlantic tomcod.

Klauda, R.J.; Muessig, P.H.; Matousek, J.A. 1988. Fisheries data sets compiled by utility-sponsored research in the Hudson River estuary. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 7-85. Keywords: Hudson River, distribution, fish community, surveys, stocking, power plants.

Klauda, R.J.; Nittel, M.; Campbell, K.P. 1976. The commercial fishery for American shad in the Hudson River: fishing effort and stock abundance trends. *In*: Proceedings of a workshop on American shad. Washington, DC: U.S. Government Printing Office; p. 107-134. Keywords: Hudson River, fishery, commercial, fishing, abundance, stocking, adult, American shad.

Klauda, R.J.; Peck, T.H.; Rice, G.K. 1981. Accumulation of polychlorinated biphenyls in Atlantic tomcod (*Microgadus tomcod*) collected form the Hudson River estuary, NY. *Bull. Environ. Contam. Toxicol*. 27:829-835. Keywords: Hudson River, New York, PCBs, polychlorinated biphenyls, estuary, adult, Atlantic tomcod.

Kneip, T.J.; Howells, G.P.; Wrenn, M.E. 1969. Trace elements, radionuclides, and pesticide residues in the Hudson River. *In*: Howell, G.P.; Lauer, G.J., eds. Hudson River Ecology: Proceedings of the 2nd Symposium on Hudson River Ecology. Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, trace elements, radionuclides, pesticide.

Knutson, A.B.; Klerks, P.L.; Levinton, J.S. 1987. The fate of metal contaminated sediments in Foundry Cove, New York. *Environ. Pollut*. 45:291-304. Keywords: Hudson River, Foundry Cove, New York, metal, contaminant, sediment, cadmium, nickel, cobalt.

Koepp, S.J.; Santoro, E.D.; DiNardo, G. 1988. Heavy metals in finfish and selected macroinvertebrates of the lower Hudson River estuary. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 273-286. Keywords: Hudson River, contaminants, benthos, fish community.

Kohlenstein, L.C. 1981. On the proportion of the Chesapeake Bay stock of striped bass that migrates into the coastal fishery. *Trans. Am. Fish. Soc*. 110:168-179. Keywords: Chesapeake Bay, stock, population, coastal fishery, migration, adult, striped bass.

Koo, T.S.Y. 1970. The striped bass fishery in the Atlantic states. *Chesapeake Sci*. 11:73-93. Keywords: Western Atlantic, fishery, adult, striped bass.

Koo, T.S.Y.; Ritchie, D.E., Jr. 1973. Growth of juvenile striped bass, *Morone saxatilis*, as determined by tagging and recapture. *In*: Pacheco, A.L., ed. Proceedings of a workshop on egg, larval and juvenile stages of fish in Atlantic coast estuaries. Highlands, NJ: *NOAA/NMFS Sandy Hook Lab. Tech. Series Rep.* 1, p. 124-125. Keywords: growth, juvenile, tagging, mark and recapture, striped bass.

Kramer, R.H.; Smith, L.L., Jr. 1962. Formation of year class in largemouth bass. *Trans. Am. Fish. Soc*. 89:222-223. Keywords: year class, young, adult, largemouth bass.

Kraus, M.L.; Bragin, A.B. 1990. Utilization of the Hackensack River by the Atlantic tomcod (*Microgadus tomcod*). *Bull. NJ Acad. Sci*. 35:25-27. Keywords: Hackensack River, New Jersey, population, distribution, adult, Atlantic tomcod.

Kretser, W. 1973. Aspects of striped bass larvae, *Morone saxatilis*, captured in Hudson River near Cornwall, NY, April-August, 1968. New York, NY: Consolidated Edison Company. Keywords: Hudson River, Cornwall, New York, larvae, food, morphology, striped bass.

Krouse, J.S. 1968. Effects of dissolved oxygen, temperature, and salinity on survival of young striped bass, *Roccus saxatilis* (Walbaum). [M.S. thesis.] Orono, ME: University of Maine; 61 p. Keywords: Hudson River, young, dissolved oxygen, temperature, salinity, survival, striped bass.

Kuntz, A. 1914. The embryology and larval development of *Bairdiella chrysoura* and *Anchoa mitchilli*. *U.S. Fish Wildl. Serv. Fish. Bull*. 33:1-19. Keywords: embryology, development, eggs, larva, bay anchovy.

Lake, T.R. 1994. Observations and opinions of Hudson River commercial fishermen. [Report.] New York, NY: Hudson River Foundation; 9 p. Keywords: Hudson River, chlorine, wastewater, fishery, commercial, fishermen, adult, American shad, alewife.

Langton, R.W.; Steneck, R.S.; Gotceitas, V.; Juanes, F.; Lawton, P. 1994. The interface between fisheries research and habitat management. *N. Am. J. Fish. Manage*. 16(1):1-7. Keywords: habitat management, fishery.

Langton, R.W.; Watling; L. 1990. The fish-benthos connection: a definition of prey groups in the Gulf of Maine. *In*: Barnes, M.; Gibson, R.N., eds. Trophic relationships in the marine environment. Aberdeen, UK: Aberdeen University Press; p. 424-438. Keywords: Gulf of Maine, Maine, fish, benthos, prey, predation, ecology.

Largier, J.L. 1992. Tidal intrusion fronts. *Estuaries* 15:26-39. Keywords: tidal, tides, intrusion fronts, estuary.

Largier, J.L. 1993. Estuarine fronts: How important are they? *Estuaries* 16:1-11. Keywords: estuarine fronts, estuary.

Lassiter, R.R. 1962. Life history aspects of the bluefish, *Pomatomus saltatrix* (Linnaeus), from the coast of North Carolina. [M.S. thesis.] Raleigh, NC: North Carolina State University. Keywords: North Carolina, life history, coast, coastal waters, adult, bluefish.

Lawler, Matusky and Skelly Engineers. 1975. Report on development of a real-time, two dimensional model of the Hudson River striped bass population. New York, NY: Consolidated Edison Co.; 122 p. Keywords: Hudson River, New York, development, model, population, adult, striped bass.

Lawler, Matusky and Skelly Engineers. 1976. 1976 Roseton intake avoidance study - preliminary report on an evaluation of intake avoidance as a function of size for white perch. Poughkeepsie, NY: Central Hudson Gas and Electric Corp. Keywords: Roseton, intake avoidance, study, power plant, body size, larva, juvenile, adult, white perch.

Lawler, Matusky and Skelly Engineers. 1977. Influence of Indian Point Unit 2 and other steam electric generating plants on the Hudson River estuary with emphasis on striped bass and other fish populations - Supplement 1. New York, NY: Consolidated Edison Co. Keywords: Indian Point, Hudson River, New York, Unit 2, steam electric plants, power plants, estuary, fish population, egg, larva, juvenile, adult, striped bass.

Lawler, Matusky and Skelly Engineers. 1977. Roseton - fish migration route study evaluation of river cross-sectional distribution patterns of fish larvae and fish eggs. Poughkeepsie, NY: Central Hudson Gas and Electric Corp. Keywords: Hudson River, New York, Roseton, fish, migration, distribution, eggs, ecology.

Lawler, Matusky and Skelly Engineers. 1977. Roseton/ Danskammer - viability studies of impinged Atlantic tomcod – 1974 – 1975. Poughkeepsie, NY: Central Hudson Gas and Electric Corp. Keywords: Hudson River, New York, Roseton, Danskammer, viability study, impingement, 1974, 1975, adult, Atlantic tomcod.

Lawler, Matusky and Skelly Engineers. 1978. Mitigation of impingement impact at Hudson River power plants. New York, NY: Consolidated Edison Co.; 14 p. Keywords: Hudson River, power plant, impingement, entrainment, egg, larva, juvenile, striped bass, white perch, Atlantic tomcod.

Lawler, Matusky and Skelly Engineers. 1981. Report on 1976 and 1977 data analyses and application of life cycle models of the Hudson River striped bass population. New York, NY: Consolidated Edison Co. Keywords: Hudson River, New York, 1976, 1977, population, egg, larva, juvenile, adult, striped bass.

Lawler, Matusky and Skelly Engineers. 1982. 1981 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Hudson River, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1982. 1981 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1983. 1982 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1983. 1982 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1984. 1983 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1984. 1983 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1985. 1984 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1985. 1984 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1986. 1985 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1986. 1985 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1987. 1986 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1987. 1986 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1988. 1987 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1988. 1987 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1989. 1986-1987 year class report for the Hudson River Estuary Monitoring Program, Vols. I-II. New York, NY: Consolidated Edison Co. Keywords: Hudson River, ecology, biology, power plant, entrainment, impingement, egg, larva, juvenile, adult, striped bass, Atlantic tomcod, white perch.

Lawler, Matusky and Skelly Engineers. 1989. 1988 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1989. 1988 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1990. 1989 impingement studies at the Lovett Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1990. 1989 impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Keywords: Bowline Point, power plant, impingement, larva, juvenile, length, population, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Lawler, Matusky and Skelly Engineers. 1992. 1990 year class report for the Hudson River Estuary Monitoring Program. New York, NY: Consolidated Edison Co.; 152 p. Keywords: Hudson River, year class, adult, Atlantic sturgeon.

Lawler, Matusky and Skelly Engineers. 1992. 1991 Impingement studies at the Bowline Point Generating Station. Pearl River, NY: Orange and Rockland Utilities. Hudson River, power plant, impingement, larva, juvenile, white perch, striped bass, Atlantic tomcod, bay anchovy, blueback herring, alewife.

Leak, J.C.; Houde, E.D. 1987. Cohort growth and survival of bay anchovy, *Anchoa mitchilli*, larvae in Biscayne Bay, Florida. *Mar. Ecol. Prog. Ser*. 37:109-122. Keywords: Biscayne Bay, Florida, cohort growth, survival, larvae, bay anchovy.

LeBlanc, L.; Brownawell, B. 1994. Tests of bioaccumulation models for PCBs: a study of young-of-the-year bluefish in the Hudson River estuary. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1993; Hudson River Foundation, New York, NY; 42 p. Keywords: Hudson River, New York, bioaccumulation, models, PCBs, young-of-the-year, estuary, bluefish.

Leggett, W.C. 1972. Weight loss in American shad (*Alosa sapidissima*) during freshwater migration. *Trans. Am. Fish. Soc*. 101:549-552. Keywords: weight loss, migration, freshwater, adult, American shad.

Leggett, W.C. 1976. The American shad, *Alosa sapidissima*, with special reference to its migration and population dynamics in the Connecticut River. *In*: Merriman, D.; Thorpe, L.M., eds. The Connecticut River ecological study. *Am. Fish. Soc. Monogr*. 1:169-225. Keywords: Connecticut River, migration, population, ecology, study, adult, American shad.

Leggett, W.C.; Carscadden, J.E. 1978. Latitudinal variation in reproductive characteristics of American shad (*Alosa sapidissima*): evidence for population specific life history strategies in fish. *J. Fish. Res. Board Can*. 35:1469-1478. Keywords: latitude, reproduction, population, life history, fish, biology, adult, American shad.

Leggett, W.C.; Whitney, R.R. 1972. Water temperature and the migrations of American shad. *Fish. Bull. (U.S.)* 70:659-670. Keywords: migration, water temperature, adult, American shad.

Lehman, B.A. 1953. Fecundity of Hudson River shad. *U.S. Fish Wildl. Serv. Res. Rept*. 33; 8 p. Keywords: Hudson River, fecundity, adult, American shad.

Leim, A.H. 1924. The life history of the shad (*Alosa sapidissima* (Wilson)) with special reference to the factors limiting its abundance. *J. Fish. Res. Board Can*., *Contr. Can. Biol*. 2:163-284. Keywords: life history, abundance, adult, American shad.

Leslie, J.A.; Abood, K.A.; Maikish, E.A.; Keeser, P.J. 1988. Recent dissolved oxygen trends in the Hudson River. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 287-303. Keywords: dissolved oxygen, distribution, wastewater.

Levandowsky, M.; Capriulo, G.M.; Fisher, N.S. 1991. Bioaccumulation and toxic effects of lead and silver in Hudson River microzooplankton. [Final report.] New York, NY: Hudson River Foundation; 18 p. Keywords: Hudson River, bioaccumulation, toxic, lead, silver, microzooplankton, metals, environment, algae.

Levesque, R.C.; Reed, R.J. 1972. Food availability and consumption by young Connecticut River shad, *Alosa sapidissima*. *J. Fish. Res. Board Can*. 29:1495-1499. Keywords: Connecticut River, food, feeding, juvenile, American shad.

Levinton, J.S. 1986. Evolution of resistance to toxicants: mechanisms of tolerance and transfer through Hudson River foodwebs. [Final report.] New York, NY: Hudson River Foundation; 61 p. Keywords: Hudson River, Foundry Cove, toxicant, foodweb, contaminant, sediments, metal, pollution, benthos, cadmium, ecology.

Libby, D.A. 1981. Differences in sex ratio of the anadromous alewife, *Alosa pseudoharengus*, between the top and bottom of a fishery at Damariscotta Lake, Maine. *Fish. Bull. (U.S.)* 79:207-211. Keywords: Damariscotta Lake, Maine, variation, sex ratio, anadromous, fishery, adult, alewife.

Lickus, M.; Barten, P. 1991. Hydrology of a freshwater tidal marsh in the Hudson River estuary. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1990, Section I. New York, NY: Hudson River Foundation; 45 p. Keywords: Hudson River, New York, Tivoli North Bay, estuary, hydrology, freshwater tidal marsh.

Limburg, K.E. 1996. Modeling the ecological constraints on growth and movement of juvenile American shad (*Alosa sapidissima*) in the Hudson River estuary. *Estuaries* 19(4):794-813. Keywords: Hudson River, ecology, growth, movement, juvenile, American shad.

Limburg, K.E. 1994. Ecological constraints on growth and migration of juvenile American shad (*Alosa sapidissima* Wilson). [Ph.D. dissertation.] Ithaca, NY: Cornell University; 352 p. Keywords: Hudson River, growth, migration, juvenile, predation, American shad.

Limburg, K.E.; Brothers, E.B.; Levin, S.A. 1991. Estimation of age and growth rates of juvenile Hudson River shad: validation and field study. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1990, Section IV. New York, NY: Hudson River Foundation; 37 p. Keywords: Hudson River, New York, estuary, juvenile, age, growth rates, field study, American shad.

Limburg, K.E.; Moran, M.A.; McDowell, W.H., editors. 1986. The Hudson River Ecosystem. New York, NY: Springer-Verlag. Keywords: Hudson River, ecosystem, river.

Limburg, K.E.; Schmidt, R.E. 1990. Patterns of fish spawning in Hudson River tributaries: response to an urban gradient? *Ecology* 71:1238-1245. Keywords: Hudson River, spawning.

Limburg, K.E.; Strayer, D. 1988. Studies of young-of-the-year river herring and American shad in the Tivoli Bays, Hudson River, NY. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1987, Section VII. New York, NY: Hudson River Foundation; 62 p. Keywords: Tivoli Bay, Hudson River, New York, estuary, study, young-of-the-year, river herring, alewife, blueback herring, American shad.

Linsalata, P. 1984. Sources distribution and mobility of plutonium and radiocesium in soils, sediments and water of the Hudson River and watershed. [Ph.D. dissertation.] New York, NY: New York University; 402 p. Keywords: Hudson River, Hudson River Watershed, New York, watershed, source, distribution, mobility, plutonium, radiocesium, soils, sediments, water.

Lippson, A.J.; Moran, R.L. 1974. Manual for identification of early developmental stages of fishes of the Potomac estuary. Annapolis, MD: Maryland Department of Natural Resources, Power Plant Siting Program; 282 p. Keywords: Potomac River estuary, egg, embryo, development, larva, juvenile, alewife, blueback herring.

Lively, J.S.; Kaufman, Z.; Carpenter, E.J. 1983. Phytoplankton ecology of a barrier island estuary: Great South Bay, New York. *Estuar. Coast. Shelf Sci*. 16:51-68. Keywords: Great South Bay, New York, phytoplankton, ecology, barrier island, estuary.

Loesch, J. G. 1987. Overview of life history aspects of anadromous alewife and blueback herring in freshwater habitats. *Am. Fish. Soc. Symp*. 1:89-103. Keywords: life history, freshwater habitat, adult, alewife, blueback herring.

Loesch, J.G.; Lund, W.A., Jr. 1977. A contribution to the life history of the blueback herring, *Alosa aestivalis*. *Trans. Am. Fish. Soc*. 106:583-589. Keywords: life history, adult, blueback herring.

Loesch, J.G. 1968. A contribution to the life history of *Alosa aestivalis*. [M.S. thesis.] Storrs, CT: University of Connecticut; 31 p. Keywords: life history, adult, blueback herring.

Loesch, J.G. 1969. A study of the blueback herring, *Alosa aestivalis* (Mitchill) in Connecticut waters. [Ph.D. dissertation.] Storrs, CT; Univ. Connecticut; 78 p. Keywords: Connecticut, Connecticut River, Long Island Sound, adult, blueback herring.

Loesch, J.G.; Kriete, W.H., Jr. 1976. Biology and management of river herring and shad. [Completion report, Anadromous Fish Project.] Raleigh, NC: North Carolina Department of Natural Resources and Community Development; 226 p. Keywords: biology, management, fishery, adult, river herring, alewife, blueback herring, American shad.

Loesch, J.G.; Kriete, W.H., Jr.; Foell, E.J. 1982. Effects of light intensity on the catchability of juvenile anadromous Alosa species. *Trans. Am. Fish. Soc*. 111:41-44. Keywords: light, catch, fishery, juvenile, alewife, American shad, blueback herring.

Longwell, A.C.; Chang, S.; Hebert, A.; Hughes, J.B.; Perry, D. 1992. Pollution and developmental abnormalities of Atlantic fishes. *Environ. Biol. Fishes* 35:1-21. Keywords: Atlantic Ocean, pollution, development, abnormalities, Atlantic fishes.

Lonsdale, D.J.; Cosper, E.M. 1994. Phytoplankton productivity in the lower Hudson River estuary. [Final report.] New York, NY: Hudson River Foundation; 33+ p. Keywords: Hudson River, phytoplankton, distribution, zooplankton, abundance.

Lorio, W. 1980. Life history of largemouth bass (*Micropterus salmoides*), found in MS coastal marshes. U.S. Fish Wildl. Serv., *Freshwater Fish. Rep. No*. 16. Keywords: life history, largemouth bass, coastal marshes.

Lukens, R.R. 1988. Habitat criteria for striped bass, stocked in rivers of the Northern Gulf of Mexico. Gulf Sates Marine Fisheries Commission; 53 p. Keywords: Northern Gulf of Mexico, habitat criteria, stocking, rivers, adult, striped bass.

Lund, W.A., Jr. 1957. Morphometric study of the striped bass. *U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. No*. 216; 24 p. Keywords: morphometric study, morphology, adult, striped bass.

Lund, W.A., Jr. 1961. A racial investigation of the bluefish, *Pomatomus saltatrix* (Linnaeus), of the Atlantic coast of North America. *Bol. Inst. Oceanogr. Venezuela* 1:73-129. Keywords: Atlantic coast, Atlantic Ocean, North America, population, race, intraspecific variation, adult, bluefish.

Lund, W.A., Jr.; Maltezos, G.C. 1970. Movements and migrations of the bluefish, *Pomatomus saltatrix*, tagged in water of New York and southern New England. *Trans. Am. Fish. Soc*. 99:719-725. Keywords: Long Island Sound, New York Bight, New York, New England, movements, migrations, population, tagging, mark and recapture, adult, bluefish.

Lux, F.E.; Mahoney, J.B. 1972. Predation by bluefish on flatfishes. *Mar. Fish. Rev*. 34:30-35. Keywords: predation, predator, prey, food, feeding, flatfishes, adult, bluefish.

Lyons-Swift, L. 1987. Upper Hudson River riparian communities: an analysis of relations between river processes and plant community composition. [Final Report.] New York, NY: Hudson River Foundation; 26 p. Keywords: Hudson River, community, plants, vegetation, environment.

MacKenzie, C.L., Jr. 1990. History of the fisheries of Raritan Bay, New York and New Jersey. *Mar. Fish. Rev*. 52(4):1-45. Keywords: Raritan Bay, New York, New Jersey, history, fisheries.

Malone, T. C. 1977. Plankton systematics and distribution. Marine Ecosystem Analysis Program, MESA New York Bight Project. Albany, NY: New York Sea Grant Institute; MESA New York Bight Atlas Monograph 13. Keywords: New York Bight, plankton, systematics, distribution.

Malone, T.C. 1977. Environmental regulation of phytoplankton productivity in the lower Hudson estuary. *Estuar. Coastal Mar. Sci*. 5:157-171. Keywords: Hudson River, New York, estuary, environmental regulation, phytoplankton, productivity.

Malone, T.C.; Garside, C.; Neale, P. 1980. Effects of silicate depletion on photosynthesis by diatoms in the plume of the Hudson River. *Mar. Biol*. 58:197-204. Keywords: Hudson River, New York, silicate, photosynthesis, diatoms, plume.

Manooch, C.S. 1973. Food habits of yearling and adult striped bass, *Morone saxatilis* (Walbaum), from Albemarle Sound, North Carolina. *Chesapeake Sci*. 14:73-86. Keywords: Albemarle River, North Carolina, food habits, yearling, young, immature, adult, feeding, striped bass.

Mansueti, R.J. 1955. Young bluefish found in the fresh tidal waters of upper Patuxent River. *Maryland Tidewater News* 12:3. Keywords: Upper Patuxent River, Patuxent River, young, tidal, tide, freshwater, bluefish.

Mansueti, R.J. 1956. Alewife herring eggs and larvae reared successfully in lab. *Maryland Tidewater News* 13:2-3. Keywords: eggs, larvae, laboratory-reared, alewife.

Mansueti, R.J. 1958. Eggs, larvae and young of the striped bass, *Roccus saxatilis*. *Chesapeake Biol. Lab. Contrib*. 112; 35 p. Keywords: eggs, larvae, juvenile, young, striped bass.

Mansueti, R.J. 1961. Age, growth and movements of the striped bass, *Roccus saxatilis*, taken in size-selective fishing gear in Maryland. *Chesapeake Sci*. 2:9-36. Keywords: Maryland, age, growth, movements, size-selective fishing gear, adult, striped bass.

Mansueti, R.J. 1961. Movements, reproduction, and mortality of the white perch, *Roccus americana*, in the Patuxent River estuary, Maryland. *Chesapeake Sci*. 2:142-205. Keywords: Patuxent River, Maryland, movement, reproduction, mortality, adult, white perch.

Mansueti, R.J. 1964. Eggs, larvae, and young of the white perch, *Roccus americana*, with comments on its ecology within the estuary. *Chesapeake Sci*. 5:3-45. Keywords: Chesapeake Bay, eggs, larvae, juvenile, young, ecology, white perch

Mansueti, R.J.; Kolb, H. 1953. A historical review of the shad fisheries of North America. *Maryland Dept. Res. Educ. Publ*. 97; 293 p. Keywords: North America, historical, history, fishery, adult, American shad.

Mansueti, R.J.; Mansueti, A.J. 1955. White perch eggs and larvae studies in the lab. *Maryland Tidewater News* 12:1-3. Keywords: eggs, larvae, white perch.

Marcy, B.C., Jr. 1968. Age determination from scales of *Alosa pseudoharengus* (Wilson), and *Alosa aestivalis* (Mitchill), in Connecticut waters. [M.S. thesis.] Storrs, CT: University of Connecticut; 25 p. Keywords: Connecticut, age, aging, scales, adult, alewife, blueback herring.

Marcy, B.C., Jr. 1969. Age determination from scales of *Alosa pseudoharengus* (Wilson), and *Alosa aestivalis* (Mitchill), in Connecticut waters. *Trans. Am. Fish. Soc*. 98:621-630. Keywords: Connecticut, age, aging, scales, adult, alewife, blueback herring.

Marcy, B.C., Jr. 1972. Spawning of the American shad, *Alosa sapidissima*, in the lower Connecticut River. *Chesapeake Sci.* 13:116-119. Keywords: Connecticut River, lower Connecticut River, spawning, reproduction, adult, American shad.

Marcy, B.C., Jr. 1976. Early life history studies of the American shad in the lower Connecticut River and the effects of the Connecticut Yankee plant. *In*: Merriman, D.; Thorpe, L.M., eds. The Connecticut River ecological study. *Am. Fish. Soc. Monogr*. 1:141-178. Keywords: Connecticut River, lower Connecticut River, larvae, life history, ecology, Connecticut Yankee, power plant, American shad.

Marcy, B.C., Jr. 1976. Fishes of the lower Connecticut River and the effects of the Connecticut Yankee Plant. *Am. Fish. Soc. Monogr*. 1:61-113. Keywords: Connecticut River, fishes, lower Connecticut River, Connecticut Yankee plant, power plant.

Marcy, B.C., Jr.; Richards, F.P. 1974. Age and growth of the white perch, *Morone americana*, in the lower Connecticut River. *Trans. Am. Fish. Soc*. 103:117-120. Keywords: Connecticut River, lower Connecticut River, age, growth, adult, white perch.

Margulies, D. 1989. Effects of food concentration and temperature on development, growth and survival of white perch, *Morone americana*, eggs and larvae. *Fish. Bull. (U.S.)* 87:63-72. Keywords: effects, food concentration, temperature, development, growth, survival, eggs, larvae, white perch.

Markle, D.F.; Grant, G.C. 1970. The summer food habits of young-of-the-year striped bass in three Virginia Rivers. *Chesapeake Sci*. 11:50-54. Keywords: Virginia, summer, season, food, feeding, habits, behavior, young-of-the-year, juvenile, striped bass.

Marks, R.E. 1991. Ontogenic shift in the diet of spring and summer-spawned bluefish (*Pomatomus saltatrix*) during the oceanic phase of the early life history. [M.S. thesis.] Stony Brooke, NY: State University of New York. Keywords: ontogeny, diet, food, season, oceanic phase, early life history, young, bluefish.

Marks, R.E.; Conover, D.O. 1993. Ontogenetic shift in the diet of young-of-the-year bluefish (*Pomatomus saltatrix*) during the oceanic phase of the early life history. *Fish. Bull. (U.S.)* 91:97-106. Keywords: ontogenetic shift, diet, food, young-of-the-year, oceanic phase, early life history, bluefish.

Marshall, H.G. 1988. Seasonal phytoplankton composition and concentration patterns within the Hudson River. [Final report.] New York, NY: Hudson River Foundation; 12+ p. Keywords: Hudson River, phytoplankton, distribution.

Martin Marietta Environmental Systems, Inc. 1984. Current status and biological characteristics of the anadromous alosid stocks of Eastern United States: American shad, hickory shad, alewife, and blueback herring: Phase 1 in interstate management planning for migratory alosids of the Atlantic Coast. [Report.] Washington, DC: Atlantic States Marine Fisheries Commission, Interstate Fisheries Management Program; 222 p. Keywords: Atlantic, biology, anadromous, stock, migration, population, management, fishery, adult, American shad, alewife, blueback herring.

Martin Marietta Environmental Systems, Inc. 1986. 1984 year class report for the Hudson River Estuary Monitoring Program, Vols. I-II. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, ecology, biology, power plant, entrainment, impingement, egg, larva, juvenile, adult, striped bass, Atlantic tomcod, white perch.

Martin, F.D.; Wright, D.A.; Means, J.C.; Setzler-Hamilton, E.M. 1985. Importance of food supply to nutritional state of larval striped bass in the Potomac River estuary. *Trans. Am. Fish. Soc*. 114:137-145. Keywords: Potomac River, food, nutrition, larvae, estuary, striped bass.

Massman, W.H. 1952. Characteristics of spawning areas of shad, *Alosa sapidissima* (Wilson), in some Virginia streams. *Trans. Am. Fish. Soc*. 82:78-93. Keywords: Virginia, streams, spawning, habitat, adult, American shad.

Massman, W.H. 1957. New and recent records for fish in Chesapeake Bay. *Copeia* 1957:156-157. Keywords: Chesapeake Bay, records, fish, sampling.

Massman, W.H. 1962. Water temperatures, salinities, and fishes collected during trawl surveys of Chesapeake Bay and York and Pamunkey Rivers, 1956-1959. *VA Inst. Mar. Sci. Spec. Sci. Rept*. 27: 51 p. Keywords: Chesapeake Bay, York River, Pamunkey River, water temperature, salinity, trawl survey.

Massman, W.H. 1963. Summer food of juvenile American shad in Virginia waters. *Chesapeake Sci*. 4:167-171. Keywords: Virginia, food, juveniles, seasonal, American shad.

Massman, W.H.; Pacheco, A.L. 1961. Movements of striped bass in Virginia waters of Chesapeake Bay. *Chesapeake Sci.* 2:37-44. Keywords: Virginia, Chesapeake Bay, movements, population, adult, striped bass.

Mattson, M.T.; Geoghegan, P.; Dunning, D.J. 1992. Accuracy of catch per unit effort indices of Atlantic tomcod abundance in the Hudson River. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p.323-338. Keywords: Hudson River, New York, catch, indices, abundance, adult, Atlantic tomcod.

Mattson, M.T.; Waxman, J.B.; Watson, D.A. 1988. Reliability of impingement sampling designs: an example from the Indian Point station. *Am. Fish. Soc. Monogr*. 4:161-169. Keywords: Hudson River, Indian Point, New York, impingement, sampling, power plant.

May, R.C. 1974. Larval mortality in marine fishes and the critical period concept. *In*: Baxter, J.H.S., ed. The early life history of fish. New York: Springer-Verlag; p. 3-19. Keywords: larvae, mortality, marine, fishes, critical period.

Mayo, R.K. 1974. Population structure, movement, and fecundity of the anadromous alewife, *Alosa pseudoharengus*

(Wilson), in the Parker River, Massachusetts, 1971-1972. [M.S. thesis.] Amherst, MA: University of Massachusetts. Keywords: Parker River, Massachusetts, fish population, population, movement, fecundity, egg, anadromous, adult, alewife.

McBride, R.S.; Conover, D.O. 1991. Recruitment of the young-of-the-year bluefish *Pomatomus saltatrix* to the New York Bight: variation in abundance and growth of spring- and summer-spawned cohorts. *Mar. Ecol. Prog. Ser*. 78:205-216. Keywords: New York Bight, New York, recruitment, metamorphosis, young-of-the-year, variation, abundance, growth, seasonal, cohorts, population, bluefish.

McCleave, J.D.; Fried, S.M.; Towt, A.K. 1977. Daily movements of shortnose sturgeon, *Acipenser brevirostrum*, on a Maine estuary. *Copeia* 1977:149-157. Keywords: Maine, estuary, movements, adult, shortnose sturgeon.

McClusky, D. 1992. Largemouth bass technical literature bibliography, 1970-1992. No publisher; 456 p. Keywords: bibliography, egg, larva, juvenile, adult, largemouth bass.

McErlean, A.J.; O'Connor, S.B.; Mihursky, J.A.; Gibson, I.C. 1973. Abundance, diversity and seasonal patterns of estuarine fish populations. *Estuar. Coast. Mar. Sci*. 1:19-36. Keywords: abundance, diversity, seasonal, population, estuary, fish.

McFadden, J.T.; Texas Instruments; Lawler, Matusky & Skelly Engineers. 1977. Influence of Indian Point unit 2 and other steam electric generating plants on the Hudson River estuary, with emphasis on striped bass and other fish populations. [Report.] New York, NY: Consolidated Edison Company. Keywords: Indian Point, Hudson River, New York, unit 2, influence, steam electric, powerplant, fish populations, egg, larva, juvenile, adult, striped bass.

McFadden, J.T.; Texas Instruments; Lawler, Matusky & Skelly Engineers. 1978. Influence of the proposed Cornwall pumped storage project and steam electric generating plants on the Hudson River estuary, with emphasis on striped bass and other fish populations, revised. Chapter 7 *In*: Report to Consolidated Edison Company of New York; 227 p. Keywords: Cornwall, Hudson River, New York, steam electric, power plants, fish populations, egg, larva, juvenile, adult, striped bass.

McGovern, J.C.; Olney, J.E. 1988. Potential predation by fish and invertebrates on early life history stages of striped bass in the Pamunkey River, Virginia. *Trans. Am. Fish. Soc*. 117:152-161. Keywords: Pamunkey River, Virginia, predation, predator, prey, fish, invertebrates, early life history, stages, striped bass.

McGovern, J.C.; Wenner, C.A. 1990. Seasonal recruitment of larval and juvenile fishes into impounded and non-impounded marshes. *Wetlands* 10:203-222. Keywords: seasonal, recruitment, larvae, juvenile, marsh habitat, wetlands.

McGrath, R.A. 1974. Benthic microfaunal census of Raritan Bay. *In*: Proceedings of 3rd Symposium of Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society; 27 p. Keywords: preliminary results, Raritan Bay, Raritan River, Hudson River, benthic microfauna, census, benthos.

McHenry, M.; Long, J. 1995. The vulnerability of striped bass in the Hudson River: Do rapid changes in water temperature decrease locomotor performance? *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1994. New York, NY: Hudson River Foundation. Keywords: Hudson River, New York, vulnerability, water temperature, locomotion, function, adult, striped bass.

McHugh, J.L. 1972. Estuarine fisheries, are they doomed? *In*: Wiley, M., ed. Estuarine processes: Vol. I. Uses, stress and adaptation to the estuary. Proceedings of 3rd International Estuarine Research Conference, Galveston, Texas. New York, NY: Academic Press; p. 15-27. Keywords: estuary, fisheries, future.

McHugh, J.L. 1977. Limiting factors affecting commercial fisheries in the Middle Atlantic estuarine area. *In*: NY Sea Grant Institute Conference Proceedings: Estuarine Pollution Control and Assessment. Washington, DC: U.S. Environmental Protection Agency. Keywords: Middle Atlantic, estuary, commercial fishery.

McKown, K.A. 1991. An investigation of the movements and growth of the 1988 Hudson River year class. *In*: A study of the striped bass in the marine district of New York VI. [Annual report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, movements, growth, year class, young, striped bass.

McKown, K.A. 1992. An investigation of the movements and growth of the 1990 Hudson River year class. *In*: A study of the striped bass in the marine district of New York State VII. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, movements, growth, year class, young, striped bass.

McKown, K.A.; Penski, M. 1994. An investigation of the movements and growth of the 1986 Hudson River year class. *In*: A study of the striped bass in the marine district of New York IX. [Completion report.] Albany, NY: New York State Department of Environmental Conservation; p. 59-120. Keywords: movement, growth, year-class, young, striped bass.

McKown, K.A.; Young, B.H. 1988. An investigation of the movements and growth of the 1986 Hudson River year class. *In*: A study of the striped bass in the marine district of New York V. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, movements, growth, year class, young, striped bass.

McKown, K.A.; Young, B.H. 1989. An investigation of the movements and growth of the 1987 Hudson River year class. *In*: A study of the striped bass in the marine district of New York VI. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, movements, growth, year class, young, striped bass.

McLaren, J.B.; Peck, T.H.; Dey, W.P.; Gardinier, M. 1988. Biology of the Atlantic tomcod in the Hudson River estuary.

Am. Fish. Soc. Monogr. 4:102-112. Keywords: Hudson River, adult, age composition, sex ratio, maturity, fecundity, abundance, mortality, food, feeding, Atlantic tomcod.

McLaren, J.B.; Cooper, J.C.; Hoff, T.B.; Lander, V. 1981. Movements of Hudson River striped bass. *Trans. Am. Fish. Soc*. 110:158-167. Keywords: Hudson River, movement, striped bass.

McNeil, K.P.; Draper, R. 1983. Water quality model of the Mohawk River. Albany, NY: New York State Department of Environmental Conservation. Keywords: Mohawk River, New York, water quality, water, model.

Mearns, E.A. 1898. A study of the vertebrate fauna of the Hudson highlands, with observations on Mollusca, Crustacea, Lepidoptera and flora of the region: Part II. Vertebrates of the Hudson Highlands. *Fish. Bull. Am. Mus. Nat. Hist*. 10:311-322. Keywords: Hudson River, Hudson Highlands, New York, vertebrates, fauna, flora, Mollusca, Crustacea, Lepidoptera.

Medeiros, W.H. 1974. The Hudson River shad fishery: background, management problems and recommendations. Stony Brook, NY: New York State Sea Grant College Program. Keywords: Hudson River, New York, fishery, management, shad.

Meldrim, J.W.; Gift, J.G. 1974. The effect of temperature and chemical pollutants on the behavior of several estuarine organisms. *Ichthyological Associates Bulletin* #11. Keywords: Delaware River estuary, temperature effects, pollutants, chlorine, salinity, light, dissolved oxygen, behavior, adult, striped bass.

Meng, L. 1993. Estimating food requirements of striped bass larvae: An energetics approach. *Trans. Am. Fish. Soc*. 122:244-251. Keywords: food, larvae, energetics, striped bass.

Merriman, D. 1941. Studies of the striped bass (*Roccus saxatilis*) of the Atlantic coast. *U.S. Fish Wildl. Serv. Fish. Bull*. 50:1-77. Keywords: Atlantic coast, adult, striped bass.

Mesing, C.L.; Wicker, A.M. 1986. Home range, spawning migrations, and homing of radio-tagged Florida largemouth bass in two central Florida lakes. *Trans. Am. Fish. Soc*. 115:286-295. Keywords: Central Florida, Florida, home range, spawning, migration, homing, radio-tagged, tagging, lakes, adult, largemouth bass.

Messieh, S.N.; Rowell, T.W.; Peer, D.L.; Cranford, P.J. 1991. The effects of trawling, dredging and ocean dumping on the eastern Canadian continental shelf seabed. *Continental Shelf Res*. 11:1237-1263. Keywords: eastern Canadian continental shelf, Canada, Atlantic Ocean, trawling, dredging, ocean dumping, continental shelf, seabed.

Metzger, S.G.; Keppel, R.G.; Geoghegan, P.; Wells, A.G. 1992. Abundance of selected Hudson River fish species in previously unsampled regions: Effect on standing crop estimates. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 348-375. Keywords: Hudson River, abundance, population estimates.

Miller, J.M.; Reed, J.P.; Pietrafesa, L.J. 1984. Patterns, mechanisms and approaches to the study of migrations of estuarine-dependent fish larvae and juveniles. *In*: J.D. McCleave; Arnold, G.P; Dodson, J.J.; Neill, W.H., eds. Mechanisms of migration in fishes. New York: Plenum Press; p. 209-225. Keywords: migration, larvae, juveniles, estuary.

Miller, K.D.; Kramer, R.H. 1971. Spawning and early life history of largemouth bass (*Micropterus salmoides*) in Lake Powell. *Am. Fish. Soc. Publ*. 8:78-83. Keywords: Lake Powell, spawning, early life history, adult, egg, larva, largemouth bass.

Miller, L.W. 1963. Growth, reproduction and food habits of the white perch, *Roccus americanus* (Gmelin) in the Delaware River. [M.S. thesis.] University of Delaware. Keywords: Delaware River, estuary, growth, reproduction, feeding, food, behavior, habits, adult, white perch.

Miller, R.V. [year unknown.] Continental migrations of fishes. Miami, FL: Bureau of Commercial Fisheries Tropical Atlantic Biological Laboratory, Contribution No. 99; p. 15-45. Keywords: migration, adult, striped bass, American shad, bluefish.

Miller, R.W. 1981. Life history aspects of a tidal stream largemouth bass population. Dover, DE: U.S. Fish Wildl. Serv. Keywords: life history, tidal, stream, population, adult, largemouth bass.

Mills, E.L.; Scheuerell, M.D.; Carlton, J.T.; Strayer, D. [year unknown.] Biological invasions in the Hudson River: an inventory and historical analysis. [Report.] 63 p. Keywords: Hudson River, introduced species, exotic species, non-indigenous species, habitat, environment, urbanization, industrialization, exploitation.

Mix, M.C. 1985. Cancerous diseases in aquatic animals and their association with environmental pollutants: A critical review of the literature. [Final report.] Washington, DC: American Petroleum Institute; 247 p. Keywords: cancer, disease, aquatic, marine, fish, environmental pollutants, pollution.

Monosson, E.; Fleming, W.J.; Sullivan, C.V. [year unknown.] Effects of a planar PCB (3,3',4,4'-tetrachlorobiphenyl) on ovarian development, plasma sex steroid hormones, and vitellogenin levels in the adult white perch (*Morone americana*), and on survival of their offspring. [Report.] 29 p. Keywords: PCBs, ovarian development, ovary, plasma sex steroid hormones, vitellogenin, adult, offspring, eggs, larvae, survival, white perch.

Monteleone, D.M.; Cerrato, R.M.; Lonsdale, D.J.; Peterson, W.T. [year unknown.] Abundance and seasonality of key forage species in Long Island Sound. [Special Report No. 100.] 111 p. Keywords: Long Island Sound, food, forage species of, life history, eggs, larvae, juvenile, adult, bay anchovy, bluefish.

Monteleone, D.M.; Houde, E.D. 1992. Vulnerability of striped bass *Morone saxatilis* (Walbaum) eggs and larvae to predation by juvenile white perch *Morone americana* (Gmelin). *J. Exp. Mar. Biol. Ecol*. 158:93-104. Keywords:

eggs, larvae, juvenile, predation, predator, prey, food, feeding, striped bass, white perch.

Moran, M.A.; Limburg, K.E. 1985. The Hudson River ecosystem. *In*: Limburg, K.E.; Moran, M.A.; McDowell, W.H., eds. Environmental impact assessment of the Hudson River ecosystem, multiple case study and database review. Ithaca, NY: Cornell University, Ecosystems Research Center; p. 8-55. Keywords: Hudson River, New York, ecosystem, estuary, impact assessment.

Morgan, R.P., III; Prince, R.D. 1977. Chlorine toxicity to eggs and larvae of five Chesapeake Bay fishes. *Trans. Am. Fish. Soc*. 106:380-385. Keywords: Chesapeake Bay, chlorine, toxicity, eggs, larvae.

Morgan, R.P., III; Rasin, V.J., Jr. 1982. Influence of temperature and salinity on development of white perch eggs. *Trans. Am. Fish. Soc*. 111:396-398. Keywords: temperature, salinity, eggs, development, white perch.

Morgan, R.P., III; Rasin, V.J., Jr.; Cop, R.L. 1981. Temperature and salinity effects on development of striped bass eggs and larvae. *Trans. Am. Fish. Soc*. 110:95-99. Keywords: striped bass, temperature, salinity, effects, eggs, larvae, development.

Mueller, J.A.; Gerrish, T.A.; Casey, M.C. 1982. Contaminant inputs to the Hudson-Raritan estuary. Boulder, CO: *NOAA Tech. Memo. OMPA*-21; 191 p. Keywords: Hudson River, Raritan River, New York, New Jersey, estuary, contaminant, inputs.

Mueller, J.A.; Jeris, J.S.; Anderson, A.R.; Hughes, C.F. 1976. Contaminant inputs to the New York Bight. *NOAA Tech. Memo. ERL Mesa*-6; 109 p. Keywords: New York, Hudson River, bight, contaminant.

Muenscher, W.C. 1933. Aquatic vegetation of the Upper Hudson watershed: A Biological Survey of the Upper Hudson Watershed. [Annual report supplement.] Albany, NY: New York State Conservation Department. Keywords: Upper Hudson River, Hudson River, New York, aquatic vegetation, watershed, biology, survey.

Muessig, P.H.; Hutchison, J.B., Jr.; King, L.R.; Ligotino, R.J.; Daley, M. 1988. Survival of fishes after impingement on traveling screens at Hudson River power plants. *Am. Fish. Soc. Monogr*. 4:170-181. Keywords: Hudson River, New York, survival, impingement, traveling screens, power plants.

Muldoon, T. 1981. Sturgeon come back to Hudson, fostering hope in caviar trade. *National Fisherman* April:64. Keywords: Hudson River, New York, caviar trade, fishery, sturgeon.

Murawski, S.A.; Pacheco, A.L. 1977. Biological and fisheries data on Atlantic sturgeon, *Acipenser oxyrhynchus* (Mitchill). *NOAA NMFS Sandy Hook Lab. Tech. Ser. Rept.* 10; 69 p. Keywords: biology, fishery, fisheries data, biological data, adult, Atlantic sturgeon.

Murawski, W.S. 1958. Comparative study of populations of the striped bass based on lateral line scale counts. [M.S. thesis.] Ithaca, NY: Cornell University; 80 p. Keywords: comparative study, population, lateral line, scale counts, adult, striped bass.

Murphy, M.J.; Skaines, J. 1994. Habitat and movement of the gulf sturgeon (*Acipenser oxyrhynchus desotoi*) in the Pascagoula River, Mississippi. Jackson, MS: Mississippi Museum of Natural Science. *Museum Tech. Rep. No*. 29; 20 p. Keywords: Pascagoula River, Mississippi, habitat, movement, spawning, radio telemetry, sturgeon subspecies, gulf sturgeon.

Myers, G.S. 1949. Usage of anadromous, catadromous and allied terms for migratory fishes. *Copeia* 1949:89-97. Keywords: anadromous, catadromous, migratory, migration.

Myers, R.A.; Cadigan, N.G. 1993. Density-dependent juvenile mortality in marine demersal fish. *Can. J. Fish. Aquat. Sci*. 50:1576-1590. Keywords: density, juvenile, mortality, marine, demersal, fish.

Nack, S.B.; Bunnell, D.; Green, D.M.; Forney, J.L. 1993. Spawning and nursery habitats of largemouth bass in the tidal Hudson River. *Trans. Am. Fish. Soc*. 122:208-216. Keywords: Hudson River, spawning, reproduction, nursery, habitat, larva, eggs, adult, largemouth bass.

Nack, S.B.; Cook, W. 1987. Characterization of spawning and nursery habitats of largemouth bass (*Micropterus salmoides*) in the Stockport component of the Hudson River National Estuarine Research Reserve. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1986, Section IV. New York, NY: Hudson River Foundation; 24 p. Keywords: Stockport, Hudson River, New York, spawning, nursery, habitats, adult, egg, larva, largemouth bass.

National Marine Fisheries Service Northeast Region. 1990. An assessment of tag and release in the Northeast Region. Gloucester, MA: National Marine Fisheries Service. Keywords: Northeast US, tagging, mark and recapture, catch and release, fishery, adult, striped bass.

Neves, R.J. 1981. Offshore distribution of alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*, along the Atlantic Coast. *Fish. Bull. (U.S.)* 79:473-485. Keywords: Atlantic Coast, distribution, marine, adult, alewife, blueback herring.

New Jersey Department of Environmental Protection. 1986. Rules on coastal resources and development. Trenton, NJ: New Jersey Department of Environmental Protection. Keywords: New Jersey, rules, coastal resources, development, coast.

New York State Department of Environmental Conservation and U.S. Department of Commerce NOAA. 1993. Hudson River National Estuarine Research Reserve Final Management Plan. Washington, DC: Office of Ocean and Coastal Resource Management, Sanctuaries and Reserves Division. Keywords: Hudson River, management

New York State Department of Environmental Conservation. 1986. Fish and their habitats in the upper Hudson estuary, November 1986. [Report.] Albany, NY: New York State Department of Environmental Conservation; 38 p. Keywords: Hudson River, habitat, freshwater, tidal, fish distribution.

New York State Department of Environmental Conservation. 1989. Fish and their habitats in the upper Hudson estuary, April 1989. [Report.] Albany, NY: New York State Department of Environmental Conservation; 22 p. Keywords: Hudson River, habitat, freshwater, tidal, fish distribution.

New York State Department of Environmental Conservation. 1991. A study of striped bass in the marine district of New York VI. Albany, NY: New York State Department of Environmental Conservation; 298 p. Keywords: New York, marine district, population, mortality, toxic content, adult, striped bass.

New York State Department of Environmental Conservation. 1995. Atlantic sturgeon management in New York State. Albany, NY: New York State Department of Environmental Conservation. Keywords: New York, management, adult, Atlantic sturgeon.

New York State Department of State, Division of Coastal Resources and Waterfront Revitalization; The Nature Conservancy (NYSDS and TNC). 1990. Hudson River significant tidal habitats: a guide to the functions, values, and protection of the river's natural resources. New York, NY: New York State Department of. Keywords: Hudson River, New York, tidal, tide, habitats, protection, natural resources, management.

New York State Department of State, Division of Coastal Resources and Waterfront Revitalization (NYSDS). 1987. Significant coastal fish and wildlife habitat: Narratives and maps. New York, NY: New York State Department of State. Keywords: Hudson River, habitat.

New York University Medical Center. 1977. Effects of entrainment by the Indian Point power plant on biota in the Hudson River estuary: a progress report for 1975. [Report.] New York, NY: Consolidated Edison Company. Keywords: Indian Point, Hudson River, New York, entrainment, egg, larva, biota, biology, power plant, 1975.

New York University Medical Center. 1978. Effects of entrainment by the Indian Point power plant on biota in the Hudson River estuary: a progress report for 1976. [Report.] New York, NY: Consolidated Edison Company. Keywords: Indian Point, Hudson River, New York, effects, entrainment, egg, larva, biota, biology, power plant, progress report, 1976.

Nichols, J.T. 1914. Concerning young bluefish. *Trans. Am. Fish. Soc*. 1913:169-172. Keywords: young, bluefish.

Nichols, P.R. 1960. Homing tendency of American shad, *Alosa sapidissima* in the York River, Virginia. *Chesapeake Sci*. 1:200-201. Keywords: York River, Virginia, homing, migration, adult, American shad.

Nittel, M. 1976. Food habits of Atlantic tomcod (*Microgadus tomcod*) in the Hudson River. *In*: Hudson River Ecology, 4th Symposium. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, food, feeding, habits, behavior, adult, Atlantic tomcod.

NOAA (National Oceanic and Atmospheric Administration) Strategic Assessments Branch. 1985. National estuarine inventory, data atlas: Vol. 1. Physical and hydrologic characteristics. Rockville, MD: NOAA Office of Oceanography and Marine Assessments.

NOAA (National Oceanic and Atmospheric Administration). 1980. Emergency striped bass research study. [Annual report.] Washington, DC: U.S. Fish and Wildlife Service and National Marine Fisheries Service; 22 p. Keywords: Atlantic coast, population, habitat, stock, age, abundance, adult, striped bass.

NOAA (National Oceanic and Atmospheric Administration). 1981. Emergency striped bass research study. [Annual report.] Washington, DC: U.S. Department of Commerce; 25 p. Keywords: Atlantic coast, habitat, health, stock, age, abundance, striped bass.

NOAA (National Oceanic and Atmospheric Administration). 1990. A proposed estuarine classification: analysis of species salinity ranges. Washington, DC: U.S. Department of Commerce; 28 p. Keywords: Hudson River, salinity, estuary, habitat.

NOAA, FDA, and EPA (National Oceanic and Atmospheric Administration, Food and Drug Administration, and Environmental Protection Administration). 1987. Report on 1984-1986 federal survey of PCBs in Atlantic Coast bluefish. [Interpretive report.] Washington, DC: NOAA, FDA, EPA; 56+ p. Keywords: Atlantic coast, PCBs, toxic, toxicology, adult, bluefish.

Norcross, J.J.; Richardson, S.L.; Massman, W.H.; Joseph, E.B. 1974. Development of young bluefish (*Pomatomus saltatrix*) and distribution of eggs and young in Virginian coastal waters. *Trans. Am. Fish. Soc*. 103:477-497. Keywords: Virginia Coast, Virginia, development, embryology, young, distribution, eggs, larvae, coast, bluefish.

Norden, C.R. 1967. Age, growth, and fecundity of the alewife, *Alosa pseudoharengus* (Wilson), in Lake Michigan. *Trans. Am. Fish. Soc*. 96:387-393. Keywords: Lake Michigan, age, egg, growth, life history, reproduction, alewife.

Normandeau Associates, Inc. 1983. 1983 year class report for the Hudson River Estuary Monitoring Program: Vols. I-III. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, ecology, biology, power plant, entrainment, impingement, egg, larva, juvenile, adult, striped bass, Atlantic tomcod, White perch.

Normandeau Associates, Inc. 1984. Abundance and stock characteristics of the Atlantic tomcod (*Microgadus tomcod*) spawning populations in the Hudson River, winter 1982-1983. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, abundance, stock, spawning, population, winter, 1982, 1983, adult, Atlantic tomcod.

Normandeau Associates, Inc. 1985. 1982 year class report for the Hudson River Estuary Monitoring Program: Vols. I-III. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, ecology, biology, power plant, entrainment, impingement, egg, larva, juvenile, adult, striped bass, Atlantic tomcod, White perch.

Normandeau Associates, Inc. 1985. Final report for the 1983-1984 Hudson River white perch stock assessment study. [Report.] Pearl River, NY: Orange and Rockland Utilities. Keywords: Hudson River, stock, population, adult, white perch.

Normandeau Associates, Inc. 1986. Abundance and stock characteristics of the Atlantic tomcod (*Microgadus tomcod*) spawning populations in the Hudson River, winter 1983-1984. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, abundance, stock, spawning, populations, winter, 1983, 1984, adult, Atlantic tomcod.

Normandeau Associates, Inc. 1987. 1985-1986 Hudson River striped bass program release and recapture data. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, mark and recapture, aquaculture, fishery, adult, striped bass.

Normandeau Associates, Inc. 1987. Abundance and stock characteristics of the Atlantic tomcod population spawning in the Hudson River, winter 1985-1986. [Report.] New York, NY: Consolidated Edison Company; 120 p. Keywords: Hudson River, power plant, age, egg, larva, juvenile, adult, spawning, population, fishery, entrainment, impingement, Atlantic tomcod.

Normandeau Associates, Inc. 1988. Abundance and stock characteristics of the Atlantic tomcod population spawning in the Hudson River, winter 1987-1988. [Report.] New York, NY: Consolidated Edison Company; 120 p. Keywords: Hudson River, power plant, population, age, egg, larva, juvenile, adult, spawning, entrainment, impingement, Atlantic tomcod.

Normandeau Associates, Inc. 1990. Abundance and stock characteristics of the Atlantic tomcod (*Microgadus tomcod*) spawning in the Hudson River, winter 1988-1989. [Report.] White Plains, NY: New York Power Authority; 109 p. Keywords: Hudson River, power plant, population, distribution, stock, spawning, Atlantic tomcod.

Normandeau Associates, Inc. 1991. Abundance and stock characteristics of the Atlantic tomcod spawning population in the Hudson River, winter 1989-1990. [Report.] White Plains, NY: New York Power Authority. Keywords: abundance, stock, spawning, population, adult, Atlantic tomcod.

Normandeau Associates, Inc. 1992. Abundance and stock characteristics of the Atlantic tomcod spawning population in the Hudson River, winter 1990-91. [Report.] White Plains, NY: New York Power Authority; 110 p. Keywords: Hudson River, abundance, stock, population, spawning, Atlantic tomcod.

Normandeau Associates, Inc. 1994. Abundance and stock characteristics of the Atlantic tomcod spawning population in the Hudson River, winter 1991-92. [Report.] White Plains, NY: New York Power Authority; 200 p. Keywords: Hudson River, power plant, abundance, stock, population, spawning, Atlantic tomcod.

Normandeau Associates, Inc. 1994. Abundance and stock characteristics of the Atlantic tomcod spawning population in the Hudson River, winter 1992-93. [Report.] White Plains, NY: New York Power Authority; 200 p. Keywords: Hudson River, power plant, abundance, stock, population, spawning, Atlantic tomcod.

Nyman, R.M.; Conover, D.O. 1988. The relation between spawning season and the recruitment of young-of-the-year bluefish (*Pomatomus saltatrix*) to New York. *Fish. Bull. (U.S.)* 86:237-250. Keywords: New York, spawning, season, recruitment, metamorphosis, young-of-the-year, bluefish.

O'Connor, J.S. 1981. Studies on fates and effects of pollutants in the New York Bight. *ICES* [Int. Counc. Explor. Sea] *Council Minutes*; 9 p. Keywords: New York Bight, New York, pollutants, pollution.

O'Connor, J.S.; Flemer, D.A. 1986. Monitoring, research and management: integration for decision making in coastal marine environments. *In*: Boyle, T.P., ed. Symposium on Monitoring in Aquatic Ecosystems. Philadelphia, PA: ASTM. Keywords: research, management, coastal, marine, environments.

O'Connor, J.S.; Stanford, H.M. 1979. Chemical pollutants in the New York Bight: priorities for research. *In*: O'Connor, J.S.; Stanford, H.M., eds. Marine Ecosystems Analysis Project. Boulder, CO: NOAA MESA. Keywords: New York Bight, Hudson River, bight, chemical, pollutants.

O'Rear, C.W., Jr. 1972. The toxicity of zinc and copper to striped bass eggs and fry with methods for providing confidence limits. *In*: Proc. 26th Ann. Conf., Southern Assoc. Game Fish Comm.; p. 427-434. Keywords: toxicity, zinc, copper, eggs, larvae, fry, young, striped bass.

O'Reilly, J.E.; Thomas, D.P.; Evans, C. 1976. Annual primary production (nanoplankton, netplankton, dissolved organic matter) in the lower NY Bay. *In*: Hudson River Ecology, 4th Symposium. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, lower New York Bay, lower Hudson River, New York, annual, primary production, nanoplankton, netplankton, dissolved organic matter.

Oak Ridge National Laboratory; Martin Marietta Environmental Systems, Inc. 1986. Linking estuarine water quality and impacts on living resources: shrinking striped bass habitat in Chesapeake Bay and Albemarle Sound: Prioritization of pollution control in estuaries through analysis of temperature and dissolved oxygen and habitat space for biota. [Interim report.] Washington, DC: U.S. Environmental Protection Agency; 40 p. Keywords: estuary, conservation, pollution, water quality, temperature, dissolved oxygen, habitat, adult, striped bass.

Ogilvy, C.S.; DuBois, A.B. 1981. The hydrodynamic drag of swimming bluefish (*Pomatomus saltatrix*) in different intensities of turbulence: variation with changes of buoyancy. *J. Exp. Biol*. 92:67-85. Keywords: hydrodynamic drag, swimming, buoyancy, turbulence, biomechanics, adult, bluefish.

Oliver, J.D.; Van Den Avyle, M.J.; Bozeman, E.L., Jr. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic): bluefish. *U.S. Fish Wildl. Serv. Biol. Rep.* 82(11.96); 13 p. Keywords: South Atlantic, life history, environment, habitat, eggs, larvae, juvenile, adult, growth, temperature, salinity, dissolved oxygen, depth, turbidity, bluefish.

Olla, B.L.; Katz, H.M.; Studholme, A.L. 1970. Prey capture and feeding motivation in the bluefish, *Pomatomus saltatrix*. *Copeia* 1970:360-362. Keywords: prey capture, predation, predator, feeding behavior, adult, bluefish.

Olla, B.L.; Studholme, A.L. 1971. The effect of temperature on the activity of bluefish, *Pomatomus saltatrix*. *Biol. Bull. (Woods Hole)* 141:337-349. Keywords: temperature, activity, adult, bluefish.

Olla, B.L.; Studholme, A.L. 1972. Daily and seasonal rhythms of activity in the bluefish (*Pomatomus saltatrix*). *In*: Winn, H.E.; Olla, B.L., eds. Behavior of marine animals: current perspectives in research, Vol. 2. New York, NY: Plenum Press; p. 303-326. Keywords: daily rhythms, seasonal rhythms, biological clock, activity, adult, bluefish.

Olla, B.L.; Studholme, A.L. 1978. Comparative aspects of the activity rhythms of tautog, *Tautoga onitis*, bluefish, *Pomatomus saltatrix*, and Atlantic mackerel, *Scomber scombrus*, as related to their life habits. *In*: Thorpe, J.E., ed. Rhythmic activity of fishes. London, UK: Academic Press; p. 131-151. Keywords: activity rhythms, tautog, Atlantic mackerel, habits, adult, bluefish.

Olla, B.L.; Studholme, A.L.; Bejda, A.J. 1985. Behavior of juvenile bluefish *Pomatomus saltatrix* in vertical thermal gradients: influence of season, temperature acclimation and food. *Mar. Ecol. Prog. Ser*. 23:165-177. Keywords: behavior, juvenile, thermal, temperature, season, food, feeding, bluefish.

Olney, J.E. 1983. Eggs and early larvae of the bay anchovy, *Anchoa mitchilli*, and the weakfish, *Cynoscion regalis*, in lower Chesapeake Bay with notes on associated ichthyoplankton. *Estuaries* 6:20-35. Keywords: lower Chesapeake Bay, Chesapeake Bay, eggs, larvae, ichthyoplankton, weakfish, bay anchovy.

Olney, J.E.; Field, J.D.; McGovern, J.C. 1991. Striped bass egg mortality, production, and female biomass in Virginia rivers, 1980-1989. *Trans. Am. Fish. Soc*. 120:354-367. Keywords: Virginia, rivers, egg, mortality, production, fecundity, female, biomass, striped bass.

Olsen, C.R. 1979. Radionuclides sedimentation and the accumulation of pollutants in the Hudson estuary. [Ph.D. dissertation.] New York, NY: Columbia University. Keywords: Hudson River, New York, radionuclides, sedimentation, pollutants, estuary.

Olsen, C.R.; Simpson, H.J. 1981. Suspended particle concentrations, compositions and fluxes in the Hudson River estuary. *Estuaries* 4:291-307. Keywords: Hudson River, New York, estuary, suspended particle, sedimentation.

Olsen, C.R.; Simpson, H.J.; Bopp, R.F.; Williams, S.C.; Peng, T.H.; Deck, B.L. 1978. A geochemical analysis of the sediments and sedimentation in the Hudson estuary. *J. Sediment. Petrol*. 48:401-418. Keywords: Hudson River, New York, estuary, geochemical analysis, sediments, petrology.

Olsen, C.R.; Simpson, H.J.; Peng, T.H.; Bopp, R.F.; Trier, R.M. 1981. Sediment mixing and accumulation rate effects on radionuclide depth profiles in Hudson estuary sediments. *J. Geophys. Res*. 86:11020-11028. Keywords: Hudson River, New York, sediments, radionuclides.

Olsen, C.R.; Simpson, H.J.; Trier, R.M. 1981. Plutonium, radiocesium, and radiocobalt in sediments of the Hudson River estuary. *Earth Planet. Sci. Let*. 55:377-392. Keywords: Hudson River, New York, plutonium, radiocesium, radiocobalt, sediments.

Pace, M.L.; Baines, S.B.; Cyr, H.; Downing, J.A. 1993. Relationships among early life stages of *Morone americana* and *Morone saxatilis* from long-term monitoring of the Hudson River estuary. *Can. J. Fish. Aquat. Sci*. 50:1976-1985. Keywords: Hudson River, early life stages, young, white perch, striped bass.

Pace, M.L.; Downing, J.A.; Cyr, H.; Baines, S.; Lalond, S. [year unknown.] Analysis of Hudson River fish populations from the utilities monitoring program. [Final report.] New York, NY: Hudson River Foundation; 112 p. Keywords: Hudson River, fish community, population, sampling, larvae, survey, life history, eggs, striped bass, white perch.

Pace, M.L.; Findlay, S.; Lints, D. 1992. Zooplankton in advective environments: the Hudson River community and a comparative analysis. *Can. J. Fish. Aquat. Sci*. 49:1060-1069. Keywords: Hudson River, zooplankton, community, advective transport, advection.

Pacheco, A.L. 1973. Alewife, blueback herring, and American shad. *In*: Pacheco, A.L., ed. Proceedings of a workshop on egg, larval and juvenile stages of fish in Atlantic coast estuaries. Highlands, NJ: *NOAA NMFS Sandy Hook Lab. Tech. Series Rep*. 1; p. 266. Keywords: Atlantic Coast, estuary, egg, larvae, juvenile, life stages, coastal fishes, alewife, blueback herring, American shad.

Parsons, T.; Lovett, G. 1992. Effects of land use on the chemistry of Hudson River tributaries. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1991. New York, NY: Hudson River Foundation. Keywords: Hudson River, water chemistry, human impact, tributary.

Pearson, J.C. 1938. The life history of the striped bass, or rockfish, *Roccus saxatilis* (Walbaum). *U.S. Fish Wildl. Serv. Fish. Bull*. 49:825-851. Keywords: life history, striped bass.

Pecovitch, A.W. 1979. Distribution and some life history aspects of the shortnose sturgeon (*Acipenser brevirostrum*) in the upper Hudson River estuary. Northbrook, IL: Hazleton Environmental Science Corporation; 67 p. Keywords: Hudson River, upper Hudson River, New York, estuary, distribution, life history, adult, shortnose sturgeon.

Pekovitch, A.W. 1979. Distribution and some life history aspects of the shortnose sturgeon (*Acipenser brevirostrum*) in the upper Hudson River estuary. Northbrook, IL: Hazleton Environmental Science Corporation; 67 p. Keywords: upper Hudson River, Hudson River, distribution, life history, estuary, adult, shortnose sturgeon.

Pendleton, E.C. 1979. Secondary productivity in a salt marsh estuary. [Ph.D. dissertation.] Raleigh, NC: North Carolina

University; 278 p. Keywords: secondary production, productivity, salt marsh, estuary.

Pepin, P. 1991. Effect of temperature and size on development, mortality and survival rates of the pelagic early life history stages of marine fish. *Can. J. Fish. Aquat. Sci*. 48:503-518. Keywords: temperature, size, development, mortality, survival, pelagic, early life history, egg, young, stage, marine fish.

Perlmutter, A.; Schmidt, E.E.; Leff, E. 1967. Distribution and abundance of fishes along the shores of the lower Hudson River during the summer of 1965. *NY Fish Game J*. 14:47-75. Keywords: Hudson River, New York, lower Hudson River, distribution, abundance, fishes, shores, summer, season, 1965.

Perlmutter, A.; Leff, E.; Schmidt, E.E.; Heller, R.; Sicilano. M. 1966. Distribution and abundance of fishes along the shores of the lower Hudson River during the summer of 1966. *In*: Hudson River ecology. Albany, NY: Hudson River Valley Commission; p. 147-200. Keywords: Hudson River, New York, lower Hudson River, distribution, abundance, fishes, shores, summer, season, 1966.

Peters, D.S.; Cross, F.A. 1992. What is coastal fish habitat? Stemming the tide of coastal fish habitat loss. *In*: Stroud, R.H., ed. Proceedings of the Symposium on Conservation of Coastal Fish Habitat, Baltimore, MD. Savannah, GA: National Coalition for Marine Conservation; p. 17-22. Keyword: habitat.

Peterson, R.H.; Johansen, P.H.; Metcalfe, J.L. 1980. Observations on early life stages of Atlantic tomcod, *Microgadus tomcod*. *Fish. Bull. (U.S.)* 78:147-158. Keywords: early life stages, egg, larva, Atlantic tomcod.

Pirnie, M. 1982. Hudson River estuary fish habitat study. [Report.] New York, NY: U.S. Army Corps of Engineers. Keywords: Hudson River, New York, estuary, fish habitat.

Pitlo, J., Jr. 1988. An evaluation of largemouth bass populations in the upper Mississippi River, largemouth bass habitat selection. [Study.] Des Moines, IA: Iowa Department of Natural Resources, Fisheries Bureau. Keywords: Upper Mississippi River, Mississippi River, evaluation, habitat selection, habitat, populations, adult, largemouth bass.

Pizza, J.C.; O'Connor, J.M. 1983. PCB dynamics in Hudson River striped bass: II. Accumulation from dietary sources. *Aquat. Toxicol*. 3:313-327. Keywords: Hudson River, New York, PCBs, accumulation, toxins, diet, food, feeding, adult, striped bass.

Polgar, T.T. 1982. Factors affecting recruitment of Potomac River striped bass and resulting implications for management. *In*: Kennedy, V.S., ed. Estuarine comparisons. New York: Academic Press; p. 427-442. Keywords: Potomac River, recruitment, larvae, management, striped bass.

Polgar, T.T.; Mihursky, J.A.; Ulanowicz, R.E.; Morgan, R.P.; Wilson, J.S. 1976. An analysis of 1974 striped bass spawning success in the Potomac estuary. *In*: Wiley, M., ed. Estuarine processes. New York, NY: Academic Press; p. 151-165. Keywords: Potomac River, estuary, 1974, spawning, adult, striped bass.

Polgar, T.T.; Summers, J.K.; Cummins, R.A.; Rose, K.A.; Heimbuch, D.G. 1985. Investigation of relationships among pollutant loadings and fish stock levels in northeastern estuaries. *Estuaries* 8:125-135. Keywords: northeastern US, pollutant, loadings, fish stock levels, estuary.

Powell, J.; Strayer, D.L. 1992. Zebra mussels in the Hudson. *Tidal Exchange* 2:1-2. Keywords: Hudson River, New York, zebra mussels.

Powles, H. 1981. Distribution and movements of neustonic young of estuarine dependent (*Mugil* sp., *Pomatomus saltatrix*) and estuarine independent (*Coryphaena* sp.) fishes off the southeastern United States. *Rapp. PV Reun. Cons. Int. Explor. Mer* 178:207-209. Keywords: Southeastern United States, Atlantic Ocean, distribution, movements, neustonic young, estuary, fishes, bluefish.

Prandle, D. 1981. Salinity intrusion in estuaries. *J. Phys. Oceanogr*. 11:1311-1324. Keywords: salinity, intrusion, estuary.

Prandle, D.; Rahman, M. 1980. Tidal response in estuaries. *J. Phys. Oceanogr*. 10:1552-1573. Keywords: tide, tidal response, estuary.

Prince, E.D.; Barwick, D.H. 1981. Landlocked blueback herring in two South Carolina reservoirs: reproduction and suitability as stocked prey. *N. Am. J. Fish. Manage*. 1:41-45. Keywords: South Carolina, landlocked, reservoirs, reproduction, stocked prey, adult, blueback herring.

Pritchard, D.W. 1967. What is an estuary? Physical viewpoint. *In*: Lauff, G., ed. Estuaries. Washington, DC: *AAAS* [American Academy for the Advancement of Science] *Spec. Publ.* 83; p. 3-5. Keywords: estuary.

Pritchard, D.W. 1969. Dispersion and flushing of pollutants in estuaries. *J. Hydraulics Div., Am. Soc. Civ. Eng.* 95(HY1):115-124. Keywords: pollutant, dispersion, flushing, estuary.

Quirk, Lawler and Matusky (QLM). 1974. Hudson River study: aquatic factors governing the siting of power plants. [Report.] New York, NY: Empire State Energy Research Corporation. Keywords: Hudson River, New York, aquatic factors, power plant.

Radtke, R.L.; Townsend, D.W.; Folsom, S.D.; Morrison, M.A. 1990. Strontium: calcium concentration ratios in otoliths of herring larvae as indicators of environmental histories. *Environ. Biol. Fishes* 27:51-61. Keywords: larvae, strontium, calcium, otoliths, environment, herring.

Rahn, K.A.; Heaton, R. 1994. Local and distant sources of contaminants in rain and air of the Lower Hudson Valley: do the Roseton and Danskammer Point power plants of Newburgh contribute substantially? An elemental tracer study. [Final report.] New York, NY: Hudson River Foundation; 78 p. Keywords: Hudson River, contaminants, pollution, elemental tracers.

Ramnarace, K.D.; Garcia, E.B.; Knizeski, H.M. 1989. The physical, chemical and biological components of two tidal creeks in the Piermont Marsh system of the Hudson River. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1988, Section II. New York, NY: Hudson River Foundation; 48 p. Keywords: Piermont Marsh, Hudson River, New York, physiology, chemistry, biology, tidal creeks, marsh.

Raney, E.C. 1952. The life history of the striped bass. *Bull. Bingham Oceanogr. Collect. (Yale Univ.)* 14:5-97. Keywords: life history, egg, larva, juvenile, adult, striped bass.

Raney, E.C. 1965. Some pan fishes of New York; yellow perch, white perch, white bass, freshwater drum. *NY State Conservationist* 19:22-28. Keywords: New York, adult, white perch.

Raney, E.C.; Woolcott, W.S.; Mehring, A.G. 1954. Migratory pattern and racial structure of Atlantic Coast striped bass. *Trans. N. Am. Wildl. Conf.* 19:376-396. Keywords: Atlantic coast, migration, adult, striped bass.

Rathjen, W.F.; Miller, L.C. 1957. Aspect of the life history of the striped bass (*Roccus saxatilis*) in the Hudson River. *NY Fish Game J.* 4:43-60. Keywords: Hudson River, New York, life history, striped bass.

Rehwoldt, R.E.; Kelley, E.; Mahoney, M. 1977. Investigations into acute toxicity and some chronic effects of selected herbicides and pesticides on several freshwater fish species. *Bull. Environ. Contam. Toxicol*. 18:361-365. Keywords: toxicity, chronic effects, herbicides, pesticides, pollution, freshwater fish.

Reichheld, B.; Barten, P. 1992. Characterization of critical streamflow and sediment source areas with geographic information for the Saw Kill watershed. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1991. New York, NY: Hudson River Foundation. Keywords: Hudson River, Saw Kill, sediment, streamflow.

Rhoads, D.C.; McCall, P.L.; Yongst, J.Y. 1978. Disturbance and protection on the estuarine seafloor. *Am. Scientist* 66:577-586. Keywords: disturbance, protection, estuary, seafloor.

Richards, S.W. 1959. Pelagic fish eggs and larvae of Long Island Sound. *Bull. Bingham Oceanogr. Collect. Yale Univ.* 17:95-124. Keywords: Long Island Sound, New York, Connecticut, ichthyoplankton, pelagic, eggs, larvae.

Richards, S.W. 1976. Age, growth and food of bluefish from east-central Long Island Sound from July through November 1975. *Trans. Am. Fish. Soc*. 105:523-525. Keywords: Long Island Sound, New York, Connecticut, Rhode Island, age, growth, food, feeding, 1975, adult, bluefish.

Richards, W.J. 1960. The life history, habits and ecology of the white perch, *Roccus americana* (Gmelin) in Cross Lake, New York. [M.S. thesis.] Syracuse, NY: State University of New York College of Forestry; 113 p. Keywords: Cross Lake, New York, life history, ecology, adult, white perch.

Richkus, W.A. 1975. Migrating behavior and growth of juvenile anadromous alewives, *Alosa pseudoharengus*, in a Rhode Island drainage. *Trans. Am. Fish. Soc*. 104:483-493. Keywords: Rhode Island, drainage, estuary, migration, behavior, growth, juvenile, anadromous, alewife.

Rieman, B.E.; Beamesderfer, R.C. 1990. White sturgeon in the Lower Columbia River: Is the stock overexploited? *N. Am. J. Fish. Manage*. 10:397-407. Keywords: Columbia River, white sturgeon, fishery.

Ritchie, D.E.; Koo, T.S.Y. 1968. Movement of juvenile striped bass in the estuary as determined by tagging and recapture. *Chesapeake Biol. Lab. Ref.* 68-31. Keywords: movement, juvenile, estuary, tagging, recapture, striped bass.

Robinson, J.B. 1960. The age and growth of striped bass (*Roccus saxatilis*) in California. *Calif. Fish Game* 46:279-290. Keywords: California, age, growth, adult, striped bass.

Rod, J.P.; Sramek, M.A. 1986. Survey of fishes of Constitution Island Marsh. [Final report.] New York, NY: Hudson River Foundation; 61 p. Keywords: Hudson River, Constitution Island, survey, abundance, seasonal pattern, marsh habitat, fish community, adult white perch, alewife, blueback herring.

Rod, S.R.; Ayers, R.U.; Small, M. 1989. Reconstruction of historical loadings of heavy metals and chlorinated hydrocarbon pesticides in the Hudson-Raritan basin, 1880-1980. [Final report.] New York, NY: Hudson River Foundation; 212 p. Keywords: Hudson River, Raritan Bay, contaminants, loadings.

Rogers, B.A.; Westin, D.T. 1978. A culture methodology for striped bass. *Ecol. Res. Ser. EPA* 660/3-78-000. Keywords: culture, method, egg, striped bass.

Rogers, B.A.; Westin, D.T. 1981. Laboratory studies on effects of temperature and delayed initial feeding on development of striped bass larvae. *Trans. Am. Fish. Soc*. 110:121-136. Keywords: temperature, feeding, development, larvae, striped bass.

Rogers, R.A.; Westin, D.T.; Saila, S.B. 1977. Life stage duration studies on Hudson River striped bass, *Morone saxatilis* (Walbaum). *Univ. Rhode Island, Mar. Tech. Rept. No*. 31; 111 p. Keywords: Hudson River, life stages, life history, egg, larva, juvenile, adult, striped bass.

Rohmann, S.O.; Lilienthal, N. 1985. Tracing a river's toxic pollution (phase II): a case study of the Hudson. New York, NY: INFORM, Inc.; 209 p. Keywords: Hudson River, New York, river, toxins, pollution, case study.

Ross, Q.E.; Stira, R.J. 1987. Microdistribution of early life stages of striped bass *Morone saxatilis* in the Hudson River estuary. *In*: Proceedings of a conference on Hudson River fishes, September 1981. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, estuary, microdistribution, early life stages, striped bass.

Ross, R.M.; Backman, T.W.H.; Bennett, R.M. 1993. Evaluation of habitat suitability index models for riverine life stages of American shad, with proposed models for premigratory juveniles. *U.S. Fish Wildl. Serv. Biol. Rep.* 14; 26 p. Keywords: eggs, larvae, juvenile, adult, spawning, habitat, American shad.

Ross, R.M.; Bennett, R.M. 1993. Morphometric differentiation of American shad and white sucker eggs from riverine samples. *J. Freshwater Ecol*. Keywords: morphometric differentiation, morphology, white sucker, eggs, riverine samples, river, adult, American shad.

Rountree, R.A.; Able, K.W. 1992. Fauna of polyhaline subtidal marsh creeks in southern New Jersey: composition, abundance and biomass. *Estuaries* 15:171-185. Keywords: southern New Jersey, fauna, polyhaline, subtidal, marsh habitat, creeks, composition, abundance, biomass.

Rozas, L.P.; Hackney, C.T. 1984. The importance of oligohaline fishes in wetland habitats to fisheries resources. *Wetlands* 3:77-89. Keywords: salinity, oligohaline, wetlands, habitat, fisheries, resources.

Runn, P.; Johansson, N.; Milbrink, G. 1977. Some effects of low pH on the hatchability of eggs of perch. *Zoon* 5:115-127. Keywords: pH, acidity, hatching, eggs, white perch.

Ryder, J.A. 1883. Observations on the absorption of the yolk, the food, feeding, and development of embryo fishes, comprising some investigations conducted at the Central Hatchery, Armour Building, Washington, DC, in 1882. *U.S. Comm. Fish. Rept.* 2(1882):179-205. Keywords: yolk, food, feeding, embryos, larvae, development.

Ryder, J.A. 1887. On the development of osseus fishes, including marine and freshwater forms. *U.S. Comm. Fish. Rept.* 3(1885):488-604. Keywords: development.

Ryder, J.A. 1888. On the development of the common sturgeon *Acipenser sturio*. *Am. Nat.* 22(259):659-660. Keywords: development, sturgeon.

Samuelian, J.H.; O'Connor, J.M. 1992. The analysis of polychlorinated biphenyl (PCB) congeners in the estuarine Hudson River. [Final report.] New York, NY: Hudson River Foundation; 328 p. Keywords: Hudson River, PCB congeners, adult, striped bass, white perch.

Sandler, R.; Shroenbrod, D. editors. 1981. The Hudson River power plant settlement. Conference sponsored by the New York University School of Law and the Natural Resources Defense Council, Inc. New York, NY: NYU School of Law; 353 p. Keywords: New York University School of Law, Hudson River, power plant, estuary, fisheries, striped bass.

Sarabun, C.C. 1993. Observations of a Chesapeake Bay tidal front. *Estuaries* 16:68-73. Keywords: Chesapeake Bay, tidal front, tides.

Sargent, W.; Boreman, J. 1984. Bluefish along the Atlantic coast. Woods Hole, MA: National Marine Fisheries Service, *Northeast Fish. Cent. Newsl. Spec. Iss*. Keywords: Atlantic, distribution, juvenile, reproduction, season, bluefish.

Savino, J.F.; Stein, R.A. 1982. Predator-prey interaction between largemouth bass and bluegill as mediated by simulated, submerged vegetation. *Trans. Am. Fish. Soc*. 111:255-266. Keywords: predator-prey interaction, bluegill, simulation, vegetation, adult, largemouth bass.

Schaaf, W.E.; Peters, D.S.; Coston-Clements, L.; Vaughn, D.S.; Krouse, C.W. 1993. A simulation model of how life history strategies mediate pollution effects on fish populations. *Estuaries* 126:697-702. Keywords: simulation, model, life history, pollution, population.

Schaefer, R.H. 1968. Size, age composition and migration of striped bass from the surf waters of Long Island. *NY Fish Game J*. Keywords: Long Island, Westhampton Beach, Hudson River, size, age, migration, dispersal, population, adult, striped bass.

Schaffer, S.A. 1978. Concentrations of organic carbon and protein in the Hudson estuary near Indian Point. [M.S. thesis.] New York, NY: New York University. Keywords: Hudson River, Indian Point, New York, estuary, concentrations, organic carbon, protein.

Schaner, E.; Sherman, K. 1960. Observations on fecundity of the tomcod, *Microgadus tomcod* (Walbaum). *Copeia* 1960:347-348. Keywords: observations, fecundity, adult, eggs, Atlantic tomcod.

Schmidt, R.E. 1986. Fish community structure in Tivoli North Bay, a Hudson River freshwater tidal marsh. *NOAA Tech. Rep. Series OCRM/SPD*; 47 p. Keywords: Hudson River, Tivoli Bay, fish community, population, marsh habitat, freshwater, white perch, blueback herring, alewife, American shad.

Schmidt, R.E. 1992. Temporal and spatial distribution of bay anchovy eggs through adults in the Hudson River estuary. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 228-241. Keywords: Hudson River, egg, larva, juvenile, adult, distribution, bay anchovy.

Schmidt, R.E. 1993. Fishes of Manitou Marsh with comments on other aquatic organisms. [Report.] Cornwall, NY: Museum of the Hudson Highlands; 64 p. Keywords: Manitou Marsh, Hudson River, marsh habitat, freshwater, white perch, striped bass, alewife.

Schmidt, R.E. 1993. Identification of Hudson River *Morone* larvae. [Draft final report.] New York, NY: Hudson River Foundation. Keywords: Hudson River, identification, larvae.

Schmidt, R.E.; Limburg, K.E.; Stillman, T. 1994. An estimate of the significance of tributary spawning of alewife (*Alosa pseudoharengus*) to the Hudson River estuary. *In*: Schmidt, R.E.; Stillman, T., eds. Drift of early life stages of fishes in Stockport Creek and significance of the phenomenon to the Hudson River estuary. New York, NY: Hudson River Foundation; p. 23-35. Keywords: Stockport Creek, Hudson River, spawning, eggs, adult, alewife, blueback herring.

Schmidt, R.E.; Anderson, A.B.; Limburg, K.E. 1992. Dynamics of larval fish populations in a Hudson River tidal marsh. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 458-475. Keywords: Hudson River, Tivoli South Bay, fish community, population, larvae, marsh habitat, freshwater.

Schmidt, R.E.; Kiviat, E. 1988. Communities of larval and juvenile fish associated with water-chestnut, watermilfoil and water-celery in the Tivoli Bays of the Hudson River. [Final report.] New York, NY: Hudson River Foundation; 35 p. Keywords: Hudson River, Tivoli Bay, fish community, larva, juvenile, water-chestnut, watermilfoil, water-celery, vegetation, habitat.

Schmidt, R.E.; Klauda, R.J.; Bartels, J.M. 1988. Distributions and movements of the early life stages of three species of

Alosa in the Hudson River, with comments on mechanisms to reduce interspecific competition. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 193-215. Keywords: Hudson River, egg, larva, juvenile, distribution, size, alewife, blueback herring.

Schmidt, R.E.; Limburg, K.E. 1989. Fishes spawning in nontidal portions of Hudson River tributaries. [Final report.] New York, NY: Hudson River Foundation; 74 p. Keywords: Hudson River, spawning.

Schmidt, R.E.; Limburg, K.E. 1990. An estimate of the significance of tributary spawning of alewife (*Alosa pseudoharengus*) to the Hudson River estuary. *In*: Pollution and water resources. New York, NY: Columbia University Press, Columbia Univ. Seminar Series 22. Keywords: Hudson River, estuary, tributary, spawning, adult, alewife.

Schmidt, R.E.; Smith, C.L. 1984. Curation of the American Museum of Natural History Hudson River larval fish collection. [Final report.] New York, NY: Hudson River Foundation; 78 p. Keywords: Hudson River, larvae, specimens, museum fish collection.

Schmidt, R.E.; Stillman, T. 1994. Drift of early life stages of fishes in Stockport Creek and significance of the phenomenon to the Hudson River estuary, New York, NY. [publisher unknown.] Keywords: Stockport Creek, Hudson River, fish community, eggs, larvae, juvenile, adult, alewife, white perch.

Schonhoff, B.J., III; Van Vooren, A. 1985. Spawning site selection and seasonal habitat associations of Mississippi River largemouth bass. [Final report.] Des Moines, IA: Iowa Conservation Commission; 17 p. Keywords: Mississippi River, Iowa, spawning, site selection, seasonal, habitat, adult, largemouth bass.

Schubel, J.R. 1990. A research program for the Hudson River estuary. [Report.] Albany, NY: New York State Department of Environmental Conservation; 135 p. Keywords: Hudson River, management, research, geology, geochemistry, ecosystem, fish community, hydrology.

Schubel, J.R.; Pritchard, D.W.; Abood, K.A.; Cosper, T.C.; Gross, M.G.; Hunkins, K.; Malone, T.C.; Terry, O.W.; Weyl, P.K. 1982. Influences of the Hudson-Raritan estuary on the New York Bight. Stony Brook, NY: SUNY Marine Sciences Research Center, Working Paper 9; 82 p. Keywords: Hudson-Raritan estuary, Hudson River, New York, Raritan River, New Jersey, New York Bight, river, ocean.

Schwartz, F.J. 1960. The perches. *Maryland Conservationist* 37:20-23. Keywords: perch.

Scofield, E.C. 1931. The life history of the striped bass. *Calif. Div. Fish Game, Fish Bull.* 29:26-60. Keywords: California, life history, adult, striped bass.

Scott, W.B.; Christie, W.J. 1963. The invasion of the lower Great Lakes by the white perch, *Roccus americanus* (Gmelin). *J. Fish. Res. Board Can.* 20:1189-1195. Keywords: lower Great Lakes, invasion, nonendemic, introduced species, adult, white perch.

Secor, D.H. 1992. Application of otolith microchemistry analysis to investigate anadromy in Chesapeake Bay striped bass *Morone saxatilis*. *Fish. Bull. (U.S.)* 90:798-806. Keywords: Chesapeake Bay, otolith, anadromy, adult, striped bass.

Secor, D.H.; Trice, T.M.; Hornick, H.T. 1994. Validation of otolith-based ageing and a comparison of otolith and scale-based ageing in mark-recaptured Chesapeake Bay striped bass, *Morone saxatilis*. *Fish. Bull. (U.S.)* 93(1):186-190. Keywords: Chesapeake Bay, otolith, age, ageing, mark-recapture, adult striped bass.

Secor, D.H.; Dean, J.M. 1991. Recruitment bottlenecks and the survival of larval striped bass in the Hudson River. [Final report.] New York, NY: Hudson River Foundation. Keywords: Hudson River, larvae, recruitment, survival, hatching, distribution, striped bass.

Secor, D.H.; Dean, J.M. 1992. Comparison of otolith-based back-calculation methods to determine individual growth histories of larval striped bass, *Morone saxatilis. Can. J. Fish. Aquat. Sci.* 49:1439-1454. Keywords: otolith, growth, larvae, striped bass.

Secor, D.H.; Henderson-Arzapalo, A.; Piccoli, P.M. 1995. Can otolith microchemistry chart patterns of migration and habitat utilization in anadromous fishes? *J. Exp. Mar. Biol. Ecol*. 192(1):15-33. Keywords: otolith, migration, habitat, anadromy.

Secor, D.H.; Houde, E.D. 1994. Age- and sex- dependent migrations of Hudson River anadromous striped bass populations. [Final report.] New York, NY: Hudson River Foundation; 57 p. Keywords: Hudson River, age, sex, migration, anadromy, adult, striped bass.

Secor, D.H.; Piccoli, P.M. 1996. Age- and sex-dependent migrations of striped bass in the Hudson River as determined by chemical microanalysis of otoliths. *Estuaries* 19(4):778-793. Keywords: Hudson River, migration, otolith, age, sex, adult, striped bass.

Seplow, S.; Bokuniewicz, H.J. 1992. Observations on the suspended sediment distribution in the Hudson River estuary. *In*: Waldman, J.R.; Blair, E.A., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1991. New York, NY: Hudson River Foundation. Keywords: Hudson River, suspended sediment.

Setzler, E.M.; Boynton, W.R.; Wood, K.V.; Zion, H.H.; Lubbers, L.; Mountford, N.K.; Frere, P.; Tucker, L.; Mihursky, J.A. 1980. Synopsis of biological data on striped bass, *Morone saxatilis* (Walbaum). Boulder, CO: NOAA. *NOAA Tech. Rep. NMFS, Circular* 433. Keywords: biology, adult, striped bass.

Setzler-Hamilton, E.M.; Boynton, W.R.; Mihursky, J.A.; Polgar, T.T.; Wood, K.V. 1981. Spatial and temporal distribution of striped bass eggs, larvae and juveniles in Potomac estuary. *Trans. Am. Fish. Soc*. 110:121-136. Keywords: Potomac River, estuary, spatial, temporal, distribution, egg, larva, juvenile, striped bass.

Setzler-Hamilton, E.M.; Jones, P.W.; Drewry, G.E.; Martin, F.D.; Ripple, K.; Beaven, M.; Mihursky, J.A. 1981. A comparison of larval feeding habits among striped bass, white perch, and Clupeidae in the Potomac estuary. Baltimore, MD: Maryland Department of Natural Resources, Power Plant Siting Program, PPRP-65. Keywords: Potomac River, comparison, feeding habits, food, larvae, estuary, striped bass, white perch.

Shelton, W.L.; Davies, W.D.; King, T.A.; Timmons, T.J. 1979. Variation on the growth of the initial year class of largemouth bass on West Point Reservoir, Alabama and Georgia. *Trans. Am. Fish. Soc*. 108:142-149. Keywords: West Point Reservoir, Alabama, Georgia, variation, growth, initial year class, young, largemouth bass.

Shenker, J.M.; Dean, J.M. 1979. The utilization of an intertidal salt marsh creek by larval and juvenile fishes: abundance, diversity and temporal variation. *Estuaries* 2:154-163. Keywords: intertidal marsh, salt marsh habitat, tide, creek, larvae, juvenile, fish abundance, fish diversity, temporal variation, estuary.

Sheppard, J.D. 1976. Valuation of the Hudson River fishery resources: past, present and future. [Report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, valuation, fishery resources.

Sheri, A.N.; Power, G. 1968. Reproduction of white perch, *Roccus americana*, in the Bay of Quinte, Lake Ontario. *J. Fish. Res. Board Can.* 25:2225-2231. Keywords: Bay of Quinte, Lake Ontario, reproduction, adult, white perch.

Sheri, A.N.; Power, G. 1969. Validity of the scale method and back calculations for estimating age and growth of white perch, *Morone americana*. *Pak. J. Zool*. 1:97-111. Keywords: scale method, age, growth, adult, white perch.

Sherman, D.; Schneider, R.; Howarth, R. 1994. Distribution and abundance of aquatic macrophytes in the freshwater tidal Hudson River. Ithaca, NY: Cornell University, Sect. Ecology and Systematics; 18 p. Keywords: Hudson River, aquatic macrophytes, distribution, abundance.

Shortnose Sturgeon Recovery Team. 1981. Shortnose sturgeon *Acipenser brevirostrum* Lesueur, 1818, recovery plan. [Draft.] Washington, DC: NOAA/NMFS; 120 p. Keywords: management, recovery plan, Lesueur, adult, shortnose sturgeon.

Sidari, M.; Schmidt, R.E. 1990. Larval fish foods in water-chestnut beds. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the 1989 Tibor T. Polgar Fellowship Program, Section VI. New York, NY: Hudson River Foundation; 23 p. Keywords: Hudson River, Tivoli South Bay, larvae, food, feeding, tidal, freshwater, marsh habitat, water-chestnut beds, vegetation.

Simpson, H.J.; Bopp, R.F.; Deck, B.; Clark, J.F. [year unknown.] Changes in total waste water ammonia loading during the last two decades in the Hudson River. [Report.] Publisher unknown; 18 p. Keywords: Hudson River, nutrients, wastewater.

Simpson, H.J.; Bopp, R.F.; Thurber, D. 1973. Salt movement patterns in the Hudson. *In*: Proceedings of 3rd Symposium of Hudson River Ecology. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, salt, movement, salinity.

Simpson, H.J.; Hammond, D.E.; Deck, B.L.; Williams, S.C. 1975. Nutrient budgets in the Hudson River estuary. *In*: Church, T.M., ed. Marine chemistry in the coastal environment. Washington, DC: American Chemical Society; p. 616-635. Keywords: Hudson River, New York, nutrient, estuary.

Simpson, H.J.; Olsen, C.R.; Williams, S.C.; Trier, R.M. 1976. Man-made radionuclides and sedimentation in the Hudson River estuary. *Science* 194:179-183. Keywords: Hudson River, New York, estuary, sediment radionuclides.

Simpson, K.W.; Bode, R.W.; Fagnani, J.P.; DeNicola, D.M. 1984. The freshwater macrobenthos of the main channel, Hudson River: Part B. Biology, taxonomy, and distribution of resident macrobenthic species. New York, NY: Hudson River Foundation; 202 p. Keywords: Hudson River, macrobenthos, freshwater, biology, distribution, taxonomy.

Simpson, K.W.; Bode, R.W.; Novak, M.; Fagnani, J.P.; DeNicola, D.M. 1988. The benthic macroinvertebrates of the Hudson River from Troy to Albany, New York. [Final report.] New York, NY: Hudson River Foundation; 145 p. Keywords: Hudson River, macroinvertebrates, invertebrates, benthos.

Simpson, K.W.; Fagnani, J.P.; Bode, R.W.; De Nicola, D.M.; Abele, L.E. 1986. Organism-substrate relationships in the main channel of the lower Hudson River. *J. N. Am. Benthol. Soc*. 5:41-57. Keywords: Lower Hudson River, Hudson River, New York, organism, substrate, benthos.

Sirois, D.L.; Frederick, S.W. 1978. Phytoplankton and primary production in the lower Hudson River estuary. *Estuar. Coastal Mar. Sci*. 7:413-423. Keywords: Hudson River, New York, estuary, phytoplankton, primary production.

Sloan, R.J. 1994. A brief report on PCB in Hudson River striped bass. Albany, NY: New York State Department of Environmental Conservation, *Div. Fish Wildl. Tech. Rep*. 94-3 (BEP);63 p. Keywords: Hudson River, PCB, contaminants, adult, striped bass.

Sloan, R.J.; Armstrong, R.W. 1981. PCB patterns in Hudson River fish: I. Resident/freshwater species; II. Migrant/ Marine Species. [Unpublished technical report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, PCB patterns, fishery, freshwater species, resident species, migrant species, marine species.

Sloan, R.J.; Armstrong, R.W. 1988. PCB patterns in Hudson River fish: II Migrant and marine species. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 325-350. Keywords: Hudson River, fish community, marine, contaminants, PCB.

Sloan, R.J.; Hattala, K. 1991. Temporal and spatial aspects of PCB contamination in Hudson River striped bass. Albany, NY: New York State Department of Environmental Conservation, Division of Fish and Wildlife, *DEC Tech. Rep*. 91-2 (BEP); 91 p. Keywords: Hudson River, New

York, temporal, spatial, PCB, contamination, adult, striped bass.

Sloan, R.J.; Horn, E.G. 1986. Contaminants in Hudson River striped bass: 1978-1985. Albany, NY: New York State Department of Environmental Conservation, Division of Fish and Wildlife, *DEC Tech. Rep*. 86-2 (BEP); 17 p. Keywords: Hudson River, New York, PCB, contamination, 1978, 1985, adult, striped bass.

Sloan, R.J.; Sheppard, J.D. 1978. Spatial and temporal distributions of PCB concentrations in Hudson River fish: a preliminary assessment. *In*: Abstracts, 34th Northeast Fish and Wildlife Conference, White Sulphur Springs, WV. Keywords: Hudson River, New York, spatial distribution, temporal distribution, PCB, contamination, fish.

Sloan, R.J.; Stang, D.; O'Connell, E.A. 1988. Ten years of monitoring PCBs in Hudson River striped bass. Albany, NY: New York State Department of Environmental Conservation, Division of Fish and Wildlife, *DEC Tech. Rep*. 88-2 (BEP); 38 p. Keywords: Hudson River, New York, monitoring, history, PCB, contamination, adult, striped bass.

Sloan, R.J.; Young, B.; McKown, K.; Vecchio, V. 1991. PCB in striped bass from New York marine waters. Albany, NY: New York State Department of Environmental Conservation, Division of Fish and Wildlife, *DEC Tech. Rep*. 91-1 (BEP); 61 p. Keywords: Hudson River, New York, PCB, contamination, estuary, adult, striped bass.

Smith, C.E.; Peck, T.H.; Klauda, R.J.; McLaren, J.B. 1979. Hepatomas in Atlantic tomcod, *Microgadus tomcod* (Walbaum) collected in the Hudson River estuary in NY. *J. Fish Dis*. 2:313-319. Keywords: Hudson River, New York, estuary, hepatomas, liver cancer, adult, Atlantic tomcod.

Smith, C.L. 1985. The Inland Fishes of New York State. Albany, NY: New York State Department of Environmental Conservation; 522 p. Keywords: New York, Hudson River.

Smith, C.L. 1988. Introduction. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 1-4. Keywords: Hudson River.

Smith, C.L.; Lake, T.R. 1990. Documentation of the Hudson River fish fauna. New York, NY: American Museum of Natural History; 17 p. Keywords: Hudson River.

Smith, E. 1897. The fishes of the fresh and brackish waters in the vicinity of New York City. *Proc. Linnaea Soc. NY* 9:1-51. Keywords: New York City, Hudson River, New York, fishes, fresh water, brackish water.

Smith, T.I.J.; Collins, M.R.; Kennedy, E. 1993. Identification of critical habitat requirements of shortnose sturgeon in South Carolina. [Final report.] Washington, DC: Department of the Interior, U.S. Fish and Wildlife Service; 102 p. Keywords: South Carolina, Savannah River, habitat, movements, spawning, behavior, growth, adult, shortnose sturgeon.

Smith, T.I.J.; Lamprecht, S.D.; Hall, J.W. 1990. Evaluation of tagging techniques for shortnose sturgeon and Atlantic sturgeon. *Am. Fish. Soc. Symp*. 7:134-141. Keywords: tagging techniques, mark and recapture, population, adult, shortnose sturgeon, Atlantic sturgeon.

Smith, W.G. 1980. What studies of young fish tell about fish populations. *Underwater Nat.* 12(4):9-16. Keywords: young fish, juvenile, population, early life history.

Squires, D.F. 1991. Determining the area of man-made land, New Jersey shore, lower Hudson region. [Final report.] New York, NY: Hudson River Foundation; 6 p. Keywords: Hudson River, New Jersey shore, man-made land, habitat loss, human impact.

Squires, D.F. 1992. Quantifying anthropogenic shoreline modification of the Hudson River and estuary from European contact to modern time. *Coast. Manage*. 20:343-354. Keywords: Hudson River, anthropogenic modifications, human impact, marsh habitat, wetland loss, historical shorelines, history.

St. Pierre, R.A.; Davis, J. 1972. Age, growth and mortality of the white perch, *Morone americana* (Gmelin), in the James and York Rivers. *Chesapeake Sci*. 13:272-281. Keywords: James River, York River, Chesapeake Bay, age, growth, mortality, adult, white perch.

Stained, D.M.; McCormick, J.M.; Molter, H.G. 1984. Seasonal survey of the macrobenthos of Raritan Bay. *Bull. NJ Acad. Sci*. 29:121-132. Keywords: New Jersey, Raritan Bay, Raritan River, Hudson River, seasonal, survey, macrobenthos.

Stumble, F.N.; Caracal-Ward, J.; From, S.; McGrath, R. 1989. The 1973-1974 benthic microfaunal and sediment survey of Raritan Bay: data report. *NOAA/NMFS Northeast Fish. Sci. Cent. Ref. Doc*. 89-07; 28 p. Keywords: Raritan Bay, Raritan River, Hudson River, 1973-1974, benthic microfauna, benthos, sediment, survey.

Stein, J.J.; Wilson, K.A. 1992. Blue crab (*Callinectes sapidus*) distribution and habitat utilization in the lower Hudson River and its tributaries. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the 1991 Tibor T. Polgar Fellowship Program. New York, NY: Hudson River Foundation; 24 p. Keywords: Lower Hudson River, blue crab, distribution, habitat utilization, tributary.

Steinberg, N.D. 1994. Young-of-the-year bluefish (*Pomatomus saltatrix*) consumption in the Hudson River estuary: a bioenergenic modeling approach. [M.S. thesis.] Stony Brook, NY: State University of New York; 100 p. Keywords: Hudson River, young-of-the-year, consumption, food, feeding, model, bioenergetics, estuary, bluefish.

Stepien, J.C.; Malone, T.C.; Chervin, M.B. 1981. Copepod communities in the estuary and coastal plume of the Hudson River. *Estuar. Coast. Shelf Sci*. 13:185-195. Keywords: Hudson River, New York, estuary, coast, plume, copepod, community.

Stevens, D.E. 1977. Striped bass (*Morone saxatilis*) year class strength in relation to river flow in the Sacramento-San Joaquin estuary, California. *Trans. Am. Fish. Soc*. 106:34-42. Keywords: Sacramento-San Joaquin estuary, California, year class strength, river flow, estuary, young, striped bass.

Stevenson, D.K.; Knowles, R.L. 1988. Physical characterization of herring egg beds on the eastern Maine coast. *In*:

Babb, I; DeLuca, M., eds. Benthic productivity and marine resources of the Gulf of Maine. Washington, DC: U.S. Department of Commerce, *Natl. Undersea Res. Rep.* 88-3. Keywords: Gulf of Maine, Maine, characteristics, herring, egg, benthos.

Stevenson, K.A.; Armstrong, R.; Schell, W.R. 1986. Chronological determination of mercury, lead, and cadmium in two Hudson River freshwater tidal marshes. *In*: Cooper, J.C., ed. Polgar Fellowship report of the Hudson River National Estuarine Sanctuary Program, 1985. New York, NY: Hudson River Foundation. Keywords: Hudson River, New York, chronology, mercury, lead, cadmium, freshwater, tidal marsh, marsh.

Stevenson, R.A., Jr. 1958. A biology of the anchovies, *Anchoa mitchilli mitchilli* Cuvier and Valenciennes 1848 and *Anchoa hepsetus hepsetus* Linnaeus 1758. [M.S. thesis.] Newark, DE: University of Delaware; 56 p. Keywords: adult, bay anchovy.

Stier, D.J.; Crance, J.H. 1985. Habitat suitability index models and instream flow suitability curves: American shad. *U.S. Fish Wildl. Serv. Biol. Rep*. 82 (10.88); 34 p. Keywords: habitat, index models, instream flow, suitability curves, adult, American shad.

Stira, R.J.; Smith, B.A. 1976. The distribution of early life stages of American shad (*Alosa sapidissima*) in the Hudson River estuary. *In*: Proceedings of a workshop on American shad. Washington, DC: U.S. Fish Wildl. Serv./ Natl. Mar. Fish. Serv.; p. 179-189. Keywords: Hudson River, distribution, life stages, eggs, larvae. American shad.

Stone and Webster Engineering Corporation. 1975. First progress report Indian Point flume study. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, impingement, entrainment, powerplant, estuary, egg, larva, juvenile, adult, striped bass.

Stone, H.H.; Daborn, G.R. 1987. Diet of alewives, *Alosa pseudoharengus* and blueback herring, *Alosa aestivalis* (Pisces: Clupeidae) in Minas Basin, Nova Scotia, a turbid, macrotidal estuary. *Environ. Biol. Fishes* 19:55-67. Keywords: Minas Basin, Nova Scotia, diet, food, turbidity, macrotidal estuary, tide, adult, alewife, blueback herring.

Storm, P.C.; Heffner, R.L. 1976. A comparison of phytoplankton abundance, chlorophyll a and water quality facts in the Hudson River and its tributaries. *In*: Hudson River Ecology, 4th symposium. New Paltz, NY: Hudson River Environmental Society. Keywords: Hudson River, New York, tributary, phytoplankton, abundance, chlorophyll a, water quality.

Strand, I.E.; Norton, V.J.; Adriance, J.G. 1980. Economic aspects of commercial striped bass harvest. *In*: Clepper, H., ed. Proceedings, 5th Annual Marine Recreational Fisheries Symposium. Washington, DC: Sports Fishing Institute; p. 51-62. Keywords: harvest, fishery, economics, commercial fishing, adult, striped bass.

Strayer, D. 1987. Ecology and zoogeography of the freshwater mollusks of the Hudson River basin. *Malacol. Rev*. 20:1-68. Keywords: Hudson River, New York, ecology, zoogeography, freshwater mollusks, river basin.

Strayer, D. 1987. The invertebrate fauna of groundwater discharges in the mid-Hudson valley. [Final report.] New York, NY: Hudson River Foundation; 18 p. Keywords: Hudson River, invertebrates, groundwater.

Strayer, D.L.; Hunter, D.C.; Smith, L.C.; Borg, C.K. 1994. Distribution, abundance, and roles of freshwater clams (Bivalvia:Unionidae) in the freshwater tidal Hudson River. *Freshw. Biol*. 31:239-248. Keywords: Hudson River, freshwater clams.

Stross, R.G.; Sokol, R.C. 1989. Runoff and flocculation modify underwater light environment of the Hudson River estuary. *Estuar. Coast. Shelf Sci*. 29:305-316. Keywords: Hudson River, New York, runoff, flocculation, light, underwater environment, estuary.

Summers, J.K.; Polgar, T.T.; Tarr, J.A.; Rose, K.A.; Heimbuch, D.G.; McCurley, J.; Cummins, R.A.; Johnson, G.F.; Yetman, K.T.; DiNardo, G.T. 1985. Reconstruction of long-term time series for commercial fisheries abundance and estuarine pollution loading. *Estuaries* 8:114-124. Keywords: long-term time series, commercial, fishery, abundance, estuarine, pollution, loading.

Sykes, J.E.; Lehman, B.A. 1957. Past and present Delaware River shad fishery and considerations for its future. *U.S. Fish Wildl. Serv. Res. Rep.* 46; 25 p. Keywords: Delaware River, fishery, adult, American shad.

Talbot, G.B. 1954. Factors associated with fluctuations in abundance of Hudson River shad. *U.S. Fish Wildl. Serv. Fish. Bull.* 58(142):473-490. Keywords: Hudson River, abundance, adult, American shad.

Talbot, G.B.; Sykes, J.E. 1958. Atlantic coast migration of American shad. *U.S. Fish Wildl. Serv. Fish. Bull.* 58(142):473-490. Keywords: migration, adult, American shad.

Tao, Y.; Hodson, R.G.; Sullivan, C.V. 1991. Vitellogenin and vitellogenesis in striped bass, *Morone saxatilis*. *Am. Zool.* 31:41A. Keywords: vitellogenin, vitellogenesis, egg, striped bass.

Tarr, J.T.; McCurley, J.; Jacobson, C.; McCauley, K.; Stevens, D. 1985. Pollution trends in five estuaries, 1880-1980, the Potomac, the Delaware, the Hudson-Raritan, the Connecticut, the Narragansett. [Unpublished report.] Pittsburgh, PA: Carnegie Mellon University. Keywords: Potomac River, Washington, D.C., Maryland, Delaware River, Delaware, Hudson River, New York, Raritan River, New York, Connecticut River, Connecticut, Massachusetts, New Hampshire, Vermont, Narragansett River, Rhode Island, estuary, pollution, 1880-1980.

Taub, S.H. 1966. Some aspects of the life history of the white perch, *Roccus americana* (Gmelin), in Quabbin Reservoir, Massachusetts. [M.S. thesis.] Amherst, MA: University of Massachusetts; 63 p. Keywords: Quabbin Reservoir, Massachusetts, life history, adult, white perch.

Taub, S.H. 1969. Fecundity of the white perch. *Prog. Fish-Cult.* 31:166-168. Keywords: fecundity, adult, white perch.

Taubert, B.D. 1980. Reproduction of shortnose sturgeon (*Acipenser brevirostrum*) in Holyoke Pool of Connecticut River, Massachusetts. *Copeia* 1980:114-117. Keywords: Holyoke Pool, Connecticut River, Massachusetts, reproduction, adult, shortnose sturgeon.

Taubert, B.D.; Dadswell, M.J. 1980. Description of some larval shortnose sturgeon (*Acipenser brevirostrum*) in Holyoke Pool of Connecticut River, Massachusetts and the Saint John River, New Brunswick, Canada. *Can. J. Zool.* 58:1125-1128. Keywords: Holyoke Pool, Connecticut River, Massachusetts, Saint John River, New Brunswick, Canada, description, larva, shortnose sturgeon.

Taubert, B.D.; Tranquilli, J. 1980. Use of daily rings in otoliths of largemouth bass and threadfin shad to determine age, growth, and time of spawning. *Prepared for*: 110th Annual Meeting, American Fisheries Society, Louisville, KY. Keywords: otoliths, age, growth, spawning, threadfin shad, adult, largemouth bass, threadfin shad.

Tebo, L.B., Jr.; McCoy, E.G. 1964. Effect of sea-water concentration on the reproduction and survival of largemouth bass and bluegills. *Prog. Fish-Cult.* 26:9-106. Keywords: salinity, sea-water, reproduction, survival, bluegill, adult, largemouth bass.

Texas Instruments, Inc. 1974. Hudson River ecological study in the area of Indian Point. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, Indian Point, ecology.

Texas Instruments, Inc. 1975. Final report of the synoptic subpopulation analysis: Phase I. Report on the feasibility of using innate tags to identify striped bass (*Morone saxatilis*) from various spawning rivers. [Report.] New York, NY: Consolidated Edison Company. Keywords: population, mark, tagging, spawning, adult, striped bass.

Texas Instruments, Inc. 1976. 1975 Cornwall transect data display. [Report.] New York, NY: Consolidated Edison Company; 39 p. Keywords: Hudson River, population, abundance, distribution, egg, larva, fishery, estuary, ichthyoplankton, striped bass, white perch, Atlantic tomcod.

Texas Instruments, Inc. 1976. Hudson River ecological study in the area of Indian Point: thermal effects report. [Report.] New York, NY: Consolidated Edison Company. Keywords: Indian Point, Hudson River, New York, ecology, thermal effects, temperature.

Texas Instruments, Inc. 1976. Predation by bluefish in the lower Hudson River. [Report.] New York, NY: Consolidated Edison Company; 23 p. Keywords: Hudson River, New York, lower Hudson River, predation, mortality, adult, bluefish, striped bass.

Texas Instruments, Inc. 1976. Report on the relative contribution of Hudson River striped bass to the Atlantic coastal fishery. [Report.] New York, NY: Consolidated Edison Company; 101 p. Keywords: Hudson River, New York, Atlantic Ocean, fishery, coastal fishery, stock, estuary, adult, striped bass.

Texas Instruments, Inc. 1977. 1974 year class report for the multi-plant impact study of the Hudson River. [Report.] New York, NY: Consolidated Edison Company; 250 p. Keywords: Hudson River, power plant, population, life history, impingement, entrainment, eggs, larva, juvenile, striped bass, white perch, Atlantic tomcod.

Texas Instruments, Inc. 1977. 1976 fisheries data display. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, 1976, fishery.

Texas Instruments, Inc. 1977. 1976 ichthyoplankton data display. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, 1976, ichthyoplankton.

Texas Instruments, Inc. 1978. 1975 year class report for the multi-plant impact study of the Hudson River. [Report.] New York, NY: Consolidated Edison Company; 450 p. Keywords: Hudson River, power plant, population, life history, impingement, entrainment, eggs, larva, juvenile, striped bass, white perch, Atlantic tomcod.

Texas Instruments, Inc. 1978. 1977 fisheries data display. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, 1977, fishery.

Texas Instruments, Inc. 1978. 1977 ichthyoplankton data display. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, 1977, ichthyoplankton.

Texas Instruments, Inc. 1978. Catch efficiency of 100-ft (30-m) beach seines for estimating density of young of the year striped bass and white perch in the shore zone of the Hudson River estuary. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, young of the year, population, abundance, age, estuary, fishery, striped bass, white perch.

Texas Instruments, Inc. 1979. 1976 year class report for the multi-plant impact study of the Hudson River estuary. [Report.] New York, NY: Consolidated Edison Company; 650 p. Keywords: Hudson River, New York, 1976, year class report, power plants, impact study, estuary, egg, larva, juvenile, adult, striped bass, white perch, Atlantic tomcod.

Texas Instruments, Inc. 1979. 1977 year class report for the multi-plant impact study of the Hudson River. [Report.] New York, NY: Consolidated Edison Company of New York; 850 p. Keywords: Hudson River, power plant, population, life history, impingement, entrainment, eggs, larva, juvenile, striped bass, white perch, Atlantic tomcod.

Texas Instruments, Inc. 1979. 1978 water quality data display. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, 1978, water quality.

Texas Instruments, Inc. 1979. Efficiency of 100-ft (30-m) beach seines for estimating shore zone densities at night of juvenile striped bass, juvenile white perch and yearling and older (<150 mm) white perch. [Report.] New York, NY: Consolidated Edison Company. Keywords: juvenile, immature adult, night, population, abundance, age, estuary, fishery, striped bass, white perch.

Texas Instruments, Inc. 1980. 1978 year class report for the multi-plant impact study of the Hudson River estuary. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, power plant, impact study, 1978, estuary, egg, larva, juvenile, adult, striped bass, white perch, Atlantic tomcod.

Texas Instruments, Inc. 1981. 1979 year class report for the multi-plant impact study of the Hudson River estuary. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, New York, 1979, year class report, power plants, impact study, estuary, egg, larva, juvenile, adult, striped bass, white perch, Atlantic tomcod.

Thayer, G.W.; Wolfe, D.A.; Williams, R.B. 1975. The impact of man on seagrass systems. *Am. Sci*. 63:288-296. Keywords: impact, human, seagrass systems, vegetation.

Thoits, C.F.; Mullan, J.W. 1958. A compendium of the life history and ecology of the white perch, *Morone americana* (Gmelin). *Mass. Div. Fish Game, Fish Sec., Fish. Bull*. 24; 19 p. Keywords: life history, ecology, adult, white perch.

Timmons, T.J.; Shelton, W.L.; Davies, W.D. 1980. Differential growth of largemouth bass on West Point Reservoir, Alabama and Georgia. *Trans. Am. Fish. Soc*. 109:176-186. Keywords: West Point Reservoir, Alabama, Georgia, variation, growth, initial year class, young, largemouth bass.

Tofflemire, T.J.; Hetling, L.J.; Quinn, S.O. 1979. PCB in the upper Hudson River: Sediment distributions, water interactions and dredging. *Bur. Water Res., DEC Tech. Rep*. 55; 68 p. Keywords: Hudson River, Upper Hudson River, New York, PCB, sedimentation, water interactions, water, dredging.

Townes, H.K. 1937. Studies on the food organisms of fish: a biological survey of the Lower Hudson Watershed. [Suppl. 26th Annual Report.] Albany, NY: New York State Conservation Department; p. 217-230. Keywords: Lower Hudson Watershed, Lower Hudson River, Hudson River, New York, food, feeding, fish diet, biology, survey.

Townsend, D.W.; Radtke, R.L.; Morrison, M.A.; Folsom, S.D. 1989. Recruitment implications of larval herring overwintering distributions in the Gulf of Maine, inferred using a new otolith technique. *Mar. Ecol. Prog. Ser*. 55:1-13. Keywords: Gulf of Maine, recruitment, larva, overwintering, distribution, otolith, herring.

Trent, L.; Hassler, W.W. 1968. Gill net selection, migration, size and age composition, sex ratio, harvest efficiency, and management of striped bass in the Roanoke River, North Carolina. *Chesapeake Sci.* 9:217-232. Keywords: Roanoke River, North Carolina, Chesapeake Bay, gill net, net selection, migration, size, age, sex, sex ratio, harvest efficiency, management, adult, striped bass.

Turner, J.T. 1982. The annual cycle of zooplankton on a Long Island estuary. *Estuaries* 4:261-274. Keywords: Long Island Sound, New York, annual cycle, zooplankton, estuary.

Tyus, H.M. 1974. Movements and spawning of anadromous alewives *Alosa pseudoharengus* (Wilson) at Lake Mattamuskeet, North Carolina. *Trans. Am. Fish. Soc*. 103:392-395. Keywords: Lake Mattamuskeet, North Carolina, movements, spawning, anadromous, adult, alewife.

U.S. Army Corps of Engineers and New York State Department of Transportation. 1985. Record of decision, with attached section 404(b)(1) Westway. New York, NY: U.S. Army Corps of Engineers; 107 p. Keywords: adult, environment, striped bass.

U.S. Army Corps of Engineers. 1984. Final supplemental environmental impact statement: Westside Highway Project: Vol. II. Fisheries portion. New York, NY: U.S. Army Corps of Engineers; 200 p. Keywords: Hudson River, adult, environment, striped bass.

U.S. Fish and Wildlife Service and Coastal Ecology Group of U.S. Army Corps of Engineers. 1982. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic): Vol. I. Washington, DC: U.S. Department of the Interior. Keywords: Atlantic coast, life history, habitat, adult, reproduction, young, striped bass, alewife, blueback herring, American shad, bluefish, bay anchovy.

U.S. Fish and Wildlife Service. 1997. Significant habitats and habitat complexes of the New York Bight watershed. Charlestown, RI: U.S. Fish and Wildlife Service, Southern New England-New York Bight Coastal Ecosystems Program. Keywords: Hudson River, New York Bight, habitat, management

U.S. Fish and Wildlife Service. 1981. Standards for the development of habitat suitability index models. Washington, DC: U.S. Fish and Wildlife Service; 103-ESM. Keywords: standards, habitat suitability, habitat, index models.

Ulanowicz, R.E.; Polgar, T.T. 1980. Influences of anadromous spawning behavior and optimal environmental conditions upon striped bass (*Morone saxatilis*) year-class success. *Can. J. Fish. Aquat. Sci*. 37:143-154. Keywords: anadromous, fishes, spawning, behavior, environment, year-class, adult, striped bass.

Uphoff, J.H. 1989. Environmental effects on survival of eggs, larvae, and juveniles of striped bass in the Choptank River, Maryland. *Trans. Am. Fish. Soc*. 118:251-263. Keywords: Maryland, Choptank River, eggs, larvae, juveniles, survival, environment, habitat, striped bass.

Van Den Avyle, M.J. 1973. Estimates of production of age I and age II largemouth bass in a 3-hectare reservoir. [M.S. thesis.] Ames, IA: Iowa State University; 102 p. Keywords: estimates, production, age I, age II, reservoir, young, largemouth bass.

Van Eenennaam, J.P.; Doroshov, S.I.; Moberg, G.P.; Watson, J.G.; Moore, D.S.; Linares, J. 1996. Reproductive conditions of the Atlantic sturgeon (*Acipenser oxyrhynchus*) broodstock in the Hudson River. *Estuaries* 19(4): 769-777. Keywords: Hudson River, New York, reproduction, broodstock, adult, Atlantic sturgeon.

Van Winkle, W.; Kirk, B.L.; Rust, B.W. 1979. Periodicities in Atlantic coast striped bass (*Morone saxatilis*) commercial fisheries data. *J. Fish. Res. Board Can*. 36:54-62. Keywords: Atlantic Coast, commercial fisheries, fishery, adult, striped bass.

Vaque, D.; Pace, M.L.; Findlay, S.; Lints, D. 1992. Fate of bacterial production in a heterotrophic ecosystem: grazing by protozoans and metazoans in the Hudson estuary.

Mar. Ecol. Prog. Ser. 89:155-163. Keywords: Hudson River, New York, bacteria, heterotrophic ecosystem, grazing, protozoans, metazoans, estuary.

Vaughan, D.S.; Van Winkle, W. 1982. Corrected analysis of the ability to detect reductions in year-class strength of the Hudson River white perch (*Morone americana*) population. *Can. J. Fish. Aquat. Sci*. 39:782-785. Keywords: Hudson River, year-class strength, population, young, white perch.

Versar, Inc. 1987. 1985 year class report for the Hudson River Estuary Monitoring Program: Vols. I-II. [Report.] New York, NY: Consolidated Edison Company. Keywords: Hudson River, ecology, biology, power plant, entrainment, impingement, egg, larva, juvenile, adult, striped bass, Atlantic tomcod, white perch.

Vladykov, V.D.; Wallace, D.H. 1952. Studies of the striped bass, *Roccus saxatilis* (Walbaum), with special reference to the Chesapeake Bay region during 1936-1938. *Bull. Bingham Oceanogr. Collect. Yale Univ.* 14:132-177. Keywords: Chesapeake Bay, 1936, 1937, 1938, adult, striped bass.

Von Geldern, C.E., Jr. 1971. Abundance and distribution of fingerling largemouth bass, *Micropterus salmoides*, as determined by electrofishing at Lake Nacimiento, California. *Calif. Fish Game* 57:228-245. Keywords: Lake Nacimiento, California, abundance, distribution, juvenile, largemouth bass.

Vouglitois, J.J. 1983. The ichthyofauna of Barnegat Bay, New Jersey: relationships between long term temperature fluctuations and the population dynamics and life history of temperate estuarine fishes during a five year period, 1976-1980. [M.S. thesis.] New Brunswick, NJ: Rutgers University; 304 p. Keywords: Barnegat Bay, New Jersey, relationships, ichthyofauna, fish, temperature, population, life history, estuary.

Walburg, C.H. 1956. Observations on the food and growth of juvenile American shad, *Alosa sapidissima*. *Trans. Am. Fish. Soc*. 86:302-306. Keywords: juvenile, food, growth, American shad.

Walburg, C.H. 1960. Abundance and life history of the shad, St. Johns River, Florida. *U.S. Fish Wildl. Serv. Res. Bull*. 60(177):487-501. Keywords: St. Johns River, Florida, abundance, life history, adult, American shad.

Walburg, C.H. 1963. Parent-progeny relation and estimation of optimum yield for American shad in the Connecticut River. *Trans. Am. Fish. Soc*. 92:436-439. Keywords: Connecticut River, adult, offspring, young, American shad.

Walburg, C.H.; Nichols, P.R. 1967. Biology and management of the American shad and status of the fisheries, Atlantic coast of the United States, 1960. *U.S. Fish Wildl. Serv., Spec. Sci. Rept., Fish*. 550; 105 pp. Keywords: management, biology, American shad.

Waldman, J.R.; Andreyko, H. 1993. Variation in patterns of interdigitation among supraneurals, pterygiophores, and vertebral elements diagnostic for striped bass and white perch. *Copeia* 1993:1097-1193. Keywords: Hudson River, identification, morphology, adult, larvae, striped bass, white perch.

Waldman, J.R.; Dunning, D.J.; Ross, Q.E.; Mattson, M.T. 1990. Range dynamics of Hudson River striped bass along the Atlantic Coast. *Trans. Am. Fish. Soc*. 119:910-919. Keywords: Hudson River, Atlantic coast, range, distribution, population, adult, striped bass.

Walford, L.A. 1971. Review of aquatic resources and hydrodynamic characteristics of Raritan Bay, Lower New York and Sandy Hook Bays. [Report.] Highlands, NJ: NOAA/NMFS Sandy Hook Sport Fisheries Marine Laboratory; 80 p. Keywords: New York, Raritan Bay, Raritan River, Hudson River, Lower New York Bay, Sandy Hook Bay, estuary, aquatic resources, hydrodynamic.

Wallace, D.C. 1971. Age, growth, year class strength, and survival rates of white perch, *Morone americana* (Gmelin), in the Delaware River in the vicinity of Artificial Island. *Chesapeake Sci.* 12:205-218. Keywords: Delaware River, Artificial Island, Chesapeake Bay, age, growth, year class strength, survival rates, adult, white perch.

Wallin, J.; Van Den Avyle, M.J.; Griffin, M.C. 1993. Reproduction, recruitment and habitat requirements of striped bass in the Savannah River. [Report.] 68 p. Keywords: Savannah River, Georgia, river, reproduction, recruitment, habitat requirements, nursery, juvenile, stocking, population, striped bass.

Walters, C.J.; Collie, J.S. 1988. Is research on environmental factors useful to fisheries management? *Can. J. Fish. Aquat. Sci*. 45:1848-1854. Keywords: environment, fisheries management, fishery.

Walters, C.J.; Juanes, F. 1993. Recruitment limitation as a consequence of natural selection for use of restricted feeding habitats and predation risk taking by juvenile fishes. *Can. J. Fish. Aquat. Sci*. 50:2058-2070. Keywords: recruitment, natural selection, feeding, food, habitat, predation, juvenile, fishes.

Walton, C.J. 1981. Population biology and management of the alewife (*Alosa pseudoharengus*) in Maine. [Annual report.] Keywords: Maine, population, biology, management, adult, alewife.

Walton, W.C. 1993. The invasion of the Hudson River estuary by the zebra mussel, *Dreissena polymorpha*. [M.S. thesis.] Rutgers, NJ: State University of New Jersey; 118 p. Keywords: Hudson River, New York, estuary, invasion, zebra mussel.

Walton, W.C.; Grassle, F.; Carlton, J. 1993. The invasion of the Hudson River estuary by the zebra mussel, *Dreissena polymorpha*, and its subsequent range overlap with the false dark mussel, *Mytilopsis leucophaeata*. *In*: Blair, E.A.; Waldman, J.R., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1992, Section VII. New York, NY: Hudson River Foundation; 31 p. Keywords: Hudson River, New York, introduced species, non-indigenous, estuary, range, zebra mussel, false dark mussel.

Watson, L.C. 1978. Methods for spawning and hatching Atlantic tomcod (*Microgadus tomcod*). [M.S. thesis.] Source unknown. Keywords: spawning, hatching, methods, adult, Atlantic tomcod.

Watson, L.C. 1978. Tomcod eggs: sticky or slippery. *Texas Instruments Science Services News* 4(2). Keywords: egg, Atlantic tomcod.

Watson, L.C. 1987. Spawning and hatching Atlantic tomcod. *Prog. Fish-Cult*. 49:69-71. Keywords: spawning, hatching, adult, egg, Atlantic tomcod.

Weaver, J.E. 1975. Food selectivity, feeding chronology, and energy transformation of juvenile alewife (*Alosa pseudoharengus*) in the James River near Hopewell, Virginia. [Ph.D. dissertation.] Charlottesville, VA: University of Virginia. Keywords: Hopewell, Virginia, James River, food selectivity, feeding, energy transformation, juvenile, alewife.

Weinstein, L.H., editor. 1977. An atlas of the biological resources of the Hudson River estuary. Yonkers, NY: Boyce Thompson Institute for Plant Research, Inc.; 104 p. Keywords: Hudson River, New York, atlas, biological resources, estuary.

Weinstein, M.P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfishes, Cape Fear, North Carolina. *Fish. Bull.* (*U.S.*) 77:339-357. Keywords: Cape Fear, North Carolina, shallow, marsh habitat, nursery, fishes, shellfishes.

Weinstein, M.P.; Weiss, S.L.; Walters, M.F. 1980. Multiple determinants of community structure in shallow marsh habitats, Cape Fear River estuary, North Carolina, USA. *Mar. Biol*. 58:227-243. Keywords: Cape Fear River, North Carolina, marsh habitat, community structure.

Wells, A.W.; Matousek, J.A.; Hutchinson, J.B. 1992. Abundance trends in Hudson River white perch. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 242-264. Keywords: Hudson River, abundance, trends, adult, white perch.

Wells, A.W.; Matousek, J.A.; Hutchison, J.B. 1992. Abundance trends in Hudson River white perch. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press. Keywords: Hudson River, abundance, trends, adult, white perch.

Wells, A.W.; Randall, D.M.; Dunning, D.J.; Young, J.R. 1991. Dispersal of young-of-the-year striped bass in the Hudson River. *N. Am. J. Fish. Manage*. 11(3):381-392. Keywords: Hudson River, YOY, young-of-the-year, dispersal, stocking, power plant, striped bass.

Wells, A.W.; Young, R.J. 1992. Long-term variability and predictability of Hudson River physical and chemical characteristics. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 29-58. Keywords: Hudson River.

Westin, D.T.; Rogers, B.A. 1978. Synopsis of biological data on the striped bass, *Morone saxatilis* (Walbaum). *Univ. Rhode Island. Mar. Tech. Rep*. No. 67; 153 p. Keywords: biology, adult, striped bass.

White, J.R.; Roman, M.R. 1992. Seasonal study of grazing by metazoan zooplankton in the mesohaline Chesapeake Bay. *Mar. Ecol. Prog. Ser*. 86:251-261. Keywords: Chesapeake Bay, seasonal, grazing, metazoan zooplankton, mesohaline.

Wilk, S.J. 1977. Biological and fisheries data on bluefish, *Pomatomus saltatrix* (Linnaeus). *NOAA/NMFS Sandy Hook Lab. Tech. Ser. Rep*. 11; 56 p. Keywords: biology, fishery, morphometrics, distribution, life history, bionomics, population structure, adult, bluefish.

Will, R.; Houston, L.J. 1992. Fish distribution survey of Newark Bay, New Jersey, May 1987-April 1988. *In*: Smith, C.L., ed. Estuarine Research in the 1980s: Hudson River Environmental Society, 7th Symposium on Hudson River Ecology. Albany, NY: State University of New York Press; p. 428-445. Keywords: Newark Bay, New Jersey, fish, distribution, survey.

Williams, R.O.; Bruger, G.E. 1972. Investigations of American shad in the St. Johns River. *Fla. Dept. Nat. Res., Tech. Ser*. 66; 49 p. Keywords: St. Johns River, adult, American shad.

Williams, S.C.; Simpson, H.J.; Olsen, C.R.; Bopp, R.F. 1978. Sources of heavy metals in sediments in the Hudson River estuary. *Mar. Chem*. 6:195-213. Keywords: Hudson River, New York, estuary, heavy metals sediments.

Wilson, K.A.; Able, K.W. 1992. Blue crab (*Callinectes sapidus*) habitat utilization and survival in the Hudson River. [Final report.] New York, NY: Hudson River Foundation; 60 p. Keywords: Hudson River, blue crab, habitat utilization, survival.

Winter, J.D. 1977. Summer home range movements and habitat use by four largemouth bass in Mary Lake, Minnesota. *Trans. Am. Fish. Soc*. 106:323-330. Keywords: Mary Lake, Minnesota, summer, seasonal, home range, movements, habitat, adult, largemouth bass.

Winters, G.H.; Moores, J.A.; Chaulk, R. 1973. Northern range extension and probable spawning of gaspereau (*Alosa pseudoharengus*) in the Newfoundland area. *J. Fish. Res. Board Can.* 30:860-861. Keywords: Newfoundland, range, distribution, spawning, adult, alewife.

Wirgin, I.; Maceda, L.; Waldman, J.R.; Crittenden, R.N. 1993. Use of mitochondrial DNA polymorphisms to estimate the relative contributions of the Hudson River and Chesapeake Bay striped bass to the mixed fishery on the Atlantic Coast. *Trans. Am. Fish. Soc*. 122:669-684. Keywords: Hudson River, Chesapeake Bay, Atlantic coast, mitochondrial DNA, polymorphisms, fishery, population, adult, striped bass.

Wofsy, S.C.; McElroy, B.M.; Elkins, J.W. 1981. Transformations of nitrogen in a polluted estuary: nonlinearities in the demand for oxygen at low flow. *Science* 213:754-757. Keywords: nitrogen, pollution, estuary, oxygen.

Woodhead, P.M.J. 1991. Inventory and characterizations of habitat and fish resources, and assessment of information on toxic effects in New York-New Jersey Harbor estuary. [Report.] Washington, DC: U.S. Environmental Protection Agency; 210 p. Keywords: New York Harbor, New Jersey Harbor, estuary, inventory, habitat, fish, resources, toxic.

Woodhead, P.M.J. 1991. The fish community of New York Harbor: spatial and temporal distributions of major species. *In*: Proceedings of the Conference on the Impacts of New York Harbor Development on Aquatic Resources, 1987. New York, NY: Hudson River Foundation; p. 103-122. Keywords: New York Harbor, Hudson River, New York, fish, community, spatial, temporal, distributions.

Woodhead, P.M.J.; Rohlf, F.J.; O'Hare, M.A. 1992. The structure of the fish community and distribution of major species in the lower Hudson estuary and New York harbor. [Final report.] New York, NY: Hudson River Foundation; 178 p. Keywords: Hudson River, New York harbor, hogchoker, windowpane flounder, winter flounder, distribution, habitat, fish community, adult, bay anchovy, Atlantic tomcod, striped bass, white perch.

Woodin, S.A.; Jackson, J.B.C. 1979. Interphyletic competition among marine benthos. *Am. Zool*. 19:1029-1043. Keywords: interphyletic competition, benthos.

Woods, L.C., III; Bennett, R.O.; Sullivan, C.V. 1992. Reproduction of a domestic striped bass broodstock: monitoring maturation and hormonal induction of spawning. *Aquacult. Fish Manage*. 24:213-224. Keywords: reproduction, broodstock, maturation, hormonal induction, spawning, adult, striped bass.

Woolcott, W.S. 1955. Comparative osteology of serranid fishes of the genus *Morone* (Mitchill) and intraspecific variation in *Morone americana* (Gmelin). [Ph.D. dissertation.] Ithaca, NY: Cornell University. Keywords: Serranidae, *Morone*, osteology, adult, white perch.

Woolcott, W.S. 1962. Intraspecific variation in the white perch, *Roccus americana* (Gmelin). *Chesapeake Sci.* 3:94-113. Keywords: intraspecific variation, individual variation, adult, white perch.

Wooley, C.M.; Crateau, E.J. 1985. Movement, microhabitat, exploitation, and management of Gulf of Mexico sturgeon, Apalachicola River, Florida. *N. Am. J. Fish. Manage*. 5:590-605. Keywords: Gulf of Mexico, Apalachicola River, Florida, movement, microhabitat, exploitation, management, sturgeon subspecies, Gulf of Mexico sturgeon.

Worth, S.G. 1898. The shad. *Rept. U.S. Fish Comm*. 1897(23):133-158. Keywords: adult, American shad.

Young, B.H. 1980. A study of the striped bass in the marine district of New York State III. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, adult, striped bass.

Young, B.H. 1982. A study of the striped bass in the marine district of New York State II. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, adult, striped bass.

Young, B.H. 1986. A study of the striped bass in the marine district of New York State IV. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, adult, striped bass.

Young, B.H. 1987. A study of the striped bass in the marine district of New York State V. [Completion report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, adult, striped bass.

Young, B.H.; McKown, K.A. 1987. An investigation of the movements and growth of the 1985 Hudson River year class: a study of the striped bass in the marine district of New York State V. [Annual report.] Albany, NY: New York State Department of Environmental Conservation. Keywords: Hudson River, New York, investigation, movements, growth, year class, young, striped bass.

Young, B.H.; McKown, K.A.; Savona, P. 1994. A study of the striped bass in the marine district of New York VII. [Final report.] Albany, NY: NOAA/NMFS; 133 p. Keywords: Long Island, Raritan Bay, New Jersey, Point Judith, Rhode Island, young-of-the-year, adults, spawning, movements, growth, striped bass.

Young, J. 1990. Human manipulation of the historical Hudson shoreline. *In*: Waldman, J.; Blair, E., eds. Final reports of the Tibor T. Polgar Fellowship Program, 1989. New York, NY: Hudson River Foundation. Keywords: Hudson River, shoreline, human manipulation, human impact, historical.

Young, J.R.; Hoff, T.B. 1984. Age specific variation in reproductive effort in female Hudson River striped bass. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 124-133. Keywords: Hudson River, females, reproduction, age, adult, striped bass.

Young, J.R.; Hoff, T.B.; Dey, W.P.; Hoff, J.G. 1988. Management recommendations for a Hudson River Atlantic fishery based on an age-structured population model. *In*: Smith, C.L., ed. Fisheries research in the Hudson River. Albany, NY: State University of New York Press; p. 353-365. Keywords: Hudson River, fishery, management.

Young, J.R.; Klauda, R.J.; Dey, W.P. 1988. Population estimates for juvenile striped bass and white perch in the Hudson River estuary. *Am. Fish. Soc. Monogr*. 4:89-101. Keywords: Hudson River, New York, estuary, population, juvenile, striped bass, white perch.

Zeisel, W. 1988. A history of recreational fishing on the Hudson River from colonial times to 1920. [Final report.] New York, NY: Hudson River Foundation; 310 p. Keywords: Hudson River, fishery, history.

Zeisel, W. 1990. History of the tidal Hackensack River fisheries. *In*: Proceedings of the Third Annual Hackensack River Symposium, 1989. Teaneck, NJ: Fairleigh Dickenson University. Keywords: Hackensack River, fishery, history.

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