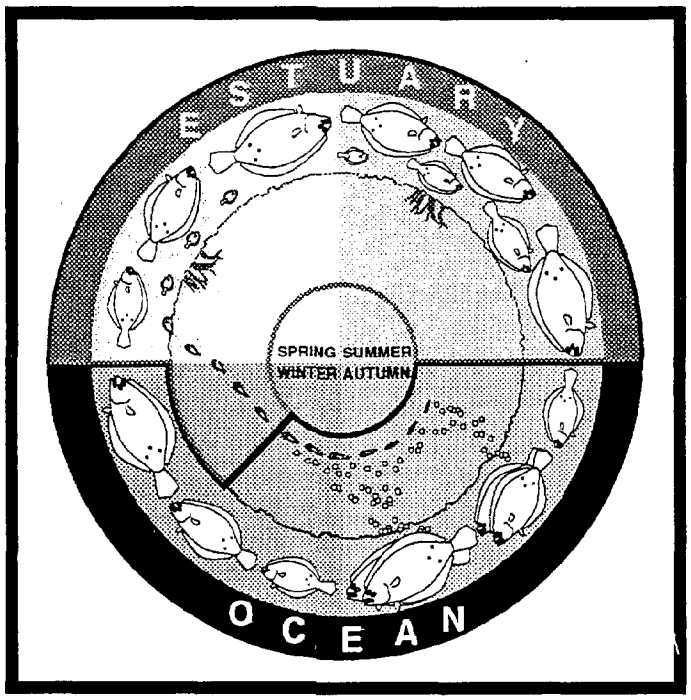
Science for Solutions

NOAA COASTAL OCEAN PROGRAM
Decision Analysis Series No. 1

SYNTHESIS OF SUMMER FLOUNDER HABITAT PARAMETERS

Kenneth W. Able
Susan C. Kaiser

May 1994



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Coastal Ocean Office

QL637
.P5A25
1994
c.1

The Decision Analysis Series has been established by NOAA's Coastal Ocean Program (COP) to present documents for coastal resource decision makers which contain analytical treatments of major issues or topics. The issues, topics, and principal investigators have been selected through an extensive peer review process. To learn more about the COP or the Decision Analysis Series, please write:

NOAA Coastal Ocean Office
1315 East-West Highway (NCOP)
Silver Spring, MD 20910

phone: 301-713-3338
fax: 301-713-4044

Cover illustration: Life History of Summer Flounder
(larger view explained in detail on inside back cover)

Science for Solutions

NOAA COASTAL OCEAN PROGRAM
Decision Analysis Series No. 1

SYNTHESIS OF SUMMER FLOUNDER HABITAT PARAMETERS

Kenneth W. Able
Susan C. Kaiser

Marine Field Station
Rutgers University
Institute of Marine and Coastal Sciences
800 Great Bay Boulevard
Tuckerton, NJ

May 1994

U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary
National Oceanic and Atmospheric Administration
D. James Baker, Under Secretary
Coastal Ocean Office
Donald Scavia, Director

LIBRARY
NOAA/CCEH
1990 HOBSON AVE.
CHAS. SC 29408-2623

QL637 .P5A25 1994 c1
OCLC # 31088683
JAN 16 1996

This publication should be cited as:

Able, Kenneth W. and Susan C. Kaiser. 1994. Synthesis of Summer Flounder Habitat Parameters. NOAA Coastal Ocean Program Decision Analysis Series No. 1. NOAA Coastal Ocean Office, Silver Spring, MD. 68 pp. + biblio. + 3 apps.

This publication does not constitute an endorsement of any commercial product or intend to be an opinion beyond scientific or other results obtained by the National Oceanic and Atmospheric Administration (NOAA). No reference shall be made to NOAA, or this publication furnished by NOAA, in any advertising or sales promotion which would indicate or imply that NOAA recommends or endorses any proprietary product mentioned herein, or which has as its purpose an interest to cause directly or indirectly the advertised product to be used or purchased because of this publication.

Note to Readers

The NOAA Coastal Ocean Program (COP) provides a focal point through which the agency, together with other organizations with responsibilities for the coastal environment and its resources, can make significant strides toward finding solutions to critical problems. By working together toward these solutions, we can ensure the sustainability of these coastal resources and allow for compatible economic development that will enhance the well-being of the Nation now and in future generations. The goals of the program parallel those of the NOAA Strategic Plan for 1995-2005.

A specific objective of COP is to provide the highest quality scientific information to coastal managers in time for critical decision making and in a format useful for these decisions. To help achieve this, COP inaugurated a program of developing documents that would synthesize information on issues that were of high priority to coastal managers. To develop such documents, a three-step process was used: 1) to compile a list of critical topics in the coastal ocean through a survey of coastal resource managers and to prioritze and select those suitable for the document series through the use of a panel of multidisciplinary technical experts; 2) to solicit proposals to do research on these topics and select principal investigators through a rigorous peer-review process; and 3) to develop peer-reviewed documents based on the winning proposals.

Seven topics and associated principal investigators were selected in the initial round. This volume, *Synthesis of Summer Flounder Habitat Parameters* by Kenneth W. Able and Susan C. Kaiser of Rutgers University, is the first document in this Decision Analysis Series to be published. Other volumes will be published over the next two years on the following topics: seagrass restoration technology, salt marsh restoration, coastal watershed restoration, restoring streams and anadromous fish habitat affected by logging, eutrophication and phytoplankton blooms, and management of cumulative coastal environmental impacts.

As with all of its products, COP is very interested in ascertaining the utility of the Decision Analysis Series particularly in regard to its application to the management decision process. Therefore, we encourage you to write, fax, call, or Internet us with your comments. Please be assured that we will appreciate these comments, either positive or negative, and that they will help us direct our future efforts. Our address and telephone and fax numbers are on the inside front cover. My Internet address is DSCAVIA@HQ.NOAA.GOV.

Donald Scavia
Director
NOAA Coastal Ocean Program

Table of Contents

LIST OF FIGURES AND TABLES v

ACKNOWLEDGMENTS ix

EXECUTIVE SUMMARY xi

CHAPTER 1:INTRODUCTION 1
- Background and Overview 1
- Scope 2

CHAPTER 2: DISTRIBUTION AND LIFE HISTORY PATTERNS 3
- Geographical Distribution 3
- General Life History 3
- Stock Identification 17

CHAPTER 3: EGGS 19
- Introduction 19
- Spatial and Temporal Distribution 19
- Temperature 19

CHAPTER 4: OFFSHORE LARVAE 21
- Introduction 21
- Spatial and Temporal Distribution 21
- Temperature 19
- Substrate 22

CHAPTER 5: ESTUARINE LARVAE 23
- Introduction 23
- Spatial and Temporal Distribution 23
- Temperature and Salinity 26
- Substrate and Behavior 26

CHAPTER 6: ESTUARINE JUVENILES 29
Introduction 29
Spatial and Temporal Distribution 29
Temperature, Salinity and Dissolved Oxygen 40
Substrate 45
Behavior 46

CHAPTER 7: OFFSHORE JUVENILES 47
Introduction 47
Spatial and Temporal Distribution 47
Temperature 51

CHAPTER 8: ESTUARINE AND OFFSHORE ADULTS 53
Introduction 53
Spatial and Temporal Distribution 53
Temperature, Salinity and Dissolved Oxygen 58
Substrate 59

CHAPTER 9: IMPLICATIONS FOR RESOURCE MANAGEMENT 61

GLOSSARY 63

APPENDICES

Appendix A.
Comprehensive Summer Flounder Bibliography A–1
Author Index A–51
Subject Index A–59

Appendix B.
List of Experts B–1

Appendix C.
User Groups C–1

List of Figures and Tables

Figures

2.1 East coast of North America location maps showing summer flounder range.

2.2 Cumulative egg distribution and abundance over northern and mid–Atlantic continental shelf.

2.3 Egg abundance by month and region over the north and mid–Atlantic continental shelf.

2.4 Monthly larval distribution and abundance over the north and mid–Atlantic continental shelf.

2.5 Larval abundance by month and region over the north and mid–Atlantic continental shelf.

2.6 Transformation stages of summer flounder.

2.7 Locations of summer flounder studies: (A) Great Bay–Little Egg Harbor, New Jersey; (B) Charleston Harbor, South Carolina; (C) Long Island Sound, New York/Connecticut; and (D) Pamlico–Albemarle sounds, North Carolina.

2.8 Cumulative length– and stage–frequency distributions for transforming larvae in two marsh creeks in Great Bay–Little Egg Harbor.

2.9 Monthly length–frequency distributions for juveniles in Great Bay–Little Egg Harbor.

2.10 Seasonal distribution on the north and mid–Atlantic continental shelf.

2.11 Synopsis of seasonal movements from tagging studies.

5.1 Seasonal variation in abundance of transforming larvae in Little Sheepshead Creek, Great Bay–Little Egg Harbor.

5.2 Seasonal variation in abundance of transforming larvae in Schooner Creek, Great Bay–Little Egg Harbor.

6.1 Monthly length–frequency distributions for juveniles in four marsh creeks in Charleston Harbor.

6.2 Monthly length–frequency distributions of juveniles and adults in Long Island Sound.

6.3 Monthly distribution and abundance of juveniles and adults in Long Island Sound.

6.4 Seasonal length–frequency distributions for juveniles and adults in Pamlico–Albemarle sounds.

6.5 Monthly length–frequency distributions for juveniles in shallow marsh habitats in Pamlico–Albemarle sounds.

6.6 Seasonal distribution and abundance of juveniles and adults in Pamlico–Albemarle sounds.

6.7 Bimonthly length–frequency distributions for juveniles in Charleston Harbor.

6.8 Juvenile abundance relative to salinity in four marsh creeks in Charleston Harbor.

6.9 Habitat–specific growth of caged juveniles in Great Bay–Little Egg Harbor.

7.1 Seasonal distribution of juveniles on the north and mid–Atlantic continental shelf.

7.2 Sampling locations for two inner continental shelf trawl surveys in the South Atlantic Bight.

7.3 Monthly length–frequency distributions for juveniles and adults on the South Atlantic Bight inner continental shelf.

8.1 Monthly distribution of adults on the north and mid–Atlantic continental shelf from the commercial fishery.

8.2 July length–frequency distributions of adults in Great Bay from the recreational fishery over a 10–year period.

Tables

6.1 Characteristics of marsh creek habitat for juveniles in Charleston Harbor.

6.2 Characteristics of marsh creek habitat for juveniles in Chesapeake Bay.

Acknowledgments

Numerous individuals and agencies contributed their time and/or resources toward the completion of this project. Special thanks go to the following individuals who provided unpublished data sets and base maps used extensively in this synthesis: M. Fahay (National Marine Fisheries Service, Sandy Hook Laboratory) for offshore egg and larval distribution data; T. Azarovitz, G. Shepherd, M. Terceiro and B. O'Gorman (National Marine Fisheries Service, Woods Hole Laboratory) for offshore adult distribution data; P. Howell and M. Johnson (Connecticut Bureau of Natural Resources – Marine Fisheries) for juvenile and adult distribution and length data; R. Jesien and C. Hocutt (University of Maryland, Horn Point Environmental Laboratory) for tagging data; L. Daniel III (Virginia Institute of Marine Sciences) for habitat data on juveniles in marsh creeks; J. Musick and J. Desfosse (Virginia Institute of Marine Sciences) for tagging data; L. Mercer and J.P. Monaghan Jr. (North Carolina Division of Marine Fisheries) for juvenile and adult distribution, length and tagging data; C. Wenner (South Carolina Marine Resources Center) for offshore South Atlantic Bight adult distribution and length data and habitat data on juveniles in marsh creeks.

The following individuals provided unpublished data that supported our work: A. Burnett and D. Byrne (New Jersey Division of Fish, Game and Wildlife); P. Carlsen (American Littoral Society); J. Casey (Maryland Department of Natural Resources); M. Fonseca (National Marine Fisheries Service, Beaufort Laboratory); T. Lynch (Rhode Island Division of Fish and Wildlife); K. McKown (New York Department of Environmental Conservation); S. Michels (Delaware Division of Fish and Wildlife); C. Powell (University of Rhode Island); C. Epifanio, K. Malloy and T. Targett (University of Delaware).

Our literature search was facilitated by unpublished bibliographies contributed by: T. Azarovitz and R. Rountree (National Marine Fisheries Service, Woods Hole Laboratory); D. Packer and A. Studholme (National Marine Fisheries Service, Sandy Hook Laboratory); R. Matheson (Florida Division of Natural Resources); J. Monaghan Jr. (North Carolina Division of Marine Fisheries).

The synthesis benefitted from discussions with and literature received from many individuals, including: J. Burke and D. Peters (National Marine Fisheries Service, Beaufort Laboratory); W. Castonguay (Massachusetts Division of Marine Fisheries); G. Gilmore (Harbor Branch Oceanographic Institute); T. Hoff (Mid–Atlantic Marine Fisheries Council); D. Hoss (National Marine Fisheries Service, Beaufort Laboratory);

Acknowledgements

J. Pafford and S. Shipman (Georgia Department of Natural Resources); A. Powell and F. Schwartz (University of North Carolina).

L. Markoff and T. Turrin, Rutgers University, Nelson Biological Laboratories Computer Lab, provided graphics support.

The following Rutgers University Marine Field Station personnel helped prepare the synthesis: E. Bender and E. Duval assisted with data entry and manipulation; A. Tonkin entered bibliographic data; B. Zlotnik provided word processing and editorial assistance. We sincerely thank all of the above and apologize to anyone inadvertently omitted. This work was supported by the National Oceanic and Atmospheric Administration Coastal Ocean Program, and Rutgers University, Institute of Marine and Coastal Sciences (IMCS). This is IMCS Contribution Number 94–14.

Executive Summary

The summer flounder, Paralichthys dentatus, is overexploited and is currently at very low levels of abundance. This is reflected in the compressed age structure of the population and the low catches in both commercial and recreational fisheries. Declining habitat quantity and quality may be contributing to these declines, however we lack a thorough understanding of the role of habitats in the population dynamics of this species. Stock structure is unresolved and current interpretations, depending on the technique and study area, suggest that there may be two or three spawning populations. If so, these stocks may have differing habitat requirements. In response to this lack of knowledge, this document summarizes and synthesizes the available information on summer flounder habitat in all life history stages (eggs, larvae, juveniles and adults) and identifies areas where further research is needed.

Several levels of investigation were conducted in order to produce this document. First, an extensive search for summer flounder habitat information was made, which included both the primary and gray literature as well as unanalyzed data. Second, state and federal fisheries biologists and resource managers in all states within the primary range of summer flounder (Massachusetts to Florida) were interviewed along with a number of fish ecologists and summer flounder experts from the academic and private sectors. Finally, information from all sources was analyzed and synthesized to form a coherent overview.

This document first presents an overview of the economic importance and current status of summer flounder (Chapter 1). It then summarizes our present state of knowledge of summer flounder distribution, life history patterns and stock identification (Chapter 2). This is followed by a synopsis of habitat requirements during each life history stage. For convenience, this is presented by general habitat as offshore eggs (Chapter 3), offshore larvae (Chapter 4), estuarine larvae (Chapter 5), estuarine juveniles (Chapter 6), offshore juveniles (Chapter 7) and estuarine and offshore adults (Chapter 8). In several instances, previously undigested data sets are analyzed to provide more detailed information, especially for estuarine juveniles. The information is then discussed in terms of its relevance to resource managers (Chapter 9).

A comprehensive bibliography on all aspects of the distribution, biology, and ecology of summer flounder (Appendix A) is provided with both an author index and a subject index for easy reference. This bibliography also serves as the primary reference for

literature cited in the text. Finally, a list of researchers who are considered experts on summer flounder (Appendix B) and a list of potential user groups of this document (Appendix C) are included.

Summer flounder occur in continental shelf and estuarine waters of the western north Atlantic from Nova Scotia (Canada) to Florida (United States). The center of abundance lies in the Middle Atlantic Bight, and due to the extensive fishery and research emphasis, our understanding of life history patterns is most complete for this portion of the range. In the Middle Atlantic Bight, temporal and spatial distribution in estuarine and offshore habitats is determined largely by temperature and salinity. Generally, adult summer flounder and older juveniles migrate seasonally in response to temperature changes, spending winters on the middle and outer continental shelf and summers on the inner continental shelf and in estuaries. Adults spawn while moving offshore in autumn and early winter. Eggs rise to near surface waters and the newly hatched larvae are planktonic and symmetrical in shape. While over the continental shelf, larvae begin transformation, the process by which the right eye migrates to the left side of the head. This is accompanied by other morphological and physiological changes as larvae prepare for settlement. During winter to early spring, transforming larvae move into estuaries where eye migration is completed and settlement to the bottom marks the beginning of the juvenile stage. In spring, many fishes that have overwintered on the continental shelf join these juveniles in estuaries. During their summer residencies, juveniles and adults are most abundant in higher salinity waters of estuaries. As winter approaches, most juveniles move offshore with adults, however some may overwinter in the deep waters of larger estuarine systems. In the South Atlantic Bight, summer flounder life history patterns have not been as thoroughly studied. In general, adults spawn on the continental shelf in autumn and winter, and transforming larvae enter estuarine nursery habitats in the spring where they settle. However, adults may predominantly use inner continental shelf waters as summer forage grounds rather than estuaries.

This synthesis indicates that temperature and dissolved oxygen are the habitat parameters of primary importance to summer flounder. Low winter temperatures are likely a source of natural mortality to transforming larvae as they enter estuaries, especially in the northern portion of their range. Low spring temperatures decrease growth rates for transforming larvae and early juveniles, and by delaying or slowing growth, may make these individuals more vulnerable to predation for longer periods of time, thus reducing survival. The presumed preference for higher salinity explains the greater abundance in the lower portions of estuaries. Low dissolved oxygen on the continental shelf and in estuaries can affect distribution and survivorship. Episodes of hypoxia or anoxia can cause habitat use patterns to change as individuals attempt to migrate away from feeding areas. These movements may concentrate individuals in a small area, making them more susceptible to fishing mortality. If migration is not

possible, natural mortality can result, which together with fishing losses can have a significant impact on local populations.

In summary, despite the economic importance of summer flounder in fisheries along the east coast of the U.S., we still lack a clear understanding of habitat requirements and this is especially true for the eggs and larvae. We know somewhat more for the juveniles and adults, although the depth of understanding varies from region to region. Due to the highly migratory nature of this species, summer flounder exploit a variety of habitats from shallow estuaries to the deep edge of the continental shelf. However, the habitats that are perhaps the most critical, estuarine nurseries, are the habitats that are most severely impacted by human activity.

As a result, we recommend that estuarine juveniles should be the focus of researchers and resource managers because: 1) juvenile growth and survival in estuarine nurseries may be especially critical to subsequent year–class strength; and 2) estuarine habitats are especially vulnerable to alteration and negative impacts that could influence habitat quantity and quality. Habitat–specific data is generally limited. Of those habitats examined, high–salinity subtidal salt marsh creeks and shallow portions of bays appear to be most important as nurseries, especially for the early juvenile stages. We therefore suggest that resource managers pay particular attention to these habitats and their maintenance in order to improve the status of summer flounder populations.

Chapter 1
Introduction

BACKGROUND AND OVERVIEW

The summer flounder, (Paralichthys dentatus), an important species in commercial and recreational fisheries on the east coast of the United States, is currently overexploited (Mid–Atlantic Fishery Management Council 1990, 1991a,b). Since implementation of the summer flounder management plan (Mid–Atlantic Fishery Management Council 1990, 1991a,b), the status has shown some improvement with about a 70% and 50% increase in commercial and recreational landings, respectively, between 1990 and 1992. However, the total reported commercial landings in 1992 (7,300 metric tons) were only about 40% of the total landings in 1979 when this fishery peaked (17,945 metric tons) and 1992 recreational landings were only about 25% of the 1983 peak for this fishery (Terceiro 1993). In addition, the most recent National Marine Fisheries Service/Northeast Fisheries Science Center fishery–independent groundfish survey indices for spring are about one–fifth of those for the mid–to–late–1970s (Mid–Atlantic Fishery Management Council 1990, 1991a,b). Along with reduced abundance, the age structure of the population is severely compressed with relatively few individuals older than three years of age (Terceiro 1993). As a result, the spawning individuals are younger, presumably less fecund than older, larger individuals, and have fewer seasons to reproduce before being harvested.

Despite the importance of summer flounder, there are significant gaps in our knowledge of the population dynamics of this species. For instance, several years of exceptionally poor recruitment throughout much of the range (Mid–Atlantic Fishery Management Council 1990, 1991a,b) suggest other factors besides fishing pressure affect summer flounder abundance, but these are poorly understood. Two major reasons why the patterns of recruitment are inadequately understood is that our knowledge of young–of–the–year habitats is poor, which may result in extremely variable young–of–the–year assessments. In addition, recent habitat–oriented studies have suggested that low temperatures encountered by juveniles in estuarine nurseries during the winter may impact both survival and subsequent year–class strength (Malloy and Targett 1991; Szedlmayer et al. 1992). These kinds of results need to be summarized so that resource managers can effectively protect or enhance important nursery habitats. Thus, the purpose of this document is: 1) to synthesize the available literature (both primary and gray) on habitat parameters and habitat use patterns of all life history stages (egg, larval, juvenile, adult) of summer flounder

throughout its range; 2) to incorporate unpublished data from federal, state and academic institutions into the synthesis; and 3) to provide a complete bibliography for all aspects of summer flounder biology.

SCOPE

For purposes of this synthesis, we define habitat as where an animal lives (Odum 1971[1]). We interpret this broadly to include general distribution of all life history stages, as well as movements and selected aspects of the biology, such as those that appear related to habitat use or impacts on habitats (anthropogenic effects). We have cautiously interpreted prior generalizations regarding summer flounder habitat, and are particularly careful not to extrapolate from general statements concerning other closely related flounders (Paralichthys spp.). Because pertinent life history information is frequently lacking, we include a brief summary of our current understanding of the salient aspects. Since different stocks or populations may have different habitat requirements or patterns of habitat use, we also briefly summarize what is known about distribution and stock identification. We recognize that we still lack important information about the habitat of summer flounder during all life history stages.

[1] Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co., Philadelphia, PA

Chapter 2
Distribution and Life History Patterns

GEOGRAPHICAL DISTRIBUTION

Summer flounder occur in continental shelf and estuarine waters of the western North Atlantic (Fig. 2.1) from Nova Scotia, Canada (Bigelow and Schroeder 1953; Scott and Scott 1988), to Florida, United States (Ginsburg 1952; Gutherz 1967; Gilbert 1986; Grimes et al. 1989). They are most abundant from Cape Cod, Massachusetts, to North Carolina (Grosslein and Azarovitz 1982). In the north, commercial and recreational catches drop in the vicinity of Rhode Island, and occurrence north of Cape Cod Bay is described as extremely rare (Bigelow and Schroeder 1953). Distribution in the southernmost part of the range is not clear partly because summer flounder are not identified to species in the commercial fisheries, which treat them largely as by-catch. Gilmore et al. (1981) list them as abundant in the Indian River Lagoon on the east coast of Florida, and Gilbert (1986) considers them to extend as far south as Sebastian Inlet, Florida.

GENERAL LIFE HISTORY

Summer flounder reproduce in the fall and perhaps into the winter. Detailed observations of the timing and location of spawning are available only for Georges Bank and the Middle Atlantic Bight (Morse 1981; Able et al. 1990; Fig. 2.1). There are no records of eggs from estuaries, but based on collections of planktonic eggs during the period from 1975 to 1985, spawning occurs during the seasonal offshore migration and is fairly equally distributed over the entire continental shelf (Fig. 2.2). Peak spawning occurs in October and November throughout the Middle Atlantic Bight and Georges Bank, although December collections are lacking from some areas (Fig. 2.3). Spawning occurs over the continental shelf in the South Atlantic Bight as well, however data are largely lacking in the existing literature (Powles and Stender 1976).

The planktonic larvae are reported over the Middle Atlantic Bight shelf but are not very abundant over Georges Bank (Fig. 2.4, 2.5). The earliest spawning and subsequent larval development occurs off eastern Long Island and on Georges Bank as early as September. By October, the larvae are primarily found on the inner continental shelf

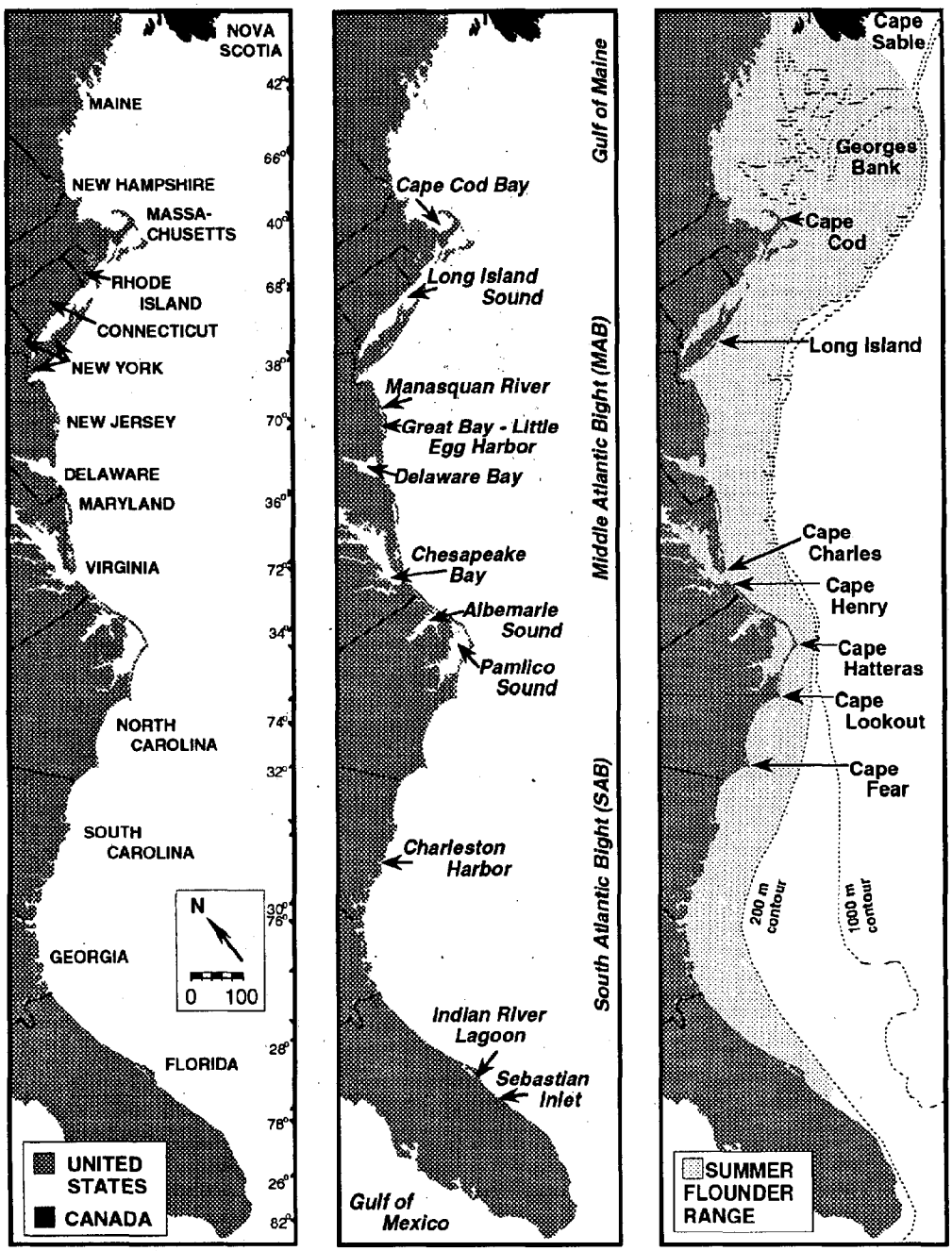


Figure 2.1. East coast of the United States and Canada with features mentioned in the text.

Distribution

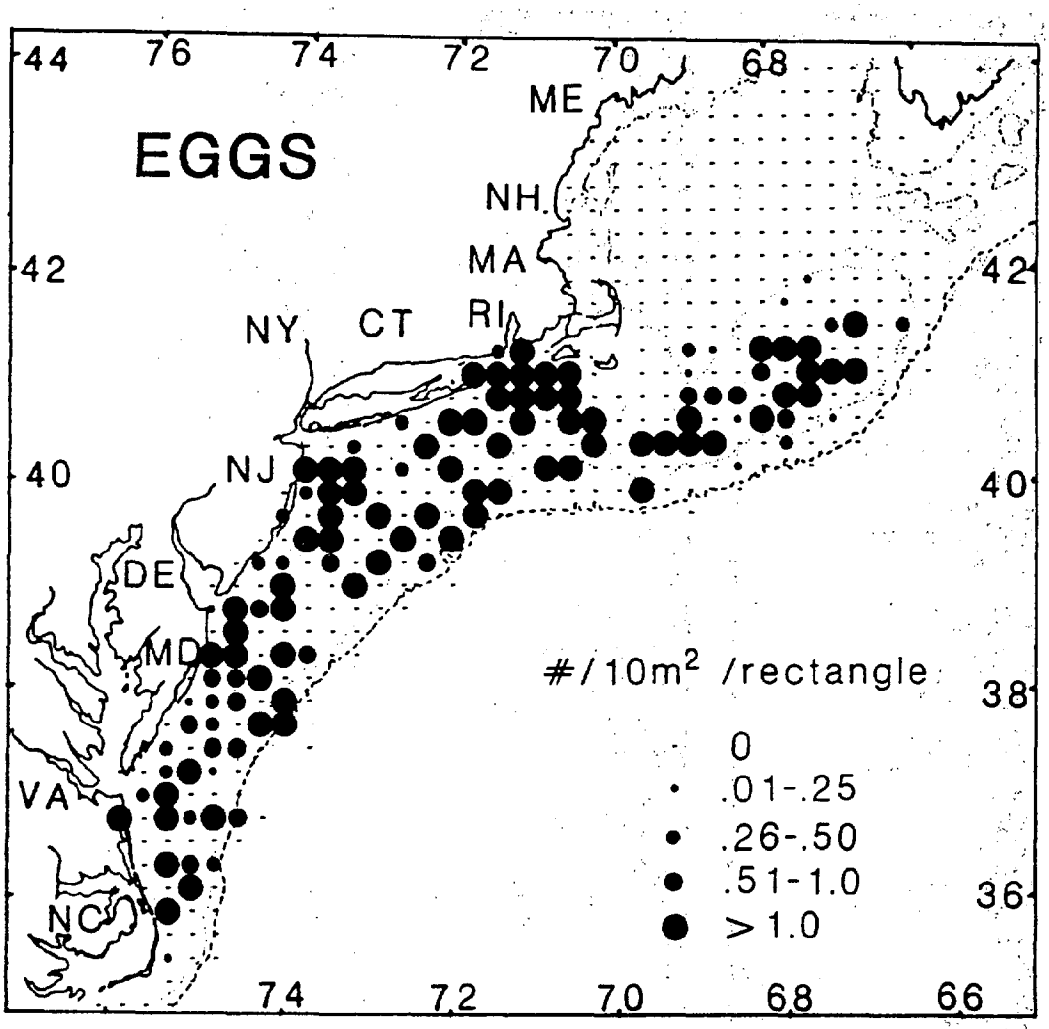


Figure 2.2. Cumulative distribution and mean abundance of summer flounder eggs from National Marine Fisheries Service (NMFS), Marine Resources Monitoring, Assessment and Prediction (MARMAP) offshore surveys during 1977-1984 (Sherman 1980, 1986). Monthly to bimonthly plankton samples were collected from Cape Sable to Cape Hatteras (Fig. 2.1) using 61 cm bongo frames (Sibunka and Silverman 1984; Morse et al. 1987). The 200 m and 1000 m contours are shown. (Figure from Able et al. 1990).

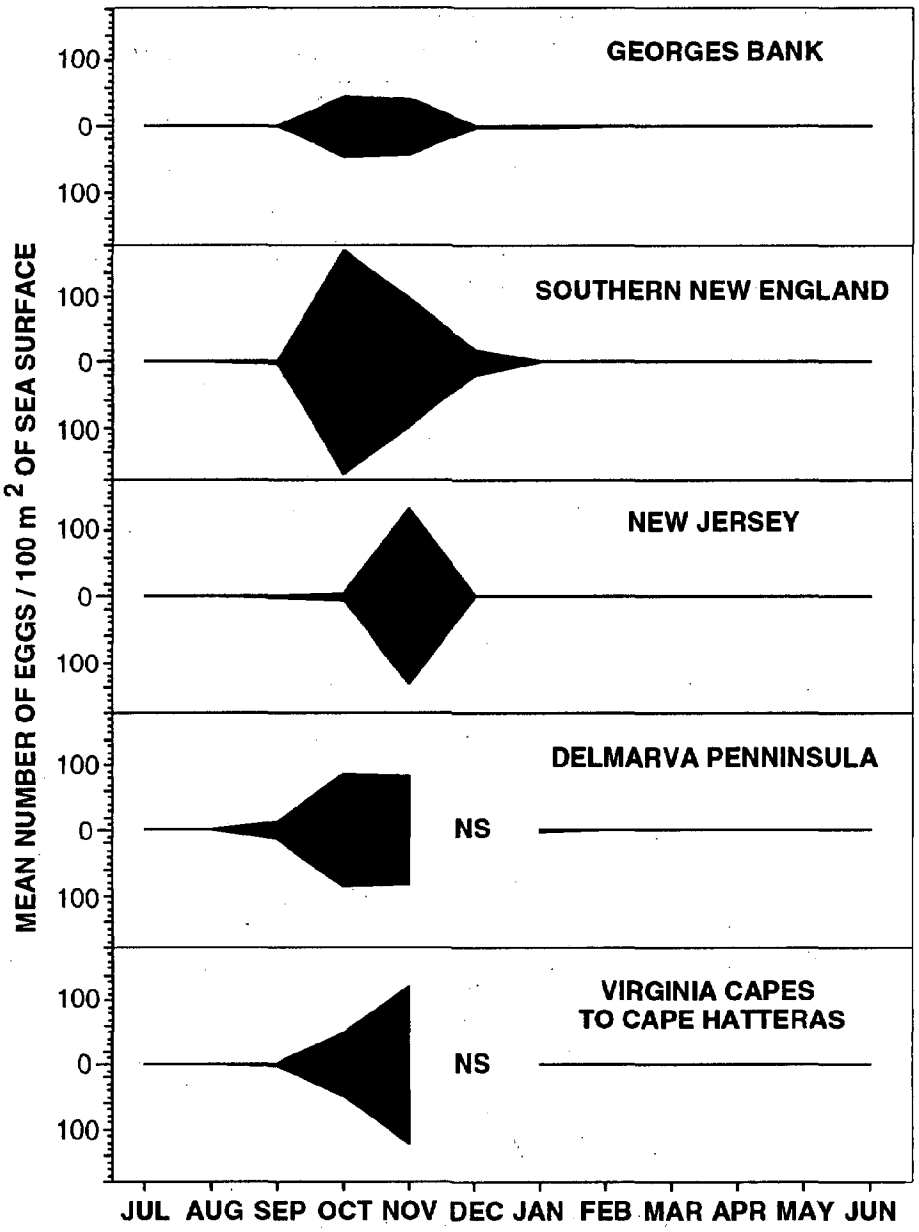


Figure 2.3. Monthly abundance of summer flounder eggs by region from National Marine Fisheries Service (NMFS), Marine Resources Monitoring, Assessment and Prediction (MARMAP), offshore surveys during 1979-81, 1984, and 1985. Monthly to bimonthly plankton samples were collected from Cape Sable to Cape Hatteras (Fig. 2.1) using 61 cm bongo frames (Sherman 1980, 1986; Sibunka and Silverman 1984; Morse et al. 1987). Southern New England is the offshore region between southeastern Cape Cod and northern coastal New Jersey. Delmarva is the peninsula between Delaware and Chesapeake bays that is part of Delaware, Maryland and Virginia. NS = no samples.

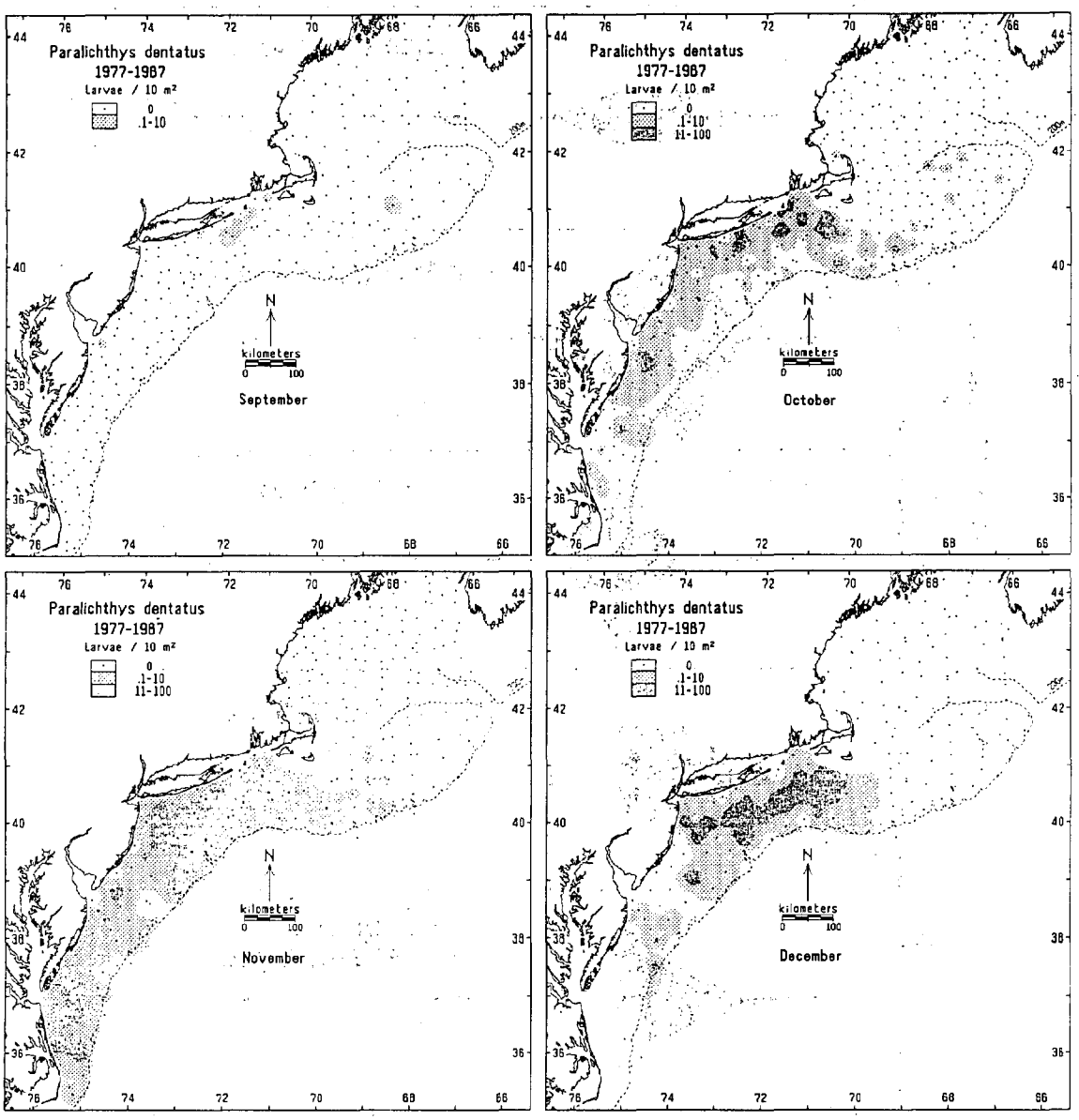


Figure 2.4. Monthly distribution and mean abundance of summer flounder larvae from National Marine Fisheries Service (NMFS), Marine Resources Monitoring, Assessment and Prediction (MARMAP) offshore surveys during 1977-1987. Monthly to bimonthly plankton samples were collected from Cape Sable to Cape Hatteras (Fig. 2.1) using 61 cm bongo frames (Sibunka and Silverman 1984; Morse et al. 1987). The 200 m contour is shown. (Figure by M.P. Fahay, National Marine Fisheries Service, Sandy Hook, New Jersey).

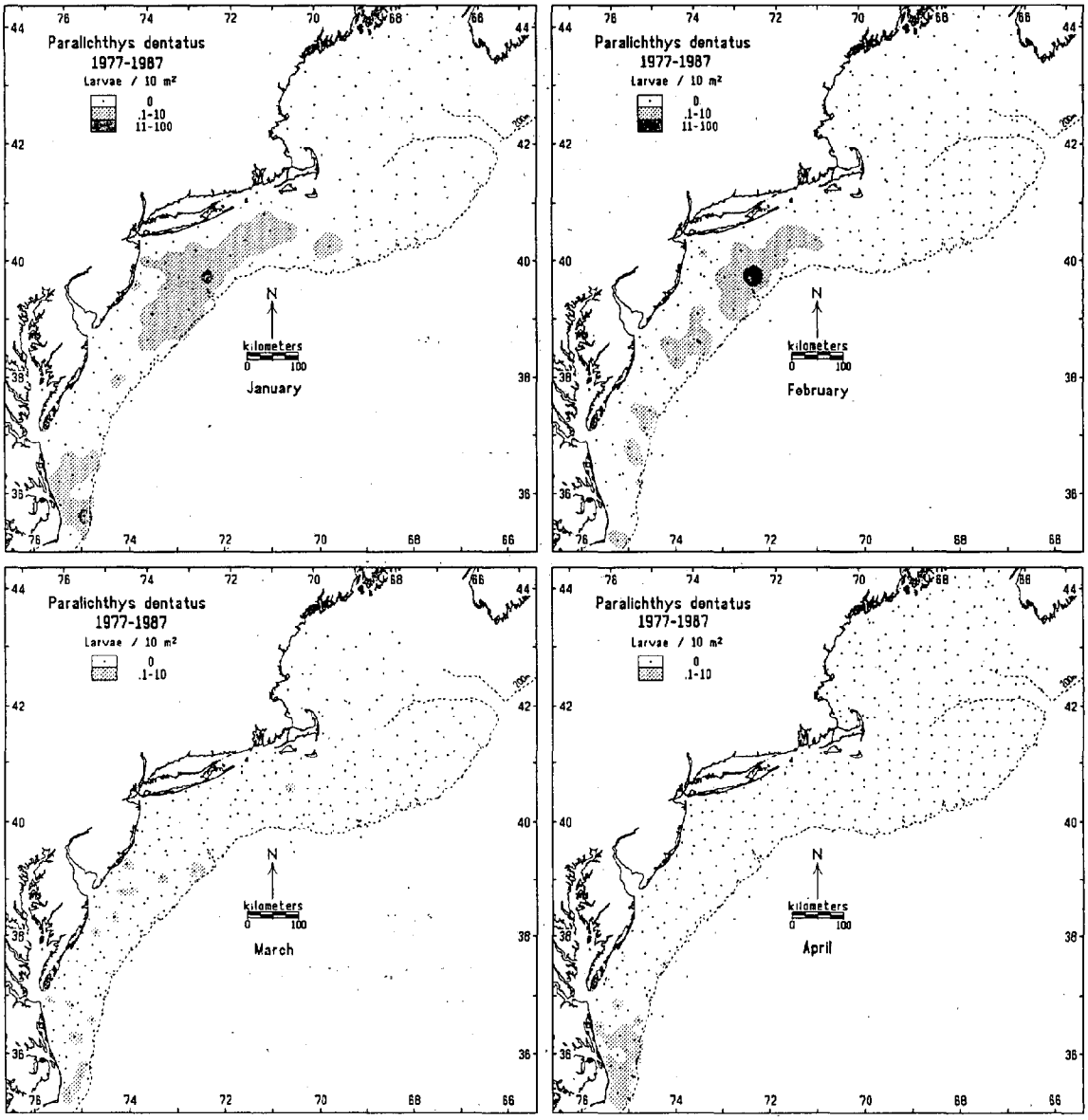


Figure 2.4 (continued).

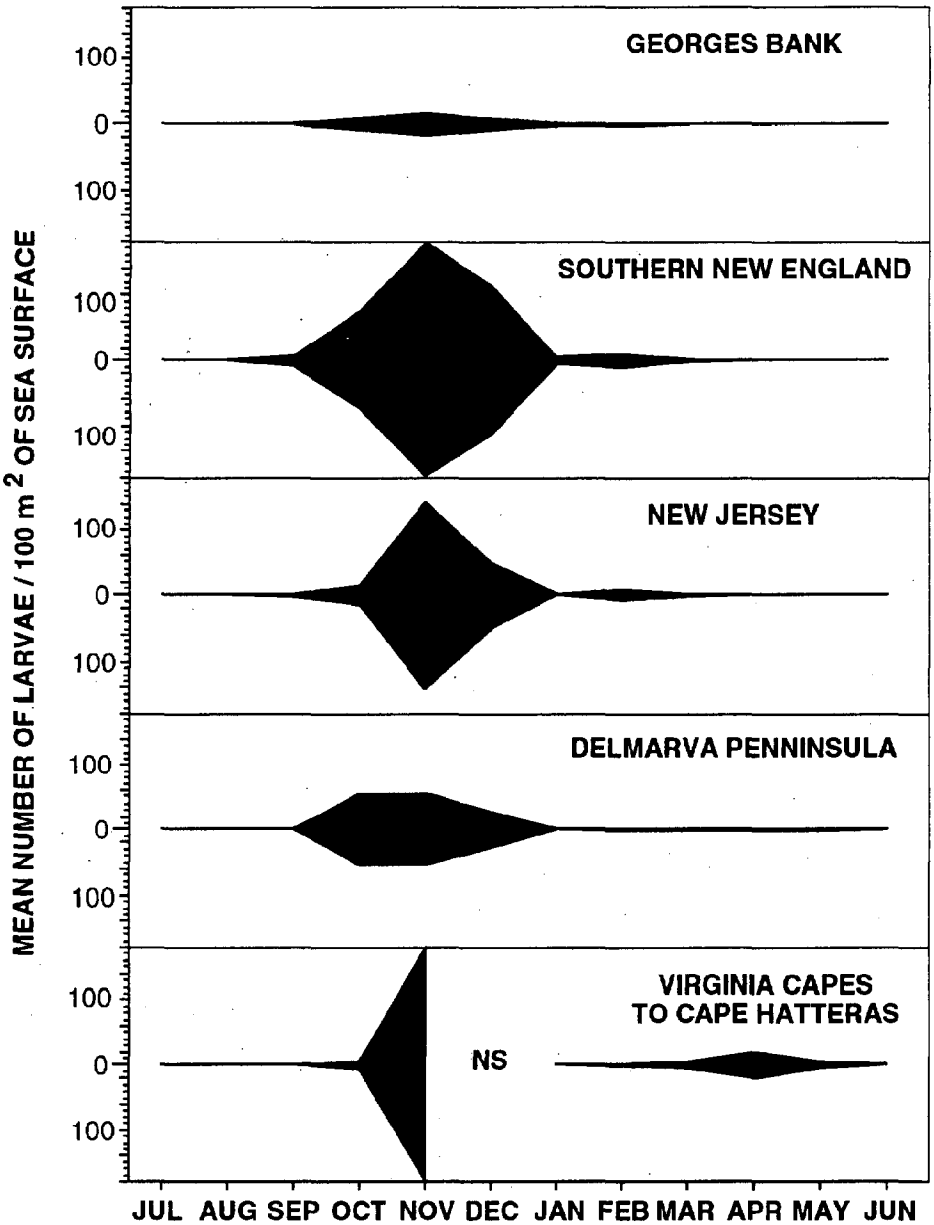


Figure 2.5. Monthly abundance of summer flounder larvae by region from National Marine Fisheries Service (NMFS), Marine Resources Monitoring, Assessment and Prediction (MARMAP), offshore surveys during 1979-81, 1984, and 1985. Monthly to bimonthly plankton samples were collected from Cape Sable to Cape Hatteras (Fig. 2.1) using 61 cm bongo frames (Sherman 1980, 1986; Sibunka and Silverman 1984; Morse et al. 1987). Southern New England is the offshore region between southeastern Cape Cod and northern coastal New Jersey. Delmarva is the peninsula between Delaware and Chesapeake bays that is part of Delaware, Maryland and Virginia. NS = no samples.

between Chesapeake Bay and Georges Bank. During November and December, when the larvae are most abundant in every region, they are fairly evenly distributed over both the inner and outer portions of the shelf. By January and February, the remaining larvae are primarily found on the middle and outer portions of the shelf. In April, the remaining larvae are concentrated off North Carolina.

As the larvae undergo eye migration during transformation (Fig. 2.6), they enter estuarine nursery areas (Burke et al. 1991; Keefe and Able 1993). Based on data from the Great Bay–Little Egg Harbor estuarine system in southern New Jersey (Fig. 2.7a), this occurs just as the right eye is migrating across the top of the head (transformation stage G through H+) at sizes of 8 – 16 mm SL [standard length] (Fig. 2.8). They then leave the water column and settle to the bottom where they begin to bury in the substrate and complete development to the juvenile stage (Keefe and Able 1994). The morphological transition from larva to juvenile lasts beyond initial settlement, making the distinction between late larva and early juvenile somewhat arbitrary. We suggest that summer flounder be considered juveniles when they have reach the I stage (Fig. 2.6), when the pectoral fin resembles that of adults, and when the scales are formed. Further, we suggest that those individuals that have not completed eye migration, pectoral fin and scale formation be referred to as transforming larvae, as Burke (1991) has done. If larvae enter the estuary when water temperatures are low, mortality can occur (Szedlmayer et al. 1992) or transformation and growth can be delayed for weeks (Keefe and Able 1994) until warmer temperatures allow continued growth and development. The ability to delay transformation may help explain the seeming disparity between a peak of spawning in October and November and the occurrence of transforming larvae in estuaries over a protracted period from October through April.

Recently settled juveniles can be found in a variety of habitats, but by summer many are found in salt marsh creeks (Szedlmayer et al. 1992; Wenner et al. 1990; Burke et al. 1991; Rountree and Able 1992a,b; Rountree and Able 1993). Growth during the summer is exceptionally fast, and at least in some estuaries can average 1.9 mm per day (Szedlmayer et al. 1992). By September or October, the individuals that were spawned the previous fall have reached 230 to 300 mm TL [total length] (Able et al. 1990; Szedlmayer et al. 1992; Fig. 2.9). These fast growth rates appear to be common to most estuarine nurseries (Almeida et al. 1992). At this time and size, many of these juveniles begin to move out of the estuaries and onto the continental shelf (Able et al. 1990; Szedlmayer and Able 1993). The adults follow a similar pattern (Fig. 2.10, 2.11), migrating in the fall to spawn over the continental shelf. They overwinter near the edge of the shelf and then migrate back into inner continental shelf and estuarine areas the following spring.

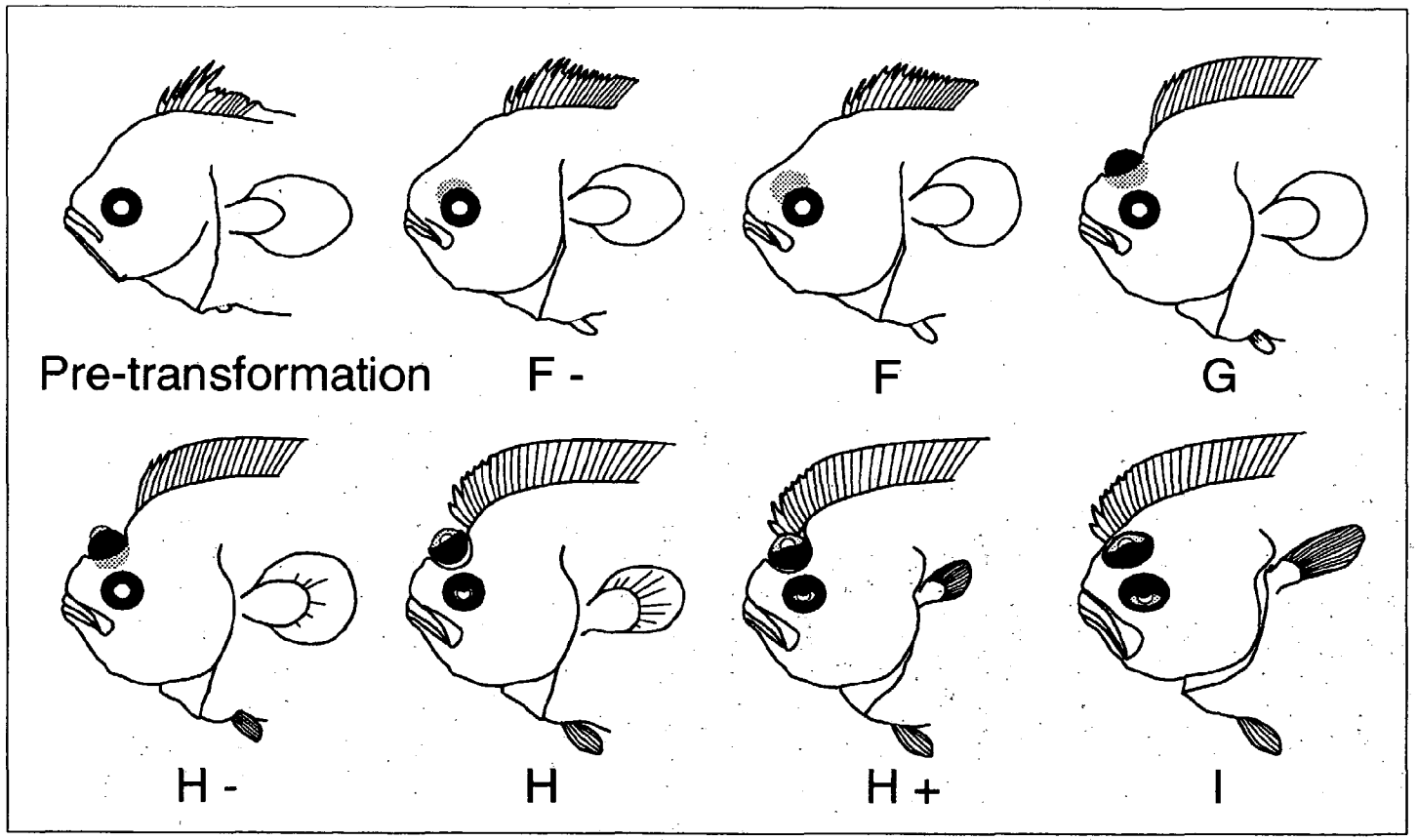


Figure 2.6. Classification of transformation stages for summer flounder based on degree of eye migration (adapted from Keefe and Able 1993). The right and left eyes are bilateral and symmetrical in pre-transformation individuals. At the first stage of transformation, F -, the eyes are bilateral but asymmetrical with the right eye just dorsal to the left eye. By Stage G, the right eye is visible from the left side of the fish. Stage H - differs from G in that the cornea of the eye is visible from the left side of the fish. At Stage H, the right eye has reached the dorsal midline. By Stage H +, the right eye has reached the left side of the head but has not yet reached its final resting place. At Stage I , the eye is set in the socket and the dorsal canal has closed.

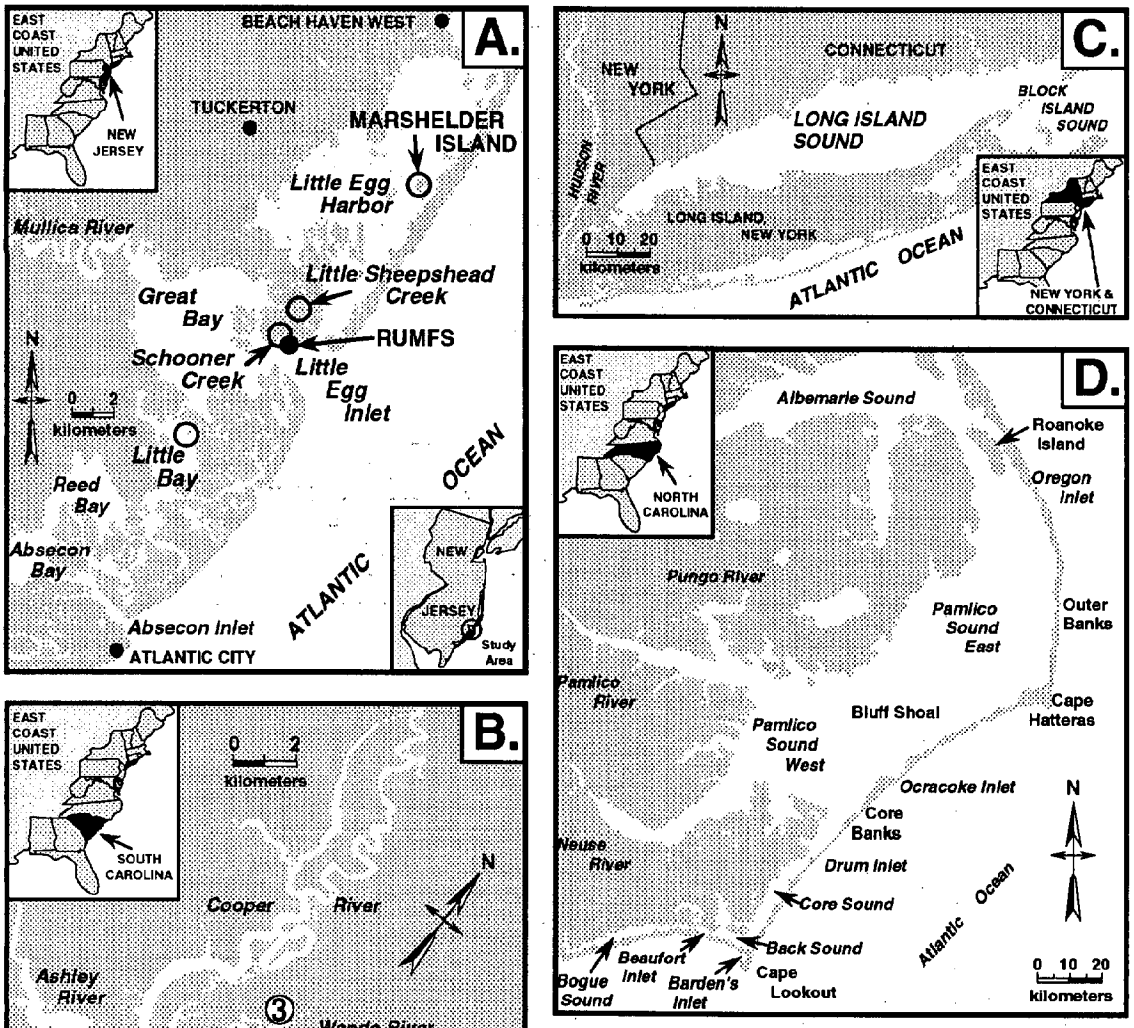


Figure 2.7. A. Great Bay - Little Egg Harbor estuarine system in southern New Jersey with the location of Rutgers University Marine Field Station (RUMFS) indicated. Study sites referred to in the text are indicated by a circle: B. Charleston Harbor estuarine system in South Carolina. Study creeks mentioned in the text are indicated by circled numbers and are as follows; 1) Pita Creek, 2) Lachicotte Creek, 3) Beresford Creek, and 4) Inlet Creek: C. Long Island Sound system bordered by New York and Connecticut: D. Pamlico-Albemarle sounds estuarine system in North Carolina.

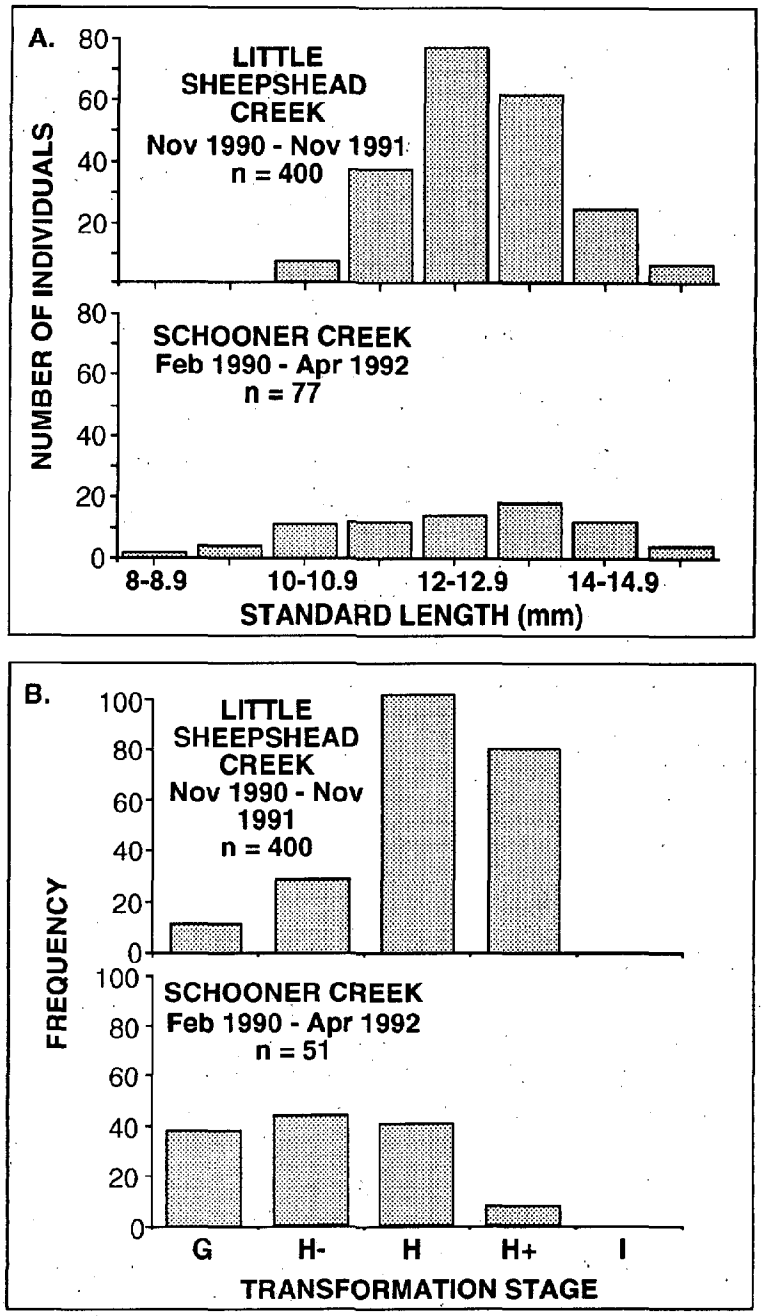


Figure 2.8. A. Length-frequency, and, B. stage-frequency distributions for transforming summer flounder larvae collected during Rutgers University Marine Field Station ichthyoplankton surveys in two Great Bay-Little Egg Harbor estuarine system marsh creeks (Fig. 2.7A). Sampling was conducted with 1.0 m and 0.5 m plankton nets with 1 mm mesh. See Fig. 2.6 for transformation stage descriptions.

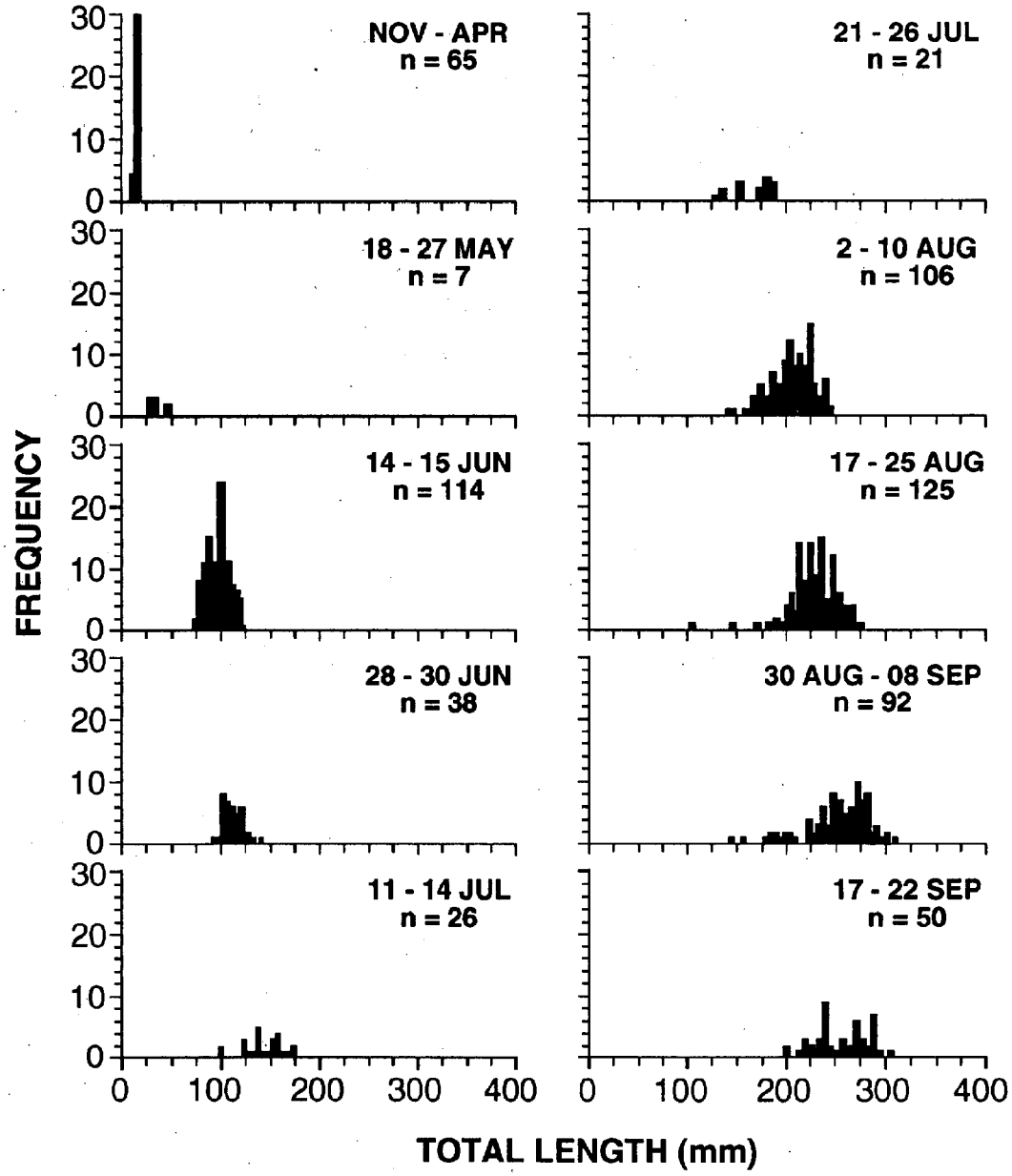


Figure 2.9. Length-frequency distributions for young-of-the-year summer flounder collected during 1988-1989 sampling in the Great Bay-Little Egg Harbor estuarine system (Fig. 2.7A; adapted from Szedlmayer et al. 1992).

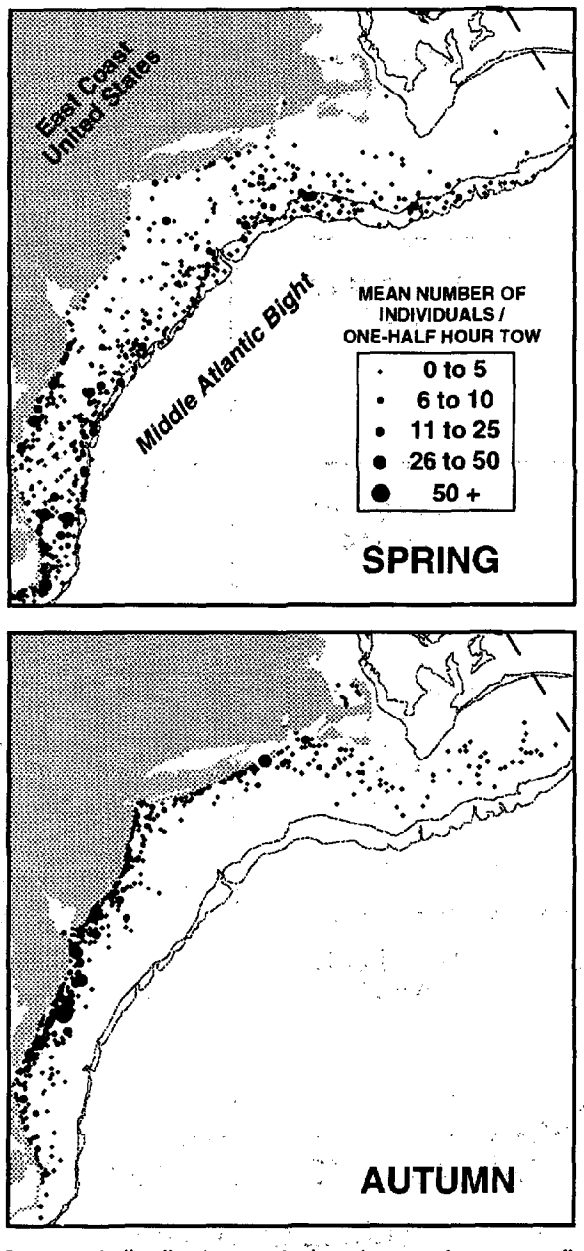


Fig. 2.10. Seasonal distribution and abundance of summer flounder from National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC) groundfish surveys for spring (1982-1990) and autumn (1981-1990). Sampling was conducted by stratified random design in the Gulf of Maine to Nova Scotia, on Georges Bank, and in the Middle Atlantic Bight (Fig. 2.1) using 0.5 hour tows of a #36 Yankee trawl with a 12.7 mm mesh liner in the codend . The 200 m and 1000 m contours are shown. (Adapted from maps provided by T. Azarovitz and B. O'Gorman, National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts).

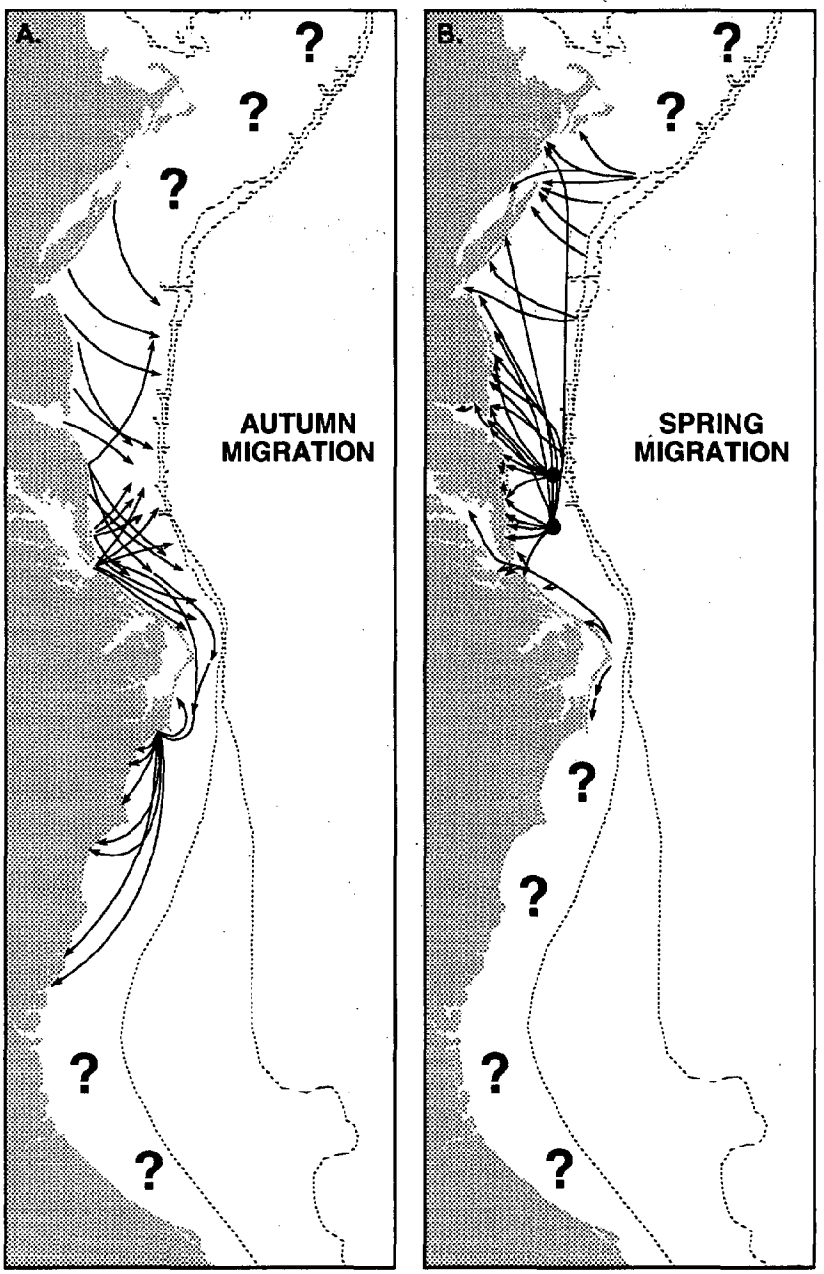


Figure 2.11. Synopsis of results of tagging studies on adult summer flounder depicting, A. offshore movement from summer feeding grounds and, B. inshore movement from overwintering grounds. ● indicates exact overwinter location was unknown; i.e., fish were tagged in an estuary in spring and were recaptured in an estuary the following spring. ? indicates no data available. Data are drawn from the following sources: Westman and Neville (1946); Hamer and Lux (1962); Poole (1962); Murawski (1970a); Scarlett (1984); Mercer et al. (1987); Desfosse et al. (1990); Jesien and Hocutt (1991).

STOCK IDENTIFICATION

There have been, and continue to be, a number of attempts to resolve the identity of summer flounder stocks with a variety of techniques. To date, there have been three basic interpretations. First, the results of some studies have suggested that there are two major stocks, one in the Middle Atlantic Bight and another in the South Atlantic Bight. Many of these studies, beginning with Ginsburg (1952), have used meristic and morphometric techniques (Smith and Daiber 1977; Wilk et al. 1980; Fogarty 1981). However, other investigators (R. Jesien and C. Hocutt, pers. comm.) have been concerned with allometric effects on the analyses by both Wilk et al. (1980) and Fogarty (1981) because northern and southern study populations were of different sizes.

A second interpretation identifies two Middle Atlantic Bight–based stocks. One stock appears to make a consistent offshore migration in the winter and return to estuaries and inner continental shelf waters in the summer. The second population appears to spend the summer in estuaries and inner continental shelf areas from Virginia to Maryland but overwinters near Cape Hatteras. This latter population has been referred to by some as the trans–Hatteras stock. This interpretation can be derived from electrophoretic (Van Housen 1984), meristic and morphometric (Delaney 1986) analyses and tagging studies (Holland 1991). Both of these potential stocks occur in Chesapeake Bay and along the eastern shore of Virginia and perhaps Maryland in the summer (J. Desfosse, J. Musick, R. Jesien, C. Hocutt, pers. comm.). A third interpretation is a combination of the previous two in that it recognizes three stocks, one from the Middle Atlantic Bight, one from the South Atlantic Bight, and the trans–Hatteras stock. Evidence to support the distinction in local populations north and south of Cape Hatteras is based on the tagging studies by the North Carolina Division of Marine Fisheries (Mercer et al. 1987; Monaghan 1992).

The resolution of these different interpretations will probably not be immediate, but because of the poor status of summer flounder populations (Mid–Atlantic Fishery Management Council 1990, 1991a,b), there is considerable focus on this problem. Current emphasis is on tagging studies in Maryland, Virginia and North Carolina. Whether or not continued study eventually resolves stock identity, two results from the tagging studies are of interest. First, studies in which fish have been tagged in estuarine areas show that there are a large number of returns to the same estuary the subsequent summer (Westman and Neville 1946; Poole 1962; Hamer and Lux 1962; Murawski 1970a; Desfosse et al. 1990; Holland 1991; Jesien and Hocutt 1991; Jesien et al. 1992; Monaghan 1992). Most of these studies are from the Middle Atlantic Bight where these fish presumably overwinter along the edge of the continental shelf or closer to shore in the south. Second, there is a trend for some fish to be found to the north and east of the original capture sites.

Chapter 3
Eggs

INTRODUCTION

Summer flounder eggs are buoyant (Smith 1973a,b), and ascend from the benthic spawning habitat on the continental shelf to upper ocean waters. Their distribution is a useful means of defining general limits of spawning.

SPATIAL AND TEMPORAL DISTRIBUTION

Summer flounder eggs have been collected over adult spawning grounds from inner to outer continental shelf waters as early as September in northern regions (Smith 1973a,b; Able et al. 1990) and as late as January (Able et al. 1990) and February (Smith 1973a,b) in southern regions (Figure 2.2, 2.3). From Georges Bank to Cape Lookout, peak concentrations occur primarily in October and November (Able et al. 1990), however Smith (1973a,b) reported a December peak off Cape Hatteras in 1965. In this region, stratified sampling to 33 m depth collected most eggs in the upper 15 m of the water column (Smith 1973a,b). Information on egg distribution south of Cape Lookout is not available.

TEMPERATURE

Vertical movement of the eggs from the bottom after spawning may expose them to as much as a 15°C change in water temperature, but the available data suggest that they can tolerate such a range. Between Cape Cod and Cape Lookout, eggs were collected in temperatures from 9.1 – 22.9°C, with most occurring in water temperatures of 13 – 17.9°C (Smith 1973a,b). Laboratory studies have shown that egg incubation time and water temperature are positively correlated between 5 – 21°C, and that in this range, normal development and hatching occurred from two to nine days (Smith and Fahay 1970; Smigielski 1975; Johns and Howell 1980; Johns et al. 1981). Further information is available from a study on the potential effects of entrainment in once–through cooling systems of power plants (Smith et al. 1979). Late embryo stage eggs were exposed to sudden increases in temperature (pre–experiment acclimation = 16°C; experimental shock exposures = 23, 26, 29, 32, and 35°C) for time periods ranging from 3 – 180 minutes at each shock level, and survivorship was high. One hundred percent mortality occurred only at 35°C for exposure times at and above 90 minutes.

Chapter 4
Offshore Larvae

INTRODUCTION

After hatching over the continental shelf, larvae are planktonic, symmetrical in form, and dependent on their yolk sacs for nutrition. Under usual temperature and salinity conditions, the yolk sac is fully absorbed within four days and feeding begins (Smigielski 1975; Johns et al. 1981). Larval development in the Middle Atlantic Bight occurs during the autumn breakdown of the thermocline and the resultant plankton bloom (Morse 1981). Transformation (Fig. 2.6) begins offshore and may be accompanied by behavioral changes that aid movement into estuaries (Burke 1991) where permanent settlement occurs.

SPATIAL AND TEMPORAL DISTRIBUTION

Offshore larval distribution (Fig. 2.4) is similar to that for eggs (Fig. 2.2). Between Georges Bank and Cape Lookout (Fig. 2.1), larvae have been collected as early as September in the northern regions (off Cape Cod) and as late as May in the south (off North Carolina) (Smith 1973a,b; Smith et al. 1975; Bolz et al. 1981; Able et al. 1990). Data on larval occurrences south of Cape Lookout are scarce, partly because identification is complicated by the presence of the larvae of two and sometimes three other species of Paralichthys (Powles and Stender 1976).

TEMPERATURE

Larvae have been collected over a wide range of water temperatures (0 – 23.1°C) between Cape Cod and Cape Lookout, with most occurring at temperatures of 9.0 – 17.9°C (Smith 1973a,b). In the laboratory, yolk sac larvae died at temperatures below 11°C, but those held above 11°C developed normally (Johns and Howell 1980; Johns et al. 1981). Studies on the potential effects of power plant cooling systems to summer flounder larvae provide further information. The ability of newly hatched yolk sac larvae to avoid predation was actually enhanced after a +10°C thermal shock (base 15.1°C; Deacutis 1978), however mortality resulted from shock exposure to 32°C (Hoss et al. 1974).

SUBSTRATE

Planktonic larvae may begin making excursions to the bottom before entering estuaries (K.W. Able, unpubl. data). Small numbers of transforming larvae have been collected with a small–mesh beam trawl during autumn 1991 from an inner continental shelf site (15 m depth) off New Jersey. These larvae were in early transformation (pre–transforming to stage H, 11.4 – 15.4 mm SL; Fig. 2.6) and had coloration typical of larvae that occurred in the plankton except some of the melanophores were stellate (expanded), which made them appear more pigmented than normal. We suspect that these larvae had settled on the substrate intermittently on their way into the adjacent estuary (Fig. 2.8) because larger, later–stage summer flounder larvae were seldom found at this site, even though large numbers of other recently settled flatfishes (Etropus, Scophthalmus) were often collected (K.W. Able, unpubl. data). There is no evidence that permanent settlement occurs on the continental shelf (Able et al. 1990), although benthic sampling with the appropriate small–mesh gear has been infrequent.

Chapter 5
Estuarine Larvae

INTRODUCTION

Summer flounder larvae entering estuaries are undergoing morphological transformation and are probably changing physiologically as well in order to cope with fluctuations of salinity in the estuary. Movement into the estuary may involve intermittent settling to test the substrate and larvae may take advantage of tidal stream transport prior to permanent settlement in the estuary. Because of the lack of developmental (stage) information in much of the literature, here we refer to all pelagic individuals as larvae and to all benthic individuals that have not achieved sexual maturity as juveniles.

SPATIAL AND TEMPORAL DISTRIBUTION

Summer flounder larvae move from offshore to shallow estuarine habitats to complete transformation and permanently settle (Keefe and Able 1993). In Middle Atlantic Bight estuaries from Long Island Sound to as far south as Chesapeake Bay, movement of larvae into estuaries has been reported to occur from October through April (Merriman and Sclar 1952; Olney 1983; Olney and Boehlert 1988; Able et al. 1990; Szedlmayer et al. 1992). The only published report of the larvae in an estuary in summer (Herman 1963) is questionable (Smith 1973a,b; Able et al. 1990). In the Great Bay–Little Egg Harbor estuarine system (Fig. 2.7a), larvae have been sampled in two marsh creeks near Little Egg Inlet, Little Sheepshead and Schooner creeks, during a five–year period (Figs. 5.1, 5.2). At Little Sheepshead Creek, temporal occurrence of larvae was sporadic within and between years. In the winters of 1989–1990, 1990–1991 and 1992–1993, most larvae occurred in January through March while few, if any, occurred in the fall. However, in the winter of 1991–1992, they were clearly more abundant in October through January. In Schooner creek, larvae were most abundant during December through March, although fall sampling did not occur in some years (Fig. 5.2). There seems to be some very general correspondence in abundance between these sites with the peaks in February 1990, February 1991, and December 1991 – February 1992 co–occurring at each creek. Earlier sampling (1962–1972) in nearby Manasquan Inlet collected all larvae during October through December (Able et al. 1990). In the South Atlantic Bight, movement into the estuary occurred from January through April with abundance peaks in February and March in North Carolina and South Carolina (Weinstein 1979; Bozeman and Dean 1980; McGovern 1986; Hettler and Chester 1990;

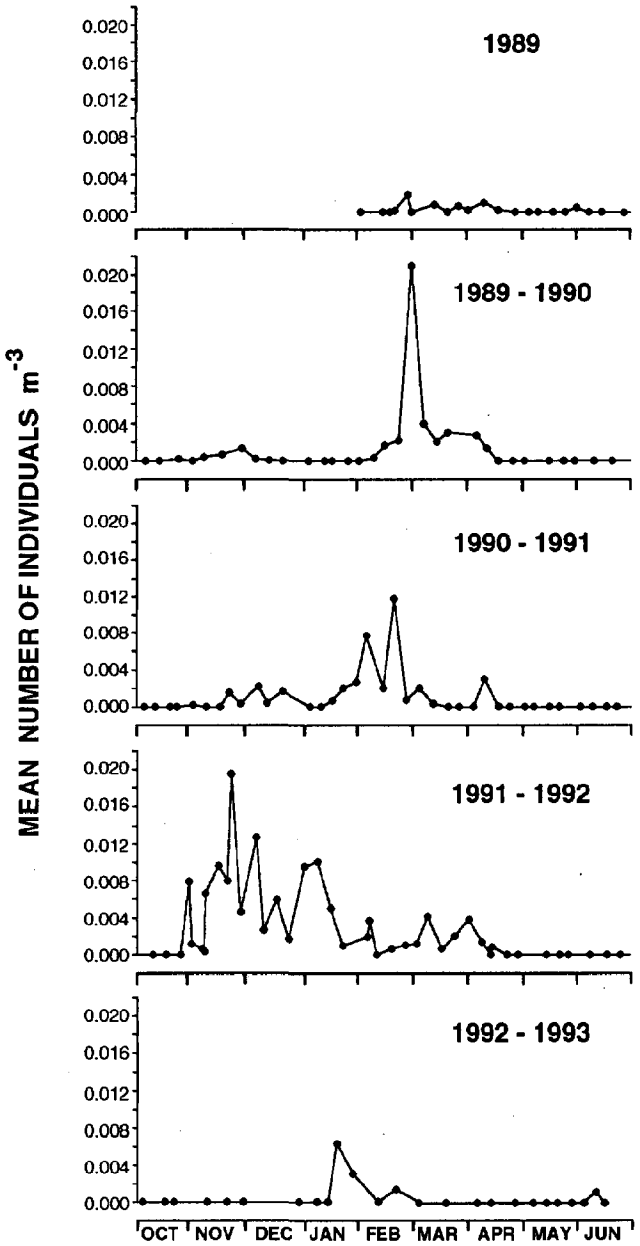


Figure 5.1. Catch per unit effort for summer flounder larvae moving into an estuary based on Rutgers University Marine Field Station ichthyoplankton survey at Little Sheepshead Creek (Fig. 2.7A) from February 1989 through May 1993. The sampling site is a broad creek that cuts through the salt marsh peninsula between Great Bay and Little Egg Harbor and recieves Atlantic Ocean water on flood tides. Two plankton nets (1 meter diameter hoop, 1 mm mesh) were deployed once a week during the night flood tide for 3 to 5 consecutive 0.5 hour sets. Volume of water strained was determined using flow meters. July, August and September were sampled but are omitted because no summer flounder were collected in these months in any year.

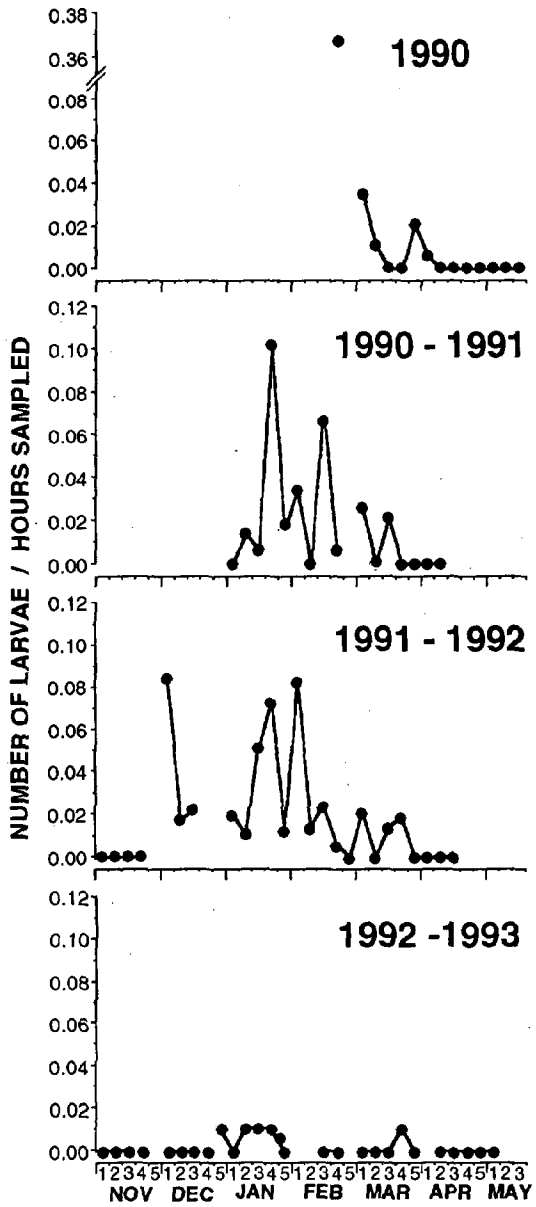


Figure 5.2. Catch per unit effort for summer flounder larvae moving into an estuary based on Rutgers University Marine Field Station ichthyoplankton survey at Schooner Creek (Fig. 2.7A) from late-February 1990 through mid-May 1993. The sampling site is a small (1 km) polyhaline marsh creek that terminates in high marsh. A stationary plankton net (0.5 m diameter hoop, 3.0 mm mesh) was fished in the lower main creek continuously (day and night) for 1 to 7, 24 hour periods each week. Data are summarized for 5 sample periods during each month where the first four periods represent 7 days and the fifth period includes the 2 or 3 days remaining in that month. Months not represented were not sampled except for several days in late October 1992 during which time no summer flounder were collected. Unconnected points indicate breaks in sampling.

McGovern and Wenner 1990; Warlen and Burke 1990; Burke et al. 1991). The consistency in transformation stages and sizes at which larvae enter Middle Atlantic Bight and South Atlantic Bight estuaries (Burke et al. 1991; Keefe and Able 1993) suggests that transforming larvae develop behaviors that first allow transport into the estuaries from offshore during early stages (Burke 1991) and then, during later stages, aid up–estuary movement to settlement habitats, perhaps by tidal stream transport as for Paralichthys spp. (Weinstein et al. 1980a). This is discussed further below (see Substrate and Behavior).

TEMPERATURE AND SALINITY

Temperature appears to be the most significant environmental factor controlling duration of transformation and thus, perhaps, timing of larval movement into estuaries. Late–development larvae have been collected in water temperatures ranging from 0 – 13°C in Middle Atlantic Bight estuaries (Olney and Boehlert 1988; Wyanski 1990; Szedlmayer et al. 1992), from 8.4 – 23.4°C in South Carolina (McGovern and Wenner 1990) and from 2 – 22°C in North Carolina (Williams and Deubler 1968a). Larvae collected in Little Sheepshead Creek (Figs. 2.7, 5.1) typically occurred at temperatures of 0 – 12.0°C. In Schooner Creek (Figs. 2.7, 5.2), larvae were collected at –2.0 – 14°C. In the laboratory, however, water temperatures less than 2°C killed transforming larvae (Szedlmayer et al. 1992). In another laboratory study of the same population, mortality of mid–transformation larvae held at 4°C was significantly greater than those held at 10°C (Keefe and Able 1993). Thus, estuarine larvae suffer increased mortality based on both the severity and duration of cold water temperatures. Further, duration of transformation was dependent on ambient water temperatures, ranging from 25 days at average temperatures of 17°C to 93 days at average temperatures of 6.6°C. Data for a South Carolina estuary suggest that a milder winter may mean earlier movement into the estuary (Cain and Dean 1976; Bozeman and Dean 1980).

Larvae moving into estuaries are reported from a wide range of salinities. In the two New Jersey marsh creeks (Figs. 5.1, 5.2), larvae occurred at salinities ranging from 20 – 33 ppt. In North Carolina, larvae were collected throughout the estuary at salinities ranging from 0.02 – 35.0 ppt (Williams and Deubler 1968a). In a South Carolina study, larvae occurred from 0 – 24.7 ppt (McGovern and Wenner 1990).

SUBSTRATE AND BEHAVIOR

The estuarine movements of transforming larvae may be accomplished by vertical migrations between pelagic and benthic habitats (Weinstein et al. 1980a,b). In North Carolina, summer flounder and other species of Paralichthys responded to diel and tidal cycles by migrating to surface waters on night flood tides (Weinstein et al. 1980a). Many others have described increased catches of transforming larvae during night

flood tides (Deubler 1958; Williams and Deubler 1968a,b; Olney and Boehlert 1988; Hettler and Chester 1990) and very high catches during new moon periods (Williams and Deubler 1968a,b; Hettler and Chester 1990). Weinstein et al. (1980a,b) suggested that this behavior allows larvae to enter shallow habitats in marsh creeks and shoals where they are retained by an ebb–tide response of seeking the substrate. More recent behavioral data support these observations and indicate that transforming larvae may test the substrate before permanent settlement. Larvae observed in the laboratory, in the absence of tidal currents, swam in the water column more often at night (Keefe and Able 1994). These larvae swam with their bodies held vertically, sank with their bodies held horizontally, and were capable of periodically resting on the substrate on their right sides even before completing eye migration (Keefe and Able 1994). Many were capable of partial burial at early stages (stages G to H–, Fig. 2.6), but were not able to bury completely until late transformation (H+). Burke (1991) suggests that these behaviors may begin to develop during transformation offshore.

Chapter 6
Estuarine Juveniles

INTRODUCTION

Permanent settlement and subsequent fast growth of juveniles occurs in estuarine nursery grounds, and recent evaluation of age data has determined that juveniles may become sexually mature as early as the end of their first summers (Able et al. 1990; Szedlmayer et al. 1992; Almeida et al. 1992). The temporal occurrence of juveniles in estuaries varies with location. In the northern part of their range, they leave during the winter and return the next spring with the adults. In the southern part of their range, they enter estuaries in the winter and may stay until the following winter.

SPATIAL AND TEMPORAL DISTRIBUTION

The best available information indicates that juveniles occur most frequently in shallow subtidal and intertidal areas in the lower portions of estuaries (Tagatz and Dudley 1961; Keup and Bayless 1964; Dahlberg 1972; Powell and Schwartz 1977), but the habitats may change with increasing size. In the South Atlantic Bight, recently settled individuals (< 25 mm TL) occur on tidal flats and in marsh creeks (Powell and Schwartz 1977; Weinstein and Brooks 1983; Burke et al. 1991). In Charleston Harbor (Fig. 2.7b), recently settled juveniles (< 25 mm TL) occurred in a number of estuarine creeks (Fig. 6.1) in the winter (January/March), which is consistent with the winter occurrence of larvae in this region (McGovern and Wenner 1990; Warlen and Burke 1990). Less is known for the Middle Atlantic Bight. In New Jersey, juveniles less than 50 mm TL are not frequently collected even though larvae are common (Able et al. 1990; Szedlmayer et al. 1992; Keefe and Able 1992). The juveniles that have been collected were in many habitats including salt marsh creeks, shallow coves and shallow portions of bays (K.W. Able, unpubl. data). In Virginia, recently settled juveniles have been collected in shallow marsh habitats on the western shore of Chesapeake Bay and the Atlantic Ocean side of Virginia's eastern shore (Wyanski 1990).

Larger juveniles (> 50 mm TL) have been collected in estuaries all along the east coast. This has been documented for New Jersey (Szedlmayer et al. 1992; Rountree and Able 1992a,b), Delaware (Smith and Daiber 1977; Malloy 1990), Maryland (Schwartz 1961a,b), Chesapeake Bay and Virginia's eastern shore (Horwitz 1978; Geer et al. 1990; Bonzek et al. 1991; Wyanski 1991; Bonzek et al. 1992), North Carolina

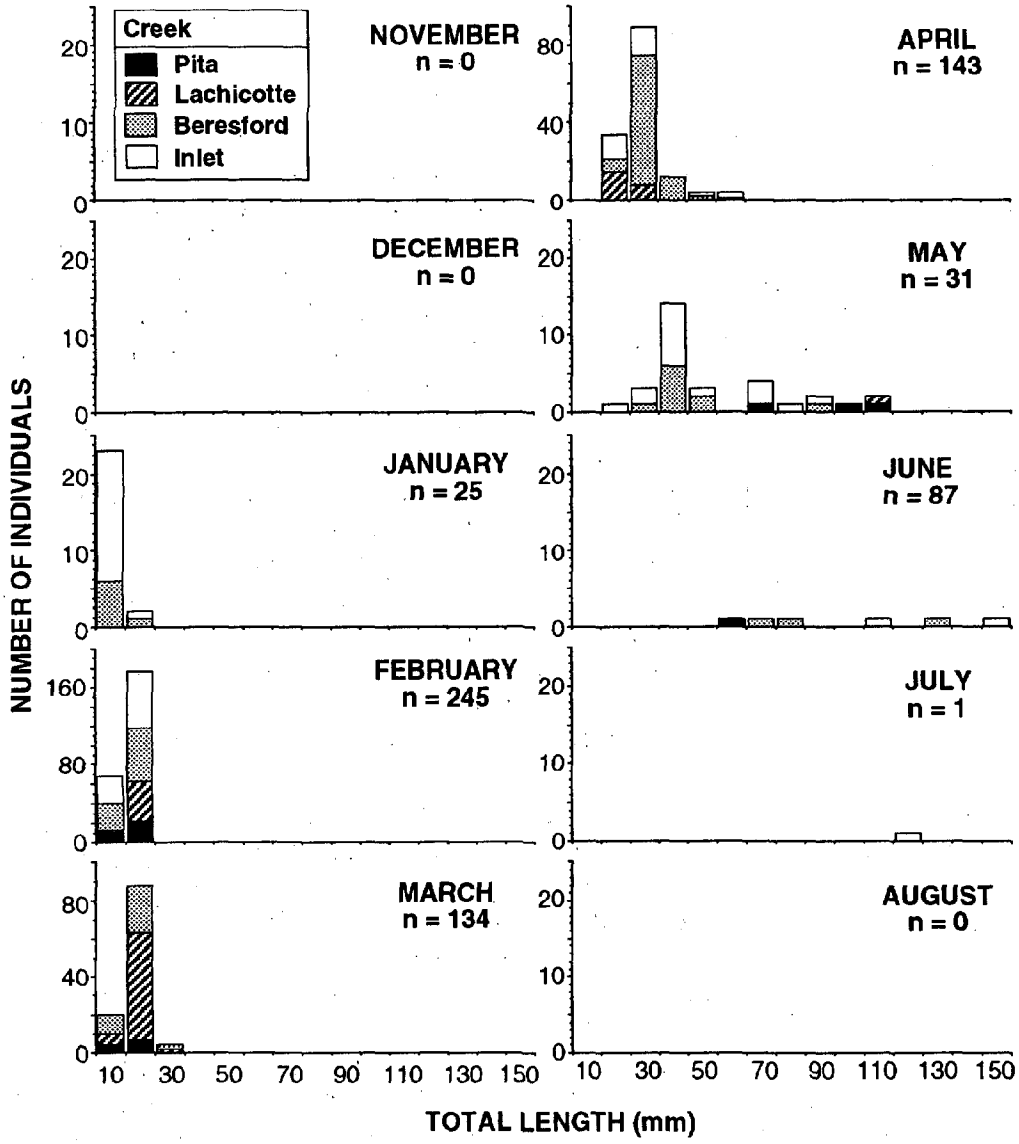


Figure 6.1. Length-frequency distributions for juvenile summer flounder collected during 1986 (November, December) -1987 from four Charleston Harbor estuarine system marsh creeks (Fig. 2.7B) using a rotenone/block net method (Wenner et al. 1990).

(Burke et al. 1991), South Carolina (Wenner et al. 1990) and Georgia (Reichert and van der Veer 1991). Additional details are available from Long Island Sound (Fig. 2.7c) where juveniles and adults, approximately 200 – 400 mm TL (Fig. 6.2), were collected throughout much of the sound (Fig. 6.3).

The temporal pattern of estuarine use by these larger juveniles varies with latitude and presumably winter water temperatures. In Long Island Sound, they appear most abundant in spring and fall, and are less abundant in mid–summer (Fig. 6.2, 6.3), when they may have moved into subestuaries of the sound. By late fall/early winter (November), they have moved offshore into the Atlantic Ocean. In Great Bay, young–of–the–year spend the summer in the estuary and begin leaving as early as August (Able et al. 1990; Rountree and Able 1992a; Szedlmayer and Able 1992; Szedlmayer et al. 1992) and this continues until November or December, when very few individuals remain. In Delaware Bay, most individuals were collected from May through September but a few were taken in every winter month in the deeper parts of the estuary (Smith and Daiber 1977). In Virginia waters of Chesapeake Bay, most collections are dominated by young–of–the–year, at least in most years (Horwitz 1978; Geer et al. 1990; Bonzek et al. 1991; Wyanski 1990; Bonzek et al. 1992). These individuals tend to be closer to the ocean in March and are more abundant farther up the bay during the summer and fall. Typically, all juveniles and adults move offshore for the winter (Hildebrand and Schroeder 1928; Musick 1972), although this pattern may vary between years. In a warm year (1991) in Chesapeake Bay, some individuals were captured during January while in other years (1989, 1990) they were absent (Horwitz 1978; Geer et al. 1990; Wyanski 1990; Bonzek et al. 1991, 1992).

For Pamlico Sound and the adjacent subestuaries in North Carolina (Fig. 2.7d), juveniles are most abundant in the summer but are collected as late as December (Fig. 6.4) and reportedly remain in the estuaries for the first 18 to 20 months of life (Powell and Schwartz 1977). The earliest collections available (March; Fig. 6.4) potentially represent individuals that overwintered. By May, the year class that entered as larvae in the winter (see above) is evident at sizes of 20 – 100 mm TL in shallow beach and marsh fringe habitats (Fig. 6.5). This same cohort is evident in trawl collections from the deeper portions of Pamlico Sound in seasonal collections from June through December (Fig. 6.4). These individuals are most abundant in the central portion of Pamlico Sound and are seldom found in the larger subestuaries (Pamlico and Neuse rivers) in the system, regardless of whether it is a year of relatively large (1987) or small (1990) abundance (Fig. 6.5). A seasonal pattern is evident with low abundance in the spring (March) and winter, and greatest abundance in summer (June and September) (Fig. 6.6). In Charleston Harbor (Fig. 2.7b), larger juveniles are evident in the harbor channels during bimonthly sampling (Fig. 6.7), thus at this latitude, a portion of the population overwinters in the estuary. In Georgia, juveniles have been collected from March through July and are most abundant in April and May (Mahood et al. 1974a,b,c,d); Shipman 1983; Music and Pafford 1984).

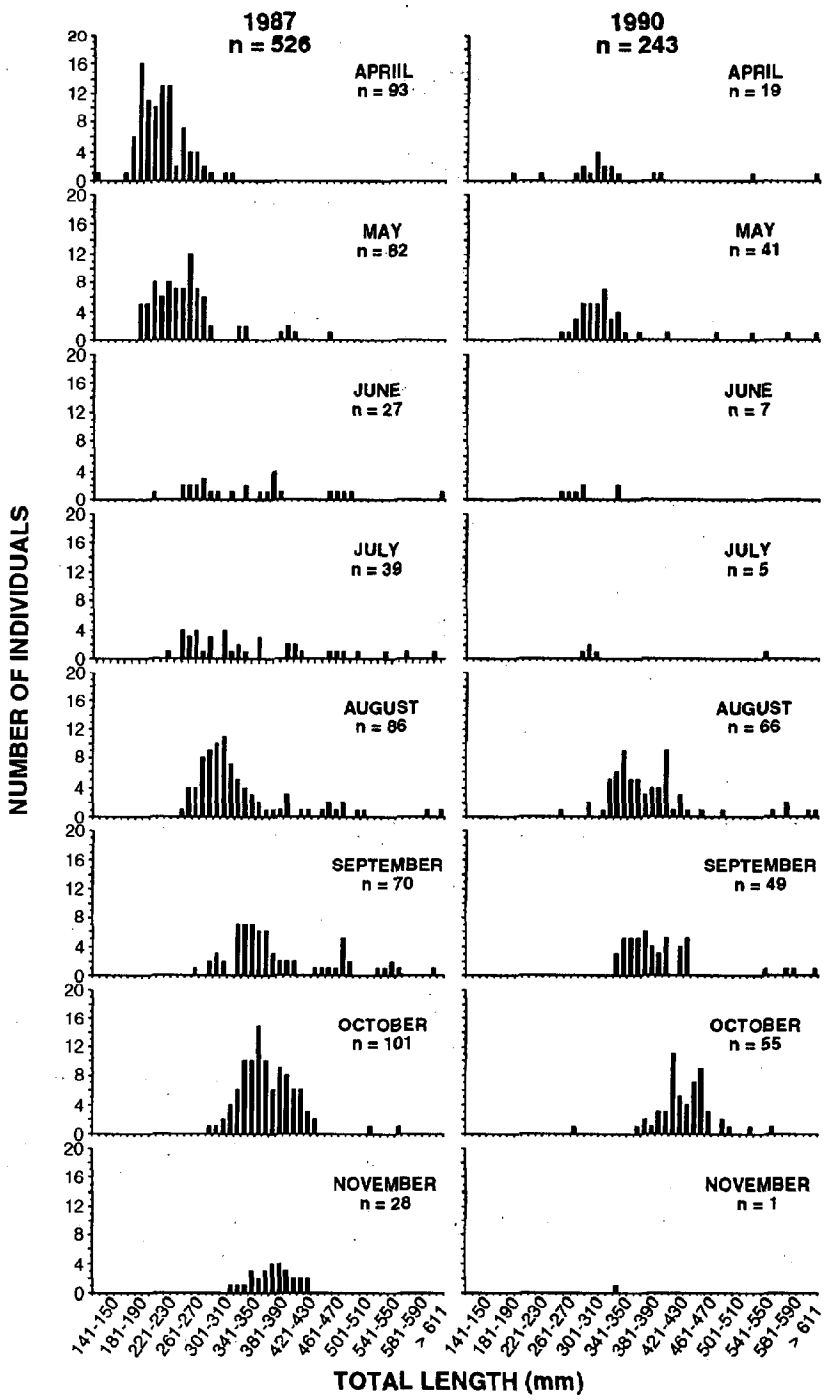


Figure 6.2. Monthly length-frequency distributions for juvenile and adult summer flounder in Long Island Sound (Fig. 2.7C) during years of high (1987) and low (1990) abundance. Collections were made with 0.5 hour tows of a 14 m otter trawl at, typically, 40 stations that were chosen by stratified random design. Data are based on the finfish surveys of the Connecticut Division of Marine Fisheries (1990a, 1990 and 1992).

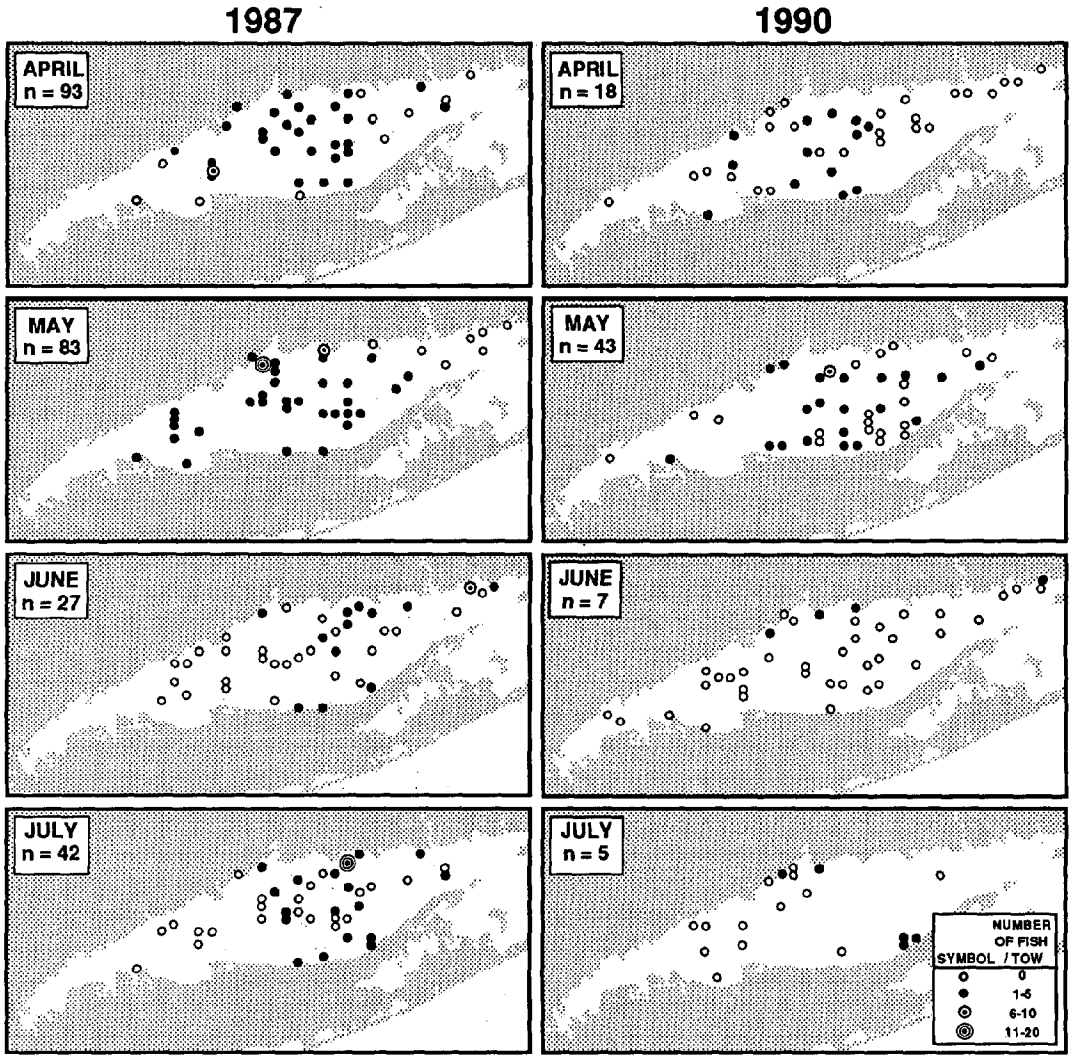


Figure 6.3. Distribution and abundance of juvenile and adult summer flounder in Long Island Sound (Fig. 2.7C) during years of high (1987) and low (1990) abundance. Collections were made with 0.5 hour tows of a 14 m otter trawl at, typically, 40 stations that were chosen by stratified random design. Data based on the finfish surveys of the Connecticut Division of Marine Fisheries (1990a, 1990b and 1992).

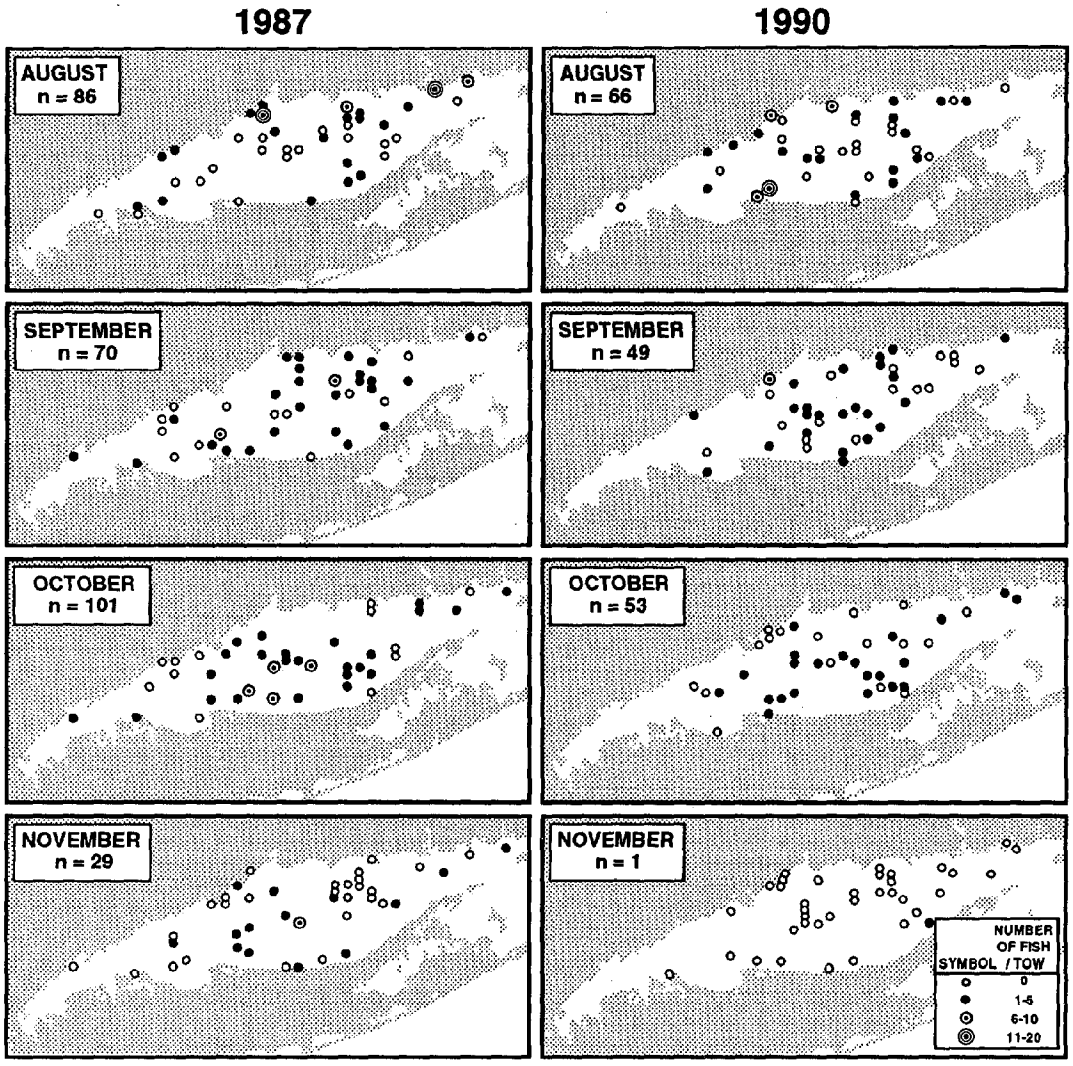


Figure 6.3 (continued).

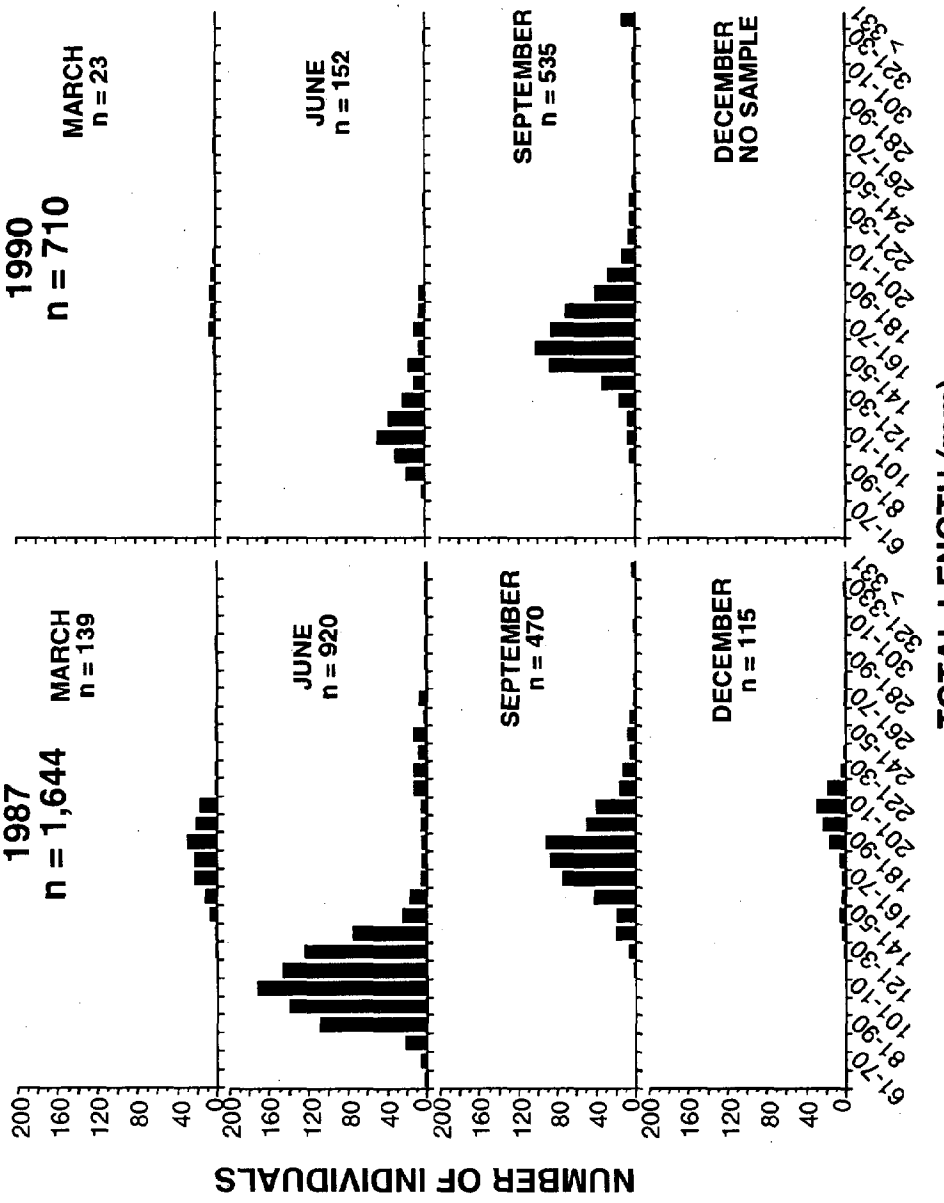


Figure 6.4. Length-frequency distributions for juvenile and adult summer flounder in the Pamlico-Albemarle sounds estuarine system (Fig. 2.7D) during years of high (1987) and low (1990) abundance. A stratified random design was used to choose sites throughout Pamlico Sound, the lower reaches of Albemarle Sound and three subestuaries (Pamlico, Neuse and Pungo rivers) for sampling by 20 minute tows of a Mongoose trawl during four months in 1987 and 3 months in 1990. Data are based on the North Carolina Division of Marine Fisheries (1987-1991) trawl survey.

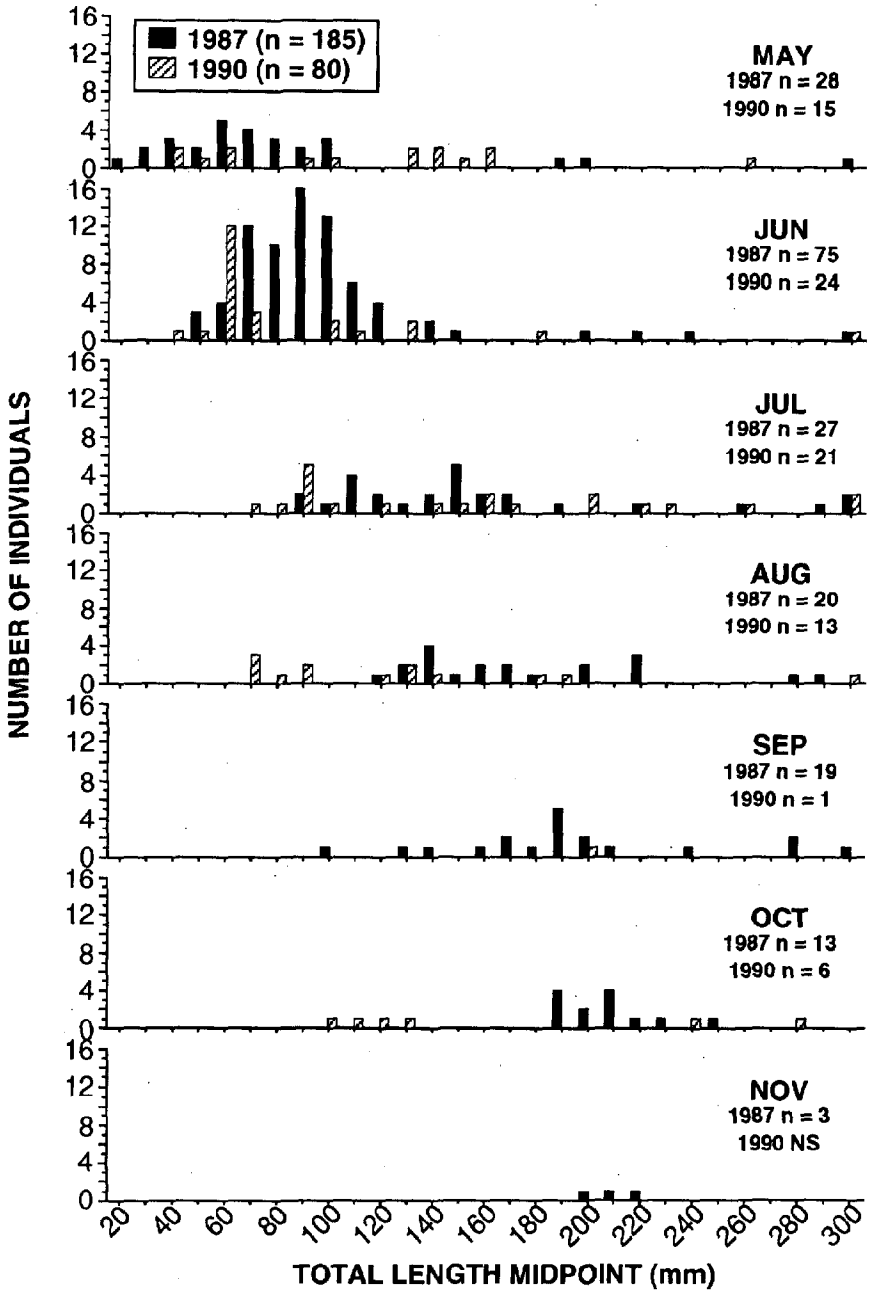


Figure 6.5. Monthly length-frequency distributions of juvenile summer flounder in shallow beach and marsh fringe habitats in the Pamlico-Albemarle sounds estuarine system (Fig. 2.7D) during years of high (1987) and low (1990) abundance. Sampling was conducted from May through November by the North Carolina Division of Marine Fisheries with 10.5 and 20 m seines. Data from Noble and Monroe (1991).

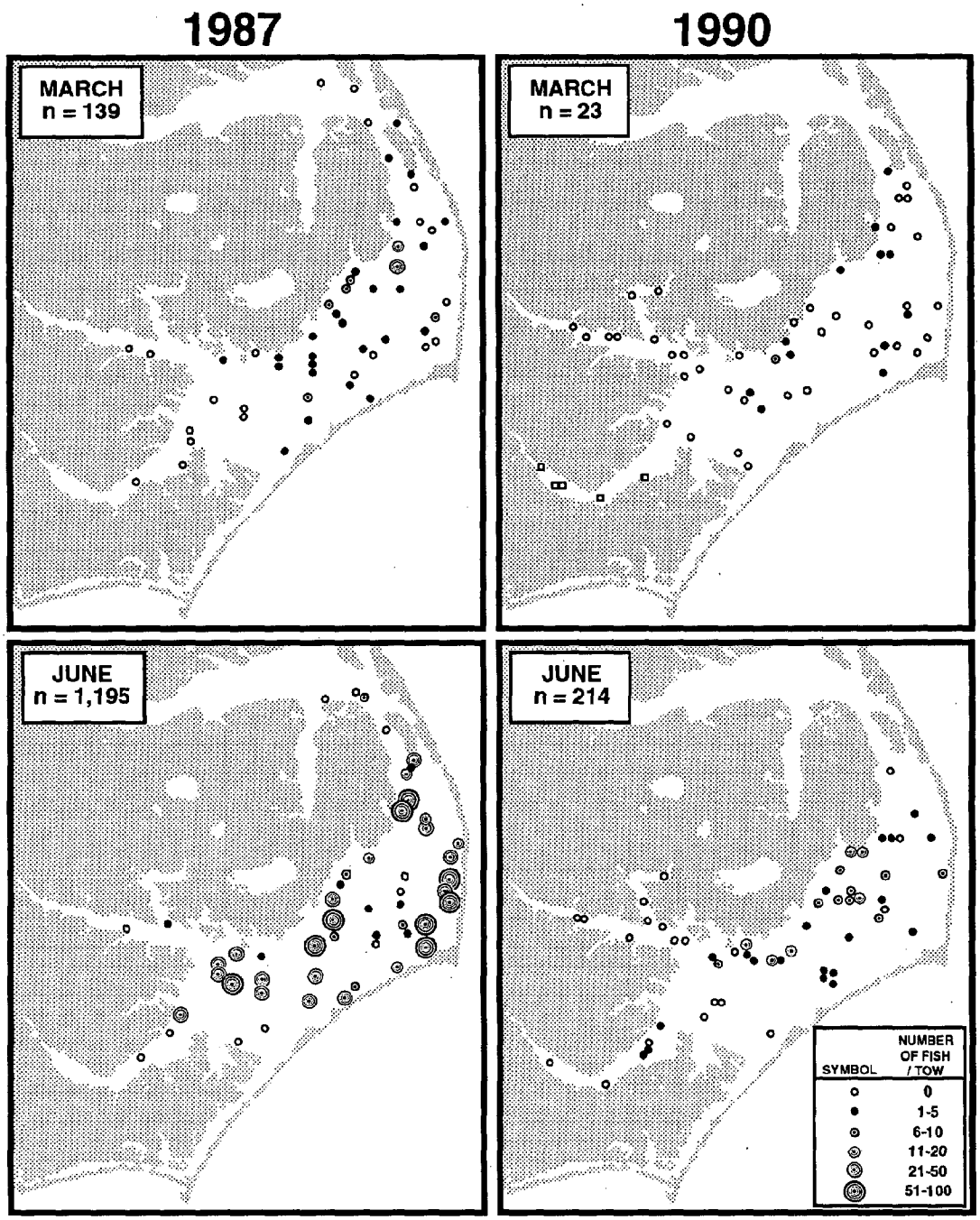


Figure 6.6. Distribution and abundance of juvenile and adult summer flounder in the Pamlico-Albemarle sounds estuarine system (Fig. 2.7D) during years of high (1987) and low (1990) abundance. A stratified random design was used to choose sites throughout Pamlico Sound, the lower reaches of Albemarle Sound and three subestuaries (Pamlico, Neuse and Pungo rivers) for sampling by 20 minute tows a Mongoose trawl during four months in 1987 and 3 months in 1990. Data are based on the North Carolina Division of Marine Fisheries (1987-1991) trawl survey.

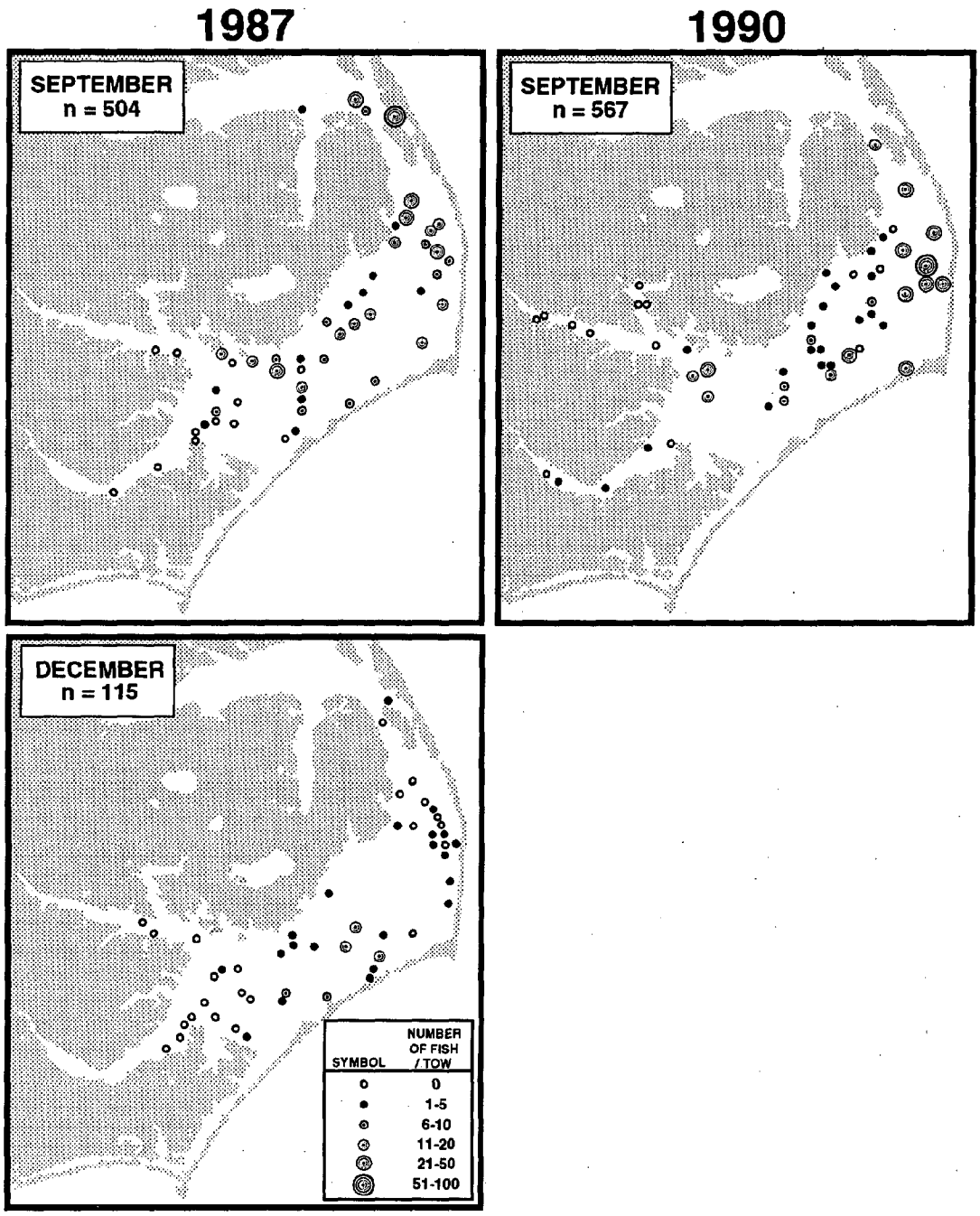


Figure 6.6 (continued).

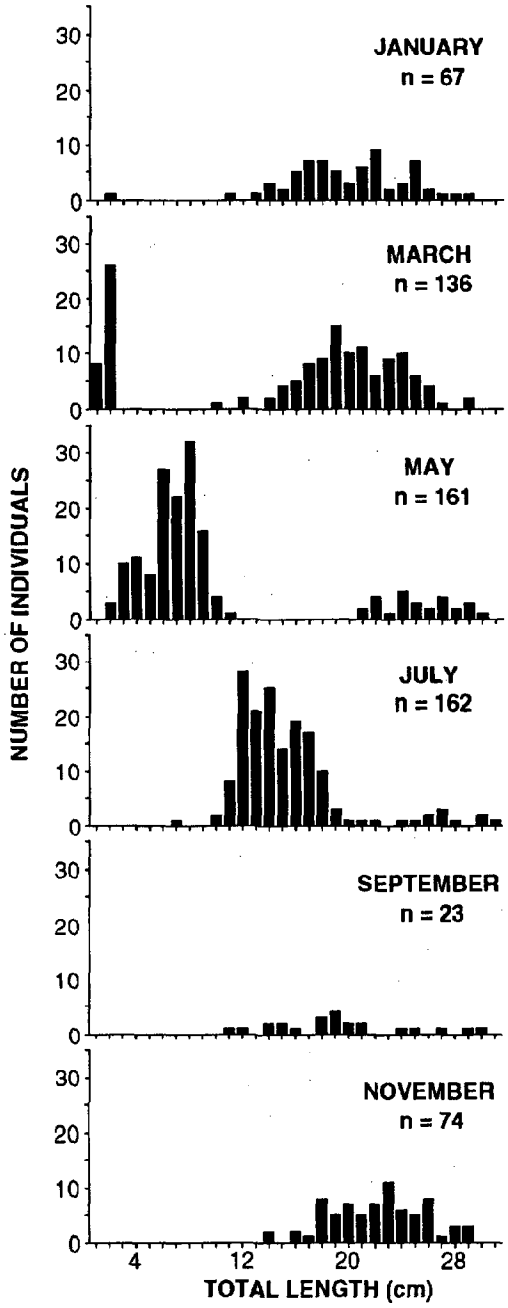


Figure 6.7. Length-frequency distributions for juvenile summer flounder in channels in the Charleston Harbor estuarine system (Fig. 2.7B) during 1985-1988. Bimonthly sampling was conducted using 4.9 and 7.6 semiballoon shrimp trawls with 3.2 - 32 mm mesh liners in the codends. Data based on a survey conducted by the South Carolina Marine Resources Center (C. Wenner, pers. comm.)

TEMPERATURE, SALINITY AND DISSOLVED OXYGEN

Estuarine juveniles can be found in a wide range of naturally occurring physical conditions. Most laboratory and field studies are in agreement regarding the preference for higher salinity, at least at larger sizes. In the winter, collections of recently settled individuals (< 50 cm TL) in the Charleston Harbor estuary (Fig. 2.7b; Table 6.1) occurred at very low as well as high salinities (February – March; Fig. 6.8). However, by May, when most individuals ranged from 20 – 110 mm TL, they were found at higher salinities (> 10 ppt). Thus in this system, as they disperse into the estuary, they may move up into nearly fresh water, but as they grow they are most abundant in the higher salinities that occur lower in the estuaries. In lower Chesapeake Bay, young–of–the–year were common in creeks that had salinities over 15 ppt and were most abundant at the highest salinities but were absent in a creek where values were 3 – 11 ppt (Table 6.2). In North Carolina, young–of–the–year have been found at salinities from 3 – 35 ppt, but were most abundant when salinities were greater than 12 ppt (Powell and Schwartz 1977). In more recent data from Pamlico Sound (Fig. 2.7d), almost all individuals were collected in the sound while few were found in the adjacent lower–salinity subestuaries such as the Pamlico and Neuse rivers (Fig. 6.6). This pattern was similar in years with both high and low abundance.

A number of laboratory studies indicate that juveniles grow best in moderate temperatures and higher salinities. For example, feeding rate is positively correlated with temperature but interacts with salinity so that higher salinities result in faster feeding rates (Peters and Kjelson 1975). These studies found that weight gain and salinity were positively correlated between 10 – 30 ppt but reduced at 40 ppt. Other studies (Malloy and Targett 1991) found little effect of salinities (10, 20 and 30 ppt) on feeding rate, assimilation efficiency and growth rate. Studies designed to test the effects of temperature on condition, growth and survival of juveniles from estuaries north (Delaware) and south of Cape Hatteras (North Carolina) indicate that differences in late winter/early spring water temperatures have significant effects on growth (Malloy 1990; Malloy and Targett 1991; Malloy and Targett 1994; Malloy and Targett in press). Southern juveniles generally experience warmer temperatures in the field and showed increased vulnerability (reduced growth and increased mortality) to cold water conditions in the laboratory compared with northern juveniles.

Low growth rates have been observed at low temperatures (< 12 – 14°C) in the laboratory (Malloy 1990; Malloy and Targett 1991; Malloy and Targett 1994; Malloy and Targett in press) and have been confirmed in caging experiments in New Jersey (Fig. 6.9). During the autumn, the average growth rate was negligible (–0.6 and 0.01 mm/day). Under these same conditions there was little change in developmental

Table 6.1. Physical characteristics of four marsh creek study sites in the Charleston Harbor estuary (Fig. 6.1) sampled monthly for 13 months from June 1986 - August 1987 (Hoffman 1991). Fishes were collected by setting paired block nets upstream and downstream of the sites, releasing rotenone upstream, and then dip-netting and seining. See Fig. 2.7B for station locations; 1 = Pita Creek; 2 = Lachicotte Creek; 3 = Beresford Creek ; 4 = Inlet Creek. (mlw = mean low water.)

(SITE NO.) LOCATION	TEMPER-ATURE (°C)	SALINITY (ppt)	DISSOLVED OXYGEN (ppm)	DEPTH (m)	SUBSTRATE	TOTAL NO. SUMMER FLOUNDER
(1) 35.6 km from mouth of Charleston Harbor	7.6-32	0.8-24.5	4.2-10.2	0.6 - 1.1 at mlw	shell hash and sand	50
(2) 30.7 km from mouth of Charleston Harbor	7.3-30.9	7.1-25.2	1.6-11.2	0.7 - 1.8 at mlw	sand and shell hash with some mud downstream	133
(3) 20.7 km from mouth of Charleston Harbor	9.6-31.5	13.0-23.7	2.0-11.7	0.4 at mlw	mud upstream, sand and some shell downstream	223
(4) 8.3 km NE of mouth of Charleston Harbor in a creek off the intracoastal waterway	7.2-32.0	27.4-36.2	0.8-10.7	0.7 at mlw	shell hash with very little mud, 2 small oyster bars in upper 1/2 partially exposed at low tide	201

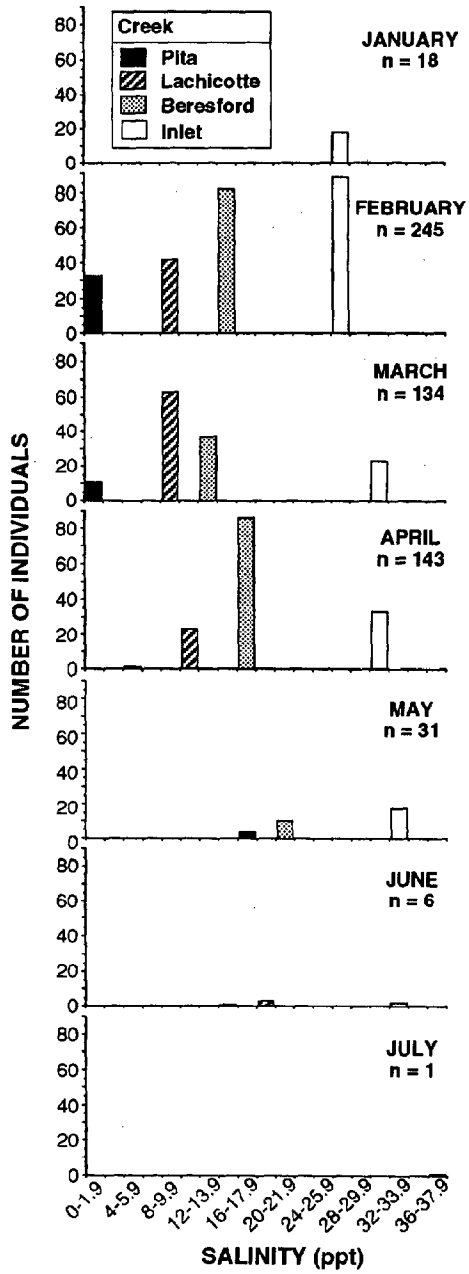


Figure 6.8. Abundance of juvenile summer flounder relative to salinity in four Charleston Harbor estuarine system marsh creeks (Fig. 2.7B) collected by a rotenone / block net method during 1987 by the South Carolina Marine Resources Center. Data based on Wenner et al. (1990).

Table 6.2. Physical characteristics of four marsh creek study sites in lower Chesapeake Bay and the ocean side of the eastern shore of Virginia (Fig. 2.1) sampled monthly from June - November in 1989 and May - November in 1990 (Daniel in prep). Fishes were collected by setting paired block nets upstream and downstream of the sites, releasing rotenone upstream, and then dip-netting and seining.

(SITE NO.) LOCATION	TEMPER-ATURE (°C)	SALNITY (ppt)	MEAN LOW WATER (m)	SUBSTRATE	VEGETATION	TOTAL NO. SUMMER FLOUNDER
(1) small tributary of the Poropotank River; ~3.1-6.1 m wide, ~30.5 m long	15-31	3-11	0.3-0.5	shell hash and very muddy	off Spartina marsh, some Juncus	0
(2) in Goodwin Islands at mouth of York River; ~9.1 m wide, ~30.5 m long	16-30	15-24	0.9	hard-packed mud and shell hash in center, very muddy sides	off Spartina marsh; Spartina island in center	26
(3) creek off main channel entering town of Wach-apreague; ~6.1 m wide, ~30.5 m long	15-30	26-29	0.8-0.9 (hole= 1.1-1.2)	shell hash in cen-ter and steep muddy sides	none	59
(4) behind Parramore Island, close to mouth of Little Machipongo Inlet; ~6.1 m wide, ~30.5 m long	17-28	28-33	0.15-0.2 (hole=1.2)	sandy mud	off Spartina marsh	68

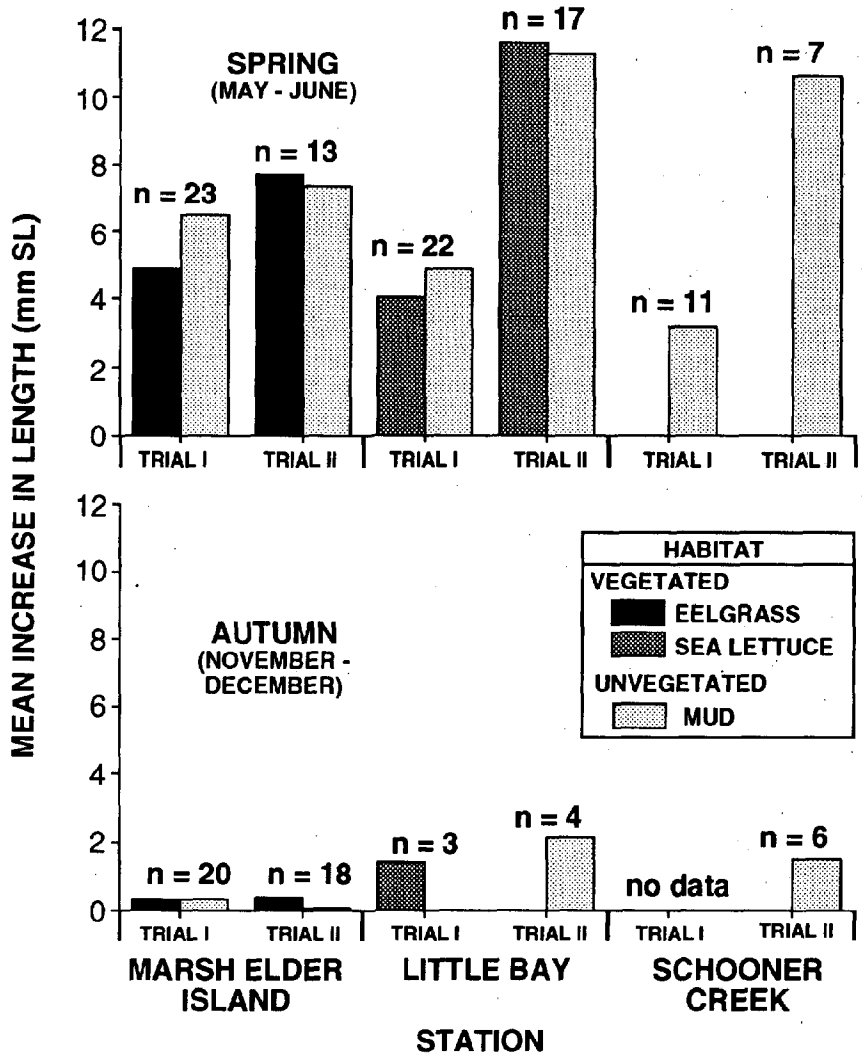


Figure 6.9. Habitat-specific growth of juvenile summer flounder held in cages (6 mm mesh) at three sites in the Great Bay-Little Egg Harbor estuarine system (Fig. 2.7A) during spring and autumn 1991. Two trials of 10 - 11 days duration were conducted at each station during each season. For each trial, four cages containing juvenile summer flounder (n = number of individuals used in each trial) of 12 - 41 mm SL were deployed: two on vegetated substrate (eelgrass = Zostera marina; sea lettuce = Ulva lactuca) and two on adjacent unvegetated substrate (mud). Adapted from Keefe and Able (1992).

stage as had been observed in laboratory experiments (Keefe and Able 1994). At temperatures below 2 – 3°C, significant mortality has been reported in laboratory experiments (Malloy 1990; Malloy and Targett 1991; Szedlmayer et al. 1992; Malloy and Targett 1994; Malloy and Targett in press) and this may be an important source of mortality affecting subsequent year–class strength. The impact of low temperatures may vary between years depending on the severity of winter. During spring and summer, growth rates have varied from approximately 0.5 – > 1.0 mm/day for recently settled individuals (Keefe and Able 1992) to a range of 1.5 – 1.9 mm/day for young–of–the–year juveniles (Szedlmayer et al. 1992; Rountree and Able 1992a). Estuarine juveniles with ultrasonic tags that were tracked for 1 – 33 days in Schooner Creek in Great Bay (Fig. 2.7a) were observed over a wide range of temperatures (16.0 – 28.0°C), salinities (22 – 35 ppt) and oxygen levels (2.4 – 8.9 ppm), but they generally stayed within narrow limits for these parameters (Szedlmayer and Able 1993). The mean values for each fish were much more restricted for temperature (22.3 – 24.9°C), salinity (27 – 31 ppt) and dissolved oxygen (5.9 – 6.8 ppm).

SUBSTRATE

Recently settled individuals have been collected in estuaries on the eastern shore of Virginia in depths typically less than 2 m where the substrate was composed of more than 50% very fine sand, silt and clay (Wyanski 1990). In North Carolina estuaries, similar–sized individuals were abundant in shallow (< 1 m) areas but were also found in slightly deeper areas (1.5 – 3 m). They were most abundant over sandy substrates (Burke et al. 1991). In laboratory experiments with the same population, juveniles (14.7 mm ± 1.2 mm SL) preferred sand substrate (< 5% silt–clay) over mud substrate (> 95% silt–clay) regardless of availability of prey (Burke 1991). This same preference for sand was observed for similar stages in the laboratory for a New Jersey population (Keefe and Able 1992). In marsh creeks in Charleston Harbor (Fig. 2.7b), similar–sized individuals were abundant over substrates that ranged from mud to sand and shell hash with occasional oyster bars (Table 6.1).

Larger young–of–the–year in North Carolina have been most abundantly collected where sand sediments or a transition from fine sand to silt and clay occurred and less abundantly where silt and clay predominated (Turner and Johnson 1973; Powell and Schwartz 1977). They also occurred abundantly in marsh creeks with soft mud bottoms and some shell hash in southern New Jersey (Szedlmayer et al. 1992; Rountree and Able 1992a), Virginia (Table 6.2) and South Carolina (Table 6.1). In Virginia, these larger individuals occurred over shallow sand, deep sand and deep fine sediments (Wyanski 1990) as well as in eelgrass beds (Orth and Heck 1980; Lascara 1981; Weinstein and Brooks 1983).

Habitat quality, as measured by relative growth, was evaluated with caging experiments in Great Bay–Little Egg Harbor (Fig. 2.7a; Fig. 6.9). Growth of recently

settled and small juveniles (17 – 41 mm SL) based on caging experiments was variable in spring (range 0.18 – 0.89 mm/day). Growth did not appear to be strictly related to the habitats tested (eelgrass and adjacent unvegetated substrate, sea lettuce and adjacent unvegetated substrate and marsh creek). The fastest growth occurred in shallow bays and marsh creeks.

BEHAVIOR

Tagging studies in Long Island (Poole 1962), New Jersey (Hamer and Lux 1962; Murawski 1970a) and Maryland (Jesien et al. 1992) estuaries indicate that a large proportion of juveniles tagged in estuaries in the summer return to the same system during the following summer. Diel movements of estuarine juveniles have been studied in two habitat types, marsh creeks and eelgrass habitats, and in the laboratory with sand and mud substrates. In the laboratory, recently settled juveniles exhibited a diel pattern of burying behavior that was influenced by several other variables as well, including substrate type, water temperature, tide and the presence and type of predator (fish or shrimp; Keefe and Able 1994). These individuals buried more during the day, especially at the time of high tide. In Great Bay, ultrasonically tagged individuals followed a regular diel cycle of movements in the 1–km–long Schooner Creek (Fig 2.7a; Szedlmayer and Able 1993). These young–of–the–year individuals (210 – 254 mm TL) spent most of the time at the mouth of the creek during the July–September study period. Movements up the creek typically occurred on night flood tides followed by a return down the creek on the following ebb tide. These tide–mediated movements were for feeding on resident marsh creek fishes and crustaceans (Rountree and Able 1992a) and may have been influenced by low dissolved oxygen conditions in the upper portion of the creek, especially on night low tides (Szedlmayer and Able 1993). In North Carolina, some individuals move onto the surface of regularly flooded salt marshes during flood tides (Hettler 1989). In both field observations in Chesapeake Bay and laboratory experiments (Lascara 1981), juveniles fed in and at the edge of patchy seagrasses (Zostera marina and Ruppia maritima) while displaying an ambush predator strategy. In these habitats most feeding occurred in the morning.

Seasonal movements of larger juveniles from estuaries occur as temperatures are dropping in autumn but this pattern may vary with latitude, water depth of the estuary and temperature. In Great Bay (Fig. 2.7a), juveniles migrated out of marsh systems in the late summer and early fall. In one instance, a single individual was tracked from Schooner creek, through Little Egg Inlet and into the ocean, a distance of about 1.5 km (Szedlmayer and Able 1993). In North Carolina, it has been assumed that juveniles overwinter in the estuaries (Powell and Schwartz 1977). However movement offshore, especially of larger individuals, may occur in late summer (A. Powell, pers. comm.), which may account for the smaller sizes reported for young–of–the–year at the end of the year (Powell 1982) relative to more northern populations. A similar migration offshore with increasing size has also been suggested for Georgia populations (Music and Pafford 1984).

Chapter 7
Offshore Juveniles

INTRODUCTION

Juveniles join adults in an offshore migration, but details are lacking. Some juveniles that spend the first summer in estuaries move onto the continental shelf as temperatures decline in the fall or as they reach larger sizes. After overwintering on the shelf, many move back into estuaries for the second summer. Details of their habitats and other aspects of the biology are not well-known because they are not frequently differentiated from adults. For purposes of this treatment, offshore juveniles are less than 320 mm in the fall, winter and spring.

SPATIAL AND TEMPORAL DISTRIBUTION

Juveniles appear to make seasonal migrations similar to those of the adults. They leave the estuaries during the summer or early autumn throughout much of their range. In the Middle Atlantic Bight, young-of-the-year have been found exclusively on the inner continental shelf in fall surveys (Able et al. 1990) and this pattern was evident in more recent surveys as well (Fig. 7.1). In the northern Middle Atlantic Bight, most collections were very close to shore while farther south they were found farther out on the shelf. In the winter, this year class was distributed off the middle and outer continental shelf from Long Island to Cape Hatteras. By spring, portions of this same year class were still found near the edge of the continental shelf but some individuals had already moved back inshore.

In the South Atlantic Bight (Fig. 7.2), the pattern of movement from the estuaries onto the continental shelf may differ in timing. South Atlantic Bight trawl surveys in depths of less than 10 m (Beatty et al. 1989; Wenner and Sedberry 1989) indicate that small juveniles (100 – 200 mm TL) could be found as early as June and that their numbers increased through July and August, when the modal size was approximately 200 mm TL. They were especially abundant at sample locations adjacent to major inlets (Beatty et al. 1989; Fig. 7.3). By September through November they were collected

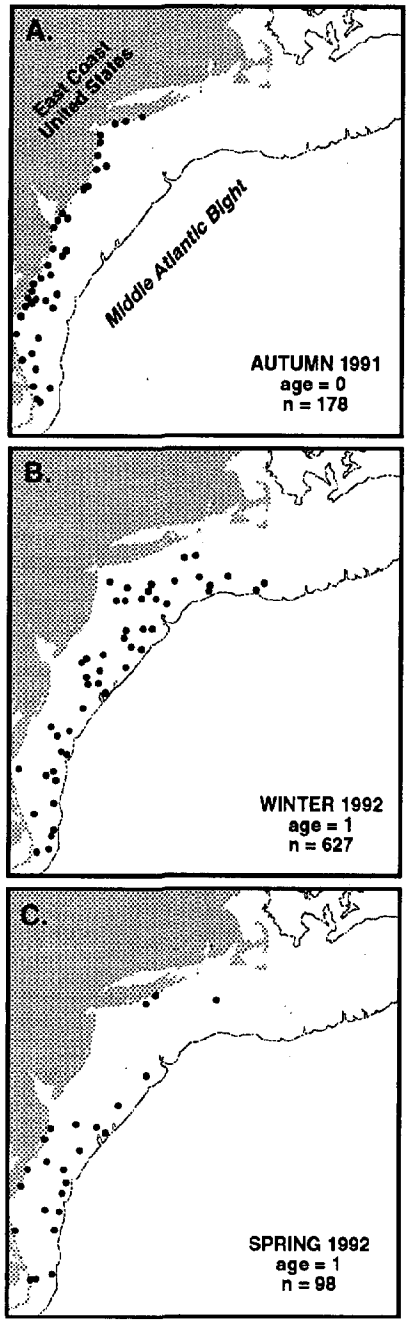


Figure 7.1. Distribution of summer flounder juveniles (< 320 mm TL; 0 - 1 year of age) from National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center (NEFSC) groundfish surveys for A. autumn, B. winter, and C. spring, 1991 - 1992. Sampling was conducted by stratified random design in the Gulf of Maine to Nova Scotia, on Georges Bank, and in the Middle Atlantic Bight (Fig. 2.1) using 0.5 hour tows of a #36 Yankee trawl with a 12.7 mm mesh liner in the codend . The 1000 m contour is shown. Collections where no juveniles were caught are omitted. (Adapted from maps provided by G. Shepherd, National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts).

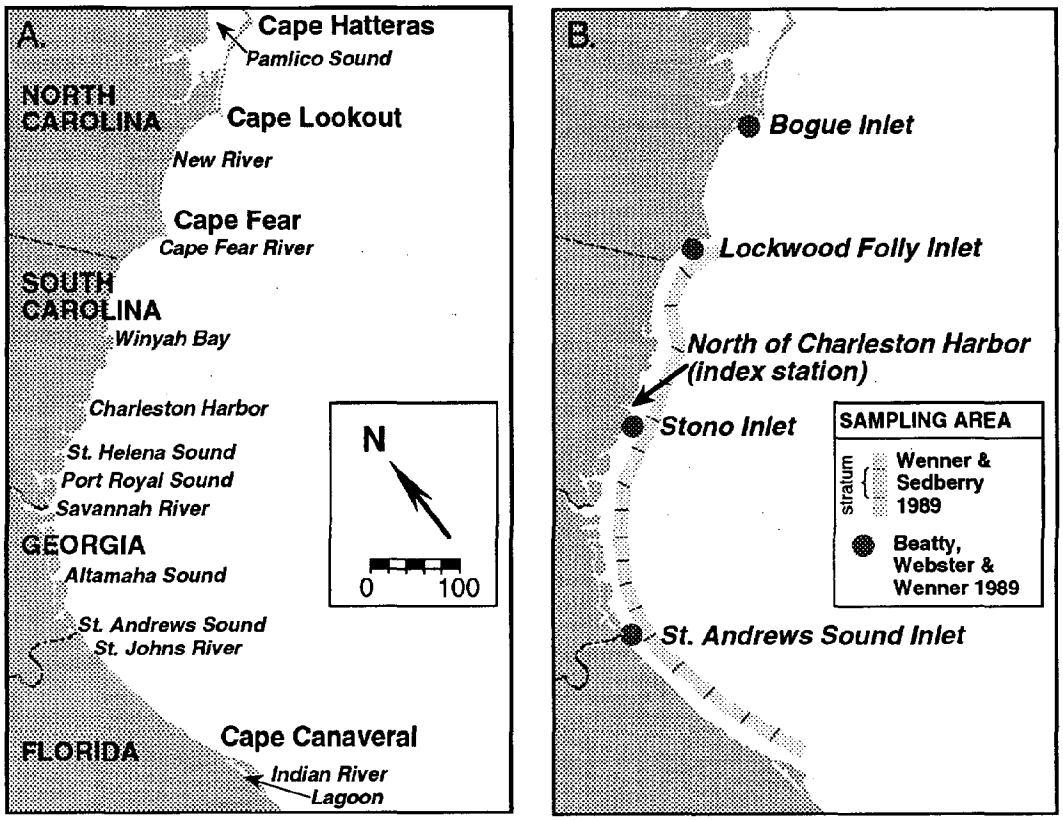


Figure 7.2. A. South Atlantic Bight (region between Cape Hatteras, North Carolina, and Cape Canaveral, Florida) with major capes, bays and rivers indicated, and B. sample areas for two South Atlantic Bight inner continental shelf (< 10 m) trawl surveys. Wenner and Sedberry (1989) sampled at randomly chosen sites within each stratum during 1980, 1981 and 1982. Beatty et al. (1989) sampled four inlet locations and an index station during 1987 and 1988. Three sites were sampled at each location; a within inlet site, a beach site and an off-beach site.

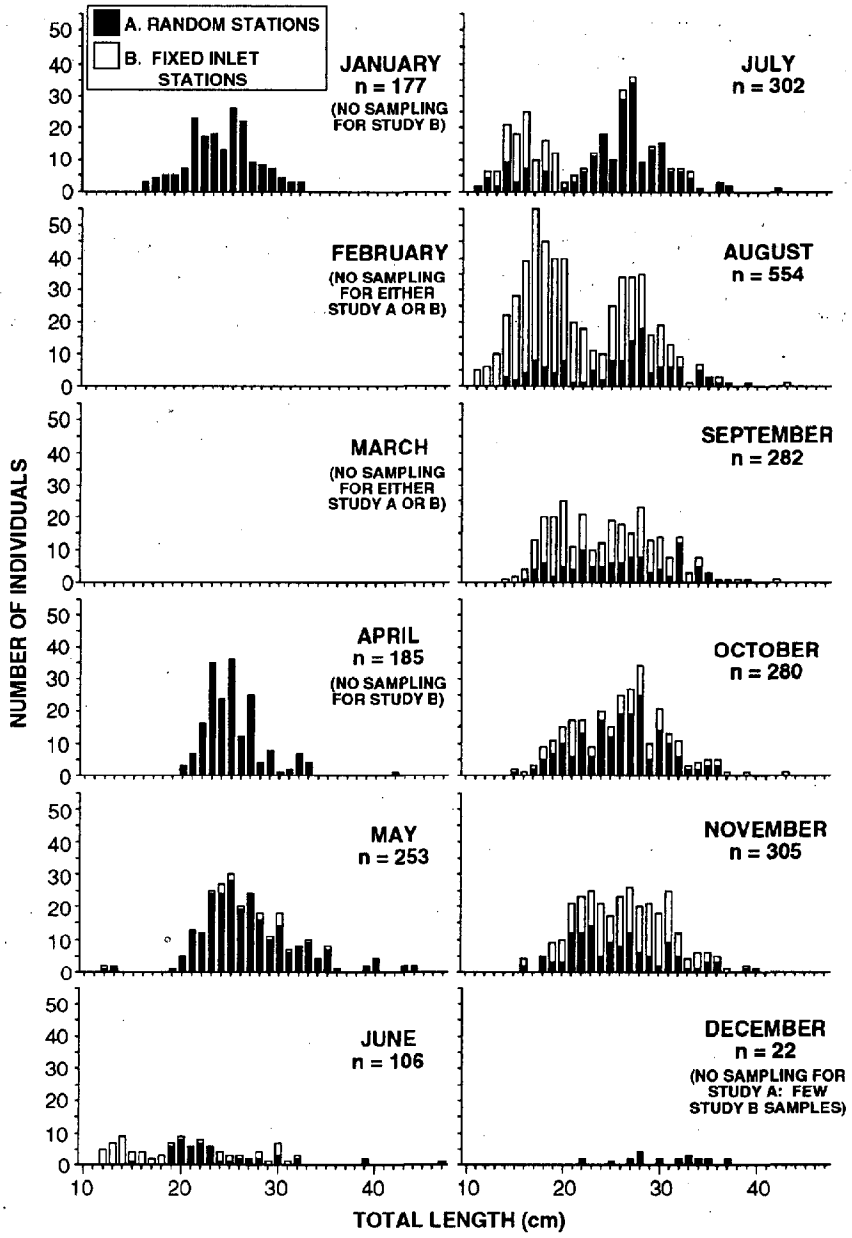


Figure 7.3. Monthly length-frequency distributions for juvenile and adult summer flounder from two trawl surveys conducted in nearshore waters (< 10 m) on the South Atlantic Bight inner continental shelf (Fig. 7.2): A. random stations sampled between Cape Fear and Cape Canaveral during 1980 - 1982 (Wenner and Sedberry 1989), and B. fixed stations sampled outside four major inlets between Cape Fear and Georgia during 1987 - 1988 (Beatty, Webster and Wenner 1989).

both near the shore and at inlets. During the winter, sampling was less frequent in both these programs, but juveniles were abundant near the shore in January. This same year class is well represented at these areas in April and May through July and August, which indicates that a portion spend the summer on the shallow inner continental shelf.

TEMPERATURE

In the Middle Atlantic Bight collections during 1970–1979, juveniles were most abundant at bottom temperatures greater than 15°C (Sissenwine et al. 1979), but nothing else is known primarily because juveniles and adults are not differentiated.

Chapter 8
Estuarine and Offshore Adults

INTRODUCTION

The adult life history stage of summer flounder begins when individuals reach sexual maturity. Based on aging and maturation studies (Poole 1961; Eldridge 1962; Smith 1969; Powell 1974; Smith and Daiber 1977; Morse 1981; Smith et al. 1981; Gillikin and Holland unpublished), the majority become sexually mature at sizes as small as 240 – 270 mm TL for males and 300 – 350 mm TL for females (Morse 1981). The habitats occupied by adults are largely determined by their extensive migratory patterns (Figs. 2.10, 2.11). Details of their seasonal distribution are limited to large–scale trawl surveys. These have been more intensive and extensive in the Middle Atlantic Bight than in the South Atlantic Bight and this is reflected in the following account in which we combine the treatment of adults in estuarine and continental shelf habitats.

SPATIAL AND TEMPORAL DISTRIBUTION

In the Middle Atlantic Bight and northern South Atlantic Bight, adults overwinter on the outer continental shelf (70 – 155 m depth; Grosslein and Azarovitz 1982), migrate inshore to shallow inner continental shelf and estuarine waters in spring, and begin offshore migration back to the outer continental shelf in autumn (Figs. 2.10, 2.11; Hildebrand and Schroeder 1928; Bigelow and Schroeder 1953; Grosslein and Bowman 1973; Smith 1973a,b; Rogers and Van Den Avyle 1983; Able et al. 1990) or as early as August in some cases (Schwartz 1961a,b). Gonad maturation may begin as early as late–summer in Middle Atlantic Bight estuaries (Schwartz 1961a,b; Smith 1969; Smith and Daiber 1977), and spawning occurs during offshore migration (Eldridge 1962; Smith 1973a,b; Murawski and Festa 1976; Able et al. 1990). There is some evidence to suggest that the largest, older individuals eventually remain over the continental shelf all year (Festa 1977). However due to current fishing pressure, the majority of adults are only three years of age or younger (Terceiro 1993), and those individuals largely utilize estuarine and inner continental shelf waters in summer.

The seasonal patterns of distribution and abundance of adults in the Middle Atlantic Bight are largely reflected in the pattern of catches from the commercial fishery (Fig. 8.1), although these must be cautiously interpreted because the patterns may reflect the fisher's behavior rather than that of summer flounder. In January–March when water temperatures are coldest, they are clearly most abundant at the edge of the

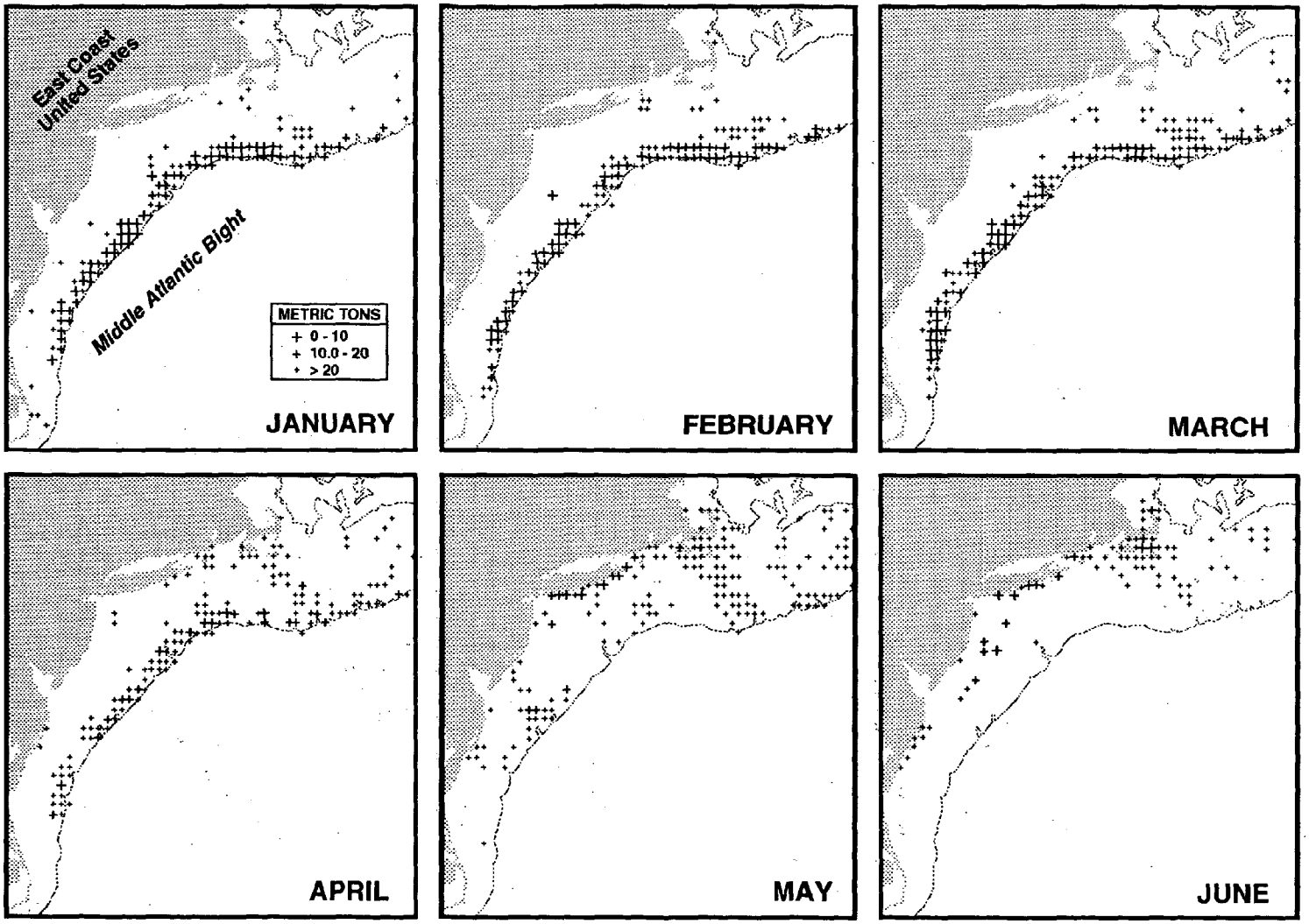


Figure 8.1. Average annual landings (metric tons per ten minutes square of latitude and longitude) of summer flounder captured in the United States commercial fishery during 1987-1989 from the Gulf of Maine to off Cape Hatteras (Fig. 2.1) by month. The 200 m contour is shown. (Adapted from maps provided by G. Shepherd, National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts.)

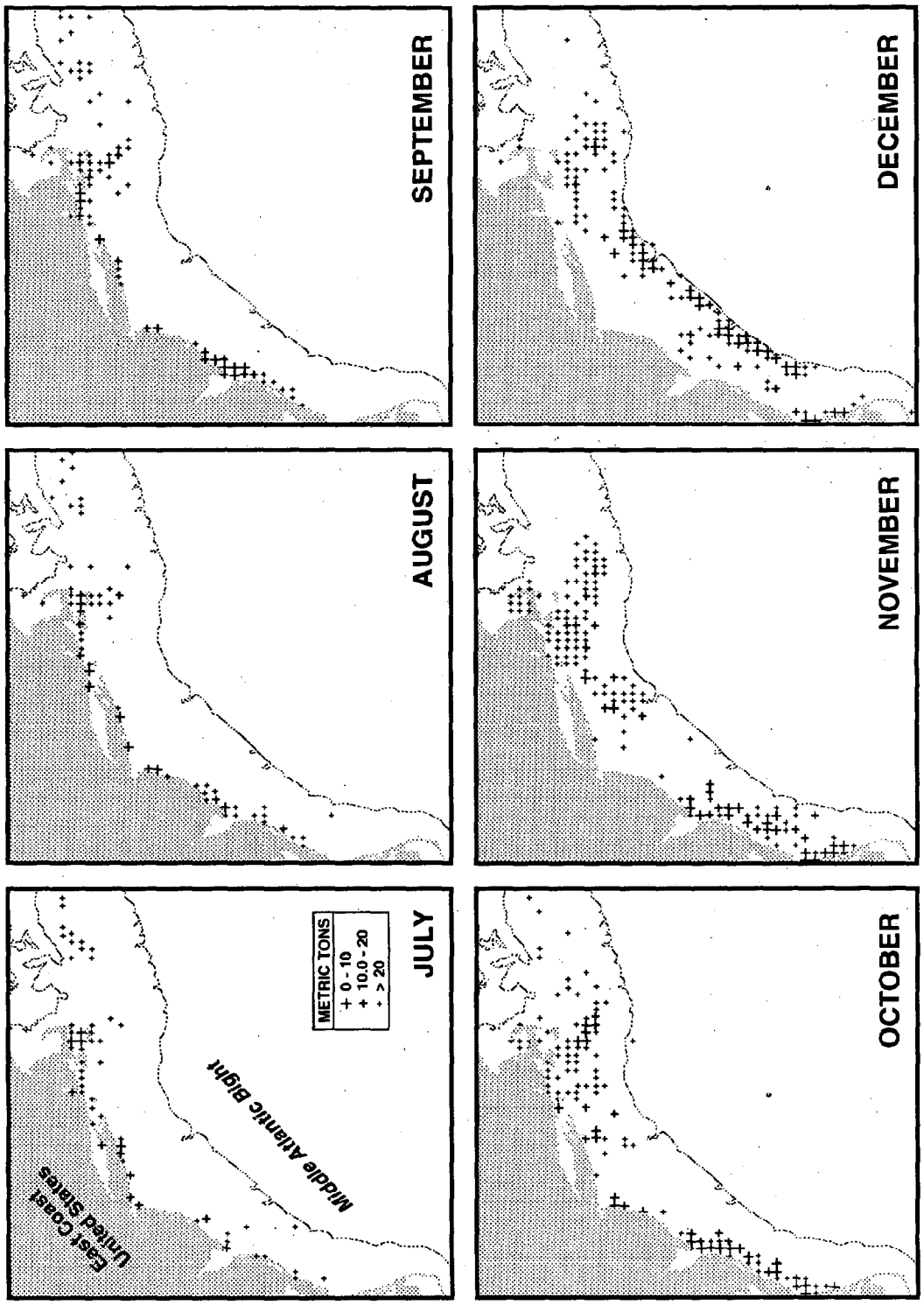


Figure 8.1 (continued).

continental shelf from the westernmost edge of Georges Bank to just south of Chesapeake Bay. By April, some catches are reported in shallower waters from off Long Island, the south shore of Massachusetts and on to Georges Bank. By May, this pattern is more pronounced with catches from inner continental shelf waters from Georges Bank south to Maryland. At this time there are much lower catches at the edge of the shelf. Catches decline on the shelf through June and July, but they begin to increase in August through September. By August, the first reports of catches north of Cape Cod occur and these continue through December. Most of the increased catches occur off southern Massachusetts and in the vicinity of Delaware Bay. By October, this trend continues while spreading over most of the Middle Atlantic Bight. In November, catches increase on the middle portions of the shelf, but none are reported from Georges Bank. By December, catches at the edge of the shelf have increased and the pattern begins to resemble that for January.

This pattern is supported by the fishery independent data from the long time series of trawl surveys conducted by the National Marine Fisheries Service in the Middle Atlantic Bight (Fig. 2.10). During the spring survey (February – March) they were most abundant at the edge of the shelf from Georges Bank south to the North Carolina – Virginia border. This center of abundance is typically in depths of 70 – 150 m (Azarovitz and Grosslein 1987). At the same time, smaller numbers were collected over middle to inner shelf waters. More fish were collected in inner shelf waters from Delaware Bay and south to Cape Hatteras. In autumn (September – November), fish were most abundant from Nantucket Shoals and shallower waters from Long Island to the mouth of Chesapeake Bay. Small collections were also made on the mid–shelf portions of Georges Bank. Earlier studies, based on trawl surveys prior to 1979 (Sissenwine et al. 1979), demonstrated a similar pattern with individuals widely distributed over the continental shelf in depths from 0 – 360 m during the spring. During summer and autumn, they occurred primarily in depths less than 100 m but in winter they were not found in water shallower than 70 m.

The occurrence of adults in estuaries in the Middle Atlantic Bight corresponds in time with their inshore movements on the continental shelf. This is evident from several systems. In Long Island Sound, individuals that are presumably age 1+ and older (Fig. 6.2) are present in April and May collections, become less abundant in June and July, and more abundant in August through October (Fig. 6.3). Fewer individuals are present in November, presumably because of the migration offshore. These are distributed throughout Long Island Sound although they are most abundant in the central portion. In Great Bay (Fig. 2.7a), based on an extensive creel survey from 1967 to 1976, adults (> 320 mm TL) are well represented in the catches, particularly from 1967 to 1972. Subsequently, the average size of fish landed was smaller during 1975 to 1976 (Fig. 8.2). In Maryland, adults are present in the estuary as early as April and through the summer (Jesien and Hocutt 1991). On the eastern shore of Virginia they occur from April – November (Richards and Castagna 1970). In Pamlico Sound

Adults

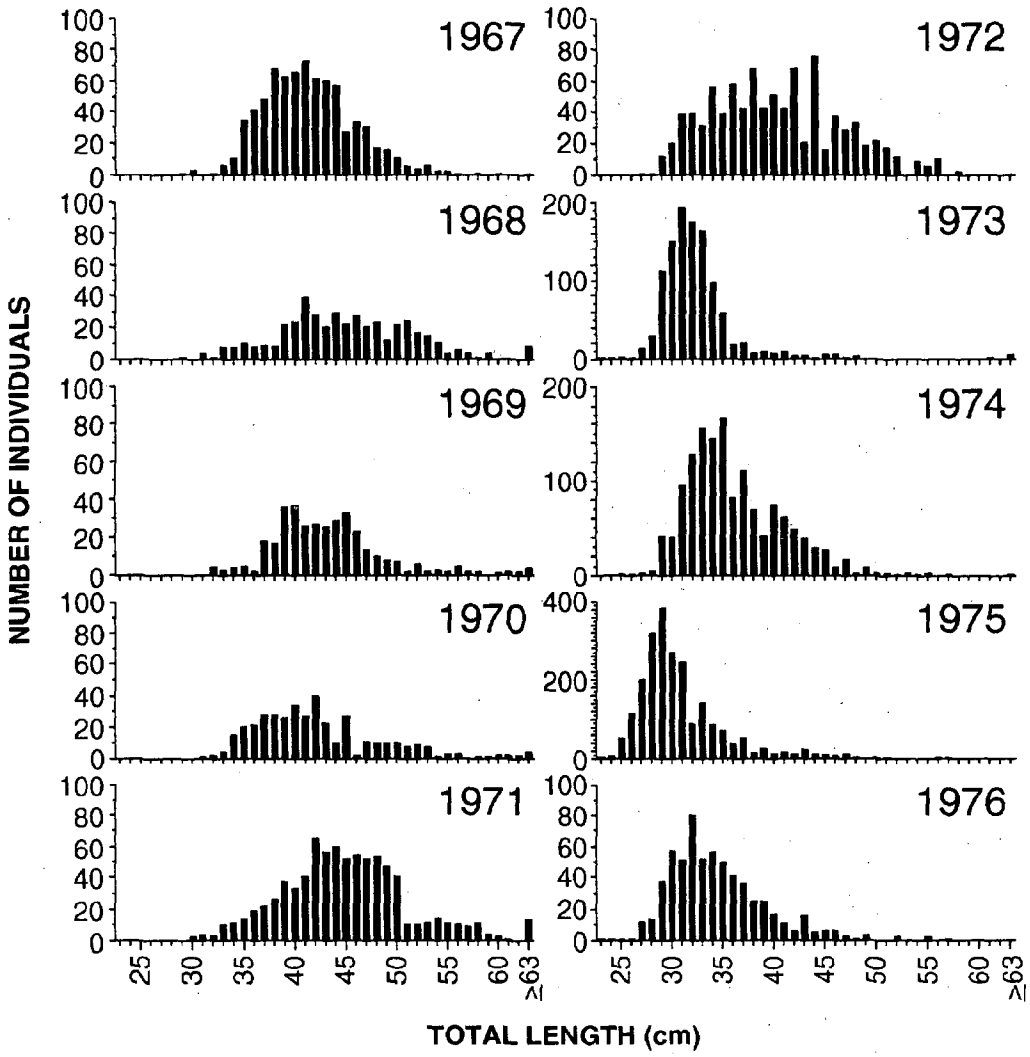


Figure 8.2. Length-frequency distributions of summer flounder in Great Bay (Fig. 2.7A) from the recreational fishery creel survey conducted by the New Jersey Department of Environmental Protection and Energy for the month of July over a ten year period (Murawski and Festa 1979).

(Fig. 2.7d), adults are notable by their absence (Fig. 6.7) and a similar situation also occurs in South Carolina (Wenner et al. 1990; Fig. 6.10) and Georgia (Dahlberg 1972; Music and Pafford 1984).

Information on offshore adults in the southern South Atlantic Bight is limited in part because summer flounder are not a major component of the commercial fisheries and also because the various species of Paralichthys are not differentiated. There are only a few adults (> 300 mm TL) captured during any month in South Atlantic Bight trawl survey programs on the inner continental shelf (< 11 m; Beatty et al. 1989; Wenner and Sedberry 1989). Prior surveys have captured few adults as well (Struhsaker 1969). Adults have been reported on ocean beaches and artificial reef habitats in spring and summer in Georgia and Florida (Miller and Jorgenson 1969; Gilmore et al. 1981) and on the outer continental shelf in the winter (Pearson 1932).

TEMPERATURE, SALINITY AND OXYGEN

Seasonal fluctuations in water temperature may be one of the primary factors controlling the timing of spring and winter migrations and spawning for summer flounder adults (Nesbit and Neville 1935; Ginsburg 1952; Edwards 1964). Spawning adults are found primarily in bottom water temperatures of 12 – 19°C (Smith 1973a,b; Festa 1974b) on the continental shelf habitat from Cape Cod to Cape Lookout. The cold bottom water present in the Middle Atlantic Bight in early autumn may limit the seaward extent of migration (Smith 1973a,b), and thus spawning habitat, during part of this time. In southern South Atlantic Bight waters, high temperatures may explain the absence of adults in estuarine habitats during spring and summer when young-of-the-year are present. Most adults occur in the high-salinity (> 28 ppt) portions of estuaries (Richards and Castagna 1970; Powell and Schwartz 1977; Mid-Atlantic Fishery Management Council 1990; 1991a,b; Burke 1991; Hoffman 1991; Noble and Monroe 1991; Szedlmayer et al. 1992).

Summer flounder oxygen requirements have not been well studied, however some reports indicate that episodes of hypoxia (low dissolved oxygen, ~< 3 ppm) or anoxia (absence of dissolved oxygen, 0 ppm) may be a common feature of the offshore habitat and may significantly impact local distribution and survival. One of the best-studied episodes of hypoxia to affect summer flounder occurred on the Middle Atlantic Bight continental shelf off New Jersey in midsummer to late-autumn 1976 (Swanson and Sinderman 1979). Reports of dramatically increased catch rates of adults in the ocean beach and estuarine recreational fishery indicate that these fishes were avoiding hypoxic areas offshore by moving into Great Bay (Murawski and Festa 1977). During this event, summer flounder were caught only in ocean areas free of hypoxic water, and divers observed dead adults on the ocean floor (Freeman and Turner 1977). Adult summer flounder were also reported among the victims of a fish kill washed onto Jones Beach, New York, in September 1951 during a period of offshore

Adults

hypoxia similar to the 1976 episode (Perlmutter 1959). Other fish kills reported for 1968, 1971 and 1974 suggest that mortality due to hypoxia is not uncommon (Freeman and Turner 1977).

SUBSTRATE

Adult summer flounder are typically described as preferring hard, sandy substrate in which they can easily bury (Bigelow and Schroeder 1953; Schwartz 1964; Smith 1969). During their stay in Middle Atlantic and northern South Atlantic estuaries, however, adults exploit a broad range of lower and mid–estuary habitats including salt marsh creeks (Dahlberg 1972; Rountree and Able 1992a) and seagrass beds (Bigelow and Schroeder 1953; Orth and Heck 1980), which frequently have muddy or silty substrates, as well as sand flats (Dahlberg 1972; Gilmore et al. 1981). Adults with normal pigment can take on camouflaging patterns that resemble nearly any bottom substrate (Mast 1916).

Chapter 9
Implications for Resource Managers

Despite the importance of summer flounder to commercial and recreational fisheries, we lack a clear understanding of habitat requirements for all life history stages, particularly for the eggs and larvae. For instance, we know nothing about the role of transport processes on the behavior that influences the movement of transforming larvae into estuaries. We know somewhat more for the juveniles and adults, although the degree of understanding varies from region to region and is made more difficult because this species is highly migratory. In general, our understanding of habitat requirements for most life history stages is better for Middle Atlantic Bight than for South Atlantic Bight populations.

Of those habitat parameters for which information is available, it appears that temperature and dissolved oxygen have the strongest influence on habitat use and quality. Temperature affects the seasonal occurrence in estuarine habitats especially in autumn when declining water temperatures result in offshore migration. This is evident in the Middle Atlantic and South Atlantic bights where the difference in seasonal temperatures in estuaries is great. In the former, most individuals leave the estuary for the winter; in the latter, some portion of the population overwinters in the estuary. This pattern may vary with the severity of the winter.

Naturally varying temperatures may also influence survival during the first year and thus impact subsequent year–class strength. Low temperatures (2 – 3°C) cause mortality in transforming larvae and small juveniles. As a result, long and cold winters may cause increased mortality, especially in the northern portion of the range. Low temperatures also cause reduced growth and potentially increased predation rates because transforming larvae and juveniles may remain at smaller, more vulnerable sizes for longer periods.

Dissolved oxygen influences habitat–use patterns during episodes of hypoxia (~ < 3 ppm) or anoxia (0 ppm). During the 1976 hypoxia/anoxia event off New Jersey, migration away from this stress caused fish to concentrate in nearby estuaries and resulted in increased fishing mortality. If migration is not possible, natural mortality can result with subsequent loss of a significant portion of the local population.

It is clear that estuaries are critical nursery areas throughout the range. High salinity, subtidal salt marsh creeks are the most important estuarine habitats because they

provide optimal conditions for growth of juveniles, especially during the spring and early summer of the first year. Natural or anthropogenic impacts on these creeks (ditching, bulkheading, etc.) probably reduce the quantity and quality of summer flounder nursery habitat and eventually reduce the growth and survival of populations anywhere this occurs. The same may be said of high–salinity bays because these habitats are also used by older juveniles and adults during the summer growing season.

In the future, habitat research should focus on the transforming larvae and early juveniles because there is increasing evidence that year–class strength may be determined at this time. In addition, the fact that summer flounder are estuarine–dependent is critical because estuaries are the most likely to be affected by present and future human activities. This is especially relevant given the increasing human population levels expected on estuarine shores throughout the range of summer flounder.

Resource managers who can influence habitat decisions should begin to recognize that habitat loss and degradation has as an important effect on fisheries as overfishing, which has received disproportionately more attention. In addition, the habitat problem affects all fisheries, both commercial and recreational. Further, because of the highly migratory nature of summer flounder populations, habitat loss and degradation in one local area can easily influence fish abundance elsewhere. Lastly, habitat research and management for summer flounder can not operate in a vacuum and requires complementary information on stocks, life history, migrations, food habits, etc., as well as a broader understanding of habitat changes on geographical and decadal scales.

Glossary

Adult: Fish that is fully developed in morphology and meristic characteristics and has also attained sexual maturity.

Allometric: Growth of a part of an organism in relation to the growth of the whole organism or some other part of it.

Ambient temperature: The natural temperature of the water.

Anoxia: Absence of dissolved oxygen in water; 0 ppm.

Anthropogenic effects: Human impacts on the natural environment and wildlife.

Assimilation efficiency: The rate at which an animal converts food into body weight.

Benthic: On or pertaining to the bottom substrate (the benthos) in an aquatic habitat.

Buoyant: Tendency to float or rise in water.

C (°C): Temperature in degrees Celsius. To convert to Fahrenheit, use equation $°F = (9/5 \times °C) + 32$.

Clay: Sediments with grain size < 0.004 mm in diameter based on the Wentworth scale.

Cohort: All the individuals resulting from the same spawning event in a population.

Continental shelf: The edge of the continent that is submerged in relatively shallow ocean water.

Creel survey: A survey of the recreational fishery that quantifies the fish landings at public piers and docks. A "creel" is the traditional satchel in which anglers pack their catch during fishing, but a creel survey is not restricted to fish packed in creels.

Crustacean: Aquatic arthropods that typically have a body covered with a hard shell, including lobsters, shrimps, crabs, etc.

Diel: Occurring on a daily basis. For instance, patterns of faunal movement that are correlated with the cycles of light and dark are diel patterns.

Dissolved oxygen: Oxygen that is in solution with water, and is available for plant and animal respiration.

Ebb tide: Tidal stage at which ocean water flows in an offshore direction and estuarine waters flow toward the ocean.

Glossary

Egg: A reproductive cell produced by a female organism; an ovum. May refer to both fertilized and unfertilized state.

Electrophoresis: A means of detecting genetic differences among populations of a species by sampling proteins from members of the populations and analyzing the movement of these protein particles in a medium through which an electrical charge is passed.

Entrainment: The intake of relatively immobile, free–floating organisms with water drawn into an industrial, municipal or electric utility power plant.

Estuary (estuarine): Transitional environments between fresh water and salt water.

Etropus microstomus: Scientific name for the flatfish with the common name smallmouth flounder. This is a lefteye flounder in the same family (Bothidae) as summer flounder.

Fauna: All of the animal life in a given region or period of time.

Flora: All of the plant life in a given region or period of time.

Flood tide: The tidal stage at which ocean water flows in an inshore direction and into estuarine systems.

Family: In scientific classifications, an assemblage of genera possessing certain characters in common by which they are distinguished. Subordinate to phylum, class and order and superordinate to genus and species.

Genus: In scientific classifications, an assemblage of species possessing certain characters in common, by which they are distinguished (plural = genera). Subordinate to phylum, class, order and family and superordinate to species.

Gonad (gonadal): A reproductive organ or sex gland (ovary, testis) in which the gametes (ova, sperm) are produced.

Georges Bank: A large, shallow (< 5 m in some areas) bank on the continental shelf in the northern Middle Atlantic Bight that is an important fishery region (see Fig. 2.1).

Groundfish: Fishes that primarily inhabit the benthic environment, such as flatfish.

Habitat: The native environment or usual dwelling place of an animal or group of animals.

High tide: The period during which water depth is highest during a given tidal cycle. This occurs as the terminus of flood tide, prior to the beginning of ebb tide.

Hypoxia: Low levels of dissolved oxygen in water (~< 3 ppm) that are extremely stressful to most aquatic life.

Ichthyoplankton: Very small fishes that drift in the water column as plankton and are typically larvae.

Inshore: Refers primarily to estuaries behind the shoreline of the coast, however may also refer to continental shelf areas close to the shore. Inshore movement is toward the shoreline and/or beyond into estuaries.

Intertidal: Shallow areas along the shore and in estuaries that are alternately exposed and covered by the tides.

Juncus: Genus name of upper estuarine plants that are generally named rushes.

Juvenile: Young fish after attaining full adult morphology and meristic characteristics, but before sexual maturation.

Larva: Young fish between time of hatching and the juvenile stage. Includes period of yolk sac absorption and morphological and physiological transformation.

Low tide: The period during which water depth is lowest during a given tidal cycle. This occurs as the terminus of the ebb tide, prior to the beginning of the flood tide.

MARMAP: Marine Resources Monitoring, Assessment and Prediction. National Marine Fisheries Service long–term offshore plankton survey.

Mean low water (MLW): The average of all the low tide depths for a given region relative to a set datum (reference point) in the region.

Melanophore: Black and brown pigmented cells (chromatophores) in the epidermis (skin) of a fish that are capable of changing size, shape and color by expansion and contraction.

Meristic: Numerical characteristics of the skeleton and musculature of an animal that can be used to identify species or races within species, such as the number of caudal (tail) fin rays.

Middle Atlantic Bight: Zoogeographic marine region of the Atlantic Ocean that includes the estuarine and the continental shelf waters between Cape Cod, Massachusetts (including the northern extension of Georges Bank) and Cape Hatteras, North Carolina (see Fig. 2.1).

Migration: 1. Movement of fauna from one region to another. Usually refers to regularly observed patterns of movement based on season and/or life history stage of a migratory animal, however, the term may also refer to a localized, anomalous movement as well. 2. Movement of a subset within a larger system, e.g., eye migration of transforming summer flounder larvae entails the movement of the right eye to the left side of the head.

Morphology (morphological): The form and structure of an organism considered as a whole.

Morphometric: The size relationships of various morphological characteristics of an animal. For instance, the width vs. the depth, or the snout to eye length vs. the snout to caudal (tail) length. These relationships can be used to identify species or races within species.

Mud: Sediments with grain sizes within both the clay and silt ranges of < 0.0063 mm in diameter.

NEFSC: Northeast Fisheries Science Center.

Glossary

NMFS: National Marine Fisheries Service.

NOAA: National Oceanic and Atmospheric Administration.

Offshore: Refers largely to the expanse of submerged continental shelf on the ocean side of the shoreline but may also refer to areas nearer the ocean edge of the shelf. Offshore movement is away from the shoreline.

Osmoregulation: The biological strategy employed by fish to regulate and maintain their internal water and salt concentrations against the water and salt concentrations in their surrounding environment; i.e., saltwater or freshwater.

Overwinter: To spend the winter, usually in a particular location or state of physiology.

Paralichthys dentatus: Scientific name for the fish with the common name summer flounder in the family Bothidae (lefteye flounders).

Pectoral fin: Paired fins located behind the head of a fish that articulate with the pectoral girdle (musculature).

Pelagic: In or pertaining to the water column as distinct from the benthic region.

Pigmentation: Coloration of tissues or cells.

Planktonic: Pertaining to the aggregate of passively floating or drifting organisms in a body of water.

Plankton bloom: An event where conditions are conducive to rapid reproduction of planktonic organisms in the ocean or other body of water.

Population: A group of individuals of any one species that are capable of interbreeding. Uses of the term vary from including all individuals throughout the range to including only those individuals in a specified region.

Ppm: Parts per million; units used to measure dissolved oxygen in water.

Ppt: Parts per thousand; units to measure the salinity of water.

Recruitment: Addition of new individuals to a life history stage by growth and survival (e.g., from larvae to juveniles), to a specified region by movement (e.g., from offshore to estuaries), or to a fishery by survival or based on capture gear (e.g., mesh size).

Ruppia maritima: Scientific name for the plant with the common name widgeon grass. Species of submerged angiosperm common to estuaries in the western Atlantic. A thin, flat-bladed grass that is anchored to the bottom by a root-rhizome system and produces stalk-like reproductive bodies.

Salinity: Salt content of water. The combined weight of certain salts dissolved in 1 kg of sea water, usually expressed as parts of salt per thousand parts of water (ppt).

South Atlantic Bight: Zoogeographic marine region of the Atlantic Ocean that includes the estuarine and continental shelf waters between Cape Hatteras, North Carolina and the southern tip of Florida (see Fig. 2.1).

Scophthalmus aquosus: Scientific name for the fish with the common name windowpane flounder, a lefteye flounder in the same family (Bothidae) as summer flounder.

Sand: Sediments with grain size ranging from 1.0 – 2.0 mm diameter (very coarse) to 0.062–0.125 mm in diameter (very fine) based on the Wentworth scale.

Silt: Sediments with grain size 0.004 – 0.062 mm in diameter based on the Wentworth scale.

Spawning: Fish reproduction process characterized by females and males depositing eggs and sperm into the water simultaneously or in succession so as to fertilize the eggs.

Spartina: The genus name of salt marsh grasses generally named cordgrasses. These are the common tall– and short–form grasses fringing the higher–salinity portions of sandy estuarine systems of the western Atlantic with the Middle Atlantic being their primary range.

Species: In scientific classifications, a group of individuals that share essential features, interbreed and produce similar progeny and possess the same scientific name. This name is typically two parts, consisting of the genus of that group (e.g., Paralichthys) followed by the "specific" name (e.g., dentatus). This name is unique among all life within that kingdom and is subordinate to phylum, class, order, family and genus.

Stellate: Descriptive term for melanophores that appear roughly star–shaped when expanded.

Stock: 1. A separate breeding population of a species. 2. Term used to identify a management unit of fishery species.

Standard length (SL): A method of measuring fish length from the anterior part of the head to the posterior margin of the hypural plates.

Stratified sampling: A study design whereby replicate sampling is conducted in predetermined subsets of a region, e.g., conducting the same standardized trawling program at surface, midwater and bottom in the water column, or at the same depth but within equal–sized blocks of an area.

Subestuary: Smaller system within a larger estuary such as a branching subtidal marsh creek with intertidal tributaries.

Substrate: General term for any benthic habitat.

Subtidal: The shallow water zone, often only a few feet deep, which is influenced by tides but never completely drained at low tide.

Thermocline: A steep, vertical temperature gradient resulting in stratification of the water column.

Tidal stream transport: A mechanism by which some marine life passively move into estuarine systems by entering the water column during flood tides and moving to the bottom during ebb tides, resulting in net up–estuary movement.

Total length (TL): A method of measuring fish length from the most anterior part of the head to the furthest extension of the caudal (tail) fin.

Transformation: Period of transition from the larval stage to the juvenile form characterized by both morphological and physiological changes.

Trophic: Feeding or feeding relationships between animals.

Ultrasonic tag: A fish–marking tag that emits a distinct radio frequency, allowing researchers to track fish movements with a receiver.

Ulva lactuca: Scientific name for the macroalga with the common name sea lettuce. Common to estuaries, it grows in broad, translucent, bright green sheets that are lobed or ruffled at the edges. Initially attaches to the substrate with a short stalk and later drifts free.

Year-class: The fish spawned and hatched in a given year. Distinct from cohort in that some species may have several spawning events in a given year resulting in several cohorts but one year–class.

Yolk sac: A bag–like ventral extension of the gut containing nutritive materials that first appears in the fish embryo and is later absorbed by the larva during the stage after hatching and before feeding.

Young-of-the-Year: Age–0 fish, or those animals born within the past year, which have not yet reached one year of age.

Zostera marina: The scientific name for the plant with the common name eelgrass. Species of submerged angiosperm common to estuaries in the western Atlantic. A broad, flat–bladed grass that is anchored to the bottom by a root–rhizome system and produces stalk–like reproductive bodies.

Appendix A
Comprehensive Summer Flounder Bibliography

1. Abbe, G.R. 1967. An evaluation of the distribution of fish populations of the Delaware River estuary. M.S. Thesis. University of Delaware. 64 pp.

2. Able, K.W., R.E. Matheson, W.W. Morse, M.P. Fahay and G.P. Shepherd. 1990. Patterns of summer flounder (Paralichthys dentatus) early life history in the Mid–Atlantic Bight and New Jersey estuaries. Fishery Bulletin, U.S. **88**(1): 1–12.

3. Adams, S.M. 1976a. The ecology of eelgrass, Zostera marina (L.), fish communities. I. Structural analysis. Journal of Experimental Marine Biology and Ecology **22**: 269–291.

4. ———. 1976b. The ecology of eelgrass, Zostera marina (L.), fish communities. II. Functional analysis. Journal of Experimental Marine Biology and Ecology **22**: 293–311.

5. Agnello, R.J. 1989. The economic value of fishing success: an application of socioeconomic survey data. Fishery Bulletin, U.S. **87**(1): 223–232.

6. Ahlstrom, E.H., K. Amoaka, D.A. Hensley, H.G. Moser and B.Y. Sumida. 1984. Pleuronectiformes: Development. Special Publication 1. Pages 640–670 *in* H.G. Moser, W.J. Richards, D.M. Cohen, M.P. Fahay, A.W. Kendall, Jr. and S.L. Richardson, editors. Ontogeny and Systematics of Fishes. American Society of Ichthyologists and Herpetologists.

7. Allen, D.M. and D.L. Barker. 1990. Interannual variations in larval fish recruitment to estuarine epibenthic habitats. Marine Ecology Progress Series **65**: 113–125.

8. Allen, D.M., J.P. Clymer III and S.S. Herman. 1978. Fishes of the Hereford Inlet estuary, southern New Jersey. Lehigh University and The Wetlands Institute. 138 pp.

9. Allen, D.M., W.K. Michener and S.E. Stancyk. 1984. Pollution ecology of Winyah Bay, S.C.: Characterization of the estuary and potential impacts of energy development. Baruch Institute Special Publication No. 84–1. University of South Carolina, Columbia. 271 pp.

10. Allen, D.M., S.E. Stancyk and W.K. Michener, editors. 1982. Ecology of Winyah Bay, S.C. and potential impacts of energy development. Baruch Institute Special Publication No. 82–1. University of South Carolina, Columbia. 275 pp.

11. Almeida, F.P., R.E. Castaneda, R.V. Jesien, R.C. Greenfield and J.M. Burnett. 1992. Proceedings of the NEFC/ASMFC summer flounder, Paralichthys dentatus, aging workshop; 11–13 June 1990, Northeast Fisheries Center, Woods Hole, Massachusetts. NOAA Technical Memorandum NMFS–F/NEC–89. National Marine Fisheries Service.

Bibliography

12. Alperin, I.M. and J.C. Poole. 1956. Long Island's fluke. New York State Conservationist **11**(3): 16–17.

13. Ames, W.H. 1954. Biological survey of the Delaware River estuary. Biennial Report 1953–1954, 2. University of Delaware, Marine Laboratory. pp. 21–31.

14. Anderson, E.D., J.M. Mason, A.M.T. Lange and C.J. Byrne. 1983. Cod–end mesh selectivity in the Long Island spring trawl fishery for summer flounder and associated species. Document No. 83–33. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 65 pp.

15. Anderson, V.T., Jr. 1978. Reverse summer flounder (Paralichthys dentatus) from the Middle Atlantic Bight. Bulletin of the New Jersey Academy of Science **23**(1): 39–41.

16. Anderson, W.W. 1968. Fishes taken during shrimp trawling along the South Atlantic coast of the United States, 1931–35. Special Scientific Report–Fisheries 570. United States Fish and Wildlife Service. 60 pp.

17. Anderson, W.W. and J.W. Gehringer. 1965. Biological–statistical census of the species entering fisheries in the Cape Canaveral area. Special Scientific Report–Fisheries No. 514. United States Fish and Wildlife Service. 79 pp.

18. Arnold, E.L. 1951. Northward dispersal of warm water fishes in southern New England during the summer of 1949. Copeia 1951.

19. Arve, J. 1960. Preliminary report on attracting fish by oyster–shell plantings in Chincoteague Bay, Maryland. Chesapeake Science **1**: 58–65.

20. Atlantic States Marine Fisheries Commission Subcommittee for Fisheries of the Atlantic Bight. 1966. A summary of current research on the summer flounder. 2 pp.

21. Atlantic States Marine Fisheries Commission Summer Flounder Subcommittee. 1970. Life history of the summer flounder. A report to the Advisory Committee. 10 pp.

22. ———. 1971. Life history of the summer flounder. A report to the Advisory Committee. 8 pp.

23. Azarovitz, T.R., C.J. Byrne, E.S. Bevacqua, L.I. Despres and H.A. Foster. 1980. Distribution and abundance trends of 22 selected species in the Middle Atlantic Bight from bottom trawl surveys during 1967–1979. Final report to BLM, AA550–1A7–35. National Marine Fisheries Service.

24. Azarovitz, T.R., C.J. Byrne, E.S. Pritchard, L.I. Despres–Patanjo and H.A. Foster. 1985. Distribution and abundance trends of 22 selected species in the Middle Atlantic Bight from bottom trawl surveys during 1967–1979. Final Report to United States Mineral Management Service, Contract No. AA 550–1A7–33. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts.

25. Azarovitz, T.R. and M.D. Grosslein. 1987. Chapter 30: Fishes and squids. *In* Backus, R.H. and D.W. Bourne, Editors. Georges Bank. Massachusetts Institute of Technology, Cambridge, Massachusetts.

26. Bailey, R.M., J.E. Fitch, E.A. Herald, E.A. Lachner, C.C. Lindsey, C.R. Robins and W.B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada. Special Publication 6. American Fisheries Society. 150 pp.

27. Baptist, J.P. and T.J. Price. 1962. Accumulation and retention of cesium–137 by marine fishes. Fishery Bulletin, U.S. **62**: 177–187.

28. Bass, D.G., Jr. 1983. North Florida streams research project, Study III: Rivers of Florida and their fishes. Completion Report for Investigations Project, Dingell–Johnson F–36. Florida Game and Fresh Water Fish Commission, Tallahassee.

29. Bean, T.H. 1888. Report on the fishes observed in Great Egg Harbor Bay, New Jersey, during the summer of 1887. Bulletin of the United States Fisheries Commission **7**: 129–154.

30. Bearden, C.M. 1960. Flounders and their cousins – unique fish. South Carolina Wildlife. 5 pp.

31. ———. 1961. Common marine fishes of South Carolina. Contribution Bears Bluff Laboratory 34. 47 pp.

32. Bearden, C.M. and C.H. Farmer, III. 1972. Fishery resources of Port Royal Sound estuary. Pages 204–212 *in* Port Royal Sound environmental study. South Carolina Water Resources Commission, Columbia.

33. Bearden, C.M., R. Low, R. Rhodes, R. Van Dolah, C. Wenner, E. Wenner and D. Whitaker. 1985. A review and analysis of commercial shrimp trawling in the sounds and bays of South Carolina. Technical Report No. 61. South Carolina Marine Resources Center. 51 pp.

34. Beatty, H.R., R.P. Webster and E.L. Wenner. 1989. Temporal and spatial variations in biomass, abundance and community composition of fishes and invertebrates from the coastal habitat, South Atlantic Bight, 1987–1988. Seamap–SA Annual Report. South Carolina Marine Resources Division.

35. Bedsole, H.L., Jr., B.F. Holland, Jr. and J.W. Gillikin, Jr. 1980. State of North Carolina R/V Dan Moore–cruise report no. 38. North Carolina Division of Marine Fisheries. 17 pp.

36. Berg, D.L. and J.S. Levinton. 1985. The biology of the Hudson–Raritan estuary, with emphasis on fishes. NOAA Technical Memorandum NOS OMA 16. National Oceanic and Atmospheric Administration.

37. Berg, M.B. and P. Weller. 1967. Studies of organic acid, sugar, and amino acid transport in isolated perfused flounder tubules. Bulletin of the Mount Desert Island Biological Laboratory **7**: 4–5.

38. Bieder, R.C. 1976. Life history study of the summer flounder. Pages 54–60 *in* C. B. Milstein, D. L. Thomas and Associates, editor. Ecological studies in the bays and waterways near Little Egg Inlet and in the ocean in the vicinity of the proposed site for the Atlantic Generating Station, New Jersey. Progress Report for January – December 1975. Ichthyological Associates Incorporated, Absecon, N.J.

Bibliography

39. Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fishery Bulletin, U.S. **53**(74): 267–270.

40. Bisbal, G.A. and D.A. Bengston. 1993. Reversed asymmetry in laboratory–reared summer flounder. Progressive Fish–Culturist **55**(2): 106–108.

41. Bodammer, J.E. 1980. Ultrastructural studies on the developing cranial cartilage in several species of larval–stage fish. International Council for the Exploration of the Sea Council Meeting 1980. 9 pp.

42. Bolz, G.R., R.G. Lough and D.C. Potter. 1981. Autumn and winter abundance and distribution of ichthyoplankton on Georges Bank and Nantucket Shoals, 1974–76, with special emphasis on dominant species. Rapports et Proces–Verbaux des Reunions, Conseil Permanent International pour l'Exploration de la Mer **178**: 168–170.

43. Bonzek, C.F., P.J. Geer, J.A. Colvocoresses and R.E. Harris. 1991. Juvenile finfish and blue crab stock assessment program bottom trawl survey annual data summary report series, Volume 1990. Special Scientific Report No. 124. Virginia Institute of Marine Science, Gloucester Point. 213 pp.

44. ———. 1992. Juvenile finfish and blue crab stock assessment program bottom trawl survey annual data summary report series, Volume 1991. Special Scientific Report No. 124. Virginia Institute of Marine Science, Gloucester Point.

45. Bozeman, E.L., Jr. and J.M. Dean. 1980. The abundance of estuarine larval and juvenile fish in a South Carolina intertidal creek. Estuaries **3**(2): 89–97.

46. Breder, C.M., Jr. 1922. The fishes of Sandy Hook Bay. Zoologica **2**(15): 331–351.

47. ———. 1948. Field book of marine fishes of the Atlantic coast. G.P. Putnam and Sons, New York. 322 pp.

48. Briggs, J.C. 1958. A list of Florida fishes and their distribution. Bulletin of the Florida State Museum **2**(8): 223–318.

49. Briggs, P.T. 1962. The sport fisheries of Great South Bay and vicinity. New York Fish and Game Journal **9**(1): 1–36.

50. ———. 1965. The sport fishery in the surf on the south shore of Long Island from Jones Inlet to Shinnecock Inlet. New York Fish and Game Journal **12**(1): 31–47.

51. ———. 1968. The sport fisheries for scup in the inshore waters of eastern Long Island. New York Fish and Game Journal **15**: 165–185.

52. ———. 1984. Fish investigation in the vicinity of a sewer outfall under construction off the south shore of Long Island, New York. New York Fish and Game Journal **31**(1).

53. Brown, R.A. and R.J. Pancirov. 1979. Polynuclear aromatic hydrocarbons in Baltimore Canyon fish. Environmental Science Technology **13**(7): 878–879.

54. Bruce, R.A. 1967. North Atlantic trawl nets. Fisheries Leaflet No. 600. United States Fish and Wildlife Service. 23 pp.

55. Buchanan, C.C. 1972. A comparison of sport fishing statistics from man-made and natural habitats in the New York Bight. Proceedings of Sport Fishing Seminar, November 18–19, 1971, Jekyll Island, Georgia. Coastal Plains Center for Marine Development Service, Washington, North Carolina.

56. Buckley, L.J. 1984. RNA/DNA ratio, an index of larval fish growth in the sea. Marine Biology **80**(3): 291–298.

57. Buckley, L.J. and D.W. Dillmann. 1962. Nitrogen utilization of larval summer flounder, Paralichthys dentatus (L.). Journal of Experimental Marine Biology and Ecology **59**(2–3): 243–256.

58. Buller, R.J. and H.S. Spear. 1949. A survey of the sports fishery of the Middle Atlantic Bight in 1948. Special Scientific Report–Fisheries No. 7.

59. Bullis, H.R. and J.R. Thompson. 1965. Collections by the exploratory fishing vessels Oregon, Silver Bay, Combat, and Pelican, made during 1956 to 1960 in the Southwestern North Atlantic. Special Scientific Report–Fisheries No. 510. United States Fish and Wildlife Service.

60. Bulloch, D.K. 1986. Marine gamefish of the Middle Atlantic. Illustrated Paper. American Littoral Society, Highlands, New Jersey.

61. Burke, J.S. 1991. Influence of abiotic factors and feeding on habitat selection of summer and southern flounder during colonization of nursery grounds. Ph.D. Dissertation. North Carolina State University, Raleigh, North Carolina. 108 pp.

62. Burke, J.S. and D.E. Hoss. Unpublished. Substrata preferences of sympatric summer (Paralichthys dentatus, Linnaeus) and southern flounder (P. lethostigma, Jordon and Gilbert) larvae in laboratory experiments. National Marine Fisheries Service, Beaufort Laboratory, North Carolina. 22 pp.

63. Burke, J.S., J.S. Miller and D.E. Hoss. 1991. Immigration and settlement pattern of Paralichthys dentatus and P. lethostigma in an estuarine nursery ground, North Carolina, U.S.A. Proceedings of the First International Symposium on Flatfish Ecology, Texel, 1990, Part 1. Netherlands Journal of Sea Research **27**(3–4): 393–405.

64. Burns, R.W. 1974. Seasonal abundance and diversity of larval fishes in a high–marsh tidal creek. M.S. Thesis. University of South Carolina, Columbia. 54 pp.

65. Burreson, E.M. 1981. Effects of mortality caused by the hemoflagellate Trypanoplasma bullocki on summer flounder populations in the Middle Atlantic Bight. International Council for the Exploration of the Sea Meeting 1981 (Collected Papers). Copenhagen, Denmark. 6 pp.

66. ———. 1982a. The life cycle of Trypanosoma bullocki (Zoomastigophorea: Kinetoplastida). Journal of Protozoology **29**(1): 72–77.

67. ———. 1982b. The ecology and pathology of the hemoflagellate Trypanosoma bullocki in Chesapeake Bay U.S.A. fishes. Proceedings of the 5th International Congress of Parasitology, Toronto, Canada, August 7–14, 1982. Molecular and Biochemical Parasitology (Supplement), 454 pp.

68. Burreson, E.M. and L.J. Frizzell. 1986. The seasonal antibody response in juvenile summer flounder (Paralichthys dentatus) to the hemoflagellate Trypanoplasma bullocki. Veterinary Immunology and Immunopathology **12**(1–4): 395–402.

69. Burreson, E.M. and J.P. Sypek. 1981. Cryptobia sp. (Mastigophora: Kinetoplastida) from the gills of marine fishes in the Chesapeake Bay. Journal of Fish Diseases **4**(6): 519–522.

70. Burreson, E.M. and D.E. Zwerner. 1980. Host range life cycle and pathology of Trypanoplasma bullocki in lower Chesapeake Bay USA fishes. Journal of Protozoology **27**(3): 23A–24A.

71. ———. 1982. The role of host biology, vector biology and temperature in the distribution of Trypanoplasma bullocki infections in the lower Chesapeake Bay, USA. Journal of Parasitology **68**(2): 306–313.

72. ———. 1984. Juvenile summer flounder, Paralichthys dentatus, mortalities in the Western Atlantic Ocean caused by the hemoflagellate Trypanoplasma bullocki; evidence from field and experimental studies. Helgolander Meeresuntersuchungen **37**(1–4): 343–352.

73. Bushing, M.F., L.L. Parker and D.L. Feigenbaum. 1985. Food of fish associated with artificial reefs in the Chesapeake Bay and Virginia's nearshore waters. 63rd Annual Meeting of the Virginia Academy of Science, Williamsburg, Virginia, U.S.A., May 14–17, 1985. Virginia Journal of Science **36**(2). 141 pp.

74. Byrne, C.J. and T.R. Azarovitz. 1982. Summer flounder Paralichthys dentatus. MESA New York Bight Atlas Monograph 15. Pages 109–113 *in* M.D. Grosslein and T.R. Azarovitz, editors. Fish Distribution. New York Sea Grant Institute, Albany, New York.

75. Cable, R.M. and A.V. Hunninen. 1942. Studies on Deropristis inflata (Molin), its life history and affinities to trematodes of the family Acanthocolpidae. Biological Bulletin **82**: 293–312. Marine Biological Laboratory, Woods Hole, Massachusetts.

76. Cain, R.E. 1973. The annual occurrence, abundance, and diversity of fishes in an intertidal creek. M.S. Thesis. University of South Carolina, Columbia. 80 pp.

77. Cain, R.E. and J.M. Dean. 1976. Annual occurrence, abundance and diversity of fish in a South Carolina intertidal creek. Marine Biology **36**: 369–379.

78. Carley, D.H. and C.M. Frisbie. 1968. The blue crab, oyster, and finfish fisheries of Georgia—an economic evaluation. Contribution Series No. 12. Georgia Game Fish Commission. 13 pp.

79. Carlson, J.K. 1991. Trophic relationships among demersal fishes of New Haven Harbor (New Haven, CT) with special emphasis on the winter flounder (Pseudopleuronectes americanus). M.S. Thesis. South Connecticut State University. 79 pp.

80. Carolina Power and Light Company. 1986. 1985 Biological monitoring report.

81. Casey, J.F., R.C. Raynie and A.E. Wesche. 1992. Investigation of Maryland's Atlantic Ocean and coastal bay finfish stocks. Federal Aid Project No. F–50–R–1. Maryland Department of Natural Resources, Tidewater Administration.

82. Chang, S. 1993. Analysis of fishery resources: Potential risk from sewage sludge dumping at the deepwater dumpsite off New Jersey. Fishery Bulletin, U.S. **91**: 594–610.

83. Chang, S. and A.L. Pacheco. 1976. An evaluation of the summer flounder population in subarea 5 and statistical area 6. International Council for the Northwest Atlantic Fisheries, Selected Papers 1.

84. Christensen, D.J. and W.J. Clifford. 1979. Composition of catches made by anglers fishing for summer flounder, Paralichthys dentatus, from New Jersey party boats in 1978. Marine Fisheries Review **41**(12): 28–30.

85. Christensen, D.J., W.J. Clifford and G.P. Shepherd. 1978. Size and age composition of the northern New Jersey party boat catch of summer flounder (Paralichthys dentatus). Reference SHL78–48. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 8 pp.

86. Clark, J.R. 1962. The 1960 salt–water angling survey. Fisheries Circular No. 153. United States Bureau of Sport Fishing and Wildlife. 36 pp.

87. Clark, J.R., W.G. Smith, A.W. Kendall, Jr. and M.P. Fahay. 1969. Studies of estuarine dependence of Atlantic coastal fishes. Technical Paper 28. United States Bureau of Sport Fishing and Wildlife. 132 pp.

88. Clark, S.H. and B.E. Brown. 1975. Changes in biomass of finfish and squid in ICNAF subarea 5 and statistical area 6 as evidenced by Albatross IV autumn survey data. International Council for the Northwest Atlantic Fisheries Research Document 75/65, Series No. 3549. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 22 pp.

89. ———. 1977. Changes in biomass of finfishes and squids from the Gulf of Maine to Cape Hatteras. Fishery Bulletin, U.S. **75**(1): 1–22.

90. Clayton, G., C. Cole, S. Murawski and J. Parrish. 1978. Common marine fishes of coastal Massachusetts. Massachusetts Cooperative Extension Service, Amherst, Massachusetts.

91. Clements, L.C. and D.E. Hoss. 1977. Effects of acclimation time on larval flounder Paralichthys sp. oxygen consumption. Assoc. Southeast Biol. Bull. **24**(2): 43.

92. Clifford, W.J. and D.J. Christensen. 1979. Length frequency of party and charter boat catch of summer flounder (Paralichthys dentatus), 1975–1978. Laboratory Reference SHL 79–25. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey.

93. Coduri, R.J. and H.G. Rand, Jr. 1972. Vertical plate gel electrophoresis for the differentiation of fish and shellfish species. Journal of the Association of Official Analytical Chemists **55**(3): 464–466.

Bibliography

94. Cole, R.W., J.C. Tinsman and R.J. Seagraves. 1985. Technical assistance to commercial fisheries for the period May 1, 1984 – April 30, 1984. Annual Report Project 3–358–D–3, Document #40–05/85/08/05. Delaware Division of Fish and Wildlife, Dover.

95. ———. 1986. Technical assistance to commercial fisheries for the period June 16, 1985 – May 31, 1986. Annual Report Project 3–358–D–4. Delaware Division of Fish and Wildlife, Dover.

96. Colton, J.B., Jr. and R.R. Byron. 1977. Gulf of Maine–Georges Bank ichthyoplankton collected on ICNAF larval herring surveys September 1971–February 1975. NOAA Technical Report NMFS SSRF–717.

97. Colton, J.B., Jr., W.G. Smith, A.W. Kendall, Jr., P.L. Berrien and M.P. Fahay. 1979. Principal spawning areas and times of marine fishes, Cape Sable to Cape Hatteras. Fishery Bulletin, U.S. **76**(4): 911–915.

98. Colton, J.B., Jr. and J.M. St. Onge. 1974. Distribution of fish eggs and larvae in continental shelf waters, Nova Scotia to Long Island. Series Atlas Marine Environment Folio 23. American Geographic Society.

99. Colton, M.D. and R.F. Temple. 1961. The enigma of Georges Bank spawning. Limnology and Oceanography **6**: 280–291.

100. Colvocoresses, J.A. and J.A. Musick. 1980. Section II. NMFS groundfish survey. *In* Historical community structure analysis of finfishes. Special Report Appl. Mar. Sci. Ocn. Eng. No. 198. Virginia Institute of Marine Sciences, Gloucester Point. pp. 45–78.

101. Connecticut Division of Marine Fisheries. 1990a. A study of marine recreational fisheries in Connecticut. Federal Aid to Sport Fisheries Restoration F54R, Annual Performance Report March 1, 1989 – February 28, 1990.

102. ———. 1990b. A study of marine recreational fisheries in Connecticut, 1984–1988. Federal Aid to Sport Fisheries Restoration F54R, Final Report, March 1, 1984 – February 29 1988.

103. ———. 1992. A study of marine fisheries in Connecticut. Federal Aid to Sport Fisheries Restoration F54R, Annual Report, March 1, 1990 – February 29, 1991.

104. Copeland, B.J., R.G. Hodson and R.J. Monroe. 1979. Larvae and post–larvae in the Cape Fear Estuary, North Carolina, during the operation of the Brunswick Steam Electric Plant 1974–1978. Report 79–3. North Carolina Power and Light Company, Raleigh.

105. Copeland, B.J., R.G. Hodson and S.R. Riggs. 1984. The ecology of the Pamlico River, North Carolina: an estuarine profile. FWS/OBS–82–06. United States Fish and Wildlife Service.

106. Copeland, B.J., R.G. Hodson, S.R. Riggs and J.E. Easley, Jr. 1983. The ecology of Albemarle Sound, North Carolina: an estuarine profile. FWS/OBS–83/01. United States Fish and Wildlife Service.

107. Cowan, J.H., Jr. and R.S. Birdsong. 1985. Seasonal occurrence of larval and juvenile fishes in a Virginia Atlantic Coast estuary with emphasis on drums (Family Sciaenidae). Estuaries **8**(1): 48–59.

108. Curley, J.R., R.P. Lawton, D.L. Chadwick, K. Reback and J.M. Hickey. 1974. A study of the marine resources of the Taunton River and Mount Hope Bay. Monograph Series No. 9. Massachusetts Division of Marine Fisheries, Sandwich. 37 pp.

109. Curley, J.R., R.P. Lawton, J.M. Hickey and J.D. Fiske. 1971. A study of the marine resources of the Waquoit Bay–Eel Pond estuary. Monograph Series No. 9. Massachusetts Division of Marine Fisheries, Sandwich. 40 pp.

110. Curley, J.R., K.E. Reback, D.L. Chadwick and R.P. Lawton. 1975. A study of the marine resources of Bass River. Monograph Series No. 16. Massachusetts Division of Marine Fisheries, Sandwich. 33 pp.

111. Dahlberg, M.D. 1970. Frequencies of abnormalities in Georgia estuarine fishes. Transactions of the American Fisheries Society **99**: 95–97.

112. ———. 1971. Habitats and diversity of the fishes in North and South Newport Rivers and adjacent waters. Final Report to Georgia Water Quality Control Board. Pages 32–121 *in* An ecological survey of the North and South Newport Rivers and adjacent waters with respect to possible effects of treated kraft mill effluent. University of Georgia, Marine Institute, Sapelo Island.

113. ———. 1972. An ecological study of Georgia coastal fishes. Fishery Bulletin, U.S. **70**(2): 323–353.

114. ———. 1975. Guide to coastal fishes of Georgia and nearby states. University of Georgia Press, Athens. 187 pp.

115. Dahlberg, M.D. and E.P. Odum. 1970. Annual cycles of species occurrence, abundance, and diversity in Georgia estuarine fish population. American Midland Naturalist **83**(2): 382–392.

116. Daiber, F.C. 1956. Marine sports fishing investigation. Annual Report on Dingell–Johnson Project F–5–R–5, Reference 56–20. 53 pp.

117. ———. 1957. Marine sports fishery investigation. Annual Report on Dingell–Johnson Project F–5–R–4, Reference 57–4. University of Delaware Marine Laboratories. 27 pp.

118. ———. 1958. Marine sports fishery investigation. Annual Report on Dingell–Johnson Project F–5–R–4, Reference 58–5. University of Delaware Marine Laboratories.

119. ———. 1972. Environmental impact of dredge and fill operations in tidal wetlands upon fisheries biology in Delaware. 1972–1973 Report Project F–13–R–15, Job No. III, 1–3. Delaware Division of Fish and Wildlife, Dover.

120. Daiber, F.C. and R.W. Smith. 1968–1972. An analysis of the summer flounder population in the Delaware Bay area. 5 reports. University of Delaware Marine Laboratories, Newark.

121. Daniel, L.B., III. In prep. Shallow marsh habitats as nursery areas for fishes in the lower Chesapeake Bay with notes on selected species.

122. Dawson, C.E. 1962. Notes on anomalous American Heterosomata with descriptions of five new records. Copeia **1992**(1): 38–46.

123. ———. 1971. A bibliography of anomalies of fishes. Supplement 2. Gulf Research Reports **3**(2): 215–239.

124. Deacutis, C.F. 1978. Effect of thermal shock on predator avoidance by larvae of two fish species. Transactions of the American Fisheries Society **107**(4): 632–635.

125. Decker, E.A., M.C. Erickson and H.O. Hultin. 1988. Enzymic lipid oxidative activities of sarcoplasmic reticulum in several species of Northwest Atlantic fish. Comparative Biochemistry and Physiology **91**(1): 7–10.

126. Deegan, L.A., J.T. Finn, S.G. Ayvazian and C. Ryder. 1993. Feasibility and application of the index of biotic integrity to Massachusetts estuaries. Final Project Report, Research and Demonstration Project 88–05, The Years of Study (1988–1990). Massachusetts Department of Environmental Protection.

127. DeGroot, S.J. 1967. A review paper on the behavior of flatfishes. Proceedings of the FAO conference on fish behavior in relation to fishing techniques and tactics, R/7, Vol. II. FAO, Rome.

128. ———. 1969. Digestive system and sensorial factors in relation to feeding behavior of flatfish (Pleuronectiformes). Conseil Permanent International pour l'Exploration de la Mer **32**: 385–395.

129. ———. 1971. On the interrelationships between morphology of the alimentary tract, food and feeding behavior in flatfishes (Pisces: Pleuronectiformes). Netherlands Journal of Sea Research **5**(2): 121–196.

130. Delaney, G.R. 1986. Morphometric and meristic stock identification of summer flounder (Paralichthys dentatus). M.A. Thesis. College of William and Mary, Williamsburg, Virginia.

131. Derickson, W.K. and K. Price, Jr. 1973. The fishes of the shore zone of Rehoboth and Indian River Bays, Delaware. Transactions of the American Fisheries Society **102**(3): 552–562.

132. Dery, L.M. 1983. Use of laminated plastic to impress fish scales. Progressive Fish–Culturist **45**(2): 88–89.

133. ———. 1988. Summer flounder, Paralichthys dentatus. NOAA Technical Report No. 72. Pages 97–102 *in* Age determination methods for Northwest Atlantic species. National Marine Fisheries Service.

134. Desfosse, J.C., J.S. Musick and A.D. Estes. 1988. Stock identification of summer flounder (Paralichthys dentatus) in the southern Mid–Atlantic Bight. VIMS Comm. WB–86–01–02. Virginia Institute of Marine Science, Gloucester Point. 35 pp.

135. Desfosse, J.C., J.A. Musick, A.D. Estes and P. Lyons. 1990. Stock identification of summer flounder (Paralichthys dentatus) in the southern Mid–Atlantic Bight. Final Report submitted to Virginia Marine Resources Commission, WB–86–01–04; Federal Aid for Sports Fisheries Restoration, F–61–R. College of William and Mary, Virginia Institute of Marine Science, Gloucester Point.

136. Despres–Patanjo, L. and R.A. Murchelano. 1981. Results of an initial survey to evaluate fish health in the western North Atlantic. International Council for the Exploration of the Sea Council Meeting 1981. Copenhagen, Denmark. 13 pp.

137. de Sylva, D.P. and F.A. Kalber. 1960. Investigations of the fishes captured by trawls in the Delaware Bay area. Marine Sport Fishery Investigation, Federal Aid to Fish and Wildlife Restoration, Delaware Project F–13–R–3, Reference 60–7. University of Delaware Marine Laboratories. 26 pp.

138. de Sylva, D.P., F.A. Kalber and C.N. Shuster, Jr. 1962. Fishes and ecological conditions in the shore zone of the Delaware River estuary, with notes on other species collected in deeper water. Project F–13–R–1–2–3, Information Series Publication No. 5. University of Delaware Marine Laboratories. 164 pp.

139. Deubler, E.E., Jr. 1958. A comparative study of the post–larvae of three flounders (Paralichthys) in North Carolina. Copeia **1958**(2): 112–116.

140. Deubler, E.E, Jr. and W.E. Fahy. 1958. A reversed ambicolorate summer flounder, Paralichthys dentatus. Copeia **1958**(1): 55.

141. Deubler, E.E., Jr. and J.C. White, Jr. 1962. Influence of salinity on growth of postlarvae of summer flounder, Paralichthys dentatus. Copeia **1962**(2): 468–469.

142. Deuel, D.G. 1973. The 1970 salt–water angling survey. Current Fisheries Statistics 6200. National Marine Fisheries Service.

143. Deuel, D.G. and J.R. Clark. 1968. The 1965 salt–water angling survey. Resource Publication 67. United States Fish and Wildlife Service. 51 pp.

144. DeVries, D.A. 1981. Stock assessment of adult fishes in the Core Sound, North Carolina area. Completion Report for Project 2–326–R. North Carolina Division of Marine Fisheries. 16 pp.

145. DeVries, D.A. and C.H. Harvell. 1982. Inshore Paralichthid flounder tagging. Completion Report for Project 2–372–R. Pages 137–156 *in* North Carolina Estuarine Finfish Management Program. North Carolina Division of Marine Fisheries.

146. Dovel, W.L. 1981. Ichthyoplankton of the lower Hudson estuary, New York. New York Fish and Game Journal **28**(1): 21–39.

147. DuPaul, W. and S. Baker. 1979. The economic impact and status of the offshore fishing industry in Virginia. Special Report 67. Virginia Institute of Marine Science, Gloucester Point. 51 pp.

148. Ecological Analysts Engineering Science and Technology Incorporated. 1986. Entrainment and impingement studies at Oyster Creek Nuclear Generating Station 1984 – 1985. Sparks, Maryland.

149. Ecological Analysts Incorporated. 1980–1984. Ecological studies at Oyster Creek Nuclear Generating Station. Progress Reports for September 1979 – August 1980, September 1980 – September 1981, September 1981 –August 1982, and September 1982 – August 1983. Sparks, Maryland.

150. Edwards, R.L. 1964. Relation of temperature to fish abundance and distribution in the southern New England area. Contribution No. A–16, International Council for the Northwest Atlantic Fisheries Environmental Symposium, Rome, 27 January – 1 February, 1964. 16 pp.

151. Edwards, R.L. and R.E. Bowman. 1979. Food consumed by continental shelf fishes. Pages 387–406 *in* Predator–prey systems in fisheries management. Sport Fisheries Institute.

152. Edwards, R.L., R. Livingstone and P.E. Hamer. 1962. Winter water temperatures and annotated list of fishes—Nantucket Shoals to Cape Hatteras. Special Scientific Report–Fisheries No. 397. United States Fish and Wildlife Service.

153. Eerly, S.P. 1984. Fishes of the Pamlico–Albemarle Peninsula, North Carolina, area utilization and potential impacts. Special Science Report No. 42. North Carolina Division of Marine Fisheries. 129 pp.

154. Eerly, S.P. and S.W. Ross. 1986. Characterization of the North Carolina Pamlico–Albemarle estuarine complex. Technical Memorandum NMFS–SEFC–175. National Marine Fisheries Service. 55 pp.

155. Eklund, A. and T.E. Targett. 1991. Seasonality of fish catch rates and species composition from the hard bottom trap fishery in the Middle Atlantic Bight (U.S. East Coast). Fisheries Research **12**: 1–22.

156. Eldridge, P.J. 1962. Observations on the winter trawl fishery for summer flounder, Paralichthys dentatus. M.A. Thesis. College of William and Mary, Williamsburg, Virginia. 371 pp.

157. Essig, R.J., J.F. Witzig and M.C. Holliday. 1991. Marine recreational fishery statistics survey, Atlantic and Gulf coasts, 1987–1989. Current Fisheries Statistics 8904. National Marine Fisheries Service. 363 pp.

158. Fahay, M.P. 1983. Guide to the early stages of marine fishes occurring in the western North Atlantic Ocean, Cape Hatteras to the southern Scotian Shelf. Journal of Northwest Atlantic Fishery Science **4**: 423.

159. Farmanfarmaian, A., M. Eisenberg, R. Socci, V. Iannaccone and R. Hsia. 1981. Interaction of mercury compounds with leucine transport in the intestine of winter and summer flounder. Biological Bulletin, Volume 161. Marine Biological Laboratory, Woods Hole, Massachusetts. 325 pp.

160. Fee, R. 1989. St. Johns River fish and fishermen are in trouble. National Fisherman **89**(10): 24–26.

161. Festa, P.J. 1974a. A study of the distribution of young and larval summer flounder in New Jersey estuarine waters. Miscellaneous Report 11m. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station. 30 pp.

162. ———. 1974b. Analysis of market size composition data for the New Jersey summer flounder commercial fishery – 1967 through 1972. Miscellaneous Report 12M. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station. 24 pp.

163. ———. 1974c. Creel census of the summer flounder sport fishery in Great Bay, New Jersey. Project Report, Federal Aid Project F–15–R–15. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station.

164. ———. 1975. Creel census of the summer flounder, Paralichthys dentatus, sportfishery in Great Bay, New Jersey. Project F–15–R. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station.

165. ———. 1976. Observations on the summer flounder (Paralichthys dentatus) sport fishery in Great Bay, N.J. Technical Report No. 19M. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station. 62 pp.

166. ———. 1977. Observations on the summer flounder (Paralichthys dentatus) sport fishery in Great Bay, N.J. during the summer of 1976 in reference to anoxic water conditions. Pages 463–470 *in* Oxygen depletion and associated environmental disturbances in the Middle Atlantic Bight in 1976. NOAA Technical Series Report No. 3. National Marine Fisheries Service.

167. ———. 1979a. Analysis of the fish forage base in the Little Egg Harbor Estuary. Technical Report No. 24M. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station.

168. ———. 1979b. Creel census of the summer flounder Paralichthys dentatus sport fishery in Great Bay, New Jersey. Technical Report No. 19M. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station. 21 pp.

169. Figley, W. 1977. Sex ratios within length groups of commercially caught summer flounder in New Jersey, 1962–1964. Technical Report 20M. New Jersey Division of Fish, Game and Shellfisheries, Trenton. 16 pp.

170. Figley, W. and K. Lockwood. 1976. Commercial and recreational marine fisheries statistics of New Jersey. Technical Report No. 23M. New Jersey Division of Fish, Game and Shellfisheries, Trenton. 59 pp.

171. Fiske, J.D., J.R. Curley and R.P. Lawton. 1968. A study of the marine resources of the Westport River. Monograph Series No. 7. Massachusetts Division of Marine Fisheries, Sandwich. 52 pp.

172. Fiske, J.D., C.E. Watson and P.G. Coates. 1967. A study of the marine resources of Pleasant Bay. Monograph Series No. 5. Massachusetts Division of Marine Fisheries, Sandwich. 56 pp.

173. Florida Department of Natural Resources. 1983. Summary of Florida commercial landings. Florida Division of Marine Resources, Tallahassee.

174. Fogarty, M.J. 1981. A review and assessment of the summer flounder (Paralichthys dentatus) fishery in the northwest Atlantic. Laboratory Reference Document 81–25. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 54 pp.

175. Fogarty, M.J., G. Delaney, J.W. Gillikin, Jr., J.C. Poole, D.E. Ralph, P.G. Scarlett, R.W. Smith and S.J. Wilk. 1983. Stock discrimination of summer flounder (Paralichthys dentatus) in the Middle and South Atlantic Bights: results of a workshop. Technical Memorandum NMFS–F/NEC–18. National Marine Fisheries Service, Woods Hole, Massachusetts. 14 pp.

176. Fowler, H.W. 1906. The fishes of New Jersey. Annual Report 1905. New Jersey State Museum.

177. ———. 1911. The fishes of Delaware. Proceedings of the Academy of Natural Sciences of Philadelphia **63**: 3–16.

178. ———. 1914a. Notes on New Jersey fishes. Copeia **1914**(13). 2 pp.

179. ———. 1914b. Notes on the fishes at Ocean City, Maryland. Copeia **1914**(2).

180. ———. 1916. Notes on New Jersey fishes, several new to the state. Copeia **1916**(27): 10–12.

181. ———. 1919. Records of northern New Jersey fishes. Copeia **1919**(31): 41–42.

182. ———. 1920. A list of the fishes of New Jersey. Proceedings of the Biological Society of Washington **33**: 139–170.

183. ———. 1952. A list of the fishes from the coast of New Jersey, with a list of offshore species. Proceedings of the Academy of Natural Sciences of Philadelphia **109**: 89–151.

184. Freeman, B.L. and S.C. Turner. 1977. The effects of anoxic water on the summer flounder (Paralichthys dentatus), a bottom dwelling fish. NOAA Technical Series Report No. 3. Pages 451–462 *in* Oxygen depletion and associated environmental disturbances in the Middle Atlantic Bight in 1976. National Marine Fisheries Service.

185. Freeman, B.L., S.C. Turner and D.J. Christensen. 1976. A preliminary report on the fishery for bluefin tuna (Thunnus thynnus) off New Jersey in relation to the catches made by party boat anglers during 1975. Informal Report 108. National Marine Fisheries Service, Sandy Hook Laboratory, Highlands, New Jersey.

186. Freeman, B.L. and L.A. Walford. 1974–1976. Anglers' guide to the United States Atlantic coast. Sections II–VII. Nantucket Shoals to Fort Pierce Inlet, Florida. National Marine Fisheries Service.

187. Gabriel, W.L. 1992. Persistence of demersal fish assemblages between Cape Hatteras and Nova Scotia, northwest Atlantic. Journal of the Northwest Atlantic Fisheries Science **14**: 29–46.

188. Gallagher, M.L., M.L. Harrell and R.A. Rulifson. 1991. Variation in lipid and fatty acid contents of Atlantic croakers, striped mullet and summer flounder. Transactions of the American Fisheries Society **120**(5): 614–619.

189. Gartner, J.V., Jr. 1986. Observations on anomalous conditions in some flatfishes (Pisces: Pleuronectiformes), with a new record of partial albinism. Environmental Biology of Fishes **17**(2): 141–152.

190. Geer, P.J., C.F. Bonzek, J.A. Colvocoresses and R.E. Harris. 1990. Juvenile finfish and blue crab stock assessment program bottom trawl survey annual data summary report series, Volume 1989. Special Scientific Report No. 124. Virginia Institute of Marine Science, Gloucester Point. 211 pp.

191. Gerhart, E.H. 1977. Concentrations of total mercury in several fishes from Delaware Bay U.S.A. Pesticide Monitoring Journal **11**(3): 132–133.

192. Gilbert, C.R. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Florida) southern, Gulf, and summer flounders. Biological Report 82(11,54). United States Fish and Wildlife Service. 24 pp.

193. Gillikin, J.W., Jr. Unpublished. Results of tagging studies on summer flounder in North Carolina. North Carolina Division of Marine Fisheries, Morehead City.

194. ———. 1982. Evaluation of trawl mesh selectivity and summer flounder in North Carolina. North Carolina Department of Natural Resources and Community Development. 65 pp.

195. Gillikin, J.W., Jr., B.F. Holland, Jr. and R.O. Guthrie, Capt. 1981. Net mesh selectivity in North Carolina's winter trawl fishery. SSR No. 37. North Carolina Department of Natural Resources and Community Development. 65 pp.

196. Gillikin, J.W., Jr. and B.F. Holland. Unpublished. Summary of summer flounder (Paralichthys dentatus) maturity data from the Atlantic Ocean offshore North Carolina. North Carolina Division of Marine Fisheries.

197. Gilmore, R.G., Jr. 1974. A regional description and checklist of fishes of the Indian River. Annual Report. Pages 110–183 *in* D. Young, editor. Indian River Coastal Zone Study 1973–1974, Volume 1. Harbor Branch Consortium, Fort Pierce, Florida.

198. ———. 1977. Fishes of the Indian River Lagoon and adjacent waters, Florida. Bulletin of the Florida State Museum, Biological Sciences **22**(3): 101–148.

199. Gilmore, R.G., Jr., C.J. Donohoe, D.W. Cooke and D.J. Herrema. 1981. Fishes of the Indian River Lagoon and adjacent waters. Technical Report No. 41. Harbor Branch Foundation, Incorporated.

200. Ginsburg, I. 1952. Flounder of the genus Paralichthys and related genera in American waters. Bulletin of the United States Fish and Wildlife Service **52**: 316–324.

201. Goldman, J.C. 1978. Combined toxicity effects of chlorine, ammonia, and temperature on marine plankton. Progress Report, November 1976–January 1978, EY–76–S–02–2532. Department of Energy. 6 pp.

202. Goldstein, R.J. 1985. Winter kill of summer flounder. Sea Frontier **31**(2): 104–111.

203. Goode, G.B. 1884. Natural history of useful aquatic animals. Part 3, The food fishes of the U.S. Pages 169–549, 610–612, 629–681 *in* Fishery Industry U.S. Section 1.

204. Gordon, B.L. 1960. A guide to the marine fishes of Rhode Island. Book and Tackle Shop, Watch Hill. 136 pp.

205. Greenwood, P.H., D.E. Rosen, S.H. Weitzman and G.S. Myer. 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. Bulletin of the American Museum of Natural History **131**: 339–455.

206. Grimes, B.H., M.T. Huish, J.H. Kerby and D. Moran. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid–Atlantic). Summer and winter flounder. Biological Report 8 (11.12). United States Fish and Wildlife Service. 27 pp.

207. Grosslein, M.D. 1969. Groundfish survey program of BCF, Woods Hole. Commercial Fisheries Review **31**: 22–30.

208. Grosslein, M.D. and T.R. Azarovitz. 1982. Fish Distribution. Monograph 15. MESA New York Bight Atlas. New York Sea Grant Institute, Albany. 182 pp.

209. Grosslein, M.D. and E. Bowman. 1973. Mixtures of species in subareas 5 and 6. International Council for the Northwest Atlantic Fisheries Research Document 73/9. National Marine Fisheries Service.

210. Grosslein, M.D., E.G. Heyerdahl and H. Stern, Jr. 1973. Status of the international fisheries off the Middle Atlantic coast. Laboratory Reference 73–4. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts.

211. Gudger, E.W. 1935. Two partially ambicolorate flatfishes (Heterosomata). American Museum Novitates. 8 pp.

212. ———. 1935. Abnormalities in flatfishes (Heterostomata). Journal of Morphology **58**(1): 1.

213. ———. 1936. A reversed almost wholly ambicolorate summer flounder, Paralichthys dentatus. American Museum Novitates **896**. 5 pp.

214. Gunter, G. 1956. A revised list of euryhaline fishes of North and Middle America. American Midland Naturalist **56**: 345–354.

215. Gusey, W.F. 1976. The fish and wildlife resources of the Middle Atlantic Bight. Environmental Affairs, Shell Oil Co., Houston, Texas.

216. Gutherz, E.J. 1967. Field guide to the flatfishes of the family Bothidae in the Western North Atlantic. Circular No. 263. United States Fish and Wildlife Service, Bureau of Commercial Fisheries.

217. Halgren, B. and P.G. Scarlett. 1985. Briefing document for mesh selectivity for summer flounder. New Jersey Division of Fish, Game and Wildlife.

218. Hamer, P.E. and F.E. Lux. 1962. Marking experiments on fluke (Paralichthys dentatus) in 1961. Minutes of the 21st Meeting of the North Atlantic Section, Atlantic States Marine Fisheries Committee, Dinkler–Plaza Hotel, Atlanta, Georgia, September 27, 1962. Appendix MA–6.

219. Hargis, W. J., Jr. 1985. Quantitative effects of marine disease on fish and shellfish populations. Pages 608–640 *in* K. Sabol, editor. Transactions of the Fiftieth North American Wildlife and Natural Resources Conference. Taking stock: Resource Management in the 50th Year, Washington, D.C., U.S.A., March 15–20, 1985. Wildlife Management Institute, Washington, D.C.

220. Hassler, W.W., N.L. Hill and J.T. Brown. 1981. The status and abundance of striped bass, Morone saxatilis, in the Roanoke River and Albemarle Sound, North Carolina, 1956–80. Special Science Report No. 38. North Carolina Division of Marine Fisheries. 156 pp.

221. Hawkins, J.H. 1982. Estuarine fish stock assessment–nursery area monitoring. Completion Report Project 2–372–R. *In* North Carolina Estuarine Finfish Management Program. North Carolina Division of Marine Fisheries.

222. Henderson, E.M. 1979. Summer flounder (Paralichthys dentatus) in the northwest Atlantic. Laboratory Reference No. 79–31. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts.

223. Hennemuth, R.C. 1968. Results of the joint USA–USSR groundfish studies: part 1. Comparative fishing experiments. International Council for the Northwest Atlantic Fisheries Research Document 68/86, Series No. 2074.

224. Hensley, D.A. and E.H. Ahlstrom. 1984. Pleuronectiformes: Relationships. Pages 670–687 *in* H.G. Moser, et al., editor. American Society of Ichthyologists and Herpetologists, Special Publication 1.

225. Herman, S.S. 1963. Planktonic fish eggs and larvae of Narragansett Bay. Limnology and Oceanography **8**: 103–109.

226. Herold, R.C. 1970. Vasodentine and mantle dentine in teleost fish teeth. A comparative microradiographic analysis. Arch. Oral. Biol. **15**: 71–85.

227. Hester, J.M. and B.J. Copeland. 1975. Nekton population dynamics in the Albemarle Sound and Neuse River estuaries. Sea Grant Publication UNC–SG–75–02. University of North Carolina.

228. Hettler, W.F., Jr. 1989. Nekton use of regularly–flooded saltmarsh cordgrass habitat in North Carolina, USA. Marine Ecology Progress Series **56**: 111–118.

229. Hettler, W.F., Jr. and A.J. Chester. 1990. Temporal distribution of ichthyoplankton near Beaufort Inlet, North Carolina. Marine Ecology Progress Series **68**: 157–168.

230. Hicks, B. 1972. Seasonal distribution and relative abundance of fishes in the channel reaches and shore areas. Pages 193–195 *in* M. Thompson, editor. Port Royal Sound environmental study. South Carolina Water Resources Commission, Columbia.

231. Hildebrand, S.F. and L.E. Cable. 1930. Development and life history of fourteen teleostean fishes at Beaufort, N.C. Bulletin of the United States Bureau of Fisheries **46**: 383–488.

232. ———. 1938. Further notes on the development and life history of some teleosts at Beaufort, North Carolina. Bulletin of U.S. Bureau of Fisheries **48**(24): 505–642.

233. Hildebrand, S.F. and W.C. Schroeder. 1928. Fishes of Chesapeake Bay. Part I. Bulletin of the United States Bureau of Fisheries **43**.

234. Hillman, R.J. 1977. Summer flounder. Pages 109–112 *in* Ecological studies for the Oyster Creek Generating Station. Progress Report for September 1975–August 1976. Ichthyological Associates Incorporated, Ithaca, New York.

235. Himchak, P.J. 1979a. Creel census of the summer flounder, Paralichthys dentatus, sportfishery in Great Bay, New Jersey. Report on Dingell–Johnson Project F–15–R. New Jersey Division of Fish, Game and Shellfisheries, Trenton. 22 pp.

236. ———. 1979b. Food items of important fishfood organisms in the Little Egg Harbor estuary. Progress Report on Dingell–Johnson Federal Aid to Fisheries Project. New Jersey Division of Fish, Game and Shellfisheries, Trenton. 16 pp.

237. ———. 1979c. Ichthyplankton study. Miscellaneous Report 47–M. Pages 109–129 *in* Studies of the back bay systems in Atlantic County, Final Report for Project 3–223–R–3. New Jersey Division of Fish, Game and Shellfisheries, Trenton.

238. ———. 1982. Distribution and abundance of larval and young finfishes in the Maurice River and in the waterways near Atlantic City, New Jersey. M.S. Thesis. Rutgers University, New Brunswick. 78 pp.

239. Hodgins, H.O., B.B. McCain and J.W. Hawkes. 1977. Marine fish and invertebrate diseases, host disease resistance, and pathological effects of petroleum. *In* D. C. Malins, editor. Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. Volume II. Biological Effects. Academic Press, New York.

240. Hoese, H.D. 1973. A trawl study of nearshore fishes and invertebrates of the Georgia coast. Contributions in Marine Science **17**: 63–98.

241. Hoffman, W.G., II. 1991. Temporal and spatial distribution of ichthyofauna inhabiting the shallow marsh habitats of the Charleston Harbor estuary. M.S. Thesis. College of Charleston, South Carolina.

242. Holland, B.F. 1991. Summary of summer flounder (Paralichthys dentatus) tagging data from the Atlantic Ocean offshore North Carolina and Virginia. North Carolina Division of Marine Fisheries.

243. Horwitz, R.J. 1978. Chapter 6: Fish. *In* K.L. Heck, Jr., editor. Lecture notes on coastal and estuarine studies, 23: Ecological studies in the middle reach of Chesapeake Bay, Calvert Cliffs. Springer–Verlag, Berlin–Heidelberg–New York.

244. Hoss, D.E. 1964. Accumulation of Zinc–65 by flounder of the genus Paralichthys. Transactions of the American Fisheries Society **93**(4): 364–368.

245. ———. 1967. Marking post–larval Paralichthid flounders with radioactive elements. Transactions of the American Fishery Society **96**(2): 151–156.

246. Hoss, D.E., L.C. Coston and W.E. Schaaf. 1974. Effects of sea water extracts of sediments from Charleston Harbor, S.C., on larval estuarine fishes. Estuarine, Coastal and Marine Science **2**: 323–328.

247. Hoss, D.E., W.F. Hettler and L.C. Coston. 1974. Effects of thermal shock on larval estuarine fish—ecological implications with respect to entrainment in power plant cooling systems. Pages 357–371 *in* J.H.S. Blaxter, editor. The Early Life History of Fish. Springer–Verlag, Berlin–Heidelberg–New York.

248. Hottell, H.E., D.R. Holder and C.E. Croomer, Jr. 1983. A fishery survey of the Altamaha River. Final Report F–29–10. Georgia Department of Natural Resources, Game Fish Division.

249. Howe, A.B. and B.T. Estrella. 1978. Fisheries resource assessment: winter flounder and other species. Massachusetts Division of Marine Fisheries, Sandwich.

250. Hughes, E.H. 1980. Estuarine subtidal food webs analyzed with stable carbon isotopic ratios. M.S. Thesis. University of Georgia, Athens. 110 pp.

251. Hughes, E.H. and E.B. Sherr. 1983. Subtidal food webs in a Georgia estuary: C analysis. Journal of Experimental Marine Biology and Ecology **67**: 227–242.

252. Hussakoff, L. 1914. On two ambicolorate specimens of the summer flounder, (Paralichthys dentatus), with an explanation of ambicoloration. Bulletin of the American Museum of Natural History **33**: 95–100.

253. Hyle, R.A. 1967. Fishes of the Newport River estuary, North Carolina, their composition, seasonality, and community structure, 1970–72. Ph.D. Dissertation. University of North Carolina, Chapel Hill. 192 pp.

254. Ichthyological Associates. 1970–1971. Ecological study of the Delaware River in the vicinity of Artificial Island. Progress Reports for January–December 1969 (Parts One and Two) and January–December 1970 (Parts I and II). Middletown, Delaware.

255. Ichthyological Associates Incorporated. 1972. Ecological considerations for ocean sites off New Jersey for proposed nuclear generating stations. Volume 1, Part 1. Ithaca, New York.

256. ———. 1973–1977. Ecological studies in the bays and other waterways near Little Egg Inlet and in the ocean in the vicinity of the proposed site for the Atlantic Generating Station, New Jersey. Progress Reports for January–December 1972 (Parts One and Two), January–December 1973 (Volumes One, Two and Three), January–December 1974 (Volumes One and Two) and January–December 1975, and Summary Report for 1972–1975. Ithaca, New York.

257. ———. 1976–1977. An ecological study of the Delaware River in the vicinity of Artificial Island. Progress Reports for January–December 1974 (Volumes One and Two), January–December 1975 and January–December 1976. Ithaca, New York.

258. ———. 1977–1979. Ecological studies for the Oyster Creek Generating Station. Progress Reports for September 1975–August 1976 (Volumes One and Two), September 1976–August 1977 (Volumes One and Two), and September 1977–August 1978. Ithaca, New York.

259. Industrial Fishery Project. 1956. The flounder and industrial fishery project. Interim Report–North Atlantic Fishery Investigation. Woods Hole, Massachusetts. 4 pp.

260. International Gamefish Association. 1992. Yearly update of new and historical angling records.

261. Ishibashi, N. 1974. Feeding, starvation and weight changes of early fish larvae. Pages 339–344 *in* J.H.S. Blaxter, editor. The Early Life History of Fish. Springer–Verlag, Berlin.

262. Itzkowitz, N., J.R. Schubel and P.M.J. Woodhead. 1983. Responses of summer flounder, Paralichthys dentatus, embryos to thermal shock. Environmental Biology of Fishes **8**: 125–135.

263. Jansen, M.E. and E.M. Burreson. 1990. Parasites of summer flounder, Paralichthys dentatus, in the Chesapeake Bay. Journal of the Helminthological Society of Washington **57**(1): 31–39.

264. Jeffries, H.P. and W.C. Johnson. 1974. Seasonal distributions of bottom fishes in the Narragansett Bay area: Seven–year variations in the abundance of winter flounder (Pseudopleuronectes americanus). Journal of the Fisheries Research Board of Canada **31**(6): 1057–1066.

265. Jeffries, H.P. and M. Terceiro. 1985. Cycle of changing abundances in the fishes of the Narragansett Bay Area. Marine Ecology Progress Series **25**: 239–244.

266. Jensen, A.C. 1967. A brief history of the New England offshore fisheries. Fishery Leaflet 594. United States Fish and Wildlife Service. 14 pp.

267. ———. 1974. New York's fisheries for scup, summer flounder, and black sea bass. New York Fish and Game Journal **21**: 126–134.

268. ———. 1975. Artificial fishing reefs. Marine Ecosystems Analysts, New York Bight Atlas Monograph.

269. Jesien, R.V. and C.H. Hocutt. 1991. Tagging studies and stock characterization of summer flounder (Paralichthys dentatus) in Maryland's coastal waters near Ocean City, Md. Final Report to Maryland Department of Natural Resources, Tidewater Administration. University of Maryland, Horn Point Environmental Laboratory, Cambridge.

270. Jesien, R.V., C.H. Hocutt and S.K. Gaichas. 1992. Tagging studies and stock characterization of summer flounder, Paralichthys dentatus, in Maryland coastal waters near Ocean City, Md. Progress Report to Maryland Department of Natural Resources, Tidewater Administration, Contract No. F252–92–008. University of Maryland, Horn Point Environmental Laboratory, Cambridge.

271. Johns, D.M. and W.H. Howell. 1980. Yolk utilization in summer flounder (Paralichthys dentatus) embryos and larvae reared at two temperatures. Marine Ecology Progress Series **2**: 1–8.

272. Johns, D.M., W.H. Howell and G. Klein–MacPhee. 1981. Yolk utilization and growth to yolk–sac absorption in summer flounder (Paralichthys dentatus) larvae at constant and cyclic temperatures. Marine Biology **63**: 301–308.

273. Johnson, K.L. 1979. Yield per recruit analysis for summer founder (Paralichthys dentatus). Laboratory Reference 79–34. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 2 pp.

274. Jones, R.S., R.G. Gilmore, Jr., G.R. Kulczyck, W.C. Magley, and B. Graunke. 1975. Studies of the fishes of the Indian River Coastal Zone, pp. 57–88 *in* D.K. Young (editor), Indian River Coastal Zone Study 1974–1975. Annual Report. Harbor Branch Consortium, Fort Pierce, Florida.

275. Jordan, D.S. and B.W. Evermann. 1896. The fishes of North and Middle America. Bulletin of the United States National Museum **47**(1–4). 3313 pp.

276. Jordan, D.S. and D.K. Goss. 1889. A review of the flounders and soles (Pleuronectidae) of America and Europe. Pages 225–342 *in* United States Commercial Fisheries Report 1886.

277. Jorgenson, S.C. and G.L. Miller. 1968. Length relations of some marine fishes from coastal Georgia. Special Scientific Report–Fisheries No. 575. United States Fisheries and Wildlife Service.

278. Judy, M.H. 1982. Catch composition, seasonality and distribution of ichthyoplankton from R/V Onslow Bay monthly cruises in Onslow Bay and Newport River estuary, North Carolina, 1972–1974. NOAA Technical Memorandum 46. National Marine Fisheries Service, Southeast Fisheries Center.

279. June, F.E. and J.W. Reintjes. 1957. Survey of the ocean fisheries off Delaware Bay. Special Scientific Report–Fisheries No. 22. United States Fish and Wildlife Service. 55 pp.

280. Junqueira, L.C.U., F. Reinach and L.M.M. Salles. 1977. The presence of spontaneous and induced filaments in the melanophores of three species of teleost. Archivum Histol. **40**(5): 435–443.

281. Junqueira, L.C.U. and L.M.M. Salles. 1978. Effects of 6–hydroxydopamine and 5–hydroxydopamine on teleost melanophores innervation. Journal of Fish Biology **13**(4): 415–419.

282. Keefe, M. and K.W. Able. 1992. Habitat quality in New Jersey estuaries: habitat–specific growth rates of juvenile summer flounder in vegetated habitats. Final Report for the New Jersey Department of Environmental Protection & Energy.

283. ———. 1993. Patterns of metamorphosis in summer flounder, Paralichthys dentatus. Journal of Fish Biology **42**:713–728.

284. ———. 1994. Contributions of abiotic and biotic factors to settlement in summer flounder, (Paralichthys dentatus). Copeia 1994(2):458–465.

285. Keirans, W.J., Jr. 1977. An immunochemically assisted ichthyplankton survey with elaboration on species specific antigens of fish egg vitellins; southern New Jersey barrier–lagoon complex. Ph.D. Dissertation. Lehigh University. 159 pp.

286. Keirans, W.J., Jr., S.S. Herman and R.G. Malsberger. Unpublished. Fish eggs and larvae of the Hereford Inlet estuary, southern New Jersey. 22 pp.

287. Keiser, R.K. 1976. Species composition and utilization of the incidental catch of the South Carolina shrimp fishery. Technical Report No. 16. South Carolina Wildlife and Marine Resources Department.

288. Kemmerle, S. and A. Meredith. 1977. Cape May County commercial fishing industry: economic and marketing considerations. Rutgers University Agricultural Experiment Station, New Brunswick, New Jersey.

289. Kendall, A.W., Jr. 1975. Patterns of larval fish distribution in the Middle Atlantic Bight. Conference at Brookhaven National Laboratory. *In* Effects of energy–related activities on the Atlantic Continental Shelf. Upton, New York.

290. Kerr, G.A. 1976. Inventory – Indian River Coastal Zone Study 1975–1976 Annual Report. Volume 2. Harbor Branch Consortium, Fort Pierce, Florida.

291. Keup, L. and J. Bayless. 1964. Fish distributions at varying salinities in Neuse River basin, North Carolina. Chesapeake Science **5**: 119–123.

292. Kimmel, J.J. 1973. Food and feeding of fish from Magothy Bay, Virginia. M.S. Thesis. Old Dominion University. 190 pp.

293. Kindred, J.E. 1971. An attempt at a subjective and objective classification of the acidophilic granulocytes of some marine fishes. Biological Bulletin **140**: 416–426.

294. Kirsch, R. 1978. Role of the esophagus in osmoregulation in teleost fishes. *In* C. B. Jorgensen and E. Skadhauge, editor. Proceedings of the Alfred Benson Symposium. Volume 11. Osmotic and Volume regulation, June 5–9, 1977, Copenhagen, Denmark. 512 pp. Muksgaard, Copenhagen, Denmark.

295. Klein–MacPhee, G. 1971. Behavior, metabolism and growth of laboratory–reared summer flounder. Ph.D. Dissertation. University of Rhode Island.

296. ———. 1980. Growth, activity and metabolism studies of summer flounder, Paralichthys dentatus (L.), under laboratory conditions. Dissertation Abstracts International (B) **40**(10): 4695.

297. ———. 1981. Effects of stocking density on survival of laboratory cultured summer flounder, Paralichthys dentatus, larvae. Rapports et Proces–Verbaux des Reunions, Conseil Permanent International pour l'Exploration de la Mer **178**: 505–506.

298. Kuntz, A. and L. Radcliffe. 1917. Notes on the embryology and larval development of twelve teleostean fishes. Document 849. Bulletin of the United States Bureau of Fisheries **35**: 87–134.

299. Kyle, H.M. 1921. The asymmetry, metamorphosis, and origin of flatfishes. Philosophical Transactions of the Royal Society of London, Series B **211**: 75–129.

300. Lange, A.M.T. 1984. Long–term effects on summer flounder. Laboratory Reference Document No. 84–04. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 13 pp.

301. Langton, R.W. 1979. Food of nine Northwest Atlantic Pleuronectiform fishes. Laboratory Reference No. 79–17. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 83 pp.

302. Langton, R.W. and R.E. Bowman. 1981. Food of nine Northwest Atlantic Pleuronectiform fishes. Laboratory Reference No. 79–17. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 83 pp.

303. ———. 1981. Food of eight Northwest Atlantic Pleuronectiform fishes. Special Scientific Report–Fisheries No. 749. National Marine Fisheries Service. 16 pp.

304. Lascara, V.J. 1981. Fish predator–prey interactions in areas of eelgrass (Zostera marina). M.S. Thesis. College of William and Mary, Virginia.

305. Latham, R. 1917. Migration notes of fishes, 1916, from Orient, Long Island. Copeia **41**: 17–23.

306. Laudan, R., J.S. Stolen and A. Cali. 1986. Immunologlobulin levels of the winter flounder (Pseudopleuronectes americanus) and the summer flounder (Paralichthys dentatus) injected with the microsporidian parasite Glugea stephani. Developmental and Comparative Immunology **10**(3): 331–340.

307. Laurence, G.C. 1979. Larval length weight relations for seven species of northwest Atlantic fishes reared in the laboratory. Fishery Bulletin, U.S. **76**(4): 890–895.

308. Leim, A.H. and W.B. Scott. 1966. Fishes of the Atlantic Coast of Canada. Bulletin 155. Fisheries Research Board of Canada.

309. Lesser, C.A. 1968. Marine fisheries survey. Delaware Division of Fish and Wildlife, Dover. 21 pp.

310. Lewis, E.J. and W.C. Mann. 1971. Occurrence and abundance of larval menhaden, Brevoortia tyrannus, at two North Carolina inlets with notes on associated species. Transactions of the American Fisheries Society **100**(2): 296–301.

311. Lewis, E.J., S.M. McLaughlin, J.E. Bodammer and T.K. Sawyer. 1992. Epitheliocystis in 10 new host species of marine fish. Journal of Fish Diseases **15**(3): 267–272.

312. Lison, A.J., M.S. Haire, A.F. Holland, F. Jacobs, J. Jensen, R.L. Moran–Johnson, T.T. Podgar and W.A. Richkus. 1979. Environmental Atlas of the Potomac Estuary. Martin Marietta Corporation, Baltimore, Maryland. 280 pp.

313. Lison, A.J. and R.L. Moran. 1974. Manual for identification of early development of fishes of the Potomac River estuary. Environmental Technology Center. Martin–Marietta Corporation, Baltimore, Maryland.

314. Lux, F.E., P.E. Hamer and J.C. Poole. 1966. Summer flounder...the Middle Atlantic flatfish. Atlantic States Marine Fisheries Commission, Leaflet No. 6. 4 pp.

315. Lux, F.E. and J.B. Mahoney. 1972. Predation by bluefish on flatfishes. Marine Fisheries Review **34**: 30–35.

316. Lux, F.E. and F.E. Nichy. 1962. A status report on the fluke or summer flounder (Paralichthys dentatus). Minutes of the 21st Meeting of the Middle Atlantic Section, Atlantic States Marine Fisheries Commission, Dinkler–Plaza Hotel, Atlanta, G.A., September 27, 1962.

317. ———. 1971. Number and lengths, by season, of fishes caught with an otter trawl near Woods Hole, Massachusetts, September 1961 to December 1962. Special Scientific Report–Fisheries No. 622. National Marine Fisheries Service.

318. ———. 1980. Movements of tagged summer flounder, Paralichthys dentatus, off southern New England. *In* Laboratory Reference Document 80–34. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 36 pp.

319. Lux, F.E. and L.R. Porter, Jr. 1966. Length–weight relation of the summer flounder Paralichthys dentatus (L.). Special Report–Fisheries No. 531. United States Fish and Wildlife Service.

320. Lynch, T.R. 1991. Rhode Island coastal fishery resource assessment (trawl survey) 1979–1991. Rhode Island Division of Fish and Wildlife, Wickford.

321. MacKenzie, C.L., Jr. 1990. History of the fisheries of Raritan Bay, New York and New Jersey. Marine Fisheries Review **52**(4): 1–45.

322. MacPhee, G. 1979. Synopsis of biological data on the summer flounder Paralichthys dentatus (Linnaeus). Unpublished manuscript. United States Environmental Protection Agency, Environmental Research Laboratory, Narragansett, Rhode Island.

323. Mahoney, J.B., F.H. Midlige and D.G. Deuel. 1975. A fin rot disease of marine and euryhaline fishes in the New York Bight. Transactions of the American Fisheries Society **102**(3): 596–605.

324. Mahood, R.K., C.D. Harris, J.L. Music, Jr. and B.A. Palmer. 1974a. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters. Part 1: Southern section, St. Andrew Sound and St. Simon Sound estuaries. *In* Contribution Series No. 22. 104 pp. Georgia Game Fish Division, Coastal Fisheries Office.

325. ———. 1974b. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters. Part 2: Central section, Doboy Sound and Sapelo Sound estuaries. Contribution Series No. 23. Georgia Game Fish Division, Coastal Fisheries Office. 99 pp.

326. ———. 1974c. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters. Part 3: Northern section, Ossabaw Sound and Wassaw Sound estuaries. Contribution Series No. 24. Georgia Game Fisheries Division, Coastal Fisheries Office. 100 pp.

327. ———. 1974d. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters. Part 4: Southern, central and northern sections. Contribution Series No. 25. Georgia Game Fisheries Division, Coastal Fisheries Office. 201 pp.

328. Malloy, K.D. 1990. Effects of temperature and salinity on the feeding, growth and survival of juvenile summer flounder (Paralichthys dentatus). M.S. Thesis. University of Delaware, Lewes.

329. Malloy, K.D. and T.E. Targett. 1991. Feeding, growth and survival of juvenile summer flounder Paralichthys dentatus: experimental analysis of the effects of temperature and salinity. Marine Ecology Progress Series **72**(3): 213–223.

330. ———. 1994. Effects of ration limitation and low temperature on growth, biochemical condition, and survival of juvenile summer flounder from two Atlantic coast nurseries. Transactions of the American Fisheries Society **123**(3):182–193.

331. ———. In press. The use of RNA:DNA ratios to predict growth limitation of juvenile summer flounder (Paralichthys dentatus) from Delaware and North Carolina estuaries. Marine Biology.

332. Manooch, C.S. III. 1984. Fisherman's guide: fishes of the southeastern United States. North Carolina Museum of Natural History, Raleigh. 362 pp.

333. Mansueti, A.J. and J.D. Hardy, Jr. 1967. Development of Fishes of the Chesapeake Region, An Atlas of Egg, Larval and Juvenile Stages. University of Maryland, National Resources Institute.

334. Marak, R.R. and J.B. Colton. 1961. Distribution of fish eggs and larvae, temperature and salinity in the Georges Bank–Gulf of Maine area, 1953. Special Scientific Report–Fisheries No. 398. United States Fish and Wildlife Service. 61 pp.

335. Marak, R.R., J.B. Colton, Jr. and D.B. Foster. 1962. Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank–Gulf of Maine area, 1955. Special Scientific Report–Fisheries No. 411. United States Fish and Wildlife Service. 66 pp.

336. Marak, R.R., J.B. Colton, Jr., D.B. Foster and D. Miller. 1962. Distribution of fish eggs and larvae, temperature, and salinity in the Georges Bank–Gulf of Maine area, 1956. Special Scientific Report–Fisheries No. 412. United States Fish and Wildlife Service. 95 pp.

337. Marcellus, K.L. 1972. Fishes of Barnegat Bay, New Jersey, with particular reference to seasonal influences and the possible effects of thermal discharges. Ph.D. Dissertation. Rutgers University, New Brunswick, New Jersey.

338. Marsh, E. 1977. Structural modifications of the pectoral fin rays in the order Pleuronectiformes. Copeia **1977**(3): 575–578.

339. Marshall, A. 1978. Data on the commercial sport fishery for summer flounder, Paralichthys dentatus, in Virginia. Virginia Marine Resources Department #80–7.

340. ———. 1980. Data on the commercial sport fishery for summer flounder, Paralichthys dentatus, in Virginia. Virginia Marine Resources Report 80–5. 5 pp.

341. Marshall, A.R. and J.A. Lucy. 1981. Virginia's charter and headboat fishery: Analysis of catch and socioeconomic impacts. Special Report Appl. Mar. Sci. Ocn. Eng. No. 253. Virginia Institute of Marine Sciences, Gloucester. 90 pp.

342. Martin, F.D. and G.E. Drewry. 1978. Development of fishes of the Mid–Atlantic Bight. *In* Stromateidae through Ogcocephalidae. Volume 1. 416 pp. United States Fish and Wildlife Service, Biological Service Program.

343. Massmann, W.H. 1954. Marine fishes in fresh and brackish waters of Virginia rivers. Ecology **35**(1): 75–78.

344. Massmann, W.H., J.J. Norcross and E.B. Joseph. 1961. Fishes and fish larvae collected from Atlantic plankton cruises of R/V Pathfinder December 1959–December 1960. Special Scientific Report No. 26. Virginia Fisheries Laboratory. 15 pp.

345. ———. 1962. Fishes and fish larvae collected from Atlantic plankton cruises of R/V Pathfinder March 1961–March 1962. Special Scientific Report No. 33. Virginia Fisheries Laboratory. 20 pp.

346. Mast, S.O. 1916. Changes in shade, color and pattern in fishes and their bearing on the problems of adaptation and behavior with special reference to the flounders Paralichthys and Ancylopsetta. Bulletin of the United States Bureau of Fisheries **34**: 173–238.

347. Maurer, R.O., Jr. and R.E. Bowman. 1975. Food habits of marine fishes of the northwest Atlantic—Data Report. Laboratory Reference Document Number 75–3. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 90 pp.

348. Mayo, R.K. 1975. Length frequencies of flounders other than yellow–tail. International Commission of the Northwest Atlantic Fisheries Workshop Paper 64. 9 pp.

349. ———. 1976. Assessment data for flounders other than yellowtail in Subarea 5 and Statistical Area 6. International Commission of the Northwest Atlantic Fisheries Workshop Paper 76/IV/47. 7 pp.

350. McAllister, D.E. 1960. List of the marine fishes of Canada. Biological Series No. 62. National Museum of Canada Bulletin No. 168.

351. McClain, J.F., Jr. 1977a. Fisheries survey of the Little Egg Harbor–Manahawkin Bay estuary. Unpublished Report. New Jersey Division of Fish, Game and Shellfisheries, Trenton.

352. ———. 1977b. Check list of fishes of New Jersey. New Jersey Division of Fish, Game and Shellfisheries, Trenton.

353. McDermott, V. 1971. Study of the ichthyoplankton associated with two of New Jersey's coastal inlets. Miscellaneous Report 7M. New Jersey Department of Environmental Protection, Trenton.

354. ———. 1972. Part 3. Study of the ichthyoplankton associated with two of New Jersey's coastal inlets. Pages 1–34 *in* Ecological considerations for ocean sites off New Jersey for proposed nuclear generating stations, 2. New Jersey Department of Environmental Protection, Trenton.

355. McErlean, A.J., S.G. O'Connor, J.A. Mihursky and C.I. Gibson. 1973. Abundance, diversity and seasonal patterns of estuarine fish populations. Estuarine, Coastal and Marine Science **1**: 19–36.

356. McGovern, J.C. 1986. Seasonal recruitment of larval and juvenile fishes into impounded and non–impounded marshes. M.S. Thesis. College of Charleston, South Carolina.

357. McGovern, J.C. and C.A. Wenner. 1990. Seasonal recruitment of larval and juvenile fishes into impounded and non–impounded marshes. Wetlands **10**(2): 203–222.

358. McHugh, J.L. 1972. Marine fisheries of New York State. Fishery Bulletin **70**(3):585–610.

359. ———. 1976. Estuarine fisheries, are they doomed? Pages 15–27 *in* M. Wiley, editor. Estuarine Processes, Volume I. Uses, Stress and Adaptation to the Estuary. Proceedings of the Third International Estuarine Research Conference, Galveston, Texas, U.S.A., October 7–9. Academic Press, New York.

360. ———. 1977a. Limiting factors affecting commercial fisheries in the Middle Atlantic estuarine area. Pages 149–169 *in* New York Sea Grant Institute, Proceedings of a Conference–Estuarine Pollution Control and Assessment. Volume I. United States Environmental Protection Agency, Washington, D.C.

361. ———. 1977b. Fisheries and fishery resources of New York Bight. Technical Report Circular 401. National Marine Fisheries Service.

362. ———. 1981. Marine fisheries of Delaware. Fishery Bulletin, U.S. **79**(4): 575–599.

363. McHugh, J.L. and Conover D.O. 1986. History and condition of food finfisheries in the Middle Atlantic regions compared with other sections of the coast. Fisheries **11**(5): 8–13.

364. McHugh, J.L. and J.J.C. Ginter. 1978. Fisheries *in* MESA New York Bight Atlas. Monograph 16.

365. Mercer, L.P., J.P. Monaghan, Jr. and J.L. Ross. 1987. Marine fisheries research. Annual Progress Report, Project F–29–1, July – December, 1986. North Carolina Division of Marine Fisheries, Morehead City.

366. Merriman, D. and R.C. Sclar. 1952. The pelagic fish eggs and larval of Block Island Sound. Bulletin of the Bingham Oceanographic Collection **13**(3): 165–219.

367. Metzger, F., Jr. 1978. Summer flounder. Pages 205–214 *in* Ecological studies for the Oyster Creek Generating Station. Volume I: Fin and Shellfish. Progress Report for the period of September 1976–August 1977. Ichthyological Associates Incorporated, Ithaca, New York.

368. Michels, S.F. 1992. Coastal finfish assessment survey annual report and bottom trawl survey of juvenile fishes in the Delaware estuaries. Project F–42–R–3, Job I–3. Delaware Division of Fish and Wildlife.

369. Mid–Atlantic Council Staff. 1978. Advice on summer flounder management. 2 pp.

370. Mid–Atlantic Fishery Management Council. 1990. Amendment 1 to the fishery management plan for the summer flounder fishery. In cooperation with National Marine Fisheries Service, New England Fishery Management Council, and South Atlantic Fishery Management Council, Washington, D.C.

371. ———. 1991a and b. Amendment 2 to the fishery management plan for the summer flounder fishery. Volumes 1 and 2. In cooperation with National Marine Fisheries Service, New England Fishery Management Council, and South Atlantic Fishery Management Council, Washington, D.C.

372. ———. 1993a. Amendment 3 to the fishery management plan for the summer flounder fishery. In cooperation with National Marine Fisheries Service, New England Fishery Management Council, and South Atlantic Fishery Management Council, Washington, D.C.

373. ———. 1993b. Amendment 4 to the fishery management plan for the summer flounder fishery. In cooperation with National Marine Fisheries Service, New England Fishery Management Council, and South Atlantic Fishery Management Council, Washington, D.C.

374. ———. 1993c. Amendment 5 to the fishery management plan for the summer flounder fishery. In cooperation with National Marine Fisheries Service, New England Fishery Management Council, and South Atlantic Fishery Management Council, Washington, D.C.

375. Miller, G.L. and S.C. Jorgenson. 1969. Seasonal abundance and length frequency distribution of some marine fishes in coastal Georgia. Data Report 35. United States Fish and Wildlife Service. 103 pp.

376. Miller, J.M., J.S. Burke and G.R. Fitzhugh. 1991. Early life history of Atlantic North American flatfish: likely (and unlikely) factors controlling recruitment. Netherlands Journal of Sea Research **27**(3/4): 261–275.

377. Miller, J.M. and D.S. Peters. Unpublished. Fishes of the Pamlico River estuary. National Marine Fisheries Service, Beaufort Laboratory.

378. Miller, J.M., J.P. Reed and L.J. Pietrafesa. 1984. Patterns, mechanisms and approaches to the study of migrations of estuarine–dependent fish larvae and juveniles. Pages 209–225 *in* J.D. McCleave, G.P. Arnold, J.J. Dodson and W.H. Neill, editors. Mechanisms of Migration in Fishes. Plenum Press, New York.

379. Miller, R.W. 1978. Marine recreational fishing in Delaware. Document 40–50/78/01/18. Delaware Division of Fish and Wildlife, Dover. 28 pp.

380a. Monaghan, J.P., Jr. 1992. Migration and population dynamics of summer flounder (Paralichthys dentatus) in North Carolina, Study 3A. Transactions of the North Carolina Division of Marine Fisheries. *In* Marine Fisheries Research, Completion Report for Project F–29. 36 pp. Morehead City.

380b. ———. 1993. Comparison of calcein and tetracycline as chemical markers in summer flounder. Transactions of the American Fisheries Society **122**(2): 298–301.

381. Moore, H.F. 1894. 7. List of fishes collected at Sea Isle City, New Jersey, during the summer of 1892. Bulletin of the United States Fisheries Commission **12**: 357–380.

382. Morris, T.L., Jr. 1981. Mouth structure relative to food habits for seven Northwest Atlantic Pleuronectiform fish species. International Council for the Exploration of the Sea Council Meeting 1981/G:67.

383. Morse, W.W. 1978. Preliminary fecundity estimates of summer flounder (Paralichthys dentatus) occurring in Middle Atlantic waters. Laboratory Reference 78–39. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 5 pp.

384. ———. 1979. An analysis of maturity observations of 12 groundfish species collected from Cape Hatteras, North Carolina to Nova Scotia in 1977. Report SHL–79–32. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 32 pp.

385. ———. 1981. Reproduction of the summer flounder, Paralichthys dentatus (L.). Journal of Fishery Biology **19**: 189–203.

386. Morse, W.W., M.P. Fahay and W.G. Smith. 1987. MARMAP surveys of the continental shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia (1977–1984). Technical Memorandum F/NEC–47. *In* Annual Distribution Patterns of Fish Larvae, Atlas Number 2. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey.

387. ———. 1987. MARMAP surveys of the continental shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia (1977–1984). Atlas No. 2. Annual distribution patterns of fish larvae. NOAA Technical Memorandum NMFS–F/NEC–47. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. pp. 177–184.

388. Murawski, W.S. 1963. Fluke investigations. New Jersey Federal Aid Project F–15–R–4, Completion Report for Job 3. New Jersey Department of Conservation and Economic Development.

389. ———. 1964. Fluke investigations. New Jersey Federal Aid Project F–15–R–5, Completion Report for Job 3. New Jersey Department of Conservation and Economic Development.

390. ———. 1965a. Fluke investigations. New Jersey Federal Aid Project F–15–R–6, Completion Report for Job 3. New Jersey Department of Conservation and Economic Development. 21 pp.

391. ———. 1965b. Fluke investigations, April 1, 1964 to March 31, 1965. Research Project Segment, Project No. F–15–R–6, Completion Report for Job 3. New Jersey Department of Environmental Protection.

392. ———. 1966. Fluke investigations. Progress Report, Federal Aid Project F–15–R–14, Completion Report for Job 3. New Jersey Department of Conservation and Economic Development.

393. ———. 1970a. Results of tagging experiments of summer flounder, Paralichthys dentatus, conducted in New Jersey waters from 1960–1967. Miscellaneous Report No. 5M. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station.

394. ———. 1970b. Marine fisheries investigation and management. New Jersey Federal Aid Project F–15–R–11, Progress Report for Job II–1. New Jersey Department of Conservation and Economic Development.

395. ———. No date. Young fluke in New Jersey—fact or fiction. Pages 10–14 *in* New Jersey Outdoors. Trenton, New Jersey.

396. Murawski, W.S. and P.J. Festa. 1974. A study of the distribution of young and larval summer flounder in New Jersey estuarine waters. Miscellaneous Report No. 11M. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Research Station.

397. ———. 1976. Ovary maturation in the summer flounder, Paralichthys dentatus. Miscellaneous Report No. 16M. New Jersey Division of Fish, Game and Shellfisheries, Nacote Creek Research Station. 16 pp.

398. ———. 1977. Creel census of the summer flounder, Paralichthys dentatus, sport fishery in Great Bay, New Jersey. Technical Report 19M. New Jersey Division of Fish, Game and Shellfisheries.

399. Murawski, W.S. and R.L. White. 1964. Studies of the reproduction of the summer flounder, Paralichthys dentatus. Dingell–Johnson Report, Project F–15–R. New Jersey Division of Fish, Game, Shellfisheries. 1 pp.

400. Murchelano, R.A. and J. Ziskowski. 1976. Fin rot disease studies in the New York Bight. Pages 329–336 *in* M.G. Gross, editor. Special Symposium of the American Society of Limnology and Oceanography. Lawrence, Kansas, U.S.A.

401. ———. 1977. Histopathology of an acute fin lesion in the summer flounder, Paralichthys dentatus, and some speculations on the etiology of fin rot disease in the New York Bight. Journal of Wildlife Diseases **13**(1): 103–106.

402. Music, J.L., Jr. and J.M. Pafford. 1984. Population dynamics and life history aspects of major marine sportfishes in Georgia's coastal waters. Contribution Series No. 38. Coastal Resources Division, Brunswick.

403. Music, J.L., Jr., B.C. Williams and S.G. Rogers. 1989. Studies and assessment of Georgia's marine fisheries resources. Annual Report, project period 1 January 1988–31 December 1988. Georgia Department Natural Resources, Coastal Resources Division. 146 pp. plus appendices.

404. Musick, J.A. 1972. Fishes of the Chesapeake Bay and adjacent coastal plain. Special Scientific Report No. 65. Pages 175–212 *in* M.L. Wass, editor. A checklist of the biota of the lower Chesapeake Bay. Virginia Institute of Marine Science.

405. ———. 1979. Section III. A summary of the distribution, abundance, and food habits of the demersal fishes of the Middle Atlantic outer Continental Shelf – a concise source document for resource managers and users. Special Report Appl. Mar. Sci. Ocn. Eng. 198. *In* Historical community structure analysis of finfishes. pp. 79–80. Virginia Institute of Marine Science.

406. Musick, J.A. and A.D. Estes. 1985. Sea Grant project summary: Stock identification of summer flounder (Paralichthys dentatus) in the southern Mid–Atlantic Bight – tagging studies. Project No. R/CF–21. College of William and Mary, Virginia Institute of Marine Science, Gloucester Point.

407. Musick, J.A. and J.D. McEachran. 1968. Seasonal distribution of major species of demersal fishes in Chesapeake Bight. Virginia Institute of Marine Science. 13 pp.

408. National Marine Fisheries Service (United States). 1930–1940. Fishery industries of the United States, 1929 to 1938. Appendices to reports on United States commercial fisheries for fiscal years 1930–1939. United States Department of Commerce. 11 volumes.

409. ———. 1942–1980. Fishery statistics of the United States, 1939 to 1976. Statistical Digests 1, 4, 7, 11, 14, 16, 18, 19, 21, 22, 25, 27, 30, 34, 36, 39, 41, 43, 44, 49, 51, 53, 54, 56–61, 62–70. United States Department of Commerce.

410. ———. 1965. The big bite—commercial fisheries of the Middle Atlantic coast. Conservation Note 17. United States Department of Commerce. 8 pp.

411. ———. 1965–1980. Nominal catch and effort statistics for the northwest Atlantic fisheries for the years 1963 to 1978. International Council for the Northwest Atlantic Fisheries Statistical Bulletin, Volumes 13–28. United States Department of Commerce.

412. ———. 1973. The 1970 salt–water angling survey. Current Fisheries Statistics 6200. United States Department of Commerce. 54 pp.

413. ———. 1975. Nominal catches of finfishes and squids in subarea 5 and statistical area 6, 1964–73. International Council for the Northwest Atlantic Fisheries Summary Document 75/10. United States Department of Commerce.

414. ———. 1977. Foreign trawl fisheries of Northwestern Atlantic, incidental catching of finfish. United States Department of Commerce Federal Register 42. United States Department of Commerce. pp.

415. ———. 1978a. Foreign fishing regulations, activities within the United States Fishery Conservation Zone. Federal Register 43. United States Department of Commerce. pp.

416. ———. 1978b. Summary of stock assessments, August 1978. Laboratory Reference No. 78–40. Resource Assessment Division, Woods Hole Laboratory. United States Department of Commerce. 26 pp.

417. ———. 1978c. Fisheries of the United States, 1977. Current Fisheries Statistics 7500. United States Department of Commerce.

418. ———. 1980a. Marine recreational fishery statistics survey, Atlantic and Gulf coasts. Current Fisheries Statistics 8000 and 8063. United States Department of Commerce.

419. ———. 1980b. Provisional nominal catches in the northwest Atlantic, 1980. North Atlantic Fish. Org. SCS Document 80/VI/15. United States Department of Commerce.

420. ———. 1987a. Bottom trawl survey preliminary catch summary ALBATROSS IV Cape Hatteras – western Scotian Shelf, September 10 – November 6, 1987. Fishery Report NEFC. United States Department of Commerce.

421. ———. 1987b. Fishery management plan for the summer flounder fishery. United States Department of Commerce. 155 pp.

422. ———. 1991. Marine recreational fishery statistics survey, Atlantic and Gulf coasts, 1987–1989. Current Fisheries Statistics 8904. United States Department of Commerce. 363 pp.

423. ———. 1992. Interactions between sea turtles and the summer flounder trawl fishery, November, 1991 – February, 1992. NOAA Technical Memorandum NMFS–SEFSC–307. United States Department of Commerce. 58 pp.

424. ———. 1993. Maturation of nineteen species of finfish off the northeast coast of the United States, 1985–1990. NOAA Technical Report NMFS 113. United States Department of Commerce.

425. Nelson, D.M., L.R. Irlandi, M.E. Settle, M.E. Monaco and L.C. Coston–Clements. 1991. Distribution and abundance of fishes and invertebrates in southeast estuaries. Estuarine Living Marine Resources Report No. 9. National Oceanic and Atmospheric Administration/National Ocean Service Strategic Environmental Assessments Division, Rockville, Maryland. 177 pp.

426. Nesbit, R.A. and W.C. Neville. 1935. Conditions affecting the southern winter trawl fishery. Fishery Circular No. 18. National Marine Fisheries Service. 12 pp.

427. Neville, W.C., C.L. Dickinson and J.R. Westman. 1939. Miscellaneous species. Pages 134–138 *in* A biological survey of the salt waters of Long Island Sound, Part I. New York State Conservation Department.

428. New Jersey Department of Environmental Protection. 1972. Studies of the Great Egg Harbor River and Bay. Final Report Project 3–137–R–1. Miscellaneous Report 8M. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Research Station.

429. ———. 1973. Studies of the upper Barnegat system. Final Report Project 3–137–R–2. Miscellaneous Report No. 10M. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Research Station.

430. ———. 1971. Studies of the Mullica River–Great Bay estuary. Final Report Project 3–78–R–1 and 2. Miscellaneous Report No. 6M. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Research Station.

431. ———. 1976. Studies of the Manahawkin Bay–Little Egg Harbor system. Miscellaneous Report No. 17. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Station.

432. ———. 1979. Studies of the back bay systems of Atlantic County. Miscellaneous Report No. 47M. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Research Station.

433. ———. 1978. Studies of the Maurice River and Cove system. Final Report Project 3–223–R–2. Miscellaneous Report No. 40M. New Jersey Division of Fish, Game and Shellfish, Nacote Creek Research Station. 337 pp.

434. Newman, M.W. 1978. Pathology associated with Cryptobia infection in a summer flounder Paralichthys dentatus. Journal of Wildlife Diseases **14**(3): 299–304.

435. Nichols, J.T. 1913. Notes on fishes near New York. Copeia **1913**(1): 1.

436. Nichols, J.T. and C.M. Breder, Jr. 1927. The marine fishes of New York and southern New England. Zoologica **9**(1): 162–164.

437. Noble, E.B. and R.J. Monroe. 1991. Classification of Pamlico Sound nursery areas: Recommendations for critical habitat criteria. Project No. 89–09. North Carolina Department of Natural Resources and Community Development, Morehead City.

438. Noble, E.B. and W.D. Noble. 1989. Pamlico–Albemarle Sound: The use of long–term fisheries databases for estuarine habitat protection. Coastal Zone '89.

439. Norman, J.R. 1934. A Systematic Monograph of the Flatfish (Heterosomata). Volume I. British Museum of Natural History, London. 459 pp.

440. North Carolina Division of Marine Fisheries. 1987–1991. State of North Carolina R/V Carolina Coast Pamlico–Albemarle Sounds survey cruise reports (monthly reports from March 1987 to September 1992). Morehead City.

441. ———. 1991. Assessment of North Carolina commercial finfisheries, 1989–90 fishing season. Annual Progress Report for Project 2–IJ–16–2. Morehead City.

442. ———. 1992a. Life history aspects of selected marine recreational fishes in North Carolina. Federal Aid to Sport Fisheries Restoration, Annual Performance Report, Segment 1. Morehead City.

443. ———. 1992b. Survey of population parameters of marine recreational fishes in North Carolina. Annual Progress Report, Project F–42, January – December 1991, Segment 1. Morehead City.

444. ———. No date. Biology and significance of the summer flounder, Paralichthys dentatus, and the southern flounder, Paralichthys lethostigma, in oceanic waters of North Carolina. A proposal to the North Carolina Department of Natural and Economic Resources. 14 pp.

445. Northeast Utilities Service Company (NUSCO). 1987–1993. Monitoring the marine environment of Long Island Sound at Millstone Nuclear Power Station, Waterford, Connecticut. Annual Reports for 1986–1992.

446. O'Brien, L., J. Burnett and R.K. Mayo. 1993. Maturation of nineteen species of finfish off the northeast coast of the United States, 1985–1990. NOAA Technical Report NMFS 113. United States Department of Commerce, Springfield, Virginia.

447. O'Conner, J.S. 1976. Contaminant effects on biota of the New York U.S.A. bight. Proceedings of the Twenty–Eighth Annual Gulf and Caribbean Fisheries Institute, Bal Harbour, Florida, U.S.A., October 1975.

448. ———. 1981. Studies on fates and effects of pollutants in the New York Bight. International Council for the Exploration of the Sea Council Meeting 1981. Copenhagen, Denmark. 9 pp.

449. Ogburn, M.V., D.M. Allen and W.K. Michener. 1988. Fishes, shrimps, and crabs of the North Inlet estuary, South Carolina: a four year seine and trawl survey. Baruch Institute Technical Report No. 88–1. University of South Carolina, Columbia. 299 pp.

450. Olla, B.L., C.E. Samet and A.L. Studholme. 1972. Activity and feeding behavior of the summer flounder (Paralichthys dentatus) under controlled laboratory conditions. Fishery Bulletin, U.S. **70**(4): 1127–1136.

451. Olney, J.E. 1983. Eggs and early larvae of the bay anchovy Anchoa mitchilli and the weakfish Cynoscion regalis in lower Chesapeake Bay, U.S.A., with notes on associated ichthyoplankton. Estuaries **6**(1): 20–35.

452. Olney, J.E., Jr. and G.W. Boehlert. 1988. Nearshore ichthyoplankton associated with seagrass beds in the lower Chesapeake Bay. Marine Ecology Progress Series **45**: 33–43.

453. Orth, R.J. and K.L. Heck, Jr. 1980. Structural components of eelgrass (Zostera marina) meadows in the lower Chesapeake Bay – fishes. Estuaries **3**(4): 278–288.

454. Osborn, C.M. 1939. The physiology of color change in flatfishes. Journal of Experimental Zoology **81**: 479–515.

455. ———. 1941. Studies on the growth of integumentary pigment in lower vertebrates. I. The origin of artificially developed melanophores on the normally unpigmented ventral surface of the summer flounder (Paralichthys dentatus). Biological Bulletin **81**: 341–351.

456. Oviatt, C.A. and S.W. Nixon. 1973. The demersal fish of Narragansett Bay: An analysis of community structure, distribution and abundance. Estuarine, Coastal and Marine Science **1**: 361–378.

457. Pacheco, A.L., editor. 1973. Proceedings of a workshop on egg, larval and juvenile stages of fish in Atlantic Coast estuaries. Technical Publication No. 1, Middle Atlantic Coastal Fisheries Center. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 338 pp.

458. Pacheco, A.L. and G.C. Grant. 1965. Studies of the early life history of Atlantic menhaden in estuarine nurseries. Part 1. Seasonal occurrence of juvenile menhaden and other small fishes in a tributary creek of Indian River, Delaware, 1957–1958. Special Scientific Report–Fisheries No. 504. United States Fish and Wildlife Service. 32 pp.

459. ———. 1973. Immature fishes associated with larval Atlantic menhaden at Indian River Inlet, Delaware, 1958–1961. Technical Publication 1. Pages 78–117 *in* A.L. Pacheco, editor. Proceedings of a workshop on egg, larval, and juvenile stages of fish in Atlantic coast estuaries. 338 pp. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey.

460. Pafford, J.M. and N. Nicholson. 1989. Georgia marine recreational fisheries survey, 1985–1987. Contribution Series No. 45. Georgia Department of Marine Resources, Coastal Resources Division. 157 pp.

461. Parker, R.O., R.B. Stone and C.C. Buchanan. 1979. Artificial reefs of Murrells Inlet, South Carolina. Marine Fisheries Review **41**(9): 12–24.

462. Pearcy, W.G. and S.W. Richards. 1962. Distribution and ecology of fishes of the Mystic River Estuary, Connecticut. Ecology **43**(2): 249–259.

463. Pearson, J.C. 1932. Winter trawl fishery off the Virginia and North Carolina coasts. Investigational Report No. 10. United States Bureau of Fisheries. 31 pp.

464. ———. 1941. The young of some marine fishes taken in lower Chesapeake Bay, Virginia, with special reference to the gray sea trout, Cynoscion regalis (Bloch). Fishery Bulletin, U.S. **50**: 79–102.

465. Pendleton, E.C. 1979. Secondary productivity in a salt marsh estuary. Ph.D. Dissertation. North Carolina State University, Raleigh. 278 pp.

466. Pentilla, A. and L.M. Dery. 1988. Age determination methods for Northwest Atlantic species. Transactions of the New York Academy of Science, Series II **21**: 484–496.

467. Perlmutter, A. 1939. An ecological survey of young fish and eggs identified from tow net collections. A biological survey of the salt waters of Long Island, 1938. 28th Annual Report, Supplement Part II. New York State Conservation Department. pp. 11–71.

468. ———. 1959. Changes in the populations of fishes and in their fisheries in the Middle Atlantic and Chesapeake regions, 1930 to 1955. Transactions of the New York Academy of Sciences **21**(6): 484–496. Series II.

469. Perra, P. 1985. Interstate fisheries management planning for Chesapeake Bay. The Chesapeake: Prologue to the Future. Pages 67–69 *in* Proceedings from the Chesapeake Bay Symposium. National Marine Educators Conference, July 30 – August 3, 1985, Williamsburg, Virginia.

470. Peters, D.S. 1971. Growth and energy utilization of juvenile flounder, Paralichthys dentatus, and Paralichthys lethostigma, as affected by temperature, salinity and food availability. Ph.D. Dissertation. North Carolina State University, Raleigh. 69 pp.

471. Peters, D.S. and J.W. Angelovic. 1973. Effect of temperature, salinity and food availability on growth and energy utilization of juvenile summer flounder, Paralichthys dentatus. *In* D.J. Nelson, editor. Radionuclides in Ecosystems, Volume I, Proceedings of the National Symposium on Radioecology, Oak Ridge, Tennessee, 1971. United States Atomic Energy Commission (CONF–710501–P1), Oak Ridge, Tennessee.

472. Peters, D.S. and M.A. Kjelson. 1975. Consumption and utilization of food by various postlarval and juvenile fishes of North Carolina estuaries. Pages 448–472 *in* L.E. Cronin, editor. Estuarine Research. Volume I. Academic Press, New York.

473. Phalen, P.S. and D.C. Stephan. 1989. North Carolina marine fisheries trawl surveys. Pages 59–64 *in* Proceedings of a Workshop on Bottom Trawl Surveys. Special Report No. 17 of the Atlantic States Marine Fisheries Commission.

474. Poole, J.C. 1956. Long Island's fluke. New York State Conservationist, December–January, 1956–1957.

475. ———. 1961. Age and growth studies of the fluke in Great South Bay and their significance to the sport fishery. New York Fish and Game Journal **8**(1): 1–18.

476. ———. 1962. The fluke population of Great South Bay in relation to the sport fishery. New York Fish and Game Journal **9**(2): 93–117.

477. ———. 1964. Feeding habits of the summer flounder in Great South Bay. New York Fish and Game Journal **11**(1): 28–34.

478. ———. 1966. A review of research concerning summer flounder and needs for further study. New York Fish and Game Journal **13**(2): 226–232.

479. ———. 1970. Life history of the summer flounder. *In* Report to the Advisory Committee Atlantic States Marine Fisheries Commission by the Summer Flounder Subcommittee, 1970. New York State Department of Environmental Conservation, Setauket.

480. Powell, A.B. 1974. Biology of the summer flounder, Paralichthys dentatus, in Pamlico Sound and adjacent waters, with comments on P. lethostigma and P. albigutta. M.S. Thesis. University of North Carolina, Chapel Hill. 145 pp.

481. ———. 1982. Annulus formation on otoliths and growth of young summer flounder Paralichthys dentatus from Pamlico Sound, North Carolina. Transactions of the American Fisheries Society **111**(6): 688–693.

482. Powell, A.B., B.F. Holland and J.W. Gillikin, Jr. 1974. State of North Carolina R/V Dan Moore – cruise report No. 2 – Currituck Beach to Cape Lookout Bight. North Carolina Division of Marine Fisheries, Morehead City. 29 pp.

483. ———. 1975. State of North Carolina R/V Dan Moore – cruise report No. 3 – Currituck Beach to Boque Inlet. North Carolina Division of Marine Fisheries, Morehead City. 30 pp.

484. Powell, A.B. and F.J. Schwartz. 1972. Anomalies of the genus Paralichthys (Pisces: Bothidae) including an unusual double-tailed Paralichthys lethostigma. Journal of the Elisha Mitchell Scientific Society **88**(3): 155–161.

485. ———. 1977. Distribution of Paralichthid flounders (Bothidae: Paralichthys) in North Carolina estuaries. Chesapeake Science **18**(4): 334–339.

486. ———. 1979. Food of Paralichthys dentatus and P. lethostigma (Pisces: Bothidae) in North Carolina estuaries. Estuaries **2**(4): 276–279.

487. Powles, H. and B.W. Stender. 1976. Observations on composition, seasonality and distribution of ichthyoplankton from MARMAP cruises in the South Atlantic Bight in 1973. Technical Report Series No. 11. South Carolina Marine Resources Center.

488. Pulley, M.G. 1991–1992 Series. Pamlico Sound survey cruise reports (5 reports; March 1990–September 1991). North Carolina Division of Marine Fisheries, Morehead City.

489. Purvis, C. 1976. Nursery area survey of northern Pamlico Sound and tributaries. North Carolina Division of Marine Fisheries. 62 pp.

490. Raney, E.C. and W.H. Massmann. 1953. The fishes of the tidewater section of the Pamunkey River, Virginia. Journal of the Washington Academy of Science **43**(2): 424–432.

491. Reed, L., J.P. Monaghan, Jr. and J.L. Ross. 1988. Marine fisheries research. Annual Progress Report Project F-29-2, January – December 1987. North Carolina Division of Marine Fisheries, Morehead City.

492. Reichert, M.J.M. and H.W. van der Veer. 1991. Settlement, abundance, growth and mortality of juvenile flatfish in a subtropical tidal estuary (Georgia, U.S.A). Proceedings of the First International Symposium on Flatfish Ecology (Texel 1990), Part 1, Volume 27. Netherlands Journal of Sea Research **27**(3/4): 375–391.

493. Reintjes, J.W. and C.M. Roithmayr. 1960. Survey of the ocean fisheries off Delaware Bay, supplemental report 1954–1957. Special Scientific Report–Fisheries No. 347. United States Fish and Wildlife Service. 18 pp.

494. Reis, R. 1977. Variations in utilization of a high marsh intertidal creek by larval and juvenile fish. M.S. Thesis. University of South Carolina.

495. Reisersen, L. 1982. The biology of common flatfishes, a selected bibliography. Rep. Forskningsprogram Havforurens. (Norw.)/Norw. Mar. Pollut. Res. Monit. Programme. 225 pp.

496. Rhode Island Division of Fish and Wildlife. No date. Marine sport fishery investigations; sport fish population surveys in Rhode Island marine waters, 1 January 1991 – 31 December 1991; VI-2 – juvenile fish survey. Wickford.

497. Richards, A. Unpublished. Proceedings of the Third Northeast Fisheries Center Stock Assessment Workshop, 1986.

498. Richards, C.E. 1962. A survey of salt-water sport fishing in Virginia, 1955–1960. Chesapeake Science **3**: 223–235.

499. ———. 1965. Availability patterns of marine fishes caught by charter boats operating off Virginia's eastern shore, 1955–1962. Chesapeake Science **6**(2): 96–108.

500. ———. 1970. Analog simulation in fish population studies. Virginia Institute of Marine Science, Gloucester Point. 4 pp.

501. Richards, C.E. and M. Castagna. 1970. Marine fishes of Virginia's eastern shore (inlet and marsh, seaside waters). Chesapeake Science **11**(4): 235–248.

502. Richards, S.W. 1963. The demersal fish population of Long Island Sound I. Species composition and relative abundance in tow localities, 1956–57. Bulletin of the Bingham Oceanographic Collection **18**: 5–29.

503. Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E A. Lachner, R.N. Lea and W.B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada. Special Scientific Publication No. 12. American Fisheries Society. Bethesda, Maryland. 174 pp.

504. ———. 1991. Common and scientific names of fishes from the United States and Canada. Fifth Edition. Special Publication No. 20, American Fisheries Society. Bethesda, Maryland.

505. Robins, C.R., G.C. Ray and J. Douglas. 1986. A field guide to Atlantic coast fishes of North America. Houghton Mifflin Company, Boston. 354 pp.

506. Robohm, R.A. and C. Brown. 1978. A new bacterium (presumptive vibrio species) causing ulcers in flatfish. Marine Fisheries Review **40**(10): 5–7.

507. Robohm, R.A., C. Brown and R.A. Murchelano. 1979. Comparison of antibodies in marine fish from clean and polluted waters of the New York Bight: relative levels against 36 bacteria. Applied and Environmental Microbiology **38**(2): 248–257.

508. Robohm, R.A. and D.S. Sparrow. 1981. Evidence for genetic selection of high antibody responders in summer flounder, Paralichthys dentatus, from polluted areas. Pages 273–278 *in* W. Hennessen and D.P. Anderson, editors. Developments in Biological Standardization. Volume 49. Proceedings of an International Symposium on Fish Biologics: Serodiagnostics and vaccines; Leetown, West Virginia, U.S.A., April 26–30, 1981.

509. Rogers, S.G., T.E. Targett and S.B. Van Sant. 1984. Fish-nursery use in Georgia salt-marsh estuaries: the influence of springtime freshwater conditions. Transactions of the American Fisheries Society **113**(5): 595–606.

510. Rogers, S.G. and M.J. Van Den Avyle. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)—summer flounder. United States Fish and Wildlife Service FWS/OBS-82/11.15. United States Army Corps of Engineers TR EL-82-4. 14 pp.

511. Rosenberg, M. 1971. Epigenetic control of lactate dehydrogenase subunit assembly. Nature **230**: 12–14.

512. Ross, J.L. 1991. Assessment of the North Carolina winter trawl fishery September 1985 – April 1988. North Carolina Division of Marine Fisheries, Morehead City.

513. Ross, J.L., J.H. Hawkins and D.A. DeVries. 1990. Assessment of the North Carolina winter trawl fishery, September 1982 – April 1985. Special Scientific Report No. 53. North Carolina Division of Marine Fisheries.

514. Ross, S.W. 1982. Estuarine fish stock assessment—long haul seine and pound net surveys. Completion Report Project 2–372–R. Pages 1–39 *in* North Carolina Estuarine Finfish Management Program. North Carolina Division of Marine Fisheries.

515. Ross, S.W. and S.P. Eerly. 1985. Utilization of shallow estuarine nursery areas by fishes in Pamlico Sound and adjacent tributaries, North Carolina. Pages 207–232 *in* A. Yanez–Arancibia, editor. Fish Community Ecology in Estuaries and Coastal Lagoons: Towards an Ecosystem Integration. UNAM Press, Mexico City.

516. Rountree, R.A. and K.W. Able. 1992a. Fauna of polyhaline subtidal marsh creeks in southern New Jersey: composition, abundance and biomass. Estuaries **15**(21): 171–185.

517. ———. 1992b. Foraging habits, growth and temporal patterns of salt–marsh creek habitat use by young–of–the–year summer flounder in New Jersey. Transactions of the American Fisheries Society **121**: 765–776.

518. ———. 1993. Diel variation in decapod crustacean and fish assemblages in New Jersey polyhaline marsh creeks. Estuarine, Coastal and Shelf Science **37**: 181–201.

519. Rozas, L.P. 1982. Utilization of oligohaline intertidal rivulets by fishes and macrofaunal crustaceans in the Cape Fear River estuary, North Carolina. M.S. Thesis. University of North Carolina, Wilmington. 74 pp.

520. Rozas, L.P. and C.T. Hackney. 1984. The importance of oligohaline fishes in wetland habitats to fisheries resources. Wetlands **3**: 77–89.

521. Rulifson, R.A. 1985. Distribution and abundance of fishes in tributaries of South Creek estuary, North Carolina. Journal of the Elisha Mitchell Scientific Society **101**(2): 160–170.

522. ———. 1991. Finfish utilization of man–initiated and adjacent natural creeks of South Creek estuary, North Carolina, using multiple gear types. Estuaries **14**(4): 447–464.

523. Sass, S.L. and R.A. Murchelano. 1988. Hepatic tumors and other liver pathology in Massachusetts flatfish. Aquatic Toxicology **11**(3, 4): 420–421.

524. Sawyer, R.T. 1972. Observations on the marine leeches of South Carolina, Annelida hirudinea. Bulletin of the South Carolina Academy of Science **34**: 103.

525. Scarlett, P.G. 1981. Fishery management plan for the summer flounder (Paralichthys dentatus) fishery. Management Report 81–1. New Jersey Division of Fish, Game and Wildlife. 80 pp.

526. ———. 1982. Annotated bibliography and subject index on the summer flounder, Paralichthys dentatus. Special Scientific Report–Fisheries No. 755. National Marine Fisheries Service. 15 pp.

527. ———. 1984. Memorandum on summer flounder scientific and statistical committee meeting, February 15, 1984, Philadelphia, Pa. New Jersey Division of Fish, Game and Wildlife, Nacote Creek Research Station.

528. ———. 1989. Results of finfish sampling in the Manasquan River, 1984–1986. Draft Report, Project F–15–R–30. New Jersey Division of Fish, Game and Wildlife, Trenton.

529. Scattergood, L.W. 1953. Notes on Gulf of Maine fishes in 1952. Copeia **1953**(3): 194–195.

530. Schaaf, W.W., D.S. Peters, L. Coston–Clements, D.S. Vaughan and C.W. Krouse. 1993. A simulation model of how life history strategies mediate pollution effects on fish populations. Estuaries **16**(4):697–702.

531. Schaaf, W.E., D.S. Peters, D.S. Vaughn, L. Coston–Clements and C.W. Krouse. 1987. Fish population responses to chronic and acute pollution: The influence of life history strategies. Estuaries **10**(3): 267–275.

532. Schaefer, R.H. 1966. A preliminary report concerning the effectiveness of New York's 14–inch minimum size limit on the summer flounder sport fishery. Submitted to Middle Atlantic Section, Atlantic States Marine Fisheries Commission, 25th Annual Meeting, Sheraton–Eastland Motor Hotel, Portland, Maine, October 4–7, 1966.

533. Schauss, R.P., Jr. 1977. Seasonal occurrence of some larval and juvenile fishes in Lynnhaven Bay, Virginia. American Midland Naturalist **98**: 275–282.

534. Schroeder, W.C. 1931. An account of the fishes dredged by the Albatross II along the continental slope south of New England in February and March, 1929. Copeia **1931**(2): 41–50.

535. Schwartz, F.J. 1961a. Fishes of Chincoteaque and Sinepuxent bays. American Midland Naturalist **65**(2): 384–408.

536. ———. 1961b. Salt and brackish species: Record Maryland fish. Maryland Conservationist **38**(3): 3–8.

537. ———. 1964. Fishes of Isle of Wight and Assawoman bays near Ocean City, Maryland. Chesapeake Science **5**(4): 172–193.

538. ———. 1989. Zoogeography and ecology of fishes inhabiting North Carolina's marine waters to depths of 600 meters. NOAA–NURP Report 89–2. Pages 335–374 *in* R.Y. George and A.W. Hulbert, editors. North Carolina Coastal Oceanography Symposium.

539. Schwartz, F.J., W.T. Hogarth and M.P. Weinstein. 1982. Marine and freshwater fishes of the Cape Fear estuary, North Carolina and their distribution in relation to environmental factors. Brimleyana **7**: 17–37.

540. Schwartz, F.J., P. Perschbacher, M. McAdams, L. Davidson, K. Sandoy, C. Simpson, J. Duncan and D. Mason. 1979. An ecological study of fishes and invertebrate macrofauna utilizing the Cape Fear River estuary, Carolina Beach Inlet and the adjacent Atlantic Ocean. Summary Report 1973–1977, Institute of Marine Science. University of North Carolina, Morehead City. 568 pp.

541. Schwartz, F.J., J.P. Perschbacher, M. McAdams, L. Davidson, K. Sandoy, C. Simpson, J. Duncan, D. Mason and J. Tate. 1979. An ecological study of fishes and invertebrate macrofauna utilizing the Cape Fear River estuary, Carolina Beach Inlet, and adjacent Atlantic Ocean. Annual Report for 1978, Institute of Marine Science. University of North Carolina, Morehead City. 326 pp.

542. Schwartz, F.J. and H.J. Porter. 1977. Fishes, macroinvertebrates, and their ecological interrelationships with a calico scallop bed off North Carolina. Fishery Bulletin, U.S. **75**(2): 427–446.

543. Scott, W.B. and M.G. Scott. 1988. Atlantic Fishes of Canada. Canadian Bulletin of Fisheries and Aquatic Science **219**: 537–538.

544. Scotton, L.N. 1970. Occurrence and distribution of larval fishes in the Rehoboth and Indian River bays of Delaware. M.S. Thesis. University of Delaware. 66 pp.

545. Scotton, L.N., R.E. Smith, N.S. Smith, K.S. Price, and D.P. de Sylva. 1973. Pictorial guide to fish larvae of Delaware Bay with information and bibliographies useful for the study of fish larvae. Delaware Bay Report Series Volume 7. College of Marine Studies, University of Delaware, Newark.

546. Seagraves, R.J. 1981. Delaware marine fishing surveys. Delaware Fishery Bulletin **2**(2): 7–9.

547. ———. 1982. Part III. 1981 Stock assessment of juvenile fishes in Delaware Bay. Delaware Division of Fish and Wildlife, Dover.

548. ———. 1983–1984. Technical assistance to commercial fisheries Delaware Bay juvenile finfish trawl survey. Annual Reports for Project 3–358–D–1 and 3–358–D–2, Document #40–05/83/08/04. Delaware Division of Fish and Wildlife, Dover.

549. ———. 1987. Survey of the sport fishery of the Delaware Bay. Annual Report, Aid to Fisheries Restoration Project F–42–R–2. Delaware Division of Fish, Game and Wildlife, Dover.

550. Sharp, J.H. 1976. Anoxia on the Middle Atlantic shelf during the summer of 1976. Report on a workshop held in Washington, D.C., October 15–16, 1976. University of Delaware.

551. Sharp, B. and H.W. Fowler. 1904. The fishes of Nantucket. Pages 504–512 *in* Proceedings of the Academy of Natural Sciences of Philadelphia, May 1904.

552. Shealy, M.H., J.V. Miglanese and E.B. Joseph. 1974. Fishes of South Carolina estuaries—relative abundance, seasonal distribution, and length frequency relationships. Technical Report Series 6. South Carolina Marine Research Center. 189 pp.

553. Shenker, J.M. and J.M. Dean. 1979. The utilization of an intertidal salt marsh creek by larval and juvenile fishes: abundance, diversity and temporal variation. Estuaries **2**(3): 154–163.

554. Shepherd, G.P. 1980. A comparative study of aging methods for summer flounder (Paralichthys dentatus). Laboratory Reference Document 80–13. National Marine Fisheries Center, Woods Hole Laboratory, Massachusetts. 29 pp.

555. Shepherd, G.P. and M. Terceiro. In prep. The summer flounder, scup and black sea bass fishery of the Middle Atlantic Bight and southern New England. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts.

556. Sheridan, P.F. and R.J. Livingston. 1979. Cyclic trophic relationships of fishes in an unpolluted, river–dominated estuary in north Florida. Pages 143–161 *in* R.J. Livingston, editor. Ecological processes in coastal and marine systems. Plenum Press, New York.

557. Sherman, K. 1980. MARMAP, a fisheries ecosystem study in the Northwest Atlantic: fluctuations in ichthyoplankton–zooplankton components and their potential for impact on the system. Pages 9–37 *in* F.P. Diemer, F.J. Vernberg and D.R. Mirkes, editors. Advanced Concepts in Ocean Measurements for Marine Biology. University of South Carolina Press, Belle W. Baruch Institute of Marine Biology and Coastal Research.

558. ———. 1987. Chapter 25: Zooplankton production and the fisheries of the Northeastern Shelf.

559. Shipman, S. 1983. Survey of Georgia's major marine fishery resources. Chapter I. Contribution No. 33. Georgia Coastal Resources Division, Brunswick.

560. Shuster, C.W. 1959. A biological evaluation of the Delaware River estuary. Information Series Publication 3. *In* State of Delaware Intra–State Water Resources Survey, Section 21. 77 pp. University of Delaware, Marine Laboratory.

561. Silverman, M.J. and J.B. Mahoney. 1985. Pictorial documentation of fin necrosis of marine fishes in the New York Bight, U.S.A. Bulletin of the New Jersey Academy of Science **30**(1): 39–42.

562. Sissenwine, M.P., R.R. Lewis and R.K. Mayo. 1979. The spatial and seasonal distribution of summer flounder (Paralichthys dentatus) based on research vessel bottom trawl surveys. Laboratory Reference 79–55. National Marine Fisheries Service, Woods Hole Laboratory, Massachusetts. 101 pp.

563. Smigielski, A.S. 1975. Hormone induced spawnings of the summer flounder and rearing of the larvae in the laboratory. Progressive Fish–Culturist **37**(1): 3–8.

564. Smith, C.F., J.R. Schubel, M.P. Greges, N. Itzkowitz, S.J. Dipiero, J. Longo and M.A. Morgan. 1979. Thermal resistance characteristics of early life history stages of finfish from Long Island waters. Special Report 26. Marine Science Research Center, Stony Brook. 64 pp.

565. Smith, H.M. 1894. Economic and natural history notes on fishes of the northern coast of New Jersey. Pages 365–380 *in* Bulletin of the United States Fisheries Commission XII.

566. ———. 1897. The fishes found in the vicinity of Woods Hole. United States Fisheries Commission Bulletin, Volume XVII, 85.

567. ———. 1907. Fishes of North Carolina, XI. Raleigh. 453 pp.

568. Smith, J.W. 1981. A guide to flounder fishing in South Carolina. South Carolina Sea Grant, Charleston. 16 pp.

569. Smith, J.W. and C.A. Wenner. Unpublished. The biology of the summer and southern flounders (Bothidae: Paralichthys) in the South Atlantic Bight.

570. Smith, R.W. 1969. An analysis of the summer flounder, Paralichthys dentatus (L.), population in the Delaware Bay. M.S. Thesis. University of Delaware, Newark, Delaware. 72 pp.

571. Smith, R.W. 1980. Marine fish populations in Delaware Bay and selected shore zone areas. I – Survey of selected marine fish populations in Delaware Bay. Job No. I–1: Sampling selected marine fish populations in Delaware Bay. Job No. I–2: Analysis of shore zone fishes in the Delaware estuary. Period covered, 1 December 1987 – 31 January 1980. Document No. 40–05/80/03/3. Delaware Division of Fish, Game and Wildlife, Dover.

572. ———. 1982. Part I. Survey of selected marine fish populations in Delaware Bay, 1981. Document #40–05–82/04/4. Delaware Division of Fish, Game and Wildlife, Dover.

573. Smith, R.W. and F.C. Daiber. 1977. Biology of the summer flounder, Paralichthys dentatus, in Delaware Bay. Fishery Bulletin, U.S. **75**(4): 823–830.

574. Smith, R.W., L.M. Dery, P.G. Scarlett and A. Jearld, Jr. 1981. Proceedings of the summer flounder (Paralichthys dentatus) age and growth workshop, 20–21 May 1980, Northeast Fisheries Center, Woods Hole, Massachusetts. NOAA Technical Memorandum NMFS–F/NEC–11. United States Department of Commerce. iv + 30 pp.

575. Smith, S.M., J.G. Hoff, S.P. O'Neil and M.P. Weinstein. 1984. Community and trophic organization of nekton utilizing shallow marsh habitats, York River, Virginia. Fishery Bulletin, U.S. **82**(3): 455–467.

576. Smith, W.G. 1973a. The distribution of summer flounder, Paralichthys dentatus, eggs and larvae on the continental shelf between Cape Cod and Cape Lookout, 1956–66. Fishery Bulletin, U.S. **71**(2): 527–548.

577. ———. 1973b. Summer flounder. *In* A.L. Pacheco, editor. Proceedings of a workshop on egg, larval and juvenile stages of fish in Atlantic coast estuaries. United States Department of Commerce, National Marine Fisheries Service, Highlands, New Jersey.

578. ———. 1980. What studies of young fish tell about fish populations. Underwater Naturalist **12**(4): 9–16.

579. ———. 1983. Temporal and spatial shifts in spawning of selected fish an invertebrate species in the Georges Bank region. National Marine Fisheries Service, Laboratory Reference SHL, Report 83–08, 22 pp.

580. Smith, W.G. and M.P. Fahay. 1970. Description of eggs and larvae of the summer flounder, Paralichthys dentatus. Research Report No. 75. United States Fish and Wildlife Service. 21 pp.

581. Smith, W.G., J.D. Sibunka and A. Wells. 1975. Seasonal distributions of larval flatfishes (Pleuronectiformes) on the continental shelf between Cape Cod, Massachusetts, and Cape Lookout, North Carolina, 1965–1966. NOAA Technical Report, SSRF–691. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 68 pp.

582. Smith, W.G., A. Wells and D.G. McMillan. 1979. The distribution and abundance of ichthyoplankton in the Middle Atlantic Bight as determined from coastal surveys and site–specific studies, 1965–1976. Report No. SHL 79–02. National Marine Fisheries Service, Sandy Hook Laboratory.

582. Spitsbergen, D. 1979. A study of the bay scallop (Argopecten irradians) in North Carolina waters. Completion Report, Project 2–256–R. North Carolina Division of Marine Fisheries. 44 pp.

583. Stender, B.W. and R.M. Martore. 1990. Chapter VIII: Finfish and invertebrate communities. Pages 241–287 *in* R.F. Van Dolah, P.H. Wendt and E.L. Wenner, editors. A physical and ecological characterization of the Charleston Harbor estuarine system. South Carolina Division of Marine Resources.

584. Stephan, C.D. 1988. North Carolina/NMFS Southeast area monitoring and assessment program (SEAMAP). Annual Report for Project SM–18–2. North Carolina Division of Marine Fisheries, Morehead City.

585. ———. 1989. North Carolina/NMFS Southeast area monitoring and assessment program (SEAMAP). Annual Report for Project SM–18–3. North Carolina Division of Marine Fisheries, Morehead City.

586. Stickney, R.R. 1972. Effects of intracoastal waterway dredging on ichthyofauna and benthic macroinvertebrates. Technical Report Series No. 72–4. Georgia Marine Science Center.

587. Stickney, R.R. and D.B. White. 1972. Vertebrate aquaculture research under the Sea Grant program at Skidaway Institute of Oceanography during 1971. Skidaway Institute Technical Report 72–1. pp. 1–22.

588. ———. 1974. Lymphocystis in tank cultured flounder. Aquaculture **4**(3): 307–308.

589. ———. 1975. Ambicoloration in tank cultured flounder, Paralichthys dentatus. Transactions of the American Fisheries Society **104**(1): 158–160.

590. Stickney, R.R., D.B. White and D. Miller. 1973. Observations of fin use in relation to feeding and resting behavior in flatfishes (Pleuronectiformes). Copeia **1973**(1): 154–156.

591. Stock Assessment Workshop. 1990. Report of the Stock Assessment Workshop (SAW) Summer Flounder Working Group (WG #21); 26–28 September 1990. Woods Hole, Massachusetts.

592. ———. 1992. Report of the stock assessment workshop (SAW) summer flounder working group. October 27–29, 1992, Woods Hole, Massachusetts.

593. Stolen, J.S., S. Draxler and J.J. Nagle. 1984. A comparison of temperature–mediated immunomodulation between two species of flounder. Immunol. Commun. **13**(3): 245–253.

594. Stolen, J.S., T. Gahn, V. Kasper and J.J. Nagle. 1984. The effect of environmental temperature on the immune response of marine teleost (Paralichthys dentatus). Developmental and Comparative Immunology **8**(1): 89–98.

595. ———. 1985. Natural and adaptive immunity in marine teleosts to bacterial isolates from sewage sludge. Pages 207–220 *in* M.J. Manning and M.F. Tatner, editors. Fish Immunology.

596. Stolen, J.S., T. Gahn and J.J. Nagle. 1982. The humoral antibody formation to erythrocyte antigens in three species of flatfish. Pages 101–106 *in* W.B. van Muiswinkel and E.L. Coer, editors. Immunology and Immunization of Fish; Proceedings of a conference, June 22–24, Wageningen, The Netherlands. Developmental and Comparative Immunology, Supplement No. 2.

597. Stolen, J.S. 1985. The effect of the polychlorinated biphenyl aroclor 1254 and ethanol on the humoral immune response of a marine teleost to a sludge bacterial isolate of Esherichia coli. Pages 419–426 *in* F. J. Vernberg, editor. Marine Pollution and Physiology: Recent Advances; proceedings of a meeting, November 1–3, Mystic, Connecticut, U.S.A. University of South Carolina Press, Columbia.

598. Stolen, J.S., V. Kasper, T. Gahn, V. Lipcon, J.J. Nagle and W.N. Adams. 1983. Monitoring environmental pollution in marine fishes by immunological techniques: the immune response of the fishes exposed by injection or bath to bacterial isolates from sludge and in situ exposure to sludge. Biotechnology Techniques **1**: 66–68.

599. Struhsaker, P. 1969. Demersal fish resources: composition, distribution and commercial potential of the continental shelf stocks off southeastern United States. Special Scientific Report–Fisheries No. 390. United States Fish and Wildlife Service. 19 pp.

600. Sumner, F.B. 1911. The adjustment of flatfishes to various backgrounds: a study of adaptive color change. Journal of Experimental Zoology **10**: 409–505.

601. Swanson, R.L. and C.J. Sindermann, editors. 1979. Oxygen depletion and associated benthic mortalities in the New York Bight, 1976. NOAA Professional Paper 11. United States Department of Commerce. v + 345 pp.

602. Sypek, J.P. and E.M. Burreson. 1983. Influence of temperature on the immune response of juvenile summer flounder Paralichthys dentatus and its role in the elimination of Trypanosoma bullocki infections. Developmental and Comparative Immunology **7**(2): 277–286.

603. Szedlmayer, S.T. and K.W. Able. 1992. Validation studies of daily increment formation for larval and juvenile summer flounder, Paralichthys dentatus. Canadian Journal of Fisheries and Aquatic Sciences **49**(9): 1856–1862.

604. ———. 1993. Ultrasonic telemetry of age–0 summer flounder, Paralichthys dentatus, movements in a southern New Jersey estuary. Copeia **1993**(3): 728–736.

605. Szedlmayer, S.T., K.W. Able and R.A. Rountree. 1992. Growth and temperature induced mortality of young–of–the–year summer flounder, Paralichthys dentatus, in southern New Jersey. Copeia **1992**(1): 120–128.

606. Tagatz, M.E. and D.L. Dudley. 1961. Seasonal occurrence of marine fishes in four shore habitats near Beaufort, North Carolina, 1957–60. Special Scientific Report–Fisheries No. 390. United States Fish and Wildlife Service. 17 pp.

607. Terceiro, M., editor. 1993. Assessment of summer flounder (Paralichthys dentatus), 1993: Report of the Stock Assessment Workshop Summer Flounder Working Group. Northeast Fisheries Science Center Reference Document 93–14. National Marine Fisheries Service, Woods Hole Laboratory. 72 pp.

608. Thayer, G.W., S.M. Adams and M.W. LaCroix. 1975. Structural and functional aspects of a recently established Zostera marina community. Pages 518–540 *in* L.E. Cronin, editor. Estuarine Research. Volume 1. Academic Press, New York.

609. Thayer, G.W., D.E. Hoss, M.A. Kjelson, W.F. Hettler, Jr. and M.W. LaCroix. 1974. Biomass of zooplankton in the Newport River estuary and the influence of postlarval fishes. Chesapeake Science **15**: 9–16.

610. Topp, R.W. and F.H. Hoff, Jr. 1972. Flatfishes (Pleuronectiformes). Pages 1–135 *in* Mem. Hourglass Cruises IV(2).

611. Truitt, R.V., B.A. Bean and H.W. Fowler. 1929. The fishes of Maryland. Conservation Bulletin 3. Maryland Conservation Department.

612. Turner, W.R. and G.N. Johnson. 1972. Standing crops of aquatic organisms in five South Carolina tidal streams. Pages 179–193 *in* M. Thompson, editor. Port Royal Sound environmental study. South Carolina Water Resources Commission, Columbia.

613. ———. 1973. Distribution and relative abundance of fishes in Newport River, North Carolina. Special Scientific Report–Fisheries No. 666. National Marine Fisheries Service. 23 pp.

614. ———. 1974. Standing crops of aquatic organisms in tidal streams of the lower Cooper River system, South Carolina. Pages 13–20 *in* F. Nelson, editor. The Cooper River environmental study. 177 pp. South Carolina Water Resources Commission, Columbia.

615. Tyler, A.V. 1971. Periodic and resident components in communities of Atlantic fishes. Journal of the Fisheries Research Board of Canada **28**: 935–946.

616. Uhler, P.R. and O. Lugger. 1876. List of fishes of Maryland. Report, January 1, 1876. Maryland Fisheries Commission.

617. Van Housen, G. 1984. Electrophoretic stock identification of summer flounder, Paralichthys dentatus. M.A. Thesis. College of William and Mary, Williamsburg, Virginia. 66 pp.

618. Varanasi, U. and D.C. Malins. 1977. Metabolism of petroleum hydrocarbons: Accumulation and biotransformation in marine organisms. *In* Effects of Petroleum on Arctic and Subarctic Marine Environments and Organisms. Volume II. Biological Effects. 500 pp. Academic Press, New York.

619. Verrill, A.E. and S.I. Smith. 1873. Lists of species found in the stomachs of fishes, food of fishes. Report, 1871–1872. Volume 1. United States Fisheries Commission.

620. Vladykov, V.D. and R.A. McKenzie. 1935. The marine fishes of Nova Scotia. Proceedings of the Nova Scotian Institute of Science **19**(1): 17–113.

621. 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. Rutgers University, New Brunswick, New Jersey. 304 pp.

622. Wang, J.C.S. and R.J. Kernehan. 1979. Fishes of the Delaware estuaries: a guide to the early life histories. Ecological Analysts Communications, Incorporated, Towson, Maryland.

623. Warfel, H.E. and D. Merriman. 1944. Studies on the marine resources of southern New England. I. An analysis of the fish population on the shore zone. Bulletin of the Bingham Oceanographic Collection **9**: 1–91.

624. Warlen, S.M. and J.S. Burke. 1990. Immigration of larvae of fall/winter spawning marine fishes into a North Carolina estuary. Estuaries **13**(4): 453–461.

625. Weber, A.M. 1984. Summer flounder in Great South Bay: Survival of sublegals caught by hook-and-line and released. New York State Division of Marine Resources, Stony Brook.

626. Weeks, B.A., A.S. Keisler, Q.N. Myrvik and J.E. Warriner. 1987. Differential uptake of neutral red by macrophages from three species of estuarine fish. Developmental and Comparative Immunology **11**(1): 117–124.

627. Weeks, B.A., J.E. Warinner and C.D. Rice. 1989. Recent advances in the assessment of environmentally-induced immunomodulation. Oceans '89 **2**: 408–411.

628. Weinstein, M.P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. Fishery Bulletin, U.S. **77**: 339–357.

629. ———. 1981. Plankton productivity and the distribution of fishes on the southeastern U. S. continental shelf. Science **214**: 351–352.

630. Weinstein, M.P. and H.A. Brooks. 1983. Comparative ecology of nekton residing in a tidal creek and adjacent seagrass meadow: community composition and structure. Marine Ecology Progress Series **12**: 15–27.

631. Weinstein, M.P. and R.W. Davis. 1980. Collection efficiency of seine and rotenone samples from tidal creeks. Estuaries **3**: 98–105.

632. Weinstein, M.P., S.L. Weiss, R.G. Hodson and L.R. Gerry. 1980a. Retention of three taxa of postlarval fishes in an intensively flushed tidal estuary, Cape Fear River, North Carolina. Fishery Bulletin, U.S. **78**: 419–436.

633. Weinstein, M.P., S.L. Weiss and M.F. Walters. 1980b. Multiple determinants of community structure in shallow marsh habitats, Cape Fear River estuary, North Carolina, USA. Marine Biology **58**: 227–243.

634. Wenner, C.A. and G.R. Sedberry. 1989. Species composition, distribution, and relative abundance of fishes in the coastal habitat off the southeastern United States. NOAA Technical Report 79. National Marine Fisheries Service. 49 pp.

635. Wenner, C.A., C.A. Barans, B.W. Stender and F.H. Berry. 1979a,b,c,d. Results of MARMAP otter trawl investigations in the South Atlantic Bight. Technical Report: 33 (I. Fall, 1973. 79 pp.), 41 (II. Spring, 1974. 62 pp.), 44 (III. Summer, 1974. 59 pp.) and 45 (IV. Winter–early spring, 1975. 57 pp.). South Carolina Marine Resources Center. 79 pp.

636. ———. 1980. Results of MARMAP otter trawl investigations in the South Atlantic Bight. V. Summer, 1975. Technical Report 45. South Carolina Marine Resources Center. 57 pp.

637. Wenner, C.A., J.C. McGovern, R. Martore, H.R. Beatty and W.A. Roumillat. 1986. Ichthyofauna. Pages 415–523 *in* M.R. DeVoe and D.S. Baughman, editors. South Carolina coastal wetland impoundments: ecological characterization, management, status and use. Volume II: Technical Synthesis. Technical Report No. SC–SG–TR–86–2. South Carolina Sea Grant Consortium.

638. Wenner, C.A., W.A. Roumillat, J.E. Moran, M.B. Maddox, L.B. Daniel III and J.W. Smith. 1990. Investigations on the life history and population dynamics of marine recreational fishes in South Carolina: Part 1. South Carolina Wildlife and Marine Resources Department, Marine Resources Research Institute, Charleston.

639. Wenner, E.L., W.P. Coon II, M.H. Shealy, Jr. and P.S. Sandifer. 1981. Species assemblages, distribution, and abundance of fishes, and decapod crustaceans from the Winyah Bay estuarine system, South Carolina. Contribution No. 137, South Carolina Marine Resource Center, Technical Report No. 3. South Carolina Sea Grant Consortium. 61 pp.

640. _____. 1984. A five year study of seasonal distribution and abundance of fishes and decapod crustaceans in the Cooper River and Charleston Harbor, South Carolina prior to diversion. NOAA Technical Report NMFS SSRF–782. National Marine Fisheries Service. 16 pp.

641. Wenner, E.L., M.H. Shealy, Jr. and P.A. Sandifer. 1982. A profile of the fish and decapod crustacean community in a South Carolina estuarine system prior to flow alteration. NOAA Technical Report, NMFS SSRF–757. National Marine Fisheries Service. 17 pp.

642. Westman, J.R. and W.C. Neville. 1946. Some studies on the life history and economics of the fluke (Paralichthys dentatus) of Long Island waters. A report printed under sponsorship of the Islip Town Board. Islip, New York. 15 pp.

643. Wheatland, S.B. 1956. Oceanography of Long Island Sound 1952–54. VII. Pelagic fish eggs and larvae. Bulletin of the Bingham Oceanographic Collection **15**: 234–314.

644. White, D.B. and R.R. Stickney. 1973. A manual of flatfish rearing. NOAA/NMFS Technical Report 73–7. National Marine Fisheries Service. 42 pp.

645. ———. 1973. A bibliography of flatfish (Pleuronectiformes) research with partial annotation. Technical Report Series No. 73–6. Georgia Marine Science Center, Skidaway Island. 76 pp.

646. White, J.C., Jr. and D.E. Hoss. 1964. Another record of incomplete ambicoloration in the summer flounder Paralichthys dentatus. Chesapeake Science **5**(3): 151–152.

647. Widerstrom, F.L., Jr. 1959. An economic and financial study of the fluke otter–trawl fishery of New Jersey. Commercial Fisheries Review **21**: 17–26.

648. Wilk, S.J. 1980. The recreational fishery. Underwater Naturalist **12**(4): 40–45.

649. Wilk, S.J. and B.M. Baker. 1989. Results of a fish–megainvertebrate survey of the New York Bight Apex, late summer 1983. Bulletin of the New Jersey Academy of Sciences **34**(2): 1–13.

650. Wilk, S.J. and B.E. Brown. 1980. A description of those fisheries, which take place in the western North Atlantic between the U.S.–Canadian border and North Carolina, that presently have or potentially could have user group allocation conflicts. Pages 502–518 *in* J.H. Grover, editor. Allocation of fishery resources. Proceedings of the technical consultation on allocation of fishery resources, April 20–23, Vichy, France, 1980. United Nations Food and Agriculture Organization and the American Fisheries Society.

651. Wilk, S.J. and W.W. Morse. 1979. Annual cycle of gonad–somatic indices as indicators of spawning times for 15 species of fish collected from the New York Bight. Laboratory Reference SHL 79–11. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 54 pp.

652. Wilk, S.J., W.W. Morse and D.E. Ralph. 1978. Length–weight relationships of fishes collected in the New York Bight. Bulletin of the New Jersey Academy of Sciences **23**(2): 58–64.

653. Wilk, S.J., W.W. Morse, D.E. Ralph and T.R. Azarovitz. 1977. Fishes and associated environmental data collected in the New York Bight, June 1974–June 1975. NOAA Technical Report, NMFS SSRF–716. National Marine Fisheries Service.

654. Wilk, S.J., W.W. Morse, D.E. Ralph and E.J. Steady. 1975. Life history aspects of New York Bight finfishes. Laboratory Reference SHL 75–1. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 265 pp.

655. ———. 1976. Life history aspects of Middle Atlantic Bight finfishes. Laboratory Reference 76–3. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 149 pp.

656. Wilk, S.J., W.W. Morse and L. Stehlik. 1990. Annual cycles of gonad–somatic indices as indicators of spawning activity for selected species of finfish collected from the New York Bight. Fishery Bulletin, U.S. **88**: 775–786.

657. Wilk, S.J., R.A. Pikanowski, A.L. Pacheco, D.G. McMillan, B.A. Phelan and L.L. Stehlik. 1992. Fish and megainvertebrates collected in the New York Bight apex during the 12–mile dumpsite recovery study, July 1986 – September 1989. NOAA Technical Memorandum NMFS–F/NEC–90. National Marine Fisheries Service.

658. Wilk, S.J. and M.J. Silverman. 1976a. Fish and hydrographic collections made by the research vessels Dolphin and Delaware II during 1968–72 from New York to Florida. Special Scientific Report–Fisheries No. 697. National Marine Fisheries Service. 159 pp.

659. ———. 1976b. Summer benthic fish fauna of Sandy Hook Bay, New Jersey. NOAA Technical Report NMFS SSRF–698. National Marine Fisheries Service, Sandy Hook Laboratory, New Jersey. 16 pp.

660. Wilk, S.J., W.G. Smith, D.E. Ralph and J. Sibunka. 1980. Population structure of summer flounder between New York and Florida based on linear discrimination analysis. Transactions of the American Fisheries Society **109**(3): 265–271.

661. Williams, A.B. 1972. A ten–year study of meroplankton in North Carolina estuaries: mysid shrimps. Chesapeake Science **13**(4): 254–262.

662. Williams, A.B. and E.E. Deubler, Jr. 1968a. A ten year study of meroplankton in North Carolina estuaries: assessment of environmental factors and sampling success among Bothid flounders and Penaeid shrimps. Chesapeake Science **9**(1): 27–41.

663. ———. 1968b. Studies on macroplanktonic crustaceans and ichthyoplankton of the Pamlico Sound complex. Special Scientific Report No. 13. North Carolina Department of Conservation and Development. 91 pp.

664. Witting, D.A. and K.W. Able. 1993. Effects of body size on probability of predation for juvenile summer flounder and winter flounder based on laboratory experiments. Fishery Bulletin, U.S. **91**: 577–581.

665. Wolff, M. 1974. Preliminary stock assessment, North Carolina flounder (Paralichthys sp.). Completion Report. North Carolina Division of Marine Fisheries, Morehead City. 24 pp.

666. ———. 1977. Preliminary stock assessment, North Carolina flounder, (Paralichthys sp.). North Carolina Division of Marine Fisheries, Morehead City. 26 pp.

667. ———. 1978. Preliminary stock assessment, North Carolina flounder (Paralichthys sp.). Completion report for Project 2–294–R. North Carolina Division of Marine Fisheries, Morehead City. 20 pp.

668. Woodward, A.G. 1989. Effects of mesh–size on the composition and quantity of white shrimp and finfish caught with the cast net in Georgia's estuarine waters. Contribution Series No. 44. Georgia Department of Natural Resources, Coastal Resources Division. 37 pp.

669. Woolcott, W.S. and C. Beirne. 1967. A comparison of the skulls of young flounders in three species of flounders, Paralichthys. ASB Bulletin **14**(2): 46.

670. Woolcott, W.S., C. Beirne and W.M. Hall, Jr. 1968. Descriptive and comparative osteology of the young of three species on flounders, genus Paralichthys. Chesapeake Science **9**(2): 109–120.

671. Wyanski, D.M. 1990. Patterns of habitat utilization in 0–age summer flounder (Paralichthys dentatus). M.A. Thesis. College of William and Mary, Gloucester Point. 54 pp.

672. Young, B.H., K.A. McKown, V.J. Vecchio, K. Hattala and J.D. Sicluna. 1990–1991. A study of the striped bass in the marine district of New York VI. Grant # NA88EA–D–ANO3O (3 Reports: Annual Report for Period April 1, 1988 – March 31, 1989; Annual Report for Period April 1, 1989 – March 31, 1990; Completion Report for Period April 1, 1988 – March 31, 1991. New York State Department of Environmental Conservation, Stony Brook.

673. Younger, R.R. and J.A. Zamos. 1955. New Jersey's marine sport fishery. Miscellaneous Report 16, Job Completion Report for Project F–2. New Jersey Division of Fish and Game.

671. Zingmark, R.G. 1978. An annotated checklist of the biota of the coastal zone of South Carolina. University of South Carolina, Columbia.

672. Ziskowski, J.J., L.M. Despres–Patanjo, A.B. Howe, D. Ralph and S. Atran. 1987. Disease in commercially valuable fish stocks in the Northwest Atlantic. Marine Pollution Bulletin **18**(9): 496–504.

Author index to the Bibliography

Note: Numbers correspond to citations listed in Appendix A

Abbe, G.R., 1
Able, K.W., 2, 282, 293, 284, 516, 517, 518, 603, 604, 605, 664
Adams, S.M., 3, 4, 608
Agnello, R.J., 5
Ahlstrom, E.H., 6, 224
Allen, D.M., 7, 8, 9, 10, 449
Almeida, F.P., 11
Alperin, I.M., 12
Ames, W.H., 13
Amoaka, K., 6
Anderson, E.D., 14
Anderson, V.T. Jr., 15
Anderson, W.W., 16, 17
Angelovic, J.W., 471
Arnold, E.L., 18
Arve, J., 19
Atlantic States Marine Fisheries Commission Subcommittee for Fisheries of the Atlantic Bight, 20
Atlantic States Marine Fisheries Commission Summer Flounder Subcommittee, 21, 22
Atran, S., 672
Ayvazian, S.G., 126
Azarovitz, T.R., 23, 24, 74, 208, 653
Bailey, R.M., 26, 503, 504
Baker, B.M., 649
Baker, S., 147
Baptist, J.P., 27
Barans, C.A., 635, 636
Barker, D.L., 7
Bass, D.G. Jr., 28
Bayless, J., 291
Bean, B.A., 611
Bean, T.H., 29
Bearden, C.M., 30, 31, 32, 33
Beatty, H.R., 34, 637
Bedsole, H.L. Jr., 35
Beirne, C., 669, 670
Bengston, D.A., 40
Berg, D.L., 36
Berg, M.B., 37
Berrien, P.L., 97
Berry, F.H., 635, 636
Bevacqua, E.S., 23
Bieder, R.C., 38
Bigelow, H.B., 39
Birdsong, R.S., 107
Bisbal, G.A., 40
Bodammer, J.E., 41, 311
Boehlert, G.W., 452
Bolz, G.R., 42
Bond, C.E., 503, 504
Bonzek, C.F., 43, 44, 190
Bowman, E., 209
Bowman, R.E., 151, 302, 303, 347
Bozeman, E.L. Jr., 45
Breder, C.M. Jr., 46, 47, 436
Briggs, J.C., 48
Briggs, P.T., 49, 50, 51, 52
Brooker, J.R., 503, 504
Brooks, H.A., 630
Brown, B.E., 88, 89, 650
Brown, C., 506, 507
Brown, R.A., 53
Brown, J.T., 220
Bruce, R.A., 54
Buchanan, C.C., 55, 461
Buckley, L.J., 56, 57
Buller, R.J., 58
Bullis, H.R., 59
Bulloch, D.K., 60
Burke, J.S., 61, 62, 63, 376, 624
Burnett, J.M., 11, 446
Burns, R.W., 64
Burreson, E.M., 65, 66, 67, 68, 69, 70, 71, 72, 263, 602
Bushing, M.F., 73
Byrne, C.J., 14, 23, 24, 74
Byron, R.R., 96
Cable, L.E., 231, 232

Cable, R.M., 75
Cain, R.E., 76
Cali, A., 306
Carley, D.H., 78
Carlson, J.K., 79
Carolina Power and Light Co., 80
Casey, J.F., 81
Castagna, M., 501
Castaneda, R.E., 11
Chadwick, D.L., 108, 110
Chang, S., 82, 83
Chester, A.J., 229
Christensen, D.J., 84, 85, 92, 185
Clark, J.R., 86, 87, 143
Clark, S.H., 88, 89
Clayton, G., 90
Clements, L.C., 91
Clifford, W.J., 84,85,92
Clymer, J.P. III, 8
Coates, P.G., 172
Coduri, R.J., 93
Cole, C., 90
Cole, R.W., 94, 95,
Colton, J.B. Jr., 96, 97, 98, 334, 335, 336
Colton, M.D., 99
Colvocoresses, J.A., 43, 44, 100, 190
Connecticut Division of Marine Fisheries, 101, 102, 103
Conover, D.O., 363
Cooke, D.W., 199
Coon, W.P. II, 639, 640
Copeland, B.J., 104, 105, 227
Coston, L.C., 246, 247
Coston–Clements, L.C., 425, 530, 531
Cowan, J.H. Jr., 107
Curley, J.R., 108, 109, 110, 171
Dahlberg, M.D., 111, 112, 113, 114, 115,
Daiber, F.C., 116, 117, 118, 119, 120, 573
Daniel, L.B. III, 121, 638
Davidson, L., 540, 541
Davis, R.W., 631
Dawson, C.E., 122, 123
Deacutis, C.F., 124
Dean, J.M., 45, 77, 553
Decker, E.A., 125
Deegan, L.A., 126
DeGroot, S.J., 127, 128, 129
Delaney, G.R., 130, 175
Derickson, W.K., 131
Dery, L.M., 132, 133, 466, 574
Desfosse, J.C., 134, 125
Despres, L.I., 23
Despres–Patanjo, L.I., 24, 135, 136, 672
de Sylva, D.P., 137, 138, 545
Deubler, E.E. Jr., 140, 141, 662, 663
Deuel, D.G., 142, 143, 323
DeVries, D.A., 144, 145, 513
Dickinson, C.L., 427
Dillmann, D.W., 57
Dipiero, S.J., 564
Donohoe, C.J., 199
Douglas, J., 505
Dovel, W.L., 146
Draxler, S., 593
Drewry, G.E., 342
Dudley, D.L., 606
Duncan, J., 540, 541
DuPaul, W., 147
Easley, J.E. Jr., 106
Ecological Analysts Engineering Science and Technology, Inc., 148
Ecological Analysts, Inc., 149
Edwards, R.L., 150, 151, 152
Eerly, S.P., 153, 154, 515
Eisenberg, M., 159
Eklund, A., 155
Eldridge, P.J., 156
Essig, R.J., 157
Estes, A.D., 134, 135
Erickson, M.C., 125
Estes, A.D., 406
Estrella, B.T., 249
Evermann, B.W., 275
Fahay, M.P., 2, 87, 97, 158, 386, 387, 580
Fahy, W.E., 140
Farmanfarmaian, A., 159
Farmer, C.H. III, 32
Fee, R., 160
Feigenbaum, D.L., 73
Festa, P.J., 161, 162, 163, 164, 165, 166, 167, 168, 396, 397, 398
Figley, W., 169, 170
Finn, J.T., 126
Fiske, J.D., 109, 171, 172
Fitch, J.E., 26
Fitzhugh, G.R., 376
Florida Department of Natural Resources, 173
Fogarty, M.J., 174, 175
Foster, D.B., 335, 336
Foster, H.A., 23, 24

Fowler, H.W., 176, 177, 178, 179, 180, 181, 182, 183, 551, 611
Freeman, B.L., 184, 185, 186
Frisbie, C.M., 78
Frizzell, L.J., 68
Gabriel, W.L., 187
Gahn, T., 594, 595, 596, 598
Gaichas, S.K., 270
Gallagher, M.L., 188
Gartner, J.V., 189
Geer, P.J., 43, 44, 190
Gehringer, J.W., 17
Gerhart, E.H., 191
Gerry, L.R., 632
Gibson, C.I., 355
Gilbert, C.R., 192
Gillikin, J.W. Jr., 35, 175, 193, 194, 195, 196, 482, 483
Gilmore, R.G. Jr., 197, 198, 199, 274
Ginsburg, I., 200
Ginter, J.J.C., 364
Goldman, J.C., 201
Goldstein, R.J., 202
Goode, G.B., 203
Gordon, B.L., 204
Goss, D.K., 276
Grant, G.C., 458, 459
Graunke, B., 274
Greenfield, R.C., 11
Greenwood, P.H., 205
Greges, M.P., 564
Grimes, B.H., 206
Grosslein, M.D., 25, 207, 208, 209, 210
Gudger, E.W., 211, 212, 214
Gunter, G., 214
Gusey, W.F., 215
Gutherz, E.J., 216
Guthrie, R.O., 195
Hackney, C.T., 520
Haire, M.S., 312
Halgren, B., 217
Hall, W.M. Jr., 670
Hamer, P.E., 152, 218, 314
Hardy, J.D. Jr., 333
Hargis, W.J. Jr., 219
Harrell, M.L., 188
Harris, C.D., 324, 325, 326, 327
Harris, R.E., 43, 44, 190
Harvell, C.H., 145
Hassler, W.W., 220
Hattala, K., 672
Hawkes, J.W., 239
Hawkins, J.H., 221, 513
Heck, K.L. Jr., 453
Henderson, E.M., 22
Hennemuth, R.C., 223
Hensley, D.A., 6, 224
Herald, E.A., 26
Herman, S.S., 8, 225, 286
Herold, R.C., 226
Herrema, D.J., 199
Hester, J.J., 227
Hettler, W.F. Jr., 228, 229, 247, 609
Heyerdahl, E.G., 210
Hickey, J.M., 108, 109
Hicks, B., 230
Hildebrand, S.F., 231, 232, 233
Hill, N.L., 220
Hillman, R.J., 234
Himchak, P.J., 235, 236, 237, 238
Hocutt, C.H., 269, 270
Hodgins, H.O., 239
Hodson, R.G., 104, 105, 106, 632
Hoese, H.D., 240
Hoff, F.H. Jr., 610
Hoff, J.G., 575
Hoffman, W.G. II, 241
Hogarth, W.T., 539
Holder, D.R., 248
Holland, A.F., 312
Holland, B.F. Jr., 35, 195, 196, 242, 482, 483
Holliday, M.C., 157
Horwitz, R.J., 243
Hoss, D.E., 62, 63, 91, 244, 245, 246, 247, 609, 646
Hottell, H.E., 248
Howe, A.B., 249, 672
Howell, W.H., 271, 272
Hsia, R., 159
Hughes, E.H., 250, 251
Huish, M.T., 206
Hultin, H.O., 125
Hunninen, A.V., 75
Hussakoff, L., 252
Iannaccone, V., 159
Ichthyological Associates, 254, 255, 256, 257, 258
Industrial Fishery Project, 259
International Gamefish Association, 260
Irlandi, L.R., 425

Ishibashi, N., 261
Itzkowitz, N., 262, 564
Jacobs, F., 312
Jansen, M.E., 263
Jearld, A. Jr., 574
Jeffries, H.P., 264, 265
Jensen, A.C., 266, 267, 268
Jensen, J., 312
Jesien, R.V., 11, 269, 270
Johns, D.M., 271, 272
Johnson, G.N., 612, 613, 614
Johnson, K.L., 273
Johnson, W.C., 264
Jones, R.S., 274
Jordan, D.S., 275, 276
Jorgenson, S.C., 277, 375
Joseph, E.B., 344, 345, 552
Judy, M.H., 278
June, F.E., 279
Junqueira, L.C., 280, 281
Kalber, F.A., 137, 138
Kasper, V., 594, 595, 596, 598
Keefe, M., 282, 283, 284
Keirans, W.J. Jr., 285, 286
Keiser, R.K., 287
Keisler, A.S., 626
Kemmerle, S., 288
Kendall, A.W. Jr., 87, 97, 289
Kerby, J.H., 206
Kernehan, R.J., 622
Kerr, G.A., 290
Keup, L., 291
Kimmel, J.J., 292
Kindred, J.E., 1971
Kirsch, R., 294
Kjelson, M.A., 472, 609
Klein-MacPhee, G., 272, 295, 296, 297
Krouse, C.W., 530, 531
Kulczyck, G.R., 274
Kuntz, A., 298
Kyle, H.M., 299
Lachner, E.A., 26, 503, 504
LaCroix, M.W., 608, 609
Lange, A.M.T., 14, 300
Langton, R.W., 301, 302, 303,
Lascara, V.J., 304
Latham, R., 305
Laudan, R., 306
Laurence, G.C., 307
Lawton, R.P., 108, 109, 110, 171
Leim, A.H., 308
Lesser, C.A., 309
Levinton, J.S., 36
Lewis, E.J., 310, 311
Lewis, R.R., 562
Lindsey, C.C., 26
Lipcon, V., 598
Lison, A.J., 312, 313,
Livingstone, R., 152
Livingston, R.J., 556
Lockwood, K., 170
Longo, J., 564
Lough, R.G., 42
Low, R., 33
Lucy, J.A., 341
Lugger, O., 616
Lux, F.E., 218, 314, 315, 316, 317, 318, 319
Lynch, T.R., 320
Lyons, P., 135
MacKenzie, C.L. Jr., 321
MacPhee, G., 322
Maddox, M.B., 638
Magley, W.C., 274
Mahoney, J.B., 315, 323, 561
Mahood, R.K., 324, 325, 326, 327
Malins, D.C., 618
Malloy, K.D., 328, 329, 330, 331
Malsberger, R.G., 286
Mann, W.C., 310
Manooch, C.S. III, 332
Mansueti, A.J., 333
Marak, R.R., 334, 335, 336
Marcellus, K.L., 337
Marsh, E., 338
Marshall, A., 339, 340, 341
Martin, F.D., 342
Martore, R.M., 583, 637
Mason, D., 540, 541
Mason, J.M., 14
Massmann, W.H., 343, 344, 345, 490
Mast, S.O., 346
Matheson, R.E., 2
Maurer, R.O. Jr., 347
Mayo, R.K., 348, 349, 446, 562
McAdams, M., 540, 541
McAllister, D.E., 350
McClain, J.F. Jr., 351, 352
McDermott, V., 353, 354
McEachran, J.D., 407
McErlean, A.J., 355

McGovern, J.C., 356, 357, 637
McHugh, J.L., 358, 359, 360, 361, 362, 363, 364
McKenzie, R.A., 620
McKown, K.A., 672
McLaughlin, S.M., 311
McMillan, D.G., 582, 657
Mercer, L.P., 365
Meredith, A., 288
Merriman, D., 366, 623
Metzger, F. Jr., 367
Michels, S.F., 368
Michener, W.K., 9, 10, 449
Mid–Atlantic Council Staff, 369
Mid–Atlantic Fishery Management Council, 370, 371, 372, 373, 374
Midlige, F.H., 323
Miglanese, J.V., 552
Mihursky, J.A., 355
Miller, D., 336, 590
Miller, G.L., 277, 375
Miller, J.M., 376, 377, 378
Miller, J.S., 63
Miller, R.W., 379
Monaco, M.E., 425
Monaghan, J.P. Jr., 365, 380a, 380b, 491
Monroe, R.J., 104, 437, 438
Moore, H.F., 381
Moran, D., 206
Moran, J.E., 638
Moran, R.L., 313
Moran–Johnson, R.L., 312
Morgan, M.A., 564
Morris, T.L. Jr., 382
Morse, W.W., 2, 383, 384, 385, 386, 387, 651, 652, 653, 654, 655, 656
Moser, H.G., 6
Murawski, S., 90, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399
Murchelano, R.A., 136, 400, 401, 507, 523
Music, J.L. Jr., 324, 325, 326, 327, 402, 403
Musick, J.A., 100, 134, 135, 404, 405, 406, 407
Myer, G.S., 205
Myrvik, Q.N., 626
Nagle, J.J., 593, 594, 595, 596, 598
National Marine Fisheries Service, 408–423
Nelson, D.M., 425
Nesbit, R.A., 426
Neville, W.C., 426, 427, 642
New Jersey Department of Environmental Protection, 428–433
Newman, M.W., 434
Nichols, J.T., 435, 436
Nicholson, N., 460
Nichy, F.E., 316, 317, 318
Nixon, S.W., 456
Noble, E.B., 437, 438
Norcross, J.J., 344, 345
Norman, J.R., 439
North Carolina Division of Marine Fisheries, 440–444
Northeast Utilities Service Company, 445
O'Brien, L., 446
O'Conner, J.S., 447, 448
O'Connor, S.G., 355
Odum, E.P., 115
Ogburn, M.V., 449
Olla, B.L., 450
Olney, J.E., 451, 452
O'Neil, S.P., 575
Orth, R.J., 453
Osborn, C.M., 454, 455
Oviatt, C.A., 456
Pacheco, A.L., 83, 457, 458, 459, 657
Pafford, J.M., 402, 460
Palmer, B.A., 324, 325, 326, 327
Pancirov, R.J., 53
Parker, L.L., 73
Parker, R.O., 461
Parrish, J., 90
Pearcy, W.G., 462
Pearson, J.C., 463, 464
Pendleton, E.C., 465
Pentilla, A., 466
Perlmutter, A., 467, 468
Perra, P., 469
Perschbacher, P., 540, 541
Peters, D.S., 377, 470, 471, 472, 530, 531
Phalen, P.S., 473
Phelan, B.A., 657
Pietrafesa, L.J., 378
Pikanowski, R.A., 657
Podgar, T.T., 312
Poole, J.C., 12, 175, 314, 474, 475, 476, 477, 478, 479
Porter, H.J., 542
Porter, L.R. Jr., 319
Potter, D.C., 42
Powell, A.B., 480, 481, 482, 483, 484, 485, 486
Powles, H., 487
Price, K. Jr., 131

Price, K.S., 545
Price, T.J., 27
Pritchard, E.S., 24
Pulley, M.G., 488
Purvis, C., 489
Radcliffe, L., 298
Ralph, D.E., 175, 652, 653, 654, 655, 660, 672
Rand, H.G. Jr., 93
Raney, E.C., 490
Ray, G.C., 505
Raynie, R.C., 81
Reback, K., 108, 110
Reed, J.P., 378
Reed, L., 491
Reichert, M.J.M., 492
Reinach, F., 280
Reintjes, J.W., 279, 493
Reis, R., 494
Reisersen, L., 495
Rhode Island Division of Fish and Wildlife, 496
Rhodes, R., 33
Rice, C.D., 627
Richards, A., 497
Richards, C.E., 498, 499, 500, 501
Richards, S.W., 462, 502
Richkus, W.A., 312
Riggs, S.R., 105, 106
Robins, C.R., 503, 504, 505
Robohm, R.A., 506, 507, 508
Rogers, S.G., 403, 509, 510
Roithmayr, C.M., 493
Rosen, D.E., 205
Rosenberg, M., 511
Ross, J.L., 365, 491, 512, 513
Ross, S.W., 154, 514, 515
Roumillat, W.A., 637, 638
Rountree, R.A., 516, 517, 518, 605
Rozas, L.P., 519, 520
Rulifson, R.A., 188, 521, 522
Ryder, C., 126
Salles, L.M.M., 280, 281
Samet, C.E., 450
Sandifer, P.S., 639, 640, 641
Sandoy, K., 540, 541
Sass, S.L., 523
Sawyer, R.T., 524
Sawyer, T.K., 311
Scarlett, P.G., 175, 217, 525, 526, 527, 528, 574
Scattergood, L.W., 529
Schaaf, W.E., 246, 530, 531
Schaefer, R.H., 532
Schauss, R.P., Jr., 533
Schroeder, W.C., 39, 233, 534
Schubel, J.R., 262, 564
Schwartz, F.J., 484, 485, 486, 535, 536, 537, 538, 539, 540, 541, 542
Sclar, R.C., 366
Scott, W.B., 26, 308, 543
Scott, R.N., 503, 504
Scotton, L.N., 544, 545
Seagraves, R.J., 94, 95, 546, 547, 548, 549
Sedberry, G.R., 634
Settle, M.E., 425
Sharp, B., 551
Sharp, J.H., 550
Shealy, M.H. Jr., 552, 639, 640, 641
Shenker, J.M., 553
Shepherd, G.P., 2, 85, 554, 555
Sheridan, P.F., 556
Sherman, K., 557, 558
Sherr, E.B., 251
Shipman, S., 559
Shuster, C.N. Jr., 138
Shuster, C.W., 560
Sibunka, J.D., 581, 660
Sicluna, J.D., 672
Silverman, M.J., 561, 658, 659
Sinderman, C.J., 601
Sissenwine, M.P., 562
Smigielski, A.S., 563
Smith, C.F., 564
Smith, H.M., 565, 566, 567
Smith, J.W., 568, 569, 638
Smith, M.G., 543
Smith, N.S., 545
Smith, R.E., 545
Smith, R.L., 570
Smith, R.W., 120, 175, 571, 572, 573, 574,
Smith, S.I., 619
Smith, S.M., 575
Smith, W.G., 87, 97, 386, 387, 558, 576–582, 660
Socci, R., 159
Sparrow, D.S., 508
Spear, H.S., 58
Spitsbergen, D., 582
Stancyk, S.E., 9, 10
Steady, E.J., 654, 655
Stehlik, L.L., 656, 657
Stender, B.W., 583, 635, 636
St. Onge, J.M., 98

Stender, B.W., 487
Stephan, C.D., 584, 585
Stephan, D.C., 473
Stern, H., Jr., 210
Stickney, R.R., 586, 587, 588, 589, 590, 644, 645
Stock Assessment Workshop, 591, 592
Stolen, J.S., 306, 593, 594, 595, 596, 597, 598,
Stone, R.B., 461
Struhsaker, P., 599
Studholme, A.L., 450
Sumida, B.Y., 6
Sumner, F.B., 600
Swanson, R.L., 601
Sypek, J.P., 69, 602
Szedlmayer, S.T., 603, 604, 605
Tagatz, M.E., 606
Targett, T.E., 155, 329, 330, 331, 509
Tate, J., 541
Temple, R.F., 99
Terceiro, M., 265, 555, 607
Thayer, G.W., 608, 609
Thompson, J.R., 59
Tinsman, J.C., 94, 95
Topp, R.W., 610
Truitt, R.V., 611
Turner, W.R., 612, 613, 614
Tyler, A.V., 615
Uhler, P.R., 616
Van Den Avyle, M.J., 510
Van Der Veer, H.W., 492
Van Dolah, R., 33
Van Housen, G., 617
Van Sant, S.B., 509
Varanasi, U., 618
Vaughn, D.S., 530, 531
Vecchio, V.J., 672
Verrill, A.E., 619
Vladykov, V.D., 620
Vouglitois, J.J., 621
Walford, L.A., 186
Walters, M.F., 633
Wang, J.C.S., 622
Warfel, H.E., 623
Warlen, S.M., 624
Warriner, J.E., 626, 627
Watson, C.E., 172
Weber, A.M., 625
Webster, R.P., 34
Weeks, B.A., 626, 627
Weinstein, M.P., 539, 575, 628, 629, 630, 631, 632, 633
Weiss, S.L., 632, 633
Weitzman, S.H., 205
Weller, P., 37
Wells, A., 581, 582
Wenner, C.A., 33, 357, 569, 634, 635, 636, 637, 638
Wenner, E.L., 33, 34, 639, 640, 641
Wesche, A.E., 81
Westman, J.R., 427, 642
Wheatland, S.B., 643
White, D.B., 587, 588, 589, 590, 644, 645
White, J.C. Jr., 141, 646
White, R.L., 399
Widerstrom, F.L. Jr., 647
Wilk, S.J., 175, 648–660
Williams, B.C., 403
Williams, A.B., 661, 662, 663
Witting, D.A., 664
Witzig, J.F., 157
Wolff, M., 665, 666, 667
Woodward, A.G., 668
Woolcott, W.S., 669, 670
Wyanski, D.M., 671
Young, B.H., 672
Younger, R.R., 673
Zamos, J.A., 673
Zingmark, R.G., 671
Ziskowski, J.J., 400, 401, 672
Zwerner, D.E., 70, 71, 72

Subject index to the Bibliography

Note: Numbers correspond to citations listed in Appendix A

adults: 144
age: 11, 132, 133, 466, 474, 481, 554
anatomy: 128, 129, 226, 280, 281, 293, 294, 299, 338, 382, 455, 669, 670 (see also anomalies)
anomalies: 15, 40, 111, 123, 140, 189, 211, 212, 213, 252, 484, 589, 646
aquaculture: 587, 588, 589, 644
Baltimore Canyon: 53
behavior: 127, 295, 296, 304, 346, 450, 590
bibliography: 123, 495, 526, 545, 645
biochemistry: 37, 125, 159, 188, 330, 331, 511
biomass: 88, 319, 516, 652
Block Island Sound: 366
Canada: 97, 98, 158, 187, 308, 350, 384, 386, 387, 420, 543, 620, 650
Chesapeake Bay: 67, 69, 70, 71, 72, 73, 121, 233, 243, 263, 333, 404, 452, 453, 464, 469
Chesapeake Bight: 407, 468
color: see pigment
commercial fisheries: see fisheries
Connecticut: 79, 101, 102, 103, 462
Delaware: 131, 331, 362, 368, 379, 458, 459, 544, 546
Delaware Bay–River: 1, 13, 120, 137, 138, 177, 191, 238, 254, 257, 279, 433, 493, 545, 547, 548, 549, 560, 570, 571, 572, 573, 622
development: 6, 41, 205, 231, 232, 283, 298, 299, 313, 333, 342, 455
disease/parasites: 65, 66, 67, 68, 69, 70, 71, 72, 75, 122, 136, 219, 239, 263, 306, 311, 323, 400, 401, 434, 506, 507, 508, 523, 524, 561, 588, 593, 594, 595, 596, 597, 598, 602, 672
distribution (temporal & spatial): 1, 23, 24, 25, 34, 42, 48, 64, 76, 77, 98, 115, 150, 208, 425, 229, 230, 264, 289, 291, 334, 335, 336, 355, 396, 405, 407, 456, 462, 485, 487, 517, 521, 544, 552, 553, 562, 576, 579, 581, 599, 629, 634, 639, 640
dredging: 119, 534, 586
early life history: 2, 158, 376, 458, 510, 622

eggs: 2, 42, 96, 98, 146, 225, 229, 237, 241, 271, 272, 278, 285, 286, 298, 333, 334, 335, 336, 352, 354, 366, 451, 452, 457, 467, 487, 557, 576, 577, 580, 582, 621, 637, 643
electrophoresis: 93, 617
entrainment: see industry/energy plant studies
estuarine dependence: 87, 378
fecundity: see reproduction
feeding: 61, 128, 129, 261, 292, 304, 328, 329, 330, 382, 450, 477, 590
fisheries (commercial/recreational): 5, 14, 16, 17, 20, 21, 22, 32, 33, 55, 58, 60, 78, 82, 84, 85, 86, 92, 94, 95, 116, 117, 118, 142, 143, 147, 155, 156, 157, 160, 162, 163, 164, 165, 166, 167, 168, 169, 170, 173, 174, 185, 186, 203, 210, 235, 249, 259, 260, 266, 267, 268, 273, 279, 287, 288, 300, 309, 316, 317, 320, 324, 325, 326, 327, 339, 340, 341, 351, 359, 360, 361, 362, 363, 364, 365, 369, 370, 371, 372, 373, 374, 379, 394, 398, 402, 403, 408, 409, 410, 411, 412, 413, 414, 415, 417, 418, 419, 421, 422, 423, 426, 438, 441, 442, 443, 460, 463, 468, 469, 473, 475, 476, 491, 493, 496, 498, 499, 512, 513, 514, 525, 527, 532, 546, 548, 549, 555, 557, 558, 559, 568, 599, 625, 642, 647, 648, 650, 672
Florida: 28, 48, 173, 192, 197, 198, 199, 186, 274, 290, 556, 658, 660
food/food habits: 73, 129, 151, 167, 236, 250, 251, 292, 301, 302, 303, 347, 405, 470, 471, 472, 486, 619
Georges Bank: 42, 96, 99, 334, 335, 336, 579
Georgia: 78, 111, 112, 113, 114, 115, 240, 248, 251, 277, 324, 325, 326, 327, 375, 402, 403, 460, 492, 509, 559, 668
Gulf of Maine: 39, 89, 96, 334, 335, 336, 529
growth: 56, 261, 282, 295, 296, 328, 329, 330, 331, 470, 471, 475, 481, 492, 517, 574, 603, 605
habitat selection/use: 61, 62, 282, 322, 437, 510, 520, 534, 671
Hudson River: 36, 146
identification: 47, 93, 114, 158, 200, 204, 216, 224, 233, 275, 276, 308, 332, 439, 505, 545, 610, 620
immunology: see physiology
impingement: see industry/energy plant studies
industry/energy plant studies: 9, 10, 80, 104, 112, 124, 148, 149, 234, 247, 254, 255, 256, 257, 258, 337, 354, 367, 564
juveniles (incl. post–larvae): 1, 2, 43, 44, 45, 68, 104, 107, 139, 141, 161, 190, 238, 245, 282, 328, 329, 330, 331, 333, 356, 357, 378, 396, 457, 458, 459, 464, 470, 471, 472, 492, 494, 533, 547, 548, 553, 577, 578, 602, 603, 604, 605, 609, 632, 664, 671
larvae: 2, 7, 41, 42, 45, 56, 62, 64, 91, 96, 98, 104, 107, 146, 158, 161, 225, 229, 237, 238, 241, 246, 247, 271, 272, 278, 285, 286, 289, 297, 298, 307, 310, 333, 334, 335, 336, 344, 345, 353, 354, 356, 357, 366, 378, 396, 451, 452, 457, 459, 467, 487, 494, 533, 544, 545, 553, 557, 563, 576, 577, 580, 581, 582, 621, 624, 637, 643
length (incl. length/weight): 92, 169, 277, 307, 317, 319, 348, 375, 552, 652
life history: 21, 22, 25, 38, 192, 203, 206, 231, 232, 322, 402, 442, 479, 530, 531, 621, 638, 642, 654
Long Island Sound: 427, 445, 502
marking: see tagging/marking
Maryland: 19, 81, 179, 269, 270, 312, 313, 535, 536, 537, 611, 616

Massachusetts: 90, 108, 109, 110, 126, 172, 249, 317, 523, 551, 566, 576, 581
maturity: see reproduction
mesh selectivity: 14, 194, 195, 217, 668
meristics: 130
metabolism: see physiology
metamorphosis: 283, 299
Middle Atlantic: 2, 23, 24, 58, 60, 65, 134, 135, 155, 175, 184, 206, 215, 289, 314, 316, 342, 360, 363, 383, 405, 406, 410, 468, 550, 555, 582, 615, 655
migration: see movement
morphometrics: 130
mortality/survival: 65, 72, 297, 328, 329, 330, 492, 601, 605, 625
movement: 145, 193, 218, 242, 245, 269, 270, 305, 378, 380a, 604 (see also tagging/marking)
Nantucket Shoals: 42, 152, 186
New England: 18, 150, 266, 318, 436, 555, 623
New Haven Harbor: 79
New Jersey: 2, 8, 29, 46, 84, 85, 148, 149, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 176, 178, 180, 181, 182, 183, 184, 185, 234, 235, 236, 237, 238, 255, 256, 258, 285, 286, 288, 321, 337, 351, 352, 353, 354, 367, 381, 388, 389, 390, 391, 392, 393, 394, 395, 396, 398, 428, 429, 430, 431, 432, 433, 516, 517, 518, 528, 565, 603, 604, 605, 647, 673
New York: 12, 14, 49, 50, 51, 52, 98, 49, 267, 321, 435, 436, 467, 474, 475, 476, 477, 478, 532, 564, 625, 642, 658, 660, 672, 358
New York Bight: 55, 74, 323, 361, 364, 400, 401, 447, 448, 507, 561, 601, 649, 651, 652, 653, 654, 656, 657
nitrogen: 57
North Atlantic: 54, 59, 83, 88, 136, 158, 174, 187, 209, 216, 222, 223, 301, 302, 303, 307, 349, 382, 411, 414, 419, 424, 466, 557, 558, 615, 650, 672
North Carolina: 35, 80, 89, 97, 104, 105, 106, 139, 141, 144, 145, 152, 153, 154, 158, 187, 193, 194, 195, 196, 220, 227, 228, 229, 232, 241, 242, 253, 278, 291, 310, 331, 377, 380b, 384, 386, 387, 420, 437, 438, 440, 441, 442, 443, 444, 463, 465, 472, 473, 480, 482, 483, 485, 486, 488, 489, 512, 513, 514, 515, 519, 521, 538, 539, 540, 541, 542, 567, 576, 581, 582, 584, 585, 606, 613, 624, 628, 650, 661, 662, 663, 665, 666, 667
nursery habitat: 61, 63, 221, 330, 458, 489, 509, 515, 628, 671
osteology: see anatomy
oyster–shell habitat: 19
oxygen: 91, 184, 550
parasites: see disease/parasites
physiology: 159, 280, 281, 293, 294, 295, 296, 306, 454, 455, 593, 594, 595, 596, 597, 598, 600, 602, 618, 626, 627
pigment: 140, 189, 211, 213, 252, 280, 281, 346, 454, 455, 589, 600, 646
pollutants/pollution: 9, 27, 53, 82, 112, 159, 190, 201, 239, 244, 246, 447, 448, 507, 508, 530, 531, 595, 597, 598, 618, 657

post–larvae: see juveniles
predation (by and on summer flounder): 304, 315, 664
Raritan Bay: 36, 321
recreational fisheries: see fisheries
recruitment: 7, 63, 273, 356, 357, 376
reproduction: 97, 99, 169, 196, 383, 384, 385, 397, 399, 424, 446, 563, 651, 656, 579
Rhode Island: 204, 225, 264, 265, 320, 456, 496
salinity: 141, 328, 329, 334, 335, 336, 470, 471
salt marsh habitat: 228, 241, 356, 357, 494, 575, 628, 633, 637
salt marsh creek habitat: 64, 76, 77, 121, 494, 516, 518, 519, 522, 553, 612, 614, 630, 631
Sandy Hook Bay: 46, 566
scallop bed habitat: 542
settlement: 63, 284, 383, 492
South Atlantic: 16, 17, 34, 175, 425, 510, 599, 615, 634, 635, 636
South Carolina: 9, 10, 30, 31, 32, 33, 45, 77, 230, 246, 287, 449, 461, 522, 524, 552, 568, 583, 612, 614, 637, 638, 639, 640, 641, 671
spawning: see reproduction
species list: 26, 176, 177, 183, 197, 214, 350, 352, 377, 381, 404, 490, 503, 504, 611, 616, 671
survival: see mortality/survival
stocks/stock assessment: 81, 130, 134, 135, 144, 175, 207, 221, 269, 270, 406, 497, 607, 617
systematics: see identification
tagging/marking: 145, 193, 218, 242, 245, 269, 270, 318, 380, 393, 406
temperature: 124, 150, 152, 202, 247, 262, 271, 272, 328, 329, 330, 331, 334, 335, 336, 337, 470, 471, 564, 593, 594, 602, 605, 621
tracking: see movement
vegetated habitat: 3, 4, 282, 304, 452, 453, 608, 630
Virginia: 43, 44, 73, 100, 107, 190, 242, 292, 339, 340, 341, 343, 463, 464, 490, 498, 499, 500, 501, 533
weight: see biomass, length (incl. length/weight)

Appendix B
List of Experts

Able, Kenneth W., Institute of Marine and Coastal Sciences, Rutgers University, Marine Field Station, 800 Great Bay Blvd., Tuckerton, NJ 08087

Azarovitz, Thomas R., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory, 116 Water Street, Woods Hole MA 02543–1097

Bengston, David A., Department of Zoology, University of Rhode Island, Kingston, RI 02881

Burke, John S., NOAA/National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory, 101 Pivers Island Rd., Beaufort, NC 28516–9722

Byrne, Donald M., New Jersey Department of Environmental Protection and Energy, Division of Fish, Game and Wildlife, Nacote Creek Research Station, P.O. Box 418, Port Republic, NJ 08241

Casey, James F., Maryland Department of Natural Resources, Tidewater Administration, Fisheries Division, 580 Taylor Avenue, Tawes State Office Bldg., Annapolis, MD 21401

Castonguay, Wayne, Massachusetts Division of Marine Fisheries, Cat Cove Lab, Salem, MA 01970

Daiber, Franklin Co., College of Marine Studies, University of Delaware, Newark, DE 19716

Daniel, Louis B., III Virginia Institute of Marine Science, College of William and Mary, P.O. Box 786, Gloucester Point, VA 23062

Desfosse, Joseph C., Virginia Institute of Marine Science, College of William and Mary, P.O. Box 1046, Gloucester Point, VA 23062

DeVries, Doug, NOAA/National Marine Fisheries Service, 3500 Delwood Beach Road, Panama City, FL 32408

Epifanio, Charles E., University of Delaware, Marine Biology–Biochemistry Program, 700 Pilottown Rd., Lewes, DE 19958

Fahay, Michael P., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ 07732

Fogarty, Michael NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory, 116 Water Street, Woods Hole MA 02543–1097

Fonseca, Mark NOAA/National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory, 101 Pivers Island Rd., Beaufort, NC 28516–9722

Experts

Gorski, Stan, NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands NJ 07732

Hettler, William, NOAA/National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory, 101 Pivers Island Rd., Beaufort, NC 28516–9722

Hocutt, Charles H., Horn Point Environmental Laboratory, University of Maryland, P.O. Box 775, Cambridge, MD 21613–0775

Hoff, Thomas B., National Marine Fisheries Service, Woods Hole Laboratory, 116 Water Street, Woods Hole, MA 02543

Howe, Arnold B., Massachusetts Division of Marine Fisheries, Sandwich, MA 02563–1802

Howell–Heller, Penelope T., Connecticut Department of Environmental Protection, Bureau of Fisheries, P.O. Box 248, Waterford, CT 06385

Jearld, Ambrose Jr. NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory, 116 Water Street, Woods Hole MA 02543–1097

Jesien, Roman, Horn Point Environmental Laboratory, University of Maryland, PO Box 775, Cambridge, MD 21613

Kaiser, Susan C., Institute of Marine and Coastal Sciences, Rutgers University, Marine Field Station, 800 Great Bay Blvd., Tuckerton, NJ 08087

Keefe, MaryLouise, Oregon Department of Fish & Wildlife, 211 Inlow Hall, Eastern Oregon State College, LaGrande, OR 97850

Klein–MacPhee, Grace, University of Rhode Island, Graduate School of Oceanography, South Ferry Road, Narragansett, RI 02882–1197

Lynch, Timothy R., Rhode Island Department of Environmental Management, Division of Fish and Wildlife, 150 Fowler St., Wickford, RI 02852

Malloy, Kirk D., Boston University, Department of Biology, 5 Cummington Street, Boston, MA 02215

Mercer, Linda P., North Carolina Department of Environment, Health and Natural Resources, Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557–0769

Michels, Stewart F., Delaware Division of Fish and Wildlife, Department of Marine Fisheries, 89 Kings Highway, PO Box 1401, Dover, DE 19903

Monaghan, James Patrick, Jr., North Carolina Department of Environment, Health and Natural Resources, Division of Marine Fisheries, P.O. Box 769, Morehead City, NC 28557–0769

Murawski, Walter S., New Jersey Department of Environmental Protection and Energy, Bureau of Freshwater Fisheries, CN 400, Trenton, NJ 08625

Musick, John A., Virginia Institute of Marine Science, College of William and Mary, P.O Box 358, Gloucester Point, VA 23062

Norcross, Brenda, University of Alaska–Fairbanks, School of Fisheries and Ocean Sciences, Institute of Marine Science, Fairbanks, AK 99775–1080

Poole, John C., P.O. Box 367, Melvin Village, NH 03850

Powell, Allyn B., NOAA/National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort Laboratory, 101 Pivers Island Rd., Beaufort, NC 28516–9722

Powell, Christopher, Rhode Island Department of Environmental Management, Division of Fish and Wildlife, Great Swamp, P.O. Box 218, West Kingston, RI 02892

Ross, Jeffrey L., North Carolina Department of Environment, Health and Natural Resources, Division of Marine Fisheries, Monteo Field Office, P.O. Box 1550, Manteo, NC 27954

Rountree, Rodney A., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory, 116 Water Street, Woods Hole, MA 02543–1097

Scarlett, Paul G., New Jersey Department of Environmental Protection and Energy, Division of Fish, Game and Wildlife, Nacote Creek Research Station, P.O. Box 418, Port Republic, NJ 08241

Shepherd, Gary P., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory, 116 Water Street, Woods Hole MA 02543–1097

Shipman, Susan, Georgia Department of Natural Resources, Coastal Fisheries Dept., 1 Conservation Way, Brunswick, GA 31523–8600.

Smith, Joseph W., NOAA/National Marine Fisheries Service, Southeast Fisheries Science Center, 101 Pivers Island Rd., Beaufort, NC 28516

Smith, Ronal W., Delaware Division of Fish and Wildlife, 89 Kings Hwy., P.O. Box 1401, Dover, DE 19903

Smith, Walter G., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands NJ 07732

Studholme, Anne L., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands NJ 07732

Targett, Timothy E., College of Marine Studies, University of Delaware, 700 Pilottown Rd., Lewes, DE 19958

Terceiro, Mark, NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole Laboratory, 116 Water Street, Woods Hole, MA 02543–1097

Wenner, Charles A. South Carolina Wildlife and Marine Resources, P.O. Box 12559, Charleston, SC 29412–2559

Wilk, Stuart J., NOAA/National Marine Fisheries Service, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands NJ 07732

Appendix C
User Groups

American Littoral Society
Sandy Hook, Highlands, NJ 07732
Attention: P. Carlsen

Connecticut Bureau of Natural Resources, Marine Fisheries
P.O. Box 248, Waterford, CT 06385
Attention: P.T. Howell, M. Johnson

Delaware Division of Fish and Wildlife
89 Kings Highway, PO Box 1401, Dover, DE 19903
Attention: S. Michels, R. Seagrave,

Harbor Branch Oceanographic Institute, Inc.
5600 Old Dixie Highway
Ft. Pierce, FL 33946
Attention: R.G. Gilmore, Jr.

Georgia Department of Natural Resources
Coastal Fisheries Dept., 1 Conservation
Way, Brunswick, GA 31523-8600.
Attention: J.L. Music, Jr., J. Pafford, S. Shipman

Maryland Department of Natural Resources
Tidewater Administration
Fisheries Division, 580 Taylor Avenue
Tawes State Office Bldg.
Annapolis, MD 21401
Attention: J.F. Casey

Massachusetts Division of Marine Fisheries
Cat Cove Laboratory, Salem, MA 01970
Attention: W. Castonguay

NOAA/National Marine Fisheries Service
Southeast Fisheries Science Center
Beaufort Laboratory
101 Pivers Island Road
Beaufort, NC 28516
Attention: J. Burke, S.E. Chester, L. Coston-Clements, D. Hoss, D. Peters, A.B. Powell

NOAA/National Marine Fisheries Service
Northeast Fisheries Science Center
James J. Howard Marine Sciences Laboratory
Highlands, NJ 07732
Attention: A. Bejda, M.P. Fahay, W.G. Smith, A.L. Studholme, S.J. Wilk

NOAA/National Marine Fisheries Service
Northeast Fisheries Science Center
Milford Laboratory
Milford, CT 06460
Attention: A. Calabrese

NOAA/National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole Laboratory
166 Water Street, Woods Hole, MA 02543–1097
Attention: T. Azarovitz, M. Fogarty, T. Hoff, A. Jearld, B. O'Gorman, G.P. Shepherd, M. Terceiro

New Jersey Department of Environmental Protection and Energy
Division of Fish, Game and Wildlife
Nacote Creek Research Station
P.O. Box 418
Port Republic, NJ 08241
Attention: D. Byrne, P.G. Scarlett, B. Halgren

New Jersey Department of Environmental Protection and Energy
Division of Fish, Game and Wildlife
Bureau of Freshwater Fisheries
501 E. State St.,CN 400
Trenton, NJ 08625
Attention: B. Freeman, W.S. Murawski

New York Department of Environmental Conservation
Stony Brook, NY 11790
Attention: K. McKown, V.J. Vecchio, B.H. Young

State University of New York
Marine Science Research Center
Stony Brook, NY 11794–5000
Attention: J. Schubel

North Carolina Division of Marine Fisheries
P.O. Box 769, Morehead City, NC 28557
Attention: D. DeVries, L. Mercer, J.P. Monaghan, Jr.

North Carolina Division of Marine Fisheries
Elizabeth City District Office, Elizabeth City, NC 27909
Attention: L. Henry

North Carolina Division of Marine Fisheries
Washington District Office, Washington, NC 27889
Attention: D. Moye

North Carolina Division of Marine Fisheries
Wilmington District Office, Wilmington, NC 28402
Attention: F. Rohde

North Carolina Division of Marine Fisheries
Monteo Field Office, P.O. Box 1550, Manteo, NC 27954
Attention: J.L. Ross

Rhode Island Division of Fish and Wildlife
150 Fowler St., Wickford, RI 02852
Attention: T.R. Lynch

Rutgers, The State University of New Jersey
Institute of Marine and Coastal Sciences
Marine Field Station, 800 Great Bay Blvd.
Tuckerton, NJ 08087
Attention: K.W. Able, S.C. Kaiser, D.A. Witting

South Carolina Wildlife and Marine Resources Center
P.O. Box 12559, Charleston, SC 29422–2559
Attention: R. Martore, J. Smith, B. Stender, R. VanDolah, C.A. Wenner, D.M. Wyanski

South Carolina Wildlife and Marine Resources Department
Waddell Mariculture Center, Bluffton, SC 29910
Attention: D. Hamilton, J. Hollaway

United States Environmental Protection Agency
South Ferry Road, Narragansett, RI 02882
Attention: D.A. Bengsten

United States National Park Service
Biscayne Bay National Park, Homestead, FL 33030
Attention: T. Rutledge

University of Delaware
College of Marine Studies
700 Pilottown Road
Lewes, DE 19958
Attention: C.E. Epifanio, T.E. Targett

University of Maryland
Horn Point Environmental Laboratory
University of Maryland System, Cambridge, MD 21613
Attention: C. Hocutt, R. Jesien

University of Massachusetts
Cooperative Extension, Essex County Office
562 Maple Street
Hawthorne, MA 01937–0362
Attention: S. Jacobson

University of North Carolina
Wilmington, NC 28402
Attention: D. Lindquist

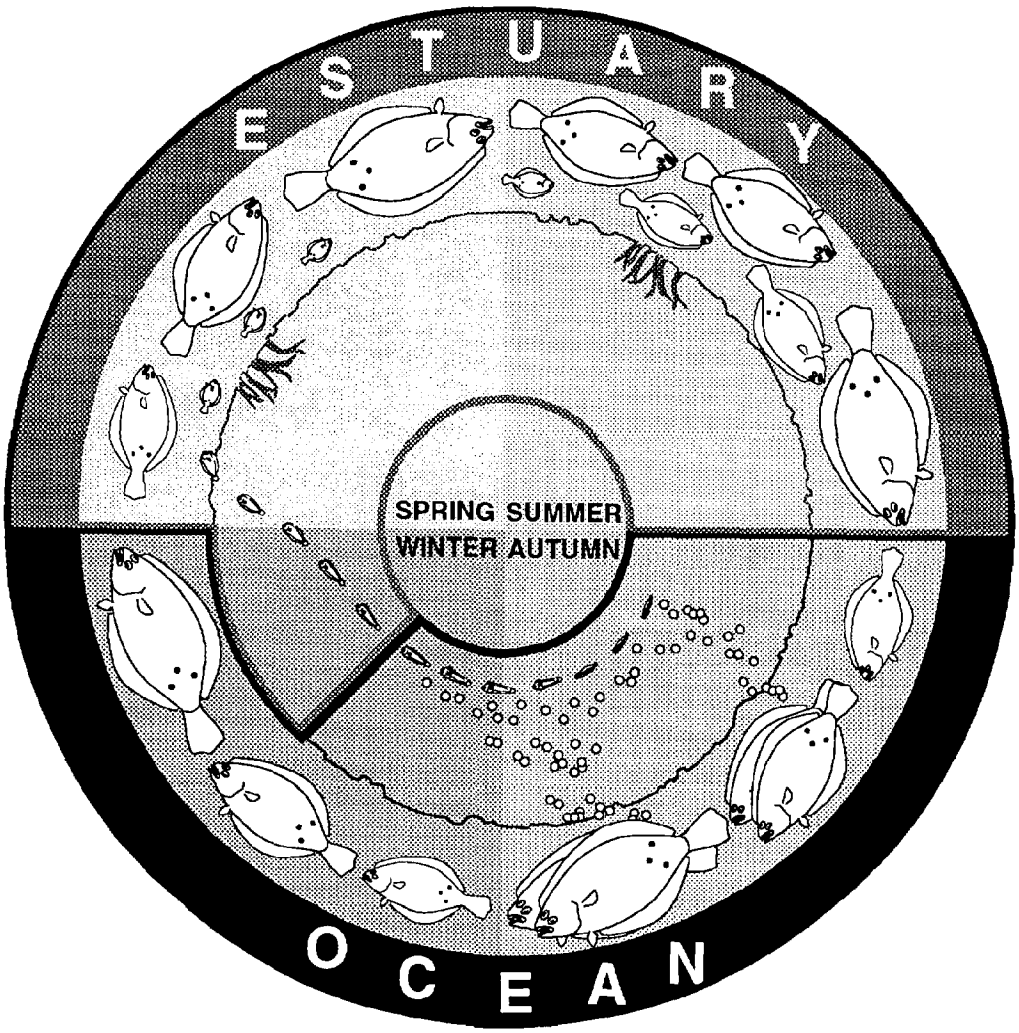
University of North Florida
Coastal Fisheries Laboratory, Jacksonville, FL 32203
Attention: C. DeMort

University of South Carolina
Belle Baruch Marine Laboratory, Georgetown, SC 29440
Attention: D. Allen, G. Ogburn

University of South Carolina
Coastal Carolina College
P.O. Box 1954, Conway, SC 29526
Attention: R. Moore

Virginia Institute of Marine Science
College of William and Mary
P.O. Box 1046, Gloucester Point, VA 23062
Attention: J.C. Desfosse, J.A. Musick

☆ U.S. GOVERNMENT PRINTING OFFICE: 1994 — 300-566/04040



Life History of Summer Flounder. Adults generally spend summer in estuaries and on the shallow continental shelf, migrate offshore in autumn, spend winter in the ocean, and migrate back inshore in spring. Adults spawn in the ocean during autumn and winter. Eggs rise to near-surface waters and larvae hatch. Larvae are pelagic and begin development in the ocean but they enter estuaries during winter and spring to complete development and settle. Juveniles grow rapidly during the summer and join adults in offshore migration in autumn, returning to estuaries the following year.

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 00003 7335