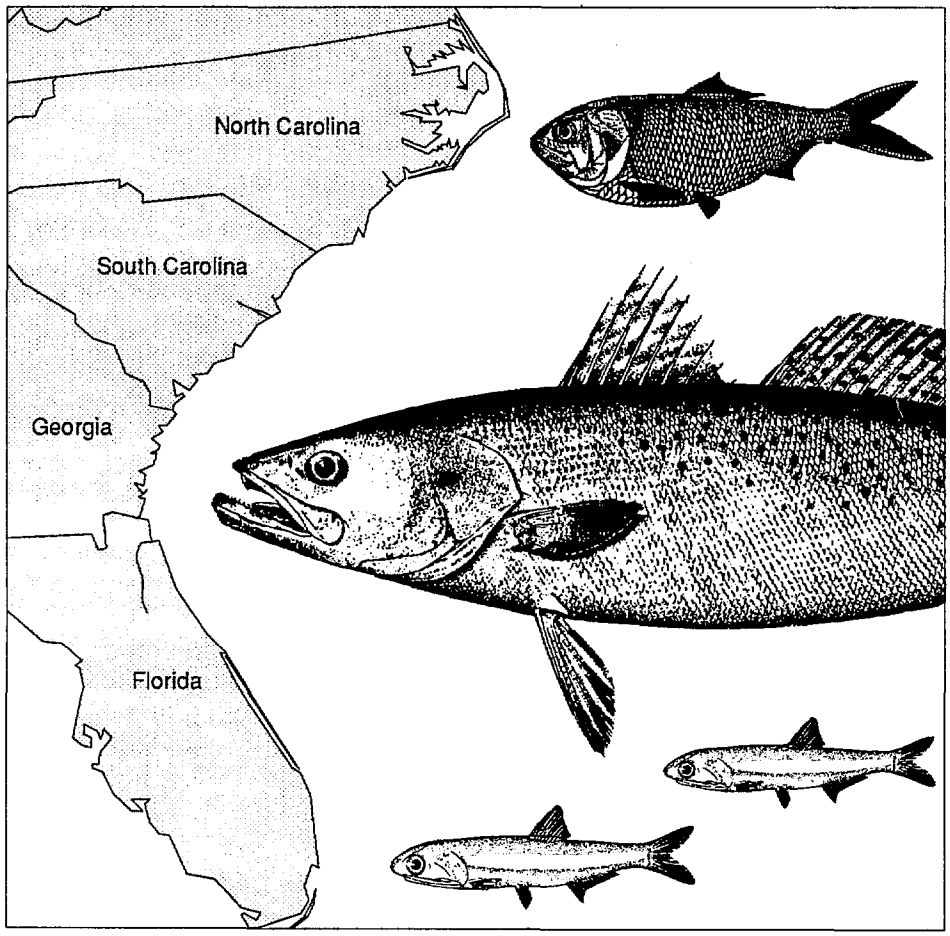
NOAA's Estuarine Living Marine Resources Program

Distribution and Abundance of Fishes and Invertebrates in Southeast Estuaries



October 1991

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

QL
139
.E4
no.9

COASTAL ZONE
INFORMATION CENTER

NOAA's Estuarine Living Marine Resources Program

The Strategic Environmental Assessments (SEA) Division of NOAA's Office of Ocean Resources Conservation and Assessment (ORCA) was created in response to the need for comprehensive information on the effects of human activities on the Nation's coastal ocean. The SEA Division performs assessments of the estuarine and coastal environments and of the resources of the U.S. Exclusive Economic Zone (EEZ).

In June 1985, the NOAA began a program to develop a comprehensive information base on the life history, relative abundance and distribution of fishes and invertebrates in estuaries throughout the Nation (Monaco 1986). The Estuarine Living Marine Resources (ELMR) program is conducted jointly by the SEA Division and laboratories of the National Marine Fisheries Service (NMFS). Currently, the Pt. Adams (Hammond), OR; Galveston, TX; Beaufort, NC; and Oxford, MD laboratories are compiling information for the contiguous West Coast, Gulf of Mexico, Southeast, and Northeast regions. Additional data for the Northeast are being compiled by the Virginia Institute of Marine Sciences and the University of Massachusetts. To date, the program has compiled data for 115 species found in 83 estuaries. Seven reports are available free upon request (see below).

Three salinity zones as defined in Volume 1 of NOAA's *National Estuarine Inventory Data Atlas* (NOAA 1985) provided the spatial framework for organizing information on species distribution and abundance within each estuary. These salinity zones are tidal fresh (0.0 to 0.5 ppt), mixing (0.5 to 25 ppt), and seawater (>25 ppt). The primary data developed for each species include spatial distribution by salinity zone, temporal distribution by month, and relative abundance by life stage, e.g., adult, spawning, juvenile, larva, and egg. In addition, a detailed estuarine life history summary is written for each species.

Additional information on this or other programs of NOAA's Strategic Environmental Assessments Division is available from:

Strategic Environmental Assessments Division
Office of Ocean Resources Conservation and Assessment
National Oceanic and Atmospheric Administration
6001 Executive Blvd., Rm. 220
Rockville, Maryland 20852
FTS/Comm. (301) 443-0453/8921

Reports available from NOAA's Estuarine Living Marine Resources program include:

Monaco, M. E., et al. 1989. Distribution and abundance of fishes and invertebrates in Texas estuaries. ELMR Rpt. No. 3. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 107 p.

Monaco, M. E., et al. 1990. Distribution and abundance of fishes and invertebrates in west coast estuaries, Volume I: Data Summaries. ELMR Rpt. No. 4. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 240 p.

Bulger, A. J., et al. 1990. A proposed estuarine classification: analysis of species salinity ranges. ELMR Rpt. No. 5. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 28 p.

Williams, C. D., et al. 1990. Distribution and abundance of fishes and invertebrates in eastern Gulf of Mexico estuaries. ELMR Rpt. No. 6. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 105 p.

Czapla, T. C., et al. 1991. Distribution and abundance of fishes and invertebrates in central Gulf of Mexico estuaries. ELMR Rept. No. 7. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 82 p.

Emmett, R. L., et al. 1991. Fishes and invertebrates in west coast estuaries, Vol II: life history summaries. ELMR Rept. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 329 p.

Nelson, D. M., et al. 1991. Distribution and abundance of fishes and invertebrates in southeast estuaries. ELMR Rept. No. 9. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 177 p.

Distribution and Abundance of Fishes and Invertebrates in Southeast Estuaries

Project Team

David M. Nelson* and Mark E. Monaco
Strategic Environmental Assessments Division**
Office of Ocean Resources Conservation and Assessment
National Ocean Service
Rockville, MD 20852

Elizabeth A. Irlandi, Lawrence R. Settle, and Linda Coston-Clements
Beaufort Laboratory
Southeast Fisheries Center
National Marine Fisheries Service
Beaufort, NC 28516

ELMR Report Number 9

October 1991

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
2234 SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

QL139 .E4 no.9
25004871

JUN 17 1997

Property of CSC Library

* contact for copies of this report.
** formerly Strategic Assessment Branch.

This report should be cited as:
Nelson, D. M., E. A. Irlandi, L. R. Settle, M. E. Monaco, and L. C. Coston-Clements. 1991. Distribution and Abundance of Fishes and Invertebrates in Southeast Estuaries. ELMR Rept. No. 9. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 177 p.

Contents

Introduction 1

Rationale 1

Data Collection and Organization 2

Selection of Estuaries 2
Selection of Species 3
Data Sheets 4
Data Verification 5

Results 5

Data Summaries 5
Seasonal Comparisons 6

Data Content and Quality 6

Analysis of Data Content and Quality 10
Variability in Space and Time 10
Life History Notes 11
Hurricane Hugo 13

Use of ELMR Data 13

Classifying and Comparing Estuaries 13
Linkages to Marine Ecosystems 14

Future Plans 14

Species Life History Summaries 14
East Coast Strategic Assessment 14

Acknowledgements 15

Literature Cited 15

Data Summary Tables 17

Spatial distribution and relative abundance 19
Temporal distribution 41
Data reliability 91
Occurrence of 40 species in 20 southeast estuaries 113

Appendices 115

Appendix 1. ELMR estuaries 116
Appendix 2. ELMR species 118
Appendix 3. National Estuarine Inventory Map of Pamlico Sound 121
Appendix 4. Life History Summary: Bluefish, Northeast region 122
Appendix 5. Life History Table Headers 127
Appendix 6. Table of references and personal communications 128
Appendix 7. Personal communications 148
Appendix 8. References 151

List of Figures

Figure 1. ELMR regions.
Figure 2. Major steps to complete the Southeast ELMR study.
Figure 3. ELMR Southeast estuaries.
Figure 4. Example of a species/estuary data sheet: Atlantic menhaden in Pamlico Sound.
Figure 5. Number of species, by salinity zone, life stage, and month.
Figure 6. Number of species, by life stage, estuary, and salinity zone.
Figure 7. Mean data reliability by estuary.
Figure 8. Mean data reliability by species.

List of Tables

Table 1. ELMR species list for the Southeast.
Table 2. Spatial distribution and relative abundance.
Table 3. Temporal distribution.
Table 4. Data reliability.
Table 5. Occurrence of 40 species in 20 southeast estuaries.

Introduction

This report presents information on the spatial and temporal distribution, relative abundance, and life history characteristics of 40 fish and invertebrate species in 20 estuaries along the Atlantic coast of North Carolina, South Carolina, Georgia, and Florida. Its purpose is to disseminate data developed in the National Oceanic and Atmospheric Administration's (NOAA) Estuarine Living Marine Resources (ELMR) program (inside front cover). The ELMR program is conducted through a series of joint regional studies by the National Ocean Service (NOS) and National Marine Fisheries Service (NMFS). The presence, distribution, and relative abundance of each species' life stage, and the time period it utilizes each estuary are the primary data compiled. The data and framework presented are illustrative of the nationwide ELMR program. Similar reports have been published for nine estuaries in Texas (Monaco et al. 1989), thirteen estuaries along the Gulf coast of Florida and Alabama (Williams et al. 1990), nine estuaries in Louisiana and Mississippi (Czapla et al. 1990), and 32 estuaries on the west coast of California, Oregon, and Washington (Monaco et al. 1990).

The objective of the ELMR program is to develop a consistent data base on the distribution, abundance, and life history characteristics of important fishes and invertebrates in the Nation's estuaries. The Nationwide data base is divided into four study regions (Figure 1). The data base contains the relative abundance and monthly occurrence of each species' life stage by estuary for three salinity zones (seawater, mixing, and tidal fresh) identified in NOAA's National Estuarine Inventory (NEI) Data Atlas-Volume I (NOAA 1985). When completed, the entire data base will contain information for 135 fish and invertebrate species found in ca. 117 U. S. estuaries.

Rationale

Estuaries are among the most productive natural systems and are important nursery areas that provide food, refuge from predation, and valuable habitat for many species (Gunter 1967, Joseph 1973, Weinstein 1979, Mann 1982). Estuarine organisms that support important commercial and recreational fisheries include sciaenids, crabs, and shrimp. In spite of the well-documented importance of estuaries to fishes and invertebrates, few consistent and comprehensive data bases exist which allow examinations of the relationships between estuarine species found in or among groups of estuaries. Furthermore, much of the distribution and abundance information for estuarine-dependent species (i.e., species that require estuaries during their life cycle) is for offshore life stages and does not adequately describe estuarine distributions (NOAA 1988, Bane and Van Devender 1989, Wenner and Sedberry 1989).

Only a few comprehensive sampling programs collect fishes and invertebrates with identical methods across groups of estuaries within a region (e.g., Hammerschmidt and McEachron 1986). Therefore, most existing estuarine fisheries data cannot be compared among estuaries because of the variable sampling strategies. In addition, existing research programs do not focus on how groups of estuaries may be important for regional fishery management, and few compile information for species having little or no economic value.

Because life stages of many species use both estuarine and marine habitats, information on distribution, abundance, temporal utilization, and life history characteristics are needed to understand the coupling of estuarine, nearshore, and offshore habitats. To date, a national, comprehensive, and consistent data base of

Figure 1. ELMR study regions and regional research labs.

this type does not exist. Consequently, there is a need to develop a program which integrates fragments of information on marine and estuarine species and their associated habitats into a useful, comprehensive, and consistent format. The ELMR program was designed to help fulfill this need by developing a uniform nationwide data base on selected estuarine species. Results will complement NOAA efforts to develop a national estuarine assessment capability (NOAA 1985), identify information gaps, and assess the content and quality of existing estuarine fisheries data.

Data Collection and Organization

Figure 2 summarizes the major steps taken to collect and organize information on the distribution and abundance of fishes and invertebrates in Southeast estuaries. The initial steps were selection of the estuaries and species to be studied.

Selection of estuaries. Estuaries in the Southeast region were selected from the National Estuarine Inventory Data Atlas - Volume I (NOAA 1985). The 20 estuaries selected for the Southeast study are shown in Figure 3.

Data on spatial and temporal distributions of species were developed and organized by the tidal fresh (0.0 to 0.5 parts per thousand (ppt)), mixing (0.5 to 25.0 ppt), and seawater (>25.0 ppt) zones delineated for each estuary in the NEI. Each salinity zone is present in most of the Southeast estuaries, except that the seawater zone is absent from Albemarle Sound, Pamlico/Pungo Rivers, Neuse River, and North/South Santee River; and the tidal fresh zone is absent from Indian River and Biscayne Bay. A representative map and data table (Pamlico Sound) from the NEI Data Atlas is shown in Appendix 3.

Compiling consistent data nationwide limits the amount of information that may be compiled for each species and estuary. Also, it would be time and cost prohibitive to map each species by life stage for each estuary (Monaco 1986). This framework enables a consistent compilation and organization of available information on the distribution of fishes and invertebrates in estuaries.

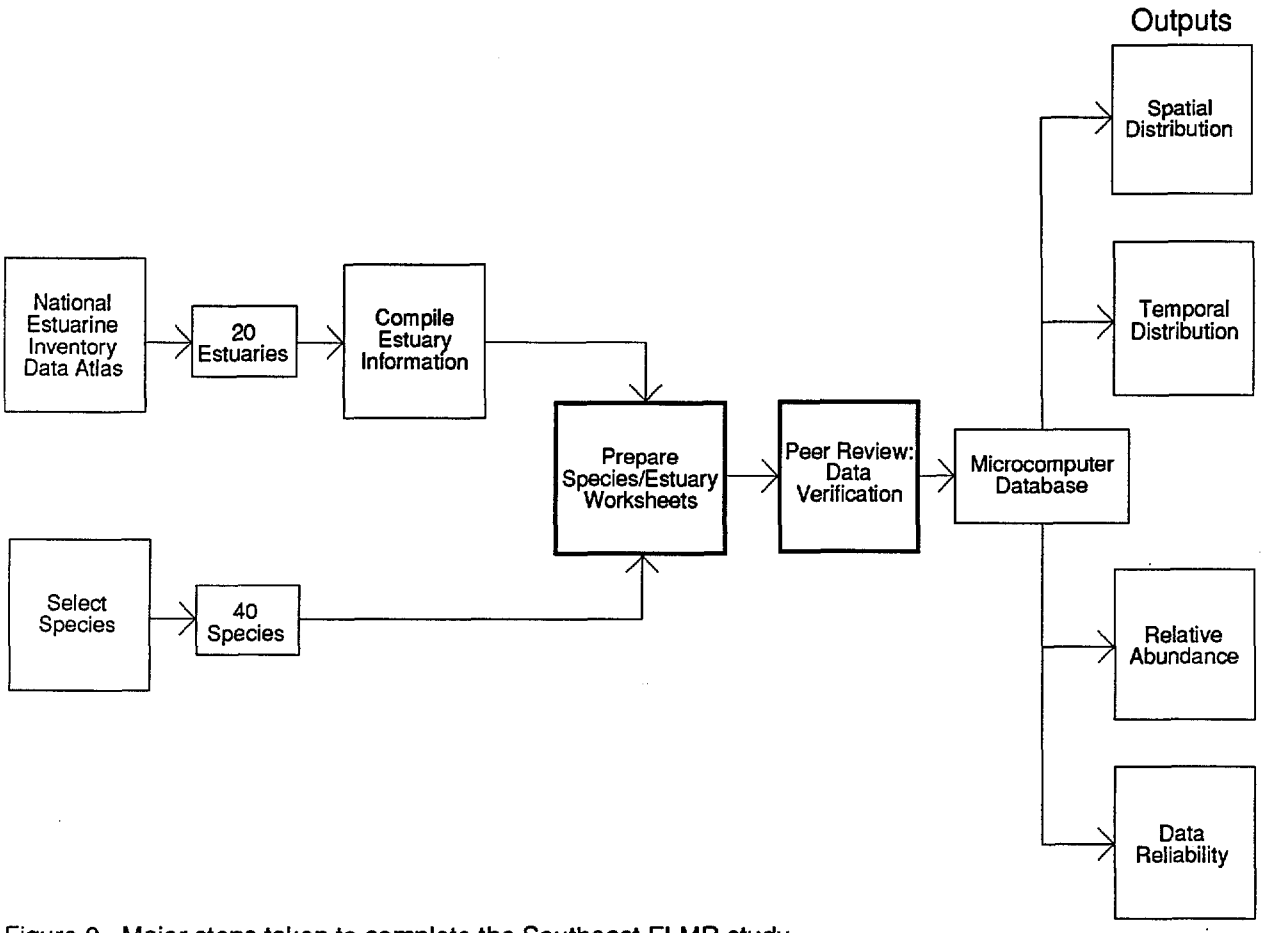


Figure 2. Major steps taken to complete the Southeast ELMR study.

Selection of Species. Four criteria were used to identify 40 species that had sufficient available information for inclusion in the ELMR data base. The four criteria were:

1) Commercial value - determined by review of catch data and value statistics from NMFS and state agencies, e.g., Atlantic menhaden (*Brevoortia tyrannus*) and blue crab (*Callinectes sapidus*).

2) Recreational value - defined as a species that recreational fishermen specifically try to catch, that may or may not be of commercial importance. Recreational species were determined by consulting regional experts and NMFS reports, e.g., spotted seatrout (*Cynoscion nebulosus*) and flounders (*Paralichthys* spp.).

3) Indicator species of environmental stress - identified from the literature, discussions with fisheries experts, and from monitoring programs such as NOAA's National Status and Trends Program (NOAA 1984). These species (e.g., American oyster, *Crassostrea virginica*, and Atlantic croaker, *Micropogonias undulatus*) are molluscs or bottom fishes that consume benthic invertebrates or have a strong association with bottom sediments. Their physiological disorders, morphological abnormalities, and bioaccumulation of contaminants, such as heavy metals, indicate episodes of environmental pollution and/or stress.

4) Ecological value - based on several attributes, including trophic level, relative abundance and importance as a key predator or prey species, e.g., bay anchovy, *Anchoa mitchilli*.

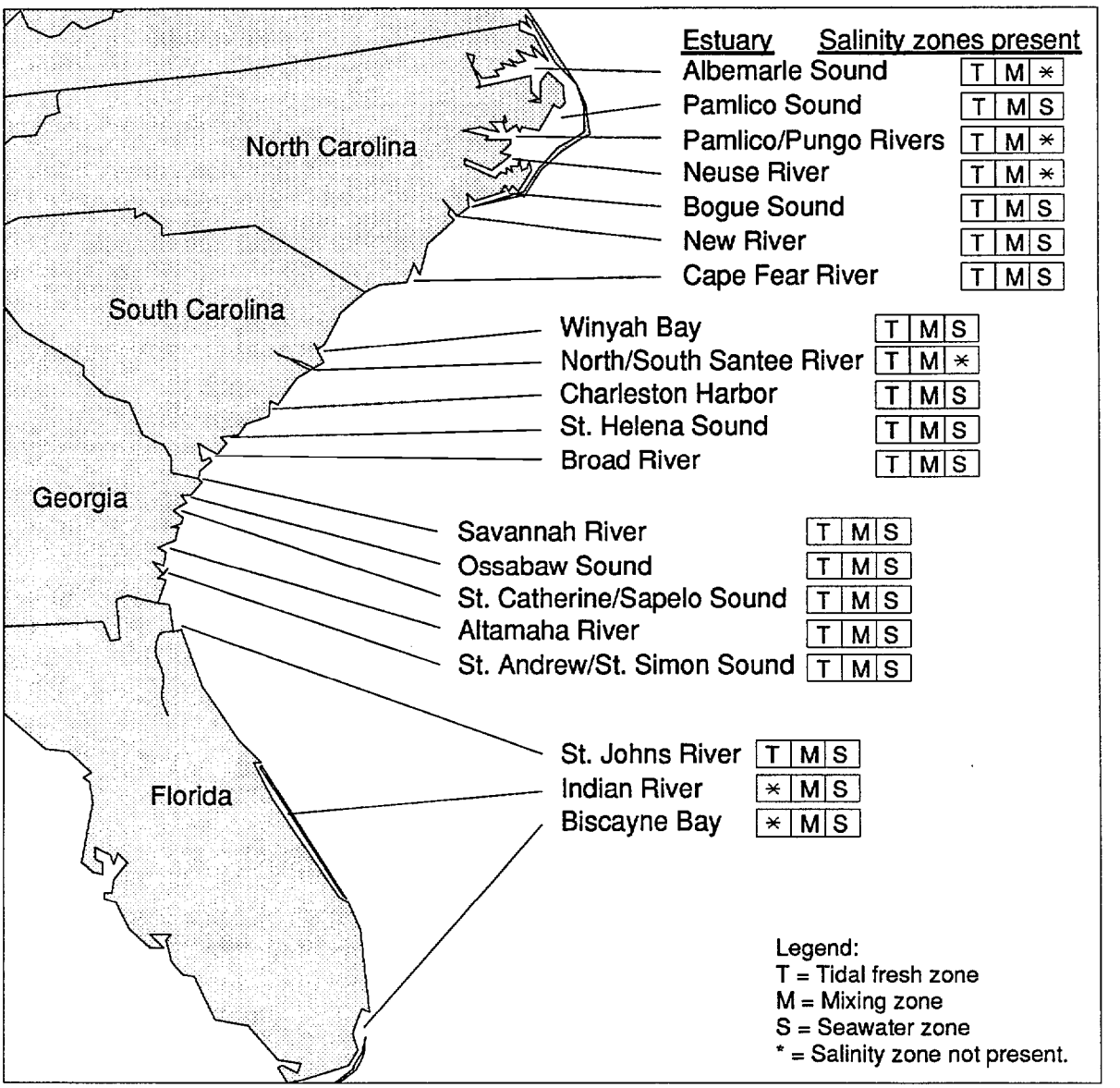


Figure 3. ELMR Southeast estuaries and associated salinity zones.

Table 1. ELMR southeast species (n=40)

Common Name	Scientific Name
Blue mussel	*Mytilus edulis*
Bay scallop	*Argopecten irradians*
American oyster	*Crassostrea virginica*
Common rangia	*Rangia cuneata*
Hard clam	*Mercenaria* species
Brown shrimp	*Penaeus aztecus*
Pink shrimp	*Penaeus duorarum*
White shrimp	*Penaeus setiferus*
Grass shrimp	*Palaemonetes pugio*
Blue crab	*Callinectes sapidus*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Ladyfish	*Elops saurus*
American eel	*Anguilla rostrata*
Blueback herring	*Alosa aestivalis*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Bay anchovy	*Anchoa mitchilli*
Sheepshead minnow	*Cyprinodon variegatus*
Mummichog	*Fundulus heteroclitus*
Silversides	*Menidia* species
White perch	*Morone americana*
Striped bass	*Morone saxatilis*
Bluefish	*Pomatomus saltatrix*
Cobia	*Rachycentron canadum*
Gray snapper	*Lutjanus griseus*
Sheepshead	*Archosargus probatocephalus*
Pinfish	*Lagodon rhomboides*
Spotted seatrout	*Cynoscion nebulosus*
Weakfish	*Cynoscion regalis*
Spot	*Leiostomus xanthurus*
Southern kingfish	*Menticirrhus americanus*
Atlantic croaker	*Micropogonias undulatus*
Black drum	*Pogonias cromis*
Red drum	*Sciaenops ocellatus*
Striped mullet	*Mugil cephalus*
Spanish mackerel	*Scomberomorus maculatus*
Gulf flounder	*Paralichthys albigutta*
Summer flounder	*Paralichthys dentatus*
Southern flounder	*Paralichthys lethostigma*

Data Sheets. A data sheet was developed for each species in each estuary to enable quick data compilation and presentation. Figure 4 depicts the data sheet for Atlantic menhaden (*Brevoortia tyrannus*) in Pamlico Sound. Data sheets were developed by project staff and reviewed by local experts. Data compiled for each species/life stage included: 1) the salinity zone it occupies (seawater, mixing, or tidal fresh), 2) its monthly distribution in those zones, and 3) its relative abundance in the zones. The ELMR data sheets were entered into a microcomputer data base management system.

The relative abundance of a species was classified using the following categories:

- Not present: species or life history stage not found, questionable data as to identification of species, and/or recent loss of habitat or environmental degradation suggests absence.

- No information available: no existing data available, and after expert review it was determined that not even an educated guess would be appropriate.

- Rare: species is definitely present but not frequently encountered.

- Common: species is frequently encountered but not in large numbers; does not imply a uniform distribution over a specific salinity zone.

- Abundant: species is often encountered in substantial numbers relative to other species.

- Highly abundant: species is numerically dominant relative to other species.

Adults were defined as reproductively mature individuals, juveniles as immature but otherwise similar to adults, and spawning adults as those releasing eggs and sperm. There were a few exceptions to these defined life stages, such as mating in crabs.

For well-studied species such as Atlantic croaker, quantitative data were used to estimate abundance levels. For many species, however, reliable quantitative data were limited. Therefore, regional and local experts were consulted to estimate relative abundances based on the above criteria. Several reference or "guide" species with abundance levels corresponding to the above criteria were identified for each estuary. These guide species typified fishes and invertebrates belonging to a particular life mode (e.g., pelagic, demersal) or occupying similar habitats. Once guide species were selected, other species were then placed into the appropriate abundance categories relative to them. These data represent relative abundance levels within a specific estuary only; relative abundance levels across southeast estuaries could not be determined.

The final level of abundance assigned to a species was determined by asking regional and local biologists for expert opinions based on their knowledge of individual species within an estuary. This effort complemented quantitative studies, the ELMR relative abundance categories, and greatly increased reliability of abundance information. The quality of relative abundance information varied between estuaries as well as spe-

cies. As a result, temporal resolution was greater in well-studied estuaries. Nevertheless, the relative abundance data shown in the data summaries are the best that could be synthesized from agency reports, academic studies, and expert reviews.

Data Verification. Approximately two years were required to develop the 800 data sheets (Figure 4) and consult with regional and local experts for the 20 estuaries studied. Nearly all of the data sheets were carefully reviewed during consultations or by mail. These consultations complemented the literature and published data sets compiled by NOAA. Sixty-four scientists and managers at 24 institutions were consulted. Local experts were especially helpful in providing estuary/species-specific information. They also provided additional references and contacts, and identified additional species to be included in the ELMR data base. The names and affiliations of these experts are listed in Appendix 7.

Results

Data summaries. The information compiled for each species and estuary (800 data sheets) was organized in four data summaries (pp. 17-113). Tables 2 and 3 provide graphic presentations of the spatial and temporal distribution and relative abundance by life stage for each species and estuary. The information shown represents the usual spatial and temporal distribution of a species in a particular estuary. Table 4 ranks the relative reliability of the information presented for each species and estuary.

Spatial distribution and relative abundance. Table 2 (pp. 19-40) summarizes the distribution and relative abundance for each species by life stage, in each estuary by salinity zone. The highest level of abundance during the year in each estuary is depicted.

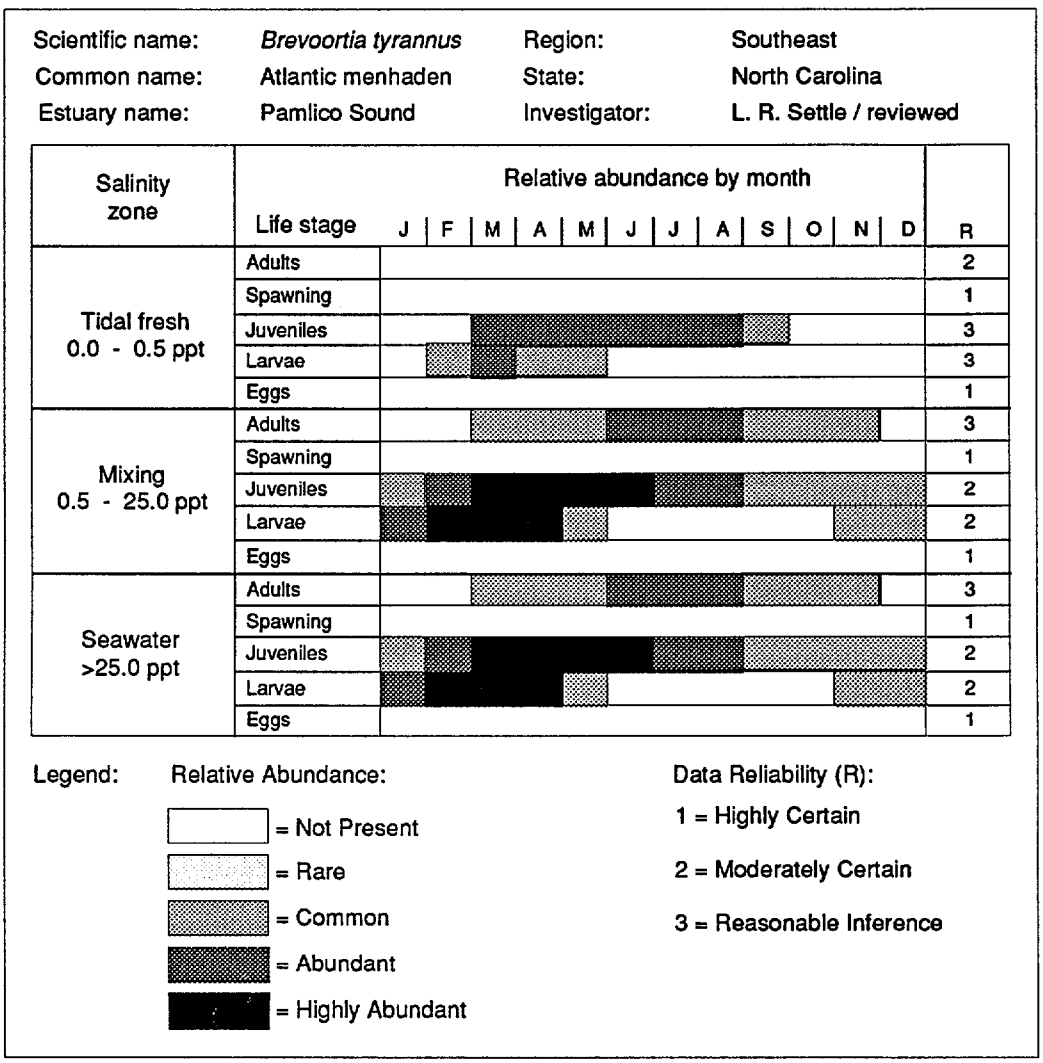


Figure 4. Example of a species/estuary data sheet: Atlantic menhaden in Pamlico Sound.

Temporal distribution. Table 3 (pp. 41-90) summarizes the temporal distribution of each species by month and life stage for each estuary. This table combines data over the three salinity zones, showing the highest level of abundance for a particular life stage by month.

Occurrence of 40 species in 20 southeast estuaries. Table 5 (p. 113) was developed to quickly determine the occurrence (as adults or juveniles) of each of the 40 ELMR species in each of the 20 southeast estuaries. The highest level of abundance over a year of the adult or juvenile life stages is depicted. The spawning, egg, and larval life stages are not included. This table suggests the relative abundance and zoogeographic distribution of species across southeast estuaries.

Seasonal Comparisons. To examine general seasonal abundance patterns, the numbers of species ranked as "common" or greater were counted for each life stage by month and by salinity zone. In Figure 5, the number of species was averaged across estuaries and plotted by month. In Figure 6, the number of species was plotted by estuary. Although these summaries are not statistical analyses, they do provide insights into the seasonal distribution of selected species in the estuaries:

- Estuarine utilization by all life stages is highest in the summer, and lowest in the winter (Figure 5).

- The number of species present as larvae reaches a peak in April (Figure 5).

- In any given month, more species utilize these estuaries as juveniles than as any other life stage (Figures 5 and 6).

- The number of species appears to be lowest in the tidal fresh zone (Figures 5 and 6). However, this may be because the selected ELMR species are primarily estuarine, not freshwater. Also, few studies exist for a large number of estuaries and species in tidal fresh waters, so any true patterns are difficult to define.

- The number of species appears to be lowest in the south Florida estuaries, Indian River and Biscayne Bay (Figure 6). However, this is probably because the selected species list does not adequately represent the south Florida estuarine fauna. The selected ELMR species are representative of the temperate Carolinian biogeographic province (Briggs 1974), whereas the south Florida estuaries include species from the tropical Caribbean biogeographic province.

- Many east coast estuarine-dependent species spawn in marine waters, thus, of the five life stages, the fewest species were present as eggs and for spawning. The paucity of these life stages may also be a result of limited studies on spawning and ichthyoplankton in estuaries.

Data Content and Quality

An important aspect of the ELMR program, especially since it is based primarily on published and unpublished literature and consultations, is to determine the quality of available data. For many species, gear selectivity, difficulty in identifying larvae, and difficulty in sampling various habitats has limited the amount of reliable information. Therefore, a deliberate effort was made to assess the overall reliability of the data base so that it could be used appropriately.

Estimates of the reliability of the distribution and abundance information organized by species, life stage, and estuary are presented in Table 4 (pp. 15-116) of the Data Summary Tables section. Data reliability was classified using the following categories:

Highly certain: Considerable sampling data available. Distribution, behavior, and preferred habitats well documented within an estuary.

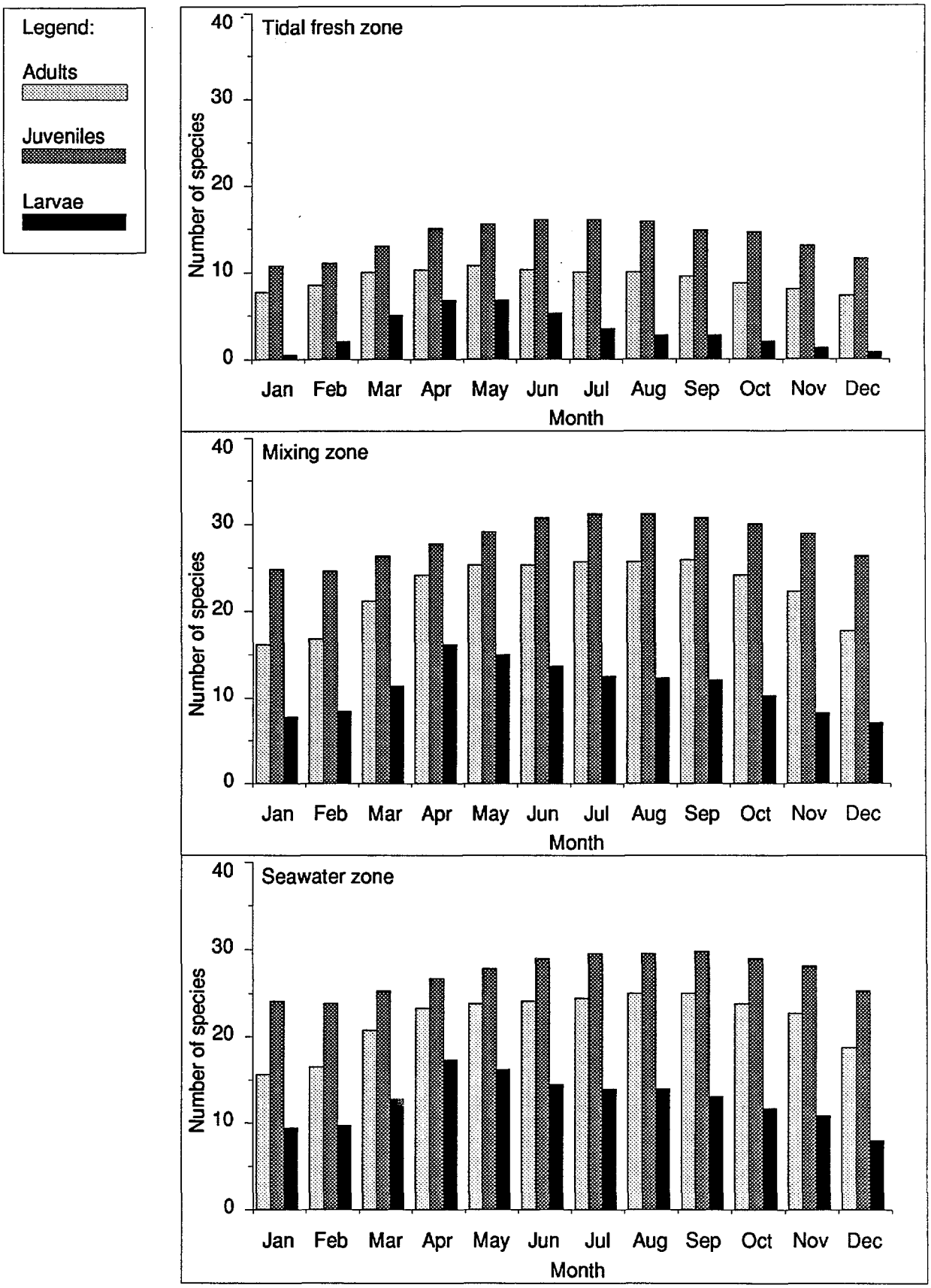
Moderately certain: Some sampling data available for an estuary. Distribution, preferred habitat, and behavior well documented in similar estuaries.

Reasonable inference: Little or no sampling data available. Information on distributions, ecology, and preferred habitats documented in similar estuaries.

The quality and quantity of available data vary by species, life stage, and estuary. For example, a large amount of information is available on blue crab because they are highly valued both commercially and recreationally. The least amount of information available and poorest quality of data occur for the spawning, egg, and larval life stages. Except for a few species (e.g., blue crab), very little data has been generated on particular habitat preferences and environmental tolerances. This is particularly true for the smaller forage and/or non-commercial fishes and invertebrates. Gear selectivity, inability to correctly identify larval stages, and difficulty of sampling various habitats limits the development and reliability of this information. In addition, life history data are lacking on some of the commercially important sciaenid and pelagic species.

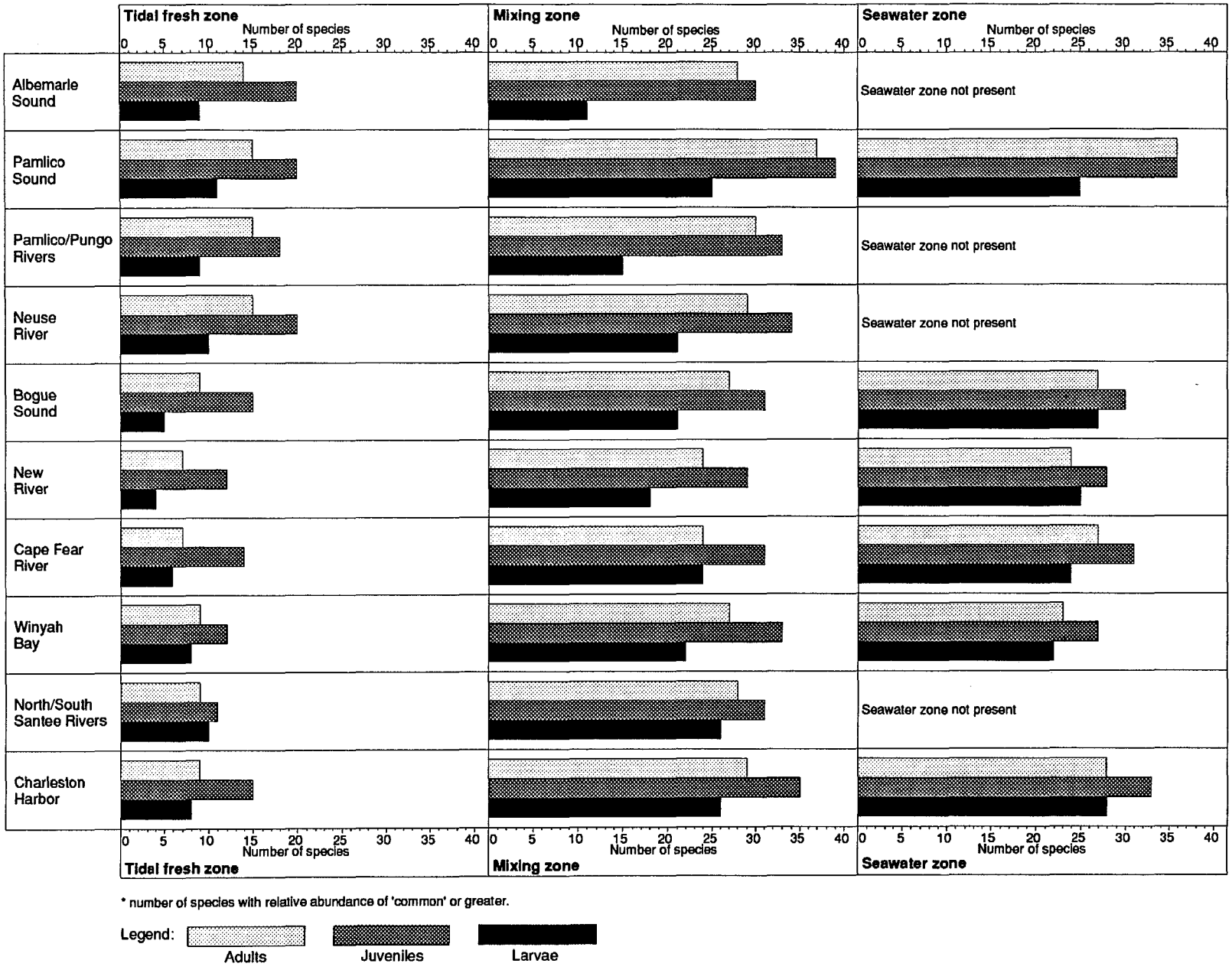
Data reliability was also based on experimental design and whether the studies were relatively recent. In the case of limited studies, information was occasionally inferred. An opportunity exists to refine the data presented based on additional reviews.

Figure 5. Number of species* in Southeast estuaries, by salinity zone, life stage, and month.



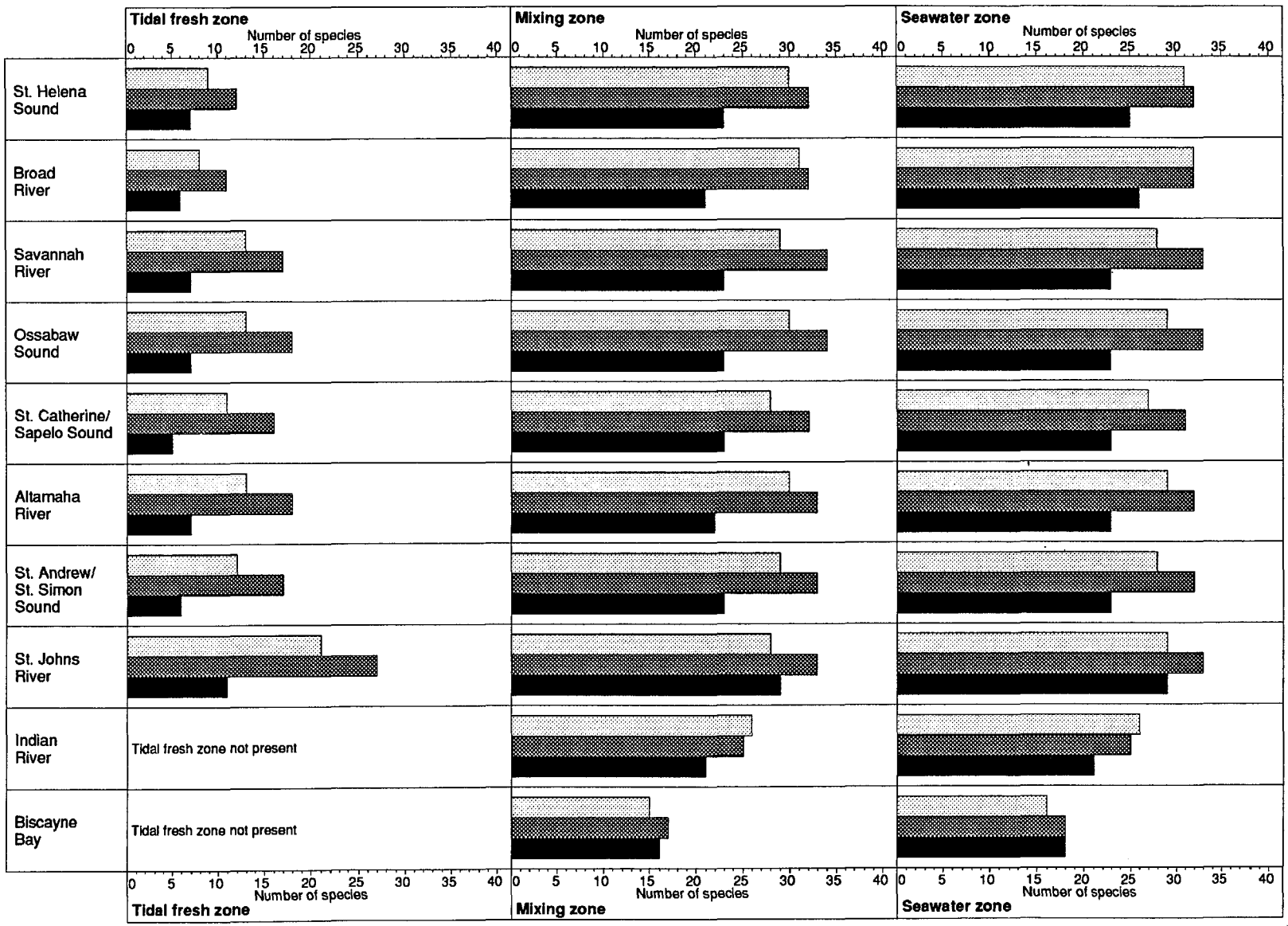
* number of species with relative abundance of 'common' or greater, averaged across estuaries.

Figure 6. Numbers of ELMR species* in Southeast estuaries, by estuary, salinity zone, and lifestage.



* number of species with relative abundance of 'common' or greater.

Figure 6, continued. Numbers of ELMR species* in Southeast estuaries, by estuary, salinity zone, and lifestage.



* number of species with relative abundance of 'common' or greater.

Given that the amount and quality of available information varies by species, by life stage, between estuaries, and even within an estuary, considerable scientific judgment is required to derive or infer spatial and temporal distributions from existing data and available literature. Unfortunately, even the most informed judgment is far from perfect due to the complexity of estuarine systems. Consequently, information on the level of certainty associated with each data element must be presented when synthesizing multiple data sets (Table 4). Appendices 6, 7, and 8 provide a complete summary of the personal communications and primary references used so that readers can track and obtain additional information efficiently.

Analysis of Data Content and Quality. To assess the overall certainty of the ELMR southeast data, mean data reliability was calculated by estuary, salinity zone, species, and life stage. In this analysis, "highly certain" = 3, "moderately certain" = 2, and "reasonable inference" = 1. Mean data reliability was calculated using data reliability values for only those species and life stages that were known to occur within an estuary. This allowed comparisons between estuaries and species, because species and life stages known to be absent were typically recorded as highly certain.

This analysis identified estuaries, species, and life stages that have the most reliable information and those with the least. This information suggests the ELMR species, life stages, and estuaries that could be the focus of research efforts. Future research should include a comprehensive and consistent sampling program to quantify species distributions and abundances within and across estuaries. In addition, life history data (Appendices 4 and 5) needs to be compiled, especially for those species that may not have economic value, but are ecologically important.

Mean data reliability of fish and invertebrate data for southeast estuaries ranged from a high of 2.27 for Cape Fear River to a low of 1.25 for Ossabaw Sound, with an overall average of 1.70 (Figure 7). In general, the reliability estimates reflect the amount of fisheries research that has been conducted within an estuary. These data reveal that large estuaries (Albemarle and Pamlico Sounds) have been relatively well-studied, while many small bays and estuaries have not. Developed estuaries (i.e., with port facilities and nearby urbanization) and their drainages typically have been the focus of numerous research studies, for example, Cape Fear River and Charleston Harbor. In contrast, some of the least-developed estuaries (e.g., the southern Georgia estuaries) appear to be less-studied. Hence, there appears to be a need to collect baseline fish and invertebrate distribution and abundance data from relatively undeveloped estuaries.

When averaged across estuaries and analyzed by salinity zone, data reliability was lower in the tidal fresh zone than in the mixing and seawater zones. This is possibly because the selected species are primarily estuarine, not freshwater, and may also be due to fewer studies of tidal fresh waters.

When averaged across salinity zones and life stages and analyzed by species (Figure 8), data reliability was relatively high for most of the invertebrate species, including bay scallop, American oyster, hard clam, blue crab, and brown, pink, and white shrimp. This reflects the economic value of these species and consequently the large number of research studies that have focused on them. It was relatively low for blue mussel and common rangia, neither of which are commercially important in the southeast. Of the fish species, data reliability was relatively high for American eel, bay anchovy, white perch, bluefish, spot, and Atlantic croaker. It was relatively low for Atlantic sturgeon, sheepshead minnow, southern kingfish, black drum, and gulf flounder.

When analyzed by life stage, data for juvenile and adult life stages were most reliable, while data pertaining to spawning adults, larvae, and eggs were less certain. This reflects the number of research studies which have concentrated on adult and juvenile life stages. Species-specific studies of spawning adults, larvae, and eggs, have not been conducted in most estuaries. Thus, some of the information for these life stages was inferred from life history studies and data from similar estuaries.

Variability in Space and Time. Species data were organized according to the salinity zone boundaries developed for each estuary in the NEI data atlas-Volume 1 (NOAA 1985). However, division of an estuary on the basis of salinity is highly variable due to the many interacting factors that affect salinity, such as variations in freshwater inflow, wind, and tides. To compile information on species distribution according to these zones, it is assumed that if a particular salinity zone expands or contracts, the distribution of a mobile species in that zone will correspond to the shift. For example, if increased freshwater inflow shifts the tidal fresh zone further down the estuary, the distribution of a species confined to that zone increases to include the new area. If a species exhibits a wide range of salinity tolerance, a shift may or may not occur. The placement of species in a salinity zone was ultimately determined by where they have been observed or captured.

Species temporal distributions are often dependent on annual climatic conditions and water currents. Monthly distributional patterns were derived based on the consistent presence of a life stage within a particular

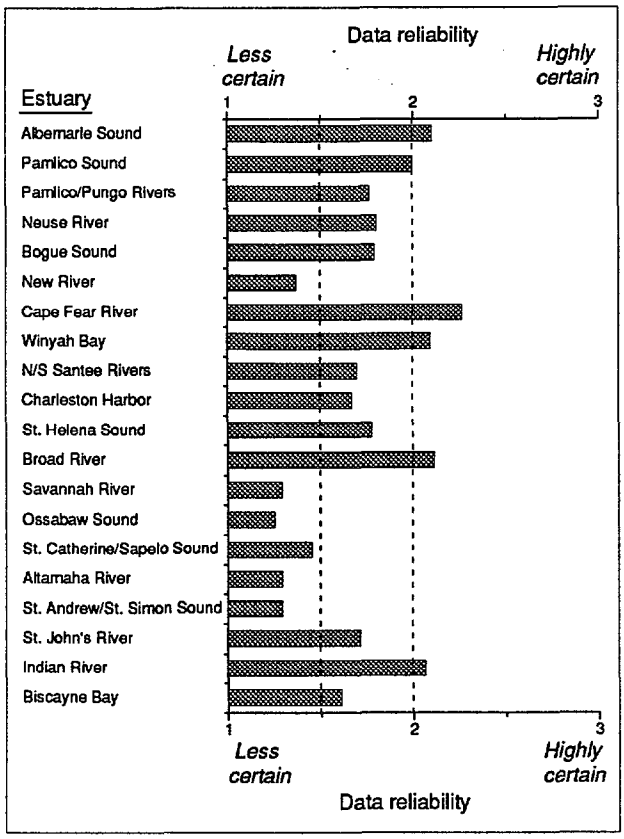


Figure 7. Mean data reliability by estuary.

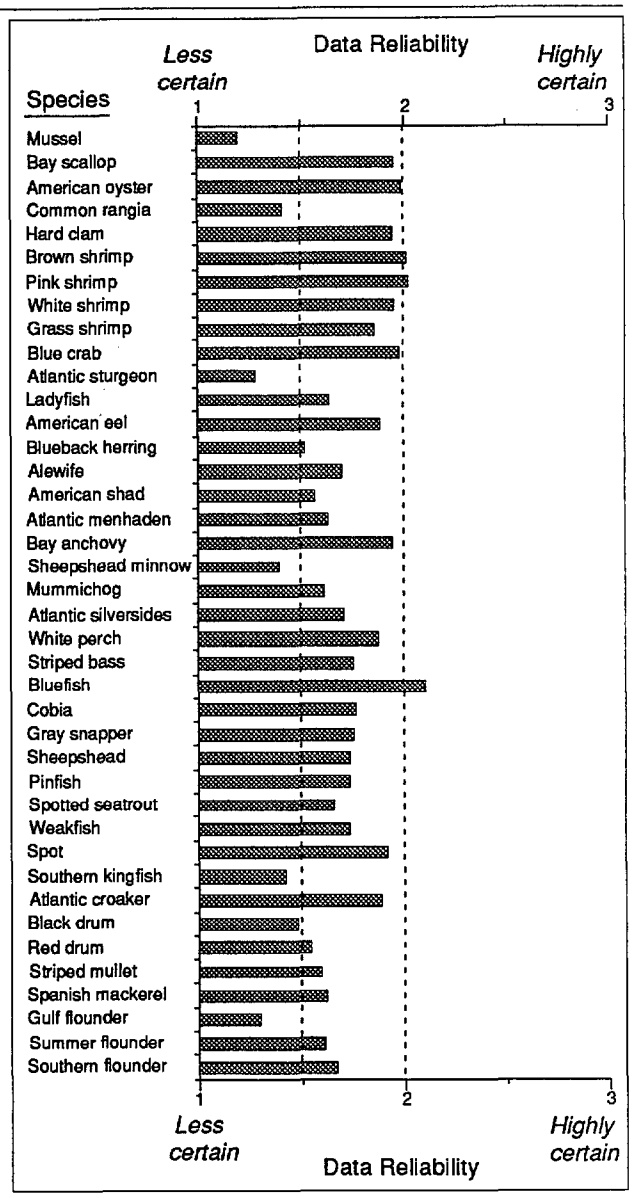


Figure 8. Mean data reliability by species.

month. If a species is only present in an estuary in unusual years (e.g., drought), it was not portrayed as part of that species' spatial or temporal distribution. However, if a species is usually there, even during a restricted time period, it was considered present for the specific month(s). Greater temporal resolution, such as on a biweekly rather than on a monthly basis, was not possible.

Life History Notes. Because of the complex life histories of some species, the following comments are provided below to clarify and supplement information presented in the data summary tables.

Invertebrates. Sessile invertebrates, such as clams and oysters, usually have a patchy rather than a uniform distribution. Therefore, the areal distribution of these organisms may be overestimated, but the salinity zones of colonization are identified. Specific areas may contain acceptable salinity regimes, but suitable bottom habitat for colonization may not exist. Specific habitat requirements and life history characteristics of a number of invertebrate species are provided below:

- Blue mussel: Not common south of Cape Hatteras. Larvae may be transported southward of Cape Hatteras, and juveniles occur in some North Carolina estuaries. However, these mussels generally don't survive to adulthood.

- Bay scallop: Usually associated with seagrass beds and salinities greater than 25 ppt.

- American oyster: Populations tend to be intertidal south of Cape Lookout, North Carolina, and subtidal from Cape Lookout northward.

- Rangia: All life stages occur in salinities below 25 ppt. Not common in the south Florida estuaries.

- Hard clam: Most life stages occur in salinities above 20 ppt.

• Penaeid shrimp: Postlarvae and juveniles are the main life stages utilizing the estuaries. Adults generally move to nearshore spawning grounds, where spawning, egg development, and most of the larval development occur.

• Grass shrimp: Fertilized eggs are held on the female's pleopods until hatching.

• Blue crab: Mating usually takes place in the low salinities of the tidal fresh to the upper region of the mixing zone. After mating, females move to the seawater zone, while males often remain in the upper reaches of the estuary. Females brood the eggs (sponge females), and larvae are released in higher salinities. Development through the late zoeal stages occurs offshore. Megalopae are transported back into the estuary and disperse throughout the salinity zones. As they approach maturity, blue crabs seek lower salinities.

Fishes. Aggregating species by salinity zone uses a single fundamental habitat parameter. However, a combination of habitat characteristics, such as bottom type, water temperature, and bathymetry, would more accurately indicate species spatial and temporal distributions. Specific habitat requirements and life history characteristics of a number of fishes are presented here:

• Atlantic sturgeon: Spawning occurs in freshwater rivers or low-salinity tidal waters. Eggs are demersal and adhesive, larvae drift downstream, and juveniles migrate seaward. Adults are iteroparous, i.e., they may return to spawn more than once. Not present south of the St. John's River, Florida.

• Ladyfish: Spawning occurs offshore. Juveniles are euryhaline, and are found in a variety of estuarine and coastal habitats. Not abundant north of Cape Hatteras.

• American eel: Spawning occurs in the Sargasso Sea in the spring, and the pelagic larvae (leptocephali) may spend over a year in marine waters before being transported shoreward. As leptocephali reach the continental shelf, they metamorphose into transparent "glass eels". As glass eels migrate into estuaries and fresh water, they develop pigment and are considered "elvers", which then grow into the "yellow eel" stage. Yellow eels inhabit estuarine and fresh waters for years before maturing into the "silver eel" stage and migrating seaward. For the purposes of this study, silver eels are considered adults, elvers and yellow eels are considered juveniles, and glass eels and leptocephali are considered larvae.

• Blueback herring: Spawning is in the spring, primarily in fresh water above and below head-of-tide. Adults typically return to sea after spawning, and may spawn repeatedly in their natal river. Not present in the southern Florida estuaries. Blueback herring and alewife are often referred to collectively as "river herring".

• Alewife: Spawning is in the spring, in fresh water above and below head-of-tide, and in low salinity estuarine waters. After spawning, adults typically move seaward. Not abundant south of Bogue Sound, North Carolina.

• American shad: An anadromous species with a fairly strong natal homing tendency. Adults spawn in freshwater rivers and die afterwards. Juveniles use low-salinity estuarine waters as a nursery area, then move offshore in the fall. Does not occur south of the St. John's River, Florida.

• Atlantic menhaden: Major winter spawning areas are offshore of Cape Hatteras and Cape Lookout, North Carolina. Larvae move inshore and into estuaries, and juveniles are often highly abundant in estuarine waters. May hybridize with yellowfin menhaden (*B. smithi*) in southern Florida.

• Bay anchovy: All life stages occur in estuaries, although adults may move offshore. A key forage species that is one of the most abundant fishes in east coast estuarine waters.

• Sheepshead minnow: The entire life cycle is completed within the estuary, and all life stages are euryhaline and eurythermal. Tends to prefer open bottom to heavily vegetated areas.

• Mummichog: The entire life cycle is completed within the estuary, and all life stages are euryhaline. One of the most abundant fishes in east coast estuarine marsh habitats. Not common south of St. John's River, Florida.

• Silversides: Large schools spawn in the intertidal zone at high tide. Spawning behavior is periodic, and may be affected by tidal cycle, lunar phase, and daylight. Silversides are often one of the most abundant fish species in an estuary.

• White perch: Spawning occurs in fresh water above and below head of tide, and in low-salinity estuarine waters. Eggs are demersal. Juveniles and adults typically remain within the estuary. Not common south of Charleston, South Carolina. Landlocked freshwater populations also exist.

- Striped bass: Spawning occurs in the spring in freshwater rivers, and in tidal low-salinity waters where there is sufficient current. Eggs are non-adhesive and semi-buoyant. Juveniles tend to form schools and remain in estuarine waters. Adults may move offshore, or stay within the estuary.

- Bluefish: Juveniles and adults are the principal life stages found in estuaries. Adults may ascend rivers into brackish waters. Spawning, egg and larval development occur offshore.

- Cobia: Adults are often attracted to large floating objects such as buoys or anchored boats. Cobia migrate to warmer tropical marine waters in the winter.

- Gray snapper: Juveniles are typically associated with vegetation in estuaries, particularly seagrass beds and mangroves. Adults, spawning,eggs, and larvae are usually offshore.

- Sheepshead: Spawning occurs in nearshore and inlet waters. Larvae are transported towards the estuaries, but typically enter as juveniles.

- Pinfish: Juveniles and adults are the predominant life stage within estuaries. Spawning and eggs occur offshore. Larvae are transported into estuaries, but may attain juvenile size before they enter.

- Sciaenids: Most sciaenids move to nearshore or offshore waters for spawning, although some may spawn in passes. Larvae may be transported toward estuaries, but typically attain juvenile size before they enter. Juveniles develop in the nursery habitats of the bays, then migrate out as subadults. Since some of these species have rather long life spans, several years may be spent in the estuaries as juveniles. As temperatures drop in the winter, they move into deeper waters.

- Striped mullet: Estuarine habitat is primarily used by juveniles and adults. They spawn offshore or near passes, and larvae move inshore and into estuaries.

- Spanish mackerel: Juveniles and adults occur in estuaries, but other life stages are pelagic and primarily in coastal waters.

- Flounders: Spawning, eggs, and larvae are in nearshore waters. Juveniles and larvae migrate into bays for growth and development. Gulf flounder appear to be more restricted in their ascent into fresher water, typically remaining in salinities greater than 20 ppt. Southern flounder are more generally distributed. Juveniles and adults migrate according to temperature, creating "fall runs" to the offshore waters.

Hurricane Hugo. In September, 1989, Hurricane Hugo came ashore, affecting 90 miles of the South Carolina coast, from Charleston to Myrtle Beach. The storm surge and heavy rainfall produced low salinity and low dissolved oxygen conditions in the Charleston Harbor estuary, resulting in extensive mortality and downstream displacement of the estuarine fauna (Knott and Martore 1991). As water quality parameters in Charleston Harbor returned to normal in the following months, grass shrimp, juvenile Atlantic croaker, and other estuarine species returned to the affected estuarine habitat in relatively high abundance (Knott and Martore 1991). At North Inlet, a tide-dominated high-salinity estuary about 50 miles north of Charleston Harbor, fishes, shrimps, and crabs were displaced toward the ocean following the retreat of a 13 foot storm surge. No significant mortality was observed, and rapid reoccupation of high marsh habitats occurred within a month (Ogburn et al. 1990, Service et al. 1990). Although it is too early to discern any long-term effects, it appears that the estuarine fauna of South Carolina are recovering to typical levels and patterns of abundance. The information presented in this volume is based on pre-Hugo conditions.

Use of ELMR Data

Classifying and Comparing Estuaries. Although the qualitative nature of the distribution data precludes statistical comparisons of species abundances among estuaries, comparisons can be made using data on the presence/absence of species in salinity zones. This information, combined with the spatial and temporal distribution data, is the strength of the data base. Estuaries can be loosely categorized by their physical and chemical characteristics and their associated species assemblages. The relative importance of individual estuaries to specific species may also be determined.

The species found in an estuary are sensitive indicators of both the mean and extreme environmental conditions within that estuary. Estuaries can be classified by the number of species present and by whether the fauna are primarily marine, estuarine, or freshwater. Species assemblages may correlate with physical characteristics, such as bottom substrate, vegetation, and areal and temporal characteristics of salinity zones. The information on species presence/absence or other attributes can be used to determine the faunal similarities and differences among estuaries.

A comparison of estuaries and associated species can identify differing factors among those estuaries that might account for shifts in species distribution and relative abundance, helping to define ecological variables controlling species distributions. For example, a

species may show differing salinity tolerances among estuaries, suggesting that some other factor, such as temperature, competition, or predation may be regulating its distribution.

Linkages to Marine Ecosystems. Estuaries are home to many aquatic species year-round, however, a large number of species only use estuaries for specific parts of their life histories and spend the rest offshore. Most of these latter species fall into four general categories: 1) diadromous species, which use estuaries as migration corridors and, in some instances, nursery areas; 2) species that use estuaries for spawning, often at specific salinities; 3) species that spawn in marine waters near the mouths of estuaries and depend on tidal- and wind-driven currents to carry eggs, larvae, or early juveniles into estuarine nursery areas; and 4) species that enter estuaries during certain times of year to feed on abundant prey. The importance of an estuary can be assessed by the intensity with which species use estuarine habitats. Importance can be estimated both by the number of species present as well as the density of specific life stages in estuaries relative to offshore habitats. These data may assist in identifying adverse effects of estuarine degradation on offshore populations.

Future Plans

Species Life History Summaries. The ELMR program is continuing to compile and assess estuarine biological and physical data to improve the Nation's ability to manage coastal ocean resources. The next step is to complete data compilation for the development of species life history summaries for each of the fishes and invertebrates in the southeast data base.

A concise life history summary will be written for each species to provide an overview of how and when a species uses estuaries and what specific habitats it uses. The summaries will highlight species-specific life history characteristics that relate directly to estuarine spatial and temporal distribution and abundance (e.g., many molluscs have particular salinity and substrate preferences). Information for the species life history summaries will be gathered primarily from published and unpublished literature; individuals who have species-specific knowledge will be consulted. As an example, the species life history summary for bluefish (*Pomatomus saltatrix*) in the northeast region is shown in Appendix 4.

While the species life history summaries will provide brief accounts of important life history attributes, they do not permit a direct and simple assessment of characteristics that a species shares with others (or lacks altogether). Furthermore, many life history attributes are categorical (e.g., feeding types can be classified as carnivore, herbivore, detritivore, etc.) and more easily viewed in a tabular format. Therefore, information found in the species life history summaries will be augmented with additional physical and biological parameters and condensed into three life history tables. Major table headings are: Habitat Associations, Biological Attributes, and Reproduction (Appendix 5). These tables will present life history characteristics for each species along with behavior traits and preferred habitats. They will reflect the most current information about a species as gathered from published and unpublished literature and can be used to quickly identify species with similar traits.

East Coast Strategic Assessment. Development of a capability to define and interpret the effects of anthropogenic and natural phenomenon on living marine resources will be a component of the Strategic Environmental Assessments Division's *East Coast of North America Strategic Assessment Project* scheduled to begin in FY 92 (NOAA 1991). This project will characterize the biological, physical, chemical, and economic characteristics of the east coast of North America to address multiple resource use conflicts. The data compiled for the ELMR southeast and northeast study regions will be a major component of this project. The new initiative will include electronic mapping of the distribution and relative abundance of living marine resources. The study area begins at the head-of-tide in estuaries and encompasses the continental shelf as defined by the 200-m isobath. Beyond the shelf the study area contains epipelagic waters. The areal coverage will extend from the Straits of Belle Isle, Newfoundland, to Tampa Bay, Florida. The ELMR distribution and abundance data will be the primary source of fish and invertebrate information for east coast estuaries. These data will be integrated with the coastal and offshore living resource information to develop a consistent data base base on species found from the head-of-tide to past the continental shelf. This will enable the development of capability to define and understand the coupling of estuarine and marine habitats based on species spatial and temporal distributions and life history characteristics.

Additional data sets developed or under development (e.g., National Status and Trends) in NOAA programs will enable regional environmental assessments of anthropogenic effects on living marine resources. Integration of biological, and physical data will significantly improve our ability to identify and define the biological linkages and physical interchanges between estuarine and shelf habitats. As it becomes apparent that the cumulative effects of small alterations in many estuaries have a total systemic impact on coastal ocean resources, it is more important than ever to compile

consistent information on the Nation's estuarine fishes and invertebrates. Although the knowledge available to effectively preserve and manage living resources is limited, the ELMR data base provides an important tool for assessing the status of estuarine fauna and examining their relationships with other species and their environment. The ELMR data base provides baseline information on the zoogeography and ecology of estuarine fishes and invertebrates, and identifies gaps in our knowledge of these resources. When combined with data sets under development in the *East Coast of North America Strategic Assessment Project*, our ability to conduct interdisciplinary assessments to identify strategies to balance resource development and conservation efforts will be significantly enhanced.

Acknowledgements

We thank those individuals that provided information and reviewed the data in this report. Without their efforts a study of this magnitude and complexity would not be possible. In addition, we thank the many other scientists and managers who provided contacts and references. A special thanks is due to Ginger Ogburn-Matthews and David M. Knott for their comments on Hurricane Hugo. Fish illustrations on the cover were obtained from Shipp 1988.

Literature Cited

Bane, N., and T. Van Devender. 1989. Annual Report of the Southeast Area Monitoring and Assessment Program (SEAMAP). Gulf States Marine Fisheries Commission. 11 p.

Barrett,B.B., J.L. Merrell, T.P. Morrison, M.C. Gillespie, E.J. Ralph and J.F. Burdon. 1978. A study of Louisiana's major estuaries and adjacent offshore waters. Louisiana Dept. Wildl. Fish., New Orleans, LA. 197 p.

Briggs, J.C. 1974. Marine Zoogeography. McGraw-Hill, New York. 475 p.

Bulger, A.J., B.P. Hayden, M.E. Monaco, D.M. Nelson, and M.G. McCormick-Ray. 1990. A proposed estuarine classification: analysis of species salinity ranges. ELMR Rept. No. 5. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 28 p.

Darnell, R. M., R. E. Defenbaugh, and D. Moore. 1983. Northwestern Gulf shelf bio-atlas. Open File Report No. 82-04. Minerals Management Service, Gulf of Mexico OCS Regional Office. Metairie, LA. 438 p.

Gilmore, R. G. 1977. Fishes of the Indian River Lagoon and adjacent waters, Florida. Bull. Fla. St. Mus., Biol. Sci. 22: 101-148.

Gunter, G. 1967. Some relationships of estuaries to the fisheries of the Gulf of Mexico. *In* G. H. Lauff (editor), Estuaries, pp. 621-638. Amer. Assoc. Adv. Sci. Sp. Publ. No. 83, Washington, DC. 757 p.

Hammerschmidt, P. C. and L. W. McEachron. 1986. Trends in relative abundance of selected shellfishes along the Texas coast: January 1977 - March 1986. Tex. Parks Wildl. Dept., Coast. Fish. Branch, Mgmt. Data Ser., No. 108: 149 p.

Joseph, E. B. 1973. Analysis of a nursery ground. In A. L. Pacheco (editor). Proceedings of a Workshop on Egg, Larval, and Juvenile Stages of Fish in Atlantic Coast Estuaries.

Knott, D.M., and R.M. Martore. 1991. The short-term effects of Hurricane Hugo on fishes and decapod crustaceans in the Ashley River and adjacent marsh creeks, South Carolina. J. Coastal Res. Spec. Iss. 8: 335-356.

Mann, K. H. 1982. Ecology of coastal waters. Univ. of California Press, Los Angeles, CA. 322 p.

Monaco, M. E. 1986. National Estuarine Inventory: Living marine resources component, preliminary West Coast study. ELMR Rpt. 1. Ocean Assessments Division, NOS/NOAA. Rockville, MD. 33 p.

Monaco, M. E., T. E. Czapla, D. M. Nelson, and M. E. Pattillo. 1989. Distribution and Abundance of Fishes and Invertebrates in Texas Estuaries. ELMR Rpt. No. 3. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 107 p.

Monaco, M. E., D. M. Nelson, R. L. Emmett, and S. A. Hinton. 1990. Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries, Volume 1: Data Summaries. ELMR Rpt. No. 4. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 240 p.

NOAA (National Oceanic and Atmospheric Administration). 1984. The national status and trends program for marine environmental quality: Program description (memo). Ocean Assessments Division, NOS/NOAA. Rockville, MD. 28 p.

NOAA (National Oceanic and Atmospheric Administration). 1985. National Estuarine Inventory: Data Atlas. Volume 1. Physical and Hydrologic Characteristics. Strategic Assessment Branch, NOS/NOAA. Rockville, MD. 103 p.

NOAA (National Oceanic and Atmospheric Administration). 1988. Bering, Chukchi, and Beaufort Seas Strategic Assessment: Data Atlas. Strategic Assess-

ment Branch, NOS/NOAA. Rockville, MD. 135 p.

NOAA (National Oceanic and Atmospheric Administration). 1991. Prospectus for the East Coast of North America Strategic Assessment Project: Biogeographic Characterization Component. Strategic Environmental Assessments Division, NOS/NOAA. Rockville, MD. 17 p.

Odum, W. E., and E. J. Heald. 1975. The detritus-based food web of an estuarine mangrove community. In L. E. Cronin (editor). Estuarine Research. Academic Press. New York, NY. pp. 265 - 286.

Ogburn, G., S. Service, and D. Allen. 1990. Effects of Hurricane Hugo and other climatic events on intertidal nekton of North Inlet, SC (abstract). Southeast Estuarine Research Society (SEERS) Spring Meeting, 1990.

Perry, H. M., G. Adkins, R. Condrey, P. C. Hammerschmidt, S. Heath, J. R. Herring, C. Moss, G. Perkins, and P. Steele. 1984. A profile of the blue crab fishery of the Gulf of Mexico. Gulf States Marine Fisheries Commission Report, December 1982. 184 pp.

Powell, A.B., D.E. Hoss, W.F. Hettler, D.S. Peters, L. Simoneaux, and S. Wagner. 1987. Abundance and distribution of ichthyoplankton in Florida Bay and adjacent waters. South Florida Research Report SFRS-87/01.

Service, S., G. Ogburn, and D. Allen. 1990. Short-term effects of Hurricane Hugo on the estuarine fauna of North Inlet, South Carolina (abstract). Benthic Ecology Meeting, 1990.

Sherman, K., and L. M. Alexander (editors). 1985. Variability and management of large marine ecosystems. AAAS Selected Symposium 99. AAAS, Washington, DC. 319 p.

Shipp, R. L. 1988. Guide to fishes of the Gulf of Mexico. Dauphin Island Sea Laboratory, Dauphin Island, AL. 256 p.

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 Tech. Rep. NMFS 79, 49 p.

Weinstein, M. P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish. Cape Fear River, North Carolina. Fish. Bull., U. S. 77: 339-357

Wilkinson, L. 1987. Systat: The system for statistics. Systat, Inc., Evanston, IL.

Data Summary Tables

Table 2. Spatial distribution and relative abundance

Table 3. Temporal distribution

Table 4. Data reliability

Table 5. Occurrence of 40 species in 20 southeast estuaries

In each data summary table, species are listed in phylogenetic order, as in Table 1. Estuaries are listed in a north to south order, from Albemarle Sound, NC, to Biscayne Bay, FL. At the beginning of each data summary is an index table showing the page location of each species and estuary within the data summary.

Table 2. Spatial distribution and relative abundance

Index to Table 2. Page location of spatial distribution table for each species and estuary.

Common and Scientific Name	Estuary: Albemarle Sound, Pamlico Sound, Pamlico/Pungo Rivers, Neuse River, Bogue Sound, New River, Cape Fear River	Winyah Bay, N/S Santee River, Charleston Harbor, St. Helena Sound, Broad River, Savannah River, Ossabaw Sound	St. Cathe./Sapelo Sound, Altamaha River, St. Andr./St. Sim. Sound, St. Johns River, Indian River, Biscayne Bay
Mussel (*Mytilis edulis*) Bay scallop (*Argopecten irradians*) American oyster (*Crassostrea virginica*) Common rangia (*Rangia cuneata*) Hard clam (*Mercenaria* species) Brown shrimp (*Penaeus aztecus*)	p. 20	p. 21	p. 22
Pink shrimp (*Penaeus duorarum*) White shrimp (*Penaeus setiferus*) Grass shrimp (*Palaemonetes pugio*) Blue crab (*Callinectes sapidus*) Atlantic sturgeon (*Acipenser oxyrhynchus*) Ladyfish (*Elops saurus*)	p. 23	p. 24	p. 25
American eel (*Anguilla rostrata*) Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Bay anchovy (*Anchoa mitchilli*)	p. 26	p. 27	p. 28
Sheepshead minnow (*Cyprinodon variegatus*) Mummichog (*Fundulus heteroclitus*) Atlantic silversides (*Menidia* species) White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*)	p. 29	p. 30	p. 31
Cobia (*Rachycentron canadum*) Gray snapper (*Lutjanus griseus*) Sheepshead (*Archosargus probatocephalus*) Pinfish (*Lagodon rhomboides*) Spotted seatrout (*Cynoscion nebulosus*) Weakfish (*Cynoscion regalis*)	p. 32	p. 33	p. 34
Spot (*Leiostomus xanthurus*) Southern kingfish (*Menticirrhus americanus*) Atlantic croaker (*Micropogonias undulatus*) Black drum (*Pogonias cromis*) Red drum (*Sciaenops ocellatus*) Striped mullet (*Mugil cephalus*)	p. 35	p. 36	p. 37
Spanish mackerel (*Scomberomorus maculatus*) Gulf flounder (*Paralichthys albigutta*) Summer flounder (*Paralichthys dentatus*) Southern flounder (*Paralichthys lethostigma*)	p. 38	p. 39	p. 40

Table 2. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Mussel	A																					
	S																					
Mytilis	J						√									√			√			√
edulis	L						√									√			√			√
	E																					
Bay scallop	A					◉	◉								○	◉		○	◉			√
	S						◉								○	●		○	●			√
Argopecten	J					◉	◉								○	◉		○	●			√
irradians	L					◉	◉								○	●		○	●			√
	E						◉								○	●		○	●			√
American oyster	A		○			◉	◉		◉			○			●	◉		●	◉		○	●
	S		○			◉	◉		◉			○			●	●		●	●		○	●
Crassostrea	J		○			◉	◉		◉			○			●	◉		●	◉		○	●
virginica	L		○			◉	◉		◉			○			●	●		●	●		○	●
	E		○			◉	◉		◉			○			●	●		●	●		○	●
Common rangia	A	◉	◉		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○	
	S	◉	◉		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○	
Rangia	J	◉	◉		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○	
cuneata	L	◉	◉		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○	
	E	◉	◉		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○	
Hard clam	A					◉	◉								◉	●		●	●		◉	●
	S					●	●								◉	●		●	●		◉	●
Mercenaria	J					◉	◉								◉	●		●	●		◉	●
species	L					◉	◉								◉	●		●	●		◉	●
	E					●	●								◉	●		●	●		◉	●
Brown shrimp	A		○			◉	◉		◉			◉										
	S																					
Penaeus	J	√	○			◉	◉		◉		○	◉			●	●		◉	◉		◉	◉
aztecus	L					○	○					○			●	●		◉	◉		◉	◉
	E																					
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Seawater zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

Species/Life Stage		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Mussel	A																					
	S																					
Mytilis edulis	J			√																		
	L			√																		
	E																					
Bay scallop	A																					
	S																					
Argopecten irradians	J																					
	L																					
	E																					
American oyster	A		●	●		○			◉	◉		●	◉		●	●		○	○		◉	◉
	S		●	●		○			◉	◉		●	◉		●	●		○	○		◉	◉
Crassostrea virginica	J		●	●		○			◉	◉		●	◉		●	●		○	○		◉	◉
	L		●	●		○			◉	◉		●	◉		●	●		○	○		●	●
	E		●	●		○			◉	◉		●	◉		●	●		○	○		●	●
Common rangia	A	√	○		○	○		√	√		√	√		√			○	○		○	○	
	S		○			○			√			√		√			○	○		○	○	
Rangia cuneata	J	√	○		○	○		√	√		√	√		√			○	○		○	○	
	L	√	○		○	○		√	√		√	√		√			○	○		○	○	
	E		○			○			√			√		√			○	○		○	○	
Hard clam	A		◉	◉		○			◉	◉		○	○		○	◉		○	○		○	○
	S		◉	◉		○			◉	◉		○	○		○	◉		◉	◉		◉	◉
Mercenaria species	J		◉	◉		○			◉	◉		○	○		○	◉		○	○		○	○
	L		◉	◉		○			◉	◉		○	○		○	◉		◉	◉		◉	◉
	E		◉	◉		○			◉	◉		○	○		○	◉		◉	◉		◉	◉
Brown shrimp	A		◉	◉		○			◉	◉		√	√		○	○		○	○		◉	◉
	S		√	√																		
Penaeus aztecus	J		◉	◉		◉			●	●		●	●		◉	◉		○	○		◉	◉
	L		◉	◉		○			●	●		◉	◉		◉	◉						
	E		√	√																		
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
Mussel	A																		
	S																		
Mytilis edulis	J																		
	L																		
	E																		
Bay scallop	A															√			○
	S															√			○
Argopecten irradians	J															√			○
	L															√			○
	E															√			○
American oyster	A		◉	◉		○	○		◉	◉		◉	◉		○	○		○	○
	S		◉	◉		○	○		◉	◉		◉	◉		○	○		○	○
Crassostrea virginica	J		◉	◉		○	○		◉	◉		◉	◉		○	○		○	○
	L		●	●		○	○		●	●		◉	◉		○	○		○	○
	E		●	●		○	○		●	●		◉	◉		○	○		○	○
Common rangia	A	○	○		○	○		○	○		○	○			√				
	S	○	○		○	○		○	○		○	○			√				
Rangia cuneata	J	○	○		○	○		○	○		○	○			√				
	L	○	○		○	○		○	○		○	○			√				
	E	○	○		○	○		○	○		○	○			√				
Hard clam	A		○	○		○	○		○	○		○	○		○	○		○	○
	S		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○
Mercenaria species	J		○	○		○	○		○	○		○	○		○	○		○	○
	L		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○
	E		◉	◉		◉	◉		◉	◉		○	○		○	○		○	○
Brown shrimp	A		◉	◉		○	○		◉	◉					√	√		√	√
	S																		
Penaeus aztecus	J		◉	◉		○	○		◉	◉	√	◉	◉		○	○		√	√
	L											◉	◉		○	○		√	√
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Pink shrimp	A		○			◉	◉		○			○										
	S																					
Penaeus duorarum	J		○			◉	◉		○			◉			◉	◉		◉	◉		◉	◉
	L														◉	◉		◉	◉		◉	◉
	E																					
White shrimp	A		○			○	○		○			○										
	S																					
Penaeus setiferus	J	○	◉		√	◉	○		○			○			○	○		○	○	√	○	◉
	L	○	◉			◉	○					○			○	○		○	○		○	○
	E																					
Grass shrimp	A	○	○			◉	◉		◉			◉			●	◉		●	◉		●	●
	S		○			◉	◉		◉			◉			◉	◉		◉	◉		◉	
Palaemonetes pugio	J		○			◉	◉		◉			◉			◉	◉		◉	◉		●	●
	L		○			◉	◉		◉			◉			◉	◉		◉	◉		◉	
	E		○			◉	◉		◉			◉			◉	◉		◉	◉		◉	
Blue crab	A	○	○		○	●	◉	○	●		○	●		◉	◉	●	◉	◉	◉	○	●	●
	M	○	○		○	●		○	●		○	●			◉	○		◉	○	○	●	
Callinectes sapidus	J	○	◉			●	●		◉			●		○	◉	◉	○	◉	◉	○	●	◉
	L		√			√	●		√			√			○	◉			◉		●	●
	E		√			√	●		√			√				◉			◉			●
Atlantic sturgeon	A	○	○		○	○	○	○	○		○	○								○	○	○
	S	○			○	○		○	○		○	○								○		
Acipenser oxyrhynchus	J	○	○		○	○	○	○	○		○	○					√	√		○	○	○
	L	○			○	○		○	○		○	○								○	○	
	E	○			○	○		○	○		○	○								○		
Ladyfish	A					○	○													○	○	○
	S																					
Elops saurus	J	○	○		○	○	○		○		○	○			√	√		√	√	○	○	○
	L					○	○									√			√	○	○	○
	E																					
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs
- M - Mating

Table 2, continued. Spatial distribution and relative

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Pink shrimp	A		√	○		○			√	√		√	√		○	○		√	√		√	√
	S																					
Penaeus duorarum	J		○	○		◉			○	○		√	√		○	○		○	○		○	○
	L		○	○		○			○	○		√	√		○	○			√			√
	E																					
White shrimp	A	√	○	○		◉			●	●		◉	◉		○	○		●	●		●	●
	S								√	√												
Penaeus setiferus	J	√	◉	◉		●			●	●		●	●		●	●		●	●		●	●
	L		◉	◉		●			●	●		●	●		◉	◉		○	○		○	○
	E								√	√												
Grass shrimp	A		●	●		◉			●	●		◉	◉		◉	◉		◉	◉		◉	◉
	S		●	●		◉			●	●		◉	◉		◉	◉		◉	◉		◉	◉
Palaemonetes pugio	J		●	●		◉			●	●		◉	◉		◉	◉		◉	◉		◉	◉
	L		●	●		◉			●	●		◉	◉		◉	◉		◉	◉		◉	◉
	E		●	●		◉			●	●		◉	◉		◉	◉		◉	◉		◉	◉
Blue crab	A	○	◉	◉	○	◉		◉	◉	◉	◉	●	●	◉	●	●	◉	◉	◉	◉	◉	◉
	M		◉			◉			◉			◉	○		◉	○	○	○		○	○	
Callinectes sapidus	J	○	●	●	○	◉		○	◉	○	○	●	◉	○	●	◉	◉	◉	◉	◉	◉	◉
	L		√	◉		◉			●	●		◉	◉			◉		√	●		√	●
	E			◉		○				◉			◉			◉		√	●		√	●
Atlantic sturgeon	A	√	√	√	√	√		√	√	√	○	○	○	○	○	○	○	○	○	○	○	○
	S	○	○		√	√		√	√		○	○		○	○		○			○		
Acipenser oxyrhynchus	J	○	○	√	√	√		√	√	√	○	○	○	○	○	○	○	○	○	○	○	○
	L	○	○		√	√		√	√		○	○		○	○		○			○		
	E	○	○		√	√		√	√		○	○		○	○		○			○		
Ladyfish	A		√	√					√	√		○	○		○	○	√	○	○	√	○	○
	S																					
Elops saurus	J	√	○	○	√	√		√	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	L		√	○		√			√	○		○	○			○		○	○		○	○
	E																					
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs
- M - Mating

Table 2, continued. Spatial distribution and relative

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
Pink shrimp	A		√	√					√	√					○	○			
	S																		
Penaeus duorarum	J		○	○		√	√		○	○	○	○	○		◉	◉		●	●
	L			√						√		○	○		◉	◉		●	●
	E																		
White shrimp	A		●	●		◉	◉		●	●					√	√		√	√
	S																		
Penaeus setiferus	J		●	●		◉	◉		●	●	◉	●	●		○	○		√	√
	L		○	○		○	○		○	○		●	●		○	○		√	√
	E																		
Grass shrimp	A		◉	◉		◉	◉		◉	◉	●	●	●		◉	◉		○	○
	S		◉	◉		◉	◉		◉	◉	○	○	○		◉	◉		○	○
Palaemonetes pugio	J		●	◉		◉	◉		◉	◉	○	○	○		◉	◉		○	○
	L		◉	◉		◉	◉		◉	◉	○	○	○		◉	◉		○	○
	E		◉	◉		◉	◉		◉	◉	○	○	○		◉	◉		○	○
Blue crab	A	◉	◉	◉	◉	◉	◉	◉	◉	◉	○	◉	●		◉	◉		●	◉
	M	○	○		○	○		○	○		○	◉	○		○	○		◉	○
Callinectes sapidus	J	◉	◉	◉	◉	◉	◉	◉	◉	◉	○	◉	◉		◉	◉		●	◉
	L		√	●		√	●		√	●		◉	◉		◉	◉		◉	◉
	E		√	●		√	●		√	●		◉	◉			○		◉	◉
Atlantic sturgeon	A	○	○	○	○	○	○	○	○	○	√	√	√						
	S	○			○			○			√	√							
Acipenser oxyrhynchus	J	○	○	○	○	○	○	○	○	○	√	√	√						
	L	○			○			○			√	√							
	E	○			○			○			√	√							
Ladyfish	A	√	○	○	√	○	○	√	○	○	○	○	○		○	○		○	○
	S																		
Elops saurus	J	○	○	○	○	○	○	○	○	○	○	○	○		●	●		○	○
	L		◉	◉		○	○		◉	◉		○	○		●	●		○	○
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs
- M - Mating

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
American eel**	A	○	○		○	○	○	○	○		○	○		○	○	○	○	○	○	○	○	○
	S																					
Anguilla rostrata	J	◉	◉		●	●	●	◉	◉		●	●		○	○	○	○	○	○	○	○	◉
	L	◉	◉		◉	◉	◉	◉	◉		◉	◉		○	○	○	○	○	○	○	○	○
	E																					
Blueback herring	A	●	◉		●	◉	◉	●	◉		●	◉		√	√	√	√	√	√	◉	○	○
	S	●			●	√		●			◉			√	√		√			◉		
Alosa aestivalis	J	◉	◉		◉	◉	◉	◉	◉		○	○		√	√	√	√	√	√	○	○	○
	L	●			●	√		◉			●	√		√	√		√			○	○	
	E	●			●	√		◉			●			√	√		√			○		
Alewife	A	●	◉		○	○	◉	○	○		◉	◉		○	○	○	√	√	√	√	√	√
	S	◉			○			○			◉			○			√			√	√	
Alosa pseudoharengus	J	◉	◉		◉	◉	◉	○	○		◉	◉		○	○	○	√	√	√	√	√	√
	L	●			◉			○			◉	√		○			√			√	√	
	E	●			◉			○			◉			○			√			√	√	
American shad	A	◉	◉		○	○	○	○	○		○	○		√	√	√	√	√	√	○	○	○
	S	○			○			○			○			√			√			○		
Alosa sapidissima	J	○	○		○	○	○	○	○		○	○		√	√	√	√	√	√	○	○	○
	L	○			○			○			○			√			√			○	○	
	E	○			○			○			○			√			√			○		
Atlantic menhaden	A					◉	◉		◉			◉			◉	◉		○	○		○	◉
	S																					
Brevoortia tyrannus	J	◉	●		◉	●	●	◉	●		◉	●		○	●	●	○	●	●	◉	●	●
	L	◉	◉		◉	●	●	◉	◉		◉	◉		◉	●	●	◉	●	●	◉	◉	●
	E																					
Bay anchovy	A	◉	●		○	●	●	○	◉		○	●		○	●	●	○	●	●	○	●	◉
	S		●			●	●		◉			●			●	●		●	●		●	◉
Anchoa mitchilli	J	◉	●		○	●	●	○	◉		○	●		○	●	●	○	●	●	○	●	◉
	L		●			●	●		◉			●			●	●		●	●		●	◉
	E		●			●	●		●			●			●	●		●	●		●	◉
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

** See *Life History Notes*, p. 12.

Table 2, continued. Spatial distribution and relative

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
American eel**	A	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	S																					
Anguilla rostrata	J	◉	◉	◉	○	○		○	○	○	○	○	○	○	○	○	◉	◉	◉	◉	◉	◉
	L	○	○	◉	○	○		○	○	○	○	○	○	○	○	○	◉	◉	◉	◉	◉	◉
	E																					
Blueback herring	A	○	○	√	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	S	○			○			○			○			○			○	√		○	√	
Alosa aestivalis	J	○	○	√	○	○		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	L	○			○	○		○			○			○			○	√		○	√	
	E	○			○			○			○			○			○	√		○	√	
Alewife	A	√	√	√																		
	S	√																				
Alosa pseudoharengus	J	√	√	√																		
	L	√																				
	E	√																				
American shad	A	○	○	√	○	○		○	○	○	○	○	○	√	√	√	○	○	○	○	○	○
	S	○			○			○			○			√			○			○		
Alosa sapidissima	J	○	○	√	○	◉		○	○	○	○	○	○	√	√	√	○	○	○	○	○	○
	L	○			○	○		○			○			√			○			○		
	E	○			○			○			○			√			○			○		
Atlantic menhaden	A	√	○	○	√	○			○	○		○	○		○	○		○	○		○	○
	S																					
Brevoortia tyrannus	J	○	●	○	○	●		○	◉	◉	◉	◉	◉	◉	◉	●	○	◉	◉	○	◉	◉
	L	√	●	○	○	●		○	●	●	√	◉	◉		◉	●		◉	◉		◉	◉
	E																					
Bay anchovy	A		●	●		●		○	●	●		●	●		●	●	○	●	●	○	●	●
	S		●	●		●			●	●		●	●		●	●		●	●		●	●
Anchoa mitchilli	J		●	●		●		○	●	●		●	●		●	●	○	●	●	○	●	●
	L		●	●		●			●	●		●	●		●	●		●	●		●	●
	E		●	●		●			●	●		●	●		●	●		●	●		●	●
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

** See *Life History Notes*, p. 12.

Table 2, continued. Spatial distribution and relative

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
American eel**	A	○	○	○	○	○	○	○	○	○	○	○	○		○	○		○	○
	S																		
Anguilla rostrata	J	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉		○	○		○	○
	L	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	●	●		○	○		○	○
	E																		
Blueback herring	A	○	○	○	○	○	○	○	○	○	○	○	○						
	S	○	√		○	√		○	√		○								
Alosa aestivalis	J	○	○	○	○	○	○	○	○	○	○	○	○						
	L	○	√		○	√		○	√		○								
	E	○	√		○	√		○	√		○								
Alewife	A																		
	S																		
Alosa pseudoharengus	J																		
	L																		
	E																		
American shad	A	√	√	√	◉	◉	◉	○	○	○	○	○	○						
	S	√			○			○			○								
Alosa sapidissima	J	√	√	√	◉	◉	◉	○	○	○	○	○	○						
	L	√			○			○			○								
	E	√			○			○			○								
Atlantic menhaden	A		○	○		○	○		○	○		◉	◉		○	○			
	S																		
Brevoortia tyrannus	J	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		○	○			
	L		◉	◉		◉	◉		◉	◉	○	○	○		○	○			
	E																		
Bay anchovy	A	○	●	●	○	●	●	○	●	●	◉	●	●		●	●		●	●
	S		●	●		●	●		●	●		●	●		●	●		●	●
Anchoa mitchilli	J	○	●	●	○	●	●	○	●	●	◉	●	●		●	●		●	●
	L		●	●		●	●		●	●		●	●		●	●		●	●
	E		●	●		●	●		●	●		●	●		●	●		●	●
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

** See *Life History Notes*, p. 12.

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Sheepshead minnow	A		√		○	◉	◉	○	○		○	◉		○	◉	◉	○	◉	◉	√	◉	◉
	S		√		○	◉	◉		○		○	◉		○	◉	◉	○	◉	◉		◉	◉
Cyprinodon variegatus	J		√		○	◉	◉	○	○		○	◉		○	◉	◉	○	◉	◉	√	◉	◉
	L		√		○	◉	◉		○		○	◉		○	◉	◉	○	◉	◉		◉	◉
	E		√		○	◉	◉		○		○	◉		○	◉	◉	○	◉	◉		◉	◉
Mummichog	A	√	○		○	●	●	○	◉		○	◉		○	●	●	○	●	●		●	◉
	S	√	○		○	●	●	○	◉		○	◉		○	●	●	○	●	●		◉	◉
Fundulus heteroclitus	J	√	○		○	●	●	○	◉		○	◉		○	●	●	○	●	●		●	◉
	L	√	○		○	●	●	○	◉		○	◉		○	●	●	○	●	●		◉	◉
	E	√	○		○	●	●	○	◉		○	◉		○	●	●	○	●	●		◉	◉
Atlantic silversides	A	○	◉		○	◉	◉	○	○		○	◉		○	●	●	√	●	●	√	◉	◉
	S		◉			◉	●		○			◉				●			●			◉
Menidia species	J	○	◉		○	◉	◉	○	○		○	◉		○	●	●	√	●	●	√	◉	◉
	L		◉			◉	●		○			◉				●			●		◉	◉
	E		◉			◉	●		○			◉				●			●			◉
White perch	A	●	●		○	○	○	○	○		○	○		√	√							
	S	●	●		○	○		○	○		○	○		√	√							
Morone americana	J	●	●		○	○		○	○		○	○		√	√							
	L	●	●		○	○		○	○		◉	○		√	√							
	E	●	●		○	○		○	○		◉	○		√	√							
Striped bass	A	○	○		○	○	√	○	○		○	○		√	√		√	√		√	√	√
	S	◉			○			○			○			√			√			√	√	
Morone saxatilis	J	◉	○		○	○		○	○		○	○		√	√		√	√		√	√	√
	L	◉	○		○			○	○		○	○		√	√		√			√	√	
	E	●			○			○			○			√			√			√	√	
Bluefish	A		○			◉	◉		○			√				◉		√	√			○
	S																					
Pomatomus saltatrix	J	○	○		√	◉	◉	√	○			○			○	◉	√	○	○	√	◉	◉
	L																					
	E																					
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs
- M - Mating

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Sheepshead minnow	A	○	○	√	○	○		○	○	○	○	◉	◉	○	○	○	○	◉	◉	○	◉	◉
	S	○	○	√	○	○		○	○	○	○	○	○	○	○	○	○	◉	◉	○	◉	◉
Cyprinodon variegatus	J	○	○	√	○	○		○	○	○	○	◉	◉	○	○	○	○	◉	◉	○	◉	◉
	L	○	○	√	○	○		○	○	○	○	○	○	○	○	○	○	◉	◉	○	◉	◉
	E	○	○	√	○	○		○	○	○	○	○	○	○	○	○	○	◉	◉	○	◉	◉
Mummichog	A	◉	◉	◉	◉	◉		◉	◉	◉	●	●	●	◉	◉	◉	○	●	●	○	●	●
	S	◉	◉	◉	◉	◉		◉	◉	◉	●	●	●	◉	◉	◉	○	●	●	○	●	●
Fundulus heteroclitus	J	◉	◉	◉	◉	◉		◉	◉	◉	●	●	●	◉	◉	◉	○	●	●	○	●	●
	L	◉	◉	◉	◉	◉		◉	◉	◉	●	●	●	◉	◉	◉	○	●	●	○	●	●
	E	◉	◉	◉	◉	◉		◉	◉	◉	●	●	●	◉	◉	◉	○	●	●	○	●	●
Atlantic silversides	A	√	○	◉		◉		√	○	○		●	●		●	●	○	◉	◉	○	◉	◉
	S			◉		●				○			●			●		○	◉		○	◉
Menidia species	J	√	○	◉		◉		√	○	○		●	●		●	●	○	◉	◉	○	◉	◉
	L			◉		●				○			●			●		○	◉		○	◉
	E			◉		●				○			●			●		○	◉		○	◉
White perch	A	◉	◉		○	○		○	○													
	S	◉	◉		○	○		○	○													
Morone americana	J	◉	◉	√	○	○		○	○													
	L	◉	◉		○	○		○	○													
	E	◉	◉		○	○		○	○													
Striped bass	A	○	○		○	○		○	○		○	○	○	○	◉	○	○	○	○	◉	◉	○
	S	○			○			○			○			○			○	√		○	√	
Morone saxatilis	J	○	○		○	○		○	○		○	○	○	○	○	○	○	○	○	○	○	○
	L	○			○			○			○			○			○	√		○	√	
	E	○			○			○			○			○			○	√		○	√	
Bluefish	A			√		√							○			○						
	S																					
Pomatomus saltatrix	J		○	◉		○			○	○		○	○		○	○		○	○		○	○
	L																					
	E																					
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
Sheepshead minnow	A	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		●	●		○	○
	S	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		●	●		○	○
Cyprinodon variegatus	J	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		●	●		○	○
	L	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		●	●		○	○
	E	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		●	●		○	○
Mummichog	A	○	●	●	○	●	●	○	●	●	○	◉	◉		√	√			
	S	○	●	●	○	●	●	○	●	●	○	◉	◉		√	√			
Fundulus heteroclitus	J	○	●	●	○	●	●	○	●	●	○	◉	◉		√	√			
	L	○	●	●	○	●	●	○	●	●	○	◉	◉		√	√			
	E	○	●	●	○	●	●	○	●	●	○	◉	◉		√	√			
Atlantic silversides	A	○	◉	◉	○	◉	◉	○	◉	◉	◉	●	●		●	●		◉	◉
	S		○	◉		○	◉		○	◉	◉	◉	●		●	●		◉	◉
Menidia species	J	○	◉	◉	○	◉	◉	○	◉	◉	◉	◉	◉		●	●		◉	◉
	L		○	◉		○	◉		○	◉	◉	◉	◉		●	●		◉	◉
	E		○	◉		○	◉		○	◉	◉	◉	◉		●	●		◉	◉
White perch	A																		
	S																		
Morone americana	J																		
	L																		
	E																		
Striped bass	A	√	√	√	○	○	○	√	√	√	○								
	S	√	√		○	√		√	√		○								
Morone saxatilis	J	√	√	√	○	○	○	√	√	√	○								
	L	√	√		○	√		√	√		○								
	E	√	√		○	√		√	√		○								
Bluefish	A												○		●	●			
	S																		
Pomatomus saltatrix	J		○	○		○	○		○	○		○	○		√	√		√	√
	L																		
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Cobia	A					○	○								○	○		○	○		√	○
	S						na															
Rachycentron	J					○	○								○	○		○	○		○	○
canadum	L					na	na									○			○			
	E					na	na															
Gray snapper	A																					
	S																					
Lutjanus	J		√			○	○		√			√			√	√		√	√		√	√
griseus	L																					
	E																					
Sheepshead	A		√			○	○		√			√			◉	◉		◉	◉		○	◉
	S															◉						
Archosargus	J		√			○	◉		√			○			◉	◉		◉	◉		○	◉
probatocephalus	L						○								○	◉			◉			○
	E															◉			◉			
Pinfish	A		○			◉	◉		◉			◉			●	●		●	●		◉	●
	S																					
Lagodon	J	√	○		○	◉	◉	○	◉		○	◉			●	●		●	●	○	●	●
rhomboides	L					●	●		○			◉			●	●		●	●		√	○
	E																					
Spotted seatrout	A		○			◉	◉		○			○			○	◉		◉	◉	√	○	○
	S					○	○								√	√		√	√			◉
Cynoscion	J	○	◉		○	◉	◉	√	○		√	○		○	○	○	○	○	○	√	○	◉
nebulosus	L					◉	◉								√	√		√	√		√	◉
	E					◉	◉								√	√		√	√			◉
Weakfish	A		○			◉	◉		○			○			◉	◉		◉	◉		○	◉
	S					◉	◉		○			○				○			√			◉
Cynoscion	J	√	○		√	◉	◉	√	◉			○		○	◉	◉	√	◉	◉		◉	◉
regalis	L		na			◉	◉		○			○			√	○			√		○	◉
	E		na			◉	◉		○			○				○			√			◉
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present
- na No data available

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs
- M - Mating

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Cobia	A		√	√		○			○	○		○	○		◉	◉		√	√		√	√
	S																					
Rachycentron canadum	J		√	√		○			○	○		○	○		◉	◉		○	○		○	○
	L																					
	E																					
Gray snapper	A																					
	S																					
Lutjanus griseus	J		√	√		○		○	○	○	√	√	√	√	√	√	√	√	√	√	√	√
	L			√		√				○												
	E																					
Sheepshead	A		○	○		○			○	○		○	○		○	○		○	○		○	○
	S																					
Archosargus probatocephalus	J		○	○		○			○	○		○	○		○	○		○	○		○	○
	L		√	√		○			○	○			○			○		○	○		○	○
	E																					
Pinfish	A		●	●		○			○	○		◉	◉		○	○		○	○		○	○
	S																					
Lagodon rhomboides	J	√	●	●		○		√	○	○		◉	◉		○	○		○	○		○	○
	L		●	●		◉			○	○		○	●		○	◉		○	○		○	○
	E																					
Spotted seatrout	A	√	○	○	√	○		√	○	○		◉	◉		◉	◉		●	◉		●	●
	S			○						○		○	○			○		◉	◉		◉	◉
Cynoscion nebulosus	J	√	○	○	√	○		√	○	○		○	○		◉	◉	√	◉	◉	○	◉	◉
	L		○	○		√			○	○		○	○			○		◉	◉		◉	◉
	E			○						○		○	○			○		◉	◉		◉	◉
Weakfish	A		○	○		◉			◉	◉		○	○		○	◉		○	○		○	○
	S												○			○		√	√		√	√
Cynoscion regalis	J		○	○		●		√	◉	◉		○	○		◉	○		◉	◉		◉	◉
	L		○	○		◉			◉	◉			○			○		◉	◉		◉	◉
	E												○			○		√	√		√	√
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
Cobia	A		√	√		√	√		√	√		○	○						
	S																		
Rachycentron canadum	J		○	○		○	○		○	○		○	○						
	L																		
	E																		
Gray snapper	A										○	○	○		●	●		●	●
	S																		
Lutjanus griseus	J	√	√	√	√	√	√	√	√	√	○	○	○		●	●		●	●
	L											○	○					◉	●
	E																		
Sheepshead	A		○	○		○	○		○	○	○	○	◉		●	●		√	√
	S												○					√	√
Archosargus probatocephalus	J		○	○		○	○		○	○	◉	◉	◉		●	●		√	√
	L		○	○		○	○		○	○		○	○					√	√
	E												○					√	√
Pinfish	A		○	○		○	○		○	○	◉	◉	◉		●	●		●	●
	S														○	○			
Lagodon rhomboides	J		○	○		○	○		○	○	◉	◉	◉		●	●		●	●
	L		○	○		○	○		○	○		◉	◉		●	●		●	●
	E														○	○			
Spotted seatrout	A		●	●		●	●		●	●	○	○	○		●	●		○	○
	S		◉	◉		◉	◉		●	●			○		●	●			○
Cynoscion nebulosus	J	○	◉	◉	○	◉	◉	○	◉	◉	○	○	○		●	●		○	○
	L		◉	◉		◉	◉		◉	◉		○	○		●	●		○	○
	E		◉	◉		◉	◉		●	●			○		●	●			○
Weakfish	A		○	○		○	○		○	○		◉	◉		○	○		√	√
	S		√	√		√	√		√	◉			◉						√
Cynoscion regalis	J		◉	◉		◉	◉		◉	◉	○	◉	◉					√	√
	L		◉	◉		◉	◉		◉	◉		◉	◉					√	√
	E		√	√		√	√		√	◉			◉						√
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Spot	A		◉			●	●		○			○			●	●		●	●		◉	◉
	S																					
Leiostomus xanthurus	J	○	●		●	●	●	●	●		●	●		○	●	●	○	●	●	●	◉	◉
	L		√			◉	●		√			√			●	●		●	●		●	●
	E																					
Southern kingfish	A		○			○	○		○			○			○	◉		○	◉		○	○
	S																					
Menticirhhus americanus	J		○			○	○		○			○			◉	◉		◉	◉		○	○
	L					○	○					○				○			○			○
	E																					
Atlantic croaker	A		○			○	◉		○			○			●	●		●	●	√	◉	◉
	S																					
Micropogonias undulatus	J	○	◉		●	●	◉	●	●		●	●		○	●	●	○	●	●	◉	●	●
	L					○	●		○			○			●	●		●	●		◉	●
	E																					
Black drum	A		√			○	○		○			○			√	√		√	√		√	√
	S																					
Pogonias cromis	J		√			○	○		○			○			√	√		√	√		√	√
	L														√	√		√	√			√
	E																					
Red drum	A					○	○					√			○	○		√	√		√	○
	S						√									○			√			○
Sciaenops ocellatus	J	√	√			○	○		○			○		√	○	◉	√	√	√		○	○
	L					○	○		○			○			○	○		√	√			○
	E						√									○			√			○
Striped mullet	A	○	◉		○	◉	◉	○	◉		○	◉		○	○	◉	○	○	○		◉	◉
	S																					
Mugil cephalus	J	○	◉		○	◉	◉	○	◉		◉	◉		○	●	◉	○	●	◉	○	●	◉
	L				○	◉	◉				√	◉			◉	◉		◉	◉		◉	◉
	E																					
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs
- M - Mating

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Spot	A		◉	◉		◉			◉	◉		◉	◉		◉	◉		○	○		◉	◉
	S																					
Leiostomus	J	√	●	●	√	●		○	●	●		◉	◉		◉	◉	○	●	●	◉	●	●
xanthurus	L		●	●		●			●	●		●	●		●	●		◉	◉		◉	◉
	E																					
Southern kingfish	A		○	○		◉			◉	◉		◉	◉		◉	◉		◉	●		◉	●
	S																	√	√		√	√
Menticirhhus	J		◉	◉		◉			◉	◉		◉	◉		◉	◉		●	●		●	●
americanus	L		◉	◉		◉			◉	◉		◉	◉		◉	◉		○	○		○	○
	E																	√	√		√	√
Atlantic croaker	A		◉	○		◉			○	○		◉	◉		◉	◉		○	○		◉	◉
	S																					
Micropogonias	J	√	●	○	√	●		○	●	●		●	●		●	●	○	◉	◉	○	●	●
undulatus	L		●	◉		●			●	●		●	●		●	●		◉	◉		●	●
	E																					
Black drum	A		○	√		√			○	○		○	○		○	○		○	○		○	○
	S									√			○			○		√	√		√	√
Pogonias	J		○	○		√			○	○		○	○		○	○	√	○	○	√	○	○
cromis	L		√	√		√			○	○		○	○		○	○		○	○		○	○
	E									√			○			○		√	√		√	√
Red drum	A	√	○	○	√	√		√	○	○		○	○		○	○		○	○		○	○
	S			○						○			○			○		√	√		√	√
Sciaenops	J	√	◉	◉	√	√		√	○	○		○	○		○	○		○	○		◉	◉
ocellatus	L		√	○		√			○	○		○	○		○	○		○	○		○	○
	E			○						○			○			○		√	√		√	√
Striped mullet	A	○	○	◉	○	○		√	◉	◉	○	○	○	○	◉	◉	○	◉	◉	○	◉	◉
	S																					
Mugil	J	○	●	●	○	◉		○	◉	◉	○	◉	◉	○	◉	◉	◉	●	●	◉	●	●
cephalus	L				○	◉			◉	◉		◉	◉		◉	◉		○	○		○	○
	E																					
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
Spot	A		◉	◉		◉	◉		◉	◉	○	○	○		●	●		○	○
	S																		
Leiostomus xanthurus	J	○	●	●	○	●	●	○	●	●	◉	◉	◉		●	●		○	○
	L		◉	◉		◉	◉		◉	◉		○	○					○	○
	E																		
Southern kingfish	A		◉	●		◉	●		◉	●		○	○		○	○		√	√
	S		√	√		√	√		√	√									
Menticirhhus americanus	J		●	●		●	●		●	●		○	○		○	○		√	√
	L		○	○		○	○		○	○		○	○		○	○		√	√
	E		√	√		√	√		√	√									
Atlantic croaker	A		◉	◉		◉	◉		◉	◉	◉	◉	◉		○	○		√	√
	S																		
Micropogonias undulatus	J	○	●	●	○	●	●	○	●	●	◉	◉	◉		○	○		√	√
	L		●	●		●	●		●	●		◉	◉					√	√
	E																		
Black drum	A		○	○		○	○		○	◉		○	○		●	●		√	√
	S		√	√		√	√		√	○			○		●	●			√
Pogonias cromis	J	√	○	○	√	○	○	√	○	○	○	◉	◉		●	●		√	√
	L		○	○		○	○		○	○		◉	◉		●	●		√	√
	E		√	√		√	√		√	○			○		●	●			√
Red drum	A		○	◉		○	●		○	○	○	○	○		◉	◉		√	√
	S		√	√		√	√		√	√			◉			◉			√
Sciaenops ocellatus	J		◉	◉		○	●		○	●	◉	◉	◉		●	●		√	√
	L		○	○		√	○		○	○		◉	◉		○	◉		√	√
	E		√	√		√	√		√	√			◉		○	◉			√
Striped mullet	A	○	◉	◉	○	◉	◉	○	◉	◉	●	●	●		●	●		○	○
	S																		
Mugil cephalus	J	◉	●	●	◉	●	●	◉	●	●	●	●	●		●	●		○	○
	L		○	○		○	○		○	○	○	●	●		●	●		○	○
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cath./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
Species/Life Stage		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
Spanish mackerel	A		○			○	○		√			√			○	◉		○	◉		√	○
	S																					
Scomberomorus maculatus	J		○			○	○		○			○			○	○		○	○		√	○
	L					na	na									○			○			
	E																					
Gulf flounder	A					√	○								○	○			○		√	√
	S																					
Paralichthys albigutta	J					○	○								○	○		○	○		√	√
	L						○									○		√	○			√
	E																					
Summer flounder	A		○			○	◉		○			○			○	◉		○	○		○	○
	S																					
Paralichthys dentatus	J	√	○			◉	◉	√	○			○			○	○		○	○		○	○
	L		○			○	◉					○			√	○		√	○		○	○
	E																					
Southern flounder	A	○	◉		○	◉	◉	○	◉		○	◉		√	◉	◉		◉	○		○	○
	S																					
Paralichthys lethostigma	J	◉	◉		◉	◉	○	◉	◉		◉	◉		○	○	○	○	○	○	◉	◉	○
	L		√			◉	◉					○			○	○		○	○		○	○
	E																					
		T	M	*	T	M	S	T	M	*	T	M	*	T	M	S	T	M	S	T	M	S
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present
- na No data available

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																				
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
Species/Life Stage		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Spanish mackerel	A			○						○		○	○		○	○					○	○
	S																					
Scomberomorus maculatus	J		√	○		√			○	○		○	○		○	○		○	○		○	○
	L			√						√			√			√						
	E																					
Gulf flounder	A		√	√		√			○	○					√	√		√	√		√	√
	S																					
Paralichthys albigutta	J		√	√		√			○	○					√	√		√	√		√	√
	L		√	√		√			○	○					√	√		√	√		√	√
	E																					
Summer flounder	A		√	○		○			○	○		○	○		○	○		√	√		√	√
	S																					
Paralichthys dentatus	J		○	◉		○			○	○		○	○		○	○		◉	◉		◉	◉
	L		○	○		○			○	○		○	○		○	○		○	○		○	○
	E																					
Southern flounder	A	○	○	◉	√	○		○	○	○	○	○	○	◉	◉	◉	○	○	◉	○	○	◉
	S																					
Paralichthys lethostigma	J	○	◉	◉	√	◉		○	○	○	○	○	○	◉	◉	◉	○	◉	◉	○	◉	◉
	L		◉	◉		○			○	○		○	○		○	○	√	○	○	√	○	○
	E																		○			○
		T	M	S	T	M	*	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
		Southeast Estuaries																				

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 2, continued. Spatial distribution and relative abundance

		Southeast Estuaries																	
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
Spanish mackerel	A		○	○		○	○		○	○			○			√		○	○
	S																		
Scomberomorus maculatus	J		○	○		○	○		○	○			○		√	√		○	○
	L												○						○
	E																		
Gulf flounder	A		√	√		√	√		√	√	○	○	○		●	●		○	○
	S																		
Paralichthys albigutta	J		√	√		√	√		√	√	○	○	○		●	●		○	○
	L		√	√		√	√		√	√		○	○		◉	◉		○	○
	E																		
Summer flounder	A		√	√		√	√		√	√	○	○	○		○	○			
	S																		
Paralichthys dentatus	J		◉	◉		◉	◉		◉	◉	○	○	○		√	√			
	L		○	○		○	○		○	○		○	○		√	√			
	E																		
Southern flounder	A	○	○	◉	○	○	◉	○	○	◉	◉	◉	◉		◉	◉		√	√
	S																		
Paralichthys lethostigma	J	○	◉	◉	○	◉	◉	○	◉	◉	◉	◉	◉		○	○		√	√
	L	√	○	○	√	○	○	√	○	○	○	◉	◉		○	○		√	√
	E			○			○			○									
		T	M	S	T	M	S	T	M	S	T	M	S	*	M	S	*	M	S
		St. Cathe./ Sapelo Sound			Altamaha River			St. Andrew/ St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
		Southeast Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present

Salinity Zone

- T - Tidal Fresh
- M - Mixing
- S - Seawater
- * - Salinity zone not present.

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 3. Temporal distribution

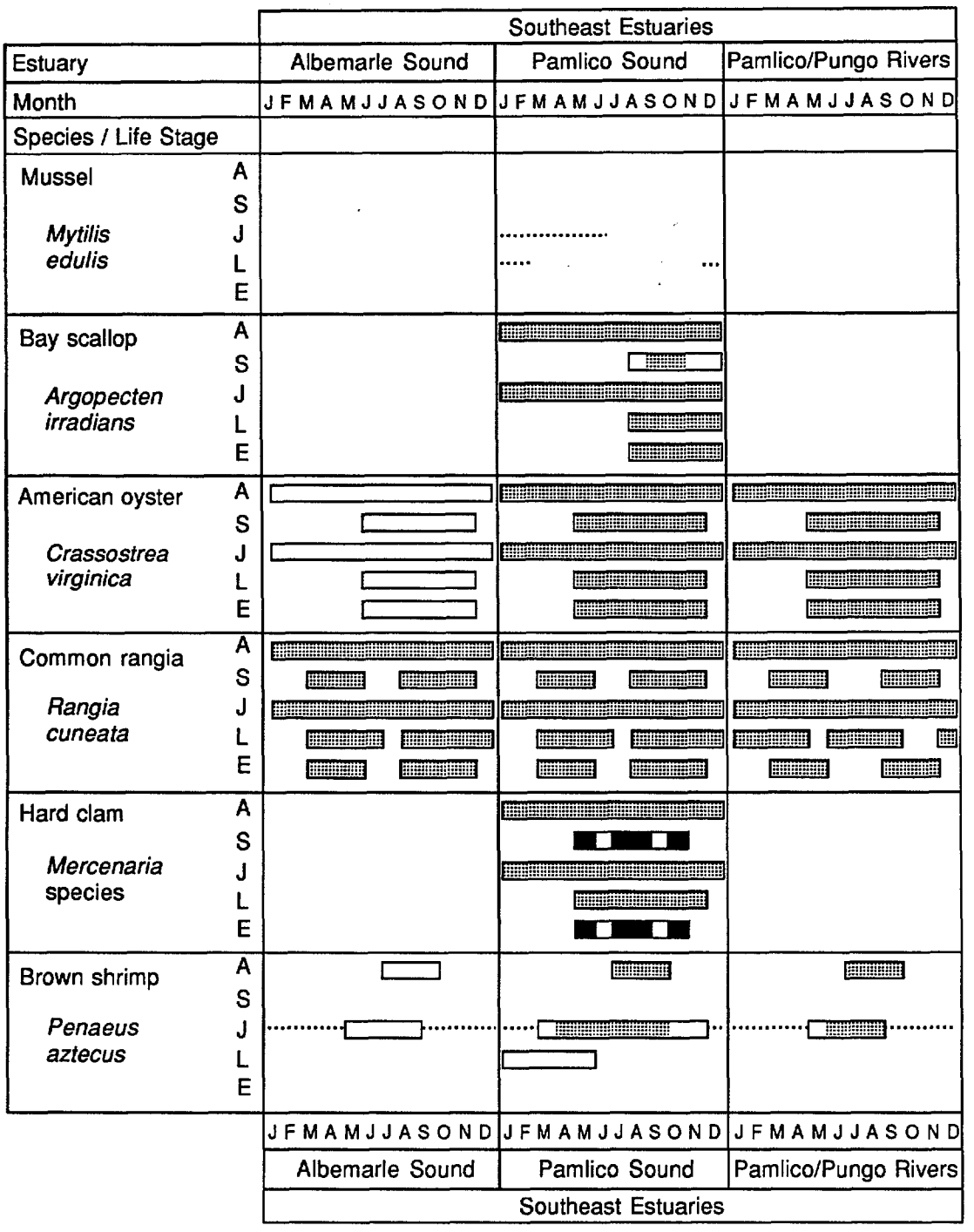
Index to Table 3. Page location of temporal distribution table for each species and estuary.

Common and Scientific Name	Estuary						
	Albemarle Sound	Pamlico Sound	Pamlico/Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Mussel (*Mytilis edulis*) Bay scallop (*Argopecten irradians*) American oyster (*Crassostrea virginica*) Common rangia (*Rangia cuneata*) Hard clam (*Mercenaria* species) Brown shrimp (*Penaeus aztecus*)	p. 42	p. 43	p. 44	p. 45	p. 46	p. 47	p. 48
Pink shrimp (*Penaeus duorarum*) White shrimp (*Penaeus setiferus*) Grass shrimp (*Palaemonetes pugio*) Blue crab (*Callinectes sapidus*) Atlantic sturgeon (*Acipenser oxyrhynchus*) Ladyfish (*Elops saurus*)	p. 49	p. 50	p. 51	p. 52	p. 53	p. 54	p. 55
American eel (*Anguilla rostrata*) Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Bay anchovy (*Anchoa mitchilli*)	p. 56	p. 57	p. 58	p. 59	p. 60	p. 61	p. 62
Sheepshead minnow (*Cyprinodon variegatus*) Mummichog (*Fundulus heteroclitus*) Atlantic silversides (*Menidia* species) White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*)	p. 63	p. 64	p. 65	p. 66	p. 67	p. 68	p. 69
Cobia (*Rachycentron canadum*) Gray snapper (*Lutjanus griseus*) Sheepshead (*Archosargus probatocephalus*) Pinfish (*Lagodon rhomboides*) Spotted seatrout (*Cynoscion nebulosus*) Weakfish (*Cynoscion regalis*)	p. 70	p. 71	p. 72	p. 73	p. 74	p. 75	p. 76
Spot (*Leiostomus xanthurus*) Southern kingfish (*Menticirrhus americanus*) Atlantic croaker (*Micropogonias undulatus*) Black drum (*Pogonias cromis*) Red drum (*Sciaenops ocellatus*) Striped mullet (*Mugil cephalus*)	p. 77	p. 78	p. 79	p. 80	p. 81	p. 82	p. 83
Spanish mackerel (*Scomberomorus maculatus*) Gulf flounder (*Paralichthys albigutta*) Summer flounder (*Paralichthys dentatus*) Southern flounder (*Paralichthys lethostigma*)	p. 84	p. 85	p. 86	p. 87	p. 88	p. 89	p. 90

Common and Scientific Name	Estuary						
	Winyah Bay	N/S Santee River	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
Mussel (*Mytilis edulis*) Bay scallop (*Argopecten irradians*) American oyster (*Crassostrea virginica*) Common rangia (*Rangia cuneata*) Hard clam (*Mercenaria* species) Brown shrimp (*Penaeus aztecus*)	p. 49	p. 50	p. 51	p. 52	p. 53	p. 54	p. 55
Pink shrimp (*Penaeus duorarum*) White shrimp (*Penaeus setiferus*) Grass shrimp (*Palaemonetes pugio*) Blue crab (*Callinectes sapidus*) Atlantic sturgeon (*Acipenser oxyrhynchus*) Ladyfish (*Elops saurus*)	p. 56	p. 57	p. 58	p. 59	p. 60	p. 61	p. 62
American eel (*Anguilla rostrata*) Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Bay anchovy (*Anchoa mitchilli*)	p. 63	p. 64	p. 65	p. 66	p. 67	p. 68	p. 69
Sheepshead minnow (*Cyprinodon variegatus*) Mummichog (*Fundulus heteroclitus*) Atlantic silversides (*Menidia* species) White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*)	p. 70	p. 71	p. 72	p. 73	p. 74	p. 75	p. 76
Cobia (*Rachycentron canadum*) Gray snapper (*Lutjanus griseus*) Sheepshead (*Archosargus probatocephalus*) Pinfish (*Lagodon rhomboides*) Spotted seatrout (*Cynoscion nebulosus*) Weakfish (*Cynoscion regalis*)	p. 77	p. 78	p. 79	p. 80	p. 81	p. 82	p. 83
Spot (*Leiostomus xanthurus*) Southern kingfish (*Menticirrhus americanus*) Atlantic croaker (*Micropogonias undulatus*) Black drum (*Pogonias cromis*) Red drum (*Sciaenops ocellatus*) Striped mullet (*Mugil cephalus*)	p. 84	p. 85	p. 86	p. 87	p. 88	p. 89	p. 90
Spanish mackerel (*Scomberomorus maculatus*) Gulf flounder (*Paralichthys albigutta*) Summer flounder (*Paralichthys dentatus*) Southern flounder (*Paralichthys lethostigma*)							

Common and Scientific Name	Estuary						
	St. Cathe./Sapelo Sound	Altamaha River	St. Andr./St. Sim. Sound	St. Johns River	Indian River	Biscayne Bay	
Mussel (*Mytilis edulis*) Bay scallop (*Argopecten irradians*) American oyster (*Crassostrea virginica*) Common rangia (*Rangia cuneata*) Hard clam (*Mercenaria* species) Brown shrimp (*Penaeus aztecus*)	p. 56	p. 57	p. 58	p. 59	p. 60	p. 61	p. 62
Pink shrimp (*Penaeus duorarum*) White shrimp (*Penaeus setiferus*) Grass shrimp (*Palaemonetes pugio*) Blue crab (*Callinectes sapidus*) Atlantic sturgeon (*Acipenser oxyrhynchus*) Ladyfish (*Elops saurus*)	p. 63	p. 64	p. 65	p. 66	p. 67	p. 68	p. 69
American eel (*Anguilla rostrata*) Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Bay anchovy (*Anchoa mitchilli*)	p. 70	p. 71	p. 72	p. 73	p. 74	p. 75	p. 76
Sheepshead minnow (*Cyprinodon variegatus*) Mummichog (*Fundulus heteroclitus*) Atlantic silversides (*Menidia* species) White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*)	p. 77	p. 78	p. 79	p. 80	p. 81	p. 82	p. 83
Cobia (*Rachycentron canadum*) Gray snapper (*Lutjanus griseus*) Sheepshead (*Archosargus probatocephalus*) Pinfish (*Lagodon rhomboides*) Spotted seatrout (*Cynoscion nebulosus*) Weakfish (*Cynoscion regalis*)	p. 84	p. 85	p. 86	p. 87	p. 88	p. 89	p. 90
Spot (*Leiostomus xanthurus*) Southern kingfish (*Menticirrhus americanus*) Atlantic croaker (*Micropogonias undulatus*) Black drum (*Pogonias cromis*) Red drum (*Sciaenops ocellatus*) Striped mullet (*Mugil cephalus*)							
Spanish mackerel (*Scomberomorus maculatus*) Gulf flounder (*Paralichthys albigutta*) Summer flounder (*Paralichthys dentatus*) Southern flounder (*Paralichthys lethostigma*)							

Table 3. Temporal distribution



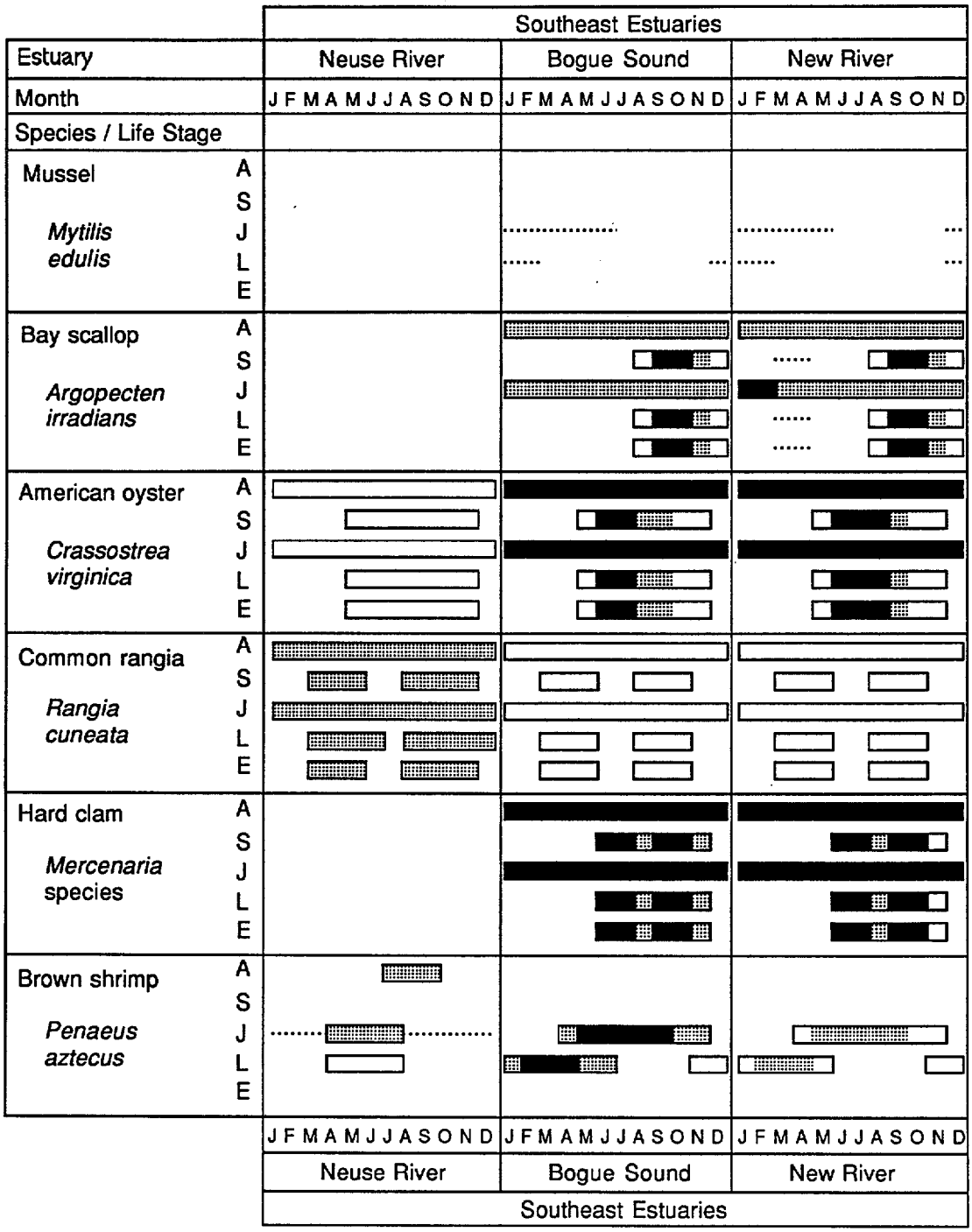
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



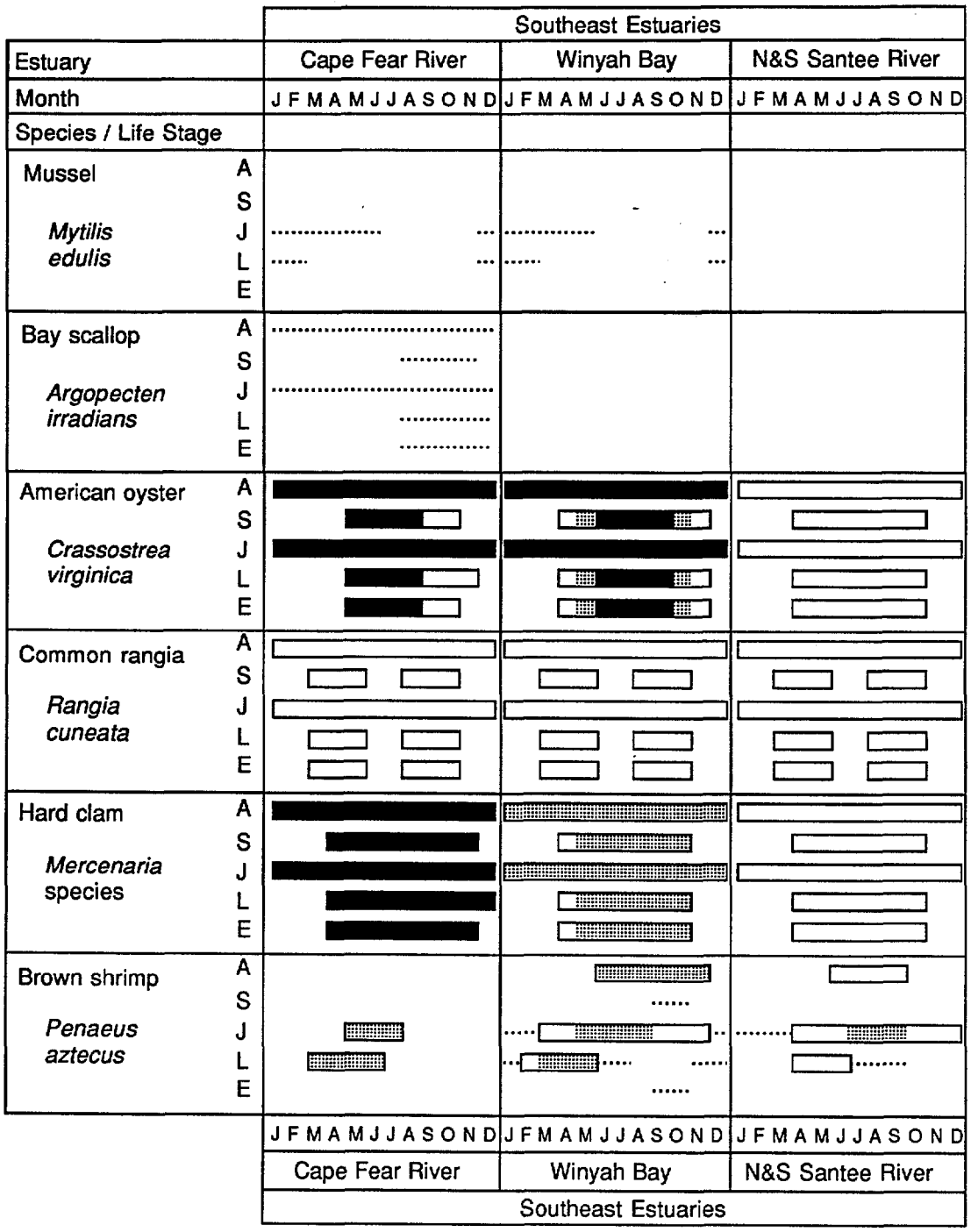
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



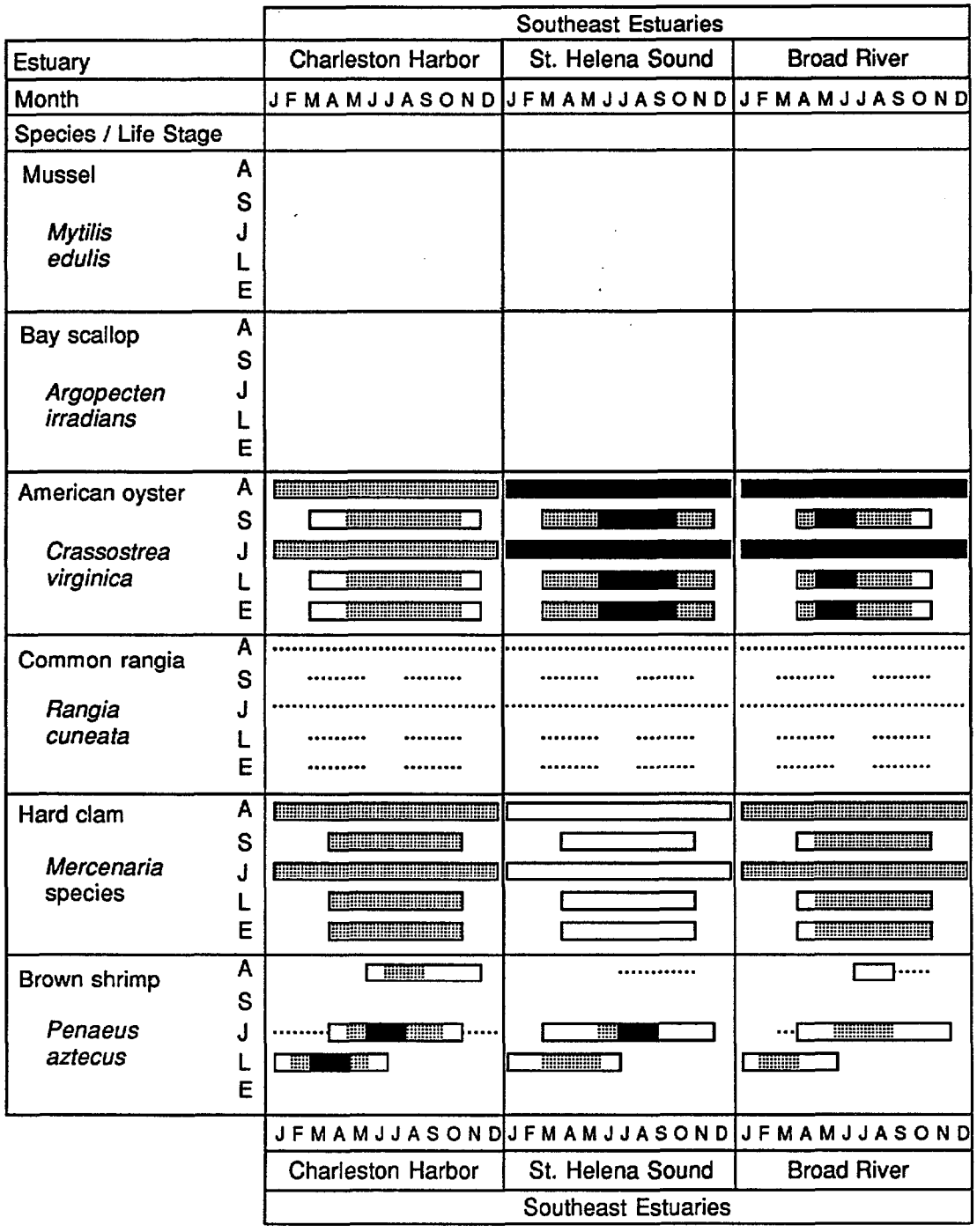
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



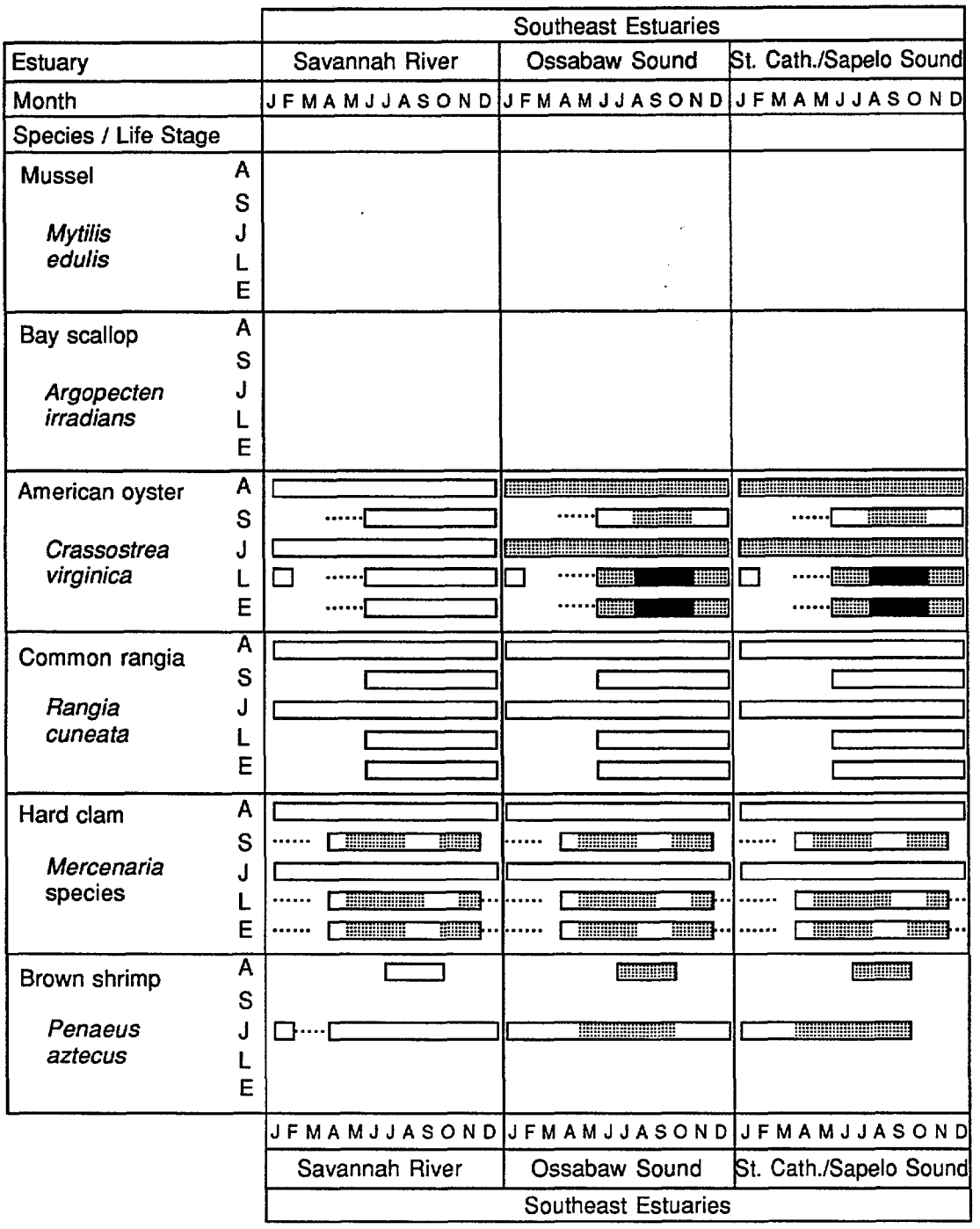
Relative

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



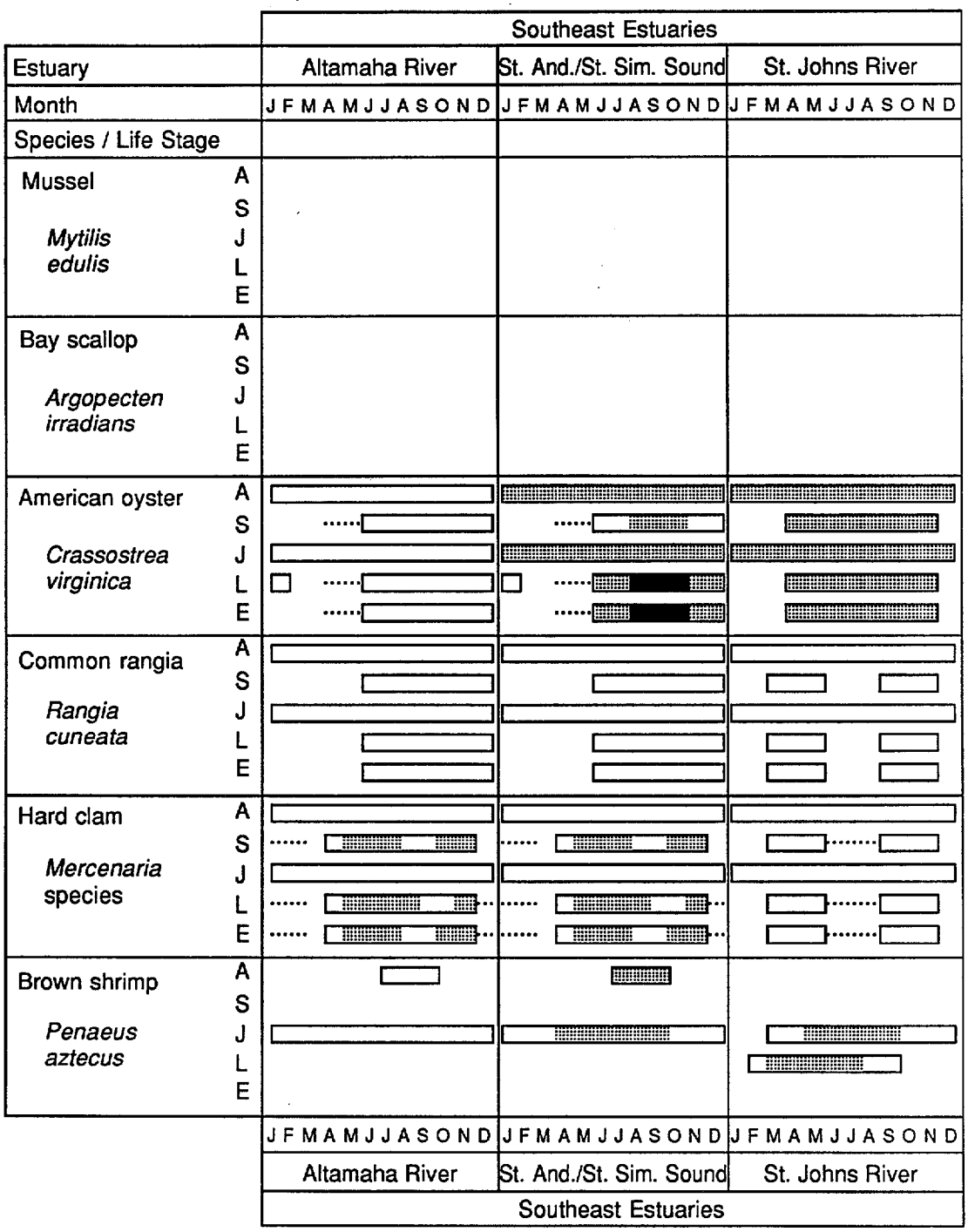
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



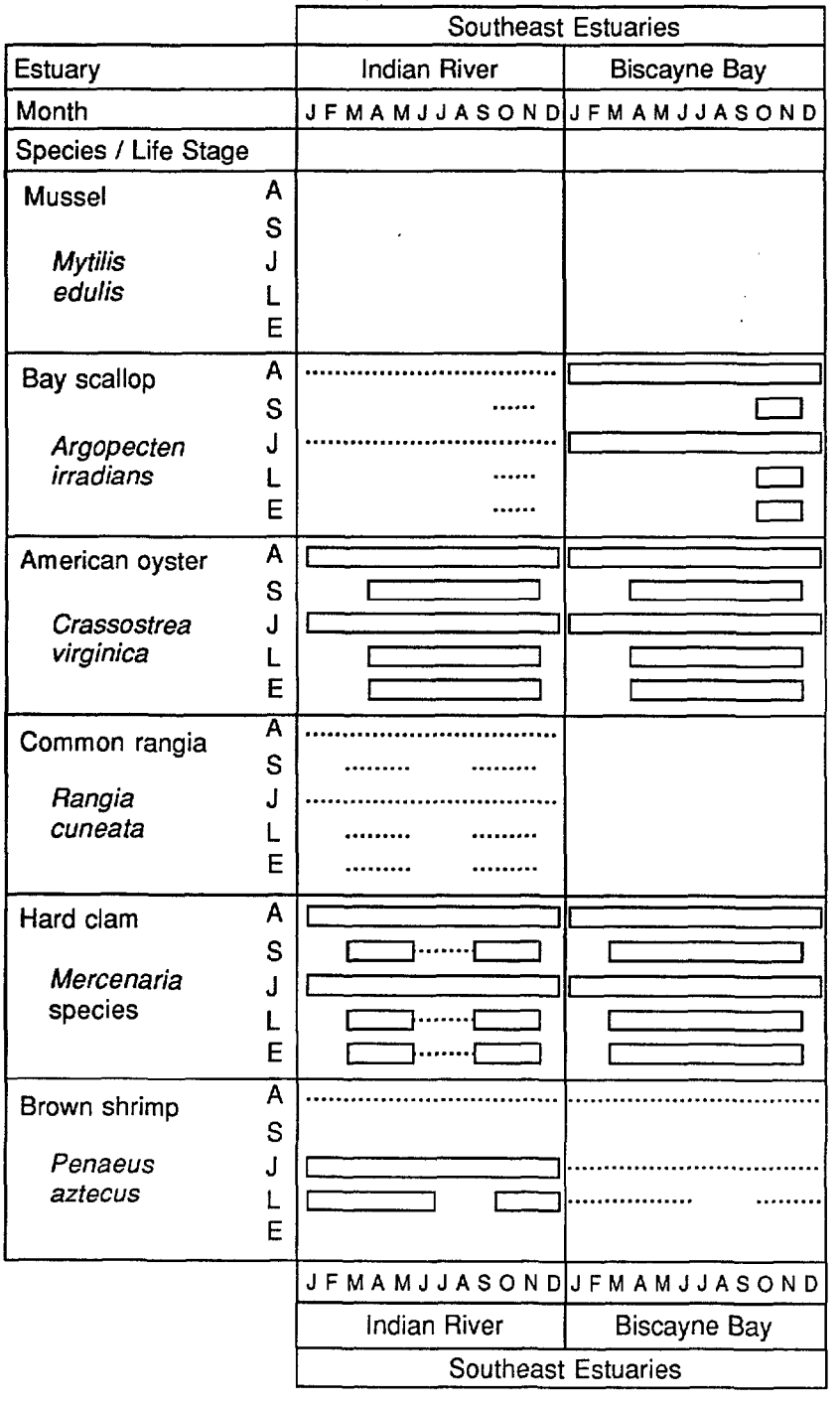
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



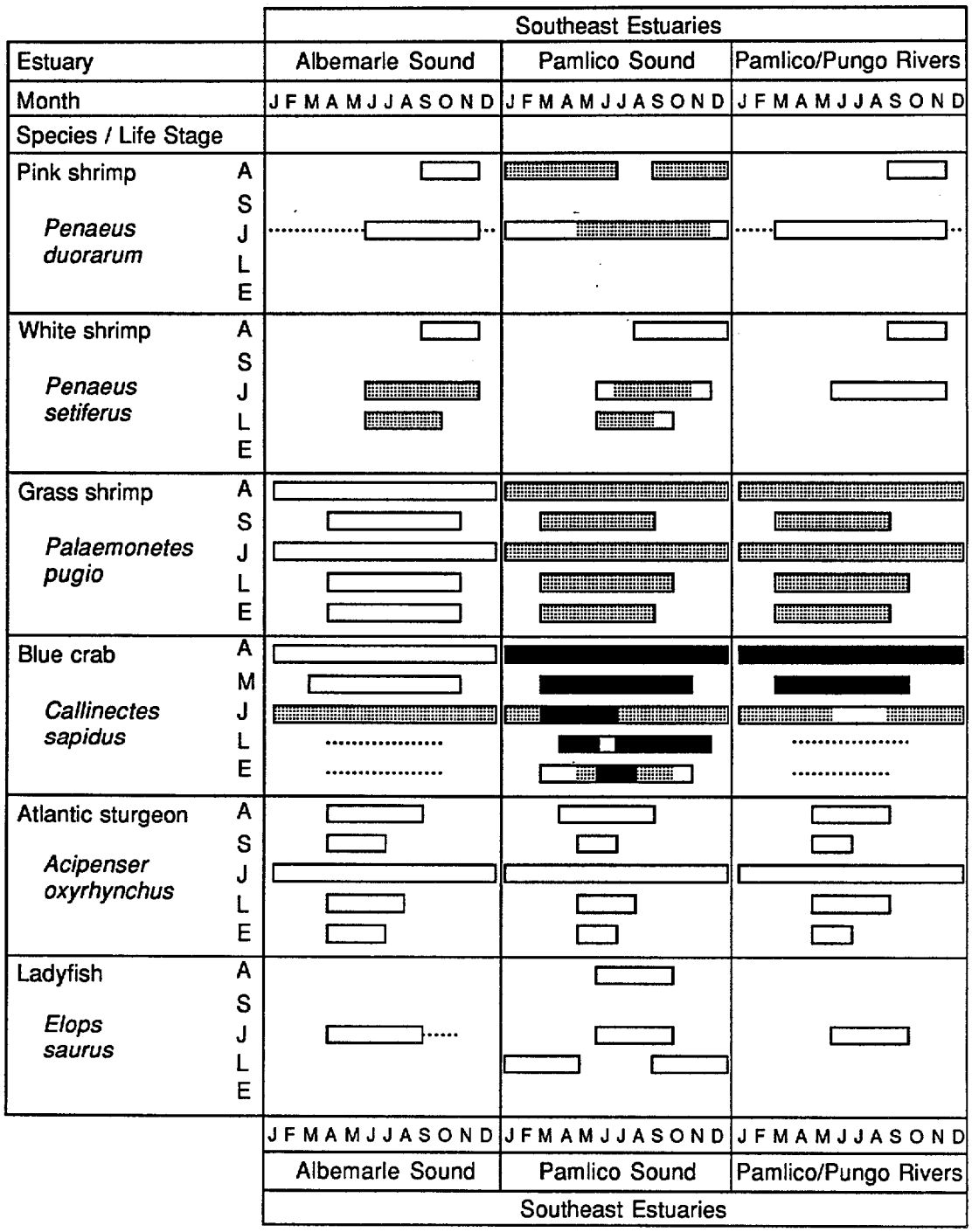
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



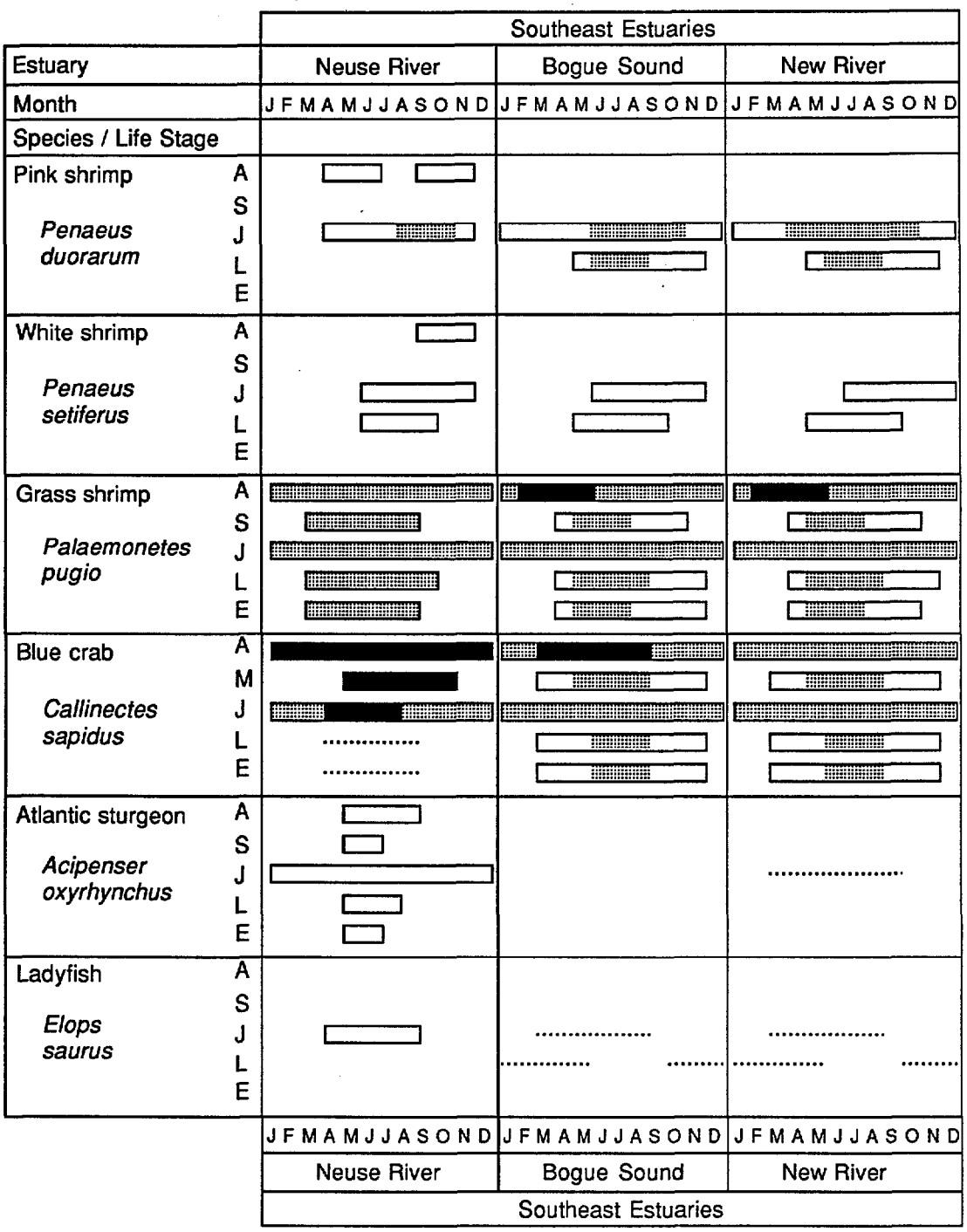
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued. Temporal distribution



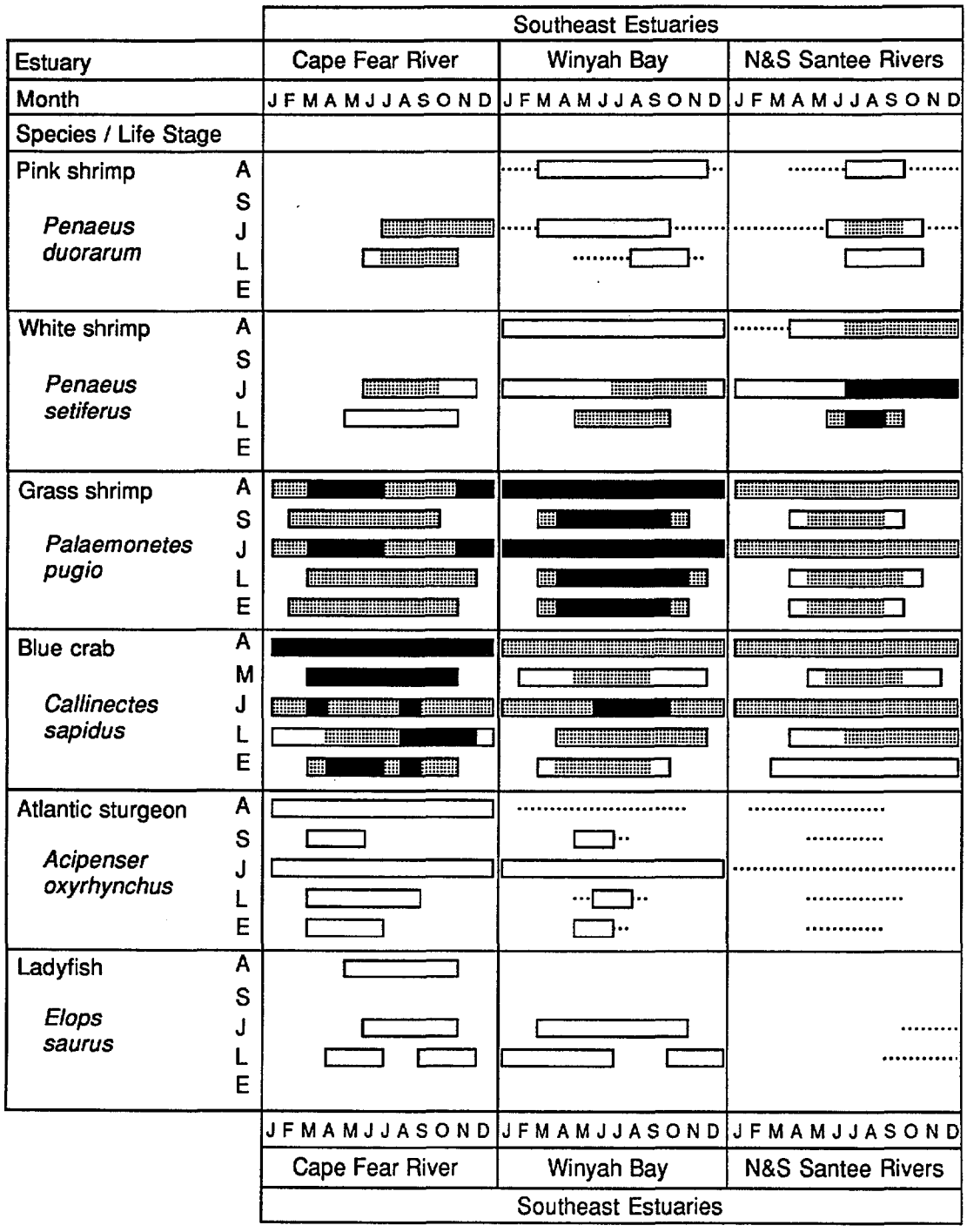
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued. Temporal distribution



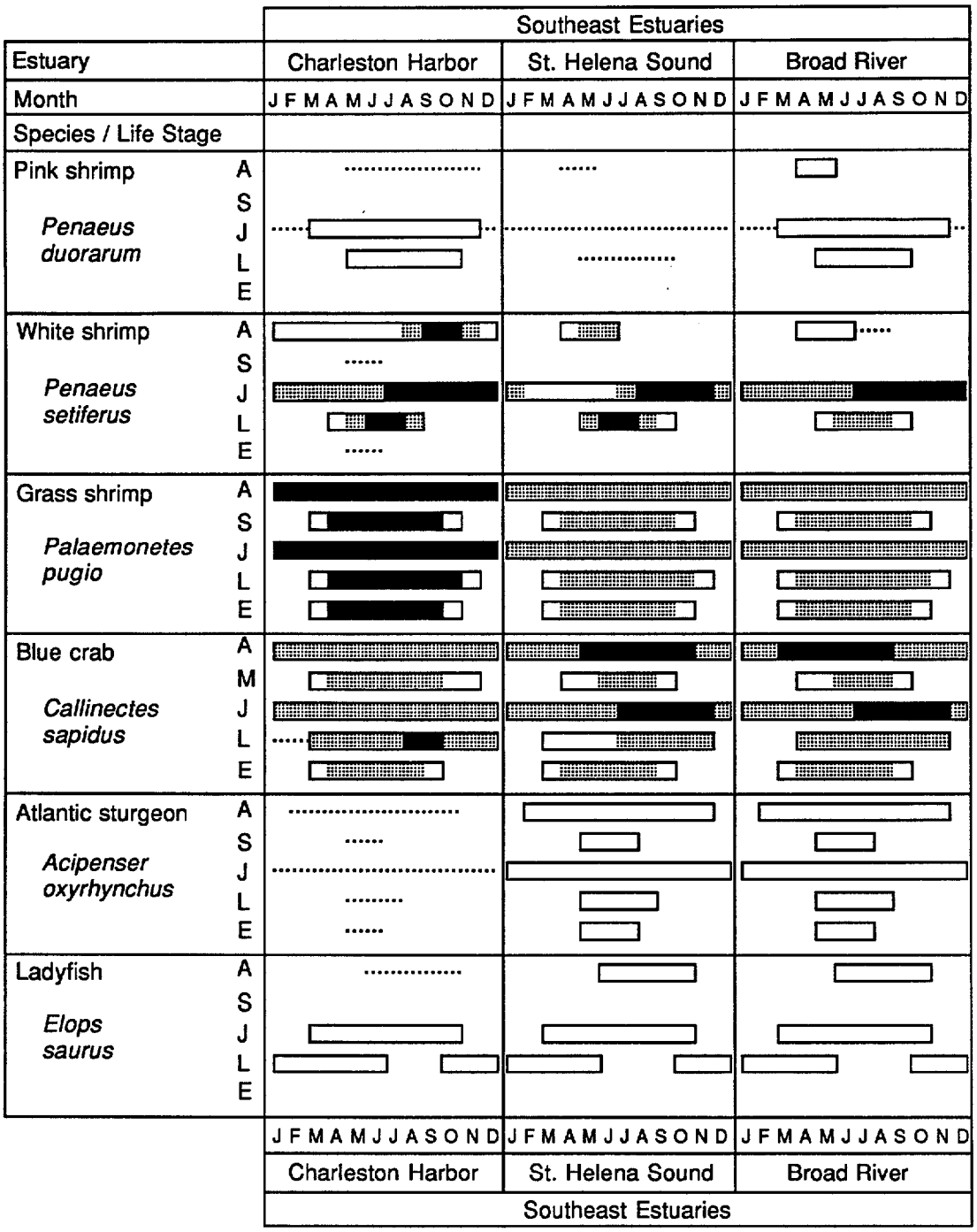
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued. Temporal distribution



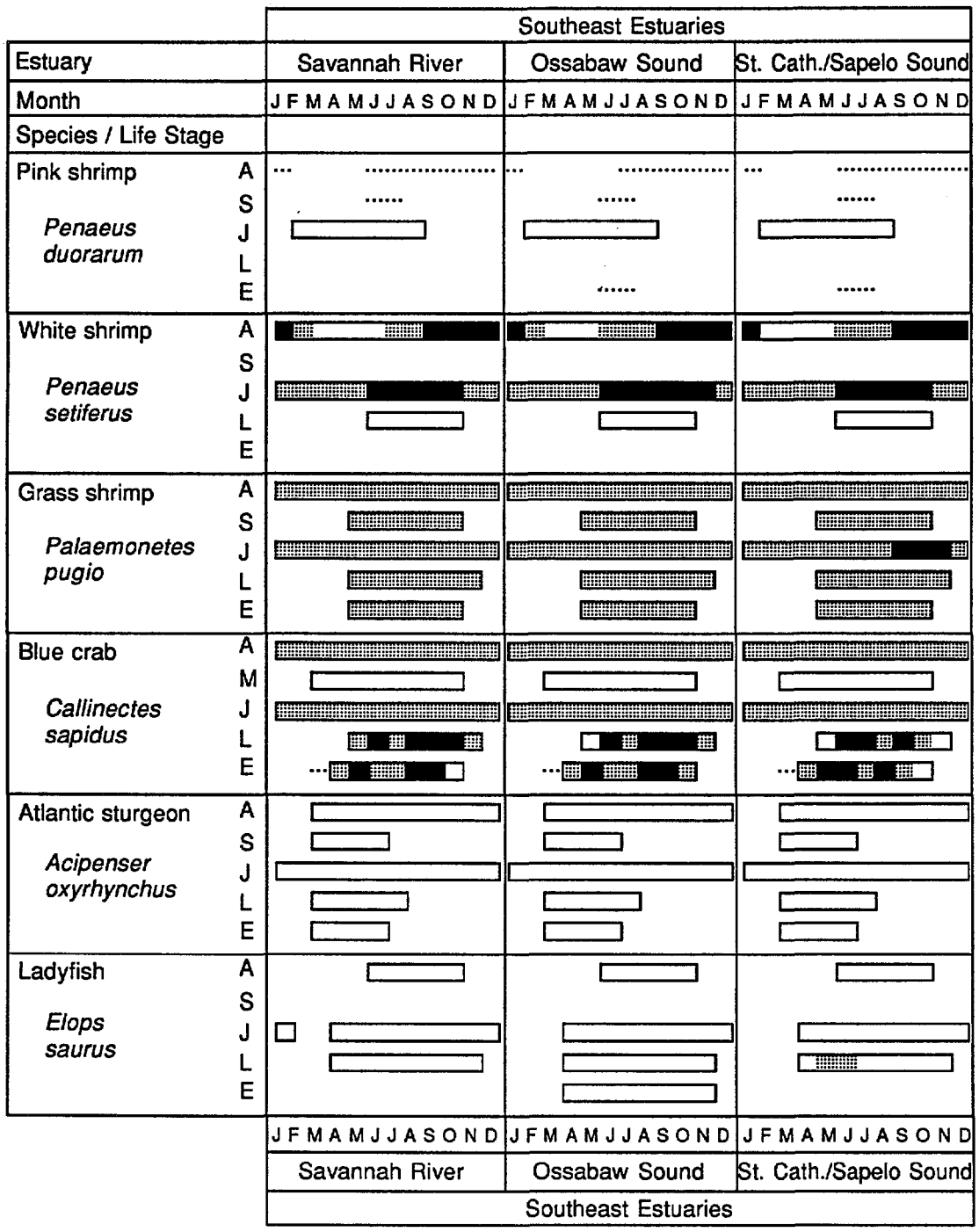
Relative

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued: Temporal distribution



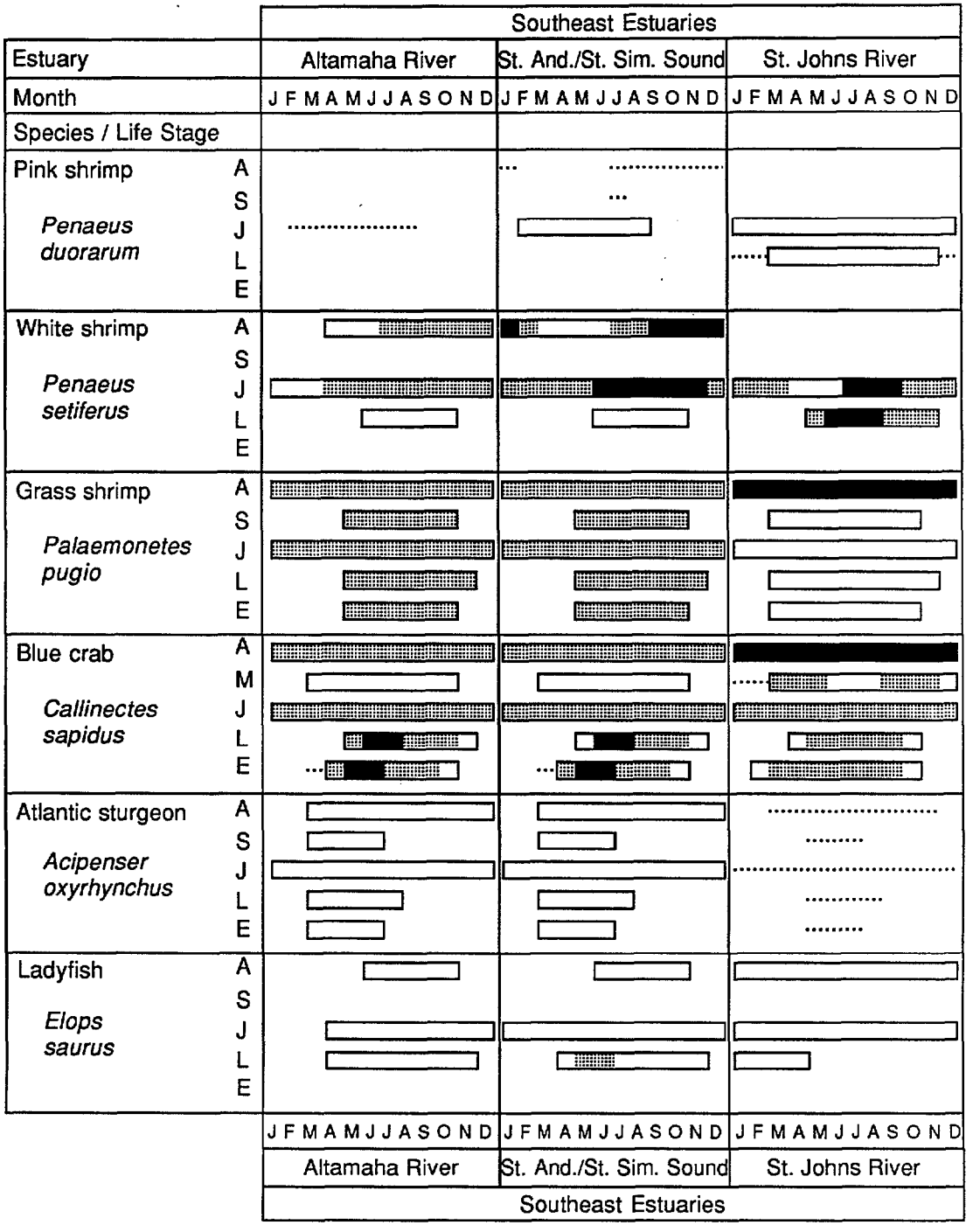
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued. Temporal distribution



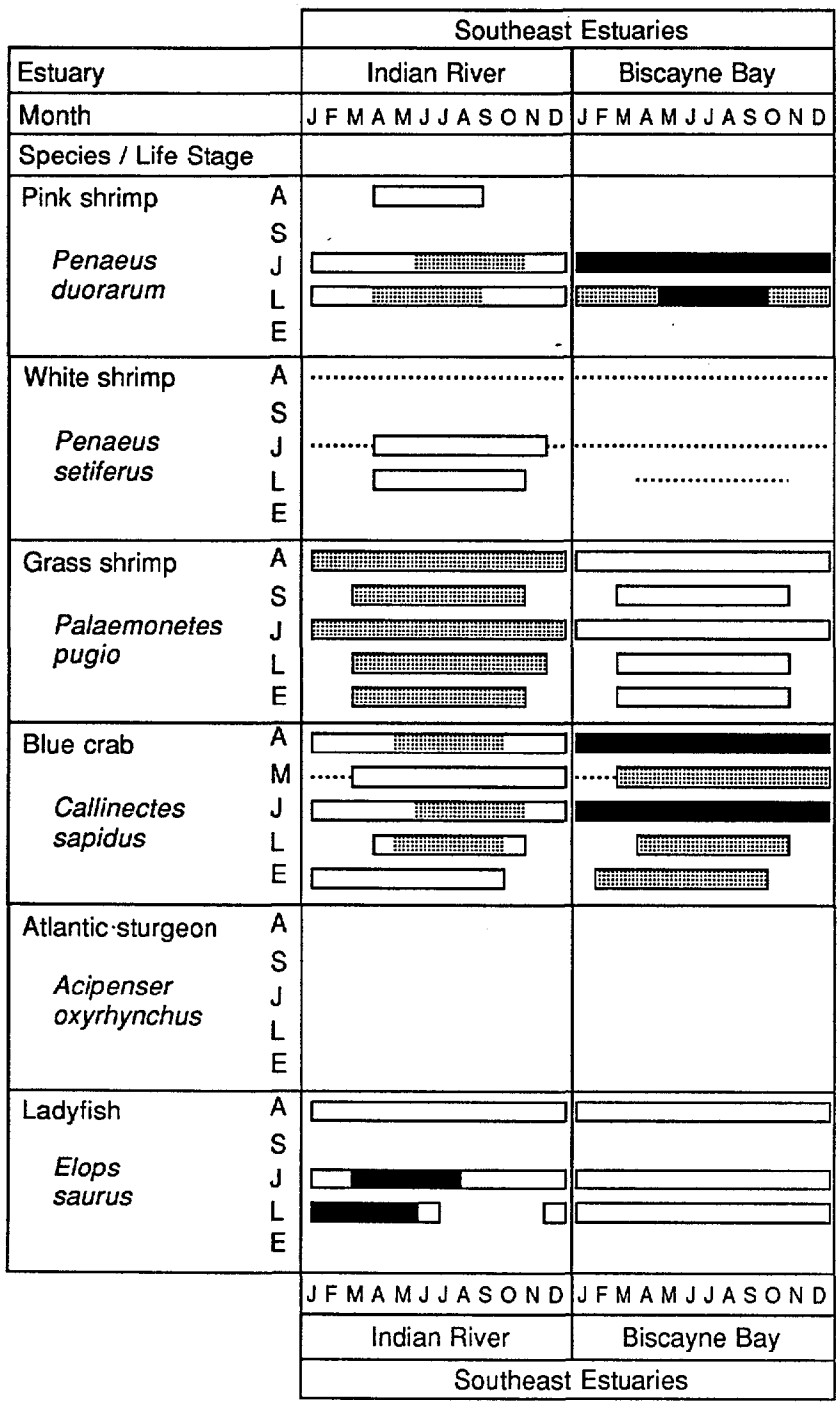
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued. Temporal distribution



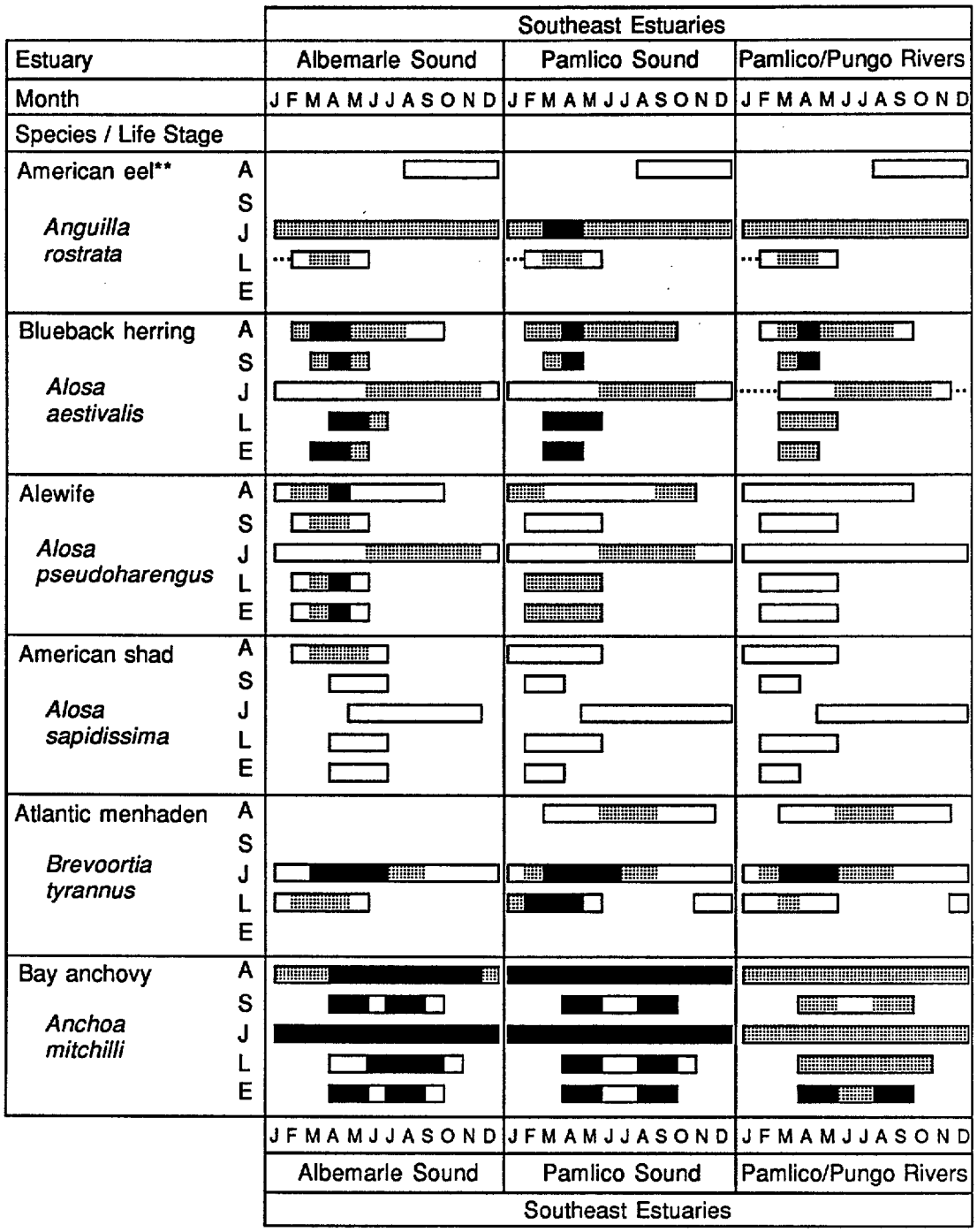
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 3, continued. Temporal distribution



Relative

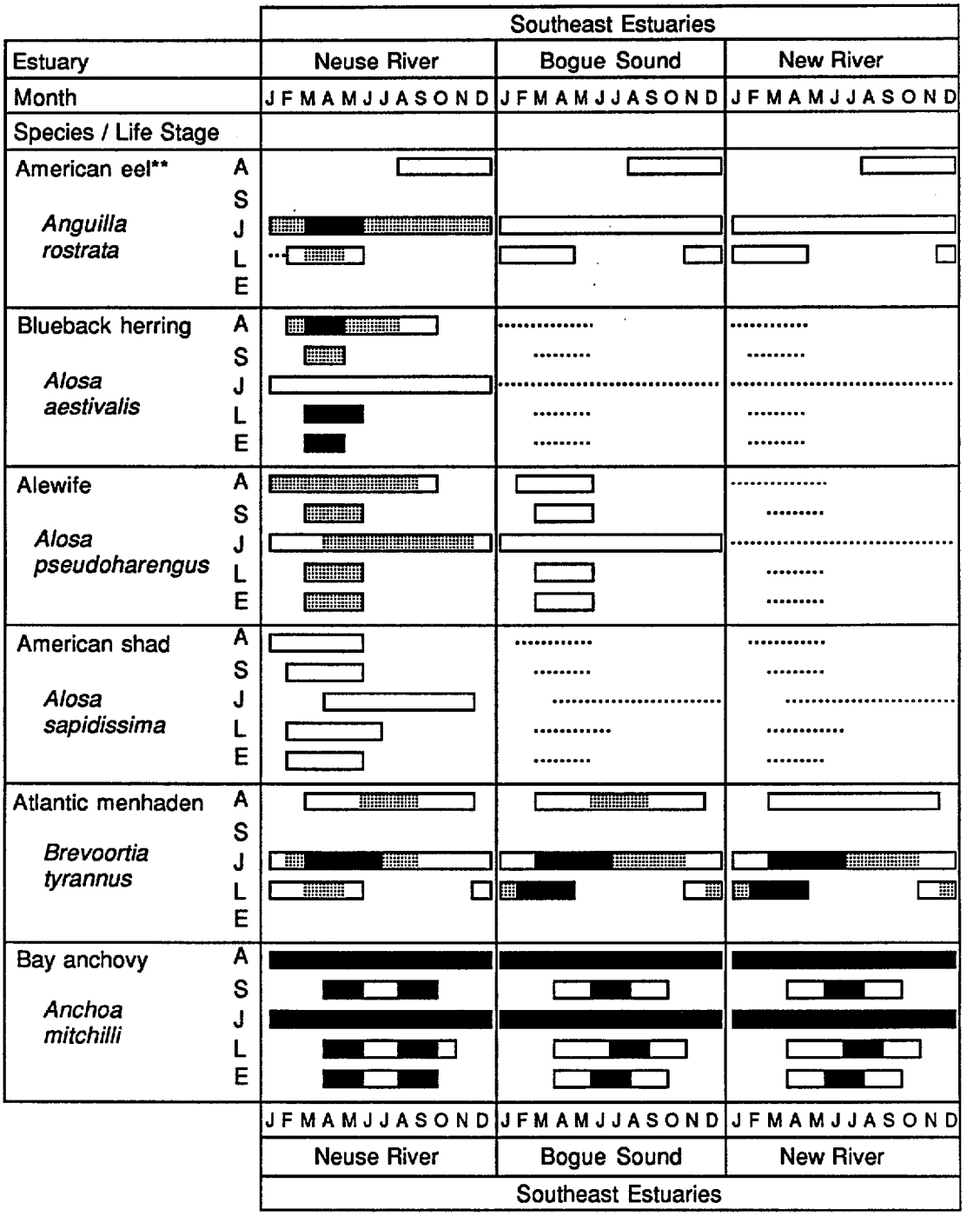
- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued: Temporal distribution



Relative

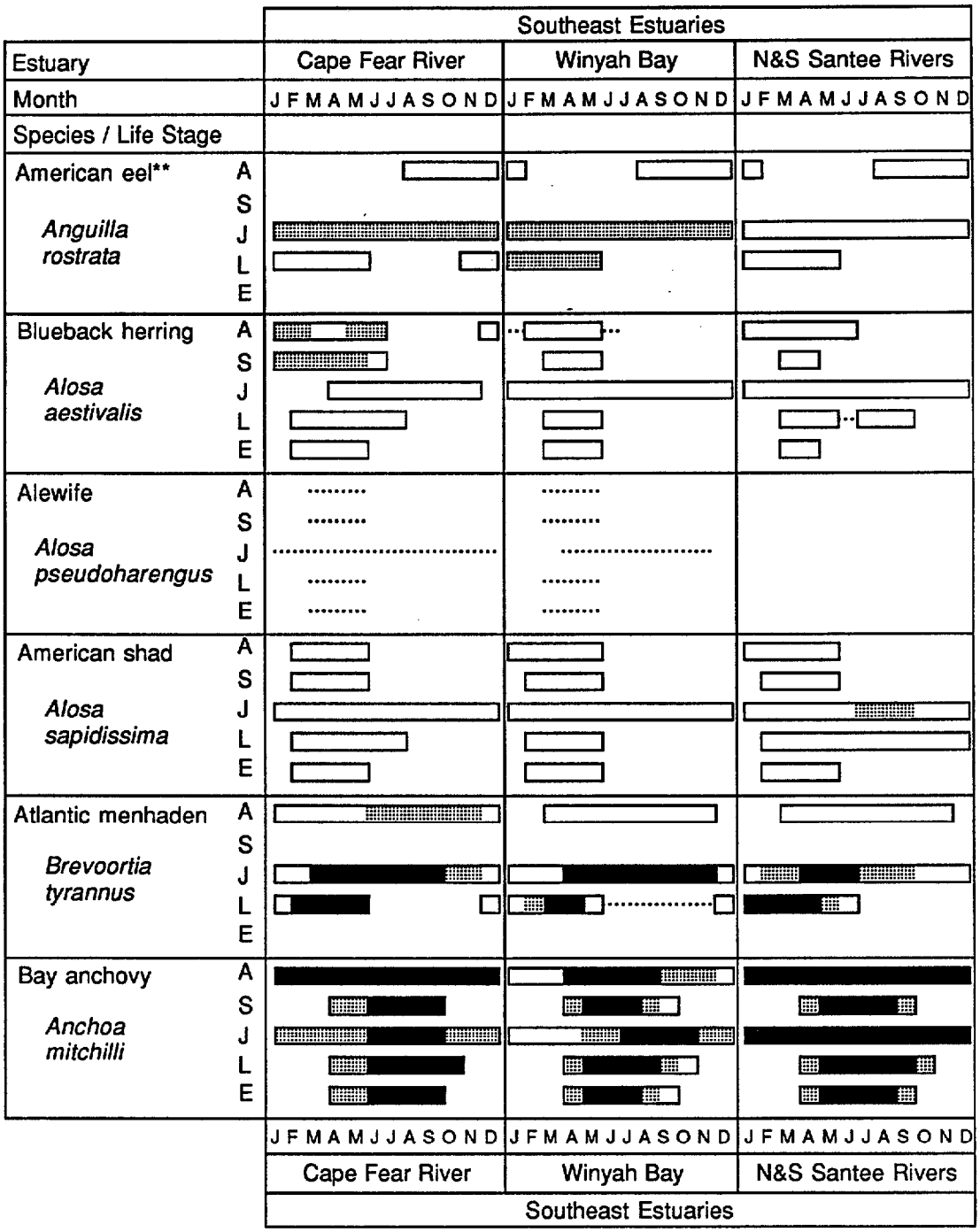
- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued. Temporal distribution



Relative

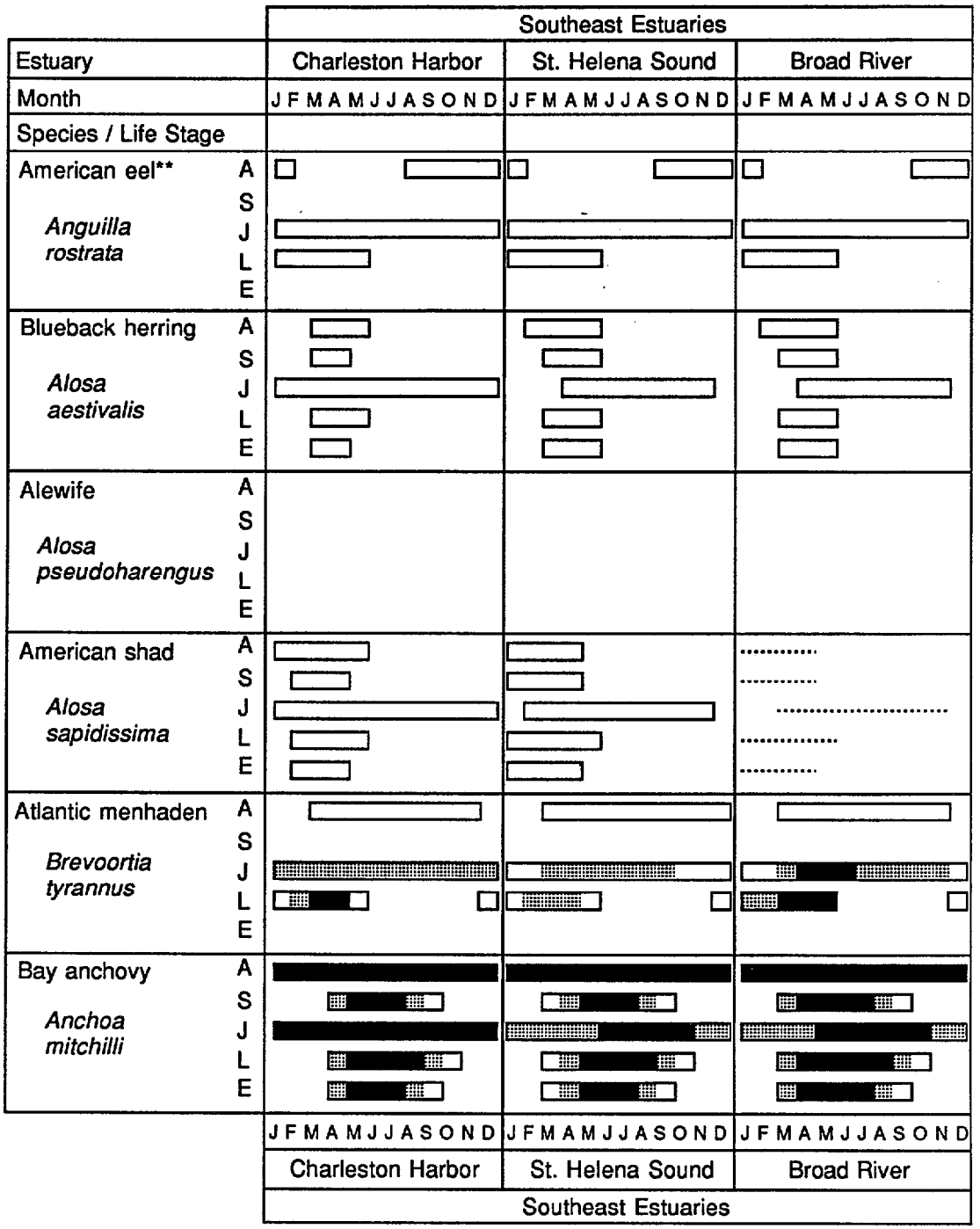
- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued: Temporal distribution



Relative

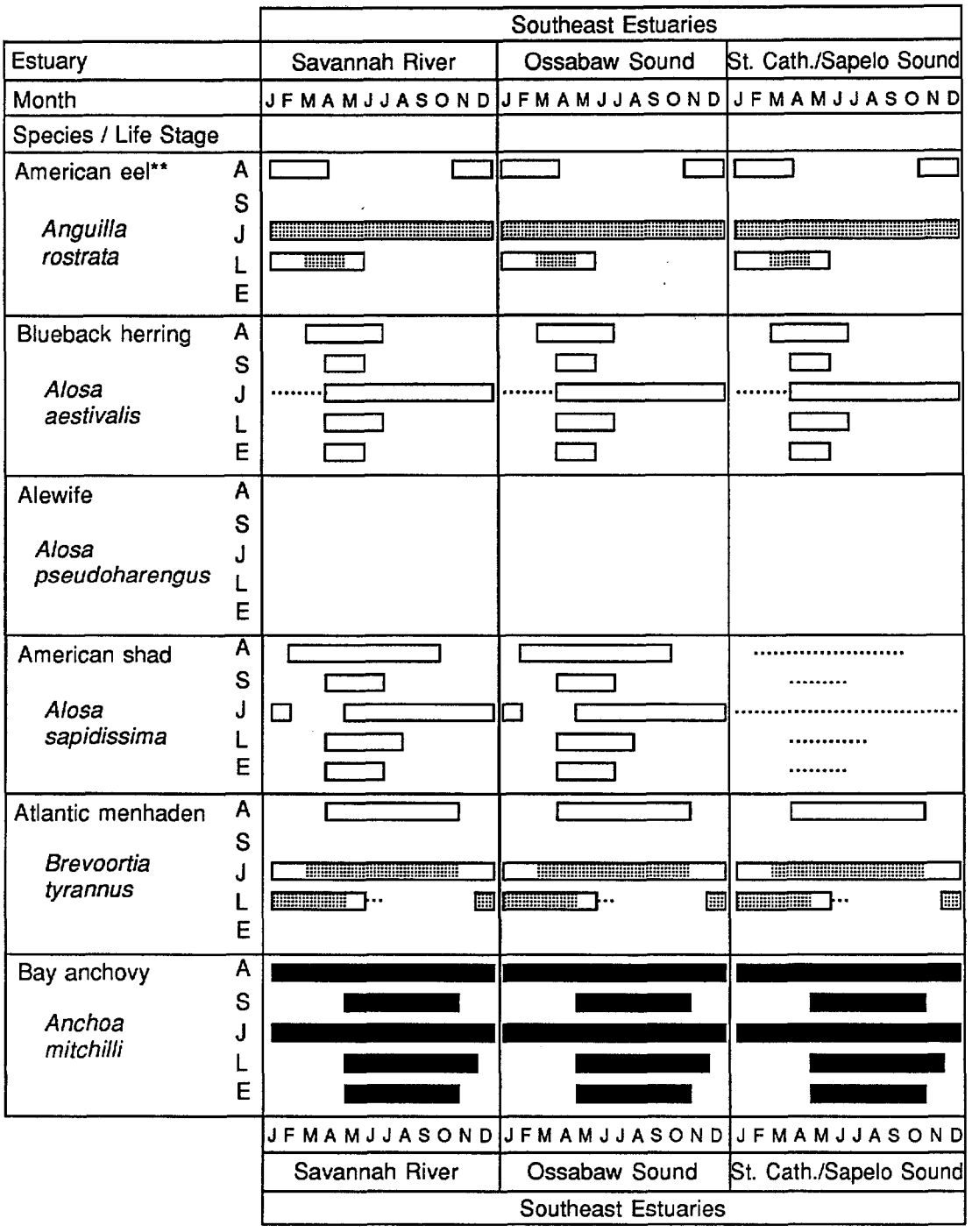
- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued. Temporal distribution



Relative

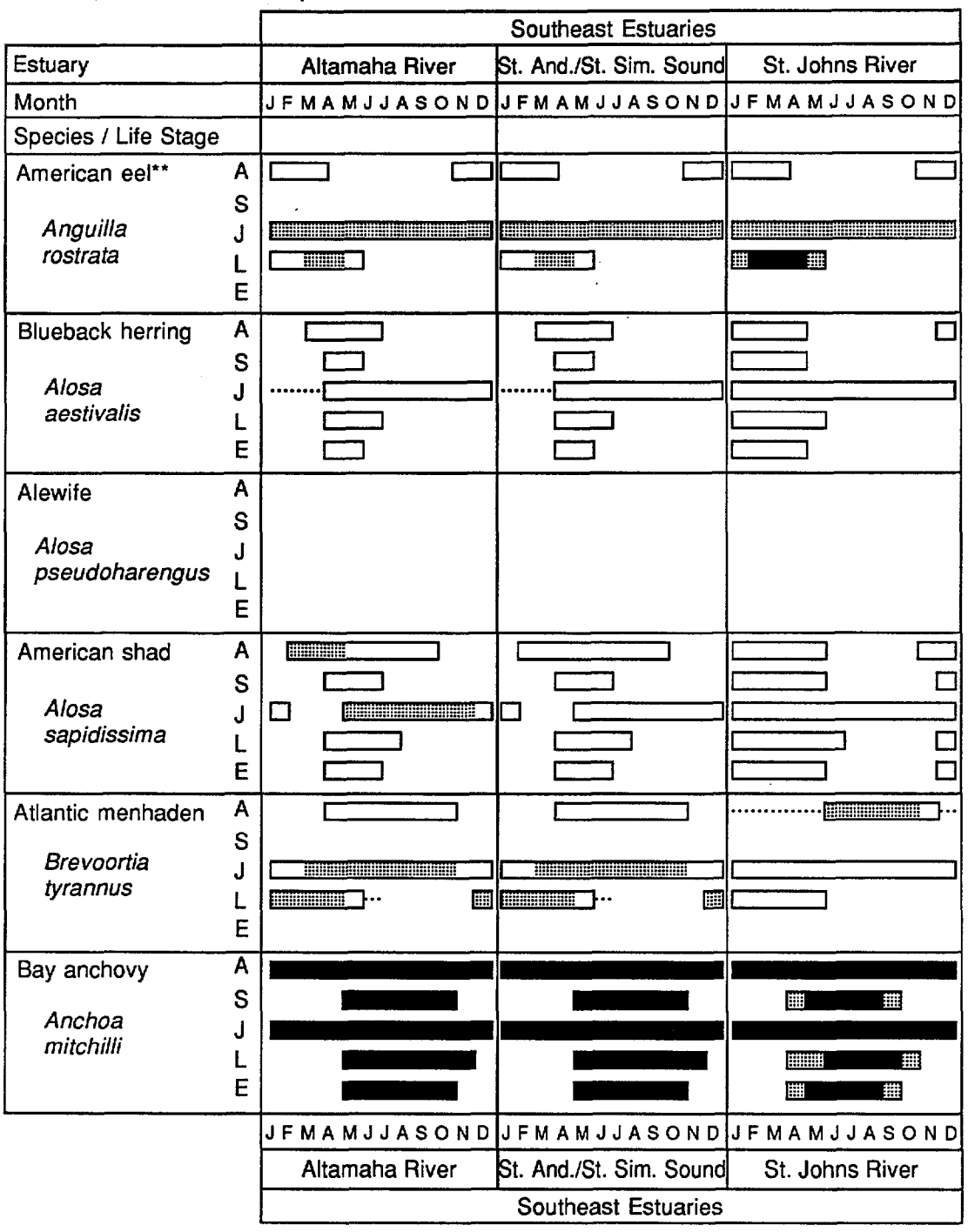
- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued. Temporal distribution



Relative

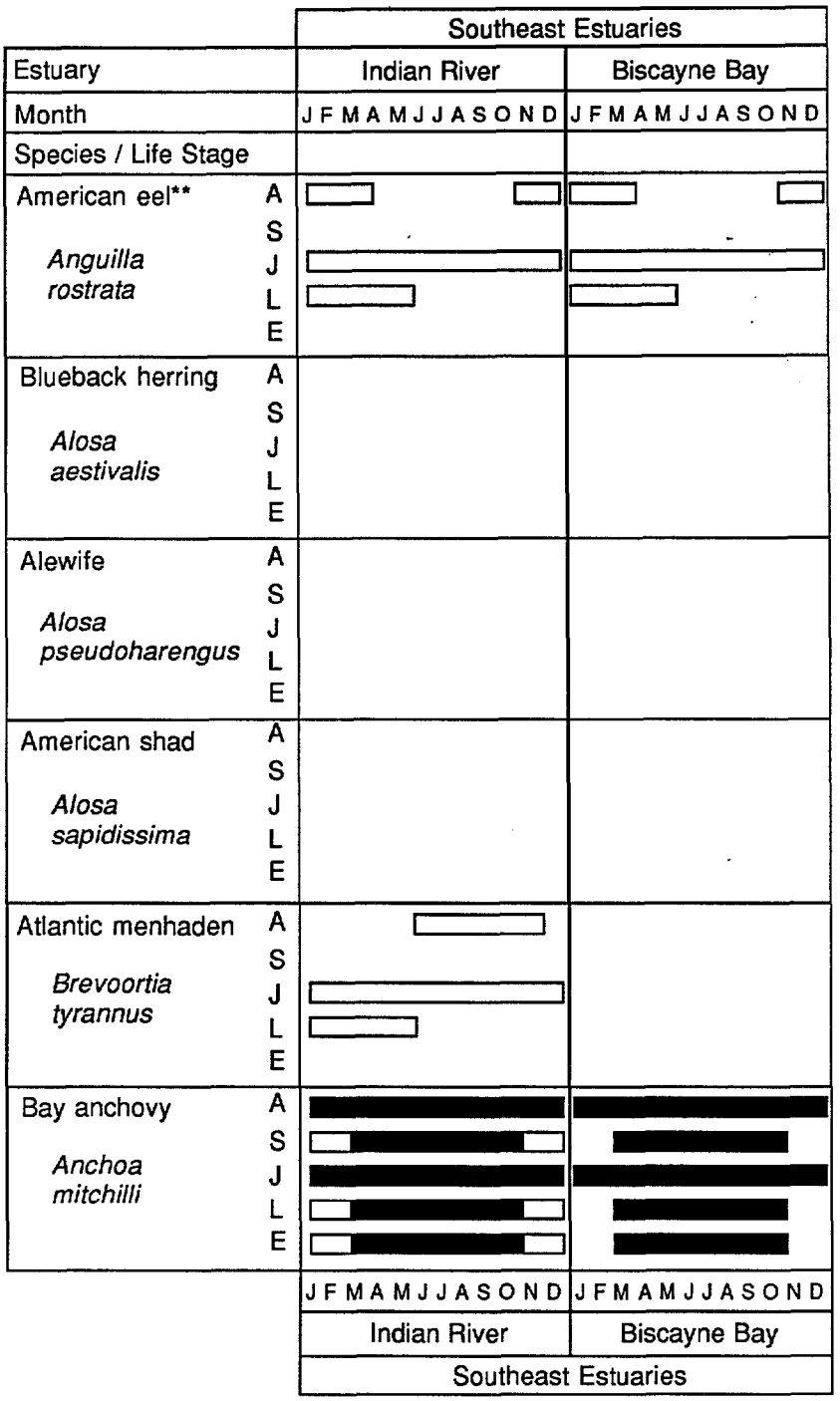
- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued. Temporal distribution



Relative

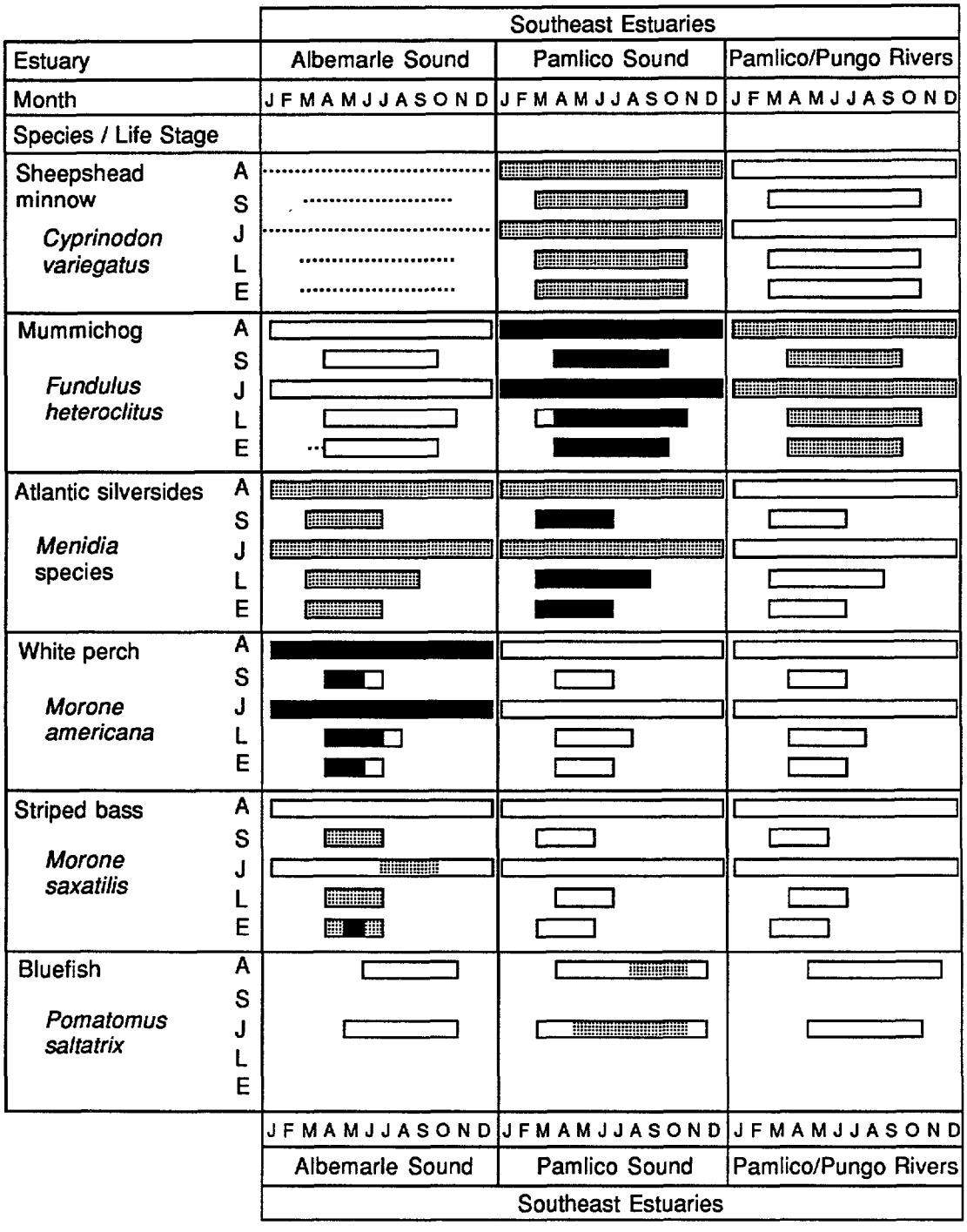
- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 3, continued: Temporal distribution



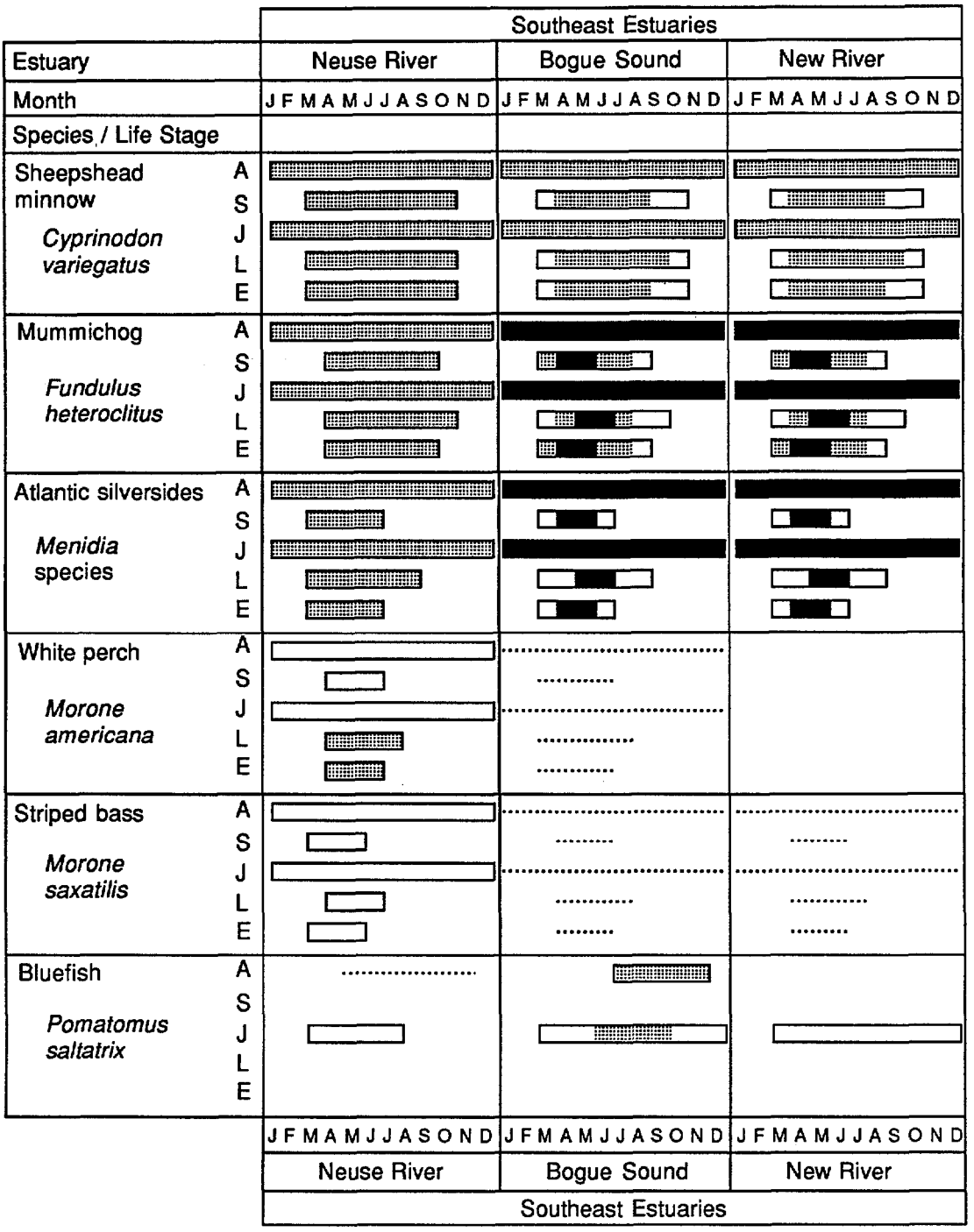
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



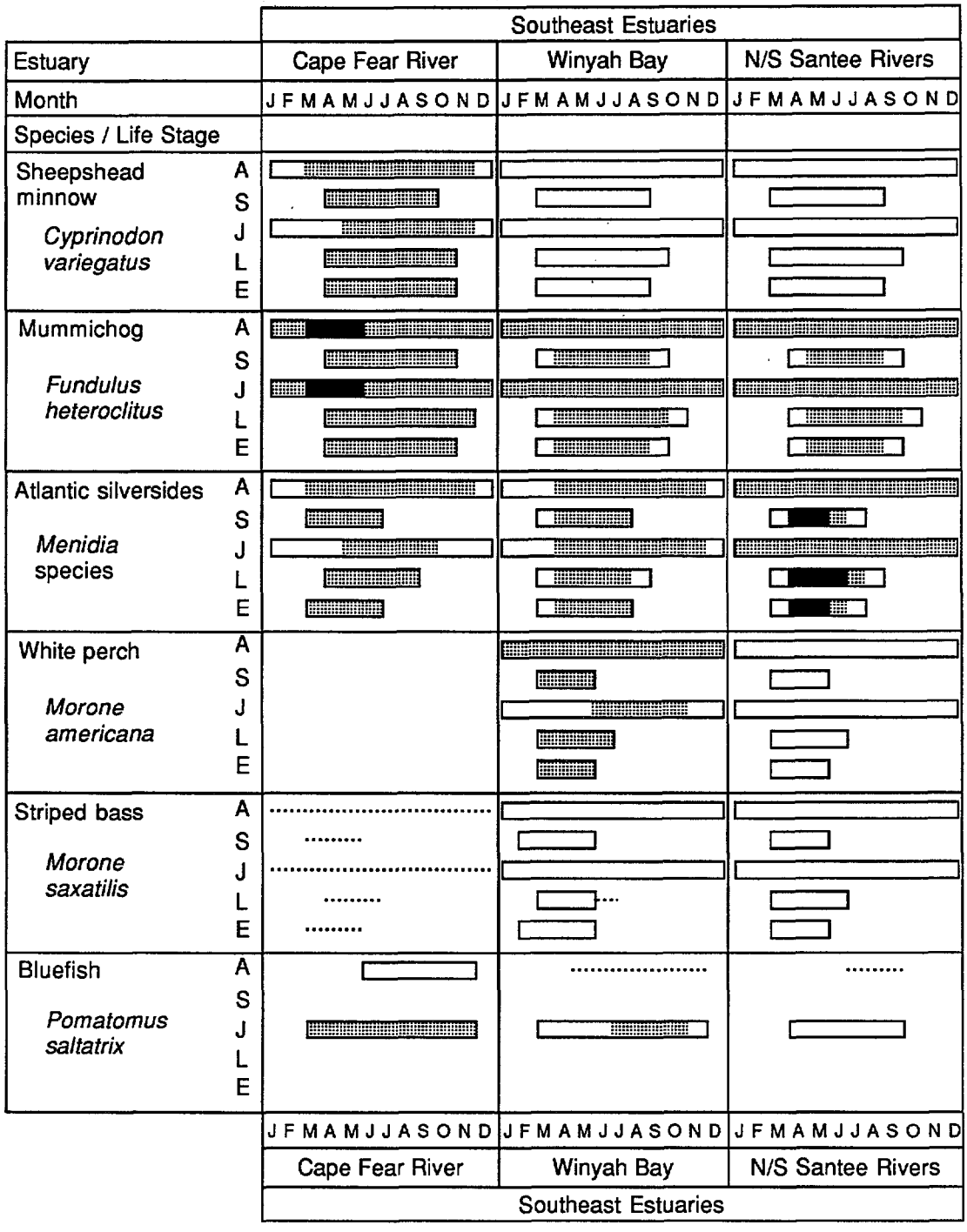
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



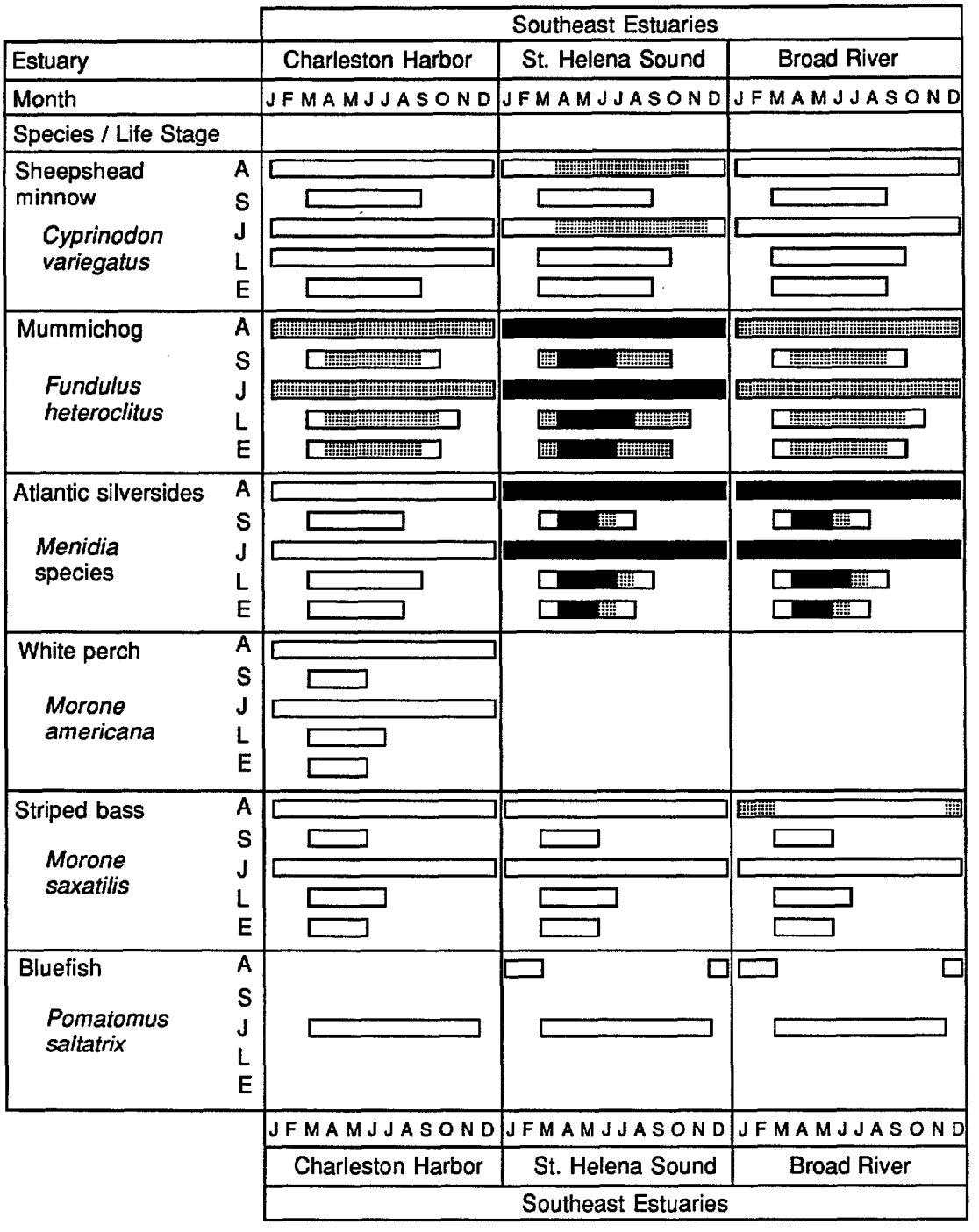
Relative

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



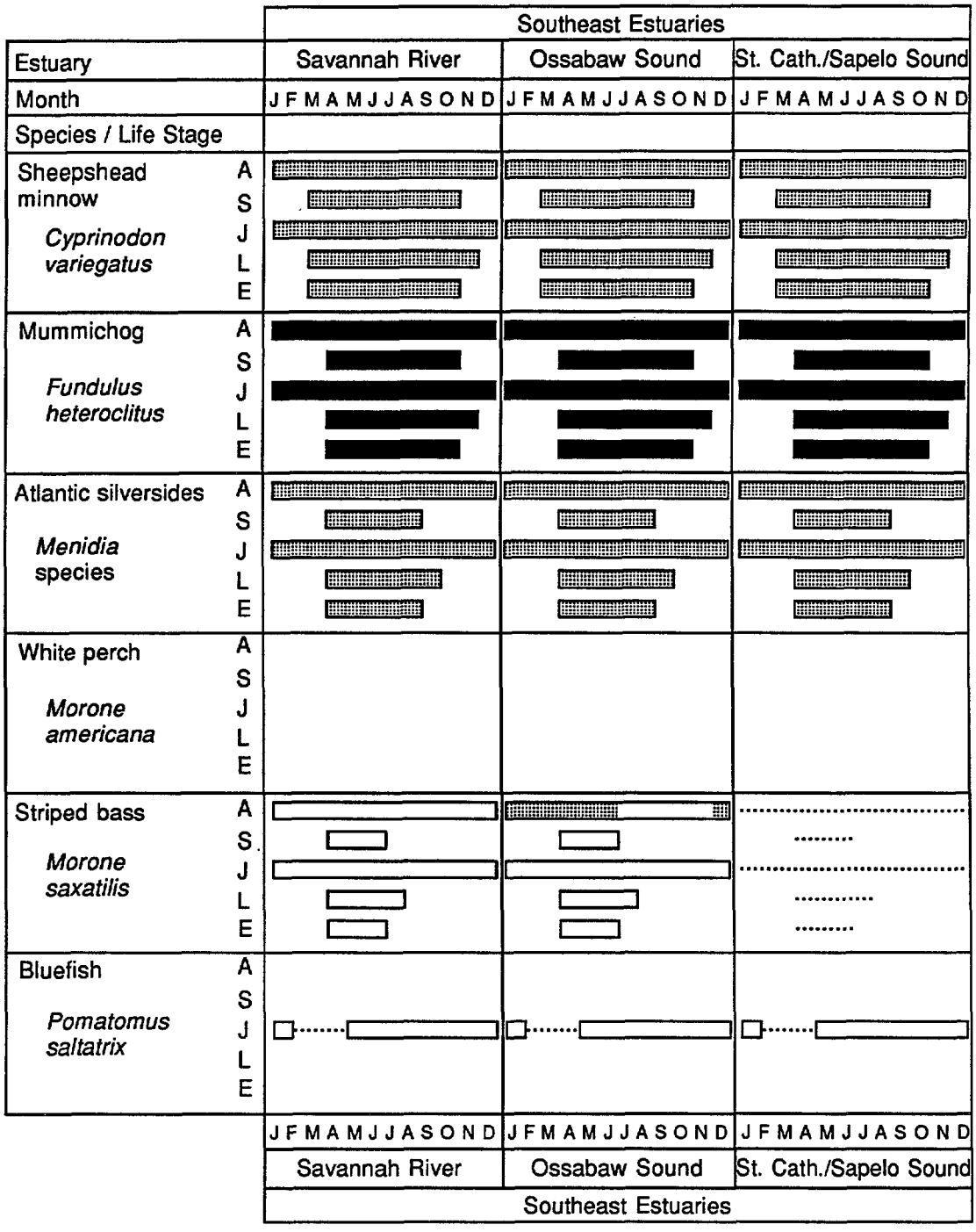
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



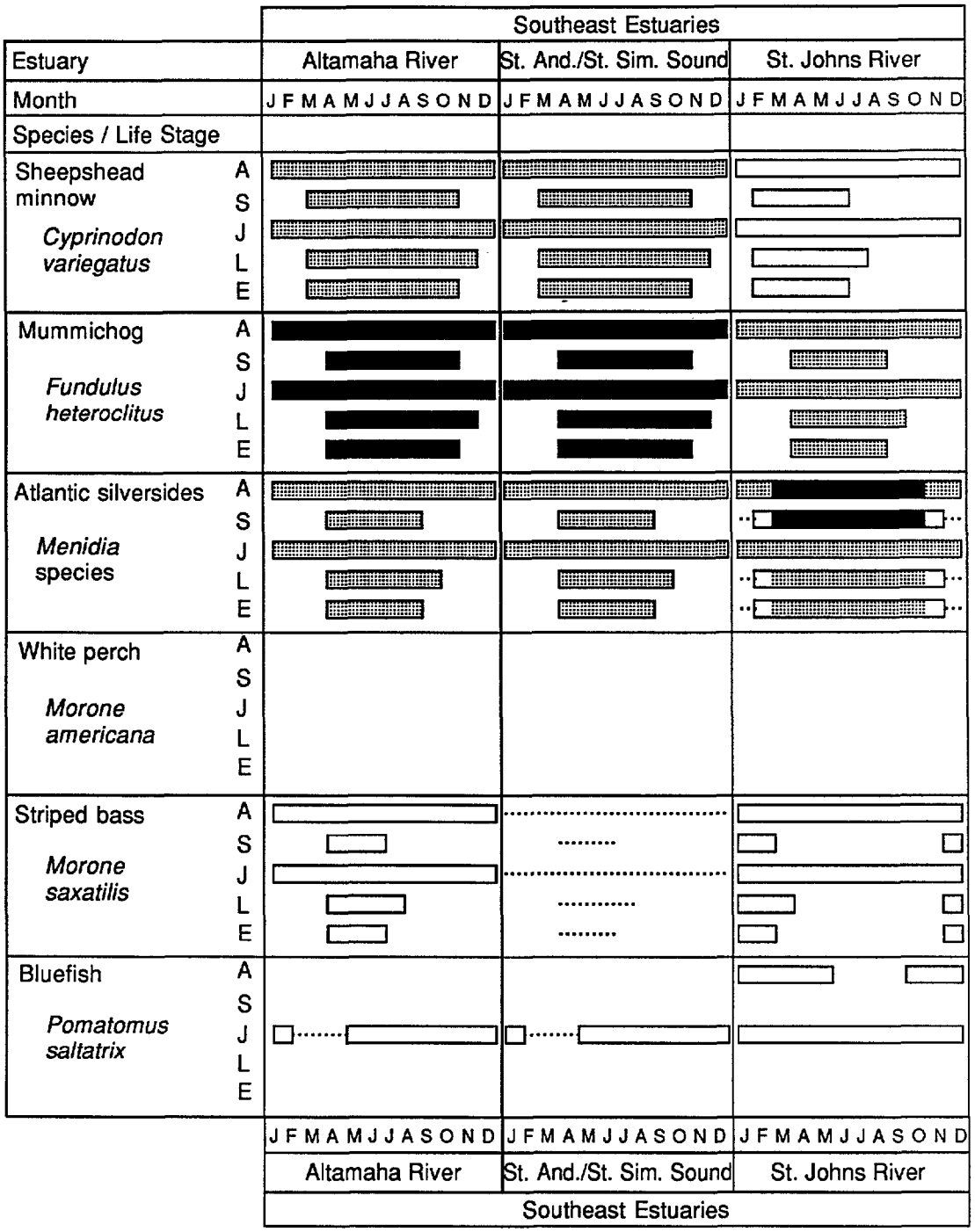
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



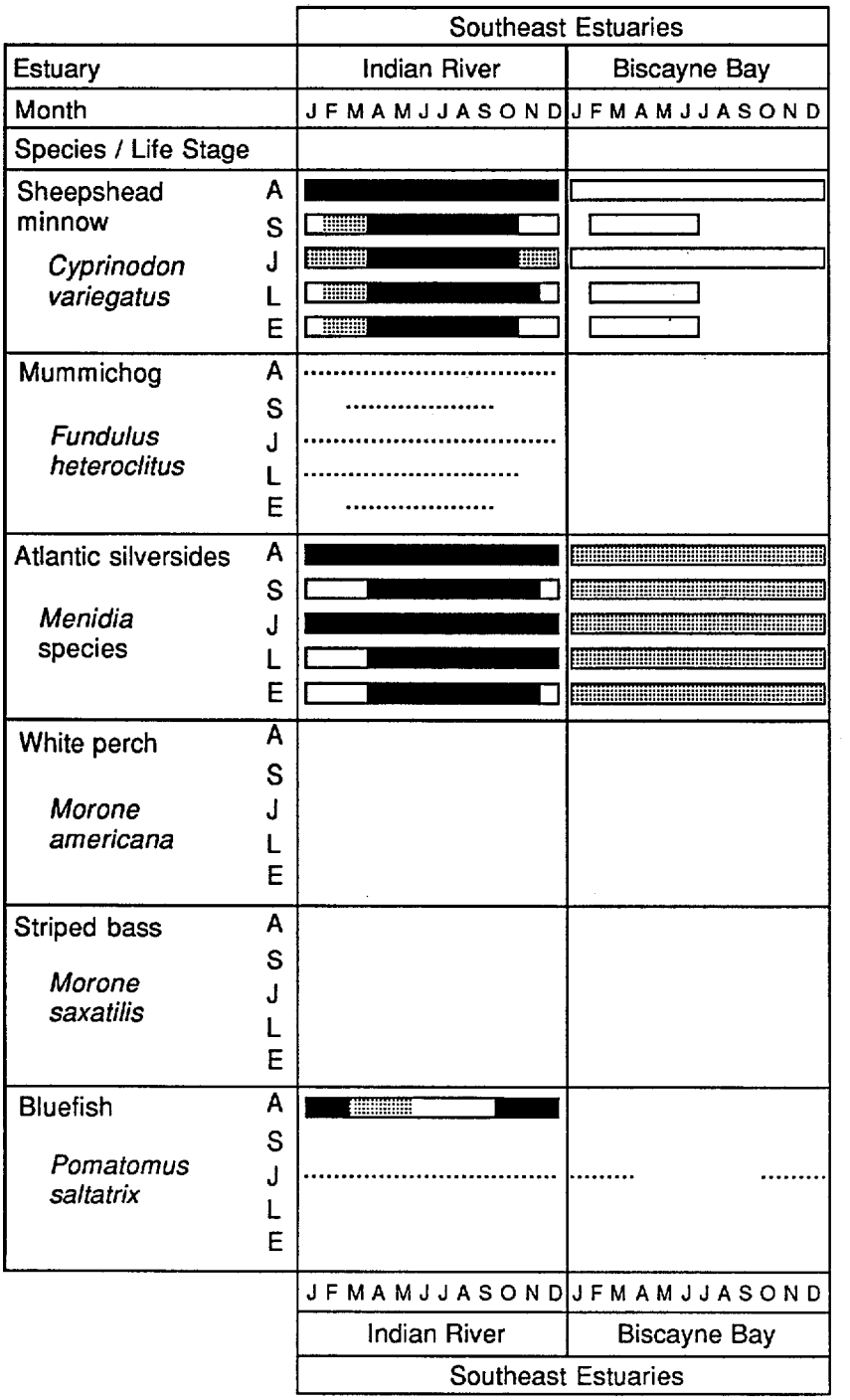
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



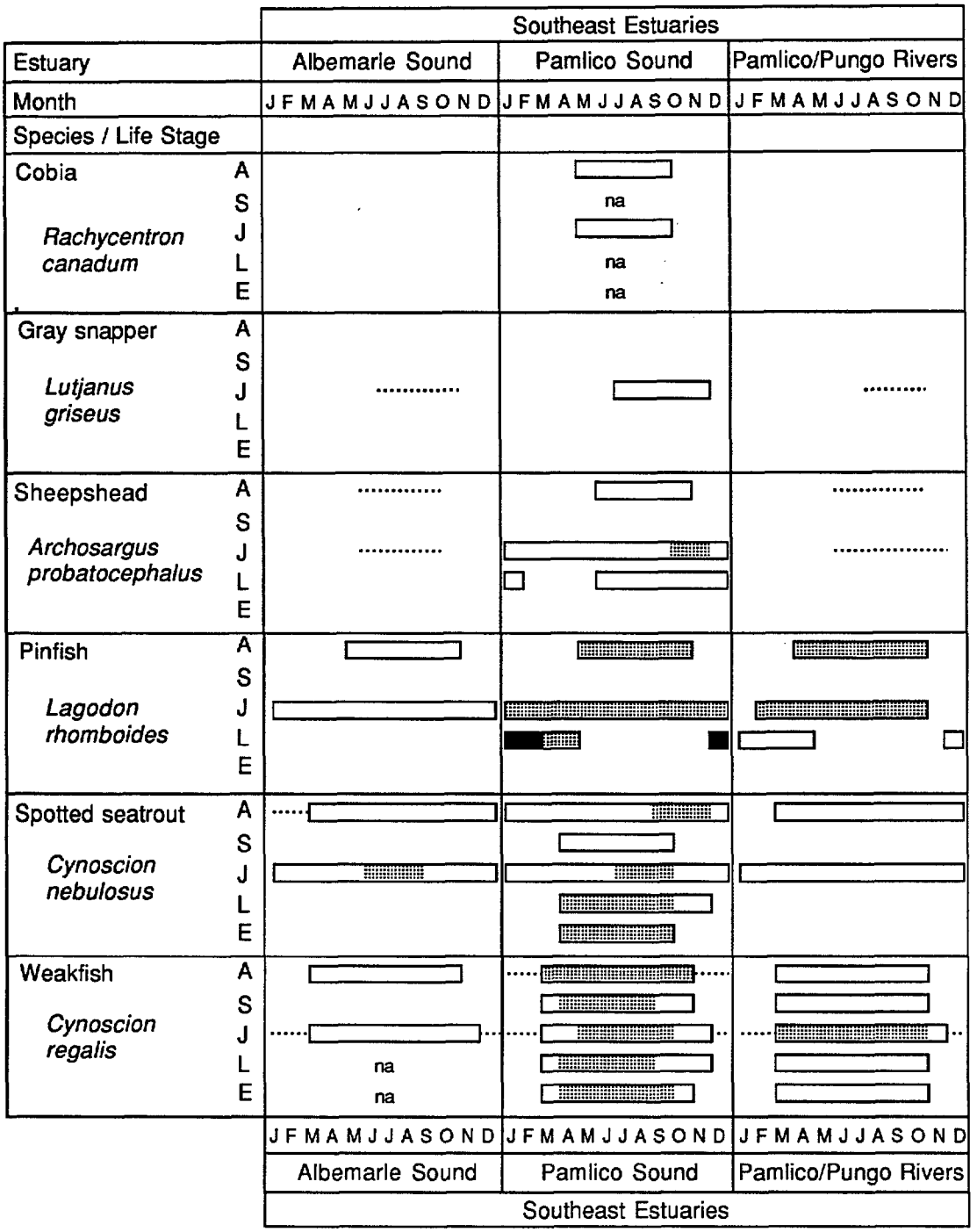
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



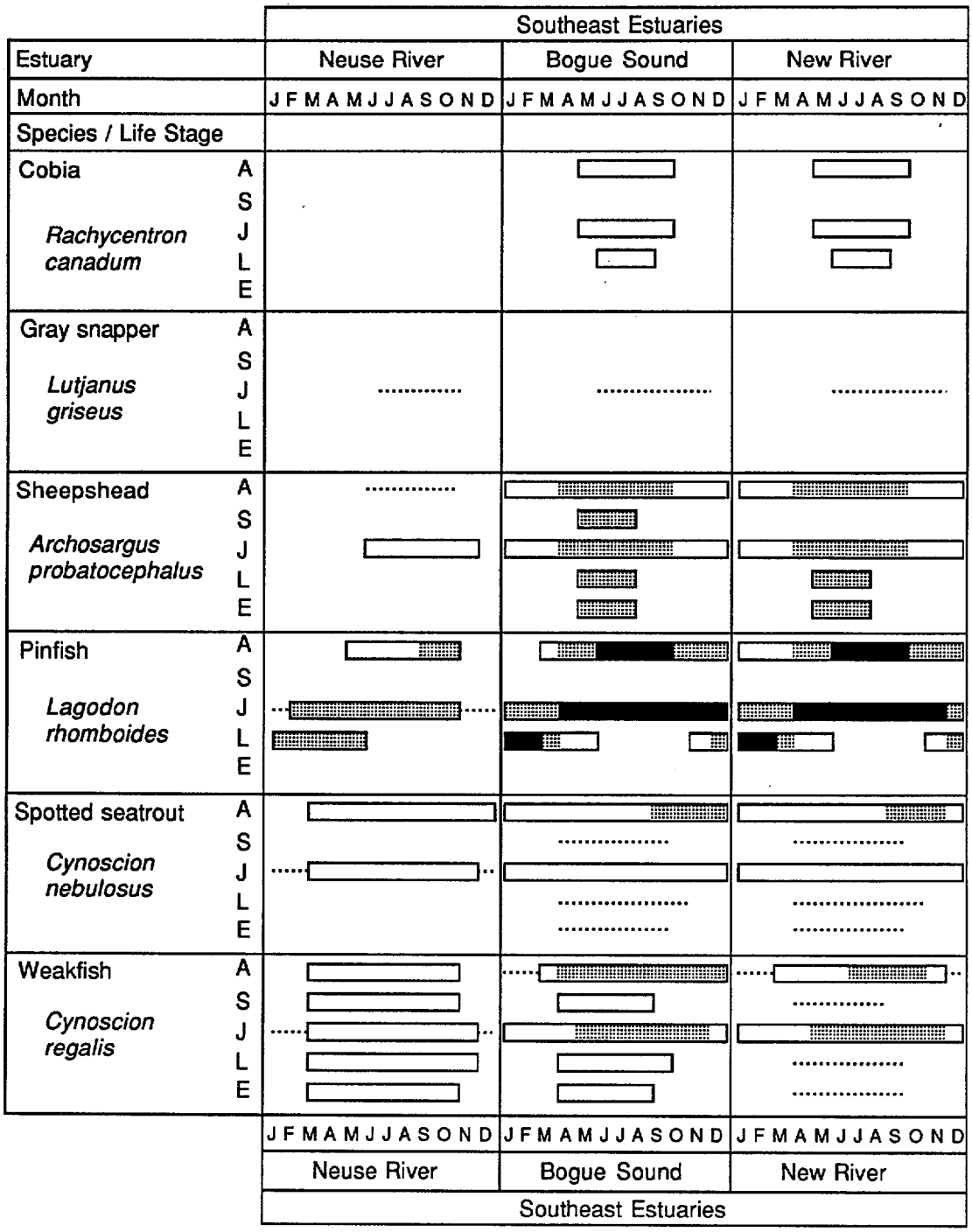
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present
- na — No Data Available

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



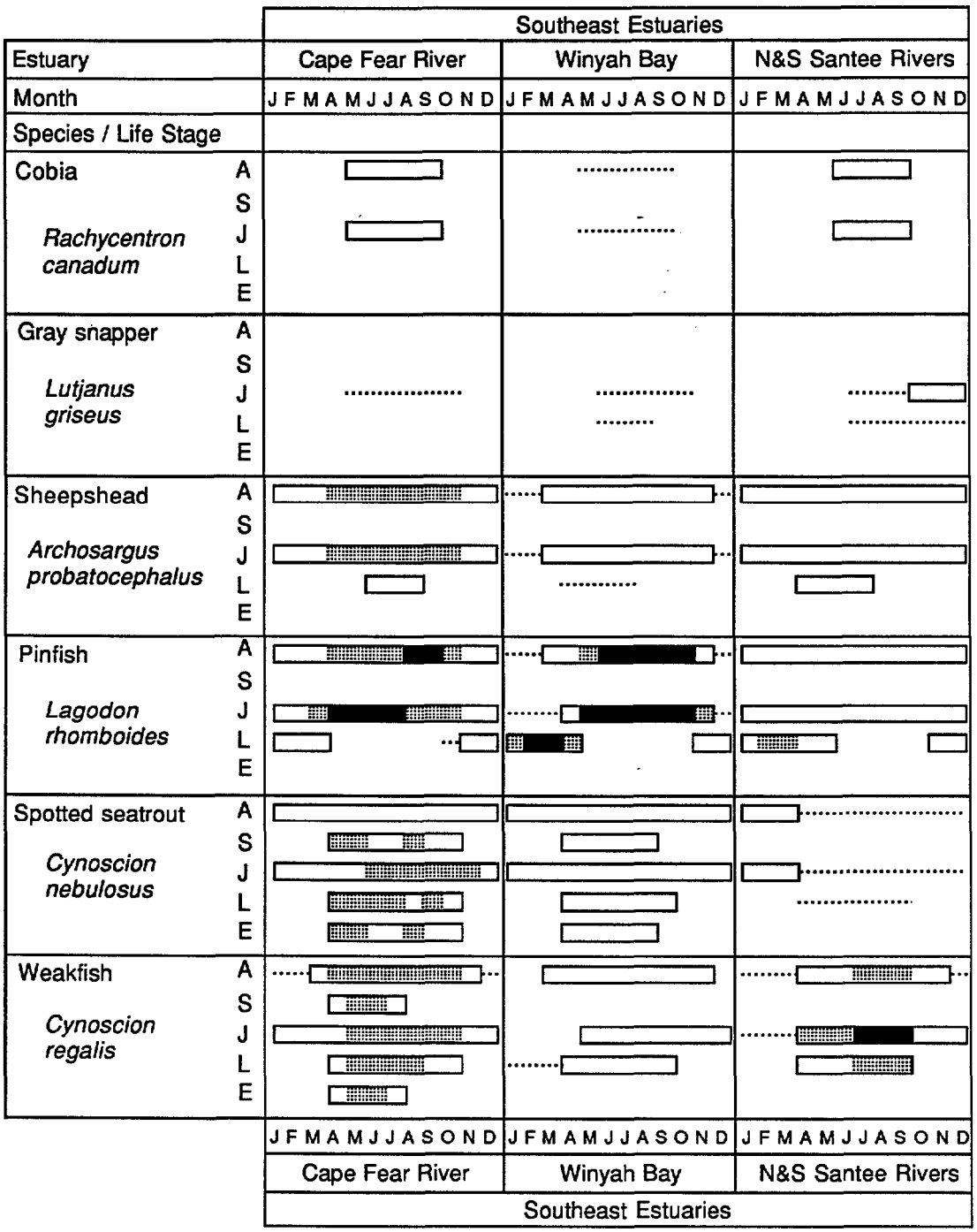
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



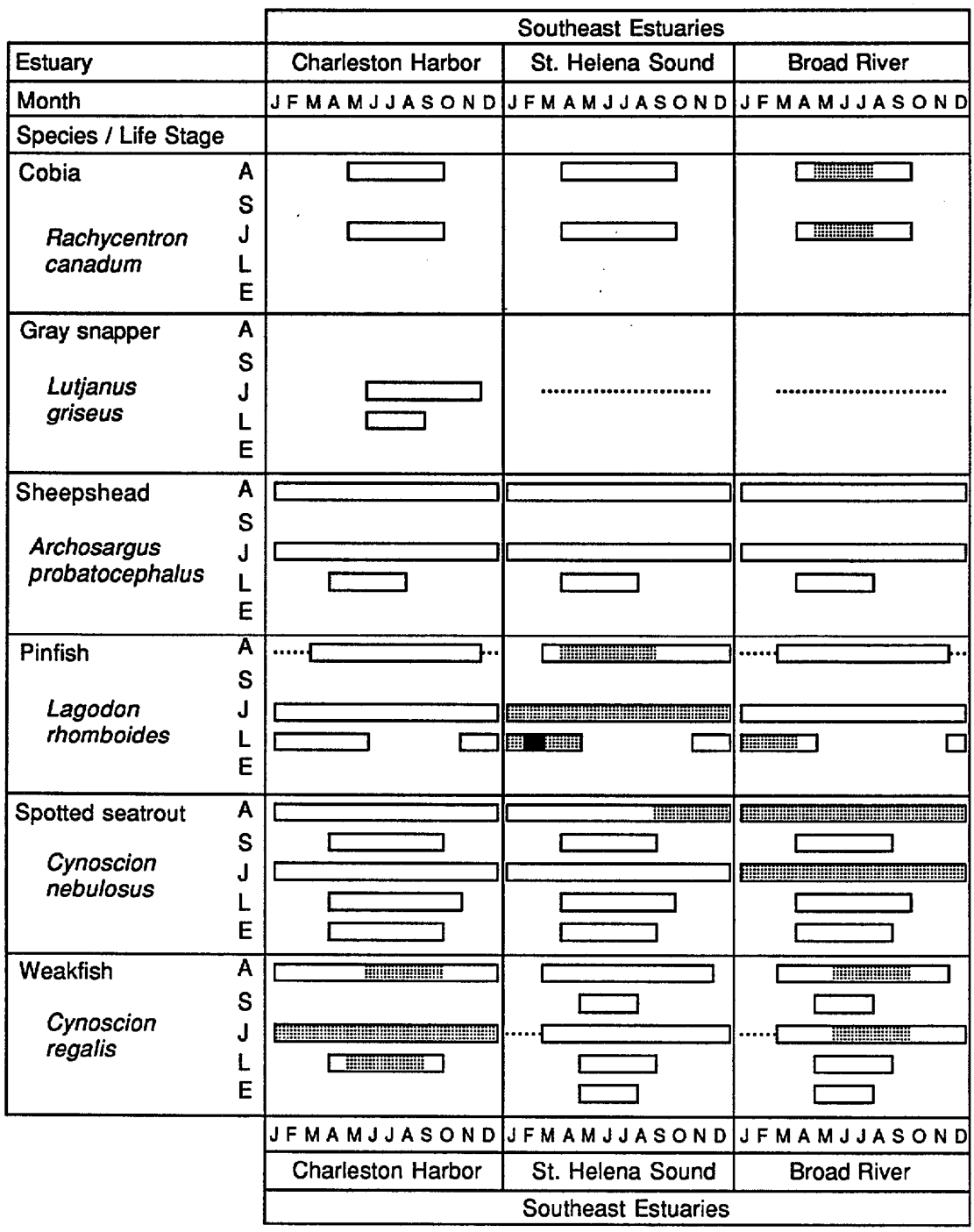
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



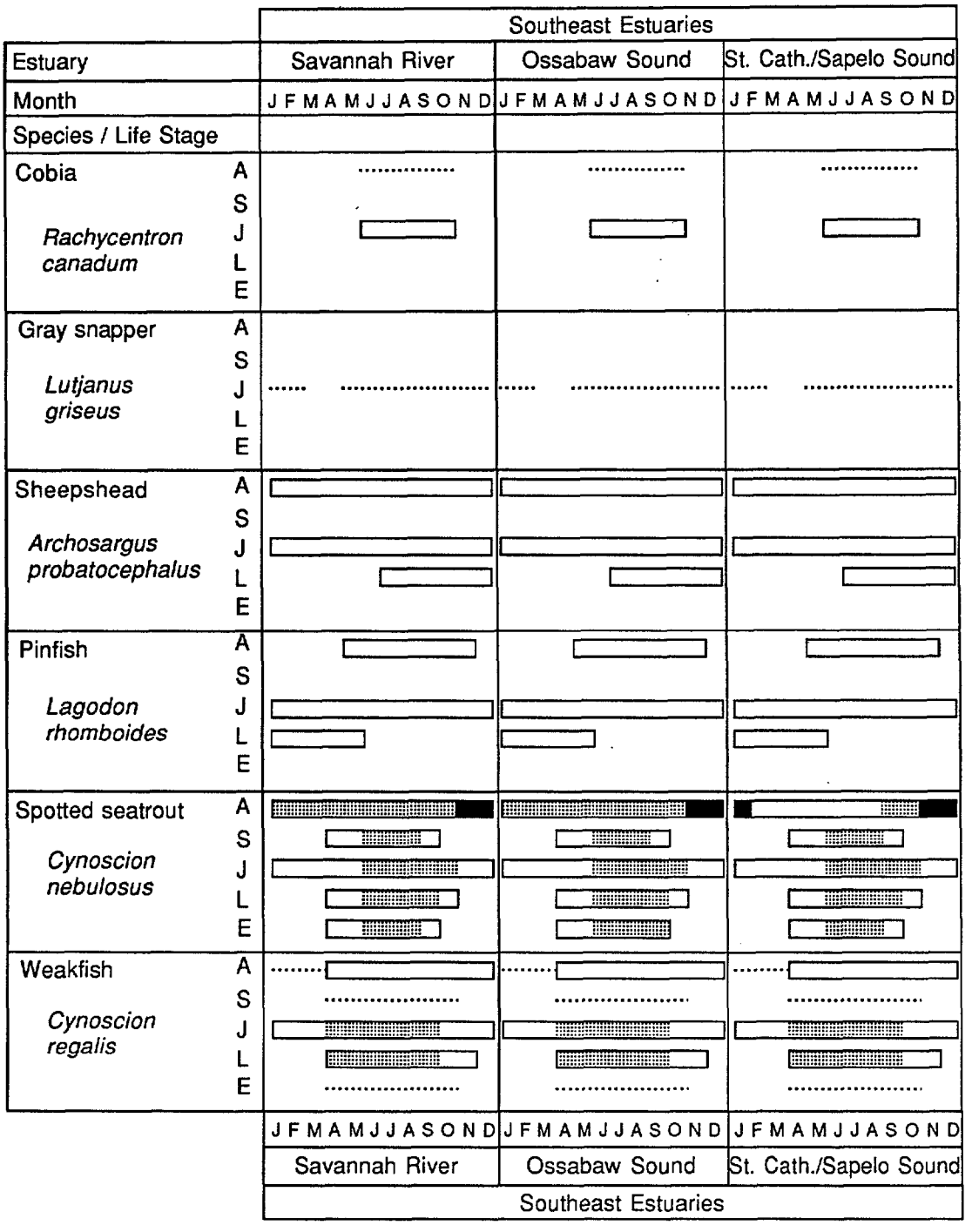
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



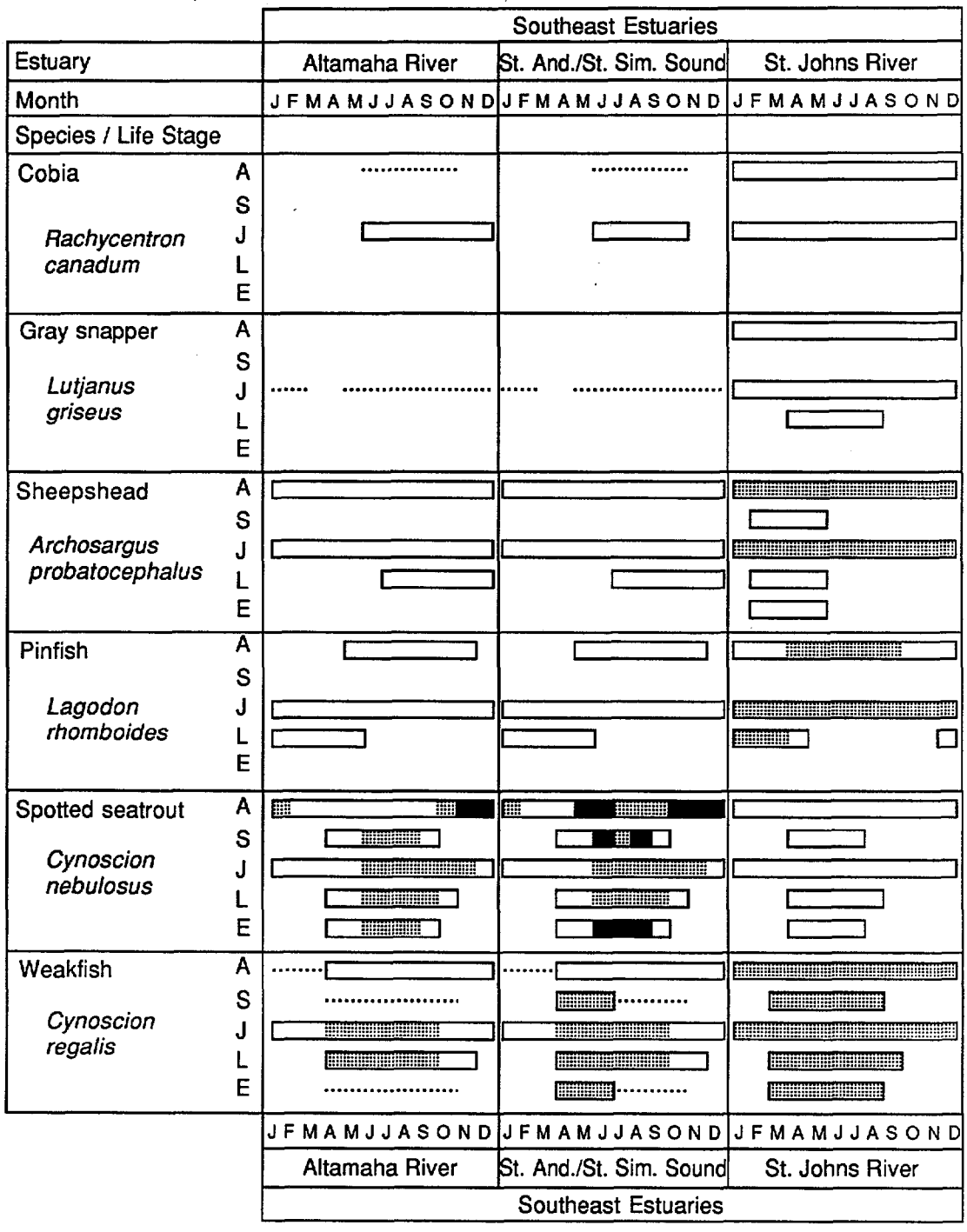
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



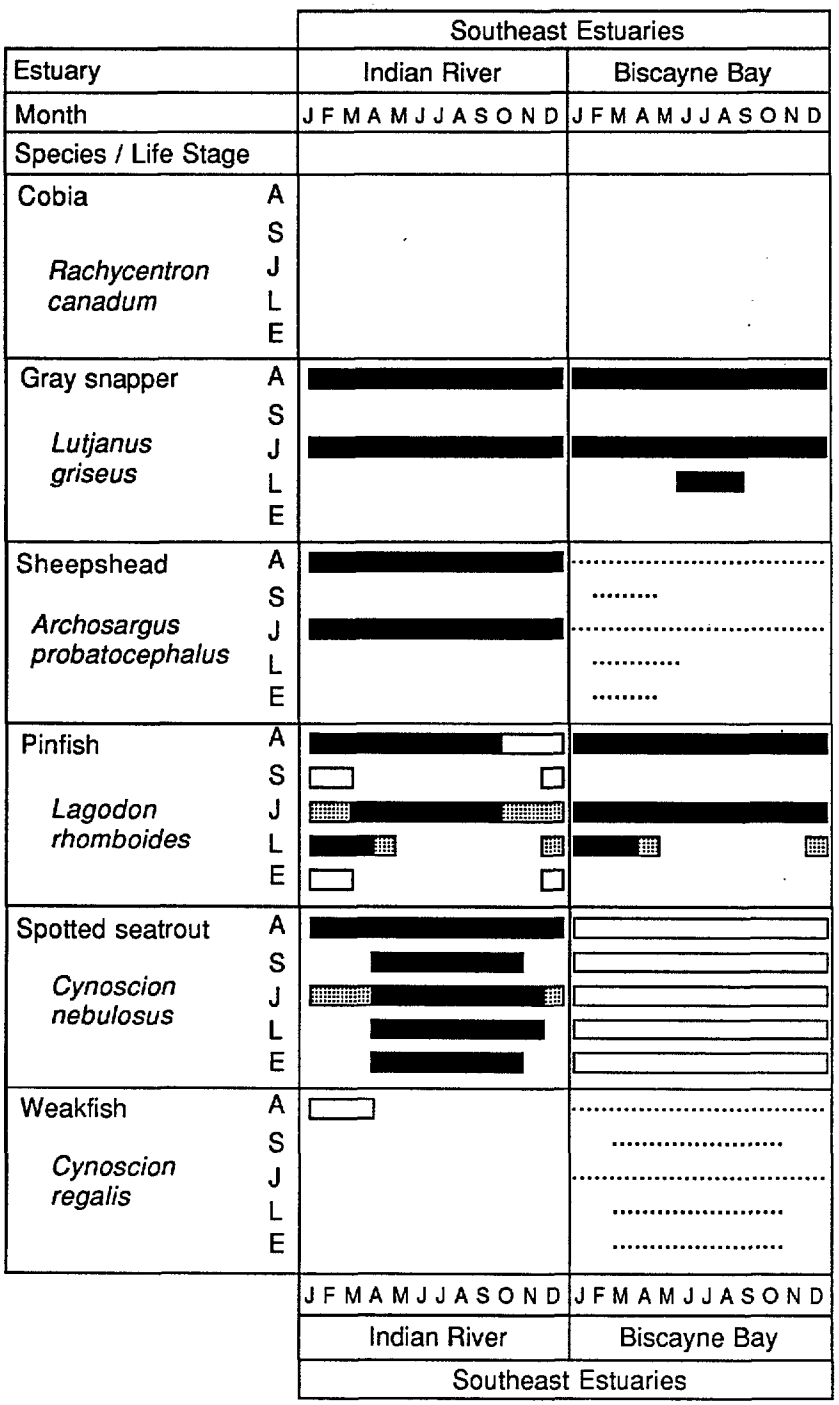
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



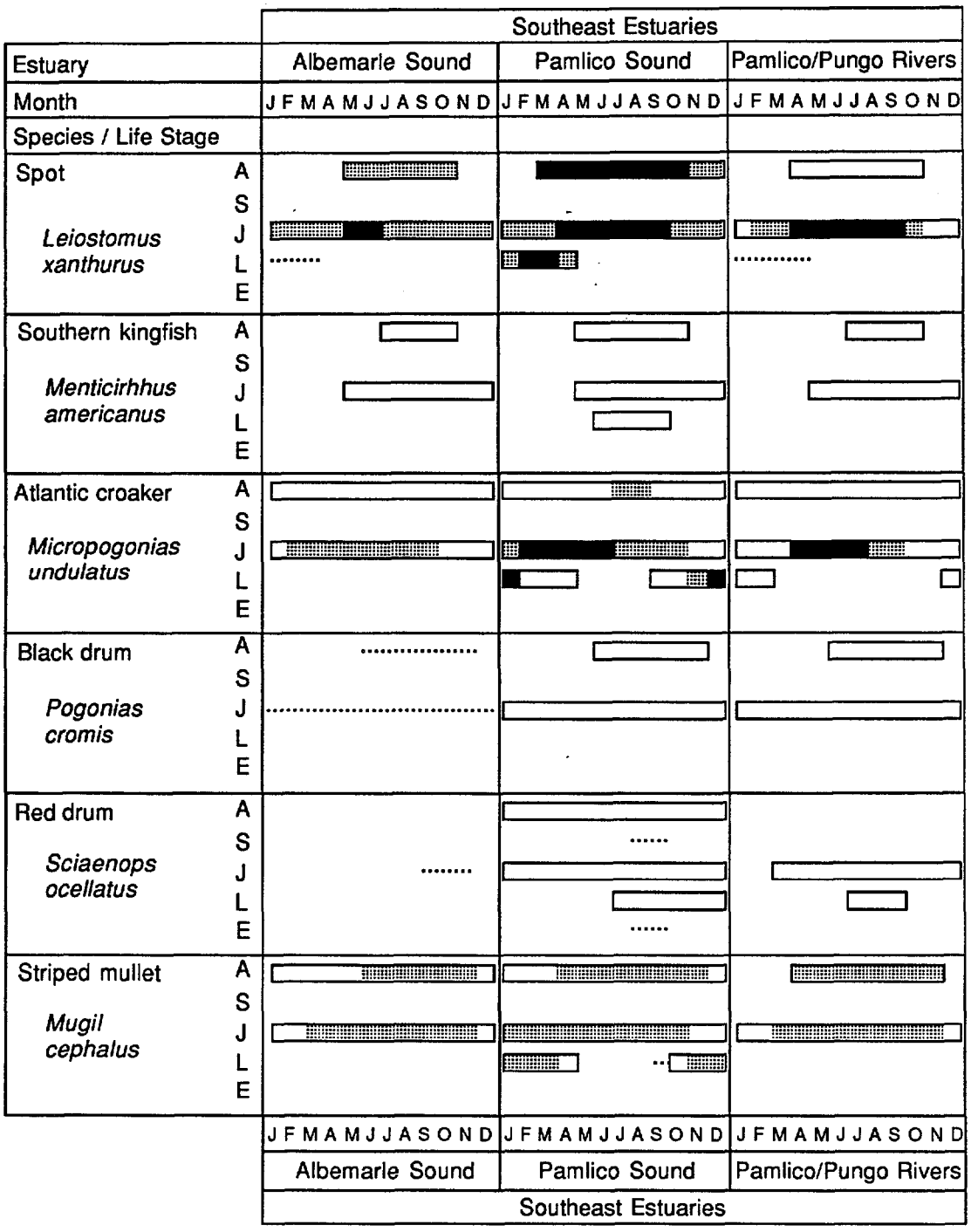
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



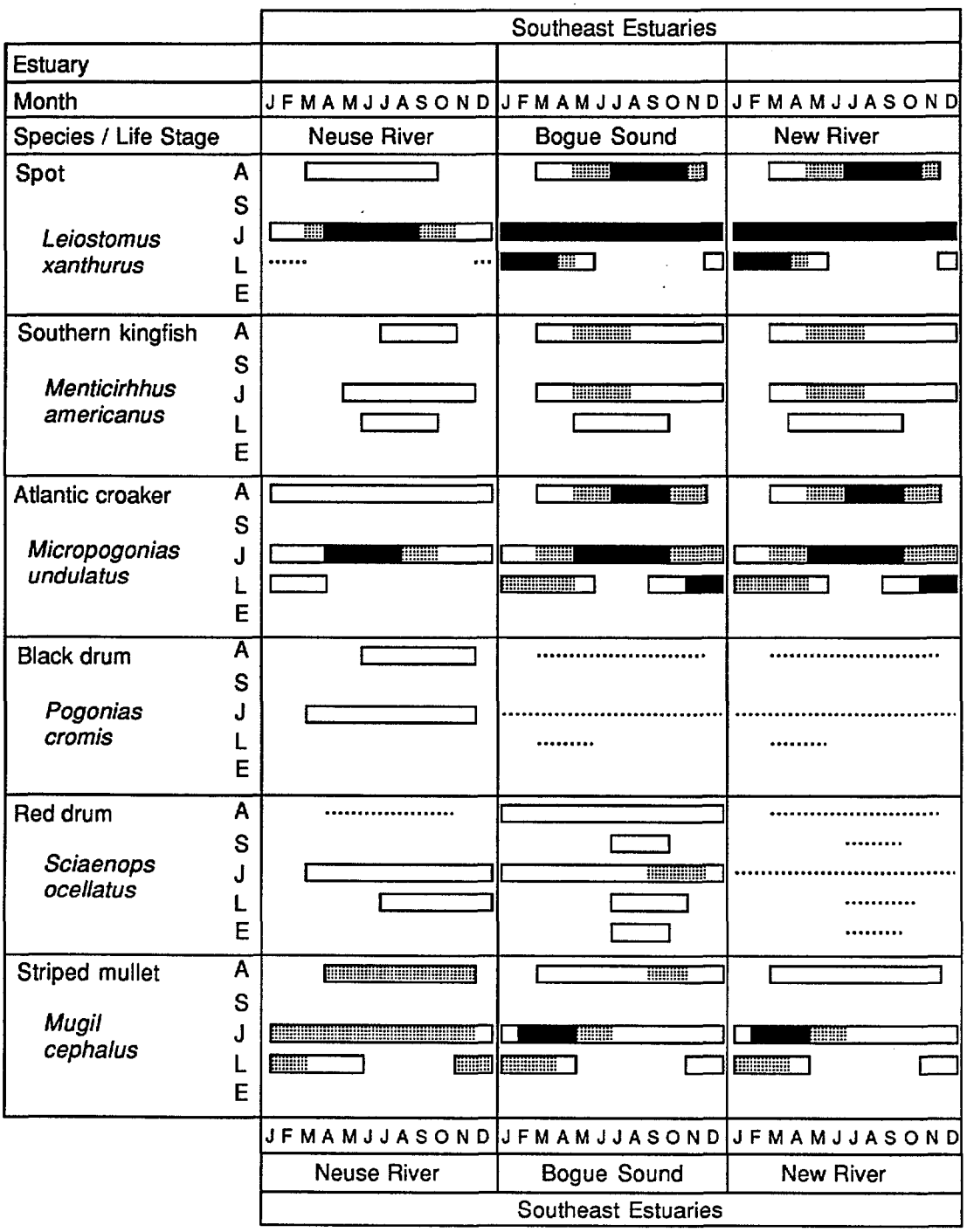
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



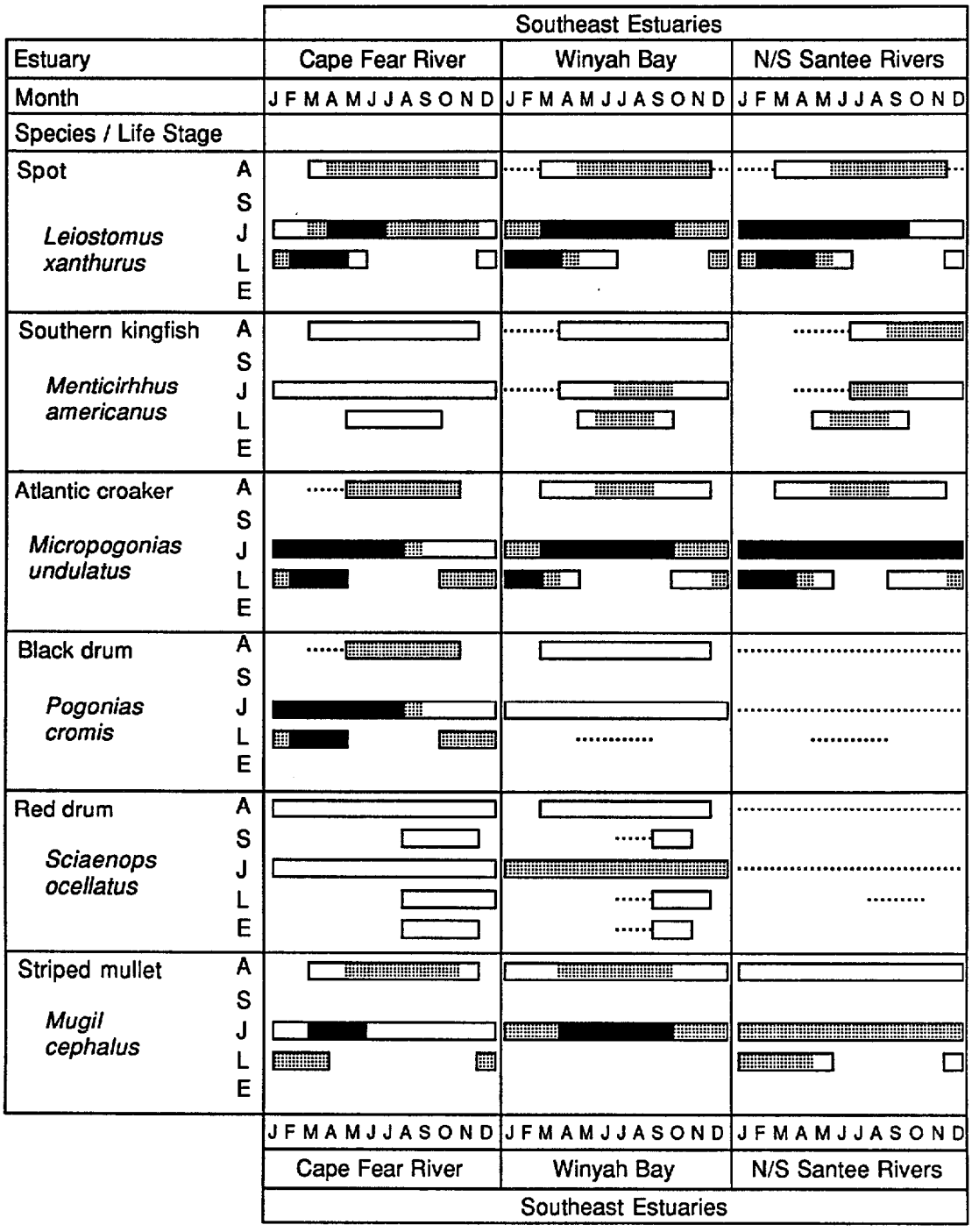
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



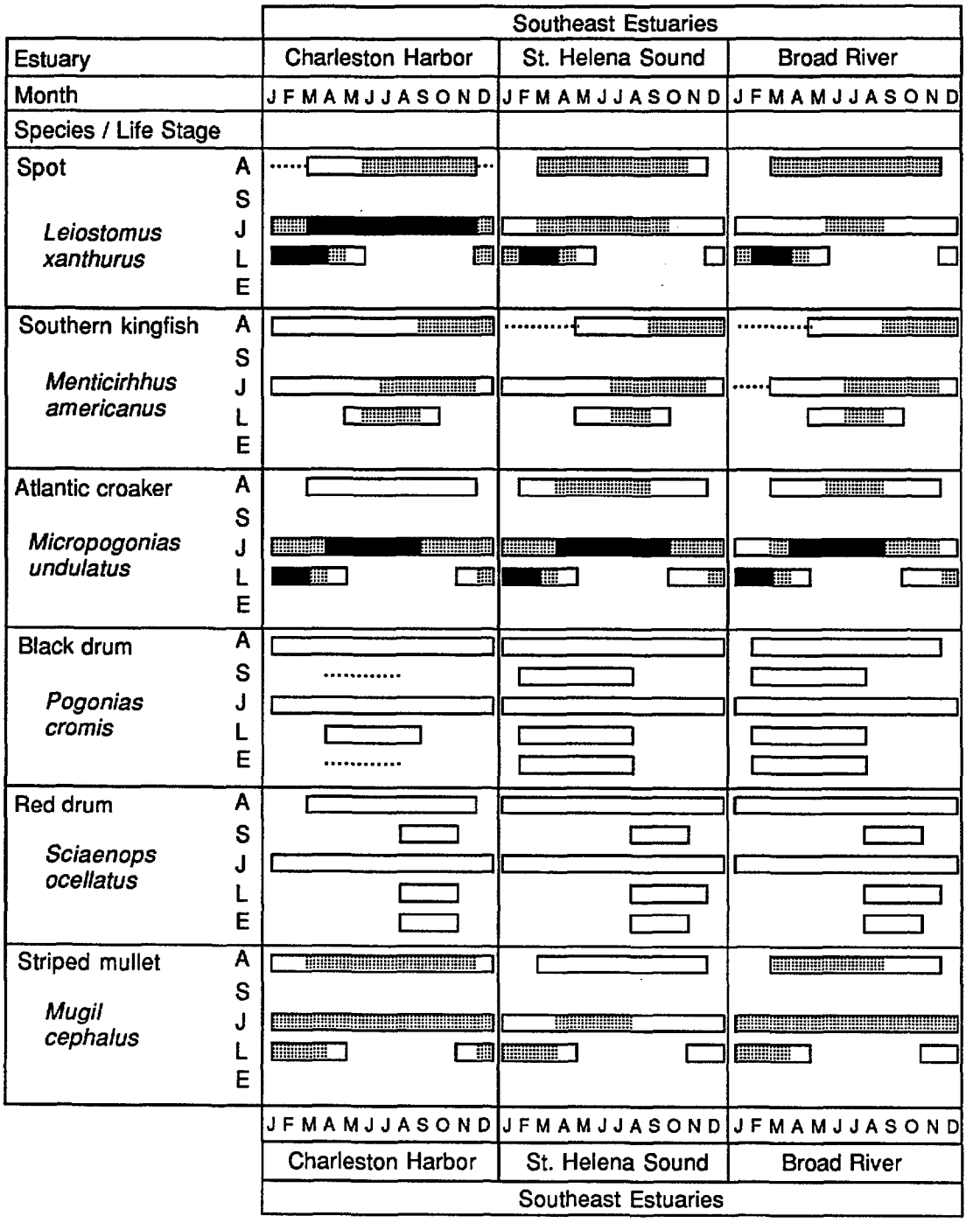
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



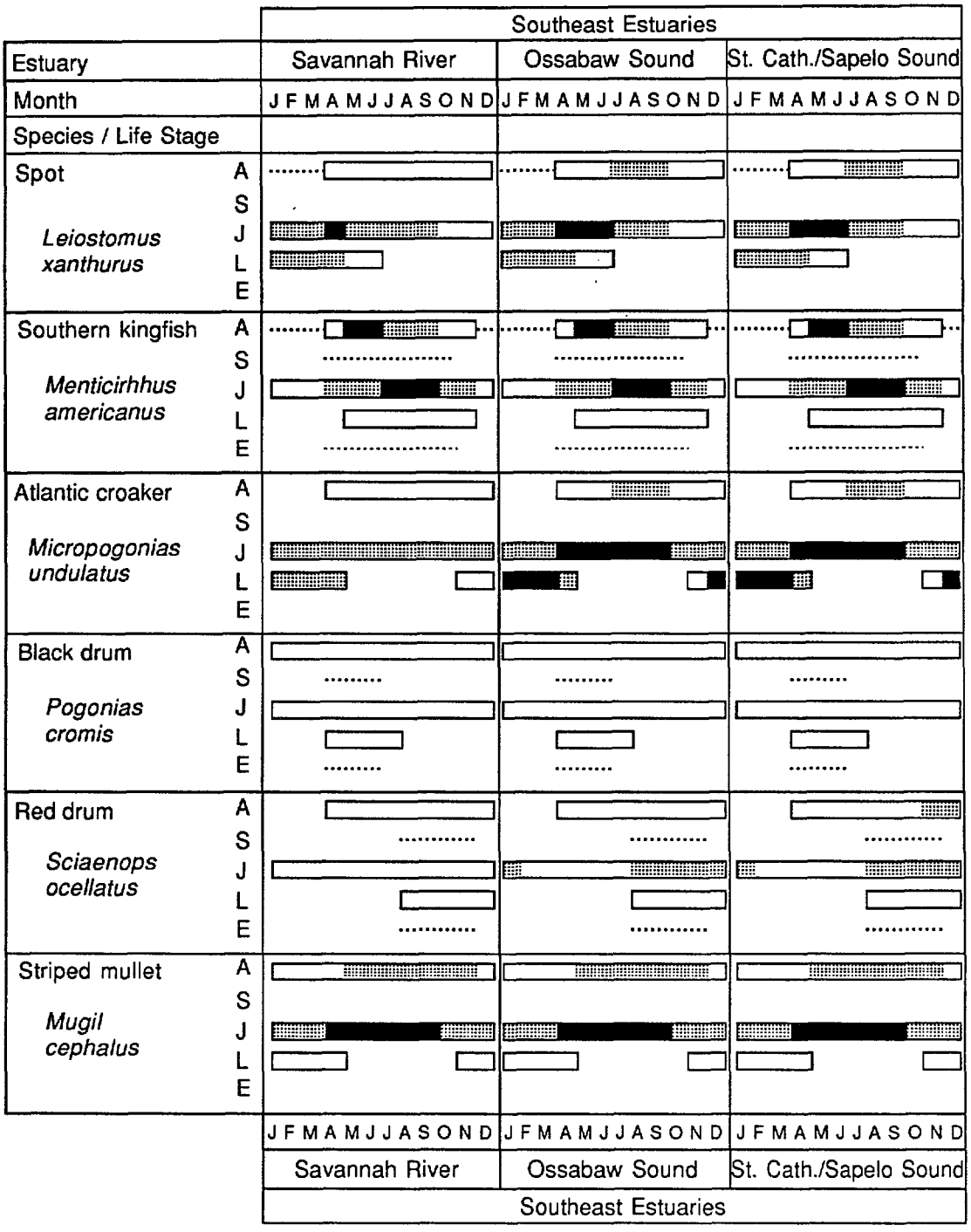
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



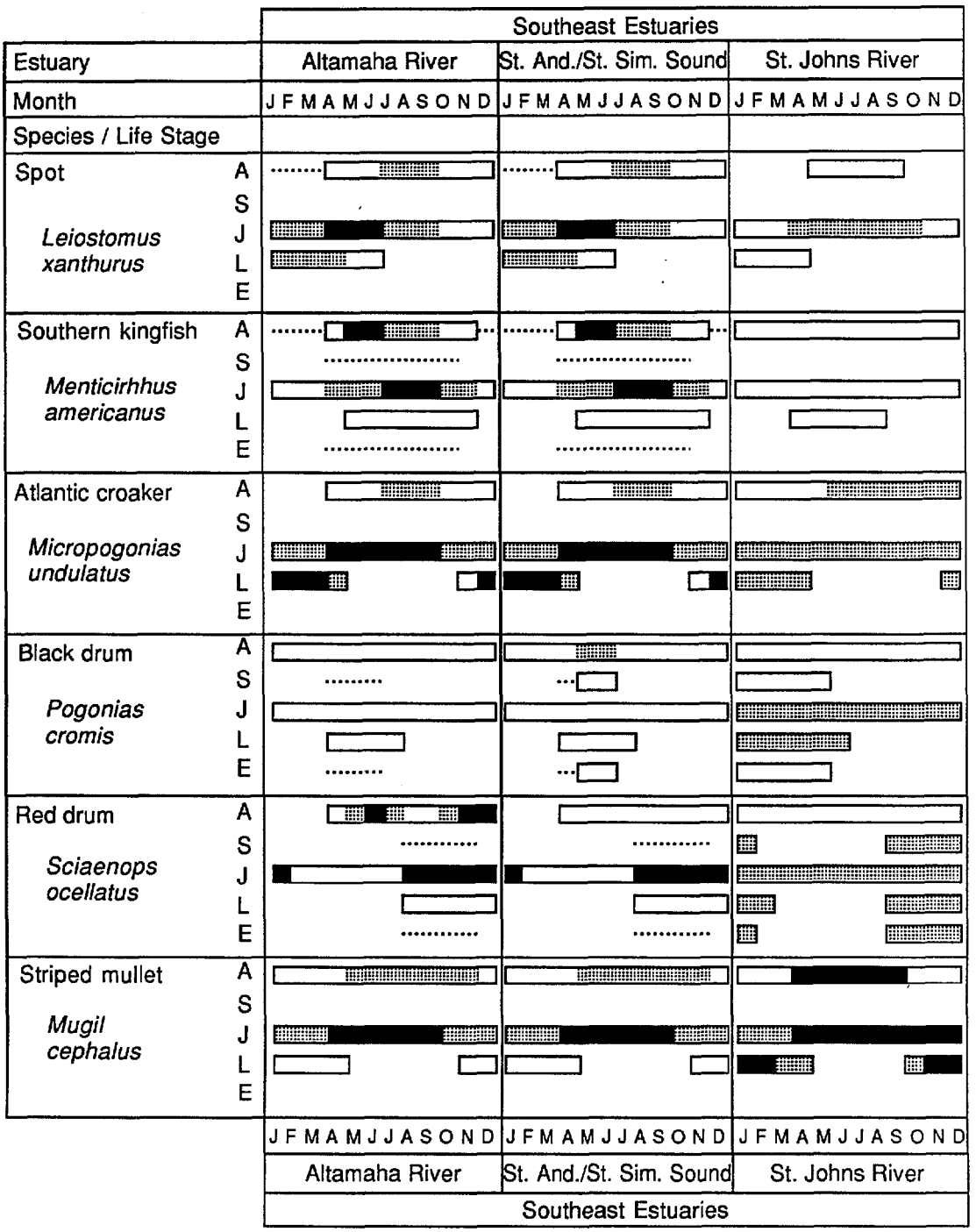
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



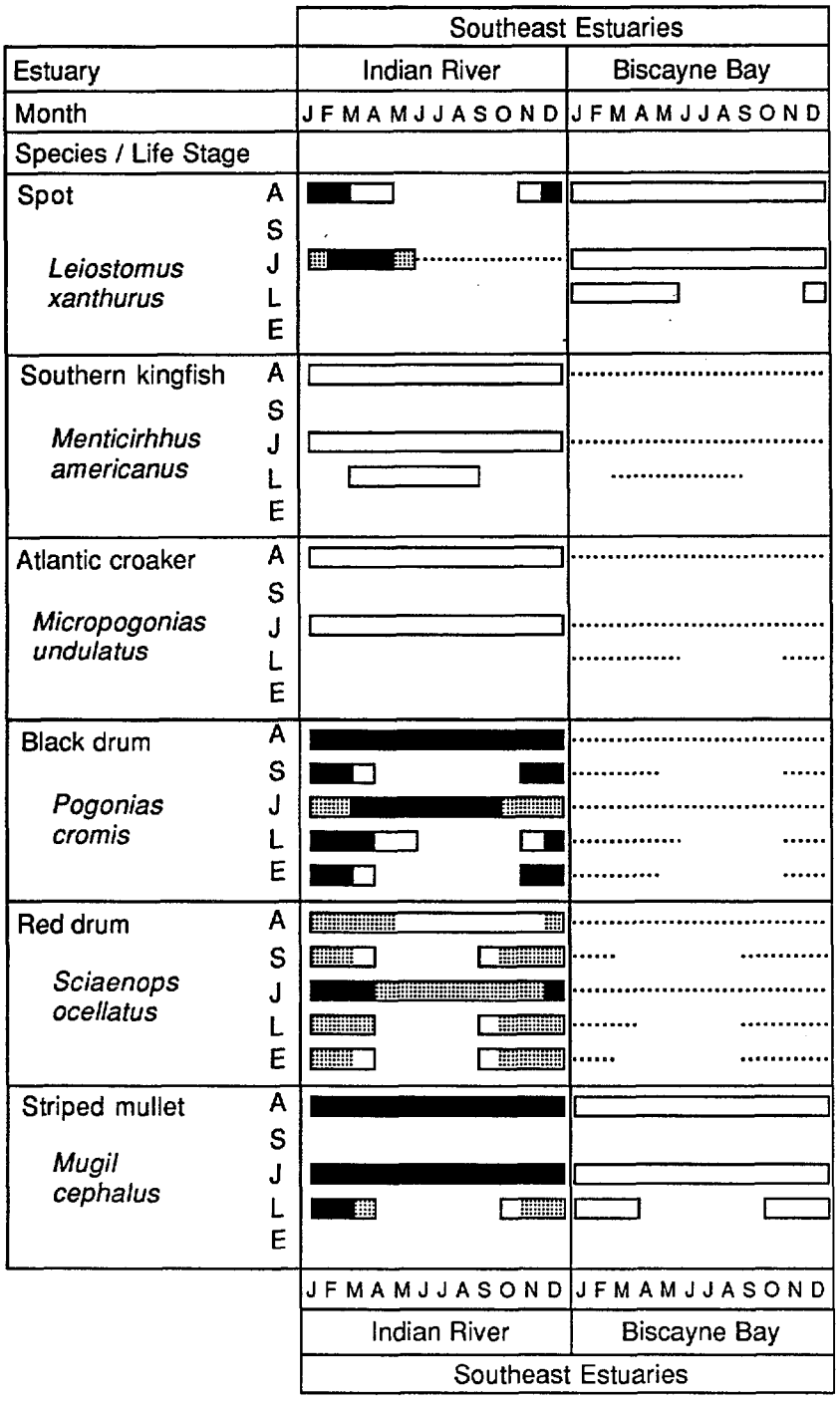
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



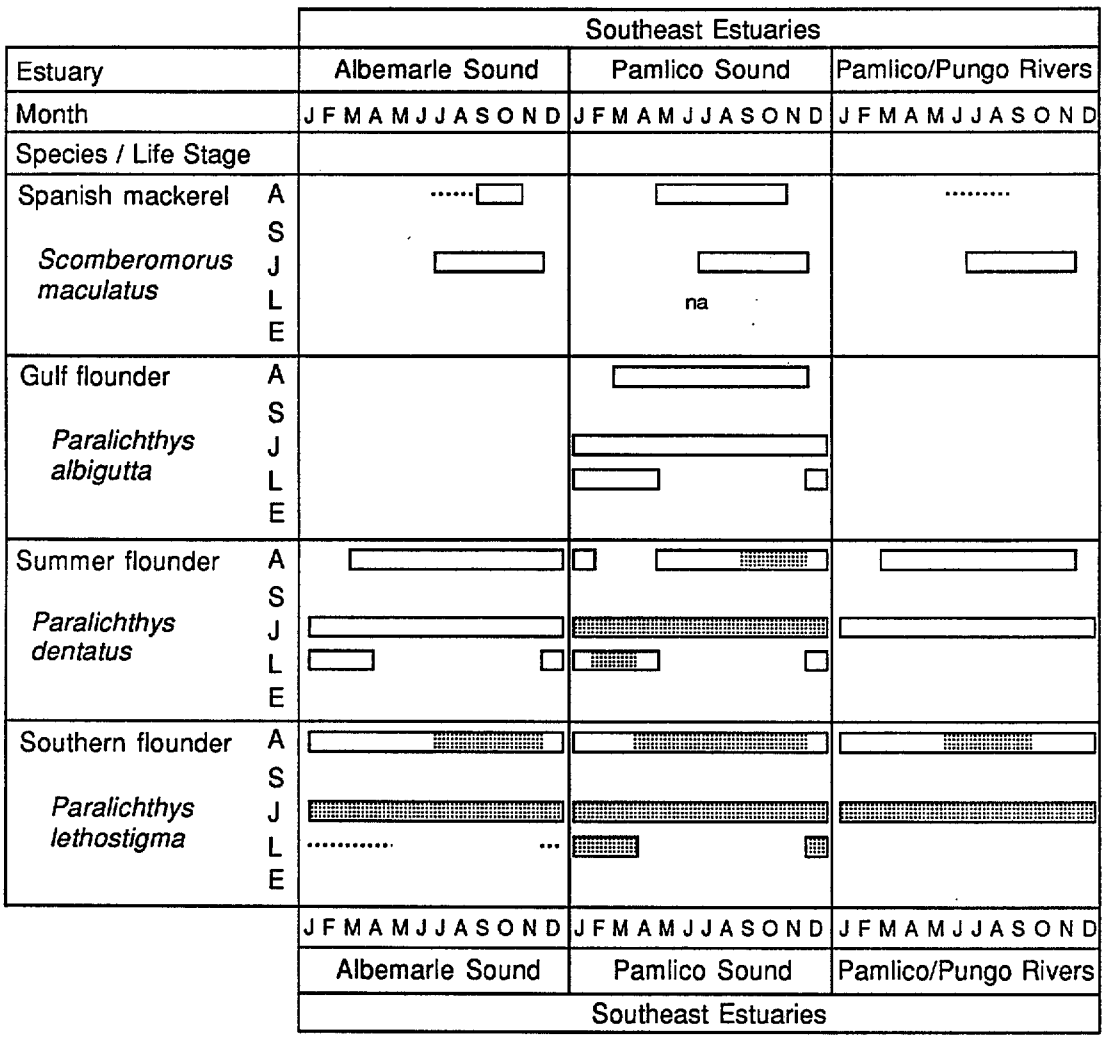
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 3, continued. Temporal distribution



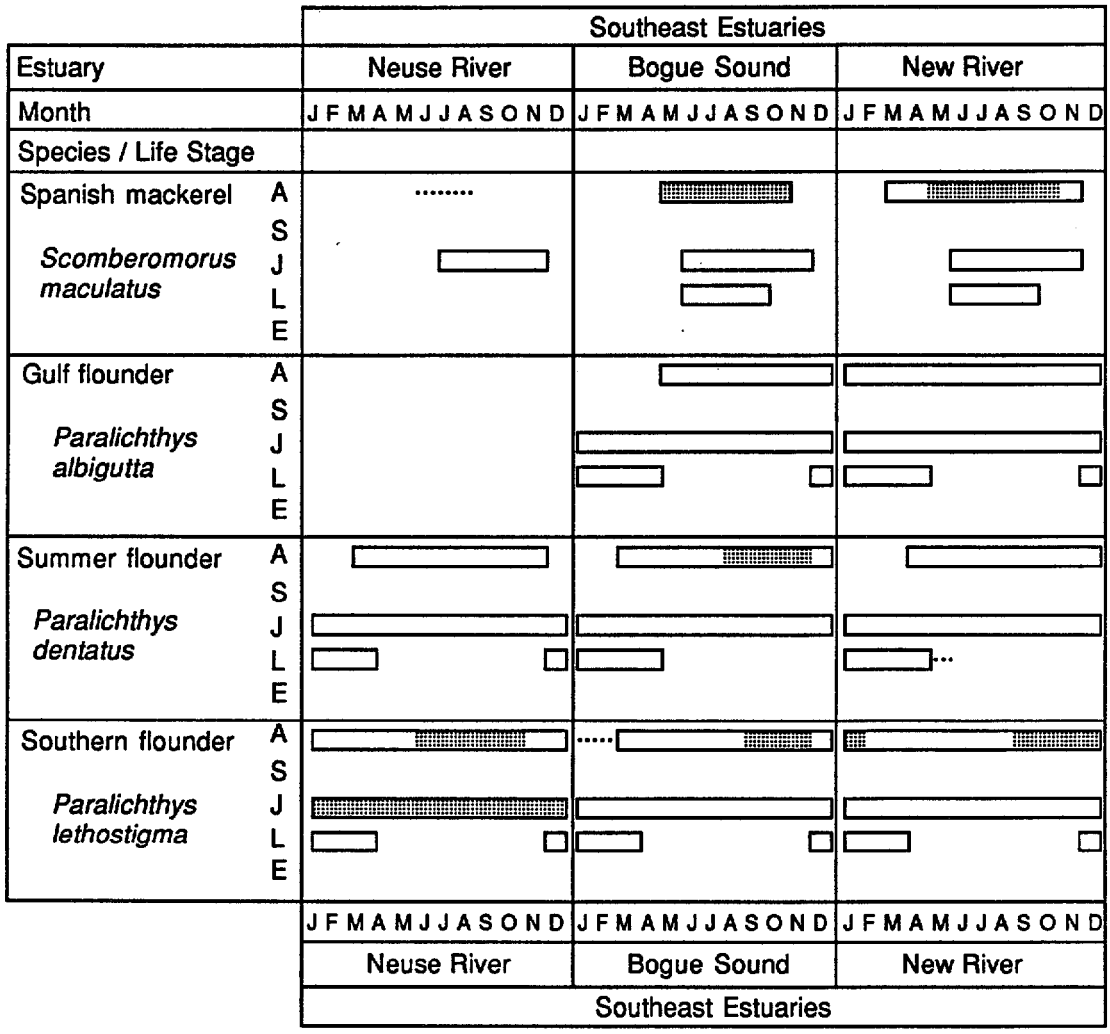
Relative

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present
- na — No Data Available

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued: Temporal distribution



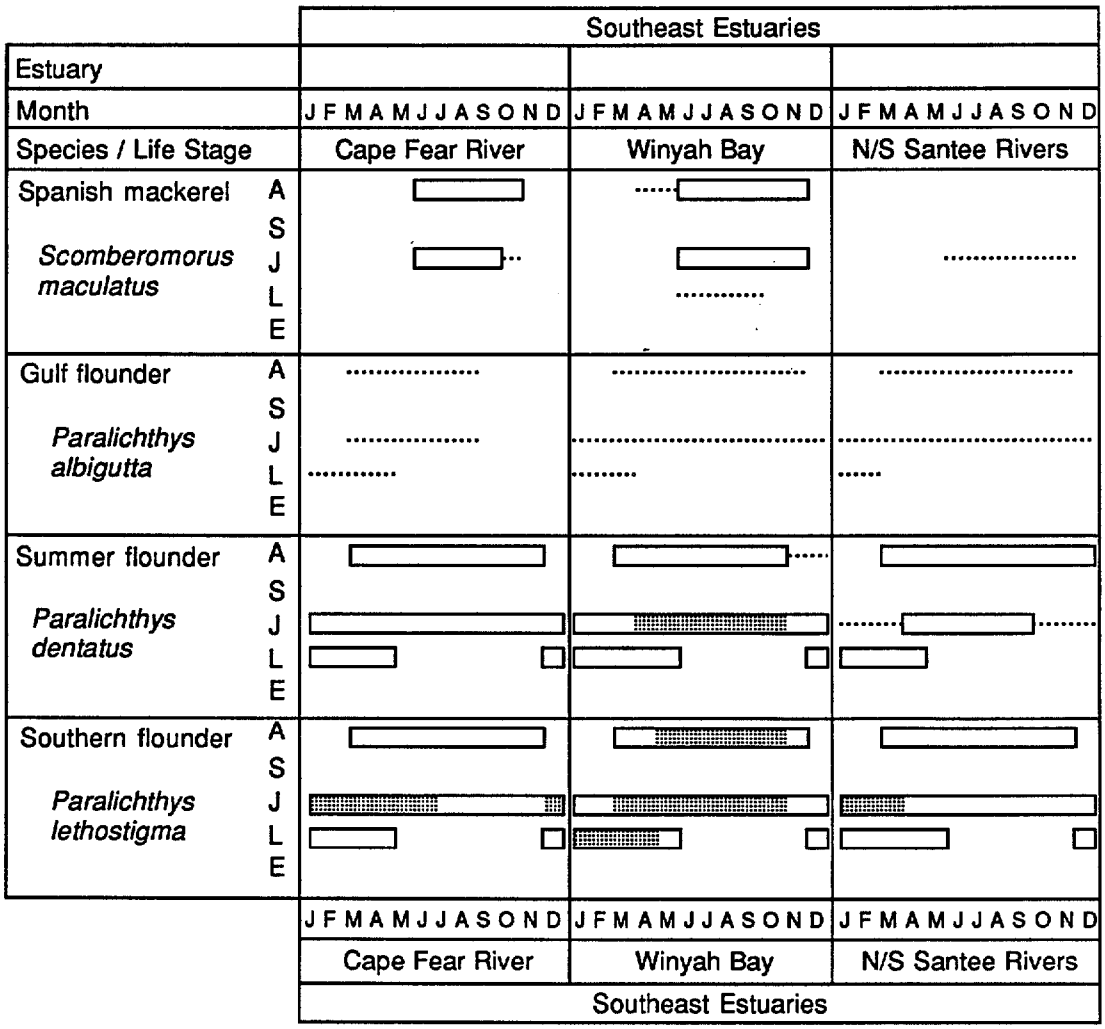
Relative

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



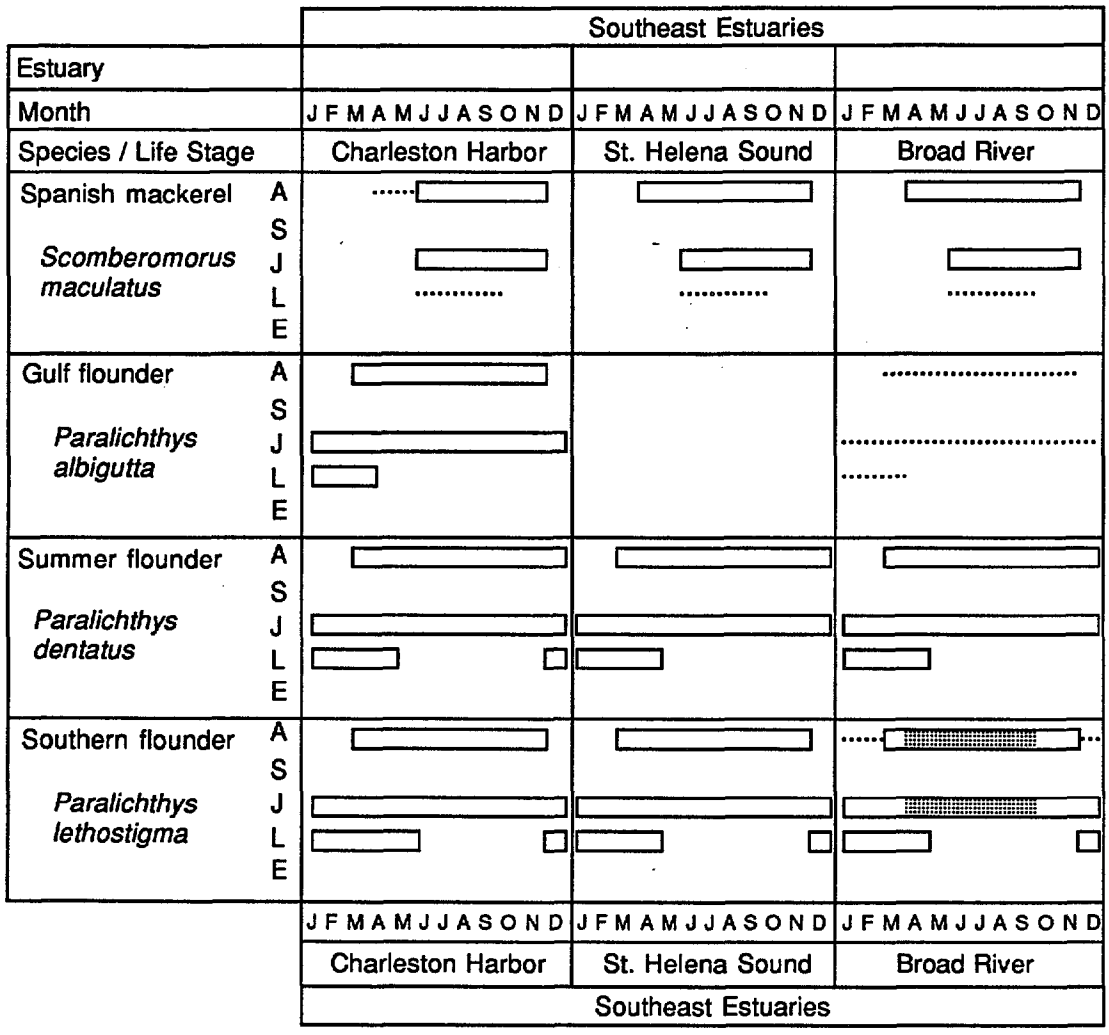
Relative

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



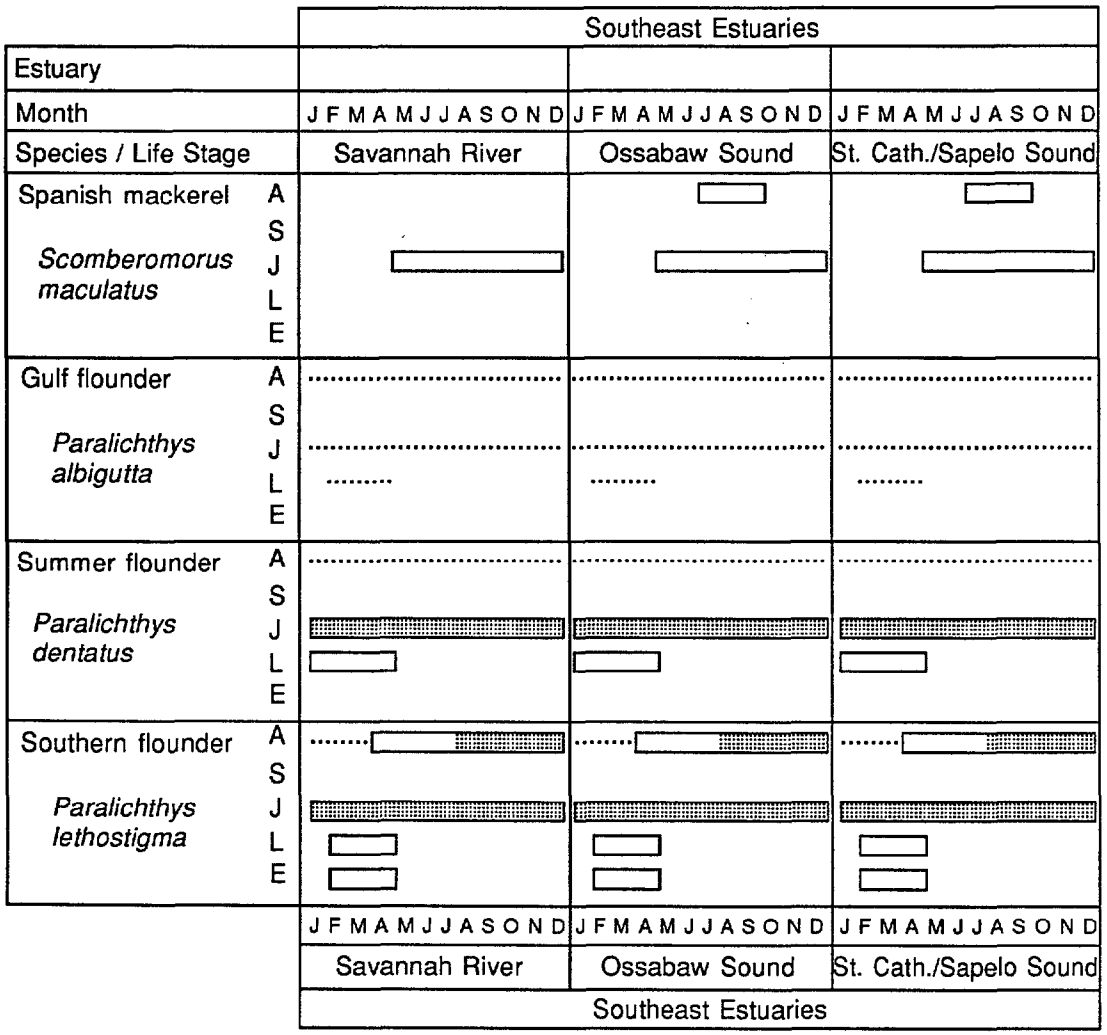
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



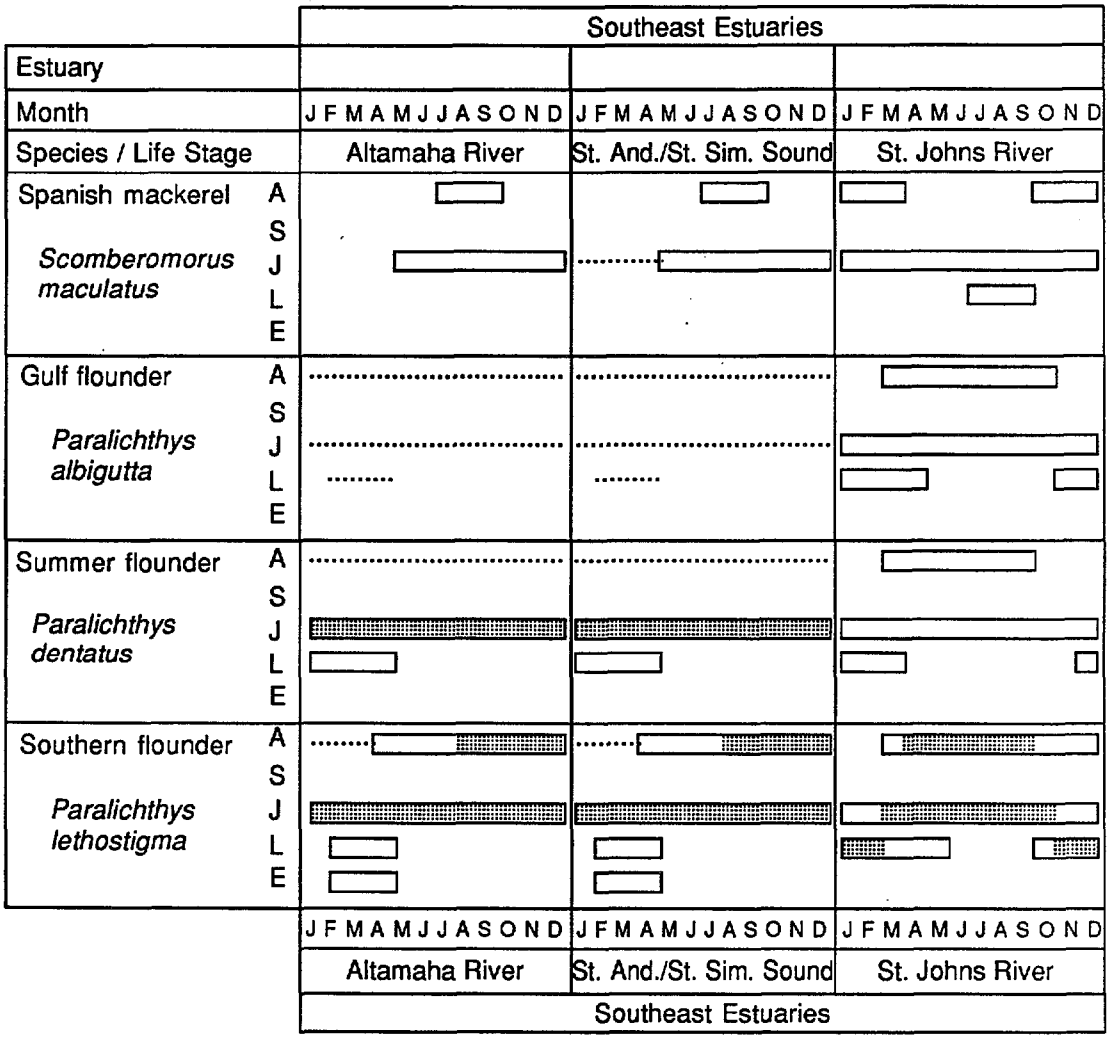
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



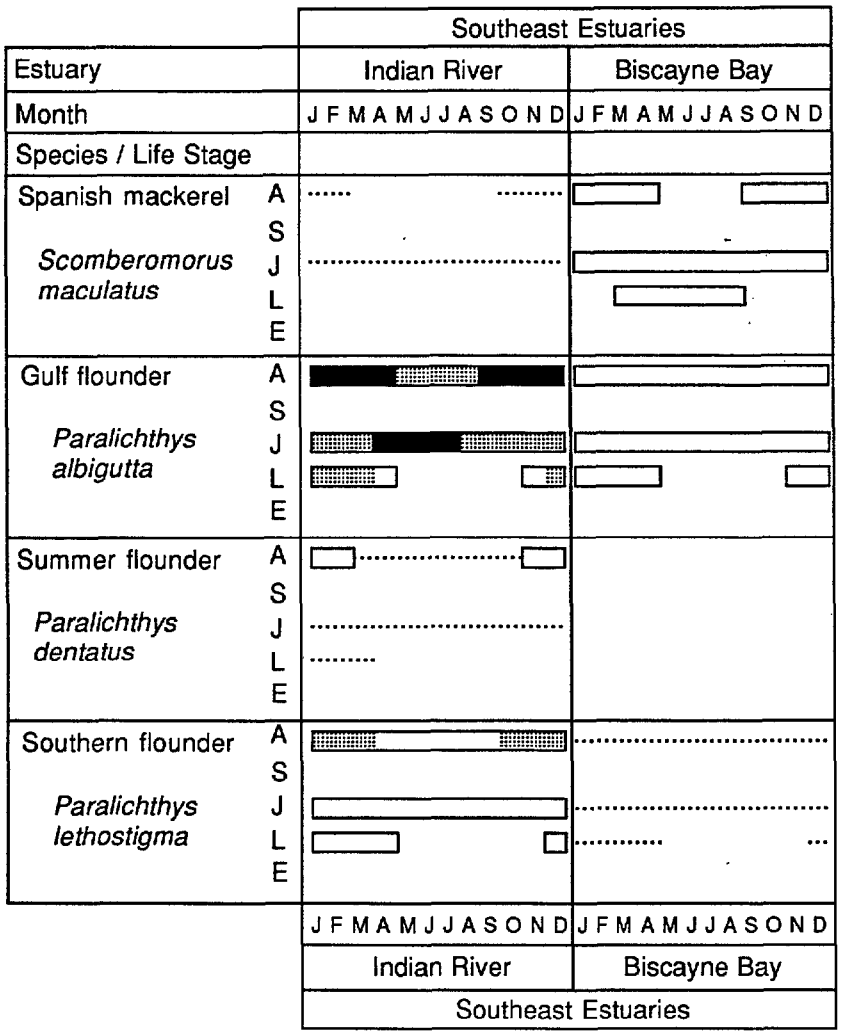
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 3, continued. Temporal distribution



Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4. Data reliability

Index to Table 4. Page location of data reliability table for each species and estuary.

Common and Scientific Name	Estuary: Albemarle Sound, Pamlico Sound, Pamlico/Pungo Rivers, Neuse River, Bogue Sound, New River, Cape Fear River	Winyah Bay, N/S Santee River, Charleston Harbor, St. Helena Sound, Broad River, Savannah River, Ossabaw Sound	St. Cathe./Sapelo Sound, Altamaha River, St. Andr./St. Sim. Sound, St. Johns River, Indian River, Biscayne Bay
Mussel (*Mytilis edulis*) Bay scallop (*Argopecten irradians*) American oyster (*Crassostrea virginica*) Common rangia (*Rangia cuneata*) Hard clam (*Mercenaria* species) Brown shrimp (*Penaeus aztecus*)	p. 92	p. 93	p. 94
Pink shrimp (*Penaeus duorarum*) White shrimp (*Penaeus setiferus*) Grass shrimp (*Palaemonetes pugio*) Blue crab (*Callinectes sapidus*) Atlantic sturgeon (*Acipenser oxyrhynchus*) Ladyfish (*Elops saurus*)	p. 95	p. 96	p. 97
American eel (*Anguilla rostrata*) Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Bay anchovy (*Anchoa mitchilli*)	p. 98	p. 99	p. 100
Sheepshead minnow (*Cyprinodon variegatus*) Mummichog (*Fundulus heteroclitus*) Atlantic silversides (*Menidia* species) White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*)	p. 101	p. 102	p. 103
Cobia (*Rachycentron canadum*) Gray snapper (*Lutjanus griseus*) Sheepshead (*Archosargus probatocephalus*) Pinfish (*Lagodon rhomboides*) Spotted seatrout (*Cynoscion nebulosus*) Weakfish (*Cynoscion regalis*)	p. 104	p. 105	p. 106
Spot (*Leiostomus xanthurus*) Southern kingfish (*Menticirrhus americanus*) Atlantic croaker (*Micropogonias undulatus*) Black drum (*Pogonias cromis*) Red drum (*Sciaenops ocellatus*) Striped mullet (*Mugil cephalus*)	p. 107	p. 108	p. 109
Spanish mackerel (*Scomberomorus maculatus*) Gulf flounder (*Paralichthys albigutta*) Summer flounder (*Paralichthys dentatus*) Southern flounder (*Paralichthys lethostigma*)	p. 110	p. 111	p. 112

Table 4. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico/ Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Mussel	A	■	□	■	■	□	□	□
	S	■	■	■	■	□	■	■
Mytilis edulis	J	■	□	■	■	□	□	□
	L	■	□	■	■	□	□	□
	E	■	■	■	■	□	■	■
Bay scallop	A	■	▣	■	■	▣	▣	■
	S	■	▣	■	■	▣	▣	■
Argopecten irradians	J	■	▣	■	■	▣	▣	■
	L	■	□	■	■	▣	▣	■
	E	■	▣	■	■	▣	▣	■
American oyster	A	■	▣	■	■	■	▣	▣
	S	■	▣	■	□	▣	▣	▣
Crassostrea virginica	J	■	▣	■	■	■	▣	▣
	L	■	▣	■	□	▣	▣	▣
	E	■	▣	■	□	▣	▣	▣
Common rangia	A	■	■	■	▣	□	□	□
	S	▣	□	□	□	□	□	□
Rangia cuneata	J	■	■	■	▣	□	□	□
	L	□	□	□	□	□	□	□
	E	▣	□	□	□	□	□	□
Hard clam	A	■	▣	■	■	■	▣	■
	S	■	▣	■	■	▣	□	■
Mercenaria species	J	■	▣	■	■	■	▣	■
	L	■	▣	■	■	▣	□	■
	E	■	▣	■	■	▣	□	■
Brown shrimp	A	■	▣	▣	■	▣	▣	■
	S	■	■	■	■	■	■	■
Penaeus aztecus	J	▣	▣	▣	□	▣	▣	■
	L	▣	▣	■	□	▣	▣	■
	E	■	■	■	■	■	■	■
		Albemarle Sound	Pamlico Sound	Pamlico/ Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
Mussel	A	▣	■	■	■	■	■	■
	S	■	■	■	■	■	■	■
Mytilis edulis	J	▣	■	■	■	■	■	■
	L	▣	■	■	■	■	■	■
	E	■	■	■	■	■	■	■
Bay scallop	A	■	■	■	■	■	■	■
	S	■	■	■	■	■	■	■
Argopecten irradians	J	■	■	■	■	■	■	■
	L	■	■	■	■	■	■	■
	E	■	■	■	■	■	■	■
American oyster	A	■	■	▣	▣	■	□	□
	S	▣	▣	▣	▣	■	□	□
Crassostrea virginica	J	■	■	▣	▣	■	□	□
	L	▣	▣	▣	▣	■	□	□
	E	▣	▣	▣	▣	■	□	□
Common rangia	A	□	□	▣	□	□	□	□
	S	□	□	□	□	□	□	□
Rangia cuneata	J	□	□	▣	□	□	□	□
	L	□	□	□	□	□	□	□
	E	□	□	□	□	□	□	□
Hard clam	A	▣	▣	▣	■	▣	▣	▣
	S	▣	▣	▣	▣	▣	▣	▣
Mercenaria species	J	▣	▣	▣	■	▣	▣	▣
	L	▣	▣	▣	▣	▣	▣	▣
	E	▣	▣	▣	▣	▣	▣	▣
Brown shrimp	A	▣	▣	▣	□	▣	▣	▣
	S	□	■	■	■	■	■	■
Penaeus aztecus	J	▣	▣	▣	▣	▣	▣	▣
	L	▣	▣	■	▣	▣	□	□
	E	□	■	■	■	■	■	■
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
Mussel	A	■	■	■	■	■	■
	S	■	■	■	■	■	■
Mytilis edulis	J	■	■	■	■	■	■
	L	■	■	■	■	■	■
	E	■	■	■	■	■	■
Bay scallop	A	■	■	■	□	□	□
	S	■	■	■	□	□	□
Argopecten irradians	J	■	■	■	□	□	□
	L	■	■	■	□	□	□
	E	■	■	■	□	□	□
American oyster	A	▣	▣	▣	▣	▣	▣
	S	□	□	▣	▣	□	□
Crassostrea virginica	J	▣	▣	▣	▣	▣	▣
	L	□	□	□	▣	□	□
	E	□	□	□	▣	□	□
Common rangia	A	□	□	□	■	■	□
	S	□	□	□	■	□	□
Rangia cuneata	J	□	□	□	■	■	□
	L	□	□	□	■	□	□
	E	□	□	□	■	□	□
Hard clam	A	▣	▣	▣	□	▣	□
	S	▣	▣	▣	□	▣	□
Mercenaria species	J	▣	▣	▣	□	▣	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	▣	□
Brown shrimp	A	▣	□	▣	■	□	□
	S	▣	■	■	■	■	■
Penaeus aztecus	J	▣	□	▣	■	▣	▣
	L	□	□	□	■	□	□
	E	■	■	■	■	■	■
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Pink shrimp	A	□	▣	□	▣	▣	▣	■
	S	■	■	■	■	■	■	■
Penaeus duorarum	J	▣	■	□	▣	▣	□	■
	L	▣	▣	■	▣	▣	▣	■
	E	■	■	■	■	■	■	■
White shrimp	A	▣	▣	▣	□	▣	■	■
	S	■	■	■	■	■	■	■
Penaeus setiferus	J	▣	□	▣	□	▣	▣	■
	L	▣	▣	■	□	▣	▣	■
	E	■	■	■	■	■	■	■
Grass shrimp	A	■	▣	▣	□	▣	■	■
	S	□	□	□	□	▣	▣	▣
Palaemonetes pugio	J	□	▣	▣	□	▣	■	■
	L	□	□	□	□	▣	▣	□
	E	□	□	□	□	▣	▣	□
Blue crab	A	■	▣	▣	■	▣	▣	■
	M	■	▣	▣	■	▣	□	▣
Callinectes sapidus	J	■	▣	▣	▣	□	▣	▣
	L	▣	▣	▣	▣	□	□	■
	E	▣	▣	▣	▣	▣	□	▣
Atlantic sturgeon	A	▣	□	□	□	▣	▣	▣
	S	▣	▣	□	□	▣	▣	▣
Acipenser oxyrhynchus	J	▣	□	□	□	▣	▣	▣
	L	□	□	□	□	▣	▣	□
	E	▣	▣	□	□	▣	▣	□
Ladyfish	A	▣	□	▣	▣	▣	□	□
	S	■	▣	■	■	■	■	▣
Elops saurus	J	▣	□	□	▣	▣	□	▣
	L	▣	▣	▣	▣	▣	□	□
	E	■	▣	■	■	■	■	▣
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
Pink shrimp	A	▣	▣	▣	▣	▣	▣	□
	S	■	■	■	■	■	▣	▣
Penaeus duorarum	J	▣	▣	▣	▣	▣	▣	□
	L	▣	▣	▣	▣	▣	□	□
	E	■	■	■	■	■	▣	▣
White shrimp	A	▣	▣	▣	▣	▣	□	▣
	S	■	■	▣	■	▣	■	■
Penaeus setiferus	J	▣	▣	▣	▣	▣	□	▣
	L	■	□	▣	▣	■	□	▣
	E	■	■	□	■	▣	■	■
Grass shrimp	A	■	■	▣	▣	▣	□	□
	S	■	▣	▣	▣	▣	□	□
Palaemonetes pugio	J	■	■	▣	▣	▣	□	□
	L	■	▣	▣	▣	▣	□	□
	E	■	▣	▣	▣	▣	□	□
Blue crab	A	▣	□	▣	▣	▣	□	□
	M	□	□	▣	□	□	□	□
Callinectes sapidus	J	■	□	□	□	□	□	□
	L	■	□	▣	□	▣	□	□
	E	▣	□	▣	□	▣	□	□
Atlantic sturgeon	A	□	□	□	□	□	□	□
	S	□	□	□	▣	□	□	□
Acipenser oxyrhynchus	J	▣	□	□	□	□	□	□
	L	▣	□	□	□	□	□	□
	E	▣	□	□	□	□	□	□
Ladyfish	A	▣	▣	□	□	▣	□	□
	S	■	■	■	▣	■	■	■
Elops saurus	J	▣	□	□	▣	■	□	□
	L	▣	□	□	▣	▣	□	□
	E	■	■	■	▣	■	■	■
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
Pink shrimp	A	▣	▣	□	■	▣	▣
	S	▣	■	▣	■	■	■
Penaeus duorarum	J	▣	▣	□	■	▣	■
	L	□	□	□	■	▣	□
	E	▣	■	▣	■	■	■
White shrimp	A	▣	□	▣	■	□	□
	S	■	■	■	■	■	■
Penaeus setiferus	J	▣	□	▣	■	▣	▣
	L	▣	□	□	■	□	□
	E	■	■	■	■	■	■
Grass shrimp	A	▣	□	□	■	■	□
	S	□	□	□	■	■	□
Palaemonetes pugio	J	▣	□	□	■	■	□
	L	□	□	□	■	■	□
	E	□	□	□	■	■	□
Blue crab	A	▣	□	□	■	■	■
	M	□	□	□	■	□	□
Callinectes sapidus	J	□	□	□	■	▣	■
	L	□	□	□	■	□	□
	E	□	□	□	■	□	□
Atlantic sturgeon	A	□	□	□	□	■	■
	S	□	□	□	□	■	■
Acipenser oxyrhynchus	J	□	□	□	□	■	■
	L	□	□	□	□	■	■
	E	□	□	□	□	■	■
Ladyfish	A	□	□	□	▣	■	▣
	S	■	■	■	▣	■	■
Elops saurus	J	□	□	□	▣	■	▣
	L	▣	□	▣	▣	▣	□
	E	■	■	■	▣	■	■
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
American eel**	A	□	□	□	□	□	□	□
	S	■	■	■	■	■	■	■
Anguilla rostrata	J	▣	▣	▣	▣	▣	□	▣
	L	□	□	□	□	□	□	□
	E	■	■	■	■	■	■	■
Blueback herring	A	▣	□	▣	▣	□	□	▣
	S	■	□	■	□	□	□	□
Alosa aestivalis	J	▣	□	▣	▣	□	□	▣
	L	■	□	■	□	□	□	▣
	E	■	□	■	□	□	□	□
Alewife	A	▣	□	▣	▣	□	□	▣
	S	■	▣	□	▣	□	□	▣
Alosa pseudoharengus	J	▣	□	▣	▣	□	□	▣
	L	▣	▣	□	□	□	□	▣
	E	▣	▣	□	▣	□	□	▣
American shad	A	▣	□	▣	▣	□	□	▣
	S	▣	▣	▣	▣	□	□	▣
Alosa sapidissima	J	▣	□	▣	▣	□	□	▣
	L	▣	□	▣	▣	□	□	□
	E	▣	▣	▣	▣	□	□	▣
Atlantic menhaden	A	▣	□	□	□	▣	□	■
	S	■	■	■	■	■	■	■
Brevoortia tyrannus	J	□	□	□	□	▣	□	■
	L	□	□	□	□	□	□	▣
	E	■	■	■	■	■	■	■
Bay anchovy	A	▣	▣	▣	▣	▣	□	▣
	S	▣	▣	▣	▣	▣	□	▣
Anchoa mitchilli	J	▣	▣	▣	▣	▣	□	▣
	L	▣	▣	▣	▣	▣	□	▣
	E	▣	▣	□	▣	▣	□	▣
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 4, continued. Data reliability

Species/Life Stage		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
American eel**	A	□	□	▣	□	□	▣	□
	S	■	■	■	■	■	■	■
Anguilla rostrata	J	▣	▣	▣	▣	▣	▣	□
	L	□	□	□	□	□	□	□
	E	■	■	■	■	■	■	■
Blueback herring	A	□	▣	▣	□	▣	□	□
	S	□	▣	▣	□	▣	□	□
Alosa aestivalis	J	□	▣	□	□	▣	□	□
	L	□	▣	▣	□	▣	□	□
	E	□	▣	▣	□	▣	□	□
Alewife	A	□	▣	■	■	■	■	■
	S	□	▣	■	■	■	■	■
Alosa pseudoharengus	J	□	▣	■	■	■	■	■
	L	□	▣	■	■	■	■	■
	E	□	▣	■	■	■	■	■
American shad	A	▣	□	▣	▣	▣	□	□
	S	▣	□	▣	▣	▣	▣	□
Alosa sapidissima	J	▣	□	▣	▣	▣	□	□
	L	▣	□	▣	▣	▣	□	□
	E	▣	□	▣	▣	▣	▣	□
Atlantic menhaden	A	▣	□	■	▣	▣	□	□
	S	■	■	■	■	■	■	■
Brevoortia tyrannus	J	▣	▣	□	▣	▣	□	□
	L	▣	□	□	□	▣	□	□
	E	■	■	■	■	■	■	■
Bay anchovy	A	▣	▣	■	▣	▣	□	□
	S	▣	□	□	▣	▣	□	□
Anchoa mitchilli	J	▣	▣	■	▣	▣	□	□
	L	▣	▣	□	▣	▣	□	□
	E	▣	□	□	▣	▣	□	□
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
American eel**	A	□	□	□	□	▣	▣
	S	■	■	■	■	■	■
Anguilla rostrata	J	□	▣	□	▣	■	▣
	L	□	▣	□	□	▣	□
	E	■	■	■	■	■	■
Blueback herring	A	□	□	□	□	■	■
	S	□	□	□	□	■	■
Alosa aestivalis	J	□	□	□	▣	■	■
	L	□	□	□	□	■	■
	E	□	□	□	□	■	■
Alewife	A	■	■	■	▣	■	■
	S	■	■	■	▣	■	■
Alosa pseudoharengus	J	■	■	■	▣	■	■
	L	■	■	■	▣	■	■
	E	■	■	■	▣	■	■
American shad	A	□	□	□	▣	■	■
	S	□	□	□	▣	■	■
Alosa sapidissima	J	□	□	□	□	■	■
	L	□	□	□	▣	■	■
	E	□	□	□	▣	■	■
Atlantic menhaden	A	□	□	□	▣	□	▣
	S	■	■	■	▣	■	■
Brevoortia tyrannus	J	▣	□	□	▣	▣	▣
	L	□	□	□	▣	□	▣
	E	■	■	■	▣	■	■
Bay anchovy	A	□	□	□	▣	■	■
	S	▣	□	□	□	■	▣
Anchoa mitchilli	J	□	□	□	▣	■	■
	L	▣	□	□	□	■	▣
	E	▣	□	□	□	■	▣
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

** See *Life History Notes*, p. 12.

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Sheepshead minnow *Cyprinodon variegatus*	A	▣	▣	□	□	□	□	□
	S	□	□	□	□	□	□	▣
	J	▣	▣	□	□	□	□	□
	L	□	□	□	□	□	□	▣
	E	□	□	□	□	□	□	▣
Mummichog *Fundulus heteroclitus*	A	□	▣	□	□	□	□	▣
	S	□	□	□	□	□	□	▣
	J	□	▣	□	□	□	□	▣
	L	□	□	□	□	□	□	▣
	E	□	□	□	□	□	□	▣
Atlantic silversides *Menidia* species	A	▣	□	□	▣	□	□	▣
	S	▣	□	□	▣	▣	□	■
	J	▣	□	□	▣	□	□	▣
	L	▣	□	□	▣	▣	□	■
	E	▣	□	□	▣	▣	□	■
White perch *Morone americana*	A	■	□	▣	▣	□	▣	▣
	S	■	□	□	□	□	▣	▣
	J	■	□	▣	▣	□	▣	▣
	L	■	□	□	□	□	▣	▣
	E	■	□	□	□	□	▣	▣
Striped bass *Morone saxatilis*	A	▣	▣	▣	■	□	□	□
	S	▣	▣	▣	■	□	□	□
	J	▣	▣	▣	■	□	□	▣
	L	▣	□	▣	▣	□	□	□
	E	▣	▣	▣	■	□	□	□
Bluefish *Pomatomus saltatrix*	A	▣	▣	▣	▣	▣	□	□
	S	■	■	■	■	■	■	■
	J	▣	▣	□	▣	▣	□	■
	L	■	▣	■	■	▣	▣	■
	E	■	■	■	■	■	■	■
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
Sheepshead minnow	A	▣	▣	□	□	□	□	□
	S	□	□	□	□	□	□	□
Cyprinodon variegatus	J	▣	▣	□	□	□	□	□
	L	□	□	□	□	□	□	□
	E	□	□	□	□	□	□	□
Mummichog	A	▣	▣	▣	▣	■	□	□
	S	□	□	▣	▣	▣	□	□
Fundulus heteroclitus	J	▣	▣	▣	▣	■	□	□
	L	□	□	▣	▣	▣	□	□
	E	□	□	▣	▣	▣	□	□
Atlantic silversides	A	▣	□	□	□	▣	□	□
	S	▣	□	▣	□	□	□	□
Menidia species	J	▣	□	□	□	▣	□	□
	L	▣	□	▣	□	□	□	□
	E	▣	□	▣	□	□	□	□
White perch	A	■	▣	▣	■	■	■	■
	S	□	□	▣	■	■	■	■
Morone americana	J	■	▣	▣	■	■	■	■
	L	□	□	▣	■	■	■	■
	E	□	□	▣	■	■	■	■
Striped bass	A	▣	▣	▣	▣	■	□	□
	S	▣	▣	▣	▣	□	□	▣
Morone saxatilis	J	▣	▣	▣	▣	■	□	□
	L	▣	▣	▣	▣	□	□	▣
	E	▣	▣	▣	▣	□	□	▣
Bluefish	A	■	▣	▣	▣	▣	□	□
	S	■	■	■	■	■	■	■
Pomatomus saltatrix	J	■	▣	■	■	■	▣	▣
	L	■	■	■	■	■	■	■
	E	■	■	■	■	■	■	■
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
Sheepshead minnow *Cyprinodon variegatus*	A	□	□	□	▣	■	■
	S	□	□	□	▣	■	▣
	J	□	□	□	▣	■	■
	L	□	□	□	▣	■	▣
	E	□	□	□	▣	■	▣
Mummichog *Fundulus heteroclitus*	A	□	□	□	□	▣	■
	S	□	□	□	□	▣	■
	J	□	□	□	□	▣	■
	L	□	□	□	□	▣	■
	E	□	□	□	□	▣	■
Atlantic silversides *Menidia* species	A	□	□	□	▣	■	■
	S	▣	▣	□	□	■	□
	J	□	□	□	▣	■	■
	L	▣	▣	□	□	■	□
	E	▣	▣	□	□	■	□
White perch *Morone americana*	A	■	■	■	■	■	■
	S	■	■	■	■	■	■
	J	■	■	■	■	■	■
	L	■	■	■	■	■	■
	E	■	■	■	■	■	■
Striped bass *Morone saxatilis*	A	□	□	□	▣	■	■
	S	□	□	□	□	■	■
	J	□	□	□	▣	■	■
	L	□	□	□	□	■	■
	E	□	□	□	□	■	■
Bluefish *Pomatomus saltatrix*	A	□	□	□	□	▣	▣
	S	■	■	■	■	■	■
	J	▣	▣	▣	□	□	▣
	L	■	■	■	▣	■	■
	E	■	■	■	■	■	■
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Cobia	A	▣	▣	▣	▣	■	□	▣
	S	▣	□	▣	▣	▣	■	■
Rachycentron canadum	J	▣	▣	▣	▣	■	□	▣
	L	▣	■	▣	▣	□	□	▣
	E	▣	■	▣	▣	▣	■	▣
Gray snapper	A	■	▣	■	■	▣	▣	■
	S	■	■	■	■	■	■	■
Lutjanus griseus	J	▣	▣	▣	□	▣	□	■
	L	■	▣	■	■	■	▣	■
	E	■	■	■	■	■	■	■
Sheepshead	A	▣	▣	▣	▣	▣	□	▣
	S	■	▣	■	■	□	■	□
Archosargus probatocephalus	J	▣	▣	▣	□	▣	□	▣
	L	■	□	■	□	□	□	□
	E	■	▣	■	■	▣	■	□
Pinfish	A	▣	□	□	□	▣	□	▣
	S	■	■	■	■	■	■	■
Lagodon rhomboides	J	▣	□	□	▣	▣	□	▣
	L	▣	▣	□	▣	□	□	▣
	E	■	■	■	■	■	■	■
Spotted seatrout	A	▣	□	□	□	▣	□	□
	S	■	▣	▣	▣	□	□	■
Cynoscion nebulosus	J	▣	□	□	□	▣	□	□
	L	▣	□	▣	□	□	□	■
	E	■	▣	▣	▣	□	□	■
Weakfish	A	▣	▣	▣	▣	▣	□	▣
	S	▣	▣	□	□	□	□	▣
Cynoscion regalis	J	□	□	□	□	▣	▣	▣
	L	▣	▣	□	□	□	□	■
	E	▣	▣	□	□	□	□	▣
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
Cobia	A	▣	▣	▣	▣	▣	□	□
	S	■	■	■	■	■	□	□
Rachycentron canadum	J	▣	▣	▣	▣	▣	□	□
	L	▣	▣	▣	▣	▣	□	□
	E	■	■	■	■	■	□	□
Gray snapper	A	■	■	▣	▣	▣	▣	▣
	S	■	■	■	■	■	■	■
Lutjanus griseus	J	▣	▣	□	▣	■	□	□
	L	■	▣	□	■	▣	▣	▣
	E	■	■	■	■	■	■	■
Sheepshead	A	▣	▣	▣	▣	▣	□	□
	S	■	■	■	▣	▣	■	■
Archosargus probatocephalus	J	▣	▣	▣	▣	▣	▣	▣
	L	□	▣	□	▣	▣	□	□
	E	■	■	■	▣	▣	■	■
Pinfish	A	▣	▣	□	▣	▣	□	□
	S	■	■	■	■	■	■	■
Lagodon rhomboides	J	▣	▣	□	▣	▣	▣	▣
	L	□	▣	□	□	□	□	□
	E	■	■	■	■	■	■	■
Spotted seatrout	A	□	▣	□	▣	■	▣	▣
	S	▣	▣	□	□	■	□	□
Cynoscion nebulosus	J	□	▣	□	▣	■	□	□
	L	□	▣	□	□	□	□	□
	E	▣	▣	□	□	■	□	□
Weakfish	A	□	□	▣	□	▣	▣	▣
	S	▣	■	▣	□	■	□	□
Cynoscion regalis	J	▣	▣	▣	□	▣	□	□
	L	▣	▣	□	□	▣	□	□
	E	▣	■	▣	□	▣	□	□
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
Cobia	A	□	□	□	□	■	▣
	S	□	□	□	□	■	■
Rachycentron canadum	J	□	□	▣	□	■	▣
	L	□	□	□	□	■	■
	E	□	□	□	▣	■	■
Gray snapper	A	▣	▣	▣	□	■	▣
	S	■	■	■	■	■	▣
Lutjanus griseus	J	□	□	□	□	■	■
	L	▣	▣	▣	□	■	▣
	E	■	■	■	■	■	▣
Sheepshead	A	□	▣	▣	□	■	▣
	S	■	■	■	□	▣	□
Archosargus probatocephalus	J	▣	▣	▣	▣	■	▣
	L	□	□	□	□	▣	□
	E	■	■	■	□	▣	□
Pinfish	A	□	□	□	▣	■	▣
	S	■	■	■	■	□	■
Lagodon rhomboides	J	▣	▣	▣	▣	▣	■
	L	□	□	□	□	□	▣
	E	■	■	■	■	□	■
Spotted seatrout	A	▣	▣	▣	▣	▣	■
	S	▣	▣	▣	□	□	▣
Cynoscion nebulosus	J	□	□	□	▣	▣	■
	L	□	□	□	□	□	▣
	E	□	□	□	□	□	▣
Weakfish	A	▣	▣	▣	□	■	▣
	S	□	□	□	□	▣	□
Cynoscion regalis	J	□	□	□	□	▣	▣
	L	□	□	□	□	▣	□
	E	□	□	□	□	▣	□
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Spot	A	▣	▣	▣	▣	■	▣	▣
	S	■	■	■	■	■	■	■
Leiostomus xanthurus	J	▣	▣	▣	▣	▣	□	▣
	L	▣	▣	▣	▣	▣	□	▣
	E	■	■	■	■	■	■	■
Southern kingfish	A	□	□	□	▣	□	□	▣
	S	■	■	■	■	■	■	■
Menticirhhus americanus	J	□	▣	□	▣	□	□	▣
	L	□	□	▣	▣	□	□	□
	E	■	■	■	■	■	■	■
Atlantic croaker	A	▣	□	□	□	▣	□	▣
	S	■	■	■	■	■	■	■
Micropogonias undulatus	J	▣	▣	▣	▣	▣	□	▣
	L	▣	▣	▣	▣	▣	□	▣
	E	■	■	■	■	■	■	■
Black drum	A	▣	▣	□	□	□	□	▣
	S	■	□	■	■	■	■	■
Pogonias cromis	J	□	▣	□	□	□	□	▣
	L	▣	□	▣	□	□	□	▣
	E	■	□	■	■	■	■	■
Red drum	A	■	▣	▣	▣	▣	□	▣
	S	■	□	▣	■	□	□	▣
Sciaenops ocellatus	J	□	▣	▣	▣	□	□	□
	L	■	□	▣	▣	□	□	▣
	E	■	□	▣	■	□	□	▣
Striped mullet	A	▣	▣	▣	▣	▣	□	□
	S	■	■	■	■	■	■	■
Mugil cephalus	J	▣	▣	▣	▣	▣	□	□
	L	▣	□	▣	□	□	□	▣
	E	■	■	■	■	■	■	■
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
Spot	A	▣	□	▣	□	▣	▣	▣
	S	■	■	■	■	■	■	■
Leiostomus xanthurus	J	▣	□	□	□	▣	□	□
	L	■	▣	□	▣	▣	□	▣
	E	■	■	■	■	■	■	■
Southern kingfish	A	□	▣	▣	▣	▣	□	□
	S	■	■	■	■	■	□	□
Menticirhhus americanus	J	□	▣	▣	▣	▣	□	□
	L	□	▣	□	▣	□	□	□
	E	■	■	■	■	■	□	□
Atlantic croaker	A	▣	▣	▣	▣	■	▣	▣
	S	■	■	■	■	■	■	■
Micropogonias undulatus	J	▣	□	□	▣	■	□	▣
	L	▣	■	□	▣	▣	□	□
	E	■	■	■	■	■	■	■
Black drum	A	□	□	□	▣	▣	□	□
	S	□	□	□	▣	■	□	□
Pogonias cromis	J	□	□	□	▣	▣	□	□
	L	□	▣	□	▣	▣	□	□
	E	□	□	□	▣	▣	□	□
Red drum	A	▣	□	□	▣	▣	□	□
	S	▣	▣	□	▣	■	□	□
Sciaenops ocellatus	J	▣	□	□	▣	▣	□	□
	L	▣	▣	▣	▣	■	□	□
	E	▣	□	□	▣	■	□	□
Striped mullet	A	▣	▣	□	□	▣	□	□
	S	■	■	■	■	■	■	■
Mugil cephalus	J	□	▣	□	□	▣	□	□
	L	■	▣	□	□	□	□	□
	E	■	■	■	■	■	■	■
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
Spot	A	▣	▣	▣	□	▣	□
	S	■	■	■	■	■	■
Leiostomus xanthurus	J	□	□	□	▣	▣	□
	L	▣	▣	▣	□	▣	□
	E	■	■	■	■	■	■
Southern kingfish	A	▣	□	▣	□	□	▣
	S	□	□	□	▣	■	■
Menticirhhus americanus	J	▣	□	▣	▣	▣	▣
	L	▣	□	□	□	□	□
	E	□	□	□	▣	■	■
Atlantic croaker	A	▣	□	□	□	▣	▣
	S	■	■	■	■	■	■
Micropogonias undulatus	J	□	□	□	▣	▣	▣
	L	□	□	□	□	▣	□
	E	■	■	■	■	■	■
Black drum	A	□	□	□	□	■	□
	S	□	□	□	□	■	□
Pogonias cromis	J	□	□	□	▣	■	□
	L	□	□	□	□	■	□
	E	□	□	□	□	■	□
Red drum	A	□	□	□	□	▣	□
	S	□	□	□	□	□	□
Sciaenops ocellatus	J	□	□	□	□	▣	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Striped mullet	A	□	□	□	□	■	□
	S	■	■	■	■	■	■
Mugil cephalus	J	□	□	□	▣	■	▣
	L	□	□	□	□	■	□
	E	■	■	■	■	■	■
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries						
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
Spanish mackerel	A	□	■	■	▣	▣	□	▣
	S	■	■	■	■	■	■	■
Scomberomorus maculatus	J	□	▣	▣	□	▣	□	▣
	L	■	■	□	▣	▣	□	▣
	E	■	■	■	■	■	■	■
Gulf flounder	A	■	□	■	▣	▣	▣	▣
	S	■	■	■	■	■	■	■
Paralichthys albigutta	J	■	▣	■	▣	▣	□	▣
	L	■	▣	■	▣	■	□	□
	E	■	■	■	■	■	■	■
Summer flounder	A	▣	▣	□	□	▣	□	▣
	S	■	■	■	■	■	■	■
Paralichthys dentatus	J	▣	▣	□	▣	▣	□	■
	L	□	▣	▣	▣	▣	□	■
	E	■	■	■	■	■	■	■
Southern flounder	A	▣	▣	□	▣	▣	□	▣
	S	■	■	■	■	■	■	■
Paralichthys lethostigma	J	▣	▣	▣	▣	▣	□	▣
	L	□	▣	▣	□	□	□	▣
	E	■	■	■	■	■	■	■
		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
Spanish mackerel	A	▣	▣	□	▣	▣	□	□
	S	■	■	■	■	■	□	□
Scomberomorus maculatus	J	▣	□	□	▣	▣	□	□
	L	▣	▣	□	□	□	□	□
	E	■	■	■	■	■	□	□
Gulf flounder	A	□	▣	□	▣	□	□	□
	S	■	■	■	■	■	■	■
Paralichthys albigutta	J	□	▣	□	▣	□	□	□
	L	□	▣	□	▣	□	□	□
	E	■	■	■	■	■	■	■
Summer flounder	A	▣	□	□	▣	■	▣	▣
	S	■	■	■	■	■	■	■
Paralichthys dentatus	J	▣	□	▣	▣	■	□	□
	L	▣	▣	□	□	□	□	□
	E	■	■	■	■	■	■	■
Southern flounder	A	▣	▣	□	□	■	□	□
	S	■	■	■	■	■	■	■
Paralichthys lethostigma	J	▣	▣	□	□	■	□	□
	L	▣	▣	□	□	□	□	□
	E	■	■	■	■	■	■	■
		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 4, continued. Data reliability

Species/Life Stage		Southeast Estuaries					
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
Spanish mackerel	A	□	□	□	□	□	▣
	S	□	□	□	■	■	■
Scomberomorus maculatus	J	▣	▣	▣	□	▣	▣
	L	□	□	□	□	▣	□
	E	□	□	□	■	■	■
Gulf flounder	A	□	□	□	□	▣	▣
	S	■	■	■	■	■	■
Paralichthys albigutta	J	□	□	□	□	▣	▣
	L	□	□	□	□	□	□
	E	■	■	■	■	■	■
Summer flounder	A	▣	▣	▣	□	□	■
	S	■	■	■	■	■	■
Paralichthys dentatus	J	▣	□	□	□	□	■
	L	□	□	□	□	□	■
	E	■	■	■	■	■	■
Southern flounder	A	□	□	□	□	▣	▣
	S	■	■	■	■	■	■
Paralichthys lethostigma	J	□	□	□	□	▣	▣
	L	□	□	□	□	□	□
	E	■	■	■	■	■	■
		St. Cathe./ Sapelo Sound	Altamaha River	St. Andrew/ St. Simon Sound	St. Johns River	Indian River	Biscayne Bay
		Southeast Estuaries					

Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Table 5. Occurrence* of 40 species in 20 southeast estuaries

*Highest relative abundance of adults or juveniles in any salinity zone, in any month.

Relative Abundance:
- ● - Highly Abundant
- ◉ - Abundant
- ○ - Common
- √ - Rare
- Blank - Not Present

Species	Albemarle Sound	Pamlico Sound	Pamlico/Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River	Winyah Bay	N/S Santee River	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound	St. Cath./Sapelo Snd.	Altamaha River	St. And./St. Sim. Snd.	St. Johns River	Indian River	Biscayne Bay
blue mussel		√			√	√	√	√												
bay scallop		◉			◉	●	√												√	○
American oyster	○	◉	◉	○	●	●	●	●	○	◉	●	●	○	◉	◉	○	◉	◉	○	○
common rangia	◉	◉	◉	◉	○	○	○	○	○	√	√	√	○	○	○	○	○	○	√	
hard clam		◉			●	●	●	◉	○	◉	○	◉	○	○	○	○	○	○	○	○
brown shrimp	○	◉	◉	◉	●	◉	◉	◉	◉	●	●	◉	○	◉	◉	○	◉	◉	○	√
pink shrimp	○	◉	○	◉	◉	◉	◉	○	◉	○	√	○	○	○	○	√	○	○	◉	●
white shrimp	◉	◉	○	○	○	○	◉	◉	●	●	●	●	●	●	●	◉	●	●	○	√
grass shrimp	○	◉	◉	◉	●	●	●	●	◉	●	◉	◉	◉	◉	●	◉	◉	●	◉	○
blue crab	◉	●	●	●	●	◉	●	●	◉	◉	●	●	◉	◉	◉	◉	◉	●	◉	●
Atlantic sturgeon	○	○	○	○		√	○	○	√	√	○	○	○	○	○	○	○	√		
ladyfish	○	○	○	○	√	√	○	○	√	○	○	○	○	○	○	○	○	○	●	○
American eel	◉	●	◉	●	○	○	◉	◉	○	○	○	○	◉	◉	◉	◉	◉	◉	◉	○
blueback herring	●	●	●	●	√	√	◉	○	○	○	○	○	○	○	○	○	○	○		
alewife	●	◉	○	◉	○	√	√	√												
American shad	◉	○	○	○	√	√	○	○	◉	○	○	√	○	○	√	◉	○	○		
Atlantic menhaden	●	●	●	●	●	●	●	●	●	◉	◉	●	◉	◉	◉	◉	◉	◉	○	
bay anchovy	●	●	◉	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
sheepshead minnow	√	◉	○	◉	◉	◉	◉	○	○	○	◉	○	◉	◉	◉	◉	◉	○	●	○
mummichog	○	●	◉	◉	●	●	●	◉	◉	◉	●	◉	●	●	●	●	●	◉	√	
Atlantic silversides	◉	◉	○	◉	●	●	◉	◉	◉	○	●	●	◉	◉	◉	◉	◉	●	●	◉
white perch	●	○	○	○	√			◉	○	○										
striped bass	◉	○	○	○	√	√	√	○	○	○	○	◉	○	◉	√	○	√	○		
bluefish	○	◉	○	○	◉	○	◉	◉	○	○	○	○	○	○	○	○	○	○	●	√
cobia		○			○	○	○	√	○	○	○	◉	○	○	○	○	○	○		
gray snapper	√	○	√	√	√	√	√	√	○	○	√	√	√	√	√	√	√	○	●	●
sheepshead	√	◉	√	○	◉	◉	◉	○	○	○	○	○	○	○	○	○	○	◉	●	√
pinfish	○	◉	◉	◉	●	●	●	●	○	○	◉	○	○	○	○	○	○	◉	●	●
spotted seatrout	◉	◉	○	○	◉	◉	◉	○	○	○	◉	◉	●	●	●	●	●	○	●	○
weakfish	○	◉	◉	○	◉	◉	◉	○	●	◉	○	◉	◉	◉	◉	◉	◉	◉	○	√
spot	●	●	●	●	●	●	●	●	●	●	◉	◉	●	●	●	●	●	◉	●	○
southern kingfish	○	○	○	○	◉	◉	○	◉	◉	◉	◉	◉	●	●	●	●	●	○	○	√
Atlantic croaker	◉	●	●	●	●	●	●	●	●	●	●	●	◉	●	●	●	●	◉	○	√
black drum	√	○	○	○	√	√	√	○	√	○	○	○	○	○	○	○	◉	◉	●	√
red drum	√	○	○	○	◉	√	○	◉	√	○	○	○	○	◉	◉	●	●	◉	●	√
striped mullet	◉	◉	◉	◉	●	●	●	●	◉	◉	◉	◉	●	●	●	●	●	●	●	○
spanish mackerel	○	○	○	○	◉	◉	○	○	√	○	○	○	○	○	○	○	○	○	√	○
gulf flounder		○			○	○	√	√	√	○		√	√	√	√	√	√	○	●	○
summer flounder	○	◉	○	○	◉	○	○	◉	○	○	○	○	◉	◉	◉	◉	◉	○	○	
southern flounder	◉	◉	◉	◉	◉	◉	◉	◉	◉	○	○	◉	◉	◉	◉	◉	◉	◉	◉	√

Appendices

Appendix 1. Nationwide ELMR estuary list
Appendix 2. Nationwide ELMR species list
Appendix 3. National Estuarine Inventory map of Pamlico Sound
Appendix 4. Life history summary: bluefish, northeast region
Appendix 5. Table of references and personal communications
Appendix 6. Life history table headers
Appendix 7. Personal communications
Appendix 8. References

Appendix 1. ELMR Estuaries

Northeast ELMR Estuaries (n=34)

Estuary	State
Passamaquoddy Bay	ME
Englishman Bay	ME
Narraguagus Bay	ME
Blue Hill Bay	ME
Penobscot Bay	ME
Muscongus Bay	ME
Sheepscot Bay	ME
Casco Bay	ME
Saco Bay	ME
Great Bay	ME/NH
Merrimack River	NH/MA
Massachusetts Bay	MA
Boston Bay	MA
Cape Cod Bay	MA
Buzzards Bay	MA
Narragansett Bay	RI
Gardiners Bay	NY
Long Island Sound	CT/NY
Connecticut River	CT
Great South Bay	NY
Hudson River/Raritan Bay	NJ/NY
Barnegat Bay	NJ
Delaware Bay	DE/NJ/PA
Delaware Inland Bays	DE
Chincoteague Bay	MD/VA
Chesapeake Bay	MD/VA
Potomac River	DC/MD/VA
Rappahannock River	VA
York River	VA
James River	VA
Patuxent River	MD
Chester River	MD
Choptank River	MD
Tangier/Pocomoke Sound	MD

Southeast ELMR Estuaries (n=20)

Estuary	State
Albemarle Sound	NC/VA
Pamlico Sound	NC
Pamlico and Pungo Rivers	NC
Neuse River	NC
Bogue Sound	NC
New River	NC
Cape Fear River	NC
Winyah Bay	SC
Charleston Harbor	SC
North and South Santee Rivers	SC
St. Helena Sound	SC
Broad River	SC
Savannah River	GA/SC
Ossabaw Sound	GA
St. Catherine's / Sapelo Sound	GA
Altamaha River	GA
St. Andrew / St. Simon's Sound	GA
St. Johns River	FL
Indian River	FL
Biscayne Bay	FL

Gulf of Mexico ELMR Estuaries (n=31)

Estuary	State
Florida Bay	FL
Ten Thousand Islands	FL
Caloosahatchee River	FL
Charlotte Harbor	FL
Tampa Bay	FL
Suwannee River	FL
Apalachee Bay	FL
Apalachicola Bay	FL
St.Andrew Bay	FL
Choctawhatchee Bay	FL
Pensacola Bay	FL
Perdido Bay	FL/AL
Mobile Bay	AL
Mississippi Sound	MS/LA
Lake Borgne	LA
Lake Pontchartrain	LA
Breton/Chandeleur Sounds	LA
Mississippi River	LA
Barataria Bay	LA
Terrebonne/Timbalier Bays	LA
Atchafalaya/Vermilion Bays	LA
Calcasieu Lake	LA
Sabine Lake	LA/TX
Galveston Bay	TX
Brazos River	TX
Matagorda Bay	TX
San Antonio Bay	TX
Aransas Bay	TX
Corpus Christi Bay	TX
Laguna Madre	TX
Baffin Bay	TX

West Coast ELMR Estuaries (n=32)

Estuary	State
Puget Sound	WA
Hood Canal	WA
Skagit Bay	WA
Grays Harbor	WA
Willapa Bay	WA
Columbia River	OR/WA
Nehalem Bay	OR
Tillamook Bay	OR
Netarts Bay	OR
Siletz River	OR
Yaquina Bay	OR
Alsea River	OR
Siuslaw River	OR
Umpqua River	OR
Coos Bay	OR
Rogue River	OR
Klamath River	CA
Humboldt Bay	CA
Eel River	CA
Tomales Bay	CA
Central San Francisco Bay*	CA
South San Francisco Bay	CA
Elkhorn Slough	CA
Morro Bay	CA
Santa Monica Bay	CA
San Pedro Bay	CA
Alamitos Bay	CA
Anaheim Bay	CA
Newport Bay	CA
Mission Bay	CA
San Diego Bay	CA
Tijuana Estuary	CA

*includes San Pablo and Suisun Bays.

Appendix 2. ELMR Species

Northeast ELMR Species (n=62)

Common name	Scientific Name
Blue mussel	*Mytilus edulis*
Bay scallop	*Argopecten irradians*
American oyster	*Crassostrea virginica*
Hard clam	*Mercenaria* species
Eastern softshell clam	*Mya arenaria*
Short-fin squid	*Illex brevis*
Brown shrimp	*Penaeus aztecus*
Grass shrimp	*Palaemonetes pugio*
Northern shrimp	*Pandalus borealis*
Sand shrimp	*Crangon septemspinosa*
American lobster	*Homarus americanus*
Blue crab	*Callinectes sapidus*
Skates	*Raja species*
Atlantic stingray	*Dasyatis sabina*
Cownose ray	*Rhinoptera bonasus*
Shortnose sturgeon	*Acipenser brevirostrum*
Atlantic sturgeon	*Acipenser oxyrhynchus*
American eel	*Anguilla rostrata*
Blueback herring	*Alosa aestivalis*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic herring	*Clupea harengus*
Bay anchovy	*Anchoa mitchilli*
Atlantic salmon	*Salmo salar*
Channel catfish	*Ictalurus punctatus*
Oyster toadfish	*Opsanus tau*
Atlantic cod	*Gadus morhua*
Haddock	*Melanogrammus aeglefinus*
Atlantic tomcod	*Microgadus tomcod*
Pollock	*Pollachius virens*
Red hake	*Urophycis chuss*
Sheepshead minnow	*Cyprinodon variegatus*
Mummichogs	*Fundulus species*
Silversides	*Menidia* species
Northern pipefish	*Syngnathus fuscus*
White perch	*Morone americana*
Striped bass	*Morone saxatilis*
Black sea bass	*Centropristis striata*
Yellow perch	*Perca flavescens*
Bluefish	*Pomatomus saltatrix*
Pinfish	*Lagodon rhomboides*
Scup	*Stenotomus chrysops*
Spotted seatrout	*Cynoscion nebulosus*
Weakfish	*Cynoscion regalis*
Spot	*Leiostomus xanthurus*
Northern kingfish	*Menticirrhus saxatilis*
Atlantic croaker	*Micropogonias undulatus*
Black drum	*Pogonias cromis*
Red drum	*Sciaenops ocellatus*
Tautog	*Tautog unitis*
Cunner	*Tautogolabrus adspersus*
Mullet	*Mugil species*
Sand lance	*Ammodytes americanus*
Gobies	*Gobiosoma species*
Atlantic mackerel	*Scomber scombrus*
Butterfish	*Peprilus triacanthus*
Northern searobin	*Prionotus carolinus*
Summer flounder	*Paralichthys dentatus*
Windowpane flounder	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Hogchoker	*Trinectes maculatus*

Southeast ELMR Species (n=40)

Common name	Scientific Name
Blue mussel	*Mytilus edulis*
Bay scallop	*Argopecten irradians*
American oyster	*Crassostrea virginica*
Common rangia	*Rangia cuneata*
Hard clam	*Mercenaria* species
Brown shrimp	*Penaeus aztecus*
Pink shrimp	*Penaeus duorarum*
White shrimp	*Penaeus setiferus*
Grass shrimp	*Palaemonetes pugio*
Blue crab	*Callinectes sapidus*
Atlantic sturgeon	*Acipenser oxyrhynchus*
Ladyfish	*Elops saurus*
American eel	*Anguilla rostrata*
Blueback herring	*Alosa aestivalis*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Bay anchovy	*Anchoa mitchilli*
Sheepshead minnow	*Cyprinodon variegatus*
Mummichog	*Fundulus heteroclitus*
Silversides	*Menidia* species
White perch	*Morone americana*
Striped bass	*Morone saxatilis*
Bluefish	*Pomatomus saltatrix*
Cobia	*Rachycentron canadum*
Gray snapper	*Lutjanus griseus*
Sheepshead	*Archosargus probatocephalus*
Pinfish	*Lagodon rhomboides*
Spotted seatrout	*Cynoscion nebulosus*
Weakfish	*Cynoscion regalis*
Spot	*Leiostomus xanthurus*
Southern kingfish	*Menticirrhus americanus*
Atlantic croaker	*Micropogonias undulatus*
Black drum	*Pogonias cromis*
Red drum	*Sciaenops ocellatus*
Striped mullet	*Mugil cephalus*
Spanish mackerel	*Scomberomorus maculatus*
Gulf flounder	*Paralichthys albigutta*
Summer flounder	*Paralichthys dentatus*
Southern flounder	*Paralichthys lethostigma*

Gulf of Mexico ELMR Species (n=44)

Common name	Scientific Name
Bay scallop	*Argopecten irradians*
American oyster	*Crassostrea virginica*
Common rangia	*Rangia cuneata*
Hard clam	*Mercenaria* species
Bay squid	*Lolliguncula brevis*
Brown shrimp	*Penaeus aztecus*
Pink shrimp	*Penaeus duorarum*
White shrimp	*Penaeus setiferus*
Grass shrimp	*Palaemonetes pugio*
Spiny lobster	*Panulirus argus*
Blue crab	*Callinectes sapidus*
Gulf stone crab	*Menippe adina*
Stone crab	*Menippe mercenaria*
Bull shark	*Carcharhinus leucas*
Tarpon	*Megalops atlanticus*
Alabama shad	*Alosa alabamae*
Gulf menhaden	*Brevoortia patronus*
Yellowfin menhaden	*Brevoortia smithi*
Gizzard shad	*Dorosoma cepedianum*
Bay anchovy	*Anchoa mitchilli*
Hardhead catfish	*Arius felis*
Sheepshead minnow	*Cyprinodon variegatus*
Gulf killifish	*Fundulus grandis*
Silversides	*Menidia* species
Snook	*Centropomus undecimalis*
Bluefish	*Pomatomus saltatrix*
Blue runner	*Caranx crysos*
Crevalle jack	*Caranx hippos*
Florida pompano	*Trachinotus carolinus*
Gray snapper	*Lutjanus griseus*
Sheepshead	*Archosargus probatocephalus*
Pinfish	*Lagodon rhomboides*
Silver perch	*Bairdiella chrysoura*
Sand seatrout	*Cynoscion arenarius*
Spotted seatrout	*Cynoscion nebulosus*
Spot	*Leiostomus xanthurus*
Atlantic croaker	*Micropogonias undulatus*
Black drum	*Pogonias cromis*
Red drum	*Sciaenops ocellatus*
Striped mullet	*Mugil cephalus*
Code goby	*Gobiosoma robustum*
Spanish mackerel	*Scomberomorus maculatus*
Gulf flounder	*Paralichthys albigutta*
Southern flounder	*Paralichthys lethostigma*

West Coast ELMR Species (n=47)

Common name	Scientific Name
Blue mussel	*Mytilus edulis*
Pacific oyster	*Crassostrea gigas*
Fat gaper	*Tresus capax*
Pacific gaper	*Tresus nuttalli*
California jacknife clam	*Tagelus californianus*
Pacific littleneck clam	*Protothaca staminea*
Manila clam	*Venerupis japonica*
Softshell	*Mya arenaria*
Geoduck	*Panope abrupta*
Bay shrimp	*Crangon franciscorum*
Dungeness crab	*Cancer magister*
Leopard shark	*Triakis semifasciata*
Green sturgeon	*Acipenser medirostris*
White sturgeon	*Acipenser transmontanus*
American shad	*Alosa sapidissima*
Pacific herring	*Clupea harengus pallasi*
Deepbody anchovy	*Anchoa compressa*
Slough anchovy	*Anchoa delicatissima*
Northern anchovy	*Engraulis mordax*
Cutthroat trout	*Oncorhynchus clarki*
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*Oncorhynchus keta*
Coho salmon	*Oncorhynchus kisutch*
Steelhead	*Oncorhynchus mykiss*
Sockeye salmon	*Oncorhynchus nerka*
Chinook salmon	*Oncorhynchus tshawytscha*
Surf smelt	*Hypomesus pretiosus*
Longfin smelt	*Spirinchus thaleichthys*
Eulachon	*Thaleichthys pacificus*
Pacific tomcod	*Microgadus proximus*
Topsmelt	*Atherinops affinis*
Jacksmelt	*Atherinopsis californiensis*
Threespine stickleback	*Gasterosteus aculeatus*
Striped bass	*Morone saxatilis*
Kelp bass	*Paralabrax clathratus*
Barred sand bass	*Paralabrax nebulifer*
White seabass	*Atractoscion nobilis*
White croaker	*Genyonemus lineatus*
Shiner perch	*Cymatogaster aggregata*
Pacific sand lance	*Ammodytes hexapterus*
Arrow goby	*Clevelandia ios*
Lingcod	*Ophiodon elongatus*
Pacific staghorn sculpin	*Leptocottus armatus*
California halibut	*Paralichthys californicus*
Diamond turbot	*Hypsopsetta guttulata*
English sole	*Pleuronectes vetulus*
Starry flounder	*Platichthys stellatus*

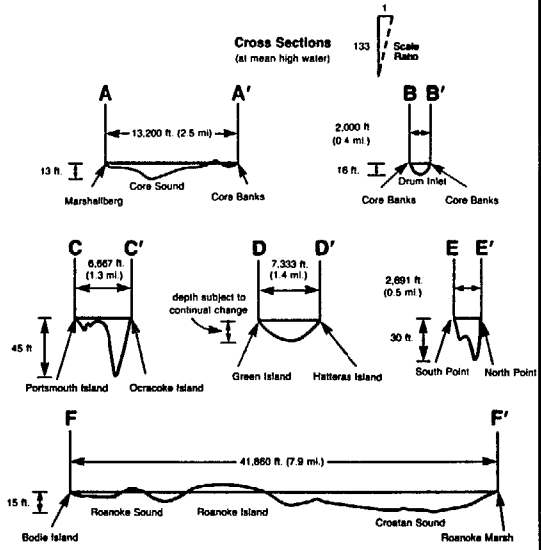
Appendix 3. National Estuarine Inventory Map of Pamlico Sound

National Estuarine Atlas

PHYSICAL AND HYDROLOGIC CHARACTERISTICS

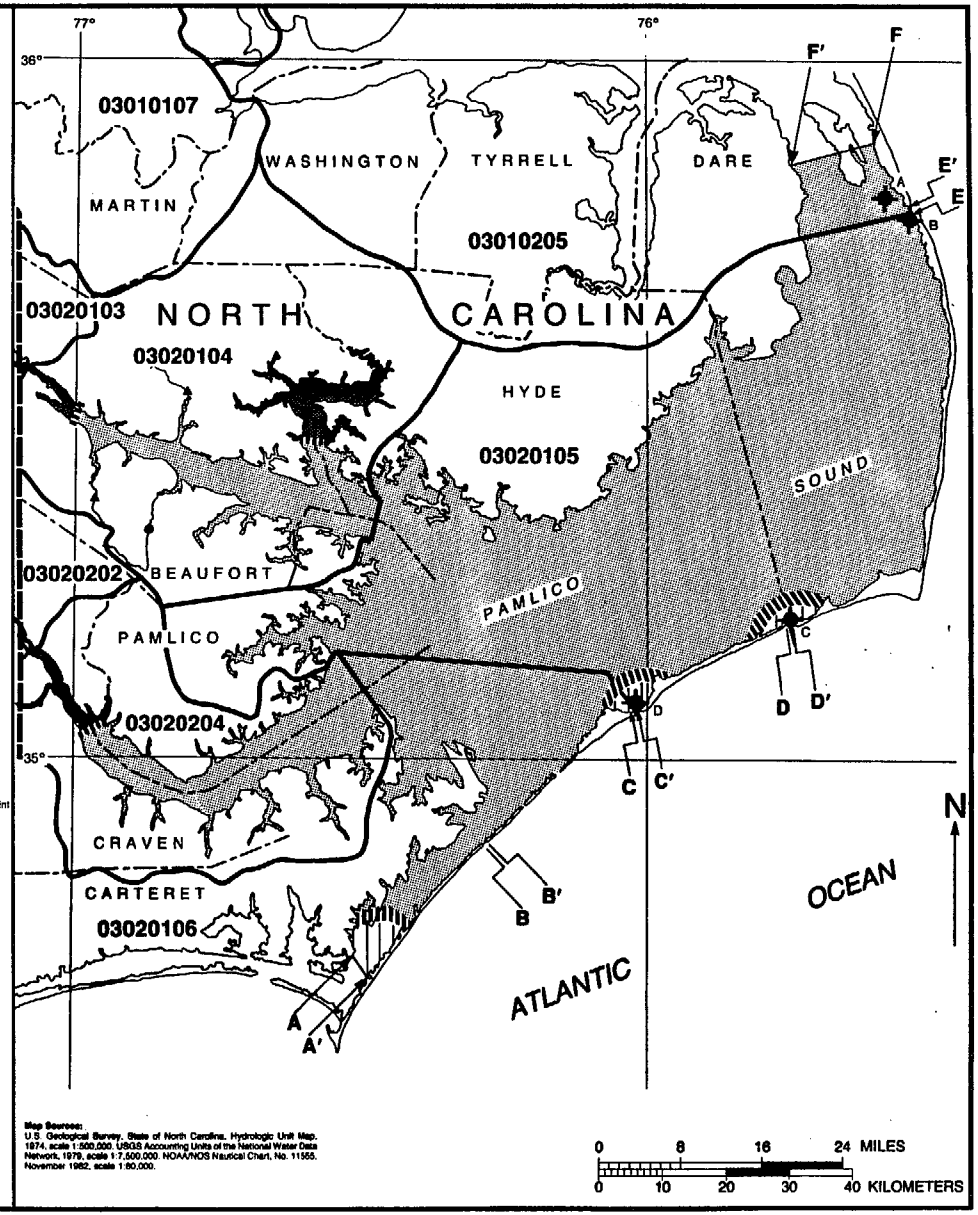
PHYSICAL		FRESHWATER INFLOW			TIDAL DATA		
Surface Areas (mi²)		*Flow Rates (1000 cfs)*			Prevailing Tide: Semidiurnal		
Fluvial Drainage	5,546	Period of Record		1971-1982	Tidal Prism (cf)		2.86x10¹⁰
Estuarine Drainage	5,790						
Estuarine Zones		Long Term Average Daily		21.2	*Phase Range of Tide (ft.)*		
Tidal Fresh	96				Map Key	Station	Range
Mixing Zone	1,891	Long Term Average Monthly	J 23.4	J 25.3	A	2453	1.7
Seawater	40		F 22.5	A 23.2	B	2447	0.3
Total	2,027		M 27.1	S 18.9	C	2457	2.0
Dimensions			A 21.9	O 14.1	C	2458	1.9
Length (mi.)	120.0		M 20.6	N 14.3			
Width (mi.) Average	15.7		J 21.6	D 17.2			
Minimum	0.9	7-Day, 10-Year Low Flow		0.4			
Maximum	29.6						
Average Depth (ft.)	18.0	50-Year Flood		98.8			
Average Depth to Width Ratio	2.2x10⁻⁴	100-Year Flood		111.5			
		Flow Ratios					
Stratification Classification		Average Annual		0.033			
3-Month High Flow	VH	High Flow Period		0.038			
3-Month Low Flow	VH	Low Flow Period		0.024			

Abbreviations: Vertically Homogeneous, VH; Moderately Stratified, MS; Highly Stratified, HS.



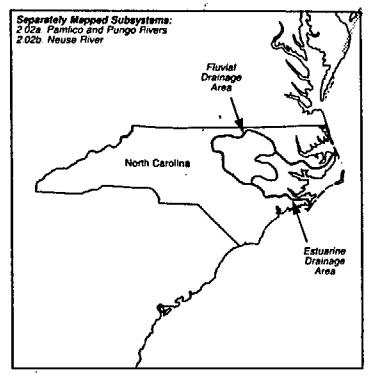
Notes:
Approximately 65% of Estuarine Drainage Area is shown on map. Drainage Divide represents portion of Estuarine Drainage Area boundary not coinciding with U.S. Geological Survey cataloging unit boundary. Tidal prism calculations assume a uniform 0.5 ft tide range except at the ocean inlets. Flows include freshwater input from precipitation.

References:
Bowden and Hobbie, 1977. Bowden and Hobbie, 1977. Geise, et al., 1979. Gunter, et al., 1982. Jackson, n.d. Schwartz and Chestnut, 1973. U.S. Department of Commerce, 1983a.



Map Sources:
U.S. Geological Survey, State of North Carolina, Hydrologic Unit Map, 1974, scale 1:500,000. USGS Accounting Units of the National Water Data Network, 1979, scale 1:7,500,000. NOAA/NOS Nautical Chart, No. 11555, November 1982, scale 1:80,000.

Pamlico Sound NC



- Tide Gage
- Flow Gage
- Head of Tide
- Estuarine Drainage Area (EDA)
- Tidal Fresh Zone
- Mixing Zone
- Seawater Zone
- Hydrologic Cataloging Unit Boundary
- County Boundary
- Salinity Zone Boundary - Low Variability
- Salinity Zone Boundary - Moderate Variability
- Salinity Zone Boundary - High Variability

Strategic Assessment Branch
Ocean Assessments Division
Office of Oceanography and Marine Assessment
National Ocean Service/NOAA

2.02

ELMR Life History Summary
Bluefish (*Pomatomus saltatrix*)
Northeast region

Common Name: Bluefish
Scientific Name: *Pomatomus saltatrix*

Other Common Names: Blue, tailor, elf, fatback, snapper, snap mackerel, skipjack, skip mackerel, horse mackerel, greenfish, chopper (Bigelow and Schroeder 1953; Manooch 1984; Pottern et al. 1989)

Classification

Phylum:	Chordata
Class:	Osteichthyes
Order:	Perciformes
Family:	Pomatomidae

Value

Commercial: Bluefish are harvested almost entirely for the fresh market and sold as whole fish or fillets. This is a result of the relatively poor freezing qualities of bluefish due to the oily, soft nature of the flesh. The market price is generally low and subject to the mercy of short-term, localized market demand, but can help to supplement fishermen's incomes when more desirable species are not available (Pottern et al. 1989; Manooch 1984). Bluefish is not a significant contributor to the overall commercial harvest in the region, accounting for only about 0.5 % of the Atlantic coast finfish and shellfish industry landings from 1980 to 1983. Pottern et al. (1989) summarized the commercial bluefish landings for the mid-Atlantic region from 1950 to 1985. For the 10 year period from 1975 to 1985, the area from Massachusetts to Virginia accounted for 54.3 percent of the U.S. total landings of bluefish. Approximately one-fifth of the U.S. total was taken from Chesapeake Bay. Historically, most of the U.S. commercial catch of bluefish (approximately 90%) was taken fewer than three miles from shore. However, since the late 1970s, offshore fishing has increased and inshore catch has dropped to about 70 percent of the total (Pottern et al. 1989). From Massachusetts to Delaware commercial fishing takes place primarily between May and November, with peak catches from July to September. Bluefish are caught year-round in Maryland and Virginia with peak catches early in the summer (Pottern et al. 1989). Fishing gear varies widely with location; otter trawls, gill nets, and pound nets yield most of the commercial catch, with traps, hand lines and seines also used (Mid-Atlantic FMC 1984; Pottern et al. 1989).

Recreational: Bluefish is one of the most important sport fish in the study area, and usually ranks first in both numbers of fish caught and weight every year. Bluefish are well-known to sport fishermen for their incredible biting power and voracious feeding habits. They are relatively easy to catch, and can be taken using a wide variety of techniques, including trolling, casting, live-bait fishing, jigging, still fishing, and drift fishing (Pottern et al. 1989). They are caught from boats, piers, bridges, jetties, and the surf (Manooch 1984). Smaller bluefish (generally less than one kilogram) are sometimes used as live bait by pier and boat anglers fishing for cobia (*Rachycentron canadum*), king mackerel (*Scomberomorous cavalla*) and greater amberjack (*Seriola dumereli*).

Indicator of Environmental Stress: Mahoney et al. (1973) found a high incidence of fin rot disease in bluefish during the summers each year from 1967 through 1973. The authors suggested that heavy metal contaminants present in high concentrations in the area (copper, zinc, chromium, and lead) weakened the fishes' immune response to the bacteria that caused the disease. These bacteria were also present in high concentrations because of poorly treated municipal and industrial sewage discharge. It has also been found that concentrations of metals in the liver (Mears and Eisler 1977) and white muscle (Cross et al. 1973) are positively correlated with body size.

Ecological: Due to the size and speed of bluefish, only a few large predators, such as sharks, tunas, swordfish, and wahoo would pose a threat (Wilk 1977; Mid-Atlantic FMC 1984). However, the bluefish's piscivorous, predacious habits could put it in competition with other predators such as striped bass (*Morone saxatilis*), Spanish mackerel (*Scomberomorous maculatus*), king mackerel (*Scomberomorous cavalla*), and large weakfish (*Cynoscion regalis*) (Wilk 1977; Mid-Atlantic FMC 1984).

Range

Overall: Bluefish occur on the continental shelf and in estuarine waters in temperate and tropical waters around much of the world. In North America they occur in Atlantic coastal waters from Nova Scotia to northern Mexico. Elsewhere in the Atlantic they occur in Bermuda, Cuba, Venezuela, Brazil to Uruguay, the Azores, Portugal to Senegal, including the Mediterranean and Black Seas, and Angola to South Africa. In the Indian Ocean they occur on the east coast of southern Africa, Madagascar, the Malay Peninsula, Tasmania, and southern and western Australia (Bigelow and Schroeder 1953; Wilk 1977; Manooch 1984; Mid-Atlantic FMC 1984; Pottern et al. 1989).

Within Study Area: Bluefish are found throughout the study area and are most common from Virginia to Cape Cod (Bigelow and Schroeder 1953; Wilk 1977; Manooch

1984; Mid-Atlantic FMC 1984). Historically, abundance in the Gulf of Maine undergoes marked fluctuations that appear to be related to the overall abundance of the north Atlantic bluefish stock (Bigelow and Schroeder 1953).

Life Mode

The bluefish is a migratory, pelagic species that primarily travels in schools. These schools are generally groups of like-sized fish that can form aggregations that cover tens of square miles (Bigelow and Schroeder 1953; Wilk 1977; Mid-Atlantic FMC 1984). Spawning occurs primarily over the outer half of the continental shelf (Norcross 1974). Eggs are found at the surface (Deuel et al 1966). Larvae are strongly associated with the surface (Kendall and Walford 1979) and show a net movement inshore as the growing season progresses (Norcross et al. 1974), but are not commonly found in nearshore waters (Boreman 1983). There are few recorded cases of bluefish larvae being caught in estuaries; a single larva of 3.12 mm was caught in Narragansett bay in July 1957 (Herman 1963). Juveniles from spring spawning move into bays and estuaries as waters warm during early summer. While inshore, they feed heavily and grow rapidly until fall, when they migrate offshore and south (Hardy 1978; Pottern et al. 1989). Juveniles from summer spawning remain mostly over continental shelf waters for the remainder of the summer and make their first coastal appearance the following spring (Wilk 1977; Pottern et al. 1989). Little information exists on the age at which bluefish mature, but Deuel (1964) reported most bluefish are mature by age two.

Habitat

Type: Eggs are spawned in the deep waters of the continental shelf. Eggs and larvae remain mostly at the surface. Juveniles are found from the surface to possibly the thermocline (Norcross et al. 1974), and from rivers and estuaries to almost 100 km offshore (Clark et al. 1969). Adults are highly migratory and pelagic and are found in a wide variety of habitats from coastal rivers and the surf zone of coastal beaches to the waters of the continental shelf.

Substrate: Due to their migratory and pelagic nature, bluefish are generally not thought of as being associated with a particular substrate. Juveniles in the Delaware River estuary were found over bottoms of sand and gravel (deSylva et al. 1962; Smith 1971).

Physical/Chemical Characteristics:

Temperature: Eggs taken from bluefish captured in New York hatched in 46 to 48 hours at 20° C (Deuel et al. 1966). Eggs from the Black Sea hatched in 46 hours at 20.3° C (Pottern et al. 1989). Adults under laboratory conditions survived temperatures as low as 11.8° C and as high as 30.4° C. Temperature was also found to directly influence swimming speed (Olla and Studholme 1971).

Salinity: Bluefish larvae have been found in salinities as high as 35-38 ppt (Kendall and Walford 1979). Little information is available on the lower limits of salinity tolerance for bluefish, but Norcross et al. (1974) indicated that they received a personal communication reporting juvenile bluefish caught in the Rappahannock River, Virginia, 135 km from the mouth of the Chesapeake Bay. Salinity at the point of capture was not indicated, but the water must have been nearly fresh.

Migrations and Movements

Bluefish undergo extensive onshore-offshore and north-south migrations. Adults overwinter off the southeastern coast of Florida and begin a northerly migration in the spring. During the migration north, a spring spawning period occurs just shoreward of the Gulf Stream from southern North Carolina to Florida, and a summer spawning period occurs off the mid-Atlantic region (Lund and Maltezos 1970; Wilk 1977; Kendall and Walford 1979). Bluefish that have completed the spring spawning in the southern Atlantic region move shoreward, with the smaller fish generally moving west, more toward northern North Carolina and the Chesapeake and Delaware Bays. The larger fish move towards shore further north in areas such as Long Island Sound and Narragansett Bay, or may continue north around Cape Cod (Pottern et al. 1989). Bluefish that have completed the summer spawning move toward shore in the mid-Atlantic and north Atlantic (Lund and Maltezos 1970) and depart in the autumn, along with the spring spawners, for their southern wintering grounds (Pottern 1989). Larvae from the spring spawning are carried north by currents past Cape Hatteras in April and May and become spread out over the continental shelf off the mid-Atlantic Bight. As shelf waters warm, juveniles move inshore and enter estuaries, where they spend the summer. In the early fall, these fish migrate out of the estuaries and move south along the coast. Larvae from the summer spawning move toward shore, but few enter estuaries, and those that do spend at most a month. They also move southward by mid- fall but their distribution in late fall and winter is still not known (Kendall and Walford 1979). In general, during the the fall migrations younger, immature fish move southward close to shore, while the mature fish move southward, more offshore (Lund and Maltezos 1970).

Reproduction

Mode: Bluefish are sexual and have separate sexes with external fertilization (Wilk 1977).

Mating and Spawning: No information could be found on the mating behavior of bluefish. Times of spawning have been inferred by the presence of larvae and to a lesser extent, eggs. The spring spawning in the southern Atlantic probably occurs in April and May. The summer spawning in the mid-Atlantic probably occurs mostly in July and August. Norcross et al. (1974) found that in summer spawning in the Chesapeake Bight, most bluefish began spawning at 22° C and that 25.6° C was the average temperature at maximum spawning. Salinity was also found to have an effect on the distribution of eggs, with an optimum salinity for spawning of 31 ppt. There is also a smaller fall and winter spawning that occurs offshore of Cape Hatteras from which larvae have been obtained in October (Kendall and Walford 1979).

Reproductive Capacity: The only estimate of fecundity that could be found for East Coast fish was for a small sample of 3- to 4-year-old females from North Carolina that ranged from 0.6 to 1.4 million eggs (Pottern et al. 1989).

Growth and Development

Eggs: In fertilized eggs, the smooth spherical egg capsule is transparent, the yolk pale amber and the single large oil globule a deeper amber. The diameter is 0.9 to 1.20 mm, averaging 1.0 mm, and the oil globule is 0.22 to 0.30 mm, averaging 0.25 mm. Eggs held in seawater of 20° C and 32.5 ppt salinity hatched in 46 to 48 hours (Deuel et al. 1966).

Larvae: Yolk-sac larvae are generally 2.0 to 2.2 mm at hatching with a maximum size of 3.08 mm. At hatching, yolk covers more than half the length of the larva but is largely consumed at a length of 3.08 mm (approximately 100 hours). Larval bluefish range from 3.0 to about 14 mm. Initially, the body is slender with a relatively large head, but the body depth is noticeably increased by 6.0 mm. The gas bladder is visible in larvae from 3.0 to 10.0 mm before becoming obscured by overlying musculature (Norcross et al. 1974).

Juveniles: Minimum size is approximately 14.0 mm. The body is fusiform by 16.5 mm and larger (Norcross et al. 1974) and by 21.0 mm is covered with fine spots. Juveniles from the spring spawning grow rapidly once they enter estuaries and coastal bays. Juveniles that enter mid-Atlantic bays are approximately 25.0 to 50.0 mm standard length (SL) but may be as large as 175 to 200 mm (SL) by the time of their southerly migration in the fall. Juveniles from the summer spawning do not spend the summer in the nutrient-rich estuaries and lag behind in growth, obtaining lengths of 40 to 70 mm SL prior to their southerly migration (Pottern et al. 1989).

Adults: There are reliable records of bluefish up to 9 years old (Wilk 1977) and as big as 3.5 feet and 27 pounds (Bigelow and Schroeder 1953).

Food and Feeding

Juvenile bluefish in Sandy Hook Bay, New Jersey were found to feed on several species of fish and invertebrates, including oppossum shrimp *Neomysis americana*, sand shrimp *Crangon septemspinosa*, grass shrimp *Palaemonetes vulgaris*, gammarid amphipods, bay anchovy *Anchoa mitchilli*, striped killifish *Fundulus majalis*, mummichog *Fundulus heteroclitus*, and Atlantic silversides *Menidia menidia*. Invertebrates were the main prey items in two of the three years that sampling took place in Sandy Hook Bay but bluefish were heavier at length when fish dominated their diets (Friedland et al. 1988). Bluefish are primarily visual predators, but can also respond to olfactory stimuli (Wilk 1977). In laboratory experiments, bluefish showed a preference for larger prey items, suggesting that feeding motivation is in part influenced by prey size (Olla et al. 1970). It was also shown in these experiments that schooling behavior broke down during feeding as individuals chased prey items. Bluefish are noted for feeding "frenzies," periods during which they violently feed on schools of bait fish, leaving behind scraps that are eagerly fed on by gulls. The presence of these birds makes it easy to spot the schools of bluefish from considerable distances. In fact, in at least one documented case, a school of large bluefish in a feeding frenzy in Dade County, Florida attacked a group of swimmers and caused several injuries requiring stitches (de Sylva 1976). There was no indication that the attack was deliberate, but rather the swimmers happened to be in the way of bluefish chasing a school of mullet. Adult bluefish feed throughout the water column on a wide variety of fish and invertebrates. Common prey species include squid (*Loligo peali*), butterfish (*Peprilus triacanthus*), menhaden (*Brevoortia tyrannus*), round herring (*Etrumeus teres*), alewife (*Alosa pseudoharengus*), bay anchovy (*Anchoa mitchilli*), silver hake (*Merluccius bilinearis*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), mackerel (*Scomber scombrus*), Atlantic silversides (*Menidia menidia*), young weakfish (*Cynoscion regalis*) and young bluefish (Richards 1976; Wilk 1977).

References

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

Boreman, J. 1983. Status of bluefish along the Atlantic coast, 1982. U.S. Nat. Mar. Fish. Serv., Woods Hole Lab. Ref. Doc. No. 83-28. 35 pp.

Clark, J., W.G. Smith, A.W. Kendall, Jr., and M.P. Fahay. 1969. Studies of estuarine dependence of Atlantic coastal fishes. Data report 1: Northern section, Cape Cod to Cape Lookout. U.S. Bur. Sport Fish. Wildl. Tech. Pap. No. 59. 97 pp.

Cross, F.A., L.H. Hardy, N.Y. Jones, and R.T. Barber. 1973. Relation between total body weight and concentrations of manganese, iron, copper, zinc, and mercury in white muscle of bluefish *Pomatomus saltatrix* and a bathy-demersal fish *Antimora rostrata*. J. Fish. Res. Board Can. 30(9):1287-1291.

de Sylva, D.P., F.A. Kalber, Jr., and C.N. Shuster, Jr. 1962. Fishes and ecological conditions in the shorezone of the Delaware estuary, with notes on other species collected in deeper water. Univ. Del. Mar. Lab. Inf. Ser. Publ. 164 pp.

de Sylva, D.P. 1976. Attacks by bluefish (*Pomatomus saltatrix*) on humans in south Florida. Copeia 1976(1):196-198.

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

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

Hardy, J.D., Jr. 1978. Development of fishes of the mid-Atlantic bight. In: An atlas of egg, larval and juvenile stages. Vol 3. U.S. Fish Wildl. Serv. Biol. Serv. Program. FWS/OBS-78/12. Pages 339-353.

Herman, S.S. 1963. Planktonic fish eggs and larvae of Narragansett Bay. Limnol. Oceanogr. 8:103-109.

Kendall, A.W., Jr., and L.A Walford. 1979. Sources and distribution of bluefish, *Pomatomus saltatrix*, larvae and juveniles of the east coast of the United States. U.S. Natl. Mar. Fish. Serv. Fish. Bull. 77(1):213-227.

Lund, W.A., Jr., and G.C. Maltezos. 1970. Movements and migrations of the bluefish, *Pomatomus saltatrix*, tagged in waters of New York and southern New England. Trans. Am. Fish. Soc. 99:719-725.

Mahoney, J., F. Midlige, and D. Deuel. 1973. The fin rot disease of marine and euryhaline fishes in the New York Bight. Trans Am. Fish. Soc. 102(3):596-605.

Manooch, C.S. III. 1984. Fisherman's guide to the fishes of the southeastern United States. N.C. Museum of Natural History, Raleigh, N.C.

Mears, H.C., and Eisler, R. 1977. Trace metals in liver from bluefish, tautog, and tilefish in relation to body length. Chesapeake Sci. 18(3):315-318.

Mid-Atlantic Fishery Management Council (Mid-Atlantic FMC). 1984. Bluefish fishery management plan. Mid-Atlantic FMC in cooperation with the U.S. Natl. Mar. Fish. Serv., New England FMC, and South Atlantic FMC. 109 pp. + appendices.

Norcross, J.J., S.L. Richardson, W.H. Massman, and E.B. Joseph. 1974. Development of young bluefish (*Pomatomus saltatrix*) and distribution of eggs and young in Virginian coastal waters. Trans. Am. Fish. Soc. 103:477-497.

Olla, B.L., H.M. Katz, and A.L. Studhome. 1970. Prey capture and feeding motivation in the bluefish, *Pomatomus saltatrix*. Copeia 1970(2):360-362.

Olla, B.L., and A.L. Studhome. 1971. The effect of temperature on the activity of bluefish, *Pomatomus saltatrix* L. Biol. Bull. (Woods Hole) 141:337-349.

Pottern, G.B., M.T. Huish, and J.H. Kerby. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) - bluefish. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.94). U.S. Army Corps of Engineers, TR EL-82-4. 20 pp.

Richards, S.W. 1976. Age, growth, and food of bluefish (*Pomatomus saltatrix*) from East-Central Long Island Sound from July through November 1975. Trans. Am. Fish. Soc. 105:523-525.

Smith, B.A. 1971. The fish of four low-salinity tidal tributaries of the Delaware River estuary. M.S. Thesis. Cornell University. 304 pp.

Wilk, S.J. 1977. Biological and fisheries data on bluefish, *Pomatomus saltatrix*. U.S. Nat. Mar. Fish. Serv., Sandy Hook Lab., Highlands, N.J. Tech. Serv. Rep. 11.

Appendix 5. Life History Table headers.

A. Habitat Associations

		Habitat Associations																																								
		Domain																									Substrate Preference									Depth Preference						
			Riverine			Estuarine																		Marine												Littoral		Sublittoral			Bathyal	
									Salinity Range								Temperature Range																									
									SEA			Venice System																														
	Life stage/activity	Lake	Coastal plain	Piedmont	Upland	Inlet mouth	Channel	Intertidal flat	Tidal fresh (0-0.5‰)	Mixing (0.5-25‰)	Seawater (>25‰)	Limnetic (0-0.5‰)	Oligohaline (0.5-5‰)	Mesohaline (5-18‰)	Polyhaline (18-30‰)	Euhaline (>30‰)	0-5 °C	5-10 °C	10-15 °C	15-20 °C	20-25 °C	25-30 °C	>30 °C	Beach/surf zone	Neritic	Oceanic	Mud/silt/clay	Sand	Pebble/cobble/gravel	Boulder/rocky outcrop	Shell	Submergent vegetation	Emergent vegetation	Floating vegetation	None	Intertidal	Subtidal	Inner shelf (10-50 m)	Middle shelf (50-100 m)	Outer shelf (100-200 m)	Mesobenthal (200-500 m)	Bathyobenthal (>500 m)
Species Name	A																																									
	S																																									
	J																																									
	L																																									
	E																																									

B. Biological Attributes

		Biological Attributes																															Value				Status				
		Life mode					Spatial strategy					Mobility			Feeding type		Prey items										Longevity														
	Life stage/activity	Epibenthic	Benthic	Demersal	Nektonic	Planktonic	Freshwater resident	Estuarine resident	Marine resident	Coastal migrant	Ocean migrant	Stationary	Low mobility	High mobility	Filter feeder	Non-filter feeder	Detritus	Phytoplankton	Zooplankton	Infauna	Epibenthos	Insects	Fish (eggs & larvae)	Fish (adults & juvs)	Macroalgae	Vascular plants	1 day	1-30 days	1-12 months	1-5 years	5-20 years	>20 years	Recreational	Commercial	Ecological	Indicator of Stress	Hatchery Stock	Listed	Licensed	Regulated	Exotic
Species Name	A																																								
	S																																								
	J																																								
	L																																								
	E																																								

C. Reproduction

	Reproduction																																														
	Fertilization/ development					Mating type			Spawning strategy					Parental care		Domain			Temporal schedule												Periodicity				Fecundity								Maturation age				
	External	Internal	Oviparous	Ovoviviparous	Viviparous	Monogamous	Polygamous	Broadcast spawner	Anadromous	Catadromous	Iteroparous	Semelparous	Batch spawn	Guard	Non-guard	Riverine	Estuarine	Marine	January	February	March	April	May	June	July	August	September	October	November	December	Annual spawning	2 or more per year	2 or more years	Undescribed	<100	100-1,000	1,000-10,000	10,000-100,000	100,000-1 million	1-10 million	>10 million	Undescribed	<1.5 years	1.5 to 3.5 years	3.5 to 5.5 years	> 5.5 years	Undescribed
Species Name																																															

Appendix 6. Table of references and personal communications

Common/Scientific Name	Albemarle Sound, NC
Mussel *Mytilis edulis*	554 McKenna, Winslow
Bay scallop *Argopecten irradians*	McKenna, Taylor, J. Ross, Chester, Winslow
American oyster *Crassostrea virginica*	57, 86, 133, 134 McKenna, Marshall, J. Ross, Chester, Winslow
Common rangia *Rangia cuneata*	86, 289, 509, 588 McKenna, Winslow
Hard clam *Mercenaria species*	134, 138 McKenna, Winslow
Brown shrimp *Penaeus aztecus*	86, 217, 586 McKenna, J. Ross, Chester, Winslow, Henry
Pink shrimp *Penaeus duorarum*	McKenna, J. Ross, Chester, Winslow
White shrimp *Penaeus setiferus*	371 McKenna, J. Ross, Chester, Winslow
Grass shrimp *Palaemonetes pugio*	86, 217, 319, 586 Winslow, McKenna, Henry
Blue crab *Callinectes sapidus*	86, 133, 201, 203, 217, 245, 358, 579, 586 Manooch, Winslow, J. Ross
Atlantic sturgeon *Acipenser oxyrhynchus*	86, 133, 203, 248, 427, 522 Manooch, J. Ross, Winslow, Henry
Ladyfish *Elops saurus*	133, 586 Manooch, J. Ross, Winslow, Henry
American eel *Anguilla rostrata*	86, 133, 201, 203, 217, 245, 260, 432, 521, 586 Manooch, J. Ross, Winslow, Henry
Blueback herring *Alosa aestivalis*	86, 133, 203, 217, 248, 381, 585, 586 Winslow, Manooch, J. Ross, Henry
Alewife *Alosa pseudoharengus*	86, 133, 203, 217, 248, 381, 585, 586 Manooch, Winslow, J. Ross, Henry
American shad *Alosa sapidissima*	86, 133, 141, 203, 248, 256, 507, 585, 586 Manooch, Winslow, J. Ross, Henry
Atlantic menhaden *Brevoortia tyrannus*	86, 133, 203, 217, 432 Ahrenholz
Bay anchovy *Anchoa mitchilli*	86, 133, 203, 206, 217, 586 J. Ross, Chester, Winslow, Henry
Sheepshead minnow *Cyprinodon variegatus*	133, 220 Henry, Winslow, J. Ross
Mummichog *Fundulus heteroclitus*	2, 133 J. Ross, Winslow, Henry
Atlantic silversides *Menidia species*	133, 147, 203, 408 J. Ross, Winslow
White perch *Morone americana*	86, 133, 201, 203, 217, 245, 260, 432, 480, 586 Manooch, Winslow, J. Ross, Henry, Chester
Striped bass *Morone saxatilis*	73, 86, 202, 203, 217, 248, 245, 256, 316, 432, 584, 585, 586 Manooch, Chester, S. Ross, J. Ross, Winslow, Hawkins
Bluefish *Pomatomus saltatrix*	133, 245, 586 Manooch, J. Ross, Winslow, Henry
Cobia *Rachycentron canadum*	Manooch, J. Smith, J. Ross, Winslow
Gray snapper *Lutjanus griseus*	133, 203 Manooch, J. Ross, Chester, Winslow, Henry
Sheepshead *Archosargus probatocephalus*	133, 245 J. Ross, Winslow, Henry
Pinfish *Lagodon rhomboides*	133, 203, 586 J. Ross, Chester, Winslow, Henry
Spotted seatrout *Cynoscion nebulosus*	86, 247, 245, 339, 341 Manooch, J. Ross, Chester, Winslow, Henry
Weakfish *Cynoscion regalis*	86, 133, 217, 247, 245, 338, 343, 346, 586 Winslow, Henry, Manooch, Chester, J. Ross
Spot *Leiostomus xanthurus*	86, 133, 203, 217, 245, 345, 401, 586 Winslow, Chester, S. Ross
Southern kingfish *Menticirrhus americanus*	133, 247 J. Ross, Winslow
Atlantic croaker *Micropogonias undulatus*	86, 133, 203, 217, 245, 344, 432, 586 S. Ross, Chester, Winslow, J. Ross
Black drum *Pogonias cromis*	133, 247, 376, 462 Manooch, J. Ross, Winslow
Red drum *Sciaenops ocellatus*	133, 247, 340, 342, 462, 505 J. Ross, Winslow, Chester, S. Ross
Striped mullet *Mugul cephalus*	86, 133, 203, 245, 586 J. Ross, Chester, Winslow, Henry
Spanish mackerel *Scomberomorus maculatus*	133, 586 Manooch, J. Ross, Chester, Winslow, Henry
Gulf flounder *Paralichthys albigutta*	402 Powell, Manooch, Winslow, Henry
Summer flounder *Paralichthys dentatus*	86, 203, 217, 400, 402 Powell, Manooch, J. Ross, Winslow, Chester
Southern flounder *Paralichthys lethostigma*	86, 201, 203, 217, 245, 400, 402 Powell, Manooch, J. Ross, Chester

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Pamlico Sound, NC
Mussel *Mytilis edulis*	554 McKenna
Bay scallop *Argopecten irradians*	133, 134, 477 Taylor, McKenna, Freeman
American oyster *Crassostrea virginica*	57, 85, 133, 134, 245 McKenna, Taylor, Freeman, Marshall, Chester
Common rangia *Rangia cuneata*	85, 134, 289, 509, 566, 588 Freeman, McKenna, Taylor
Hard clam *Mercenaria species*	85, 134, 138, 398 Freeman, McKenna, Taylor, Marshall
Brown shrimp *Penaeus aztecus*	85, 133, 134, 206, 242, 251, 319, 357, 408, 426, 477, 581 Freeman, McKenna, Taylor, J. Ross, Chester
Pink shrimp *Penaeus duorarum*	85, 133, 134, 206, 319, 408, 426, 477 Freeman, McKenna, Taylor, J. Ross, Chester
White shrimp *Penaeus setiferus*	85, 133, 134, 206, 371, 426 Freeman, McKenna, Taylor, J. Ross, Chester
Grass shrimp *Palaemonetes pugio*	85, 134, 206, 319 McKenna
Blue crab *Callinectes sapidus*	85, 118, 122, 123, 133, 134, 206, 251, 319, 356, 358, 408, 426, 477, 579 Freeman, Taylor, Winslow, S. Ross, Chester, Hawkins
Atlantic sturgeon *Acipenser oxyrhynchus*	85, 134, 245, 256, 356, 424, 426, 427, 522 Manooch
Ladyfish *Elops saurus*	133, 206, 271, 356, 408, 429, 505 Moye, Manooch, J. Ross, Hettler
American eel *Anguilla rostrata*	85, 133, 134, 201, 206, 245, 260, 271, 356, 408, 426, 429, 505, 521, 585, 586 Moye, J. Ross
Blueback herring *Alosa aestivalis*	85, 133, 134, 204, 205, 206, 245, 256, 271, 356, 381, 408, 426, 427, 429, 505, 585, 586 Moye, Manooch, J. Ross, Chester
Alewife *Alosa pseudoharengus*	85, 133, 134, 204, 205, 206, 245, 251, 256, 271, 356, 381, 408, 426, 427, 429, 505, 585, 586 Moye, Manooch, J. Ross, Chester
American shad *Alosa sapidissima*	85, 133, 134, 141, 204, 205, 206, 248, 256, 271, 356, 426, 429, 505, 507, 533, 585, 586 Moye, J. Ross
Atlantic menhaden *Brevoortia tyrannus*	85, 133, 134, 206, 217, 251, 271, 354, 356, 357, 396, 408, 424, 426, 429, 505 Ahrenholz
Bay anchovy *Anchoa mitchilli*	85, 133, 134, 206, 271, 319, 356, 357, 408, 426, 429, 463, 505, 586 Moye, J. Ross, Chester
Sheepshead minnow *Cyprinodon variegatus*	133, 220, 319, 408, 505 Marraro
Mummichog *Fundulus heteroclitus*	2, 133, 206, 271, 319, 357, 505 Moye, Marraro
Atlantic silversides *Menidia species*	85, 133, 134, 147, 206, 319, 356, 426, 505 J. Ross
White perch *Morone americana*	85, 133, 134, 206, 245, 251, 271, 356, 408, 426, 429, 480 Moye, J. Ross, Chester
Striped bass *Morone saxatilis*	85, 134, 204, 205, 245, 256, 356, 357, 426, 429 Chester, S. Ross, Winslow, J. Ross, Manooch, Hawkins
Bluefish *Pomatomus saltatrix*	85, 118, 133, 206, 245, 356, 408, 424, 426, 429, 505 Moye, Manooch, J. Ross, Chester
Cobia *Rachycentron canadum*	426 Manooch, J. Smith, J. Ross
Gray snapper *Lutjanus griseus*	85, 118, 133, 206, 356, 408, 426, 477, 505 Manooch, J. Ross
Sheepshead *Archosargus probatocephalus*	85, 118, 133, 206, 245, 356, 408, 424, 426 Moye, Manooch, J. Ross
Pinfish *Lagodon rhomboides*	85, 118, 133, 134, 206, 271, 319, 356, 408, 424, 426, 429, 505 Moye, J. Ross, Chester
Spotted seatrout *Cynoscion nebulosus*	85, 118, 133, 134, 206, 247, 245, 251, 339, 341, 356, 408, 424, 426, 429, 505 Moye, Manooch, J. Ross
Weakfish *Cynoscion regalis*	85, 133, 134, 206, 247, 245, 251, 338, 343, 346, 356, 424, 426, 505 Moye, Manooch, J. Ross, Chester
Spot *Leiostomus xanthurus*	85, 99, 118, 133, 134, 206, 245, 251, 271, 319, 345, 356, 357, 366, 396, 401, 408, 424, 426, 429, 463, 477, 505, 549, 566 Winslow, Chester, Hawkins
Southern kingfish *Menticirrhus americanus*	118, 133, 134, 206, 247, 245, 356, 408, 424, 426 Moye, J. Ross
Atlantic croaker *Micropogonias undulatus*	85, 99, 118, 133, 134, 206, 217, 245, 251, 271, 319, 344, 355, 356, 357, 366, 408, 424, 425, 426, 429, 463, 505, 566 J. Ross, Chester, Winslow, Hawkins
Black drum *Pogonias cromis*	85, 133, 206, 247, 356, 376, 424, 426. 462 Moye, Manooch, J. Ross
Red drum *Sciaenops ocellatus*	85, 133, 134, 206, 217, 247, 245, 340 342, 356, 408, 424, 426, 462, 505 Manooch, Chester, S. Ross, J. Ross, Hawkins
Striped mullet *Mugul cephalus*	85, 118, 133, 134, 206, 245, 271, 319, 356, 408, 426, 429, 505 Moye, J. Ross, Chester
Spanish mackerel *Scomberomorus maculatus*	118, 133, 206, 245, 408, 426, 505 Moye, Manooch, J. Ross
Gulf flounder *Paralichthys albigutta*	402, 424, 426, 477 Moye, Powell, J. Ross, Chester
Summer flounder *Paralichthys dentatus*	85, 118, 119, 133, 134, 206, 245, 356, 357, 400, 402, 408, 424, 426, 477, 505 Moye, Powell, Manooch, J. Ross, Chester
Southern flounder *Paralichthys lethostigma*	85, 117, 118, 119, 133, 134, 206, 245, 251, 271, 356, 357, 400, 402, 408, 424, 426, 429, 477, 494, 505 Moye, J. Ross, Chester, Manooch, Powell

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Pamlico and Pungo Rivers, NC
Mussel *Mytilis edulis*	554 McKenna
Bay scallop *Argopecten irradians*	85, 134 Chester, Taylor, McKenna
American oyster *Crassostrea virginica*	57, 85, 134 McKenna, Marshall, Chester
Common rangia *Rangia cuneata*	85, 134, 289, 395 McKenna, Marshall
Hard clam *Mercenaria species*	85, 134, 138 Chester, McKenna
Brown shrimp *Penaeus aztecus*	85, 133, 134, 206, 393, 426 McKenna, Chester
Pink shrimp *Penaeus duorarum*	85, 133, 134, 206, 426, 581 McKenna, Chester
White shrimp *Penaeus setiferus*	85, 133, 134, 206, 371 McKenna, Chester
Grass shrimp *Palaemonetes pugio*	85, 206 McKenna
Blue crab *Callinectes sapidus*	85, 122, 123, 133, 206, 356, 358, 426, 579 Chester, Winslow, S. Ross, Hawkins
Atlantic sturgeon *Acipenser oxyrhynchus*	85, 134, 245, 256, 356, 426, 427, 522 not reviewed
Ladyfish *Elops saurus*	133, 356 Moye, Manooch
American eel *Anguilla rostrata*	85, 133, 134, 356, 426, 521 Moye
Blueback herring *Alosa aestivalis*	85, 133, 134, 204, 245, 256, 356, 426, 585 Manooch, Moye, Chester
Alewife *Alosa pseudoharengus*	85, 133, 134, 204, 256, 356, 426, 585 Manooch, Moye, Chester
American shad *Alosa sapidissima*	85, 133, 134, 141, 204, 256, 356, 426, 585 Manooch, Moye
Atlantic menhaden *Brevoortia tyrannus*	85, 134, 206, 356, 396, 424, 426, 429 Ahrenholz
Bay anchovy *Anchoa mitchilli*	85, 356, 426, 505 Moye, Chester
Sheepshead minnow *Cyprinodon variegatus*	133, 220 not reviewed
Mummichog *Fundulus heteroclitus*	2, 133 Moye
Atlantic silversides *Menidia species*	85, 133, 134, 147, 356, 426 not reviewed
White perch *Morone americana*	85, 133, 134, 245, 356, 480 Moye, Chester
Striped bass *Morone saxatilis*	85, 204, 256, 356 Chester, S. Ross, Winslow, J. Ross, Hawkins
Bluefish *Pomatomus saltatrix*	85, 133, 245, 356, 426 Manooch, Moye, Chester
Cobia *Rachycentron canadum*	 Moye, Smith, J.
Gray snapper *Lutjanus griseus*	85, 133, 356, 408, 426 Manooch, Chester
Sheepshead *Archosargus probatocephalus*	85, 133, 356, 408, 424, 426 Manooch, Moye, Chester
Pinfish *Lagodon rhomboides*	85, 133, 206, 356, 426 Moye, Chester
Spotted seatrout *Cynoscion nebulosus*	85, 133, 134, 206, 247, 245, 339, 341, 356, 426 Manooch, Moye
Weakfish *Cynoscion regalis*	85, 133, 134, 206, 247, 245, 338, 343, 346, 356, 426, 494 Manooch, Moye, Chester
Spot *Leiostomus xanthurus*	85, 133, 134, 206, 345, 356, 357, 401, 424, 426 S. Ross, Chester, Winslow, J. Ross, Hawkins
Southern kingfish *Menticirrhus americanus*	133, 134, 206, 247, 356, 426 Moye
Atlantic croaker *Micropogonias undulatus*	85, 133, 134, 344, 356, 357, 424, 425, 426, 494 S. Ross, Chester, Winslow, J. Ross, Hawkins
Black drum *Pogonias cromis*	85, 133, 134, 206, 247, 356, 376, 426, 462 Manooch, Moye
Red drum *Sciaenops ocellatus*	85, 133, 134, 206, 247, 340, 342, 356, 426, 462 Winslow, Chester, Ross, J, S. Ross, Hawkins
Striped mullet *Mugul cephalus*	85, 133, 134, 206, 356 Moye, Chester
Spanish mackerel *Scomberomorus maculatus*	133, 206, 426 Manooch, Moye
Gulf flounder *Paralichthys albigutta*	402 Powell, Moye, Chester
Summer flounder *Paralichthys dentatus*	85, 117, 133, 134, 356, 400, 402, 426 Manooch, Powell, Moye, Chester
Southern flounder *Paralichthys lethostigma*	85, 119, 133, 134, 206, 356, 400, 402, 426, 494 Manooch, Powell, Moye, Chester

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Neuse River, NC
Mussel *Mytilis edulis*	554 McKenna
Bay scallop *Argopecten irradians*	134 Chester, Taylor, McKenna
American oyster *Crassostrea virginica*	57, 134 McKenna, Marshall, Chester
Common rangia *Rangia cuneata*	289, 588 McKenna, Marshall
Hard clam *Mercenaria species*	134, 138 McKenna, Chester
Brown shrimp *Penaeus aztecus*	134, 206, 217, 426 McKenna, Chester
Pink shrimp *Penaeus duorarum*	206, 217 McKenna, Chester
White shrimp *Penaeus setiferus*	206, 217, 371 McKenna, Chester
Grass shrimp *Palaemonetes pugio*	217 McKenna
Blue crab *Callinectes sapidus*	122, 123, 217, 358, 579 Chester, S. Ross, Winslow, Hawkins
Atlantic sturgeon *Acipenser oxyrhynchus*	205, 256, 427, 522 not reviewed
Ladyfish *Elops saurus*	206, 271, 505 Manooch, Moye
American eel *Anguilla rostrata*	134, 206, 217, 271, 505, 521 Moye, Manooch
Blueback herring *Alosa aestivalis*	134, 205, 206, 256, 271, 505, 585 Moye, Manooch, Chester
Alewife *Alosa pseudoharengus*	134, 205, 206, 217, 256, 271, 505 Moye, Manooch, Chester
American shad *Alosa sapidissima*	141, 205, 256, 271, 505 Moye
Atlantic menhaden *Brevoortia tyrannus*	206, 271, 505 Ahrenholz
Bay anchovy *Anchoa mitchilli*	206, 217, 271, 580 Moye, Chester
Sheepshead minnow *Cyprinodon variegatus*	133, 220, 505 Moye, Marraro
Mummichog *Fundulus heteroclitus*	2, 271, 505 Marraro
Atlantic silversides *Menidia species*	147, 206, 505 not reviewed
White perch *Morone americana*	206, 217, 271, 480 Moye, Chester
Striped bass *Morone saxatilis*	205, 256 Chester, S. Ross, Winslow, J. Ross, Manooch, Hawkins
Bluefish *Pomatomus saltatrix*	206, 217, 505 Moye, Manooch
Cobia *Rachycentron canadum*	 Moye, Manooch, Smith, J.
Gray snapper *Lutjanus griseus*	206, 505 Manooch, Chester
Sheepshead *Archosargus probatocephalus*	424 Moye, Manooch, Chester
Pinfish *Lagodon rhomboides*	206, 217, 271, 505 Moye, Chester
Spotted seatrout *Cynoscion nebulosus*	134, 206, 247, 339, 341, 505 Moye, Manooch
Weakfish *Cynoscion regalis*	206, 217, 247, 338, 343, 346, 505 Moye, Manooch, Chester
Spot *Leiostomus xanthurus*	206, 217, 271, 345, 401, 426, 463, 494, 505 S. Ross, Chester, Winslow, J. Ross, Hawkins
Southern kingfish *Menticirrhus americanus*	206, 247 Moye, Manooch, Chester
Atlantic croaker *Micropogonias undulatus*	206, 217, 271, 344, 425, 426, 463, 505 S. Ross, Winslow, J. Ross, Hawkins
Black drum *Pogonias cromis*	133, 134, 206, 247, 376, 426, 462 Manooch, Moye
Red drum *Sciaenops ocellatus*	206, 217, 247, 340, 342, 462, 505 Winslow, J. Ross, Chester, S. Ross, Hawkins
Striped mullet *Mugul cephalus*	133, 206, 217, 271, 505 Moye, Chester
Spanish mackerel *Scomberomorus maculatus*	133, 206, 426, 505 Moye, Manooch
Gulf flounder *Paralichthys albigutta*	117, 402 Moye, Powell, Chester
Summer flounder *Paralichthys dentatus*	206, 400, 402, 505 Moye, Powell, Manooch, Chester
Southern flounder *Paralichthys lethostigma*	118, 119, 206, 217, 271, 400, 402, 426, 505, 581 Moye, Powell, Manooch, Chester

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Bogue Sound, NC
Mussel *Mytilis edulis*	46, 272, 325, 554 not reviewed
Bay scallop *Argopecten irradians*	148, 188, 435, 436, 477, 496 Taylor, Frreman
American oyster *Crassostrea virginica*	27, 57, 75, 76, 77, 185, 553 Marshall, Freeman, Taylor
Common rangia *Rangia cuneata*	61, 231, 289, 509, 553, 587, 588 Freeman
Hard clam *Mercenaria species*	72, 75, 138, 398, 479, 553 Freeman, Marshall, Taylor
Brown shrimp *Penaeus aztecus*	82, 152.1, 329, 380, 574, 575, 576, 577, 578, 579 Taylor, Freeman
Pink shrimp *Penaeus duorarum*	87, 152.1, 329, 380, 574, 575, 576, 577, 578, 579 Taylor, Freeman
White shrimp *Penaeus setiferus*	298, 329, 371, 380, 574, 575, 577, 578, 579 Taylor, Freeman
Grass shrimp *Palaemonetes pugio*	12, 52, 152.1, 284, 319, 513, 578, 579 not reviewed
Blue crab *Callinectes sapidus*	122, 123, 258, 523, 578, 579 Taylor, Freeman
Atlantic sturgeon *Acipenser oxyrhynchus*	372, 427, 441, 455, 464, 522 not reviewed
Ladyfish *Elops saurus*	250, 257, 293, 505, 516, 550 Hettler, Manooch, Spence
American eel *Anguilla rostrata*	142, 194, 497, 505, 511, 516, 521, 550 Spence
Blueback herring *Alosa aestivalis*	146, 243, 390, 431, 455, 516 not reviewed
Alewife *Alosa pseudoharengus*	146, 243, 390, 455 not reviewed
American shad *Alosa sapidissima*	141, 205, 243, 455, 456, 506, 516 not reviewed
Atlantic menhaden *Brevoortia tyrannus*	218, 243, 259, 291, 293, 294, 295, 420, 423, 463, 510, 511, 516, 550, 573 Ahrenholz, Hettler
Bay anchovy *Anchoa mitchilli*	218, 223, 243, 286, 293, 463, 505, 511, 516, 550 Mercer, Manooch, Spence, Hettler
Sheepshead minnow *Cyprinodon variegatus*	194, 218, 220, 243, 505, 516 Hettler, Spence
Mummichog *Fundulus heteroclitus*	2, 194, 218, 243, 274, 282, 505, 516 Hettler, Spence
Atlantic silversides *Menidia species*	147, 218, 221, 243, 293, 505, 511, 516 Hettler, Spence
White perch *Morone americana*	195, 516 not reviewed
Striped bass *Morone saxatilis*	149, 195, 205, 448 not reviewed
Bluefish *Pomatomus saltatrix*	80, 243, 257, 265, 399, 423, 505, 516, 571 Manooch, Mercer, Monaghan, Spence
Cobia *Rachycentron canadum*	195, 243, 315 Smith, J., Manooch, Monaghan
Gray snapper *Lutjanus griseus*	195, 243, 505, 516 Mercer, Manooch, Spence
Sheepshead *Archosargus probatocephalus*	218, 225, 243, 247, 264, 315, 440, 511, 516 Mercer, Spence, Monaghan, Manooch
Pinfish *Lagodon rhomboides*	5, 108, 218, 234, 243, 257, 293, 505, 510, 511, 516, 550 Mercer, Monaghan, Spence, Hettler
Spotted seatrout *Cynoscion nebulosus*	224, 243, 257, 339, 341, 502, 516, 555 Manooch, Mercer, Monaghan, Spence
Weakfish *Cynoscion regalis*	224, 243, 257, 338, 343, 346, 423, 516, 555 Manooch, Mercer, Monaghan, Spence
Spot *Leiostomus xanthurus*	218, 223, 243, 257, 292, 293, 345, 401, 406, 423, 463, 505, 510, 511, 516, 548, 550, 549 Mercer, Monaghan, Spence, Hettler, Lewis
Southern kingfish *Menticirrhus americanus*	224, 243, 247, 423, 516 Spence, Mercer
Atlantic croaker *Micropogonias undulatus*	218, 223, 243, 257, 292, 293, 344, 406, 423, 463, 511, 516, 548, 550 Mercer, Monaghan, Spence, Hettler, Lewis
Black drum *Pogonias cromis*	243, 247, 315, 376, 423, 462, 516 Manooch, Monaghan, Spence, Mercer
Red drum *Sciaenops ocellatus*	247, 340, 342, 394, 462, 505 Monaghan, Mercer, Manooch, Spence
Striped mullet *Mugul cephalus*	14, 218, 243, 293, 315, 319, 505, 511, 516, 550 Monaghan, Spence
Spanish mackerel *Scomberomorus maculatus*	80, 157, 225, 243, 511, 516 Mercer, Monaghan, Manooch, Spence
Gulf flounder *Paralichthys albigutta*	132, 243, 400, 505, 516, 550, 581, 589 Powell, Mercer, Monaghan, Spence, Burke
Summer flounder *Paralichthys dentatus*	243, 293, 365, 400, 421, 505, 516, 550, 589 Powell, Burke, Mercer, Monaghan, Spence
Southern flounder *Paralichthys lethostigma*	132, 243, 400, 505, 516, 550, 589 Powell, Manooch, Burke, Mercer, Monaghan, Spence

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	New River, NC
Mussel *Mytilis edulis*	46, 272, 325, 554 not reviewed
Bay scallop *Argopecten irradians*	148, 188, 435, 436, 477 Taylor
American oyster *Crassostrea virginica*	27, 57, 75, 76, 77, 185, 553 Marshall, Parker, Taylor
Common rangia *Rangia cuneata*	61, 231, 289, 509, 553, 587, 588 not reviewed
Hard clam *Mercenaria species*	72, 75, 138, 398, 479, 553 Marshall, Parker, Taylor
Brown shrimp *Penaeus aztecus*	82, 329, 380, 574, 575, 576, 577, 579 Allison, Taylor
Pink shrimp *Penaeus duorarum*	87, 329, 380, 574, 575, 576, 577, 578, 579 Allison, Taylor
White shrimp *Penaeus setiferus*	298, 329, 371, 380, 574, 575, 577, 578, 579 Allison, Taylor
Grass shrimp *Palaemonetes pugio*	12, 52, 284, 319, 513, 578, 579 Schoolfield
Blue crab *Callinectes sapidus*	122, 123, 258, 523, 578, 579 Schoolfield
Atlantic sturgeon *Acipenser oxyrhynchus*	372, 427, 441, 455, 464, 522 Schoolfield
Ladyfish *Elops saurus*	250, 257, 293, 505, 516, 550 Schoolfield
American eel *Anguilla rostrata*	142, 194, 497, 505, 511, 516, 521, 550 Schoolfield
Blueback herring *Alosa aestivalis*	146, 243, 390, 431, 455, 516 Schoolfield
Alewife *Alosa pseudoharengus*	146, 243, 390, 455 Schoolfield
American shad *Alosa sapidissima*	141, 205, 243, 455, 456, 506, 516 Schoolfield
Atlantic menhaden *Brevoortia tyrannus*	218, 243, 259, 291, 293, 294, 295, 420, 423, 463, 510, 511, 516, 550, 573 Ahrenholz, Schoolfield
Bay anchovy *Anchoa mitchilli*	218, 223, 243, 286, 293, 463, 505, 511, 516, 550 Schoolfield
Sheepshead minnow *Cyprinodon variegatus*	194, 218, 220, 243, 505, 516 Schoolfield
Mummichog *Fundulus heteroclitus*	2, 194, 218, 243, 274, 282, 505, 516 Schoolfield
Atlantic silversides *Menidia species*	147, 218, 221, 243, 293, 505, 511, 516 Schoolfield
White perch *Morone americana*	195, 516 Schoolfield, Rohde
Striped bass *Morone saxatilis*	149, 195, 205, 448 Schoolfield
Bluefish *Pomatomus saltatrix*	80, 243, 257, 265, 399, 423, 505, 516, 571 Schoolfield
Cobia *Rachycentron canadum*	195, 243, 315 Manooch, Smith, J.
Gray snapper *Lutjanus griseus*	195, 243, 505, 516 Manooch, Schoolfield
Sheepshead *Archosargus probatocephalus*	218, 225, 243, 247, 264, 315, 511, 516 Manooch, Schoolfield
Pinfish *Lagodon rhomboides*	5, 108, 218, 234, 243, 257, 293, 505, 510, 511, 516, 550 Schoolfield
Spotted seatrout *Cynoscion nebulosus*	224, 243, 257, 339, 341, 502, 516, 555 Manooch, Schoolfield
Weakfish *Cynoscion regalis*	224, 243, 257, 338, 343, 346, 423, 516, 555 Manooch, Schoolfield
Spot *Leiostomus xanthurus*	218, 223, 243, 257, 292, 293, 345, 401, 406, 423, 463, 505, 510, 511, 516, 548, 550, 549 Lewis, Schoolfield
Southern kingfish *Menticirrhus americanus*	224, 243, 247, 423, 516 Rohde
Atlantic croaker *Micropogonias undulatus*	218, 223, 243, 257, 292, 293, 344, 406, 423, 463, 511, 516, 548, 550 Rohde, Lewis
Black drum *Pogonias cromis*	243, 247, 315, 376, 423, 462, 516 Manooch, Rohde
Red drum *Sciaenops ocellatus*	247, 340, 342, 394, 462, 505 Rohde, Manooch
Striped mullet *Mugul cephalus*	14, 218, 243, 293, 315, 319, 505, 511, 516, 550 Rohde
Spanish mackerel *Scomberomorus maculatus*	80, 157, 225, 243, 511, 516 Manooch, Rohde
Gulf flounder *Paralichthys albigutta*	132, 243, 400, 505, 516, 550, 581, 589 Powell, Rohde
Summer flounder *Paralichthys dentatus*	243, 293, 365, 400, 421, 505, 516, 550, 589 Powell, Rohde
Southern flounder *Paralichthys lethostigma*	132, 243, 400, 505, 516, 550, 589 Powell, Rohde

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Cape Fear River, NC
Mussel *Mytilis edulis*	554 not reviewed
Bay scallop *Argopecten irradians*	148 Taylor, Parker
American oyster *Crassostrea virginica*	27, 57, 69 Parker
Common rangia *Rangia cuneata*	1, 231, 289 Lindquist
Hard clam *Mercenaria species*	138 Parker
Brown shrimp *Penaeus aztecus*	69, 70, 227, 240, 551 Allison, Cooke, Lindquist
Pink shrimp *Penaeus duorarum*	70, 227, 551 Allison, Cooke, Lindquist
White shrimp *Penaeus setiferus*	70, 371, 578, 579 Allison, Cooke, Lindquist
Grass shrimp *Palaemonetes pugio*	12, 47 Pollard
Blue crab *Callinectes sapidus*	122, 304, 428, 523, 578, 579 Pollard, Schoolfield, Lindquist
Atlantic sturgeon *Acipenser oxyrhynchus*	41, 250, 315, 427, 442, 443, 444 Schoolfield, Lindquist, Thompson, Moser, S. Ross
Ladyfish *Elops saurus*	250, 442 Schoolfield, Thompson, Lindquist
American eel *Anguilla rostrata*	143, 442, 521 Schoolfield, Lindquist
Blueback herring *Alosa aestivalis*	109, 151, 315, 441, 442 Schoolfield, Thompson, Lindquist, Moser
Alewife *Alosa pseudoharengus*	109, 151, 315, 442 Schoolfield, Thompson, Lindquist, Moser
American shad *Alosa sapidissima*	109, 151, 315, 442, 457 Pollard, Schoolfield, Lindquist, Moser
Atlantic menhaden *Brevoortia tyrannus*	6, 69, 70, 83, 259, 291, 428, 442, 551 Ahrenholz, Smith, J.
Bay anchovy *Anchoa mitchilli*	70, 240, 428, 442, 514, 551 Schoolfield, Cooke, Lindquist
Sheepshead minnow *Cyprinodon variegatus*	194, 220, 442 Lindquist
Mummichog *Fundulus heteroclitus*	194, 428, 442 Schoolfield, Pollard, Lindquist
Atlantic silversides *Menidia species*	70, 147, 442 Schoolfield, Cooke, Lindquist
White perch *Morone americana*	195, 315, 442 Rohde, Lindquist
Striped bass *Morone saxatilis*	151, 442, 457 Rohde, Thompson, Lindquist, Moser, S. Ross
Bluefish *Pomatomus saltatrix*	80, 442 Rohde, Benedict, Lindquist
Cobia *Rachycentron canadum*	315, 442 Rohde, Lindquist, J. Smith, Herring
Gray snapper *Lutjanus griseus*	240, 315, 442 Manooch, Herring, Lindquist, Rohde
Sheepshead *Archosargus probatocephalus*	143, 264, 315, 442, 440 Rohde, Herring, Lindquist
Pinfish *Lagodon rhomboides*	108, 442, 443, 444 Rohde, Herring, Lindquist
Spotted seatrout *Cynoscion nebulosus*	227, 240, 247, 315, 442 Benedict, Rohde, Lindquist
Weakfish *Cynoscion regalis*	70, 240, 338, 346, 442, 443, 444 Schoolfield, Benedict, Lindquist
Spot *Leiostomus xanthurus*	47, 70, 99, 227, 428, 443, 444, 549, 551, 552 Schoolfield, Cates, Lindquist
Southern kingfish *Menticirrhus americanus*	247, 376, 442 Schoolfield, Cates, Lindquist
Atlantic croaker *Micropogonias undulatus*	47, 70, 99, 240, 442, 443, 444, 548 Cates, Schoolfield, Lindquist
Black drum *Pogonias cromis*	247, 315, 376, 442, 462 Lindquist, Benedict, Schoolfield
Red drum *Sciaenops ocellatus*	240, 442, 462, 551 Schoolfield, Benedict, Lindquist
Striped mullet *Mugul cephalus*	69, 79, 442, 551 Pollard, Schoolfield, Lindquist
Spanish mackerel *Scomberomorus maculatus*	80, 240, 442 Schoolfield, Pollard, Lindquist
Gulf flounder *Paralichthys albigutta*	84, 442 Rohde, Herring
Summer flounder *Paralichthys dentatus*	70, 84, 376, 421, 442, 443, 444, 551 Powell, Herring, Rohde, Lindquist
Southern flounder *Paralichthys lethostigma*	84, 117, 240, 442, 443, 444 Rohde, Herring, Lindquist

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Winyah Bay, SC
Mussel *Mytilis edulis*	1, 153, 433, 593 Allen, Ogburn, Anderson
Bay scallop *Argopecten Irradians*	63, 153, 184, 593 Allen, Ogburn, Anderson
American oyster *Crassostrea virginica*	8, 27, 57, 183, 226, 262, 263, 269, 307, 335, 476 Allen, Ogburn, Anderson
Common rangia *Rangia cuneata*	61, 289, 593 Allen, Ogburn, Anderson
Hard clam *Mercenaria species*	8, 13, 138, 139, 140, 184, 226, 317 Allen, Ogburn, Anderson
Brown shrimp *Penaeus aztecus*	9, 34, 38, 82, 144, 145, 226, 329, 385, 387, 512, 559, 564, 579 Whitaker, Delancey, Allen, Ogburn
Pink shrimp *Penaeus duorarum*	9, 38, 87, 130, 144, 226, 329, 385, 387, 512, 559, 564, 579 Whitaker, Delancey, Allen, Ogburn
White shrimp *Penaeus setiferus*	8, 9, 34, 130, 144, 226, 297, 298, 329, 371, 385, 387, 512, 559, 564, 579 Whitaker, Delancey, Allen, Ogburn
Grass shrimp *Palaemonetes pugio*	8, 9, 10, 12, 284, 387, 452, 459, 559, 564, 579 Whitaker, Delancey, Allen, Ogburn
Blue crab *Callinectes sapidus*	8, 9, 131, 226, 304, 328, 385, 449, 452, 523, 564, 579 Whitaker, Delancey, Allen, Ogburn
Atlantic sturgeon *Acipenser oxyrhynchus*	33, 290, 372, 470, 472, 473, 522, 564 Allen, Ogburn, Moore
Ladyfish *Elops saurus*	8, 9, 33, 59, 60, 222, 250, 315, 593 Allen, Ogburn, Moore
American eel *Anguilla rostrata*	8, 9, 59, 60, 192, 194, 197, 232, 449, 521, 564 Allen, Ogburn, Moore
Blueback herring *Alosa aestivalis*	8, 9, 59, 60, 146, 250, 336, 385, 390, 451, 452, 519, 564 Allen, Ogburn, Moore
Alewife *Alosa pseudoharengus*	146, 250, 390 Allen, Ogburn, Moore
American shad *Alosa sapidissima*	96, 97, 141, 519, 520, 533, 564 Allen, Ogburn, Moore
Atlantic menhaden *Brevoortia tyrannus*	7, 8, 9, 50, 59, 385, 411, 420, 451, 452, 564 Allen, Ogburn, Moore
Bay anchovy *Anchoa mitchilli*	7, 8, 9, 50, 59, 60, 226, 385, 449, 451, 452, 564 Allen, Ogburn, Moore
Sheepshead minnow *Cyprinodon variegatus*	9, 59, 60, 194, 593 Allen, Ogburn, Moore
Mummichog *Fundulus heteroclitus*	2, 7, 9, 59, 60, 194, 385, 452 Allen, Ogburn, Moore
Atlantic silversides *Menidia species*	8, 9, 59, 60, 147, 221, 349, 351, 452 Allen, Ogburn, Moore
White perch *Morone americana*	8, 195, 336, 385, 564 Allen, Ogburn, Moore
Striped bass *Morone saxatilis*	8, 149, 195, 474, 519, 564 Allen, Ogburn, Moore
Bluefish *Pomatomus saltatrix*	9, 33, 38, 59, 60, 80, 68.1, 305, 385, 399, 564 Allen, Ogburn, Moore
Cobia *Rachycentron canadum*	9, 33, 195, 385 Allen, Ogburn, Moore
Gray snapper *Lutjanus griseus*	8, 9, 59, 195, 385, 564, 593 Allen, Moore, Ogburn
Sheepshead *Archosargus probatocephalus*	9, 59, 60, 225, 247, 305, 564, 593 Allen, Ogburn, Moore
Pinfish *Lagodon rhomboides*	7, 8, 9, 33, 50, 59, 60, 385, 452, 564 Allen, Ogburn, Moore
Spotted seatrout *Cynoscion nebulosus*	7, 9, 33, 59, 60, 247, 305, 339, 341, 385, 405, 502, 564 Allen, Ogburn, Moore
Weakfish *Cynoscion regalis*	7, 8, 9, 308, 338, 343, 385, 449, 451, 564 Allen, Ogburn, Moore
Spot *Leiostomus xanthurus*	7, 8, 9, 50, 59, 60, 111, 305, 345, 385, 449, 451, 452, 564 Allen, Ogburn, Moore
Southern kingfish *Menticirrhus americanus*	8, 9, 33, 35, 385, 451, 465, 564 Allen, Ogburn, Moore
Atlantic croaker *Micropogonias undulatus*	7, 8, 9, 36, 50, 59, 60, 305, 333, 352, 385, 449, 564 Allen, Ogburn, Moore
Black drum *Pogonias cromis*	7, 9, 38, 247, 376, 564 Allen, Ogburn, Moore
Red drum *Sciaenops ocellatus*	7, 8, 9, 33, 38, 59, 60, 247, 305, 342, 564 Allen, Ogburn, Moore
Striped mullet *Mugul cephalus*	8, 9, 14, 50, 59, 60, 385, 452, 564 Allen, Ogburn, Moore
Spanish mackerel *Scomberomorus maculatus*	33, 59, 60, 80, 157, 225, 305, 385, 593 Allen, Ogburn, Moore
Gulf flounder *Paralichthys albigutta*	50, 132, 385, 451, 452, 593 Allen, Ogburn, Moore
Summer flounder *Paralichthys dentatus*	7, 8, 9, 33, 50, 59, 60, 385, 421, 452, 564 Allen, Ogburn, Moore
Southern flounder *Paralichthys lethostigma*	7, 8, 9, 50, 59, 60, 385, 452, 564 Allen, Ogburn, Moore

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	North and South Santee Rivers, SC
Mussel *Mytilis edulis*	1, 153, 593 Anderson
Bay scallop *Argopecten irradians*	153, 593 Anderson
American oyster *Crassostrea virginica*	27, 57, 64, 183, 262, 263, 335, 476 Stender, Anderson
Common rangia *Rangia cuneata*	61, 289, 593 Anderson
Hard clam *Mercenaria species*	13, 56, 64, 138, 139, 140, 184, 317, 414 Stender, Anderson
Brown shrimp *Penaeus aztecus*	34, 38, 64, 82, 130, 144, 329, 387, 512, 559, 560, 579 Stender, Whitaker, Delancey
Pink shrimp *Penaeus duorarum*	87, 130, 144, 329, 387, 512, 559, 563, 579 Stender, Whitaker, Delancey
White shrimp *Penaeus setiferus*	64, 130, 144, 297, 298, 329, 371, 387, 512, 559, 563, 579 Stender, Whitaker, Delancey
Grass shrimp *Palaemonetes pugio*	10, 12, 64, 284, 387, 459, 559, 563, 579 Stender, Whitaker, Delancey
Blue crab *Callinectes sapidus*	64, 131, 304, 328, 523, 559, 563, 579 Stender, Whitaker, Delancey
Atlantic sturgeon *Acipenser oxyrhynchus*	33, 290, 372, 470, 472, 473, 522 Stender, Moore
Ladyfish *Elops saurus*	33, 222, 250, 326, 557, 593 Stender, Moore
American eel *Anguilla rostrata*	192, 194, 232, 326, 521, 557, 563 Moore
Blueback herring *Alosa aestivalis*	54, 146, 250, 336, 390, 519, 563 Stender, Moore
Alewife *Alosa pseudoharengus*	146, 250, 390, 519, 593 Stender, Moore
American shad *Alosa sapidissima*	96, 97, 141, 519, 520, 533, 563 Stender, Moore
Atlantic menhaden *Brevoortia tyrannus*	326, 411, 420, 557, 563 Stender, Moore
Bay anchovy *Anchoa mitchilli*	7, 326, 412, 449, 451, 557, 563 Stender, Moore
Sheepshead minnow *Cyprinodon variegatus*	194, 326, 557, 593 Moore
Mummichog *Fundulus heteroclitus*	2, 60, 194, 326, 412, 557 Moore
Atlantic silversides *Menidia species*	147, 221, 326, 349, 350, 351, 363, 412, 557, 563 Stender, Moore
White perch *Morone americana*	195, 336, 557, 563 Stender, Moore
Striped bass *Morone saxatilis*	149, 195, 320, 445, 446, 474, 484, 519, 557, 563 Stender, Moore
Bluefish *Pomatomus saltatrix*	9, 33, 80, 68.1, 305, 399, 557, 563 Stender, Moore
Cobia *Rachycentron canadum*	33, 195 Stender, Moore
Gray snapper *Lutjanus griseus*	9, 195, 326, 557, 563 Stender, Moore
Sheepshead *Archosargus probatocephalus*	9, 247, 326, 557, 563, 593 Stender, Moore
Pinfish *Lagodon rhomboides*	108, 326, 557, 563 Stender, Moore
Spotted seatrout *Cynoscion nebulosus*	33, 247, 305, 326, 339, 341, 405, 502, 557, 563 Stender, Moore
Weakfish *Cynoscion regalis*	308, 326, 338, 343, 449, 451, 557, 563 Stender, Moore
Spot *Leiostomus xanthurus*	111, 326, 345, 449, 451, 557, 563 Stender, Moore
Southern kingfish *Menticirrhus americanus*	33, 35, 247, 326, 451, 465, 557, 563 Stender, Moore
Atlantic croaker *Micropogonias undulatus*	36, 326, 352, 449, 451, 557, 563 Stender, Moore
Black drum *Pogonias cromis*	7, 38, 247, 326, 376, 557 Stender, Moore
Red drum *Sciaenops ocellatus*	33, 247, 305, 326, 342, 557, 148 Stender, Moore
Striped mullet *Mugul cephalus*	14, 326, 557, 563 Stender, Moore
Spanish mackerel *Scomberomorus maculatus*	33, 80, 157, 225, 305, 593 Stender, Moore
Gulf flounder *Paralichthys albigutta*	326, 557 Stender, Moore
Summer flounder *Paralichthys dentatus*	33, 326, 421, 557, 563 Stender, Moore
Southern flounder *Paralichthys lethostigma*	326, 449, 451, 557, 563 Stender, Moore

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Charleston Harbor, SC
Mussel *Mytilis edulis*	1, 153, 593 Anderson, Martone
Bay scallop *Argopecten irradians*	153, 593 Andeson, Martone, VanDolah
American oyster *Crassostrea virginica*	27, 57, 183, 184, 262, 263, 335, 476, 524 Anderson, Martone
Common rangia *Rangia cuneata*	61, 289, 593 Anderson, Martone
Hard clam *Mercenaria species*	13, 138, 139, 140, 184, 317, 524 Anderson, Martone
Brown shrimp *Penaeus aztecus*	38, 82, 329, 450, 483, 512, 524, 560, 565, 562, 579 Whitaker, Delancey, Martone, Archambault, Wenner, Van Dolah
Pink shrimp *Penaeus duorarum*	87, 130, 144, 329; 483, 524, 560, 565, 562, 579 Whitaker, Delancey, Martone, Archambault, Wenner, Van Dolah
White shrimp *Penaeus setiferus*	34, 130, 144, 145, 297, 298, 329, 371, 450, 483, 512, 524, 560, 565, 562, 579 Whitaker, Delancey, Martone, Archambault, Wenner, Van Dolah
Grass shrimp *Palaemonetes pugio*	10, 12, 284, 459, 483, 517, 565, 562, 579 Whitaker, Delancey, Martone, Archambault, Wenner, Van Dolah
Blue crab *Callinectes sapidus*	19, 20, 304, 328, 337, 450, 483, 517, 523, 524, 565, 562, 579 Whitaker, Delancey, Martone, Archambault, Wenner, Van Dolah
Atlantic sturgeon *Acipenser oxyrhynchus*	33, 290, 372, 449, 470, 472, 473, 522, 565 Martone, VanDolah
Ladyfish *Elops saurus*	9, 33, 222, 250, 326, 565, 593 Martone
American eel *Anguilla rostrata*	191, 192, 194, 196, 197, 232, 517, 521, 565 Martone, VanDolah
Blueback herring *Alosa aestivalis*	54, 146, 250, 336, 390, 451, 517, 519, 565 Martone, VanDolah
Alewife *Alosa pseudoharengus*	146, 250, 390 Martone
American shad *Alosa sapidissima*	96, 97, 141, 450, 519, 520, 533, 565 Martone, VanDolah
Atlantic menhaden *Brevoortia tyrannus*	411, 420, 450, 451, 483, 517, 524, 565 Martone, VanDolah
Bay anchovy *Anchoa mitchilli*	7, 250, 412, 450, 451, 483, 517, 524, 565 Martone, VanDolah
Sheepshead minnow *Cyprinodon variegatus*	194, 593
Mummichog *Fundulus heteroclitus*	2, 60, 194, 517 Martone
Atlantic silversides *Menidia species*	147, 221, 349, 351, 517, 565 Martone, VanDolah
White perch *Morone americana*	195, 336, 565 Martone, VanDolah
Striped bass *Morone saxatilis*	149, 195, 320, 445, 446, 474, 484, 517, 519, 565 VanDolah
Bluefish *Pomatomus saltatrix*	33, 80, 68.1, 399, 517, 565 Martone, VanDolah
Cobia *Rachycentron canadum*	33, 195 Martone, VanDolah
Gray snapper *Lutjanus griseus*	195, 565 VanDolah
Sheepshead *Archosargus probatocephalus*	247, 565, 593 Martone, VanDolah
Pinfish *Lagodon rhomboides*	9, 50, 108, 326, 565 Martone, VanDolah
Spotted seatrout *Cynoscion nebulosus*	33, 107, 247, 339, 341, 406, 451, 502, 517, 565, 558 Martone, VanDolah
Weakfish *Cynoscion regalis*	308, 338, 343, 451, 483, 524, 565 Martone, VanDolah
Spot *Leiostomus xanthurus*	111, 345, 451, 483, 517, 524, 565 Martone, VanDolah
Southern kingfish *Menticirrhus americanus*	33, 35, 465, 565 Martone, VanDolah
Atlantic croaker *Micropogonias undulatus*	36, 333, 352, 451, 483, 517, 524, 565 Martone, VanDolah
Black drum *Pogonias cromis*	7, 247, 326, 376, 451, 565
Red drum *Sciaenops ocellatus*	33, 107, 247, 342, 565, 558 Martone, VanDolah
Striped mullet *Mugul cephalus*	14, 517, 565 Martone, VanDolah
Spanish mackerel *Scomberomorus maculatus*	33, 80, 157, 225, 565, 593 Martone, VanDolah
Gulf flounder *Paralichthys albigutta*	132, 593 Martone
Summer flounder *Paralichthys dentatus*	7, 8, 326, 421, 483, 517, 565, 558 Martone, VanDolah
Southern flounder *Paralichthys lethostigma*	7, 8, 33, 326, 451, 483, 517, 565, 593, 558 Martone, VanDolah

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	St. Helena Sound, SC
Mussel *Mytilis edulis*	1, 153, 5 Anderson, Stokes, Hopkins, Holloway, Hamilton
Bay scallop *Argopecten irradians*	63, 153, 184, 593 Anderson, Stokes
American oyster *Crassostrea virginica*	27, 57, 183, 262, 263, 330, 335, 476 Anderson, Stokes, Hopkins, Holloway, Hamilton
Common rangia *Rangia cuneata*	61, 289, 593 Anderson, Stokes, Hopkins, Holloway, Hamilton
Hard clam *Mercenaria species*	13, 138, 139, 140, 184, 306 Anderson, Stokes, Hopkins, Holloway, Hamilton
Brown shrimp *Penaeus aztecus*	34, 38, 82, 130, 144, 329, 449, 512, 579 Stokes, Whitaker, Delancey, Wenner
Pink shrimp *Penaeus duorarum*	34, 38, 87, 130, 144, 329, 449, 512, 579 Stokes, Hopkins, Whitaker, Delancey, Wenner
White shrimp *Penaeus setiferus*	34, 38, 62, 63, 130, 144, 145, 297, 298, 329, 371, 449, 512, 579 Stokes, Hopkins, Whitaker, Delancey, Wenner
Grass shrimp *Palaemonetes pugio*	10, 12, 284, 449, 452, 459, 579 Stokes, Hopkins, Whitaker, Delancey, Wenner
Blue crab *Callinectes sapidus*	304, 449, 523, 579 Stokes, Hopkins, Whitaker, Delancey, Wenner
Atlantic sturgeon *Acipenser oxyrhynchus*	290, 372, 449, 470, 472, 473, 522, 593 Stokes, Hopkins, Holloway, Moore
Ladyfish *Elops saurus*	33, 222, 250, 315, 593 Stokes, Hopkins, Moore
American eel *Anguilla rostrata*	192, 194, 197, 232, 521 Stokes, Hopkins, Moore
Blueback herring *Alosa aestivalis*	146, 250, 336, 390, 451, 519 Stokes, Hopkins
Alewife *Alosa pseudoharengus*	146, 250, 390, 593 Stokes, Holloway, Hopkins, Hamilton, Moore
American shad *Alosa sapidissima*	141, 519, 520, 533, 593 Stokes, Holloway, Hopkins, Moore
Atlantic menhaden *Brevoortia tyrannus*	50, 336, 411, 420, 451 Stokes, Holloway, Hopkins, Moore
Bay anchovy *Anchoa mitchilli*	50, 60, 95, 250, 412, 450, 451, 452 Stokes, Hopkins, Moore
Sheepshead minnow *Cyprinodon variegatus*	60, 95, 194, 593 Stokes, Hopkins, Moore
Mummichog *Fundulus heteroclitus*	2, 60, 95, 194, 412 Stokes, Holloway, Hopkins, Moore
Atlantic silversides *Menidia species*	60, 95, 147, 221, 349, 351, 363, 412, 452 Stokes, Holloway, Hopkins, Moore
White perch *Morone americana*	195, 336 Stokes, Holloway, Hopkins, Hamilton
Striped bass *Morone saxatilis*	149, 195, 449, 474, 519 Stokes, Holloway, Hamilton
Bluefish *Pomatomus saltatrix*	33, 38, 305, 399, 450, 451, 593 Stokes, Holloway, Hamilton
Cobia *Rachycentron canadum*	33, 38, 195, 305 Stokes, Holloway, Hamilton, Moore
Gray snapper *Lutjanus griseus*	60, 95, 195, 449, 593 Holloway, Moore
Sheepshead *Archosargus probatocephalus*	38, 247, 593 Stokes, Holloway, Hamilton, Moore
Pinfish *Lagodon rhomboides*	50, 60, 108, 452 Stokes, Hopkins, Holloway, Moore
Spotted seatrout *Cynoscion nebulosus*	33, 247, 308, 339, 341, 405, 502, 558 Stokes, Holloway, Hopkins, Hamilton, Moore
Weakfish *Cynoscion regalis*	308, 338, 343, 406, 449, 451 Stokes, Hamilton, Holloway, Moore
Spot *Leiostomus xanthurus*	95, 111, 345, 449, 451 Stokes, Hamilton, Holloway, Moore
Southern kingfish *Menticirrhus americanus*	35, 449, 451, 465 Stokes, Holloway, Moore
Atlantic croaker *Micropogonias undulatus*	36, 333, 352, 449, 451 Stokes, Hamilton, Holloway, Moore
Black drum *Pogonias cromis*	38, 247, 376, 451 Stokes, Holloway, Moore
Red drum *Sciaenops ocellatus*	33, 38, 247, 342, 558 Stokes, Holloway, Moore
Striped mullet *Mugul cephalus*	14, 50, 60, 95 Stokes, Holloway, Hopkins, Hamilton, Moore
Spanish mackerel *Scomberomorus maculatus*	38, 80, 157, 593 Stokes, Holloway, Hamilton, Moore
Gulf flounder *Paralichthys albigutta*	50, 60, 451, 593 Stokes, Hamilton, Moore
Summer flounder *Paralichthys dentatus*	33, 38, 50, 60, 421, 451, 558, 593 Stokes, Holloway, Hamilton, Moore
Southern flounder *Paralichthys lethostigma*	38, 50, 60, 449, 451, 558, 593 Moore, Stokes

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Broad River, SC
Mussel *Mytilis edulis*	1, 153, 593 Anderson, Stokes, Hopkins, Holloway, Hamilton
Bay scallop *Argopecten irradians*	63, 153, 184, 593 Anderson, Stokes, Hopkins, Holloway, Hamilton
American oyster *Crassostrea virginica*	27, 37, 57, 183, 262, 263, 335, 476 Anderson, Stokes, Hopkins, Holloway, Hamilton
Common rangia *Rangia cuneata*	61, 289, 593 Anderson, Stokes, Hopkins, Holloway
Hard clam *Mercenaria species*	13, 37, 138, 139, 140, 184 Anderson, Stokes, Hopkins, Holloway
Brown shrimp *Penaeus aztecus*	34, 37, 38, 82, 144, 145, 329, 449, 512, 517, 570, 579 Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Pink shrimp *Penaeus duorarum*	34, 37, 38, 87, 130, 144, 329, 512, 579 Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
White shrimp *Penaeus setiferus*	34, 37, 130, 144, 145, 297, 298, 371, 449, 512, 579 Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Grass shrimp *Palaemonetes pugio*	10, 12, 284, 452, 459, 515, 579 Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Blue crab *Callinectes sapidus*	37, 131, 304, 328, 449, 515, 523, 579 Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Atlantic sturgeon *Acipenser oxyrhynchus*	219, 290, 372, 470, 473, 522 Stokes, Hopkins, Holloway
Ladyfish *Elops saurus*	33, 219, 222, 250, 515, 593 Stokes, Hopkins, Holloway
American eel *Anguilla rostrata*	37, 192, 194, 197, 232, 515, 521 Stokes, Hopkins, Holloway
Blueback herring *Alosa aestivalis*	37, 146, 250, 336, 390, 449, 519 Stokes, Holloway
Alewife *Alosa pseudoharengus*	146, 250, 390 Stokes, Holloway
American shad *Alosa sapidissima*	141, 519, 533 Stokes, Hopkins, Holloway
Atlantic menhaden *Brevoortia tyrannus*	37, 50, 219, 336, 411, 420, 449, 515 Stokes, Hopkins, Holloway, Hamilton
Bay anchovy *Anchoa mitchilli*	37, 250, 327, 449, 451, 515 Stokes, Holloway
Sheepshead minnow *Cyprinodon variegatus*	37, 194, 593 Stokes, Hopkins, Holloway
Mummichog *Fundulus heteroclitus*	2, 37, 60, 194, 412, 515 Stokes, Hopkins, Holloway
Atlantic silversides *Menidia species*	37, 60, 147, 221, 327, 349, 363, 452, 515 Stokes, Hopkins, Holloway
White perch *Morone americana*	37, 195, 336 Stokes, Hopkins, Holloway, Hamilton
Striped bass *Morone saxatilis*	149, 195, 474, 519 Stokes, Hopkins, Holloway, Hamilton
Bluefish *Pomatomus saltatrix*	33, 37, 38, 80, 219, 68.1, 305, 399, 449, 515 Stokes, Hopkins, Holloway
Cobia *Rachycentron canadum*	33, 37, 38, 195, 305 Stokes, Hopkins, Holloway
Gray snapper *Lutjanus griseus*	60, 195, 515, 593 Stokes, Hopkins, Holloway
Sheepshead *Archosargus probatocephalus*	37, 38, 60, 225, 247, 515, 593 Stokes, Hopkins, Holloway
Pinfish *Lagodon rhomboides*	33, 37, 50, 108, 452, 515 Stokes, Hopkins, Holloway
Spotted seatrout *Cynoscion nebulosus*	33, 37, 219, 247, 339, 341, 405, 502, 515 Stokes, Hamilton, Holloway
Weakfish *Cynoscion regalis*	37, 219, 308, 338, 343, 449, 451, 515 Stokes, Hamilton, Holloway
Spot *Leiostomus xanthurus*	37, 50, 111, 219, 345, 449, 451, 515 Stokes, Holloway
Southern kingfish *Menticirrhus americanus*	33, 35, 37, 247, 449, 451, 465 Stokes, Holloway
Atlantic croaker *Micropogonias undulatus*	36, 37, 50, 219, 333, 352, 449, 451, 515 Stokes, Hopkins, Holloway
Black drum *Pogonias cromis*	37, 38, 219, 247, 376, 515 Stokes, Holloway
Red drum *Sciaenops ocellatus*	33, 37, 38, 219, 247, 342, 515 Stokes, Holloway
Striped mullet *Mugul cephalus*	14, 37, 50, 515 Stokes, Hamilton, Holloway
Spanish mackerel *Scomberomorus maculatus*	37, 80, 157, 515, 593 Stokes, Hopkins, Holloway
Gulf flounder *Paralichthys albigutta*	37, 132, 451, 515 Stokes, Hamilton
Summer flounder *Paralichthys dentatus*	33, 37, 38, 50, 60, 219, 421, 515, 593 Stokes, Hamilton, Holloway
Southern flounder *Paralichthys lethostigma*	33, 37, 38, 219, 449, 515, 593 Stokes, Hamilton, Holloway

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Savannah River, GA
Mussel *Mytilis edulis*	1, 378
Bay scallop *Argopecten irradians*	211, 229 Music
American oyster *Crassostrea virginica*	57, 67, 200, 208, 210, 228, 300, 384, 528, 540 Music
Common rangia *Rangia cuneata*	289 Music
Hard clam *Mercenaria species*	21, 138, 209, 241, 368, 397, 528, 534, 535, 536, 538, 540, 541, 542, 543, 546 Music, Walker
Brown shrimp *Penaeus aztecus*	16, 68, 199, 288, 312, 313, 374, 377, 486, 487, 489, 490 Music
Pink shrimp *Penaeus duorarum*	16, 45, 312, 313, 367, 374, 377, 487, 489 Music
White shrimp *Penaeus setiferus*	68, 199, 290, 312, 313, 371, 374, 377, 486, 487, 489, 490, 529, 567 Music
Grass shrimp *Palaemonetes pugio*	101, 127, 154, 189, 207, 238, 239, 276, 277, 280, 281, 376, 415, 416
Blue crab *Callinectes sapidus*	21, 67, 208, 312, 313, 314, 374, 377, 389, 453, 486, 487, 490, 523, 540 Music
Atlantic sturgeon *Acipenser oxyrhynchus*	42, 103, 105, 290, 312, 313, 372, 430, 438, 522 Music
Ladyfish *Elops saurus*	103, 164, 312, 313, 377, 388, 438
American eel *Anguilla rostrata*	42, 103, 105, 312, 313, 377, 388, 410, 438, 467, 468, 521 Music
Blueback herring *Alosa aestivalis*	42, 51, 103, 105, 312, 313, 377, 390, 430, 438, 467, 468, 492, 495, 518 Music
Alewife *Alosa pseudoharengus*	51, 105, 390 Music, Schmitt
American shad *Alosa sapidissima*	42, 67, 103, 105, 135, 141, 176, 193, 375, 410, 430, 438, 467, 468, 487, 518, 533 Music, Schmitt
Atlantic menhaden *Brevoortia tyrannus*	103, 283, 312, 313, 377, 410, 420, 438, 467, 468, 486, 487, 489, 490 Music
Bay anchovy *Anchoa mitchilli*	103, 312, 313, 377, 410, 438, 467, 468, 486, 487, 489, 490 Music
Sheepshead minnow *Cyprinodon variegatus*	103, 220, 438
Mummichog *Fundulus heteroclitus*	2, 103, 278, 313, 438
Atlantic silversides *Menidia species*	103, 147, 312, 313, 377, 410, 467, 468 Music
White perch *Morone americana*	103 Music
Striped bass *Morone saxatilis*	42, 103, 105, 124, 125, 126, 165, 312, 313, 323, 324, 388, 410, 430, 438, 467, 468, 469, 474, 490, 518, 568 Music, Schmitt
Bluefish *Pomatomus saltatrix*	103, 261, 283, 312, 313, 377, 386, 388, 438, 487, 489, 490, 571 Music
Cobia *Rachycentron canadum*	103, 195, 312, 313, 388 Music
Gray snapper *Lutjanus griseus*	49, 312, 313, 388, 438, 487 Music
Sheepshead *Archosargus probatocephalus*	103, 261, 312, 313, 376, 377, 388, 438 Music
Pinfish *Lagodon rhomboides*	103, 108, 312, 313, 377, 388, 438, 487 Music
Spotted seatrout *Cynoscion nebulosus*	103, 249, 261, 285, 312, 313, 339, 376, 377, 388, 438, 487 Music
Weakfish *Cynoscion regalis*	103, 261, 283, 312, 313, 338, 343, 376, 377, 388, 486, 487, 489, 490, 572 Music
Spot *Leiostomus xanthurus*	103, 190, 261, 283, 312, 313, 345, 376, 377, 388, 438, 486, 487, 488, 489, 490 Music
Southern kingfish *Menticirrhus americanus*	67, 103, 261, 283, 312, 313, 376, 377, 388, 460, 487, 489, 490 Music
Atlantic croaker *Micropogonias undulatus*	103, 120, 261, 283, 312, 313, 344, 376, 377, 388, 486, 487, 489, 490 Music
Black drum *Pogonias cromis*	103, 155, 247, 261, 312, 313, 376, 388, 438, 461 Music
Red drum *Sciaenops ocellatus*	53, 103, 261, 312, 313, 340, 341, 376, 377, 388, 438, 490 Music
Striped mullet *Mugul cephalus*	14, 79, 103, 105, 312, 313, 377, 388, 410, 438, 467, 468, 487, 489, 490 Music, Schmitt
Spanish mackerel *Scomberomorus maculatus*	80, 103, 173, 261, 283, 312, 313, 377, 388, 487, 489, 490 Music
Gulf flounder *Paralichthys albigutta*	67, 103, 132, 164, 569 Music
Summer flounder *Paralichthys dentatus*	67, 103, 164, 312, 313, 376, 377, 388, 421, 487, 569 Music
Southern flounder *Paralichthys lethostigma*	67, 103, 132, 164, 283, 312, 313, 376, 377, 388, 410, 438, 486, 487, 489, 490, 569 Music

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Ossabaw Sound, GA
Mussel *Mytilis edulis*	1, 378
Bay scallop *Argopecten irradians*	211, 229 Music
American oyster *Crassostrea virginica*	57, 67, 88, 200, 228, 267, 300, 384, 528 Music
Common rangia *Rangia cuneata*	289 Music
Hard clam *Mercenaria species*	138, 368, 528, 543 Music, Walker
Brown shrimp *Penaeus aztecus*	16, 68, 156, 199, 288, 312, 313, 374, 377, 486, 487 Music
Pink shrimp *Penaeus duorarum*	16, 45, 156, 312, 313, 367, 377, 453 Music
White shrimp *Penaeus setiferus*	68, 156, 199, 267, 290, 312, 313, 371, 374, 377, 453, 486, 487, 529, 567 Music
Grass shrimp *Palaemonetes pugio*	101, 127, 154, 189, 207, 238, 239, 276, 277, 280, 281, 376, 415, 416
Blue crab *Callinectes sapidus*	67, 156, 312, 313, 374, 377, 389, 453, 486, 487, 523 Music
Atlantic sturgeon *Acipenser oxyrhynchus*	103, 312, 313, 372, 430, 522
Ladyfish *Elops saurus*	103, 164, 312, 313, 377, 388 Schmitt
American eel *Anguilla rostrata*	103, 312, 313, 377, 388, 410, 437, 453, 521 Music, Schmitt
Blueback herring *Alosa aestivalis*	51, 103, 312, 313, 377, 390, 430, 453, 467, 468, 492, 518 Music
Alewife *Alosa pseudoharengus*	51, 105, 390 Music, Schmitt
American shad *Alosa sapidissima*	67, 103, 135, 141, 193, 233, 347, 375, 407, 410, 430, 437, 453, 467, 468, 487, 498, 507, 518, 533 Music, Schmitt
Atlantic menhaden *Brevoortia tyrannus*	103, 283, 312, 313, 377, 410, 420, 422, 453, 467, 468, 486, 487 Music
Bay anchovy *Anchoa mitchilli*	103, 312, 313, 377, 410, 453, 467, 468, 486, 487 Music
Sheepshead minnow *Cyprinodon variegatus*	103, 220, 313
Mummichog *Fundulus heteroclitus*	2, 103, 278, 313, 453, 467, 468, 487
Atlantic silversides *Menidia species*	103, 147, 312, 313, 377, 453, 467, 468, 487 Music
White perch *Morone americana*	103, 388 Music
Striped bass *Morone saxatilis*	103, 161, 162, 230, 233, 312, 313, 323, 324, 388, 410, 430, 437, 467, 468, 469, 474, 518, 568 Music, Schmitt
Bluefish *Pomatomus saltatrix*	103, 261, 283, 312, 313, 377, 386, 388, 453, 487, 571 Music
Cobia *Rachycentron canadum*	103, 195, 312, 313, 388 Music
Gray snapper *Lutjanus griseus*	49, 312, 313, 388, 453 Music
Sheepshead *Archosargus probatocephalus*	103, 261, 312, 313, 376, 377, 388, 453 Music
Pinfish *Lagodon rhomboides*	103, 108, 312, 313, 377, 388, 453, 487 Music
Spotted seatrout *Cynoscion nebulosus*	103, 156, 162, 233, 249, 261, 285, 312, 313, 339, 376, 377, 388, 453, 487 Music
Weakfish *Cynoscion regalis*	103, 156, 261, 283, 312, 313, 338, 343, 376, 377, 388, 453, 486, 487, 572 Music
Spot *Leiostomus xanthurus*	103, 156, 190, 261, 283, 312, 313, 345, 376, 377, 388, 422, 437, 453, 467, 468, 486, 487, 488, 489 Music
Southern kingfish *Menticirrhus americanus*	67, 103, 261, 283, 312, 313, 376, 377, 388, 453, 460, 487 Music
Atlantic croaker *Micropogonias undulatus*	103, 120, 156, 261, 267, 283, 312, 313, 344, 376, 377, 388, 422, 453, 467, 468, 486, 487 Music
Black drum *Pogonias cromis*	103, 155, 247, 261, 312, 313, 376, 388, 453, 461 Music
Red drum *Sciaenops ocellatus*	53, 103, 162, 233, 261, 312, 313, 340, 341, 376, 377, 388, 437, 453 Music
Striped mullet *Mugul cephalus*	14, 79, 103, 312, 313, 377, 388, 410, 422, 437, 453, 467, 468, 487 Music
Spanish mackerel *Scomberomorus maculatus*	80, 103, 173, 261, 283, 312, 313, 377, 388, 487 Music
Gulf flounder *Paralichthys albigutta*	67, 103, 132, 164 Music
Summer flounder *Paralichthys dentatus*	67, 103, 164, 312, 313, 376, 377, 388, 421, 453, 487 Music
Southern flounder *Paralichthys lethostigma*	67, 103, 132, 164, 283, 312, 313, 376, 377, 388, 410, 422, 453, 467, 468, 486, 487 Music

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	St. Catherine/Sapelo Sound, GA
Mussel *Mytilis edulis*	1, 378
Bay scallop *Argopecten irradians*	211, 229 Music
American oyster *Crassostrea virginica*	26, 57, 67, 128, 154, 158, 200, 207, 228, 238, 239, 299, 300, 384, 485, 528, 583 Music
Common rangia *Rangia cuneata*	289 Music
Hard clam *Mercenaria species*	127, 138, 178, 207, 241, 368, 528, 538, 544, 543 Music, Walker
Brown shrimp *Penaeus aztecus*	16, 68, 101, 156, 199, 207, 229, 238, 239, 276, 287, 288, 311, 313, 322, 374, 377 Music
Pink shrimp *Penaeus duorarum*	16, 45, 156, 207, 229, 311, 313, 367, 377 Music
White shrimp *Penaeus setiferus*	68, 101, 106, 154, 156, 199, 207, 229, 238, 239, 276, 287, 290, 311, 313, 322, 371, 374, 377, 415, 416, 567 Kneib, Music
Grass shrimp *Palaemonetes pugio*	101, 127, 154, 189, 207, 238, 239, 276, 277, 280, 281, 376, 415, 416 Kneib
Blue crab *Callinectes sapidus*	67, 101, 154, 156, 229, 238, 239, 276, 299, 311, 313, 314, 322, 374, 377, 389, 415, 416, 453, 523, 583 Music
Atlantic sturgeon *Acipenser oxyrhynchus*	103, 311, 313, 372, 430, 522 Music
Ladyfish *Elops saurus*	100, 101, 103, 164, 238, 239, 311, 313, 377, 388, 415, 416
American eel *Anguilla rostrata*	101, 103, 104, 105, 311, 313, 377, 388, 521 Music
Blueback herring *Alosa aestivalis*	51, 101, 103, 311, 313, 377, 390, 430, 518 Music
Alewife *Alosa pseudoharengus*	51, 105, 390 Music
American shad *Alosa sapidissima*	67, 101, 103, 104, 105, 135, 141, 430, 518, 533 Music
Atlantic menhaden *Brevoortia tyrannus*	100, 101, 103, 104, 238, 239, 283, 311, 313, 377, 382, 383, 415, 416, 420 Kneib, Music
Bay anchovy *Anchoa mitchilli*	100, 101, 103, 104, 229, 311, 313, 322, 377, 415, 416, 447 Music
Sheepshead minnow *Cyprinodon variegatus*	101, 103, 220, 415, 416
Mummichog *Fundulus heteroclitus*	2, 101, 103, 104, 154, 238, 239, 275, 276, 278, 279, 280, 322, 409, 415, 416 Kneib
Atlantic silversides *Menidia species*	100, 103, 104, 147, 311, 313, 322, 377 Music
White perch *Morone americana*	103, 388 Music
Striped bass *Morone saxatilis*	101, 103, 388, 430, 474, 518 Music
Bluefish *Pomatomus saltatrix*	101, 103, 104, 229, 261, 283, 311, 313, 377, 386, 388, 571 Music
Cobia *Rachycentron canadum*	103, 195, 388 Music
Gray snapper *Lutjanus griseus*	49, 311, 313, 388 Music
Sheepshead *Archosargus probatocephalus*	101, 103, 261, 299, 311, 313, 376, 377, 388 Music
Pinfish *Lagodon rhomboides*	101, 103, 108, 229, 238, 239, 311, 313, 377, 388 Music
Spotted seatrout *Cynoscion nebulosus*	101, 103, 104, 156, 229, 238, 239, 249, 261, 285, 311, 313, 322, 339, 376, 377, 388, 415, 416, 447 Kneib, Music
Weakfish *Cynoscion regalis*	100, 103, 104, 106, 156, 229, 261, 283, 311, 313, 338, 343, 376, 377, 388, 447, 572 Music
Spot *Leiostomus xanthurus*	101, 103, 104, 156, 190, 229, 238, 239, 261, 283, 311, 313, 322, 345, 376, 377, 388, 416, 447, 488, 583 Kneib, Music
Southern kingfish *Menticirrhus americanus*	67, 100, 101, 103, 104, 229, 261, 283, 311, 313, 376, 377, 388, 447, 460 Music
Atlantic croaker *Micropogonias undulatus*	101, 103, 104, 106, 120, 156, 229, 261, 283, 311, 313, 322, 344, 376, 377, 388 Music
Black drum *Pogonias cromis*	101, 103, 104, 106, 155, 247, 261, 299, 311, 313, 376, 388, 461 Music
Red drum *Sciaenops ocellatus*	53, 101, 103, 238, 239, 261, 311, 313, 340, 341, 376, 377, 388, 447 Music
Striped mullet *Mugul cephalus*	14, 55, 101, 103, 104, 105, 154, 238, 239, 311, 313, 322, 377, 382, 383, 388, 409, 415, 416 Kneib, Music
Spanish mackerel *Scomberomorus maculatus*	80, 101, 103, 173, 261, 283, 311, 313, 377, 388 Music
Gulf flounder *Paralichthys albigutta*	67, 101, 103, 104, 132, 164 Music
Summer flounder *Paralichthys dentatus*	67, 100, 101, 103, 104, 164, 229, 238, 239, 311, 313, 376, 377, 388, 421 Music
Southern flounder *Paralichthys lethostigma*	67, 100, 101, 103, 104, 132, 164, 229, 283, 311, 313, 376, 377, 388 Music

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Altamaha River, GA
Mussel *Mytilis edulis*	1, 378
Bay scallop *Argopecten irradians*	211, 229 Music
American oyster *Crassostrea virginica*	57, 67, 200, 228, 238, 239, 299, 300, 384, 528, 583 Music
Common rangia *Rangia cuneata*	174, 175, 289 Music
Hard clam *Mercenaria species*	138, 174, 368, 528, 543 Music, Walker
Brown shrimp *Penaeus aztecus*	16, 68, 238, 239, 288, 311, 313, 377, 453 Music
Pink shrimp *Penaeus duorarum*	16, 45, 229, 311, 313, 367, 377 Music
White shrimp *Penaeus setiferus*	68, 238, 239, 290, 311, 313, 371, 374, 377, 567, 591 Music
Grass shrimp *Palaemonetes pugio*	101, 127, 154, 189, 207, 238, 239, 276, 277, 280, 281, 376, 415, 416
Blue crab *Callinectes sapidus*	67, 229, 238, 239, 311, 313, 314, 374, 377, 389, 453, 523, 583 Music
Atlantic sturgeon *Acipenser oxyrhynchus*	103, 105, 235, 311, 313, 372, 430, 522
Ladyfish *Elops saurus*	103, 164, 238, 239, 253, 311, 313, 353, 377, 388
American eel *Anguilla rostrata*	103, 105, 212, 213, 214, 235, 253, 311, 313, 353, 377, 388, 467, 468, 521 Music
Blueback herring *Alosa aestivalis*	3, 4, 51, 103, 105, 179, 235, 253, 311, 313, 353, 377, 390, 430, 466, 467, 468, 492, 493, 495, 518 Music
Alewife *Alosa pseudoharengus*	51, 105, 390 Music
American shad *Alosa sapidissima*	3, 67, 103, 105, 135, 141, 176, 180, 179, 193, 235, 253, 347, 348, 353, 375, 407, 430, 466, 467, 468, 495, 518, 527, 533 Music
Atlantic menhaden *Brevoortia tyrannus*	103, 238, 239, 253, 283, 311, 313, 353, 377, 420, 591 Music
Bay anchovy *Anchoa mitchilli*	103, 229, 253, 311, 313, 353, 377, 467, 468, 591 Music
Sheepshead minnow *Cyprinodon variegatus*	103, 220, 253, 353
Mummichog *Fundulus heteroclitus*	2, 103, 238, 239, 253, 278, 313, 353, 591
Atlantic silversides *Menidia species*	103, 147, 253, 311, 313, 353, 377, 467, 468, 591 Music
White perch *Morone americana*	103, 388 Music
Striped bass *Morone saxatilis*	103, 105, 235, 323, 388, 430, 466, 467, 468, 474, 518, 568 Music
Bluefish *Pomatomus saltatrix*	103, 253, 261, 283, 311, 313, 353, 377, 386, 388, 571 Music
Cobia *Rachycentron canadum*	103, 195, 388 Music
Gray snapper *Lutjanus griseus*	49, 235, 253, 311, 312, 353, 388 Music
Sheepshead *Archosargus probatocephalus*	103, 253, 261, 313, 353, 376, 377, 388 Music
Pinfish *Lagodon rhomboides*	103, 108, 229, 238, 239, 253, 311, 313, 353, 377, 388, 591 Music
Spotted seatrout *Cynoscion nebulosus*	103, 229, 235, 238, 239, 249, 253, 261, 285, 311, 313, 339, 353, 376, 377, 388, 447, 591 Music
Weakfish *Cynoscion regalis*	103, 229, 253, 261, 283, 311, 313, 338, 343, 353, 376, 377, 388, 447, 572, 591 Music
Spot *Leiostomus xanthurus*	103, 190, 229, 238, 239, 253, 261, 283, 311, 313, 345, 353, 373, 376, 377, 388, 447, 467, 468, 488, 583 Music
Southern kingfish *Menticirrhus americanus*	67, 103, 229, 253, 261, 283, 311, 313, 353, 376, 377, 388, 447, 460, 591 Music
Atlantic croaker *Micropogonias undulatus*	103, 120, 229, 253, 261, 283, 311, 313, 344, 353, 376, 377, 388, 447, 467, 468 Music
Black drum *Pogonias cromis*	103, 155, 247, 253, 261, 311, 313, 353, 376, 388, 461, 591 Music
Red drum *Sciaenops ocellatus*	53, 103, 235, 238, 239, 253, 261, 311, 313, 340, 341, 353, 376, 377, 388, 447 Music
Striped mullet *Mugul cephalus*	14, 79, 103, 105, 235, 238, 239, 253, 311, 313, 377, 388, 467, 468 Music
Spanish mackerel *Scomberomorus maculatus*	80, 103, 173, 253, 261, 283, 311, 313, 353, 377, 388 Music
Gulf flounder *Paralichthys albigutta*	67, 103, 132, 164, 353 Music
Summer flounder *Paralichthys dentatus*	67, 103, 164, 229, 235, 238, 239, 253, 311, 313, 353, 376, 377, 388, 421, 591 Music
Southern flounder *Paralichthys lethostigma*	67, 103, 132, 164, 229, 235, 253, 283, 311, 313, 353, 376, 377, 388, 467, 468, 591 Music

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	St. Andrew/St. Simon Sound, GA
Mussel *Mytilis edulis*	1, 378
Bay scallop *Argopecten irradians*	211, 229 Music
American oyster *Crassostrea virginica*	57, 67, 200, 228, 266, 267, 300, 321, 376, 384, 528 Music
Common rangia *Rangia cuneata*	174, 266, 289 Music
Hard clam *Mercenaria species*	138, 177, 178, 241, 267, 368, 376, 528, 543 Music, Walker
Brown shrimp *Penaeus aztecus*	16, 68, 156, 189, 199, 266, 267, 288, 310, 313, 374, 376, 377 Music
Pink shrimp *Penaeus duorarum*	16, 45, 156, 310, 313, 367, 376, 377 Music
White shrimp *Penaeus setiferus*	68, 156, 189, 199, 267, 290, 310, 313, 371, 374, 376, 377, 567, 591 Music
Grass shrimp *Palaemonetes pugio*	101, 127, 154, 189, 207, 238, 239, 266, 276, 277, 280, 281, 376, 415, 416
Blue crab *Callinectes sapidus*	67, 156, 189, 266, 310, 313, 314, 374, 376, 377, 389, 453, 523 Music
Atlantic sturgeon *Acipenser oxyrhynchus*	15, 103, 267, 310, 313, 372, 430, 522
Ladyfish *Elops saurus*	103, 164, 310, 313, 376, 377, 388
American eel *Anguilla rostrata*	103, 189, 310, 313, 376, 377, 388, 521 Music
Blueback herring *Alosa aestivalis*	51, 103, 310, 313, 377, 390, 430, 518 Music
Alewife *Alosa pseudoharengus*	51, 105, 390 Music
American shad *Alosa sapidissima*	67, 103, 135, 141, 193, 430, 518, 533 Music
Atlantic menhaden *Brevoortia tyrannus*	15, 103, 189, 283, 309, 310, 313, 376, 377, 420, 591 Music
Bay anchovy *Anchoa mitchilli*	15, 103, 189, 309, 310, 313, 376, 377, 591 Music
Sheepshead minnow *Cyprinodon variegatus*	103, 220, 309, 376
Mummichog *Fundulus heteroclitus*	2, 103, 189, 278, 309, 310, 313, 376, 591
Atlantic silversides *Menidia species*	103, 147, 310, 313, 376, 377, 591 Music
White perch *Morone americana*	103, 388 Music
Striped bass *Morone saxatilis*	103, 310, 313, 388, 430, 474, 518, 568 Music
Bluefish *Pomatomus saltatrix*	15, 103, 261, 283, 310, 313, 377, 386, 388, 571 Music
Cobia *Rachycentron canadum*	15, 103, 195, 310, 313, 388 Music
Gray snapper *Lutjanus griseus*	49, 189, 310, 313, 376, 388 Music
Sheepshead *Archosargus probatocephalus*	103, 189, 261, 310, 313, 376, 377, 388 Music
Pinfish *Lagodon rhomboides*	15, 103, 108, 189, 310, 313, 376, 377, 388, 591 Music
Spotted seatrout *Cynoscion nebulosus*	15, 103, 156, 189, 249, 261, 267, 285, 310, 313, 339, 376, 377, 388, 591 Music
Weakfish *Cynoscion regalis*	15, 103, 156, 189, 261, 283, 309, 310, 313, 338, 343, 376, 377, 388, 572, 591 Music
Spot *Leiostomus xanthurus*	15, 103, 156, 189, 190, 261, 267, 283, 310, 313, 345, 373, 376, 377, 388, 488, 591 Music
Southern kingfish *Menticirrhus americanus*	15, 67, 103, 189, 261, 283, 310, 313, 376, 377, 388, 460, 591 Music
Atlantic croaker *Micropogonias undulatus*	15, 103, 120, 156, 189, 261, 266, 267, 283, 310, 313, 344, 376, 377, 388, 591 Music
Black drum *Pogonias cromis*	15, 103, 155, 189, 247, 261, 266, 310, 313, 376, 388, 461, 591 Music
Red drum *Sciaenops ocellatus*	53, 103, 106, 261, 310, 313, 340, 341, 376, 377, 388 Music
Striped mullet *Mugul cephalus*	14, 15, 79, 103, 106, 189, 310, 313, 377, 388, 591 Music
Spanish mackerel *Scomberomorus maculatus*	80, 103, 173, 261, 283, 310, 313, 377, 388 Music
Gulf flounder *Paralichthys albigutta*	67, 103, 132, 164, 376 Music
Summer flounder *Paralichthys dentatus*	15, 67, 103, 164, 310, 313, 376, 377, 388, 421, 591 Music
Southern flounder *Paralichthys lethostigma*	67, 103, 106, 132, 164, 189, 283, 310, 313, 376, 377, 388, 591 Music

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	St. John's River, FL
Mussel *Mytilis edulis*	1, 378 A.Q. White
Bay scallop *Argopecten irradians*	152 A.Q. White
American oyster *Crassostrea virginica*	27, 57, 150, 152, 244, 302 A.Q. White
Common rangia *Rangia cuneata*	94, 289 A.Q. White
Hard clam *Mercenaria species*	138, 152, 215 A.Q. White
Brown shrimp *Penaeus aztecus*	82, 150, 254, 255, 288, 329, 579 DeMort, A.Q. White
Pink shrimp *Penaeus duorarum*	87, 126.1, 254, 255, 268, 329, 579 DeMort, A.Q. White
White shrimp *Penaeus setiferus*	112, 150, 152, 254, 255, 297, 298, 329, 371, 579 DeMort, A.Q. White
Grass shrimp *Palaemonetes pugio*	12, 74, 90, 579 A.Q. White
Blue crab *Callinectes sapidus*	92, 126.1, 150, 152, 361, 503, 523, 579 DeMort, A.Q. White
Atlantic sturgeon *Acipenser oxyrhynchus*	31, 89, 91, 152, 331, 361, 372, 522 A.Q. White
Ladyfish *Elops saurus*	31, 71, 74, 89, 90, 91, 92, 94, 129, 150, 152, 250, 331, 360, 504 DeMort, A.Q. White
American eel *Anguilla rostrata*	31, 74, 89, 90, 91, 92, 93, 94, 150, 152, 194, 331, 360, 361, 362, 504, 521 DeMort, A.Q. White
Blueback herring *Alosa aestivalis*	31, 74, 89, 90, 91, 92, 94, 146, 250, 331, 360, 361, 504 DeMort, A.Q. White
Alewife *Alosa pseudoharengus*	146, 250, 361 DeMort, A.Q. White
American shad *Alosa sapidissima*	31, 74, 89, 90, 91, 94, 110, 141, 152, 331, 360, 361, 379, 532, 533, 582 DeMort, A.Q. White
Atlantic menhaden *Brevoortia tyrannus*	31, 71, 74, 90, 91, 92, 150, 152, 259, 420, 504 DeMort, A.Q. White
Bay anchovy *Anchoa mitchilli*	71, 74, 89, 90, 91, 92, 250, 331, 361, 504 DeMort, A.Q. White
Sheepshead minnow *Cyprinodon variegatus*	31, 71, 89, 90, 91, 92, 93, 94, 194, 331, 361, 504 DeMort, A.Q. White
Mummichog *Fundulus heteroclitus*	2, 31, 71, 194, 331, 361, 504 DeMort, A.Q. White
Atlantic silversides *Menidia species*	31, 74, 89, 90, 91, 92, 93, 94, 147, 221, 331, 361, 504 DeMort, A.Q. White
White perch *Morone americana*	195 A.Q. White
Striped bass *Morone saxatilis*	31, 74, 89, 90, 91, 92, 94, 149, 195, 331, 360, 361, 474, 504 DeMort, A.Q. White
Bluefish *Pomatomus saltatrix*	150, 152, 386 DeMort, A.Q. White
Cobia *Rachycentron canadum*	152, 195 A.Q. White
Gray snapper *Lutjanus griseus*	31, 49, 71, 90, 152, 195, 331, 360, 361, 504 DeMort, A.Q. White
Sheepshead *Archosargus probatocephalus*	31, 71, 90, 152, 247, 331, 360, 361, 504 DeMort, A.Q. White
Pinfish *Lagodon rhomboides*	31, 71, 90, 92, 108, 150, 331, 360, 361, 504 DeMort, A.Q. White
Spotted seatrout *Cynoscion nebulosus*	31, 71, 74, 89, 92, 126.1, 150, 152, 247, 249, 331, 339, 341, 360, 361, 501, 503 DeMort, A.Q. White
Weakfish *Cynoscion regalis*	31, 74, 90, 150, 152, 338, 343, 504 DeMort, A.Q. White
Spot *Leiostomus xanthurus*	31, 71, 74, 150, 152, 331, 345, 360, 361, 362, 504 DeMort, A.Q. White
Southern kingfish *Menticirrhus americanus*	31, 224, 247, 465, 504 DeMort, A.Q. White
Atlantic croaker *Micropogonias undulatus*	31, 71, 74, 89, 90, 91, 92, 94, 150, 152, 331, 344, 360, 361, 362, 504 DeMort, A.Q. White
Black drum *Pogonias cromis*	31, 71, 150, 152, 247, 331, 360, 376, 504 DeMort, A.Q. White
Red drum *Sciaenops ocellatus*	31, 71, 74, 90, 94, 126.1, 150, 152, 247, 246, 331, 340, 342, 360, 361, 394, 504, 592 DeMort, A.Q. White
Striped mullet *Mugul cephalus*	14, 31, 71, 74, 79, 89, 90, 91, 92, 93, 94, 116, 150, 152, 331, 360, 361, 362, 504 DeMort, A.Q. White
Spanish mackerel *Scomberomorus maculatus*	31, 40, 152, 157, 173, 403, 504, 590 DeMort, A.Q. White
Gulf flounder *Paralichthys albigutta*	31, 152, 164, 504 DeMort, A.Q. White
Summer flounder *Paralichthys dentatus*	31, 150, 152, 164, 421, 504 DeMort, A.Q. White
Southern flounder *Paralichthys lethostigma*	31, 71, 74, 89, 90, 91, 94, 152, 164, 331, 360, 361, 504 DeMort, A.Q. White

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Indian River, FL
Mussel *Mytilis edulis*	1, 378 Hall, Provencha, C. White
Bay scallop *Argopecten irradians*	30, 152, 270 Hall, Provencha, C. White
American oyster *Crassostrea virginica*	27, 57, 152, 159, 186.1, 244, 270, 302, 413, 568.1 Hall, Provencha, C. White
Common rangia *Rangia cuneata*	187, 289, 413, 568.1 C. White
Hard clam *Mercenaria species*	58, 138, 152, 172, 216, 215, 270, 318, 413, 568.1 Hall, Provencha, C. White
Brown shrimp *Penaeus aztecus*	18, 82, 112, 181, 182, 187, 255, 270, 288, 329, 579 Hall, Provencha, C. White
Pink shrimp *Penaeus duorarum*	18, 87, 98, 112, 181, 182, 186, 187, 254, 255, 268, 270, 329, 579 Hall, Provencha, C. White
White shrimp *Penaeus setiferus*	18, 112, 152, 186, 187, 254, 255, 270, 297, 298, 329, 367, 579 Hall, Provencha, C. White
Grass shrimp *Palaemonetes pugio*	12, 18, 112, 181, 182, 186, 187, 270, 530, 568.1, 579 Hall, Provencha, C. White
Blue crab *Callinectes sapidus*	17, 18, 152, 181, 182, 186, 187, 270, 391, 503, 523, 579 Hall, Provencha, C. White
Atlantic sturgeon *Acipenser oxyrhynchus*	152, 169, 170, 372, 522 Gilmore, Hall, Provencha
Ladyfish *Elops saurus*	17, 129, 152, 166, 167, 169, 171, 187, 198, 250, 252, 270, 296, 369, 370, 475, 547 Gilmore
American eel *Anguilla rostrata*	78, 152, 166, 167, 169, 194, 270, 475, 478, 521 Gilmore, Hall, Provencha
Blueback herring *Alosa aestivalis*	146, 250 Gilmore, Hall, Provencha
Alewife *Alosa pseudoharengus*	146, 250 Gilmore, Hall, Provencha
American shad *Alosa sapidissima*	136, 141, 152, 166, 167, 169, 270, 533 Gilmore, Hall, Provencha
Atlantic menhaden *Brevoortia tyrannus*	78, 136, 152, 166, 167, 169, 187, 270, 420, 475, 478, 547 Hall, Provencha
Bay anchovy *Anchoa mitchilli*	18, 78, 166, 167, 168, 169, 171, 187, 250, 252, 270, 296, 332, 369, 370, 439, 475, 478, 547 Gilmore, Hall, Provencha
Sheepshead minnow *Cyprinodon variegatus*	136, 166, 167, 168, 169, 187, 194, 198, 270, 296, 332, 439, 475, 547 Gilmore, Hall, Provencha
Mummichog *Fundulus heteroclitus*	2, 136, 167, 169, 194, 270, 332, 475 Gilmore, Hall, Provencha
Atlantic silversides *Menidia species*	147, 166, 167, 169, 171, 187, 221, 252, 270, 296, 332, 439, 475, 547 Gilmore, Hall, Provencha
White perch *Morone americana*	195 Gilmore, Hall, Provencha
Striped bass *Morone saxatilis*	149, 169, 170, 195, 474 Gilmore, Hall, Provencha
Bluefish *Pomatomus saltatrix*	17, 78, 136, 152, 166, 167, 169, 252, 270, 386, 475 Gilmore, Hall, Provencha
Cobia *Rachycentron canadum*	78, 152, 166, 167, 169, 195, 270 Gilmore, Hall, Provencha
Gray snapper *Lutjanus griseus*	17, 49, 78, 152, 166, 167, 169, 171, 187, 195, 252, 270, 296, 369, 370, 475, 478, 481, 491 Gilmore, Hall, Provencha
Sheepshead *Archosargus probatocephalus*	17, 18, 78, 136, 152, 166, 167, 169, 171, 187, 247, 252, 270, 296, 369, 370, 475, 478 Gilmore, Hall, Provencha
Pinfish *Lagodon rhomboides*	17, 18, 78, 108, 136, 166, 167, 169, 171, 187, 252, 270, 296, 332, 334, 369, 370, 439, 475, 478, 491 Gilmore, Hall, Provencha
Spotted seatrout *Cynoscion nebulosus*	17, 78, 136, 152, 166, 167, 169, 171, 187, 247, 249, 252, 270, 339, 341, 369, 370, 439, 475, 478, 499, 500, 501, 502, 547 Gilmore, Hall, Provencha
Weakfish *Cynoscion regalis*	152, 166, 167, 169, 187, 270, 338, 343, 369, 370, 475, 478 Gilmore, Hall, Provencha
Spot *Leiostomus xanthurus*	17, 18, 78, 136, 152, 166, 167, 169, 171, 187, 252, 270, 296, 332, 345, 369, 370, 439, 478 Gilmore, Hall, Provencha
Southern kingfish *Menticirrhus americanus*	18, 136, 166, 167, 169, 187, 224, 247, 270, 369, 370, 439, 465, 475 Gilmore, Hall, Provencha
Atlantic croaker *Micropogonias undulatus*	17, 18, 78, 136, 152, 166, 167, 169, 187, 252, 270, 296, 332, 344, 369, 370, 475, 478 Gilmore, Hall, Provencha
Black drum *Pogonias cromis*	17, 78, 136, 152, 166, 167, 169, 187, 247, 252, 270, 296, 369, 370, 376, 439, 475 Gilmore, Hall, Provencha
Red drum *Sciaenops ocellatus*	17, 78, 136, 152, 166, 167, 169, 171, 187, 247, 246, 252, 270, 296, 340, 342, 394, 439, 475, 592 Gilmore, Hall, Provencha
Striped mullet *Mugul cephalus*	14, 17, 78, 79, 116, 136, 152, 166, 167, 169, 171, 187, 198, 296, 332, 439, 475, 547 Gilmore, Hall, Provencha
Spanish mackerel *Scomberomorus maculatus*	40, 136, 152, 157, 166, 167, 169, 173, 252, 270, 403, 475, 590 Gilmore, Hall, Provencha
Gulf flounder *Paralichthys albigutta*	18, 78, 152, 164, 166, 167, 169, 270, 369, 370, 475 Gilmore
Summer flounder *Paralichthys dentatus*	152, 164, 166, 167, 169, 270 Gilmore
Southern flounder *Paralichthys lethostigma*	78, 136, 152, 164, 166, 167, 169, 270, 475 Gilmore

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 6, continued. Table of references and personal communications.

Common/Scientific Name	Biscayne Bay, FL
Mussel *Mytilis edulis*	1, 378 Rutledge
Bay scallop *Argopecten irradians*	22, 23, 24, 25, 30, 152, 419, 418 Rutledge, Curry, Tilmant
American oyster *Crassostrea virginica*	25, 27, 57, 152, 244, 302, 419, 418 Rutledge, Curry
Common rangia *Rangia cuneata*	289 Rutledge
Hard clam *Mercenaria species*	138, 152, 172 Rutledge, Tilmant
Brown shrimp *Penaeus aztecus*	22, 23, 25, 82, 255, 288, 419, 418, 434, 531, 579 Rutledge, Tilmant
Pink shrimp *Penaeus duorarum*	22, 23, 24, 25, 43, 66, 87, 255, 268, 419, 418, 434, 531, 579 Rutledge, Tilmant
White shrimp *Penaeus setiferus*	152, 255, 298, 367, 579 Rutledge, Tilmant
Grass shrimp *Palaemonetes pugio*	12, 22, 23, 43, 419, 418, 579 Rutledge
Blue crab *Callinectes sapidus*	22, 24, 25, 43, 152, 419, 418, 458, 523, 579 Rutledge
Atlantic sturgeon *Acipenser oxyrhynchus*	470, 522 Rutledge
Ladyfish *Elops saurus*	43, 113, 129, 152, 250, 303, 359, 531 Rutledge, Tilmant
American eel *Anguilla rostrata*	113, 152, 194, 521, 531 Rutledge, Tilmant
Blueback herring *Alosa aestivalis*	146, 250 Rutledge
Alewife *Alosa pseudoharengus*	146, 250 Rutledge
American shad *Alosa sapidissima*	141, 533 Rutledge
Atlantic menhaden *Brevoortia tyrannus*	40, 152, 236, 303, 420, 526 Rutledge, Schmidt
Bay anchovy *Anchoa mitchilli*	11, 22, 23, 25, 31, 43, 113, 114, 236, 237, 250, 303, 531 Rutledge, Schmidt
Sheepshead minnow *Cyprinodon variegatus*	43, 113, 194, 303, 359, 531 Rutledge, Schmidt
Mummichog *Fundulus heteroclitus*	2, 194 Rutledge, Schmidt
Atlantic silversides *Menidia species*	115, 147, 221, 531 Rutledge, Schmidt
White perch *Morone americana*	195 Rutledge
Striped bass *Morone saxatilis*	149, 195 Rutledge
Bluefish *Pomatomus saltatrix*	43, 113, 115, 152, 359, 386, 458, 531 Rutledge, Tilmant
Cobia *Rachycentron canadum*	43, 113, 152, 195, 359, 531 Rutledge
Gray snapper *Lutjanus griseus*	22, 23, 25, 43, 44, 49, 65, 113, 115, 152, 195, 303, 418, 458, 482, 531 Rutledge
Sheepshead *Archosargus probatocephalus*	43, 113, 114, 152, 247, 303, 359, 418, 458, 531 Rutledge
Pinfish *Lagodon rhomboides*	22, 23, 24, 25, 44, 49, 65, 108, 113, 114, 115, 303, 359, 418, 458 Rutledge
Spotted seatrout *Cynoscion nebulosus*	11, 23, 43, 44, 113, 152, 236, 247, 249, 303, 339, 341, 359, 418, 465, 502, 531 Rutledge
Weakfish *Cynoscion regalis*	113, 152, 338, 531 Rutledge
Spot *Leiostomus xanthurus*	113, 114, 152, 303, 345, 531 Rutledge
Southern kingfish *Menticirrhus americanus*	113, 224, 247, 531 Rutledge
Atlantic croaker *Micropogonias undulatus*	11, 113, 152, 236, 303, 344, 531 Rutledge
Black drum *Pogonias cromis*	43, 113, 115, 152, 247, 376, 458 Rutledge
Red drum *Sciaenops ocellatus*	115, 152, 247, 340, 342, 359, 394, 531, 592 Rutledge
Striped mullet *Mugul cephalus*	14, 43, 79, 113, 114, 116, 152, 303, 359, 458, 478, 531 Rutledge, Tilmant
Spanish mackerel *Scomberomorus maculatus*	40, 43, 113, 114, 115, 152, 157, 173, 273, 303, 359, 403, 458, 531, 590 Rutledge
Gulf flounder *Paralichthys albigutta*	22, 25, 43, 44, 113, 114, 152, 164, 236, 303, 418, 531 Rutledge
Summer flounder *Paralichthys dentatus*	152, 164 Rutledge
Southern flounder *Paralichthys lethostigma*	152, 164 Rutledge, Schmidt, Tilmant

Numbers correspond to references in Appendix 8, p. 151-177.
Names correspond to individuals in Appendix 7, p. 148-150.

Appendix 7. Personal communications

Name	Affiliation
D. Ahrenholz	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
D. Allen	Univ. of South Carolina, Belle Baruch Marine Lab., Georgetown, SC
M. Allison	North Carolina Div. of Marine Fisheries, Wilmington Dist. Ofc., Wilmington, NC
W. Anderson	South Carolina Wildlife and Marine Resources, Charleston, SC
J. Archambault	South Carolina Wildlife and Marine Resources, Charleston, SC
C. Benedict	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
G.F. Booth	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
J. Burke	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
K.N. Cates	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
S.E. Chester	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
D.S. Cooke	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
R. Curry	US Natl. Park Serv, Biscayne Bay Natl. Park, Homestead, FL
L. Delancey	South Carolina Wildlife and Marine Resources, Charleston, SC
C. DeMort	Univ. of N. Florida, Coastal Fisheries Lab., Jacksonville, FL
D. Freeman	North Carolina Div. of Marine Fisheries, Morehead City, NC
R.G. Gilmore	Harbor Branch Oceanographic Institute, Fort Pierce, FL
C. Hall	Bionetic Corp. Environmental Labs., Kennedy Space Center, FL
D. Hamilton	South Carolina Wildl. & Marine Res., Waddell Mariculture Ctr., Bluffton, SC
J. Hawkins	North Carolina Div. of Marine Fisheries, Washington Dist. Ofc., Washington, NC
L. Henry	North Carolina Div. of Marine Fisheries, Elizabeth City Dist. Ofc., Elizabeth City, NC
W.E. Herring, Jr.	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
W. Hettler	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
J. Holloway	South Carolina Wildl. & Marine Res., Waddell Mariculture Ctr., Bluffton, SC
S. Hopkins	South Carolina Wildl. & Marine Res., Waddell Mariculture Ctr., Bluffton, SC
R.T. Kneib	Univ. of Georgia, Marine Inst., Sapelo Island, GA
R.M. Lewis	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC

Appendix 7, continued: Personal communications

D. Lindquist	Univ. of North Carolina - Wilmington, Dept. of Biol. Sci., Wilmington, NC
C. Manooch	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
P. Marraro	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
M. Marshall	North Carolina Div. of Marine Fisheries, Morehead City, NC
R. Martore	South Carolina Wildlife and Marine Resources, Charleston, SC
S. McKenna	North Carolina Div. of Marine Fisheries, Washington Dist. Ofc., Washington, NC
L. Mercer	North Carolina Div. of Marine Fisheries, Morehead City, NC
R. Monaghan	North Carolina Div. of Marine Fisheries, Morehead City, NC
R. Moore	Univ. of South Carolina, Coastal Carolina College, Conway, SC
M. Moser	North Carolina State Univ., Zoology Dept., Raleigh, NC
D. Moye	North Carolina Div. of Marine Fisheries, Washington Dist. Ofc., Washington, NC
J. Music	Georgia Dept. Nat. Res., Coastal Resources Div., Brunswick, GA
G. Ogburn	Univ. of South Carolina, Belle Baruch Marine Lab., Georgetown, SC
J. Parker	North Carolina Div. of Marine Fisheries, Wilmington Dist. Ofc., Wilmington, NC
L.W. Pollard	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
A. Powell	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
M. Provencha	Bionetic Corp. Environmental Labs., Kennedy Space Center, FL
F. Rohde	North Carolina Div. of Marine Fisheries, Wilmington Dist. Ofc., Wilmington, NC
J. Ross	North Carolina Div. of Marine Fisheries, Manteo Field Ofc., Manteo, NC
S. Ross	North Carolina State Univ., Zoology Dept., Raleigh, NC
T. Rutledge	US Natl. Park Serv, Biscayne Bay Natl. Park, Homestead, FL
T. Schmidt	US Natl. Park Serv, Everglades Natl. Park, Homestead, FL
D.N. Schmitt	Georgia Dept. Nat. Res., Game & Fish Div., Richmond Hill, GA
J. Schoolfield	North Carolina Div. of Marine Fisheries, Wilmington Dist. Ofc., Wilmington, NC
J. Smith	NOAA / National Marine Fisheries Service, Beaufort Lab., Beaufort, NC
S. Spence	North Carolina Div. of Marine Fisheries, Morehead City, NC
B. Stender	South Carolina Wildlife and Marine Resources, Charleston, SC
A. Stokes	South Carolina Wildl. & Marine Res., Waddell Mariculture Ctr., Bluffton, SC
D. Taylor	North Carolina Div. of Marine Fisheries, Morehead City, NC

T.E. Thompson	Carolina Power & Light Co., Brunswick Biological Lab., Southport, NC
J. Tilmant	US Natl. Park Service, Everglades Natl. Park, Homestead, FL
R. VanDolah	South Carolina Wildlife and Marine Resources, Charleston, SC
R.L. Walker	Univ. of Georgia, Marine Extension Service, Savannah, GA
E. Wenner	South Carolina Wildlife and Marine Resources, Charleston, SC
D. Whitaker	South Carolina Wildlife and Marine Resources, Charleston, SC
A.Q. White	Jacksonville Univ., Div. of Sci. & Math, Jacksonville, FL
C. White	Brevard County Ofc. of Nat. Res. Mgt., Merrit Island, FL
S. Winslow	North Carolina Div. of Marine Fisheries, Elizabeth City Dist. Ofc., Elizabeth City, NC

Appendix 8. References

1. Abbott, R.T., and S.P. Dance. 1986. Compendium of Seashells. Madison Publishing Associates. Dai Nippon Printing Co., Ltd. Tokyo.

2. Abraham, B.J. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) - mummichog and striped killifish. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.40).

3. Adams, J.G. 1970. Clupeids in the Altamaha River, Georgia. Ga. Game Fish Comm., Coast. Fish. Div. Contrib. Ser. No. 20.

4. Adams, J.G. and M.W. Street. 1969. Notes on the spawning and embryological development of the blueback herring, *Alosa aestivalis* Mitchell, in the Altamaha River, Georgia. Ga. Game Fish Comm., Mar. Fish Div., Contrib. Ser. No. 16. 14 p.

5. Adams, S.M. 1974. Structural and functional analysis of eelgrass fish communities. Ph. D. Thesis, Univ. North Carolina, Chapel Hill, NC, 131 p.

6. Ahrenholz, D.W., W.R. Nelson, and S.P. Epperly. 1987. Population and fishery characteristics of Atlantic menhaden, *Brevoortia tyrannus*. Fish. Bull., U.S. 85: 569-600.

7. Allen, D.M., and D.L. Barker. 1990. Interannual variations in larval fish recruitment to estuarine epibenthic habitats. Mar. Ecol. Prog. Ser. 65: 113-125.

8. Allen, D.M., W.K. Michener, and S.E. Stancyk (editors). 1984. Pollution Ecology of Winyah Bay, S.C.: Characterization of the Estuary and Potential Impacts of Petroleum. Baruch Institute Special Publication No. 84-1, Univ. of South Carolina, Columbia, S.C., 271 p.

9. 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, Univ. of South Carolina, Columbia, S.C., 275 p.

10. Alon, N.C., and S.E. Stancyk. 1982. Variation in life-history patterns of the grass shrimp *Palaemonetes pugio* in two South Carolina estuarine systems. Mar. Biol. 68: 265-276.

11. Alpern, J.D. 1981. Relationships between larval fishes and their prey in Biscayne Bay, Florida. M.S. Thesis, Univ. Miami, Coral Gables, FL, 103 p.

12. Anderson, G. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico)—grass shrimp. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.35).

13. Anderson, W.D., W.J. Keith, F.H. Mills, M.E. Baily, and J.L. Steinmeyer. 1978. A survey of South Carolina hard clam resources. S.C. Mar. Resour. Cent., Tech. Rep. No. 32, 17 p.

14. Anderson, W.W. 1958. Larval development, growth, and spawning of striped mullet (*Mugil cephalus*) along the south Atlantic coast of the United States. Fish. Bull., U.S. 58: 501-519.

15. Anderson, W.W. 1968. Fishes taken during shrimp trawling along the South Atlantic coast of the United States. U.S. Fish Wildl. Serv., Special Scient. Rep., Fish. No. 570.

16. Anderson, W.W. 1970. Contributions to the life histories of several penaeid shrimps (Penaeidae) along the South Atlantic coast of the United States. U.S. Fish. Wildl. Serv., Spec. Sci. Rep. Fish. No. 605.

17. Anderson, W.W., and J.W. Gehringer. 1965. Biological-statistical census of the species entering fisheries in the Cape Canaveral area. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. No. 514.

18. Applied Biology, Inc., and R.L. Lyerly and Associates. 1980. Biological and environmental studies at the Florida Power and Light Company Cape Canaveral Plant and the Orlando Utilities Commission Indian River Plant, Vol. I. Atlanta, GA 30033.

19. Archambault, J.A., and E.L. Wenner. (in press). Results of 18 months of crab potting in Charleston Harbor and the Ashley River. S.C. Wildl. Mar. Resour., Charleston, S.C.

20. Archambault, J.A., E.L. Wenner, and J.D. Whitaker. 1990. Life history and abundance of blue crab, *Callinectes sapidus*, at Charleston Harbor, South Carolina. Bull. Mar. Sci. 46(1): 145-158.

21. Arnold, W.S. 1983. The effects of prey size, predator size, and sediment composition on the rate of predation of the blue crab (*Callinectes sapidus*) on the hard clam (*Mercenaria mercenaria*). M.S. thesis, Univ. Ga., Athens. 46 p.

22. Bader, R.G. 1969. An ecological study of south Biscayne Bay in the vicinity of Turkey Point. Univ. Miami Institute of Marine Sciences, Progress Report to the U.S. Atomic Energy Commission. Contract No. (AT-(40-1)-3801-1).

23. Bader, R.G., and M.A. Roessler. 1971. An ecological survey of south Biscayne Bay and Card Sound. Univ. Miami Rosenstiel School of Marine and Atmospheric Sciences, Progress Report to the U.S. Atomic Energy Commission and the Florida Power and Light Co. Contract No. (AT-(40-1)-3801-3).

24. Bader, R.G., and M.A. Roessler. 1972. An ecological study of South Biscayne Bay and Card Sound. Univ. of Miami Rosenstiel School of Marine and Atmospheric Science, Progress Report to the U.S. Atomic Energy Commission and the Florida Power and Light Co. Contract No. (AT-(40-1)-3801-4).

25. Bader, R.G., and D.C. Tabb. 1970. An ecological study of south Biscayne Bay in the vicinity of Turkey Point. Univ. Miami Rosenstiel School of Marine and Atmospheric Sciences, Progress Report to the U.S. Atomic Energy Commission. Contract No. (AT-(40-1)-3801-2).

26. Bahr, L.M., Jr. 1974. Aspects of the structure and function of the intertidal oyster community in Georgia. Ph.D.. Dissertation, Univ. Ga., Athens. 149 p.

27. Bahr, L.M., Jr. and W.P. Lanier. 1981. The ecology of intertidal oyster reefs of the south Atlantic coast: a community profile. U.S. Fish Wildl. Serv. FWS/OBS-81/15.

28. Baisden, V.W. 1983a. Juvenile penaeid shrimp, blue crab, and finfish assessment in coastal Georgia. Ga. Dept. Nat. Res., Coast. Res. Div. Contrib. Ser. No. 34

29. Baisden, V.W. 1983b. Postlarval penaeid shrimp assessment in coastal Georgia. Ga. Dept. Nat. Res., Coast. Res. Div. Contrib. Ser. No. 37.

30. Barber, B.J., and N.J. Blake. 1983. Growth and reproduction of the bay scallop, *Argopecten irradians* (Lamarck) at its southern distributional limit. J. Exp. Mar. Biol. Ecol. 66: 247-256.

31. Bass, D.G., Jr. 1983. Completion report for investigations project Dingell-Johnson project F-36. North Florida streams research project, Study III: Rivers of Florida and their fishes. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

32. Battle, J.D. 1892. An investigation of the coast waters of South Carolina with reference to oyster culture. Bull. U.S. Fish. Comm. 10: 300-330.

33. Bearden, C.M. 1961a. Common marine fishes of South Carolina. Contrib. Bears Bluff Lab. No. 34, 47 p.

34. Bearden, C.M. 1961b. Notes on post larvae of commercial shrimp (*Penaeus*) in South Carolina. Contrib. Bears Bluff Lab. No. 33, 8 p.

35. Bearden, C.M. 1963. A contribution to the biology of the king whitings, genus *Menticirrhus*, of South Carolina. Contrib. Bears Bluff. No. 38, 27 p.

36. Bearden, C.M. 1964. Distribution and abundance of Atlantic croaker, *Micropogon undulatus*, in South Carolina. Contrib. Bears Bluff Lab. No. 40, 23 p.

37. Bearden, C.M., and C.H. Farmer, III. 1972. Fishery resources of Port Royal Sound Estuary. *In* Port Royal Sound Environmental Study, p. 204-212. South Carolina Water Resources Commission, Columbia, S.C.

38. Bearden, C., 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. S.C. Mar. Resour. Cent., Tech. Rep. No. 61, 51 p.

39. Beaumariage, D.S. 1969. Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results. Fla. Dept. Nat. Resour. Tech. Ser. No. 59, 38 p.

40. Beaumariage, D.S. 1970. Current status of the biological investigations of Florida's mackerel fisheries. Gulf Caribb. Fish. Inst. 22: 79-86.

41. Benedict, C., and M.T. Hirsh. 1982. Sonic tracking of Atlantic sturgeon and white catfish in the lower Cape Fear River, NC. J. Elisha Mitchell Sci. Soc. 96(2): 113.

42. Bennett, D.H. and R.W. McFarlane. 1983. The fishes of the Savannah River Plant: National Environmental Research Park. US Dept. Energy, SRO-NERP-12.

43. Berkeley, S.A. 1984. Fisheries assessment. Final Report to Dade County Department of Environmental Resources Management, Miami, FL.

44. Berkeley, S.A., D.W. Pybas, and W.L Compos. 1985. Bait shrimp fishery of Biscayne Bay. Fla. Sea Grant Extension Program, Tech. Paper No. 40.

45. Bielsa, L.M., W.H. Murdich, and R.F. Labisky. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Florida) - pink shrimp. U.S. Fish Wildl. Serv. Biol. Rep. FWS/OBS-82/11.17. 21 p.

46. Bird, S.O. 1970. Shallow-marine and estuarine benthic molluscan communities from area of Beaufort, NC. Am. Assoc. Petrol. Geol. Bull. 54(9): 1651-1676.

47. Birkhead, W.A., B.J. Copeland, and R.G. Hodson. 1979. Ecological monitoring in the lower Cape Fear River estuary 1971-1976. Report 79-1, Carolina Power and Light Company, Raleigh, NC, 292 p.

48. Bishop, J.M, and M.H. Shealy. 1977. Biological observations on commercial Penaeid shrimps caught by bottom trawl in South Carolina estuaries-February 1973-January 1975. S.C. Mar. Resour. Cent., Tech. Rep. No. 25, 97 p.

49. Bortone, S.A. and J.L. Williams. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates(South Florida) - gray, lane, mutton, and yellowtail snappers. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.52). 18 p.

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

51. Bozeman, E.L., Jr., and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) - alewife and blueback herring. U. S. Fish Wildl. Serv. Biol. Rep. 82(11.111). 17 p.

52. Broad, A.C. 1957. Larval development of *Palaemonetes pugio*. Biol. Bull. 112: 144-161.

53. Buckley, J. 1984. Habitat suitability index models: larval and juvenile red drum. U.S. Fish Wildl. Serv. FWS/OBS-82/10.74. 15 p.

54. Bulak, J.S., and R.W. Christie. 1981. Santee-Cooper blueback herring studies. Ann. Prog. Rep. SCR1-5 Oct. 1, 1980- Sept. 30, 1981. S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

55. Bunker, S.M. 1979. The retention of various components of *Spartina alterniflora* detritus by the striped mullet, *Mugil cephalus*. M.S. thesis, Univ. Ga., Athens. 48 p.

56. Burrell, V.G., Jr. 1977. Mortalities of oysters and hard clams associated with heavy runoff in the Santee River System, South Carolina in the Spring of 1975. Proc. Natl. Shellfish. Assoc. 67: 35-43.

57. Burrell, V.G., Jr. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic)—American oyster. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.57).

58. Busby, D. (editor). 1986. An overview of the Indian River clamming industry and the Indian River Lagoon. Fla. Sea Grant College Tech. Paper No. 44.

59. Cain, R.L. 1973. The annual occurrence, abundance, and diversity of fishes in an intertidal creek. M.S. Thesis, Univ. South Carolina, Columbia, S.C., 80 p.

60. Cain, R.L., and J.M. Dean. 1976. Annual occurrence, abundance, and diversity of fish in a South Carolina intertidal creek. Mar. Biol., 36: 369-379.

61. Cain, T.D. 1975. Reproduction and recruitment of the brackish water clam *Rangia cuneata* in the James River, Virginia. Fish. Bull., U.S. 73: 412-430.

62. Calder, D.R., and B.B. Boothe, Jr. 1977a. Data from some subtidal quantitative benthic samples taken in estuaries of South Carolina. Data Rep. No. 3., S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

63. Calder, D.R., and B.B. Boothe, Jr. 1977b. Some subtidal epifaunal assemblages in South Carolina estuaries. Data Rep. No. 4., S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

64. Calder, D.R., B.B. Boothe, Jr., and M.S. Madin. 1977. A preliminary report on estuarine macrobenthos of the Edisto and Santee River systems, South Carolina. SC Mar. Resour. Cent., Tech. Rep. No. 22, 50 p.

65. Campos, W.L. 1985. Distribution patterns of juvenile epibenthic fish in south Biscayne Bay, Florida. M.S. Thesis, Univ. Miami, Coral Gables, FL, 109 p.

66. Campos, W.L., and S.A. Berkeley. 1986. Impact of the commercial fishery on the population of bait shrimp (*Penaeus* spp.) in Biscayne Bay. Final Report to Dade County Department of Environmental Resources Management, 46 p.

67. Carley, D.H. and C.M. Frisbie. 1968a. The blue crab, oyster, and finfish fisheries of Georgia - an economic evaluation. Ga. Game Fish Comm., Contrib. Ser. No. 12. 13 p.

68. Carley, D.H. and C.M. Frisbie. 1968b. The shrimp fishery of Georgia - an economic evaluation. Ga. Game Fish Comm., Contrib. Ser. No. 13. 14 p.

69. Carolina Power and Light Company (CPL). 1985. 1984 Biological monitoring report. Carolina Power and Light Co., New Hill, NC.

70. Carolina Power and Light Company (CPL). 1986. 1985 Biological monitoring report. Carolina Power and

Light Co., New Hill, NC.

71. Carr, W.E.S., and J.T. Giesel. 1975. Impact of thermal effluent from a steam-electric station on a marshland nursery area during the hot season. Fish. Bull., U.S. 73: 67-80.

72. Carriker, M.R. 1961. Interrelation of functional morphology, behavior, and autecology in early life stages of the bivalve *Mercenaria mercenaria*. J. Elisha Mitchell Sci. Soc. 77: 168-241.

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

74. Cheek, T.E., L.L. Connor, E.A. Long, A.M. Wicker, and R.L. Smith. 1984. Final report for investigations project Dingell-Johnson project F-33, Study III: Relationships of fish populations to habitat types in the lower St. Johns River. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

75. Chestnut, A.F. 1951. The oyster and other mollusks in North Carolina. *In* H. F. Taylor (editor), Survey of Marine Fisheries of North Carolina. Chapel Hill, NC.

76. Chestnut, A.F., and W.E. Fahy. 1953a. Studies on the setting intensity of oysters in Bogue Sound, North Carolina. Proc. Natl. Shellfish Assoc. 43: 79-89.

77. Chestnut, A.F., and W.E. Fahy. 1953b. Studies on the vertical distribution of setting of oysters in North Carolina. Proc. Gulf Caribb. Fish. Inst. 5: 106-112.

78. Christensen, R.F. 1965. An ichthyological survey of Jupiter Inlet and Loxahatchee River, Florida. M.S. Thesis, Florida State Univ., Tallahassee, FL, 318 p.

79. Collins, M.R. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Florida) - striped mullet. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.34). 11 p

80. Collins, M.R., and B.W. Stender. 1987. Larval king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculatus*), and bluefish (*Pomatomus saltatrix*) off the southeast coast of the United States, 1973-1980. Bull. Mar. Sci. 41: 822-834.

81. Collins, M.R., and B.W. Stender. 1989. Larval striped mullet (*Mugil cephalus*) and white mullet (*Mugil curema*) off the southeastern United States. Bull. Mar. Sci. 45(3): 580-589.

82. Cook, H.L., and M.J. Lindner. 1970. Synopsis of biological data on the brown shrimp, *Penaeus aztecus* Ives, 1891. FAO Fish. Synop. No. 102. *In* M.N. Mistakidis (editor), Proceedings of the World Scientific Conference on the Biology and Culture of Shrimps and Prawns, p. 1471-1479. FAO Fish. Rep. No. 57, Vol. 4.

83. Copeland, B.J., and R.G. Hodson. 1977. Larvae and postlarvae in the Cape Fear Estuary, NC, 1976-1977. Report 77-5 to Carolina Power and Light Co., Raleigh, NC.

84. Copeland, B.J., R.G. Hodson, and R.J. Monroe. 1979. Larvae and post-larvae in the Cape Fear Estuary, NC, during the operation of the Brunswick Steam Electric Plant 1974-1978. Report 79-3 to Carolina Power and Light Co., Raleigh, NC.

85. Copeland, B.J., R.G. Hodson, and S.R. Riggs. 1984. The ecology of the Pamlico River, North Carolina: an estuarine profile. U.S. Fish Wildl. Serv. FWS/OBS-82/06.

86. 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. U.S. Fish Wildl. Serv. FWS/OBS-83/01.

87. Costello, T.J., and D.M. Allen. 1970. Synopsis of biological data on the pink shrimp, *Penaeus duorarum* Burkenroad, 1939. FAO Fish. Synop. No. 103. *In* M.N. Mistakidis (editor), Proceedings of the World Scientific Conference on the Biology and Culture of Shrimps and Prawns, p. 1499-1537. FAO Fish. Rep. No. 57, Vol. 4.

88. Cowman, C.F., Jr., and S.A. Stevens. 1983. Georgia shellfish sanitation program sanitary survey, Series 200 Ossabaw shellfish harvesting area. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick. 32 p.

89. Cox, D.T., E.D. Vosatka, G. Horel, R. Eisenhauer, H.L. Moody, W.K. Bradley, L.L. Connore, and R. Smith. 1980. Annual progress report for research project Dingell-Johnson project F-33-4. St. Johns River fishery resources, Study I: Ecological aspects of the fishery. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

90. Cox, D.T., E.D. Vosatka, G. Horel, R. Eisenhauer, H.L. Moody, L.L. Connor, and R. Smith. 1981. Completion report for investigations project Dingell-Johnson project F-33. St. Johns River fishery resources, Study I: Ecological aspects of the fishery. Fla.Game Fresh Water Fish Comm., Tallahassee, FL.

91. Cox, D.T., E.D. Vosatka, G. Horel, R. Eisenhauer, H.L. Moody, D. Koehl, and R. Smith. 1979. Annual

progress report for research project Dingell-Johnson project F-33-3. St. Johns River fishery resources, Study I: Ecological aspects of the fishery. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

92. Cox, D.T., E.D. Vosatka, G. Horel, H.L. Moody, D. Hoehl, and R. Smith. 1978. Annual progress report for research project Dingell-Johnson project F-33-2. St. Johns River fishery resources, Study I: Ecological aspects of the fishery. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

93. Cox, D.T., E. Vosatka, and D. Mannes. 1974. Annual progress report for the investigations project Dingell-Johnson project F-25-7. Stream investigations, Study III: Upper St. Johns River Study. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

94. Cox, D.T., E.D. Vosatka, K.E. Rawlings, H.L. Moody, L. Hartzog, and R. Smith. 1976. Completion report for investigations project Dingell-Johnson project F-25. Stream investigations- upper St. Johns River study 1971-1976. Fla. Game Fresh Water Fish Comm.,Tallahassee, FL.

95. Crabtree, R.E., and J.M. Dean. 1982. The structure of two South Carolina tide pool fish assemblages. Estuaries 5(1): 2-9.

96. Crochet, D.W., D.E. Allen, and M.L. Hornberger. 1976a. Commercial anadromous fishery of Waccamaw and Pee Dee Rivers. Job Compl. Rep. for period Oct. 1, 1973-Sept. 1, 1976, AFC-5, S.C. Wildl. Mar. Resour. Dep., Charleston, S.C., 114 p.

97. Crochet, D.W., D.E. Allen, and M.L. Hornberger. 1976b. Evaluation of commercial fisheries for American shad in South Carolina and status of the species in selected waters. *In* (unedited), Proceedings of a Workshop on American Shad, Amherst, MA Dec. 14-16, 1976. U.S. Fish Wildl. Serv., N.E. Region and NMFS.

98. Cummings, W.C. 1961. Maturation and spawning of pink shrimp, *Penaeus duorarum*. Trans. Am. Fish. Soc. 90: 462-264.

99. Currin, B.M., J.P. Reed, and J.M. Miller. 1984. Growth, production, food consumption, and mortality of juvenile spot and croaker: a comparison of tidal and non-tidal nursery areas. Estuaries 7: 451-459.

100. Dahlberg, M.D. 1970. Frequencies of abnormalities in Georgia estuarine fishes. Trans. Am. Fish. Soc. 99: 95-97.

101. Dahlberg, M.D. 1971. Habitats and diversity of the fishes in North and South Newport Rivers and adjacent waters. Pages 36-121 *in* An ecological survey of the North and South Newport Rivers and adjacent waters with respect to possible effects of treated kraft mill effluent. Final Rep. to Ga. Water Quality Control Board. Univ. Ga., Mar. Inst., Sapelo Island.

102. Dahlberg, M.D. 1972. An ecological study of Georgia coastal fishes. Fish. Bull., U.S. 70(2): 323-353.

103. Dahlberg, M.D. 1975. Guide to coastal fishes of Georgia and nearby states. Univ. Ga. Press, Athens. 187 p.

104. Dahlberg, M.D., and E.P. Odum. 1970. Annual cycles of species occurrence, abundance, and diversity in Georgia fish populations. Am. Midl. Nat. 83(2): 382-392.

105. Dahlberg, M.D., and D.C. Scott. 1971. The freshwater fishes of Georgia. Bull. Ga. Acad. Sci. 29: 1-64.

106. Dahlberg, M.D. and F.G. Smith. 1970. Mortality of estuarine animals due to cold on the Georgia coast. Ecology 51: 931-933.

107. Daniel, L.B., III. 1988. Aspects of the biology of juvenile red drum, *Sciaenops ocellatus*, and spotted seatrout, *Cynoscion nebulosus* (Pisces: Sciaenidae) in South Carolina. M.S. Thesis, College of Charleston, Charleston, S.C., 58 p.

108. Darcy, G.H. 1985. Synopsis of biological data on the pinfish, *Lagodon rhomboides* (Pisces: Sparidae). NOAA Tech. Rep. NMFS 23. 32 p.

109. Davis, J.R., and R.P. Cheek. 1966. Distribution, food habits, and growth of young clupeids, Cape Fear River System, NC. Proc. 20th Ann. Conf SE Assoc. Game Fish Comm. 20: 250-260.

110. Davis, S.M. 1980. American shad movement, weight loss and length frequencies before and after spawning in the St. Johns River, Florida. Copeia 1980: 889-892.

111. Dawson, C.E. 1958. A study of the biology and life history of the spot, *Leiostomus xanthurus* Lacepede, with special reference to South Carolina. Contrib. Bears Bluff Lab. No. 28, 48 p.

112. de Sylva, D.P. 1954. The live bait shrimp fishery of the northeast coast of Florida. Fla. Brd. Conserv. Tech. Ser. No. 11, 35 p.

113. de Sylva, D.P. 1970. Ecology and distribution of postlarval fishes of southern Biscayne Bay, Florida. Report to the U.S. Environmental Protection Agency, Contract No. FWQA 18050 DIU. Rosenstiel School of Marine and Atmospheric Sciences, Univ. Miami, Miami, FL.

114. de Sylva, D.P. 1976a. Ecology and distribution of larval fishes of Biscayne Bay, Florida. Report to the U.S. Environmental Protection Agency, Project R 800996-03. Rosenstiel School of Marine and Atmospheric Sciences. Univ. Miami, Miami, FL.

115. de Sylva, D.P. 1976b. Fishes of Biscayne Bay Florida. *In* A. Thorhaug and A. Volker (editors), Biscayne Bay: past/present/future, p. 181-202. Univ. of Miami Sea Grant Spec. Rep. No. 5, Coral Gables, FL.

116. de Sylva, D.P., H.B. Stearns, and D.C. Tabb. 1956. Populations of the black mullet (*Mugil cephalus* L.) in Florida. Fla. Brd. Conserv. Tech. Ser. No. 19, 45 p.

117. Deubler, E.E., Jr. 1958. A comparative study of the postlarvae of three flounders (*Paralichthys*) in North Carolina. Copeia 1958(2): 112-116.

118. DeVries, D.A. 1981. Stock assessment of adult fishes in the Core Sound, NC area. NC Div. Mar. Fish., Compl. Rept. Proj. 2-326-R, 16 p.

119. DeVries, D.A., and C.H. Harvell. 1982. Inshore paralichthid flounder tagging. *In* North Carolina Estuarine Finfish Management Program., p. 137-156. NC Div. Mar. Fish., Compl. Rept. Proj. 2-372-R.

120. Diaz, R.J. and C.P. Onuf. 1985. Habitat suitability index models: juvenile Atlantic croaker (revised). U.S. Fish Wildl. Serv. Biol. Rep. 82(10.98). 23 p.

121. Dietrich, C.S., Jr. 1979. Fecundity of the Atlantic menhaden, *Brevoortia tyrannus*. Fish. Bull., U.S. 77: 308-311.

122. Dudley, D.L., and M.H. Judy. 1971. Occurrence of larval, juvenile, and mature crabs in the vicinity of Beaufort. NOAA Tech. Rept. NMFS SSRF-637, 10 p.

123. Dudley, D.L., and M.H. Judy. 1973. Seasonal abundance and distribution of juvenile blue crabs in Core Sound, NC 1965-68. Chesapeake Sci. 14:51-55.

124. Dudley, R.G. and K.N. Black. 1978. Distribution of striped bass eggs and larvae in the Savannah River estuary. Proc. Ann. Conf. S.E. Assoc. Fish Wildl. Agencies 32: 561-570.

125. Dudley, R.G. and T.G. McGahee. 1983. Winter and altered spring movements of striped bass in the Savannah River, Georgia. Fish. Bull., U.S. 81: 20-25.

126. Dudley, R.G., A.W. Mullis, and J.W. Terrell. 1977. Movements of adult striped bass *Morone saxatilis* in the Savannah River, Georgia. Trans. Am. Fish. Soc. 106: 314-322.

126.1. Durako, M.J., M.D. Murphy, and K.D. Haddad. 1988. Assessment of fisheries habitat: Northeast Florida. Fla. Mar. Res. Publ. No. 45, Fla. Dept. Nat. Resour.

127. Durant, J.E. 1969a. Notes on the fauna associated with oyster beds Pages 96-101 in T.L. Linton (editor). Feasibility study of methods for improving oyster production in Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Final Rep. Proj. 2-10-R.

128. Durant, J.E. 1969b. The effects of temperature and salinity upon the gonadal cycle of *Crassostrea virginica* (Gmelin) in Georgia. Pages 132-144 *In* T.L. Linton (editor). Feasibility study of methods for improving oyster production in Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Final Rep. Proj. 2-10-R.

129. Eldred, B., and W.G. Lyons. 1966. Larval ladyfish, *Elops saurus* Linnaeus 1766, (Elopidae) in Florida and adjacent waters. Fla. Brd. Conserv. Div. Salt water Fish. Mar. Lab. Leaflet Ser. Vol. IV, Part I, No. 2, 6 p.

130. Eldridge, P.J., and S.A. Goldstein. 1975. The shrimp fishery of the South Atlantic United States: A regional management plan. S.C. Mar. Resour. Cent., Tech. Rep. No. 8, 66 p.

131. Eldridge, P.J., and W. Waltz. 1977. Observations on the commercial fishery for blue crabs, *Callinectes sapidus* in estuaries in the southern half of South Carolina. S.C. Mar. Resour. Cent., Tech. Rep. No. 21, 35 p.

132. Engle, K.M., and R. Mulholland. 1985. Habitat suitability index models: southern and Gulf flounders. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.92).

133. Epperly, S.P. 1984. Fishes of the Pamlico-Albemarle peninsula, NC, area utilization and potential impacts. NC Div. Mar. Fish., Spec. Sci. Rep. No. 42, 129 p.

134. Epperly, S.P., and S.W. Ross. 1986. Characterization of the North Carolina Pamlico-Albemarle estuarine complex. NOAA Tech. Memo. NMFS-SEFC-175, 55 p.

135. Essig, R.J. 1983. Georgia commercial shad fishery assessment 1979-1982. Ga. Dept. Nat. Res., Coast. Res. Div., Contrib. Ser. No. 32. 79 p.

136. Evermann, B.W., and B.A. Bean. 1897. Indian River and its fishes. U.S. Comm. Fish Fish. Rep. Prt. XXII 1896: 227-248.

137. Evermann, B.W., and N.C. Kendall. 1900. Checklist of the fishes of Florida. U.S. Comm. Fish Fish. Rep. Prt. XXV 1899: 35-103.

138. Eversole, A.G. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic)—hard clam. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.75).

139. Eversole, A.G., W.K. Michener, and P.J. Eldridge. 1980. Reproductive cycle of *Mercenaria mercenaria* in a South Carolina estuary. Proc. Natl. Shellfish. Assoc. 70: 22-30.

140. Eversole, A.G., W.K. Michener, and P.J. Eldridge. 1984. Gonadal condition of hard clams in a South Carolina estuary. Proc. Annu. Conf. S.E. Assoc. Fish Wildl. Agen. 38: 495-505.

141. Facey, D.E. and M.J. Van Den Avyle. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)—American shad. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.45). 18 p.

142. Fahay, M.P. 1978. Biological and fisheries data on American eel, *Anguilla rostrata*. NOAA Tech. Rep. NMFS-NEFC-17, 84 p.

143. 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. J. NW Atl. Fish. Sci. 4: 1-423.

144. Farmer, C.H., III, C.W. Boardman, and J.D. Whitaker. 1977. The South Carolina shrimp fishery. Education Rep. No. 8., S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

145. Farmer, C.H., III, J.D. Whitaker, and N.L. Chipley. 1978. Pilot study to determine the overwintering patterns of white shrimp. Final Report for period Sept. 1, 1975-Oct. 31, 1977. S.C. Wildl. Mar. Resour. Dep., Div. Mar. Res., Contract No. 03-6-042-35105 with NMFS.

146. Fay, C.W., R.J. Neves, and G.B. Pardue. 1983a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)—alewife and blueback herring. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.91).

147. Fay, C.W., R.J. Neves, and G.B. Pardue. 1983b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)—Atlantic silversides. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.10).

148. Fay, C.W., R.J. Neves, and G.B. Pardue. 1983c. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)—bay scallop. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.12).

149. Fay, C.W., R.J. Neves, and G.B. Pardue. 1983d. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)—striped bass. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.18).

150. Fee, R. 1989. St. Johns River fish and fisherman are in trouble. National Fisherman. 89(10): 24-26.

151. Fischer, C.A. 1980. Anadromous fisheries research program Cape Fear River system Phase II. NC Div. Mar. Fish., Compl. Rep. Proj. AFCS-15, 65 p.

152. Florida Department of Natural Resources. 1983. Summary of Florida Commercial Landings. Fla. Dept. Nat. Resour. Div. Mar. Resour. Tallahassee, FL.

152.1. Fonseca, M.S., W.J. Kenworthy, D.R. Colby, K.A. Rittmaster, and G.W. Thayer. 1990. Comparisons of fauna among natural and transplanted eelgrass *Zostera marina* meadows: criteria for mitigation. Mar. Ecol. Prog. Ser. 65: 251-264.

153. Fox, R.S., and E.E. Ruppert. 1985. Shallow-water marine benthic macroinvertebrates of South Carolina. Species identification, community composition and symbiotic associations. Univ. South Carolina Press, Columbia, S.C.

154. Frankenberg, D. and K.L. Smith, Jr. 1967. Coprophagy in marine animals. Limnol. Oceanogr. 12: 443-450.

155. Frisbie, C.M. 1961. Young black drum, *Pogonias cromis*, in tidal fresh and brackish waters, especially in the Chesapeake and Delaware Bay area. Chesapeake Sci. 2: 94-100.

156. Frisbie, C.M. 1967. Preliminary studies of the seasonal abundance and biological stability of the commercial shrimp of Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 4. 19 p.

157. Fritzsche, R.A. 1978. Development of fishes of the mid-Atlantic Bight. An atlas of egg, larval, and juvenile stages. Vol. I, Chaetodontidae through Ophidiidae. U.S. Fish Wildl. Serv. FWS/OBS- 78/12.

158. Furukawa, A. and T.L. Linton. 1969. Oyster spat setting patterns in a medium salinity sound of Georgia. Pages 81-88 in T.L. Linton (editor). Feasibility study of methods for improving oyster production in Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Final Rep. Proj. 2-10-R.

159. Futch, C.R. 1967. A survey of the oyster resources of Brevard County, Florida. Fla. Brd. Conserv. Mar. Lab. Spec. Sci. Rep. No. 18, 6 p.

160. Galtsoff, P.S. and R.H. Luce. 1930. Oyster investigations in Georgia. U.S. Bur. Fish. Rep. Commissioner Fish. Appendix V: 61-100.

161. Geddings, W.R. 1973. Evaluation of stocking fingerling striped bass. Ga. Dept. Nat. Res., Game Fish Div., Ann. Prog. Rep. AFS-9-2. 28 p.

162. Geddings, W.R. 1974. Evaluation of stocking fingerling striped bass. Ga. Dept. Nat. Res., Game Fish Div., Ann. Prog. Rep. AFS-9-3. 30 p.

163. Gehringer, J.W. 1959. Early development and metamorphosis of the tenpounder *Elops saurus* Linnaeus. Fish. Bull., U.S. 59: 619-647.

164. Gilbert, C.R. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Florida) southern, Gulf, and summer flounders. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.54). 24 p.

165. Gilbert, R.J., S. Larson, and A. Wentworth. 1985. The relative importance of the lower Savannah River as a striped bass spawning area. School of Forest Research, Univ. Ga., Athens. Final Rep. Proj. No. F-39. 34 p.

166. Gilmore, R.G., Jr. 1974. A regional description and checklist of fishes of the Indian River. *In* D. Young et al. (editors), Indian River Coastal Zone Study 1973-1974 Annual Report, Vol. I, p. 110-183. Harbor Branch Consortium. Ft. Pierce, FL.

167. Gilmore, R.G., Jr. 1977. Fishes of the Indian River Lagoon and adjacent waters, Florida. Bull. Fla. St. Mus., Biol. Sci. 22(3): 101-148.

168. Gilmore, R.G., D.W. Cooke, and C.J. Donohoe. 1982. A comparison of the fish populations and habitat in open and closed salt marsh impoundments in east-central Florida. N.E. Gulf Sci. 5(2): 25-37.

169. Gilmore, R.G., Jr., C.J. Donohoe, D.W. Cooke, D.J. Herrema. 1981. Fishes of the Indian River Lagoon and adjacent waters. Harbor Branch Foundation, Inc. Tech. Rep. No. 41.

170. Gilmore, R.G., P.A. Hastings, and D.J. Herrema. 1983. Ichthyofaunal additions to the Indian River Lagoon and adjacent waters, east-central Florida. Fla. Sci. 46: 22-30.

171. Gilmore, R.G., G.R. Kulczycki, P.A. Hastings, and W.C. Magley. 1976. Studies of fishes of the Indian River Lagoon and vicinity. *In* D.K. Young (editor), Indian River Coastal Zone Study 1975-1976 Annual Report, p. 133-147. Harbor Branch Consortium, Ft. Pierce, FL.

172. Godcharles, M.F., and W.C. Jaap. 1973. Exploratory clam survey of Florida nearshore and estuarine waters with commercial hydraulic dredging gear. Fla. Dept. Nat. Resour. Mar. Res. Lab. Prof. Pap. Ser. 21, 51 p.

173. Godcharles, M.F., and M.D. Murphy. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Florida) - king mackerel and Spanish mackerel. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.58).

174. Godwin, W.F. 1967. Preliminary survey of a potential hard clam fishery. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 1. 23 p.

175. Godwin, W.F. 1968a. The distribution and density of the brackish water clam, *Rangia cuneata*, in the Altamaha River, Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 5. 10 p.

176. Godwin, W.F. 1968b. The shad fishery of the Altamaha River, Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 8. 39 p.

177. Godwin, W.F. 1968c. The growth and survival of planted clams, *Mercenaria mercenaria*, on the Georgia coast. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 9. 16 p.

178. Godwin, W.F. 1968d. The distribution and density of the hard-clam, *Mercenaria mercenaria*, on the Georgia coast. Ga. Game Fish Comm., Mar. Fish. Div. Contrib. Ser. No. 10. 30 p.

179. Godwin, W.F. and J.G. Adams. 1969. Young clupeids of the Altamaha River, Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 15. 30

p.

180. Godwin, W.F. and L.G. McBay. 1967. Preliminary studies of the shad fishery of the Altamaha River, Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 2. 24 p.

181. Gore, R.H., L.S. Becker, N. Blum, and L.E. Scotto. 1976. Studies of the decapod crustacea in the Indian River region of Florida. *In* D. Young (editor), Indian River Coastal Zone Study 1975-1976 Annual Report, Vol. I, p.148-161. Harbor Branch Consortium, Ft. Pierce, FL.

182. Gore, R.H., E.E. Gallagher, L.E. Scotto, and K.A. Wilson. 1981. Studies on decapod crustacea from the Indian River Region of Florida. Estuar. Coast. Shelf Sci. 12: 4855-508.

183. Gracy, R.C., and W.J. Keith. 1972. Survey of the South Carolina oyster fishery. S.C. Mar. Resour. Cent., Tech. Rep. No. 3, 28 p.

184. Gracy, R.C., W.J. Keith, and R.J. Rhodes. 1978. Management and development of the shellfish industry in South Carolina. S.C. Mar. Resour. Cent., Tech. Rep. No. 28, 33 p.

185. Graves, C. 1903. Investigation for the promotion of the oyster industry of North Carolina. U.S. Comm. Fish Fish. Rep. 29: 249-315.

186. Grizzle, R.E. 1974. The estuarine decapod crustaceans in Brevard County, Florida. Quart. J. Fla. Acad. Sci. 37(3): 129-141.

186.1. Grizzle, R.E. 1988. Distribution and abundance of commercially important molluscan shellfish in saline waters of the Canaveral National Seashore. Final Report. Center for Coastal and Environmental Studies, Rutgers Univ., New Brunswick, NJ.

187. Gunter, G., and G.E. Hall. 1963. Biological investigations of the St. Lucie Estuary (Florida) in connection with Lake Okeechobee discharge through St. Lucie Canal. Gulf Res. Rep. 1(5): 189-307.

188. Gutsell, J.S. 1930. Natural history of the bay scallop. Bull. U.S. Bur. Fish. 46: 569-632.

189. Hackney, C.T., W.D. Burbanck, and O.P. Hackney. 1976. Biological and physical dynamics of a Georgia tidal creek. Chesapeake Sci. 17: 271-280.

190. Hales, L.S. and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) - spot. U.S. Fish Wildl. Biol. Rep. 82(11.91). 24 p.

191. Hansen, R.A. 1979. Age, growth, and sex ratio of the American eel, *Anguilla rostrata* (LeSueur), in brackish water portions of Cooper River, South Carolina. M.S. Thesis, Clemson Univ., Clemson, S.C., 45 p.

192. Hansen, R.A., and A.G. Eversole. 1984. Age, growth, and sex ratio of American eels in brackish-water portions of a South Carolina River. Trans. Am. Fish. Soc. 113: 744-749.

193. Hardisky, M.A. and K.H. Smith. 1980. 1979 Georgia shad catch-effort study. Ga. Dept. Nat. Res. Coast. Res. Div., Proj. Rep. AFC-11. 41 p.

194. Hardy, J.D. 1978a. Development of fishes of the mid-Atlantic Bight. An atlas of egg, larval, and juvenile stages. Vol. II, Anguillidae through Syngnathidae. U.S. Fish Wildl. Serv. FWS/OBS-78/12.

195. Hardy, J.D. 1978b. Development of fishes of the mid-Atlantic Bight. An atlas of egg, larval, and juvenile stages. Vol. III, Aphredoderidae through Rachycentridae. U.S. Fish. Wildl. Serv. FWS/OBS-78/12. 394 p.

196. Harrell, R.M. 1977. Age, growth, and sex ratio of the American eel, *Anguilla rostrata* (LeSueur), in the Cooper River, South Carolina. M.S. Thesis, Clemson Univ., Clemson, S.C., 55 p.

197. Harrell, R.M., and H.A. Loyacana, Jr. 1982. Age, growth, and sex ratio of the American eel in the Cooper River, South Carolina. Proc. Ann. Conf. S.E. Assoc. Fish Wildl. Agen. 34: 349-359.

198. Harrington, R.W., Fr., and E.S. Harrington. 1961. Food selection among fishes invading a high subtropical salt marsh: from onset of flooding through the progress of a mosquito brood. Ecology 42: 646-666.

199. Harris, C.D. 1974. Observations on the white shrimp (*Penaeus setiferus*) in Georgia. Ga. Dept. Nat. Res., Game Fish Div., Coast Fish. Office, Contrib. Ser. No. 27.

200. Harris, C.D. 1980. Survey of the intertidal and subtidal oyster resources of the Georgia coast. Ga. Dept. Nat. Res., Coast. Res. Div., Brunswick, Georgia. 44 p.

201. Harriss, R.C., Jr. 1982. Western Albemarle Sound non-anadromous fishes. *In* North Carolina Estuarine Finfish Management Program, p. 157-171. NC Div. Mar. Fish., Compl. Rep. Proj. 2-372-R.

202. Hassler, W.W. 1984. The status and abundance of striped bass, *Morone saxatilis*, in the Roanoke River and Albemarle Sound, North Carolina, 1977-1981. NC Div. Mar. Fish., Compl. Rep. Proj. AFS-14, 40 p.

203. 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. NC Div. Mar. Fish., Spec. Sci. Rep. No. 38, 156 p.

204. Hawkins, J.H. 1980a. Anadromous fisheries research programs, Tar-Pamlico River. NC Div. Mar. Fish., Compl. Rep. Proj. AFCS-13, 26 p.

205. Hawkins, J.H. 1980b. Investigations of anadromous fishes of the Neuse River, North Carolina. NC Div. Mar. Fish., Spec. Sci. Rep. No. 34, 111 p.

206. Hawkins, J.H. 1982. Estuarine fish stock assessment-nursery area monitoring. *In* North Carolina Estuarine Finfish Management Program, NC Div. Mar. Fish., Compl. Rep. Proj. 2-372-R.

207. Heard, R.W. and E.J. Heard. 1971. Invertebrate fauna of the North and South Newport Rivers and adjacent waters. Pages 122-246 *In* An ecological survey of the North and South Newport Rivers and Adjacent waters with respect to possible effects of treated kraft mill effluent. Final Rep. to Ga. Water Quality Control Board. Univ. Ga., Mar. Inst., Sapelo Island.

208. Heffernan, P.B. and R.L. Walker. 1988. Preliminary observations on oyster pearl net cultivation in coastal Georgia. NE Gulf Sci. 10: 33-43.

209. Heffernan, P.B., R.L. Walker, and J.L. Carr. 1989a. Gametogenic cycles of three bivalves in Wassaw Sound, Georgia: I. *Mercenaria mercenaria*. J. Shellfish Res. 8: 51-60.

210. Heffernan, P.B., R.L. Walker, and J.L. Carr. 1989b. Gametogenic cycles of three bivalves in Wassaw Sound, Georgia: II. *Crassostrea virginica*. J. Shellfish Res. 8: 61-70.

211. Heffernan, P.B., R.L. Walker, and D.M. Gillespie. 1988. Biological feasibility of growing the northern bay scallop, *Argopecten irradians*, in coastal waters of Georgia. J. Shellfish Res. 7: 83-88.

212. Helfman, G.S. 1982. Development of the fishery for American eels (*Anguilla rostrata*) in Georgia. Page 53 *In* K.H. Loftus (editor). Proceedings of the 1980 North American eel conference. Ontario Fisheries Tech. Rep. Ser. No. 4. 97 p.

213. Helfman, G.S. and E.L. Bozeman. 1984. Size, age, and sex of American eels in a Georgia river. Trans. Am. Fish. Soc. 113: 132-141.

214. Helfman, G.S., D.L. Stoneburner, E.L. Bozeman, P.A. Christian, and R.Whalen. 1983. Ultrasonic telemetry of American eel movements in a tidal creek. Trans. Am. Fish. Soc. 112: 105-110.

215. Hesselman, D.M, B.J. Barber, and N.J. Blake. 1989. The reproductive cycle of the adult hard clam, *Mercenaria* spp., in the Indian River Lagoon, Florida. J. Shellfish Res. 8: 43-49.

216. Hesselman, D.M., and P.A. Gill. 1988. The reproductive cycle of hard clams, *Mercenaria* spp., in the Indian River Lagoon. *In* The Second Indian River Research Symposium, Sept, 12-13, 1988. Florida Institute of Technology, Melbourne, FL.

217. Hester, J.M., and B.J. Copeland. 1975. Nekton population dynamics in the Albemarle Sound and Neuse River estuaries. Univ. North Carolina Sea Grant Pub. UNC-SG-75-02.

218. Hettler, W.F., and A.J. Chester. 1990. Temporal distribution of ichthyoplankton near Beaufort Inlet, North Carolina. Mar. Ecol. Prog. Ser. 68: 157-168.

219. Hicks, D.B. 1972. Seasonal distribution and relative abundance of fishes in the channel reaches and shore areas. *In* Port Royal Sound Environmental Study, p. 193-201. S.C. Water Resources Commission, Columbia, S.C.

220. Hildebrand, S.F. 1917. Notes on the life history of the minnows *Gambusia affinis* and *Cyprinodon variegatus*. U.S. Comm. Fish. Fish Rep. Append. 6: 1-14.

221. Hildebrand, S.F. 1922. Notes on habits and development of eggs and larvae of the silversides *Menidia menidia* and *Menidia beryllina*. Bull. Bur. Fish. 38: 113-120.

222. Hildebrand, S.F. 1963. Family Elopidae. *In* H.B. Bigelow (editor), Fishes of the Western North Atlantic. No. 1. New Haven, CT.

223. Hildebrand, S.F., and L.E. Cable. 1930. Development and life history of fourteen teleostean fishes at Beaufort, NC. Bull. U.S. Bur. Fish. 46: 383-488.

224. Hildebrand, S.F., and L.E. Cable. 1934. Reproduction and development of whitings or kingfishes, drums, spot, croaker, and weakfishes or seatrouts, family Sciaenidae, of the Atlantic coast of the United

States. Bull. Bur. Fish. 48: 41-117.

225. Hildebrand, S.F., and L.E. Cable. 1938. Further notes on the development and life history of some teleosts at Beaufort, N.C. Bull. Bur. Fish. 48: 505-642.

226. Hinde, P.M., C.A. Wenner, J. Smith, D.R. Calder. 1981. Benthic and nektonic studies of Winyah Bay for the proposed channel deepening project and dredging of the western channel turning basin. Report for contract #DACW60-80-0029 for the Charleston District U.S. Army Corps of Engineers, 141 p.

227. Hodson, R.G. 1979. Utilization of marsh habitats as primary nursery areas by young fish and shrimp, Cape Fear Estuary, North Carolina. Report 79-5 to Carolina Power and Light Co., Raleigh, NC.

228. Hoese, H.D. 1969. Studies of the parasitic oyster fungus *Labyrinthomyxa* spp. in Georgia salt waters. Pages 102-120 *In* T.L. Linton (editor). Feasibility study of methods for improving oyster production in Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Final Rep. Proj. 2-10-R.

229. Hoese, H.D. 1973. A trawl study of nearshore fishes and invertebrates of the Georgia coast. Contrib. Mar. Sci. 17: 63-98.

230. Holder, D.R. and C.S. Hall. 1975. Recruitment of hatchery-reared striped bass fingerlings in a native river population. Ga. Dept. Nat. Res., Game Fish Div., Final Rep. AFS-9. 24 p.

231. Hopkins, S.H., and J.D. Andrews. 1970. *Rangia cuneata* on the east coast: thousand mile range extension, or resurgence? Science 167: 868-869.

232. Hornberger, M.L., J.S. Tuten, A. Eversole, J. Crane, R. Hansen, and M. Hinton. 1978. American eel investigations. Compl. Rep. for period March 1977-July 1978. S.C. Wildl. Mar. Resour. Dep., Charleston, S.C., and Clemson Univ., Clemson, S.C., 311 p.

233. Hornsby, J.H. and C.S. Hall. 1981. Impact of supplemental stocking of striped bass fingerlings in the Ogeechee River. Ga. Dept. Nat. Res., Game Fish Div., Final Rep. AFS-11. 62 p.

234. Hoss, D.E. 1971. Routine energy requirements of a population of pinfish (*Lagodon rhomboides*) in the Newport River Estuary, North Carolina. Ph.D. Thesis, North Carolina State Univ., Raleigh, NC, 78 p.

235. Hottell, H.E., D.R. Holder, and C.E. Coomer, Jr. 1983. A fishery survey of the Altamaha River. Ga. Dept. Nat. Res., Game Fish Div., Final Rep. F-29-10. 68 p.

236. Houde, E.D., and J.A. Lovdal. 1984. Seasonality of occurrence, foods and food preference of ichthyoplankton in Biscayne Bay, Florida. Estuar. Coast. Shelf Sci. 18: 403-419.

237. Houde, E.D., and J.A. Lovdal. 1985. Patterns of variability in ichthyoplankton occurrence and abundance in Biscayne Bay, Florida. Est. Coast. Shelf Sci. 20: 79-103.

238. Hughes, E.H. 1980. Estuarine subtidal food webs analyzed with stable carbon isotopic ratios. M.S. Thesis, Univ. Ga., Athens. 110 p.

239. Hughes, E.H. and E.B. Sherr. 1983. Subtidal food webs in a Georgia estuary: ^{13}C analysis. J. Exp. Mar. Biol. Ecol. 67: 227-242.

240. Huish, M.T., and J.P. Geaghan 1979. A study of adult and juvenile fishes of the lower Cape Fear River near the Brunswick Steam Electric plant 1975-1976. Report 79-4, to Carolina Power and Light Co., Raleigh, NC, 148 p.

241. Humphrey, C.M. and R.L. Walker. 1982. The occurrence of *Mercenaria mercenaria* form *notata* in Georgia and South Carolina: calculations of phenotypic and genotypic frequencies. Malacologia 23: 75-79.

242. Hunt, J.H., R.J. Carroll, V. Chinchilli, and D. Frankenburg. 1979. Relationship between environmental factors and brown shrimp production in Pamlico Sound, North Carolina. NC Div. Mar. Fish., Compl. Rep. Proj. 2-315-R, 29 p.

243. Hyle, R.A. 1976. Fishes of the Newport River Estuary, North Carolina, their composition, seasonality, and community structure, 1970-72. Ph. D. Thesis, Univ. North Carolina, Chapel Hill, NC, 192 p.

244. Ingle, R.M., and F.G.W. Smith. 1953. Oyster culture in Florida. Fla. Brd. Conserv. Educational Ser. No. 5, 24 p.

245. Johnson, D.R. and W. Seaman, Jr. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Florida) - spotted seatrout. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.43). 18 p.

246. Johnson, D.R., and N.A. Funicelli. 1988. Estuarine spawning of red drum in the Indian River Lagoon system. *In* The Second Indian River Research Symposium, Sept. 12-13, 1988. Florida Institute of Technology, Melbourne, FL.

247. Johnson, G.D. 1978. Development of fishes of the Mid-Atlantic Bight: an atlas of egg, larval, and juvenile stages. Vol. IV, Carangidae through Ephippidae. U.S. Fish Wildl. Serv. FWS/OBS-78/12. 314 p.

248. Johnson, H.B., S.E. Winslow, D.W. Crocker, B.F. Holland Jr., J.W. Gilliken, and D.L. Taylor. 1981. Biology and management of mid-Atlantic anadromous fishes under extended jurisdiction - Part one: North Carolina. NC Div. Mar. Fish., Spec. Sci. Rep. No. 36, 204 p.

249. Johnson, J.C., P. Fricke, M. Hepburn, J. Sabella, W. Still, and C.R. Hayes. 1986. Recreational fishing in the sounds of North Carolina: a socioeconomic analysis. Univ. North Carolina Sea Grant Pub. UNC-SG-86-12/ CR/MD-7.

250. Jones, P.W., F.D. Martin, and J.D. Hardy, Jr. 1978. Development of fishes of the mid-Atlantic Bight. An atlas of egg, larval, and juvenile stages. Vol. I, Acipenseridae through Ictaluridae. U.S. Fish Wildl. Serv. FWS/OBS-78/12.

251. Jones, R.A., and T.M. Sholar. 1981. The effects of freshwater discharge on estuarine nursery areas of Pamlico Sound. NC Div. Mar. Fish., Compl. Rep. Proj., CEIP 79-11, 60 p.

252. 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. *In* D.K. Young (editor), Indian River Coastal Zone Study 1974-1975 Annual Report, p. 57-88. Harbor Branch Consortium, Ft. Pierce, FL.

253. Jorgenson, S.C. and G.L. Miller. 1968. Length relations of some marine fishes from coastal Georgia. U.S. Fish Wildl. Serv., Special Scient. Rep. Fish. No. 575.

254. Joyce, E.A., Jr. 1965. The commercial shrimps of the northeast coast of Florida. Fla. Brd. Conserv. Mar. Lab. Prof. Paper Ser. No. 6, 224 p.

255. Joyce, E.A., Jr., and B. Eldred. 1966. The Florida shrimping industry. Fla. Brd. Conserv. Education Ser. No. 15, 47 p.

256. Judy, G.W., and J.H. Hawkins. 1983. Neuse River and Pamlico-Tar River anadromous fisheries assessment. *In* North Carolina Anadromous Fisheries Management Program, p. 1520-209. NC Div. Mar. Fish., Compl. Rep. Proj. AFCS-16.

257. 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 Tech. Memo. NMFS-SEFC-46, 10 p.

258. Judy, M.H., and D.L. Dudley. 1970. Movements of tagged blue crabs in North Carolina waters. Commer. Fish. Rev. 32(4): 29-35.

259. Judy, M.H., and R.M. Lewis. 1983. Distribution of eggs and larvae of Atlantic menhaden, *Brevoortia tyrannus*, along the Atlantic coast of the United States. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-774, 23 p.

260. Keefe, S.G., and R.C. Harriss Jr. 1981. Preliminary assessment of non-anadromous fishes of the Albemarle Sound. NC Div. Mar. Fish., Compl. Rep. Proj. 2-234-R, 46 p.

261. Keiser, R.K. Jr. 1977. The incidental catch from commercial shrimp trawlers of the South Atlantic States. SC Mar. Res. Center, Tech. Rep. No. 26. 38 p.

262. Keith, W.J, and H.S. Cochran, Jr. 1968. Charting of subtidal oyster beds and experimental planting of seed oysters in South Carolina. Contrib. Bears Bluff Lab. No. 48, 19 p.

263. Keith, W.J., and R.C. Gracy. 1972. History of the South Carolina oyster. Education Rep. No. 1., S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

264. Kendall, A.W. 1973. Sheepshead. *In* A.L. Pacheco (editor), Proceedings of a Workshop on Egg, Larval, and Juvenile Stages of Fish in Atlantic Coast Estuaries, Wadmalaw Island, SC 1968, p. 259. NMFS, Mid-Atl. Coast. Fish. Ctr., Tech. Pub. No. 1.

265. Kendall, A.W., Jr., and L.A. Walford. 1979. Sources and distribution of bluefish, *Pomatomus saltatrix*), larvae and juveniles off the east coast of the United States. Fish. Bull., U.S. 77: 213-228.

266. Kendall, D.R. 1974. The ecology of the macrobethos of a tidal creek, St. Simons Island, Georgia. M.S. thesis, Emory Univ., Atlanta. 212 p.

267. Kendall, D.R. 1978. The role of macrobenthic organisms in mercury, cadmium, copper, and zinc transfer in Georgia saltmarsh ecosystems. Ph.D. Dissertation, Emory University, Atlanta. 241 p.

268. Kennedy, F.S., Jr., and D.G. Barber. 1981. Spawning and recruitment of pink shrimp, *Penaeus duorarum*, off eastern Florida. J. Crustacean Biol. 1(4):

474-485.

269. Kenny, P.D., W.K. Michener, D.M. Allen. (in press). Spatial and temporal patterns of oyster settlement in a high salinity estuary. Mar. Ecol. Prog. Ser.

270. Kerr, G.A. 1976. Inventory-Indian River Coastal Zone Study 1975-1976 Annual Report, Vol. 2. Harbor Branch Consortium, Ft. Pierce, FL.

271. Keup, L., and J. Bayless. 1964. Fish distributions at varying salinities in Neuse River basin, North Carolina. Chesapeake Sci. 5: 119-123.

272. Kirby-Smith, W.W., and I.E. Gray. 1973. A checklist of common marine animals of Beaufort, NC. Duke Univ. Marine Lab. Reference Museum, 34 p.

273. Klima, E.F. 1959. Aspects of the biology and the fishery for Spanish mackerel, *Scomberomorus maculatus* (Mitchill), of southern Florida. Fla. Brd. Conserv. Tech. Ser. No. 27, 37 p.

274. Kneib, R.T. 1976. Feeding, reproduction, growth, and movements of killifishes on a North Carolina salt marsh. M.S. Thesis, Univ. North Carolina, Chapel Hill, NC, 139 p.

275. Kneib, R.T. 1984a. Patterns in the utilization of the intertidal salt marsh by larvae and juvenile of *Fundulus heteroclitus* (Linnaeus) and *Fundulus luciae* (Baird). J. Exp. Mar. Biol. 83: 41-51.

276. Kneib, R.T. 1984b. Patterns of invertebrate distribution and abundance in the intertidal salt marsh: causes and questions. Estuaries 7: 392-412.

277. Kneib, R.T. 1985. Predation and disturbance by grass shrimp, *Palaemonetes pugio*, in soft-substratum benthic invertebrate assemblages. J. Exp. Mar. Biol. Ecol. 93: 91-102.

278. Kneib, R.T. 1986a. The role of *Fundulus heteroclitus* in salt marsh trophic dynamics. Amer. Zool. 26: 259-269.

279. Kneib, R.T. 1986b. Size specific patterns in the reproductive cycle of the killifish *Fundulus heteroclitus* (Pisces: Fundulidae) from Sapelo Island, Georgia. Copeia 1986: 342-351.

280. Kneib, R.T. 1987a. Predation risk and use of intertidal habitats by young fishes and shrimp. Ecology 68: 379-386.

281. Kneib, R.T. 1987b. Seasonal abundance, distribution and growth of postlarval and juvenile grass shrimp (*Palaemonetes pugio*) in a Georgia, U.S.A., salt marsh. Mar. Biol. 96: 215-223.

282. Kneib, R.T., and A.E. Stiven. 1978. Growth, reproduction, and feeding of *Fundulus heteroclitus* on a North Carolina salt marsh. J. Exp. Mar. Biol. Ecol. 31: 121-140.

283. Knowlton, C. 1972. Fishes taken during commercial shrimping in Georgia's close inshore ocean waters. Ga. Game Fish Comm., Coast. Fish. Office Contrib. Ser. No. 21.

284. Knowlton, R.E., and A.B. Williams. 1970. The life history of *Palaemonetes vulgaris* (Say) and *Palaemonetes pugio* (Holthuis) in coastal North Carolina. J. Elisha Mitch. Sci. Soc. 86: 185.

285. Kostecki, P.T. 1984. Habitat suitability index models: spotted seatrout. U.S. Fish Wildl. Serv. FWS/OBS-82/10.75. 22 p.

286. Kuntz, A. 1914. Embryology and larval development of *Anchoa mitchilli*. Bull. U.S. Bur. Fish. 33: 1-19.

287. Kurata, H. 1970. Studies of the life histories of decapod crustacea of Georgia. M.S. thesis, Univ. Ga., Mar. Inst., Sapelo Island, 274 p.

288. Larson, S.C., M.J. Van Den Avyle, and E.L. Bozeman, Jr. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) - brown shrimp. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.90). 14 p.

289. LaSalle, M.W., and A.A. de la Cruz. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico)—common rangia. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.31).

290. Leland, J.G., II. 1968. A survey of the sturgeon fishery of South Carolina. Contrib. Bears Bluff Lab. 47: 3-27.

291. Lewis, R.M., D.W. Ahrenholz, and S.P. Epperly. 1987. Fecundity of Atlantic menhaden, *Brevoortia tyrannus*. Estuaries 10: 347-350.

292. Lewis, R.M., and M.H. Judy. 1983. The occurrence of spot, *Leiostomus xanthurus*, and Atlantic croaker, *Micropogonias undulatus*, larvae in Onslow Bay and Newport River Estuary, North Carolina. Fish. Bull., U.S. 81: 405-412.

293. Lewis, R.M., and W.C. Mann. 1971. Occurrence and abundance of larval Atlantic menhaden, *Brevoortia tyrannus*, at two North Carolina inlets with notes on associated species. Trans. Amer. Fish. Soc. 100(2): 296-301.

294. Lewis, R.M., and E.P.H. Wilkens. 1971. Abundance of Atlantic menhaden larvae and associated species during a diel collection at Beaufort, NC. Chesapeake Science. 12: 185-187.

295. Lewis, R.M., E.P.H. Wilkens, and H.R. Gordy. 1971. A description of young Atlantic menhaden, *Brevoortia tyrannus*, in the White Oak River estuary, North Carolina. Fish. Bull., U.S. 70: 1150-118.

296. Lewis, R.R., III, R.G. Gilmore, Jr., D.W. Crewz, and W.E. Odum. 1985. Mangrove habitat and fishery resources of Florida. *In* W. Seaman, Jr. (editor), Florida Aquatic Habitat and Fishery Resources, p. 281-336. Fla. Chapter of American Fisheries Society, Kissimmee, FL.

297. Lindner, M.J. and W.W. Anderson. 1956. Growth, migrations, spawning and size distribution of shrimp *Penaeus setiferus*. Fish. Bull., U.S. 56: 555-645.

298. Lindner, M.J., and H.L. Cook. 1970. Synopsis of biological data on the white shrimp *Penaeus setiferus* (Linnaeus) 1767. FAO Fish. Synop. No. 101. *In* M.N. Mistakidis (editor), Proceedings of the World Scientific Conference on the Biology and Culture of Shrimps and Prawns, p. 1439-1469. FAO Fish. Rep. No. 57, Vol. 4.

299. Linton, T.L. 1968. Feasibility studies of raft-culturing oysters in Georgia. Pages 69-73 *In* T.L. Linton (editor). Proceedings of the oyster culture workshop July 11-13, 1967. Ga. Game.Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 6. 83 p.

300. Linton, T.L. 1969. Inventory of the intertidal oyster resources of Georgia. Pages 5-10 *In* T.L. Linton (editor). Feasibility study of methods for improving oyster production in Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Final Rep. Proj. 2-10-R.

301. Linton, T.L. and W.L. Rickards. 1965. Young common snook on the coast of Georgia. Quart. J. Fla. Acad. Sci. 28: 185-189.

302. Loosanoff, V.L. 1965. The American or Eastern Oyster. U.S. Fish Wildl. Serv. Circ. 205.

303. Low, R.A., Jr. 1973. Shoreline grassbed fishes in Biscayne Bay, Florida with notes on the availability of clupeid fishes. M.S. Thesis, Univ. Miami, Coral Gables, FL, 145 p.

304. Low, R., R. Rhodes, E.R. Hens, D. Theiling, E. Wenner, and D. Whitaker. 1987. A profile of the blue crab fishery in South Carolina. S.C. Mar. Resour. Cent., Tech. Rep. No. 66, 37 p.

305. Low, R.A., W. Waltz, R. Martore, and C.J. Moore. 1986. South Carolina marine recreational fishery surveys, 1985 and 1986. S.C. Mar. Resour. Cent., Tech. Rep. No. 65, 65 p.

306. Lunz, G.R. 1949. The clam situation in South Carolina. Contrib. Bears Bluff Lab. No. 6, 4 p.

307. Lunz, G.R. 1954. The general pattern of oyster setting in South Carolina. Proc. Natl. Shellfish. Assoc. 45: 47-51.

308. Lunz, G.R., and F.J. Schwartz. 1970. Analysis of eighteen year trawl captures of seatrout (*Cynoscion* sp.: Sciaenidae) from South Carolina. Contrib. Bears Bluff Lab. No. 53, 29 p.

309. Mahood, R.K. 1974. Seatrout of the genus *Cynoscion* in coastal waters of Georgia. Ga. Dept. Nat. Res., Game Fish Div., Coast. Fish. Office. Contrib. Ser. No. 26. 36 p.

310. 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. Ga. Dept. Nat. Res., Game Fish Div. Coast. Fish. Office, Contrib. Ser. No. 22. 104 p.

311. Mahood, R.K., C.D. Harris, J.L. Music, Jr. and B.A. Palmer. 1974b. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, part 2: central section, Doboy Sound and Sapelo Sound estuaries. Ga. Dept. Nat. Res., Game Fish Div. Coast. Fish. Office, Contrib. Ser. No. 23. 99 p.

312. Mahood, R.K., C.D. Harris, J.L. Music, Jr., and B.A. Palmer. 1974c. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, part 3: northern section, Ossabaw Sound and Wassaw Sound estuaries. Ga. Dept. Nat. Res., Game Fish. Div., Coast. Fish. Office, Contrib. Ser. No. 24. 100 p.

313. Mahood, R.K., C.D. Harris, J.L. Music, Jr., and B.A.Palmer. 1974d. Survey of the fisheries resources in Georgia's estuarine and inshore ocean waters, part 4: southern, central, and northern sections. Ga. Dept. Nat. Res., Game Fish. Div., Coast. Fish. Office, Contrib. Ser. No. 25. 201 p.

314. Mahood, R.K., M.D. McKenzie, D.P. Middaugh, S.J. Bollar, J.R. Davis, and D.S. Spitsbergen. 1970. A

report on the cooperative blue crab study - South Atlantic States. Ga. Game Fish Comm., Coast. Fish. Div., Contrib. Ser. No. 19. 32 p.

315. Manooch, C.S., III. 1984. Fisherman's guide to the fishes of the Southeastern United States. North Carolina State Museum of Natural History. Raleigh, N.C. 362 p.

316. Manooch, C.S. III, and R.A. Rulifson, editors. 1989. Roanoke River water flow committee report: a recommended water flow regime for the Roanoke River, North Carolina, to benefit anadromous striped bass and other below-dam users. NOAA Tech. Memo. NMFS-SEFC-216, 224 p.

317. Manzi, J.J., M.Y. Bobo, and V.G. Burrell, Jr. 1985. Gametogenesis in a population of the hard clam, *Mercenaria mercenaria* (Linnaeus), in North Santee Bay, South Carolina. The Veliger 28: 186-194.

318. Marelli, D.C., and W.S. Arnold. 1988. Temporal and spatial patterns of recruitment of *Mercenaria* spp. in the Indian River Lagoon. *In* The Second Indian River Research Symposium, Sept. 12-13, 1988. Florida Institute of Technology, Melbourne, FL.

319. Marshall, H.L. 1976. Effects of mosquito ditching on *Juncus* marshes and utilization of mosquito control ditches by estuarine fishes and invertebrates. Ph.D. Thesis, Univ. North Carolina, Chapel Hill, NC, 204 p.

320. May, O.D., Jr., and J.C. Fuller, Jr. 1965. A study on the striped bass egg production in the Congaree and Wateree Rivers. Proc. 16th Annu. Conf. S.E. Assoc. Game Fish. Comm. 1962: 285-301.

321. May,M.S., III. 1972. A contribution to the ecology of a subtidal oyster bed in the Mackay River, St. Simons Island, Georgia. Ph.D. Dissertation, Emory Univ., Atlanta. 182 p.

322. Mayer, M.A. 1985. Ecology of juvenile white shrimp, *Penaeus setiferus* Linnaeus, in the salt marsh habitat. M.S. thesis, Ga. Inst. Tech., Atlanta. 62 p.

323. McBay, L.G. 1968. Location of sexually mature striped bass. Ga. Game Fish. Comm., Final Rep. D.J.; F-20-R-3: 27-49.

324. McBay, L.G. 1970. A preliminary report on fry production and rearing of fingerling striped bass *Morone saxatilis* Walbaum at Richmond Hill Fish Hatchery in Georgia. Ga. Game Fish Comm., Completion Rep. Proj. D.J.-F-20-R-3. 33 p

325. McCloskey, L.R. 1970. The dynamics of the community associated with a marine scleractinian coral. Int. Rev. Ges. Hydrobiol. 55(1): 13-81.

326. McGovern, J.C. 1986. Seasonal recruitment of larval and juvenile fishes into impounded and non-impounded marshes. M.S. Thesis, College of Charleston, Charleston, S.C., 123 p.

327. McKenney, T.W. 1972. Fish eggs and larvae from Port Royal Sound and adjacent waters. *In* Port Royal Sound Environmental Study, p. 234-240. S.C. Water Resources Commission, Columbia, S.C.

328. McKenzie, M.D. 1970. Fluctuations in abundance of the blue crab and factors affecting mortalities. S.C. Mar. Resour. Cent., Tech. Rep. No. 1, 45 p.

329. McKenzie, M.D. (editor). 1981. Profile of the Penaeid shrimp fishery in the south Atlantic. South Atlantic Fishery Management Council, Charleston, SC.

330. McKenzie, M.D., and A.C. Badger. 1969. A systematic survey of intertidal oysters in the Savannah River Basin area of South Carolina. Contrib. Bears Bluff Lab. No. 50, 15 p.

331. McLane, W.M. 1955. The fishes of the St. Johns River system. Ph.D. Thesis, Univ. Florida, Gainesville, FL, 361 p.

332. McLaughlin, B.J.P. 1985. A study of the fish population and habitat of an ecologically designed mosquito impoundment. M.S. Thesis, Florida Inst. Tech., Melbourne, FL, 70 p.

333. McMillan, C., M.H. Shealy, Jr., and J.V. Miglarese. 1975. Occurrence of Atlantic croaker (*Micropogon undulatus*) in relation to bottom salinity and temperature in South Carolina estuaries. S.C. Acad. Sci. Bull. 37: 84.

334. McNeese, P.L. 1986. Spatial and temporal variability of fish communities inhabiting *Halodule wrightii* seagrass beds in the lower Indian River estuary. M.S. Thesis, Florida Institute of Technology, Melbourne, FL, 34 p.

335. McNulty, J.K. 1953. Seasonal and vertical patterns of oyster setting off Wadmalaw Island, S.C. Contrib. Bears Bluff Lab. No. 15, 17 p.

336. Meador, M.R., A.G. Eversole, and J.S. Bulak. 1984. Utilization of portions of the Santee River system by spawning blueback herring. N. Am. J. Fish. Manag. 4: 155-163.

337. Mense, D.J., and E.L. Wenner. 1989. Distribution and abundance of early life history stages of the blue crab, *Callinectes sapidus*, in tidal marsh creeks near Charleston, S.C. Estuaries 12: 157-168.

338. Mercer, L.P. 1983. A biological and fisheries profile of weakfish, *Cynoscion regalis*. N.C. Divn. Mar. Fish., Spec. Sci. Rep. No. 39. 107 p.

339. Mercer, L.P. 1984a. A biological and fisheries profile of the spotted seatrout, *Cynoscion nebulosus*. N.C. Divn. Mar. Fish., Spec. Sci. Rep. 40, 87 p.

340. Mercer, L.P. 1984b. A biological and fisheries profile of red drum, *Sciaenops ocellatus*. N.C. Divn. Mar. Fish., Spec. Sci. Rep. 41, 89 p.

341. Mercer, L.P. 1984c. Fishery management plan for the spotted seatrout, *Cynoscion nebulosus*, fishery. N.C. Divn. Mar. Fish., Spec. Sci. Rep. 43, 14 p.

342. Mercer, L.P. 1984d. Fishery management plan for the red drum, *Sciaenops ocellatus*, fishery. N.C. Divn. Mar. Fish., Spec. Sci. Rep. 44, 107 p.

343. Mercer, L.P. 1985. Fishery management plan for the weakfish, *Cynoscion regalis*, fishery. N.C. Divn. Mar. Fish. Spec. Sci. Rep. 46, 129 p.

344. Mercer, L.P. 1987a. Fishery management plan for the Atlantic croaker, *Micropogonias undulatus*, fishery. N.C. Divn. Mar. Fish., Spec. Sci. Rep. 48, 90 p.

345. Mercer, L.P. 1987b. Fishery management plan for the spot, *Leiostomus xanthurus*, fishery. N.C. Divn. Mar. Fish., Spec. Sci. Rep. 49, 81 p.

346. Merriner, J.V. 1976. Aspects of the reproductive biology of the weakfish, *Cynoscion regalis* (Sciaenidae) in North Carolina. Fish. Bull., U.S. 74: 18-26.

347. Michaels, R. 1980. Shad position statement - the current status of Georgia's shad fishery. Ga. Dept. Nat. Res., Game Fish Div., Atlanta. 12 p.

348. Michaels, R.A. 1984. Population dynamics of American shad in the Altamaha River. Interim report for the years 1982-1984. Ga. Dept. Nat. Res., Game Fish Div., Atlanta. Proj. G-3. 39 p.

349. Middaugh, D.P. 1981. Reproductive ecology and spawning periodicity of the Atlantic silverside, *Menidia menidia* (Pisces: Atherinidae). Copeia 1981: 766-776.

350. Middaugh, D.P., R.G. Donney, and G.I. Scott. 1984. Reproductive rhythmicity of the Atlantic silverside. Trans. Am. Fish. Soc. 113: 462-478.

351. Middaugh, D.P., G.I. Scott, and J.M. Dean. 1981. Reproductive behavior of the Atlantic silverside, *Menidia menidia* (Pisces: Atherinidae). Env. Biol. Fish. 6: 269-276.

352. Miglarese, J.V., C.W. McMillan, and M.H. Shealy, Jr. 1982. Seasonal abundance of Atlantic croaker (*Micropogonias undulatus*) in relation to bottom salinity and temperature in South Carolina estuaries. Estuaries 5(3): 216-223.

353. Miller, G.L. and S.C. Jorgenson. 1969. Seasonal abundance and length frequency distribution of some marine fishes in coastal Georgia. U.S. Bur. Commercial Fish., Data Rep. No. 35.

354. Miller, J.M., L.B. Crowder, and M.L. Moser. 1985. Migration and utilization of estuarine nurseries by juvenile fishes: an evolutionary perspective. Contrib. Mar. Sci. 27: 338-352.

355. Miller, J.M., and B.M. Currin. 1982. Production of juvenile spot *Leiostomus xanthurus* and croaker *Micropogonias undulatus* in North Carolina estuaries. Proceedings of the 112th annual American Fisheries Society meeting, Hilton Head, SC, Sept. 22-25, 1982.

356. Miller, J.M., and D.S. Peters. Unpublished manuscript. Fishes of the Pamlico River estuary. NOAA/NMFS/SEFC Beaufort Lab., Beaufort, NC.

357. 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. *In* J.D. McCleave, G.P. Arnold, J.J. Dodson, and W.H. Neill (editors), Mechanisms of Migration in Fishes, p. 209-225. Plenum Press, New York.

358. Millikin, M.R., and A.B. Williams. 1984. Synopsis of biological data on the blue crab, *Callinectes sapidus*. FAO Fish. Synop. No. 138.

359. Moe, M.A., Jr. 1972. Movement and migration of south Florida fishes. Fla. Dept. Nat. Resour. Tech. Ser. 69, 25 p.

360. Moody, H.L. 1961. Exploited fish populations of the St. Johns River, Florida. Quart. J. Fla. Acad. Sci. 24: 1-18.

361. Moody, H. 1963. Fishing and boating facts, the St. Johns River. Fla. Wildl. 17(3): 20-27.

362. Moody, H.L., T.E. Cheek, L.L. Connor, E.A. Long, and R.L. Smith. 1983. Annual progress report for

Dingell-Johnson project F-33. St. Johns River fishery resources, Study III: Relationships of fish populations to habitat types in the lower St. Johns River. Fla. Game Fresh Water Fish Comm., Tallahassee, FL.

363. Moore, C.J. 1980. Spawning of *Menidia menidia* (Pisces: Atherinidae). Copeia 1980: 886-887.

364. Morse, W.W. 1980. Maturity, spawning, and fecundity of Atlantic croaker, *Micropogonias undulatus*, occurring north of Cape Hatteras, North Carolina. Fish. Bull., U.S. 78: 190-195.

365. Morse, W.W. 1981. Reproduction of the summer flounder, *Paralichthys dentatus*. J. Fish Biol. 19: 189-203.

366. Moser, M.L., and L.R. Gerry. 1989. Differential effects of salinity changes on two estuarine fishes, *Leiostomus xanthurus* and *Micropogonias undulatus*. Estuaries 12(1): 35-41.

367. Mulholland, R. 1984a. Habitat suitability index models: pink shrimp. U.S. Fish Wildl. Serv. FWS/OBS-82/10.76. 17 p.

368. Mulholland, R. 1984b. Habitat suitability index models: hard clam. U.S. Fish Wildl. Serv. FWS/OBS-82/10.77. 21 p.

369. Mulligan, T.J. 1981. Summer season populations of epibenthic marine fishes in the Indian River Lagoon System, Florida. Ph.D. Thesis, Univ. Central Florida, Orlando, FL, 251 p.

370. Mulligan, T.J., and F.F. Snelson, Jr. 1983. Summer-season populations of epibenthic marine fishes in the Indian River Lagoon system, Florida. Fla. Sci. 46: 250-277.

371. Muncy, R.J. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic) white shrimp. U.S. Fish Wildl. Serv. FWS/OBS-82/11.27. 19 p.

372. Murawski, S.A., and A.L. Pacheco. 1977. Biological and fisheries data on Atlantic sturgeon *Acipenser oxyrhynchus*. NOAA/NMFS NEFC Tech. Rep. 10. 69 p.

373. Music, J.L., Jr. 1974. Observations on the spot (*Leiostomus xanthurus*) in Georgia's estuaries and close inshore ocean waters. Ga. Dept. Nat. Res. Game Fish Div., Coast. Fish. Office, Contrib. Ser. No. 28. 29 p.

374. Music, J.L., Jr. 1979. Assessment of Georgia's shrimp and crab resources. Ga. Dept. Nat. Res., Coast. Res. Div., Contrib. Ser. No. 30. 75 p.

375. Music, J.L., Jr. 1981. Assessment of Georgia's 1980 commercial shad season. Ga. Dept. Nat. Res. Coast. res. Div., Proj. Rep. AFC-11-1. 41 p.

376. Music, J.L., Jr. and J.N. Pafford. 1984. Population dynamics and life history aspects of major marine sport fishes in Georgia's coastal waters. Georgia Dept. Nat. Res., Coastal Res. Div., Contrib. Ser. No. 38. 382 p.

377. 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 Jan. 88 - 31 Dec. 88. Ga. Dept. Nat. Res., Coast. Res. Div., Coast. Fish. Sect. 146 p plus appendices.

378. Newell, R.I.E. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (north and mid-Atlantic)—blue mussel. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.02).

379. Nichols, P.R. 1959. St. Johns shad fever. Fla. Wildl. 12(9): 22-23, 39.

380. North Carolina Division of Marine Fisheries. 1985. North Carolina Shrimp Assessment. Memorandum. 6 p.

381. O'Rear, C.W. 1983. A study of river herring spawning and water quality in Chowan River, NC. NC Div. Mar. Fish., Compl. Rep. Proj. AFC-17, 31 p.

382. Odum, W.E. 1968a. Mullet grazing on the dinoflagellate bloom. Chesapeake Sci. 9: 202-204.

383. Odum, W.E. 1968b. The ecological significance of fine particle selection by the striped mullet *Mugil cephalus*. Limnol. Oceanogr. 13: 92-98.

384. Ofiara, D.D. and S.A. Stevens. 1987. Shellfish in Georgia: resource description and economic significance of the shellfish harvesting and processing sectors. Georgia Sea Grant College Program, University of Georgia, Athens. 34 p.

385. Ogburn, M.V., D.M. Allen, and W.K. Michener. 1988. Fishes, shrimps, and crabs of the North Inlet Estuary, SC: A four year seine and trawl survey. Baruch Institute Tech. Rep. No. 88-1, Univ. of South Carolina, Columbia, S.C., 299 p.

386. Oliver, J.D., M.J. Van Den Avyle, and E.L. Bozeman, Jr. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic) - bluefish. U.S. Fish Wildl.

Serv. Biol. Rep. 82(11.96). 13 p.

387. Olmi, E.J., III. 1986. Recruitment patterns of selected decapod crustaceans. *In* M.R. DeVoe and D.S. Baughman (editors), South Carolina Coastal Wetland Impoundments: Ecological Characterization, Management, Status, and Use. Vol. II, Technical Synthesis, p. 303-360. S.C. Sea Grant Consortium Tech. Rep. #SC-SG-TR-86-2.

388. Pafford, J.M. and N. Nicholson. 1989. Georgia marine recreational fisheries survey, 1985-1987. Ga. Dept. Mar. Res., Coast. Res. Div., Contrib. Ser. No. 45. 157 p.

389. Palmer, B.A. 1974. Studies of the blue crab (*Callinectes sapidus*) in Georgia. Ga. Dept. Nat. Res., Game Fish Comm., Coastal Fish. Office. Contrib. Ser. No. 29. 59 p.

390. Pardue, G.B. 1983. Habitat suitability index models: alewife and blueback herring. U.S. Fish Wildl. Serv. FWS/OBS-82/10.58. 22 p.

391. Park, J.R. 1969. A preliminary study of the portunid crabs in Biscayne Bay. Quart. J. Fla. Acad. Sci. 32: 12-20.

392. Parrish, L.P. 1972. Seasonal abundance and distributions of the benthic invertebrate community. *In* Port Royal Sound Environmental Study, p. 242-247. S.C. Water Resources Commission, Columbia, S.C.

393. Pate, P.P. Jr., and R. Jones. 1981. Effects of upland drainage on estuarine nursery areas of Pamlico Sound, North Carolina. *In* R.D. Cross and D.L. Williams (editors), Proceedings of the National Symposium on Freshwater Inflow to Estuaries, Vol. II, p. 402-418. U.S. Fish Wildl. Serv. FWS/OBS-81/04.

394. Perret, W.S., J.E. Weaver, R.O. Williams, P.L Johansen, T.F. McIlwain, R.C. Raulerson, and W.M. Tatum. 1980. Fishery profiles of red drum and spotted seatrout. Gulf States Mar. Fish. Comm. No. 6.

395. Peters, D.S. 1968. A study of relationships between zooplankton abundance and selected environmental variables in the Pamlico River estuary of eastern North Carolina. M.S. Thesis, NC State Univ., Raleigh, NC, 38 p.

396. Pietrafesa, L.J., G.S. Janowitz, J.M. Miller, E.B. Noble, S.W. Ross, and S.P. Epperly. 1986. Abiotic factors influencing the spatial and temporal variability of juvenile fish in Pamlico Sound, North Carolina. *In* D.A. Wolfe (editor), Estuarine Variability, p. 341-353.

397. Pline, M.J. 1984. Reproductive cycle and low salinity stress in adult *Mercenaria mercenaria* L. of Wassaw Sound, Georgia. M.S. thesis, Ga. Inst. Tech., Atlanta. 74 p.

398. Porter, H.J. 1964. Seasonal gonadal changes of adult clams, *Mercenaria mercenaria* in North Carolina. Proc. Natl. Shellfish Assoc. 55: 35-72.

399. Pottern, G.B., M.T. Huish, and J.H. Kerby. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)—bluefish. U.S. Fish Wild. Serv. Biol. Rep. 82(11.94).

400. 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, Univ. North Carolina, Chapel Hill, NC, 145 p.

401. Powell, A.B., and H.R. Gordy. 1980. Egg and larval development of the spot, *Leiostomus xanthurus* (Sciaenidae). Fish. Bull., U.S. 78: 701-714.

402. Powell, A.B., and F.J. Schwartz. 1977. Distribution of paralichthid flounders (Bothidae: *Paralichthys*) in North Carolina estuaries. Chesapeake Sci. 18: 334-339.

403. Powell, D. 1975. Age, growth, and reproduction in Florida stocks of Spanish mackerel, *Scomberomorus maculatus*. Fla. Dept. Nat. Resour. Mar. Res. Lab., Fla. Mar. Res. Publ. No. 5, 21 p.

404. Powell, D., L.M. Dwinell, and S.E. Dwinell. 1972. An annotated listing of the fish reference collection at the Florida Department of Natural Resources Marine Research Laboratory. Fla. Dept. Nat. Resour. Mar. Res. Lab., Spec. Sci. Rep. No. 36, 179 p.

405. 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. S.C. Mar. Resour. Cent., Tech. Rep. No. 11, 47 p.

406. Powles, H., and B.W. Stender. 1978. Taxonomic data on the early life history stages of Sciaenidae of the South Atlantic Bight of the United States. S.C. Mar. Resour. Cent., Tech. Rep. No. 31, 64 p.

407. Probst, W. 1988. Evaluation of successive year class strength of juvenile American shad in the Ogeechee River. Ga. Dept. Nat. Res., Game Fish Div. Final Rep. C-5. 29 p.

408. Purvis, C. 1976. Nursery area survey of northern Pamlico Sound and tributaries. NC Div. Mar. Fish., Compl. Rep. Proj. 2-230-R, 47 p.

409. Rawson, M.V., Jr. 1973. The development and seasonal abundance of the parasites of striped mullet, *Mugil cephalus* L., and mummichog *Fundulus heteroclitus* L. Ph.D. Dissertation, Univ. Ga., Athens. 100 p.

410. Rees, R.A. 1972. A survey of the aquatic organism population of the Savannah and Ogeechee River estuaries and their relationship in the diet of the striped bass, *Morone saxatilis*, (Walbaum). M.S. thesis, Univ. Ga., Athens. 144 p.

411. Reintjes, J.W., and A. Pacheco. 1966. The relation of menhaden to estuaries. Am. Fish. Soc. Spec. Publ. 3: 50-58.

412. Reise, R.R., and J.M. Dean. 1981. Temporal variation in the utilization of an intertidal creek by the bay anchovy (*Anchoa mitchilli*). Estuaries 4: 16-23.

413. Reish, D.J., and M.L. Hallisey. 1983. A check-list of the benthic macroinvertebrates of Kennedy Space Center, Florida. Fla. Sci. 46: 295-306.

414. Rhodes, R.J., W.J. Keith, P.J. Eldridge, and V.G. Burrell, Jr. 1977. An empirical evaluation of the Leslie-DeLury method applied to estimating hard clam, *Mercenaria mercenaria*, abundance in the Santee River estuary, South Carolina. Proc. Natl. Shellfish. Assoc. 67: 44-52.

415. Rickards, W.L. 1966. A study of the ecology of first-year tarpon, *Megalops atlanticus* Valenciennes, in a Georgia salt-marsh with laboratory studies of growth rates and ecological growth efficiencies. M.S. thesis, Univ. Ga., Athens. 67 p.

416. Rickards, W.L. 1968. Ecology and growth of juvenile tarpon, *Megalops atlanticus*, in a Georgia salt marsh. Bull. Mar. Sci. 18: 220-239.

417. Robins, R.C. 1958. Florida game and commercial marine fishes. Fla. Brd. Conserv. Educational Ser. No. 12, 46 p.

418. Roessler, M.A., and D.C. Tabb. 1974. Studies of effects of thermal pollution in Biscayne Bay, Florida. Project 18080 DFU Program element 1BA032 prepared for the U.S. Environ. Prot. Agen., Washington.

419. Roessler, M.A., G.L. Beardsley, R.R. Rehrer, and J. Garcia. 1975. Effects of thermal effluents on the fishes and benthic invertebrates of Biscayne Bay-Card Sound, Florida. Univ. Miami, Rosenstiel School of Marine and Atmospheric Sciences. Tech. Rep. U-RSMAS-#75027.

420. Rogers, S.G., and M.J. Van Den Avyle. 1983a. Species profiles life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic) - Atlantic menhaden. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.11). 20 p.

421. Rogers, S.G., and M.J. Van Den Avyle. 1983b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic)—summer flounder. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.15). 14 p.

422. 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. Trans. Am. Fish. Soc. 113: 595-606.

423. Ross, J.L., D.A. DeVries, J.N. Hawkins III, and J.B. Sullivan. 1986. Assessment of North Carolina commercial finfisheries. NC Div. Mar. Fish., Comp. Rep. Proj. 2-386-R, 418 p.

424. Ross, S.W. 1982. Estuarine fish stock assessment - long haul seine and pound net surveys. *In* North Carolina Estuarine Finfish Management Program, p. 1-39. NC Div. Mar. Fish., Compl. Rep. Proj. 2-372-R.

425. Ross, S.W. 1988. Age, growth, and mortality of Atlantic croaker in North Carolina, with comments on population dynamics. Trans. Am. Fish. Soc. 117: 461-473.

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

427. Ross, S.W., F.C. Rohde, and D.G. Lindquist. 1988. Endangered, threatened, and rare fauna of North Carolina. Occasional papers of the North Carolina Biological Survey 1988-7, 20 p.

428. Rozas, L.P., and C.T. Hackney. 1984. Use of oligohaline marshes by fishes and macrofaunal crustaceans in North Carolina. Estuaries 7: 213-224.

429. Rulifson, R.A. 1985. Distribution and abundance of fishes in tributaries of South Creek Estuary, North Carolina. J. Elisha Mitchell Sci. Soc. 101: 160-176.

430. Rulifson, R.A., M.T. Huish, and R.W. Thoesen. 1982a. Anadromous fish in the Southeastern United States and recommendations for development of a management plan. U. S. Fish Wildl. Serv., Fish. Res., Region 4, Atlanta, Ga. 525 p.

431. Rulifson, R.A., M.T. Huish, and R.W. Thoesen. 1982b. Status of anadromous fishes in southeastern U.S. estuaries. *In* V.S. Kennedy (editor), Estuarine Comparisons, p. 413-425.

432. Rulifson, R.A., and D.W. Stanley. 1985. Food and feeding of young striped bass in Roanoke River and western Albemarle Sound, North Carolina: 1984. NC Div. Mar. Fish., Annual Prog. Rep. Proj. AFS-24, Segment 1, 55 p.

433. Ruppert, E.E., and R.S. Fox. 1988. Seashore Animals of the Southeast: A Guide to Common Shallow Water Invertebrates of the Southeastern Atlantic Coast. Univ. S.C. Press, Columbia, SC. 429 p.

434. Saloman, C.H., D.M. Allen, and T.J. Costello. 1968. Distribution of three species of shrimp (genus *Penaeus*) in waters contiguous to southern Florida. Bull. Mar. Sci. 18: 342-350.

435. Sastry, A.N. 1963. Reproduction of the bay scallop, *Aequipecten irradians*. Influence of temperature on maturation and spawning. Biol. Bull. 125: 146-153.

436. Sastry, A.N. 1966. Temperature effects in reproduction of the bay scallop, *Aequipecten irradians*. Biol. Bull. 130: 118-134.

437. Schmitt, D.S. 1988. A fisheries survey of the Ogeechee River. Ga. Dept. Nat. Res., Game Fish Div. Final Rep. Proj. No. F-30-15.

438. Schmitt, D.S. and J.H. Hornsby. 1985. A fisheries survey of the Savannah River. Ga. Dept. Nat. Res., Game Fish Div. Final Rep. F-30-12. 91p.

439. Schooley, J.K. 1977. Factors affecting the distribution of the nearshore fishes in the lagoonal waters of the Indian River, Florida. M.S. Thesis, Univ. Florida, Gainesville, FL, 165 p.

440. Schwartz, F.J. 1990. Length-weight, age and growth, and landings observations for sheepshead *Archosargus probatocephalus* from North Carolina. Fish. Bull. U.S. 88(4): 829-832.

441. Schwartz, F.J., W.W. Hassler, J.W. Reintjes, and M.W. Street. 1977. Marine fishes. *In* J.E. Cooper, S.S. Robison, and J.B. Funderburg (editors), Endangered and Threatened Plants and Animals of North Carolina, p. 250-264. NC St. Mus. Nat. Hist., Raleigh, NC.

442. 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.

443. 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 adjacent Atlantic Ocean. Summary report 1973-1977, Inst. Mar. Sci., Univ. North Carolina, Morehead City, NC, 568 p.

444. Schwartz, F.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, Inst. Mar. Sci., Univ. North Carolina, Morehead City, NC, 326 p.

445. Scruggs, G.D., Jr. 1955. Reproduction of resident striped bass in Santee-Cooper reservoir, South Carolina. Trans. Am. Fish. Soc. 85: 144-159.

446. Scruggs, G.D., Jr., and J.C. Fuller, Jr. 1954. Indications of a freshwater population of striped bass *Roccus saxatilis* (Walbaum), in Santee-Cooper reservoirs. Proc. Annu. Conf. S.E. Assoc. Game Fish Comm. 1954: 64-69.

447. Setzler, E.M. 1977. A quantitative study of the movement of larval and juvenile sciaenidae and engraulidae into the estuarine nursery grounds of Doboy Sound, Sapelo Island, Georgia. Ph.D. Dissertation, Univ. Ga. Athens.

448. Setzler, E.M., R.W. Boynton, K.V. Wood, H.H. Zion, L. Lubbers, N.K. Mountford, P. Frere, L. Tucker, and J.A. Mihursky. 1980. Synopsis of biological data on striped bass, *Morone saxatilis*. NOAA Tech. Rep. NMFS Circ. 433.

449. Shealy, M.H., Jr. 1974. Bottom trawl data from South Carolina estuarine survey cruises, 1973. Data Rep. No.1., S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

450. Shealy, M.H., Jr. 1975. Midwater trawl data from South Carolina estuarine survey cruises (North Edisto, South Edisto, and Cooper Rivers), 1973 and 1974. Data Rep. No. 2., S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

451. Shealy, M.H., Jr., J.V. Miglarese, E.B. Joseph. 1974. Bottom fishes of South Carolina estuaries: relative abundance, seasonal distribution, and length-frequency relationships. SC Mar. Resour. Ctr., Tech. Rep. No. 6, 189 p.

452. 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 utilization. Estuaries 2: 154-163.

453. Shipman, S. 1983a. Survey of Georgia's major marine fishery resources. Ga. Dept. Nat. Res., Coast. Res. Div., Contrib. Ser. No. 33. 159 p + Appendix.

454. Shipman, S. 1983b. Mark-recapture studies of penaeid shrimp in Georgia, 1978-1981. Ga. Dept. Nat. Res., Coast. Res. Div. Contrib. Ser. No. 35.

455. Sholar, T.M. 1975. Anadromous fisheries survey of the New and White Oak River systems. NC Div. Mar. Fish., Compl. Rep. Proj. AFC-9, 49 p.

456. Sholar, T.M. 1977a. Status of American shad in North Carolina. *In* Proceedings of a Workshop on American shad, Amherst, MA. Dec. 14-16, 1976, p. 17-32. U.S. Fish Wildl. Serv. NE Region and NMFS.

457. Sholar, T.M. 1977b. Anadromous fisheries research program, Cape Fear River System, Phase 1. NC Div. Mar. Fish., Prog. Rep. Proj. AFSC-12.

458. Siebenaler, J.B. 1953. The Biscayne Bay commercial fishery. Fla. Brd. Conserv. Tech. Ser. No. 6, 20 p.

459. Sikora, W.B. 1977. The ecology of *Palaemonetes pugio* in a southern salt marsh ecosystem with particular emphasis on production and trophic relationships. Ph.D. Thesis, Univ. South Carolina, Columbia, S.C.

460. Sikora, W.B. and J.P. Sikora. 1982. Habitat suitability index models: southern kingfish. U.S. Fish Wildl. Serv. FWS/OBS-82/10.31. 22 p.

461. Silverman, M.J. 1979. Biological and fisheries data on black drum *Pogonias cromis* (Linnaeus). NOAA, NEFC Tech. Rep. No. 22. 35 p.

462. Simmons, R.G., and J.P. Breuer. 1962. A study of redfish, *Sciaenops ocellatus* and black drum, *Pogonias cromis*. Univ. Tex. Inst. Mar. Sci. Publ. 8: 184-211.

463. Simoneaux, L. Unpublished manuscript. Juvenile fish distribution in North Carolina by salinity and season. NOAA-NMFS-SEFC Beaufort Lab., Beaufort, NC, 32 p.

464. Smith, H.M. 1907. The fishes of North Carolina. NC Geol. and Econ. Surv. Rep., Vol 2. E.M. Uzzell and Co., Raleigh, NC.

465. Smith, J.W., and C.A. Wenner. 1985. Biology of the southern kingfish in the South Atlantic Bight. Trans. Am. Fish. Soc. 114: 356-366.

466. Smith, L.D. 1968. Notes on the distribution, relative abundance, and growth of juvenile anadromous fish in the Altamaha River system, Georgia, with specific reference to striped bass, *Roccus saxatilis* (Walbaum). Ga. Game Fish Comm., Sport Fish. Div., Contrib. Ser. No.1. 22 p.

467. Smith, L.D. 1970. Life history studies of striped bass. Ga. Game Fish Div., Final Rep. Proj. AFS-2. 134 p.

468. Smith, L.D., Z. Bunch, and S. Hester. 1968. Life history studies of striped bass. Ga. Game Fish Comm., Ann. Prog. Rep. Proj. AFS-2. July 1, 1967-June 30, 1968. 94 p.

469. Smith, L.D. and L.E. Gardner. 1969. Life history studies of striped bass. Ga. Game Fish Comm., Ann. Prog. Rep. Proj. AFS-2. July 1, 1968-June 30, 1969. 70 p.

470. Smith, T.I.J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrhynchus*, in North America. *In* F. Binkowski and S.I. Doroshov (editors), North American Sturgeons: Biology, and Aquaculture Potential. Dr. W. Junk Publishers, Dordrecht, Netherlands.

471. Smith, T.I.J., E.K. Dingley, and D.E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon. Prog. Fish. Cult. 42(3): 147-151.

472. Smith, T.I.J., D.E. Marchette, and R.A. Smiley. 1982. Life history, ecology, culture, and management of the Atlantic sturgeon, *Acipenser oxyrhynchus* Mitchell, in South Carolina. Final Tech. Rep. Proj. AFS-9, 75 p.

473. Smith, T.I.J., D.E. Marchette, and G.F. Ulrich. 1984. The Atlantic sturgeon fishery in South Carolina. N. Am. J. Fish. Manag. 4: 164-176.

474. Smith, W.G. and A. Wells. 1977. Biological and fisheries data on striped bass, *Morone saxatilis* (Walbaum). NOAA/NMFS NEFC Tech. Rep. No. 4. 42 p.

475. Snelson, F.F., Jr. 1983. Ichthyofauna of the northern part of the Indian River Lagoon system, Florida. Fla. Sci. 46: 187-206.

476. South Carolina Wildlife and Marine Resources Department. Resource Assessment 1980-1987. S.C. Wildl. Mar. Resour., Charleston, S.C.

477. Spitsbergen, D. 1979. A study of the bay scallop (*Argopecten irradians*) in North Carolina waters. NC Div. Mar. Fish., Compl. Rep. Proj. 2-256-R, 44 p.

478. Springer, V.G. 1960. Ichthyological surveys of the lower St. Lucie and Indian Rivers, Florida east coast. Fla. Brd. Conserv. Mar. Lab. No. 60-19, 17 p.

479. Stanley, J.G. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) - hard clam. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.41).

480. Stanley, J.G., and D.S. Davie. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (north Atlantic) - white perch. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.17).

481. Starck, W.A., II, and R.E. Schroeder. 1971. Investigations on the gray snapper, *Lutjanus griseus*. Univ. Miami Press, Coral Gables, FL.

482. Starck, W.A., II. 1964. A contribution to the biology of the gray snapper, *Lutjanus griseus* (Linnaeus), in the vicinity of lower Matecumbe Key, Florida. Ph.D. Thesis, Univ. Miami, Coral Gables, FL, 258 p.

483. Stender, B.W., and R.M. Martore. 1990. Finfish and invertebrate communities. *In* Van Dolah, R.F., P.H. Wendt, and E.L. Wenner (editors). A physical and ecological characterization of the Charleston Harbor estuarine system, pp. 241-287. Marine Resources Division, S.C. Wildl. & Marine Res. Dept. 634 p.

484. Stevens, R.E. 1958. The striped bass of the Santee-Cooper reservoir. Proc. Annu. Conf. S.E. Assoc. Game Fish Comm.(1975)11: 253-264.

485. Stevens, S.A. 1983. Ecology of intertidal oyster reefs: food, distribution, and carbon/nutrient flow. Ph.D. Dissertation, Univ. Ga., Athens.

486. Stickney, R.R. 1972a. Length-weight relationships for several fishes and invertebrates in Georgia coastal waters with condition factors for fish species. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 72-3. 21 p.

487. Stickney, R.R. 1972b. Effects of Intracoastal Waterway dredging on ichthyofauna and benthic macroinvertebrates. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 72-4.

488. Stickney, R.R. and M.L. Cuenco. 1982. Habitat suitability index models: juvenile spot. U.S. Fish Wildl. Serv. FWS/OBS-82/10.20.

489. Stickney, R.R. and D. Miller. 1973. Chemical and biological survey of the Savannah River adjacent to Elba Island. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 73-3. 68 p.

490. Stickney, R.R. and D. Miller. 1974. Chemistry and biology of the lower Savannah River. J. Water Pollut. Control Fedn. 46(10): 2316-2326.

491. Stoner, A.W. 1983. Distribution of fishes in seagrass meadows: role of macrophyte biomass and species composition. Fish. Bull., U.S. 81: 837-846.

492. Street, M.W. 1969. Fecundity of the blueback herring in Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 17. 15 p.

493. Street, M.W. 1970. Some aspects of the life histories of hickory shad, *Alosa mediocris* (Mitchill) and blueback herring, *Alosa aestivalis* (Mitchill) in the Altamaha River, Georgia. M.S. thesis, University of Georgia. 85 p.

494. Street, M.W. 1981. Trends in North Carolina's commercial fisheries. NC Div. Mar. Fish., Morehead City, NC.

495. Street, M.W. and J.G. Adams. 1969. Aging of hickory shad and blueback herring in Georgia by the scale method. Ga. Game Fish Comm., Mar. Fish. Div. Contrib. Ser. No. 18.

496. Summerson, H.C., and C.H. Peterson. 1990. Recruitment failure of the bay scallop, *Argopecten irradians*, during the first red tide, *Ptychodiscus brevis*, outbreak recorded in North Carolina. Estuaries 13: 322-331.

497. Sykes, D.P. 1981. Migration and development of young American eels, *Anguilla rostrata*, in coastal North Carolina. NC St. Univ. Sea Grant Working Paper 81-5, Raleigh, NC, 34 p.

498. Sykes, J.E. 1956. Shad fishery of the Ogeechee River, Georgia, in 1954. U. S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. No. 191. 11 p.

499. Tabb, D. 1958. Difference in the estuarine ecology of Florida waters and their effect on populations of the spotted weakfish, *Cynoscion nebulosus* (Cuvier and Valenciennes). 23rd N. Am. Wildl. Conf. Trans. p. 392-401.

500. Tabb, D.C. 1960. The spotted seatrout fishery of the Indian River area Florida. Fla. Brd. Conserv. Tech. Ser. No. 33, 20 p.

501. Tabb, D.C. 1961. A contribution to the biology of the spotted seatrout, *Cynoscion nebulosus* (Cuvier) of east-central Florida. Fla. Brd. Conserv. Tech. Ser. No. 35, 24 p.

502. Tabb, D.C. 1966. The estuary as a habitat for spotted seatrout, *Cynoscion nebulosus*. Trans. Amer. Fish. Soc. 95: 59-67.

503. Tagatz, M.E. 1968a. Biology of the blue crab, *Callinectes sapidus* Rathbun, in the St. Johns River, Florida. Fish. Bull., U.S. 67: 17-33.

504. Tagatz, M.E. 1968b. Fishes of the St. Johns River, Florida. Quart. J. Fla. Acad. Sci. 30: 25-50.

505. Tagatz, M.E., and D.L. Dudley. 1961. Seasonal occurrence of marine fishes in four shore habitats near Beaufort, NC, 1957-60. U.S. Fish Wildl. Serv. SSRF 390, 19 p.

506. Talbot, G.B. 1961. The American shad. U.S. Fish Wildl. Serv. Fish. Leafl. 504.

507. Talbot, G.B. and J.E. Sykes. 1958. Atlantic coast migrations of American shad. Fish. Bull., U.S. 58: 473-490.

508. Targett, T.E. and E.E. Wester. 1985. Utilization of salt marsh surface habitat by estuarine fishes. Estuaries 8: 8A (abstract only).

509. Tenore, K.R., R.B. Horton, and T.W. Duke. 1968. Effects of bottom substrate on the brackish water bivalve *Rangia cuneata*. Chesapeake Sci. 9: 238-248.

510. Thayer, G.W., D.E. Hoss, M.A. Kjelson, W.F. Hettler Jr., and M.A. LaCroix. 1974. Biomass of zooplankton in the Newport River Estuary and influence of postlarval fish. Chesapeake Sci. 15: 9-16.

511. Thayer, G.W., M.W. LaCroix, and J.M. Lewis. 1974. Seasonal distributions of larval fishes in the Newport River Estuary and the carbon, nitrogen, and caloric content of three estuarine fish species. *In* Annual Report to the Atomic Energy Commission, p. 238-244. NOAA-NMFS-SEFC Beaufort Lab.

512. Theiling, D.L. 1977. South Carolina's 1976 shrimp trawler season. S.C. Mar. Resour. Cent., Tech. Rep. No. 24, 19 p.

513. Thorp, J.H. III. 1975. Mechanisms of coexistence between two sympatric species of the grass shrimp *Paleamonetes* (Decapoda: Palaemonidae). Ph.D. Thesis, NC St. Univ., Raleigh, NC, 42 p.

514. Tucker, J.W. Jr. 1983. Energy utilization in bay anchovy and black sea bass eggs and larvae contrasting ecological roles. Ph.D. Thesis, Col. of Wm. and Mary, Williamsburg, VA, 85 p.

515. Turner, W.R., and G.N. Johnson. 1972. Standing crop of aquatic organisms in five South Carolina tidal streams. *In* Port Royal Sound Environmental Study, p. 179-201. S.C. Water Resources Commission, Columbia, S.C.

516. Turner, W.R., and G.N. Johnson. 1973. Distribution and relative abundance of fishes in Newport River, North Carolina. NOAA Tech. Rep. NMFS SSRF-666, 23 p.

517. Turner, W.R., and G.N. Johnson. 1974. Standing crop of aquatic organisms in tidal streams of the lower Cooper River system, South Carolina. U.S. Dep. Commer., NOAA-NMFS-SEFC Beaufort Lab.

518. Ulrich, G., N. Chipley, J.W. McCord, D. Cupka, J.L. Music, Jr., and R.K. Mahood. 1979a. Development of fishery management plans for selected anadromous fishes in South Carolina and Georgia. Ga. Dept. Nat. Res., Coast. Re. Div., Contrib. Ser. No. 31. 135 p.

519. Ulrich, G., N. Chipley, J.W. McCord, D. Cupka, J.L. Music, Jr., and R.K. Mahood. 1979b. Development of fishery management plans for selected anadromous fishes in South Carolina and Georgia. S.C. Wildl. Mar. Resour. Dep., Spec. Sci. Rep. No. 14.

520. Ulrich, G.F., N.C. Jenkings, and J.W. McCord. 1983. Monitoring and assessment of the South Carolina commercial fishery for American shad. Compl. Rep. FY 80-82. Proj. No. AFC-8-3, 71 p.

521. Van Den Avyle, M.J. 1984a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic) - American eel. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.24). 20 p.

522. Van Den Avyle, M.J. 1984b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic) - Atlantic sturgeon. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.25).

17 p.

523. Van Den Avyle, M.J., and D.L. Fowler. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (south Atlantic) - blue crab. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.19). 16 p.

524. Van Dolah, R.F., and K.B. Davis. 1989. Living resources of Charleston Harbor. *In* NOAA Estuary-of-the-Month Sem. Ser. No. 16, Charleston Harbor: Issues, Resources, Status, and Management. NOAA Estuarine Programs Office, Washington, DC, 62 p.

525. Van Dolah, R.F., P.H. Wendt, and E.L. Wenner (editors). 1990. A physical and ecological characterization of the Charleston Harbor estuarine system. Marine Resources Division, S.C. Wildl. & Marine Res. Dept. 634 p.

526. Vaughan, D.S., and J.S. Smith. 1988. Stock assessment of the Atlantic menhaden, *Brevoortia tyrannus*, fishery. U.S. Dep. Commer., NOAA Tech. Rep. NMFS 63, 18 p.

527. Vaughn, T.L. 1967. Fecundity of the American shad in the Altamaha River, Georgia. Ga. Game Fish Comm., Mar. Fish. Div., Contrib. Ser. No. 3. 9 p.

528. Veazey, J.E. and S.A. Stevens. 1988. A description of biological and physical parameters affecting the sanitary quality of Georgia's shellfish resources: a sanitary survey. Ga. Dept. Nat. Res., Coast. Res. Div., Contrib. Ser. No. 39.

529. Vetter, E.F. 1983. The ecology of *Penaeus setiferus*: habitat selection, carbon and nitrogen metabolism, and simulation modeling. Ph.D. Dissertation, Univ. Ga., Athens. 151 p .

530. Virnstein, R.W., and R.K. Howard. 1987. Motile epifauna of marine macrophytes in the Indian River Lagoon, Florida. II. Comparisons between drift algae and three species of seagrass. Bull. Mar. Sci. 41(1): 13-26.

531. Voss, G.L., F.M. Bayer, C.R. Robins, M. Gomon, and E.T LaRoe. 1969. A report to the National Park Service, Department of the Interior, on the marine ecology of the Biscayne Bay National Monument. Univ. Miami, Institute of Marine and Atmospheric Sciences, Miami, FL.

532. Walburg, C.H. 1960. Abundance and life history of shad, St. Johns River, Florida. Fish. Bull., U.S. 60: 487-505.

533. Walburg, C.H. and P.R. Nichols. 1967. Biology and management of the American shad and status of the fisheries, Atlantic coast of the United States, 1960. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. No. 550. 105 p.

534. Walker, R.L. 1983a. Population dynamics of the hard clam, *Mercenaria mercenaria* and its relation to the Georgia hard clam fishery. M.S. Thesis, Ga. Inst. Tech., Atlanta, 121 p.

535. Walker, R.L. 1983b. Feasibility of mariculture of the hard clam *Mercenaria mercenaria* in coastal Georgia. J. Shellfish Res. 3: 169-174.

536. Walker, R.L. 1984. Effects of density and sampling time on the growth of the hard clam, *Mercenaria mercenaria*, planted in predator-free cages in coastal Georgia. The Nautilus 98: 114-119.

537. Walker, R.L. 1985. Growth and optimum seeding time for the hard clam, *Mercenaria mercenaria*, in coastal Georgia. The Nautilus 99: 127-133.

538. Walker, R.L. 1987. Hard clam, *Mercenaria mercenaria*, populations of coastal Georgia. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 87-1, 73 p.

539. Walker, R.L. 1988. Hard clam, *Mercenaria mercenaria*, resources of Julieton Plantation. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 88-1, 38 p.

540. Walker, R.L., M.A. Fleetwood, and K.R. Tenore. 1980. The distribution of the hard clam, *Mercenaria mercenaria*, and clam predators in Wassaw Sound, Georgia. Ga. Mar. Sci. Center, Tech. Rep. 80-8. 59 p.

541. Walker, R.L., P.B. Heffernan, and S.A. Stevens. 1989. Hard clam harvesting season in the coastal waters of Georgia. Malacol. Data Net. 2: 105-112.

542. Walker, R.L. and C.M. Humphrey. 1984. Growth and survival of the northern hard clam *Mercenaria mercenaria* from Georgia, Virginia, and Massachusetts in coastal waters of Georgia. J. Shellfish Res. 4: 125-129.

543. Walker, R.L. and M.V. Rawson. 1985. Subtidal hard clam, *Mercenaria mercenaria* resources in coastal Georgia. Ga. Mar. Sci. Center, Tech. Rep. 85-1. 164 p.

544. Walker, R.L. and S.A. Stevens. 1988a. Hard clam, *Mercenaria mercenaria*, resources of Christmas Creek, Little Cumberland, and Cumberland Islands, Georgia. Ga. Dept. Nat. Res., Coast. Res. Div. Contrib. Ser. No. 41.

545. Walker, R.L. and S.A. Stevens. 1988b. Hard clam, *Mercenaria mercenaria*, recruitment into Christmas Creek after harvesting. Ga. Dept. Nat. Res., Coast. Res. Div. Contrib. Ser. No. 43.

546. Walker, R.L. and K.R. Tenore. 1984. the distribution and production of the hard clam, *Mercenaria mercenaria*, in Wassaw Sound, Georgia. Estuaries 7: 19-27.

547. Wargo, J.A. 1978. Fish species diversity in a salt marsh ecosystem. M.S. Thesis, Florida Institute of Technology, Melbourne, FL.

548. Warlen, S.M. 1980. Age and growth of larvae and spawning time of Atlantic croaker in North Carolina. Proc. Annu. Conf. SE Assoc. Fish Wildl. Agencies 34: 204-214.

549. Warlen, S.M., and A.J. Chester. 1985. Age, growth, and distribution of larval spot, *Leiostomus xanthurus*, off North Carolina. Fish. Bull., U.S. 83: 587-599.

550. 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.

551. Weinstein, M.P. 1979. Shallow marsh habitats as primary nurseries for fishes and shellfish, Cape Fear River, North Carolina. Fish. Bull., U.S. 77: 339-357.

552. Weinstein, M.P., and M.P. Walters. 1981. Growth, survival, and production in young-of-year populations of *Leiostomus xanthurus* residing in tidal creeks. Estuaries 4(3): 185-197.

553. Wells, H.W. 1961. The fauna of oyster beds, with special reference to the salinity factor. Ecol. Monogr. 31(3): 239-266.

554. Wells, H.W., and I.E. Gray. 1960. The seasonal occurrence of *Mytilis edulis* on the Carolina coast as a result of transport around Cape Hatteras. Biol. Bull. 119: 550-559.

555. Welsh, W.A., and C.M. Breder Jr. 1923. Contributions to life histories of Sciaenidae of the eastern United States coast. Bull. U.S. Bur. Fish. 39: 141-201.

556. 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 Tech. Rep. NMFS 79, 49 p.

557. Wenner, C.A., J.C. McGovern, R. Martore, H.R. Beatty, and W.A. Roumillat. 1986. Ichthyofauna. *In* M.R. DeVoe and D.S. Baughman (editors), South Carolina Coastal Wetland Impoundments: Ecological Characterization, Management, Status, and Use. Vol. II, Technical Synthesis, p. 415-523. S.C. Sea Grant Consortium. Tech. Rep. #SC-SG-TR-86-2.

558. Wenner, C.A., W.A. Roumillat, J.E. Moran Jr., 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. Mar. Resources Res. Inst., Charleston, SC.

559. Wenner, E.L. 1986. Decapod crustacean community. *In* M.R. DeVoe and D.S. Baughman (editors), South Carolina Coastal Wetland Impoundments: Ecological Characterization, Management, Status, and Use. Vol. II, Technical Synthesis, p. 361 406. S.C. Sea Grant Consortium. Tech. Rep. #SC-SG-TR-86-2.

560. Wenner, E.L. 1988. The utilization of shallow estuarine habitats by post larval and juvenile stages of *Penaeus* spp. Unpub. manuscript. S.C. Wildl. Mar. Resour. Dep., Charleston, S.C.

561. Wenner, E.L., and C.A. Wenner. 1989. Seasonal composition and abundance of decapod and stomatopod crustaceans from coastal habitats, southeastern United States. Fish. Bull., U.S. 87: 155-176.

562. Wenner, E.L., J. Archambault, and J. Boylan. 1990. Recruitment of fishes and decapod crustaceans into nursery areas. *In* Van Dolah, R.F., P.H. Wendt, and E.L. Wenner (editors). A physical and ecological characterization of the Charleston Harbor estuarine system, pp. 289-383. Marine Resources Division, S.C. Wildl. & Marine Res. Dept. 634 p.

563. Wenner, E.L., M.H. Shealy, Jr., P.A. Sandifer. 1982. A profile of the fish and decapod crustacean community in a South Carolina estuarine system prior to flow alteration. U.S. Dep. Commer., NOAA Tech. Rep., NMFS SSRF-757, 17 p.

564. Wenner, E.L., W.P. Coon, III, 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, S.C. Contrib. No. 137 from S.C. Mar. Resour. Cent., Tech. Rep. No. 3., and S.C. Sea Grant Consortium, 61 p.

565. Wenner, E.L., W.P. Coon, III, M.H. Shealy, Jr., and P.A. Sandifer. 1984. A five-year study of seasonal distribution and abundance of fishes and decapod crustaceans in the Cooper River and Charleston Harbor, S.C. prior to diversion. U.S. Dep. Commer., NOAA Tech. Rep., NMFS SSRF-782, 16 p.

566. West, T.L. 1985. Abundance and diversity of benthic macrofauna in sub-tributaries of the Pamlico River estuary. J. Elisha Mitchell Sci. Soc. 101: 142-159.

567. Weymouth, F.W., M.J. Lindner, and W.W. Anderson. 1933. Preliminary report on the life history of the common shrimp, *Penaeus setiferus* Bull. U.S. Bur. Fish. 48: 1-26.

568. Whaley, G., H. Rainey, C. Parker, G.D. Adams, and H. Leggett. 1969. Status of the striped bass (rockfish) in Georgia, and its future potential. A report to the 1969 General Assembly by the Striped Bass Subcommittee of the House of Representatives. 9 p.

568.1. White, C. 1990. Benthic macroinvertebrate survey of the Indian River Lagoon: 1988-1989. Unpublished manuscript. Brevard County Office of Natural Resources Management, Merritt Island, FL.

569. White, D.B. and R.R. Stickney. 1973. A manual of flatfish rearing. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 73-7. 36 p.

570. Whitker, J.D., L. DeLancey, J.E. Jenkins. 1989 (in press). A study of the experimental closure of South Carolina's sounds and bays to commercial trawling. S.C. Mar. Resour. Cent., Tech. Rep. Ser., Charleston, S.C.

571. Wilk, S.J. 1977. Biological and fisheries data on bluefish, *Pomatomus saltatrix* (Linnaeus). NOAA, NEFC Tech. Rep. No. 11. 56 p.

572. Wilk, S.J. 1979. Biological and fisheries data on weakfish, *Cynoscion regalis* (Bloch and Schneider). NOAA, NEFC Tech. Rep. No 21. 49 p.

573. Wilkens, E.P.H., and R.M. Lewis. 1971. Abundance and distribution of young Atlantic menhaden, *Brevoortia tyrannus*, in the White Oak River Estuary, North Carolina. Fish. Bull., U.S. 60: 783-789.

574. Williams, A.B. 1955a. A contribution to the life histories of commercial shrimps (Penaeidae) in North Carolina. Bull. Mar. Sci. Gulf Caribb. 5: 116-146.

575. Williams, A.B. 1955b. A survey of North Carolina shrimp nursery grounds. J. Elisha Mitchell Sci. Soc. 71. 200-207.

576. Williams, A.B. 1959. Spotted and brown shrimp postlarvae (Penaeus) in North Carolina. Bull. Mar. Sci. Gulf Caribb. 9: 281-290.

577. Williams, A.B. 1964. A postlarval shrimp survey in North Carolina. NC Dept. Conserv. and Develop., Div. Commer. Fish., Spec. Sci. Rep. No. 3.

578. Williams, A.B. 1965. Marine decapod crustaceans of the Carolinas. Fish. Bull., U.S.

579. Williams, A.B. 1984. Shrimp, lobsters, and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Institution Press, Washington, D.C.

580. Williams, A.B., and E.E. Deubler Jr. 1968a. Studies of macrozooplanktonic crustaceans and ichthyoplankton of the Pamlico Sound complex. NC Div. Commer. Sport Fish., Spec. Sci. Rep. 13, 103 p.

581. Williams, A.B., and E.E. Deubler Jr. 1968b. A ten year study of macroplankton in North Carolina estuaries: assessment of environmental factors and sampling success among bothid flounders and penaeid shrimps. Chesapeake Sci. 9(1): 27-41.

582. Williams, R.O., and G.E. Bruger. 1972. Investigations on American shad in St. Johns River. Fla. Dept. Nat. Resour. Tech. Ser. No. 66, 49 p.

583. Windom, H.L. 1971. Chemical analysis of biological, water, and sediment samples from the Altamaha and a control estuary. Ga. Mar. Sci. Center, Tech. Rep. Ser. No. 71-1. 20 p.

584. Winslow, S.E., and R.C. Harriss Jr. 1986. An investigation of size, age, and sex of North Carolina striped bass. NC Div. Mar. Fish., Compl. Rep. Proj. AFC-25, 22 p.

585. Winslow, S.E., S.C. Mozley, and R.A. Rulifson. 1985. North Carolina anadromous fisheries management program. NC Div. Mar. Fish., Compl. Rep. Proj. AFCS-22, 207 p.

586. Winslow, S.E., and N.S. Sanderlin. 1983. Albemarle Sound shad and river herring assessment. *In* North Carolina Anadromous Fisheries Management Program, p. 51-151. NC Div. Mar. Fish., Comp. Rep. Proj. AFCS-16.

587. Wolfe, D.A. 1967. Seasonal variation of Cesium-137 from fallout in a clam, *Rangia cuneata*. Nature 215: 1270-1271.

588. Wolfe, D.A., and E.N. Petteway. 1968. Growth of *Rangia cuneata*. Chesapeake Sci. 9: 99-102.

589. Wolff, M. 1978. Preliminary stock assessment, North Carolina: Flounder (*Paralichthys* sp.). NC Div.

Mar. Fish., Compl. Rep. Proj. 2-294-R, 19 p.

590. Wollam, M.B. 1970. Description and distribution of larvae and early juveniles of king mackerel, *Scomberomorus cavalla* (Cuvier), and Spanish mackerel, *Scomberomorus maculatus* (Mitchill); (Pisces: Scombridae); in the western north Atlantic. Fla. Dept. Nat. Resour. Tech. Ser. No. 61, 35 p.

591. 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. Ga. Dept. Nat. Res., Coast. Res. Div., Contrib. Ser. No. 44. 37 p.

592. Yokel, B.J. 1966. A contribution to the biology and distribution of the red drum, *Sciaenops ocellata*. M.S. Thesis, Univ. Miami, Coral Gables, FL, 160 p.

593. Zingmark, R.G. (editor). 1978. An annotated checklist of the biota of the coastal zone of South Carolina. Univ. South Carolina Press, Columbia, S.C.