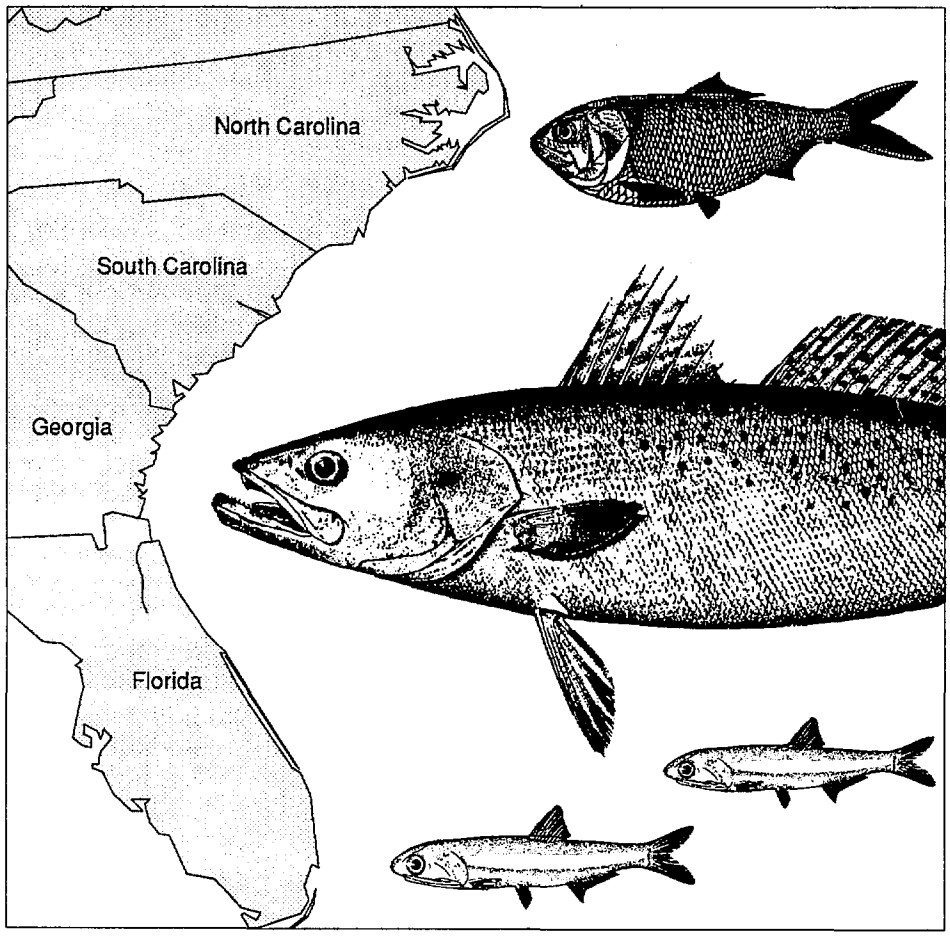
NOAA's Estuarine Living Marine Resources Program

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

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

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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

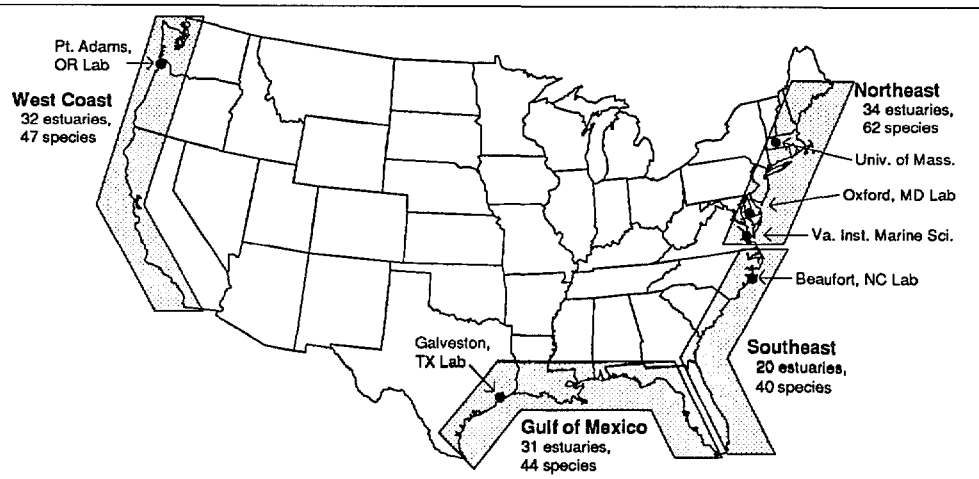


Figure 1. ELMR study regions and regional research labs.

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.

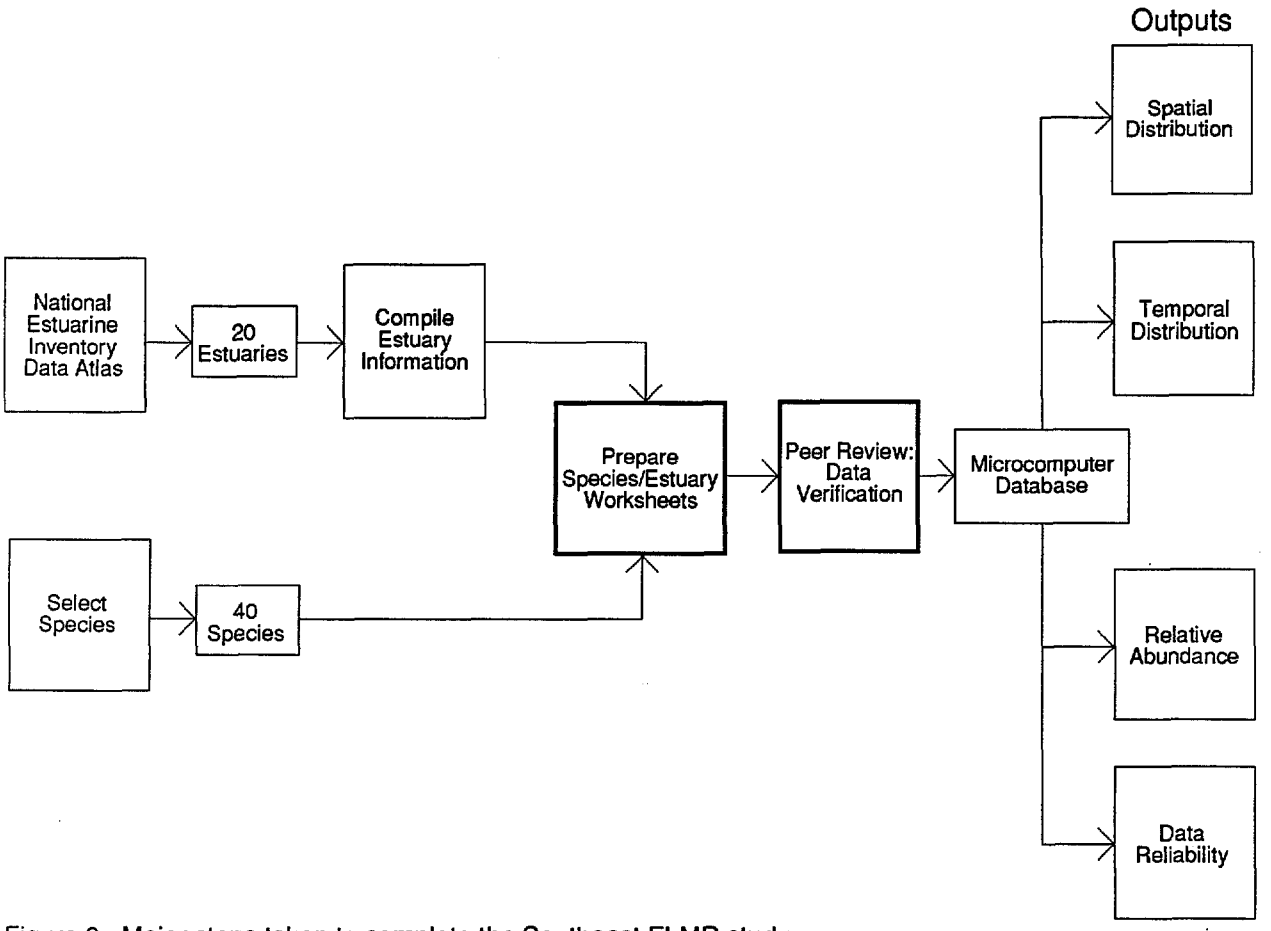


Figure 2. Major steps taken to complete the Southeast ELMR study.

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*.

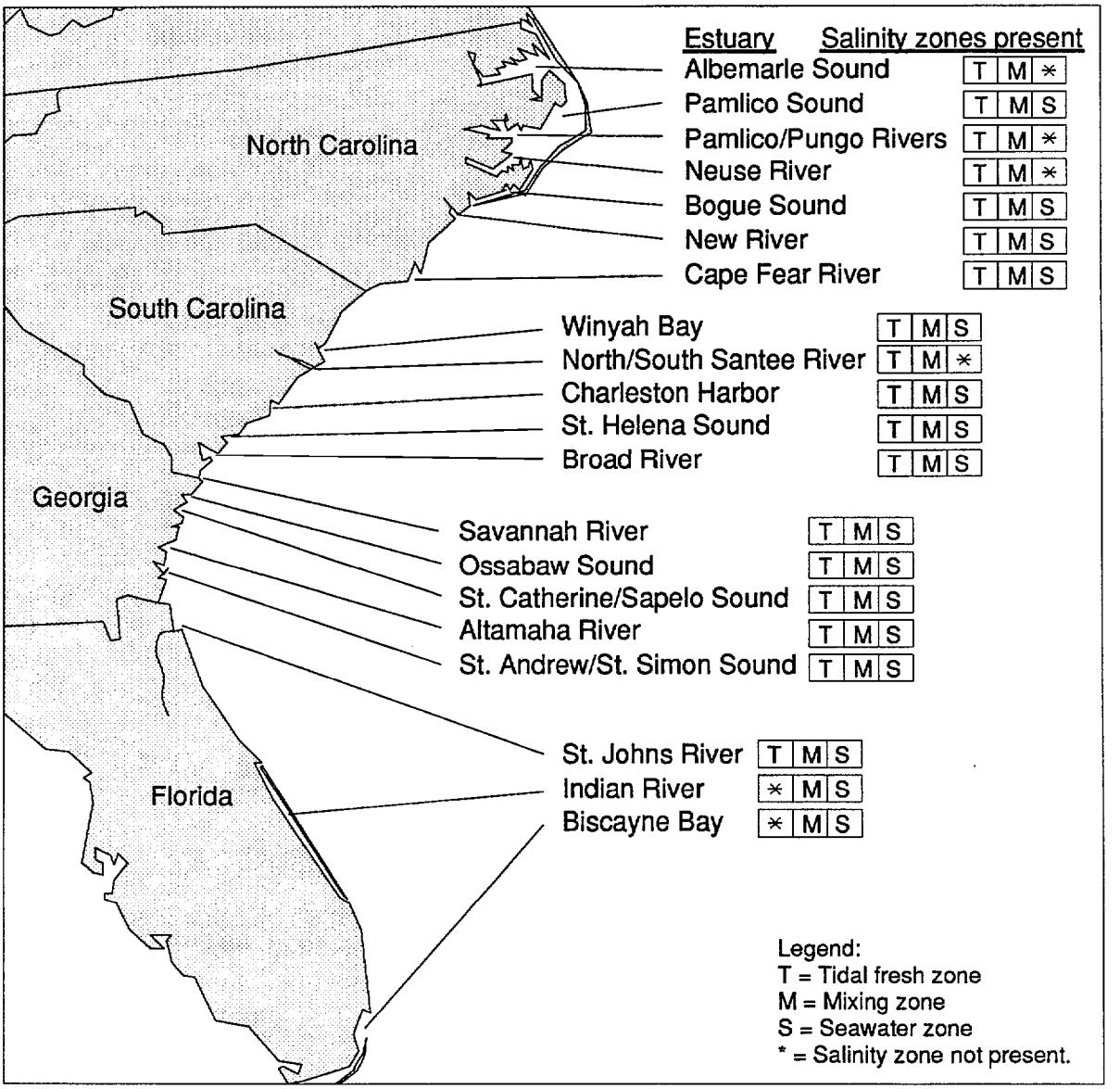


Figure 3. ELMR Southeast estuaries and associated salinity zones.

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.

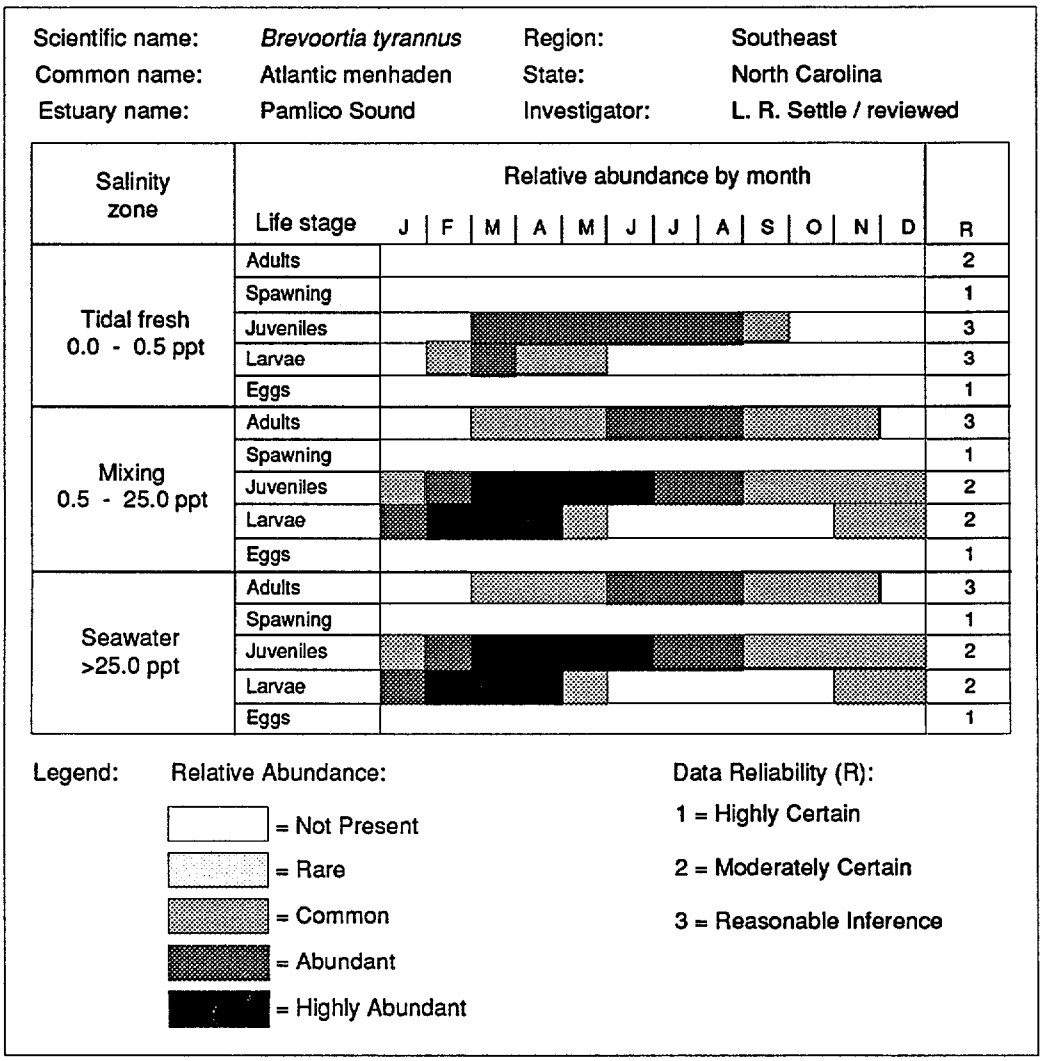


Figure 4. Example of a species/estuary data sheet: Atlantic menhaden in Pamlico Sound.

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.

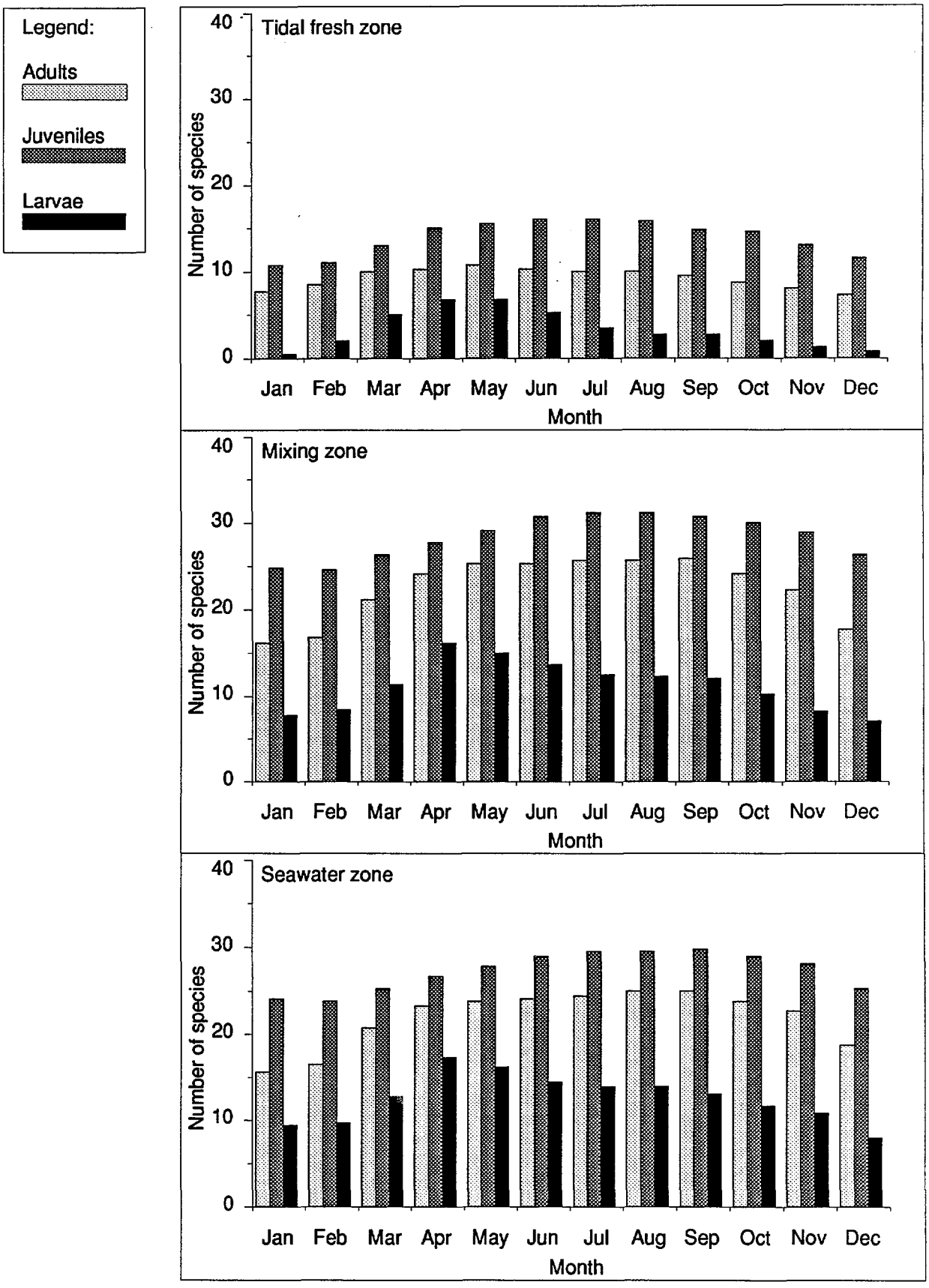
Moderately certain: Some sampling data available for an estuary. Distribution, preferred habitat, and behavior well documented in similar estuaries.

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.

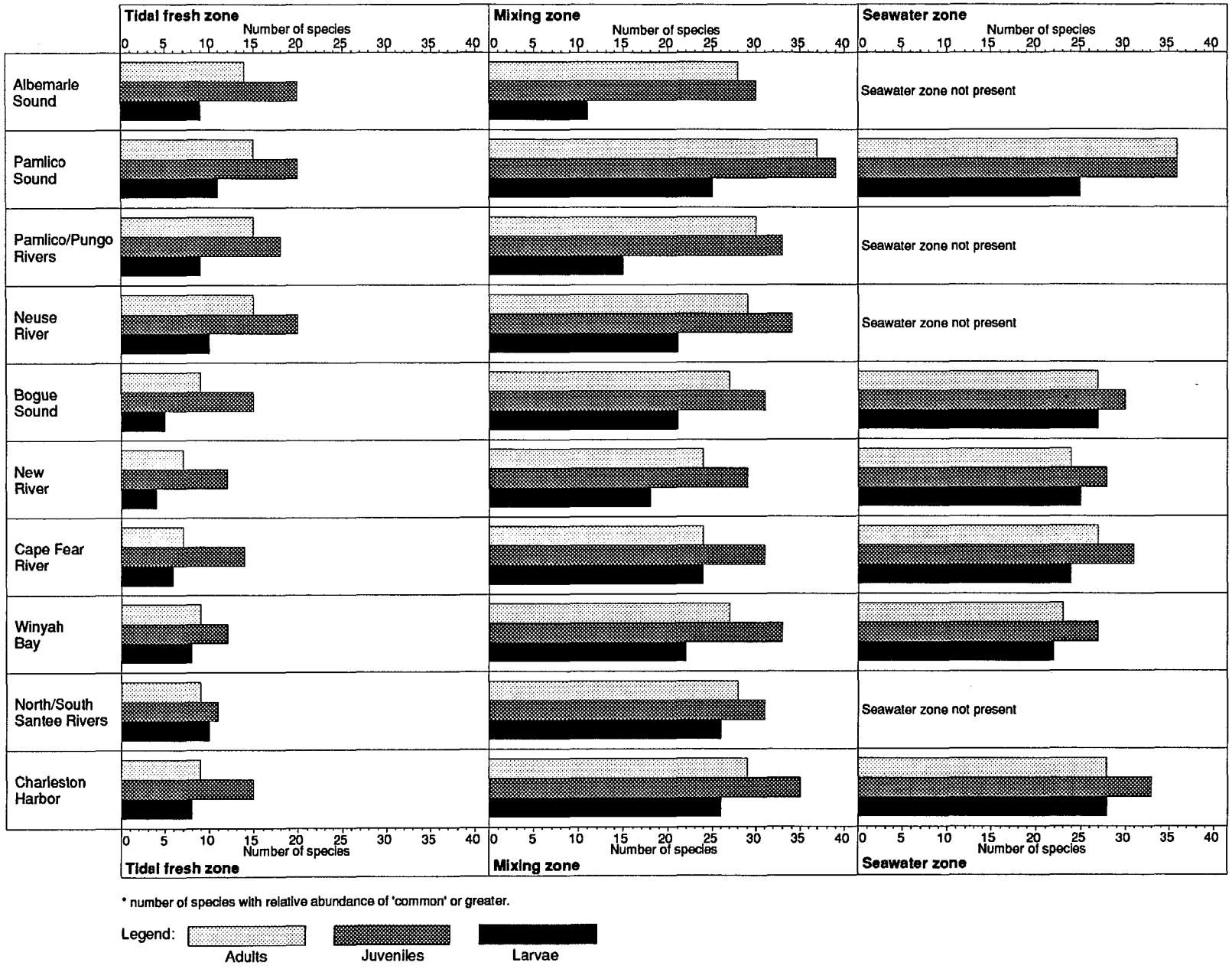
Data reliability was also based on experimental design and whether the studies were relatively recent. In the case of limited studies, information was occasionally inferred. An opportunity exists to refine the data presented based on additional reviews.

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



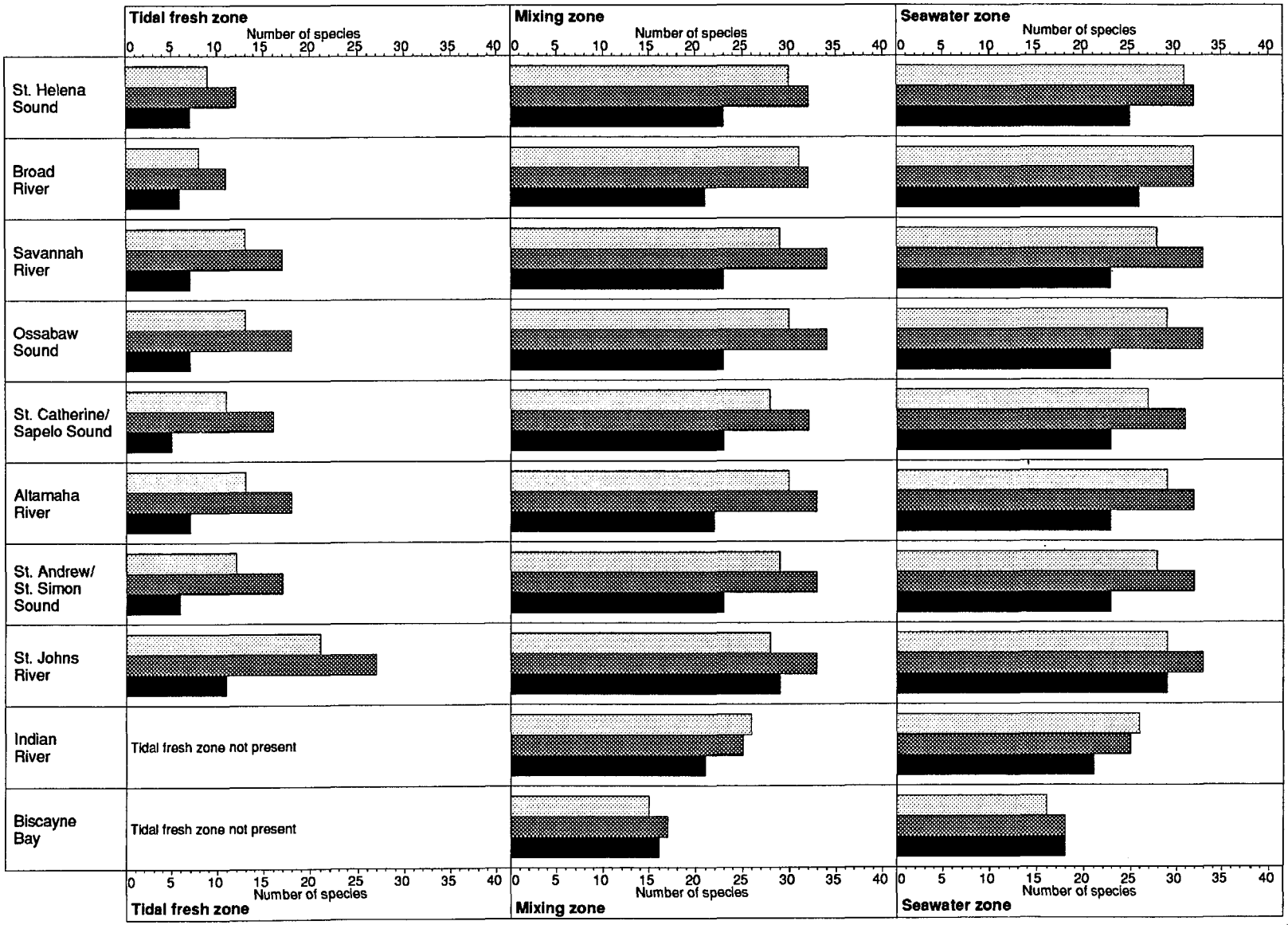
* number of species with relative abundance of 'common' or greater, averaged across estuaries.

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.

Legend: Adults, Juveniles, Larvae

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

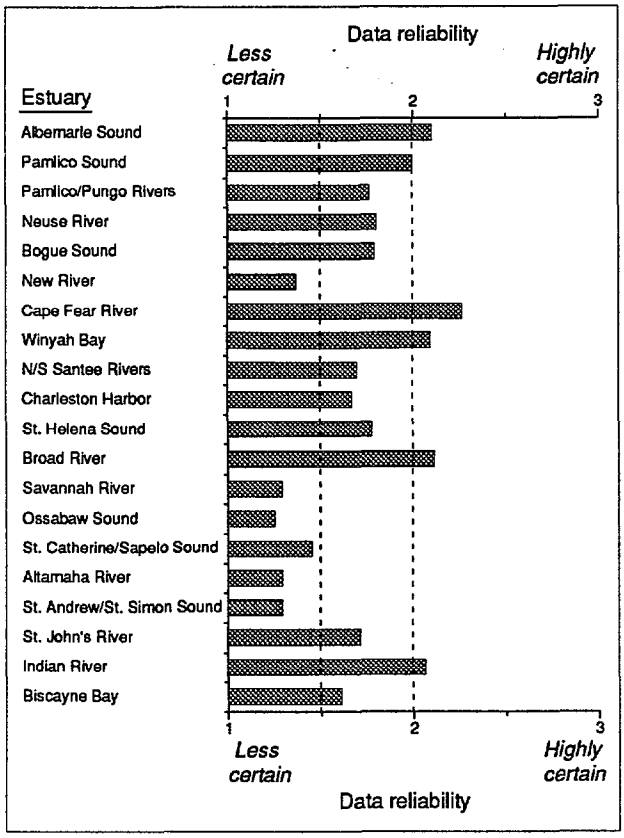


Figure 7. Mean data reliability by estuary.

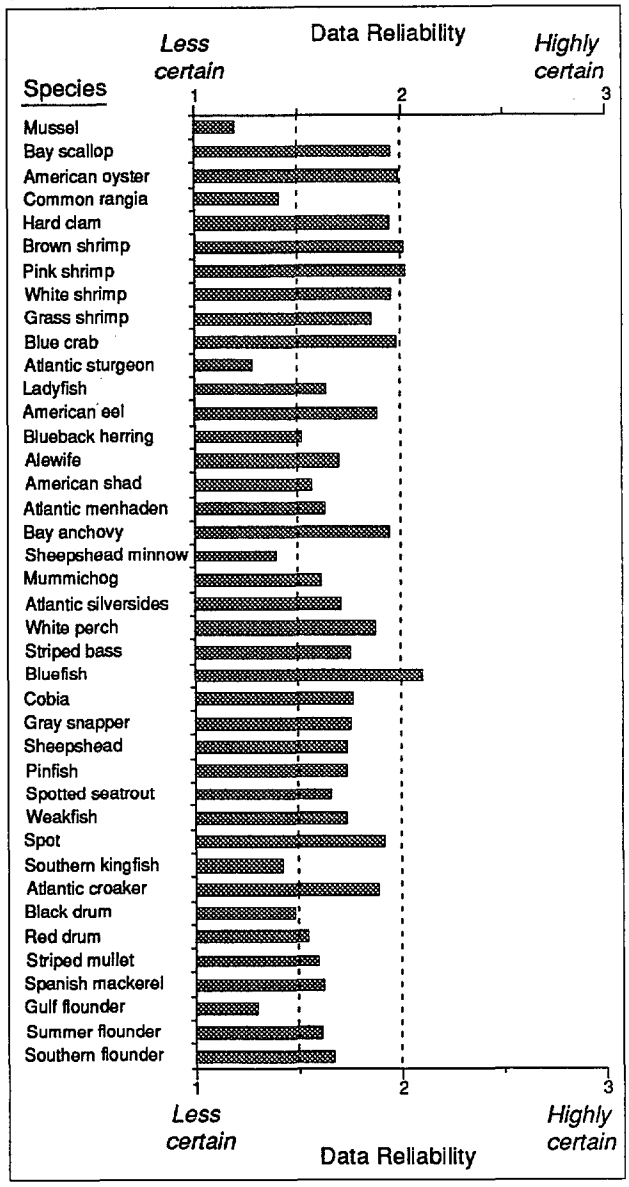


Figure 8. Mean data reliability by species.

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.

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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

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

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

- T - Tidal Fresh
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Life Stage

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

Table 2, continued. Spatial distribution and relative abundance

Species/Life Stage		Southeast Estuaries																					
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		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
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- S - Seawater
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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

Species/Life Stage		Southeast Estuaries																					
		Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bogue Sound			New River			Cape Fear River		
		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

Species/Life Stage		Albemarle Sound T	Albemarle Sound M	Albemarle Sound *	Pamlico Sound T	Pamlico Sound M	Pamlico Sound S	Pamlico/ Pungo Rivers T	Pamlico/ Pungo Rivers M	Pamlico/ Pungo Rivers *	Neuse River T	Neuse River M	Neuse River *	Bogue Sound T	Bogue Sound M	Bogue Sound S	New River T	New River M	New River S	Cape Fear River T	Cape Fear River M	Cape Fear River S
Cobia	A					○	○								○	○		○	○		√	○
	S						na															
Rachycentron canadum	J					○	○								○	○		○	○		○	○
	L					na	na									○			○			
	E					na	na															
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		na			◉	◉		○			○			√	○			√		○	◉
	E		na			◉	◉		○			○				○			√			◉

T M * T M S T M * T M * T M S 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

Species/Life Stage		Winyah Bay T	Winyah Bay M	Winyah Bay S	N & S Santee Rivers T	N & S Santee Rivers M	N & S Santee Rivers *	Charleston Harbor T	Charleston Harbor M	Charleston Harbor S	St. Helena Sound T	St. Helena Sound M	St. Helena Sound S	Broad River T	Broad River M	Broad River S	Savannah River T	Savannah River M	Savannah River S	Ossabaw Sound T	Ossabaw Sound M	Ossabaw Sound 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	*	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

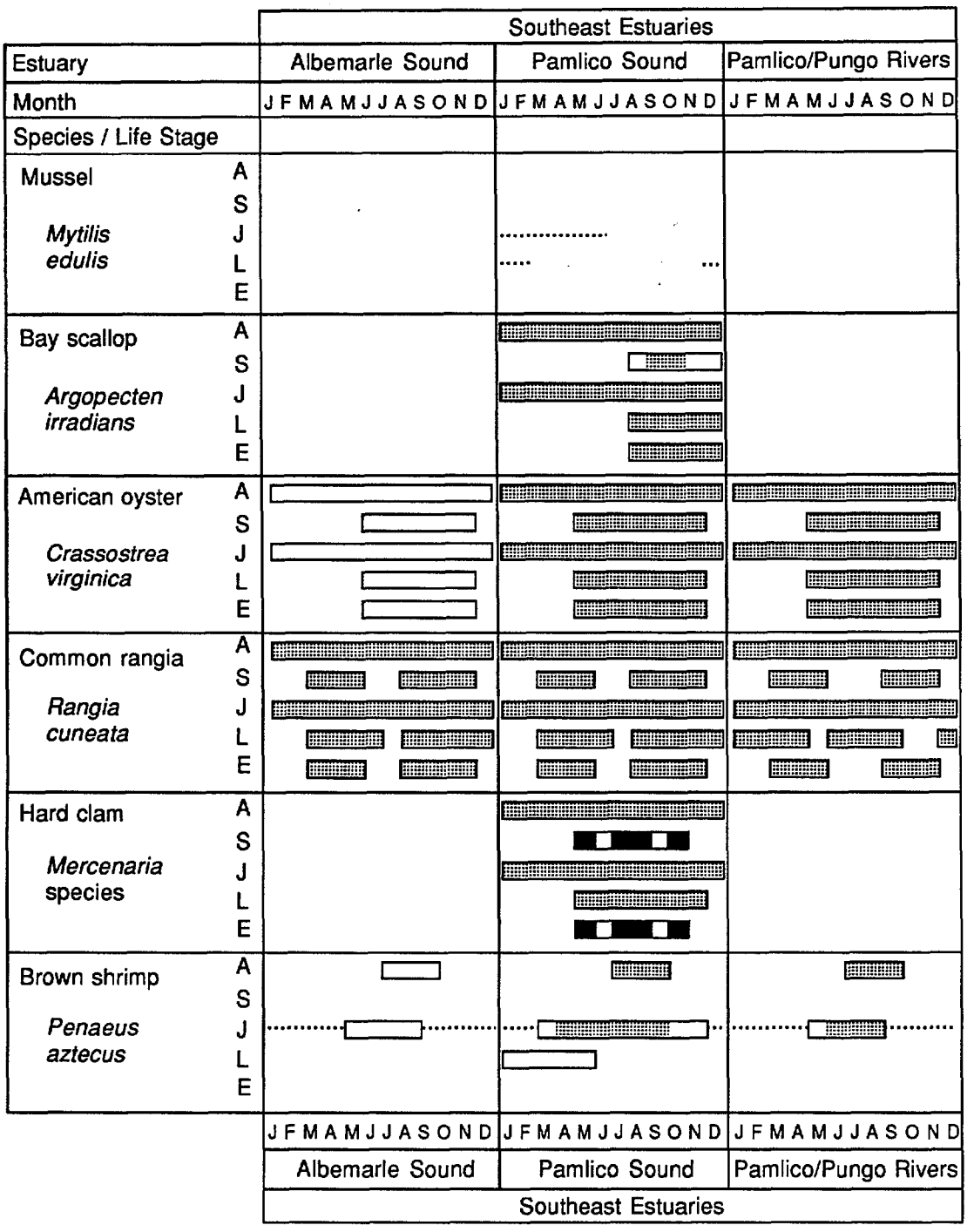
- A - Adults
- S - Spawning adults
- J - Juveniles
- L - Larvae
- E - Eggs

Table 3. Temporal distribution

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

Common and Scientific Name	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. Catha./Sapelo Sound	Altamaha River	St. Andr./St. Sim. Sound	St. Johns River	Indian River	Biscayne Bay
	Estuary																			
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		

Table 3. Temporal distribution



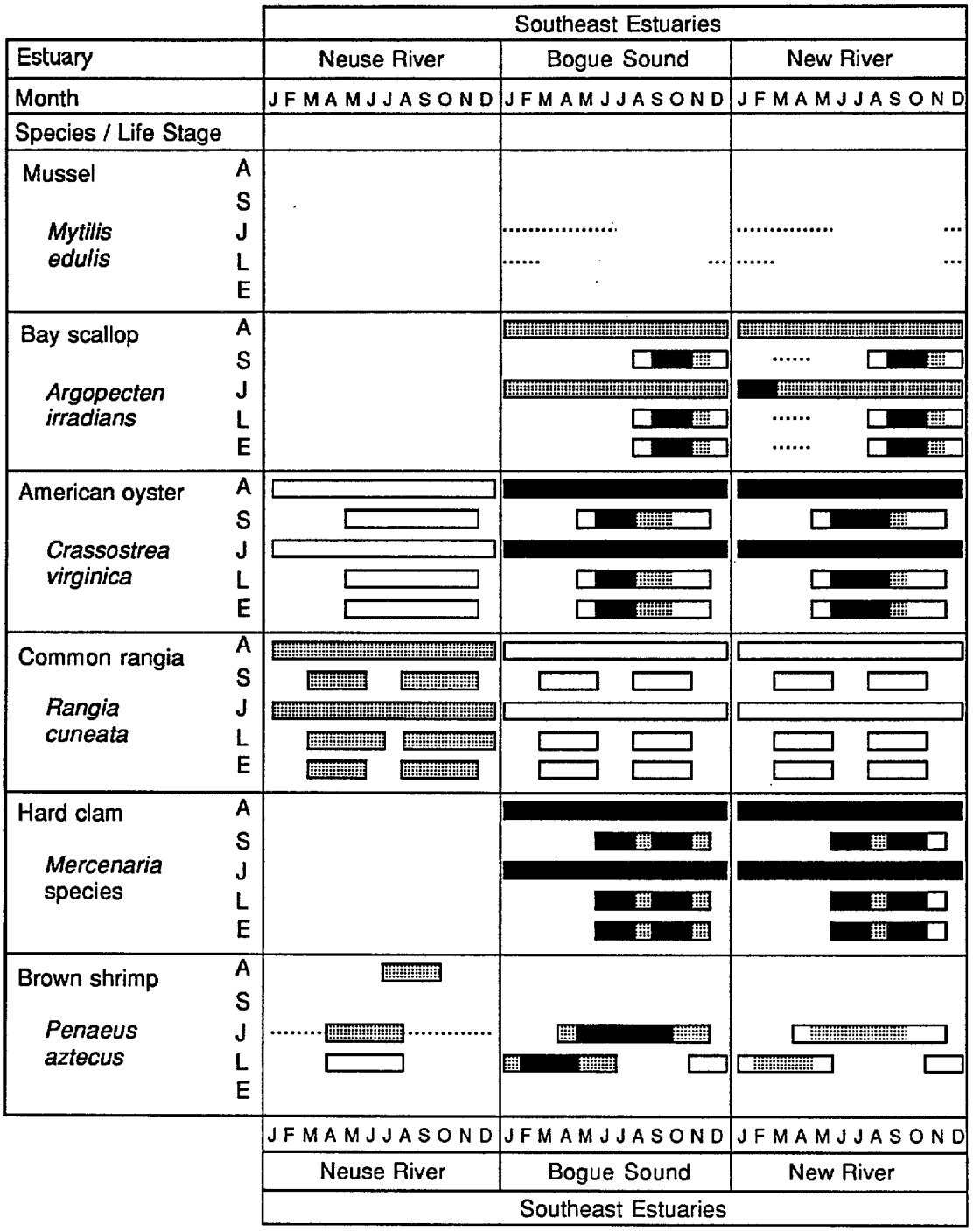
Relative Abundance

- 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



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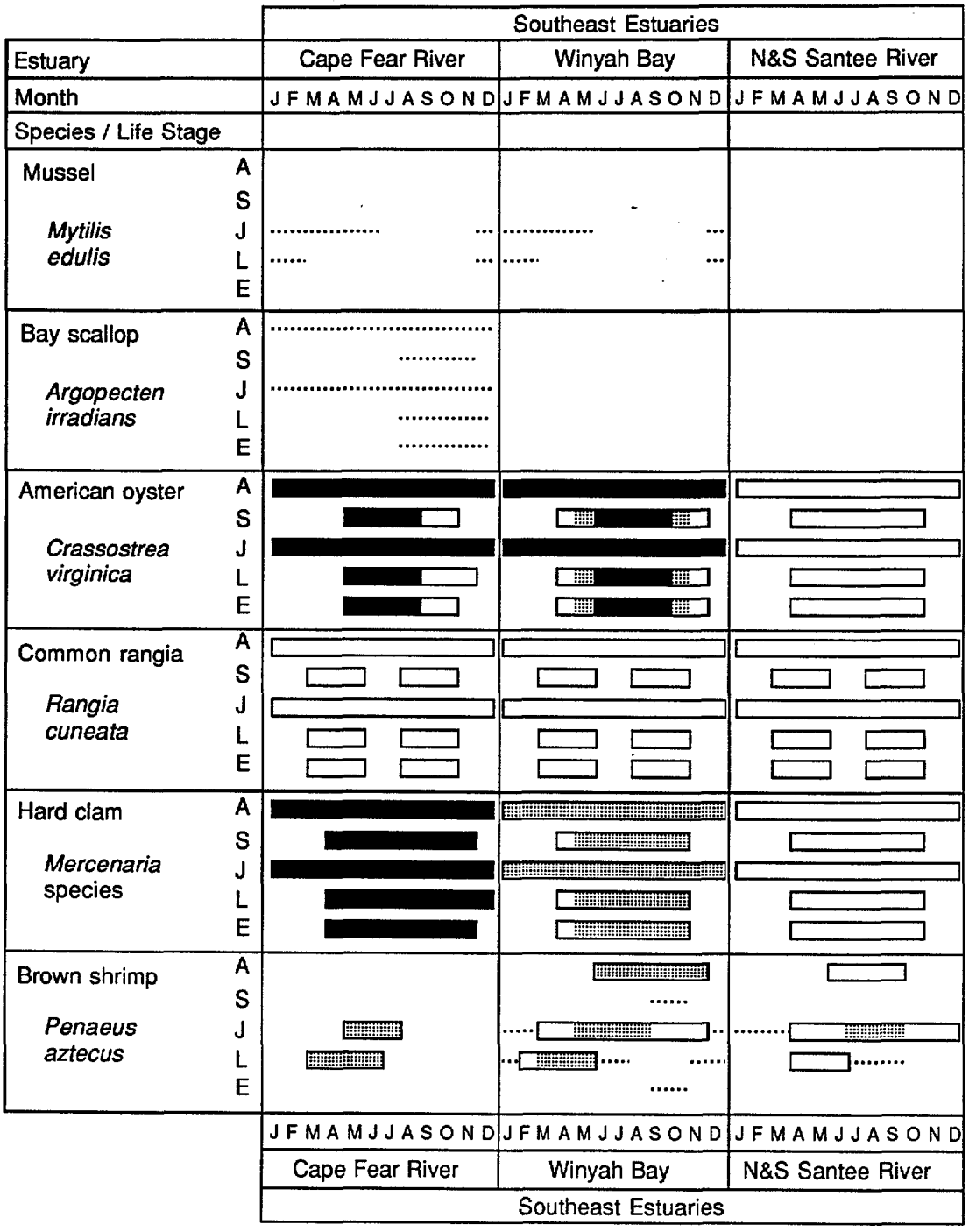

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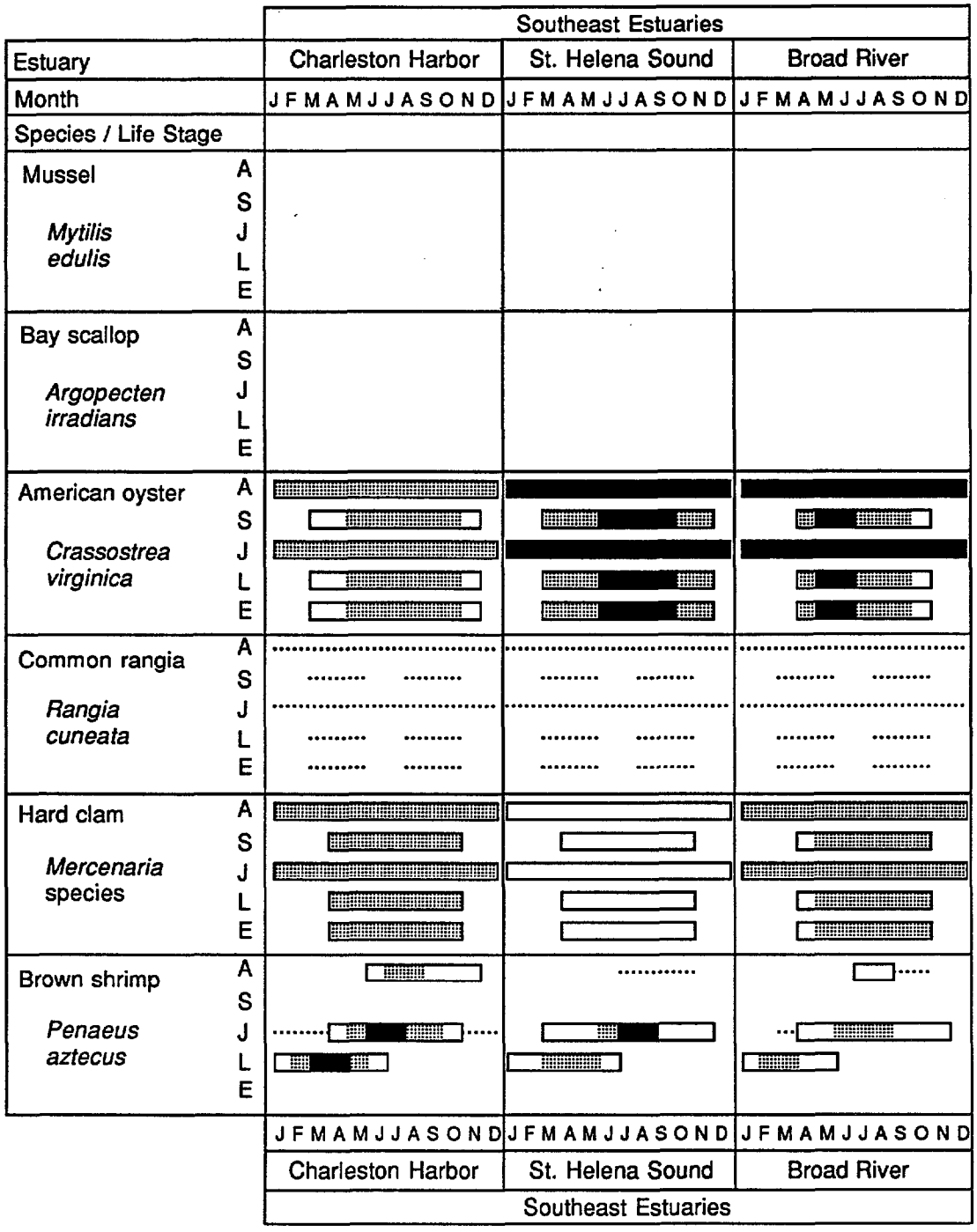

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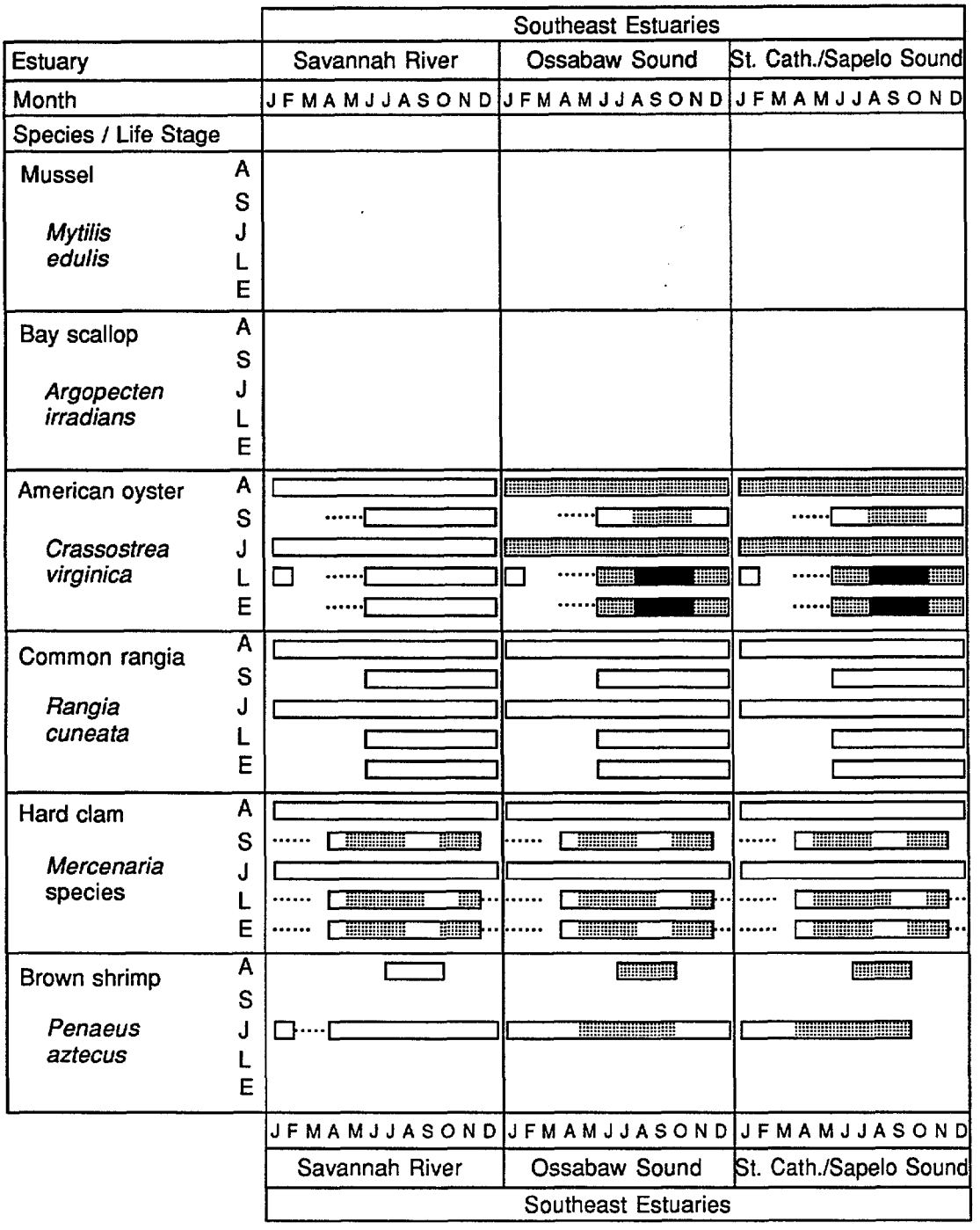

Relative Abundance

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Life Stage

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Table 3, continued. Temporal distribution

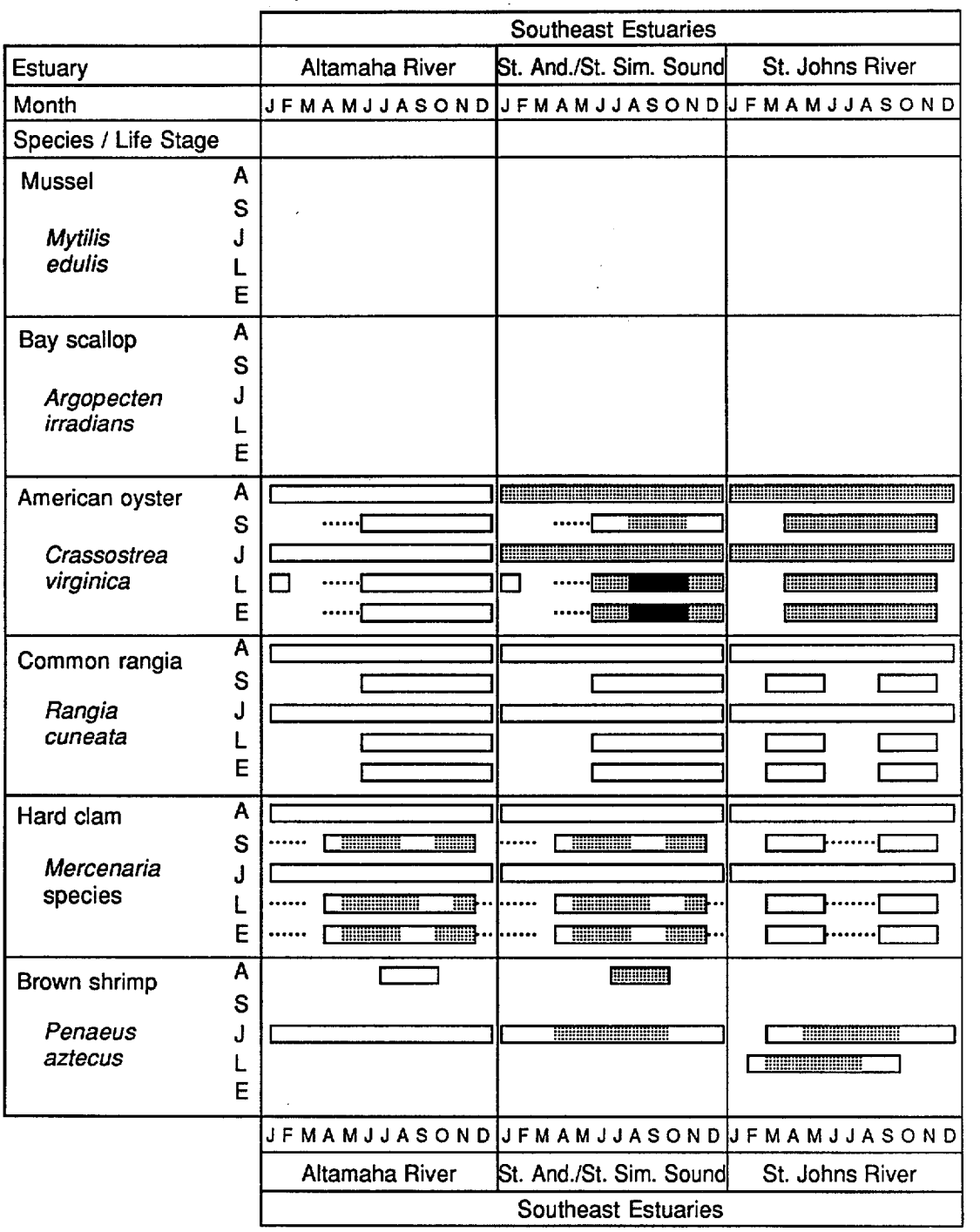

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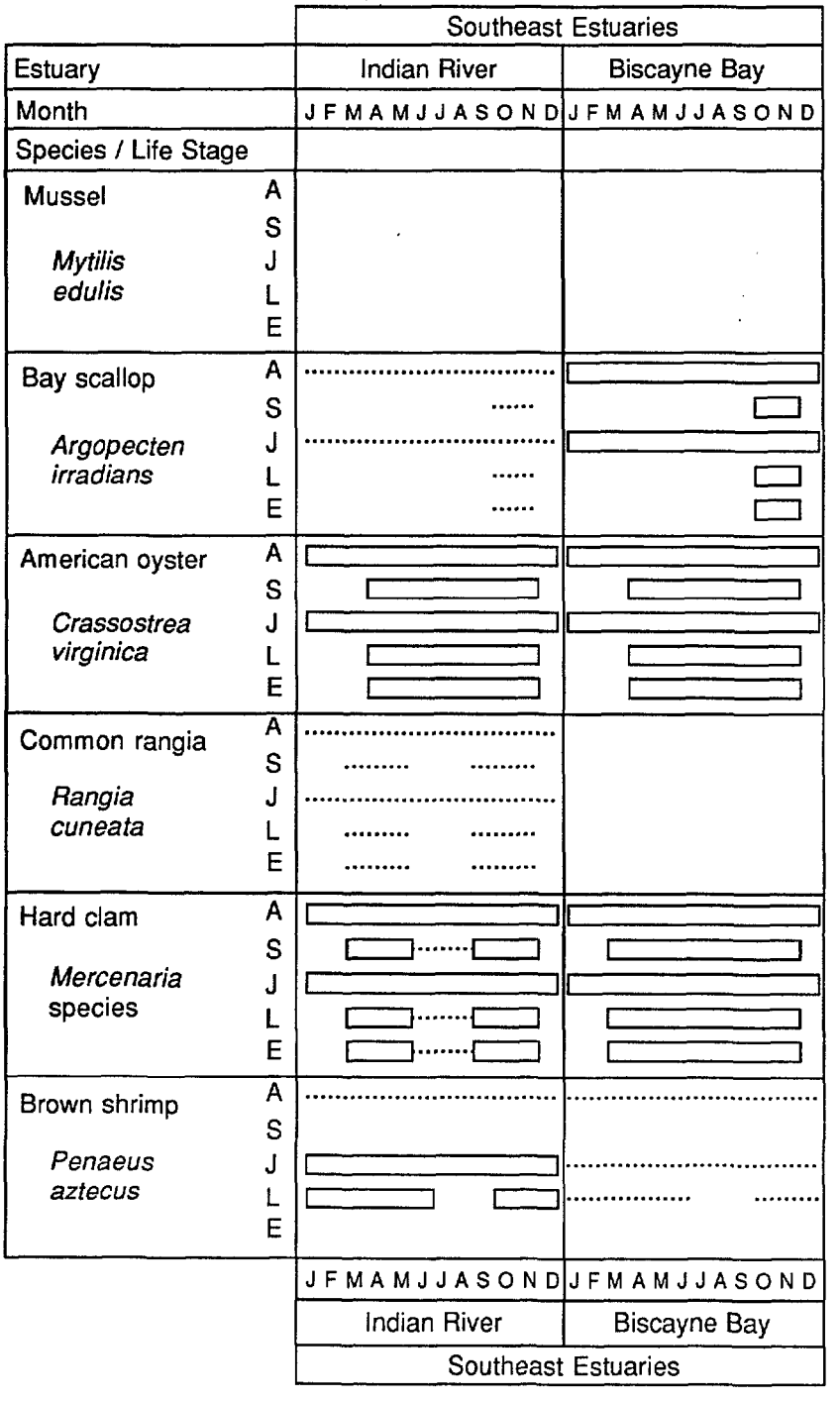
Table 3, continued. Temporal distribution



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Life Stage

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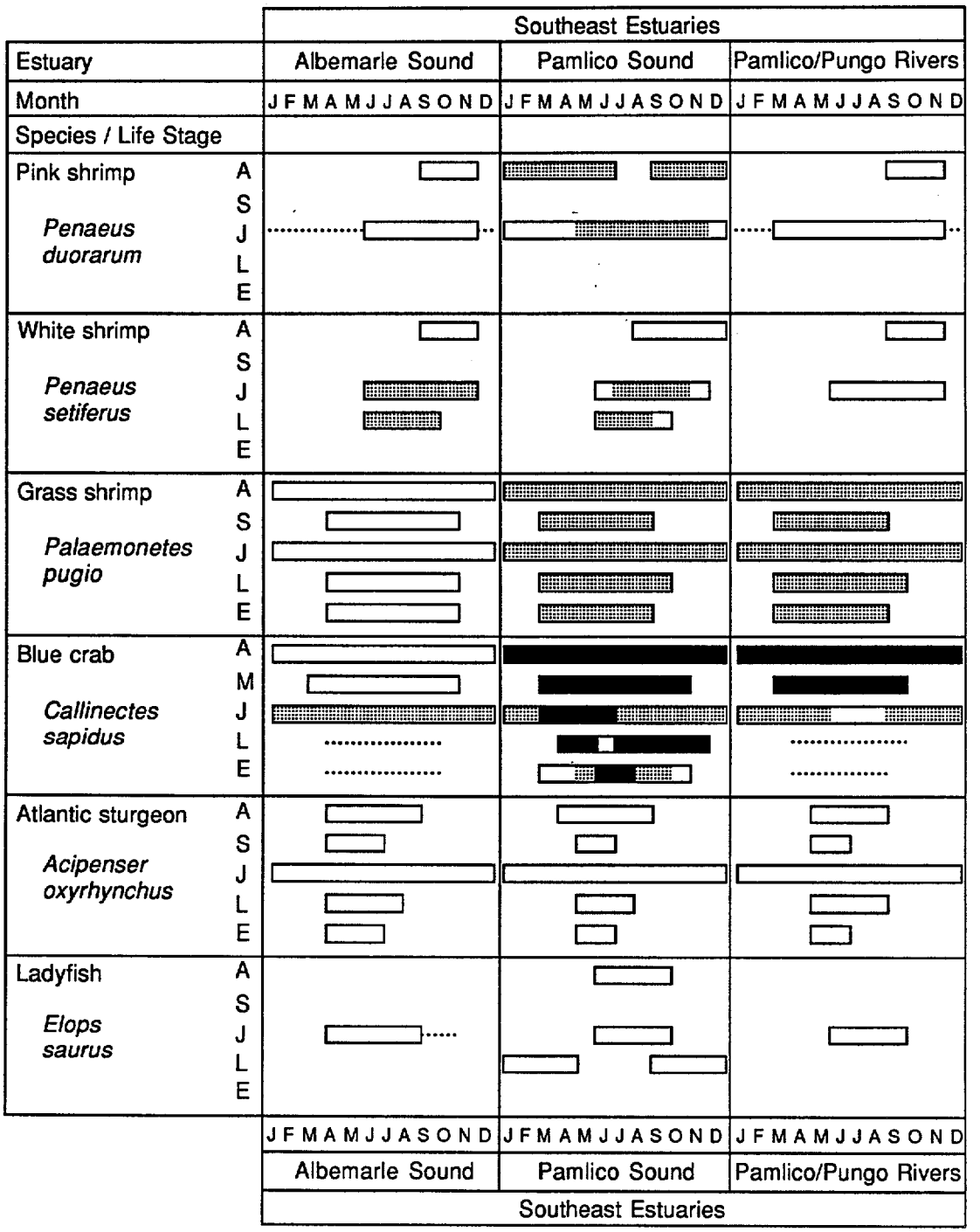

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Life Stage

A - Adults
S - Spawning adults
J - Juveniles
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M - Mating

Table 3, continued. Temporal distribution

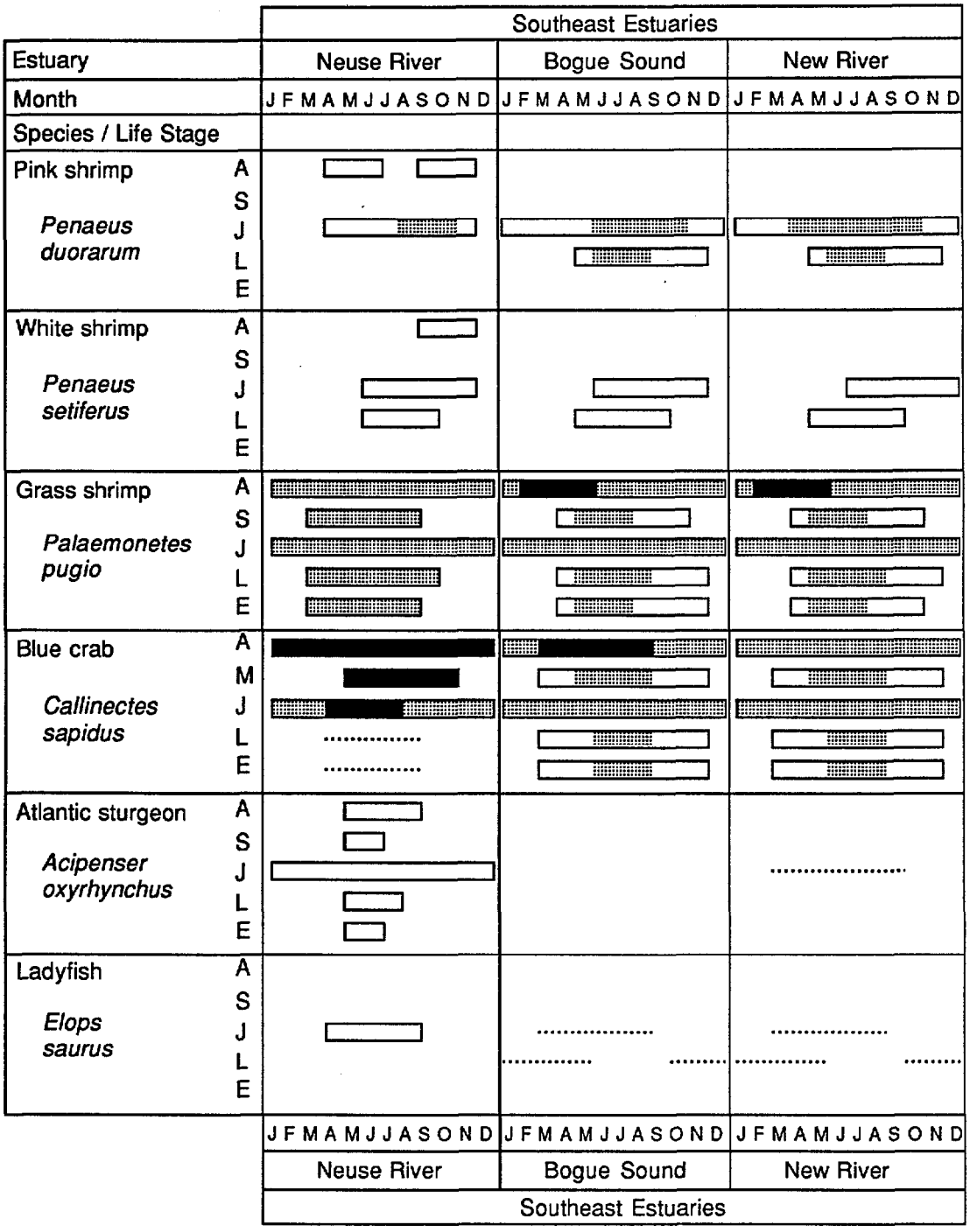

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Table 3, continued. Temporal distribution

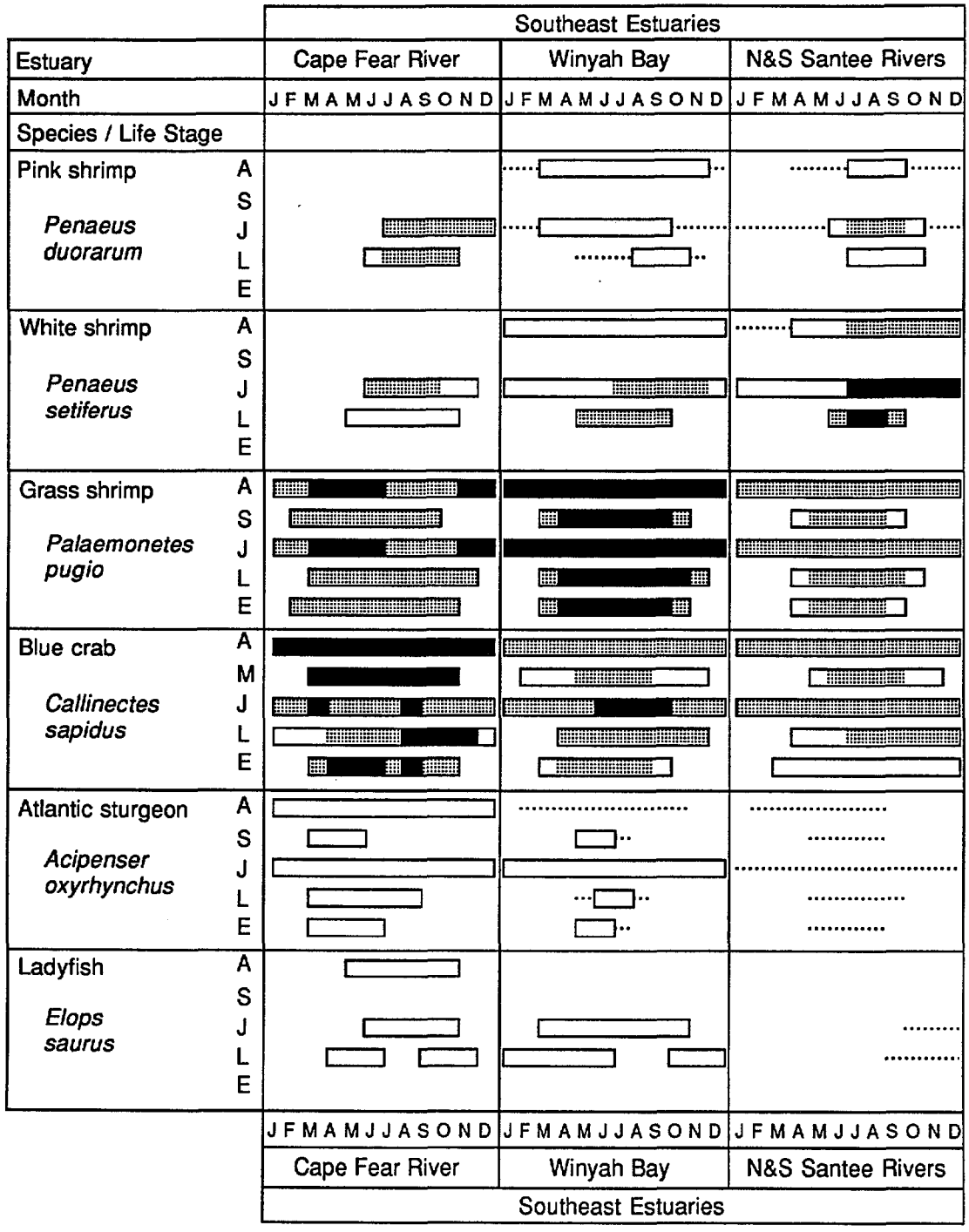

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Table 3, continued. Temporal distribution

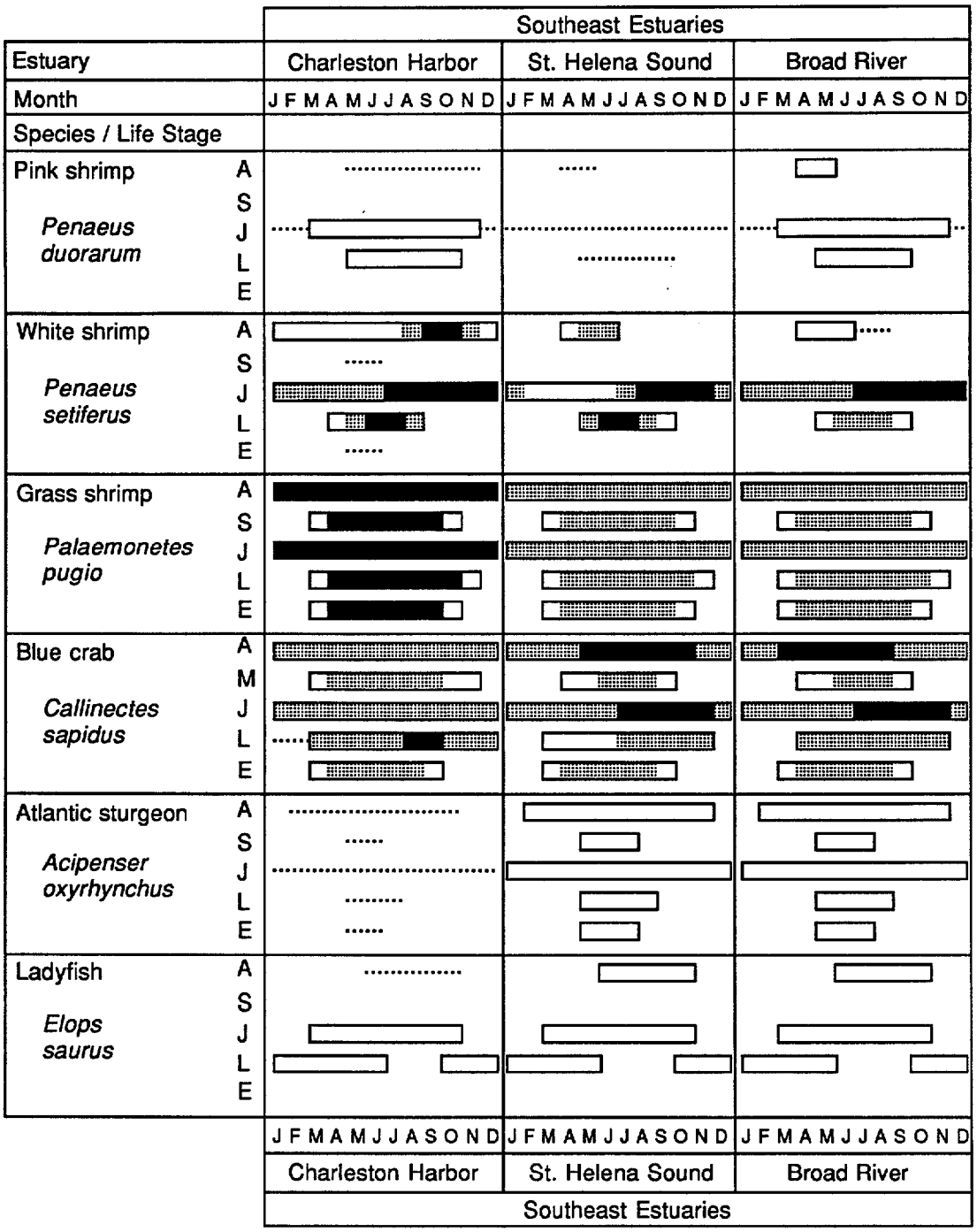

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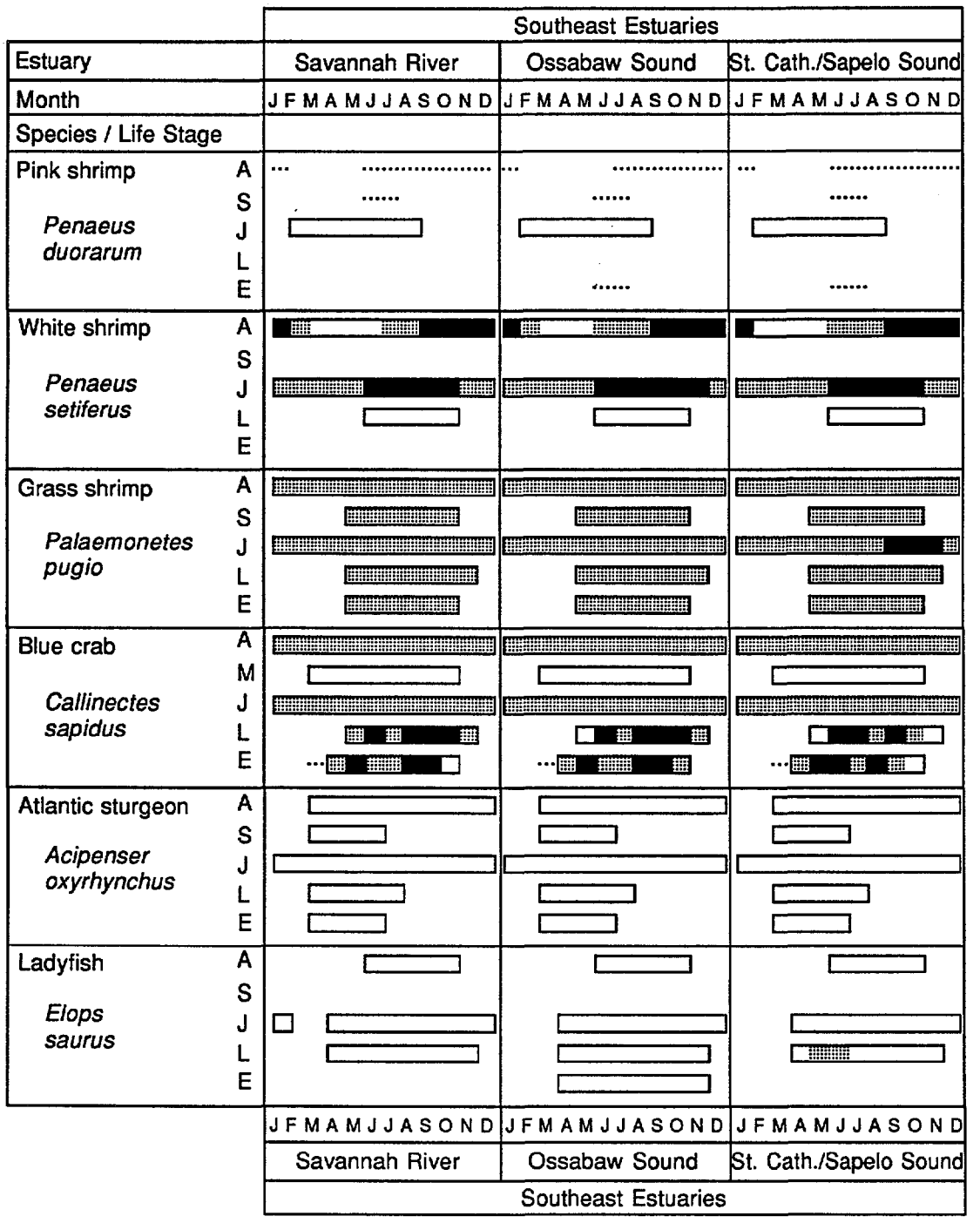
Table 3, continued: Temporal distribution



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Life Stage

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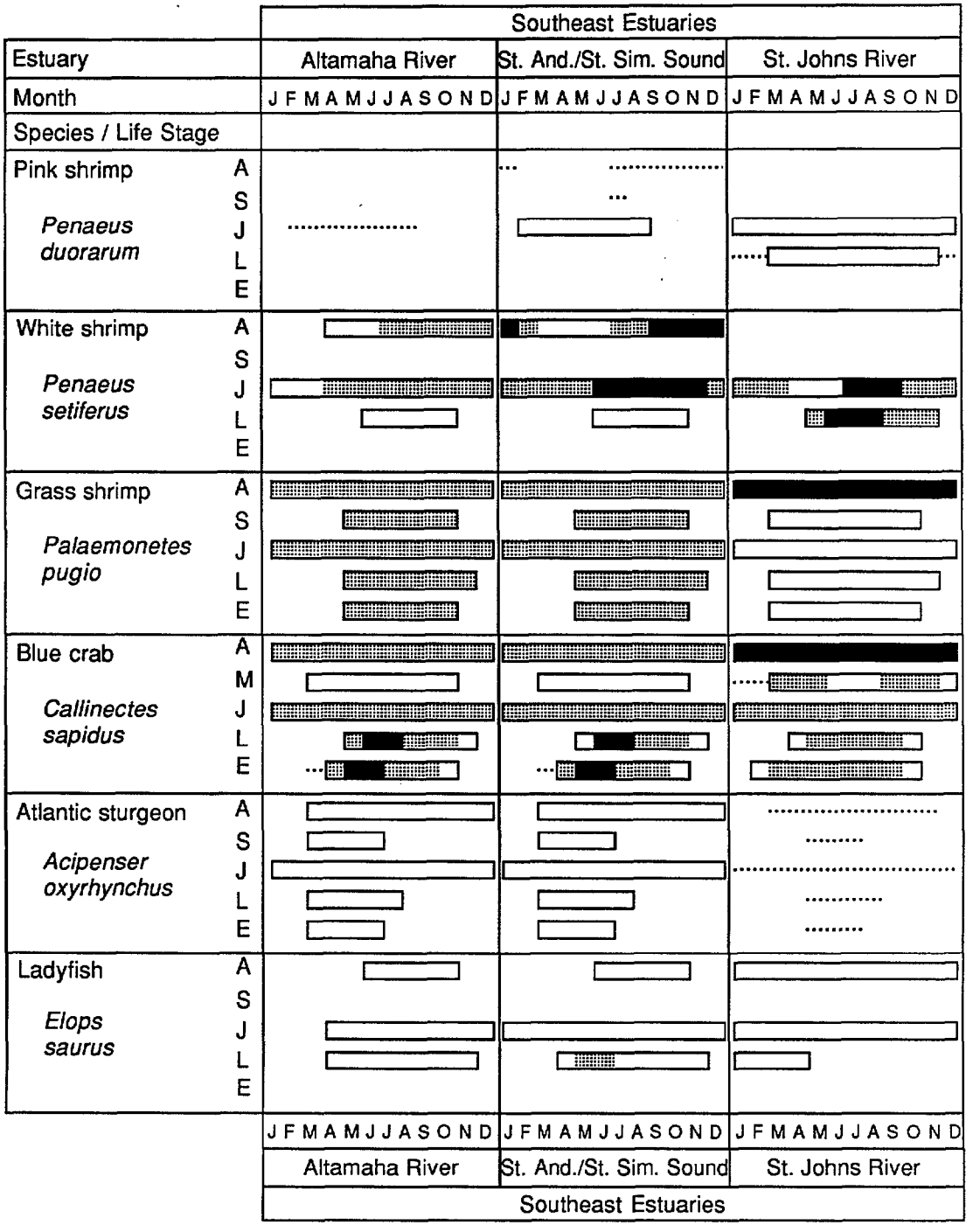
Table 3, continued. Temporal distribution



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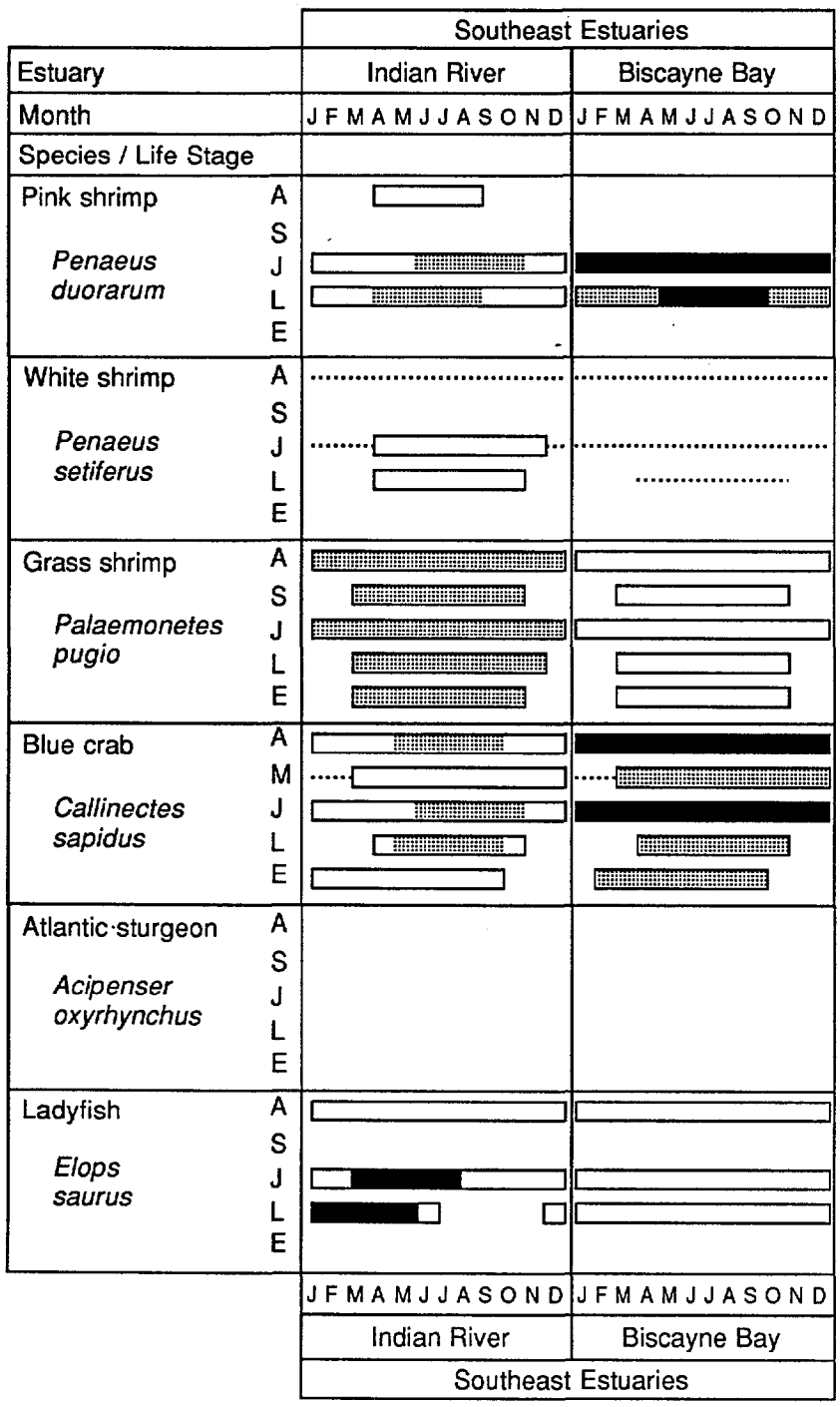

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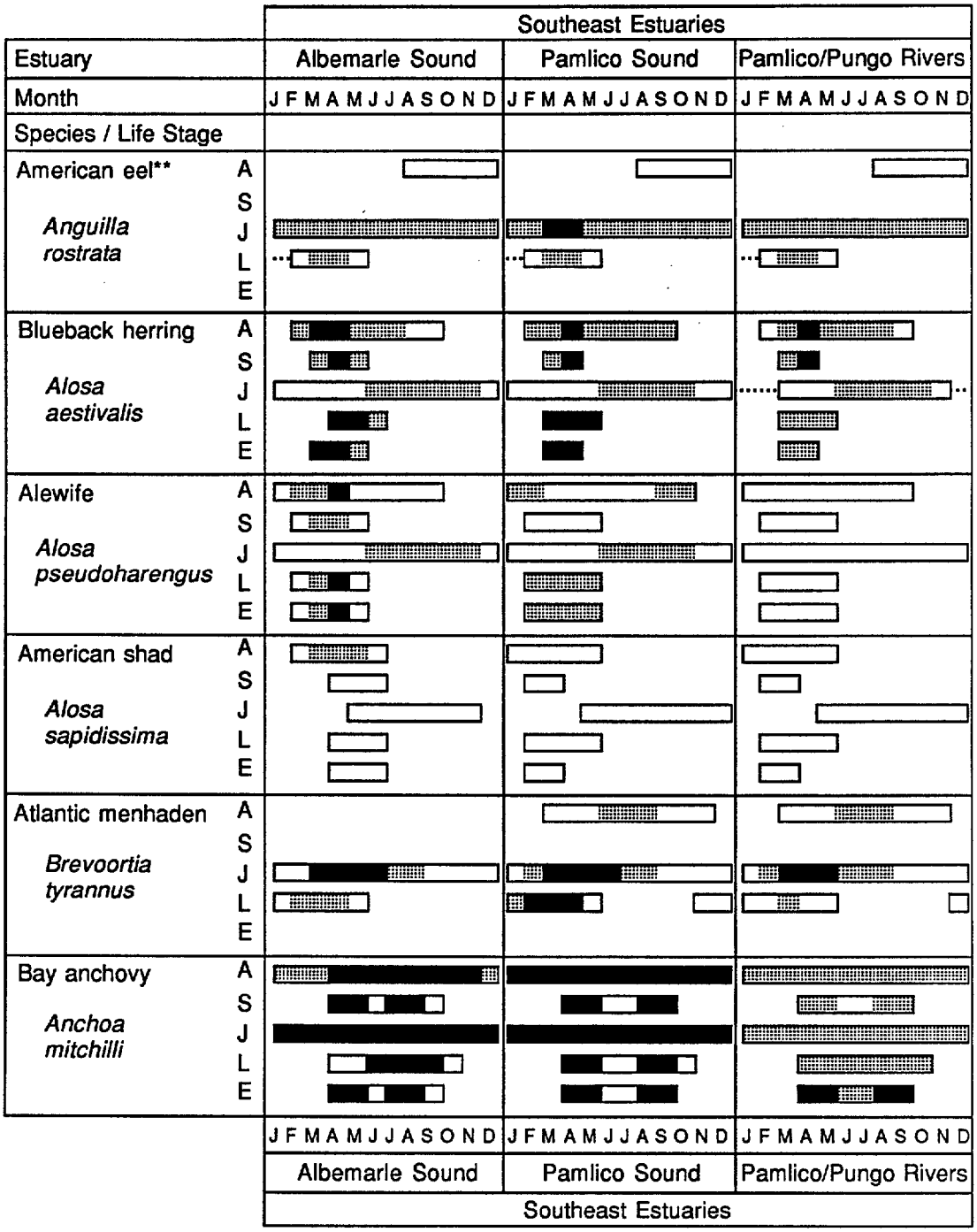
Table 3, continued. Temporal distribution



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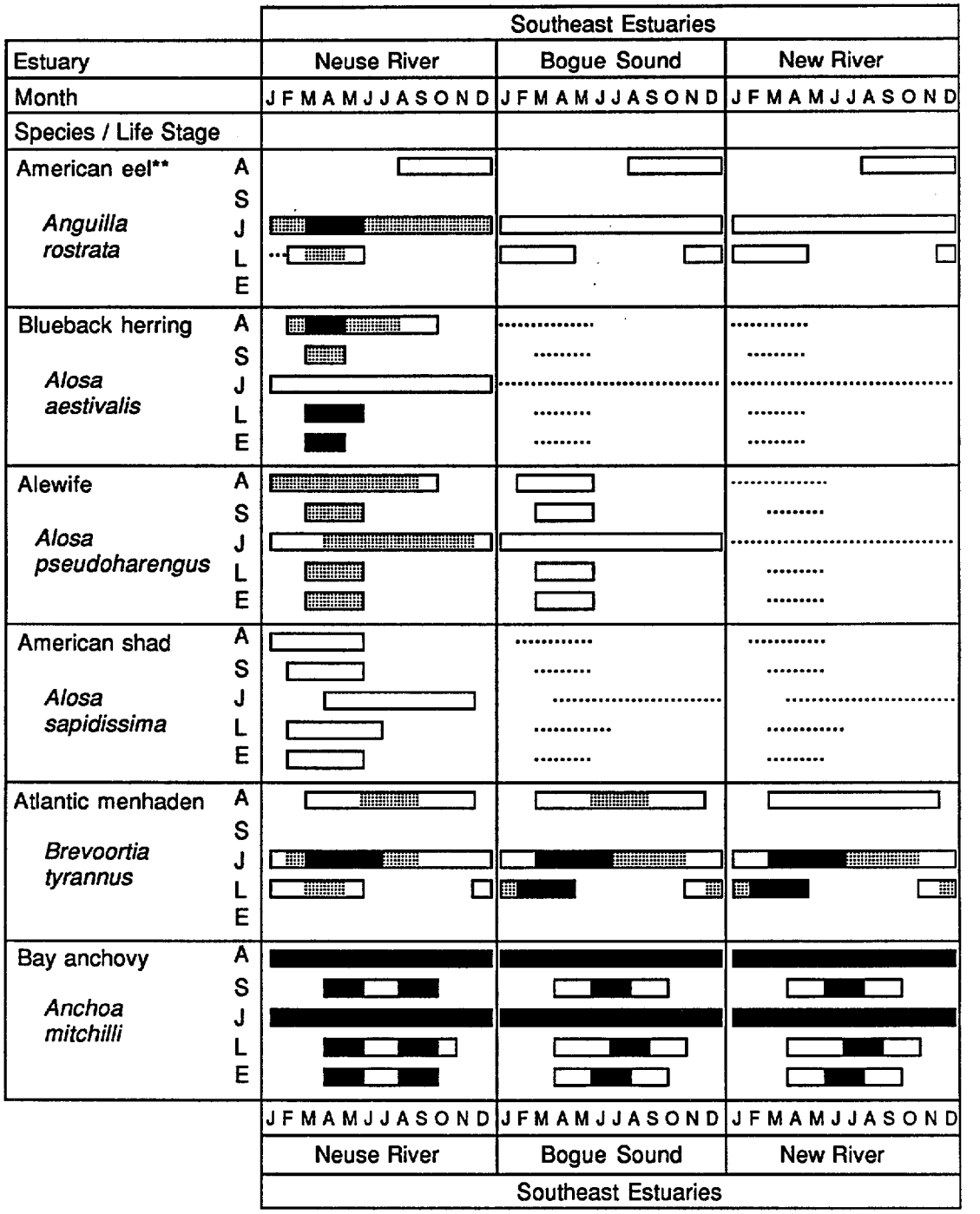
** See *Life History Notes*, p. 12.

Table 3, continued: Temporal distribution



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Life Stage

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S - Spawning adults
J - Juveniles
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E - Eggs

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

Table 3, continued. Temporal distribution

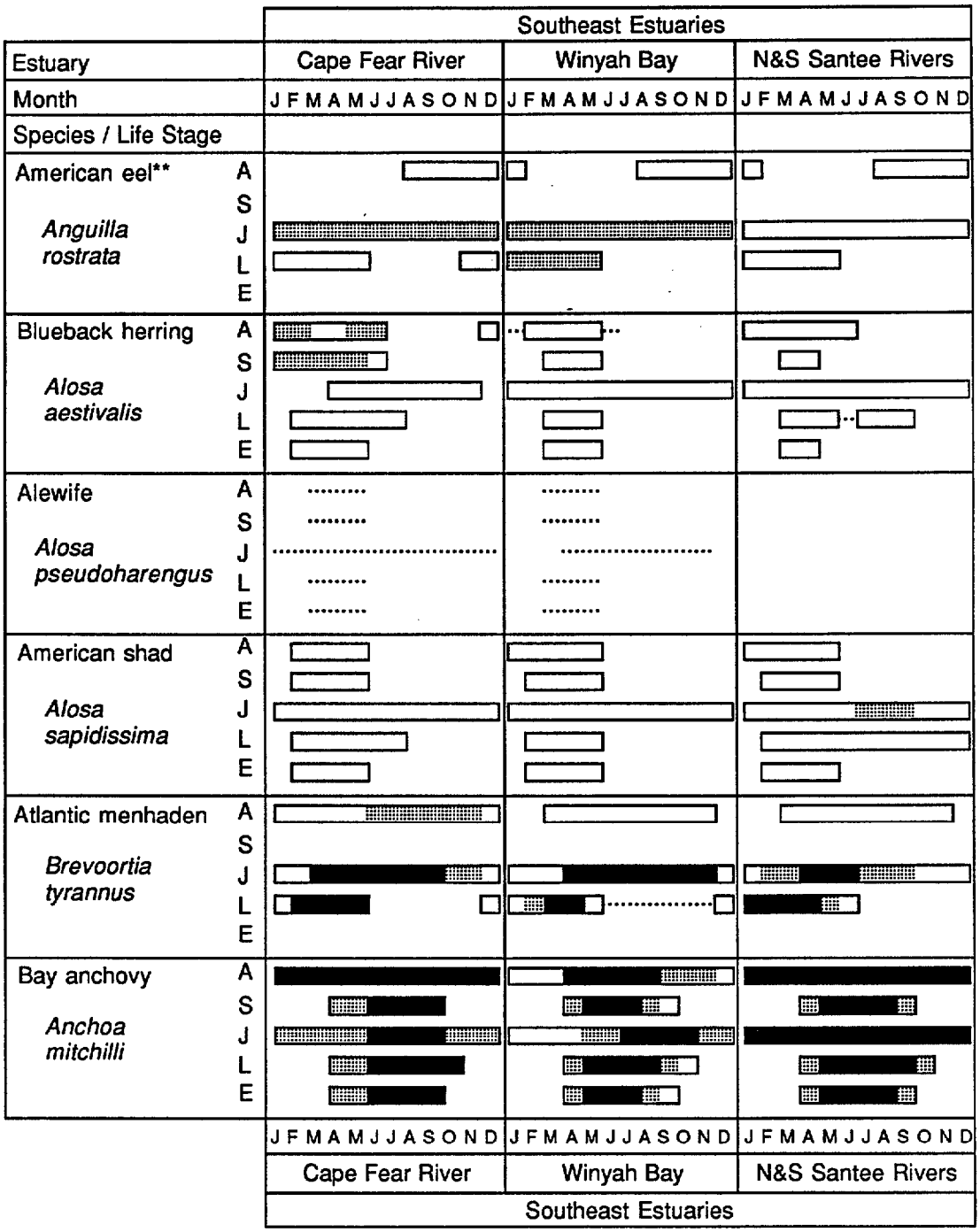

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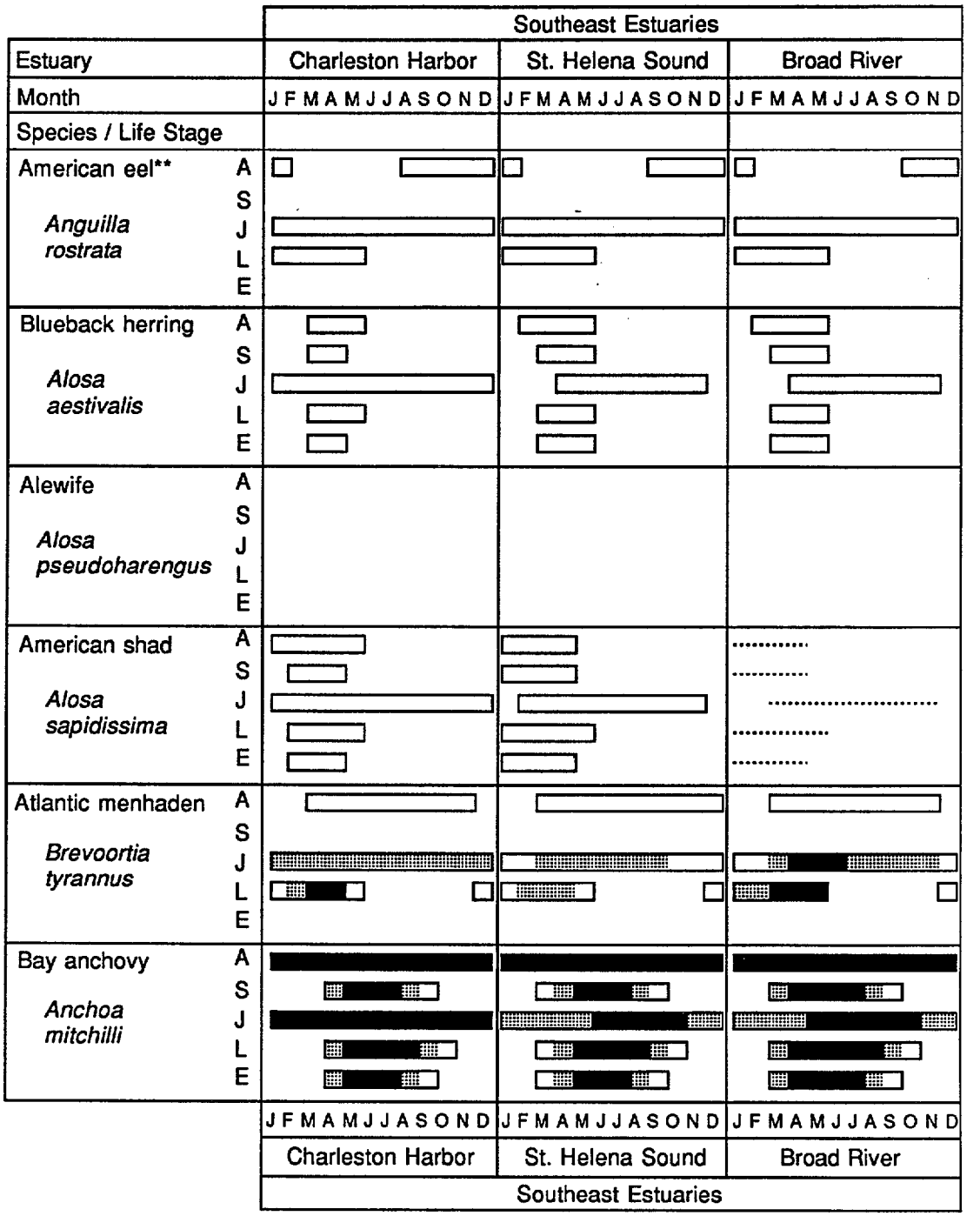
Table 3, continued: Temporal distribution



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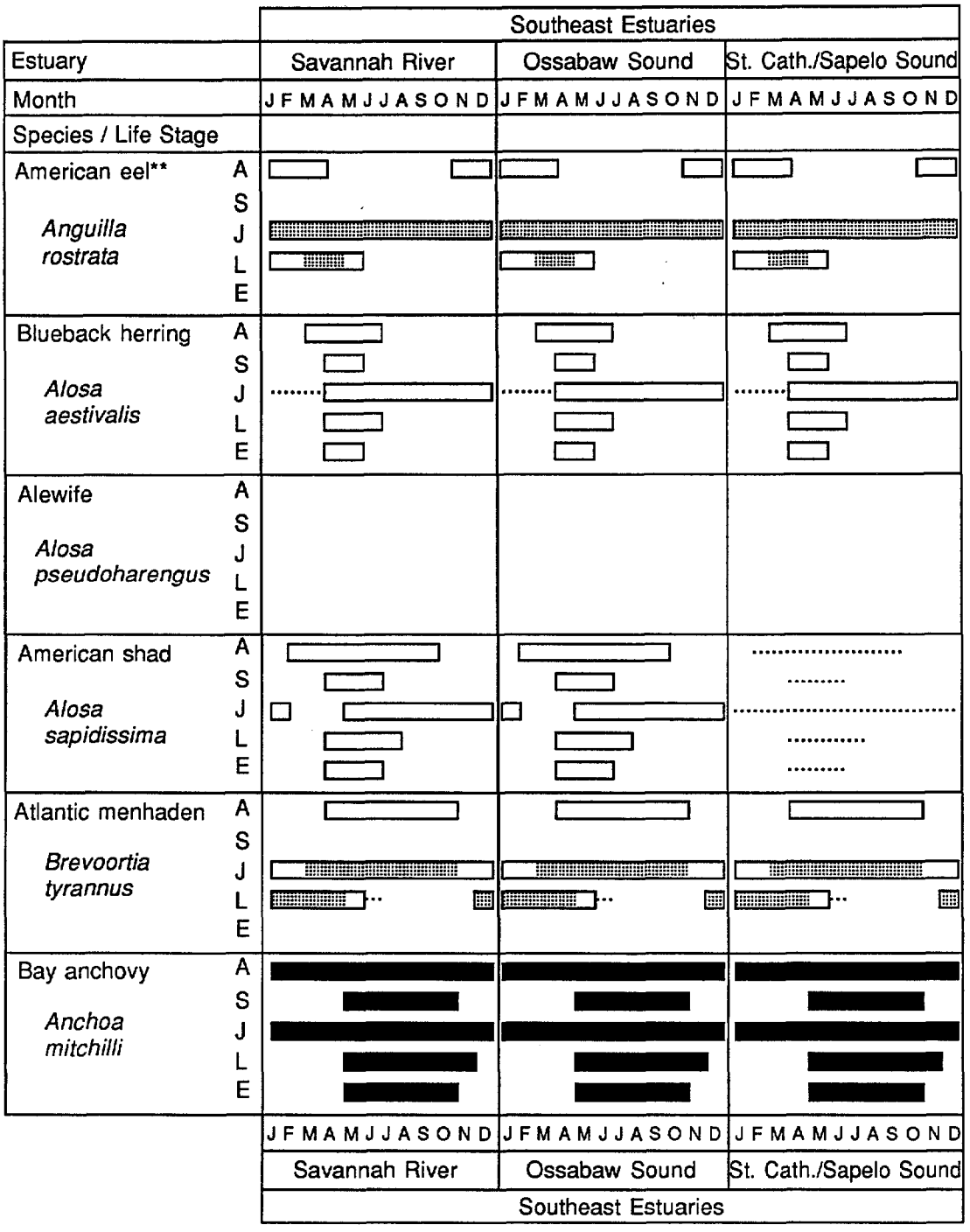

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Table 3, continued. Temporal distribution

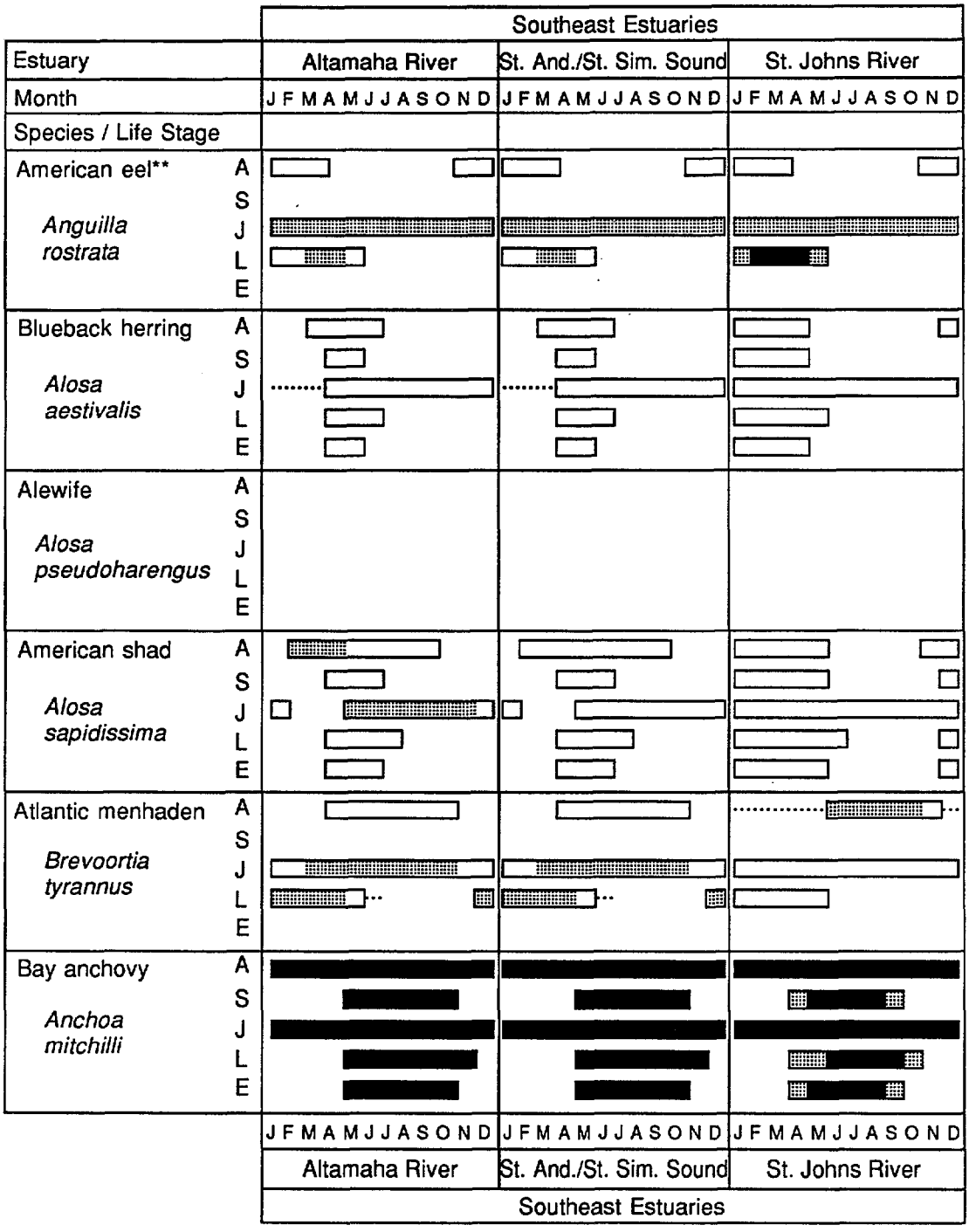

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Table 3, continued. Temporal distribution

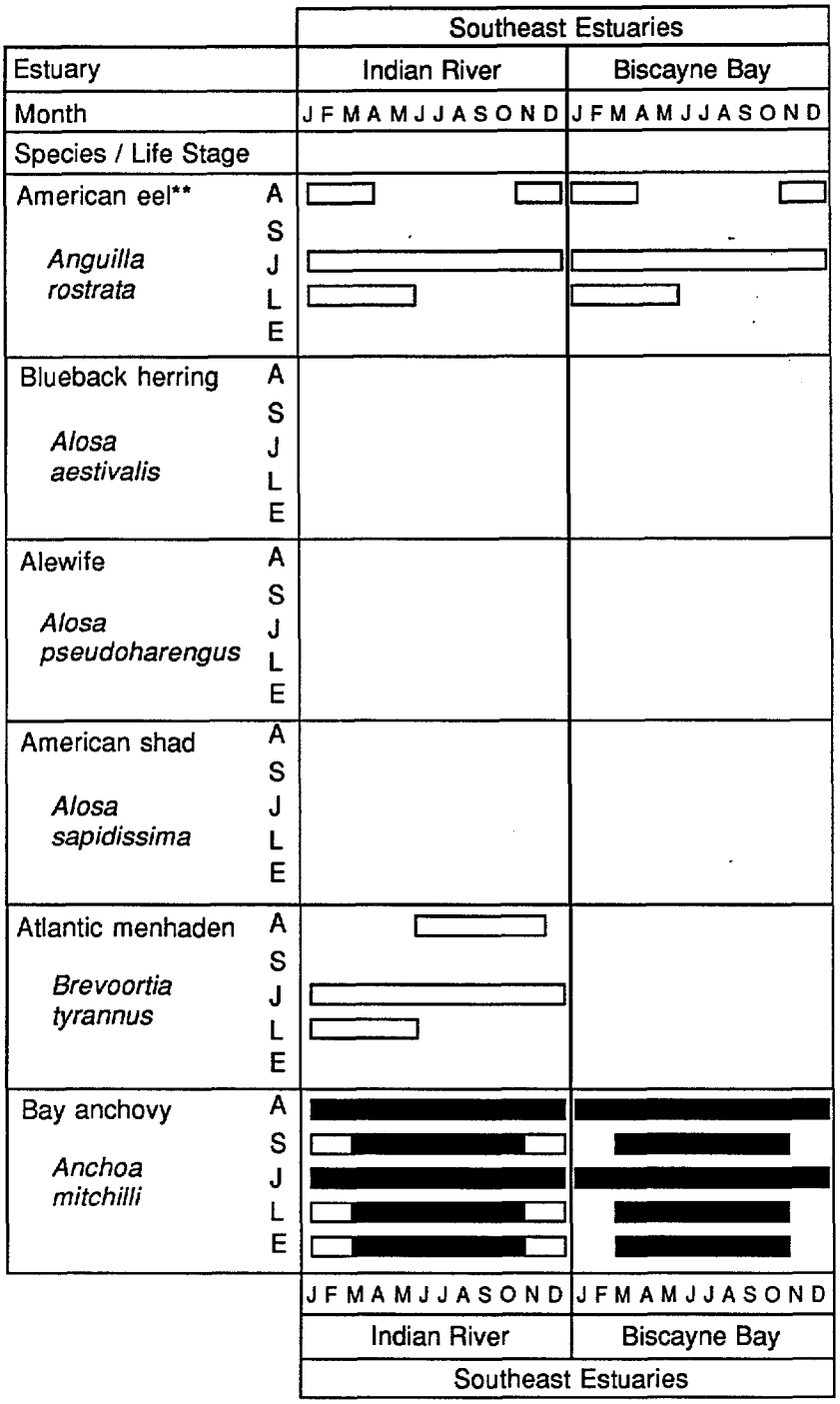

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Table 3, continued: Temporal distribution

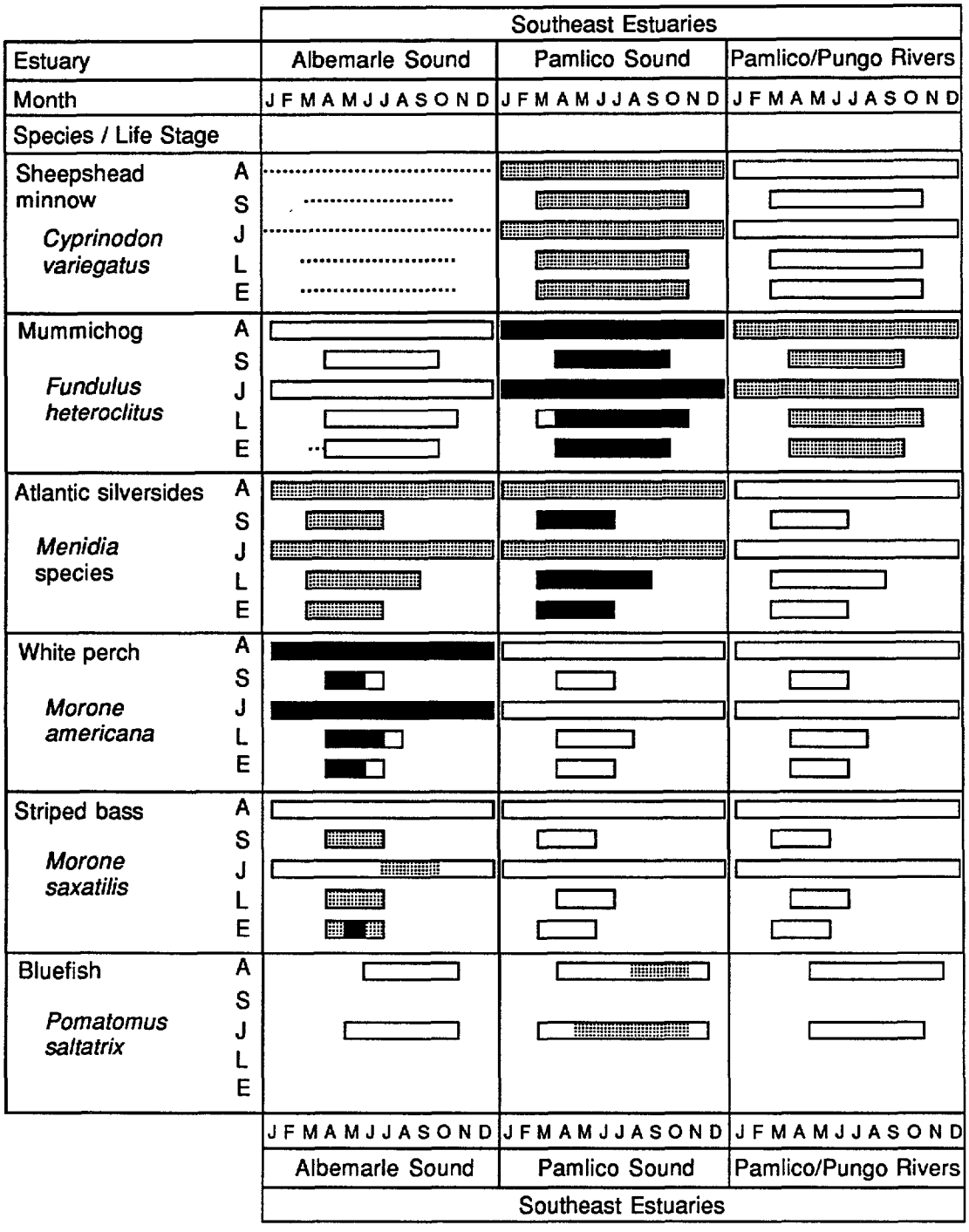

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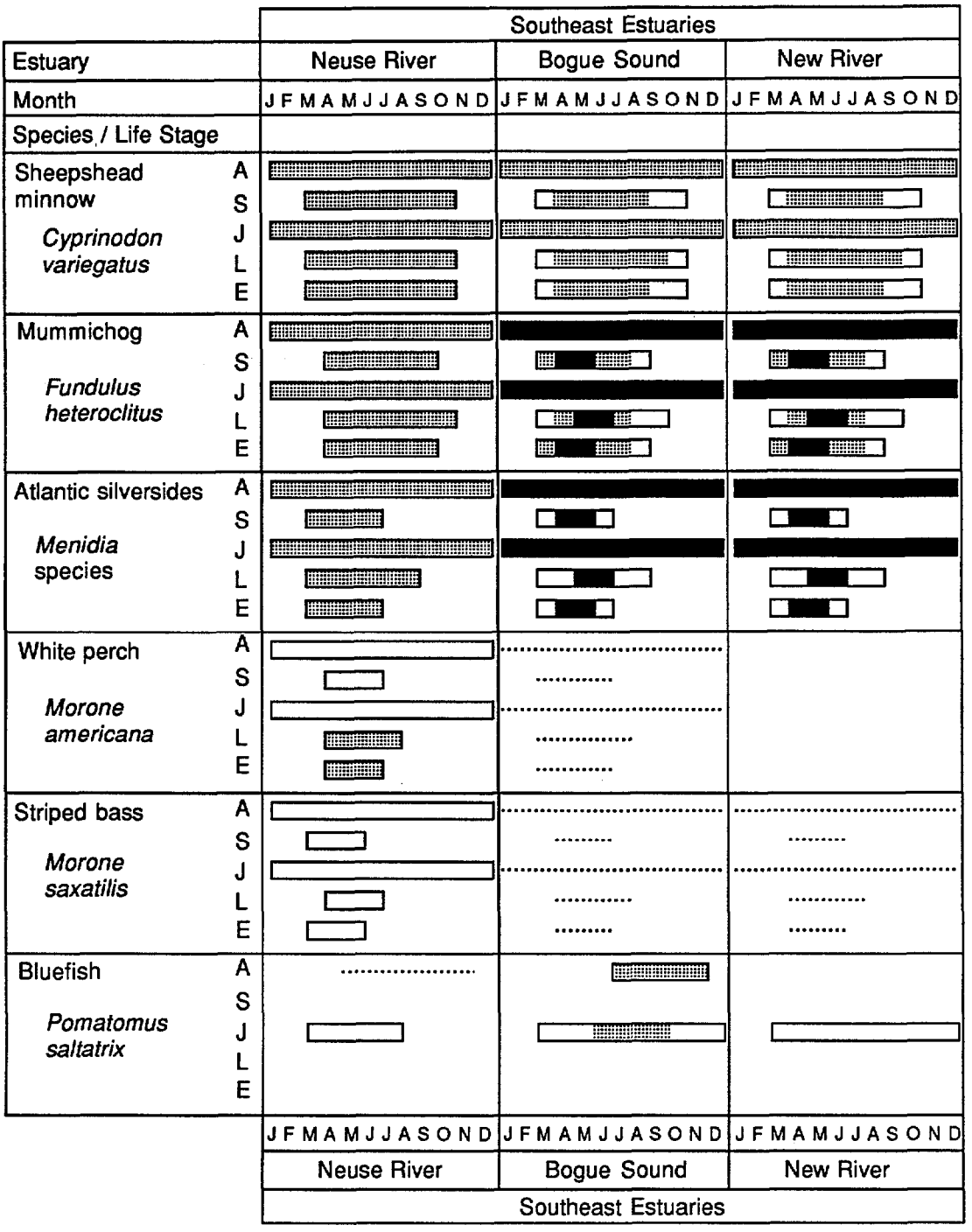
Table 3, continued. Temporal distribution



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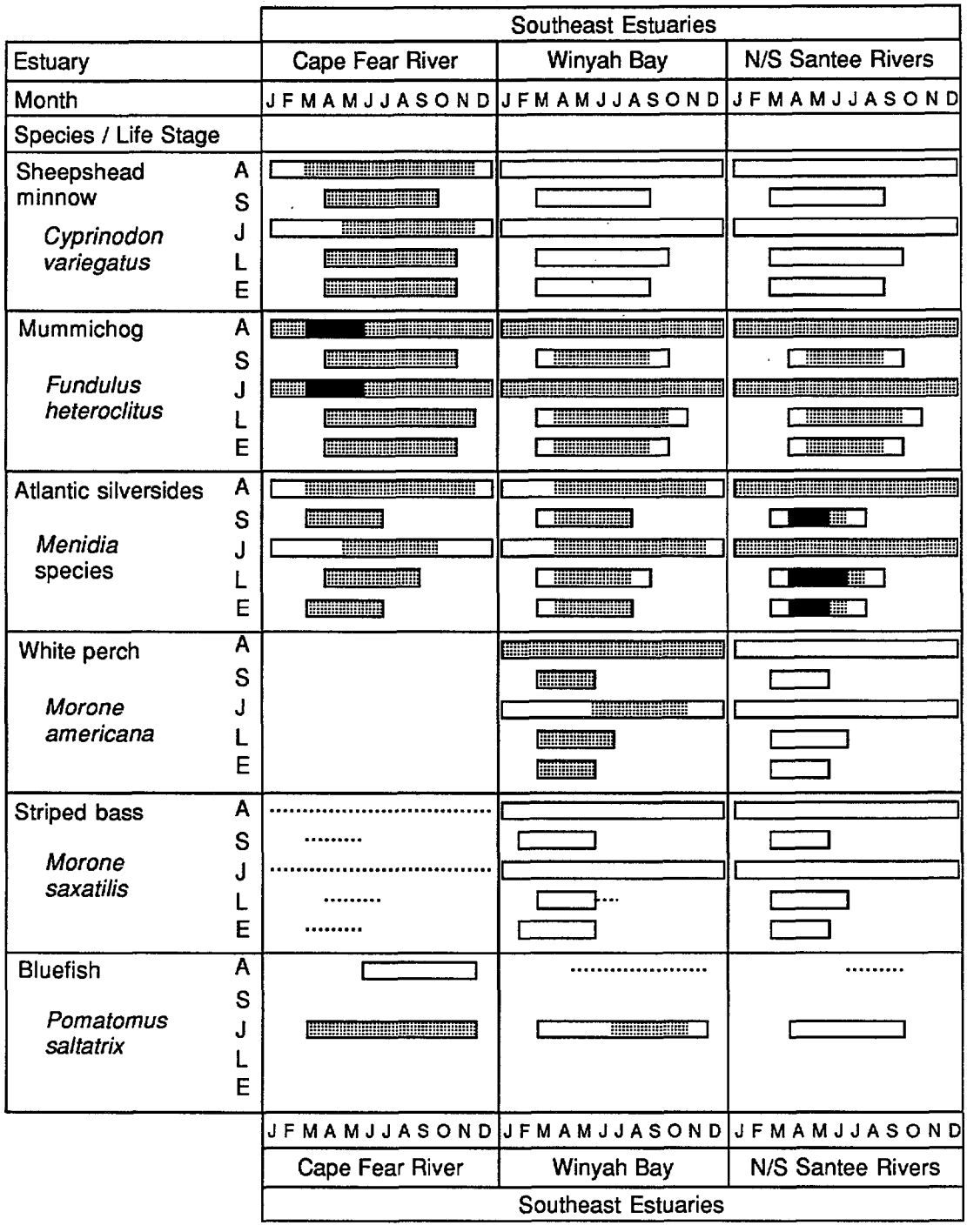

Relative

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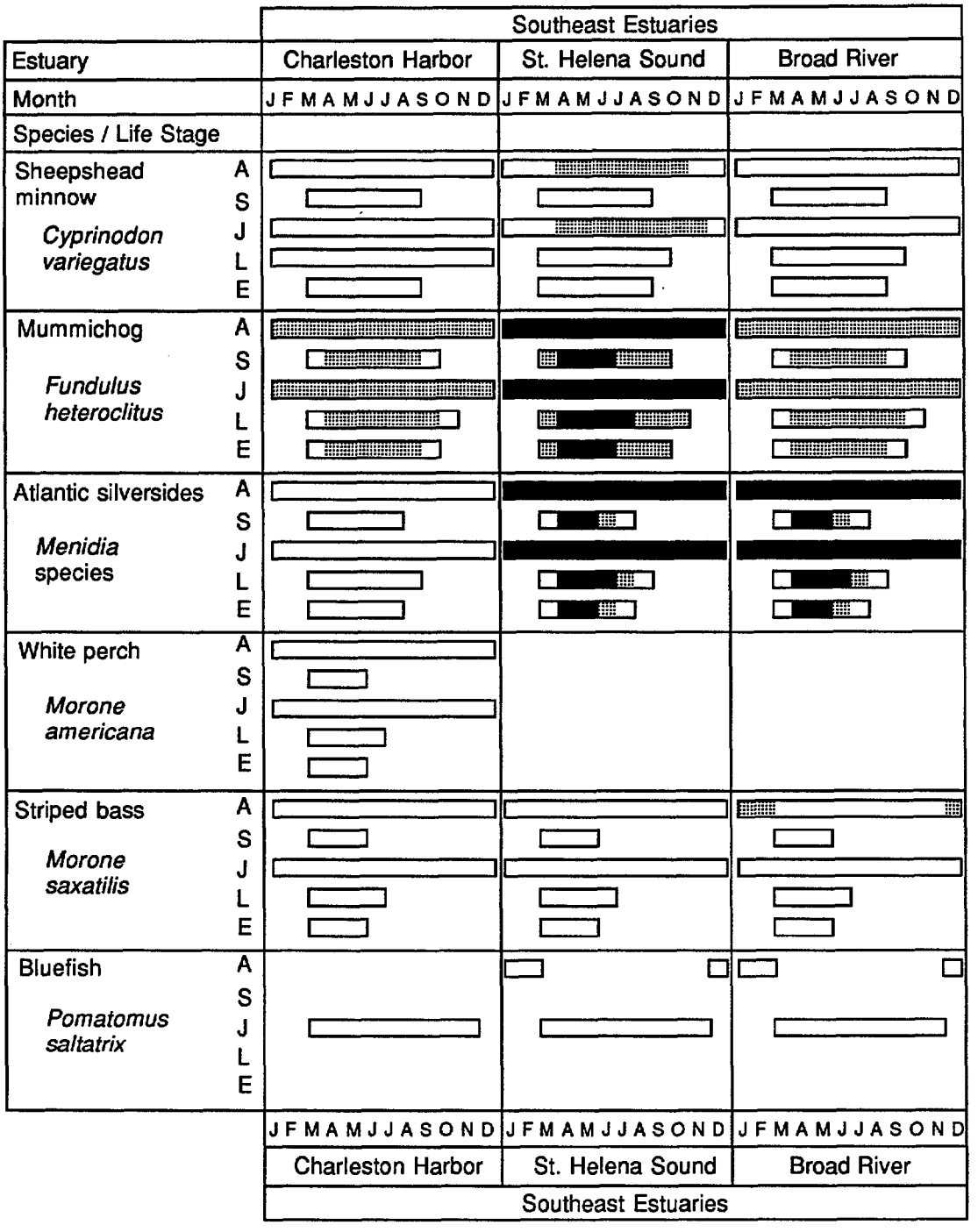
- Common
- ..... Rare
- Blank Not Present

Life Stage

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

Table 3, continued. Temporal distribution



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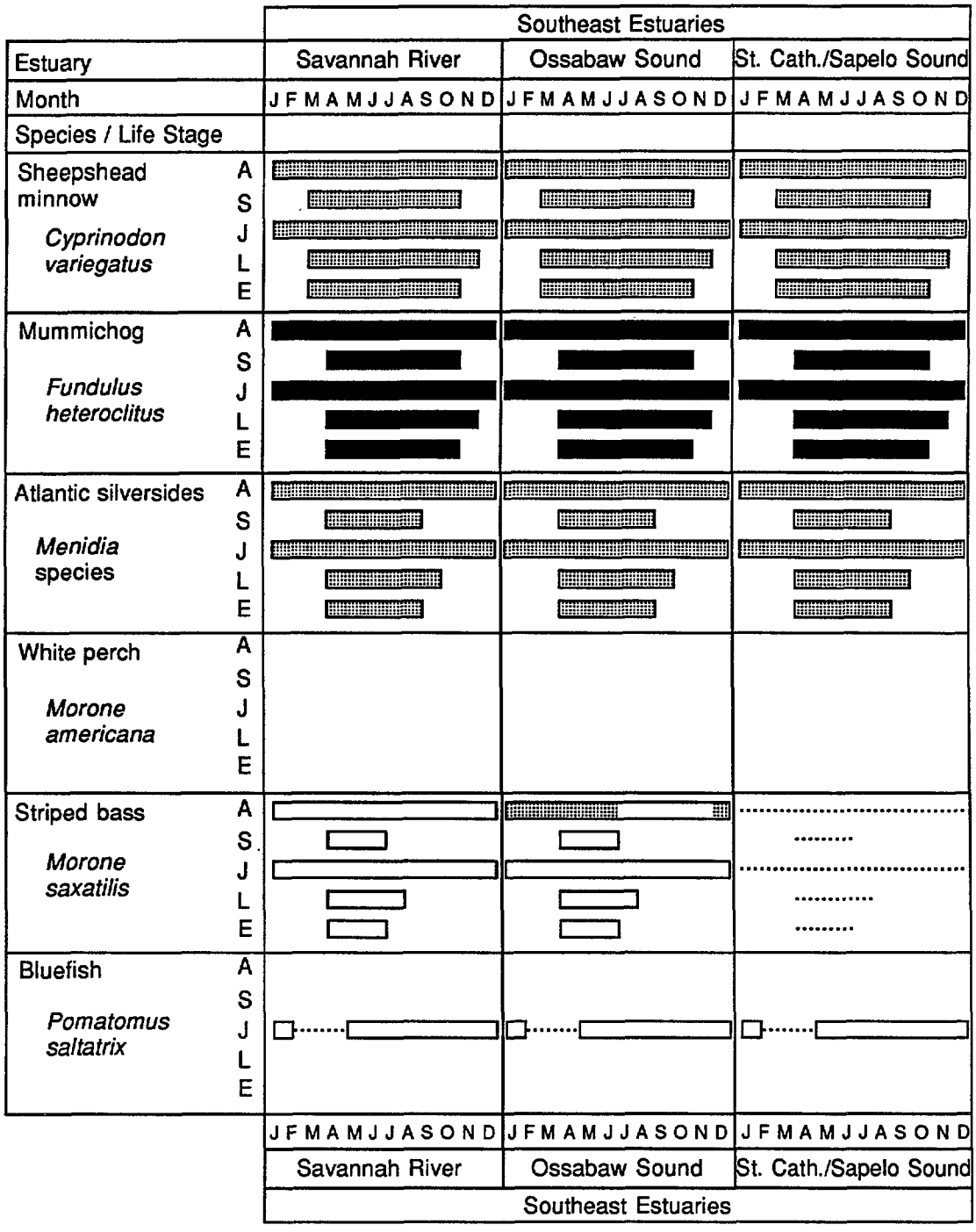

Relative Abundance

- Highly Abundant
- Abundant
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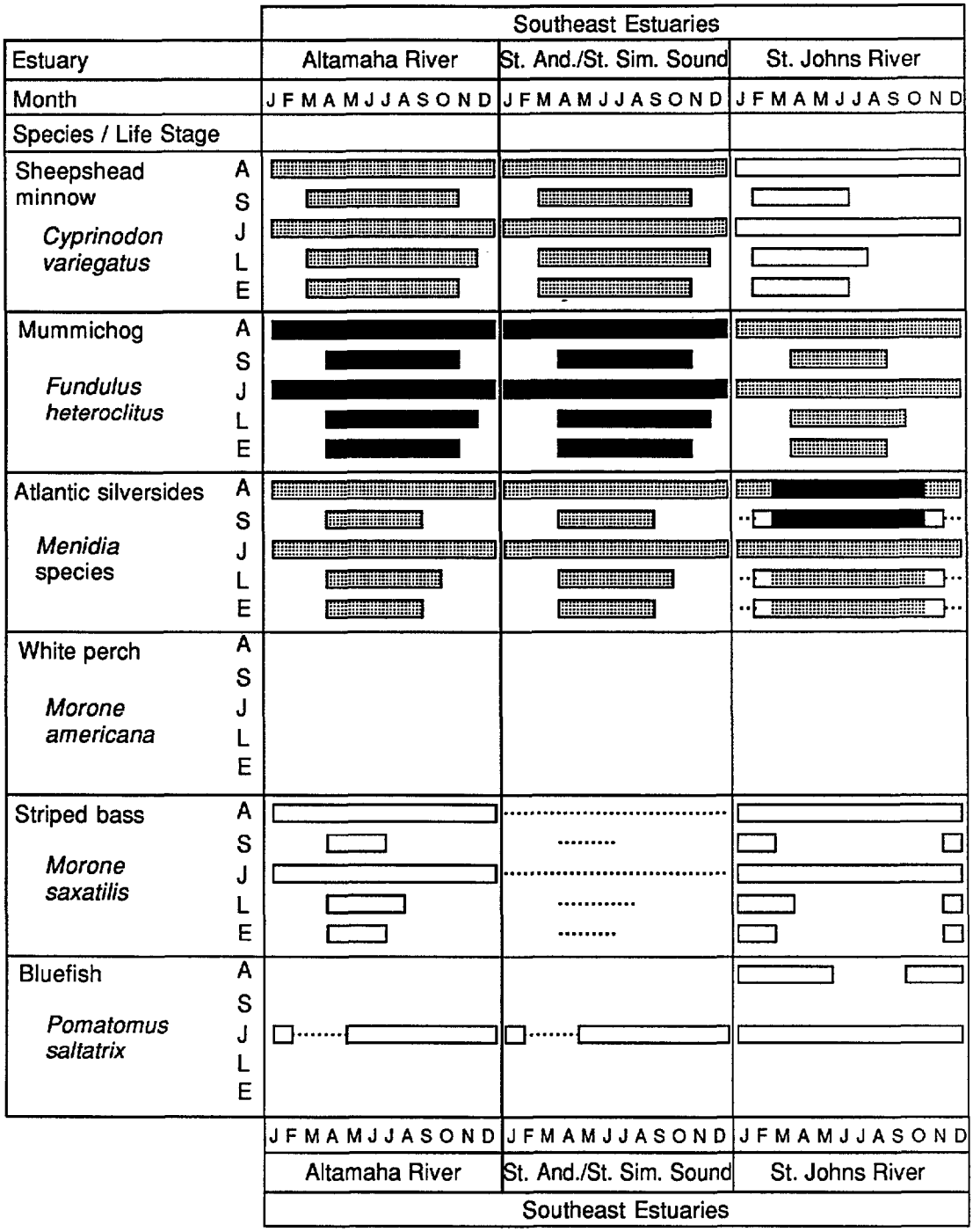
Table 3, continued. Temporal distribution



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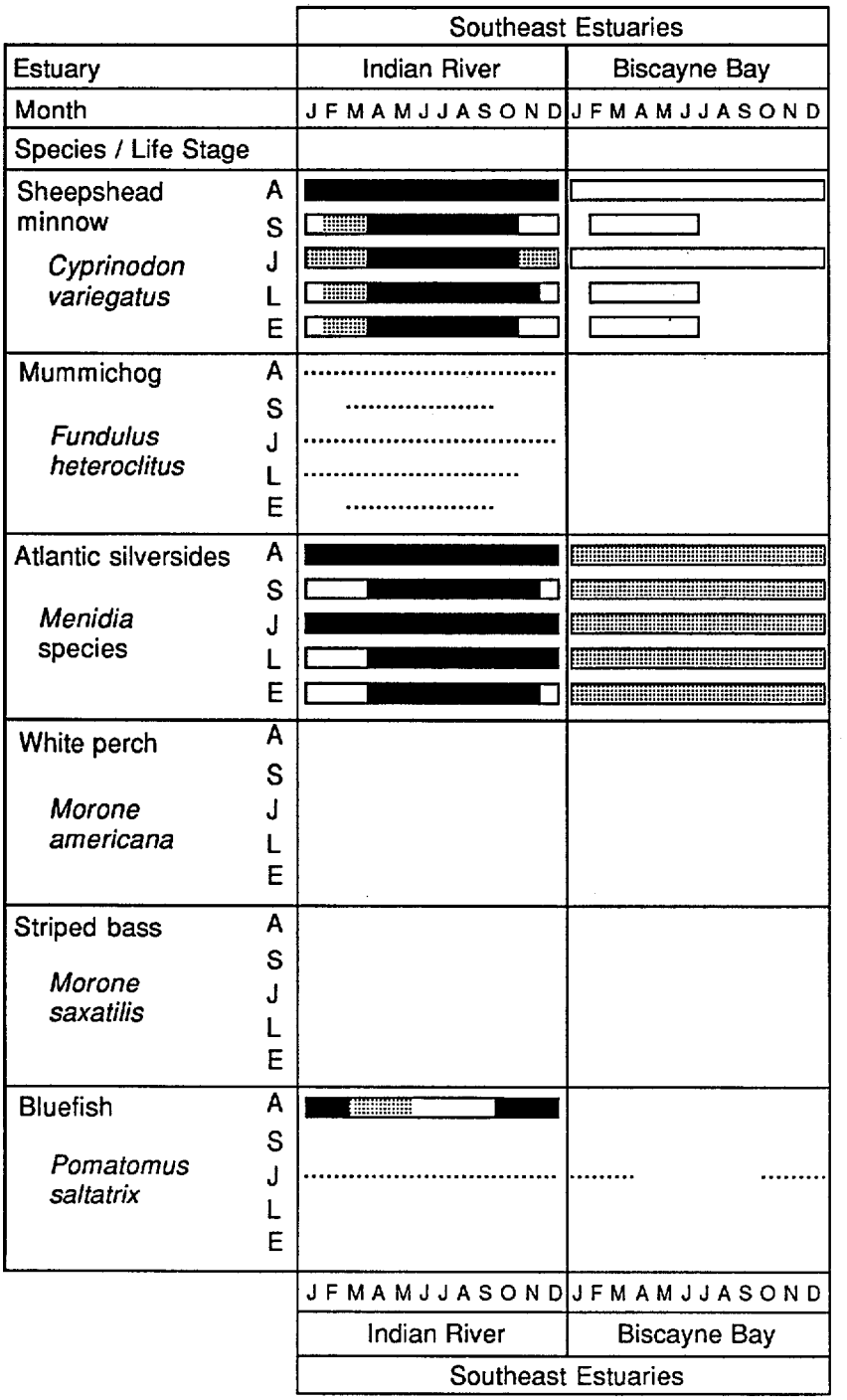

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Table 3, continued. Temporal distribution

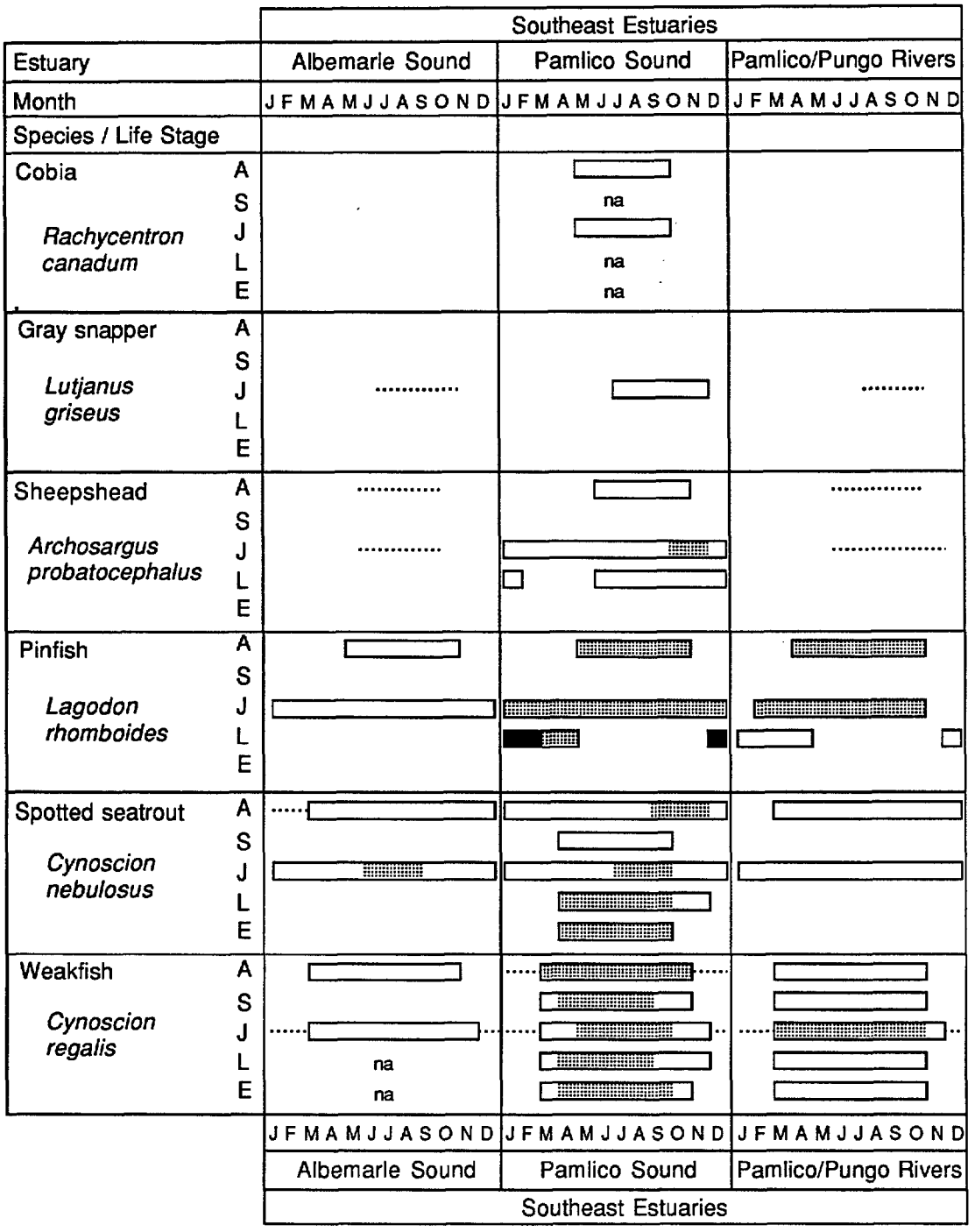

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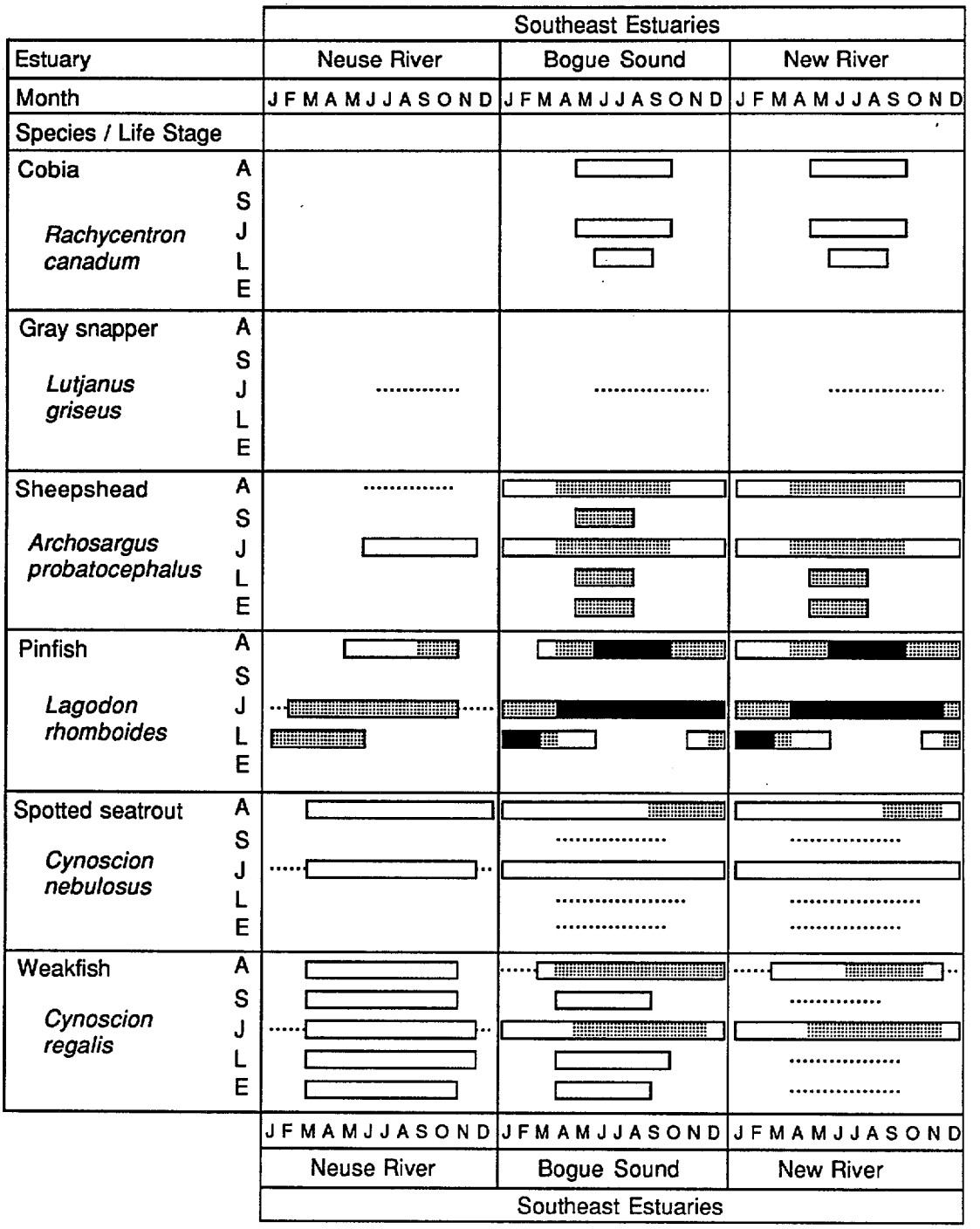
Table 3, continued. Temporal distribution



Relative Abundance

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Life Stage

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J - Juveniles
L - Larvae
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Table 3, continued. Temporal distribution

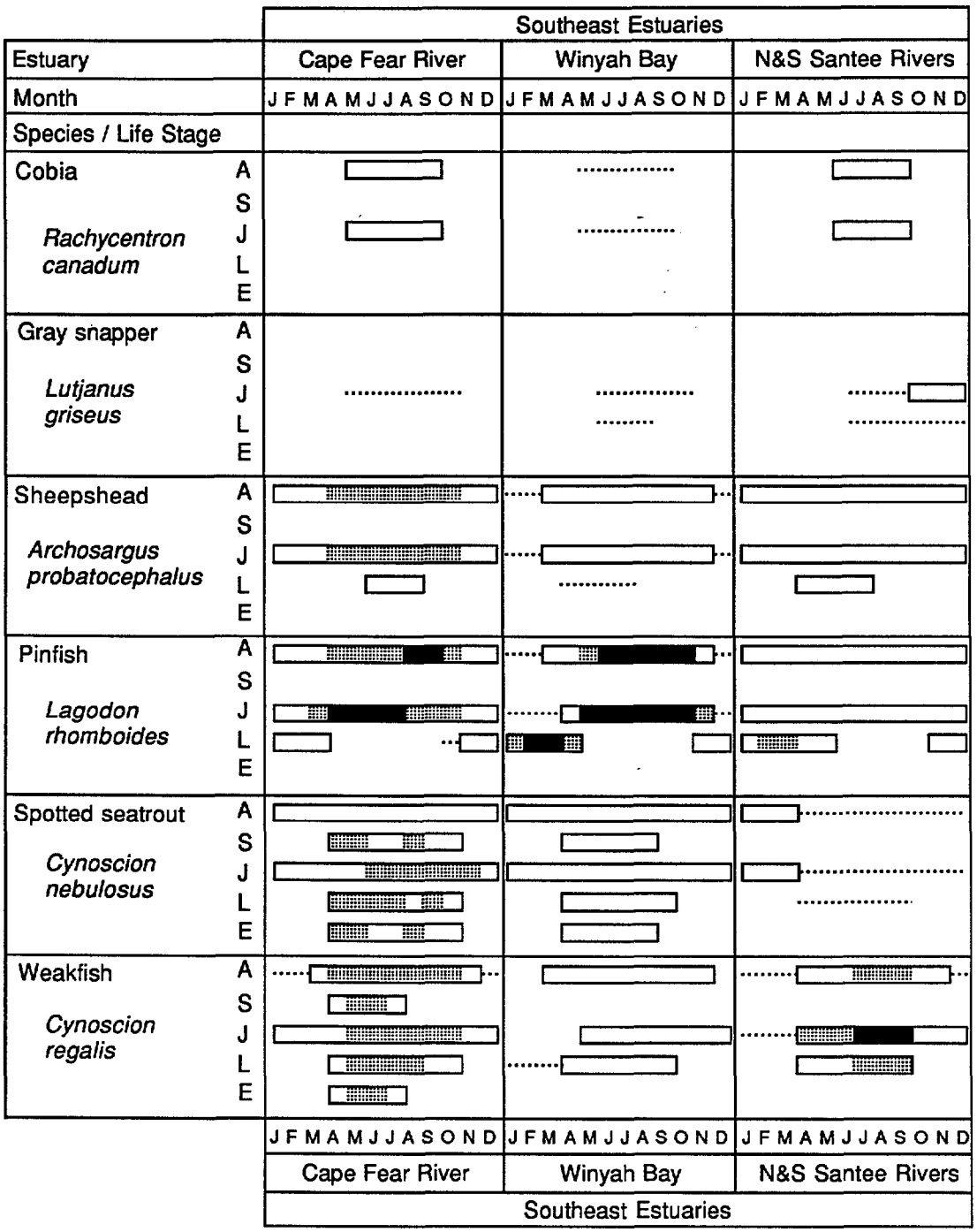

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Table 3, continued: Temporal distribution

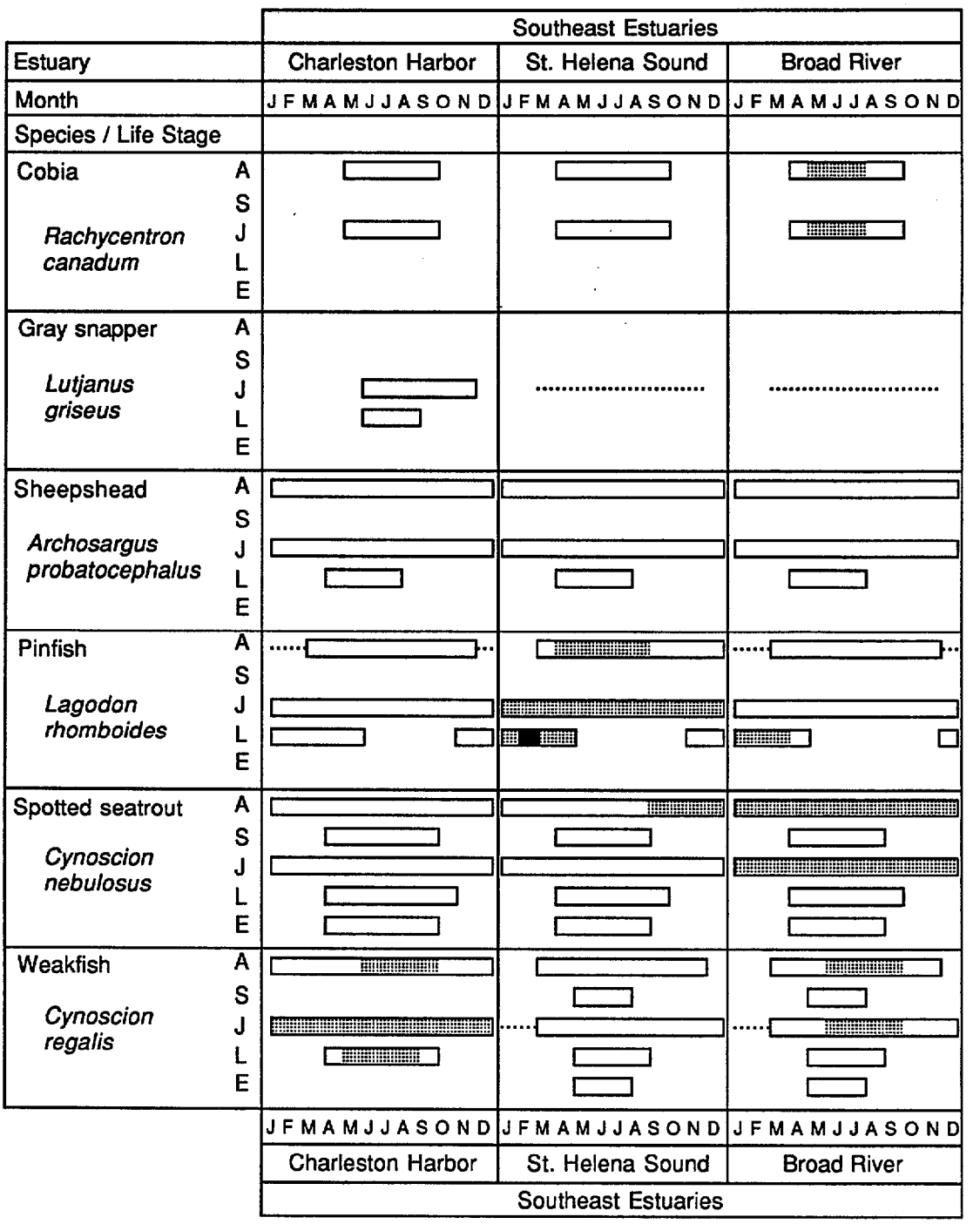

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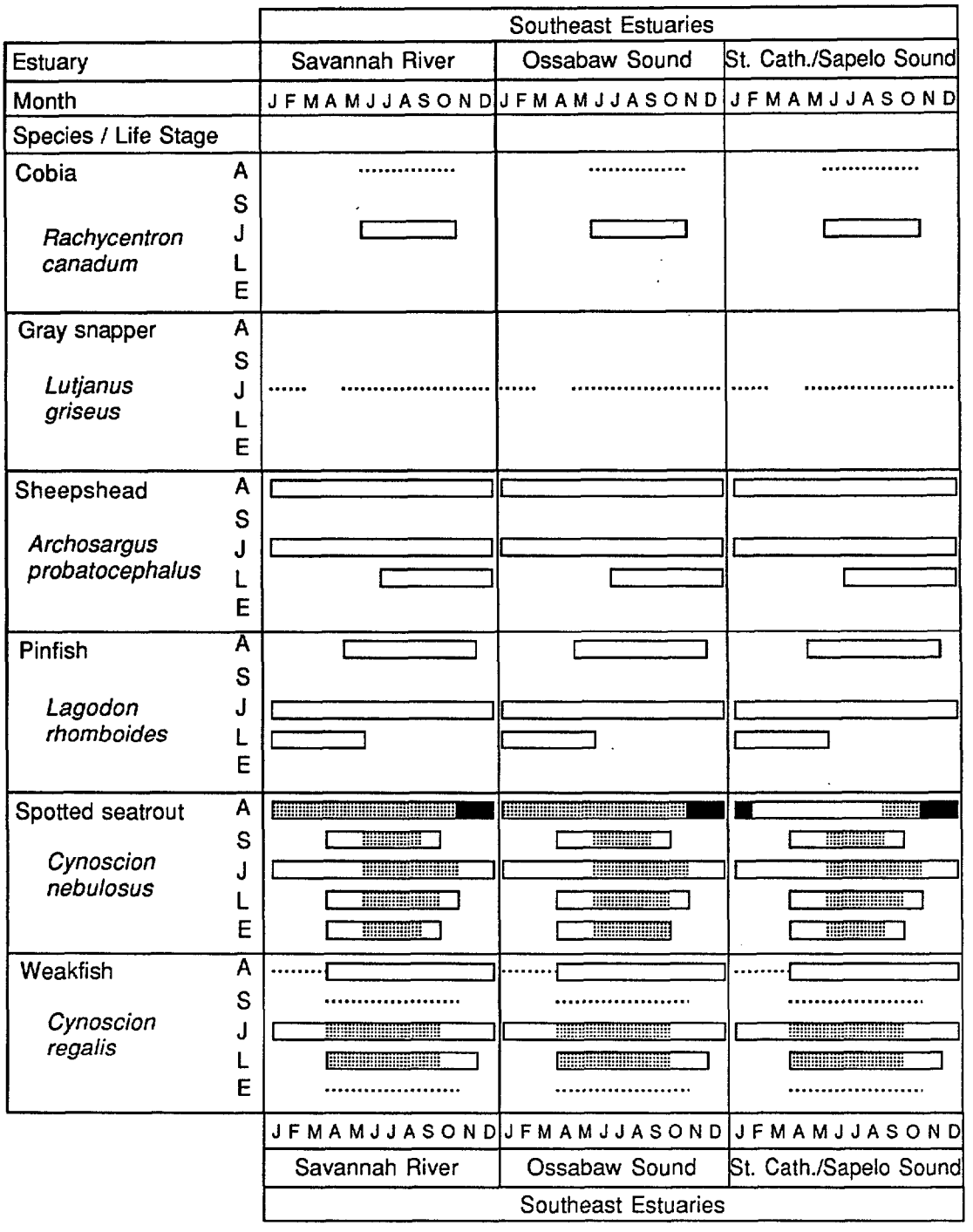
Table 3, continued. Temporal distribution



Relative Abundance

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Life Stage

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Table 3, continued: Temporal distribution

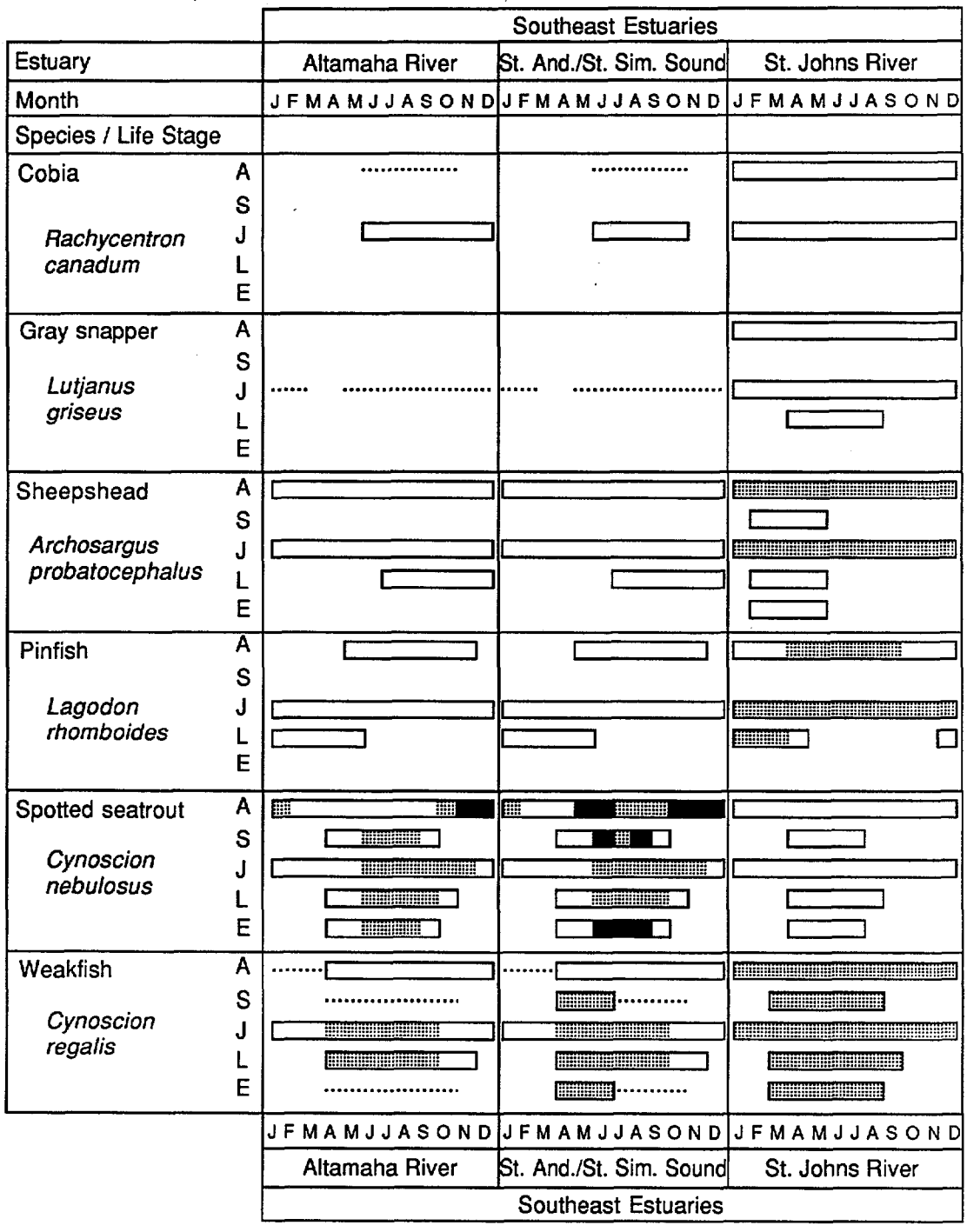

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Table 3, continued. Temporal distribution

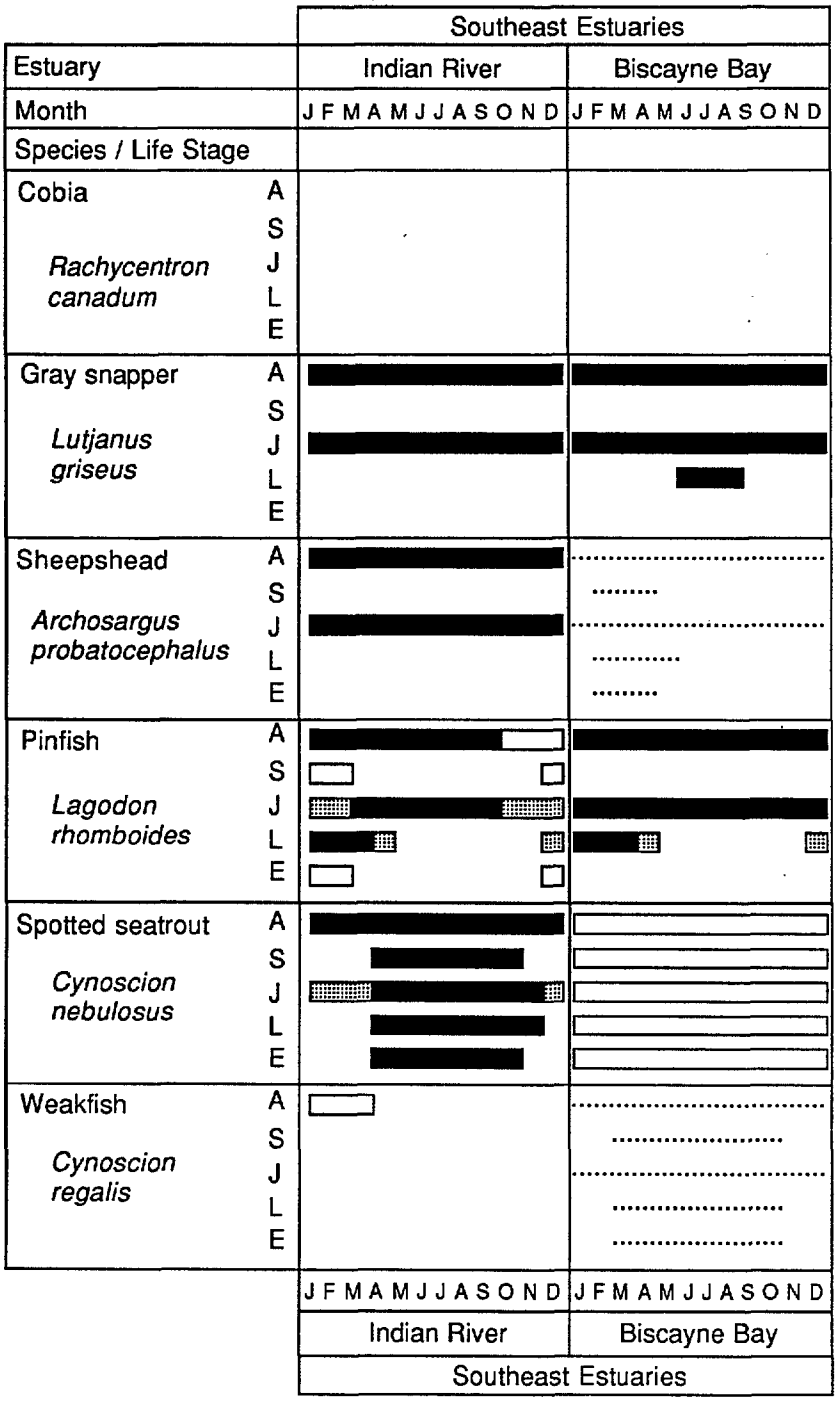

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Table 3, continued: Temporal distribution

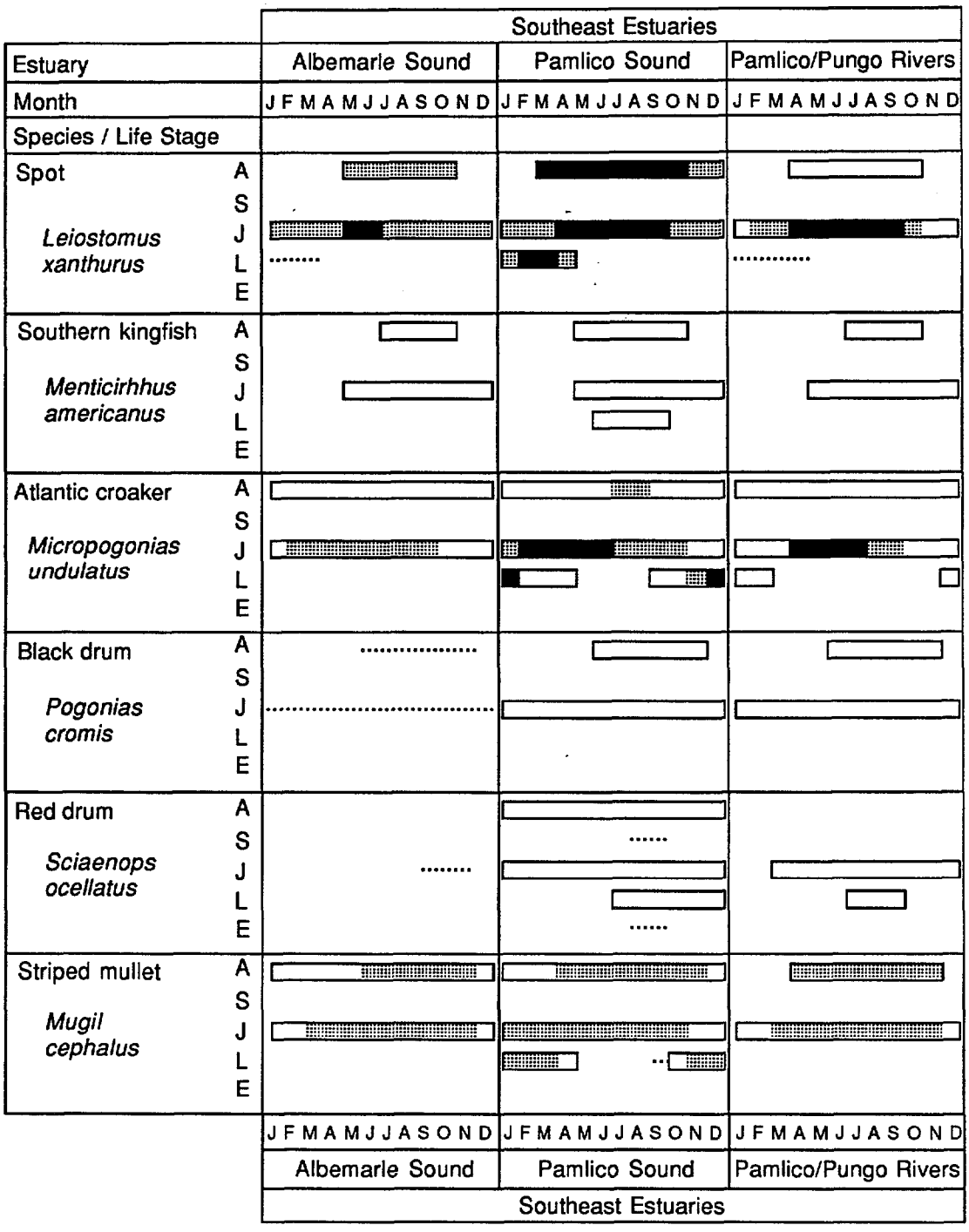
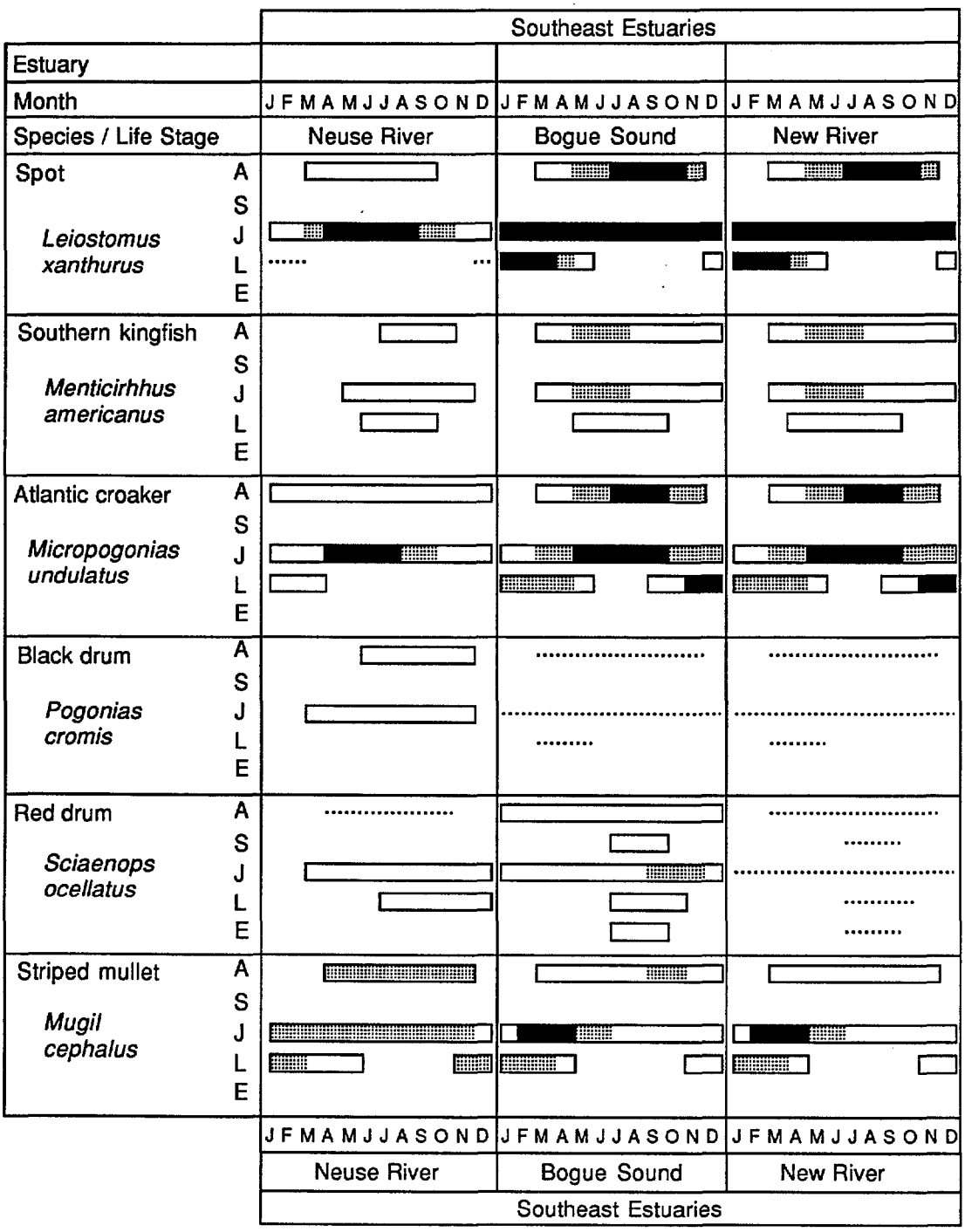


Table 3, continued. Temporal distribution



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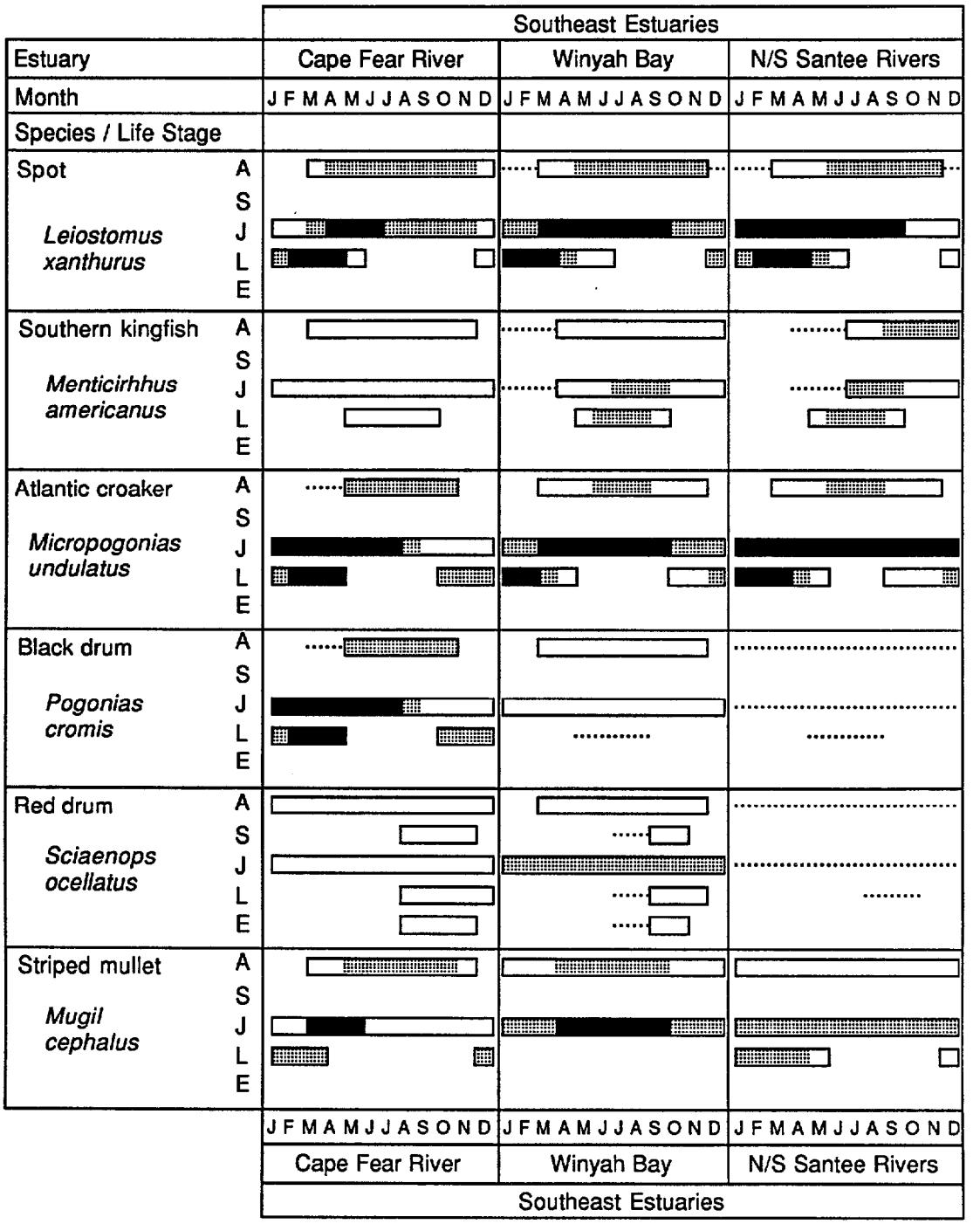

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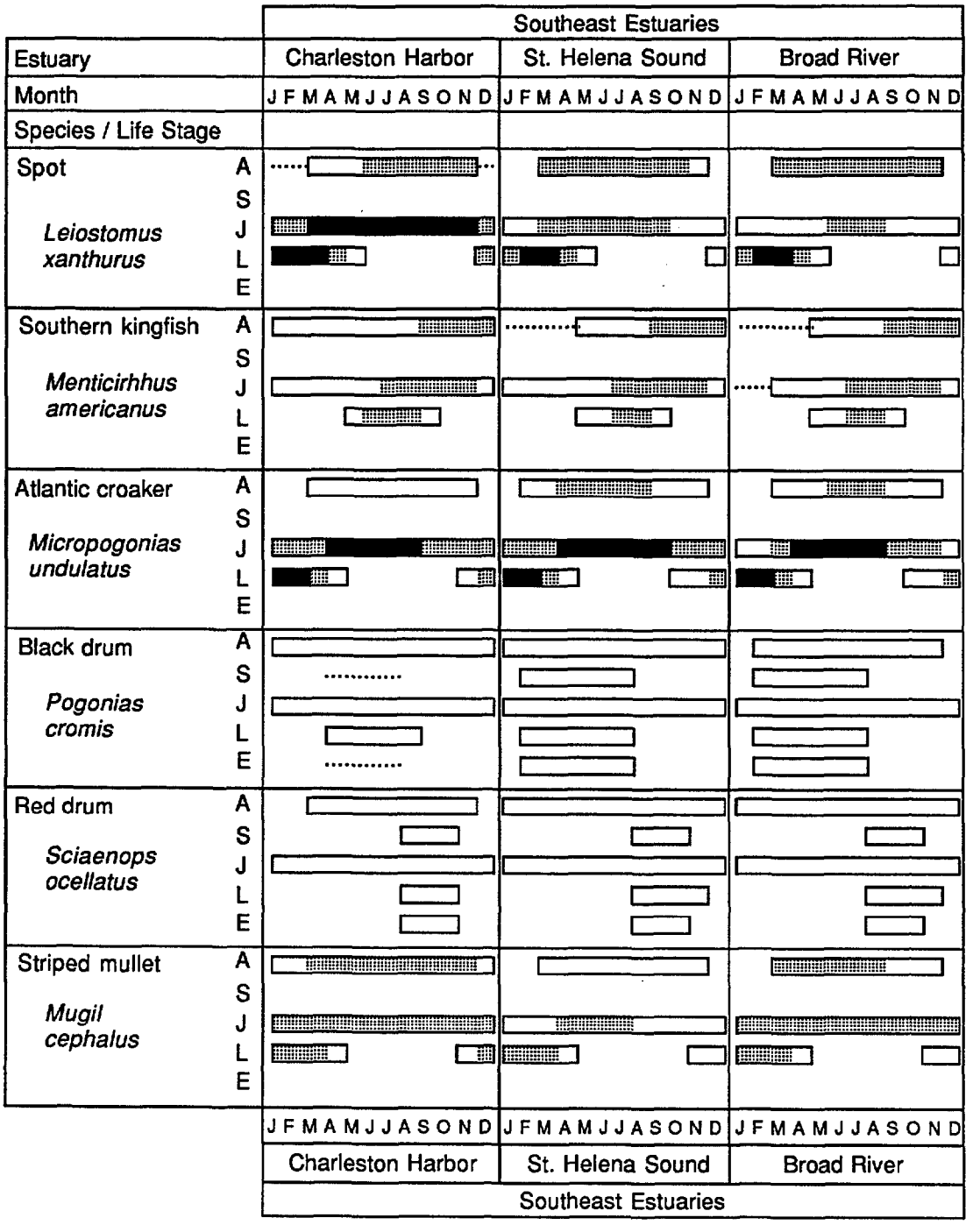

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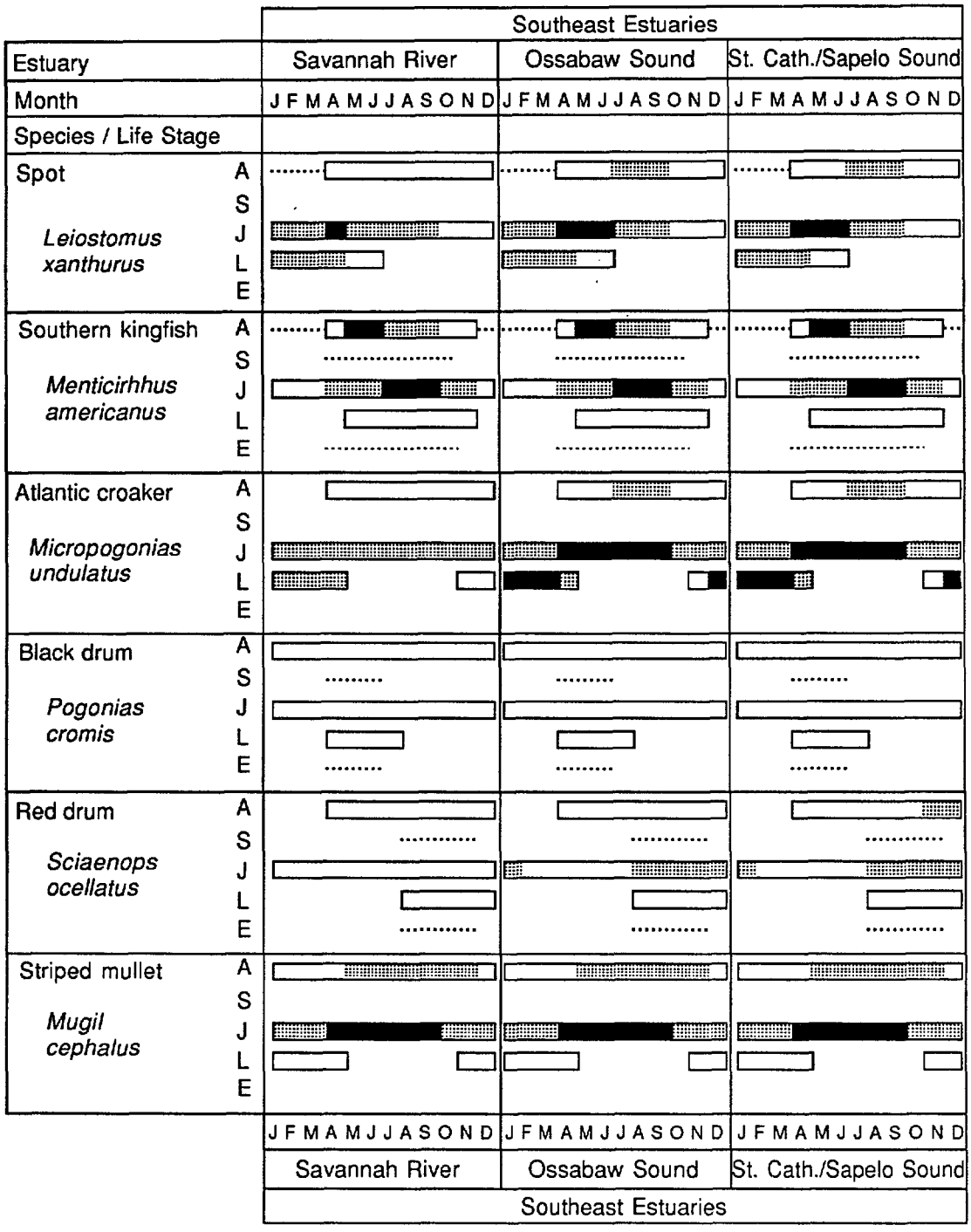

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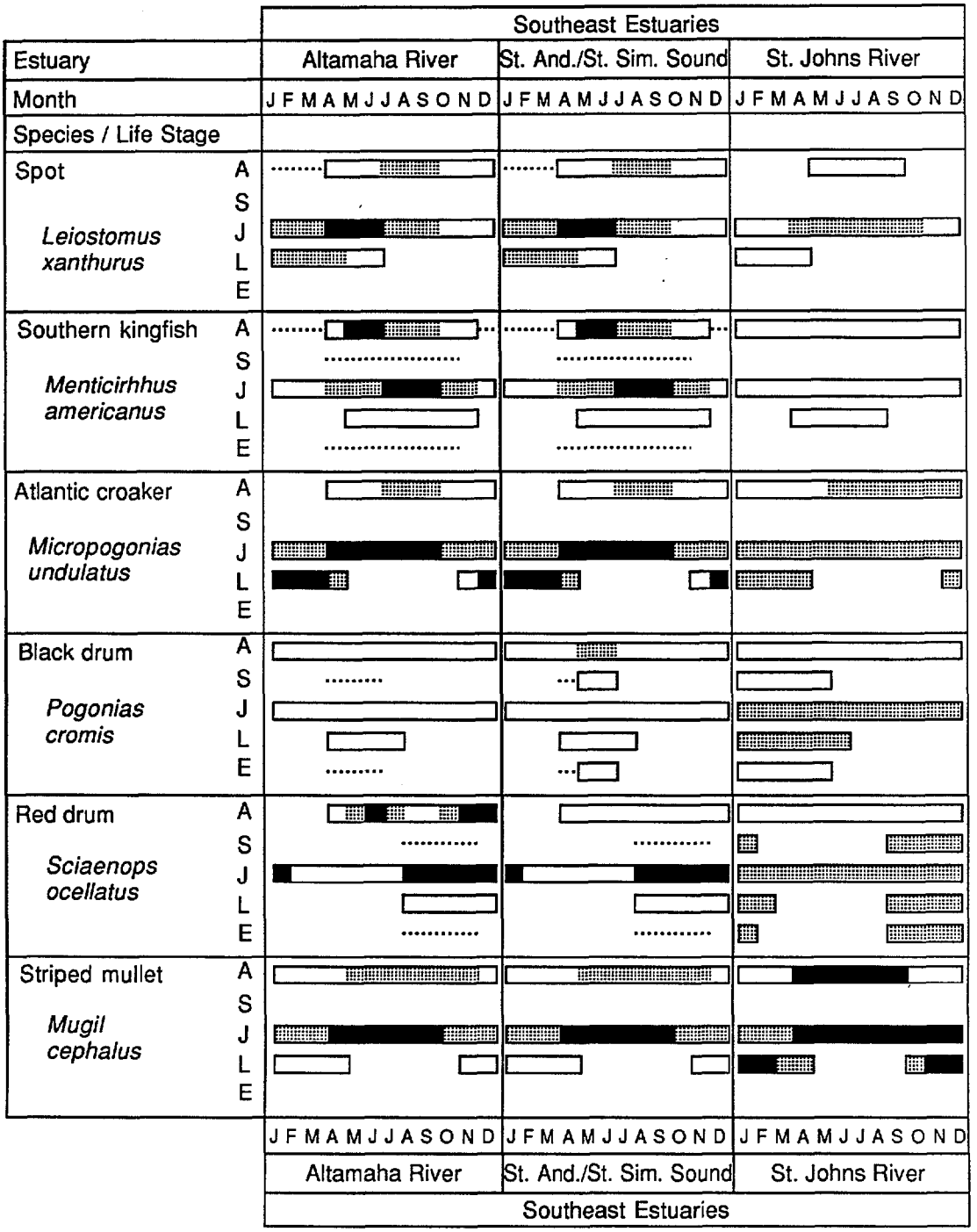

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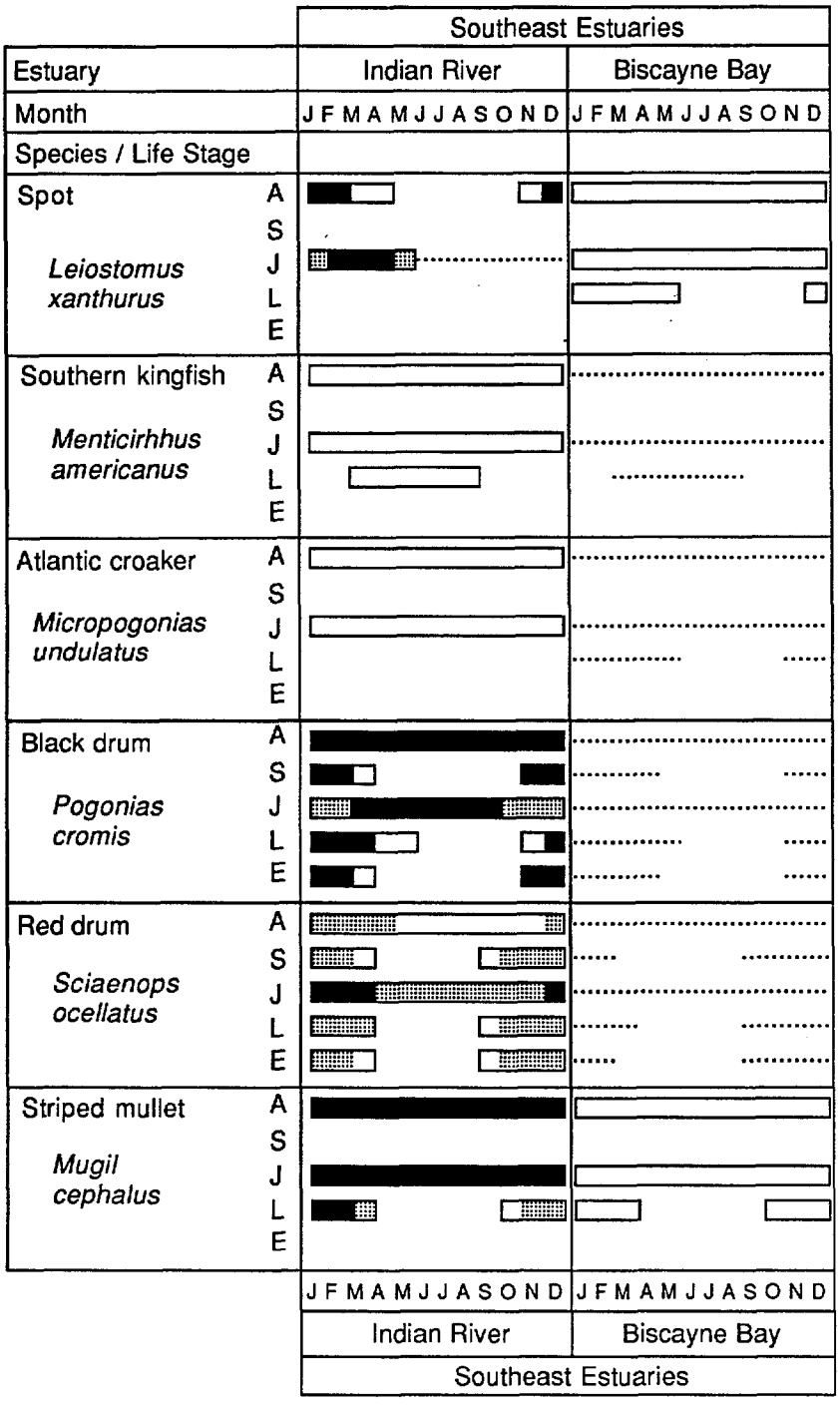

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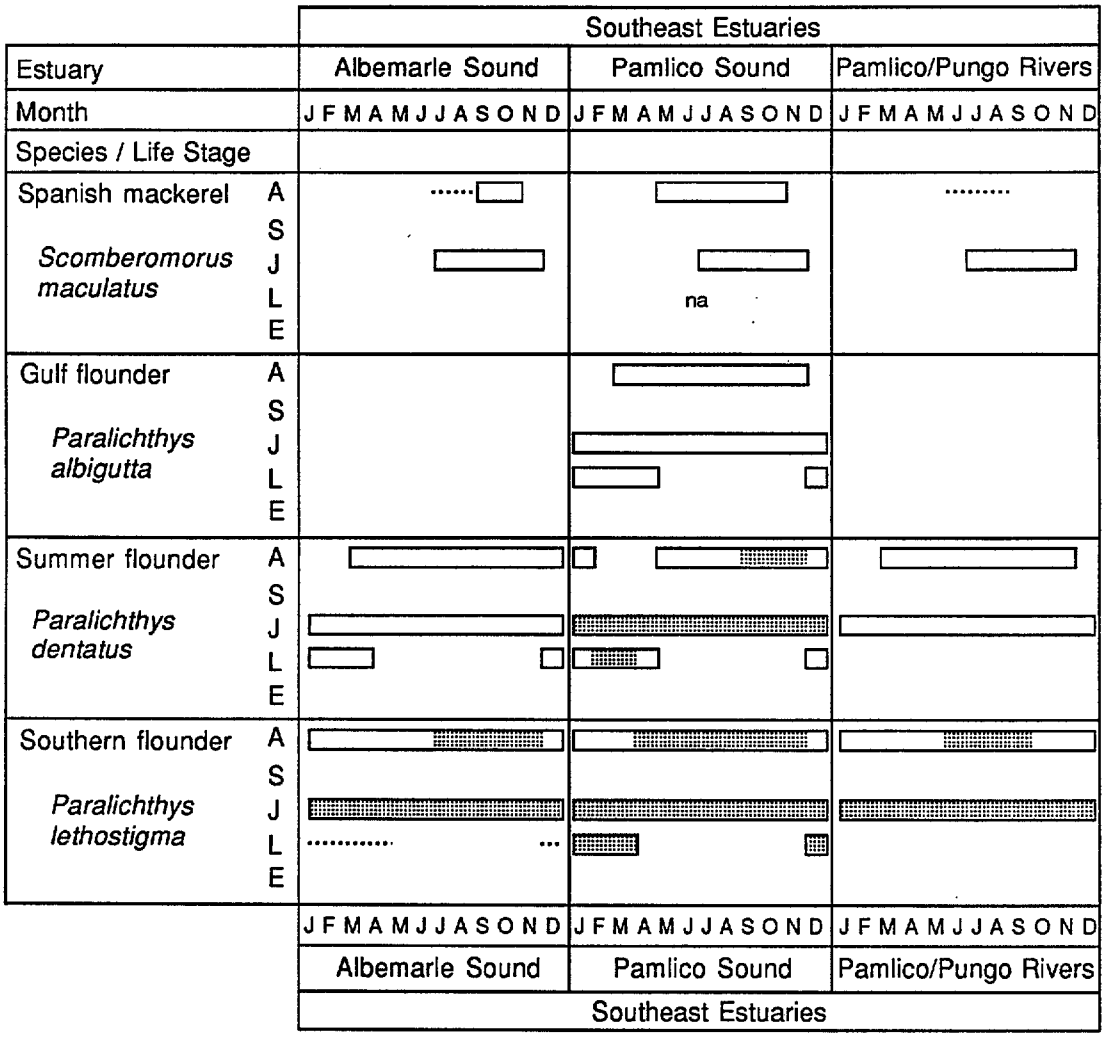

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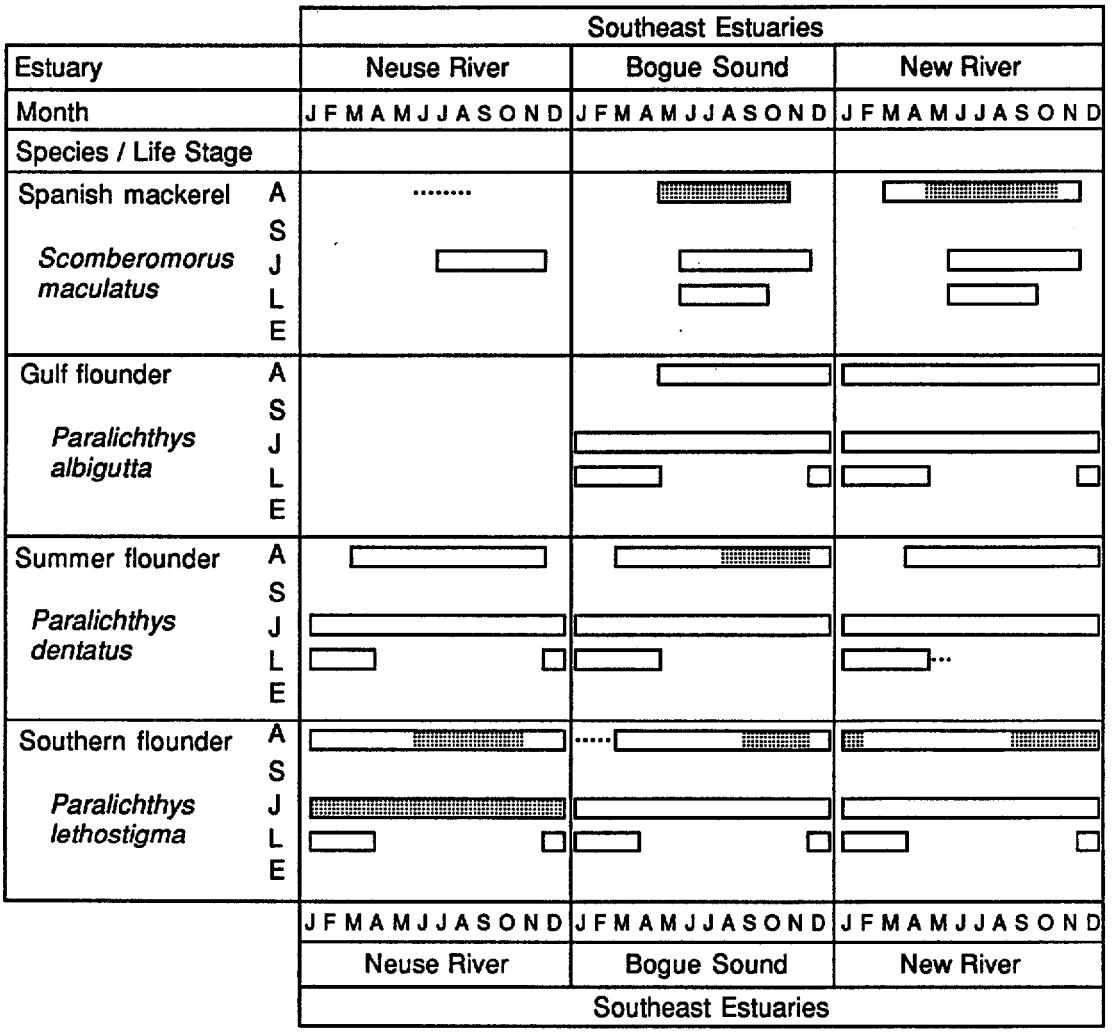

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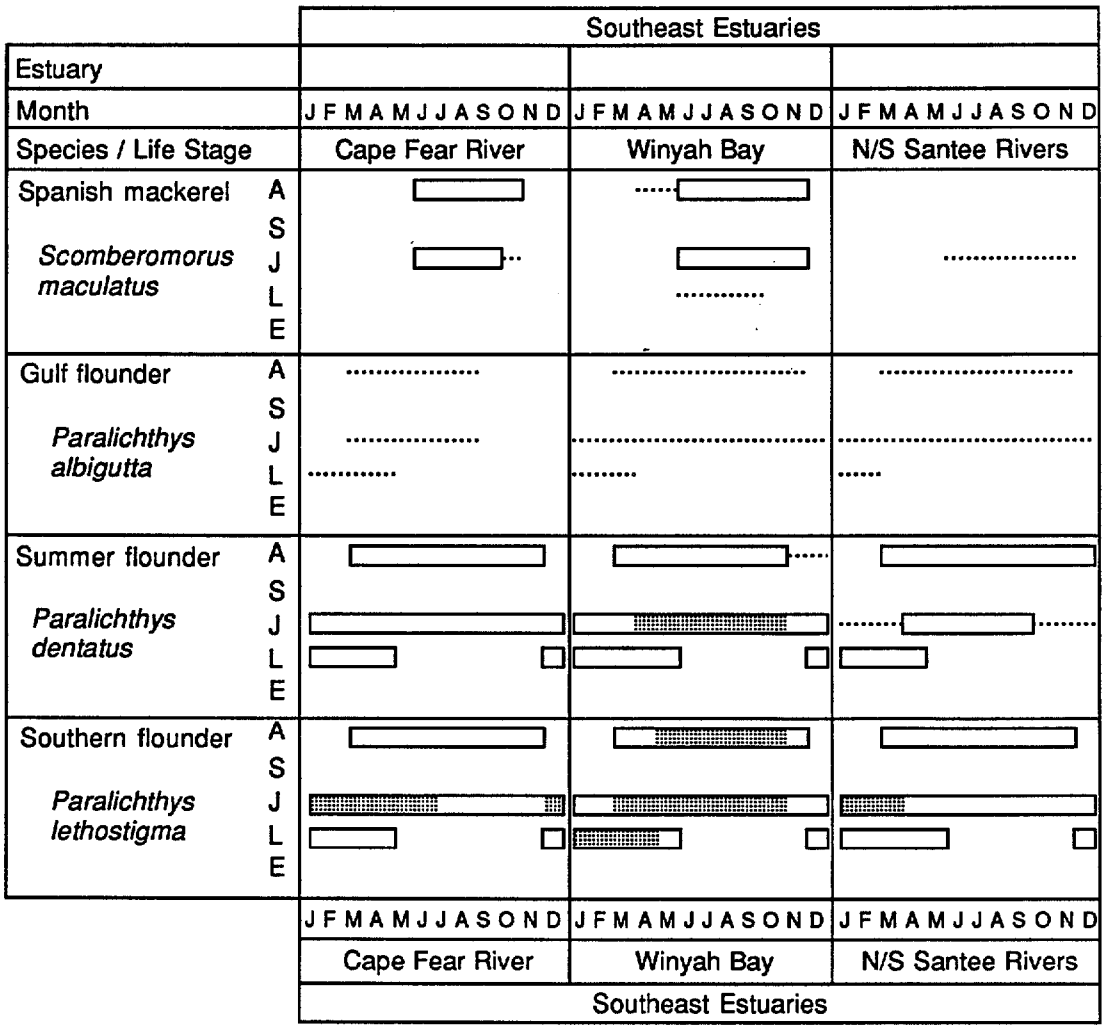

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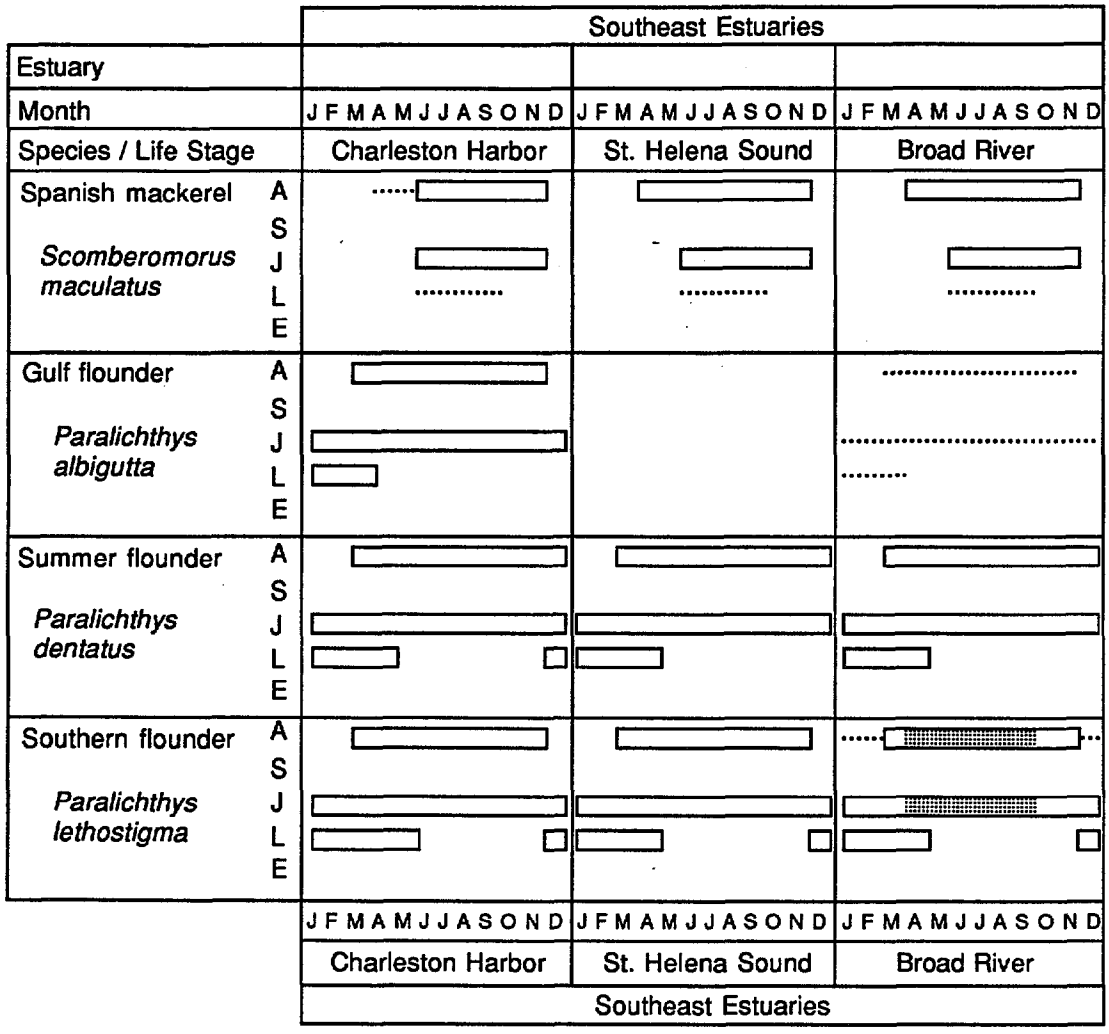

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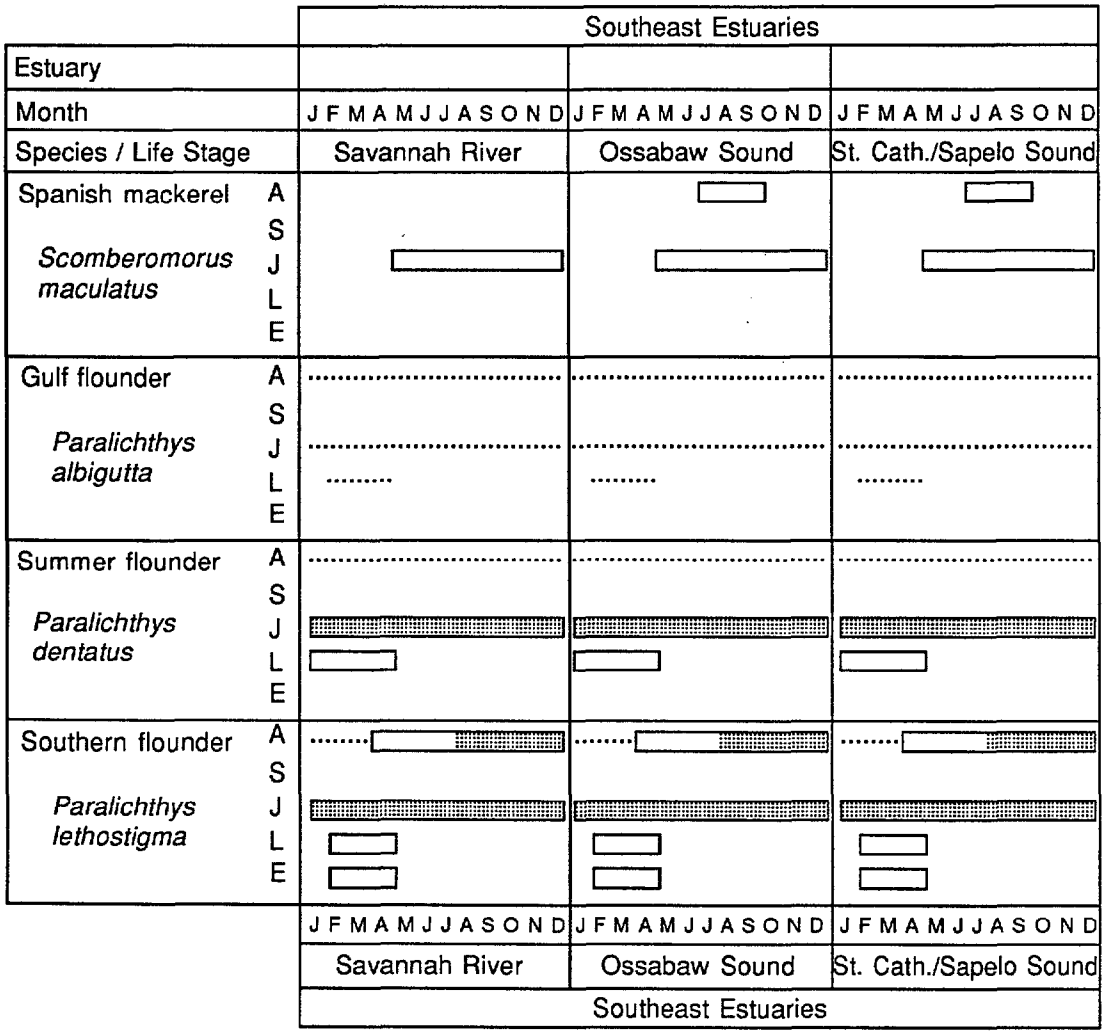

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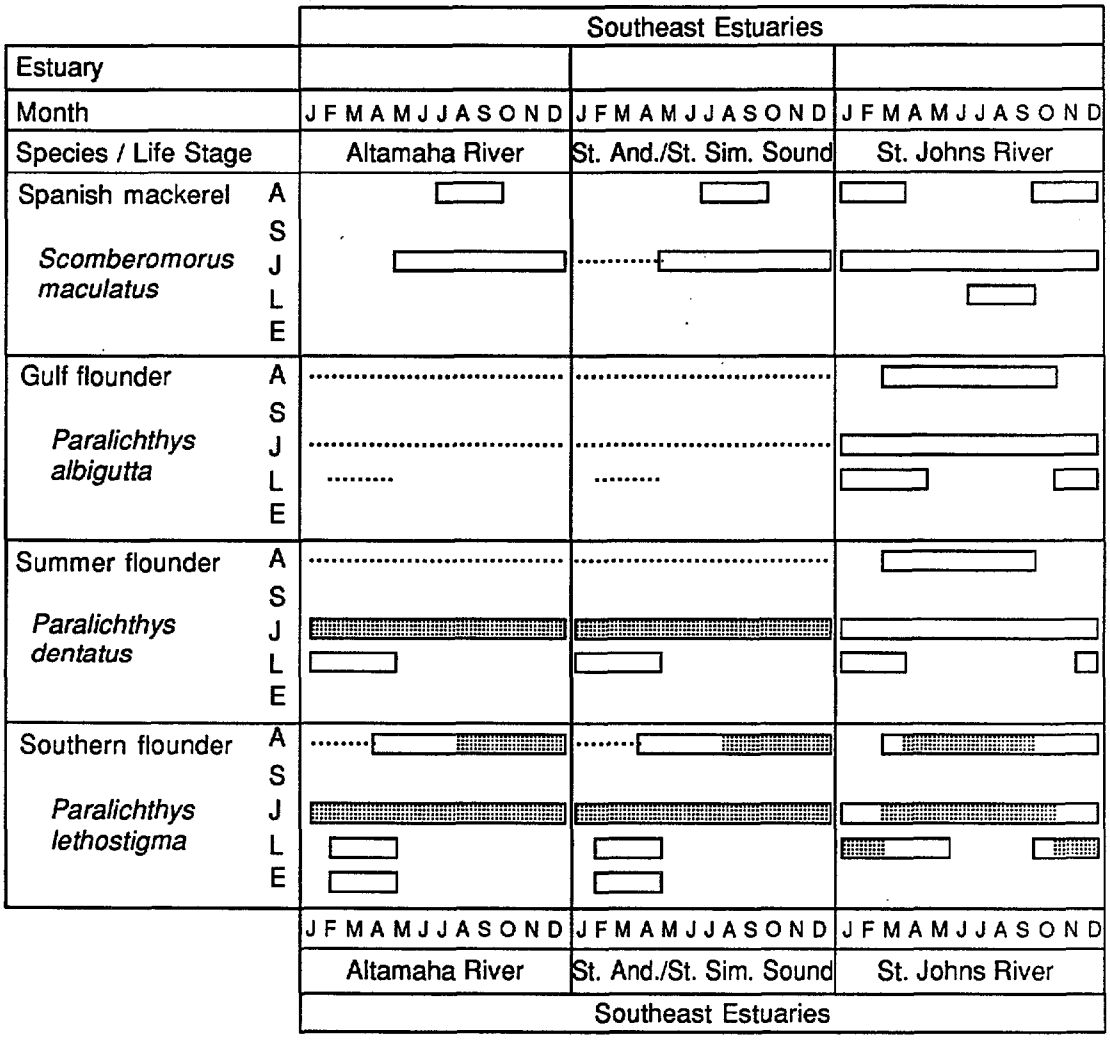

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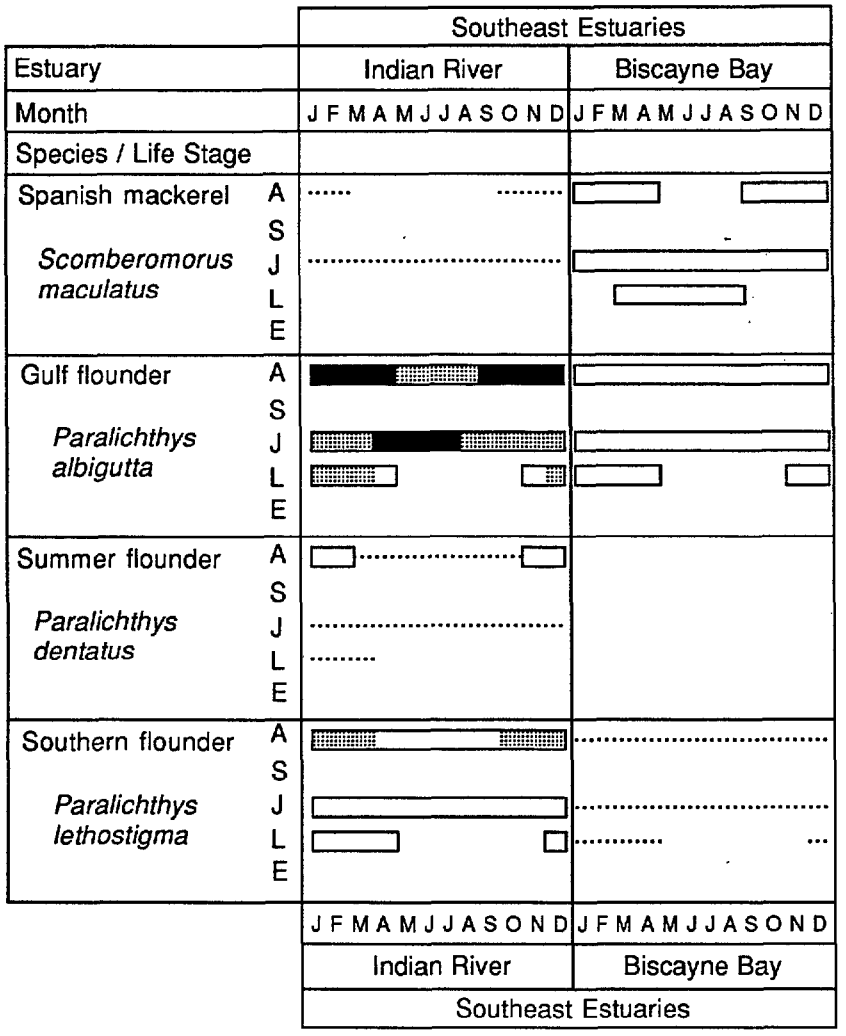

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Table 4. Data reliability

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		Albemarle Sound	Pamlico Sound	Pamlico/ Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		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	■	■	■	■	■	■	■
		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 *Mytilis edulis*	A	■	■	■	■	■	■
	S	■	■	■	■	■	■
	J	■	■	■	■	■	■
	L	■	■	■	■	■	■
	E	■	■	■	■	■	■
Bay scallop *Argopecten irradians*	A	■	■	■	□	□	□
	S	■	■	■	□	□	□
	J	■	■	■	□	□	□
	L	■	■	■	□	□	□
	E	■	■	■	□	□	□
American oyster *Crassostrea virginica*	A	▣	▣	▣	▣	▣	▣
	S	□	□	▣	▣	□	□
	J	▣	▣	▣	▣	▣	▣
	L	□	□	□	▣	□	□
	E	□	□	□	▣	□	□
Common rangia *Rangia cuneata*	A	□	□	□	■	■	□
	S	□	□	□	■	□	□
	J	□	□	□	■	■	□
	L	□	□	□	■	□	□
	E	□	□	□	■	□	□
Hard clam *Mercenaria species*	A	▣	▣	▣	□	▣	□
	S	▣	▣	▣	□	▣	□
	J	▣	▣	▣	□	▣	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	▣	□
Brown shrimp *Penaeus aztecus*	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		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		Southeast Estuaries						
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		Winyah Bay	N & S Santee Rivers	Charleston Harbor	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound
		Southeast Estuaries						
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		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		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	▣	▣	□	▣	▣	□	▣
		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		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		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	■	■	■	■	■	■	■
		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		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		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	▣	▣	□	□	□	□	▣
		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		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		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	■	■	■	■	■	■	■
		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		Albemarle Sound	Pamlico Sound	Pamlico & Pungo Rivers	Neuse River	Bogue Sound	New River	Cape Fear River
		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	■	■	■	■	■	■	■
		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	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. 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. 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

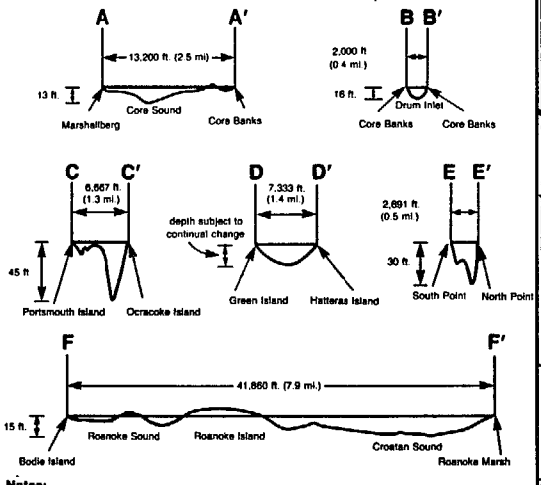
PHYSICAL AND HYDROLOGIC CHARACTERISTICS

PHYSICAL		FRESHWATER INFLOW			TIDAL DATA		
Surface Areas (mi^2)		*Flow Rates (1000 cfs)*			Prevailing Tide: Semidiurnal		
Fluvial Drainage	5,548	Period of Record		1971-1982	Tidal Prism (cf)		2.86×10^{10}
Estuarine Drainage	5,790	Long Term Average Daily		21.2	*Phase Range of Tide (ft.)*		
Estuarine Zones		Long Term Average Monthly	J 23.4	J 25.3	Map Key	Station	Range
Tidal Fresh	96		F 22.5	A 23.2	A	2453	1.7
Mixing Zone	1,691		M 27.1	S 18.9	B	2447	0.3
Seawater	40		A 21.9	O 14.1	C	2457	2.0
Total	2,027		M 20.6	N 14.3	C	2458	1.9
Dimensions			J 21.6	D 17.2			
Length (mi.)	120.0	7-Day, 10-Year Low Flow		0.4			
Width (mi.) Average	15.7	50-Year Flood		98.8			
Minimum	0.9	100-Year Flood		111.5			
Maximum	29.6	*Flow Ratios*					
Average Depth (ft.)	18.0	Average Annual		0.033			
Average Depth to Width Ratio	2.2×10^{-4}	High Flow Period		0.038			
Stratification Classification		Low Flow Period		0.024			
3-Month High Flow	VH						
3-Month Low Flow	VH						

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

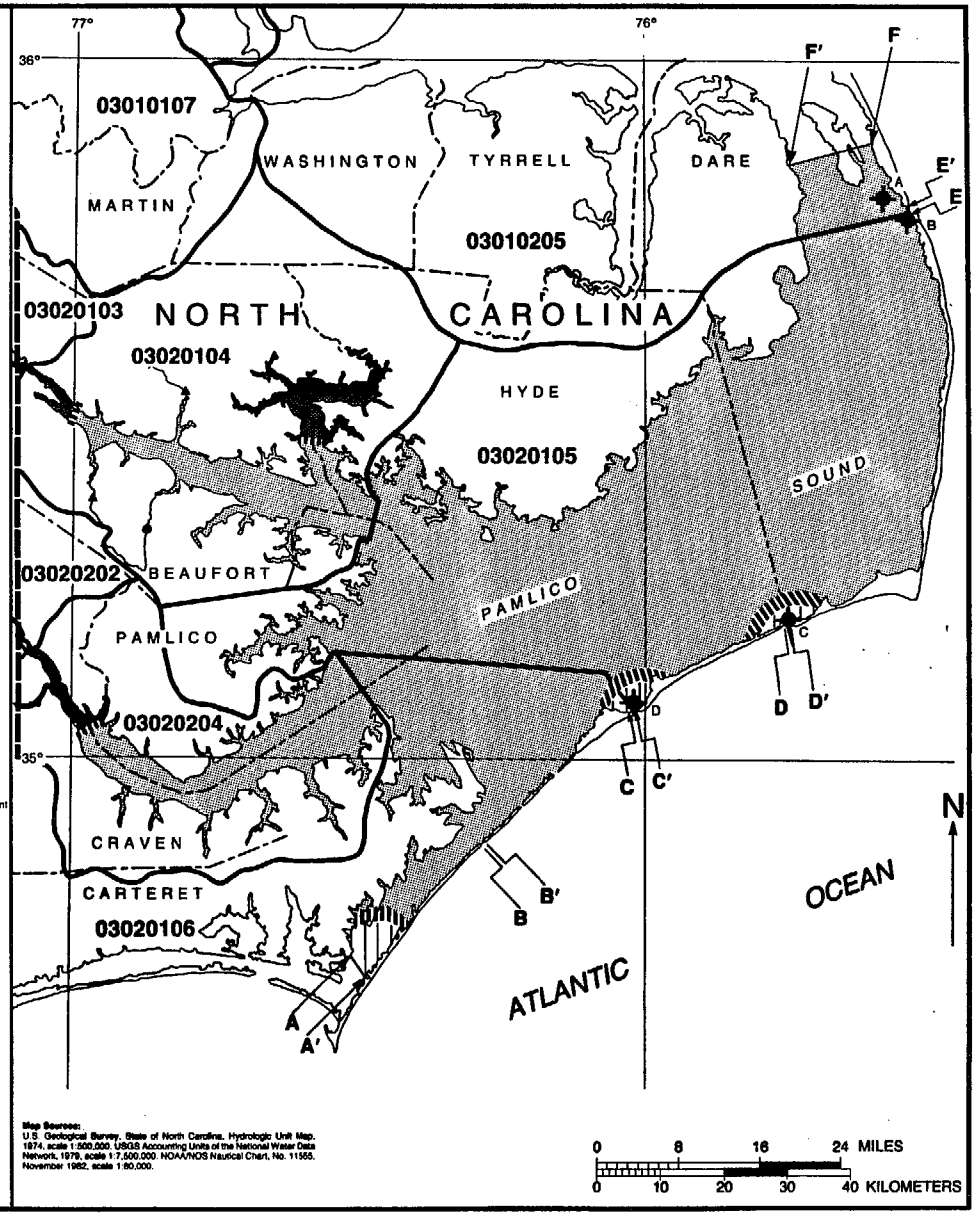
Cross Sections
(at mean high water)

1 / 133 Scale Ratio



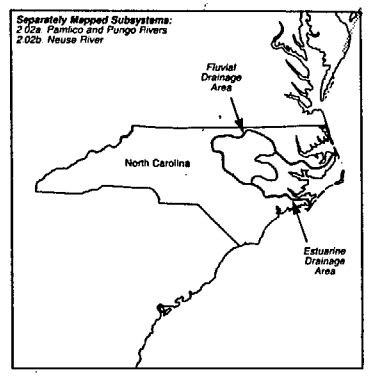
Notes:
Approximately 65% of Estuarine Drainage Area is shown on map. Drainage Divide represents portion of Estuarine Drainage Area boundary not coinciding with U.S. Geological Survey cataloging unit boundary. Tidal prism calculations assume a uniform 0.5 ft tide range except at the ocean inlets. Flows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

Appendix 4. ELMR Life History Summary

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).

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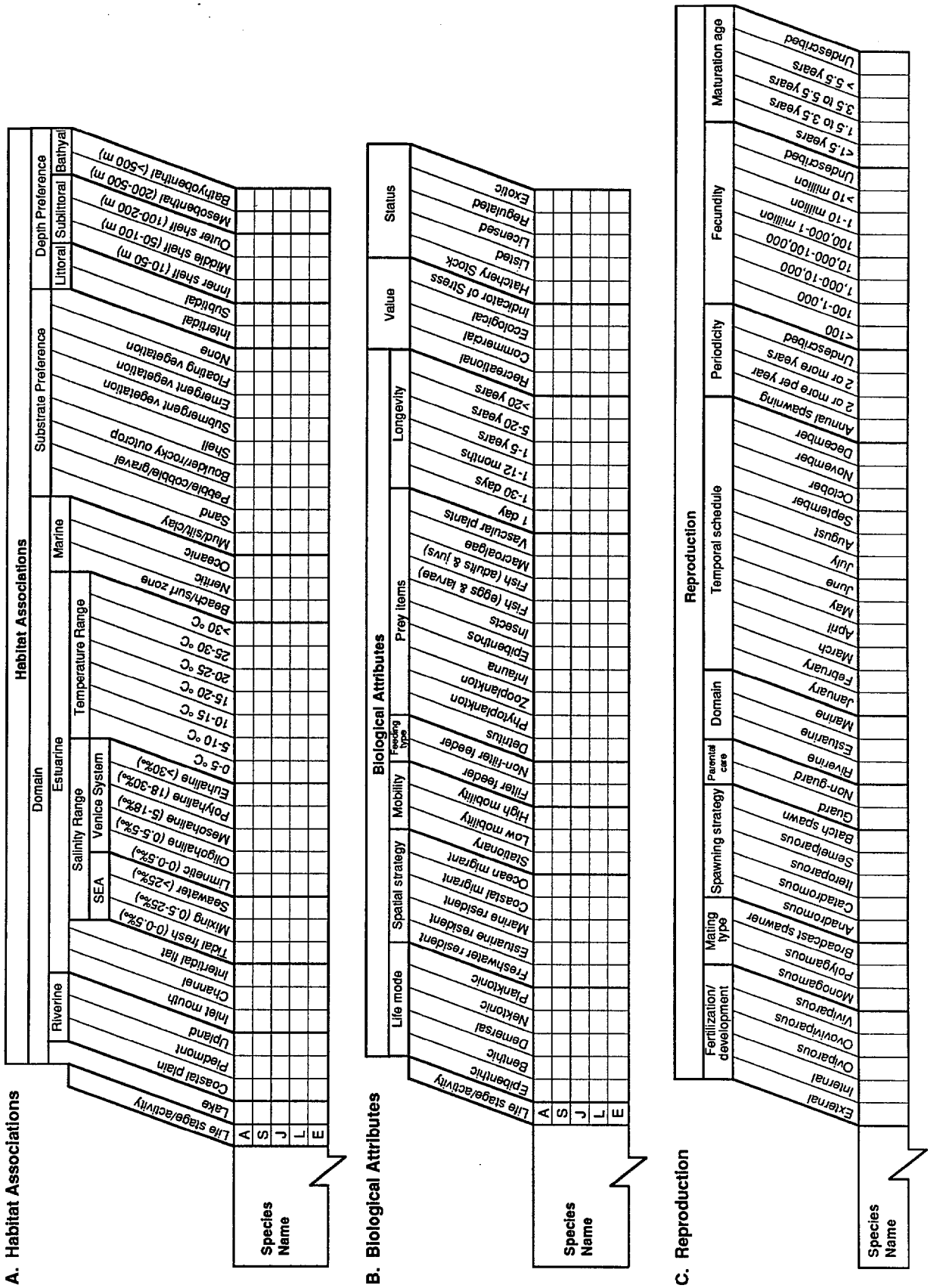
Appendix 5. Life History Table headers.



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 *Mugil 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	554
Mytilis edulis	not reviewed
Bay scallop	148
Argopecten irradians	Taylor, Parker
American oyster	27, 57, 69
Crassostrea virginica	Parker
Common rangia	1, 231, 289
Rangia cuneata	Lindquist
Hard clam	138
Mercenaria species	Parker
Brown shrimp	69, 70, 227, 240, 551
Penaeus aztecus	Allison, Cooke, Lindquist
Pink shrimp	70, 227, 551
Penaeus duorarum	Allison, Cooke, Lindquist
White shrimp	70, 371, 578, 579
Penaeus setiferus	Allison, Cooke, Lindquist
Grass shrimp	12, 47
Palaemonetes pugio	Pollard
Blue crab	122, 304, 428, 523, 578, 579
Callinectes sapidus	Pollard, Schoolfield, Lindquist
Atlantic sturgeon	41, 250, 315, 427, 442, 443, 444
Acipenser oxyrhynchus	Schoolfield, Lindquist, Thompson, Moser, S. Ross
Ladyfish	250, 442
Elops saurus	Schoolfield, Thompson, Lindquist
American eel	143, 442, 521
Anguilla rostrata	Schoolfield, Lindquist
Blueback herring	109, 151, 315, 441, 442
Alosa aestivalis	Schoolfield, Thompson, Lindquist, Moser
Alewife	109, 151, 315, 442
Alosa pseudoharengus	Schoolfield, Thompson, Lindquist, Moser
American shad	109, 151, 315, 442, 457
Alosa sapidissima	Pollard, Schoolfield, Lindquist, Moser
Atlantic menhaden	6, 69, 70, 83, 259, 291, 428, 442, 551
Brevoortia tyrannus	Ahrenholz, Smith, J.
Bay anchovy	70, 240, 428, 442, 514, 551
Anchoa mitchilli	Schoolfield, Cooke, Lindquist
Sheepshead minnow	194, 220, 442
Cyprinodon variegatus	Lindquist
Mummichog	194, 428, 442
Fundulus heteroclitus	Schoolfield, Pollard, Lindquist
Atlantic silversides	70, 147, 442
Menidia species	Schoolfield, Cooke, Lindquist
White perch	195, 315, 442
Morone americana	Rohde, Lindquist
Striped bass	151, 442, 457
Morone saxatilis	Rohde, Thompson, Lindquist, Moser, S. Ross
Bluefish	80, 442
Pomatomus saltatrix	Rohde, Benedict, Lindquist
Cobia	315, 442
Rachycentron canadum	Rohde, Lindquist, J. Smith, Herring
Gray snapper	240, 315, 442
Lutjanus griseus	Manooch, Herring, Lindquist, Rohde
Sheepshead	143, 264, 315, 442, 440
Archosargus probatocephalus	Rohde, Herring, Lindquist
Pinfish	108, 442, 443, 444
Lagodon rhomboides	Rohde, Herring, Lindquist
Spotted seatrout	227, 240, 247, 315, 442
Cynoscion nebulosus	Benedict, Rohde, Lindquist
Weakfish	70, 240, 338, 346, 442, 443, 444
Cynoscion regalis	Schoolfield, Benedict, Lindquist
Spot	47, 70, 99, 227, 428, 443, 444, 549, 551, 552
Leiostomus xanthurus	Schoolfield, Cates, Lindquist
Southern kingfish	247, 376, 442
Menticirrhus americanus	Schoolfield, Cates, Lindquist
Atlantic croaker	47, 70, 99, 240, 442, 443, 444, 548
Micropogonias undulatus	Cates, Schoolfield, Lindquist
Black drum	247, 315, 376, 442, 462
Pogonias cromis	Lindquist, Benedict, Schoolfield
Red drum	240, 442, 462, 551
Sciaenops ocellatus	Schoolfield, Benedict, Lindquist
Striped mullet	69, 79, 442, 551
Mugul cephalus	Pollard, Schoolfield, Lindquist
Spanish mackerel	80, 240, 442
Scomberomorus maculatus	Schoolfield, Pollard, Lindquist
Gulf flounder	84, 442
Paralichthys albigutta	Rohde, Herring
Summer flounder	70, 84, 376, 421, 442, 443, 444, 551
Paralichthys dentatus	Powell, Herring, Rohde, Lindquist
Southern flounder	84, 117, 240, 442, 443, 444
Paralichthys lethostigma	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	1, 153, 593
Mytilis edulis	Anderson, Stokes, Hopkins, Holloway, Hamilton
Bay scallop	63, 153, 184, 593
Argopecten irradians	Anderson, Stokes, Hopkins, Holloway, Hamilton
American oyster	27, 37, 57, 183, 262, 263, 335, 476
Crassostrea virginica	Anderson, Stokes, Hopkins, Holloway, Hamilton
Common rangia	61, 289, 593
Rangia cuneata	Anderson, Stokes, Hopkins, Holloway
Hard clam	13, 37, 138, 139, 140, 184
Mercenaria species	Anderson, Stokes, Hopkins, Holloway
Brown shrimp	34, 37, 38, 82, 144, 145, 329, 449, 512, 517, 570, 579
Penaeus aztecus	Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Pink shrimp	34, 37, 38, 87, 130, 144, 329, 512, 579
Penaeus duorarum	Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
White shrimp	34, 37, 130, 144, 145, 297, 298, 371, 449, 512, 579
Penaeus setiferus	Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Grass shrimp	10, 12, 284, 452, 459, 515, 579
Palaemonetes pugio	Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Blue crab	37, 131, 304, 328, 449, 515, 523, 579
Callinectes sapidus	Stokes, Hopkins, Holloway, Whitaker, Delancey, Wenner
Atlantic sturgeon	219, 290, 372, 470, 473, 522
Acipenser oxyrhynchus	Stokes, Hopkins, Holloway
Ladyfish	33, 219, 222, 250, 515, 593
Elops saurus	Stokes, Hopkins, Holloway
American eel	37, 192, 194, 197, 232, 515, 521
Anguilla rostrata	Stokes, Hopkins, Holloway
Blueback herring	37, 146, 250, 336, 390, 449, 519
Alosa aestivalis	Stokes, Holloway
Alewife	146, 250, 390
Alosa pseudoharengus	Stokes, Holloway
American shad	141, 519, 533
Alosa sapidissima	Stokes, Hopkins, Holloway
Atlantic menhaden	37, 50, 219, 336, 411, 420, 449, 515
Brevoortia tyrannus	Stokes, Hopkins, Holloway, Hamilton
Bay anchovy	37, 250, 327, 449, 451, 515
Anchoa mitchilli	Stokes, Holloway
Sheepshead minnow	37, 194, 593
Cyprinodon variegatus	Stokes, Hopkins, Holloway
Mummichog	2, 37, 60, 194, 412, 515
Fundulus heteroclitus	Stokes, Hopkins, Holloway
Atlantic silversides	37, 60, 147, 221, 327, 349, 363, 452, 515
Menidia species	Stokes, Hopkins, Holloway
White perch	37, 195, 336
Morone americana	Stokes, Hopkins, Holloway, Hamilton
Striped bass	149, 195, 474, 519
Morone saxatilis	Stokes, Hopkins, Holloway, Hamilton
Bluefish	33, 37, 38, 80, 219, 68.1, 305, 399, 449, 515
Pomatomus saltatrix	Stokes, Hopkins, Holloway
Cobia	33, 37, 38, 195, 305
Rachycentron canadum	Stokes, Hopkins, Holloway
Gray snapper	60, 195, 515, 593
Lutjanus griseus	Stokes, Hopkins, Holloway
Sheepshead	37, 38, 60, 225, 247, 515, 593
Archosargus probatocephalus	Stokes, Hopkins, Holloway
Pinfish	33, 37, 50, 108, 452, 515
Lagodon rhomboides	Stokes, Hopkins, Holloway
Spotted seatrout	33, 37, 219, 247, 339, 341, 405, 502, 515
Cynoscion nebulosus	Stokes, Hamilton, Holloway
Weakfish	37, 219, 308, 338, 343, 449, 451, 515
Cynoscion regalis	Stokes, Hamilton, Holloway
Spot	37, 50, 111, 219, 345, 449, 451, 515
Leiostomus xanthurus	Stokes, Holloway
Southern kingfish	33, 35, 37, 247, 449, 451, 465
Menticirrhus americanus	Stokes, Holloway
Atlantic croaker	36, 37, 50, 219, 333, 352, 449, 451, 515
Micropogonias undulatus	Stokes, Hopkins, Holloway
Black drum	37, 38, 219, 247, 376, 515
Pogonias cromis	Stokes, Holloway
Red drum	33, 37, 38, 219, 247, 342, 515
Sciaenops ocellatus	Stokes, Holloway
Striped mullet	14, 37, 50, 515
Mugul cephalus	Stokes, Hamilton, Holloway
Spanish mackerel	37, 80, 157, 515, 593
Scomberomorus maculatus	Stokes, Hopkins, Holloway
Gulf flounder	37, 132, 451, 515
Paralichthys albigutta	Stokes, Hamilton
Summer flounder	33, 37, 38, 50, 60, 219, 421, 515, 593
Paralichthys dentatus	Stokes, Hamilton, Holloway
Southern flounder	33, 37, 38, 219, 449, 515, 593
Paralichthys lethostigma	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 puglo*	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 puglo*	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

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C. White	Brevard County Ofc. of Nat. Res. Mgt., Merrit Island, FL
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