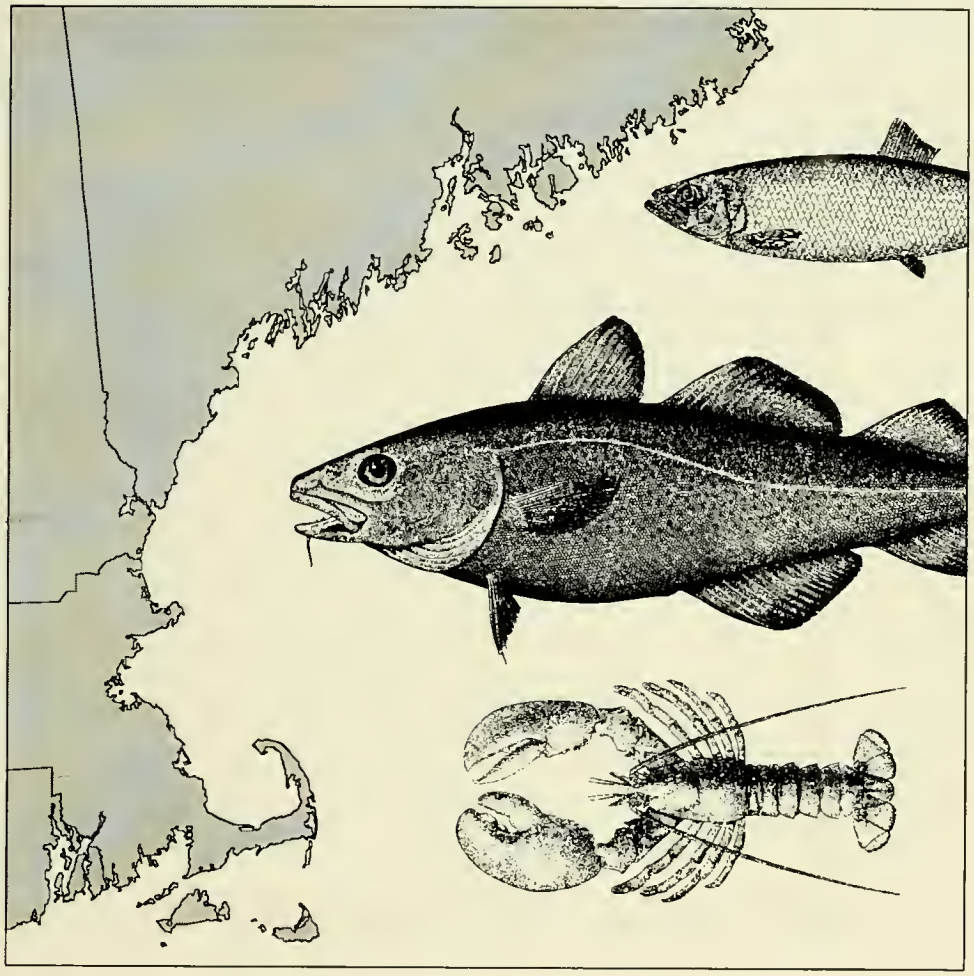
NOAA's Estuarine Living Marine Resources Program

Distribution and Abundance of Fishes and Invertebrates in North Atlantic Estuaries



May 1994

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, 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 has been conducted jointly by the SEA Division, the National Marine Fisheries Service (NMFS), and other agencies and institutions. The nationwide ELMR data base was completed in January 1994, and includes data for 135 species found in 122 estuaries and coastal embayments. Eight reports and reprints are now available free upon request, and another is scheduled for completion in 1994 (see below). This report, *Distribution and Abundance of Fishes and Invertebrates in North Atlantic Estuaries,* summarizes information on the distribution and abundance of 58 fish and invertebrate species in 17 North Atlantic estuaries. A national report summarizing the data and results from the program will be published in 1995.

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.

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

NOAA/NOS SEA Division, N/ORCA1
1305 East-West Hwy., 9th Floor
Silver Spring, Maryland 20910
Phone (301) 713-3000
Fax (301) 713-4384

Selected reports and reprints available from NOAA's Estuarine Living Marine Resources program include:

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

Emmett, R.L., et al. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries, Vol. II: Species life history summaries. ELMR Rep. 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 Rep. No. 9. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 177 p.

Monaco, M.E., et al. 1992. Assemblages of U.S. west coast estuaries based on the distribution of fishes. Journal of Biogeography 19: 251-267.

Nelson, D.M. (editor), et al. 1992. Distribution and abundance of fishes and invertebrates in Gulf of Mexico estuaries, Vol. I: data summaries. ELMR Rep. No. 10. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 273 p.

Bulger, A.J., et al. 1993. Biologically-based salinity zones derived from a multivariate analysis. Estuaries 16: 311-322.

Pattillo, M.E., et al. In prep. Distribution and abundance of fishes and invertebrates in Gulf of Mexico estuaries, Vol. II: species life history summaries. ELMR Rep. No. 11. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD.

Stone, S.L., et al. 1994. Distribution and abundance of fishes and invertebrates in Mid-Atlantic estuaries. ELMR Rep. No. 12. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD. 280 p.

Jury, S.H., et al. 1994. Distribution and abundance of fishes and invertebrates in North Atlantic estuaries. ELMR Rep. No. 13. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD. 221 p.

Distribution and Abundance of Fishes and Invertebrates in North Atlantic Estuaries

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Introduction

This report presents information on the spatial and temporal distribution, relative abundance, and life history characteristics of 58 species of fishes and invertebrates (Table 1) in 17 estuaries in Massachusetts, New Hampshire, and Maine. Its purpose is to disseminate data developed from the National Oceanic and Atmospheric Administration's (NOAA) Estuarine Living Marine Resources (ELMR) program (see inside front cover). The ELMR program is conducted by the Biogeographic Characterization Branch of the Strategic Environmental Assessments (SEA) Division. The primary data compiled include the presence, distribution, and relative abundance of each species and the time period it utilizes each estuary. The data and framework presented are illustrative of the nationwide ELMR program (Monaco et al. 1990, Nelson et al. 1991, Nelson 1992, Stone et al. 1994).

The objective of the ELMR program is to develop a consistent data base on the presence, distribution, relative abundance, and life history characteristics of ecologically and economically important fishes and invertebrates in the nation's estuaries. The data base is divided into five study regions (Figure 1) and contains the monthly relative abundance 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 and supplement (NOAA 1985). The nationwide data base contains information for 135 fish and invertebrate species found in 122 estuaries.

Rationale

Estuaries are among the most productive natural systems and have been shown to be important nursery areas that provide food, refuge from predation, and valuable habitat for many species (Tyler 1971, MacDonald et al. 1984, Langton et al. 1989, Day et al. 1989, Ayvazian et al. 1992). Estuarine organisms that support important commercial and recreational fisheries include bivalves, decapods, and a variety of finfish. In spite of the well-documented importance of estuaries to fishes and invertebrates, few consistent and comprehensive data bases exist that 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 1990, Darnell et al. 1983).

Only a few sampling programs (e.g., Massachusetts Division of Marine Fisheries, Maine Department of Marine Resources inshore trawl surveys) collect fishes and invertebrates with identical methods across groups of estuaries within a region (Howe et al. 1991, MDMR 1993). 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.

Figure 1. ELMR study regions and regional research institutions.

Because different life stages of many species use both estuarine and marine habitats, information on the distribution, abundance, temporal utilization and life history characteristics are needed to understand the coupling of estuarine, nearshore, and offshore habitats. Consequently, the ELMR program was developed to integrate fragments of information on these species and their associated habitats into a useful, comprehensive and consistent format. A national data base of this type does not presently exist. Results from this program 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. In addition the ELMR data will be integrated with information from NOAA's East Coast of North America Strategic Assessment Project to provide consistent species distribution data in marine, as well as estuarine, environments (NOAA, 1991).

Data Collection and Organization

Compiling consistent data nationwide limits the amount of information that may be collected for each species and estuary. It would also be both time and cost-prohibitive to map each species by life stage for each estuary (Monaco 1986). The NOAA framework enables a consistent compilation and organization of all available data on the distribution and abundance of fishes and invertebrates in estuaries. Figure 2 summarizes the major steps taken to collect and organize this information. The initial steps were selection of the estuaries and species to be studied.

Selection of estuaries. Thirteen North Atlantic estuaries were selected from the National Estuarine Inventory (NEI) Data Atlas-Volume I (NOAA 1985) and, after discussions with several regional researchers, four additional estuaries were included. The locations of the 17 selected estuaries and their associated salinity zones are shown in Figure 3.

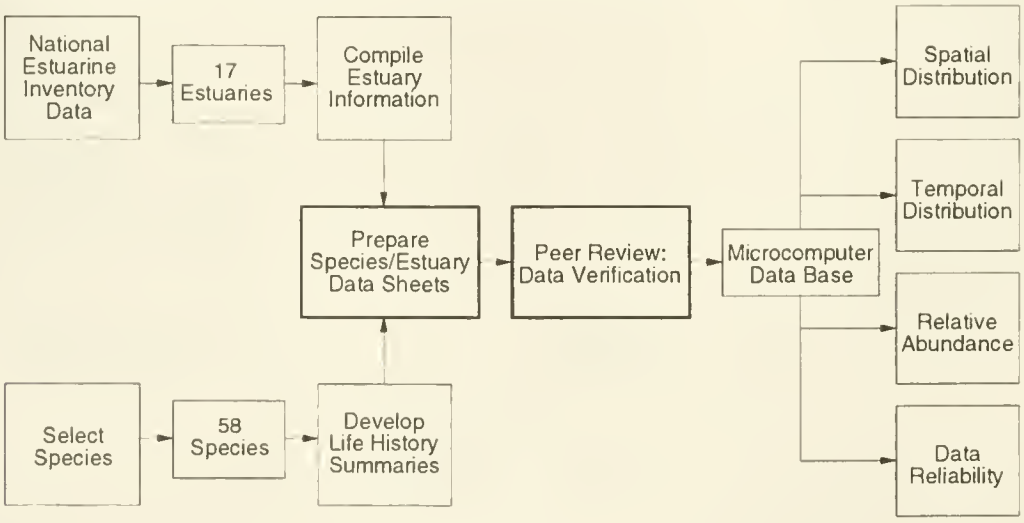
Data on the spatial and temporal distributions of species were compiled for the tidal fresh (0.0-0.5 parts per thousand (ppt)), mixing (0.5-25.0 ppt), and seawater (> 25 ppt) zones delineated for each estuary in the NEI. A representative map and data table for Penobscot Bay from the NEI Data Atlas is shown in Appendix 1. Each salinity zone is represented in 12 of the 17 North Atlantic estuaries, but for the purposes of this study 5 estuaries are considered to be missing at least one of the aforementioned zones (Figure 3). Salinity zones that are only seasonally present or are extremely small (i.e., <1 km^2) were generally omitted from this large-scale assessment (see NOAA 1985 for a discussion of zone delineation). Refer to Appendix 2, *Estuary notes*, for the rationale for additions to the NEI and a discussion of unique features of estuaries in the Gulf of Maine region.

Selection of species. ELMR personnel and local reviewers used the following four criteria, together with data availability, to select 58 species for inclusion in the ELMR data base (Table 1). The common and scientific names of all species are those adopted by the American Fisheries Society (Turgeon et al. 1988, Williams et al. 1988, Robins et al. 1991):

- Commercial value—determined by review of catch data and value statistics from NMFS and state agencies, e.g., Atlantic cod (*Gadus morhua*) and softshell clam (*Mya arenaria*).

- Recreational value—determined by relative importance in recreational fisheries that may or may not be commercially exploited. Recreational species were

Figure 2. Major steps taken to complete the North Atlantic ELMR study.



determined by consulting regional experts and NMFS reports, e.g., Atlantic salmon (*Salmo salar*) and striped bass (*Morone saxatilis*).

• Indicator of environmental stress—determined from the literature, discussions with fisheries experts, and from monitoring programs such as NOAA's National Status and Trends Program (O'Connor 1990). These species are typically molluscs or demersal fishes that consume benthic invertebrates or have a strong association with bottom sediments, e.g., blue mussel (*Mytilus edulis*) and winter flounder (*Pleuronectes americanus*). Their physiological disorders, morphological abnormalities, and bioaccumulation of contaminants, such as heavy metals, indicate exposure to environmental pollution and/or stress.

• Ecological value—based on several attributes including trophic level, relative abundance, and importance as a key predator or prey species, e.g., silversides (*Menidia* species) and sevenspine bay shrimp (*Crangon septemspinosa*).

For the majority of species considered in this report, growth and development involve a direct progression through several distinct life stages. Accordingly, the ELMR program has compiled information based on five "typical" life stages: adult (A), spawning adult (S), juvenile (J), larvae (L) and egg (E). *Adults* were defined as reproductively mature individuals while *juveniles* were defined as immature but otherwise similar to adults. Species with a larval stage typically undergo metamorphosis to the juvenile stage, hence larvae usually differ from juveniles and adults in form. In addition, most species rely on external fertilization via spawning, when gametes combine externally after being released by males and/or females. Therefore, *spawning adults* were defined as those releasing eggs or sperm and *larvae* and *eggs* included most early life history stages. The complex life histories of some species, and the subsequent difficulty in placing them into a comprehensive classification scheme, required some deviation from this general classification. For example, mating (M) or parturition (P) replaced spawning (S) for some species (e.g., green crab and spiny dogfish respectively) because the reproductive mode of certain species differs from the norm in that there is internal fertilization of eggs, ovoviviparity, delayed fertilization, etc. In addition, egg and/or larval stages are not applicable for certain species because the stage(s) is either absent or better defined by the presence of gravid females. Refer to Appendix 3, *Species life history notes,* for a discussion of these deviations for individual species. This section identifies cases where the ELMR program has considered alternate life stages, cases in which two or more species are considered as a single unit, comments on specific habitat preferences and behaviors, and other pertinent life history information.

Figure 3. ELMR North Atlantic estuaries and associated salinity zones.

Legend: T =Tidal fresh zone M = Mixing zone S = Seawater zone * = Salinity zone not present

Table 1. ELMR North Atlantic species.

Common name	Scientific name	Family
Blue mussel	*Mytilus edulis*	Mytilidae
Sea scallop	*Placopecten magellanicus*	Pectinidae
American oyster	*Crassostrea virginica*	Ostreidae
Northern quahog	*Mercenaria mercenaria*	Veneridae
Softshell clam	*Mya arenaria*	Myidae
Daggerblade grass shrimp	*Palaemonetes pugio*	Palaemonidae
Northern shrimp	*Pandalus borealis*	Pandalidae
Sevenspine bay shrimp	*Crangon septemspinosa*	Crangonidae
American lobster	*Homarus americanus*	Nephropidae
Jonah crab	*Cancer borealis*	Cancridae
Atlantic rock crab	*Cancer irroratus*	Cancridae
Green crab	*Carcinus maenas*	Portunidae
Green sea urchin	*Strongylocentrotus droebachiensis*	Strongylocentrotidae
Spiny dogfish	*Squalus acanthias*	Squalidae
Skates	*Raja* species	Rajidae
Shortnose sturgeon	*Acipenser brevirostrum*	Acipenseridae
Atlantic sturgeon	*Acipenser oxyrhynchus*	Acipenseridae
American eel	*Anguilla rostrata*	Anguillidae
Blueback herring	*Alosa aestivalis*	Clupeidae
Alewife	*Alosa pseudoharengus*	Clupeidae
American shad	*Alosa sapidissima*	Clupeidae
Atlantic menhaden	*Brevoortia tyrannus*	Clupeidae
Atlantic herring	*Clupea harengus*	Clupeidae
Rainbow smelt	*Osmerus mordax*	Osmeridae
Atlantic salmon	*Salmo salar*	Salmonidae
Atlantic cod	*Gadus morhua*	Gadidae
Haddock	*Melanogrammus aeglefinus*	Gadidae
Silver hake	*Merluccius bilinearis*	Gadidae
Atlantic tomcod	*Microgadus tomcod*	Gadidae
Pollock	*Pollachius virens*	Gadidae
Red hake	*Urophycis chuss*	Gadidae
White hake	*Urophycis tenuis*	Gadidae
Mummichogs	*Fundulus heteroclitus*	Cyprinodontidae
Silversides	*Menidia* species	Atherinidae
Fourspine stickleback	*Apeltes quadracus*	Gasterosteidae
Threespine stickleback	*Gasterosteus aculeatus*	Gasterosteidae
Ninespine stickleback	*Pungitius pungitius*	Gasterosteidae
Northern pipefish	*Syngnathus fuscus*	Syngnathidae
Northern searobin	*Prionotus carolinus*	Triglidae
Grubby	*Myoxocephalus aenaeus*	Cottidae
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	Cottidae
Shorthorn sculpin	*Myoxocephalus scorpius*	Cottidae
White perch	*Morone americana*	Percichthyidae
Striped bass	*Morone saxatilis*	Percichthyidae
Bluefish	*Pomatomus saltatrix*	Pomatomidae
Scup	*Stenotomus chrysops*	Sparidae
Tautog	*Tautoga onitis*	Labridae
Cunner	*Tautogolabrus adspersus*	Labridae
Ocean pout	*Macrozoarces americanus*	Zoarcidae
Rock gunnel	*Pholis gunnellus*	Pholidae
American sand lance	*Ammodytes americanus*	Ammodytidae
Atlantic mackerel	*Scomber scombrus*	Scombridae
Butterfish	*Peprilus triacanthus*	Stromateidae
Windowpane flounder	*Scophthalmus aquosus*	Bothidae
American plaice	*Hippoglossoides platessoides*	Pleuronectidae
Winter flounder	*Pleuronectes americanus*	Pleuronectidae
Yellowtail flounder	*Pleuronectes ferrugineus*	Pleuronectidae
Smooth flounder	*Pleuronectes putnami*	Pleuronectidae

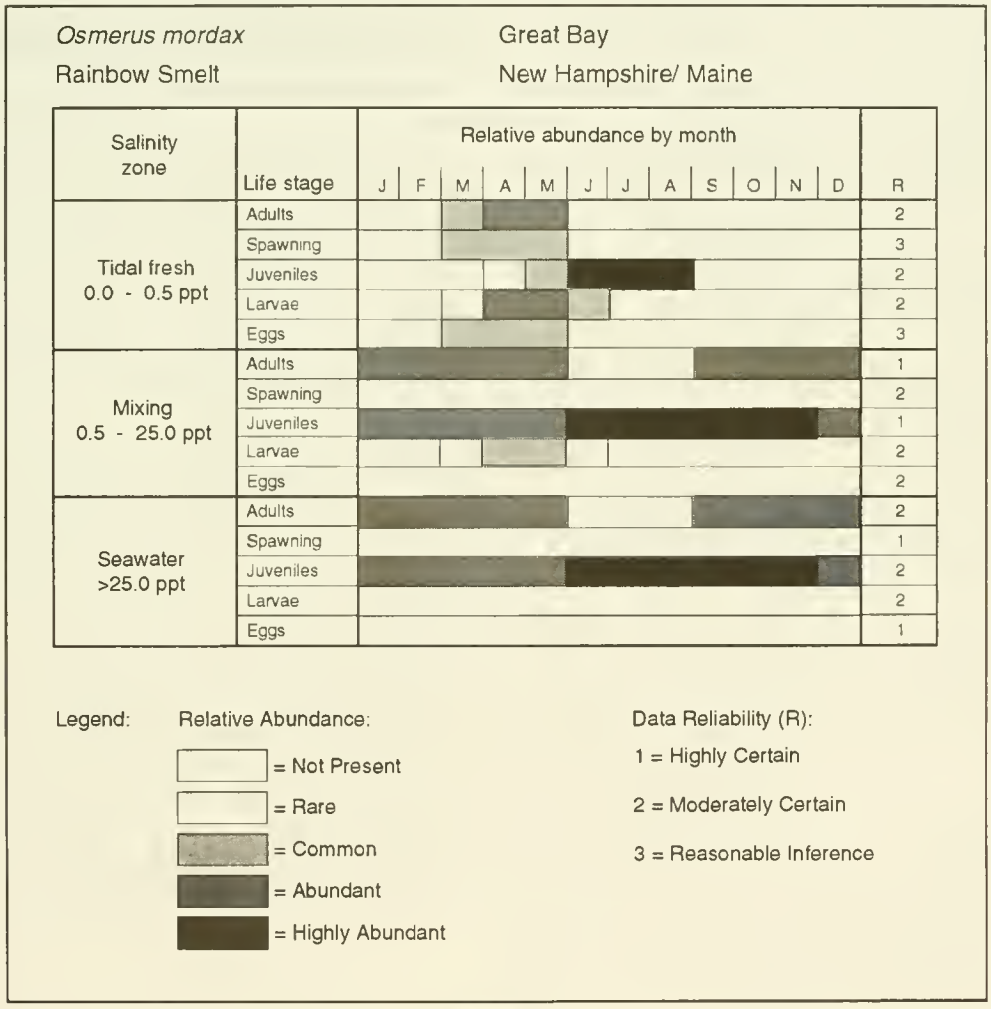
Data sheet development. A data sheet was developed for each species in each estuary to facilitate the review and presentation of the information. Data compiled for each species/life stage included: 1) the salinity zone it occupies (seawater, mixing, tidal fresh), 2) its monthly distribution in those zones, and 3) its relative abundance in those zones. Figure 4 depicts the data sheet for rainbow smelt (*O. mordax*) in Great Bay, NH/ME. Project staff developed these data sheets by conducting exhaustive literature searches, and examining published and unpublished data sets. To complement the information from these quantitative studies, regional and local biologists were asked for their knowledge of estuary/species-specific spatial and temporal distribution patterns and relative abundance levels based upon their experience and research. The final level of relative abundance assigned to a species was determined from the available data and expert review.

The abundance of a species was assessed relative to that of the same life stage of other species with similar behaviors (e.g., pelagic, demersal), gear susceptibilities, and/or habitats. Based upon these similarities, it was possible to derive several "guilds" from the North Atlantic ELMR species list and meaningfully assess the relative abundance of species within each guild (Table 2). For example, bluefish were compared to other pelagic species and blue mussels were compared to other bivalves but they were not compared to each other. To rank relative abundances, ELMR staff used 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. This category was also infrequently used if the limited data available were extremely conflicting and/or contradictory (e.g., white hake spawning); in these cases, *no information available* actually describes a situation where the available information was indecipherable.

Figure 4. Example of a species/estuary data sheet: Rainbow smelt in Great Bay.



• 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 with similar life modes.

• Highly abundant—species is numerically dominant relative to other species with similar life modes.

Table 2. Classification of ELMR North Atlantic species by guild.

Sessile Invertebrates

Blue mussel
Sea scallop
American oyster
Northern quahog
Softshell clam
Green sea urchin

Shrimps

Daggerblade grass shrimp
Northern shrimp
Sevenspine bay shrimp

Large Crustaceans

American lobster
Jonah crab
Atlantic rock crab
Green crab

Pelagic Fishes

Blueback herring
Alewife
American shad
Atlantic menhaden
Atlantic herring
Rainbow smelt
Atlantic salmon
White perch
Striped bass
Bluefish
Atlantic mackerel
Butterfish

Shallow Water Fishes

Mummichog
Silversides
Fourspine stickleback
Threespine stickleback
Ninespine stickleback
Northern pipefish
American sand lance

Demersal Fishes

Spiny dogfish
Skates
Shortnose sturgeon
Atlantic sturgeon
American eel
Atlantic cod
Haddock
Silver hake
Atlantic tomcod
Pollock
Red hake
White hake
Northern searobin
Grubby
Longhorn sculpin
Shorthorn sculpin
Scup
Tautog
Cunner
Ocean pout
Rock gunnel
Windowpane flounder
American plaice
Winter flounder
Yellowtail flounder
Smooth flounder

The data presented here represent relative abundance levels within a specific estuary; relative abundance levels across all Gulf of Maine estuaries could **not** be determined in this analysis. Nevertheless, the relative abundance data shown in the data summaries depict the best available information that could be synthesized from agency reports, academic studies, and expert reviews (see *Data Content and Quality* section, below).

Data verification. For many well-studied species (e.g., winter flounder, American lobster), quantitative data were used to estimate spatial and temporal distributions. For other species, however, reliable quantitative data were limited. Therefore, nearly all data sheets were submitted to panels of local researchers, managers, and technicians for peer review based upon their knowledge of individual species within an estuary. Approximately one and a half years were required to develop the 986 data sheets (Figure 4) and consult with more than 72 scientists and managers at 33 institutions (see Appendix 4 for names and affiliations). As stated previously, this review process complemented the information gathered from the literature and published data sets compiled by NOAA.

Results

Presence/absence of ELMR species in North-Atlantic estuaries. Table 3 (p. 8-9) was developed to readily convey the occurrence of each of the 58 ELMR species in each of the 17 North Atlantic estuaries. This table depicts the highest relative abundance of the adult or juvenile life stage of each species, in any month, in any salinity zone within each estuary. The spawning, egg, and larval life stage categories are not considered. This table also depicts the zoogeography of species among estuaries.

Data summaries. The information compiled for each species and estuary (986 data sheets) was organized in three data summaries that begin on p. 17. Table 4 (pp. 19-49) summarizes the distribution and relative abundance (the highest level of abundance during the year in each estuary is depicted) for each species by life stage, in each estuary by salinity zone. Table 5 (pp. 51-111) summarizes the temporal distribution and relative abundance 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. The information shown represents the expected spatial and temporal distribution of a species in a particular estuary based upon available data.

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

• The number of species present appeared to be higher in some estuaries than in others (Figure 5). However, only 58 species were selected for the ELMR North Atlantic region study, and thus the species list was not comprehensive for the region. Some of the selected species occur primarily in the northern Gulf of Maine estuaries (e.g., smooth flounder, ninespine stickleback), and some occur primarily in the more southern estuaries (e.g., American oyster, scup, daggerblade grass shrimp). In addition, some estuaries and salinity zones (e.g., Wells Harbor, Damariscotta River tidal fresh) were quite small and contained relatively little habitat for several of the selected species.

• The number of larval species was higher in the southern estuaries (Cape Cod Bay, Boston Bay, Massachusetts Bay, Great Bay) than in the northern ones (Figure 5). This may have resulted, in part, from spawning activity by the more southern species (e.g., American oyster, scup, daggerblade grass shrimp) in these systems, and large seawater zones which could accommodate more of the marine spawners.

• The number of species appeared to be lowest in the tidal fresh zone (Figures 5 and 6). However, this could have been partially due to the fact that the selected ELMR species are primarily estuarine, not freshwater. Most of the ELMR species found in fresh water are diadromous, temporarily using the zone as a spawning ground or corridor to other breeding areas. In addition, the lack of systematic faunal surveys in many tidal freshwater zones contribute to this apparent lower diversity.

• Estuarine utilization by all three life stages was highest in the summer and lowest in the winter, with some notable exceptions (e.g., winter flounder, Atlantic herring) (Figure 6).

• The number of species present as larvae in the mixing and seawater zones was highest in June. The number of species present as adults or juveniles was highest in September and October (Figure 6).

Data Content and Quality

Data reliability. An important aspect of the ELMR program, especially since it is based primarily on literature and consultations, is to determine the quality of available data. The quality of available information varied between species, life stage, and estuary, due to differences in gear selectivity, difficulty in identifying larvae, difficulty in sampling various habitats, and the extent of sampling and analysis in particular studies. As a result, spatial and temporal resolution was greater in well-studied estuaries and for well-studied species. For example, a large amount of information was available on the American lobster in the seawater zone because it is highly valued both commercially and recreationally. Conversely, very little is known about smooth flounder in the tidal fresh zone. Similarly, early life history and spawning activity are often poorly documented. Except for a few species, very little data has been generated on specific habitat preferences. This is particularly true for the forage and/or noncommercial fishes and invertebrates. In addition, life history data are lacking or incomplete even for some of the commercially important and pelagic species. Given this situation, an objective of the ELMR program was to describe the quality of available data. Therefore, a deliberate effort was made to assess the data reliability so that the data base could be used appropriately. Estimates of the data reliability for each species and estuary are presented in Table 6 (pp. 113-143) 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.

Appendices 4, 5, and 6 provide a complete summary of the personal communications and primary references used so that readers can easily obtain additional information. An opportunity exists to further refine the data presented based upon additional reviews or new research findings.

Variability in space and time. Species distribution data were organized according to the salinity zone boundaries developed for each estuary in the NEI data atlas-Vol. I and supplement (NOAA 1985). However, these zones can be highly variable due to the many

Table 3. Presence/absence of ELMR species in North Atlantic estuaries. Symbols represent the highest relative abundance of adults or juveniles of a species, in any salinity zone, in any month, within each estuary.

Species	Passamaquoddy Bay	Englishman/Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay	Damariscotta River	Sheepscot River	Kennebec/Androscoggin Rivers	Casco Bay	Saco Bay	Wells Harbor	Great Bay	Merrimack River	Massachusetts Bay	Boston Harbor	Cape Cod Bay
	Estuary																
Blue mussel	●	●	●	●	●	●	●	●	●	●	●	●	●	◉	●	●	●
Sea scallop	◉	◉	◉	◉	◉	○	○	○	√	○	√		○		○	√	◉
American oyster	√							√					●				○
Northern quahog	○			√	√	√	○	√	√	○		√		√	○	○	●
Softshell clam	●	○	●	●	●	●	●	●	●	●	●	●	◉	●	◉	●	●
Daggerblade grass shrimp										√	√	√	○	√	○	○	◉
Northern shrimp	◉	○	○	○	◉	◉	○	◉	○	○	√				◉	○	√
Sevenspine bay shrimp	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
American lobster	○	●	●	●	●	◉	◉	●	◉	●	◉	○	◉	○	◉	◉	◉
Jonah crab	√	◉	◉	◉	○	○	◉	○	●	●	◉	●	○	√	○	○	○
Rock crab	○	●	●	●	●	●	●	●	●	●	●	●	●	○	◉	●	◉
Green crab	◉	◉	◉	◉	◉	●	●	●	●	●	●	●	●	◉	◉	●	●
Green sea urchin	●	●	●	●	●	●	●	●	●	◉	○		○		○	○	○
Spiny dogfish	◉	◉	◉	◉	◉	○	○	○	○	○	○				◉	√	◉
Skates	○	○	○	○	○	○	○	○	○	○	○	√	○	√	◉	◉	●
Shortnose sturgeon					na			√	○					○			
Atlantic sturgeon	√	√	√	√	√	√	√	√	√	√	√		√	○	√	na	√
American eel	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉
Blueback herring	◉	√	○	○	○	√	○	○	√	○	○	◉	◉	◉	○	○	○
Alewife	◉	◉	◉	◉	◉	●	●	●	●	●	●	◉	●	●	◉	◉	◉
American shad	◉	√	○	√	√	√	√	√	○	√	○		√	○	√	√	√
Atlantic menhaden	○	○	○	○	◉	◉	◉	◉	○	◉	○	√	√	○	◉	○	◉
Atlantic herring	●	●	●	●	●	◉	◉	◉	○	◉	◉	●	○	○	◉	◉	◉
Rainbow smelt	◉	○	○	○	◉	◉	◉	◉	◉	◉	◉	○	●	○	◉	◉	○
Atlantic salmon	○	○	○	○	○	√	na	○	○	√	√		√	○			
Atlantic cod	○	◉	◉	◉	○	○	○	◉	○	○	○	√	√	√	○	○	○
Haddock	√	√	√	√	√	√	√	√		√	√				√	√	√
Silver hake	◉	◉	◉	◉	◉	○	○	◉	○	○	○	√	√	√	○	○	○
Atlantic tomcod	◉	◉	◉	◉	◉	◉	◉	●	●	◉	◉	◉	◉	○	○	◉	○

Relative abundance: ● - Highly abundant ◉ - Abundant ○ - Common √ - Rare Blank - Not present na - No data available

Table 3, continued. Presence/absence of ELMR species in North Atlantic estuaries. Symbols represent the highest relative abundance of adults or juveniles of a species, in any salinity zone, in any month, within each estuary.

Species	Passamaquoddy Bay	Englishman/Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay	Damariscotta River	Sheepscot River	Kennebec/Androscoggin Rivers	Casco Bay	Saco Bay	Wells Harbor	Great Bay	Merrimack River	Massachusetts Bay	Boston Harbor	Cape Cod Bay
	Estuary																
Pollock	◉	○	○	○	○	◉	◉	◉	◉	○	○	√	○	○	◉	○	●
Red hake	○	○	○	○	○	○	○	○	○	○	○	√	○	√	○	○	◉
White hake	◉	○	○	○	◉	○	○	◉	○	○	○	○	○	√	○	○	○
Mummichog	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◉	●	●
Silversides	○	○	○	○	●	●	●	●	●	●	●	●	●	●	●	●	●
Fourspine stickleback	○	○	○	○	○	◉	◉	○	◉	○	○	○	○	√	○	○	○
Threespine stickleback	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Ninespine stickleback	○	○	○	○	○	○	○	○	○	○	○	●	○	○	√	○	
Northern pipefish	○	√	√	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Northern searobin				√		√	√	√	√	√	√		√	√	○	√	○
Grubby	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Longhorn sculpin	●	●	●	●	●	●	●	◉	●	●	◉	○	○	√	◉	○	◉
Shorthorn sculpin	○	○	○	○	○	○	○	○	○	○	○	√	√	√	○	√	√
White perch	○	○	○	○	○	○	○	○	○	○	○	√	◉	○		√	√
Striped bass	√	○	○	○	○	○	○	○	○	○	○	○	○	√	○	○	○
Bluefish	√	√	√	√	○	○	○	○	○	○	○	○	○	√	○	○	○
Scup										√	√				○	√	○
Tautog					√	√	√	√	√	√	√	√	√		○	○	○
Cunner	○	○	○	○	○	○	○	○	○	○	○	○	○	√	◉	◉	◉
Ocean pout	◉	○	○	○	○	○	○	○	○	○	○		√		○	○	○
Rock gunnel	○	○	○	○	○	○	○	○	○	○	○	○	○	√	○	○	○
American sand lance	○	○	○	○	○	◉	◉	◉	◉	◉	◉	●	○	◉	◉	○	◉
Atlantic mackerel	○	○	○	○	○	◉	◉	◉	◉	○	○	√	○	√	○	○	◉
Butterfish	√	√	√	√	√	√	√	√	√	√	√		√	√	○	√	○
Windowpane flounder	○	○	○	○	◉	○	○	○	○	○	○	○	○	√	○	○	◉
American plaice	○	○	○	○	○	●	●	●	●	●	●	√	√	√	●	◉	●
Winter flounder	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Yellowtail flounder	√	√	√	√	√	√	√	○	√	○	√	√			◉	◉	○
Smooth flounder	○	○	○	○	○	◉	◉	◉	◉	◉	◉	○	●	√	√	√	

Relative abundance: ● - Highly abundant ◉ - Abundant ○ - Common √ - Rare Blank - Not present na - No data available

Figure 5. Numbers of ELMR species (with relative abundance of common or greater) in North Atlantic estuaries, by estuary, salinity zone, and life stage.

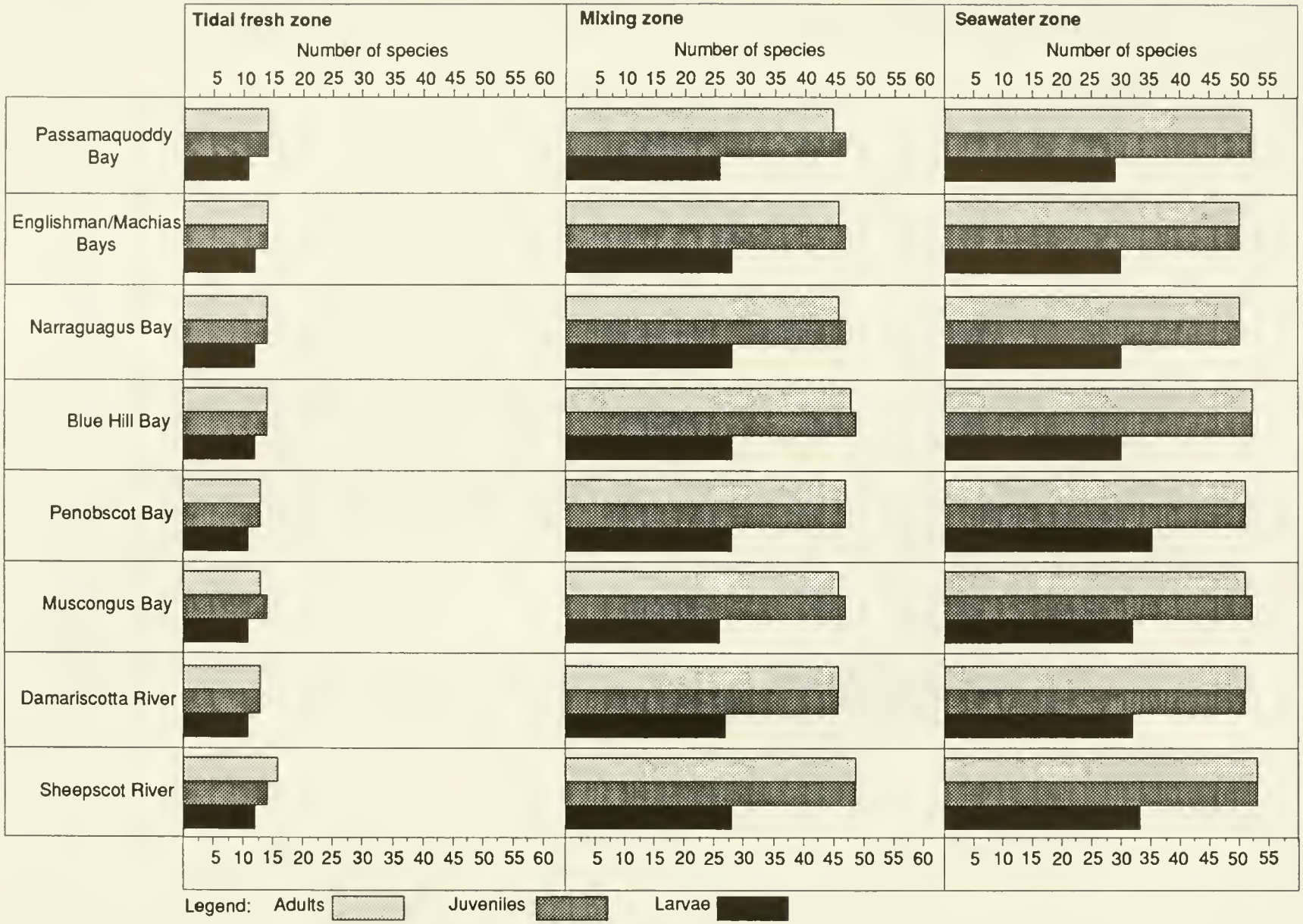


Figure 5, continued. Numbers of ELMR species (with relative abundance of common or greater) in North Atlantic estuaries, by estuary, salinity zone, and life stage.

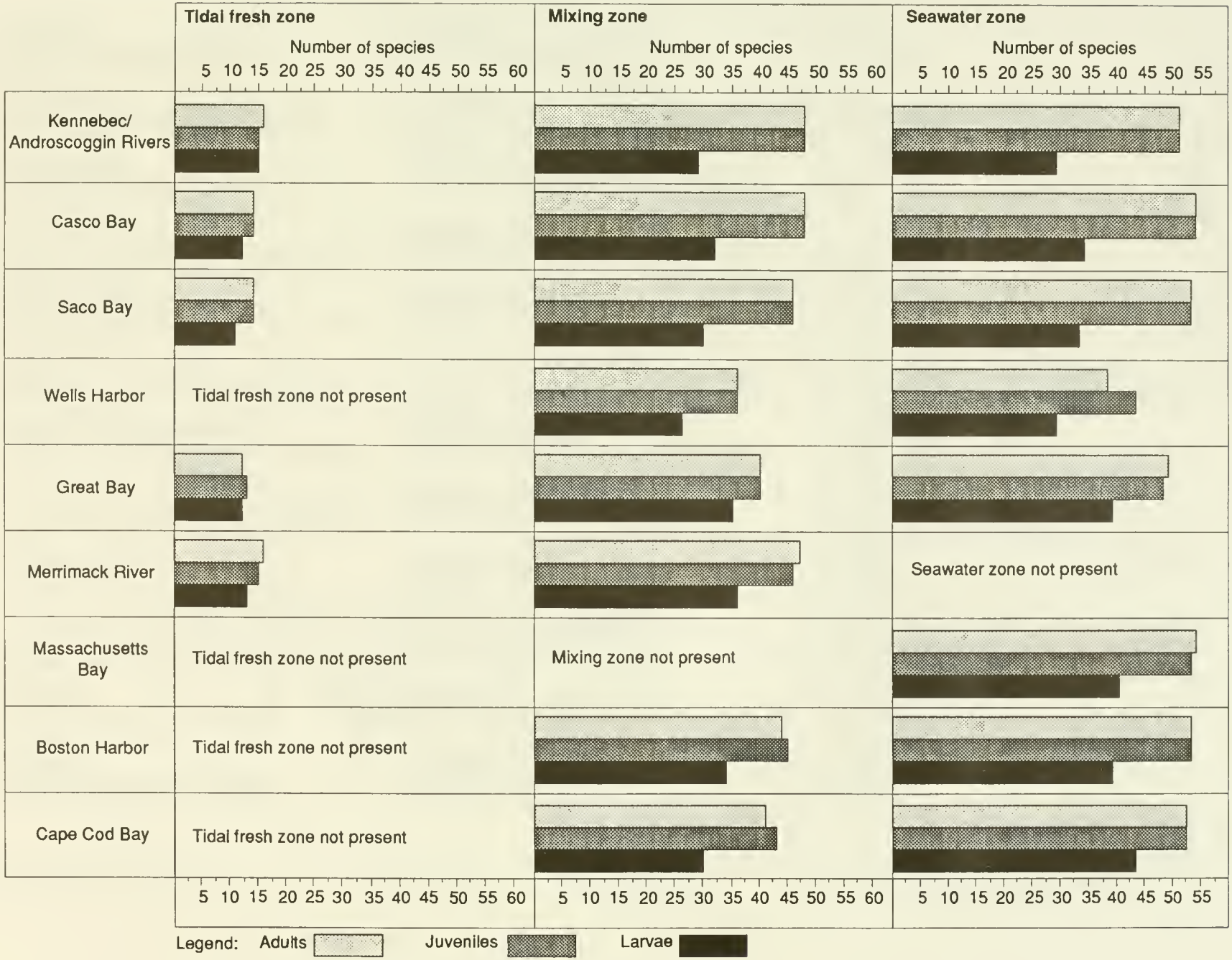
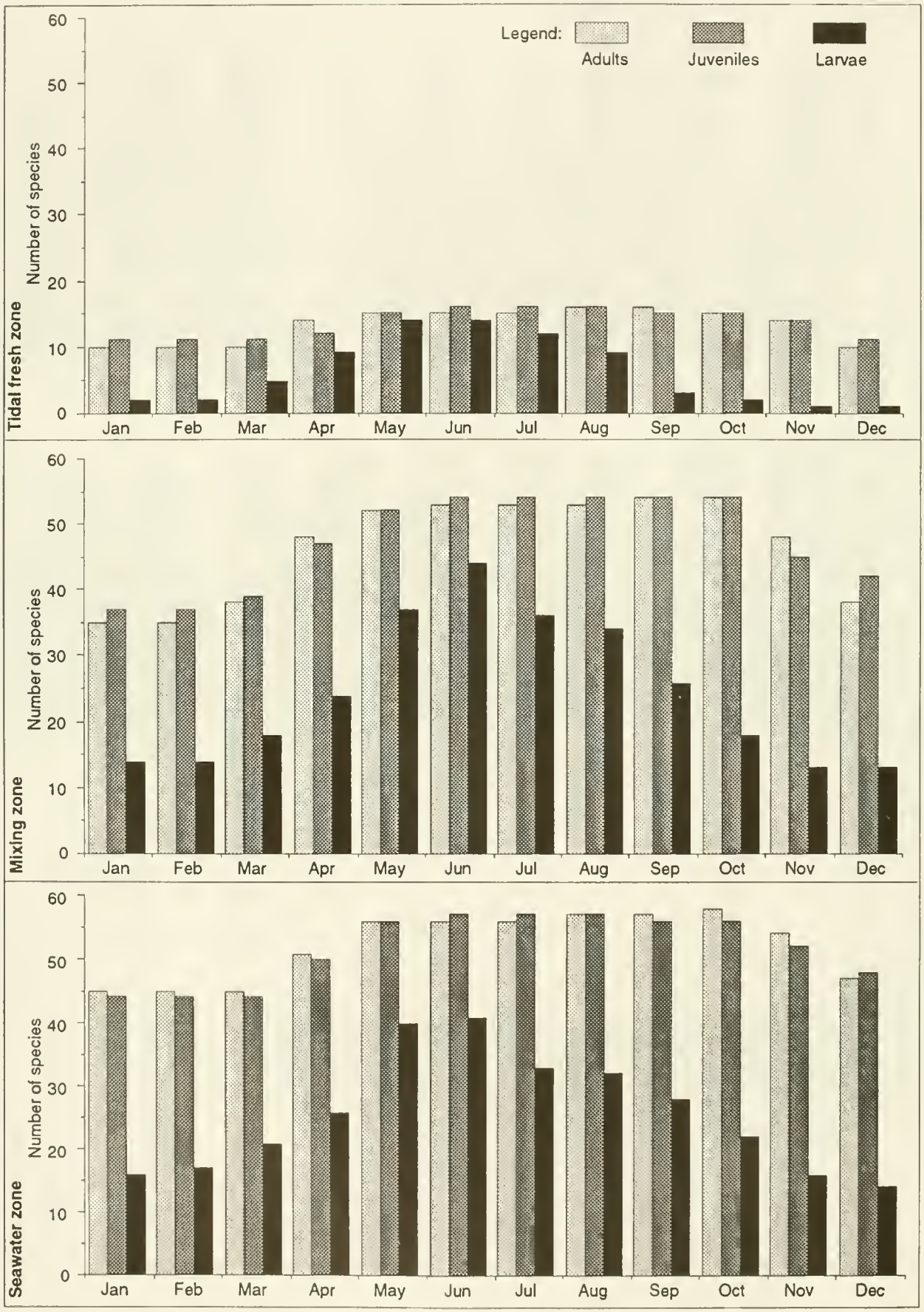


Figure 6. Number of ELMR species* in North Atlantic estuaries, by salinity zone, life stage, and month.



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

interacting factors that affect salinity such as 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 enlarges the tidal fresh zone, the distribution of a species confined to that zone increases to include the new area. If a species tolerates a wide range of salinity, a shift may or may not occur. The assignment of a species in a salinity zone was ultimately determined by where they have been regularly observed or captured.

Species temporal distributions are often dependent on annual climatic conditions and water currents. Monthly distribution patterns were derived based on the consistent presence of a life stage within a particular month. If a species was only present during unusual events (e.g., drought), it was not included in the description of that species' distribution. However, if a species regularly occurs, even during a restricted time period, it was considered to be present for the specific month(s). Greater temporal resolution, such as on a biweekly rather than on a monthly basis, was not feasible.

Data reliability analysis. Mean data reliability by estuary was highest for the Sheepscot River and lowest for Narraguagus Bay (Figure 7). The reliability estimates seem to reflect the amount of fisheries research that has been conducted within an estuary. These data reveal that some estuaries have been the focus of numerous studies (e.g., Passamaquoddy Bay, Sheepscot River, Great Bay, Cape Cod Bay), particularly those that have academic/state research facilities or industries requiring environmental monitoring (e.g., nuclear power plants). These estimates also suggest that many smaller bays and estuaries have not been extensively researched (e.g., Englishman/Machias bays, Narraguagus Bay, Saco River, Wells Harbor, Merrimack River).

• When averaged across estuaries and analyzed by salinity zone, data reliability was lower in the tidal fresh than in the mixing and seawater zones. This may be because the selected species are primarily estuarine, not freshwater. In addition, relatively few systematic faunal surveys have been conducted in tidal freshwaters.

• Data for juveniles and adults were most reliable, while data for spawning adults, larvae, and eggs (particularly demersal eggs) were less certain. This reflects that most biological surveys have focused 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 general life history studies and data from similar estuaries.

• When averaged across salinity zones and life stages, and analyzed by species (Figure 8), data reliability was relatively high for most of the highly exploited commercial and recreational species (e.g., bivalves, Atlantic salmon, striped bass), and for endangered species (shortnose sturgeon). This reflects the comparatively greater number of studies conducted to monitor and manage species that are economically important. Data reliability was relatively low for several species that: 1) were at the edge of their environmental ranges (e.g., daggerblade grass shrimp, tautog); 2) were of little commercial importance (e.g., sticklebacks, smooth flounder); 3) had relatively unclear present distributions compared to past estimates (e.g., haddock, Atlantic sturgeon); and/or 4) had certain life stages that were unavailable to conventional gear types (e.g., rock gunnel, American sand lance).

Figure 7. Mean data reliability by estuary.

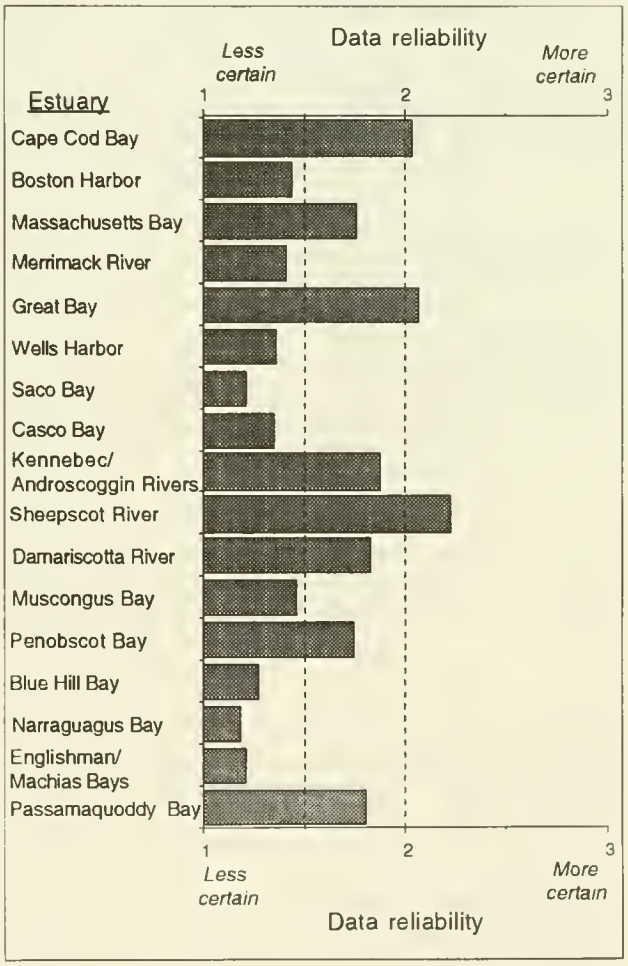
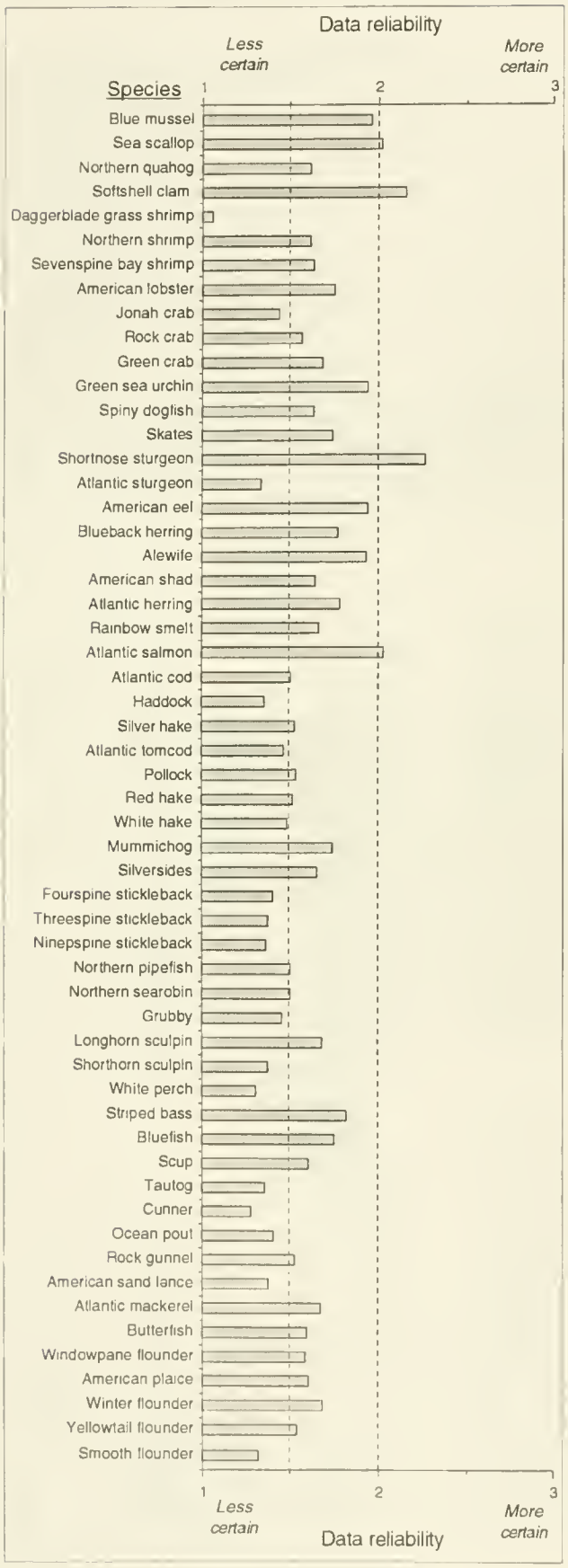


Figure 8. Mean data reliability by species.



Coupling of Estuarine and Marine Ecosystems

Classifying and comparing estuaries. Although the qualitative nature of the data presented precludes statistical analysis 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 ELMR data base. Estuaries can be loosely categorized by their physical and chemical characteristics and their associated species assemblages (Monaco and Lowery in prep). 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 (Tyler 1971, MacDonald et al. 1984, Ayvazian et al. 1992). Species assemblages may correlate with physical characteristics, such as bottom substrate, vegetation, and spatial/temporal characteristics of salinity zones. Thus, information on species presence/absence or other attributes may be used to determine the similarities and differences among estuaries. Alternately, a comparison of estuaries and associated species can help elucidate ecological variables that might account for shifts in species distribution and community structure. 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. Many species inhabit estuaries year-round; however, a large number of species only use estuaries for specific parts of their life histories. 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 and/or utilize preferred habitats. The biological importance of an estuary can be assessed both by the number of species present and the density, and/or abundance, of specific life stages in the system relative to offshore habitats. Since many offshore species use estuaries as nursery areas or feeding grounds, these data may assist in identifying adverse effects of estuarine degradation on offshore populations.

East Coast of North America Strategic Assessment Project. Development of a diagnostic capability to link estuaries to marine ecosystems is a component of the *East Coast of North America Strategic Assessment Project* (ECNASAP) (NOAA 1991). The ECNASAP is currently under development through two joint pilot projects between NOAA and Canada (ACZISCC 1993). This project is defining the major biological, physical, chemical, and economic characteristics of the East Coast of North America to address multiple resource-use conflicts. The study area begins at the head of tide in estuaries and encompasses the continental shelf as defined by the 200-m isobath and epipelagic waters. The ELMR distribution and abundance data are the primary source of fish and invertebrate information for U.S. East Coast estuaries. These data will be integrated with the coastal and offshore living resource information to develop a consistent GIS data base on species found from the head of tide to past the continental shelf. This will enable the development of a capability to define the coupling of estuarine and marine ecosystems based on species' spatial and temporal distributions, life history strategies, and physical and hydrological habitat requirements (Monaco and Lowery in prep)

The ECNASAP complements other Federal marine environmental programs, e.g., National Status and Trends (O'Connor 1990), and will support 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 estuaries have a 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 conserve and manage living resources is limited, the ELMR program 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 the best available baseline information on the zoogeography and ecology of estuarine fishes and invertebrates, and identifies gaps in our knowledge of these resources.

Acknowledgements

We thank those individuals that reviewed the data in this report and provided additional information. Without their efforts, a study of this magnitude and complexity would not be possible. In addition, we thank the many other scientists and managers who provided contacts and references. Special thanks are due to Tony Lowery and Pamela Rubin for their comments on this manuscript. The cover illustrations of lobster, cod, and herring are from Goode (1884).

Literature Cited

ACZISCC (Atlantic Coastal Zone Information Steering Committee of Canada). 1993. East Coast of North America Strategic Assessment Project: Pilot project proposal. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD. 22 p.

Ayvazian, S.G., L.A. Deegan, and J.T. Finn. 1992. Comparison of habitat use by estuarine fish assemblages in the Acadian and Virginian zoogeographic provinces. Estuaries 15(3):368-383.

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

Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons, New York, NY. 558 p.

Goode, G.B. 1884. The Fisheries and Fishing Industry of the United States. Sec. I: Natural history of useful aquatic animals. U.S. Comm. Fish., Washington, D.C. 895 p., 277 pl.

Howe, A.B., T.P. Currier, S.L. Sass, and B.C. Kelly. 1991. Coastwide fishery resource assessment: fishery resource assessment, coastal Massachusetts: final report. Unpublished data. Massachusetts Div. Marine Fisheries, Sandwich, MA.

Langton, R.W., R.K. Knowles, and K.J. Ward. 1989. Examination and ecology of potential nursery areas along coastal Maine for groundfish. Final Rep. Project No. 3-426-R, Maine Dept. Marine Resources, W. Boothbay, ME. 114 p.

MacDonald, J.S., M.J. Dadswell, R.G. Appy, G.D. Melvin, and D.A. Methven. 1984. Fishes, fish assemblages, and their seasonal movements in the lower Bay of Fundy and Passamaquoddy Bay, Canada. Fish. Bull., U.S. 82(1):121-139.

MDMR (Maine Dept. Marine Resources). 1993. Inshore trawl survey data, Ipswich Bay to Frenchman's Bay. Unpublished data. Maine Dept. Marine Resources, W. Boothbay Harbor, ME.

Monaco, M.E. 1986. National Estuarine Inventory: Living marine resources component, preliminary West Coast study. ELMR Rep. No. 1. Ocean Assessments Division, NOS/NOAA. Rockville, MD. 33 p.

Monaco, M.E., D.M. Nelson, R.L. Emmett, and S.A. Hinton. 1990. Distribution and abundance of fishes and invertebrates in West Coast estuaries. ELMR Rep. No. 4. NOAA/NOS Strategic Assessment Branch, Rockville, MD. 240 p.

Monaco, M.E., and T.A. Lowery. In prep. Biogeographic estuary assemblages: Coupling of physical and biological characteristics. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD.

Nelson, D.M., M.E. Monaco, C.D. Williams, T.E. Czapla, M.E. Pattillo, L. Coston-Clements, L.R. Settle, and E.A.Irlandi. 1991. Distribution and abundance of fishes and invertebrates in southeast estuaries. ELMR Rep. No. 9. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 177 p.

Nelson, D.M. (ed.). 1992. Distribution and abundance of fishes and invertebrates in Gulf of Mexico estuaries, Vol. 1: Data summaries. ELMR Rep. No. 10. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 273 p.

NOAA (National Oceanic and Atmospheric Administration). 1985. National Estuarine Inventory: Data atlas. Vol. 1. Physical and hydrologic characteristics. Strategic Assessment Branch, NOAA/NOS, Rockville, MD. 103 p.

NOAA (National Oceanic and Atmospheric Administration). 1990. West Coast of North America strategic assessment: Data atlas. Invertebrate and fish volume. Pre-publication edition. Strategic Assessment Branch, NOAA/NOS, Rockville, MD. 112 p.

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

O'Connor, T.P. 1990. Coastal environmental quality in the United States, 1990: Chemical contamination in sediment and tissues. Ocean Assessments Division, NOAA/NOS, Rockville, MD. 34 p.

Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.A. Lachner, R.N. Lea, and W.B. Scott. 1991. Common and scientific names of fishes from the United States and Canada, fifth edition. Spec. Pub. No. 20. American Fisheries Society, Bethesda, MD. 183 p.

Stone, S.L., T.A. Lowery, J.D. Field, S.H. Jury, D.M. Nelson, M.E. Monaco, C.D. Williams, and L.A. Andreasen. 1994. Distribution and abundance of fishes and invertebrates in Mid-Atlantic estuaries. ELMR Rep. No. 12. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, MD. 280 p.

Turgeon, D.D., A.E. Bogan, E.V. Coan, W.K. Emerson, W.G. Lynons, W.L. Pratt, C.F.E. Roper, A. Scheltema, F.G. Thompson, and J.D. Williams. 1988. Common and scientific names of aquatic invertebrates from the United States and Canada: Mollusks. Spec. Pub. No. 16. American Fisheries Society, Bethesda, MD. 277 p.

Tyler, A.V. 1971. Periodic and resident components in communities of Atlantic fishes. J. Fish Res. Bd. Can. 28:935-946.

Williams, A.B., L.G. Abele, D.L. Felder, H.H. Hobbs, Jr., R.B. Manning, P.A. McLaughlin, and I. Pérez Farfante. 1988. Common and scientific names of aquatic invertebrates from the United States and Canada: Decapod crustaceans. Spec. Pub. No. 17. American Fisheries Society, Bethesda, MD. 77 p.

Data Summary Tables

Table 4. Spatial distribution and relative abundance

Table 5. Temporal distribution and relative abundance

Table 6. Data reliability

In each data summary table, species are listed in phylogenetic order (see Table 1, p. 4). Estuaries are listed in a north-to-south order (see Figure 3, p. 3). At the beginning of each data summary is an index table showing the page location of each species and estuary in the data summary.

Table 4. Spatial distribution and relative abundance

Index to Table 4. Page location of spatial distribution table for each species and estuary.

	Passamaquoddy Bay, Englishman/Machias Bays, Narraguagus Bay, Blue Hill Bay, Penobscot Bay, Muscongus Bay	Damariscotta River, Sheepscot River, Kennebec/Androscoggin Rivers, Casco Bay, Saco Bay, Wells Harbor	Great Bay, Merrimack River, Massachusetts Bay, Boston Harbor, Cape Cod Bay
Blue mussel (*Mytilus edulis*) Sea scallop (*Placopecten magellanicus*) American oyster (*Crassostrea virginica*) Northern quahog (*Mercenaria mercenaria*) Softshell clam (*Mya arenaria*) Daggerblade grass shrimp (*Palaemonetes pugio*)	p. 20	p. 21	p. 22
Northern shrimp (*Pandalus borealis*) Sevenspine bay shrimp (*Crangon septemspinosa*) American lobster (*Homarus americanus*) Jonah crab (*Cancer borealis*) Atlantic rock crab (*Cancer irroratus*) Green crab (*Carcinus maenas*)	p. 23	p. 24	p. 25
Green sea urchin (*Strongylocentrotus droebachiensis*) Spiny dogfish (*Squalus acanthias*) Skates (*Raja* species) Shortnose sturgeon (*Acipenser brevirostrum*) Atlantic sturgeon (*Acipenser oxyrhynchus*) American eel (*Anguilla rostrata*)	p. 26	p. 27	p. 28
Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Atlantic herring (*Clupea harengus*) Rainbow smelt (*Osmerus mordax*)	p. 29	p. 30	p. 31
Atlantic salmon (*Salmo salar*) Atlantic cod (*Gadus morhua*) Haddock (*Melanogrammus aeglefinus*) Silver hake (*Merluccius bilinearis*) Atlantic tomcod (*Microgadus tomcod*) Pollock (*Pollachius virens*)	p. 32	p. 33	p. 34
Red hake (*Urophycis chuss*) White hake (*Urophycis tenuis*) Mummichog (*Fundulus heteroclitus*) Silversides (*Menidia* species) Fourspine stickleback (*Apeltes quadracus*) Threespine stickleback (*Gasterosteus aculeatus*)	p. 35	p. 36	p. 37
Ninespine stickleback (*Pungitius pungitius*) Northern pipefish (*Syngnathus fuscus*) Northern searobin (*Prionotus carolinus*) Grubby (*Myoxocephalus aenaeus*) Longhorn sculpin (*Myoxocephalus octodecemspinosus*) Shorthorn sculpin (*Myoxocephalus scorpius*)	p. 38	p. 39	p. 40
White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*) Scup (*Stenotomus chrysops*) Tautog (*Tautoga onitis*) Cunner (*Tautogolabrus adspersus*)	p. 41	p. 42	p. 43
Ocean pout (*Macrozoarces americanus*) Rock gunnel (*Pholis gunnelus*) American sand lance (*Ammodytes americanus*) Atlantic mackerel (*Scomber scombrus*) Butterfish (*Peprilus triacanthus*) Windowpane (*Scophthalmus aquosus*)	p. 44	p. 45	p. 46
American plaice (*Hippoglossoides platesoides*) Winter flounder (*Pleuronectes americanus*) Yellowtail flounder (*Pleuronectes ferrugineus*) Smooth flounder (*Pleuronectes putnami*)	p. 47	p. 48	p. 49

Table 4. Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Blue mussel	A		◉	●		○	●		○	●		○	●		○	●		○	●
	S		◉	●		○	●		○	●		○	●		○	●		○	●
Mytilus edulis	J		◉	●		○	●		○	●		○	●		○	●		○	●
	L		◉	●		○	●		○	●		○	●		○	●		○	●
	E		◉	●		○	●		○	●		○	●		○	●		○	●
Sea scallop	A		√	◉		√	◉		√	◉		√	◉		√	◉			○
	S			◉			◉			◉			◉			◉			○
Placopecten magellanicus	J		√	◉		√	◉		√	◉		√	◉		√	◉			○
	L		√	◉		√	◉		√	◉		√	◉		√	◉			○
	E		√	◉			◉			◉			◉		√	◉			○
American oyster	A			√															
	S			na															
Crassostrea virginica	J			√															
	L			na															
	E			na															
Northern quahog	A			○								√	√		√	√		√	√
	S			na								na	na		na	na		na	na
Mercenaria mercenaria	J			○								√	√		√	√		√	√
	L			na								na	na		na	na		na	na
	E			na								na	na		na	na		na	na
Softshell clam	A		●	◉		○	○		●	◉		●	◉		●	◉		●	◉
	S		●	◉		○	○		●	◉		●	◉		●	◉		●	◉
Mya arenaria	J		●	◉		○	○		●	◉		●	◉		●	◉		●	◉
	L		●	◉		○	○		●	◉		●	◉		●	◉		●	◉
	E		●	◉		○	○		●	◉		●	◉		●	◉		●	◉
Daggerblade grass shrimp	A																		
	S																		
Palaemonetes pugio	J																		
	L																		
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Blue mussel	A		○	●		○	●		○	●		○	●		◉	●		○	●
	S		○	●		○	●		○	●		○	●		○	●		○	●
Mytilus edulis	J		○	●		○	●		○	●		○	●		◉	●		◉	●
	L		○	●		○	●		○	●		○	●		○	●		○	●
	E		○	●		○	●		○	●		○	●		○	●		○	●
Sea scallop	A			○			○			√			○			√			
	S			○			○			√			○			√			
Placopecten magellanicus	J			○			○			√			○			√			
	L			○			○			√			○			√			
	E			○			○			√			○			√			
American oyster	A					√													
	S					√													
Crassostrea virginica	J					√													
	L					√													
	E					√													
Northern quahog	A		○	√		√	√		√	√		○	○					√	√
	S		na	na		na	na		na	na		√	√					na	na
Mercenaria mercenaria	J		○	√		√	√		√	√		○	○					√	√
	L		na	na		na	na		na	na		√	√					na	na
	E		na	na		na	na		na	na		√	√					na	na
Softshell clam	A		●	◉		●	◉		●	◉		●	●		●	◉		●	◉
	S		●	◉		●	◉		●	◉		●	●		●	◉		●	◉
Mya arenaria	J		●	◉		●	◉		●	◉		●	●		●	◉		●	●
	L		●	◉		●	◉		●	◉		●	●		●	◉		●	◉
	E		●	◉		●	◉		●	◉		●	●		●	◉		●	◉
Daggerblade grass shrimp	A											√	√		√	√		√	√
	S											√	√		√	√		√	√
Palaemonetes pugio	J											√	√		√	√		√	√
	L											√	√		√	√		√	√
	E											√	√		√	√		√	√
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Blue mussel	A		○	●		◉				●		◉	●		◉	●
	S		○	●		◉				●		◉	●		◉	●
Mytilus edulis	J		○	●		◉				●		◉	●		◉	●
	L		○	●		◉				●		◉	●		◉	●
	E		○	●		◉				●		◉	●		◉	●
Sea scallop	A			○						○			√			◉
	S									○			na			◉
Placopecten magellanicus	J			○						○			√			◉
	L			√						○			na			◉
	E									○			na			◉
American oyster	A		●	○											○	○
	S		◉	○											○	○
Crassostrea virginica	J		●	○											○	○
	L		◉	○											○	○
	E		◉	○											○	○
Northern quahog	A					√				○		○	○		●	●
	S					√				○		√	√		●	●
Mercenaria mercenaria	J					√				○		○	○		●	●
	L					√				○		√	√		●	●
	E					√				○		√	√		●	●
Softshell clam	A		◉	◉		●				◉		●	●		●	●
	S		○	○		◉				◉		●	●		●	●
Mya arenaria	J		◉	◉		●				◉		●	●		●	●
	L		○	○		◉				◉		●	●		●	●
	E		○	○		◉				◉		●	●		●	●
Daggerblade grass shrimp	A		○	○		√				○		○	○		◉	◉
	S		√	√		√				○		√	√		○	○
Palaemonetes pugio	J		○	○		√				○		○	○		◉	◉
	L		√	√		√				○		√	√		○	○
	E		√	√		√				○		√	√		○	○
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Northern shrimp	A			◉			○			○			○			◉			◉
	S			◉															
Pandalus borealis	J			○			○			○			○			○			○
	L			◉			○			○			○			◉			◉
	E			◉			○			○			○			◉			◉
Sevenspine bay shrimp	A		●	●		●	●		●	●		●	●		●	●		●	●
	S		●	●		●	●		●	●		●	●		●	●		●	●
Crangon septemspinosa	J		●	●		●	●		●	●		●	●		●	●		●	●
	L		●	●		●	●		●	●		●	●		●	●		●	●
	E		●	●		●	●		●	●		●	●		●	●		●	●
American lobster	A		○	○		○	◉		○	◉		○	◉		○	◉		○	○
	S			○			◉			◉			◉			◉			○
Homarus americanus	J		○	○		○	●		○	●		○	●		○	●		○	◉
	L		na	○		√	◉		√	◉		√	◉		√	◉		na	◉
	E			○			○			○			○			○			○
Jonah crab	A		na	√		√	◉		√	◉		√	◉		√	○		√	○
	S			na			○			○			○			○			○
Cancer borealis	J		na	√		na	√		na	√		na	√		na			na	
	L			na			○			○			○			○			○
	E			na			○			○			○			○			○
Atlantic rock crab	A		○	○		◉	◉		◉	◉		◉	◉		◉	◉		◉	◉
	S		○	○		√	◉		√	◉		√	◉		○	◉		√	◉
Cancer irroratus	J		○	○		◉	●		◉	●		◉	●		◉	●		◉	●
	L		○	○		○	◉		○	◉		○	◉		◉	◉		○	◉
	E		○	○		√	○		√	○		√	○		○	○		√	○
Green crab	A		◉	◉		◉	◉		◉	◉		◉	◉		◉	◉		●	●
	M		○	○		○	○		○	○		○	○		○	○		●	●
Carcinus maenas	J		◉	◉		◉	◉		◉	◉		◉	◉		◉	◉		●	●
	L		○	○		○	○		○	○		○	○		○	○		●	●
	E		○	○		○	○		○	○		○	○		○	○		●	●
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Northern shrimp	A			√			◉			√			○			√			
	S																		
Pandalus borealis	J			○			○			○			○			√			
	L			√			◉			√			○			√			
	E			√			◉			√			○			√			
Sevenspine bay shrimp	A		●	●		●	●		●	●		●	●		●	●		●	●
	S		●	●		●	●		●	●		●	●		●	●		●	●
Crangon septemspinosa	J		●	●		●	●		●	●		●	●		●	●		●	●
	L		●	●		●	●		●	●		●	●		●	●		●	●
	E		●	●		●	●		●	●		●	●		●	●		●	●
American lobster	A		○	○		○	◉		○	○		○	◉		○	◉		√	○
	S			○			◉			○			◉			○			
Homarus americanus	J		○	◉		○	●		○	◉		○	●		○	◉		√	○
	L		na	◉		na	◉		na	◉		√	◉		√	○			√
	E			○			○			○			○			○			
Jonah crab	A		√	○		√	○		√	○		√	○		√	○		√	○
	S			○			○			○			○			○			○
Cancer borealis	J		na	√		na			na			na	○		na			na	√
	L			○			○			○			○			○			○
	E			○			○			○			○			○			○
Atlantic rock crab	A		◉	◉		◉	◉		◉	◉		◉	◉		◉	◉		◉	◉
	S		√	◉		√	◉			◉		√	○			○			○
Cancer irroratus	J		◉	●		◉	●		◉	●		◉	●		◉	●		◉	●
	L		○	◉		○	◉		○	◉		○	◉		√	◉		○	◉
	E		√	○		√	○			○		√	○			○			○
Green crab	A		●	●		●	●		●	●		●	◉		●	◉		●	●
	M		●	●		●	●		●	●		●	◉		●	◉		●	◉
Carcinus maenas	J		●	●		●	●		●	●		●	◉		●	◉		●	●
	L		●	●		●	●		●	●		●	◉		●	◉		●	●
	E		●	●		●	●		●	●		●	◉		●	◉		●	◉
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Northern shrimp	A									◉			○			√
	S															
Pandalus borealis	J									◉			○			√
	L									◉			○			√
	E									◉			○			√
Sevenspine bay shrimp	A		●	●		●				●		●	●		●	●
	S		●	●		●				●		●	●		●	●
Crangon septemspinosa	J		●	●		●				●		●	●		●	●
	L		●	●		●				●		●	●		●	●
	E		●	●		●				●		●	●		●	●
American lobster	A		○	○		√				◉		◉	◉		○	◉
	S			○						○			○			○
Homarus americanus	J		○	◉		○				◉		◉	◉		◉	◉
	L		√	○						○		√	○		√	○
	E			√						○			○			○
Jonah crab	A		√	○		√				○		√	○		√	○
	S			○						○			√			○
Cancer borealis	J		na	○		na				○		na	○		na	○
	L			○						○			√			○
	E			○						○			√			○
Atlantic rock crab	A		○	○		○				◉		○	◉		○	◉
	S		√	○						○			○			○
Cancer irroratus	J		◉	●		○				◉		◉	●		◉	◉
	L		○	◉		√				○		√	○		√	○
	E		√	○						○			○			○
Green crab	A		◉	◉		◉				◉		●	◉		●	◉
	M		◉	○		◉				◉		◉	◉		◉	◉
Carcinus maenas	J		●	◉		◉				◉		●	◉		●	◉
	L		●	◉		◉				◉		◉	◉		◉	◉
	E		◉	◉		◉				◉		◉	◉		◉	◉
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Green sea urchin	A		√	●		√	●		√	●		√	●		√	●		√	●
	S			●			●			●			●			●			●
Strongylocentrotus droebachiensis	J		√	●		√	●		√	●		√	●		√	●		√	●
	L			●			●			●			●			●			●
	E			●			●			●			●			●			●
Spiny dogfish	A		○	◉		○	◉		○	◉		○	◉		○	◉		○	○
	M			na			na			na			na			na			na
Squalus acanthias	J		○	◉		○	◉		○	◉		○	◉		○	○		○	○
	P			na			na			na			na			na			na
Skates	A		√	○		√	○		√	○		√	○		√	○		√	○
	M			○			○			○			○			○			○
Raja species	J		√	○		√	○		√	○		√	○		√	○		√	○
	E			○			○			○			○			○			○
Shortnose sturgeon	A													na	na	na			
	S													na					
Acipenser brevirostrum	J													na	na	na			
	L													na					
	E													na					
Atlantic sturgeon	A	na	√	√	na	√	√	na	√	√	na	√	√	na	√	√		√	√
	S	na			na			na			na			na					
Acipenser oxyrhynchus	J	na	√	√	na	√	√	na	√	√	na	√	√	na	na	na		na	na
	L	na			na			na			na			na					
	E	na			na			na			na			na					
American eel	A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	◉	◉	◉
	S																		
Anguilla rostrata	J	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉
	L	◉	◉	○	○	○	○	○	○	○	○	○	○		○	○		○	○
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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
- P - Parturition
- M - Mating

Table 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Green sea urchin	A		√	●		√	●		√	●		√	◉		√	○			
	S			●			●			●			◉			○			
Strongylocentrotus droebachiensis	J		√	●		√	●		√	●		√	◉		√	○			
	L			●			●			●			◉			○			
	E			●			●			●			◉			○			
Spiny dogfish	A		○	○		○	○		○	○		√	○		√	○			
	M			na			na			na									
Squalus acanthias	J		○	○		○	○		○	○		√	○		√	○			
	P			na			na			na									
Skates	A		√	○		√	○		√	○		√	○		√	○		√	√
	M			○			○			○			○			○			√
Raja species	J		√	○		√	○		√	○		√	○		√	○		√	√
	E			○			○			○			○			○			√
Shortnose sturgeon	A				√	√	√	○	○	○									
	S				na			○											
Acipenser brevirostrum	J				na	na	na	○	na	na									
	L				na			○											
	E				na			○											
Atlantic sturgeon	A		√	√	√	√	√	√	√	√	na	√	√	na	√	√			
	S							√											
Acipenser oxyrhynchus	J		na	na	na	√	√	na	√	√	na	na	na	na	na	na			
	L							√	√										
	E							√											
American eel	A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	S																		
Anguilla rostrata	J	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉		◉	◉
	L		○	○		○	○		○	○	○	○	○	○	○	○		○	○
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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
- P - Parturition
- M - Mating

Table 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Green sea urchin	A			○						○			○			○
	S			○						○			○			○
Strongylocentrotus droebachiensis	J			○						○			○			○
	L			○						○			○			○
	E			○						○			○			○
Spiny dogfish	A									◉		√	√		√	◉
	M									na						na
Squalus acanthias	J									◉		√	√		√	◉
	P									na						na
Skates	A		√	○		√				◉		√	◉		√	◉
	M			√						○			○			○
Raja species	J		√	○		√				◉		√	◉		√	●
	E			√						○			○			○
Shortnose sturgeon	A				○	○										
	S				○											
Acipenser brevirostrum	J				na	na										
	L				○											
	E				○											
Atlantic sturgeon	A	na	√	√	√	√				√		na	na			√
	S															
Acipenser oxyrhynchus	J	na	na	na	√	○				na		na	na			
	L															
	E															
American eel	A	○	○	○	○	○				○		○	○		○	○
	S															
Anguilla rostrata	J	◉	◉	◉	◉	◉				◉		◉	◉		◉	◉
	L	○	○	○	○	○				○		○	○		○	○
	E															
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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
- P - Parturition
- M - Mating

Table 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passama-quoddy Bay			Englishman Machias Bays			Narra-guagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Blueback herring	A	○	○	◉	√	√	√	○	○	○	○	○	○	○	○	○	√	√	√
	S	√			√			√			√			○			√		
Alosa aestivalis	J	○	◉	◉	√	√	√	○	○	○	○	○	○	○	○	○	√	√	√
	L	√			√			√			√			○			√		
	E	√			√			√			√			○			√		
Alewife	A	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	●	●	●
	S	√			√			√			√			√			√		
Alosa pseudoharengus	J	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	●	●	●
	L	√			√			√			√			√			√		
	E	√			√			√			√			√			√		
American shad	A	√	√	◉	√	√	√	○	○	○	√	√	√	na	√	√	na	na	na
	S				√			○			√			na			na		
Alosa sapidissima	J	√	√	√	√	√	√	○	○	○	√	√	√	na	√	√	√	√	√
	L				√			○			√			na			√		
	E				√			○			√			na			na		
Atlantic menhaden	A		○	○		○	○		○	○		○	○		◉	◉		◉	◉
	S																		
Brevoortia tyrannus	J		√	√		√	√		√	√		√	√		√	√		√	√
	L															√			√
	E															√			
Atlantic herring	A		◉	●		○	●		○	●		○	●		○	●		○	◉
	S						○												
Clupea harengus	J		◉	●		○	●		○	●		○	●		○	●		◉	◉
	L		○	◉		◉	●		◉	●		◉	●		●	●		◉	●
	E						○												
Rainbow smelt	A	◉	◉	◉	○	○	○	○	○	○	○	○	○	◉	◉	◉	◉	◉	◉
	S	○			○			○			○			○			○		
Osmerus mordax	J	○	◉	◉	○	○	○	○	○	○	○	○	○	○	◉	◉	○	◉	◉
	L	◉	○		○	○		○	○		○	○		◉	○		◉	◉	√
	E	○			○			○			○			○			○		
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passama-quoddy Bay			Englishman Machias Bays			Narra-guagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Blueback herring	A	○	○	○	○	○	○	√	√	√	○	○	○	○	○	○		○	○
	S	○			○			√			√			√				na	
Alosa aestivalis	J	○	○	○	○	○	○	√	√	√	○	○	○	○	○	○		◉	○
	L	○			○			√			√			√					
	E	○			○			√			√			√					
Alewife	A	●	●	●	●	●	●	●	●	●	◉	◉	◉	◉	◉	◉		○	○
	S	√			√			◉			√			√				na	
Alosa pseudoharengus	J	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		◉	◉
	L	√			√			◉			√			√					
	E	√			√			◉			√			√					
American shad	A	√	√	√	√	√	√	○	○	○	√	√	√	○	○	○			
	S	√			√			○			√								
Alosa sapidissima	J	√	√	√	√	√	√	○	○	○	√	√	√	○	○	○			
	L	√			√			○			√								
	E	√			√			○			√								
Atlantic menhaden	A		◉	◉		◉	◉		○	○		○	◉		○	○		√	√
	S																		
Brevoortia tyrannus	J		√	√		√	√		√	√		√	○		√	○		√	√
	L			√			√			√			√			√			
	E																		
Atlantic herring	A		○	◉		○	◉		○	○		√	○		√	○		√	○
	S												√						
Clupea harengus	J		○	◉		○	◉		○	○		○	◉		○	◉		◉	●
	L		◉	●		◉	●		○	○		◉	◉		○	◉		○	◉
	E												√						
Rainbow smelt	A	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	○	○	○		○	○
	S	◉			○			◉			◉			○					
Osmerus mordax	J	◉	◉	◉	○	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉		○	○
	L	◉	◉	√	◉	●	√	◉	◉	√	◉	○		◉	○			√	
	E	◉			○			◉			◉			○					
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
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			√						○			○			○
Atlantic herring	A		√	○		√				◉		○	◉		○	◉
	S															√
Clupea harengus	J		○	○		○				◉		○	◉		○	◉
	L		○	○		○				◉		√	◉			○
	E															√
Rainbow smelt	A	◉	◉	◉	○	○				○		○	○		○	○
	S	○			√							○				
Osmerus mordax	J	●	●	●	○	○				◉		◉	◉		○	○
	L	◉	○		○	√						○			√	√
	E	○			√							○				
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Atlantic salmon	A	○	○	○	√	√	√	√	√	√	√	√	√	○	○	○	√	√	√
	S													√					
Salmo salar	J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	√	√	√
	L													√					
	E													√					
Atlantic cod	A		√	○		√	○		√	○		√	○		√	○		√	○
	S						○			○			○						√
Gadus morhua	J		√	○		√	◉		√	◉		√	◉		√	○		√	○
	L			○		√	○		√	○		√	○			○			√
	E						○			○			○						√
Haddock	A			√			√			√			√			√			√
	S																		
Melanogrammus aeglefinus	J			√			√			√			√			√			√
	L																		
	E																		
Silver hake	A		○	◉		○	◉		○	◉		○	◉		○	◉		○	○
	S			√			√			√			√			√			√
Merluccius bilinearis	J		○	◉		○	◉		○	◉		○	◉		○	◉		○	○
	L			√			√			√			√			√			√
	E			√			√			√			√			√			√
Atlantic tomcod	A	◉	◉	○	○	◉	○	○	◉	○	○	◉	○	◉	◉	○	◉	◉	○
	S	◉	○		○	○		○	○		○	○		◉	○		◉	○	
Microgadus tomcod	J	◉	◉	○	○	◉	○	○	◉	○	○	◉	○	◉	◉	○	◉	◉	○
	L	◉	○		○	○	√	○	○	√	○	○	√	◉	○		◉	○	
	E	◉	○		○	○		○	○		○	○		◉	○		◉	○	
Pollock	A			○			√			√			√			√			√
	S																		
Pollachius virens	J		○	◉		○	○		○	○		○	○		○	○		○	◉
	L			○			na			na			na						√
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Atlantic salmon	A		na	na	○	○	○	○	○	○	√	√	√	√	√	√			
	S				○			√											
Salmo salar	J		na	na	○	○	○	√	√	√	√	√	√	√	√	√			
	L				○			√											
	E				○			√											
Atlantic cod	A		√	○		√	◉		√	○		√	○		√	○			
	S			√			◉						√			√			
Gadus morhua	J		√	○		√	○		√	○		√	○		√	○			√
	L			√			◉					√	○			○			√
	E			√			◉						○			○			√
Haddock	A			√			√						√			√			
	S																		
Melanogrammus aeglefinus	J			√			√						√			√			
	L																		
	E																		
Silver hake	A		○	○		○	◉		○	○		○	○		○	○			√
	S			√			√			na			√			√			
Merluccius bilinearis	J		○	○		○	○		○	○		○	○		○	○			√
	L			√			√			na		√	○		√	√			√
	E			√			√			na		√	○		√	√			√
Atlantic tomcod	A	◉	◉	○	◉	●	○	◉	●	○	○	◉	○	○	◉	○		◉	○
	S	◉	○		◉	○		◉	○		○	○		○	○			○	
Microgadus tomcod	J	◉	◉	○	◉	◉	○	◉	●	○	○	◉	○	○	◉	○		◉	○
	L	◉	○		◉	○		○	○		○	○	√	○	○	√		○	√
	E	◉	○		◉	○		◉	○		○	○		○	○			○	
Pollock	A			○			√			√			√			√			
	S																		
Pollachius virens	J		○	◉		○	◉		○	◉		○	○		○	○		√	√
	L		√	√		√	○		√	√		√	√		√	√		√	√
	E																		
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Atlantic salmon	A				√	√										
	S															
Salmo salar	J	√	√		○	○										
	L															
	E															
Atlantic cod	A			√		√				○		○	○		√	○
	S			√						○			○			○
Gadus morhua	J			√		√				○		○	○		√	○
	L			○		√				○		√	○		√	○
	E			○		√				○		√	○		√	○
Haddock	A									√			√			
	S									√						
Melanogrammus aeglefinus	J									√			√			√
	L			√						√			√			√
	E			√						√			√			√
Silver hake	A			√		√				○		○	○		○	○
	S									○						○
Merluccius bilinearis	J			√		√				○		○	○		○	○
	L			√		√				○		√	○		√	○
	E			√		○				○		√	○		√	○
Atlantic tomcod	A	○	◉	○	○	○				○		◉	○		○	√
	S	○	○		○	○						○			○	
Microgadus tomcod	J	○	◉	○	○	○				○		◉	○		○	√
	L	○	○	√	○	○						○			○	
	E	○	○		○	○						○			○	
Pollock	A			√		√				○			√			○
	S									○						√
Pollachius virens	J		√	○		○				◉		○	○		○	●
	L		√	○		○				○			○			○
	E		√	○		○				○			○			√
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Red hake	A		○	○		√	○		√	○		√	○		○	○		○	○
	S															√			na
Urophycis chuss	J		○	○		√	○		√	○		√	○		○	○		○	○
	L															√			na
	E															√			na
White hake	A		◉	◉		√	○		√	○		√	○		√	◉		○	○
	S			na			na			na			na			√			na
Urophycis tenuis	J		◉	◉		○	○		○	○		○	○		◉	◉		○	○
	L			na			na			na			na			√			na
	E			na			na			na			na			√			na
Mummichog	A	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○
	S	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○
Fundulus heteroclitus	J	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○
	L	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○
	E	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○
Silversides	A		○	○		○	○		○	○		○	○		◉	●		○	◉
	S		○	○		○	○		○	○		○	○		◉	●		○	◉
Menidia species	J		○	○		○	○		○	○		○	○		◉	●		◉	●
	L		○	○		○	○		○	○		○	○		◉	●		○	◉
	E		○	○		○	○		○	○		○	○		◉	●		○	◉
Fourspine stickleback	A	√	○	○	√	○	○	√	○	○	√	○	○	√	○	○	√	◉	◉
	S	√	○		√	○		√	○		√	○		√	○		√	○	
Apeltes quadracus	J	√	○	○	√	○	○	√	○	○	√	○	○	√	○	○	√	○	○
	L	√	○		√	○		√	○		√	○		√	○		√	○	
	E	√	○		√	○		√	○		√	○		√	○		√	○	
Threespine stickleback	A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	S	○	○		○	○		○	○		○	○		○	○		○	○	
Gasterosteus aculeatus	J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	L	○	○		○	○		○	○		○	○		○	○		○	○	
	E	○	○		○	○		○	○		○	○		○	○		○	○	
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Red hake	A		√	○		○	○		○	○		√	○		√	○			√
	S			na			○			na									
Urophycis chuss	J		○	○		○	○		○	○		√	○		√	○			√
	L			na			○			na			na			na			√
	E			na			○			na			na			na			√
White hake	A		○	○		◉	○		○	○		○	○		○	○		○	○
	S			na			na			na									
Urophycis tenuis	J		○	○		◉	○		○	○		○	○		○	○		○	○
	L			na			na			na			na			na			na
	E			na			na			na			na			na			na
Mummichog	A	●	●	○	●	●	◉	●	●	○	●	●	○	●	●	○		●	●
	S	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○		●	○
Fundulus heteroclitus	J	●	●	○	●	●	◉	●	●	○	●	●	○	●	●	○		●	●
	L	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○		●	○
	E	●	●	○	●	●	○	●	●	○	●	●	○	●	●	○		●	○
Silversides	A		○	◉		○	◉		○	◉		○	◉		○	◉		◉	◉
	S		○	◉		○	◉		○	◉		○	◉		○	◉		○	●
Menidia species	J		◉	●		◉	●		◉	●		◉	●		◉	●		◉	●
	L		○	◉		○	◉		○	◉		○	◉		○	◉		○	●
	E		○	◉		○	◉		○	◉		○	◉		○	◉		○	●
Fourspine stickleback	A	√	◉	◉	√	○	○	√	◉	○	√	○	○	√	○	○		○	○
	S	√	○		√	○		√	○		√	○		√	○			○	
Apeltes quadracus	J	√	○	○	√	○	○	√	○	○	√	○	○	√	○	○		○	○
	L	√	○		√	○		√	○		√	○		√	○			○	
	E	√	○		√	○		√	○		√	○		√	○			○	
Threespine stickleback	A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	S	○	○		○	○		○	○		○	○		○	○			○	
Gasterosteus aculeatus	J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	L	○	○		○	○		○	○		○	○		○	○			○	
	E	○	○		○	○		○	○		○	○		○	○			○	
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Red hake	A		√	○		√				○		○	○		○	◉
	S									○						○
Urophycis chuss	J		√	○		√				○		○	○		○	○
	L		√	√		√				◉		√	○			◉
	E		√	○		◉				◉		○	◉		○	◉
White hake	A		√	○		√				○		√	○		○	○
	S									na			na			na
Urophycis tenuis	J		√	○		√				○		√	○		○	○
	L		√	√		√				○			○			○
	E		√	○		○				○		√	○		√	○
Mummichog	A	●	●	◉	●	●				◉		●	○		●	◉
	S	◉	●	◉	◉	●				○		●	○		●	○
Fundulus heteroclitus	J	●	●	◉	●	●				◉		●	○		●	◉
	L	◉	●	◉	◉	●				○		●	○		●	○
	E	◉	●	◉	◉	●				○		●	○		●	○
Silversides	A		●	●		◉				●		●	●		◉	●
	S		◉	●		○				●		○	●		○	●
Menidia species	J		●	●		●				●		●	●		◉	●
	L		◉	●		○				●		◉	●		◉	●
	E		◉	●		○				●		◉	●		◉	●
Fourspine stickleback	A	√	○	○	√	√				○		○	○		○	○
	S	√	○		√	√						○			○	
Apeltes quadracus	J	√	○	○	√	√				○		○	○		○	○
	L	√	○		√	√						○			○	
	E	√	○		√	√						○			○	
Threespine stickleback	A	○	○	○	○	○				○		○	○		○	○
	S	○	○		○	○						○			○	
Gasterosteus aculeatus	J	○	○	○	○	○				○		○	○		○	○
	L	○	○		○	○						○			○	
	E	○	○		○	○						○			○	
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Ninespine stickleback	A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	S	○	○		○	○		○	○		○	○		○	○		○	○	
Pungitius	J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
pungitius	L	○	○		○	○		○	○		○	○		○	○		○	○	
	E	○	○		○	○		○	○		○	○		○	○		○	○	
Northern pipefish	A		○	○		√	√		√	√		○	○		○	○		○	○
	M		○	○		√	√		√	√		√	√		○	○		○	○
Syngnathus	J		○	○		√	√		√	√		○	○		○	○		○	○
fuscus	L		○	○		√	√		√	√		√	√		○	○		○	○
Northern searobin	A											√	√					√	√
	S																		
Prionotus	J											√	√					√	√
carolinus	L																		
	E																		
Grubby	A		○	○		○	○		○	○		○	○		○	○		○	○
	S		○	○		○	○		○	○		○	○		○	○		○	○
Myoxocephalus	J		○	○		○	○		○	○		○	○		○	○		○	○
aeneaus	L		○	○		○	○		○	○		○	○		○	○		◉	○
	E		○	○		○	○		○	○		○	○		○	○		○	○
Longhorn sculpin	A		√	●		√	●		√	●		√	●		√	●		√	●
	S		√	●		√	●		√	●		√	●		√	●		√	●
Myoxocephalus	J		√	●		○	●		○	●		○	●		√	●		√	●
octodecemspinosus	L		○	●		○	●		○	●		○	●		○	●		○	●
	E		√	●		√	●		√	●		√	●		√	●		√	●
Shorthorn sculpin	A		√	○		√	○		√	○		√	○		√	○		√	○
	S		√	○		√	○		√	○		○	○		√	○		√	○
Myoxocephalus	J		√	○		√	○		√	○		√	○		√	○		√	○
scorpius	L		○	○		√	○		√	○		√	○		√	○		√	○
	E		√	○		√	○		√	○		√	○		√	○		√	○
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Ninespine stickleback	A	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		◉	◉
	S	○	○		○	○		○	○		○	○		○	○			◉	
Pungitius pungitius	J	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		●	●
	L	○	○		○	○		○	○		○	○		○	○			◉	
	E	○	○		○	○		○	○		○	○		○	○			◉	
Northern pipefish	A		○	○		○	○		○	○		○	○		○	○		○	○
	M		○	○		○	○		○	○		○	○		○	○		○	○
Syngnathus fuscus	J		○	○		○	○		○	○		○	○		○	○		○	○
	L		○	○		○	○		○	○		○	○		○	○		○	○
Northern searobin	A		√	√		√	√		√	√		√	√		√	√			
	S																		
Prionotus carolinus	J		√	√		√	√		√	√		√	√		√	√			
	L																		
	E																		
Grubby	A		○	○		○	○		○	○		○	○		○	○		○	○
	S		○	○		○	○		○	○		○	○		○	○		○	○
Myoxocephalus aeneaus	J		○	○		○	○		○	○		○	○		○	○		○	○
	L		◉	○		◉	○		◉	○		○	○		○	○		○	○
	E		○	○		○	○		○	○		○	○		○	○		○	○
Longhorn sculpin	A		√	●		√	◉		√	●		√	●		√	◉		√	○
	S		√	●		√	◉		√	●		√	●		√	◉		√	○
Myoxocephalus octodecemspinosus	J		√	●		√	◉		√	●		√	●		√	◉		√	○
	L		○	●		○	◉		○	●		○	●		○	◉		√	○
	E		√	●		√	◉		√	●		√	●		√	◉		√	○
Shorthorn sculpin	A		√	○		√	○		√	○		√	○		√	○			√
	S		√	○		√	○		√	○		√	○		√	○			√
Myoxocephalus scorpius	J		√	○		√	○		√	○		√	○		√	○			√
	L		√	○		√	○		√	○		√	○		√	○			√
	E		√	○		√	○		√	○		√	○		√	○			√
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Ninespine stickleback	A	○	○	○	○	○				√		√	√			
	S	○	○		○	○						√				
Pungitius	J	○	○	○	○	○				√		○	√			
pungitius	L	○	○		○	○						√				
	E	○	○		○	○						√				
Northern pipefish	A		○	○		○				○		○	○		○	○
	M		○	○		○				○		○	○		○	○
Syngnathus	J		○	○		○				○		○	○		○	○
fuscus	L		○	○		○				○		○	○		○	○
Northern searobin	A		√	√		√				○		√	√		○	○
	S									√		√	√		√	√
Prionotus	J		√	√		√				○		√	√		○	○
carolinus	L			√		√				√		√	√		√	√
	E			√		√				√		√	√		√	√
Grubby	A		○	○		○				○		○	○		○	○
	S		○	○		○				○		○	○		○	○
Myoxocephalus	J		○	○		○				○		○	○		○	○
aeneaus	L		◉	○		○				○		○	○		○	○
	E		◉	○		○				○		○	○		○	○
Longhorn sculpin	A		√	○		√				◉		√	○			◉
	S			○		√				◉			○			◉
Myoxocephalus	J		√	○		√				◉		√	○			◉
octodecemspinosus	L		√	○		○				◉		√	○			◉
	E			○		√				◉			○			◉
Shorthorn sculpin	A			√		√				○			√			√
	S			√		na				○			√			√
Myoxocephalus	J			√		√				○			√			√
scorpius	L			√		na				○			√			√
	E			√		na				○			√			√
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
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																		
Scup	A																		
	S																		
Stenotomus chrysops	J																		
	L																		
	E																		
Tautog	A															na			na
	S															na			na
Tautoga onitis	J															√			√
	L															√			na
	E															√			na
Cunner	A		○	○		√	○		√	○		√	○		○	○		○	○
	S			○		√	○			○			○			○			○
Tautogolabrus adspersus	J		○	○		√	○		√	○		√	○		○	○		○	○
	L		√	◉		√	○		√	○		√	◉		√	◉		√	◉
	E		√	◉		√	○		√	○		√	◉		√	◉		√	◉
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
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																		
Scup	A												√			√			
	S																		
Stenotomus chrysops	J												√			√			
	L																		
	E																		
Tautog	A			na			na			na			na			na			na
	S			na			na			na									
Tautoga onitis	J			√			√			√			√			√			√
	L			na			na			na			na			na			na
	E			na			na			na			na			na			na
Cunner	A		√	○		○	○		√	○		○	○		○	○		○	○
	S		√	○			○			○			○			○			○
Tautogolabrus adspersus	J		○	○		○	○		○	○		○	○		○	○		○	○
	L		√	◉		√	◉		√	◉		○	◉		○	◉		○	○
	E		√	◉		√	◉		√	◉		○	◉		○	◉		○	○
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
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															
Scup	A									√			√			○
	S															
Stenotomus chrysops	J									○		√	√		○	○
	L									√			√			√
	E															
Tautog	A			√						○		√	√		○	○
	S									○						○
Tautoga onitis	J			√						○		√	○		○	○
	L			√						○		√	○		√	○
	E			√						○		√	○		√	○
Cunner	A		○	○		√				◉		○	◉		○	◉
	S			○						◉			○			◉
Tautogolabrus adspersus	J		○	○		√				◉		○	◉		○	◉
	L		◉	◉		●				●		◉	●		○	●
	E		◉	◉		●				●		◉	●		○	●
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
Ocean pout	A		√	◉		√	○		√	○		√	○		√	○		√	○
	S			◉			○			○			○			○			○
Macrozoarces americanus	J		√	◉		√	○		√	○		√	○		√	○		√	○
	L			◉			○			○			○			○			○
	E			◉			○			○			○			○			○
Rock gunnel	A		○	○		○	○		○	○		○	○		○	○		○	○
	S		○	○		○	○		○	○		○	○		○	○		○	○
Pholis gunnelus	J		○	○		○	○		○	○		○	○		○	○		○	○
	L		○	●		○	●		○	●		○	●		○	●		○	◉
	E		○	◉		○	◉		○	◉		○	◉		○	◉		○	◉
American sand lance	A		√	○		√	○		√	○		√	○		√	○		√	◉
	S			○			○			○			○			○			○
Ammodytes americanus	J		√	○		√	○		√	○		√	○		√	○		√	◉
	L		√	◉		○	◉		○	◉		○	◉		√	◉		√	◉
	E			○			○			○			○			○			○
Atlantic mackerel	A		○	○		○	○		○	○		○	○		○	○		○	◉
	S																		
Scomber scombrus	J		○	○		√	√		√	√		√	√		○	○		○	◉
	L			na			na			na			na			√			
	E			na			na			na			na			√			
Butterfish	A		√	√		√	√		√	√		√	√		√	√		√	√
	S																		
Peprilus triacanthus	J		√	√		√	√		√	√		√	√		√	√		√	√
	L		na	na											√	√			
	E		na	na											√	√			
Windowpane	A		○	○		○	○		○	○		○	○		○	◉		○	○
	S		○	○		○	○		○	○		○	○		○	◉		○	○
Scopthalmus aquosus	J		○	○		○	○		○	○		○	○		○	◉		○	○
	L		○	○		○	○		○	○		○	○		○	◉		○	○
	E		○	○		○	○		○	○		○	○		○	◉		○	○
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
Ocean pout	A		√	○		√	○		√	○		√	○			○			
	S			○			○			○			○			○			
Macrozoarces americanus	J		√	○		√	○		√	○		√	○			○			
	L			○			○			○			○			○			
	E			○			○			○			○			○			
Rock gunnel	A		○	○		○	○		○	○		○	○		○	○		√	○
	S		○	○		○	○		○	○		○	○		○	○		√	○
Pholis gunnelus	J		○	○		○	○		○	○		○	○		○	○		√	○
	L		○	◉		◉	◉		○	◉		○	◉		○	◉		√	○
	E		○	◉		○	◉		○	◉		○	◉		○	◉		√	○
American sand lance	A		√	◉		√	◉		√	◉		√	◉		√	◉		○	◉
	S			○			○			○			○			○			○
Ammodytes americanus	J		√	◉		√	◉		√	◉		√	◉		√	◉		○	●
	L		√	◉		√	◉		√	◉		√	◉		√	◉		√	◉
	E			○			○			○			○			○			◉
Atlantic mackerel	A		○	◉		○	◉		○	◉		○	○		○	○		√	√
	S																		
Scomber scombrus	J		○	◉		○	◉		○	◉		○	○		○	○		√	√
	L												na						
	E												na						
Butterfish	A		√	√		√	√		√	√		√	√		√	√			
	S																		
Peprilus triacanthus	J		√	√		√	√		√	√		√	√		√	√			
	L																		
	E																		
Windowpane	A		○	○		○	○		○	○		○	○		○	○		○	○
	S		○	○		○	○		○	○		○	○		○	○		○	○
Scopthalmus aquosus	J		○	○		○	○		○	○		○	○		○	○		○	○
	L		○	○		○	○		○	○		○	○		○	○		○	○
	E		○	○		○	○		○	○		○	○		○	○		○	○
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic 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 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
Ocean pout	A			√						○			○			○
	S									○						○
Macrozoarces americanus	J			√						○			○			○
	L									○						○
	E									○						○
Rock gunnel	A		√	○		√				○		○	○		○	○
	S		√	○						○		○	○		○	○
Pholis gunnelus	J		√	○		√				○		○	○		○	○
	L		√	○		√				○		○	○		○	○
	E		√	○		√				○		○	○		○	○
American sand lance	A		√	○		◉				◉		√	○			◉
	S					na				○			○			○
Ammodytes americanus	J		√	○		◉				◉		○	○		○	◉
	L		○	●		○				◉		○	◉		○	●
	E					√				◉			○			●
Atlantic mackerel	A			√		√				○		○	○		○	◉
	S									○						◉
Scomber scombrus	J			○		√				○		○	○		○	◉
	L		○	○		○				◉		○	◉		○	●
	E		○	◉		●				◉		○	◉		○	●
Butterfish	A		√	√		√				○		√	√		○	○
	S									√						
Peprilus triacanthus	J		√	√		√				○		√	√		○	○
	L		√	√		√				√			○			√
	E		√	√		√				○			○			○
Windowpane	A		√	○		√				○		○	○		◉	◉
	S		√	○		√				○		○	○		○	○
Scopthalmus aquosus	J		√	○		√				○		○	○		◉	◉
	L		√	○		√				○		○	○		○	○
	E		√	○		√				○		○	○		○	○
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic Estuaries														

Relative Abundance

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

Salinity Zone

- T - Tidal Fresh
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- S - Seawater
- * - Salinity zone not present

Life Stage

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

Table 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
American plaice	A			○			○			○			○			○			◉
	S			○			○			○			○			○			○
Hippoglossoides platesoides	J		○	○		○	○		○	○		○	○		○	○		○	●
	L			○			○			○			○			○		√	○
	E			○			○			○			○			○			○
Winter flounder	A		●	●		◉	◉		◉	◉		◉	◉		●	●		●	●
	S		●	●		◉	◉		◉	◉		◉	◉		●	●		●	●
Pleuronectes americanus	J		●	●		●	◉		●	◉		●	◉		●	●		●	●
	L		●	●		◉	◉		◉	◉		◉	◉		●	●		●	●
	E		●	●		◉	◉		◉	◉		◉	◉		●	●		●	●
Yellowtail flounder	A			√			√			√			√			√			√
	S			√			√			√			√			√			√
Pleuronectes ferrugineus	J			√			√			√			√			√			√
	L			√			√			√			√			√			√
	E			√			√			√			√			√			√
Smooth flounder	A	√	○	√	√	○	√	√	○	√	√	○	√	√	○	√	√	◉	√
	S	√	○	√	√	○	√	√	○	√	√	○	√	√	○	√	√	◉	√
Pleuronectes putnami	J	√	○	√	√	○	√	√	○	√	√	○	√	√	○	√	√	◉	√
	L	√	○	√	√	○	√	√	○	√	√	○	√	√	○	√	√	◉	√
	E	√	○	√	√	○	√	√	○	√	√	○	√	√	○	√	√	◉	√
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
		Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
		North Atlantic Estuaries																	

Relative Abundance

- ● Highly Abundant
- ◉ Abundant
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Salinity Zone

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Life Stage

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

Table 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries																	
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Species/Life Stage		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
American plaice	A			◉			◉			◉			◉			◉			
	S			○			○			○			○			○			
Hippoglossoides platesoides	J		○	●		○	●		○	●		○	●		√	●			√
	L		√	○		√	○		√	○		√	○		√	○			√
	E			○			○			○			○			○			√
Winter flounder	A		●	●		●	●		●	●		●	●		●	●		●	●
	S		●	●		●	●		●	●		◉	◉		◉	◉		●	◉
Pleuronectes americanus	J		●	●		●	●		●	●		●	●		●	●		●	●
	L		●	●		●	●		●	●		◉	◉		◉	◉		●	◉
	E		●	●		●	●		●	●		◉	◉		◉	◉		●	◉
Yellowtail flounder	A			√			○			√			○			√			
	S			√			√			√			○			√			
Pleuronectes ferrugineus	J			√			○			√			○			√			√
	L			√			√			√			○			√			√
	E			√			√			√			○			√			
Smooth flounder	A	√	◉	√	√	◉	√	√	◉		√	○	√	√	○	√		○	√
	S	√	◉	√	√	◉	√	√	◉		√	○	√	√	○	√		○	√
Pleuronectes putnami	J	√	◉	√	√	◉	√	√	◉		√	◉	√	√	◉	√		○	√
	L	√	◉	√	√	◉	√	√	◉		√	○	√	√	○	√		○	√
	E	√	◉	√	√	◉	√	√	◉		√	○	√	√	○	√		○	√
		T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
		Damari-scotta River			Sheepscot River			Kennebec/ Andro-scoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
		North Atlantic Estuaries																	

Relative Abundance

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

Salinity Zone

- 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

Table 4 (continued). Spatial distribution and relative abundance

		North Atlantic Estuaries														
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
Species/Life Stage		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
American plaice	A			√						●			◉			◉
	S									●			○			●
Hippoglossoides platesoides	J			√		√				●			◉			●
	L			√		√				◉		√	○		√	●
	E			√		√				◉		√	○		√	●
Winter flounder	A		◉	◉		◉				●		●	●		●	●
	S		◉	◉		◉				◉		◉	◉		◉	◉
Pleuronectes americanus	J		●	●		●				●		●	●		●	●
	L		◉	◉		◉				●		●	●		◉	◉
	E		◉	◉		◉				◉		◉	◉		◉	◉
Yellowtail flounder	A									◉			◉			○
	S									◉			◉			○
Pleuronectes ferrugineus	J									◉			◉			○
	L			√		√				◉			◉			○
	E			√		√				◉			◉			○
Smooth flounder	A	○	◉	○	√	√				√		√	√			
	S	√	◉	○	√	√				na		√	√			
Pleuronectes putnami	J	√	●	○	√	√				√		√	√			
	L	○	◉	○	√	√				na		√	√		√	√
	E	○	◉	○	√	√				na		√	√			
		T	M	S	T	M	*	*	*	S	*	M	S	*	M	S
		Great Bay			Merrimack River			Massa-chusetts Bay			Boston Harbor			Cape Cod Bay		
		North Atlantic Estuaries														

Relative Abundance

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

Salinity Zone

- T - Tidal Fresh
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- * - Salinity zone not present

Life Stage

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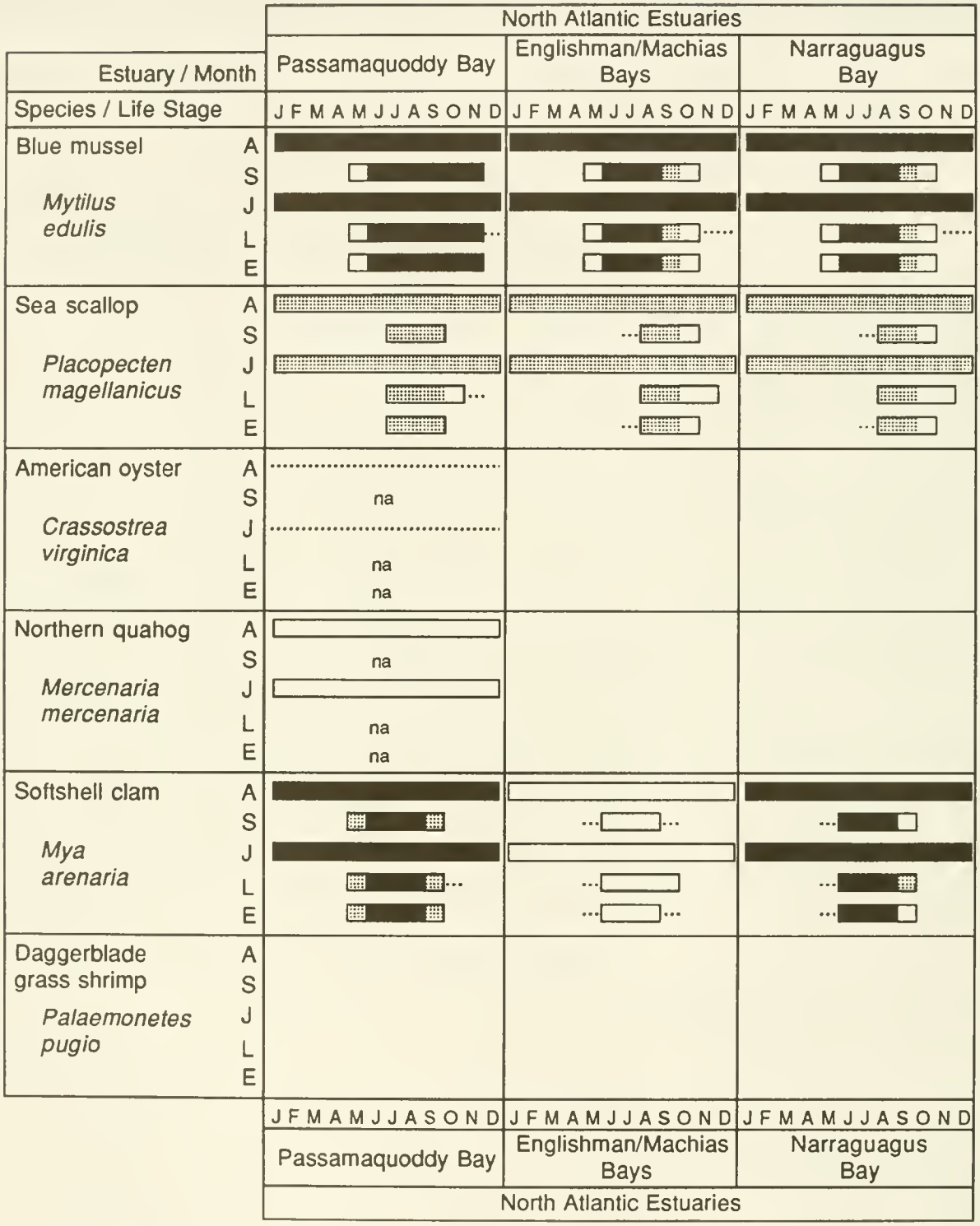
- L - Larvae
- E - Eggs

Table 5. Temporal distribution and relative abundance

Index to Table 5. Page location of temporal distribution table for each species and estuary.

	Passamaquoddy Bay Englishman/Machias Bays Narraguagus Bay	Blue Hill Bay Penobscot Bay Muscongus Bay	Damariscotta River Sheepscot River Kennebec/Androscoggin Rivers	Casco Bay Saco Bay Wells Harbor	Great Bay Merrimack River Massachusetts Bay	Boston Harbor Cape Cod Bay
Blue mussel (*Mytilus edulis*) Sea scallop (*Placopecten magellanicus*) American oyster (*Crassostrea virginica*) Northern quahog (*Mercenaria mercenaria*) Softshell clam (*Mya arenaria*) Daggerblade grass shrimp (*Palaemonetes pugio*)	p. 52	p. 53	p. 54	p. 55	p. 56	p. 57
Northern shrimp (*Pandalus borealis*) Sevenspine bay shrimp (*Crangon septemspinosa*) American lobster (*Homarus americanus*) Jonah crab (*Cancer borealis*) Atlantic rock crab (*Cancer irroratus*) Green crab (*Carcinus maenas*)	p. 58	p. 59	p. 60	p. 61	p. 62	p. 63
Green sea urchin (*Strongylocentrotus droebachiensis*) Spiny dogfish (*Squalus acanthias*) Skates (*Raja* species) Shortnose sturgeon (*Acipenser brevirostrum*) Atlantic sturgeon (*Acipenser oxyrhynchus*) American eel (*Anguilla rostrata*)	p. 64	p. 65	p. 66	p. 67	p. 68	p. 69
Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Atlantic herring (*Clupea harengus*) Rainbow smelt (*Osmerus mordax*)	p. 70	p. 71	p. 72	p. 73	p. 74	p. 75
Atlantic salmon (*Salmo salar*) Atlantic cod (*Gadus morhua*) Haddock (*Melanogrammus aeglefinus*) Silver hake (*Merluccius bilinearis*) Atlantic tomcod (*Microgadus tomcod*) Pollock (*Pollachius virens*)	p. 76	p. 77	p. 78	p. 79	p. 80	p. 81
Red hake (*Urophycis chuss*) White hake (*Urophycis tenuis*) Mummichog (*Fundulus heteroclitus*) Silversides (*Menidia* species) Fourspine stickleback (*Apeltes quadracus*) Threespine stickleback (*Gasterosteus aculeatus*)	p. 82	p. 83	p. 84	p. 85	p. 86	p. 87
Ninespine stickleback (*Pungitius pungitius*) Northern pipefish (*Syngnathus fuscus*) Northern searobin (*Prionotus carolinus*) Grubby (*Myoxocephalus aenaeus*) Longhorn sculpin (*Myoxocephalus octodecemspinosus*) Shorthorn sculpin (*Myoxocephalus scorpius*)	p. 88	p. 89	p. 90	p. 91	p. 92	p. 93
White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*) Scup (*Stenotomus chrysops*) Tautog (*Tautoga onitis*) Cunner (*Tautogolabrus adspersus*)	p. 94	p. 95	p. 96	p. 97	p. 98	p. 99
Ocean pout (*Macrozoarces americanus*) Rock gunnel (*Pholis gunnelus*) American sand lance (*Ammodytes americanus*) Atlantic mackerel (*Scomber scombrus*) Butterfish (*Peprilus triacanthus*) Windowpane (*Scophthalmus aquosus*)	p. 100	p. 101	p. 102	p. 103	p. 104	p. 105
American plaice (*Hippoglossoides platesoides*) Winter flounder (*Pleuronectes americanus*) Yellowtail flounder (*Pleuronectes ferrugineus*) Smooth flounder (*Pleuronectes putnami*)	p. 106	p. 107	p. 108	p. 109	p. 110	p. 111

Table 5. Temporal distribution and relative abundance



Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present
- na — No data available

Life Stage

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

Table 5 (continued). Temporal distribution and relative abundance

Estuary / Month		North Atlantic Estuaries		
		Blue Hill Bay	Penobscot Bay	Muscongus Bay
Species / Life Stage		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
Blue mussel	A			
	S			
Mytilus edulis	J			
	L			
	E			
Sea scallop	A			
	S			
Placopecten magellanicus	J			
	L			
	E			
American oyster	A			
	S			
Crassostrea virginica	J			
	L			
	E			
Northern quahog	A			
	S	na	na	na
Mercenaria mercenaria	J			
	L	na	na	na
	E	na	na	na
Softshell clam	A			
	S			
Mya arenaria	J			
	L			
	E			
Daggerblade grass shrimp	A			
	S			
Palaemonetes pugio	J			
	L			
	E			
		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
		Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries		

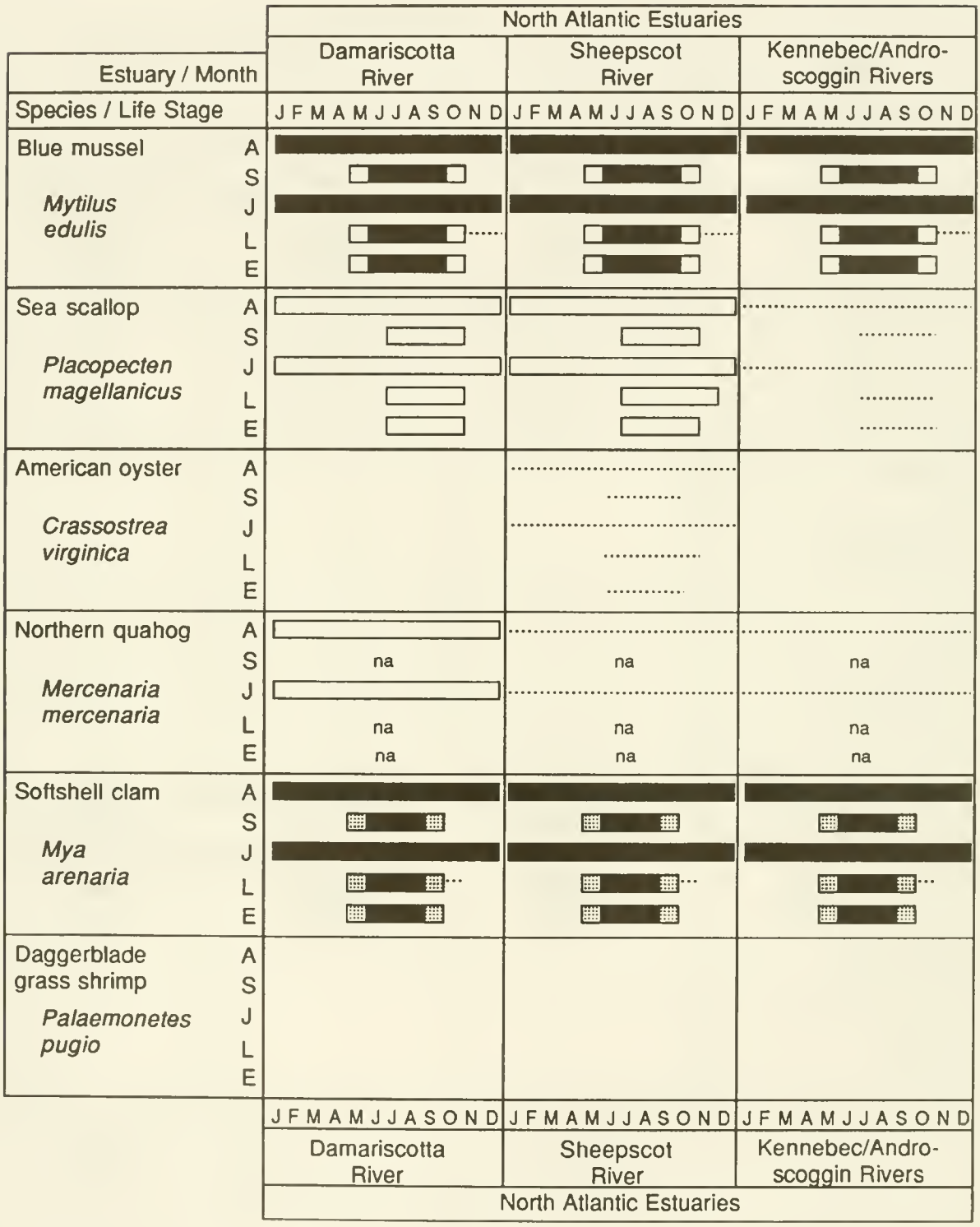
Relative Abundance

- Highly Abundant
- Abundant
- Common
- Rare
- Blank — Not Present
- na — No data available

Life Stage

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

Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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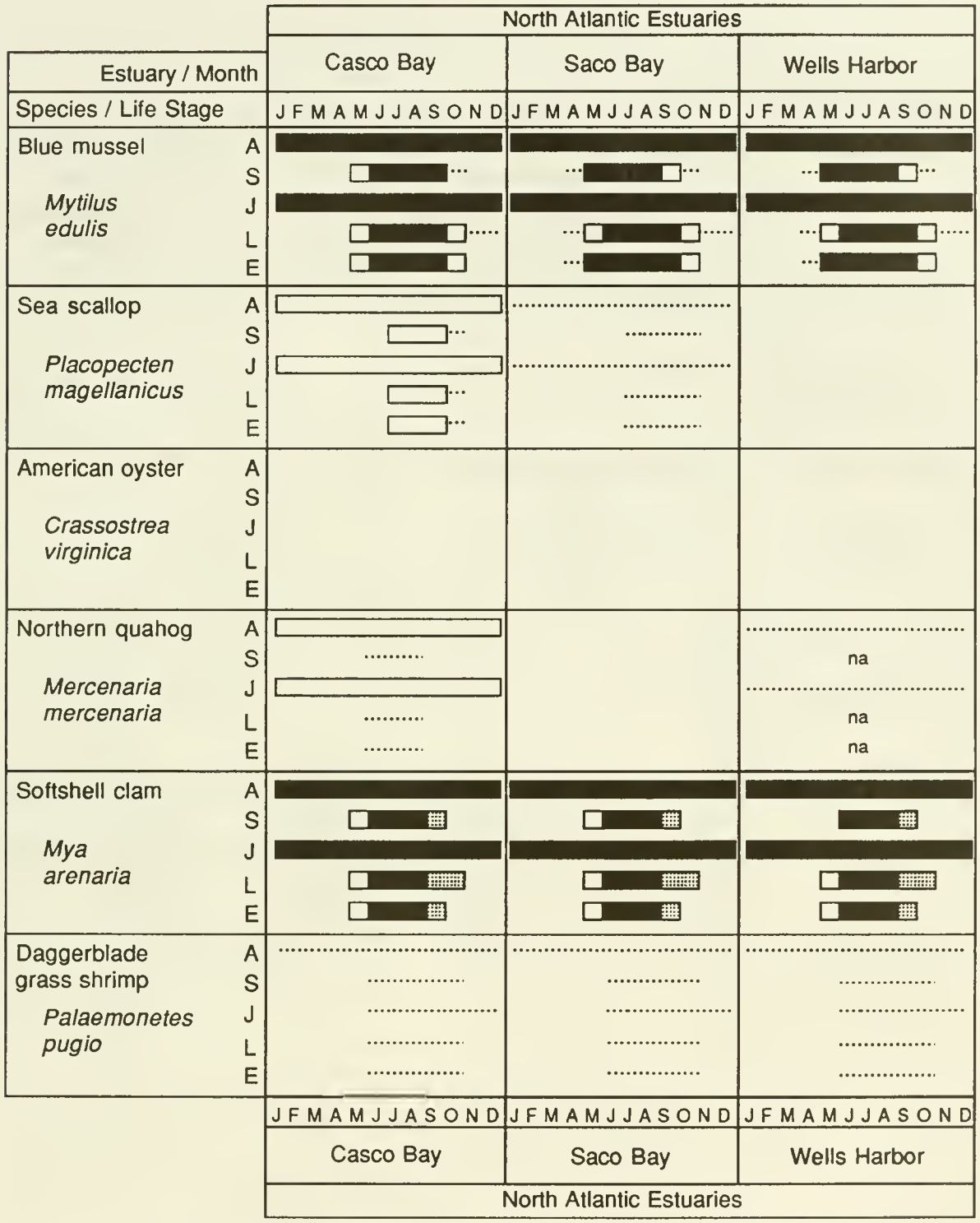
Life Stage

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

Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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

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S - Spawning adults
J - Juveniles
L - Larvae
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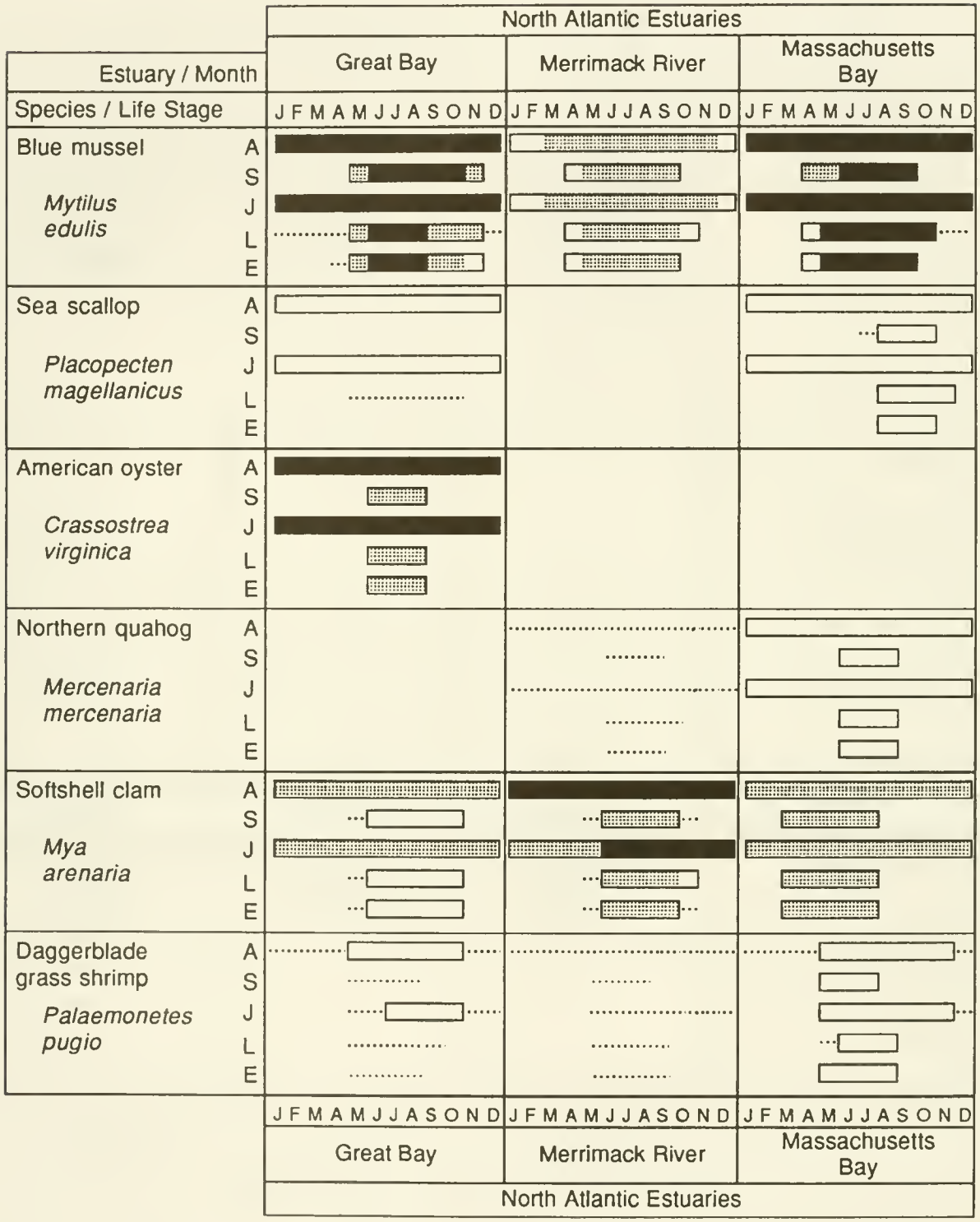
Table 5 (continued). Temporal distribution and relative abundance



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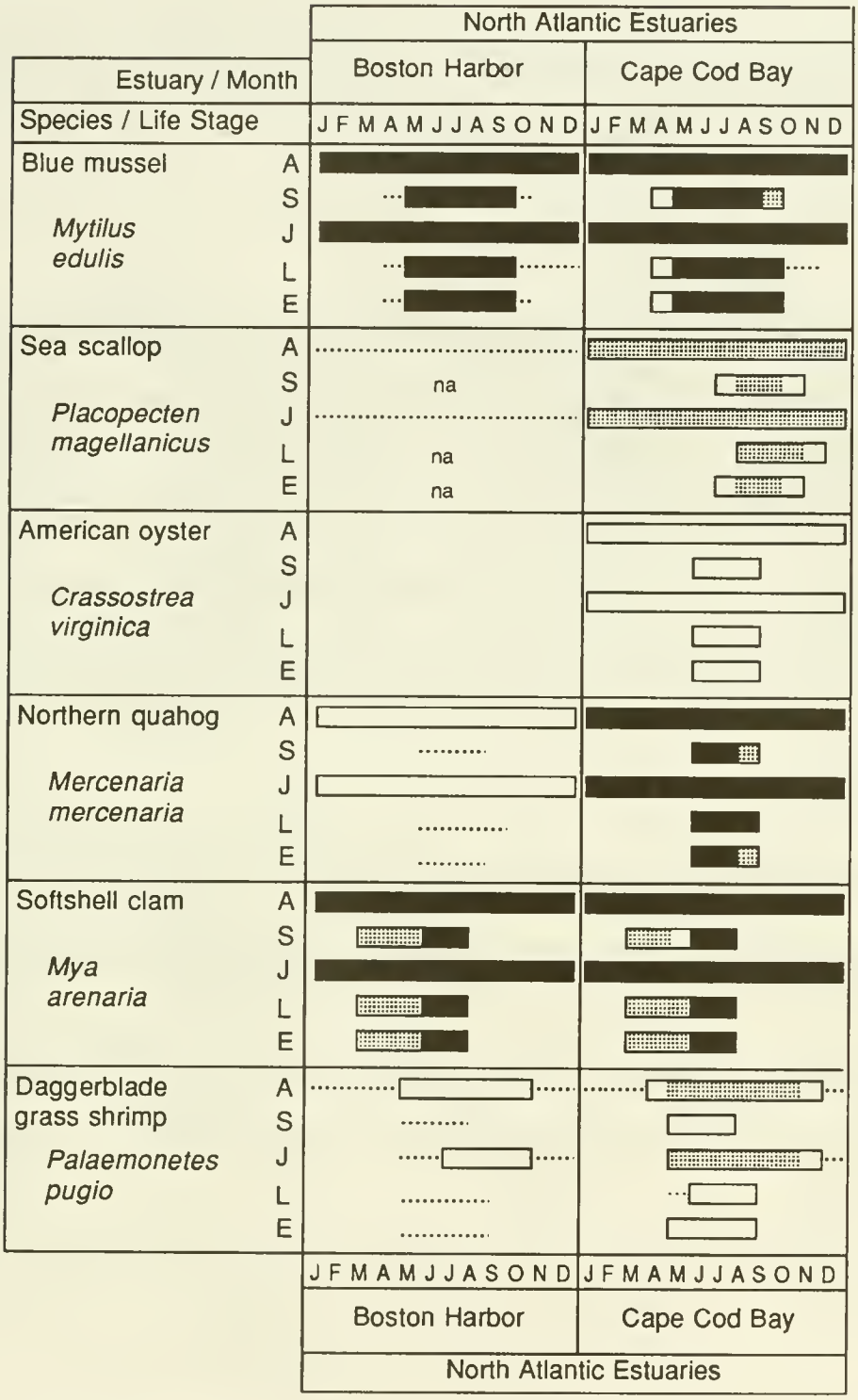

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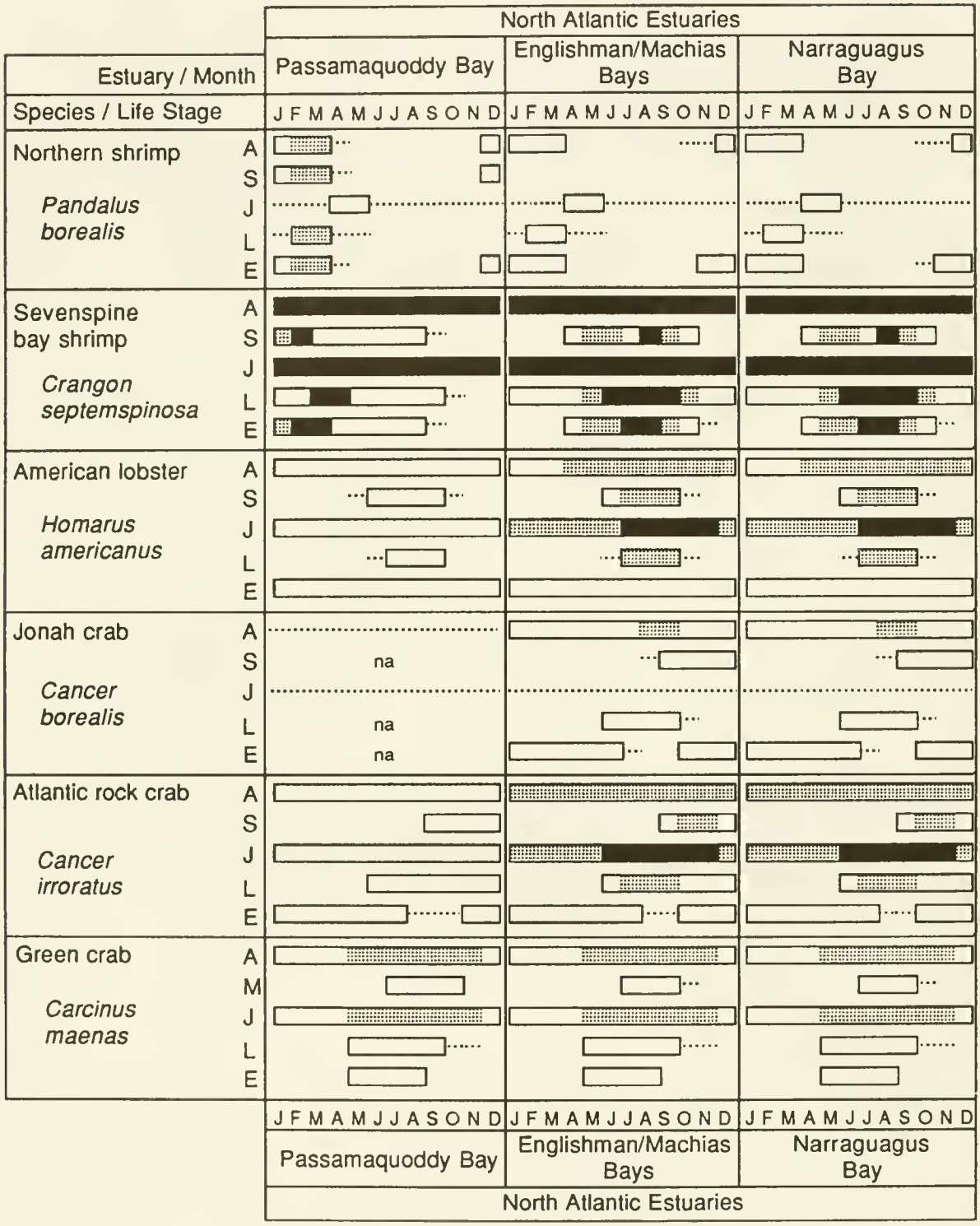

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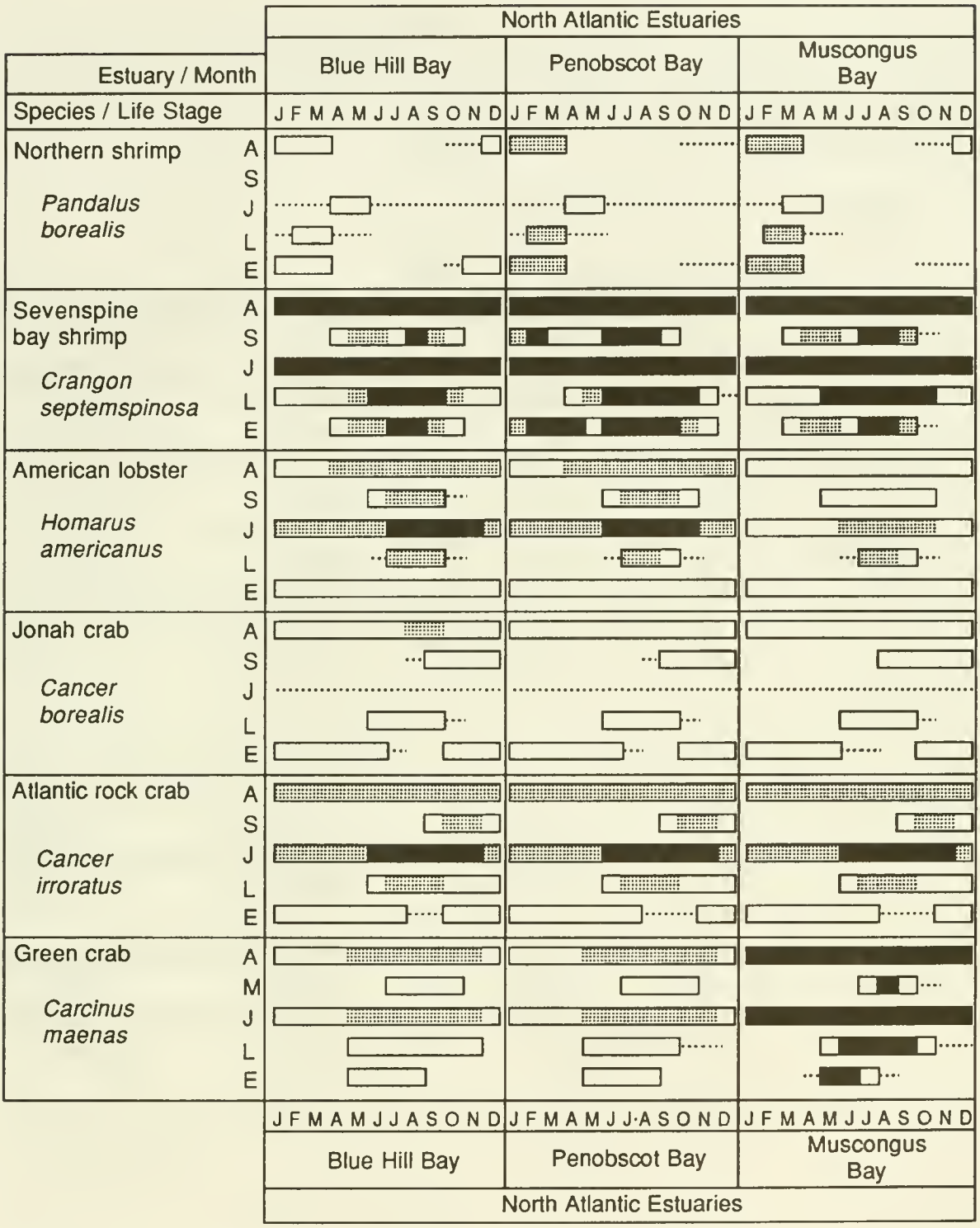

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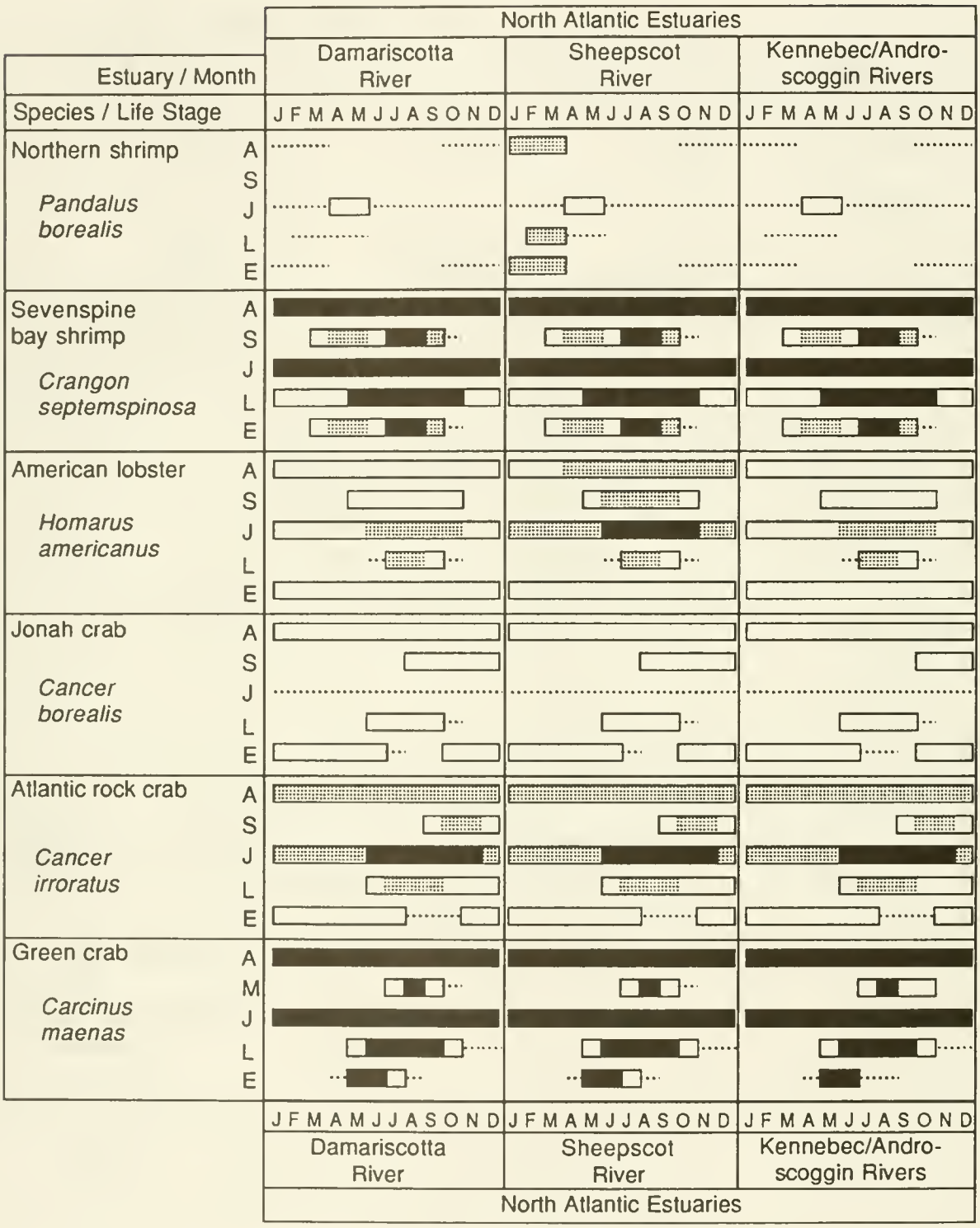

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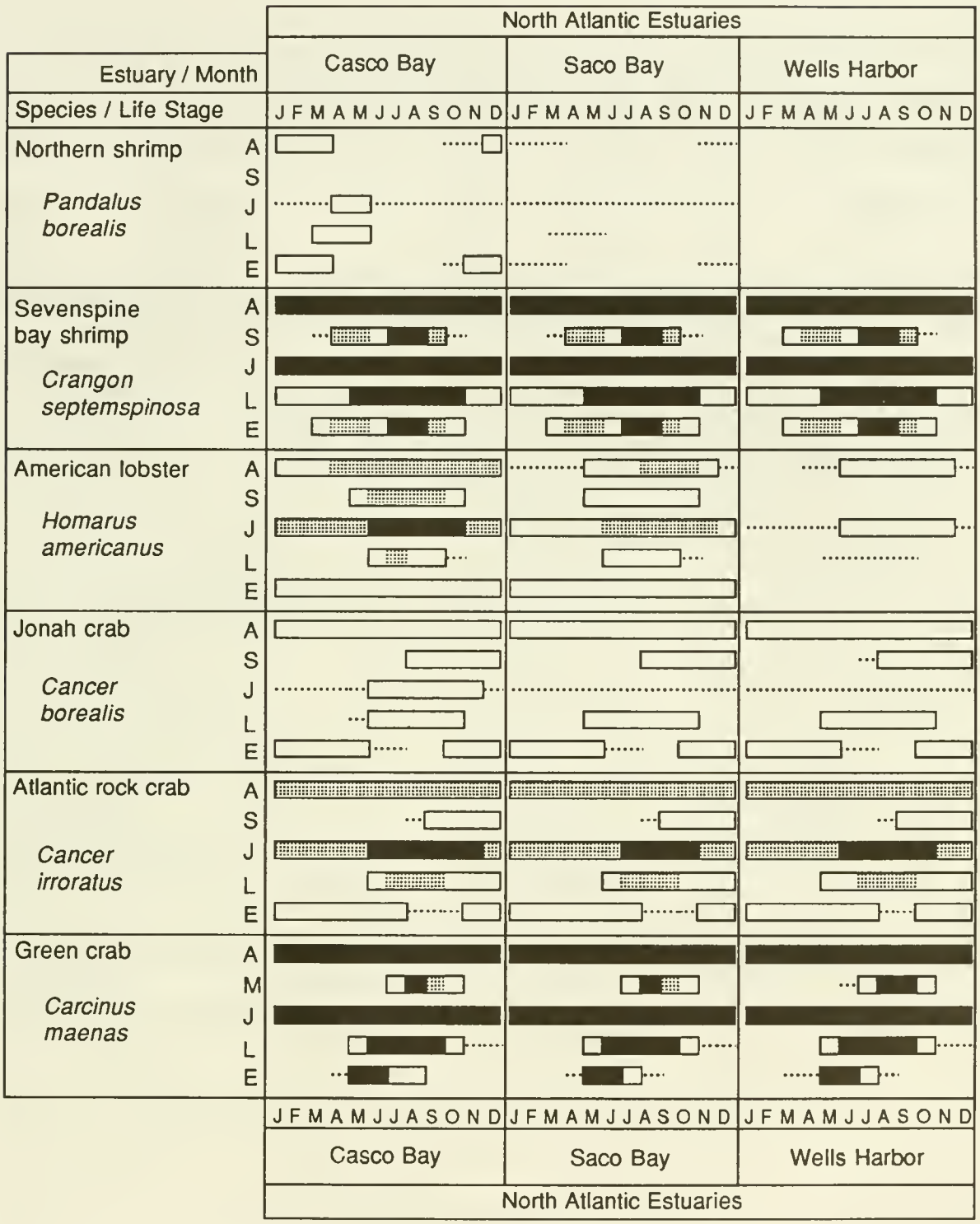

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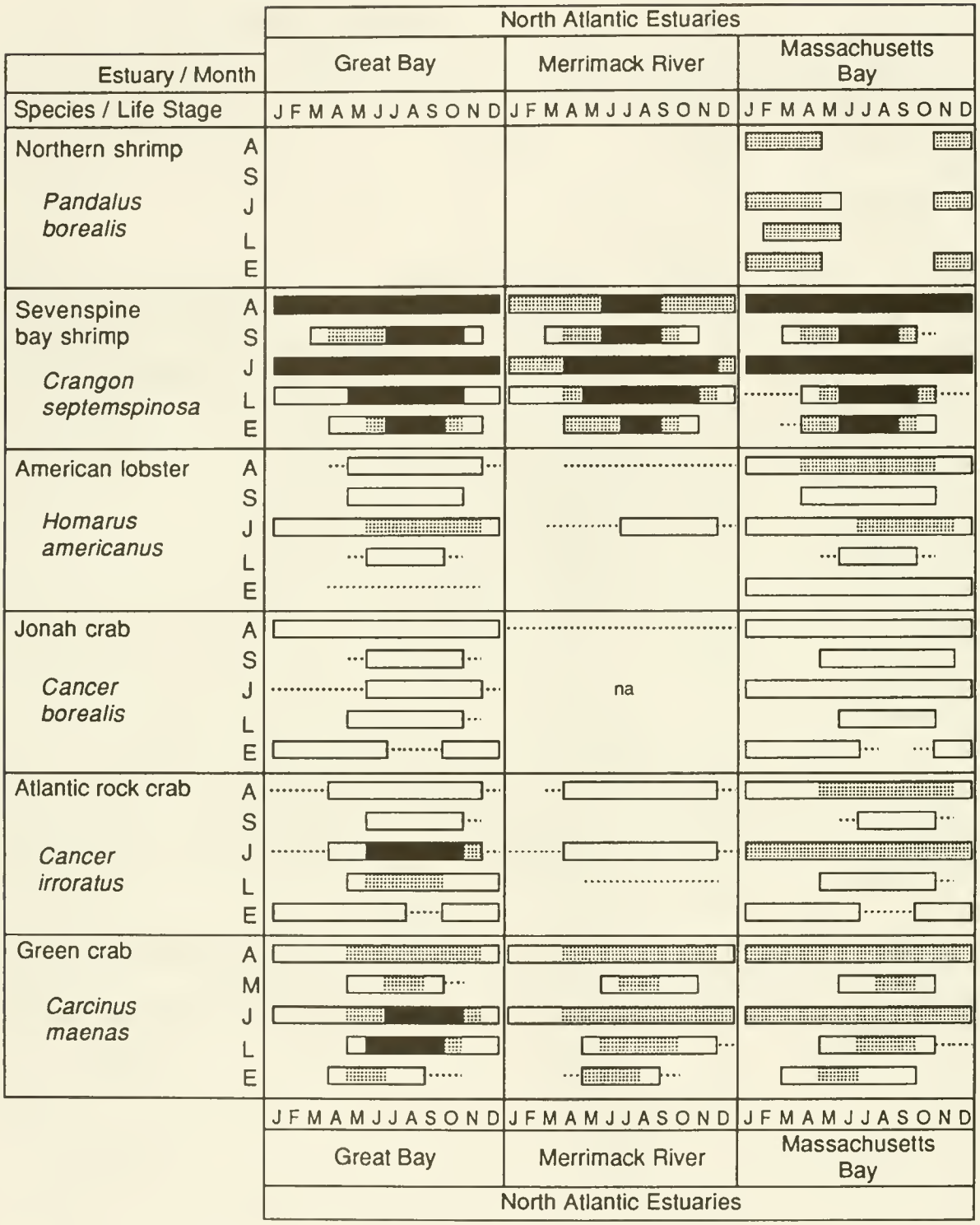

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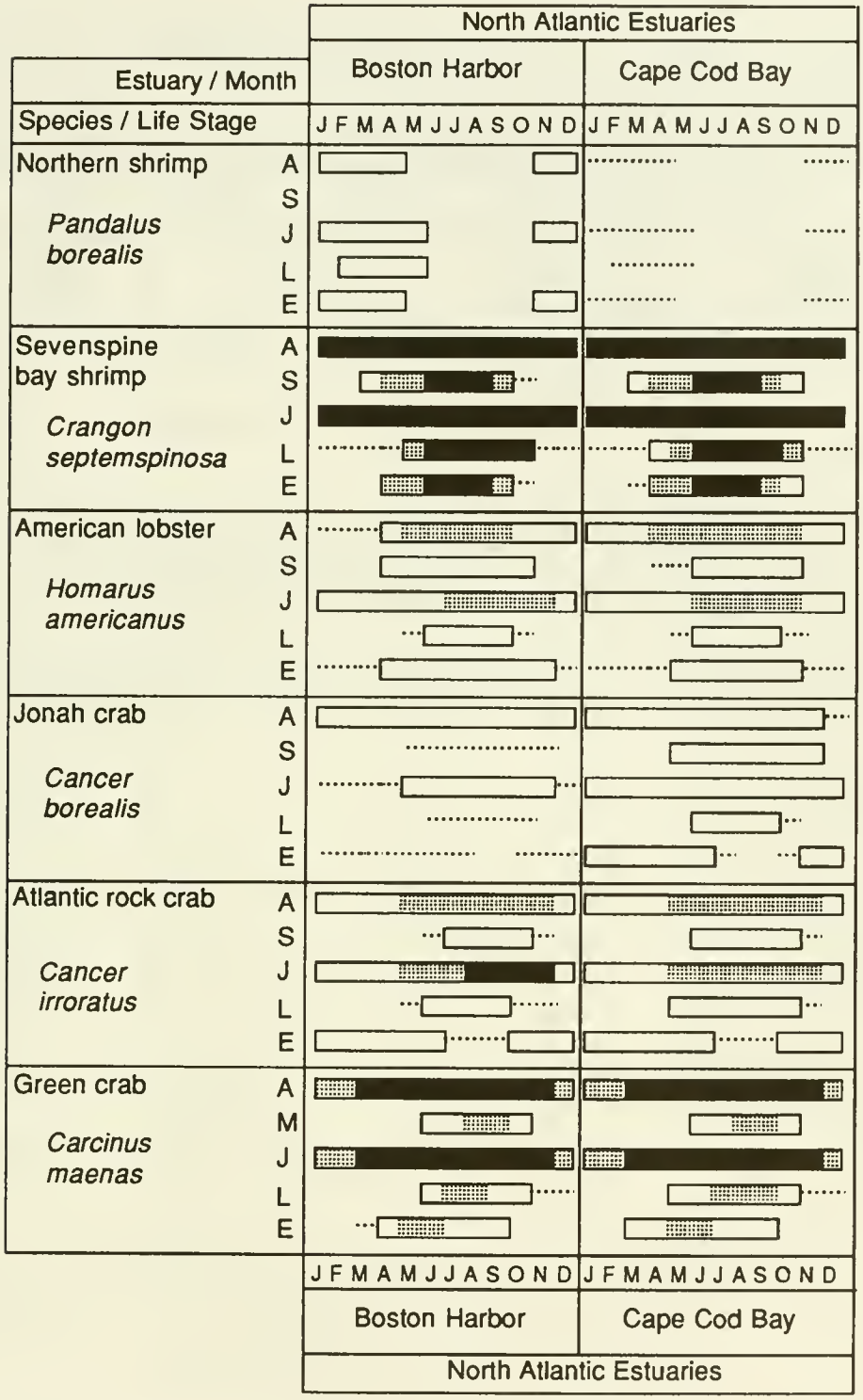

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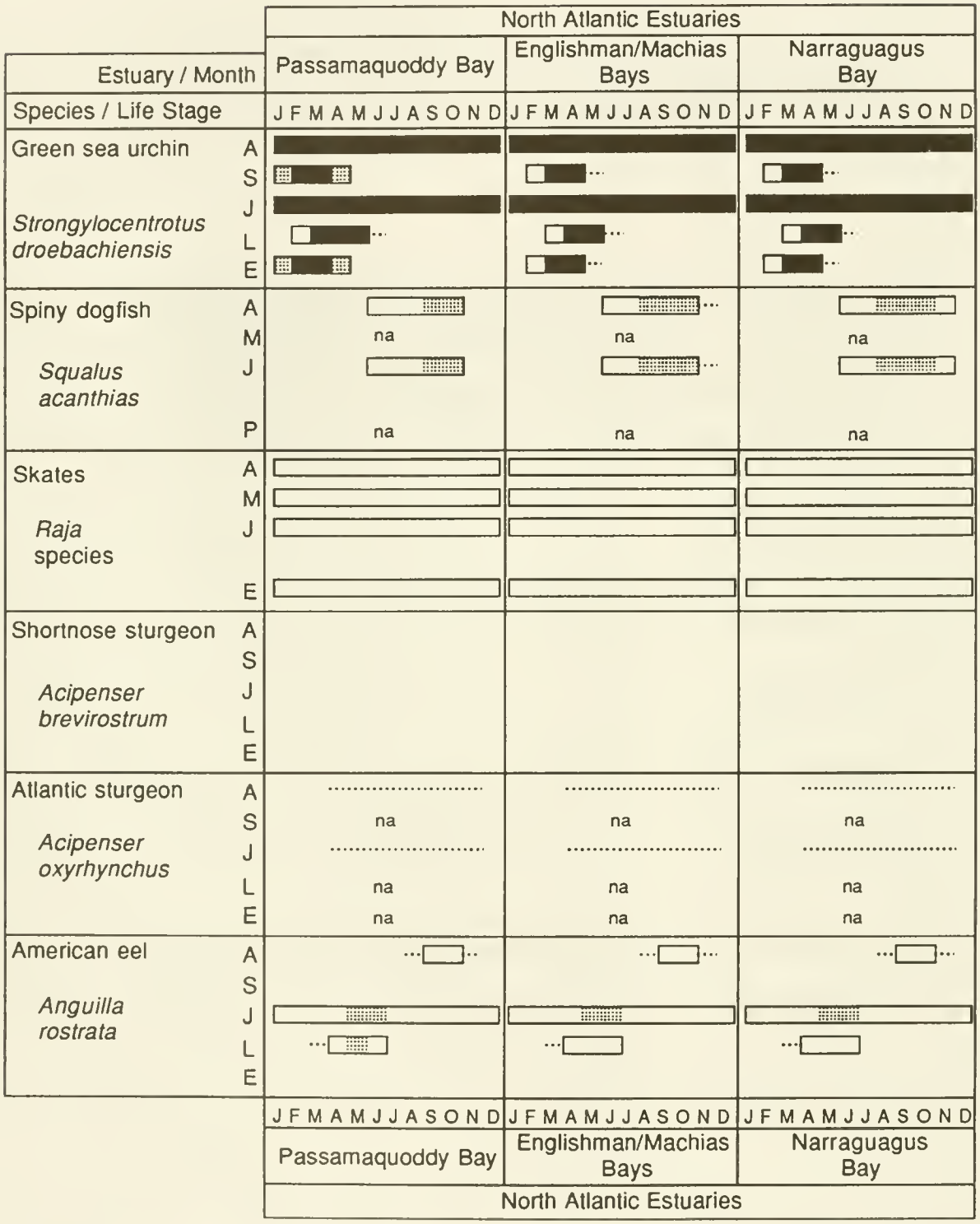

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Table 5 (continued). Temporal distribution and relative abundance

Estuary / Month		North Atlantic Estuaries		
		Blue Hill Bay	Penobscot Bay	Muscongus Bay
Species / Life Stage		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
Green sea urchin	A	■	■	■
	S	□ ■ ···	··· ■ ···	··· ■ ···
Strongylocentrotus droebachiensis	J	■	■	■
	L	□ ■ ···	□ ■ ···	□ ■ ···
	E	□ ■ ···	··· ■ ···	··· ■ ···
Spiny dogfish	A	▒	▒ ···	··· □ ·····
	M	na	na	na
Squalus acanthias	J	▒	□ ···	··· □ ·····
	P	na	na	na
Skates	A	□	□	□
	M	□	□	□
Raja species	J	□	□	□
	E	□	□	□
Shortnose sturgeon	A		na	
	S		na	
Acipenser brevirostrum	J		na	
	L		na	
	E		na	
Atlantic sturgeon	A	·····	·····	·····
	S	na	na	
Acipenser oxyrhynchus	J	·····	na	na
	L	na	na	
	E	na	na	
American eel	A	··· □ ···	··· □ ···	··· ▒ ···
	S			
Anguilla rostrata	J	□ ▒	□ ▒	□ ▒
	L	··· □	··· □	□
	E			
		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
		Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries		

Relative Abundance

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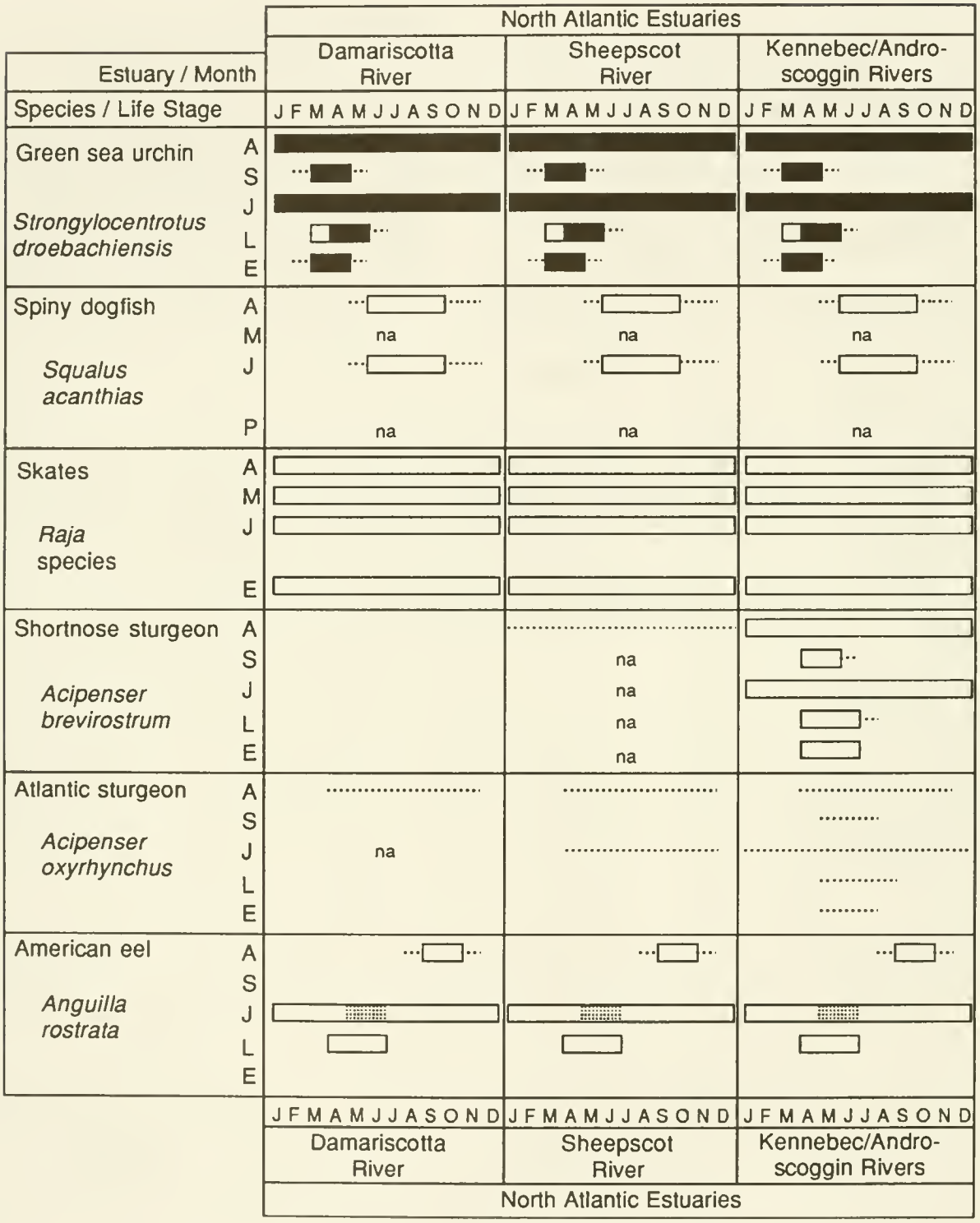
Table 5 (continued). Temporal distribution and relative abundance



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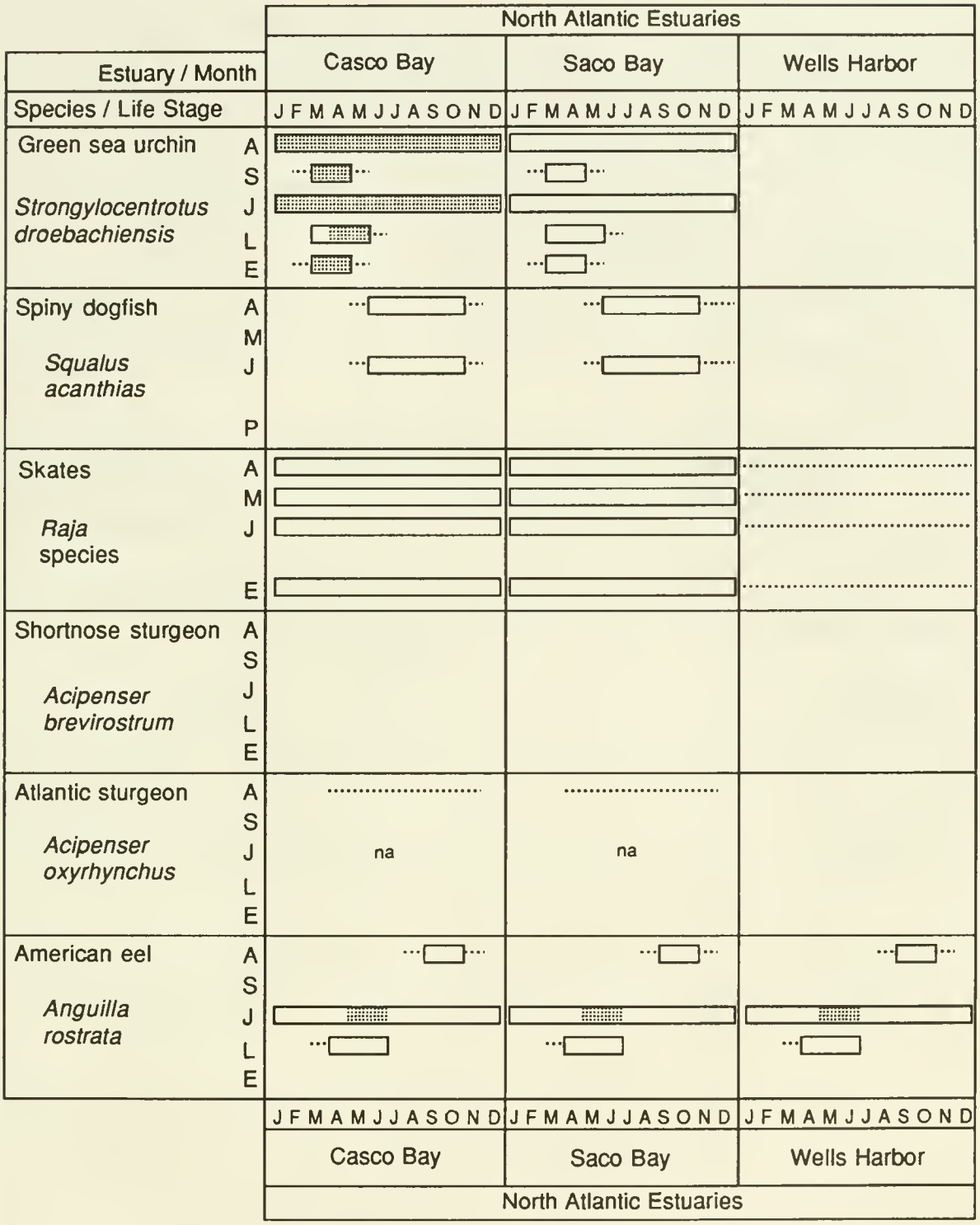

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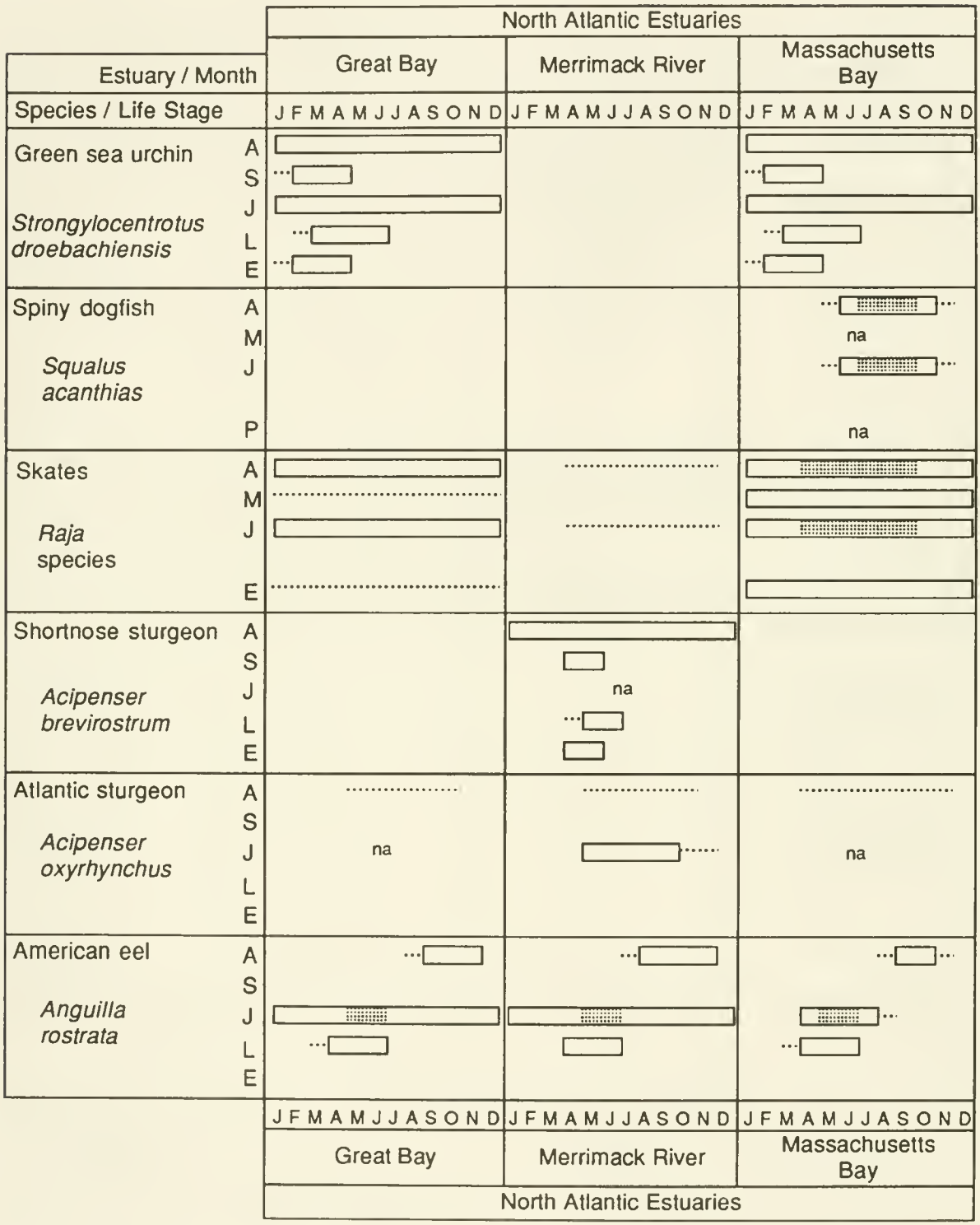

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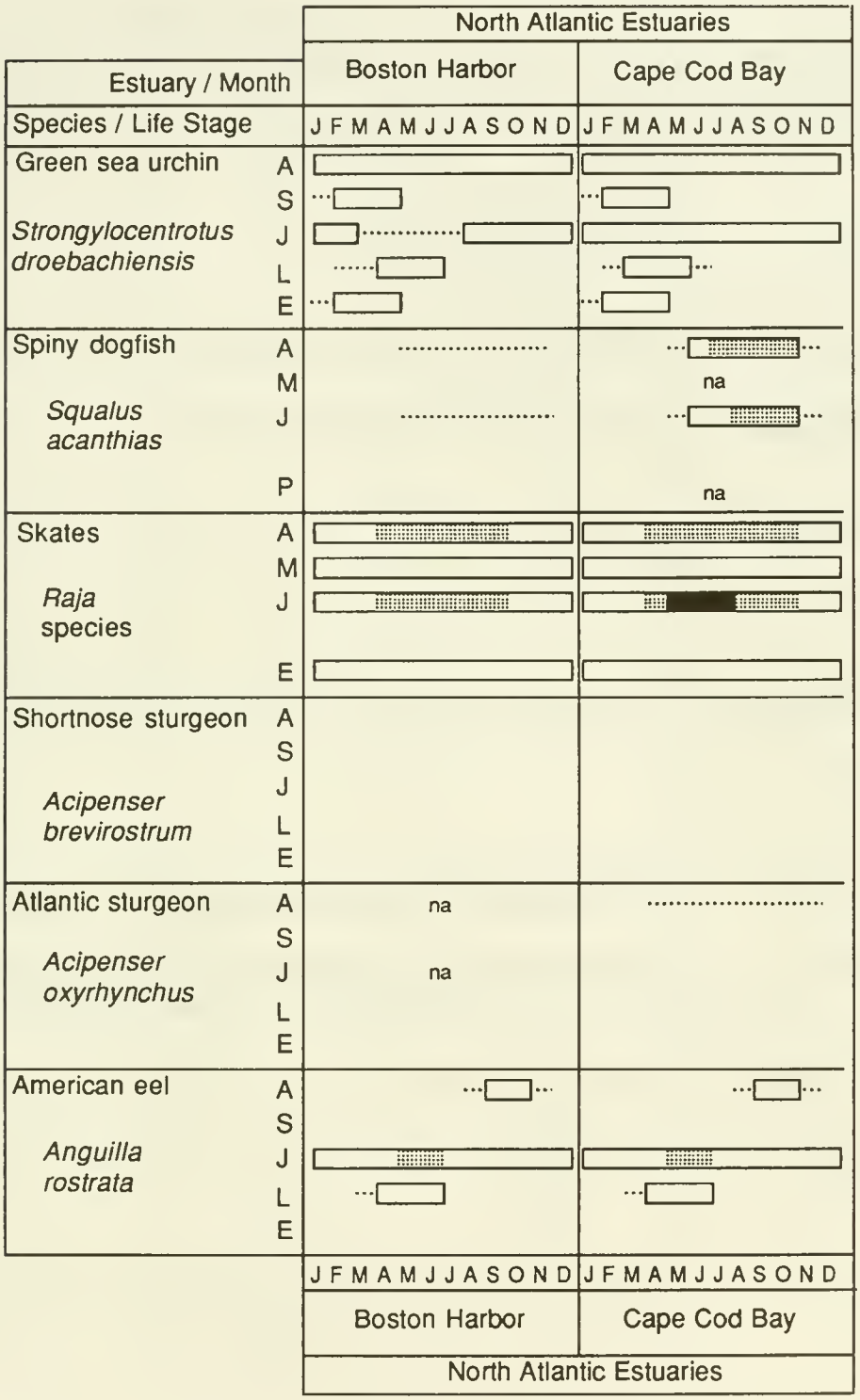

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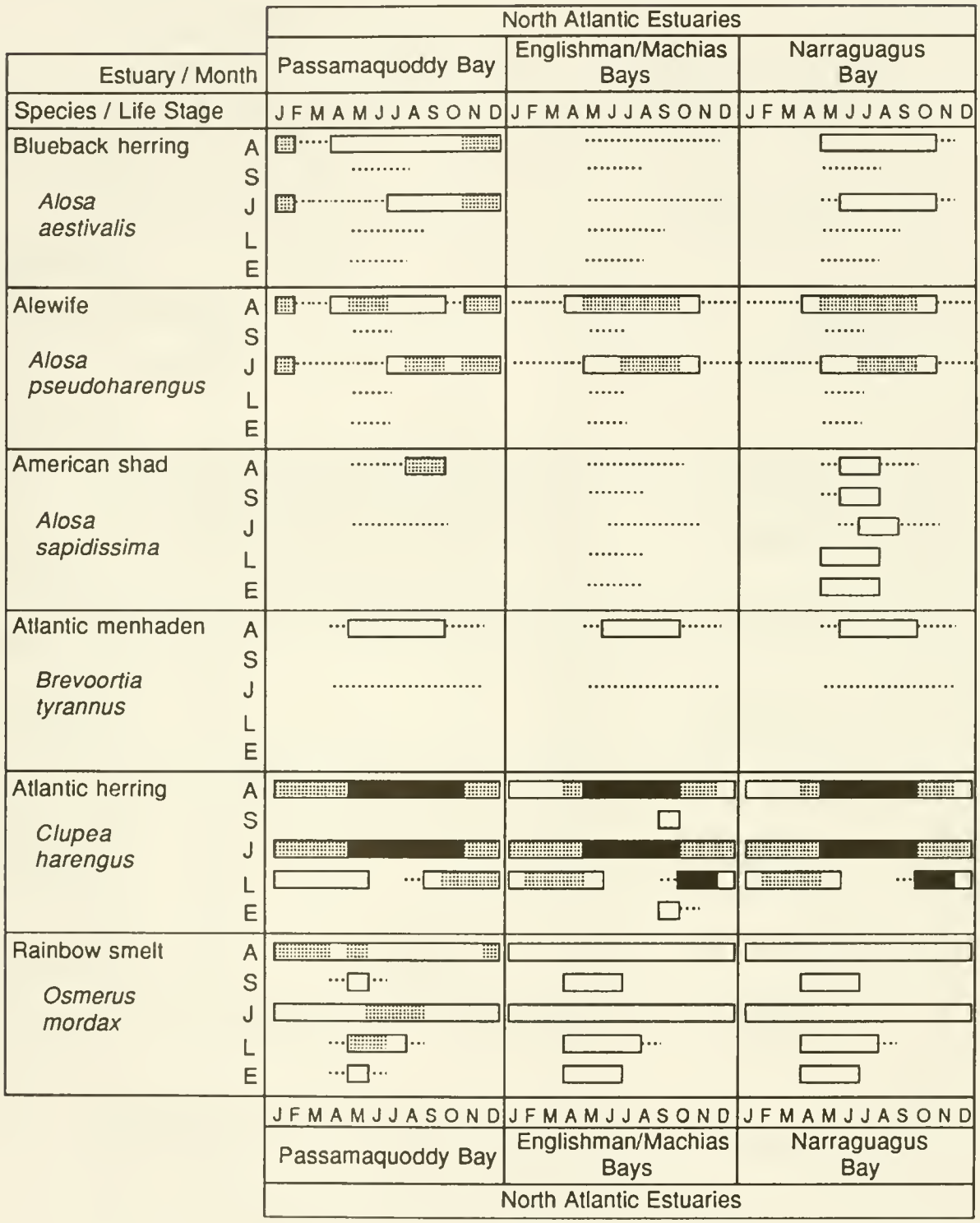

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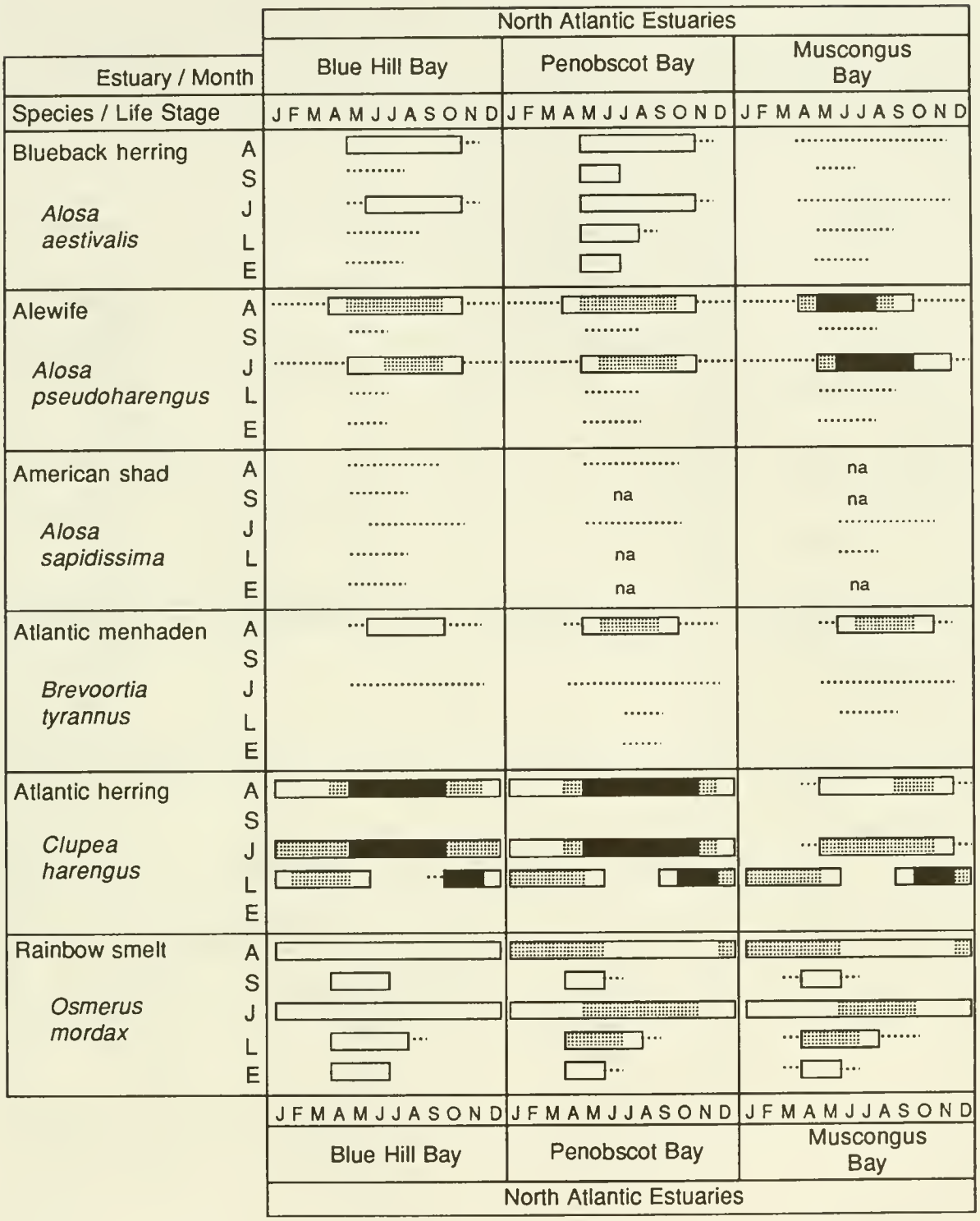

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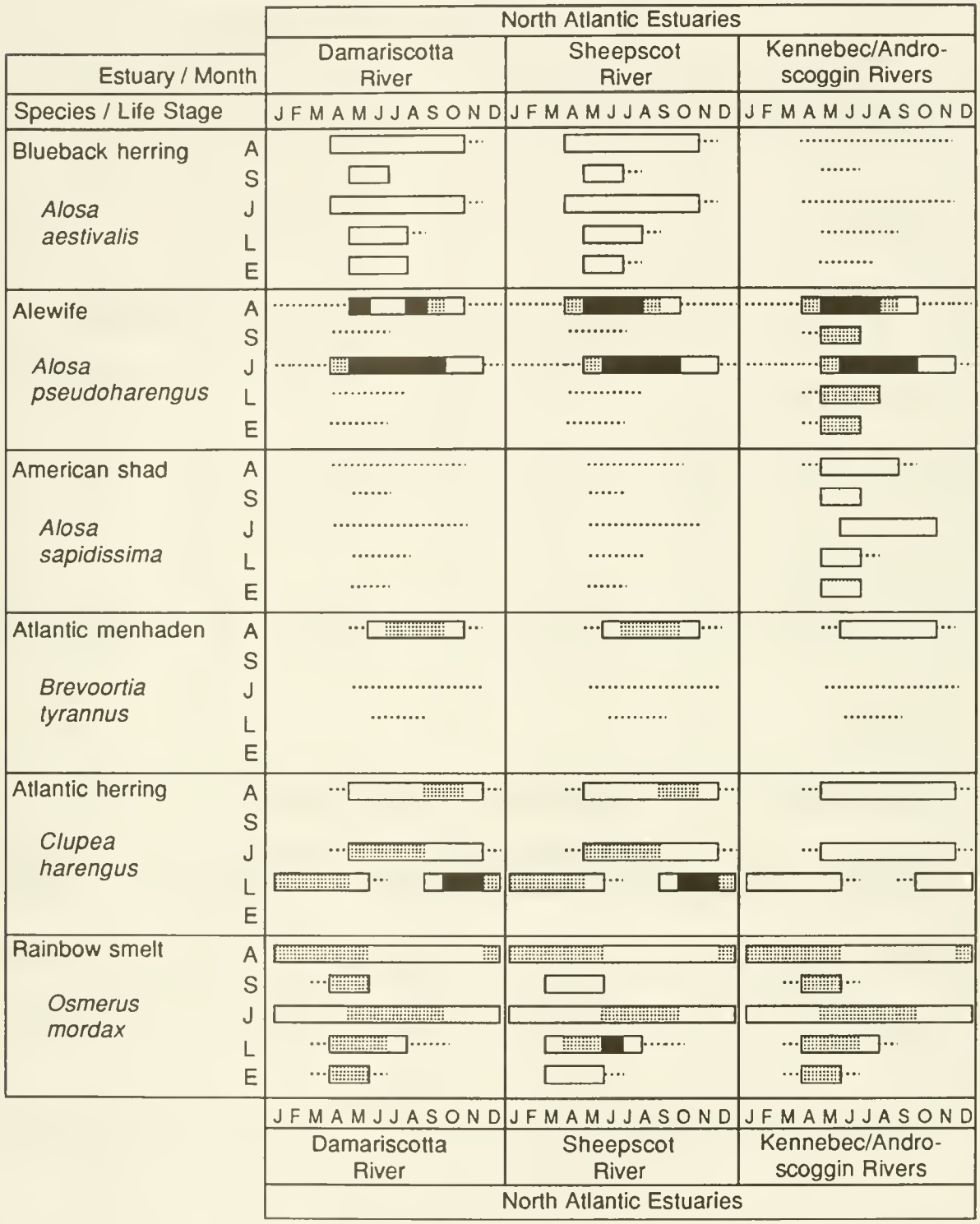

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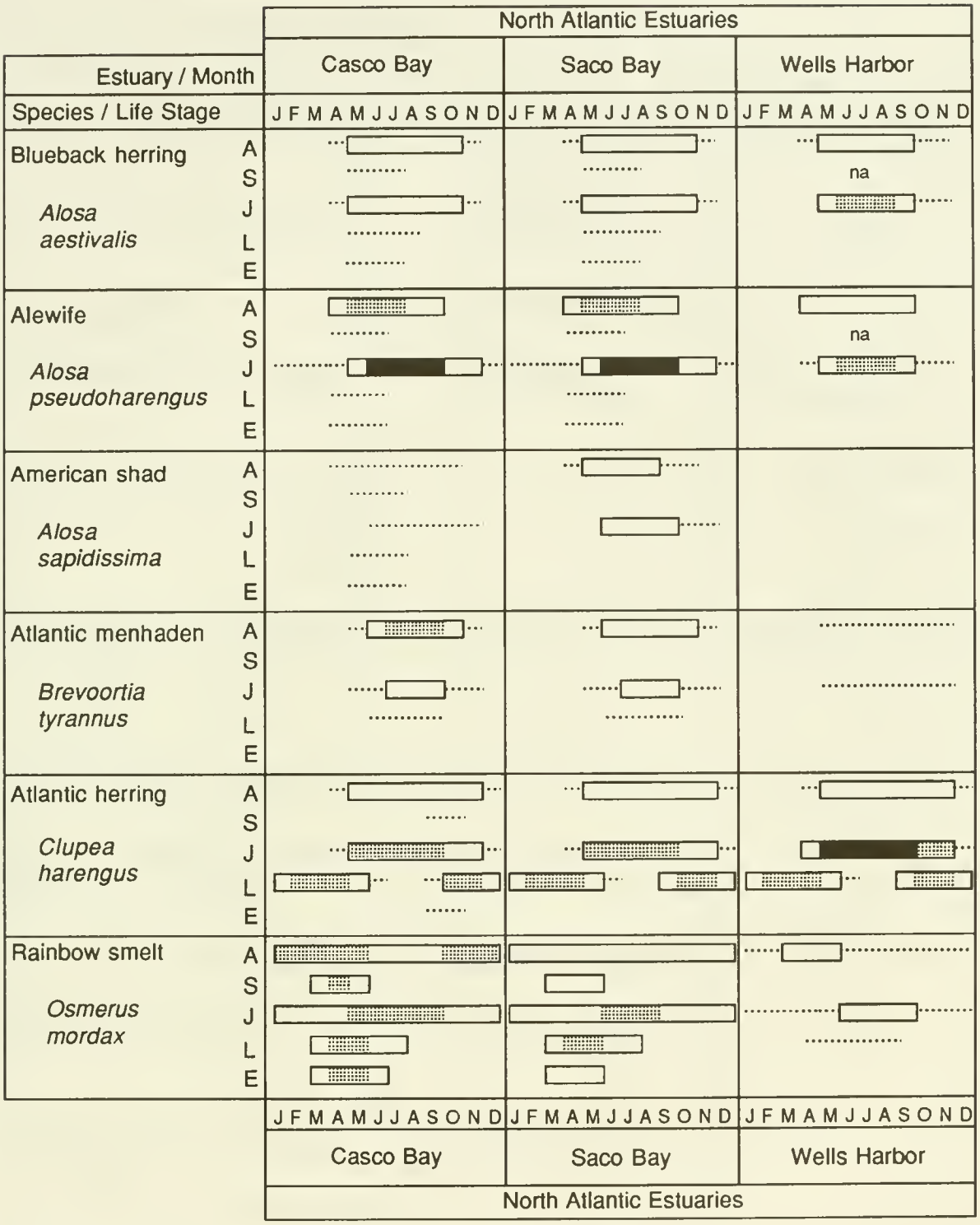

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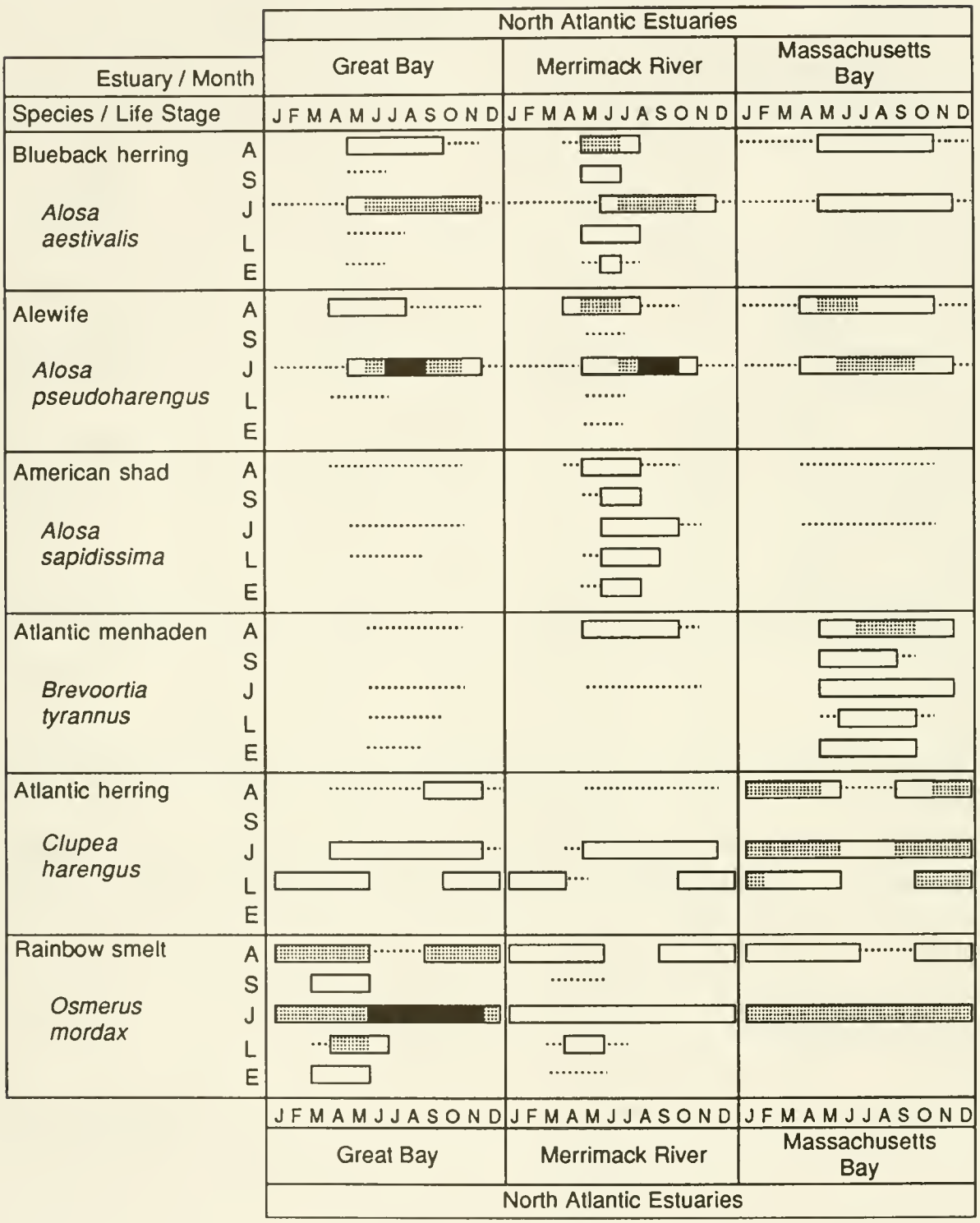

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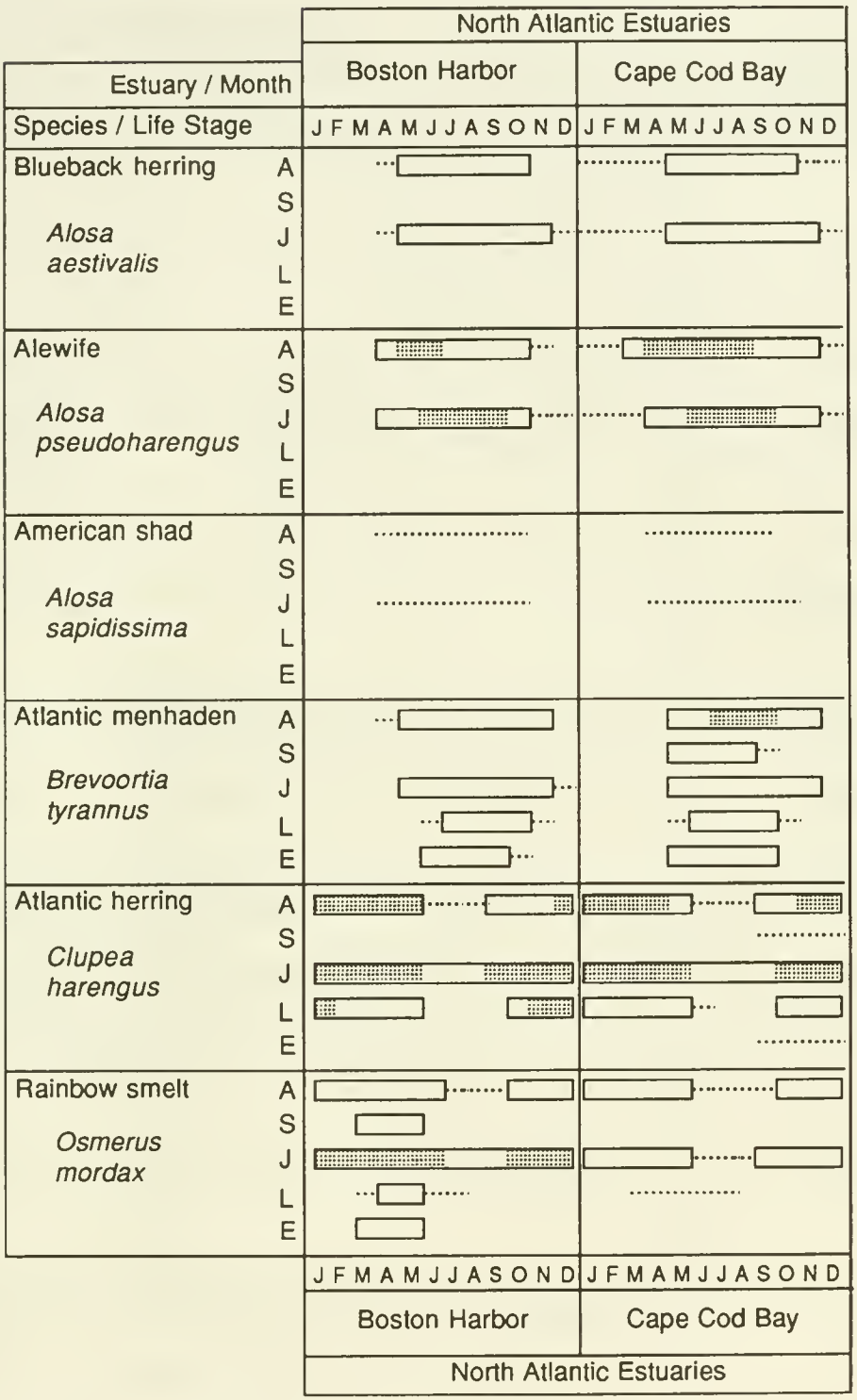

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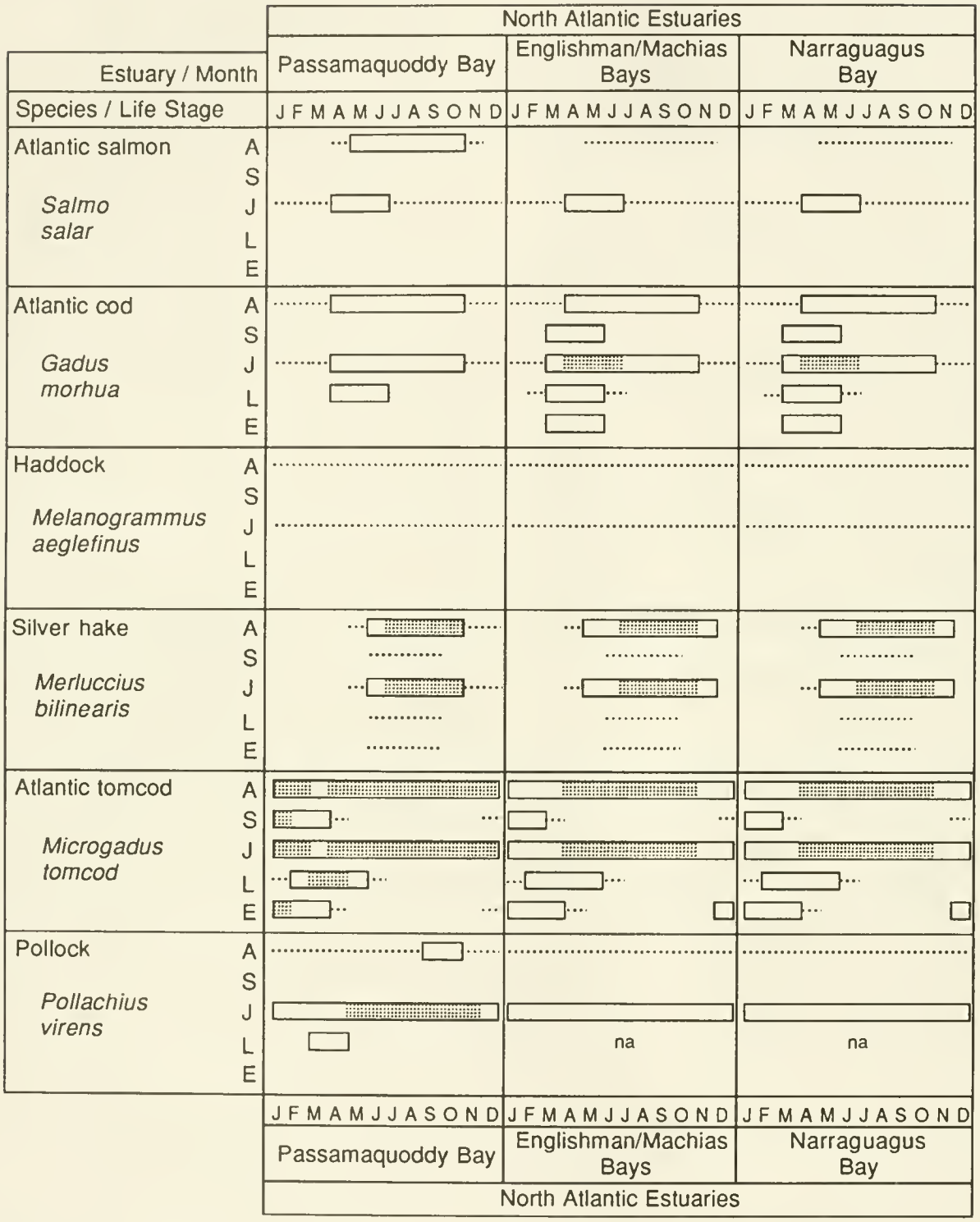

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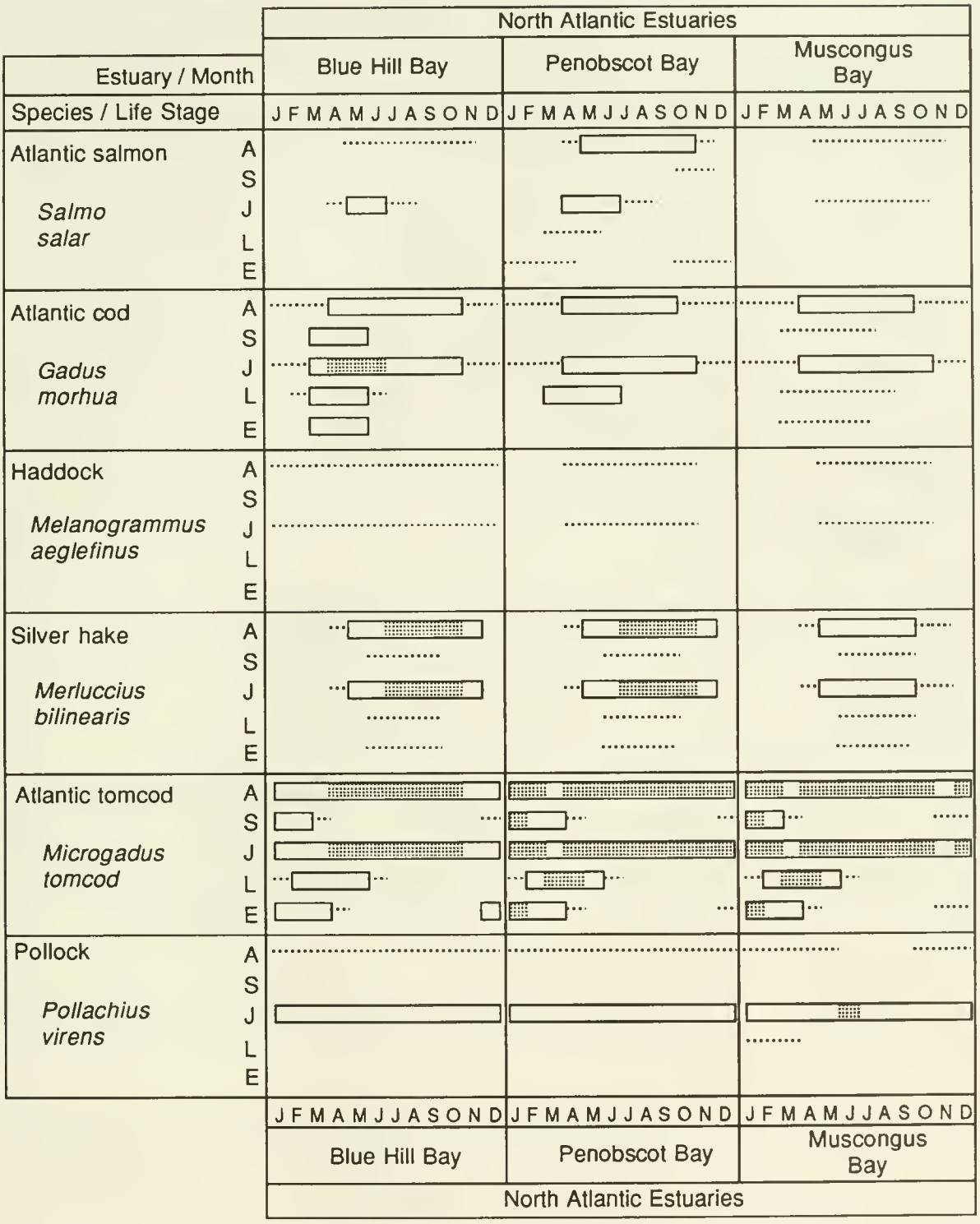

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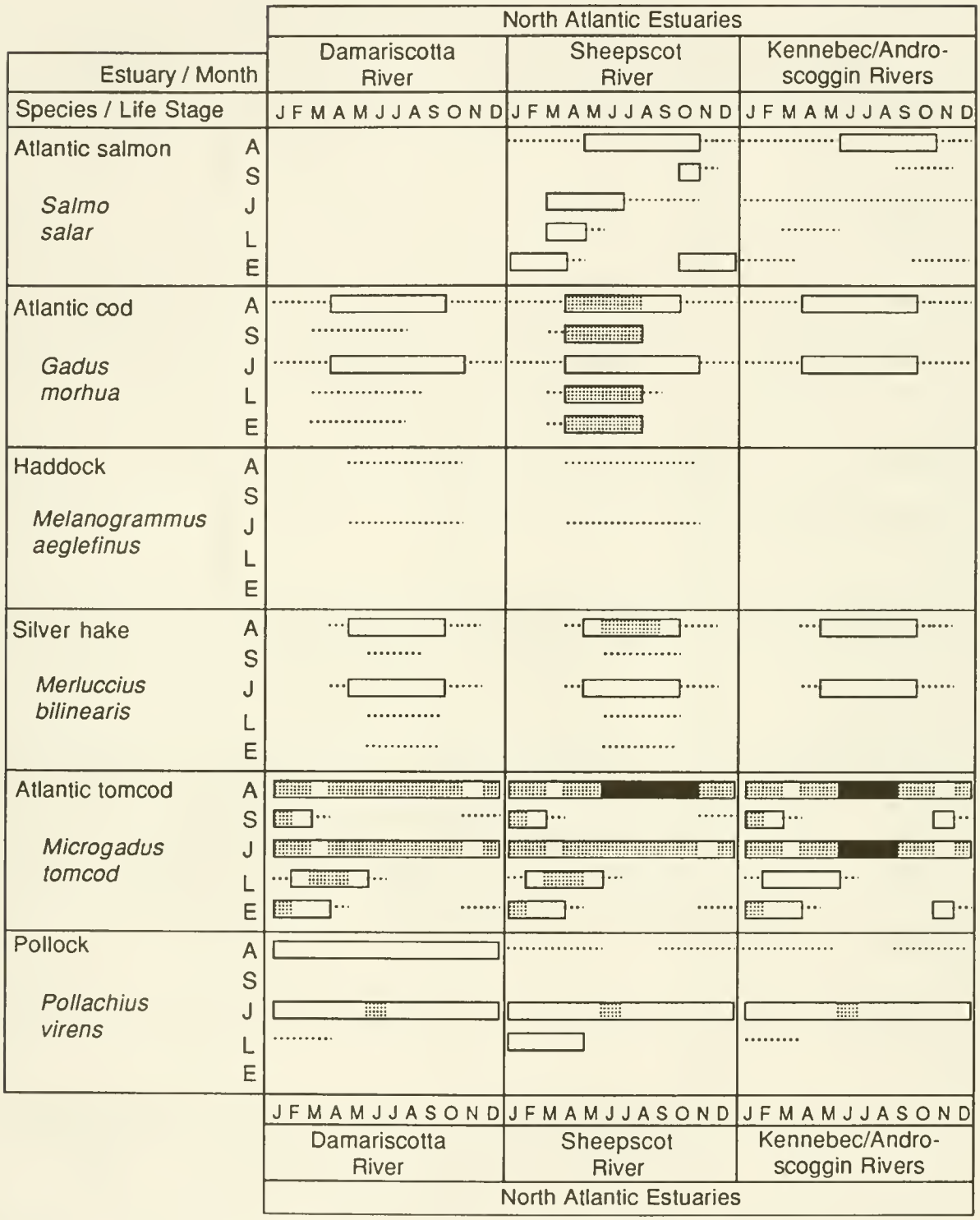

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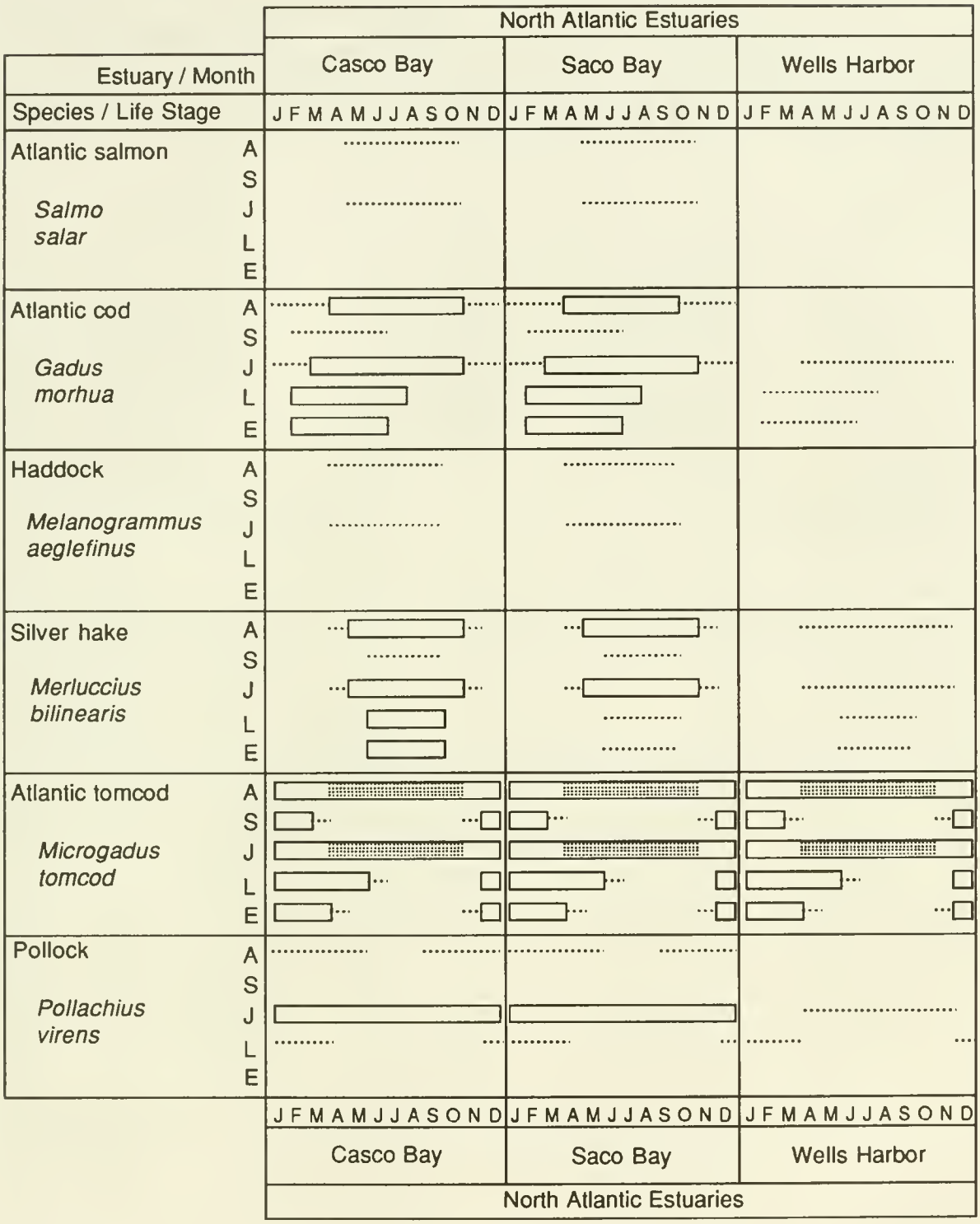

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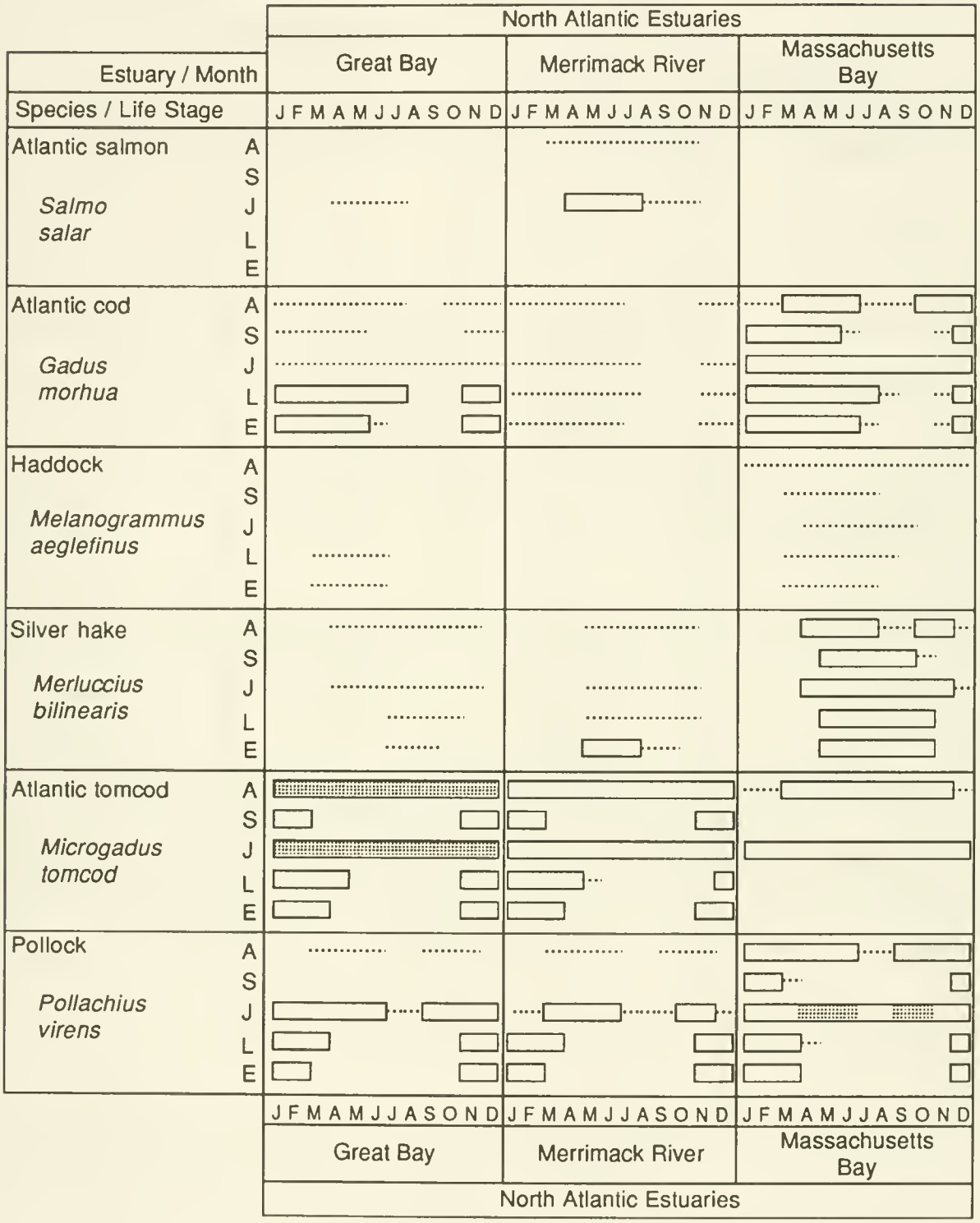

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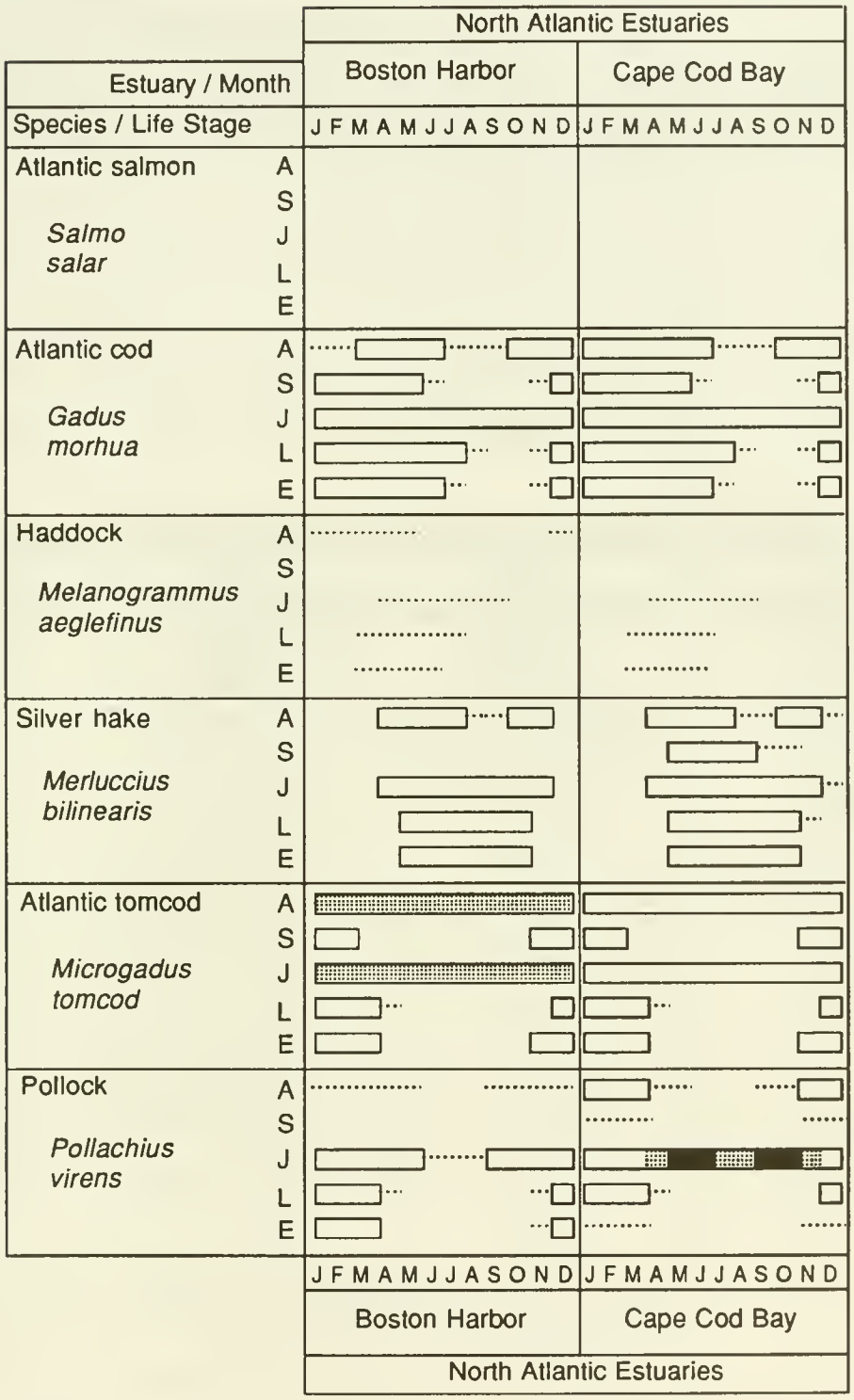

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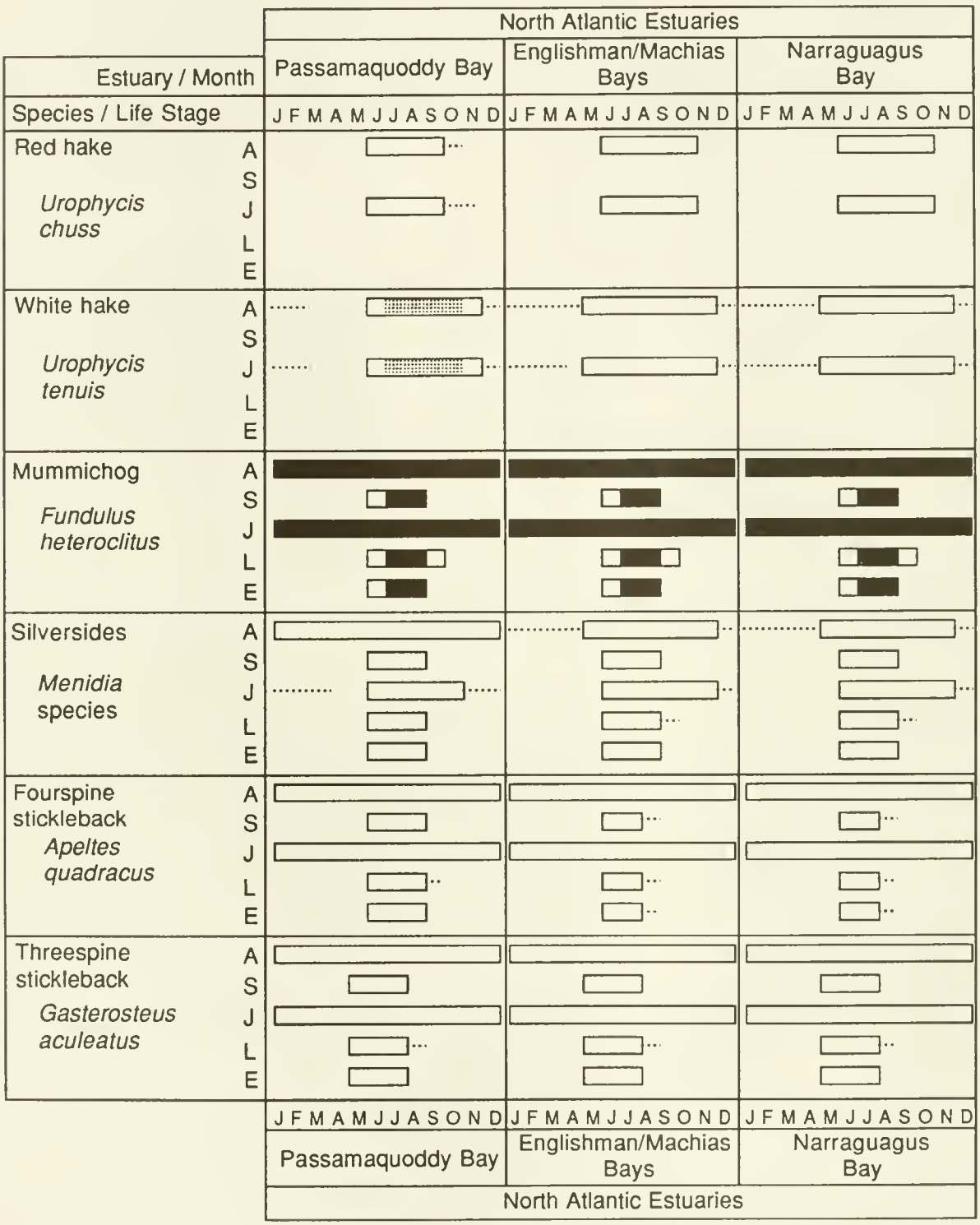

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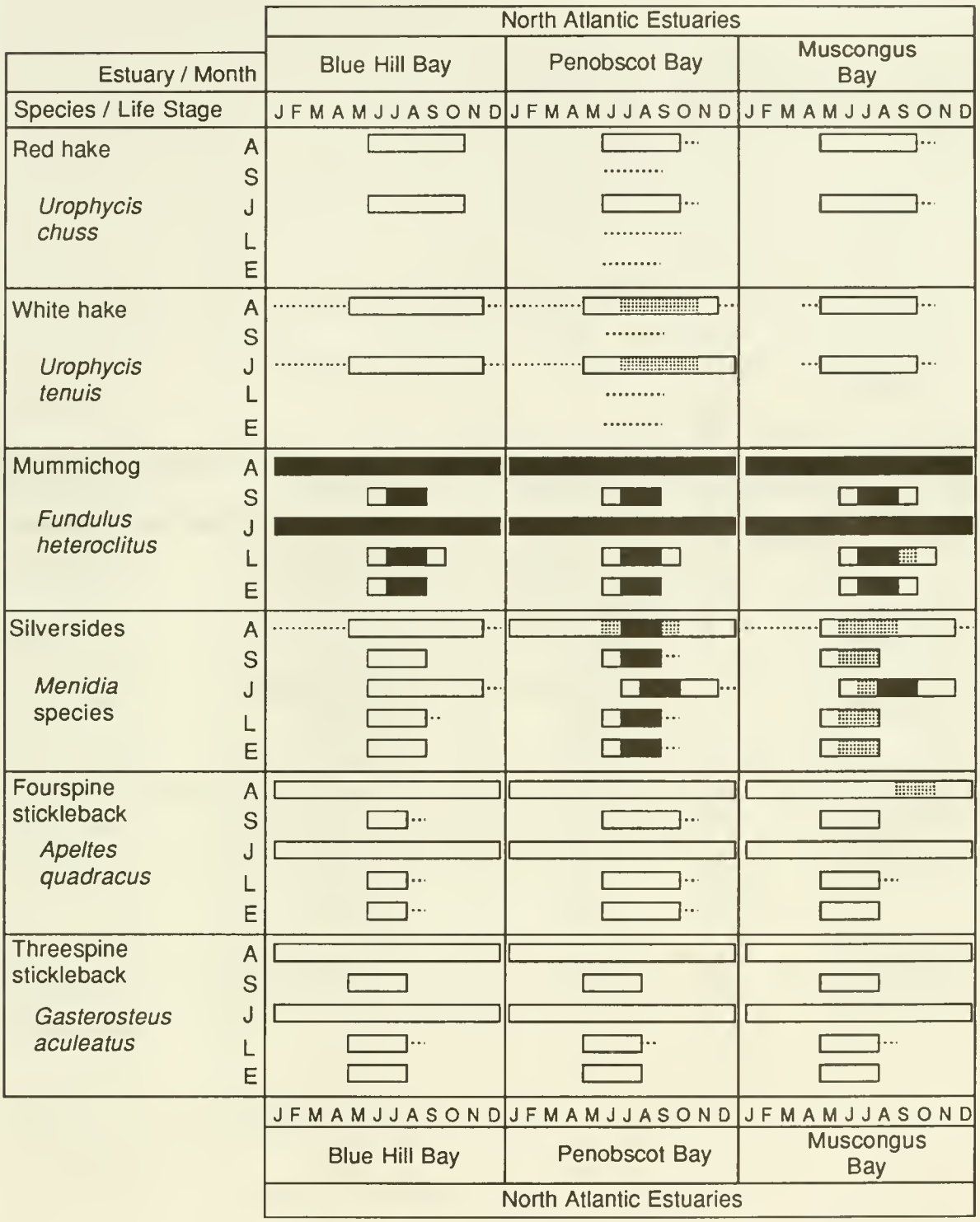

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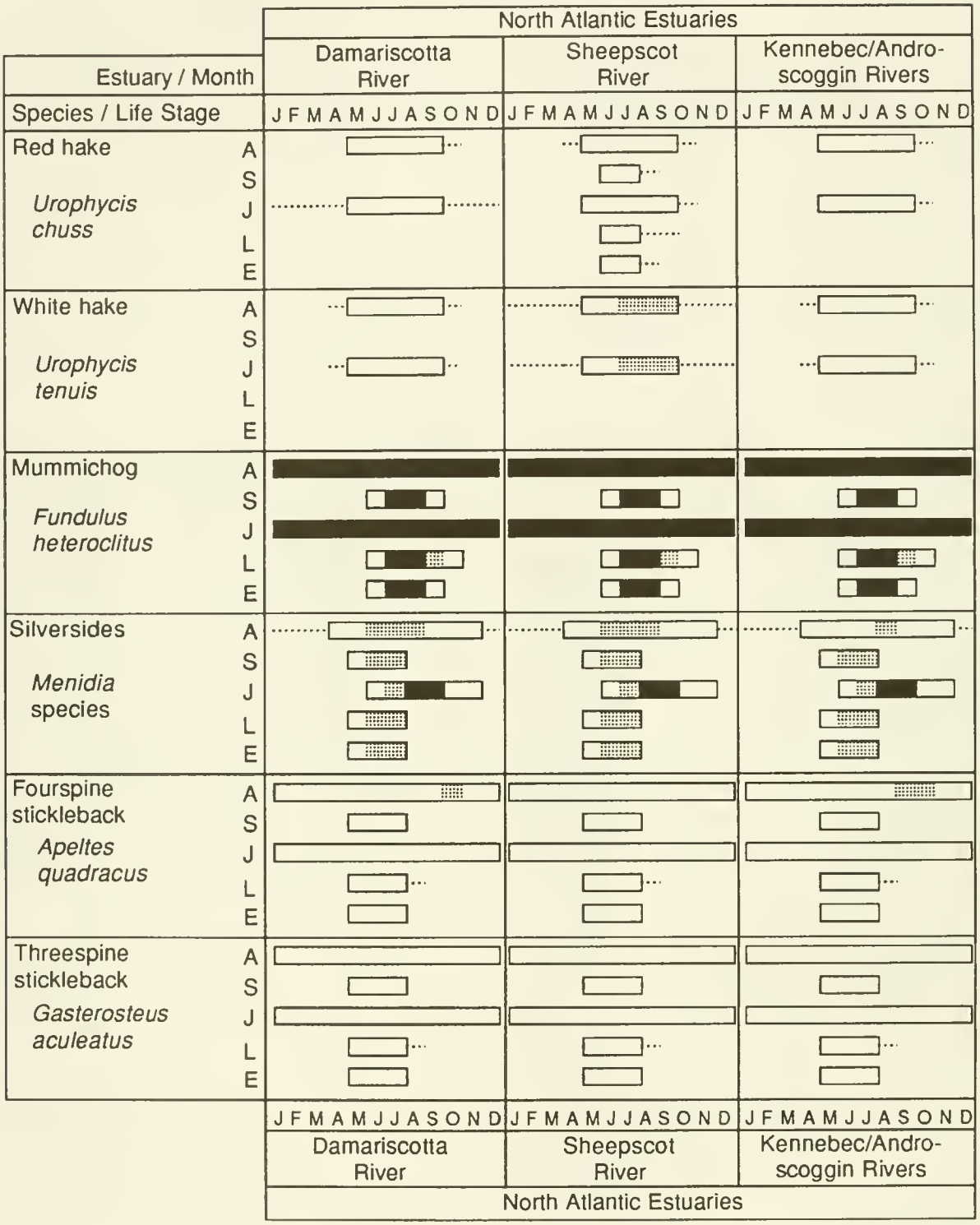

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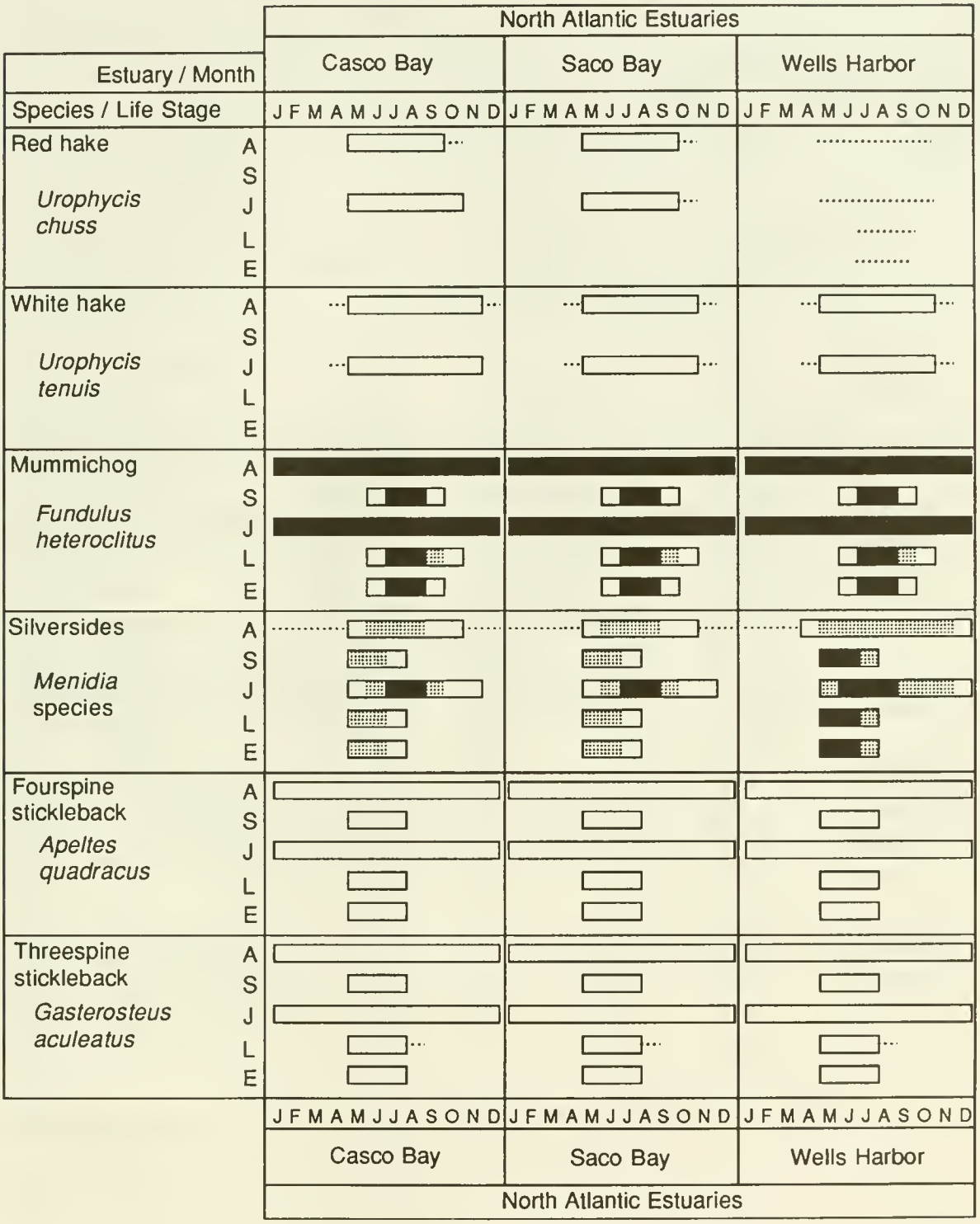

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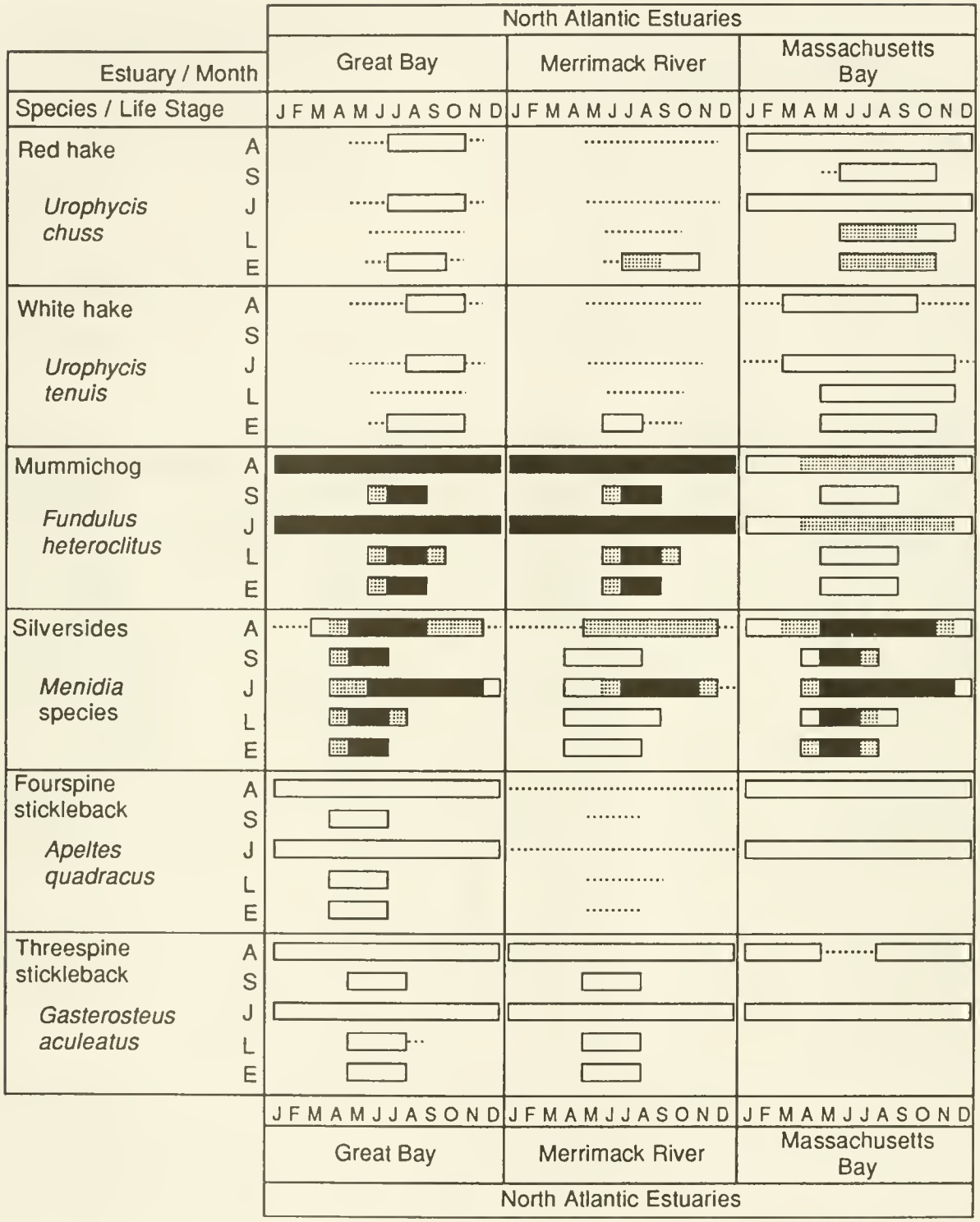

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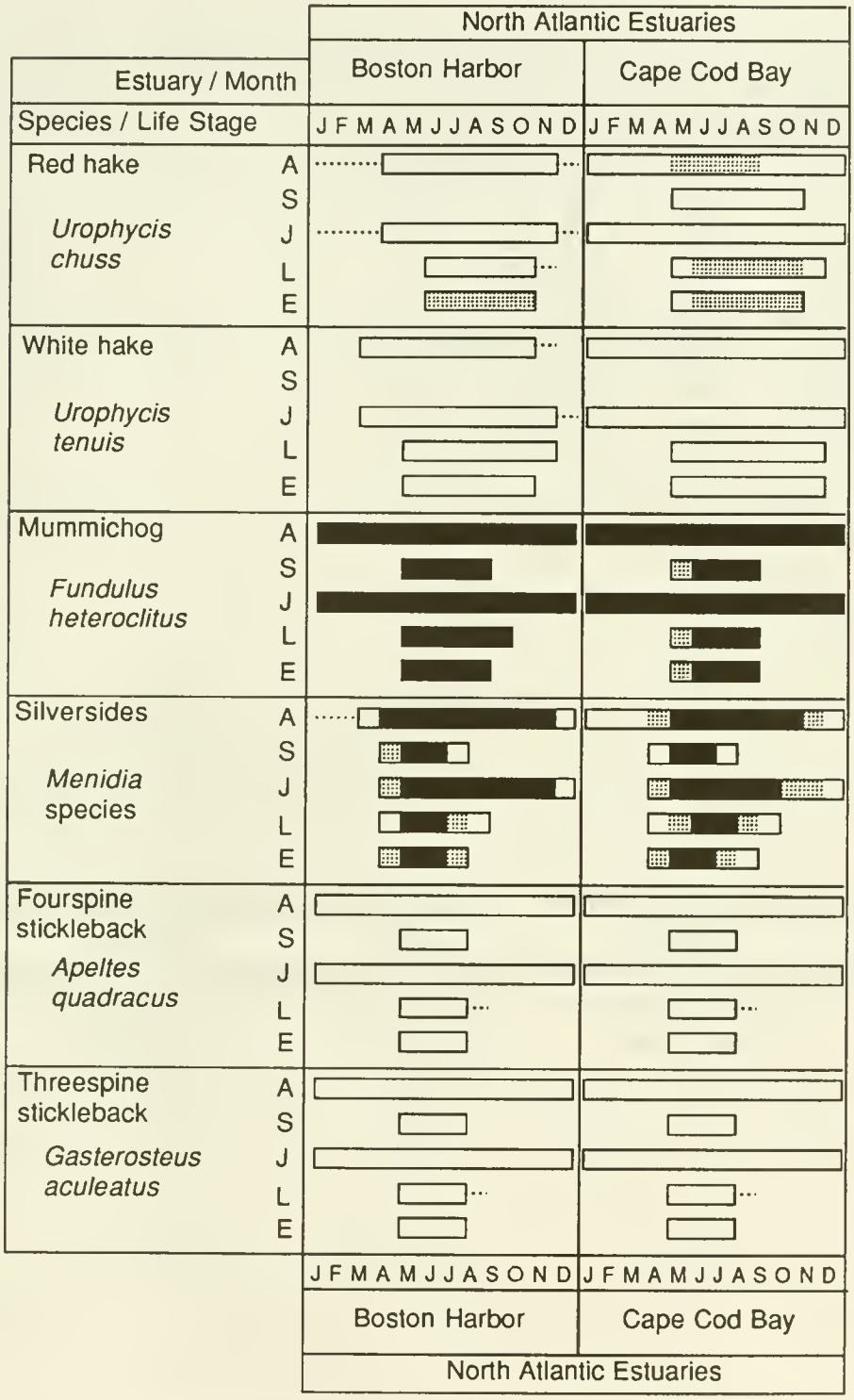

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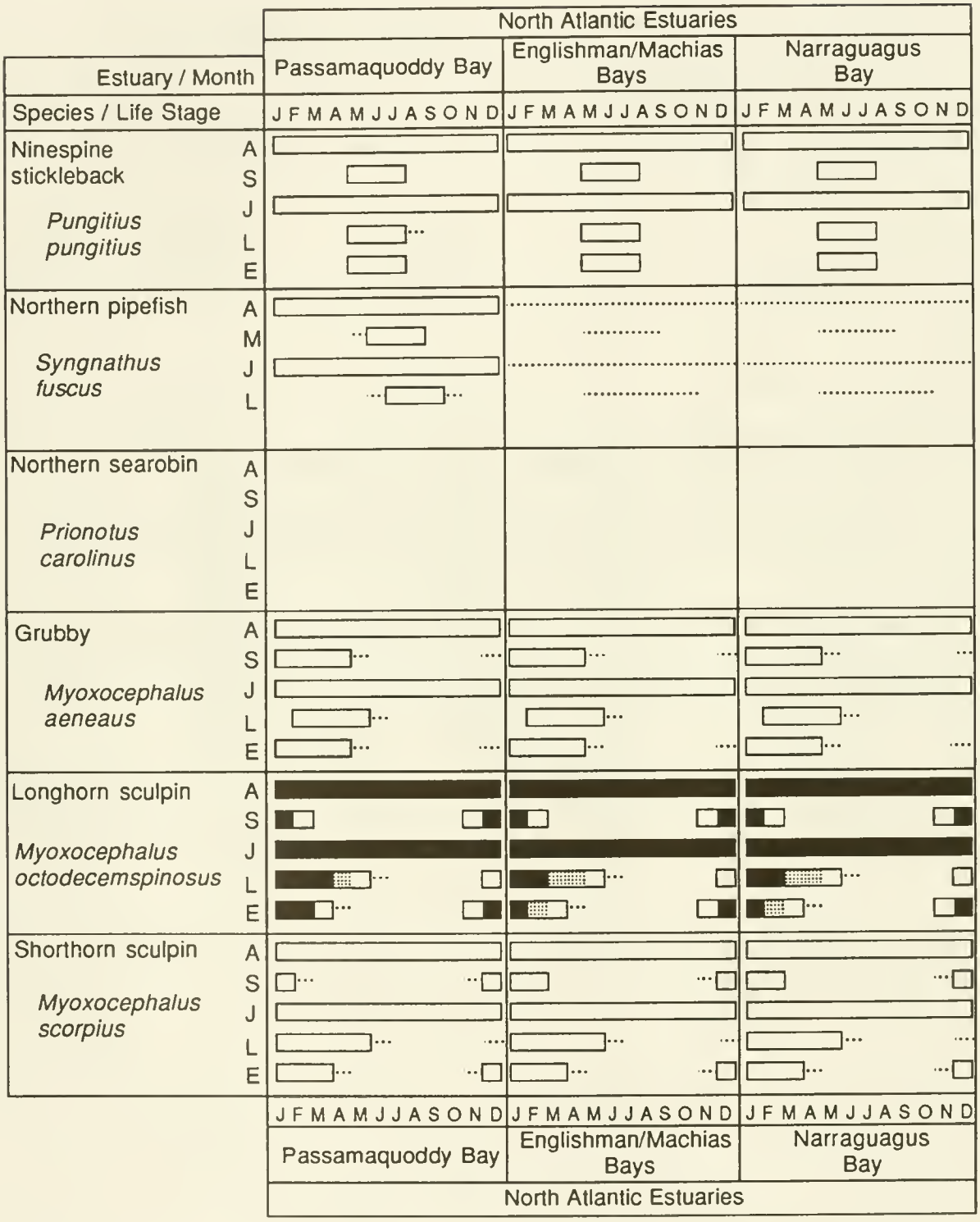

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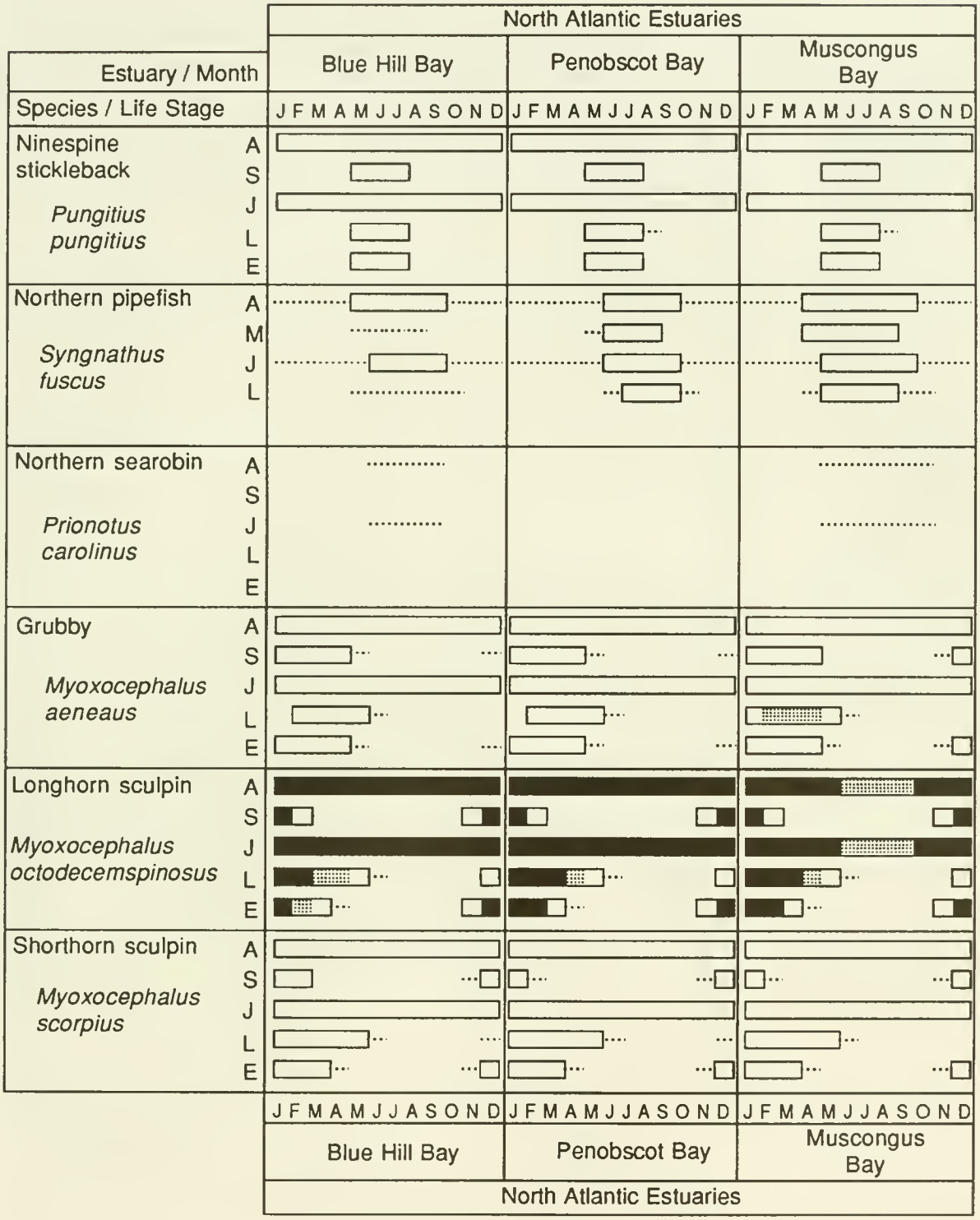

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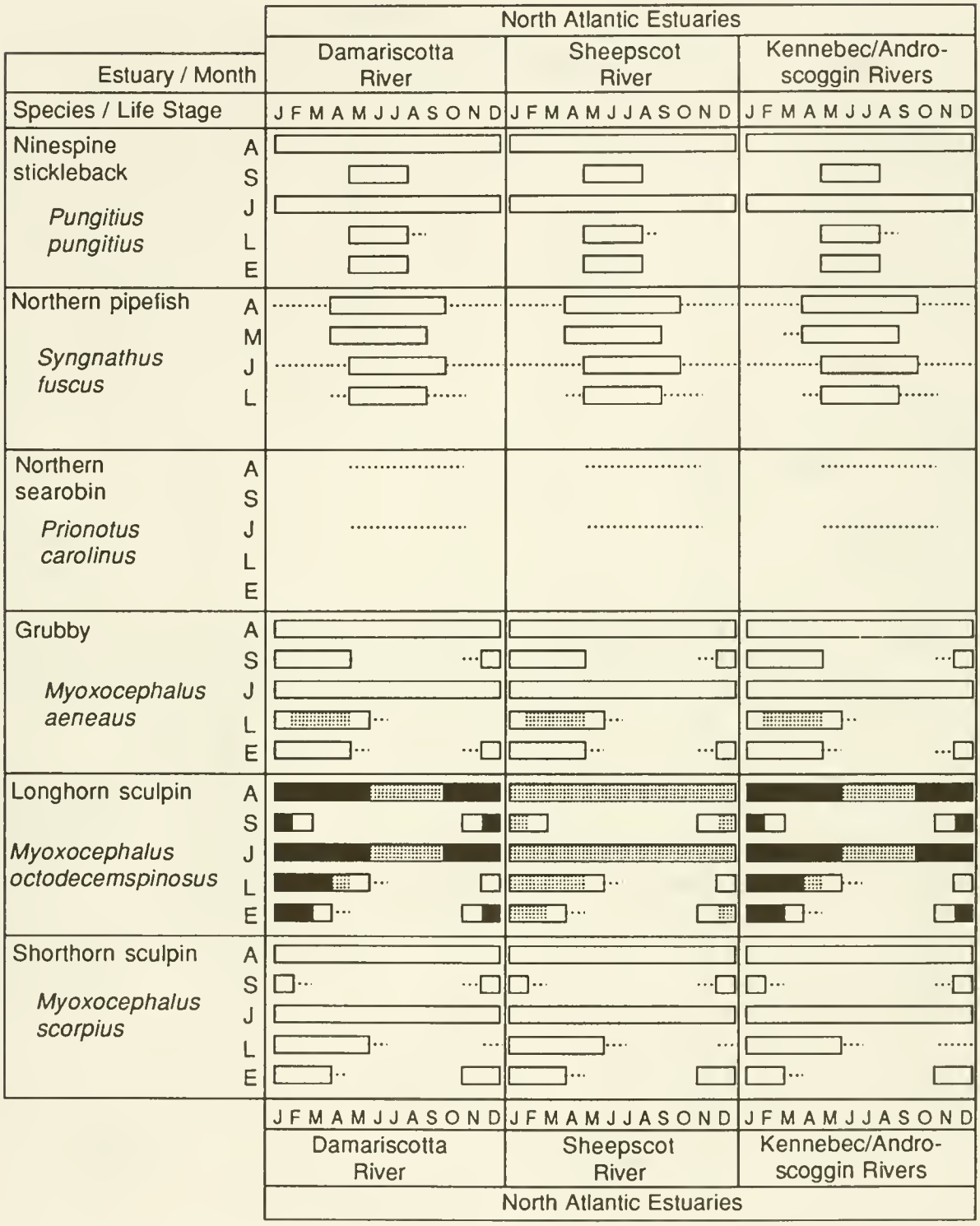
Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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

Life Stage

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

Table 5 (continued). Temporal distribution and relative abundance

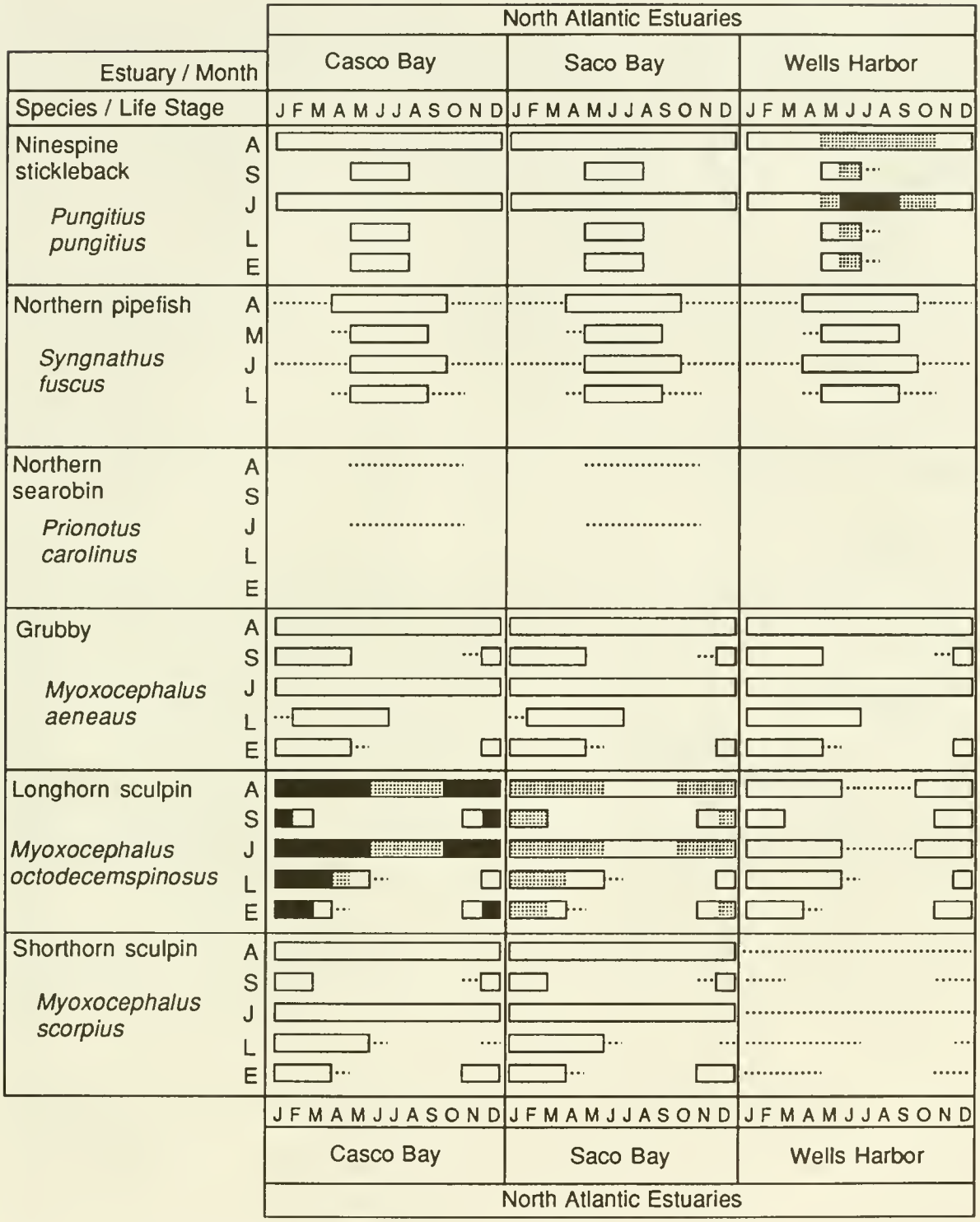


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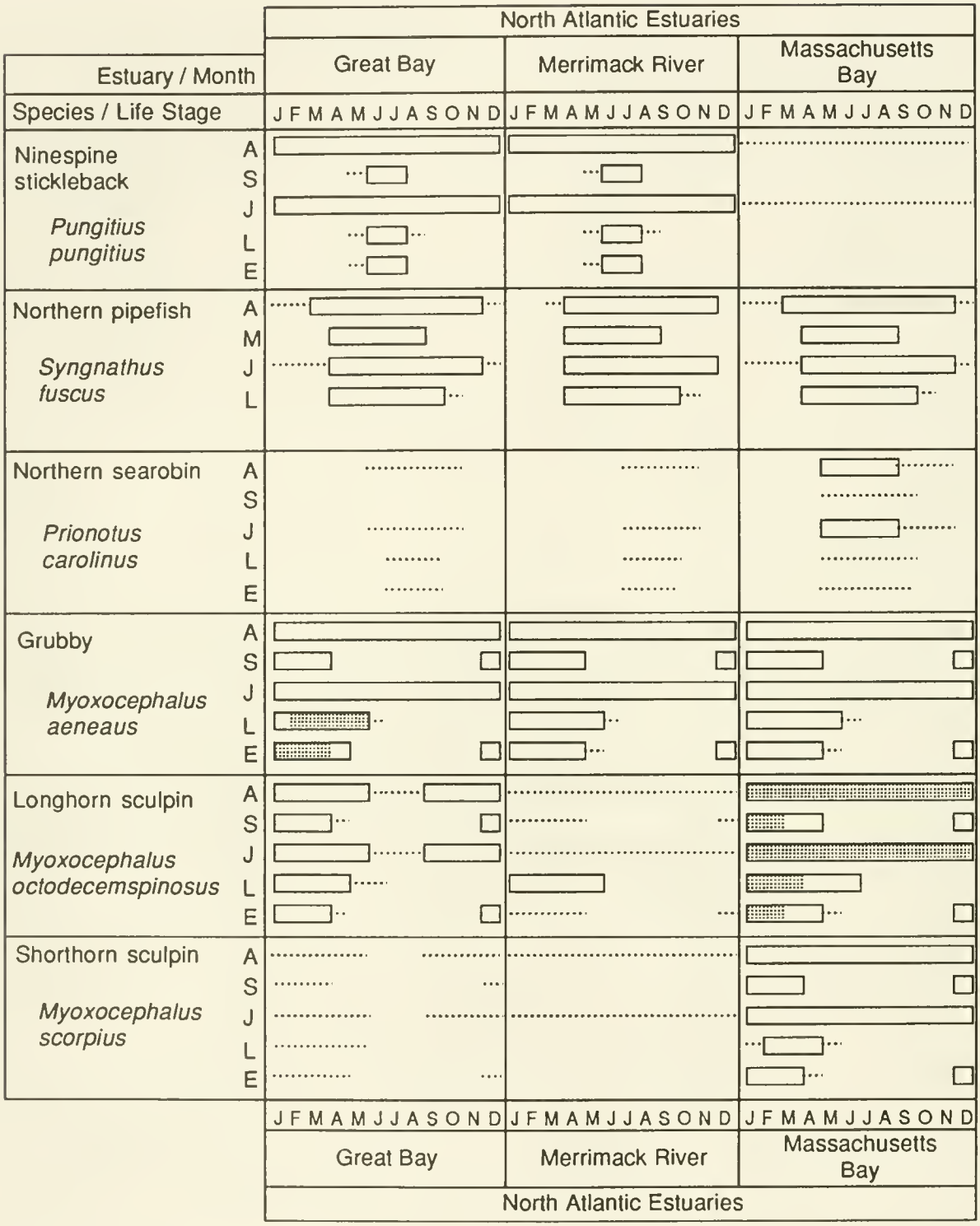
Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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Life Stage

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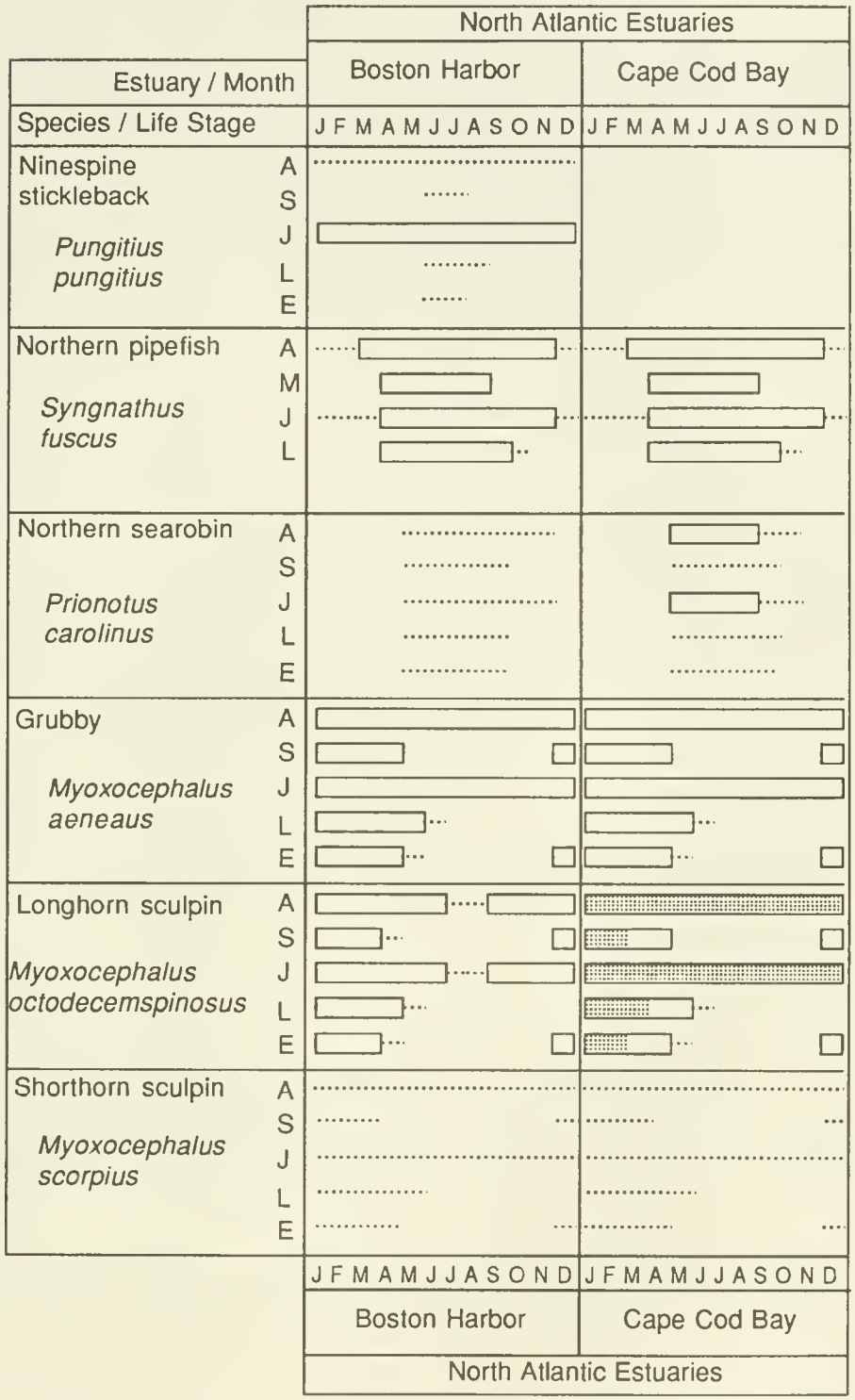
Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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Life Stage

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- S - Spawning adults
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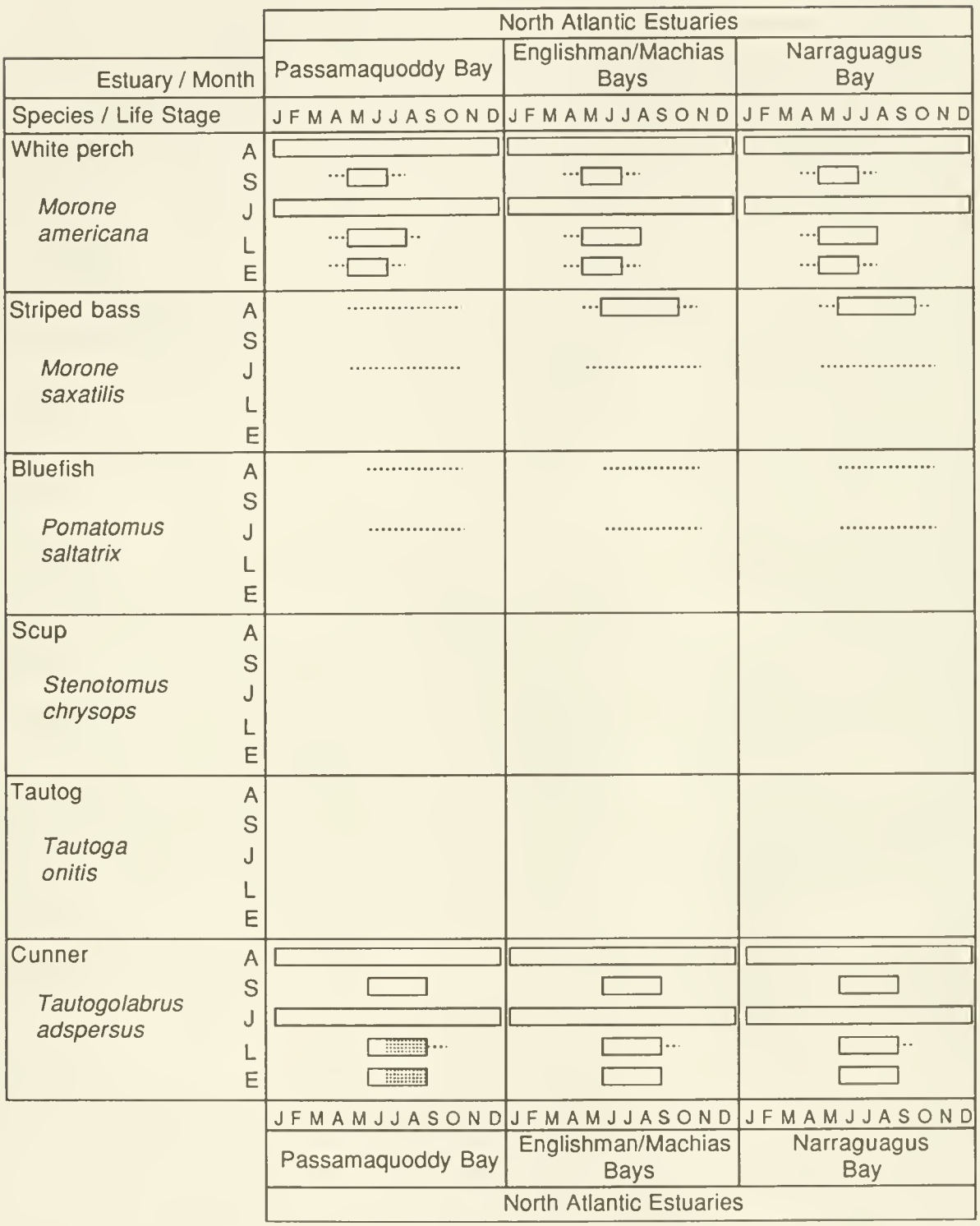
Table 5 (continued). Temporal distribution and relative abundance



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Life Stage

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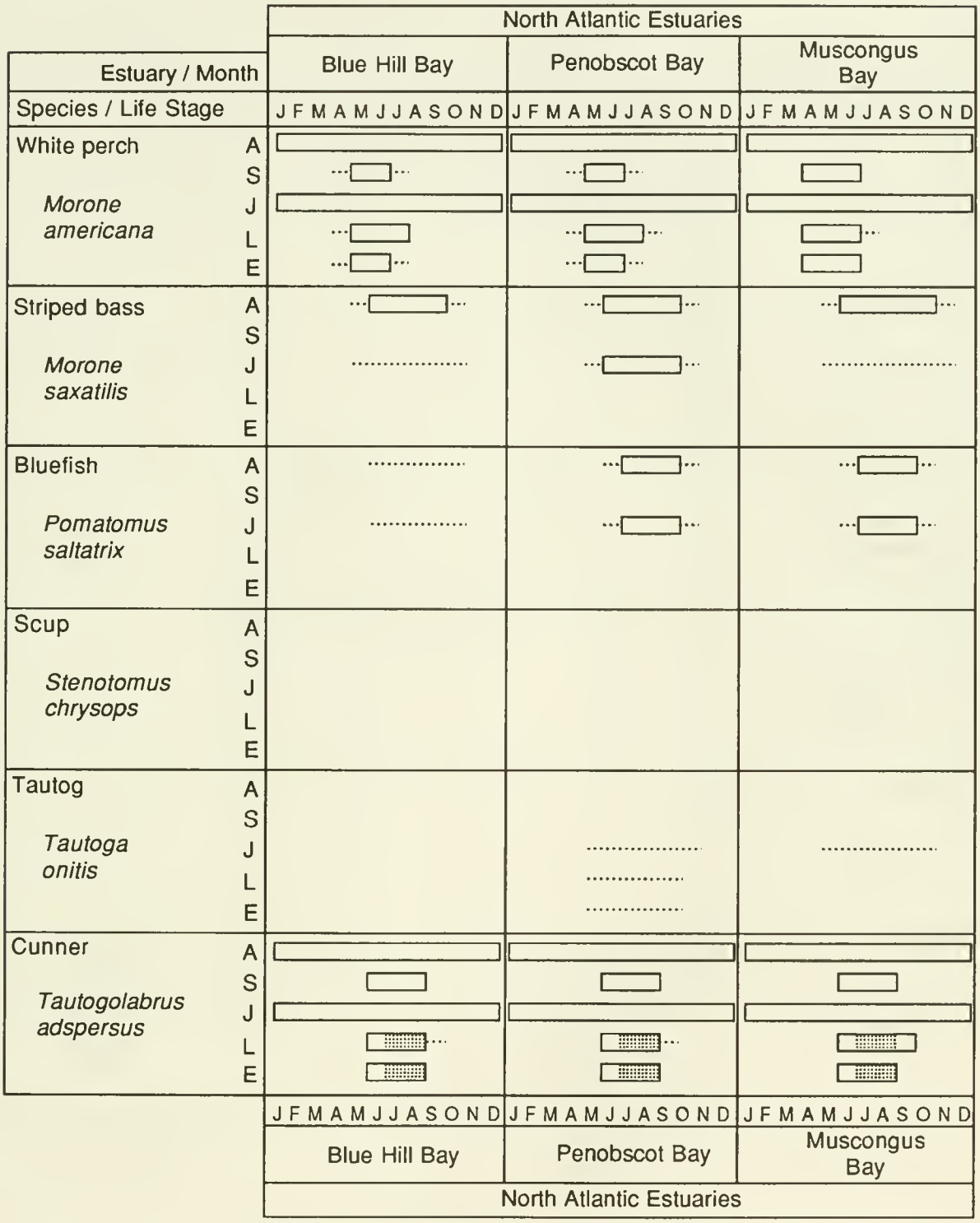
Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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Life Stage

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Table 5 (continued). Temporal distribution and relative abundance

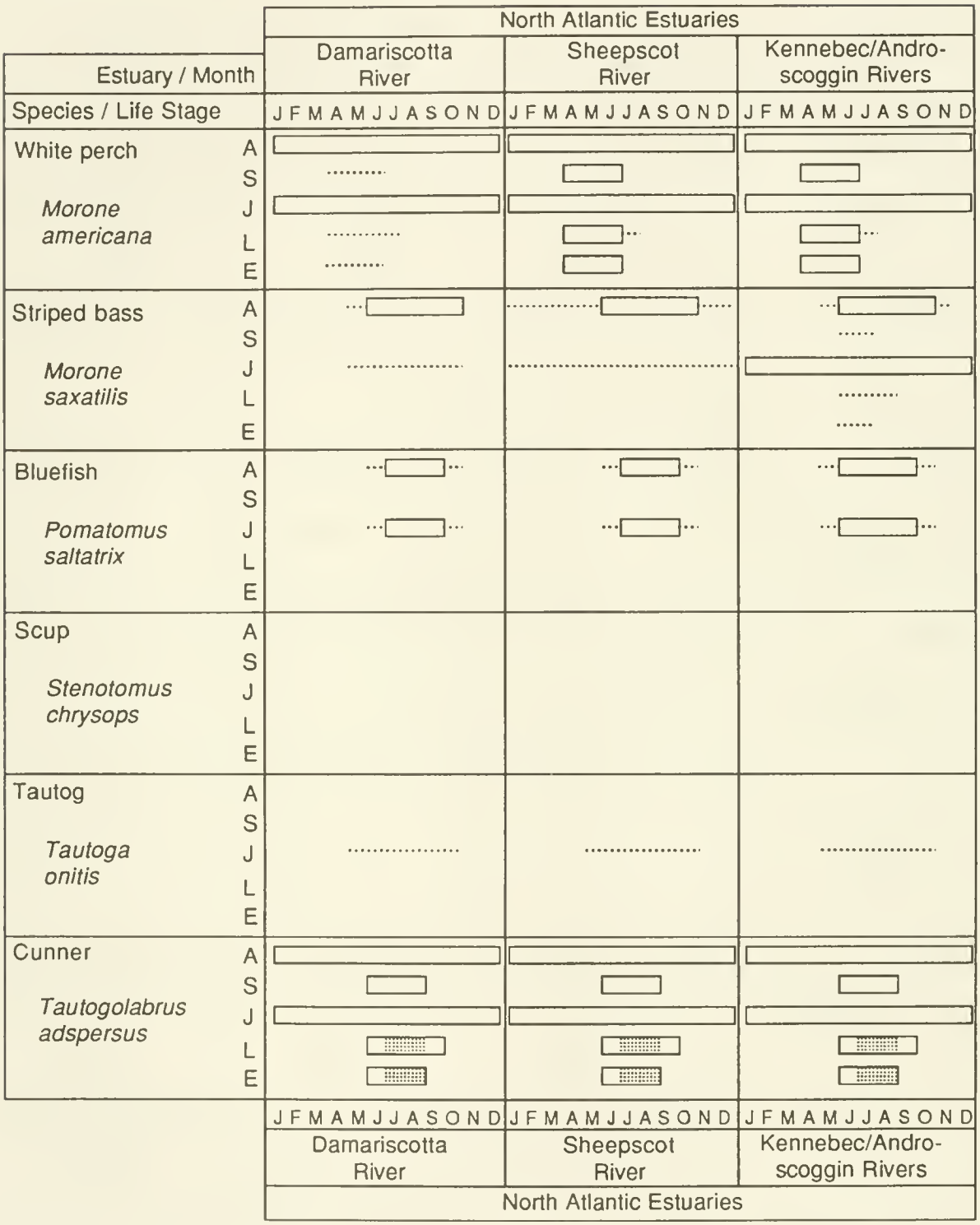

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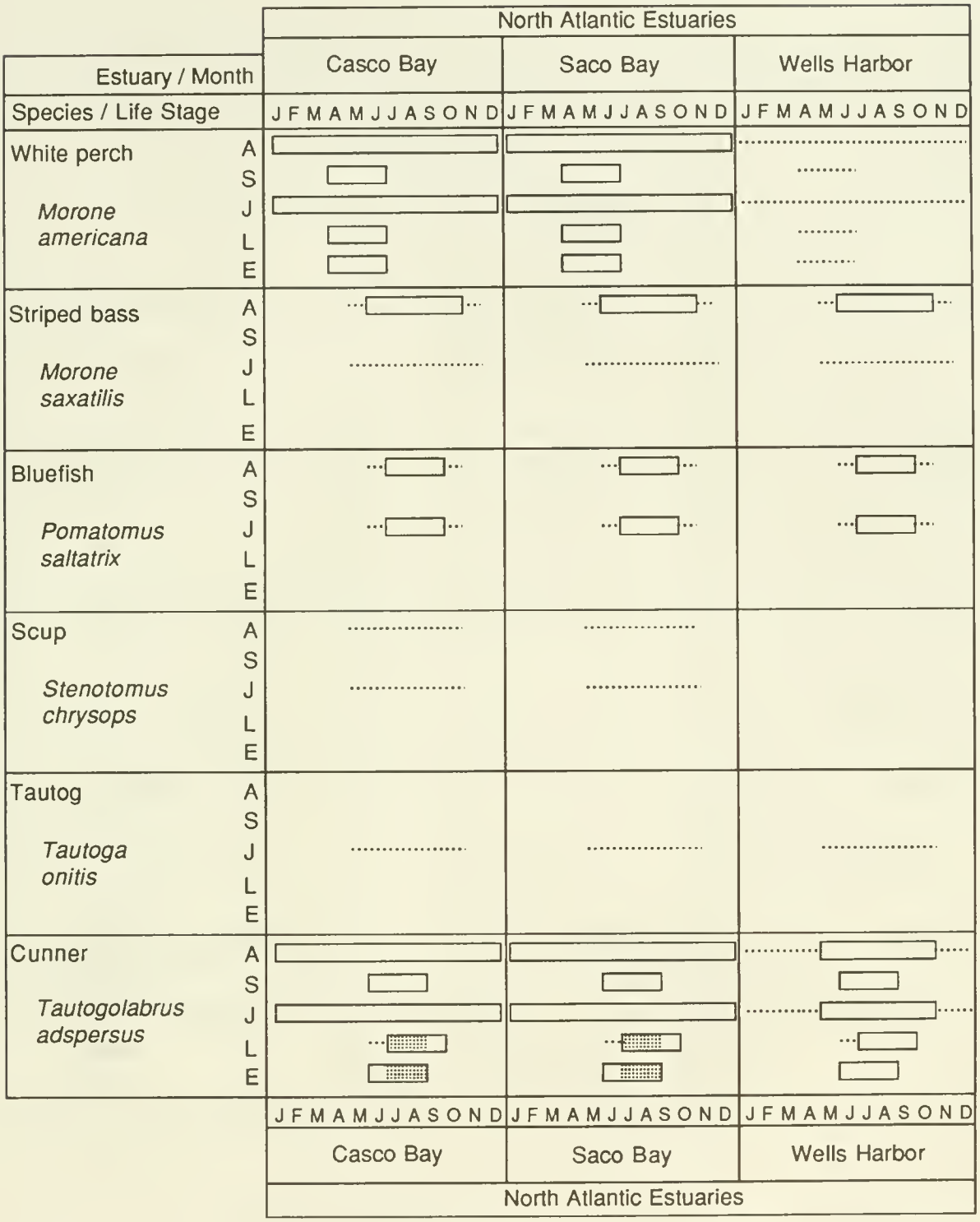
Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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- Common
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Life Stage

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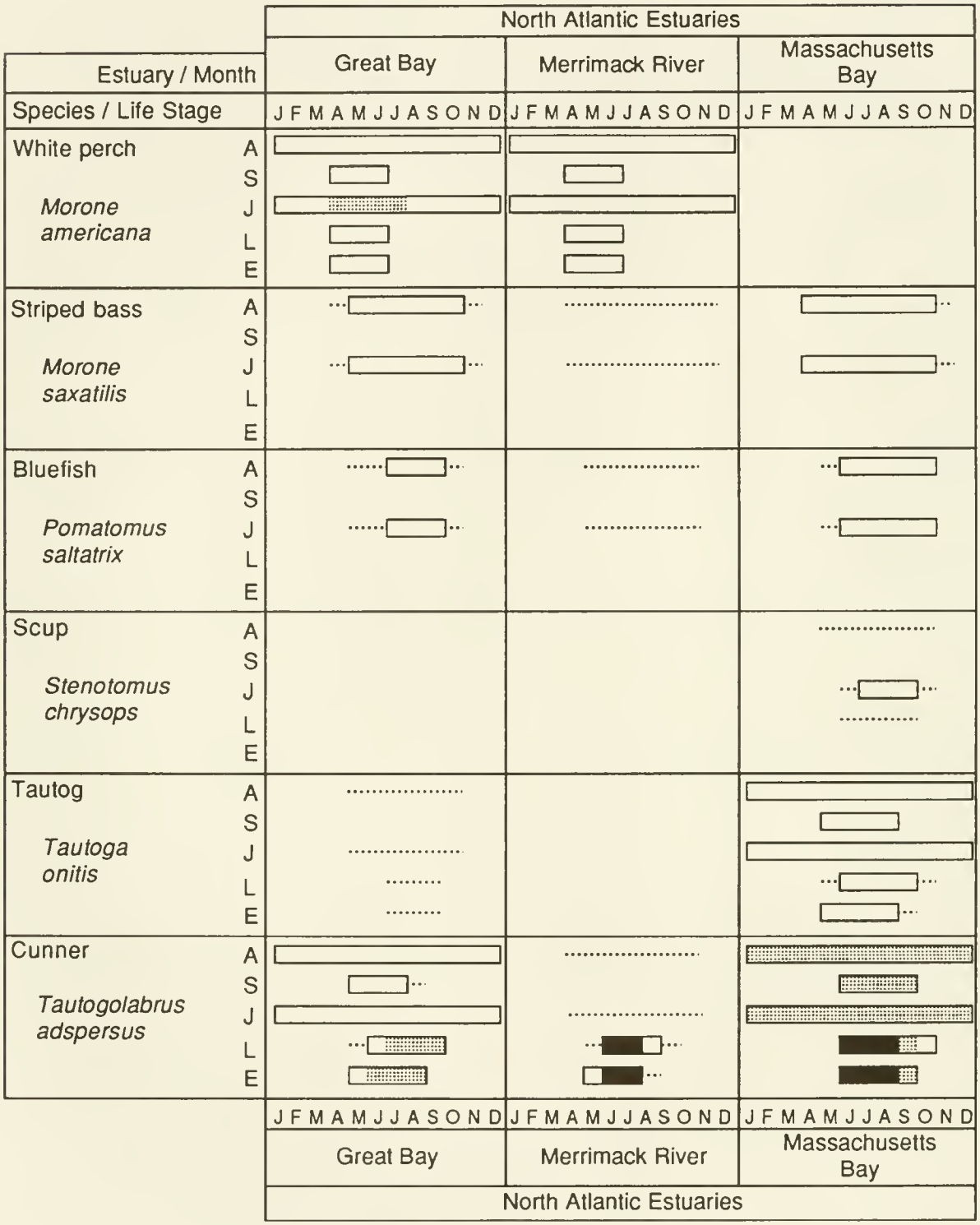
Table 5 (continued). Temporal distribution and relative abundance



Relative Abundance

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- Common
- Rare
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Life Stage

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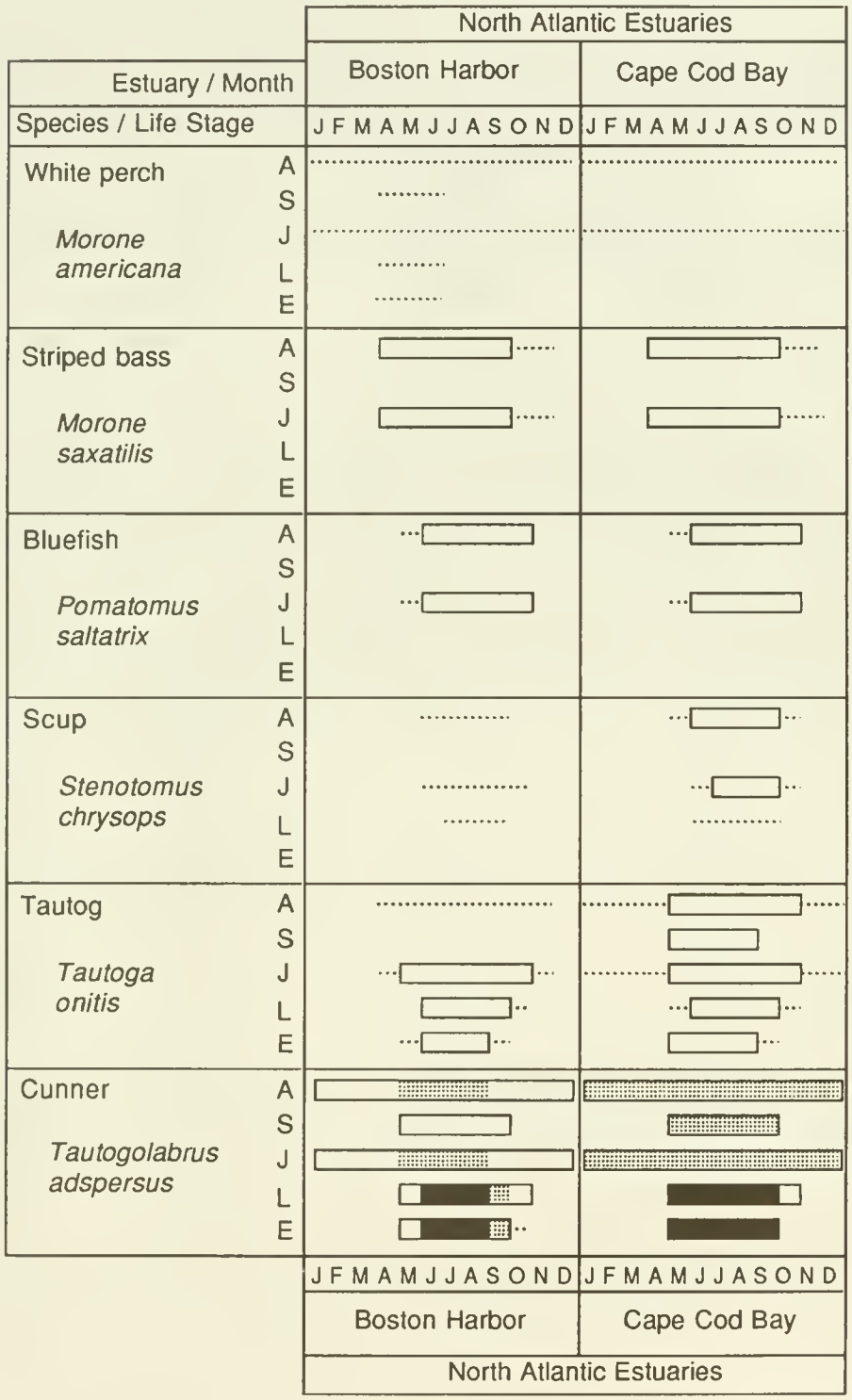
Table 5 (continued). Temporal distribution and relative abundance



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Life Stage

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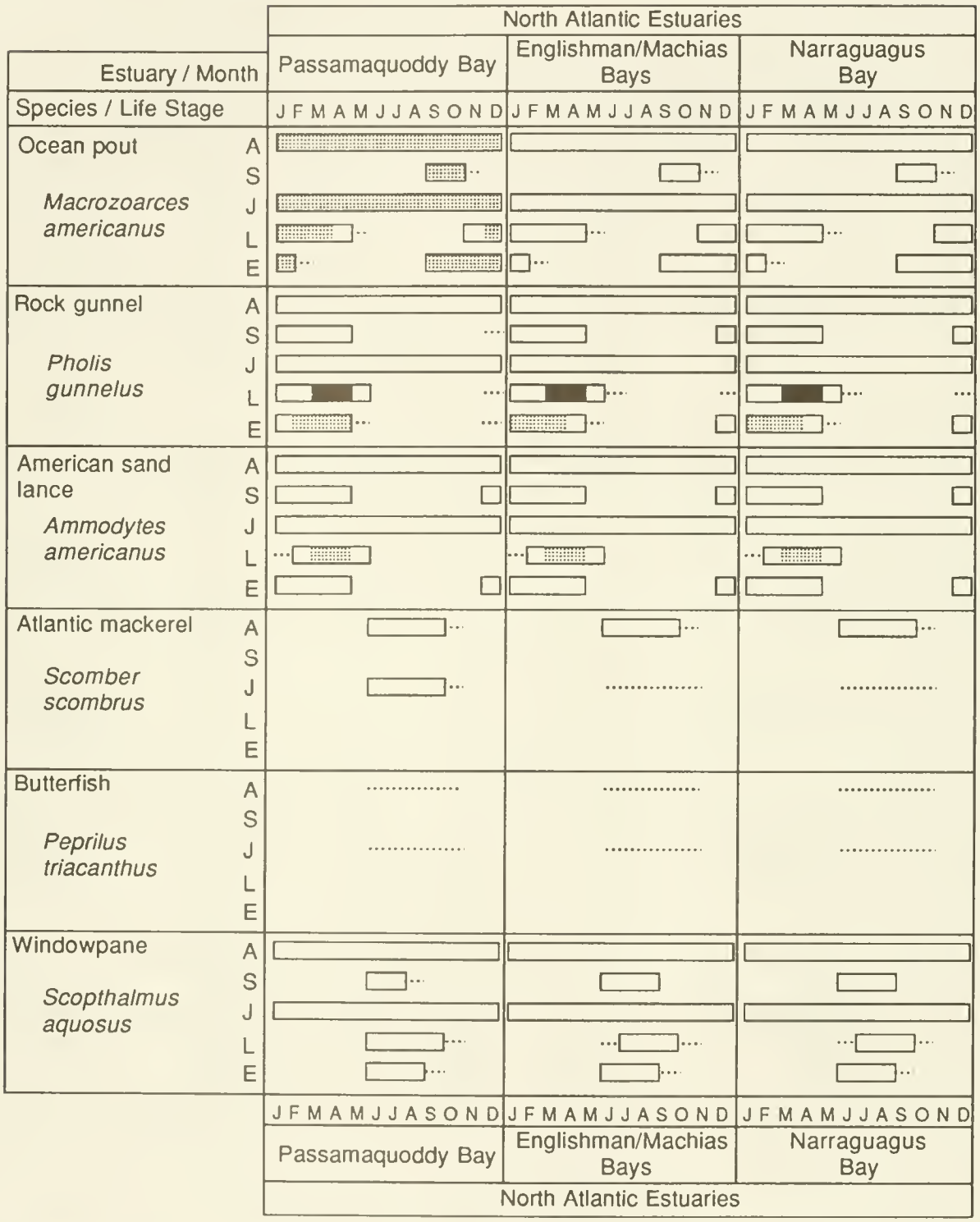
Table 5 (continued). Temporal distribution and relative abundance



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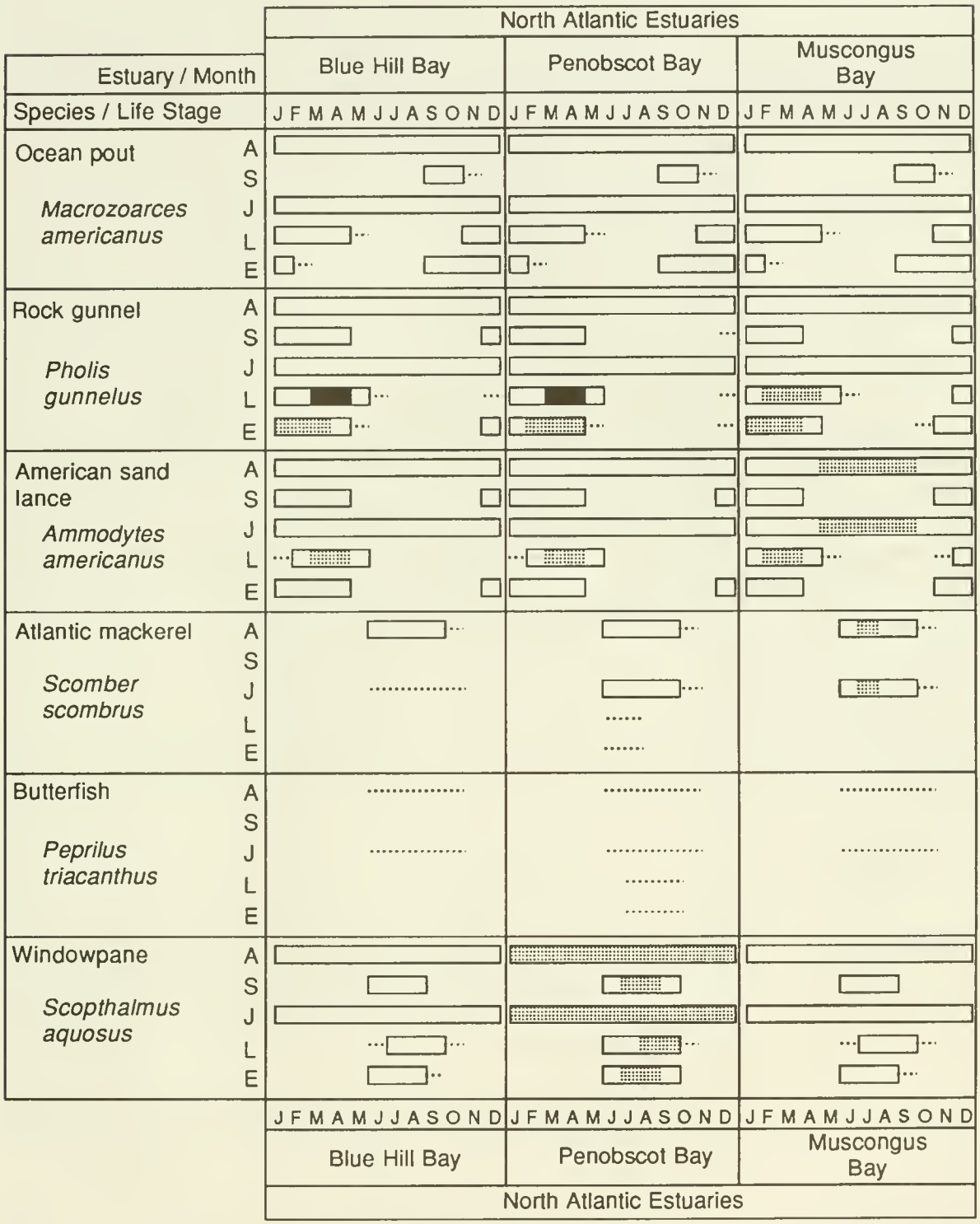

Relative Abundance

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Life Stage

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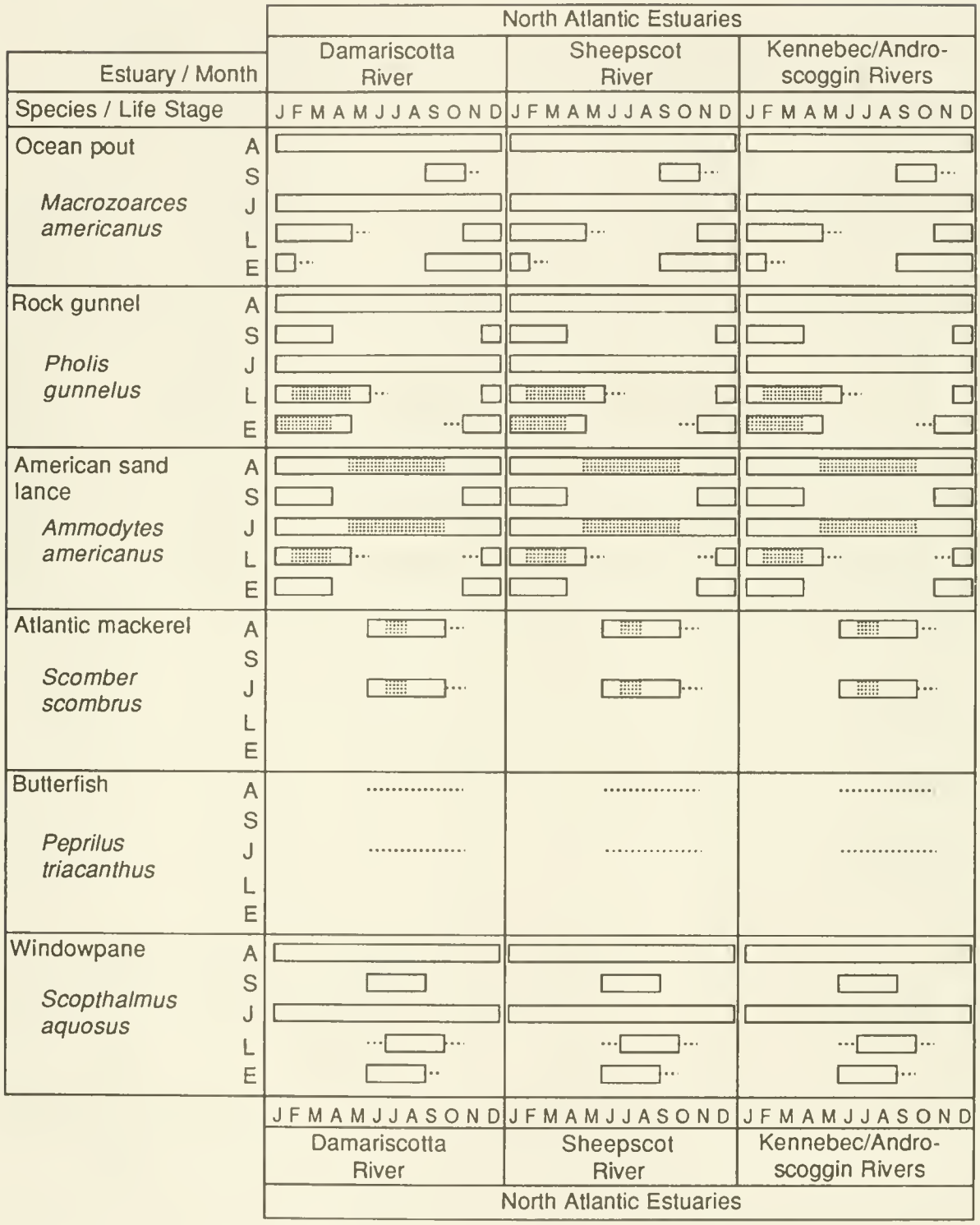
Table 5 (continued). Temporal distribution and relative abundance



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Life Stage

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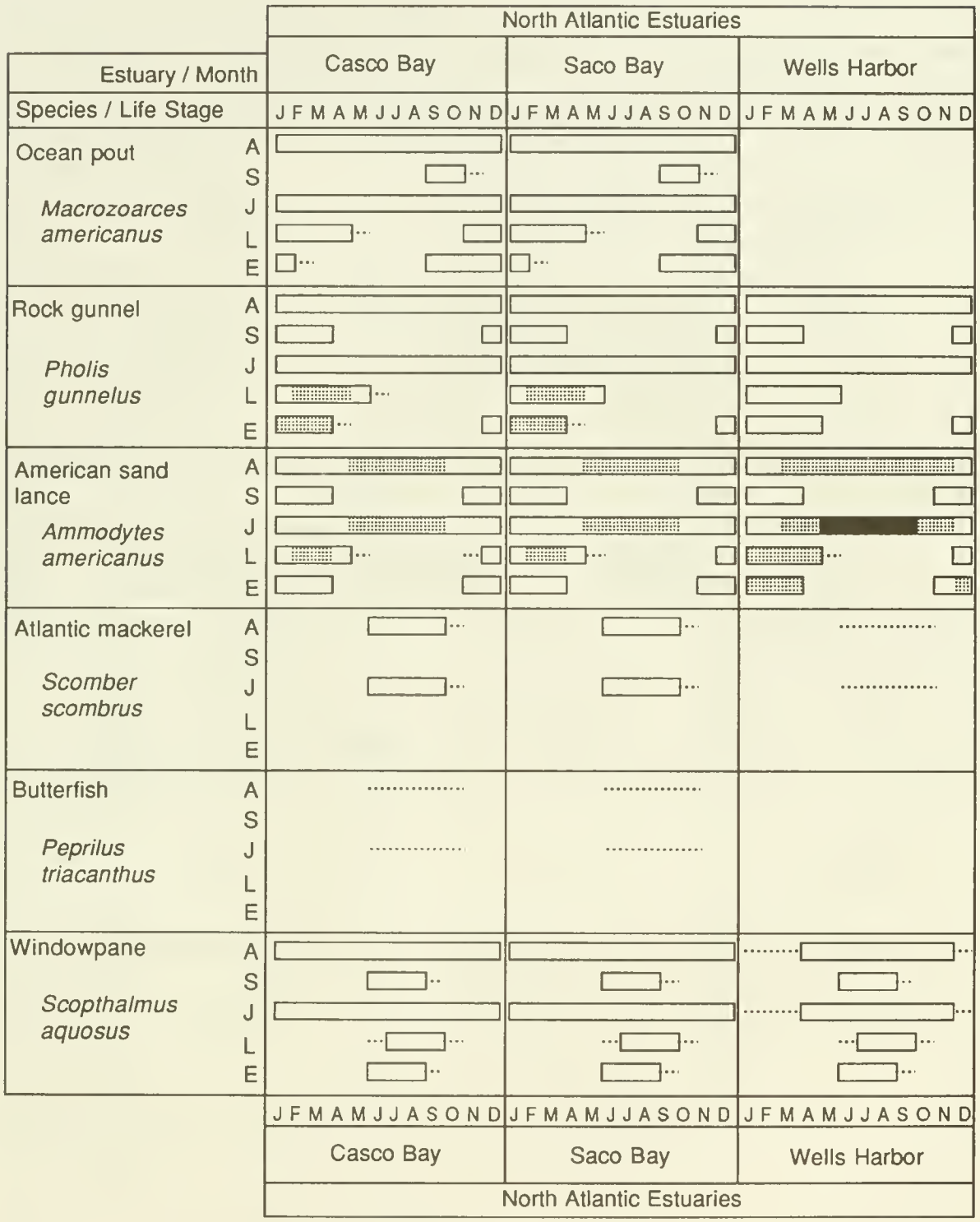
Table 5 (continued). Temporal distribution and relative abundance



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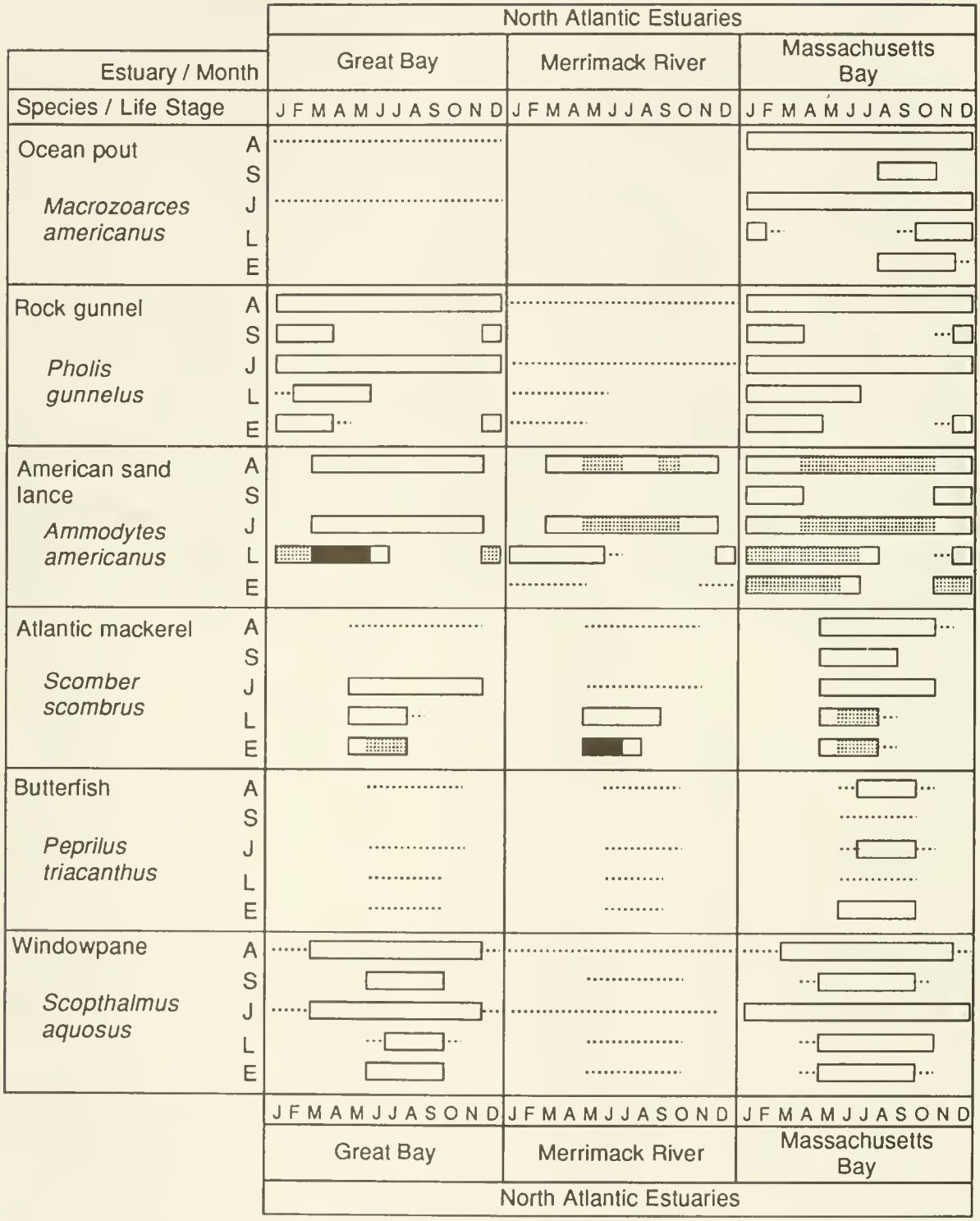

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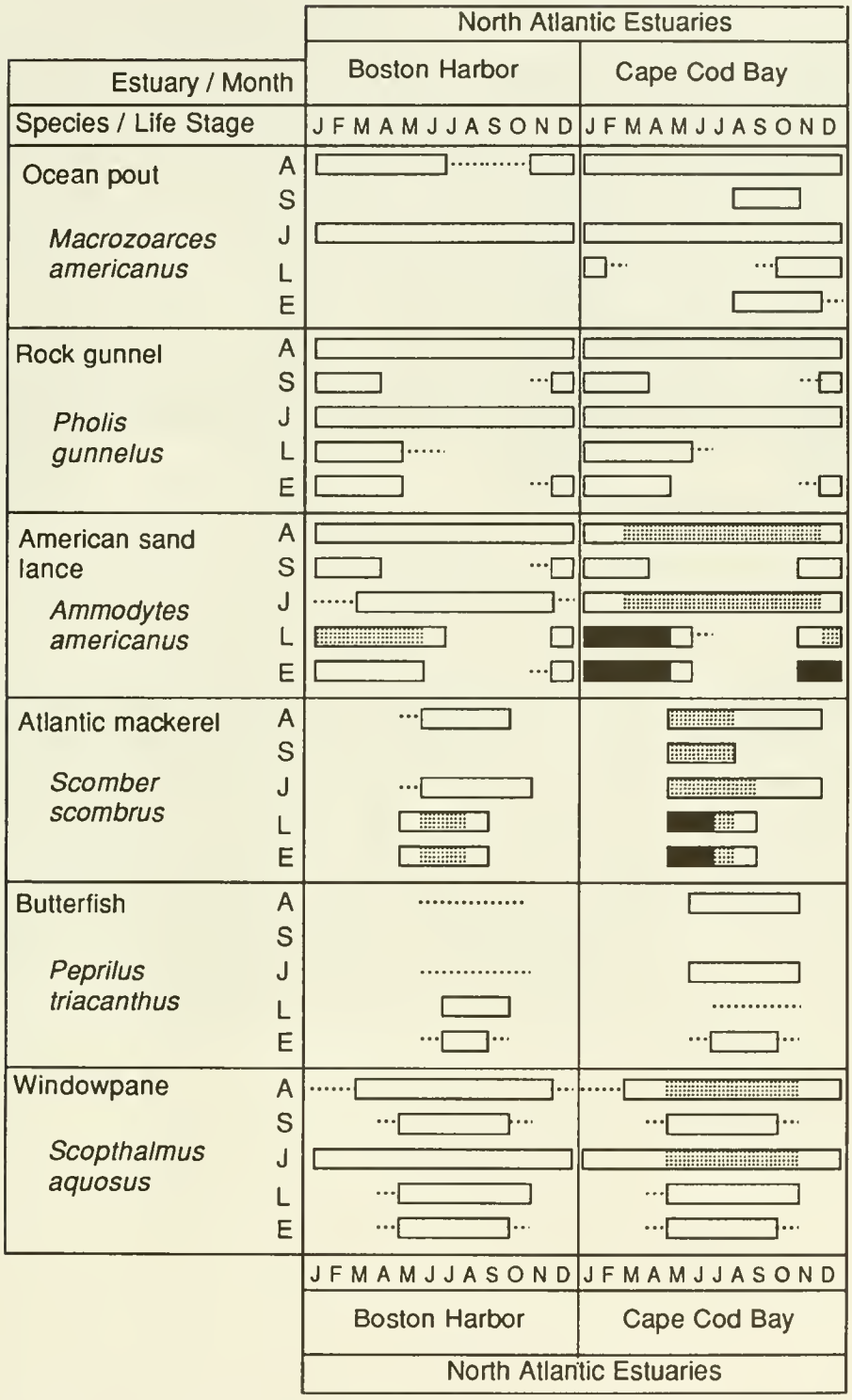

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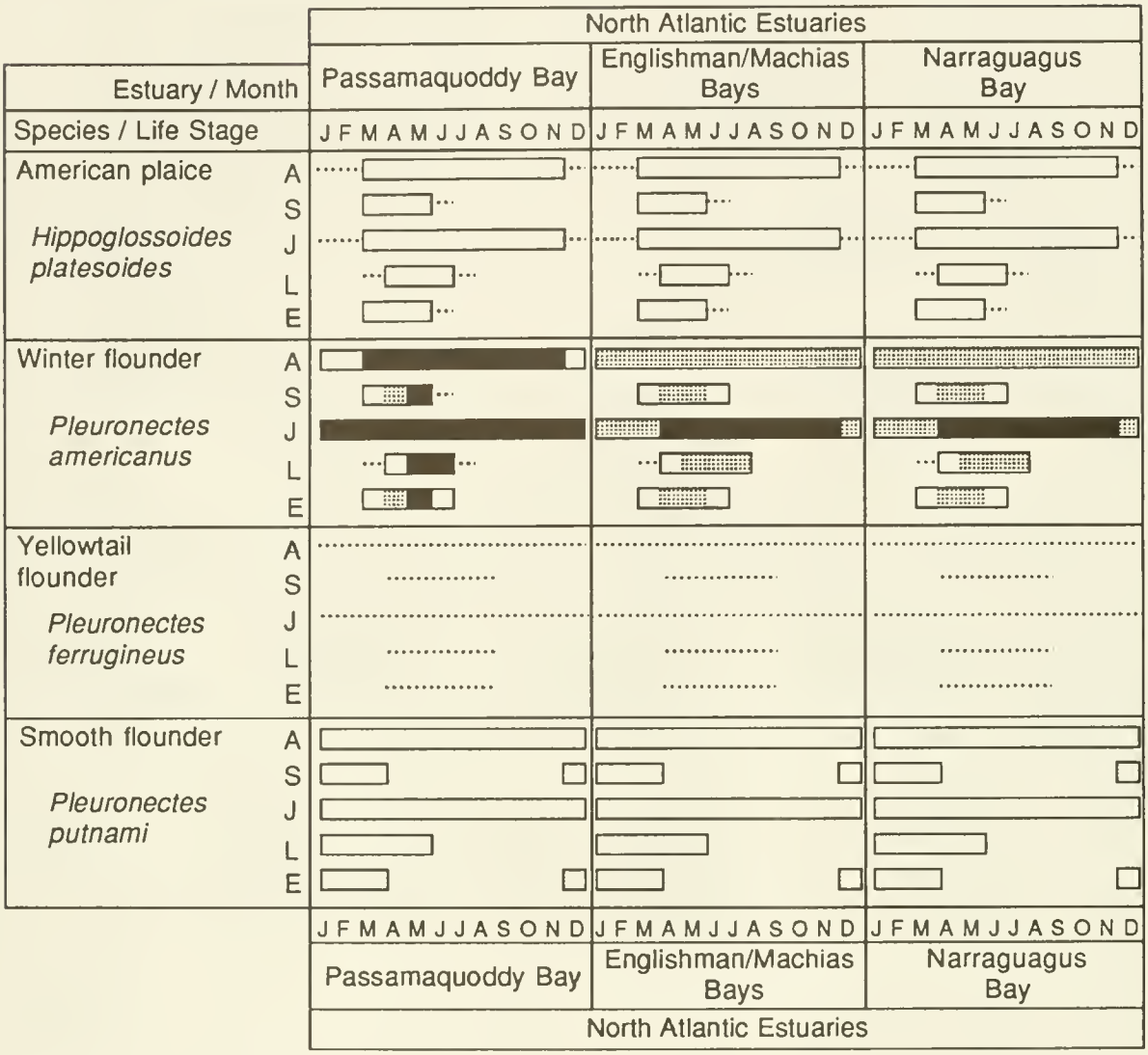

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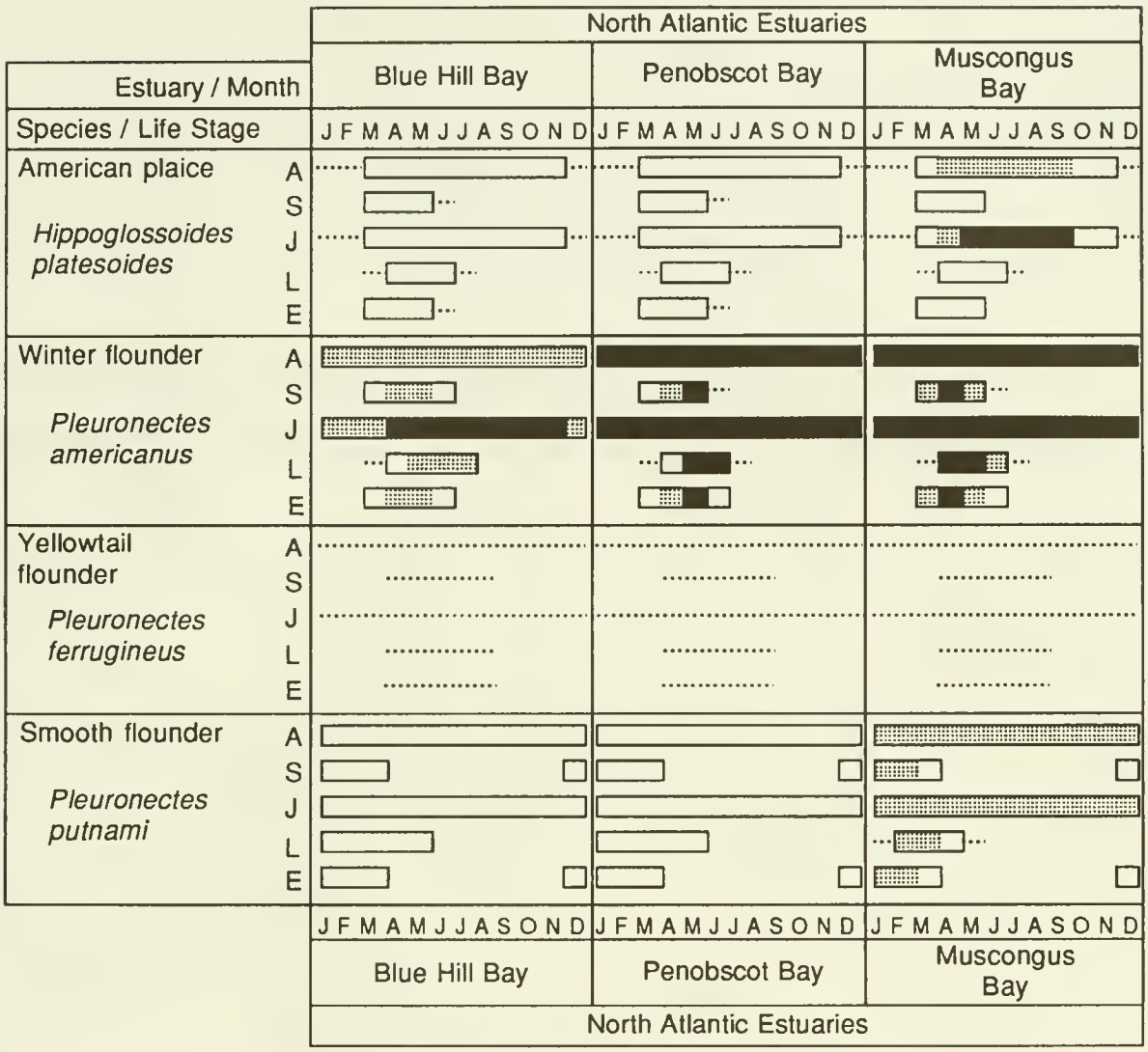

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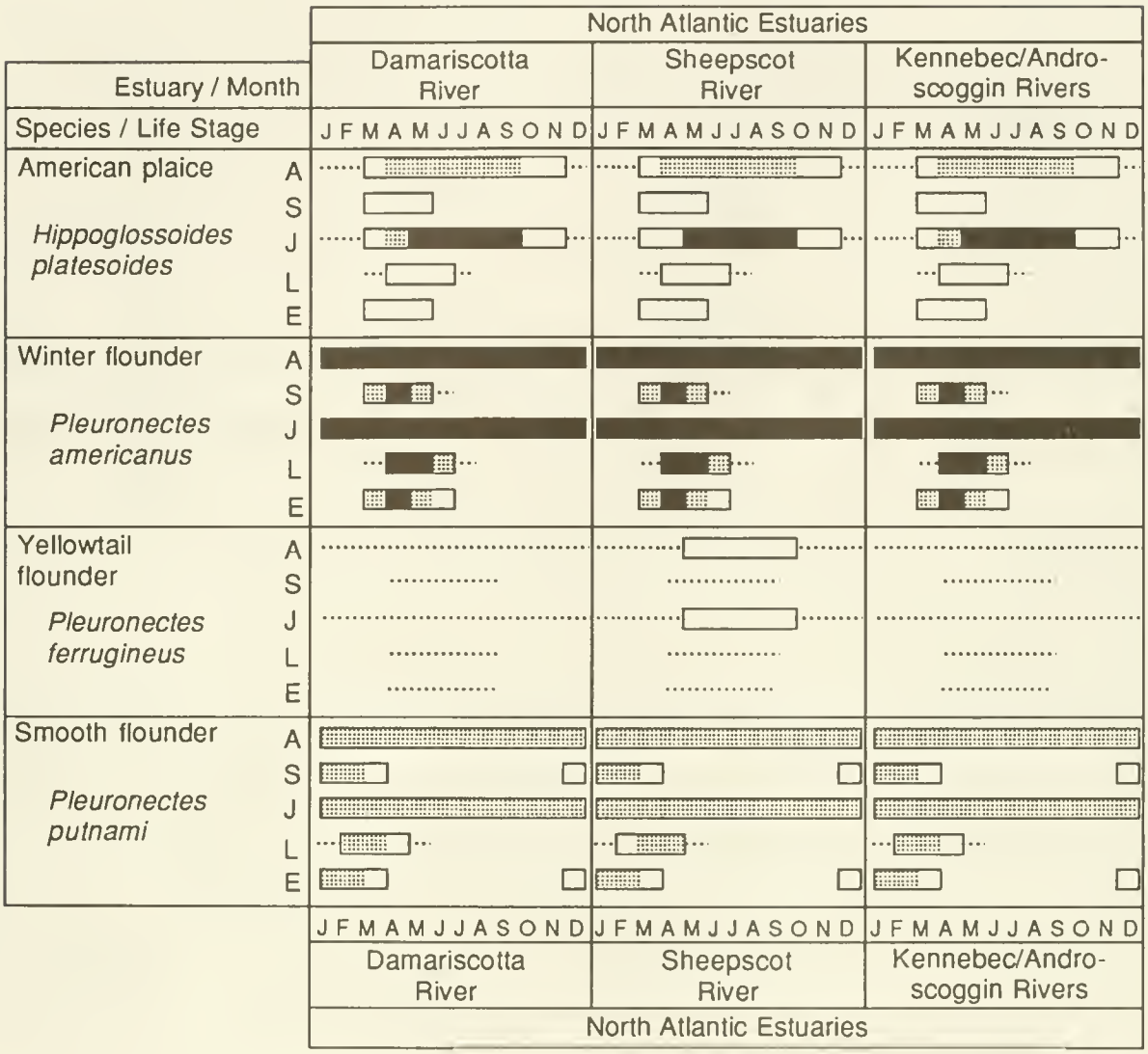

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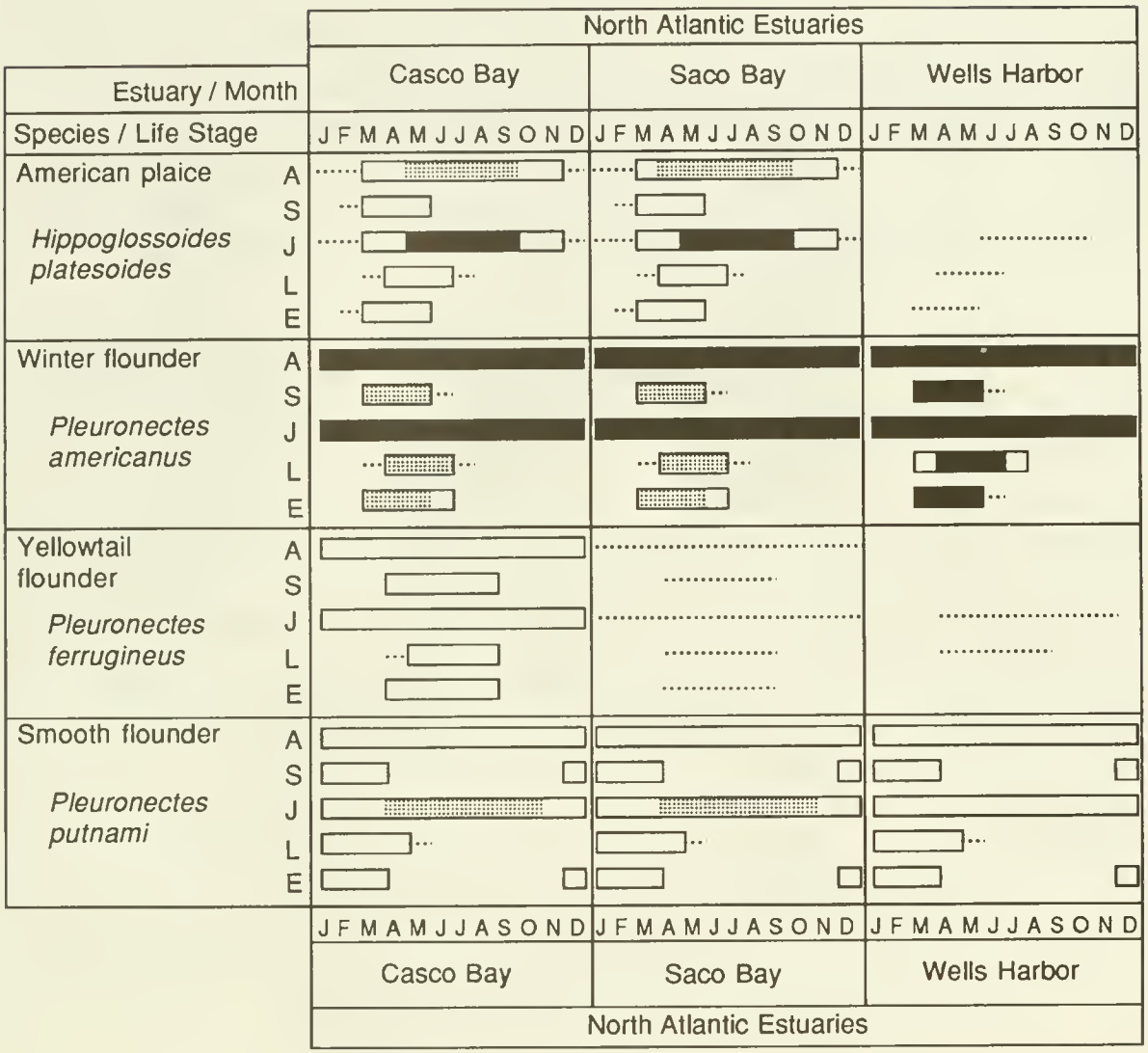

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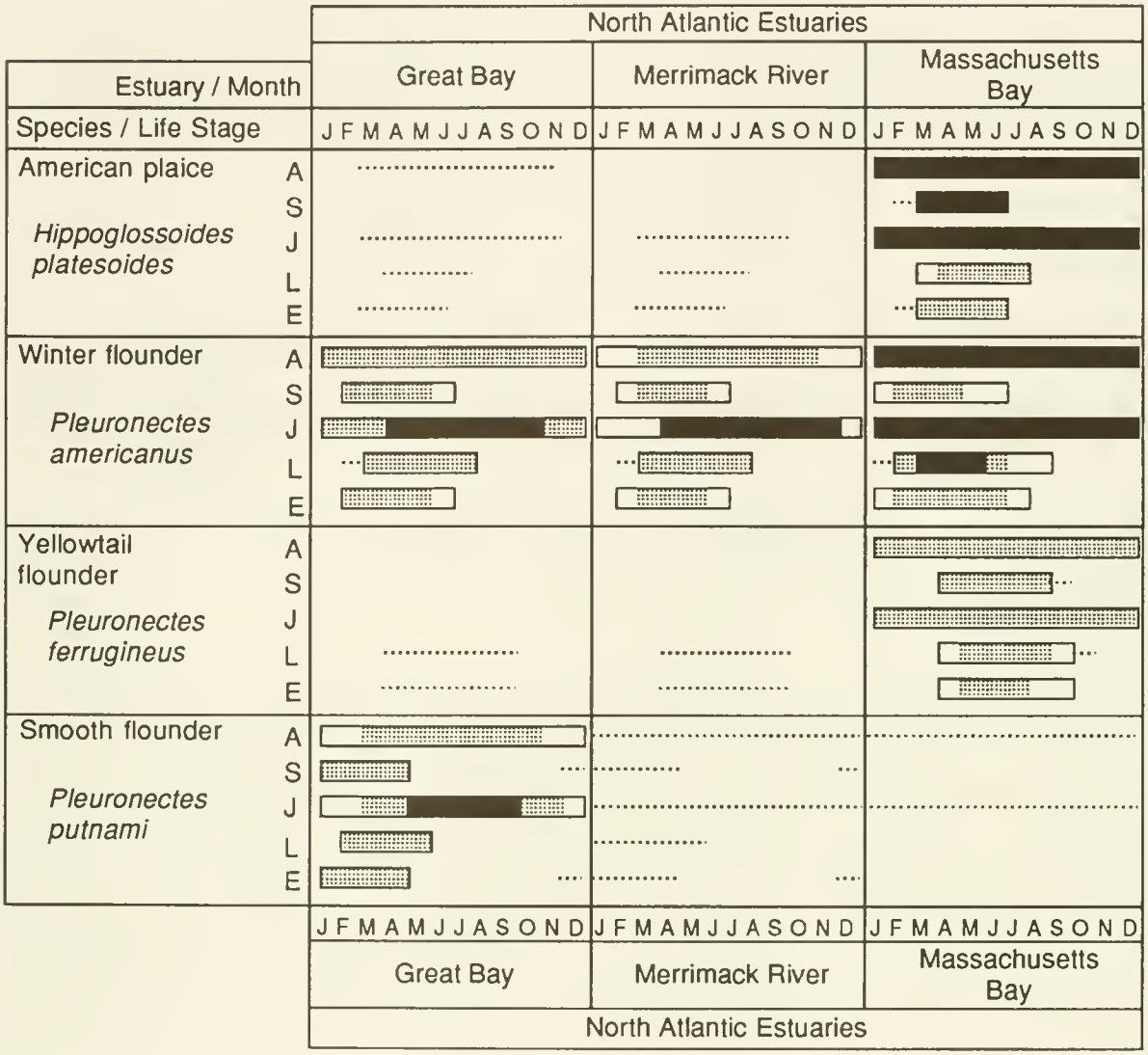

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Table 5 (continued). Temporal distribution and relative abundance

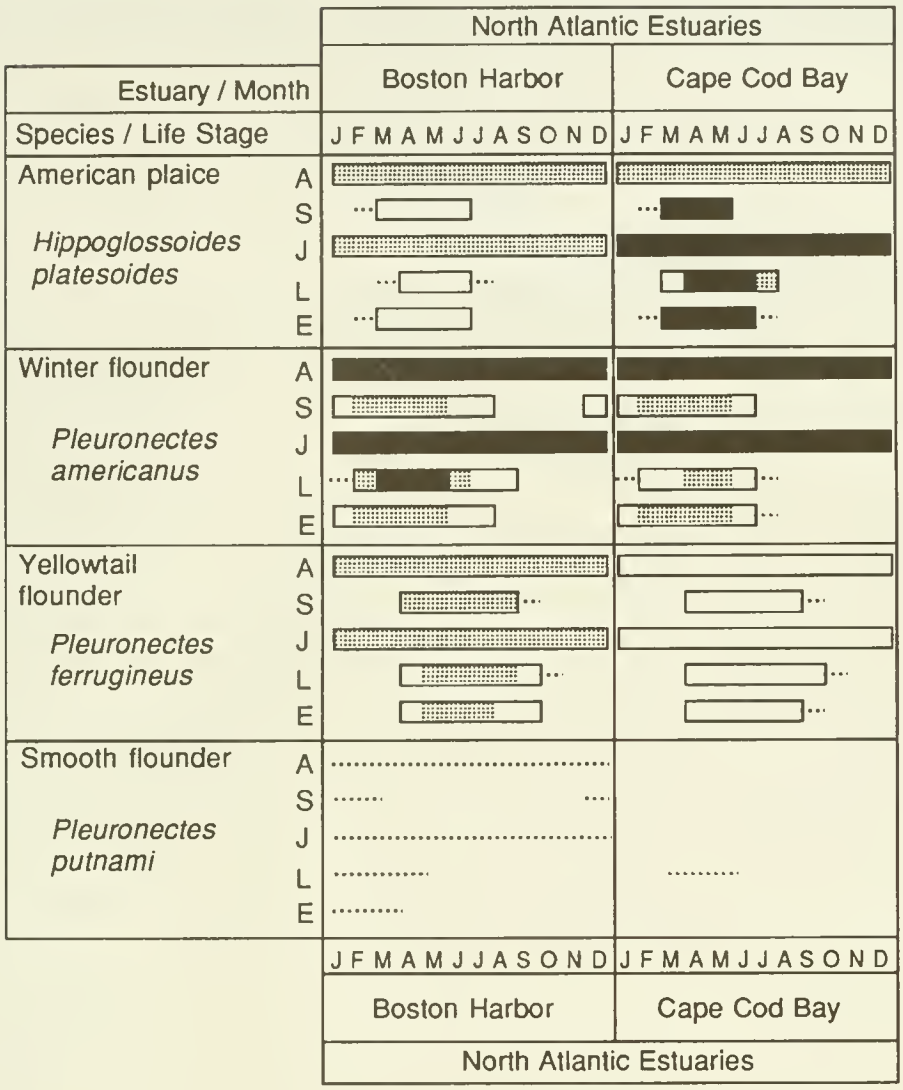

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Table 6. Data reliability

Index to Table 6. Page location of data reliability table for each species and estuary.

	Passamaquoddy Bay, Englishman/Machias Bays, Narraguagus Bay, Blue Hill Bay, Penobscot Bay, Muscongus Bay	Damariscotta River, Sheepscot River, Kennebec/Androscoggin Rivers, Casco Bay, Saco Bay, Wells Harbor	Great Bay, Merrimack River, Massachusetts Bay, Boston Harbor, Cape Cod Bay
Blue mussel (*Mytilus edulis*) Sea scallop (*Placopecten magellanicus*) American oyster (*Crassostrea virginica*) Northern quahog (*Mercenaria mercenaria*) Softshell clam (*Mya arenaria*) Daggerblade grass shrimp (*Palaemonetes pugio*)	p. 114	p. 115	p. 116
Northern shrimp (*Pandalus borealis*) Sevenspine bay shrimp (*Crangon septemspinosa*) American lobster (*Homarus americanus*) Jonah crab (*Cancer borealis*) Atlantic rock crab (*Cancer irroratus*) Green crab (*Carcinus maenas*)	p. 117	p. 118	p. 119
Green sea urchin (*Strongylocentrotus droebachiensis*) Spiny dogfish (*Squalus acanthias*) Skates (*Raja* species) Shortnose sturgeon (*Acipenser brevirostrum*) Atlantic sturgeon (*Acipenser oxyrhynchus*) American eel (*Anguilla rostrata*)	p. 120	p. 121	p. 122
Blueback herring (*Alosa aestivalis*) Alewife (*Alosa pseudoharengus*) American shad (*Alosa sapidissima*) Atlantic menhaden (*Brevoortia tyrannus*) Atlantic herring (*Clupea harengus*) Rainbow smelt (*Osmerus mordax*)	p. 123	p. 124	p. 125
Atlantic salmon (*Salmo salar*) Atlantic cod (*Gadus morhua*) Haddock (*Melanogrammus aeglefinus*) Silver hake (*Merluccius bilinearis*) Atlantic tomcod (*Microgadus tomcod*) Pollock (*Pollachius virens*)	p. 126	p. 127	p. 128
Red hake (*Urophycis chuss*) White hake (*Urophycis tenuis*) Mummichog (*Fundulus heteroclitus*) Silversides (*Menidia* species) Fourspine stickleback (*Apeltes quadracus*) Threespine stickleback (*Gasterosteus aculeatus*)	p. 129	p. 130	p. 131
Ninespine stickleback (*Pungitius pungitius*) Northern pipefish (*Syngnathus fuscus*) Northern searobin (*Prionotus carolinus*) Grubby (*Myoxocephalus aenaeus*) Longhorn sculpin (*Myoxocephalus octodecemspinosus*) Shorthorn sculpin (*Myoxocephalus scorpius*)	p. 132	p. 133	p. 134
White perch (*Morone americana*) Striped bass (*Morone saxatilis*) Bluefish (*Pomatomus saltatrix*) Scup (*Stenotomus chrysops*) Tautog (*Tautoga onitis*) Cunner (*Tautogolabrus adspersus*)	p. 135	p. 136	p. 137
Ocean pout (*Macrozoarces americanus*) Rock gunnel (*Pholis gunnelus*) American sand lance (*Ammodytes americanus*) Atlantic mackerel (*Scomber scombrus*) Butterfish (*Peprilus triacanthus*) Windowpane (*Scophthalmus aquosus*)	p. 138	p. 139	p. 140
American plaice (*Hippoglossoides platesoides*) Winter flounder (*Pleuronectes americanus*) Yellowtail flounder (*Pleuronectes ferrugineus*) Smooth flounder (*Pleuronectes putnami*)	p. 141	p. 142	p. 143

Table 6. Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
Blue mussel	A	■	□	□	□	■	▣
	S	■	□	□	□	▣	□
Mytilus edulis	J	■	□	□	□	■	▣
	L	■	□	□	□	▣	□
	E	■	□	□	□	▣	□
Sea scallop	A	■	□	□	□	■	▣
	S	■	□	□	□	▣	□
Placopecten magellanicus	J	■	□	□	□	■	▣
	L	■	□	□	□	▣	□
	E	■	□	□	□	▣	□
American oyster	A	□	▣	▣	▣	▣	□
	S	□	■	■	■	▣	□
Crassostrea virginica	J	□	▣	▣	▣	▣	□
	L	□	■	■	■	▣	□
	E	□	■	■	■	▣	□
Northern quahog	A	■	▣	▣	□	▣	▣
	S	□	▣	▣	□	□	□
Mercenaria mercenaria	J	■	▣	▣	□	▣	▣
	L	□	▣	▣	□	□	□
	E	□	▣	▣	□	□	□
Softshell clam	A	■	▣	▣	▣	■	▣
	S	■	▣	□	□	▣	□
Mya arenaria	J	■	▣	▣	▣	■	▣
	L	■	▣	□	□	▣	□
	E	■	▣	□	□	▣	□
Daggerblade grass shrimp	A	■	▣	▣	□	□	▣
	S	■	▣	▣	□	□	▣
Palaemonetes pugio	J	■	▣	▣	□	□	▣
	L	■	▣	▣	□	□	▣
	E	■	▣	▣	□	□	▣
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Blue mussel	A	▣	■	■	▣	▣	□
	S	■	■	■	□	□	□
Mytilus edulis	J	■	■	■	□	□	□
	L	■	■	■	□	□	□
	E	■	■	■	□	□	□
Sea scallop	A	■	■	■	▣	□	□
	S	■	■	■	□	□	□
Placopecten magellanicus	J	■	■	■	▣	□	□
	L	■	■	■	□	□	□
	E	■	■	■	□	□	□
American oyster	A	▣	▣	▣	□	▣	▣
	S	▣	▣	▣	▣	▣	▣
Crassostrea virginica	J	▣	▣	▣	□	▣	▣
	L	▣	▣	▣	▣	▣	▣
	E	▣	▣	▣	▣	▣	▣
Northern quahog	A	▣	▣	□	▣	□	□
	S	□	□	□	□	▣	□
Mercenaria mercenaria	J	▣	▣	□	□	□	□
	L	□	□	□	□	▣	□
	E	□	□	□	□	▣	□
Softshell clam	A	▣	■	■	■	▣	■
	S	▣	■	■	□	□	□
Mya arenaria	J	▣	■	■	■	▣	▣
	L	▣	■	■	□	□	□
	E	▣	■	■	□	□	□
Daggerblade grass shrimp	A	▣	▣	▣	□	□	□
	S	▣	▣	▣	□	□	□
Palaemonetes pugio	J	▣	▣	▣	□	□	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Blue mussel	A	■	▣	■	■	■
	S	▣	□	▣	▣	□
Mytilus edulis	J	▣	▣	■	▣	■
	L	▣	□	▣	▣	□
	E	▣	□	▣	▣	□
Sea scallop	A	▣	■	▣	□	▣
	S	□	■	□	□	□
Placopecten magellanicus	J	▣	■	▣	□	▣
	L	▣	▣	□	□	□
	E	□	■	□	□	□
American oyster	A	▣	▣	▣	□	■
	S	□	■	▣	□	□
Crassostrea virginica	J	▣	▣	▣	□	■
	L	▣	■	▣	□	□
	E	▣	■	▣	□	□
Northern quahog	A	▣	□	■	□	■
	S	■	□	▣	□	▣
Mercenaria mercenaria	J	▣	□	■	□	▣
	L	■	□	▣	□	▣
	E	■	□	▣	□	▣
Softshell clam	A	■	■	■	■	■
	S	■	▣	▣	▣	▣
Mya arenaria	J	■	▣	■	■	■
	L	■	▣	▣	▣	▣
	E	■	▣	▣	▣	▣
Daggerblade grass shrimp	A	▣	□	□	□	□
	S	□	□	□	□	□
Palaemonetes pugio	J	▣	□	□	□	□
	L	□	□	□	□	□
	E	□	□	□	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

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Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
Northern shrimp *Pandalus borealis*	A	▣	□	□	▣	▣	▣
	S	□	■	■	■	■	■
	J	□	□	□	▣	□	□
	L	▣	□	□	▣	□	▣
	E	▣	□	□	▣	▣	▣
Sevenspine bay shrimp *Crangon septemspinosa*	A	■	□	□	▣	▣	▣
	S	□	□	□	□	□	▣
	J	■	□	□	▣	▣	▣
	L	□	□	□	□	▣	▣
	E	▣	□	□	□	▣	▣
American lobster *Homarus americanus*	A	▣	□	□	□	□	□
	S	▣	□	□	□	□	▣
	J	▣	□	□	□	□	□
	L	□	□	□	□	□	□
	E	▣	□	□	□	□	▣
Jonah crab *Cancer borealis*	A	□	□	□	□	▣	▣
	S	□	□	□	□	□	□
	J	□	□	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Atlantic rock crab *Cancer irroratus*	A	▣	□	□	□	▣	▣
	S	□	□	□	□	□	□
	J	▣	□	□	□	▣	▣
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Green crab *Carcinus maenas*	A	▣	▣	▣	▣	▣	■
	M	□	□	□	□	□	▣
	J	▣	▣	▣	▣	▣	■
	L	□	□	□	□	□	▣
	E	□	□	□	□	□	▣
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Northern shrimp *Pandalus borealis*	A	▣	■	▣	▣	▣	□
	S	■	■	■	■	■	■
	J	□	□	□	▣	□	□
	L	▣	■	▣	▣	□	□
	E	▣	■	▣	▣	□	□
Sevenspine bay shrimp *Crangon septemspinosa*	A	▣	▣	▣	▣	▣	□
	S	▣	▣	▣	□	□	□
	J	▣	▣	▣	▣	▣	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	□	□
American lobster *Homarus americanus*	A	▣	■	▣	▣	▣	□
	S	▣	▣	▣	□	□	□
	J	▣	■	▣	▣	▣	□
	L	□	□	□	□	□	□
	E	▣	▣	▣	□	□	□
Jonah crab *Cancer borealis*	A	▣	▣	▣	▣	□	□
	S	□	□	□	□	□	□
	J	□	□	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Atlantic rock crab *Cancer irroratus*	A	▣	▣	▣	▣	▣	□
	S	□	□	□	□	□	□
	J	▣	▣	▣	▣	▣	□
	L	□	□	□	□	□	□
	E	▣	□	□	□	□	□
Green crab *Carcinus maenas*	A	■	■	▣	▣	□	▣
	M	▣	■	▣	□	□	□
	J	■	■	▣	▣	□	▣
	L	▣	▣	▣	□	□	□
	E	▣	■	▣	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Northern shrimp	A	▣	■	▣	□	▣
	S	■	■	□	■	▣
Pandalus borealis	J	▣	■	▣	□	□
	L	■	■	□	□	□
	E	■	■	□	□	□
Sevenspine bay shrimp	A	■	▣	▣	▣	▣
	S	▣	□	□	□	□
Crangon septemspinosa	J	■	▣	▣	▣	▣
	L	▣	▣	□	□	□
	E	▣	□	□	□	□
American lobster	A	■	□	■	▣	▣
	S	▣	▣	▣	□	▣
Homarus americanus	J	■	□	■	▣	□
	L	□	□	▣	□	□
	E	▣	▣	▣	□	□
Jonah crab	A	▣	□	■	□	□
	S	▣	▣	▣	□	□
Cancer borealis	J	□	□	■	□	□
	L	□	▣	▣	□	□
	E	□	▣	▣	□	□
Atlantic rock crab	A	■	□	■	▣	□
	S	□	□	□	□	□
Cancer irroratus	J	■	□	■	▣	□
	L	▣	□	□	□	□
	E	□	□	▣	□	□
Green crab	A	■	▣	▣	▣	▣
	M	□	□	□	□	□
Carcinus maenas	J	■	▣	▣	▣	▣
	L	□	▣	□	□	□
	E	□	□	□	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
Green sea urchin *Strongylocentrotus droebachiensis*	A	▣	□	□	□	□	■
	S	▣	□	□	□	□	▣
	J	▣	□	□	□	□	■
	L	▣	□	□	□	□	▣
	E	▣	□	□	□	□	▣
Spiny dogfish *Squalus acanthias*	A	▣	□	□	□	□	▣
	M	□	□	□	□	□	□
	J	▣	□	□	□	□	▣
	P	□	□	□	□	□	□
Skates *Raja* species	A	▣	□	□	□	□	▣
	M	▣	□	□	□	▣	▣
	J	▣	□	□	□	□	▣
	E	▣	□	□	□	▣	▣
Shortnose sturgeon *Acipenser brevirostrum*	A	▣	□	□	□	□	▣
	S	▣	□	□	□	□	▣
	J	▣	□	□	□	□	▣
	L	▣	□	□	□	□	▣
	E	▣	□	□	□	□	▣
Atlantic sturgeon *Acipenser oxyrhynchus*	A	□	□	□	□	□	□
	S	□	□	□	□	□	▣
	J	□	□	□	□	□	□
	L	□	□	□	□	□	▣
	E	□	□	□	□	□	▣
American eel *Anguilla rostrata*	A	▣	▣	▣	▣	▣	▣
	S	■	■	■	■	■	■
	J	▣	▣	▣	▣	▣	▣
	L	▣	□	□	□	□	□
	E	■	■	■	■	■	■
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Green sea urchin *Strongylocentrotus droebachiensis*	A	■	■	■	□	□	□
	S	▣	▣	▣	▣	□	▣
	J	■	■	■	□	□	□
	L	▣	▣	▣	▣	□	▣
	E	▣	▣	▣	▣	□	▣
Spiny dogfish *Squalus acanthias*	A	▣	▣	▣	□	□	▣
	M	□	□	□	□	□	■
	J	▣	▣	▣	□	□	▣
	P	□	□	□	□	□	■
Skates *Raja* species	A	▣	▣	▣	□	□	□
	M	▣	□	▣	□	□	□
	J	▣	▣	▣	□	□	□
	E	▣	□	▣	□	□	□
Shortnose sturgeon *Acipenser brevirostrum*	A	▣	▣	□	□	□	▣
	S	■	□	■	□	□	■
	J	▣	□	□	□	□	▣
	L	■	□	□	□	□	■
	E	■	□	□	□	□	■
Atlantic sturgeon *Acipenser oxyrhynchus*	A	▣	▣	□	□	□	□
	S	▣	▣	□	□	□	■
	J	□	□	□	□	□	□
	L	▣	▣	□	□	□	■
	E	▣	▣	□	□	□	■
American eel *Anguilla rostrata*	A	▣	■	■	▣	□	▣
	S	■	■	■	■	■	■
	J	▣	■	■	▣	□	▣
	L	□	▣	▣	□	□	□
	E	■	■	■	■	■	■
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Green sea urchin *Strongylocentrotus droebachiensis*	A	▣	▣	▣	□	▣
	S	▣	■	□	□	□
	J	▣	▣	▣	□	▣
	L	▣	■	□	□	□
	E	▣	■	□	□	□
Spiny dogfish *Squalus acanthias*	A	▣	▣	▣	□	□
	M	■	■	□	□	□
	J	▣	▣	▣	□	□
	P	■	■	□	□	□
Skates *Raja* species	A	▣	□	■	▣	■
	M	□	■	▣	□	▣
	J	▣	□	■	▣	■
	E	▣	■	▣	□	□
Shortnose sturgeon *Acipenser brevirostrum*	A	■	■	▣	▣	□
	S	■	■	■	▣	▣
	J	■	□	▣	▣	□
	L	■	■	■	▣	▣
	E	■	■	■	▣	▣
Atlantic sturgeon *Acipenser oxyrhynchus*	A	□	□	□	□	□
	S	■	□	■	▣	▣
	J	□	■	□	□	□
	L	■	□	■	▣	▣
	E	■	□	■	▣	▣
American eel *Anguilla rostrata*	A	■	▣	▣	▣	■
	S	■	■	■	■	■
	J	■	▣	▣	▣	■
	L	▣	□	□	□	▣
	E	■	■	■	■	■
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
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	□	▣	▣	▣	▣	□
Atlantic herring	A	▣	□	□	□	▣	□
	S	■	▣	▣	▣	▣	▣
Clupea harengus	J	▣	□	□	□	▣	□
	L	▣	□	□	□	▣	□
	E	■	▣	▣	▣	▣	▣
Rainbow smelt	A	□	□	□	□	▣	▣
	S	□	□	□	□	▣	▣
Osmerus mordax	J	□	□	□	□	▣	▣
	L	□	□	□	□	▣	▣
	E	□	□	□	□	▣	▣
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

- ■ Highly Certain
- ▣ Moderately Certain
- □ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
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	□	□	□	□	□	▣
Atlantic herring	A	□	▣	□	□	□	□
	S	▣	▣	▣	□	□	▣
Clupea harengus	J	□	▣	□	□	□	□
	L	□	■	□	□	□	□
	E	▣	▣	▣	□	□	▣
Rainbow smelt	A	▣	▣	■	□	□	□
	S	▣	▣	▣	□	□	▣
Osmerus mordax	J	▣	▣	■	□	□	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	□	▣
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
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	▣	□	▣	□	□
Atlantic herring	A	▣	□	▣	□	■
	S	■	■	□	▣	□
Clupea harengus	J	▣	□	▣	□	■
	L	▣	▣	▣	□	□
	E	■	■	□	▣	□
Rainbow smelt	A	▣	□	▣	▣	▣
	S	□	□	■	■	▣
Osmerus mordax	J	▣	□	▣	▣	▣
	L	▣	□	■	▣	▣
	E	□	□	■	■	▣
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
Atlantic salmon	A	▣	▣	▣	▣	■	□
	S	▣	▣	▣	▣	■	▣
Salmo salar	J	▣	▣	▣	□	■	□
	L	▣	▣	▣	▣	■	▣
	E	▣	▣	▣	▣	■	▣
Atlantic cod	A	▣	□	□	□	□	□
	S	▣	□	□	□	▣	□
Gadus morhua	J	▣	□	□	□	□	□
	L	▣	□	□	□	▣	□
	E	▣	□	□	□	▣	□
Haddock	A	▣	□	□	□	□	□
	S	▣	□	□	□	▣	□
Melanogrammus aeglefinus	J	▣	□	□	□	□	□
	L	▣	□	□	□	□	□
	E	▣	□	□	□	□	□
Silver hake	A	▣	□	□	□	▣	▣
	S	□	□	□	□	▣	▣
Merluccius bilinearis	J	▣	□	□	□	▣	▣
	L	□	□	□	□	▣	▣
	E	□	□	□	□	▣	▣
Atlantic tomcod	A	▣	□	□	□	▣	□
	S	▣	□	□	□	▣	□
Microgadus tomcod	J	▣	□	□	□	▣	□
	L	▣	□	□	□	▣	□
	E	▣	□	□	□	▣	□
Pollock	A	□	□	□	□	▣	□
	S	▣	□	□	□	□	□
Pollachius virens	J	▣	□	□	□	▣	□
	L	▣	□	□	□	□	□
	E	▣	□	□	□	□	□
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Atlantic salmon *Salmo salar*	A	□	▣	■	□	□	■
	S	▣	▣	▣	■	■	■
	J	□	▣	■	□	▣	▣
	L	▣	▣	▣	■	■	■
	E	▣	▣	▣	■	■	■
Atlantic cod *Gadus morhua*	A	□	■	▣	□	□	□
	S	□	▣	▣	□	□	□
	J	□	■	▣	□	□	□
	L	□	▣	▣	□	□	□
	E	□	▣	▣	□	□	□
Haddock *Melanogrammus aeglefinus*	A	▣	▣	■	□	□	▣
	S	▣	□	■	▣	▣	■
	J	▣	▣	■	□	□	▣
	L	▣	□	■	□	□	▣
	E	▣	□	■	▣	▣	▣
Silver hake *Merluccius bilinearis*	A	▣	▣	▣	□	□	□
	S	▣	▣	□	□	□	□
	J	▣	▣	▣	□	□	□
	L	▣	▣	□	□	□	□
	E	▣	▣	□	□	□	□
Atlantic tomcod *Microgadus tomcod*	A	▣	▣	▣	□	□	□
	S	▣	▣	▣	□	□	□
	J	▣	▣	▣	□	□	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	□	□
Pollock *Pollachius virens*	A	□	□	□	□	□	□
	S	▣	▣	▣	□	□	□
	J	▣	▣	▣	▣	▣	□
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Atlantic salmon	A	▣	▣	▣	▣	▣
	S	■	■	■	■	■
Salmo salar	J	▣	■	■	■	■
	L	■	■	■	■	■
	E	■	■	■	■	■
Atlantic cod	A	□	□	▣	□	▣
	S	□	□	▣	□	▣
Gadus morhua	J	□	□	▣	□	▣
	L	□	□	□	□	▣
	E	□	□	□	□	▣
Haddock	A	■	■	▣	□	▣
	S	■	■	▣	▣	■
Melanogrammus aeglefinus	J	▣	■	▣	□	▣
	L	□	■	□	□	▣
	E	□	■	□	□	▣
Silver hake	A	□	□	▣	□	□
	S	▣	▣	▣	□	□
Merluccius bilinearis	J	□	□	▣	□	□
	L	▣	□	▣	□	□
	E	▣	▣	▣	□	□
Atlantic tomcod	A	□	□	▣	□	▣
	S	□	□	□	□	□
Microgadus tomcod	J	□	□	□	□	▣
	L	▣	□	□	□	□
	E	▣	□	□	□	□
Pollock	A	□	□	▣	□	▣
	S	▣	▣	□	□	□
Pollachius virens	J	□	□	▣	□	▣
	L	□	□	□	□	▣
	E	□	□	□	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
Red hake	A	▣	☐	☐	☐	▣	☐
	S	▣	☐	☐	☐	☐	☐
Urophycis chuss	J	▣	☐	☐	☐	▣	☐
	L	▣	☐	☐	☐	☐	☐
	E	▣	☐	☐	☐	☐	☐
White hake	A	▣	☐	☐	☐	▣	☐
	S	☐	☐	☐	☐	☐	☐
Urophycis tenuis	J	▣	☐	☐	☐	▣	☐
	L	☐	☐	☐	☐	☐	☐
	E	☐	☐	☐	☐	☐	☐
Mummichog	A	☐	☐	☐	☐	☐	▣
	S	☐	☐	☐	☐	☐	☐
Fundulus heteroclitus	J	☐	☐	☐	☐	☐	▣
	L	☐	☐	☐	☐	☐	☐
	E	☐	☐	☐	☐	☐	☐
Silversides	A	▣	☐	☐	☐	▣	▣
	S	▣	☐	☐	☐	☐	▣
Menidia species	J	▣	☐	☐	☐	▣	▣
	L	▣	☐	☐	☐	☐	▣
	E	▣	☐	☐	☐	☐	▣
Fourspine stickleback	A	☐	☐	☐	☐	▣	☐
	S	☐	☐	☐	☐	☐	☐
Apeltes quadracus	J	☐	☐	☐	☐	▣	☐
	L	☐	☐	☐	☐	☐	☐
	E	☐	☐	☐	☐	☐	☐
Threespine stickleback	A	☐	☐	☐	☐	▣	☐
	S	☐	☐	☐	☐	▣	☐
Gasterosteus aculeatus	J	☐	☐	☐	☐	▣	☐
	L	☐	☐	☐	☐	▣	☐
	E	☐	☐	☐	☐	▣	☐
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

☐ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Red hake	A	▣	■	□	□	□	□
	S	□	▣	□	□	□	□
Urophycis chuss	J	▣	■	□	□	□	□
	L	□	▣	□	□	□	□
	E	□	▣	□	□	□	□
White hake	A	▣	■	□	□	□	□
	S	□	□	□	□	□	□
Urophycis tenuis	J	▣	■	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Mummichog	A	▣	▣	▣	▣	▣	▣
	S	▣	▣	▣	□	□	▣
Fundulus heteroclitus	J	▣	▣	▣	▣	▣	▣
	L	▣	▣	▣	□	□	▣
	E	▣	▣	▣	□	▣	▣
Silversides	A	▣	▣	▣	▣	□	▣
	S	▣	▣	▣	□	□	□
Menidia species	J	▣	▣	▣	▣	□	▣
	L	▣	▣	▣	□	□	□
	E	▣	▣	▣	□	□	□
Fourspine stickleback	A	□	□	□	□	□	■
	S	□	□	□	□	□	▣
Apeltes quadracus	J	□	□	□	□	□	■
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Threespine stickleback	A	□	□	□	□	▣	■
	S	□	□	□	□	□	□
Gasterosteus aculeatus	J	□	□	□	□	□	■
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Red hake *Urophycis chuss*	A	□	□	▣	□	□
	S	▣	▣	□	□	□
	J	□	□	▣	□	□
	L	□	□	▣	□	□
	E	□	□	▣	□	□
White hake *Urophycis tenuis*	A	□	□	▣	□	□
	S	▣	▣	□	□	□
	J	□	□	▣	□	□
	L	□	▣	□	□	▣
	E	□	▣	□	□	▣
Mummichog *Fundulus heteroclitus*	A	■	▣	▣	▣	■
	S	▣	□	□	□	▣
	J	■	▣	▣	▣	■
	L	▣	□	□	□	▣
	E	▣	□	□	□	□
Silversides *Menidia* species	A	▣	▣	■	▣	▣
	S	▣	□	□	□	▣
	J	▣	▣	■	▣	▣
	L	▣	▣	□	□	▣
	E	▣	□	□	□	▣
Fourspine stickleback *Apeltes quadracus*	A	▣	□	□	□	▣
	S	▣	□	□	□	▣
	J	▣	□	□	□	▣
	L	▣	□	□	□	▣
	E	▣	□	□	□	▣
Threespine stickleback *Gasterosteus aculeatus*	A	▣	□	□	□	▣
	S	▣	□	■	□	□
	J	▣	□	□	□	▣
	L	▣	□	■	□	□
	E	▣	□	■	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					
Ninespine stickleback	A	□	□	□	□	□	□
	S	□	□	□	□	□	□
Pungitius pungitius	J	□	□	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Northern pipefish	A	▣	□	□	□	▣	□
	M	▣	□	□	□	▣	□
Syngnathus fuscus	J	▣	□	□	□	▣	□
	L	▣	□	□	□	▣	□
Northern searobin	A	▣	□	□	□	▣	□
	S	▣	■	■	■	▣	▣
Prionotus carolinus	J	▣	□	□	□	▣	□
	L	▣	■	■	■	▣	▣
	E	▣	■	■	■	▣	▣
Grubby	A	▣	□	□	□	▣	▣
	S	□	□	□	□	□	□
Myoxocephalus aeneaus	J	▣	□	□	□	▣	▣
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Longhorn sculpin	A	■	□	□	□	■	▣
	S	▣	□	□	□	▣	□
Myoxocephalus octodecemspinosus	J	■	□	□	□	■	▣
	L	▣	□	□	□	▣	□
	E	▣	□	□	□	▣	□
Shorthorn sculpin	A	▣	□	□	□	▣	▣
	S	□	□	□	□	□	□
Myoxocephalus scorpius	J	▣	□	□	□	▣	▣
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Ninespine stickleback *Pungitius pungitius*	A	□	▣	□	□	□	■
	S	□	▣	□	□	□	□
	J	□	▣	□	□	□	■
	L	□	▣	□	□	□	□
	E	□	▣	□	□	□	□
Northern pipefish *Syngnathus fuscus*	A	□	▣	□	□	□	▣
	M	□	▣	□	□	□	□
	J	□	▣	□	□	□	▣
	L	□	▣	□	□	□	□
Northern searobin *Prionotus carolinus*	A	▣	▣	▣	□	□	□
	S	▣	▣	▣	▣	▣	▣
	J	▣	▣	▣	□	□	□
	L	▣	▣	▣	▣	▣	▣
	E	▣	▣	▣	▣	▣	▣
Grubby *Myoxocephalus aeneaus*	A	▣	▣	▣	▣	▣	□
	S	□	□	□	□	□	□
	J	▣	▣	▣	▣	▣	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Longhorn sculpin *Myoxocephalus octodecemspinosus*	A	▣	■	▣	□	□	□
	S	▣	■	□	□	□	□
	J	▣	■	▣	□	□	□
	L	▣	■	□	□	□	□
	E	▣	■	□	□	□	□
Shorthorn sculpin *Myoxocephalus scorpius*	A	▣	▣	▣	□	□	□
	S	▣	▣	□	□	□	□
	J	▣	▣	▣	□	□	□
	L	▣	▣	□	□	□	□
	E	▣	▣	□	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Ninespine stickleback *Pungitius pungitius*	A	▣	□	□	□	□
	S	▣	□	■	□	▣
	J	▣	□	□	□	□
	L	▣	□	■	□	▣
	E	▣	□	■	□	▣
Northern pipefish *Syngnathus fuscus*	A	□	□	▣	□	■
	M	▣	□	□	□	□
	J	□	□	▣	□	■
	L	□	□	□	□	▣
Northern searobin *Prionotus carolinus*	A	□	□	■	□	▣
	S	□	□	□	□	▣
	J	□	□	■	□	▣
	L	□	▣	□	□	▣
	E	□	▣	□	□	▣
Grubby *Myoxocephalus aeneaus*	A	■	□	▣	▣	▣
	S	▣	□	□	□	▣
	J	■	□	▣	▣	▣
	L	■	□	□	□	▣
	E	▣	□	□	□	▣
Longhorn sculpin *Myoxocephalus octodecemspinosus*	A	□	□	■	□	□
	S	□	□	▣	□	▣
	J	□	□	■	□	□
	L	□	▣	▣	□	▣
	E	□	□	▣	□	▣
Shorthorn sculpin *Myoxocephalus scorpius*	A	□	□	▣	□	□
	S	□	□	□	□	□
	J	□	□	▣	□	□
	L	□	□	□	□	□
	E	□	□	□	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
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	▣	■	■	■	▣	▣
Scup	A	▣	▣	▣	▣	▣	▣
	S	▣	■	■	■	▣	▣
Stenotomus chrysops	J	▣	▣	▣	▣	▣	▣
	L	▣	■	■	■	▣	▣
	E	▣	■	■	■	▣	▣
Tautog	A	▣	□	□	□	□	□
	S	▣	□	□	□	□	□
Tautoga onitis	J	▣	□	□	□	□	□
	L	▣	□	□	□	□	□
	E	▣	□	□	□	□	□
Cunner	A	□	□	□	□	□	□
	S	□	□	□	□	□	□
Tautogolabrus adspersus	J	□	□	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
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	▣	▣	▣	■	■	■
Scup *Stenotomus chrysops*	A	▣	■	▣	□	□	□
	S	▣	■	▣	■	■	■
	J	▣	■	▣	□	□	□
	L	▣	■	▣	■	■	■
	E	▣	■	▣	■	■	■
Tautog *Tautoga onitis*	A	□	□	□	□	□	□
	S	□	□	□	□	□	□
	J	□	□	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Cunner *Tautogolabrus adspersus*	A	□	▣	□	□	□	□
	S	□	□	□	□	□	□
	J	▣	▣	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
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	■	■	■	■	■
Scup	A	▣	▣	▣	□	▣
	S	■	■	□	▣	□
Stenotomus chrysops	J	▣	▣	▣	□	▣
	L	▣	■	▣	▣	□
	E	▣	■	□	▣	□
Tautog	A	□	□	▣	□	□
	S	□	□	▣	□	□
Tautoga onitis	J	□	□	▣	□	□
	L	□	□	▣	□	□
	E	□	□	▣	□	□
Cunner	A	▣	□	▣	□	▣
	S	□	□	□	□	□
Tautogolabrus adspersus	J	▣	□	▣	□	▣
	L	▣	□	□	□	□
	E	▣	□	□	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
Ocean pout	A	□	□	□	□	□	□
	S	□	□	□	□	□	□
Macrozoarces americanus	J	□	□	□	□	□	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Rock gunnel	A	▣	□	□	□	■	▣
	S	□	□	□	□	□	□
Pholis gunnelus	J	▣	□	□	□	■	▣
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
American sand lance	A	▣	□	□	□	▣	□
	S	□	□	□	□	□	□
Ammodytes americanus	J	▣	□	□	□	▣	□
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Atlantic mackerel	A	▣	□	□	□	▣	□
	S	▣	□	□	□	▣	▣
Scomber scombrus	J	▣	□	□	□	▣	□
	L	□	□	□	□	▣	▣
	E	□	□	□	□	▣	▣
Butterfish	A	▣	□	□	□	▣	□
	S	□	□	□	□	□	▣
Peprilus triacanthus	J	▣	□	□	□	▣	□
	L	□	□	□	□	□	▣
	E	□	□	□	□	□	▣
Windowpane	A	▣	□	□	□	▣	□
	S	▣	□	□	□	▣	□
Scopthalmus aquosus	J	▣	□	□	□	▣	▣
	L	▣	□	□	□	▣	□
	E	▣	□	□	□	▣	□
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
Ocean pout	A	☐	▣	☐	☐	☐	☐
	S	☐	▣	☐	☐	☐	☐
Macrozoarces americanus	J	☐	▣	☐	☐	☐	☐
	L	☐	▣	☐	☐	☐	☐
	E	☐	▣	☐	☐	☐	☐
Rock gunnel	A	▣	■	▣	☐	☐	☐
	S	▣	■	▣	☐	☐	☐
Pholis gunnelus	J	▣	■	▣	☐	☐	☐
	L	▣	■	▣	☐	☐	☐
	E	▣	■	▣	☐	☐	☐
American sand lance	A	▣	▣	▣	☐	☐	☐
	S	☐	☐	☐	☐	☐	☐
Ammodytes americanus	J	▣	▣	▣	☐	☐	☐
	L	☐	☐	☐	☐	☐	☐
	E	▣	☐	☐	☐	☐	☐
Atlantic mackerel	A	▣	■	▣	☐	☐	☐
	S	▣	▣	▣	▣	▣	▣
Scomber scombrus	J	▣	■	▣	☐	☐	☐
	L	▣	▣	▣	☐	☐	☐
	E	▣	▣	▣	☐	☐	☐
Butterfish	A	▣	▣	▣	☐	☐	☐
	S	▣	▣	▣	▣	▣	■
Peprilus triacanthus	J	▣	▣	▣	☐	☐	☐
	L	▣	▣	▣	☐	☐	☐
	E	▣	▣	▣	☐	☐	☐
Windowpane	A	▣	■	▣	☐	☐	☐
	S	▣	▣	☐	☐	☐	☐
Scopthalmus aquosus	J	▣	■	▣	☐	☐	☐
	L	▣	▣	☐	☐	☐	☐
	E	▣	▣	☐	☐	☐	☐
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

☐ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
Ocean pout	A	□	▣	▣	□	▣
	S	▣	■	□	□	▣
Macrozoarces americanus	J	□	▣	▣	□	▣
	L	▣	■	□	□	□
	E	▣	■	□	□	□
Rock gunnel	A	▣	□	▣	□	□
	S	□	▣	□	□	□
Pholis gunnelus	J	▣	□	▣	□	□
	L	□	□	□	□	■
	E	□	□	□	□	□
American sand lance	A	□	▣	▣	□	▣
	S	□	□	□	□	□
Ammodytes americanus	J	□	▣	▣	□	▣
	L	▣	▣	□	□	□
	E	□	□	□	□	□
Atlantic mackerel	A	□	▣	■	▣	▣
	S	■	▣	□	□	□
Scomber scombrus	J	□	▣	■	▣	▣
	L	□	▣	□	□	▣
	E	□	▣	□	□	▣
Butterfish	A	□	□	▣	□	▣
	S	■	■	□	□	▣
Peprilus triacanthus	J	□	□	▣	□	▣
	L	▣	□	□	□	▣
	E	▣	□	□	□	▣
Windowpane	A	▣	□	■	□	■
	S	▣	□	▣	□	▣
Scopthalmus aquosus	J	▣	□	▣	▣	■
	L	▣	□	▣	□	▣
	E	▣	□	▣	□	▣
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
American plaice *Hippoglossoides platesoides*	A	▣	☐	☐	☐	▣	▣
	S	▣	☐	☐	☐	▣	☐
	J	☐	☐	☐	☐	☐	☐
	L	▣	☐	☐	☐	▣	☐
	E	▣	☐	☐	☐	▣	☐
Winter flounder *Pleuronectes americanus*	A	▣	☐	☐	☐	▣	▣
	S	▣	☐	☐	☐	▣	☐
	J	▣	☐	☐	☐	▣	▣
	L	▣	☐	☐	☐	▣	☐
	E	▣	☐	☐	☐	▣	☐
Yellowtail flounder *Pleuronectes ferrugineus*	A	▣	▣	▣	▣	▣	▣
	S	☐	☐	☐	☐	☐	☐
	J	▣	▣	▣	▣	▣	▣
	L	☐	☐	☐	☐	☐	☐
	E	☐	☐	☐	☐	☐	☐
Smooth flounder *Pleuronectes putnami*	A	☐	☐	☐	☐	☐	☐
	S	☐	☐	☐	☐	☐	☐
	J	☐	☐	☐	☐	☐	☐
	L	☐	☐	☐	☐	☐	☐
	E	☐	☐	☐	☐	☐	☐
		Passamaquoddy Bay	Englishman/ Machias Bays	Narraguagus Bay	Blue Hill Bay	Penobscot Bay	Muscongus Bay
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

☐ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries					
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
American plaice	A	▣	■	▣	□	□	□
	S	▣	■	□	□	□	▣
Hippoglossoides platesoides	J	□	■	□	□	□	□
	L	□	■	□	□	□	□
	E	▣	▣	□	□	□	□
Winter flounder	A	▣	■	▣	▣	▣	▣
	S	□	□	□	□	□	□
Pleuronectes americanus	J	▣	■	▣	▣	▣	▣
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
Yellowtail flounder	A	▣	■	▣	□	□	□
	S	□	■	□	□	□	□
Pleuronectes ferrugineus	J	▣	■	▣	□	□	▣
	L	□	■	□	□	□	□
	E	□	■	□	□	□	□
Smooth flounder	A	□	□	□	□	□	▣
	S	□	□	□	□	□	□
Pleuronectes putnami	J	□	□	□	□	□	▣
	L	□	□	□	□	□	□
	E	□	□	□	□	□	□
		Damari-scotta River	Sheepscot River	Kennebec/ Andro-scoggin Rivers	Casco Bay	Saco Bay	Wells Harbor
		North Atlantic Estuaries					

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Table 6 (continued). Data reliability

Species/Life Stage		North Atlantic Estuaries				
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
American plaice *Hippoglossoides platesoides*	A	□	□	■	▣	▣
	S	▣	▣	▣	□	▣
	J	□	□	■	□	▣
	L	□	□	□	□	▣
	E	□	□	□	□	▣
Winter flounder *Pleuronectes americanus*	A	▣	▣	■	▣	▣
	S	▣	▣	▣	□	▣
	J	▣	▣	■	▣	▣
	L	■	▣	□	□	■
	E	▣	▣	□	□	■
Yellowtail flounder *Pleuronectes ferrugineus*	A	▣	▣	■	▣	▣
	S	■	▣	□	□	□
	J	▣	▣	■	▣	▣
	L	▣	□	□	□	▣
	E	▣	□	□	□	▣
Smooth flounder *Pleuronectes putnami*	A	▣	□	□	□	□
	S	□	□	□	□	□
	J	▣	□	□	□	□
	L	□	□	□	□	□
	E	□	□	□	□	□
		Great Bay	Merrimack River	Massa-chusetts Bay	Boston Harbor	Cape Cod Bay
		North Atlantic Estuaries				

Data Reliability

■ Highly Certain

▣ Moderately Certain

□ Reasonable Inference

Life Stage

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

Appendices

Appendix 1. National Estuarine Inventory map of Penobscot Bay

Appendix 2. Estuary notes

Appendix 3. Species life history notes

Appendix 4. Table of references and personal communications

Appendix 5. Reviewers and personal communications

Appendix 6. References

Appendix 1. National Estuarine Inventory map of Penobscot Bay

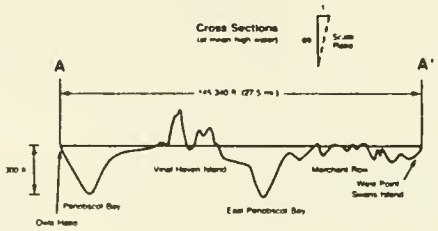
National Estuarine Atlas

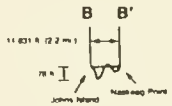
PHYSICAL AND HYDROLOGIC CHARACTERISTICS

PHYSICAL		FRESHWATER INFLOW		TIDAL DATA		
Surface Areas (km²)		Flow Rates (1000 cfs)		Prevailing Tide: Semidiurnal		
Fluvial Drainage	8,240	Period of Record	1903 1980	Total Prism (m³)	9.9x10¹⁰	
Estuarine Drainage	3,180			Phase Range of Tide (ft)		
Estuarine Zones		Long Term Average Daily	18.1	Map Km	Season	Range
Tidal Fresh	45	Long Term Average Monthly	J 10.6	A	767	13.0
Mixing Zone	70		F 9.5	B	761	12.9
Seawater	248		M 14.7	C	766	9.9
Total	363		A 61.5	D	745	10.0
Observations			M 25.8	E	731	10.0
Length (km)	62.9		J 18.1	F	773	9.6
Width (km) Average	7.8	7 Day 10 Year Low Flow	9.7			
Minimum	0.7	50 Year Flood	151.0			
Maximum	27.5	100 Year Flood	144.0			
Average Depth (m)	7.1	Flow Ratios				
Average Depth in Main River	1.6x10⁷	Average Annual	0.107			
Stability (mean Classification)		High Flow Period	0.013			
3 Month High Flow	MS	Low Flow Period	0.004			
3 Month Low Flow	MS					

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

Cross Sections (at mean high water)



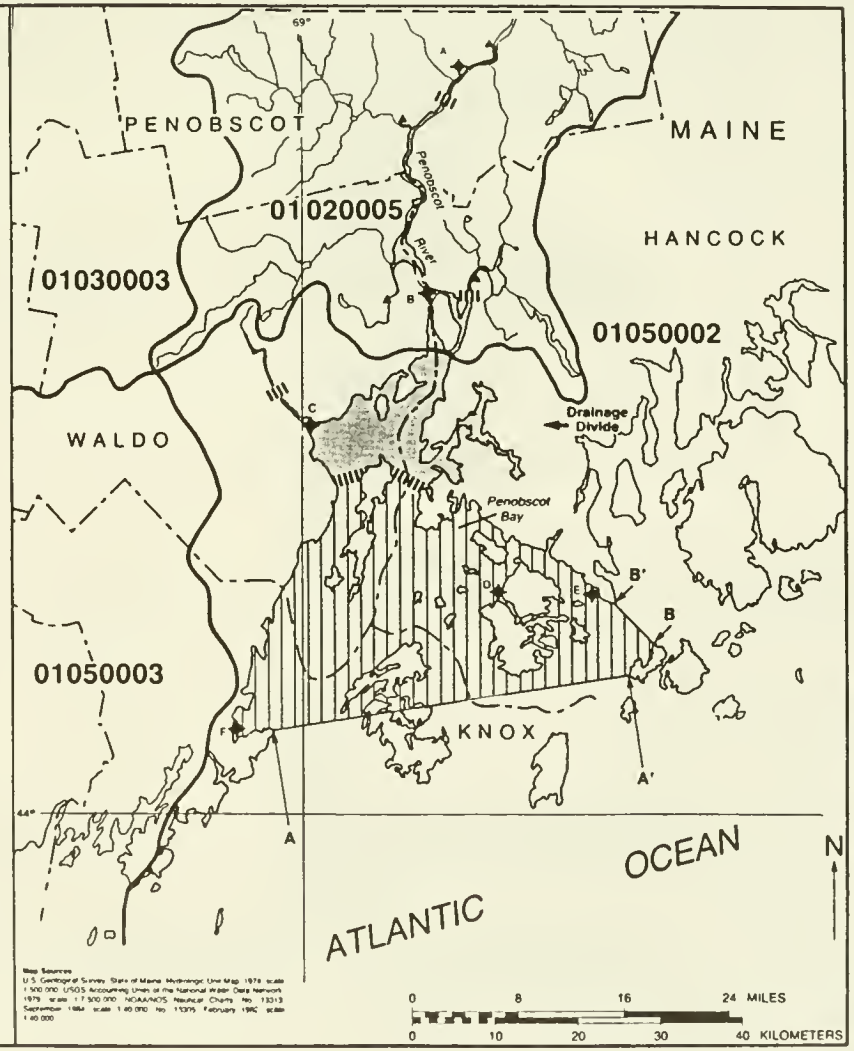


Notes

Approximately 50% 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.

References

Fink, et al., 1980. Fontaine, 1978. Fontaine, 1981. Fontaine, 1982. Haefner, 1967. Hatch, 1971. Morrill, 1975. Morrill et al., 1982. Murrhead and Wartha, 1971. Parker, 1978. U.S. Department of Commerce, 1983a.



Map Sources: U.S. Geological Survey, State of Maine Hydrologic Unit Map, 1979, scale 1:500,000; USGS Accounting Units of the National Water Data Network, 1979, scale 1:7,500,000; NOAA/NOS Nautical Charts No. 13313 September 1984, scale 1:40,000; No. 13375 February 1986, scale 1:40,000.

Penobscot Bay
ME

- 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

1.05

Appendix 2. Estuary notes

Compared to the Atlantic coast south of Cape Cod, estuaries in the North Atlantic region have colder and deeper waters, little seasonal variation in temperature, significant freshwater inflow from only a few large rivers (Figure 9), stronger tides, and a predominantly cold-temperate fauna (Gosner 1971, TRIGOM-PARC 1974, Berrill and Berrill 1981, NOAA 1990, Anonymous 1991, Ayvazian et al. 1992). The Gulf of Maine consists of a deep central basin enclosed by Georges Bank, with water circulating counterclockwise through the gulf; entering through the Northeast Channel and Browns Bank and exiting via Great South Channel and Nantucket Shoals. The northern coastline is mostly rocky, consisting primarily of granite, schist, and gneiss. In many regions the consolidated rocks are overlaid by glacial till, or sand/gravel deposits. The estuaries of this area are dominated by submerged, glacier-scoured river valleys with unmodified mouths, but there are some exceptions (e.g., Boston Harbor, Wells Harbor). Tides are semidiurnal and peak freshwater inflow occurs during April and May due to the spring runoff. Average precipitation across the region is 40-46 inches/yr. Cape Cod is generally considered to be the biogeographic boundary between the Virginian province to the south and the Scotian province to the north (Briggs 1974). However, it is considered to act as a "selective filter" rather than an absolute barrier (Gosner 1971) because many of the cold-temperate, boreal fauna that dominate the North Atlantic have ranges extending south of the cape and several eurythermal migrants from the south enter the Gulf of Maine seasonally.

For a general description of the physical and hydrological characteristics of individual estuaries the reader is referred to NOAA 1985, NOAA 1990, Anonymous 1991, and Larsen and Dogget 1976. Average daily flow is one of the primary determinants of the salinity distribution and stratification in each system, while surface area and depth (approximated at mean tide level) describe the relative size of the estuaries (NOAA 1990, NOAA 1993). The Penobscot, Kennebec/Androscoggin, Merrimack and St. Croix (Passamaquoddy Bay) Rivers have the highest average daily freshwater inflow and contribute more fresh water to the Gulf of Maine than the remaining thirteen watersheds combined (Figure 9). Massachusetts and Cape Cod bays have the highest average depth and surface area, however, several of the eastern Maine systems (e.g., Penobscot, Blue Hill, and Passamaquoddy bays) are also comparatively large. The comparatively smaller systems (e.g., Wells Harbor, Great Bay, and Merrimack River) occur in the midwestern portion of the Gulf of Maine (Figure 9). To assist in the interpretation of ELMR data, unique features of certain estuaries and the rationale for their inclusion to our database are presented below. Modifications to specific National Estuarine Inventory (NEI) maps (NOAA 1985) are also listed; however, a more complete revision of the NEI is in progress.

- **Passamaquoddy Bay:** Extremely strong tidal currents make the salinity zone boundaries highly variable within the system. Intrusion of lower Bay of Fundy water often makes Passamaquoddy Bay warmer than neighboring systems just to the west, and causes certain biological processes (e.g., herring spawning) to occur earlier than in those estuaries (Thomas 1983). Refer to NEI map 1.01 (Passamaquoddy Bay) and NOAA charts # 13328 or 13398 for more information.

- **Penobscot Bay:** According to regional hydrological work, the seawater zone boundary should be relocated in NEI map 1.05 (Penobscot Bay) to the area between Fort Point and West Penobscot (Normandeau 1975). Refer to NOAA chart #13309 for help in locating these landmarks.

- **Damariscotta River:** This system was differentiated from the large estuary depicted in NEI map 1.07 (Sheepscot Bay) due to its distinct hydrology. A small tidal fresh zone is usually present just below the head of tide dam at Damariscotta Mills. Manual closure of the dam's sluiceway during exceptionally dry seasons, however, may result in the disappearance of the freshwater lens. McAlice (1977) provides the only detailed hydrological information for the estuary. The system's seaward boundary is a straight line from Pemaquid Point to Ocean Point. Refer to NOAA chart #13293 for help in locating the landmarks mentioned.

- **Sheepscot River:** This system was differentiated from the estuary depicted in original NEI map 1.07 (Sheepscot Bay) due to its distinct hydrology. It is separated from the Kennebec/Androscoggin estuary by Upper Hell Gate on the Sasanoa River and by the marshland at the southern end of Hockomock Bay. Also, in the original NEI, the seawater zone is erroneously drawn through the entire Back River/Montsweag Bay branch. Hydrographic data from Maine Yankee Nuclear Power Company (1978) and Stickney (1959) indicate that brackish water fills most of this system, from Bailey Point southward through Knubble Bay. Paradoxically, the seawater zone extends up through the lower Sheepscot River mainstem, as indicated in the NEI. The Back River/Montsweag Bay complex exhibits lower salinities because it is diluted from Kennebec water entering through the Sasanoa River. Head of tide is at the dam in Head Tide village and the system's seaward boundary is a line from Ocean Point to Cape Newagen to Indian Point. Refer to NOAA chart #13293 for help in identifying the landmarks mentioned.

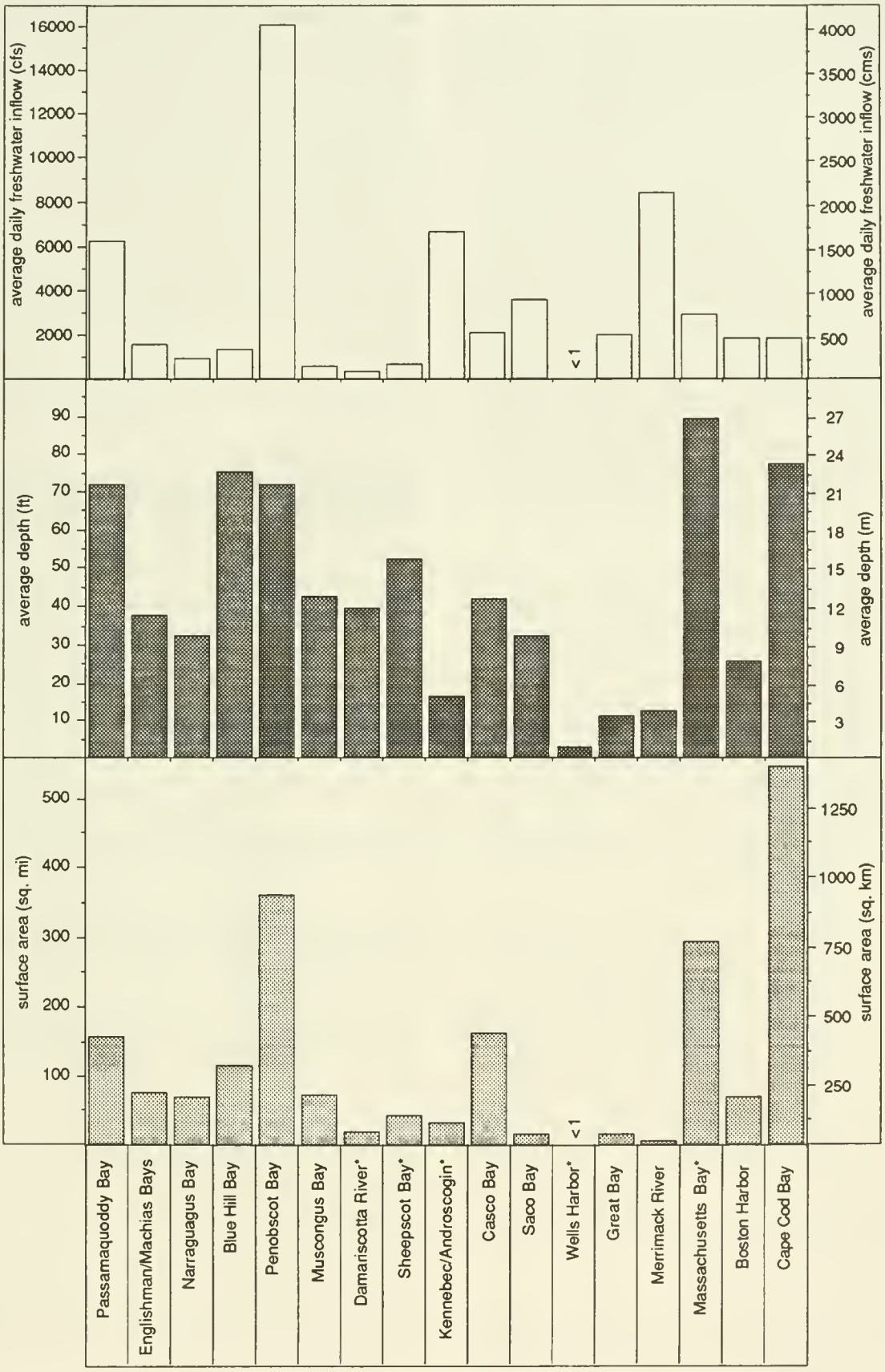


Figure 9. Average flow, depth, and surface area of North Atlantic estuaries. (NOAA 1990, NOAA 1993)
* additions to NEI (NOAA 1985)

• **Kennebec/Androscoggin Rivers:** This system was differentiated from the large estuary depicted in original NEI map 1.07 (Sheepscot Bay) due to its distinct hydrology. It is separated from the Sheepscot estuary by Upper Hell Gate on the Sasanoa River and by the marshland at the southern end of Hockomock Bay. In addition, the seawater and mixing zones of the Kennebec/Androscoggin Rivers are incorrectly depicted in the NEI as extending through Merrymeeting Bay. Squiers (1990) indicates that the huge volume of fresh water emanating from these systems creates a tidal freshwater lens extending through the bay to just above Chops Point. Furthermore, Larsen and Doggett (1976) report that the bottom salinity just 7 miles from the river mouth was 24 ppt in August (low flow season). This suggests that the mixing zone extends through most of the lower Kennebec, from Merrymeeting Bay to Squirrel Point. Head of tide is at the dam in Augusta, and the system's seaward boundary is a straight line from Indian Point to Small Point. Refer to NOAA chart #13293 for help in identifying the landmarks mentioned.

• **Wells Harbor**: Although this estuary is relatively smaller than the other North Atlantic estuaries considered, it was added to the NEI due to its importance as a National Estuarine Research Reserve. We consider the Wells Harbor system to consist of the Webhannet and Little River watersheds (Ayvazian et al. 1992, Ward 1993). These are both shallow, bar-built systems connected by a small marsh behind Laudhaum Beach. Both seawater (> 25 ppt) and mixing zones (0.5-25 ppt) were considered to be present for the ELMR analysis, however, a tidal fresh zone was not included due to its relatively small surface area. Refer to NOAA chart #13286 for more information.

• **Merrimack River:** This estuary is not considered to have a seawater zone according to NEI map 1.11 (Merrimack River) due to the extreme fluctuations in salinity at its shallow mouth. Species diversity is highest closest to the marine waters just outside of the mixing zone, which can range from 25 to 5 ppt over a tidal cycle. The primary habitats in the mixing zone are tidal flats and the daily freshwater inflow is relatively high. Changes from the original NEI map are that the mixing zone is considered to extend from the mouth of the river to Pow Pow River, and that the head of tide is now considered to be approximately 3000 m north of Haverill. Refer to NOAA chart #13282 or 13274 for help in identifying these landmarks.

• **Massachusetts Bay, Boston Harbor and Cape Cod Bay**: NEI map 1.12 (Boston Bay) shows the delineation for Boston Harbor and NEI map 1.13 shows Cape Cod Bay. Due to its regional importance and distinct hydrography, Massachusetts Bay was added to the ELMR database with Boston Harbor considered as a sub-estuary of this system. Massachusetts Bay and Cape Cod Bay are considered to be large seawater embayments functioning as estuaries. We realize that there are undoubtedly small mixing and tidal fresh zones in the areas not included in the NEI delineations, but these are not considered due to their relatively small surface areas. The larger Massachusetts Bay "ecosystem" is sometimes considered to include Massachusetts Bay proper, Boston Harbor and Cape Cod Bay with some of the freshwater inflow coming from the Merrimack River (Townsend et al. 1991). These three areas are separated to present the fisheries information on a somewhat finer scale. For ELMR purposes, Massachusetts Bay is considered to be the area from the mouth of Boston Harbor to a line drawn from Eastern Point of Gloucester Harbor to Brant Rock to the south. Refer to NOAA chart #13267 for help in identifying these landmarks.

Literature Cited

Anonymous. 1991. Estuary profile series. Maine Coastal Program, Maine State Planning Office, Augusta, ME.

Ayvazian, S.G., L.A. Deegan, and J.T. Finn. 1992. Comparison of habitat use by estuarine fish assemblages in the Acadian and Virginian zoogeographic provinces. Estuaries 15(3):368-383.

Berril, M., and D. Berril. 1981. A Sierra Club naturalist's guide to the North Atlantic coast: Cape Cod to Newfoundland. Sierra Club Books, San Francisco, CA. 464 p.

Briggs, J.C. 1974. Marine zoogeography. McGraw Hill series in population biology. McGraw Hill Book Co., New York, NY. 475 p.

Gosner, K.L. 1971. Guide to identification of marine and estuarine invertebrates: Cape Hatteras to the Bay of Fundy. John Wiley and Sons, Inc., New York, NY. 693 p.

Larsen, P.F., and L.F. Doggett. 1976. The salinity and temperature distributions of selected Maine estuaries. Bigelow Laboratory Contrib. No. 2-76 . Maine State Planning Office, Maine Coastal Program, Augusta, ME.

McAlice, B.J. 1977. A preliminary oceanographic survey of the Damariscotta River estuary, Lincoln County, Maine. Univ. Maine, Ira C. Darling Center, Walpole, ME. 17 p.

Maine Yankee Power Company. 1978. Final report: environmental surveillance and studies at the Maine Yankee Nuclear Generating Station 1969-1977. Maine Yankee Atomic Power Company, Wiscassett, ME.

NOAA (National Oceanic and Atmospheric Administration). 1985. National Estuarine Inventory: Data atlas, Vol. 1: Physical and hydrologic characteristics. Strategic Assessment Branch, NOAA/NOS, Rockville, MD. 103 p.

NOAA. 1990. Estuaries of the United States: Vital statistics of a national resource base. Strategic Assessment Branch, NOAA/NOS, Rockville, MD. 79 p.

NOAA. 1993. Unpublished data. Strategic Environmental Assessments Division, NOAA/NOS, Silver Spring, MD.

Normandeau Associates, Inc. 1975. Environmental survey of upper Penobscot Bay, Maine. Unpublished data. Annual report for Central Maine Power. Central Maine Power, Augusta, ME. 300 p.

Squiers, T.S. 1990. Kennebec River anadromous fish restoration: Annual progress report 1990. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 31 p.

Stickney, A.P. 1959. Ecology of the Sheepscot River Estuary. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fisheries No. 309. 21 p.

Thomas, M.L.H. (ed.). 1983. Marine and coastal systems of the Quoddy Region, New Brunswick. Can. Spec. Publ. Fish. Aquat. Sci. 64. 306 p.

Townsend, D.W., L.M. Cammen, J.P. Christensen, S.G. Ackleson, M.D. Keller, E.M. Haugen, S. Corwin, W.K. Bellows, and J.F. Brown. 1991. Seasonality of oceanographic conditions in Massachusetts Bay: Final report. Bigelow Lab. Ocean Sci. Tech. Rep. No. 83. Submitted to Massachusetts Water Resources Authority, Boston, MA. 109 p.

TRIGOM-PARC. 1974. A socio-economic and environmental inventory of the North Atlantic region-including the outer contintental shelf and adjacent waters from Sandy Hook, New Jersey, to Bay of Fundy. Volume 1, Book 3. The Research Institute of the Gulf of Maine, as partial fulfillment of contract 08550-CT3-8. U.S. Bureau of Land Management, Marine Minerals Division, S. Portland, ME.

Ward, L.G. 1993. Precipitation, streamflow and water characteristics (physical and chemical) of the Webhannet River estuary, Wells, Maine. Draft Final Report. Jackson Estuarine Lab, Univ. New Hampshire, Durham, NH.

Appendix 3. Species life history notes

The five "typical" life stages considered by the ELMR program were adults (A), spawning adults (S), juveniles (J), larvae (L), and eggs (E). *Adults* were defined as reproductively mature individuals, *Juveniles* as immature but otherwise similar to adults, *Spawning* adults as those releasing eggs and sperm, *Larvae* as the early developmental stage(s) from hatching to a form resembling the adult, and *Eggs* as the early developmental stage from spawning to hatching. The complex life histories of some species, and the subsequent difficulty in placing them into a comprehensive classification scheme, necessitate the following supplementary information when there was deviation from the typical categorization (e.g., ovoviviparous reproduction in spiny dogfish).

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

• **Blue mussel:** *Mytilus edulis* is common on hard substrates in intertidal and subtidal beds throughout the Gulf of Maine. The reproductive cycle may vary significantly between years, and larvae may settle out at low levels throughout the year in certain areas. High winter mortality occurs in some years and locations (Newell 1989).

• **Sea scallop:** *Placopecten magellanicus* is not regularly found in < 20 ppt and beds in estuarine areas tend to be patchy, especially compared to those further offshore (Mullen and Moring 1986, Shumway 1991). Eggs are buoyant and larvae remain pelagic for 4-6 weeks before settling to the bottom. Spawning is intermittent and a percentage may mature in one year in some areas.

• **American oyster:** *Crassostrea virginica* is also known as the Eastern oyster. It is present only in relatively warm subtidal or intertidal areas of a few estuaries in the study area. Northern Atlantic oysters may be a distinct physiological race with spawning temperature requirements (Sellers and Stanley 1984) different from those of Mid-Atlantic oysters. (*Ostrea edulis*, the European oyster, was not assessed in this study but it has been introduced to some areas of the Maine coast through mariculture projects.)

• **Northern quahog:** *Mercenaria mercenaria* is also known as the hard clam. Populations north of Massachusetts are small and patchy in relatively warm, high salinity (>20 ppt) areas. In the extreme northern populations, spawning success may be limited (Stanley and DeWitt 1984).

• **Softshell clam:** *Mya arenaria* usually spawns once a year in the northern Gulf of Maine, whereas southern populations have exhibited bimodal spawning. Settlement of seed clams tends to be very patchy and dependent upon hydrographic conditions and/or predation (Newell and Hidu 1986). Mortality of eggs, larvae, and seed clams is extremely high. Larvae are less tolerant of low salinities than adults. Its northern range is limited by water temperature that must be >12-15°C for successful spawning. In some areas (e.g., Machias Bay) artificial seeding programs may temporarily increase the abundance of juveniles.

• **Daggerblade grass shrimp:** *Palaemonetes pugio* is also known as the grass shrimp. It is most abundant locally in vegetated habitats of warm bays. Soon after mating, females fertilize and extrude eggs onto their pleopods where they are held for up to two months until hatching as larvae (Williams 1984). This species may be confused or grouped with *P. vulgaris,* which is more boreal and prefers higher salinities than *P. pugio. P. pugio* is much more common south of Cape Cod. Juveniles mature early in their first year. For the purposes of the ELMR program, the spawning stage (S) is defined as the period of mating/fertilization/egg extrusion; the larval stage (L) consists of the protozoeal and zoeal stages; and the egg stage (E) refers to ovigerous females.

• **Northern shrimp:** *Pandalus borealis* is the most common species of its genus in the Gulf of Maine, but the closely related *P. propinquus* and *P. montagui* are also found in some areas. This species is hermaphroditic, maturing first as males to spawn in the summer at approximately 2.5 years, then passing through a series of transitional stages to spawn the next summer as females at 3.5 yr. Soon after mating in the summer/early fall, females fertilize and extrude eggs onto their pleopods, where they are held for several months until hatching as larvae the following spring (Haynes and Wigley 1969, Shumway et al. 1985). The bulk of the inshore fishery consists of berried females that have moved inshore in the fall and winter to release their larvae. The distribution of juveniles is largely unknown. For the purposes of the ELMR program, the spawning stage (S) is defined as the period of mating/fertilization/egg extrusion; the larval stage (L) consists of the protozoeal and zoeal stages; and the egg stage (E) is synonymous with ovigerous females.

• **Sevenspine bay shrimp:** *Crangon septemspinosa* is also known as the sand shrimp. It is the most common shallow water shrimp in the Gulf of Maine and is found primarily in eelgrass beds and sandy bottoms. This species exhibits seasonal movements from shallow to deeper water and is relatively inactive in the winter months. Soon after mating females fertilize and extrude eggs onto their pleopods, where they are held for approximately one month until hatching as larvae (Haefner 1979). There is some evidence showing two separate spawning periods in the northern part of its range (Corey 1987). For the purposes of the ELMR program, the spawning stage (S) is defined as the period of mating/fertilization/egg extrusion; the larval stage (L) consists of the protozoeal and zoeal stages; and the egg stage (E) is synonymous with ovigerous females.

• **American lobster:** *Homarus americanus* is found primarily in salinities >20 ppt (Cooper and Uzmann 1980, MacKenzie and Moring 1985). Eggs and larvae are less tolerant of low salinity than juveniles and adults. Mating typically occurs every other year for individual females, when the male places a spermatophore into a freshly molted female (but intermolt matings have been reported). Eggs are normally extruded 11-13 months later (MacKenzie and Moring 1985) and multiple fertilizations are possible from a single spermatophore. Eggs are carried 9-11 months and hatch in spring to early fall depending upon temperature. Berried females are present throughout the year but numbers may be lower in the summer as eggs are hatched and molting/mating is occurring. Pelagic larvae molt four times, then settle to bottom as early benthic phase lobsters with adult characteristics. For the purposes of the ELMR program, the spawning stage (S) is defined as the period of fertilization/egg extrusion; the larval stage (L) consists of the mysis and postlarval stages; and the egg stage (E) is synonymous with ovigerous (berried) females.

• **Jonah and Atlantic rock crabs**: *Cancer borealis* and *C. irroratus* are found primarily in salinities >20 ppt and are sometimes grouped together (Krouse 1980, Williams 1984). *Cancer irroratus* prefers sandy substrates and is usually in shallower water, whereas *Cancer borealis* prefers rockier substrates, is usually in deeper water, and is less tolerant of low salinities. Juvenile *C. borealis* are seldom recorded from inshore areas and are easily confused with juvenile *C. irroratus* (Williams and Wahle 1992). For the purposes of the ELMR program, the spawning stage (S) is defined as mating/fertilization/egg extrusion; the larval stage (L) consists of the zoeal and megalopal stages; and the egg stage (E) is synonymous with ovigerous (sponge) females.

• **Green crab:** *Carcinus maenas* is the most common shore crab found intertidally and subtidally in the Gulf of Maine down to at least 6 ppt. Abundance in mid-coast and northern Maine may be affected by interannual variations in temperature as this species nears the edge of its range. Mating typically occurs in the summer and/or fall and hatching of eggs occurs in the spring and/or summer (Berrill 1982, Williams 1984). For the purposes of the ELMR program, the spawning stage (S) is replaced by mating (M), which designates copulation only; the larval stage (L) consists of the zoeal and megalopal stages; and the egg stage (E) is synonymous with ovigerous (sponge) females.

• **Green sea urchin:** *Strongylocentrotus droehbachiensis* is usually not found in salinities < 29 ppt, however, it does occur intertidally as well as subtidally in the Gulf of Maine. Spawning seems to coincide with the spring phytoplankton bloom (Starr et al. 1990), but there is some anecdotal evidence suggesting more than one spawning event. Sperm and eggs are shed into the water where fertilization takes place. Within approximately 12 hours of fertilization, the blastula becomes ciliated and free swimming. Gastrulation ensues and a planktonic "echinopluteus" larvae develops and persists for up to 3-4 months. Late in the larval stage, usually early summer, the test begins to form and the echinopluteus sinks to the bottom as a settling juvenile that is < 1 mm in diameter. This settlement usually occurs over a 4-6 week period showing a peak of young-of-year juveniles (L. Harris, pers. comm.). Growth rates are highly variable and it takes approximately 1.5-3.5 years for individuals to reach maturity at >20 mm diameter. There may be some local migration to deeper water to overwinter but this species is primarily a slow moving, shallow water species in the Gulf of Maine (Himmelman et al. 1983). Harvesting of ripe animals for high quality roe has developed fairly recently and it is unclear how this fishery is impacting local populations (Chenoweth 1992).

Fishes. The use of salinity zones generally describes the spatial distribution of estuarine fishes. However, for some species a combination of habitat characteristics, such as bottom type, water temperature, bathymetry, etc., would more accurately indicate these distributions. Specific habitat requirements and life history characteristics of a number of fishes are presented below.

• **Spiny dogfish:** *Squalus acanthias* is a summer migrant to the Gulf of Maine, moving offshore in the winter and inshore in the summer. Catch statistics show high inter- and intra-annual variability due to their tendency to school by size and sex. Males and mature females are most common inshore. Spiny dogfish are long lived and ovoviviparous. Fecundity is low (2-15

pups after 18-22 month gestation) and the juvenile stage may last >10 years. Individual females produce young only in alternate years. In the Gulf of Maine, mating is assumed to occur in the colder months (Feb.-Mar.) offshore (Bigelow and Schroeder 1953, Nammack et al. 1985). It has also been suggested that females migrate into shallow water from November to January to bear their young (Jensen 1966, Nammack et al. 1985). Nonetheless, there are few recorded observations of parturition and/or mating, and the actual occurrence of these events in particular estuaries and embayments is somewhat questionable (Jensen 1966). We have reflected this uncertainty by assessing the mating and parturition stages as *no information available* in some systems. For the purposes of the ELMR program, the spawning stage refers to mating (M) and internal fertilization of eggs; and while no egg or larval stages are recognized, the egg stage (E) is replaced by parturition (P) data.

• **Skates:** The most common species of *Raja* in the inshore areas of the North Atlantic are little skate (*R. erinacea*), winter skate (*R. ocellata*), and barndoor skate (*R. laevis*). Thorny skate (*R. radiata*) and smooth-tailed skate (*R. senta*) are less commonly found (Bigelow and Schroeder 1953, Scott and Scott 1988). Skates are oviparous, and generally extrude egg cases shortly after fertilization. Spawning season differs between species. Most species tend to migrate in response to seasonal changes in temperature. For the purposes of the ELMR program, the spawning stage refers to mating (M) and internal fertilization of eggs and the egg stage (E) refers to the period from egg extrusion to hatching. Upon hatching, young skates are considered juveniles so there is no larval stage.

• **Shortnose and Atlantic sturgeons:** Shortnose sturgeon (*Acipenser brevirostrum*) is considered to be endangered throughout its range (USFWS 1993) and is protected in Massachusetts and New Hampshire (Johnson 1987). Atlantic sturgeon (*Acipenser oxyrhynchus*) is protected in Massachusetts (R. Iwanowicz pers. comm.) and is a species of special concern in New Hampshire and Maine (Johnson 1987). Both species are anadromous, occur primarily in large river systems, are slow growing, and long-lived. Spawning may occur in fresh or brackish water and presumably does not occur every year for individual females. Atlantic sturgeon eggs are demersal and adhesive, larvae drift downstream, and juveniles remain in fresh/brackish water for their first summer, then migrate seaward (Dadswell et al. 1984, Kieffer 1991) Little is known about juvenile stages, which are not caught by the large mesh gillnets used in most surveys. It is unknown if there is migration of adult shortnose sturgeon out of fresh/brackish water areas as is true for the Atlantic sturgeon. In some areas strays have been encountered (e.g., shortnose sturgeon in Cape Cod Bay), but are not considered to be regularly present.

• **American eel:** *Anguilla rostrata* is catadromous with spawning occurring in the Sargasso Sea in the spring (Facey and VanDenAvyle 1987). The early pelagic larvae, called "leptocephali," may spend over a year in marine waters before being transported shoreward. As the leptocephali reach the continental shelf, they begin their metamorphosis 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 the ELMR program, emigrating silver eels are considered to be adults (A); yellow eels and elvers are considered to be juveniles (J); and glass eels are considered to be larvae (L) (leptocephali are not regularly encountered in the coastal North Atlantic). We retain spawning (S) and egg (E) stages in our data presentation but stipulate that both occur only in offshore waters.

• **Blueback herring and alewife**: *Alosa aestivalis* and *A. pseudoharengus* are often grouped together as river herring. Spawning occurs in spring, with alewives breeding 3-4 weeks earlier than bluebacks in the same watershed. Spawning habitats also tend to differ, with alewives spawning in slow flowing sections of slightly brackish or freshwater, and bluebacks spawning in more lotic sites (Mullen et al. 1986, Loesch 1987). Alewives are usually more abundant than bluebacks in the northern Atlantic region. Adults typically return to sea after spawning, and may spawn repeatedly in their natal river. Habitat alteration resulting from dams and pollution have historically limited areas available for the spawning of anadromous species throughout New England, and thus many local stocks are reduced from previous levels. Stocking and habitat mitigation programs exist for several rivers to attempt the restoration of target species including river herring.

• **American shad:** *Alosa sapidissima* is an anadromous species with a strong natal homing tendency. Adults tend to spawn only once in the freshwater portions of rivers at the southern edge of its range. However, with increasing latitude, the mean age at first spawning increases, the number of eggs spawned decreases, and the number of spawnings per lifetime increase so that a large percentage are iteroparous in the Gulf of Maine. Young of the year spend their first summer in the river/estuary and then migrate to the ocean in the fall. Shad tend to school during their oceanic phase (Weiss-Glanz et al. 1986, Dadswell et al. 1987). Johnson (1987) listed shad as a species of special concern in Maine.

• **Atlantic menhaden:** *Brevoortia tyrannus* are also known as pogies, and are summer migrants to the North Atlantic region. Spawning generally occurs offshore and south of Cape Cod (Rogers and VanDen Avyle 1989), where larvae and juveniles move inshore and into estuaries. Juveniles are often highly abundant in estuarine waters south of Cape Cod. The spawning status north of Cape Cod is unclear, but it is assumed that primarily large adults move into the North Atlantic to feed. There is high intra- and interannual variability in the presence and abundance of this species, especially in northern areas.

• **Atlantic herring:** *Clupea harengus* migrate from feeding grounds along the Maine coast during fall, arriving in southern New England during winter (Kelly and Moring 1986). Larger individuals move further distances. Spawning begins earliest (late summer to early fall) in northern locations and progressively later westward and southward. Spawning occurs just outside the mouths of many North Atlantic estuaries/embayments (e.g., Massachusetts Bay, Saco Bay, Boothbay Harbor, Blue Hill Bay, Machias Bay) where demersal eggs are typically deposited on rocky or gravelly substrates. Larvae are dispersed to the estuaries/embayments upon hatching. Significant mortality occurs during this stage, presumably from predation and food limitation (Campbell and Graham 1991). Larvae become juveniles, called "brit herring," in the spring and form large schools inshore. During summer, the larger juveniles are harvested in a directed fishery as "sardines." Adults are also commercially harvested. The possibility of northern and southern breeding stocks within the Gulf of Maine is presently under investigation.

• **Atlantic salmon:** *Salmo salar* is anadromous. Spawning adults (S) occur in freshwater during the fall. Eggs (E) overwinter in a gravel nest, called a "redd," until they hatch in the spring as yolk-sac larvae (L), called "alevins." After yolk-sac absorption, the "fry" disperse from the redd. Juveniles (J), called "parr," remain in freshwater for 2-3 years and then mature into "smolts" which migrate to the sea. Some adults, called "grilse," spend one year feeding at sea before returning to their natal river to spawn. Other adults return after two or more winters at sea and are usually larger than grilse. Repeat spawners have also been recorded but are relatively uncommon in the North Atlantic (Danie et al. 1984, Friedland 1993). Salmon are stocked as fry, parr, and/or smolts in several rivers throughout the Gulf of Maine to attempt restoration of populations. The abundance of salmon in the North Atlantic region at present is extremely low. Although there have been documented returns of wild salmon—most notably in the Penobscot, Narraguagus, and Merrimack rivers (Anonymous 1993)—most of the populations mentioned in this report are assumed to be at least partially sustained by stocking.

• **Haddock:** *Melanogrammus aeglefinus* rarely enter salinities <30 ppt and generally avoid depths of < 9m. Juvenile haddock remain pelagic for several months before settling to the bottom. At present stocks are believed to be severely depleted compared to historic levels (NEFSC 1992).

• **Silver hake:** *Merluccius bilinearis* is also known as whiting. Migration is extensive, with overwintering in deeper waters of the Gulf of Maine and movement to shallow water in the spring to spawn. This report focuses upon the northern stock, although there is a southern stock south of Georges Bank which appears to have different seasonal migration patterns (NEFSC 1992).

• **Atlantic tomcod:** *Microgadus tomcod* is also known as frostfish. This semi-anadromous species spawns in fresh and brackish water, but the larvae can only develop in brackish water. Therefore, they drift seaward shortly after hatching so that larvae, and young of the year, are found primarily in the mixing zone (Stewart and Auster 1987).

• **Red and white hakes:** The early life stages of *Urophycis chuss* and *U. tenuis* are often not distinguished from each other in ichthyoplankton surveys. In the Gulf of Maine, adult *U. chuss* are more abundant than juveniles, whereas the reverse is true for *U. tenuis*. North of Cape Cod, *U. tenuis* appears to be the more abundant species. Depth distribution of both species varies by age and season, with younger juveniles tending to be in shallower areas (Musick 1974, Markle et al. 1982). Red hake juveniles often live within or around sea scallops (*Placopecten magellanicus*). In the North Atlantic, spawning of white hake has been variously described in the winter and spring, aperiodically throughout the year, and/or in the summer (Bigelow and Schroeder 1953, Markle et al. 1982). Clearly, the reproductive period is not well defined for estuaries in the Gulf of Maine and this is reflected in our assessment.

• **Mummichog**: The entire life cycle of *Fundulus heteroclitus* is completed within the estuary, and all life stages are euryhaline. One of the most abundant fishes in East Coast estuarine marsh habitats, *F. heteroclitis* often co-occurs in the North Atlantic with the less abundant *F. majalis*, particularly south of Massachusetts Bay. *F. heteroclitis* is relatively inactive and may move to deeper water in the winter months, but it is expected to be resident year-round in estuaries. Mummichogs may spawn more than 8 times in a season. The eggs incubate in air and are not sub-

merged until the next spring tide after they are laid (Abraham 1985).

• **Silversides:** *Menidia menidia* is the dominant species in the North Atlantic region but *M. beryllina* co-occurs in some systems. This species exhibits at least some seasonal migration to warmer waters in winter months. Spawning occurs primarily in the intertidal zone during high tide and seems to be dependent upon lunar phase and daylight (Fay et al. 1983a). Most silversides mature by age one and die after their first spawning, although a small percentage may live a second year. Early life history stages are not as euryhaline as the adults and juveniles.

• **Sticklebacks:** The threespine (*Gasterosteus aculeatus*), fourspine (*Apeltes quadracus*), and ninespine (*Pungitius pungitius*) are the most common stickleback species in the region and are sympatric. *Gasterosteus wheatlandii* may also be present in some areas and grouped with these sticklebacks. All of these species have highly plastic life histories, with anadromous and non-migratory populations often existing in the same estuarine systems. These species build nests and have highly ritualized breeding behaviors. Temperature and salinity can cause morphological variations. *A.quadracus* can be found in fresh water (Wooten 1976, Hardy 1978), but not as commonly as *G. aculeatus* or *P. pungitius*. Spawning usually occurs in brackish or fresh water for these species, but primarily in brackish water for *A. quadracus*. In all species, most individuals are mature by their first year of age. However, reproductive maturity is not recognized until the spring/early summer prior to breeding when temperature and/or photoperiod trigger this condition (Wooten 1976, Wooten 1984).

• **Northern pipefish:** Male pipefish (*Syngnathus fuscus*) brood their young. Upon hatching (about 10 days post-spawning), young pipefish are considered larvae until they reach a length of approximately 20 mm (Hardy 1978). It is assumed that pipefish move to deeper, warmer waters in winter (Bigelow and Schroeder 1953). For the purposes of the ELMR program, spawning refers to mating (M)(female places eggs into male's brood pouch) and the concomitant fertilization of eggs. The egg stage (E) was not considered in this study.

• **Longhorn and shorthorn sculpins**: Both *Myoxocephalus octodecemspinosus* and *M. scorpius* generally prefer salinities >25 ppt (Bigelow and Schroeder 1953, Scott and Scott 1988). Longhorns appear to be the more abundant of the two species in North Atlantic estuaries. Shorthorns tend to be restricted to relatively cold, shallow water, whereas the longhorn has a greater temperature and depth range. Nonetheless, there is considerable overlap in the habitats utilized by both species. There also seems to be some seasonal onshore-offshore movements, particularly by longhorns.

• **White perch**: Relative to the mid-Atlantic, few large populations of *Morone americana* occur in estuaries north of Cape Cod. Nonetheless, this species is abundant in many rivers, lakes and ponds throughout New England. Spawning occurs in fresh water above and below the head of tide, and in low salinity estuarine waters. Juveniles and adults typically remain within estuarine and freshwater areas throughout their lives. In the North Atlantic region, this species is only occasionally seen in the seawater zone, possibly in association with feeding movements. This species is not considered to be a regular component of this zone in the Gulf of Maine even though they are commonly found in higher salinities south of Cape Cod (Bigelow and Schroeder 1953, Stanley and Danie 1983).

• **Striped bass:** *Morone saxatilis* spawn in the spring in tidal freshwater where there is sufficient current. Most of the fish found in Gulf of Maine waters are suspected to spawn to the south in the Hudson River or Chesapeake Bay, but there is some evidence of limited spawning in some northern rivers (e.g., Kennebec/Androscoggin rivers) (Squiers 1990). Therefore, most of the striped bass in the North Atlantic seem to be involved in a coastal feeding migration, not a spawning migration. Females mature at 4-5 years old, whereas males do so at 2-3 years. Studies in the mid-Atlantic indicate that most juveniles remain in or near their natal rivers until they are mature. Consequently, most of the individuals in the North Atlantic are adults, and a large proportion of these may be female (Fay et al. 1983b, Boreman and Lewis 1987). Johnson (1987) listed striped bass as a species of special concern in Maine.

• **Bluefish:** Adult *Pomatomus saltatrix* are found in estuaries throughout the Gulf of Maine, but juveniles are primarily found south of Maine (Bigelow and Schroeder 1953). Schools migrate north to feed in the summer months and their distribution tends to be patchy, with high intra- and interannual variability. Spawning, egg and larval development occur primarily offshore and south of Cape Cod.

• **Tautog and cunner**: Both *Tautoga onitis* and *T. adspersus* are found in rocky areas, eelgrass beds, and other areas with significant habitat structure and tend to be solitary or in small groups. Both are also active daytime feeders and tend to be less active at night and in winter months. As the temperature decreases, both species become torpid within shelters and there is some movement to deeper water. This seasonal movement is greatest in adult tautogs (Olla et

al. 1974, Auster 1989). In general, cunner and juvenile tautogs have a home range of less than several hundred meters and are assumed to remain in a particular system even though they may be relatively "uncatchable" in the winter. These species are generally found in >25 ppt but both species occasionally enter brackish water. Competition for shelter may be a limiting factor in some areas. Tautog are much more common south of Massachusetts Bay. In the northern Gulf of Maine it is unclear if there are established populations of tautog, however, there are some reports of juveniles, eggs and larvae in systems as far north as Penobscot Bay (Alexander 1976, B. Blackwell, pers. comm.). It is possible that these are rare exogenous specimens that can survive during the warmer months of the year.

• **Ocean pout:** *Macrozoarces americanus* prefers sand/sand-gravel areas and depths of 15-80 m. In the late summer, they stop feeding and move to rocky areas to spawn in the early fall. They are typically unavailable to the fishery during this time, while they guard their eggs for the 2.5-3.5 month incubation period. Nonetheless, we assume that they are still present in the system even though their catchability is reduced. The southern stock is considered to extend from Cape Cod Bay south to Delaware, and a second stock from Cape Elizabeth east to the Bay of Fundy (NEFSC 1992).

• **Sand lance:** *Ammodytes americanus* are also called sand eels. This species may co-occur with *Ammodytes dubius* in some areas. Adults and juveniles can be found in <25 ppt, but tolerance of low salinity seems to decrease with increasing age. This species is difficult to sample due to its burrowing behavior and heavy schooling. Ichthyoplankton surveys suggest that spawning occurs primarily inshore, but there is some evidence of later offshore spawning. Demersal eggs are laid in, or on, sand or gravel. Spawning is seldom observed, but it is inferred from egg/larval presence and/or proper habitat. Larvae are planktonic for 2-3 months before settling and then burrowing into the bottom. Sand lance generally mature in 1-2 years (Bigelow and Schroeder 1953, Auster and Stewart 1986). Sampling indicates that peak abundance occurs in the summer months and that sand lance are rare to absent in many inshore areas in the winter. However, because most spawning occurs inshore in the winter, we assume that this species is present year-round in most of the systems studied, but simply unavailable to the sampling gear used.

• **American plaice and yellowtail flounder:** Both *Hippoglossoides platessoides* and *Pleuronectes ferrugineus* are primarily marine and caught in relatively deep water (Bigelow and Schroeder 1953). However, they can be common to highly abundant in seawater zones (>25 ppt) and just outside of many estuary mouths. *Hippoglossoides platessoides* is also known as dab.

• **Winter flounder:** *Pleuronectes americanus* is also called blackback or lemon sole. This species may move out of shallow areas in the summer months if waters become too warm (Buckley 1989). Demersal eggs are seldom mentioned in ichthyoplankton work, as is true of other species with demersal eggs. Although winter flounder are still one of the most important commercial species in the region and have dominated recent trawl surveys, historic data indicate that the Gulf of Maine population has waned considerably (NEFSC 1992).

Literature Cited

Abraham, B.J. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—mummichog and striped killifish. U.S. Fish Wildl. Serv. Biol. Rep. No. 82(11.40). 23 p.

Alexander, L.C. 1976. Fish survey of upper Penobscot Bay, Maine: September 1974-1975. Unpublished data. Environmental Studies Dept., Central Maine Power. 200 p.

Anonymous. 1993. Annual report of the U.S. Atlantic Salmon Assessment Committee. Rep. No. 5-1992 Activity. U.S. Atlantic Salmon Assessment Committee, Turner's Falls, MA.

Auster, P.J., and L.L. Stewart. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)-sand lance. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.66). 11 p.

Auster, P.J. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic and Mid-Atlantic)-tautog and cunner. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.105). 13 p.

Berrill, M. 1982. The life cycle of the green crab (*Carcinus maenus*) at the northern end of its range. J. Crustacean Biol. 2:31-39.

Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fish. Bull., U.S. 74(53). 577 p.

Boreman, J., and R.R. Lewis. 1987. Atlantic coastal migration of striped bass. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 331-339. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

Buckley, J. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—winter flounder. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.87). 12 p.

Campbell, D.E., and J.J. Graham. 1991. Herring recruitment in Maine coastal waters: an ecological model. Can. J. Fish. Aquat. Sci. 48:448-471.

Chenoweth, S. 1992. The green sea urchin in Maine, fishery and biology. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 8 p.

Cooper, R. A., and J.R. Uzmann. 1980. Ecology of juvenile and adult *Homarus*. *In*: Cobb, J.S., and B.F. Phillips (eds.), The biology and management of lobsters, Vol. II, Ecology and management, pp. 97-141. Academic Press.

Corey, S. 1987. Reproductive strategies and comparative fecundity of *Crangon septemspinosa* Say (Decapoda, Caridea). Crustaceana 52(1):25-28.

Dadswell, M.J., B.D. Taubert, T.S. Squiers, D. Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum*, LeSueur 1818. NOAA Tech. Rep. NMFS 14/FAO Fisheries Synopsis no. 140. 5 p.

Dadswell, M.J., G.D. Melvin, P.J. Williams, and D.E. Themelis. 1987. Influences of origin, life history, and chance on the Atlantic coast migration of American shad. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 313-330. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

Danie, D.S., J.G. Trial, and J.G. Stanley. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—Atlantic salmon. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.22). 19 p.

Facey, D.E., and M.J. Van Den Avyle. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American eel. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.74). 28 p.

Fay, C.W., R.J. Neves, and G.B. Pardue. 1983a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—Atlantic silverside. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.10). 15 p.

Fay, C.W., R.J. Neves, and G.B. Pardue. 1983b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—striped bass. U.S. Fish Wildl. Serv., Biol. Rep. No. 82 (11.8). 36 p.

Friedland, K. 1993. History of salmon fisheries and management in the North Atlantic. *In*: Ninth ICES dialogue meeting and the tenth annual meeting of the North Atlantic Salmon Conservation Organization: Briefing book. Balmorall Hotel, Edinburgh, Scotland. 125 p.

Haefner, P.A.J. 1979. Comparative review of the biology of north Atlantic Caridean shrimps (*Crangon*), with emphasis on *C. septemspinosa*. Bull. Biol. Soc. Wash. 3:1-40.

Hardy, J.D., Jr., (ed.). 1978. Development of fishes of the Mid-Atlantic bight: an atlas of egg, larval and juvenile stages. Vols. I-VI., U.S. Fish Wildl. Serv., FWS/OBS-78/12.

Haynes, E.B., and R. L. Wigley. 1969. Biology of the northern shrimp, *Pandalus borealis*, in the Gulf of Maine. Trans. Am. Fish. Soc. 98:60-76.

Himmelman, J.H., Y. Lavergne, F. Axelsen, A. Cardinal, and E. Bourget. 1983. Sea urchins in the Saint Lawrence Estuary: Their abundance, size-structure, and suitability for commercial exploitation. Can. J. Fish. Aquat. Sci. 40:474-486.

Jensen, A.C. 1966. Life history of the Spiny Dogfish. Fish. Bull., U.S. 65(3):527-554.

Johnson, J.E. 1987. Protected fishes of the United States and Canada. American Fisheries Society, Bethesda, MD.

Kelly, K.H., and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—Atlantic herring. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.38). 22 p.

Kieffer, M.C. 1991. Annual movements of Shortnose and Atlantic sturgeons in the lower Merrimack River. M.S. thesis, Univ. Massachusetts, Amherst, MA.

Krouse, J.S. 1980. Distribution and catch composition of Jonah crab, *Cancer borealis*, and rock crab, *Cancer irroratus*, near Boothbay Harbor, Maine. Fish Bull., U.S. 77(3): 685-693.

Loesch, J.G. 1987. Overview of life history aspects of anadromous alewife and blueback herring in freshwater habitats. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 89-103. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

MacKenzie, C., and J.R. Moring. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American lobster. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.33). 19 p.

Markle, D.F., D.A. Methven, and L.J. Coates-Markle. 1982. Aspects of spatial and temporal co-occurrence in the life history stages of the sibling hakes, *Urophycis chuss* (Waldbaum 1792) and *Urophycis tenuis* (Mitchill 1815) (Pisces: Gadidae). Can. J. Zool. 60:2057-2078.

Mullen, D.M., C.W. Fay, and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—alewife/blueback herring. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.56). 21 p.

Mullen, D.M., and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)- sea scallop. U.S. Fish Wildl. Serv. Biol. Rep. No. 82 (11.67). 13 p.

Musick, J.A. 1974. Seasonal distribution of sibling hakes, *Urophycis chuss* and *U. tenuis* (Pisces, Gadidae) in New England. Fish. Bull., U.S. 72(2):481-495.

Nammack, M.F., J.A. Musick, and J.A. Colvocoresses. 1985. Life history of spiny dogfish off the northeastern United States. Trans. Am. Fish. Soc. 114: 367-376.

Newell, R.I.E. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North and Mid-Atlantic)—blue mussel. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.102). 25 p.

Newell, C.R., and H. Hidu. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—softshell clam. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.53). 17 p.

NEFSC (Northeast Fisheries Science Center). 1992. Status of fishery resources off the northeastern United States for 1992. NOAA Tech. Memo. NMFS-F/NEC-95. 133 p.

Olla, B.L., A.J. Bejda, and A.D. Martin. 1974. Daily activity, movements, feeding, and seasonal occurrences in the tautog, *Tautoga onitis*. Fish. Bull., U.S. 72:27-35.

Rogers, S.G., and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—Atlantic menhaden. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.108). 23 p.

Scott, W.B., and M.G. Scott. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219. 731 p.

Sellers, M.A., and J.G. Stanley. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American oyster. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.23). 15 p.

Shumway, S.E., H.C. Perkins, D.F. Schick, and A.P. Stickney. 1985. Synopsis of biological data on the pink shrimp, *Pandalus borealis* Krøyer, 1838. NOAA Tech. Rep. NMFS 30/FAO Fisheries Synopsis No. 144. 57 p.

Shumway, S.E. 1991. Scallops: biology, ecology and aquaculture. Developments in aquaculture and fisheries science, Vol. 21. Elsevier, New York. 1095 p.

Squiers, T.S. 1990. Kennebec River anadromous fish restoration: Annual progress report 1990. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 31 p.

Stanley, J.G., and D.S. Danie. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—white perch. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.7). 12 p.

Stanley, J.G., and R. Dewitt. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—hard clam. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.18). 19 p.

Starr, M., J.H. Himmelman, and J.C. Therriault. 1990. Direct coupling of marine invertebrate spawning with phytoplankton blooms. Science 247:1071-1074.

Stewart, L.L., and P.J. Auster. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—Atlantic tomcod. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.76). 8 p.

USFWS (U.S. Fish and Wildlife Service). 1993. Endangered and threatened wildlife. Code of Federal Regulations, 50 CFR 17.11.

Weiss-Glanz, L.S., J.G. Stanley, and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American shad. U.S. Fish Wildl. Serv., Biol. Rep. No. 82(11.59). 16 p.

Williams, A.B. 1984. Shrimps, lobsters, and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Institution Press, Washington D.C.

Williams, A.B., and R. Wahle. 1992. Distinguishing juvenile stages of Jonah and Atlantic rock crabs, *Cancer borealis* and *C. irroratus* (Decapoda: Cancridae). J. Crustacean Biol. 12(3):464-466.

Wooten, R.J. 1976. The biology of the sticklebacks. Academic Press, London.

Wooten, R.J. 1984. A functional biology of sticklebacks. *In* Calow, P. (ed.),Functional biology series. University of California Press, Berkeley and Los Angeles.

Appendix 4. Table of references and personal communications

Species	Passamaquoddy Bay
Blue mussel *Mytilus edulis*	59, 77, 264, 311, 419, Beal, Clifford, Dadswell, Hargrave, Kraus, Moring
Sea scallop *Placopecten magellanicus*	34, 59, 107, 120, 333, 379, Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson
American oyster *Crassostrea virginica*	142, 158, 240, 419, Beal, Clifford, Hargrave, Kraus, Moring
Northern quahog *Mercenaria mercenaria*	59, 419, Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson
Softshell clam *Mya arenaria*	59, 142, 348, 349, 419, Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson
Grass shrimp *Palaemonetes pugio*	142, 212, 336, 419, 433, Beal, Clifford, Pohle, Hargrave, Kraus, Lawton, Dadswell, Moring
Northern shrimp *Pandalus borealis*	79, 142, 182, 380, 433, Beal, Clifford, Pohle, Hargrave, Kraus, Lawton, Moring
Sevenspine bay shrimp *Crangon septemspinosa*	99, 100, 176, 419, Beal, Clifford, Hargrave, Kraus, Lawton, Moring
American lobster *Homarus americanus*	16, 59, 64, 142, 171, 196, 217, 351, 433, Beal, Dadswell, Hargrave, Kraus, Krouse, Lawton, Pohle
Jonah crab *Cancer borealis*	142, 219, 362, Beal, Clifford, Dadswell, Hargrave, Kraus, Lawton, Pohle
Atlantic rock crab *Cancer irroratus*	142, 216, 218, 219, 362, 419, 433, Clifford, Hargrave, Kraus, Krouse, Lawton, Dadswell, Pohle
Green crab *Carcinus maenus*	4, 50, 83, 419, 433, Beal, Clifford, Dadswell, Hargrave, Kraus, Lawton, Moring, Pohle
Green sea urchin *Strongylocentrotus droebachiensis*	78, 185, 186, 221, 256, 305, 352, Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson
Spiny dogfish *Squalus acanthias*	51, 255, 421, Clifford, Dadswell, Moring
Skates *Raja* species	51, 255, 421, Clifford, Dadswell, Moring
Shortnose sturgeon *Acipenser brevirostrum*	51, 104, 255, 272, 370, 421, Clifford, Dadswell, Jessop, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	42, 51, 150, 255, 370, Clifford, Dadswell, Jessop, Moring, Squiers
American eel *Anguilla rostrata*	37, 42, 51, 137, 150, 373, Clifford, Dadswell, Jessop, Peterson, Squiers
Blueback herring *Alosa aestivalis*	42, 150, 206, 255, 370, 421, Beland, Clifford, Dadswell, Jessop, Moring, Squiers
Alewife *Alosa pseudoharengus*	42, 59, 150, 206, 255, 370, 421, Beal, Beland, Clifford, Dadswell, Jessop, Kraus, Moring, Squiers
American shad *Alosa sapidissima*	42, 59, 105, 150, 370, Clifford, Dadswell, Jessop, Moring, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 255, 370, 421, Clifford, Dadswell, Moring
Atlantic herring *Clupea harengus*	101, 165, 166, 250, 255, 280, 281, 400, 411, 412, Clifford, Dadswell, Moring, Power, Stephenson
Rainbow smelt *Osmerus mordax*	42, 144, 150, 255, 282, 421, Beal, Clifford, Jessop, Kraus, Dadswell, Moring, Squiers
Atlantic salmon *Salmo salar*	25, 41, 150, 156, 370, Beland, Clifford, Dadswell, Jessop, Kraus, Moring, Squiers
Atlantic cod *Gadus morhua*	51, 79, 255, 421, Clifford, Dadswell, Moring
Haddock *Melanogrammus aeglefinus*	51, 255, 274, 421, Clifford, Dadswell, Moring
Silver hake *Merluccius bilinearis*	51, 255, 421, Clifford, Dadswell, Moring
Atlantic tomcod *Microgadus tomcod*	51, 255, 398, 421, Clifford, Dadswell, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Passamaquoddy Bay, continued
Pollock *Pollachius virens*	51, 79, 255, 368, 421, Clifford, Dadswell, Moring
Red hake *Urophycis chuss*	51, 255, 370, Clifford, Dadswell, Moring
White hake *Urophycis tenuis*	51, 255, 265, 370, 421, Clifford, Dadswell, Moring
Mummichog *Fundulus heteroclitus*	31, 42, 150, 370, Clifford, Dadswell, Moring
Silversides *Menidia* species	31, 42, 150, 255, 370, 421, Clifford, Dadswell, Jessop, Moring
Fourspine stickleback *Apeltes quadracus*	28, 255, 440, Clifford, Dadswell, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 255, 370, 440, Clifford, Dadswell, Moring
Ninespine stickleback *Pungitius pungitius*	28, 255, 370, 440, Clifford, Dadswell, Moring
Northern pipefish *Syngnathus fuscus*	181, 248, 255, 370, Clifford, Dadswell, Moring
Northern searobin *Prionotus carolinus*	51, 255, 370, 421, Clifford, Dadswell, Moring
Grubby *Myoxocephalus aeneus*	51, 255, 370, 421, Clifford, Dadswell, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 255, 370, 421, Clifford, Dadswell, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 255, 421, Clifford, Dadswell, Moring
White perch *Morone americana*	42, 51, 150, 255, Clifford, Dadswell, Moring, Squiers
Striped bass *Morone saxatilis*	42, 51, 150, 370, Clifford, Dadswell, Jessop, Moring, Peterson, Squiers
Bluefish *Pomatomus saltatrix*	51, 370, Clifford, Dadswell, Moring
Scup *Stenotomus chrysops*	51, 255, 370, 421, Clifford, Dadswell, Moring
Tautog *Tautoga onitis*	51, 54, 255, 370, 421, Clifford, Dadswell, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 370, Clifford, Dadswell, Moring
Ocean pout *Macrozoarces americanus*	255, 370, 421, Clifford, Dadswell, Moring
Rock gunnel *Pholis gunnellus*	51, 255, 289, 360, 414, Clifford, Dadswell, Moring
American sandlance *Ammodytes americanus*	51, 255, 288, 368, 436, Clifford, Dadswell, Moring
Atlantic mackerel *Scomber scombrus*	51, 255, 370, Clifford, Dadswell, Moring
Butterfish *Peprilus triacanthus*	51, 255, 370, 421, Clifford, Dadswell, Moring
Windowpane flounder *Scophthalmus aquosus*	51, 255, 370, 421, Clifford, Dadswell, Moring
American plaice *Hippoglossoides platessoides*	255, 370, 421, Clifford, Dadswell, Moring
Winter flounder *Pleuronectes americanus*	255, 275, 370, 421, 422, Clifford, Dadswell, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	51, 255, 370, 421, Clifford, Dadswell, Moring
Smooth flounder *Pleuronectes putnami*	51, 255, 370, 421, Clifford, Dadswell, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Englishman/Machias Bays
Blue mussel *Mytilus edulis*	77, 142, 211, 239, 240, 264, 310, 311, 337, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Sea scallop *Placopecten magellanicus*	34, 47, 142, 253, 295, 333, 337, 379, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
American oyster *Crassostrea virginica*	142, 158, 337, 371, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Northern quahog *Mercenaria mercenaria*	142, 337, 393, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Softshell clam *Mya arenaria*	15, 142, 239, 240, 308, 337, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Grass shrimp *Palaemonetes pugio*	9, 337, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Moring
Northern shrimp *Pandalus borealis*	142, 182, 331, 380, 419, 433, Barr, Clifford, Dearborn, Knowlton, McGowan, Moring
Sevenspine bay shrimp *Crangon septemspinosa*	99, 100, 129, 142, 176, 337, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
American lobster *Homarus americanus*	64, 97, 110, 142, 217, 257, 259, 337, 351, 419, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Jonah crab *Cancer borealis*	142, 201, 218, 219, 259, 337, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Atlantic rock crab *Cancer irroratus*	52, 142, 216, 218, 219, 362, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Green crab *Carcinus maenus*	50, 83, 337, 428, 433, 434, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Green sea urchin *Strongylocentrotus droebachiensis*	78, 142, 185, 186, 337, 372, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Spiny dogfish *Squalus acanthias*	51, 64, 92, 142, 149, 202, 253, 259, 304, 370, 419, Clifford, McGowan, Moring
Skates *Raja* species	51, 64, 142, 255, 259, 276, 370, 419, 421, Clifford, Moring
Shortnose sturgeon *Acipenser brevirostrum*	17, 51, 106, 142, 161, 370, 419, Clifford, Marancik, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	17, 51, 142, 161, 255, 370, 405, Clifford, Marancik, Moring, Squiers
American eel *Anguilla rostrata*	17, 42, 51, 122, 137, 142, 145, 149, 184, 255, 288, 370, 414, Beal, Clifford, Kraus, Marancik, McGowan, Moring, Squiers
Blueback herring *Alosa aestivalis*	17, 42, 51, 122, 142, 149, 251, 255, 259, 294, 402, 419, Beland, Clifford, Marancik, Moring, Squiers
Alewife *Alosa pseudoharengus*	17, 42, 51, 122, 142, 149, 251, 255, 259, 294, 402, 419, 421, Beal, Clifford, Kraus, Marancik, Moring, Squiers
American shad *Alosa sapidissima*	17, 42, 51, 108, 122, 142, 149, 255, 419, 427, Beland, Clifford, Marancik, McGowan, Moring, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 118, 142, 354, 419, Clifford, McGowan, Moring, Squiers
Atlantic herring *Clupea harengus*	64, 68, 80, 101, 102, 166, 167, 168, 208, 381, 396, 414, 415, 416, 417, Beal, Clifford, Kraus, McGowan, Moring, Squiers
Rainbow smelt *Osmerus mordax*	17, 42, 51, 64, 122, 142, 149, 169, 255, 259, 414, 419, 421, Beal, Clifford, Kraus, McGowan, Moring, Squiers
Atlantic salmon *Salmo salar*	17, 24, 25, 42, 42, 109, 122, 142, 149, 358, Beal, Beland, Clifford, Kraus, Marancik, McGowan, Moring, Squiers
Atlantic cod *Gadus morhua*	51, 64, 142, 255, 259, 370, 419, 421, Clifford, McGowan, Moring
Haddock *Melanogrammus aeglefinus*	51, 53, 142, 255, 259, 370, 419, 421, Clifford, Moring
Silver hake *Merluccius bilinearis*	8, 51, 64, 142, 255, 259, 370, 419, 421, Clifford, Moring
Atlantic tomcod *Microgadus tomcod*	42, 51, 122, 142, 149, 255, 338, 398, 414, Clifford, McGowan, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Englishman/Machias Bays, continued
Pollock *Pollachius virens*	51, 64, 118, 142, 255, 259, 269, 288, 419, 421, Clifford, Moring
Red hake *Urophycis chuss*	51, 142, 159, 255, 259, 265, 302, 419, Clifford, Moring
White hake *Urophycis tenuis*	51, 64, 138, 142, 255, 259, 265, 288, 302, 419, 421, Clifford, McGowan, Moring
Mummichog *Fundulus heteroclitus*	2, 42, 51, 118, 122, 142, 149, 169, 255, 288, 419, Beal, Clifford, Kraus, McGowan, Moring
Silversides *Menidia* species	51, 94, 118, 141, 142, 255, 288, 419, Clifford, McGowan, Moring
Fourspine stickleback *Apeltes quadracus*	28, 118, 142, 169, 255, 288, 439, 440, Clifford, McGowan, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 42, 51, 118, 122, 142, 149, 169, 255, 288, 435, 439, 440, Clifford, McGowan, Moring
Ninespine stickleback *Pungitius pungitius*	28, 42, 51, 118, 122, 142, 149, 169, 288, 439, 440, Clifford, McGowan, Moring
Northern pipefish *Syngnathus fuscus*	51, 142, 248, 255, Beal, Clifford, Kraus, Moring
Northern searobin *Prionotus carolinus*	51, 142, 350, Clifford, Kraus, Moring
Grubby *Myoxocephalus aeneus*	51, 142, 255, 259, 288, 414, Clifford, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 64, 142, 255, 259, 288, 414, 415, 419, 421, Beal, Clifford, Kraus, McGowan, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 64, 142, 255, 259, 288, 414, 415, Beal, Clifford, Kraus, McGowan, Moring
White perch *Morone americana*	42, 51, 122, 142, 149, 169, 392, Clifford, Marancik, McGowan, Moring
Striped bass *Morone saxatilis*	17, 42, 56, 122, 140, 142, 149, 419, 426, Clifford, Marancik, McGowan, Moring
Bluefish *Pomatomus saltatrix*	42, 51, 122, 142, 149, 287, 327, 419, Clifford, McGowan, Moring
Scup *Stenotomus chrysops*	51, 142, 290, 419, Clifford, McGowan, Moring
Tautog *Tautoga onitis*	29, 51, 142, 419, Clifford, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 142, 288, 419, Clifford, McGowan, Moring
Ocean pout *Macrozoarces americanus*	51, 64, 142, 255, 259, 419, 421, Clifford, McGowan, Moring
Rock gunnel *Pholis gunnellus*	51, 142, 255, 288, 289, 360, 414, 415, Beal, Clifford, Kraus, McGowan, Moring
American sandlance *Ammodytes americanus*	30, 51, 142, 255, 288, 306, 382, 414, 419, 436, Beal, Clifford, Kraus, McGowan, Moring
Atlantic mackerel *Scomber scombrus*	42, 51, 64, 122, 142, 149, 255, 259, 419, Beal, Clifford, Kraus, Moring
Butterfish *Peprilus triacanthus*	51, 64, 142, 255, 259, 296, 419, Clifford, Moring
Windowpane flounder *Scophthalmus aquosus*	51, 64, 142, 255, 259, Clifford, Moring
American plaice *Hippoglossoides platessoides*	51, 142, 255, 259, 419, 421, Clifford, McGowan, Moring
Winter flounder *Pleuronectes americanus*	63, 64, 142, 255, 259, 275, 288, 414, 419, 421, 422, Clifford, McGowan, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	51, 64, 118, 142, 255, 259, 419, Clifford, McGowan, Moring
Smooth flounder *Pleuronectes putnami*	27, 51, 142, 255, 414, Clifford, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Narraguagus Bay
Blue mussel *Mytilus edulis*	77, 142, 211, 239, 264, 310, 311, 337, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Sea scallop *Placopecten magellanicus*	34, 47, 142, 253, 295, 333, 337, 379, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
American oyster *Crassostrea virginica*	142, 158, 337, 371, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Northern quahog *Mercenaria mercenaria*	142, 337, 393, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Softshell clam *Mya arenaria*	142, 239, 240, 308, 337, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Grass shrimp *Palaemonetes pugio*	9, 336, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Moring
Northern shrimp *Pandalus borealis*	142, 182, 331, 380, 419, 433, Barr, Clifford, Dearborn, Knowlton, McGowan, Moring
Sevenspine bay shrimp *Crangon septemspinosa*	99, 100, 129, 142, 176, 337, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
American lobster *Homarus americanus*	64, 97, 110, 142, 217, 257, 259, 337, 351, 419, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Jonah crab *Cancer borealis*	142, 201, 218, 219, 259, 337, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Atlantic rock crab *Cancer irroratus*	52, 142, 216, 218, 219, 337, 362, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Green crab *Carcinus maenus*	50, 83, 337, 428, 433, 434, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Green sea urchin *Strongylocentrotus droebachiensis*	78, 142, 185, 186, 337, 372, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Spiny dogfish *Squalus acanthias*	39, 51, 64, 92, 142, 202, 255, 259, 304, 370, 419, Clifford, McGowan, Moring
Skates *Raja* species	51, 64, 142, 255, 259, 276, 370, 419, 421, Clifford, Moring
Shortnose sturgeon *Acipenser brevirostrum*	17, 51, 106, 142, 161, 370, 419, Clifford, Marancik, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	17, 51, 142, 161, 255, 370, 405, Clifford, Marancik, Moring, Squiers
American eel *Anguilla rostrata*	17, 39, 51, 123, 137, 142, 145, 184, 255, 288, 370, 414, Beal, Clifford, Kraus, Marancik, McGowan, Moring, Squiers
Blueback herring *Alosa aestivalis*	17, 39, 51, 123, 142, 251, 255, 259, 294, 402, 419, Beland, Clifford, Marancik, Moring, Squiers
Alewife *Alosa pseudoharengus*	17, 39, 51, 123, 142, 251, 255, 259, 294, 402, 419, 421, Beal, Clifford, Kraus, Marancik, Moring, Squiers
American shad *Alosa sapidissima*	17, 39, 51, 108, 123, 142, 255, 419, 427, Beland, Clifford, Marancik, McGowan, Moring, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 118, 142, 354, 419, Clifford, McGowan, Moring, Squiers
Atlantic herring *Clupea harengus*	51, 68, 80, 101, 102, 165, 166, 167, 168, 208, 396, 414, 415, 416, 417, Beal, Clifford, Kraus, McGowan, Moring, Squiers
Rainbow smelt *Osmerus mordax*	17, 39, 51, 64, 64, 123, 142, 144, 169, 255, 259, 414, 419, 421, Beal, Clifford, Kraus, McGowan, Moring, Squiers
Atlantic salmon *Salmo salar*	17, 24, 25, 39, 40, 42, 51, 109, 123, 142, 255, 358, 419, Beal, Beland, Clifford, Kraus, Marancik, McGowan, Moring, Squiers
Atlantic cod *Gadus morhua*	51, 64, 142, 255, 259, 370, 419, 421, Clifford, McGowan, Moring
Haddock *Melanogrammus aeglefinus*	51, 53, 142, 255, 259, 370, 419, 421, Clifford, Moring
Silver hake *Merluccius bilinearis*	8, 51, 64, 142, 255, 259, 370, 419, 421, Clifford, Moring
Atlantic tomcod *Microgadus tomcod*	40, 51, 123, 142, 255, 338, 398, 414, Clifford, McGowan, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Narraguagus Bay, continued
Pollock *Pollachius virens*	51, 64, 118, 142, 255, 259, 269, 288, 419, 421, Clifford, Moring
Red hake *Urophycis chuss*	51, 142, 159, 255, 259, 265, 302, 419, Clifford, Moring
White hake *Urophycis tenuis*	51, 64, 138, 142, 255, 259, 265, 288, 302, 419, 421, Clifford, McGowan, Moring
Mummichogs *Fundulus heteroclitus*	2, 39, 51, 118, 123, 142, 169, 255, 288, 419, Beal, Clifford, Kraus, McGowan, Moring
Silversides *Menidia* species	51, 94, 118, 141, 142, 255, 288, 419, Clifford, McGowan, Moring
Fourspine stickleback *Apeltes quadracus*	28, 118, 142, 169, 255, 288, 439, 440, Clifford, McGowan, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 39, 51, 118, 123, 142, 169, 255, 288, 435, 439, 440, Clifford, McGowan, Moring
Ninespine stickleback *Pungitius pungitius*	28, 39, 51, 118, 123, 142, 169, 288, 439, 440, Clifford, McGowan, Moring
Northern pipefish *Syngnathus fuscus*	51, 142, 248, 255, Beal, Clifford, Kraus, Moring
Northern searobin *Prionotus carolinus*	51, 142, 350, Clifford, Kraus, Moring
Grubby *Myoxocephalus aeneus*	51, 142, 255, 259, 288, 414, Clifford, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 64, 142, 255, 259, 288, 414, 415, 419, 421, Beal, Clifford, Kraus, McGowan, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 64, 142, 255, 259, 288, 414, 415, Beal, Clifford, Kraus, McGowan, Moring
White perch *Morone americana*	39, 51, 123, 142, 169, 392, Clifford, Marancik, McGowan, Moring
Striped bass *Morone saxatilis*	17, 40, 56, 123, 140, 142, 419, 426, Clifford, Marancik, McGowan, Moring
Bluefish *Pomatomus saltatrix*	40, 51, 123, 142, 287, 327, 419, Clifford, McGowan, Moring
Scup *Stenotomus chrysops*	51, 142, 290, 419, Clifford, McGowan, Moring
Tautog *Tautoga onitis*	29, 51, 142, 419, Clifford, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 142, 288, 419, Clifford, McGowan, Moring
Ocean pout *Macrozoarces americanus*	51, 64, 142, 255, 259, 419, 421, Clifford, McGowan, Moring
Rock gunnel *Pholis gunnellus*	51, 142, 253, 288, 289, 360, 414, 415, Beal, Clifford, Kraus, McGowan, Moring
American sandlance *Ammodytes americanus*	30, 51, 142, 255, 288, 306, 382, 414, 419, 436, Beal, Clifford, Kraus, McGowan, Moring
Atlantic mackerel *Scomber scombrus*	40, 51, 64, 123, 142, 255, 259, 419, Beal, Clifford, Kraus, Moring
Butterfish *Peprilus triacanthus*	51, 64, 142, 255, 259, 296, 419, Clifford, Moring
Windowpane flounder *Scophthalmus aquosus*	51, 64, 142, 255, 259, Clifford, Moring
American plaice *Hippoglossoides platessoides*	51, 142, 255, 259, 419, 421, Clifford, McGowan, Moring
Winter flounder *Pleuronectes americanus*	63, 64, 142, 255, 259, 275, 288, 414, 419, 421, 422, Clifford, McGowan, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	51, 64, 118, 142, 255, 259, 419, Clifford, McGowan, Moring
Smooth flounder *Pleuronectes putnami*	27, 51, 142, 255, 414, Clifford, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Blue Hill Bay
Blue mussel *Mytilus edulis*	77, 142, 211, 239, 240, 264, 310, 311, 337, 344, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Sea scallop *Placopecten magellanicus*	34, 47, 142, 253, 295, 333, 337, 344, 379, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
American oyster *Crassostrea virginica*	142, 158, 337, 371, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Northern quahog *Mercenaria mercenaria*	142, 337, 393, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Softshell clam *Mya arenaria*	142, 239, 240, 308, 337, 344, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Grass shrimp *Palaemonetes pugio*	9, 337, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Moring
Northern shrimp *Pandalus borealis*	142, 182, 331, 380, 419, 433, Barr, Clifford, Dearborn, Knowlton, McGowan, Moring
Sevenspine bay shrimp *Crangon septemspinosa*	99, 100, 129, 142, 176, 337, 344, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
American lobster *Homarus americanus*	64, 97, 110, 142, 217, 257, 259, 337, 351, 419, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Jonah crab *Cancer borealis*	142, 201, 218, 219, 259, 337, 344, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Atlantic rock crab *Cancer irroratus*	52, 142, 216, 218, 219, 337, 344, 362, 433, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring
Green crab *Carcinus maenus*	50, 83, 337, 428, 433, 434, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Green sea urchin *Strongylocentrotus droebachiensis*	78, 142, 185, 186, 337, 344, 372, 419, Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring
Spiny dogfish *Squalus acanthias*	36, 51, 64, 92, 142, 202, 255, 259, 304, 344, 370, 419, Clifford, McGowan, Moring
Skates *Raja* species	51, 64, 142, 255, 259, 276, 344, 370, 419, 421, Clifford, Moring
Shortnose sturgeon *Acipenser brevirostrum*	17, 51, 106, 142, 161, 370, 419, Clifford, Marancik, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	17, 51, 142, 161, 255, 370, 405, Clifford, Marancik, Moring, Squiers
American eel *Anguilla rostrata*	17, 36, 51, 137, 142, 145, 184, 255, 288, 344, 370, 414, Beal, Clifford, Kraus, Marancik, McGowan, Moring, Squiers
Blueback herring *Alosa aestivalis*	17, 36, 51, 142, 251, 255, 259, 294, 402, 419, Beland, Clifford, Marancik, Moring, Squiers
Alewife *Alosa pseudoharengus*	17, 36, 51, 142, 251, 255, 259, 294, 402, 419, 421, Beal, Clifford, Kraus, Marancik, Moring, Squiers
American shad *Alosa sapidissima*	17, 36, 51, 108, 142, 255, 419, 427, Beland, Clifford, Marancik, McGowan, Moring, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 118, 142, 354, 419, Clifford, McGowan, Moring, Squiers
Atlantic herring *Clupea harengus*	51, 64, 69, 80, 101, 102, 118, 165, 166, 167, 168, 208, 381, 396, 414, 415, 416, 417, Beal, Clifford, Kraus, McGowan, Moring, Squiers
Rainbow smelt *Osmerus mordax*	17, 36, 51, 62, 64, 142, 144, 169, 255, 259, 414, 419, 421, Beal, Clifford, Kraus, McGowan, Moring, Squiers
Atlantic salmon *Salmo salar*	17, 24, 25, 36, 39, 42, 51, 109, 142, 255, 358, 419, Beal, Beland, Clifford, Kraus, Marancik, McGowan, Moring, Squiers
Atlantic cod *Gadus morhua*	51, 64, 142, 255, 259, 344, 370, 419, 421, Clifford, McGowan, Moring
Haddock *Melanogrammus aeglefinus*	51, 53, 142, 255, 259, 344, 370, 419, 421, Clifford, Moring
Silver hake *Merluccius bilinearis*	8, 51, 64, 142, 255, 259, 370, 419, 421, Clifford, Moring
Atlantic tomcod *Microgadus tomcod*	36, 51, 142, 255, 338, 398, 414, Clifford, McGowan, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Blue Hill Bay, continued
Pollock *Pollachius virens*	51, 64, 118, 142, 255, 259, 269, 288, 419, 421, Clifford, Moring
Red hake *Urophycis chuss*	51, 142, 159, 255, 259, 265, 302, 419, Clifford, Moring
White hake *Urophycis tenuis*	51, 64, 138, 142, 255, 259, 265, 288, 302, 344, 419, 421, Clifford, McGowan, Moring
Mummichogs *Fundulus heteroclitus*	2, 36, 51, 118, 142, 169, 255, 288, 344, 419, Beal, Clifford, Kraus, McGowan, Moring
Silversides *Menidia* species	51, 94, 118, 141, 142, 255, 288, 344, 419, Clifford, McGowan, Moring
Fourspine stickleback *Apeltes quadracus*	28, 118, 142, 169, 255, 288, 344, 439, 440, Clifford, McGowan, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 36, 51, 118, 142, 169, 255, 288, 344, 435, 439, 440, Clifford, McGowan, Moring
Ninespine stickleback *Pungitius pungitius*	28, 36, 51, 118, 142, 169, 288, 344, 439, 440, Clifford, McGowan, Moring
Northern pipefish *Syngnathus fuscus*	51, 142, 248, 255, 344, Beal, Clifford, Kraus, Moring
Northern searobin *Prionotus carolinus*	51, 142, 350, Clifford, Kraus, Moring
Grubby *Myoxocephalus aeneus*	51, 142, 255, 259, 288, 414, Clifford, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 64, 142, 255, 259, 288, 344, 414, 415, 419, 421, Beal, Clifford, Kraus, McGowan, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 64, 142, 255, 259, 288, 414, 415, Beal, Clifford, Kraus, McGowan, Moring
White perch *Morone americana*	36, 51, 142, 169, 392, Clifford, Marancik, McGowan, Moring
Striped bass *Morone saxatilis*	17, 36, 56, 140, 142, 419, 426, Clifford, Marancik, McGowan, Moring
Bluefish *Pomatomus saltatrix*	36, 51, 142, 287, 327, 419, Clifford, McGowan, Moring
Scup *Stenotomus chrysops*	51, 142, 290, 419, Clifford, McGowan, Moring
Tautog *Tautoga onitis*	29, 51, 142, 419, Clifford, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 142, 288, 419, Clifford, McGowan, Moring
Ocean pout *Macrozoarces americanus*	51, 64, 142, 255, 259, 419, 421, Clifford, McGowan, Moring
Rock gunnel *Pholis gunnellus*	51, 142, 255, 288, 289, 344, 360, 414, 415, Beal, Clifford, Kraus, McGowan, Moring
American sandlance *Ammodytes americanus*	30, 51, 142, 255, 288, 306, 382, 414, 419, 436, Beal, Clifford, Kraus, McGowan, Moring
Atlantic mackerel *Scomber scombrus*	36, 51, 64, 142, 255, 259, 419, Beal, Clifford, Kraus, Moring
Butterfish *Peprilus triacanthus*	51, 64, 142, 255, 259, 296, 419, Clifford, Moring
Windowpane flounder *Scophthalmus aquosus*	51, 64, 142, 255, 259, Clifford, Moring
American plaice *Hippoglossoides platessoides*	51, 142, 255, 259, 419, 421, Clifford, McGowan, Moring
Winter flounder *Pleuronectes americanus*	63, 64, 142, 255, 259, 275, 288, 344, 414, 419, 421, 422, Clifford, McGowan, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	51, 64, 118, 142, 255, 259, 419, Clifford, McGowan, Moring
Smooth flounder *Pleuronectes putnami*	27, 51, 142, 255, 414, Clifford, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Penobscot Bay
Blue mussel *Mytilus edulis*	21, 77, 264, 311, 315, 317, Barr, Knowlton, McGowan, Moring
Sea scallop *Placopecten magellanicus*	23, 34, 315, 317, 379, Dearborn, Knowlton, McGowan, Moring
American oyster *Crassostrea virginica*	142, 158, 240, 419, Barr, Knowlton, McGowan, Moring
Northern quahog *Mercenaria mercenaria*	21, 315, 317, 419, Barr, Knowlton, McGowan, Moring
Softshell clam *Mya arenaria*	21, 142, 315, 317, Barr, Knowlton, McGowan, Moring
Grass shrimp *Palaemonetes pugio*	21, 142, 419, 433, Barr, Dearborn, Knowlton
Northern shrimp *Pandalus borealis*	79, 142, 182, 380, 433, Barr, Knowlton, McGowan, Moring
Sevenspine bay shrimp *Crangon septemspinosa*	129, 176, 419, 433, Barr, Dearborn, Knowlton, McGowan, Moring
American lobster *Homarus americanus*	16, 64, 142, 170, 196, 217, 433, Barr, Dearborn, Knowlton, Krouse, McGowan, Moring
Jonah crab *Cancer borealis*	142, 219, 362, Barr, Dearborn, Knowlton, Krouse, McGowan, Moring
Atlantic rock crab *Cancer irroratus*	142, 218, 362, 419, 433, Barr, Knowlton, Krouse, McGowan, Moring
Green crab *Carcinus maenus*	4, 50, 83, 419, 433, Barr, Dearborn, Knowlton, McGowan, Moring
Green sea urchin *Strongylocentrotus droebachiensis*	21, 78, 185, 315, 317, Barr, Dearborn, Knowlton, McGowan, Moring
Spiny dogfish *Squalus acanthias*	7, 21, 51, 317, Dearborn, McGowan, Moring
Skates *Raja* species	7, 21, 51, 317, Moring
Shortnose sturgeon *Acipenser brevirostrum*	51, 142, 272, 370, 386, 387, Marancik, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	7, 37, 51, 386, Marancik, Moring, Squiers
American eel *Anguilla rostrata*	37, 51, 137, 373, Marancik, McGowan, Moring
Blueback herring *Alosa aestivalis*	7, 21, 37, 315, 317, Fay, Marancik, Moring, Squiers
Alewife *Alosa pseudoharengus*	7, 37, 64, 259, 315, 317, Fay, Marancik, Moring, Squiers
American shad *Alosa sapidissima*	7, 37, 259, 317, 387, Baum, Marancik, McGowan, Moring, Spencer, Squiers
Atlantic menhaden *Brevoortia tyrannus*	7, 64, 259, 315, 421, McGowan, Moring
Atlantic herring *Clupea harengus*	7, 64, 101, 165, 166, 259, 315, 317, 400, 421, McGowan, Moring
Rainbow smelt *Osmerus mordax*	7, 21, 144, 282, 315, 317, Marancik, Moring, Squiers
Atlantic salmon *Salmo salar*	25, 37, 38, 41, 156, Baum, Beland, Fay, McGowan, Moring, Spencer, Squiers
Atlantic cod *Gadus morhua*	7, 21, 51, 79, 315, 317, 335, 421, McGowan, Moring
Haddock *Melanogrammus aeglefinus*	7, 51, 64, 259, 315, 317, Moring
Silver hake *Merluccius bilinearis*	7, 21, 51, 64, 259, 315, 317, Moring
Atlantic tomcod *Microgadus tomcod*	7, 21, 51, 315, 317, 398, McGowan, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Penobscot Bay, continued
Pollock *Pollachius virens*	7, 21, 51, 64, 79, 259, 315, 317, Moring
Red hake *Urophycis chuss*	7, 21, 51, 64, 79, 315, 317, Moring
White hake *Urophycis tenuis*	7, 21, 51, 64, 79, 315, 317, McGowan, Moring
Mummichogs *Fundulus heteroclitus*	7, 21, 31, 37, 317, Dearborn, McGowan, Moring
Silversides *Menidia* species	7, 21, 31, 315, 317, Moring
Fourspine stickleback *Apeltes quadracus*	7, 21, 28, 315, 317, 440, McGowan, Moring
Threespine stickleback *Gasterosteus aculeatus*	7, 21, 28, 315, 317, 440, McGowan, Moring
Ninespine stickleback *Pungitius pungitius*	7, 28, 315, 317, 440, McGowan, Moring
Northern pipefish *Syngnathus fuscus*	7, 181, 248, 315, Moring
Northern searobin *Prionotus carolinus*	7, 51, 64, 315, 317, 421, Moring
Grubby *Myoxocephalus aeneus*	7, 21, 51, 315, 317, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	7, 21, 51, 64, 259, 315, 317, McGowan, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	7, 21, 51, 64, 315, 317, McGowan, Moring
White perch *Morone americana*	7, 37, 51, Marancik, McGowan, Moring, Squiers
Striped bass *Morone saxatilis*	7, 37, Baum, Marancik, Moring, Spencer, Squiers
Bluefish *Pomatomus saltatrix*	7, 21, 51, 315, McGowan, Moring
Scup *Stenotomus chrysops*	7, 21, 51, 259, 315, 317, Moring
Tautog *Tautoga onitis*	7, 21, 51, 315, 317, Blackwell, Moring
Cunner *Tautogolabrus adspersus*	7, 29, 51, McGowan, Moring
Ocean pout *Macrozoarces americanus*	7, 21, 64, 259, 315, 317, 421, McGowan, Moring
Rock gunnel *Pholis gunnellus*	7, 21, 51, 289, 315, 360, 414, McGowan, Moring
American sandlance *Ammodytes americanus*	7, 21, 51, 288, 315, 317, 436, McGowan, Moring
Atlantic mackerel *Scomber scombrus*	7, 21, 51, 291, 315, McGowan, Moring
Butterfish *Peprilus triacanthus*	7, 51, 64, 79, 259, 315, Moring
Windowpane flounder *Scophthalmus aquosus*	7, 21, 315, Moring
American plaice *Hippoglossoides platessoides*	7, 21, 64, 79, 259, 315, McGowan, Moring
Winter flounder *Pleuronectes americanus*	7, 64, 79, 259, 315, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	7, 21, 64, 79, 259, 315, 421, McGowan, Moring
Smooth flounder *Pleuronectes putnami*	7, 51, 79, 259, 315, 317, 421, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Muscongus Bay
Blue mussel *Mytilus edulis*	77, 260, 311, 343, Chenoweth, Larsen, Moring, Shumway
Sea scallop *Placopecten magellanicus*	34, 142, 264, 295, 379, Chenoweth, Larsen, Moring, Schick, Shumway
American oyster *Crassostrea virginica*	142, 158, 240, 419, Chenoweth, Larsen, Moring, Shumway
Northern quahog *Mercenaria mercenaria*	71, 239, 393, 419, Chenoweth, Larsen, Moring, Shumway
Softshell clam *Mya arenaria*	71, 142, 260, 419, Chenoweth, Larsen, Moring, Shumway
Grass shrimp *Palaemonetes pugio*	142, 163, 336, 399, 419, 433, Chenoweth, Larsen, Moring, Shumway
Northern shrimp *Pandalus borealis*	142, 182, 259, 380, 419, 433, Chenoweth, Larsen, Moring, Schick, Shumway
Sevenspine bay shrimp *Crangon septemspinosa*	129, 176, 419, 433, Chenoweth, Larsen, Moring, Shumway
American lobster *Homarus americanus*	16, 142, 196, 217, 220, 419, 433, Chenoweth, Krouse, Larsen, Moring, Shumway
Jonah crab *Cancer borealis*	142, 218, 260, 362, 399, 419, 433, Chenoweth, Krouse, Larsen, Moring, Shumway
Atlantic rock crab *Cancer irroratus*	142, 216, 218, 219, 260, 362, 399, 419, 433, Chenoweth, Krouse, Larsen, Moring, Shumway
Green crab *Carcinus maenus*	4, 50, 83, 419, 433, Chenoweth, Krouse, Larsen, Moring, Shumway
Green sea urchin *Strongylocentrotus droebachiensis*	78, 186, 325, 419, Chenoweth, Larsen, Moring, Shumway
Spiny dogfish *Squalus acanthias*	51, 154, 172, 259, 260, 419, Chenoweth, Langton, Moring
Skates *Raja* species	51, 154, 227, 259, 260, Chenoweth, Moring
Shortnose sturgeon *Acipenser brevirostrum*	51, 142, 155, 272, 386, 399, 419, Chenoweth, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 142, 155, 272, 386, 399, 419, Chenoweth, Moring, Squiers
American eel *Anguilla rostrata*	51, 76, 260, 283, 373, Chenoweth, Moring, Squiers
Blueback herring *Alosa aestivalis*	142, 260, 345, 419, Chenoweth, Moring, Squiers
Alewife *Alosa pseudoharengus*	142, 260, 345, 419, Chenoweth, Libby, Moring, Squiers
American shad *Alosa sapidissima*	260, 345, 387, Chenoweth, Moring, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 76, 142, 260, 345, 419, Chenoweth, Moring, Nutting, Stevenson
Atlantic herring *Clupea harengus*	51, 76, 142, 345, 404, 419, Chenoweth, Moring, Nutting, Stevenson
Rainbow smelt *Osmerus mordax*	51, 76, 144, 260, 282, 345, 370, Chenoweth, Moring, Squiers
Atlantic salmon *Salmo salar*	41, 260, 283, Chenoweth, Moring, Squiers
Atlantic cod *Gadus morhua*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 335, 345, Chenoweth, Moring
Haddock *Melanogrammus aeglefinus*	51, 53, 76, 225, 226, 227, 228, 229, 232, 259, 335, 383, Chenoweth, Moring
Silver hake *Merluccius bilinearis*	51, 142, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Moring
Atlantic tomcod *Microgadus tomcod*	31, 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 398, Chenoweth, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Muscongus Bay, continued
Pollock *Pollachius virens*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Moring
Red hake *Urophycis chuss*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Moring
White hake *Urophycis tenuis*	31, 76, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Moring
Mummichogs *Fundulus heteroclitus*	31, 223, 260, 283, 413, 419, Chenoweth, Moring
Silversides *Menidia* species	31, 51, 76, 95, 223, 260, 404, 413, Chenoweth, Moring
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 76, 223, 260, 288, 404, 413, 440, Chenoweth, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, Moring
Ninespine stickleback *Pungitius pungitius*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, Moring
Northern pipefish *Syngnathus fuscus*	31, 51, 181, 223, 248, 260, 404, 413, Chenoweth, Moring
Northern searobin *Prionotus carolinus*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404, Chenoweth, Moring
Grubby *Myoxocephalus aeneus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, Chenoweth, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 76, 154, 172, 225, 226, 227, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
White perch *Morone americana*	51, 260, 283, 345, 404, Chenoweth, Moring
Striped bass *Morone saxatilis*	23, 51, 56, 260, 283, 426, Chenoweth, Moring, Squiers
Bluefish *Pomatomus saltatrix*	51, 76, 260, 325, 419, Chenoweth, Moring, Squiers
Scup *Stenotomus chrysops*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Tautog *Tautoga onitis*	51, 76, 154, 225, 226, 227, 228, 229, 232, 232, 259, 260, 419, Chenoweth, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Ocean pout *Macrozoarces americanus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Rock gunnel *Pholis gunnellus*	51, 76, 154, 260, 288, 289, 360, 419, Chenoweth, Moring
American sandlance *Ammodytes americanus*	51, 76, 260, 288, 325, 404, 436, Chenoweth, Moring
Atlantic mackerel *Scomber scombrus*	51, 76, 260, 325, 345, 419, Chenoweth, Moring, Nutting, Squiers, Stevenson
Butterfish *Peprilus triacanthus*	51, 76, 260, 296, 325, 345, 419, Chenoweth, Moring, Nutting, Squiers
Windowpane flounder *Scophthalmus aquosus*	154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
American plaice *Hippoglossoides platessoides*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Winter flounder *Pleuronectes americanus*	154, 225, 226, 227, 228, 229, 232, 259, 260, 275, 419, Chenoweth, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Moring
Smooth flounder *Pleuronectes putnami*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Damariscotta River
Blue mussel *Mytilus edulis*	343, 77, 311, 260, Moring, Chenoweth, Shumway, Hurst, Larsen
Sea scallop *Placopecten magellanicus*	379, 295, 142, 264, Schick, Chenoweth, Shumway, Hurst, Moring, Larsen
American oyster *Crassostrea virginica*	142, 419, 240, 158, Hurst, Shumway, Moring, Chenoweth, Creaser, Larsen
Northern quahog *Mercenaria mercenaria*	419, 393, 71, 240, Hurst, Chenoweth, Moring, Shumway, Creaser, Larsen
Softshell clam *Mya arenaria*	419, 142, 71, 260, Hurst, Shumway, Chenoweth, Moring, Larsen, Moring
Grass shrimp *Palaemonetes pugio*	433, 399, 419, 142, 336, 163, Larsen, Shumway, Moring, Perkins, Chenoweth
Northern shrimp *Pandalus borealis*	433, 419, 182, 142, 380, 259, Shumway, Larsen, Schick, Moring, Chenoweth
Sevenspine bay shrimp *Crangon septemspinosa*	176, 433, 419, 129, Larsen, Moring, Chenoweth, Perkins, Shumway
American lobster *Homarus americanus*	142, 220, 419, 433, 16, 196, 217, Krouse, Larsen, Moring, Chenoweth
Jonah crab *Cancer borealis*	260, 433, 219, 419, 399, 362, 142, Krouse, Moring, Chenoweth, Shumway, Larsen
Atlantic rock crab *Cancer irroratus*	433, 218, 260, 419, 142, 399, 362, 219, 216, Krouse, Larsen, Chenoweth, Moring
Green crab *Carcinus maenus*	50, 419, 433, 83, 4, Moring, Chenoweth, Larsen
Green sea urchin *Strongylocentrotus droebachiensis*	419, 78, 325, 186, Moring, Chenoweth, Larsen
Spiny dogfish *Squalus acanthias*	51, 419, 260, 154, 172, Perkins, Moring, Chenoweth
Skates *Raja* species	51, 227, 154, 260, Moring, Chenoweth
Shortnose sturgeon *Acipenser brevirostrum*	51, 142, 399, 419, 272, 155, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 142, 399, 419, 272, 155, Squiers
American eel *Anguilla rostrata*	51, 260, 283, 76, 373, Moring, Squiers, Chenoweth
Blueback herring *Alosa aestivalis*	260, 345, 419, 142, Squiers, Moring
Alewife *Alosa pseudoharengus*	345, 260, Libby, Squiers
American shad *Alosa sapidissima*	387, 345, 260, Squiers, Moring
Atlantic menhaden *Brevoortia tyrannus*	345, 76, 260, 142, 419, 51, Stevenson, Moring, Chenoweth
Atlantic herring *Clupea harengus*	419, 51, 345, 76, 404, 142, Stevenson, Moring, Chenoweth
Rainbow smelt *Osmerus mordax*	282, 260, 51, 370, 144, 345, 76, Squiers
Atlantic salmon *Salmo salar*	24, 25, 109, Squiers, Moring
Atlantic cod *Gadus morhua*	76, 51, 260, 154, 345, 335, 232, 225, 226, 227, 228, 229, 259, Langton, Moring, Chenoweth
Haddock *Melanogrammus aeglefinus*	53 335, 383, 76, 51, 232, 225, 226, 227, 228, 229, 259, Langton, Chenoweth, Moring
Silver hake *Merluccius bilinearis*	260, 154, 51, 419, 142, 232, 225, 226, 227, 228, 229, 259, Langton, Moring, Chenoweth
Atlantic tomcod *Microgadus tomcod*	398, 51, 31, 154, 260, 232, 225, 226, 227, 228, 229, Moring, Chenoweth, Langton

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Damariscotta River, continued
Pollock *Pollachius virens*	260, 76, 419, 154, 51, 66, 259, Schick, Moring, Langton, Chenoweth
Red hake *Urophycis chuss*	51,419, 260, 154, 232, 225, 226, 227, 228, 229, 259, Schick, Chenoweth, Moring
White hake *Urophycis tenuis*	419, 76, 260, 232, 225, 226, 227, 228, 229, 259, Chenoweth, Moring
Mummichogs *Fundulus heteroclitus*	31, 223, 260, 283, 413, 419, Chenoweth, Moring
Silversides *Menidia* species	31, 51, 76, 95, 223, 260, 404, 413, Chenoweth, Moring
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 76, 223, 260, 288, 404, 413, 440, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, Moring
Ninespine stickleback *Pungitius pungitius*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, Moring
Northern pipefish *Syngnathus fuscus*	31, 51, 181, 223, 248, 260, 404, 413, Chenoweth, Moring
Northern searobin *Prionotus carolinus*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404, Chenoweth, Moring
Grubby *Myoxocephalus aeneus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, Chenoweth, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
White perch *Morone americana*	51, 260, 283, 345, 404, Chenoweth, Moring
Striped bass *Morone saxatilis*	23, 51, 56, 260, 283, 426, Chenoweth, Moring, Squiers
Bluefish *Pomatomus saltatrix*	51, 76, 260, 325, 419, Chenoweth, Moring, Squiers
Scup *Stenotomus chrysops*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Tautog *Tautoga onitis*	51, 76, 154, 225, 226, 227, 228, 229, 232, 232, 259, 260, 419, Chenoweth, Langton, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Ocean pout *Macrozoarces americanus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Rock gunnel *Pholis gunnellus*	51, 76, 154, 260, 288, 289, 360, 419, Chenoweth, Moring
American sandlance *Ammodytes americanus*	51, 76, 260, 288, 325, 404, 436, Chenoweth, Moring
Atlantic mackerel *Scomber scombrus*	51, 76, 260, 325, 345, Chenoweth, Moring, Squiers
Butterfish *Peprilus triacanthus*	51, 76, 260, 296, 325, 345, 419, Chenoweth, Moring, Squiers
Windowpane flounder *Scophthalmus aquosus*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
American plaice *Hippoglossoides platessoides*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Winter flounder *Pleuronectes americanus*	154, 225, 226, 227, 228, 229, 232, 259, 260, 275, 419, Chenoweth, Langton, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Smooth flounder *Pleuronectes putnami*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Sheepscot River
Blue mussel *Mytilus edulis*	77, 260, 311, 343, Chenoweth, Creaser, Moring, Shumway
Sea scallop *Placopecten magellanicus*	34, 142, 295, 379, Chenoweth, Creaser, Schick, Shumway
American oyster *Crassostrea virginica*	142, 158, 240, 419, Chenoweth, Creaser, Moring, Shumway
Northern quahog *Mercenaria mercenaria*	71, 239, 393, 419, Chenoweth, Creaser, Larsen, Moring, Shumway
Softshell clam *Mya arenaria*	71, 142, 260, 419, Chenoweth, Creaser, Larsen, Moring, Shumway
Grass shrimp *Palaemonetes pugio*	142, 163, 399, 419, 433, Chenoweth, Larsen, Perkins
Northern shrimp *Pandalus borealis*	142, 182, 380, 419, 433, Chenoweth, Perkins, Schick, Shumway
Sevenspine bay shrimp *Crangon septemspinosa*	129, 176, 419, 433, Chenoweth, Creaser, Larsen, Perkins
American lobster *Homarus americanus*	16, 142, 196, 217, 220, 419, 433, Chenoweth, Creaser, Krouse, Moring
Jonah crab *Cancer borealis*	142, 219, 260, 362, 399, 419, 433, Chenoweth, Krouse, Larsen, Moring
Atlantic rock crab *Cancer irroratus*	142, 216, 218, 219, 260, 362, 399, 419, 433, Chenoweth, Krouse, Larsen, Shumway
Green crab *Carcinus maenus*	4, 50, 83, 419, 433, Chenoweth, Moring
Green sea urchin *Strongylocentrotus droebachiensis*	78, 186, 325, 419, Chenoweth, Creaser, Larsen
Spiny dogfish *Squalus acanthias*	51, 154, 172, 225, 226, 227, 228, 229, 232, 259, 260, 345, 419, Chenoweth, Langton, McCleave, Moring, Perkins
Skates *Raja* species	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, McCleave, Moring, Perkins
Shortnose sturgeon *Acipenser brevirostrum*	51, 142, 272, 386, McCleave, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 142, 155, 272, 386, 399, 419, Squiers
American eel *Anguilla rostrata*	18, 19, 20, 51, 76, 146, 147, 148, 260, 373, 385, 389, 390, 391, Squiers
Blueback herring *Alosa aestivalis*	18, 19, 20, 146, 147, 148, 260, 345, 385, 389, 390, 391, McCleave, Squiers
Alewife *Alosa pseudoharengus*	18, 19, 20, 146, 260, 345, 385, 389, 390, 391, McCleave, Squiers
American shad *Alosa sapidissima*	18, 19, 20, 108, 146, 147, 148, 260, 345, 385, 389, 391, 391, McCleave, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 76, 142, 260, 345, 419, Chenoweth, McCleave, Moring, Nutting, Stevenson
Atlantic herring *Clupea harengus*	51, 76, 142, 345, 404, 419, Chenoweth, McCleave, Moring, Nutting, Stevenson
Rainbow smelt *Osmerus mordax*	51, 76, 144, 260, 282, 345, 370, McCleave, Squiers
Atlantic salmon *Salmo salar*	18, 19, 20, 41, 146, 147, 148, 260, 283, 385, 389, 390, 391, Beland, McCleave, Squiers
Atlantic cod *Gadus morhua*	51, 76, 79, 154, 225, 226, 227, 228, 229, 232, 259, 260, 335, 345, Chenoweth, Langton, Moring, Perkins
Haddock *Melanogrammus aeglefinus*	51, 53, 76, 225, 226, 227, 228, 229, 232, 259, 335, 383, Chenoweth, Langton, Moring, Perkins
Silver hake *Merluccius bilinearis*	51, 142, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, McCleave, Moring, Perkins
Atlantic tomcod *Microgadus tomcod*	31, 51, 154, 225, 226, 227, 228, 229, 232, 260, 398, Chenoweth, Langton, McCleave, Moring, Perkins

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Sheepscot River, continued
Pollock *Pollachius virens*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, McCleave, Moring
Red hake *Urophycis chuss*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, McCleave, Moring, Perkins
White hake *Urophycis tenuis*	76, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, McCleave, Moring, Perkins
Mummichogs *Fundulus heteroclitus*	31, 223, 260, 283, 413, 419, Chenoweth, McCleave, Moring
Silversides *Menidia* species	31, 51, 76, 95, 223, 260, 404, 413, Chenoweth, McCleave, Moring
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 76, 223, 260, 288, 404, 413, 440, Chenoweth, McCleave, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, McCleave, Moring
Ninespine stickleback *Pungitius pungitius*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, McCleave, Moring
Northern pipefish *Syngnathus fuscus*	31, 51, 181, 223, 248, 260, 404, 413, Chenoweth, McCleave
Northern searobin *Prionotus carolinus*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404, Chenoweth, Moring
Grubby *Myoxocephalus aeneus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, McCleave, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, 370, Chenoweth, Langton, McCleave, Moring, Perkins
Shorthorn sculpin *Myoxocephalus scorpius*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, Chenoweth, Langton, McCleave, Moring
White perch *Morone americana*	18, 19, 20, 51, 146, 147, 148, 260, 283, 345, 385, 391, 391, 404, McCleave
Striped bass *Morone saxatilis*	18, 19, 20, 51, 56, 146, 147, 148, 260, 283, 385, 389, 390, 391, 426, McCleave, Squiers
Bluefish *Pomatomus saltatrix*	51, 76, 260, 325, 419, McCleave, Moring, Nutting, Squiers
Scup *Stenotomus chrysops*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, McCleave, Moring
Tautog *Tautoga onitis*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, McCleave, Moring
Cunner *Tautogolabrus adspersus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, McCleave, Moring
Ocean pout *Macrozoarces americanus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, McCleave, Moring
Rock gunnel *Pholis gunnellus*	51, 76, 154, 260, 289, 360, 419, Chenoweth, McCleave, Moring
American sandlance *Ammodytes americanus*	51, 76, 260, 288, 325, 404, 436, Chenoweth, Moring
Atlantic mackerel *Scomber scombrus*	51, 76, 260, 325, 345, Chenoweth, McCleave, Moring, Nutting, Squiers, Stevenson
Butterfish *Peprilus triacanthus*	51, 76, 260, 296, 325, 345, 419, Chenoweth, McCleave, Moring, Nutting, Squiers
Windowpane flounder *Scophthalmus aquosus*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, McCleave, Moring
American plaice *Hippoglossoides platessoides*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Winter flounder *Pleuronectes americanus*	154, 225, 226, 227, 228, 229, 232, 259, 260, 275, 419, Chenoweth, Langton, McCleave, Moring, Perkins
Yellowtail flounder *Pleuronectes ferrugineus*	76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring, Perkins
Smooth flounder *Pleuronectes putnami*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, McCleave, Moring, Perkins

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Kennebec/ Androscoggin Rivers
Blue mussel *Mytilus edulis*	77, 260, 311, 343, Creaser, Larsen, Moring, Shumway
Sea scallop *Placopecten magellanicus*	34, 142, 295, 379, Chenoweth, Creaser, Larsen, Moring, Schick, Shumway
American oyster *Crassostrea virginica*	142, 158, 240, 419, Chenoweth, Creaser, Larsen, Moring, Shumway
Northern quahog *Mercenaria mercenaria*	71, 240, 393, 419, Chenoweth, Creaser, Larsen, Moring, Shumway
Softshell clam *Mya arenaria*	71, 142, 260, 419, Chenoweth, Creaser, Larsen, Moring, Shumway
Grass shrimp *Palaemonetes pugio*	142, 163, 212, 336, 399, 419, 433, Chenoweth, Creaser, Larsen, Moring, Perkins, Shumway
Northern shrimp *Pandalus borealis*	142, 182, 259, 380, 419, 433, Chenoweth, Creaser, Larsen, Moring, Shumway,
Sevenspine bay shrimp *Crangon septemspinosa*	129, 176, 419, 433, Chenoweth, Creaser, Larsen, Moring, Shumway
American lobster *Homarus americanus*	16, 142, 196, 217, 220, 419, 433, Chenoweth, Creaser, Krouse, Larsen, Moring
Jonah crab *Cancer borealis*	142, 218, 260, 362, 399, 419, 433, Chenoweth, Creaser, Krouse, Larsen, Moring, Shumway
Atlantic rock crab *Cancer irroratus*	142, 216, 218, 219, 260, 362, 399, 419, 433, Chenoweth, Creaser, Krouse, Larsen, Moring, Shumway
Green crab *Carcinus maenus*	4, 50, 83, 419, 433, Chenoweth, Creaser, Krouse, Larsen, Moring, Shumway
Green sea urchin *Strongylocentrotus droebachiensis*	78, 185, 325, 419, Chenoweth, Creaser, Larsen, Moring, Shumway
Spiny dogfish *Squalus acanthias*	51, 154, 172, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Skates *Raja* species	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Shortnose sturgeon *Acipenser brevirostrum*	51, 142, 155, 272, 384, 386, 399, 419, Chenoweth, Moring, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 142, 155, 272, 384, 386, 399, 419, Chenoweth, Moring, Squiers
American eel *Anguilla rostrata*	18, 19, 20, 76, 146, 147, 148, 260, 283, 373, 385, 389, 390, 391, Chenoweth, Moring, Squiers
Blueback herring *Alosa aestivalis*	18, 19, 20, 146, 147, 148, 260, 345, 385, 389, 390, 391, Chenoweth, Moring, Squiers
Alewife *Alosa pseudoharengus*	18, 19, 20, 146, 147, 148, 385, 389, 390, 391, Chenoweth, Libby, Moring, Squiers
American shad *Alosa sapidissima*	18, 19, 20, 108, 146, 147, 148, 260, 345, 385, 389, 390, 391, Chenoweth, Moring, Squiers
Atlantic menhaden *Brevoortia tyrannus*	76, 142, 260, 345, 419, Chenoweth, Moring, Nutting, Stevenson
Atlantic herring *Clupea harengus*	51, 76, 142, 345, 404, 419, Chenoweth, Moring, Stevenson
Rainbow smelt *Osmerus mordax*	51, 76, 144, 260, 282, 345, 370, Chenoweth, Moring, Squiers
Atlantic salmon *Salmo salar*	18, 19, 20, 41, 146, 147, 148, 260, 283, 385, 389, 390, 391, Chenoweth, Moring, Squiers
Atlantic cod *Gadus morhua*	76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 335, 345, Chenoweth, Langton, Moring
Haddock *Melanogrammus aeglefinus*	51, 53, 76, 225, 226, 227, 228, 229, 232, 259, 335, 383, Chenoweth, Langton, Moring
Silver hake *Merluccius bilinearis*	51, 142, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Atlantic tomcod *Microgadus tomcod*	31, 51, 154, 225, 226, 227, 228, 229, 232, 260, 398, Chenoweth, Langton, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Kennebec/Androscoggin Rivers, continued
Pollock *Pollachius virens*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Red hake *Urophycis chuss*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
White hake *Urophycis tenuis*	31, 76, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Mummichogs *Fundulus heteroclitus*	31, 223, 260, 283, 413, 419, Chenoweth, Moring
Silversides *Menidia* species	31, 51, 76, 95, 223, 260, 404, 413, Chenoweth, Moring
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 76, 223, 260, 288, 404, 413, 440, Chenoweth, Moring
Threespine stickleback *Gasterosteus aculeatus*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, Moring
Ninespine stickleback *Pungitius pungitius*	28, 51, 223, 260, 283, 288, 404, 413, 440, Chenoweth, Moring
Northern pipefish *Syngnathus fuscus*	31, 51, 181, 223, 248, 260, 404, 413, Chenoweth, Moring
Northern searobin *Prionotus carolinus*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404, Chenoweth, Moring
Grubby *Myoxocephalus aeneus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, 370, Chenoweth, Langton, Moring
Shorthorn sculpin *Myoxocephalus scorpius*	51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, Chenoweth, Langton, Moring
White perch *Morone americana*	51, 260, 283, 345, 404, Chenoweth, Moring
Striped bass *Morone saxatilis*	18, 19, 20, 56, 146, 147, 148, 260, 385, 389, 390, 391, 426, Chenoweth, Moring, Squiers
Bluefish *Pomatomus saltatrix*	51, 76, 260, 324, 419, Chenoweth, Moring, Nutting, Squiers, Stevenson
Scup *Stenotomus chrysops*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Moring
Tautog *Tautoga onitis*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Cunner *Tautogolabrus adspersus*	29, 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Ocean pout *Macrozoarces americanus*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Rock gunnel *Pholis gunnellus*	51, 76, 154, 260, 288, 289, 360, 419, Chenoweth, Moring
American sandlance *Ammodytes americanus*	51, 76, 260, 288, 325, 404, 436, Chenoweth, Moring
Atlantic mackerel *Scomber scombrus*	51, 76, 260, 325, 345, Chenoweth, Moring, Nutting, Squiers
Butterfish *Peprilus triacanthus*	51, 76, 260, 296, 325, 345, 419, Chenoweth, Moring, Nutting, Squiers
Windowpane flounder *Scophthalmus aquosus*	154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
American plaice *Hippoglossoides platessoides*	51, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring
Winter flounder *Pleuronectes americanus*	154, 225, 226, 227, 228, 229, 232, 232, 259, 260, 275, 419, Chenoweth, Langton, Moring
Yellowtail flounder *Pleuronectes ferrugineus*	76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419, Chenoweth, Langton, Moring
Smooth flounder *Pleuronectes putnami*	51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, Chenoweth, Langton, Moring

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Casco Bay
Blue mussel *Mytilus edulis*	70, 74, 142, 238, 309, 310, 311, 343, 419, Creaser, Doggett, Goode, Larsen, Shumway, Sterl
Sea scallop *Placopecten magellanicus*	70, 142, 295, 379, 419, Creaser, Doggett, Goode, Larsen, Shumway, Sterl
American oyster *Crassostrea virginica*	142, 158, 371, Creaser, Doggett, Goode, Larsen, Shumway, Sterl
Northern quahog *Mercenaria mercenaria*	142, 393, 419, Creaser, Doggett, Goode, Larsen, Shumway, Sterl
Softshell clam *Mya arenaria*	67, 142, 238, 308, 419, Creaser, Doggett, Goode, Larsen, Shumway, Sterl
Grass shrimp *Palaemonetes pugio*	9, 73, 213, 433, Creaser, Doggett, Larsen, Perkins, Shumway, Sterl
Northern shrimp *Pandalus borealis*	73, 74, 142, 182, 278, 332, 380, 419, 433, Creaser, Doggett, Goode, Larsen, Perkins, Shumway, Sterl
Sevenspine bay shrimp *Crangon septemspinosa*	73, 100, 176, 433, Creaser, Doggett, Goode, Larsen, Perkins, Shumway, Sterl
American lobster *Homarus americanus*	70, 73, 97, 142, 217, 324, 325, 419, Creaser, Doggett, Goode, Krouse, Larsen, Perkins, Shumway, Sterl
Jonah crab *Cancer borealis*	73, 75, 142, 175, 201, 219, 238, 325, 433, Creaser, Doggett, Goode, Krouse, Larsen, Perkins, Shumway, Sterl
Atlantic rock crab *Cancer irroratus*	52, 73, 75, 142, 201, 216, 219, 238, 325, 433, Creaser, Doggett, Goode, Krouse, Larsen, Perkins, Shumway, Sterl
Green crab *Carcinus maenus*	50, 73, 83, 355, 428, 433, Creaser, Doggett, Goode, Larsen, Perkins, Shumway, Sterl
Green sea urchin *Strongylocentrotus droebachiensis*	78, 185, 186, 238, 293, 372, 419, Creaser, Doggett, Goode, Larsen, Shumway, Sterl
Spiny dogfish *Squalus acanthias*	51, 70, 73, 142, 202, 304, 325, 345, 419, Goode, Langton, Perkins
Skates *Raja* species	51, 70, 73, 142, 232, 260, 276, 370, 419, Goode, Langton, Perkins
Shortnose sturgeon *Acipenser brevirostrum*	51, 106, 142, 161, 370, 419, Goode, Langton, Perkins, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 142, 161, 370, 405, Goode, Langton, Perkins, Squiers
American eel *Anguilla rostrata*	31, 51, 76, 137, 142, 184, 370, Goode, Langton, Perkins, Squiers
Blueback herring *Alosa aestivalis*	31, 51, 70, 142, 251, 260, 294, 345, 370, 419, Goode, Squiers,
Alewife *Alosa pseudoharengus*	31, 51, 70, 74, 142, 251, 294, 370, 404, 419, Goode, Squiers
American shad *Alosa sapidissima*	51, 108, 142, 260, 345, 370, 419, 427, Goode, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 70, 74, 142, 260, 345, 354, 370, 419, Chenoweth, Goode
Atlantic herring *Clupea harengus*	31, 70, 73, 76, 101, 102, 142, 166, 167, 168, 208, 381, 404, 419, Chenoweth, Goode
Rainbow smelt *Osmerus mordax*	31, 51, 62, 70, 73, 76, 142, 260, 345, 370, 419, Goode, Squiers
Atlantic salmon *Salmo salar*	24, 25, 41, 51, 109, 142, Goode, Squiers,
Atlantic cod *Gadus morhua*	51, 70, 73, 74, 76, 142, 320, 321, 325, 335, 370, 419, Goode, Langton, Perkins
Haddock *Melanogrammus aeglefinus*	51, 53, 74, 142, 320, 321, 335, 370, 419, Goode, Langton, Perkins
Silver hake *Merluccius bilinearis*	51, 70, 73, 74, 76, 142, 232, 260, 321, 370, 419, Goode, Langton, Perkins
Atlantic tomcod *Microgadus tomcod*	31, 51, 70, 73, 142, 260, 370, 398, 404, Goode, Langton, Perkins

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Casco Bay, continued
Pollock *Pollachius virens*	51, 70, 73, 74, 142, 269, 325, 370, 419, Goode, Langton, Perkins
Red hake *Urophycis chuss*	51, 70, 73, 74, 142, 232, 260, 265, 302, 370, Goode, Langton, Perkins
White hake *Urophycis tenuis*	31, 51, 70, 73, 74, 138, 142, 260, 265, 302, 370, 419, Goode, Langton, Perkins
Mummichogs *Fundulus heteroclitus*	2, 31, 51, 121, 142, 370, 404, 419, Chenoweth, Goode
Silversides *Menidia* species	31, 51, 73, 94, 121, 141, 142, 370, 404, 419, Chenoweth, Goode
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 142, 370, 404, 439, 440, Chenoweth, Goode
Threespine stickleback *Gasterosteus aculeatus*	28, 31, 51, 121, 142, 370, 404, 439, 440, Chenoweth, Goode
Ninespine stickleback *Pungitius pungitius*	28, 31, 51, 121, 142, 370, 404, 439, 440, Chenoweth, Goode
Northern pipefish *Syngnathus fuscus*	31, 51, 73, 76, 142, 248, 370, Chenoweth, Goode
Northern searobin *Prionotus carolinus*	51, 142, 350, 370, Goode, Langton, Perkins
Grubby *Myoxocephalus aeneus*	31, 51, 73, 142, 247, 260, 370, Goode, Langton, Perkins
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 70, 73, 76, 142, 232, 235, 260, 325, 370, 419, Goode, Langton, Perkins
Shorthorn sculpin *Myoxocephalus scorpius*	51, 70, 76, 142, 235, 325, 370, Goode, Langton, Perkins
White perch *Morone americana*	51, 121, 142, 260, 370, 392, Chenoweth
Striped bass *Morone saxatilis*	51, 56, 121, 140, 142, 260, 370, 419, 426, Chenoweth, Goode, Squiers
Bluefish *Pomatomus saltatrix*	51, 70, 73, 121, 142, 260, 287, 327, 370, 419, Chenoweth, Goode, Squiers
Scup *Stenotomus chrysops*	51, 74, 142, 290, 370, 419, Langton, Perkins
Tautog *Tautoga onitis*	29, 51, 142, 370, 419, Goode, Langton, Perkins
Cunner *Tautogolabrus adspersus*	29, 51, 70, 76, 142, 325, 370, 419, Goode, Langton, Perkins
Ocean pout *Macrozoarces americanus*	51, 70, 73, 142, 232, 260, 370, 419, Goode, Langton, Perkins
Rock gunnel *Pholis gunnellus*	31, 51, 70, 73, 76, 142, 360, 370, Goode, Langton, Perkins
American sandlance *Ammodytes americanus*	30, 31, 51, 76, 121, 142, 306, 347, 370, 382, 419, Chenoweth
Atlantic mackerel *Scomber scombrus*	51, 70, 73, 74, 142, 260, 325, 345, 370, 419, Chenoweth, Goode, Squiers
Butterfish *Peprilus triacanthus*	51, 70, 73, 142, 296, 297, 370, 419, Chenoweth, Goode, Squiers
Windowpane flounder *Scophthalmus aquosus*	51, 70, 73, 74, 76, 142, 232, 260, 370, Goode, Langton, Perkins
American plaice *Hippoglossoides platessoides*	51, 70, 74, 142, 232, 320, 321, 335, 370, 419, Goode, Langton, Perkins
Winter flounder *Pleuronectes americanus*	27, 31, 51, 63, 70, 74, 142, 260, 275, 370, 404, 419, Goode, Langton, Perkins
Yellowtail flounder *Pleuronectes ferrugineus*	51, 70, 74, 76, 142, 232, 320, 321, 321, 370, 419, Goode, Langton, Perkins
Smooth flounder *Pleuronectes putnami*	27, 31, 51, 142, 234, 260, 370, 404, Goode, Langton, Perkins

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Saco Bay
Blue mussel *Mytilus edulis*	70, 74, 142, 309, 310, 311, 343, 419, Creaser, Goode, Larsen, Shumway, Sterl
Sea scallop *Placopecten magellanicus*	70, 142, 295, 379, 419, Creaser, Goode, Larsen, Shumway, Sterl
American oyster *Crassostrea virginica*	142, 158, 371, Creaser, Goode, Larsen, Shumway, Sterl
Northern quahog *Mercenaria mercenaria*	393, 419, Creaser, Goode, Larsen, Shumway, Sterl
Softshell clam *Mya arenaria*	142, 308, 419, Creaser, Goode, Larsen, Shumway, Sterl
Grass shrimp *Palaemonetes pugio*	9, 213, 433, Creaser, Larsen, Perkins, Shumway, Sterl
Northern shrimp *Pandalus borealis*	74, 142, 182, 278, 332, 380, 419, 433, Creaser, Goode, Larsen, Perkins, Shumway, Sterl
Sevenspine bay shrimp *Crangon septemspinosa*	100, 176, 284, 346, 433, Creaser, Goode, Larsen, Perkins, Shumway, Sterl
American lobster *Homarus americanus*	70, 97, 142, 217, 324, 325, 346, 419, Creaser, Goode, Krouse, Larsen, Perkins, Shumway, Sterl
Jonah crab *Cancer borealis*	75, 142, 175, 201, 219, 284, 324, 325, 346, 433, Creaser, Goode, Krouse, Larsen, Perkins, Shumway, Sterl
Atlantic rock crab *Cancer irroratus*	52, 75, 142, 201, 216, 219, 324, 325, 346, 433, Creaser, Goode, Krouse, Larsen, Perkins, Shumway, Sterl
Green crab *Carcinus maenus*	50, 83, 284, 346, 355, 428, 433, Creaser, Goode, Larsen, Perkins, Shumway, Sterl
Green sea urchin *Strongylocentrotus droebachiensis*	78, 185, 186, 293, 346, 372, 419, Creaser, Larsen, Shumway
Spiny dogfish *Squalus acanthias*	51, 70, 142, 202, 260, 304, 324, 325, 345, 370, 419, Goode, Langton, Perkins
Skates *Raja* species	51, 70, 72, 142, 232, 260, 276, 346, 370, 419, Goode, Langton, Perkins
Shortnose sturgeon *Acipenser brevirostrum*	17, 51, 106, 142, 161, 370, 419, Goode, Langton, Perkins, Squiers
Atlantic sturgeon *Acipenser oxyrhynchus*	17, 51, 142, 161, 370, 405, Goode, Langton, Perkins, Squiers
American eel *Anguilla rostrata*	31, 51, 72, 76, 137, 142, 184, 346, 370, Goode, Langton, Perkins, Squiers
Blueback herring *Alosa aestivalis*	17, 31, 51, 70, 121, 142, 251, 260, 294, 345, 370, 419, Goode, Squiers
Alewife *Alosa pseudoharengus*	17, 31, 51, 70, 74, 121, 142, 251, 294, 345, 370, 404, 419, Goode, Squiers
American shad *Alosa sapidissima*	17, 51, 72, 108, 121, 142, 260, 345, 370, 419, 427, Goode, Squiers
Atlantic menhaden *Brevoortia tyrannus*	51, 70, 74, 121, 142, 260, 345, 354, 370, 419, Chenoweth, Goode
Atlantic herring *Clupea harengus*	31, 51, 70, 74, 102, 121, 142, 208, 249, 370, 404, 419, Chenoweth, Goode
Rainbow smelt *Osmerus mordax*	17, 31, 51, 62, 70, 76, 121, 142, 260, 345, 370, 419, Goode, Squiers
Atlantic salmon *Salmo salar*	17, 24, 25, 41, 51, 109, 142, 346, Goode, Squiers
Atlantic cod *Gadus morhua*	51, 70, 74, 76, 142, 320, 321, 324, 325, 335, 346, 370, 419, Goode, Langton, Perkins
Haddock *Melanogrammus aeglefinus*	51, 53, 74, 142, 320, 321, 335, 370, 419, Goode, Langton, Perkins
Silver hake *Merluccius bilinearis*	51, 70, 74, 76, 142, 232, 260, 320, 321, 346, 370, 419, Goode, Langton, Perkins
Atlantic tomcod *Microgadus tomcod*	31, 51, 70, 121, 142, 260, 346, 370, 398, 404, Langton, Perkins

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Saco Bay, continued
Pollock *Pollachius virens*	51, 70, 74, 121, 142, 269, 324, 325, 346, 370, 419, Goode, Langton, Perkins
Red hake *Urophycis chuss*	51, 70, 72, 74, 142, 232, 260, 265, 302, 346, 370, Goode, Langton, Perkins
White hake *Urophycis tenuis*	31, 51, 70, 74, 138, 142, 227, 260, 265, 302, 370, 419, Goode, Langton, Perkins
Mummichogs *Fundulus heteroclitus*	2, 31, 51, 72, 121, 142, 346, 370, 404, 419, Chenoweth, Goode
Silversides *Menidia* species	31, 51, 72, 94, 121, 141, 142, 370, 404, 419, Chenoweth, Goode
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 72, 142, 346, 370, 404, 439, 440, Chenoweth, Goode
Threespine stickleback *Gasterosteus aculeatus*	28, 31, 51, 72, 121, 142, 346, 370, 404, 439, 440, Chenoweth, Goode
Ninespine stickleback *Pungitius pungitius*	28, 31, 51, 121, 142, 346, 370, 404, 439, 440, Chenoweth, Goode
Northern pipefish *Syngnathus fuscus*	31, 51, 72, 76, 142, 248, 370, Chenoweth
Northern searobin *Prionotus carolinus*	51, 142, 350, 370, Goode, Langton, Perkins
Grubby *Myoxocephalus aeneus*	31, 51, 142, 247, 260, 370, Goode, Langton, Perkins
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 70, 76, 142, 232, 235, 260, 325, 370, 419, Goode, Langton, Perkins
Shorthorn sculpin *Myoxocephalus scorpius*	51, 70, 76, 142, 235, 325, 370, Goode, Langton, Perkins
White perch *Morone americana*	51, 121, 142, 260, 370, 392, Chenoweth
Striped bass *Morone saxatilis*	17, 51, 56, 121, 140, 142, 260, 370, 419, 426, Chenoweth, Goode, Squiers
Bluefish *Pomatomus saltatrix*	51, 70, 121, 142, 260, 287, 327, 370, 419, Chenoweth, Goode, Squiers
Scup *Stenotomus chrysops*	51, 74, 142, 290, 370, 419, Goode, Langton, Perkins
Tautog *Tautoga onitis*	29, 51, 142, 370, 419, Goode, Langton, Perkins
Cunner *Tautogolabrus adspersus*	29, 51, 70, 76, 142, 325, 346, 370, 419, Goode, Langton, Perkins
Ocean pout *Macrozoarces americanus*	51, 70, 142, 232, 260, 370, 419, Goode, Langton, Perkins
Rock gunnel *Pholis gunnellus*	31, 51, 70, 76, 142, 360, 370, Goode, Langton, Perkins
American sandlance *Ammodytes americanus*	30, 31, 51, 72, 76, 121, 142, 306, 346, 347, 370, 419, Chenoweth
Atlantic mackerel *Scomber scombrus*	51, 70, 74, 121, 142, 260, 324, 325, 345, 346, 370, 419, Chenoweth, Goode, Squiers
Butterfish *Peprilus triacanthus*	51, 70, 142, 296, 297, 370, 419, Chenoweth, Goode, Squiers
Windowpane flounder *Scophthalmus aquosus*	51, 70, 74, 76, 142, 232, 260, 346, 370, Goode, Langton, Perkins
American plaice *Hippoglossoides platessoides*	51, 70, 74, 142, 232, 335, 370, 419, Goode, Langton, Perkins
Winter flounder *Pleuronectes americanus*	27, 31, 51, 63, 70, 74, 142, 275, 346, 370, 404, 419, Goode, Langton, Perkins
Yellowtail flounder *Pleuronectes ferrugineus*	51, 70, 74, 76, 142, 232, 320, 321, 370, 419, Goode, Langton, Perkins
Smooth flounder *Pleuronectes putnami*	27, 31, 51, 142, 234, 260, 370, 404, Langton, Perkins

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Wells Harbor
Blue mussel *Mytilus edulis*	142, 238, 309, 310, 311, 343, 419, Dionne, Sterl
Sea scallop *Placopecten magellanicus*	142, 295, 379, 419, Dionne, Sterl
American oyster *Crassostrea virginica*	142, 158, 371, Dionne, Sterl
Northern quahog *Mercenaria mercenaria*	393, 419, Sterl
Softshell clam *Mya arenaria*	142, 162, 238, 308, 419, Dionne, Sterl
Grass shrimp *Palaemonetes pugio*	9, 213, 312, 429, 433, Dionne, Sterl
Northern shrimp *Pandalus borealis*	142, 182, 278, 332, 380, 419, 433, Dionne, Sterl
Sevenspine bay shrimp *Crangon septemspinosa*	100, 162, 176, 433, Dionne, Sterl
American lobster *Homarus americanus*	1, 97, 142, 162, 217, 257, 419, Dionne, Sterl
Jonah crab *Cancer borealis*	75, 142, 175, 201, 219, 433, Dionne, Sterl
Atlantic rock crab *Cancer irroratus*	52, 75, 142, 201, 216, 219, 433, Dionne, Sterl
Green crab *Carcinus maenus*	50, 83, 162, 355, 428, 433, Dionne, Sterl
Green sea urchin *Strongylocentrotus droebachiensis*	78, 185, 186, 293, 372, 419, Dionne, Sterl
Spiny dogfish *Squalus acanthias*	51, 142, 202, 304, 345, 370, 419, Dionne, Sterl
Skates *Raja* species	51, 142, 232, 276, 370, 419, Dionne, Sterl
Shortnose sturgeon *Acipenser brevirostrum*	51, 106, 142, 161, 370, 419, Dionne, Sterl
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 142, 161, 370, 405, Dionne, Sterl
American eel *Anguilla rostrata*	31, 51, 76, 114, 137, 142, 184, 370, Dionne, Sterl
Blueback herring *Alosa aestivalis*	31, 51, 114, 142, 251, 294, 345, 370, 419, Dionne, Sterl
Alewife *Alosa pseudoharengus*	31, 51, 114, 142, 251, 294, 345, 370, 404, 419, Dionne, Sterl
American shad *Alosa sapidissima*	51, 108, 142, 345, 370, 419, 427, Dionne, Sterl
Atlantic menhaden *Brevoortia tyrannus*	51, 142, 345, 354, 370, 419, Dionne, Sterl
Atlantic herring *Clupea harengus*	31, 51, 102, 114, 142, 166, 208, 249, 370, 404, 419, Dionne, Sterl
Rainbow smelt *Osmerus mordax*	31, 51, 62, 76, 114, 142, 345, 370, 419, Dionne, Sterl
Atlantic salmon *Salmo salar*	24, 25, 41, 51, 109, 142, Dionne
Atlantic cod *Gadus morhua*	51, 76, 142, 335, 370, 419, Dionne, Sterl
Haddock *Melanogrammus aeglefinus*	51, 53, 142, 335, 370, 419, Dionne, Sterl
Silver hake *Merluccius bilinearis*	51, 76, 142, 232, 370, 419, Dionne, Sterl
Atlantic tomcod *Microgadus tomcod*	31, 51, 114, 142, 370, 398, 404, Dionne, Sterl

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Wells Harbor, continued
Pollock *Pollachius virens*	51, 142, 162, 269, 370, 419, Dionne, Sterl
Red hake *Urophycis chuss*	51, 142, 232, 265, 302, 370, Sterl
White hake *Urophycis tenuis*	31, 51, 114, 138, 142, 232, 265, 302, 370, 419, Sterl
Mummichogs *Fundulus heteroclitus*	2, 31, 51, 114, 142, 301, 370, 404, 419, Dionne, Sterl
Silversides *Menidia* species	31, 51, 94, 114, 141, 142, 370, 404, 419, Dionne, Sterl
Fourspine stickleback *Apeltes quadracus*	28, 31, 51, 114, 142, 370, 404, 439, 440, Dionne, Sterl
Threespine stickleback *Gasterosteus aculeatus*	28, 31, 51, 114, 142, 370, 404, 439, 440, Dionne, Sterl
Ninespine stickleback *Pungitius pungitius*	28, 31, 51, 114, 142, 370, 404, 439, 440, Dionne, Sterl
Northern pipefish *Syngnathus fuscus*	31, 51, 76, 114, 142, 248, 370, Dionne, Sterl
Northern searobin *Prionotus carolinus*	51, 142, 350, 370, Dionne, Sterl
Grubby *Myoxocephalus aeneus*	31, 51, 114, 142, 370, Sterl
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 76, 142, 232, 235, 370, 419, Dionne, Sterl
Shorthorn sculpin *Myoxocephalus scorpius*	51, 76, 142, 235, 370, Dionne, Sterl
White perch *Morone americana*	51, 142, 370, 392, Dionne, Sterl
Striped bass *Morone saxatilis*	51, 56, 140, 142, 162, 370, 419, 426, Dionne, Sterl
Bluefish *Pomatomus saltatrix*	51, 142, 287, 327, 370, 419, Dionne, Sterl
Scup *Stenotomus chrysops*	51, 142, 290, 370, 419, Sterl
Tautog *Tautoga onitis*	29, 51, 142, 370, 419, Sterl
Cunner *Tautogolabrus adspersus*	29, 51, 76, 142, 370, 419, Sterl
Ocean pout *Macrozoarces americanus*	51, 142, 232, 370, 419, Dionne, Sterl
Rock gunnel *Pholis gunnellus*	31, 51, 76, 142, 289, 360, 370, Sterl
American sandlance *Ammodytes americanus*	30, 31, 51, 76, 114, 142, 162, 347, 370, 382, 419, Dionne, Sterl
Atlantic mackerel *Scomber scombrus*	51, 142, 162, 345, 370, 419, Dionne, Sterl
Butterfish *Peprilus triacanthus*	51, 142, 296, 297, 370, 419, Dionne, Sterl
Windowpane flounder *Scophthalmus aquosus*	51, 76, 114, 142, 232, 370, Dionne, Sterl
American plaice *Hippoglossoides platessoides*	51, 142, 232, 335, 370, 419, Dionne, Sterl
Winter flounder *Pleuronectes americanus*	27, 31, 51, 63, 114, 142, 232, 275, 370, 404, 419, Dionne, Sterl
Yellowtail flounder *Pleuronectes ferrugineus*	51, 76, 114, 142, 232, 370, 419, Dionne, Sterl
Smooth flounder *Pleuronectes putnami*	27, 31, 51, 114, 142, 370, 404, Dionne, Sterl

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Great Bay
Blue mussel *Mytilus edulis*	22, 115, 116, 180, 309, 310, 311, 318, 343, 378, 420, Armstrong, Bowen, Grizzle, Harris, Howell, Nelson, Short
Sea scallop *Placopecten magellanicus*	142, 295, 318, 379, 420, Armstrong, Bowen, Grizzle, Harris, Howell, Nelson
American oyster *Crassostrea virginica*	22, 115, 116, 180, 200, 371, 378, 420, Armstrong, Bowen, Grizzle, Howell, Nelson, Short
Northern quahog *Mercenaria mercenaria*	115, 116, 378, 393, Armstrong, Bowen, Grizzle, Howell, Nelson
Softshell clam *Mya arenaria*	22, 61, 115, 116, 180, 200, 308, 318, 378, 420, Armstrong, Bowen, Grizzle, Howell, Nelson, Short
Grass shrimp *Palaemonetes pugio*	9, 213, 312, 433, Armstrong, Bowen, Gestring, Howell, Nelson, Short
Northern shrimp *Pandalus borealis*	182, 278, 332, 380, 433, Armstrong, Bowen, Gestring, Howell, Nelson
Sevenspine bay shrimp *Crangon septemspinosa*	22, 99, 100, 115, 116, 176, 318, 420, 433, Armstrong, Bowen, Gestring, Howell, Nelson
American lobster *Homarus americanus*	22, 115, 116, 164, 192, 257, 318, 378, 420, 425, 433, Armstrong, Bowen, Howell, Nelson, Short
Jonah crab *Cancer borealis*	75, 115, 116, 175, 201, 318, 378, 420, 433, Armstrong, Bowen, Harris, Howell, Nelson, Short
Atlantic rock crab *Cancer irroratus*	22, 52, 75, 115, 116, 201, 216, 318, 378, 420, 433, Armstrong, Bowen, Harris, Howell, Nelson, Short
Green crab *Carcinus maenus*	50, 115, 116, 180, 318, 355, 378, 420, 428, 433, Armstrong, Bowen, Harris, Howell, Nelson, Short
Green sea urchin *Strongylocentrotus droebachiensis*	180, 372, 420, Armstrong, Bowen, Harris, Howell, Nelson
Spiny dogfish *Squalus acanthias*	51, 92, 115, 202, 304, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Skates *Raja* species	51, 115, 116, 276, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Shortnose sturgeon *Acipenser brevirostrum*	51, 106, 161, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 115, 161, 200, 370, 378, 405, Armstrong, Bowen, Gestring, Howell, Nelson
American eel *Anguilla rostrata*	51, 115, 116, 137, 184, 200, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Blueback herring *Alosa aestivalis*	22, 51, 115, 116, 117, 160, 251, 294, 316, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Alewife *Alosa pseudoharengus*	3, 22, 51, 115, 116, 117, 160, 224, 251, 294, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
American shad *Alosa sapidissima*	51, 108, 115, 117, 370, 378, 427, Armstrong, Bowen, Howell, Nelson
Atlantic menhaden *Brevoortia tyrannus*	51, 115, 116, 316, 318, 354, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Atlantic herring *Clupea harengus*	22, 31, 51, 102, 115, 116, 208, 316, 318, 370, 378, 381, 416, Armstrong, Bowen, Gestring, Howell, Nelson
Rainbow smelt *Osmerus mordax*	22, 51, 62, 115, 116, 117, 160, 200, 298, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Atlantic salmon *Salmo salar*	22, 24, 25, 51, 109, 115, 116, 117, 200, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Atlantic cod *Gadus morhua*	51, 115, 116, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Haddock *Melanogrammus aeglefinus*	22, 51, 53, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Silver hake *Merluccius bilinearis*	51, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Atlantic tomcod *Microgadus tomcod*	22, 51, 115, 116, 160, 200, 316, 318, 338, 370, 378, 398, Armstrong, Bowen, Gestring, Howell, Nelson

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Great Bay, continued
Pollock *Pollachius virens*	22, 51, 115, 116, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Red hake *Urophycis chuss*	22, 51, 115, 116, 265, 302, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
White hake *Urophycis tenuis*	22, 51, 115, 116, 138, 265, 302, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Mummichogs *Fundulus heteroclitus*	2, 22, 31, 51, 115, 116, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Silversides *Menidia* species	22, 31, 51, 95, 96, 115, 116, 141, 160, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Fourspine stickleback *Apeltes quadracus*	22, 28, 31, 51, 115, 116, 160, 316, 318, 370, 378, 440, Armstrong, Bowen, Gestring, Howell, Nelson, Short
Threespine stickleback *Gasterosteus aculeatus*	22, 28, 31, 51, 115, 116, 160, 316, 318, 370, 378, 440, Armstrong, Bowen, Gestring, Howell, Nelson
Ninespine stickleback *Pungitius pungitius*	22, 28, 31, 51, 115, 116, 160, 316, 318, 370, 378, 440, Armstrong, Bowen, Gestring, Howell, Nelson
Northern pipefish *Syngnathus fuscus*	31, 51, 115, 116, 160, 248, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Northern searobin *Prionotus carolinus*	22, 51, 316, 350, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Grubby *Myoxocephalus aeneus*	22, 51, 115, 116, 160, 247, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Longhorn sculpin *Myoxocephalus octodecemspinosus*	22, 51, 115, 116, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Shorthorn sculpin *Myoxocephalus scorpius*	22, 51, 316, 370, Armstrong, Bowen, Gestring, Howell, Nelson
White perch *Morone americana*	51, 115, 116, 160, 370, 378, 392, Armstrong, Bowen, Gestring, Howell, Nelson
Striped bass *Morone saxatilis*	51, 56, 116, 117, 140, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Bluefish *Pomatomus saltatrix*	51, 117, 287, 327, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson, Short
Scup *Stenotomus chrysops*	51, 290, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Tautog *Tautoga onitis*	22, 29, 51, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson, Short
Cunner *Tautogolabrus adspersus*	22, 29, 51, 115, 116, 160, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
Ocean pout *Macrozoarces americanus*	51, 116, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Rock gunnel *Pholis gunnellus*	22, 51, 115, 116, 316, 318, 360, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
American sandlance *Ammodytes americanus*	22, 30, 31, 51, 160, 306, 316, 318, 347, 370, 378, 382, Armstrong, Bowen, Gestring, Howell, Nelson
Atlantic mackerel *Scomber scombrus*	22, 51, 117, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Butterfish *Peprilus triacanthus*	22, 51, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Windowpane flounder *Scophthalmus aquosus*	51, 115, 116, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson
American plaice *Hippoglossoides platessoides*	22, 51, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Winter flounder *Pleuronectes americanus*	22, 27, 63, 115, 116, 160, 275, 316, 318, 378, Armstrong, Bowen, Gestring, Howell, Nelson, Short
Yellowtail flounder *Pleuronectes ferrugineus*	22, 51, 316, 318, 370, Armstrong, Bowen, Gestring, Howell, Nelson
Smooth flounder *Pleuronectes putnami*	22, 27, 51, 115, 116, 234, 246, 316, 318, 370, 378, Armstrong, Bowen, Gestring, Howell, Nelson

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Merrimack River
Blue mussel *Mytilus edulis*	203, 205, 267, 310, 311, 314, 318, 343, Bowen, Deegan, Iwanowicz
Sea scallop *Placopecten magellanicus*	203, 267, 295, 303, 314, 318, Bowen, Deegan, Iwanowicz
American oyster *Crassostrea virginica*	203, 205, 267, 314, 318, 371, Bowen, Deegan, Iwanowicz
Northern quahog *Mercenaria mercenaria*	203, 205, 267, 314, 393, Bowen, Deegan, Iwanowicz
Softshell clam *Mya arenaria*	61, 203, 205, 267, 308, 314, 318, Bowen, Deegan, Iwanowicz
Grass shrimp *Palaemonetes pugio*	9, 213, 312, 433, Bowen, Iwanowicz
Northern shrimp *Pandalus borealis*	26, 182, 332, 380, 433, Bowen, Iwanowicz
Sevenspine bay shrimp *Crangon septemspinosa*	99, 100, 176, 318, Deegan, Iwanowicz
American lobster *Homarus americanus*	135, 151, 188, 203, 205, 257, 314, 318, Bowen, Deegan, Iwanowicz
Jonah crab *Cancer borealis*	75, 203, 205, 314, 318, 433, Iwanowicz
Atlantic rock crab *Cancer irroratus*	52, 75, 203, 205, 314, 318, 433, Deegan, Iwanowicz
Green crab *Carcinus maenus*	50, 203, 314, 318, 355, 428, 433, Bowen, Deegan, Iwanowicz
Green sea urchin *Strongylocentrotus droebachiensis*	314, 372, Bowen, Iwanowicz,
Spiny dogfish *Squalus acanthias*	51, 84, 92, 202, 205, 304, 320, 321, 356, 370, Bowen, Iwanowicz,
Skates *Raja* species	51, 84, 205, 318, 320, 321, 356, 370, Bowen, Deegan, Iwanowicz
Shortnose sturgeon *Acipenser brevirostrum*	84, 106, 161, 209, 210, 370, Deegan, Iwanowicz, Keiffer
Atlantic sturgeon *Acipenser oxyrhynchus*	84, 161, 205, 209, 210, 370, 405, Deegan, Iwanowicz, Keiffer
American eel *Anguilla rostrata*	137, 184, 205, 314, 339, 356, 370, Bowen, Deegan, Iwanowicz
Blueback herring *Alosa aestivalis*	51, 84, 197, 203, 205, 251, 294, 314, 339, 370, Bowen, Iwanowicz, Keiffer, Stolte
Alewife *Alosa pseudoharengus*	51, 84, 203, 205, 251, 294, 314, 339, 370, Bowen, Iwanowicz, Keiffer, Stolte
American shad *Alosa sapidissima*	51, 108, 126, 197, 314, 320, 321, 356, 370, 427, Bowen, Deegan, Iwanowicz, Keiffer, Stolte
Atlantic menhaden *Brevoortia tyrannus*	51, 339, 354, 370, Bowen, Deegan, Iwanowicz, Keiffer
Atlantic herring *Clupea harengus*	51, 102, 208, 249, 318, 339, 370, 381, 416, Bowen, Iwanowicz
Rainbow smelt *Osmerus mordax*	51, 62, 84, 203, 205, 298, 314, 318, 339, 370, Bowen, Iwanowicz, Keiffer
Atlantic salmon *Salmo salar*	24, 25, 51, 84, 109, 126, 197, 314, 370, 401, Bowen, Deegan, Iwanowicz, Keiffer, Stolte
Atlantic cod *Gadus morhua*	51, 84, 205, 318, 320, 321, 339, 356, 370, Bowen, Deegan, Iwanowicz
Haddock *Melanogrammus aeglefinus*	51, 84, 203, 320, 321, 356, 370, Bowen, Deegan, Iwanowicz
Silver hake *Merluccius bilinearis*	51, 84, 318, 320, 321, 339, 356, 370, Bowen, Deegan, Iwanowicz
Atlantic tomcod *Microgadus tomcod*	84, 205, 338, 339, 356, 370, 398, Bowen, Deegan, Iwanowicz

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Merrimack River, continued
Pollock *Pollachius virens*	51, 84, 203, 269, 318, 339, 370, Bowen, Deegan, Iwanowicz
Red hake *Urophycis chuss*	51, 84, 203, 205, 265, 318, 320, 321, 339, 356, 370, Bowen, Deegan, Iwanowicz
White hake *Urophycis tenuis*	51, 84, 203, 205, 265, 318, 356, 370, Bowen, Deegan, Iwanowicz
Mummichogs *Fundulus heteroclitus*	2, 51, 84, 203, 205, 318, 370, Bowen, Deegan, Iwanowicz
Silversides *Menidia* species	51, 84, 95, 96, 141, 203, 205, 370, Bowen, Deegan, Iwanowicz
Fourspine stickleback *Apeltes quadracus*	28, 51, 84, 205, 318, 370, 439, 440, Bowen, Iwanowicz
Threespine stickleback *Gasterosteus aculeatus*	28, 51, 203, 205, 339, 370, 434, 439, 440, Bowen, Iwanowicz
Ninespine stickleback *Pungitius pungitius*	28, 51, 84, 203, 205, 370, 439, 440, Bowen, Iwanowicz
Northern pipefish *Syngnathus fuscus*	51, 84, 203, 205, 248, 339, 370, Bowen, Deegan, Iwanowicz
Northern searobin *Prionotus carolinus*	51, 84, 339, 350, Bowen, Iwanowicz
Grubby *Myoxocephalus aeneus*	51, 84, 247, 339, Bowen, Deegan, Iwanowicz
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 84, 205, 235, 339, 370, Bowen, Deegan, Iwanowicz
Shorthorn sculpin *Myoxocephalus scorpius*	51, 84, 235, 339, 356, 370, Bowen, Iwanowicz
White perch *Morone americana*	51, 84, 203, 205, 370, 392, Bowen, Iwanowicz, Keiffer
Striped bass *Morone saxatilis*	51, 56, 84, 140, 197, 203, 320, 321, 370, 426, Bowen, Deegan, Iwanowicz, Keiffer
Bluefish *Pomatomus saltatrix*	51, 84, 320, 321, 327, Bowen, Deegan, Iwanowicz
Scup *Stenotomus chrysops*	51, 84, 290, 318, 320, 321, Bowen, Deegan, Iwanowicz
Tautog *Tautoga onitis*	29, 51, 84, 339, 356, 370, Bowen, Deegan, Iwanowicz
Cunner *Tautogolabrus adspersus*	29, 51, 84, 339, 356, 370, Bowen, Deegan, Iwanowicz
Ocean pout *Macrozoarces americanus*	51, 84, 318, 370, Bowen, Iwanowicz
Rock gunnel *Pholis gunnellus*	51, 84, 339, 370, Bowen, Deegan, Iwanowicz
American sandlance *Ammodytes americanus*	30, 84, 203, 205, 314, 318, 339, 347, 370, 430, Bowen, Deegan, Iwanowicz
Atlantic mackerel *Scomber scombrus*	51, 84, 203, 314, 318, 320, 321, 339, 370, Bowen, Iwanowicz
Butterfish *Peprilus triacanthus*	51, 84, 296, 297, 318, 320, 321, 370, Bowen, Iwanowicz
Windowpane flounder *Scophthalmus aquosus*	51, 205, 318, 320, 321, 339, 356, 370, Bowen, Deegan, Iwanowicz
American plaice *Hippoglossoides platessoides*	51, 84, 203, 320, 321, 339, 370, Bowen, Iwanowicz
Winter flounder *Pleuronectes americanus*	51, 63, 84, 203, 205, 275, 314, 318, 320, 321, 328, 339, 353, 356, 370, Bowen, Deegan, Iwanowicz
Yellowtail flounder *Pleuronectes ferrugineus*	51, 84, 203, 205, 318, 320, 321, 339, 370, Bowen, Iwanowicz
Smooth flounder *Pleuronectes putnami*	51, 203, 318, 370, Bowen, Iwanowicz

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Massachusetts Bay
Blue mussel *Mytilus edulis*	10, 13, 82, 112, 143, 190, 191, 310, Chase, Deegan, Lawton, Robinson, Toner
Sea scallop *Placopecten magellanicus*	10, 13, 74, 82, 143, 190, 191, 193, 295, 320, 321, Chase, Deegan, Robinson
American oyster *Crassostrea virginica*	10, 13, 82, 143, 371, Chase, Deegan, Robinson, Toner
Northern quahog *Mercenaria mercenaria*	10, 13, 82, 143, 393, Chase, Deegan
Softshell clam *Mya arenaria*	10, 13, 82, 143, 308, Chase, Deegan, Robinson, Toner
Grass shrimp *Palaemonetes pugio*	9, 10, 112, 213, 312, 429, 433, Chase, Deegan
Northern shrimp *Pandalus borealis*	10, 74, 112, 182, 193, 320, 321, 380, 433, Chase
Sevenspine bay shrimp *Crangon septemspinosa*	10, 112, 176, 433, Chase, Lawton, Scherer
American lobster *Homarus americanus*	11, 13, 74, 82, 132, 133, 134, 135, 136, 143, 190, 191, 193, 320, 321, 433, Chase, Deegan, Estrella, Lawton, Scherer
Jonah crab *Cancer borealis*	13, 82, 143, 175, 190, 191, 193, 394, 433, Chase, Scherer
Atlantic rock crab *Cancer irroratus*	10, 13, 52, 82, 143, 190, 191, 193, 394, 433, Chase, Deegan, Scherer
Green crab *Carcinus maenus*	50, 112, 433, Chase, Deegan
Green sea urchin *Strongylocentrotus droebachiensis*	10, 112, 372, 395, Chase
Spiny dogfish *Squalus acanthias*	10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 202, 356, Carriea, Chase, Deegan, Ross
Skates *Raja* species	10, 13, 51, 74, 82, 84, 127, 143, 190, 191, 193, 356, Carriea, Chase, Deegan, Lawton, Ross
Shortnose sturgeon *Acipenser brevirostrum*	13, 51, 82, 84, 88, 106, 127, 143, 161, 190, 191, Brady, Carriea, Chase, Deegan, Ross
Atlantic sturgeon *Acipenser oxyrhynchus*	13, 51, 82, 127, 143, 190, 191, Brady, Carriea, Chase, Deegan, Ross
American eel *Anguilla rostrata*	13, 51, 82, 84, 88, 127, 137, 143, 152, 184, 190, 191, 356, Brady, Carriea, Chase, Chisholm, Deegan, Ross
Blueback herring *Alosa aestivalis*	13, 19, 51, 74, 82, 84, 127, 143, 190, 191, 193, 320, 356, Boreman, Carriea, Chase, Deegan, Ross
Alewife *Alosa pseudoharengus*	13, 51, 74, 82, 84, 127, 143, 190, 191, 193, 320, 356, Boreman, Carriea, Chase, Deegan, Ross
American shad *Alosa sapidissima*	13, 51, 82, 84, 88, 127, 143, 190, 191, 193, 320, 321, Boreman, Carriea, Chase, Deegan, Ross
Atlantic menhaden *Brevoortia tyrannus*	13, 51, 82, 112, 127, 143, 190, 191, 193, Carriea, Chase, Deegan, Lawton, Ross
Atlantic herring *Clupea harengus*	13, 51, 82, 84, 112, 127, 143, 190, 191, 193, 320, Carriea, Chase, Deegan, Lawton, Ross
Rainbow smelt *Osmerus mordax*	13, 51, 62, 82, 84, 88, 127, 143, 190, 191, 356, Carriea, Chase, Deegan, Ross
Atlantic salmon *Salmo salar*	13, 24, 25, 51, 82, 84, 88, 109, 127, 143, 320, 321, 356, Boreman, Carriea, Chase, Deegan, Ross
Atlantic cod *Gadus morhua*	10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193, Carriea, Chase, Deegan, Lawton, Ross
Haddock *Melanogrammus aeglefinus*	11, 13, 51, 53, 74, 82, 84, 88, 127, 143, 190, 191, 193, 193, 320, 321, 356, Carriea, Chase, Deegan, Ross
Silver hake *Merluccius bilinearis*	10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 356, Carriea, Chase, Deegan, Ross
Atlantic tomcod *Microgadus tomcod*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 356, 398, Carriea, Chase, Deegan, Ross

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Massachusetts Bay, continued
Pollock *Pollachius virens*	10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193, Carriea, Chase, Deegan, Lawton, Ross
Red hake *Urophycis chuss*	10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 199, 320, Carreia, Chase, Deegan, Ross
White hake *Urophycis tenuis*	10, 13, 51, 74, 82, 84, 88,127, 143, 190, 191, 193, Carreia, Chase, Deegan, Ross
Mummichogs *Fundulus heteroclitus*	2, 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, Carreia, Chase, Chisholm, Deegan, Scherer
Silversides *Menidia* species	10, 13, 51, 82, 84, 88, 94, 127, 143, 190, 191, 193, Carreia, Chase, Lawton, Deegan, Scherer
Fourspine stickleback *Apeltes quadracus*	10, 13, 51, 82, 84, 88, 127, 143, 439, 440, Carreia, Chase, Chisholm, Deegan
Threespine stickleback *Gasterosteus aculeatus*	10, 13, 51, 82, 84, 88, 127, 143, 439, 440, Carreia, Chase, Chisholm, Deegan
Ninespine stickleback *Pungitius pungitius*	10, 13, 51, 82, 84, 88, 127, 143, 439, 440, Carreia, Chase, Chisholm, Deegan
Northern pipefish *Syngnathus fuscus*	10, 13, 51, 82, 84, 88, 127, 143, 190,191, Carreia, Chase, Deegan
Northern searobin *Prionotus carolinus*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193, Carreia, Chase, Deegan, Ross
Grubby *Myoxocephalus aeneus*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, Carreia, Chase, Deegan, Ross
Longhorn sculpin *Myoxocephalus octodecemspinosus*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193, Carreia, Chase, Deegan, Ross
Shorthorn sculpin *Myoxocephalus scorpius*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193, Carreia, Chase, Deegan, Ross
White perch *Morone americana*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 356, Boreman, Carreia, Chase, Deegan, Ross
Striped bass *Morone saxatilis*	10, 13, 51, 82, 84, 127, 143, 190, 191, Boreman, Carreia, Chase, Deegan, Ross
Bluefish *Pomatomus saltatrix*	10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 199, 320, Boreman, Carreia, Chase, Deegan, Lawton, Ross
Scup *Stenotomus chrysops*	10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 320, 321, Carreia, Chase, Deegan, Ross
Tautog *Tautoga onitis*	10, 13, 51, 74, 82, 84, 88, 127, 143, 190, 191, Carreia, Chase, Deegan, Ross
Cunner *Tautogolabrus adspersus*	10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193, Carreia, Chase, Deegan, Lawton, Ross
Ocean pout *Macrozoarces americanus*	10, 13, 74, 82, 88, 112, 127, 143, 190, 191, 193, 320, 321, Carreia, Chase, Deegan, Lawton, Ross
Rock gunnel *Pholis gunnellus*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193, Carreia, Chase, Deegan,
American sandlance *Ammodytes americanus*	10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193, Carreia, Chase, Deegan,
Atlantic mackerel *Scomber scombrus*	10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 320, 321, Carreia, Chase, Deegan, Lawton, Ross
Butterfish *Peprilus triacanthus*	10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 320, 321, Carreia, Chase, Deegan, Ross
Windowpane flounder *Scophthalmus aquosus*	10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193, Carreia, Chase, Deegan, Lawton, Ross
American plaice *Hippoglossoides platessoides*	10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 320, 321, Carreia, Chase, Deegan, Ross
Winter flounder *Pleuronectes americanus*	10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193, Carreia, Chase, Deegan, Lawton, Ross
Yellowtail flounder *Pleuronectes ferrugineus*	10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 320, 321, Carreia, Chase, Deegan, Ross
Smooth flounder *Pleuronectes putnami*	10, 13, 51, 82, 88, 127, 143, 370, Carreia, Chase

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Boston Harbor
Blue mussel *Mytilus edulis*	14, 81, 131, 190, 191, 198, 204, 310, Chase, Hubbard, Robinson, Truchon, Toner
Sea scallop *Placopecten magellanicus*	14, 81, 131, 190, 191, 198, 204, 295, Chase, Hubbard, Robinson, Truchon
American oyster *Crassostrea virginica*	14, 81, 131, 198, 204, 371, Chase, Hubbard, Toner
Northern quahog *Mercenaria mercenaria*	14, 81, 131, 198, 204, 393, Chase, Hubbard, Toner
Softshell clam *Mya arenaria*	14, 81, 131, 198, 204, 308, Chase, Hubbard, Truchon
Grass shrimp *Palaemonetes pugio*	14, 112, 131, 194, 213, 312, 433, 9, 429, Chase, Hubbard
Northern shrimp *Pandalus borealis*	112, 131, 182, 194, 380, 433, Hubbard, Chase
Sevenspine bay shrimp *Crangon septemspinosa*	10, 112, 131, 176, 194, 433, Chase, Hubbard
American lobster *Homarus americanus*	10, 112, 131, 133, 134, 135, 136, 188, 190, 191, 194, 257, 433, Chase, Estrella, Hubbard, Scherer, Truchon
Jonah crab *Cancer borealis*	10, 112, 131, 190, 191, 194, 433, Chase, Hubbard, Scherer
Atlantic rock crab *Cancer irroratus*	10, 52, 112, 131, 190, 191, 194, 433, Chase, Hubbard, Scherer
Green crab *Carcinus maenus*	10, 50, 112, 131, 194, 433, Chase, Hubbard, Scherer, Truchon
Green sea urchin *Strongylocentrotus droebachiensis*	10, 81, 131, 198, 204, 372, Chase, Hubbard, Truchon
Spiny dogfish *Squalus acanthias*	51, 81, 84, 92, 127, 131, 173, 194, 198, 202, 204, Chase, Howe, Hubbard, Ross, Scherer
Skates *Raja* species	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Shortnose sturgeon *Acipenser brevirostrum*	51, 81, 84, 127, 131, 161, 173, 194, 198, 204, Brady, Chase, Howe, Hubbard, Ross, Scherer
Atlantic sturgeon *Acipenser oxyrhynchus*	51, 81, 84, 127, 131, 161, 173, 194, 198, 204, 405, Brady, Chase, Howe, Hubbard, Ross, Scherer
American eel *Anguilla rostrata*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Brady, Chase, Howe, Hubbard, Ross, Scherer
Blueback herring *Alosa aestivalis*	11, 81, 127, 131, 173, 194, 198, 204, 261, 262, Boreman, Brady, Chase, Howe, Hubbard, Scherer
Alewife *Alosa pseudoharengus*	11, 81, 127, 131, 173, 194, 198, 204, 261, 262, Boreman, Brady, Chase, Howe, Hubbard, Scherer
American shad *Alosa sapidissima*	11, 51, 81, 84, 127, 131, 173, 191, 194, 198, 204, 261, 262, Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer
Atlantic menhaden *Brevoortia tyrannus*	11, 81, 127, 131, 173, 194, 198, 204, 261, Chase, Howe, Hubbard, Ross, Scherer
Atlantic herring *Clupea harengus*	11, 81, 127, 131, 173, 194, 198, 204, 261, Chase, Howe, Hubbard, Ross, Scherer
Rainbow smelt *Osmerus mordax*	11, 51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Brady, Chase, Howe, Hubbard, Ross, Scherer
Atlantic salmon *Salmo salar*	24, 25, 51, 81, 84, 127, 131, 173, 194, 198, 204, Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer
Atlantic cod *Gadus morhua*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Haddock *Melanogrammus aeglefinus*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Chase, Howe, Hubbard, Ross, Scherer
Silver hake *Merluccius bilinearis*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Atlantic tomcod *Microgadus tomcod*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Scherer

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Boston Harbor, continued
Pollock *Pollachius virens*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Red hake *Urophycis chuss*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
White hake *Urophycis tenuis*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Chase, Howe, Hubbard, Ross, Scherer
Mummichogs *Fundulus heteroclitus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Hubbard, Scherer, Howe ,
Silversides *Menidia* species	11, 81, 84, 127, 131, 173, 194, 198, 204, 261, 262, 51, Chase, Hubbard, Scherer, Howe ,
Fourspine stickleback *Apeltes quadracus*	11, 51, 81, 84, 127, 131, 173, 194, 198, 204, Chase, Howe, Hubbard, Scherer
Threespine stickleback *Gasterosteus aculeatus*	11, 51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Hubbard, Scherer, Howe
Ninespine stickleback *Pungitius pungitius*	11, 51, 81, 84, 127, 131, 173, 194, 198, 204, Chase, Howe, Hubbard
Northern pipefish *Syngnathus fuscus*	51, 81, 84, 87, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Scherer
Northern searobin *Prionotus carolinus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard
Grubby *Myoxocephalus aeneus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Scherer
Longhorn sculpin *Myoxocephalus octodecemspinosus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Scherer
Shorthorn sculpin *Myoxocephalus scorpius*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Scherer
White perch *Morone americana*	11, 81, 127, 131, 173, 194, 198, 204, 261, 262, Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer
Striped bass *Morone saxatilis*	11, 81, 127, 131, 173, 194, 198, 204, 262, Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer
Bluefish *Pomatomus saltatrix*	11, 81, 127, 131, 173, 194, 198, 204, 261, 262, Boreman, Chase, Howe, Hubbard, Ross, Scherer
Scup *Stenotomus chrysops*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Scherer
Tautog *Tautoga onitis*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Cunner *Tautogolabrus adspersus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Ocean pout *Macrozoarces americanus*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Chase, Howe, Hubbard, Ross, Scherer
Rock gunnel *Pholis gunnellus*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Chase, Howe, Hubbard, Scherer
American sandlance *Ammodytes americanus*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Chase, Howe, Hubbard, Scherer
Atlantic mackerel *Scomber scombrus*	11, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Butterfish *Peprilus triacanthus*	11, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Windowpane flounder *Scophthalmus aquosus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
American plaice *Hippoglossoides platessoides*	51, 81, 84, 127, 131, 173, 191, 194, 198, 204, Chase, Howe, Hubbard, Ross, Scherer
Winter flounder *Pleuronectes americanus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Hubbard, Ross, Scherer, Truchon, Howe
Yellowtail flounder *Pleuronectes ferrugineus*	51, 81, 127, 131, 173, 194, 198, 204, 261, 262, Chase, Howe, Hubbard, Ross, Scherer
Smooth flounder *Pleuronectes putnami*	51, 81, 84, 127, 131, 173, 194, 198, 204, 370, Chase, Howe, Hubbard, Ross, Scherer

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 4, continued. Table of references and personal communications

Species	Cape Cod Bay
Blue mussel *Mytilus edulis*	11, 103, 112, 190, 191, 199, 310, Collings, Deegan, Kelly, Lawton, Toner
Sea scallop *Placopecten magellanicus*	11, 74, 103, 112, 190, 191, 199, 295, 321, 320, Kelly
American oyster *Crassostrea virginica*	11, 103, 112, 199, 371, Kelly, Toner
Northern quahog *Mercenaria mercenaria*	11, 103, 112, 199, 393, Deegan, Kelly, Toner
Softshell clam *Mya arenaria*	11, 103, 112, 199, 308, Deegan, Kelly, Toner
Grass shrimp *Palaemonetes pugio*	9, 11, 112, 213, 312, 429, 433, Deegan, Kelly
Northern shrimp *Pandalus borealis*	11, 74, 112, 182, 320, 321, 380, 433 Collings, Kelly
Sevenspine bay shrimp *Crangon septemspinosa*	11, 74, 112, 176, 183, 433, Deegan, Kelly
American lobster *Homarus americanus*	1, 11, 89, 103, 112, 133, 134, 135, 136, 183, 188, 190, 191, 199, 242, 257, 268, 320, 321, 433, Scherer, Estrella, Kelly, Collings
Jonah crab *Cancer borealis*	11, 103, 112, 190, 191, 199, 245, 394, 433, Kelly
Atlantic rock crab *Cancer irroratus*	11, 52, 103, 112, 183, 190, 191, 199, 245, 394, 433, Kelly
Green crab *Carcinus maenus*	11, 103, 112, 183, 199, 245, 433, Kelly, Deegan
Green sea urchin *Strongylocentrotus droebachiensis*	11, 112, 372, 395, Kelly
Spiny dogfish *Squalus acanthias*	11, 51, 74, 84, 92, 103, 112, 190, 191, 199, 202, 245, 304, 320, 321, Currier, Deegan, Kelly, Ross
Skates *Raja* species	11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 276, 320, 321, Currier, Deegan, Kelly, Ross
Shortnose sturgeon *Acipenser brevirostrum*	11, 51, 84, 103, 106, 112, 161, 199, 245, Brady, Currier, Deegan, Kelly, Ross
Atlantic sturgeon *Acipenser oxyrhynchus*	11, 103, 112, 199, 245, 161, 405, 51, 84, 320, 321, Brady, Currier, Deegan, Kelly, Ross
American eel *Anguilla rostrata*	11, 51, 84, 103, 112, 137, 152, 183, 184, 190, 191, 199, 245, Brady, Currier, Deegan, Kelly, Ross, Scherer
Blueback herring *Alosa aestivalis*	11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 294, 320, 321, Boreman, Brady, Currier, Deegan, Kelly, Scherer
Alewife *Alosa pseudoharengus*	11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 294, 320, 321, Boreman, Currier, Deegan, Kelly, Scherer
American shad *Alosa sapidissima*	11, 51, 84, 103, 108, 112, 190, 191, 199, 320, 321, 427, Boreman, Brady, Deegan, Currier, Kelly, Ross
Atlantic menhaden *Brevoortia tyrannus*	11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321, 354, Deegan, Collings, Currier, Kelly, Ross, Scherer
Atlantic herring *Clupea harengus*	11, 51, 74, 84, 103, 112, 183, 190, 191, 199, 208, 245, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
Rainbow smelt *Osmerus mordax*	11, 51, 62, 84, 103, 112, 190, 191, 199, 245, Brady, Currier, Deegan, Kelly, Ross, Scherer
Atlantic salmon *Salmo salar*	11, 24, 25, 51, 84, 103, 109, 112, 199, 245, Boreman, Brady, Currier, Kelly, Ross, Scherer
Atlantic cod *Gadus morhua*	11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
Haddock *Melanogrammus aeglefinus*	11, 51, 53, 74, 84, 103, 112, 190, 191, 199, 245, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
Silver hake *Merluccius bilinearis*	11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
Atlantic tomcod *Microgadus tomcod*	11, 51, 84, 103, 112, 183, 190, 191, 199, 245, 398, Collings, Currier, Deegan, Kelly, Ross, Scherer

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Species	Cape Cod Bay, continued
Pollock *Pollachius virens*	11, 51, 84, 103, 112, 183, 190, 191, 199, 243, 245, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
Red hake *Urophycis chuss*	11, 51, 74, 84, 89, 103, 112, 183, 190, 191, 199, 245, 265, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
White hake *Urophycis tenuis*	11, 51, 74, 84, 103, 112, 183, 190, 191, 199, 245, 265, 320, 321, Currier, Deegan, Kelly, Ross, Scherer
Mummichogs *Fundulus heteroclitus*	2, 11, 51, 84, 103, 112, 183, 199, 245, Deegan, Currier, Kelly, Scherer
Silversides *Menidia* species	11, 51, 84, 94, 103, 112, 141, 183, 190, 191, 199, 245, Deegan, Currier, Kelly, Scherer
Fourspine stickleback *Apeltes quadracus*	11, 51, 84, 103, 112, 183, 199, 245, 439, 440, Currier , Deegan, Kelly
Threespine stickleback *Gasterosteus aculeatus*	11, 51, 84, 103, 112, 183, 199, 245, 439, 440, Currier, Deegan, Kelly
Ninespine stickleback *Pungitius pungitius*	11, 51, 84, 103, 112, 199, 439, 440, Currier, Kelly
Northern pipefish *Syngnathus fuscus*	11, 51, 84, 103, 112, 183, 199, 245, 248, Currier, Deegan, Kelly, Scherer
Northern searobin *Prionotus carolinus*	11, 51, 84, 89, 103, 112, 190, 191, 199, 245, 350, Collings, Currier, Deegan, Kelly, Scherer
Grubby *Myoxocephalus aeneus*	11, 51, 84, 89, 103, 112, 190, 191, 199, 245, 247, Collings, Currier, Deegan, Kelly, Scherer
Longhorn sculpin *Myoxocephalus octodecemspinosus*	11, 51, 84, 89, 103, 112, 190, 191, 199, 245, Collings, Currier, Deegan, Kelly, Scherer
Shorthorn sculpin *Myoxocephalus scorpius*	11, 51, 84, 89, 103, 112, 190, 191, 199, 245, Collings, Currier, Deegan, Kelly, Scherer
White perch *Morone americana*	11, 51, 84, 103, 112, 199, 245, 392, Brady, Currier, Kelly, Ross, Scherer
Striped bass *Morone saxatilis*	11, 51, 56, 84, 103, 112, 140, 199, 245, 243, 320, 321, Boreman, Brady, Currier, Deegan, Kelly, Ross, Scherer
Bluefish *Pomatomus saltatrix*	11, 51, 74, 84, 103, 112, 199, 243, 245, 320, 321, 327, Boreman, Currier, Deegan, Kelly, Ross, Scherer
Scup *Stenotomus chrysops*	11, 51, 74, 84, 103, 112, 190, 191, 183, 199, 245, 290, 320, 321, Collings, Currier, Deegan, Kelly, Scherer
Tautog *Tautoga onitis*	11, 29, 51, 74, 84, 89, 103, 112, 190, 191, 183, 199, 243, 245, 329, Collings, Currier, Deegan, Kelly, Lawton, Ross, Scherer
Cunner *Tautogolabrus adspersus*	11, 29, 51, 84, 89, 103, 112, 183, 190, 191, 199, 243, 245, Collings, Currier, Deegan, Kelly, Ross, Scherer
Ocean pout *Macrozoarces americanus*	11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 320, 321, Currier, Deegan, Kelly, Scherer
Rock gunnel *Pholis gunnellus*	11, 51, 84, 89, 103, 112, 190, 191, 199, 245, 360, Collings, Currier, Deegan, Kelly, Scherer
American sandlance *Ammodytes americanus*	11, 30, 51, 84, 89, 103, 112, 183, 190, 191, 199, 245, 382, Currier, Deegan, Kelly, Scherer
Atlantic mackerel *Scomber scombrus*	11, 49, 51, 74, 84, 89, 91, 103, 112, 190, 191, 199, 245, 320, 321, 330, Collings, Currier, Deegan, Kelly, Ross, Scherer
Butterfish *Peprilus triacanthus*	11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 296, 320, 321, Currier, Deegan, Kelly, Ross, Scherer
Windowpane flounder *Scophthalmus aquosus*	11, 51, 74, 84, 89, 103, 112, 183, 190, 191, 199, 245, 320, 321, 410, Collings, Currier, Deegan, Kelly, Ross, Scherer
American plaice *Hippoglossoides platessoides*	11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 89, 320, 321, Collings, Currier, Deegan, Kelly, Ross, Scherer
Winter flounder *Pleuronectes americanus*	11, 51, 63, 74, 84, 89, 103, 112, 183, 190, 191, 199, 245, 275, 320, 321, 342 Collings, Currier, Deegan, Kelly, Ross, Scherer
Yellowtail flounder *Pleuronectes ferrugineus*	11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321, 322, Collings, Currier, Deegan, Kelly, Lawton, Ross, Scherer
Smooth flounder *Pleuronectes putnami*	11, 51, 103, 112, 199, 370, Currier, Kelly, Scherer

Numbers correspond to references listed in Appendix 6, pp. 201-221.

Names correspond to individuals listed in Appendix 5, pp. 197-199.

Appendix 5. Reviewers and personal communications

Armstrong, M.	Massachusetts Division of Marine Fisheries, Sandwich, MA
Barr, D.	Biology Dept., Texas A&M University, College Station, TX
Beal, B.	University of Maine, Machias, ME
Beland, K.	Atlantic Sea Run Salmon Commission, Bangor, ME
Blackwell, B.	U.S. Fish and Wildlife Service Cooperative Extension, Orono, ME
Boreman, J.	University of Massachusetts/NOAA CMER Program, Amherst, MA
Bowen, M.	Normandeau Associates, Inc., Bedford, NH
Brady, P.	Massachusetts Division of Marine Fisheries, Sandwich, MA
Carriera, S.	Massachusetts Division of Marine Fisheries, Sandwich, MA
Chang, B.	Canadian Dept. of Fisheries and Oceans, St. Andrews, NB
Chase, B.	Massachusetts Division of Marine Fisheries, Salem, MA
Chenoweth, S.	Maine Dept. of Marine Resources, West Boothbay Harbor, ME
Chisholm, J.	Massachusetts Division of Marine Fisheries, Sandwich, MA
Clifford, D.	Maine Dept. of Marine Resources, East Machias, ME
Collings, S.	Commonwealth Electric Co., Wareham, MA
Creaser, T.	Maine Dept. of Marine Resources, West Boothbay Harbor, ME
Currier, T.	Massachusetts Division of Marine Fisheries, Sandwich, MA
Dadswell, M.	Acadia University, Wolfeville, NS
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Appendix 6. References

1. Able, K.W., K.L. Heck, Jr., M.P. Fahay, and C.T. Roman. 1988. Use of salt-marsh peat reefs by small juvenile lobsters on Cape Cod, Massachusetts. Estuaries 11(2): 83-86.

2. Abraham, B.J. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—mummichog and striped killifish. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.40). 23 p.

3. Adams, D.H. 1990. The timing of seaward migration by juvenile alewives, *Alosa pseudoharengus*, in a coastal river of New Hampshire. M.S. thesis, Univ. New Hampshire, Durham, NH. 109 p.

4. Aho, R. 1991. Sampling the green crab *Carcinus maenas*. Maine Dept. Marine Resources, West Boothbay Harbor, ME. 6 p.

5. Ahrenholz, D. W. 1991. Population biology and life history of the North American menhadens, *Brevoortia* spp. Mar. Fish. Rev. 53(4):3-10.

6. Aiken, D.E. and S.L. Waddy. 1986. Environmental influence on recruitment of the American lobster, *Homarus americanus*: a perspective. Can. J. Fish. Aquat. Sci. 43(11):2258-2270.

7. Alexander, L.C. 1976. Fish survey of upper Penobscot Bay, Maine: September 1974-1975. Unpublished data. Environmental Studies Department, Central Maine Power. 200 p.

8. Almeida, F.P. 1987. Stock definition of silver hake in the New England-Middle Atlantic area. N. Am. J. Fish. Manag. 7:169-186.

9. Anderson, G. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico)—grass shrimp. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.35). 19 p.

10. Anderson, R.D. 1992a. Impingement of organisms at Pilgrim Nuclear Power Station. *In*: Marine ecology studies related to operation of Pilgrim Station semi-annual Rep. No. 39., Boston Edison Company, MA. 27 p.

11. Anderson, R.D. 1992b. Marine ecology studies related to operation of Pilgrim Station semi-annual Rep. No. 39., Boston Edison Co., Braintree, MA.

12. Anderson, R.D. 1990. Marine ecology studies related to operation of Pilgrim Station, semi-annual Rep. No. 35. Boston Edison Co., Braintree, MA.

13. Anderson, C.O. Jr., D.J. Brown, B.A. Ketschke, E.M. Elliott, and P.L. Rule. 1975. The effects of the addition of a fourth generating unit at the Salem Harbor electric generating station on the marine ecosystem of Salem Harbor. Massachusetts Div. Marine Fisheries, Salem, MA. 47 p.

14. Anderson, C.O., Jr., and T.B. Hoopes. 1992. Final report: Fisheries statistics and automated data processing. NOAA/NMFS, Massachusetts Project No. 3-1J-29-3, Grant No. NA 90AA-D-1J453. 15 p.

15. Anonymous. 1970. The soft shelled clams (*Mya arenaria*) in the Machias River Estuary and Starboard Island Bar Machias and Machiasport, Maine. U.S. Dept. Interior, Federal Water Quality Admin., Needham Heights, MA. 10 p.

16. Anonymous. 1981. Some life history notes on lobsters. Maine Dept. Marine Resources, West Boothbay Harbor, ME. 6 p.

17. Anonymous. 1982. State of Maine: Statewide river fisheries management plan. Maine Dept. Inland Fisheries and Wildlife/Maine Dept. Marine Resources/Atlantic Sea Run Salmon Commission, Augusta, ME. 37 p.

18. Anonymous. 1984. Androscoggin River anadromous fish restoration: 1983 program results. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 24 p.

19. Anonymous. 1985a. Androscoggin River anadromous fish restoration: 1984 program results. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 25 p.

20. Anonymous. 1985b. Androscoggin River anadromous fish restoration: 1985 program results. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 43 pp.

21. Anonymous. 1987. Sears Island dry cargo terminal and access road, Searsport, Waldo County, Maine. U.S. Dept. of Transportation # "FHWA-ME-EIS-86-01-F. 100 p.

22. Anonymous. 1989. Great Bay national estuarine research reserve management plan. U.S. Dept. of Commerce/NOAA/NOS. Prepared by Office of State Planning, Concord, NH. pp. 30-111.

23. Anonymous. 1991. Estuary profile series. Maine Coastal Program/Maine State Planning Office, Augusta, ME.

24. Anonymous. 1992. Annual report of the U.S. Atlantic Salmon Assessment Committee. Rep. No. 4-1991 Activity. U.S. Atlantic Salmon Assessment Committee, Turner's Falls, MA, 72 p.

25. Anonymous. 1993. Annual report of the U.S. Atlantic Salmon Assessment Committee. Rep. No. 5-1992 Activity. U.S. Atlantic Salmon Assessment Committee, Turner's Falls, MA.

26. Apollonio, S., D.K. Stevenson, and E.E. Dunton. 1986. Effects of temperature on the biology of the Northern shrimp, *Pandalus borealis*, in the Gulf of Maine. NOAA/NMFS Tech. Rep. 42. 22 p.

27. Armstrong, M.P. In prep. A comparative study of the ecology of smooth, *Pleuronectes putnami*, and winter, *Pleuronectes americanus*, flounder in Great Bay estuary, N.H. Ph.D. dissertation, Univ. New Hampshire, Durham, NH. 175 p.

28. Audet, C., G.J. FitzGerald, and H. Guderley. 1985. Salinity preferences of four sympatric species of sticklebacks (Pisces: Gasterosteidae) during their reproductive season. Copeia 1985(1):209-213.

29. Auster, P.J. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic and Mid-Atlantic)—tautog and cunner. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.105). 13 p.

30. Auster, P.J., and L.L. Stewart. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—sandlance. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.66). 11 p.

31. Ayvazian, S.G., L.A. Deegan, and J.T. Finn. 1992. Comparison of habitat use by estuarine fish assemblages in the Acadian and Virginian zoogeographic provinces. Estuaries 15(3):368-383.

32. Azarovitz, T.R., and M.D. Grosslein. 1987. Fishes and squids. *In:* Backus, R.H. (ed), pp. 315-345. Georges Bank. MIT Press, Cambridge, MA.

33. Babb, I., and M. DeLuca (eds.). 1988. Benthic productivity and marine resources of the Gulf of Maine. NOAA/NURP Research Rep. 88/3. 276 p.

34. Baird, F.T., Jr. 1967. The sea scallop (*Pecten magellanicus*): Fisheries education series unit No. 2. Maine Dept. Sea and Shore Fisheries, Augusta, ME. 10 p.

35. Barber, B.J., R. Getchell, S. Shumway, and D. Schick. 1988. Reduced fecundity in a deep-water population of the giant scallop *Placopecten magellanicus* in the Gulf of Maine, USA. Mar. Ecol. Prog. Ser. 42:207-212.

36. Baum, E.T. 1982. The Union River: An Atlantic salmon river management report. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME. pp. 1-25.

37. Baum, E.T. 1983. The Penobscot River: An Atlantic salmon river management report. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME. 67 p.

38. Baum, E.T. 1993. Performance report (final) Maine Atlantic salmon restoration program, October 1, 1985-February 28, 1991. Atlantic Sea Run Salmon Commission, Bangor, ME. 20 p.

39. Baum, E.T., and R.M. Jordan. 1982. The Narraguagus River: An Atlantic salmon river management report. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME. pp. 1-41.

40. Baum, E.T., and A.L. Meister. 1971. Fecundity of Atlantic Salmon (*Salmo salar*) from two Maine rivers. J. Fish. Res. Bd. Can. 28(5):764-767.

41. Beland, K.F. 1984. Strategic plan for management of Atlantic salmon in the state of Maine. Atlantic Sea Run Salmon Commission, Bangor, ME.

42. Beland, K.F., J.S. Fletcher, and A.L. Meister. 1982. The Dennys River: An Atlantic salmon river management report. Atlantic Sea Run Salmon Commission, Bangor, ME. 40 p.

43. Beland, K.F., R.M. Jordan, and A.L. Meister. 1982. Water depth and velocity preferences of spawning Atlantic salmon in Maine rivers. N. Am. J. Fish. Manag. 2:11-13.

44. Belanger, G., H. Guderley, and G.J. FitzGerald. 1987. Salinity during embryonic development influences the response to salinity of *Gasterosteus aculeatus L. (trachurus)*. Can. J. Zool. 65:451-454.

45. Bell, M.A., and J.V. Baumgartner. 1984. An unusual population of *Gasterosteus aculeatus* from Boston, Massachusetts. Copeia 1984(1):258-262.

46. Bell, J.D., A.S. Steffe, and M. Westoby. 1988. Location of seagrass beds in estuaries: effects on associated fish and decapods. J. Exp. Mar. Biol. Ecol. 122:127-146.

47. Beninger, P.G. 1987. A qualitative and quantitative study of the reproductive cycle of the giant scallop, *Placopecten magellanicus*, in the Bay of Fundy (New Brunswick, Canada). Can. J. Zool. 65:495-498.

48. Bergström, B.I. 1991. Reproductive cycle and the effect of temperature on oogenesis of *Pandalus borealis* Krøyer, 1838. J. Shellfish Res.10(2):327-331.

49. Berrien, P.L., N.A. Naplin, and M.R. Pennington. 1981. Atlantic mackerel, *Scomber scombrus*, egg production and spawning population estimates for 1977 in the Gulf of Maine, Georges Bank, and Middle Atlantic Bight. Conseil International pour l'explortion de la Mer. J. du Conseil 178:279-288.

50. Berrill, M. 1982. The life cycle of the green crab (*Carcinus maenus*) at the northern end of its range. J. Crustacean Biol. 2:31-39.

51. Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. Fish. Bull., U.S. 74(53). 577 p.

52. Bigford, T.E. 1979. Synopsis of biological data on the rock crab, *Cancer irroratus* Say. NOAA Tech. Rep. NMFS Circular 426, FAO Fisheries Synopsis No. 123. 26 p.

53. Blacker, R.W. 1971. Synopsis of biological data on haddock, *Melanogrammus aeglefinus* (Linnaeus 1758). FAO Fisheries Synopsis No. 84. 30 p.

54. Bleakney, J.S. 1963. Notes on the distribution and reproduction of the fish *Tautoga onitis* in Nova Scotia. The Canadian Field Naturalist 77:64-65.

55. Boesch, D.F., and R.E. Turner. 1984. Dependence of fishery species on salt marshes: the role of food and refuge. Estuaries 7(4A):460-468.

56. Boreman, J., and R.R. Lewis. 1987. Atlantic coastal migration of striped bass. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 331-339. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

57. Bowman, R.E., and W.L. Michaels. 1984. Food of seventeen species of Northwest Atlantic fish. NOAA Tech. Memo. NMFS-F/NEC-28:1-110.

58. Bowman, R.E., T.R. Azarovitz, E.S. Howard, and B.P. Hayden. 1987. Food and distribution of juveniles of seventeen Northwest Atlantic fish species 1973-1976. NOAA Tech. Memo. NMFS-F/NEC-45:1-58.

59. Boyar, H.C., R.L. Dow, C.M. Larsen, L.J. Lozier, L.W. Scattergood, C.J. Sindermann, and J.E. Watson. 1959. International Passamaquoddy Fisheries Board—Report to the International Joint Commission: Appendix III Biology-United States. International Passamaquoddy Fisheries Board. 103 p.

60. Boyar, H.C. and J.J. Graham. 1962. Occurrence of scup, *Stenotomus versicolor*, in Maine waters in November. Maine Field Naturalist 18:131.

61. Brousseau, D.J. 1978. Spawning cycle, fecundity, and recruitment in a population of soft-shell clam, *Mya arenaria*, from Cape Ann, Massachusetts. Fish. Bull., U.S. 76(1):155-166.

62. Buckley, J.L. 1989a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—rainbow smelt. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.106), 11 p.

63. Buckley, J. 1989b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—winter flounder. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.87), 12 p.

64. Burnett, J. 1992. Gulf of Maine bottom trawl survey, Cruise No. DE 92-07. Unpublished data. NOAA/NMFS Northeast Fisheries Science Center, Woods Hole, MA.

65. Caddy, J.F. (ed.). 1989. Marine Invertebrate Fisheries: Their Assessment and Management. John Wiley and Sons, New York, NY. 752 p.

66. Campbell, A.J. 1984. Revised report of the pollock tagging study at East Boothbay, Maine, from 1981-1983. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 4 p.

67. Campbell, D.E. 1989. The Maquoit Bay shellfish kill of 1988: An ecological tragedy. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 5 p.

69. Campbell, D.E., and J.J. Graham. 1991. Herring recruitment in Maine coastal waters: an ecological model. Can. J. Fish. Aquat. Sci. 48:448-471.

68. Campbell, A., D.J. Moakes, and R.W. Elner. 1991. Temperature and lobster, *Homarus americanus*, yield relationships. Can. J. Fish. Aquat. Sci. 48:2073-2082.

70. Card, D.J., R.A. Aho, and L.M. Gillespie. 1981. Casco Bay coastal resources inventory. Maine Dept. Environmental Protection, prepared by Maine Dept. Natural Resources, W. Boothbay Harbor, ME.

71. Card, D.J. and R.A. Aho. 1982. Coastal marine resources inventory: Small Point to Pemaquid Point. Maine Dept. Marine Resources, West Boothbay Harbor, ME. 411 p.

72. Carter, J. 1993. Fyke, trawl and beach seine surveys of the Saco River Estuary. Unpublished data. Univ. New England, Biddeford, ME.

73. Central Maine Power Co. 1975. Environmental report: W.F. Wyman station, Yarmouth, Maine-unit number four addition, Vols. I, IIA, and IIB. Central Maine Power Co.

74. Chang, S. 1990. Seasonal distribution patterns of commercial landings of 45 species off the northeastern United States during 1977-1988. NOAA Tech. Memo. NMFS-F/NEC-78. 130 p.

75. Charmantier, G., and M. Charmantier-Daures. 1991. Ontogeny of osmoregulation and salinity tolerance in *Cancer irroratus*; elements of comparison with *C. borealis* (Crustacea, Decapoda). Biol. Bull. (Woods Hole) 180:125-134.

76. Chenoweth, S.B. 1973. Fish larvae of the estuaries and coast of central Maine. Fish. Bull., U.S. 71(1):105-113.

77. Chenoweth, S. 1991. The blue mussel in Maine. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 11 p.

78. Chenoweth, S. 1992. The green sea urchin in Maine, fishery and biology. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 8 p.

79. Chenoweth, S.B., D.A. Libby, and K.E. Geib. 1987. Early life histories of commercial shrimp and fish. NOAA /NMFS Final Project No. 3/378/R/2, Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 250 p.

80. Chenoweth, S.B., D.A. Libby, R.L. Stephenson, and M.J. Power. 1989. Origin and dispersion of larval herring (*Clupea harengus*) in coastal waters of eastern Maine and southwestern New Brunswick. Can. J. Fish. Aquat. Sci. 46:624-632.

81. Chesmore, A.P., S.A. Testaverde, and F.P. Richards. 1971. A study of the marine resources of Dorchester Bay. Massachusetts Div. Marine Fisheries Monogr. Ser. No. 10. 42 p.

82. Chesmore, A.P., D.J. Brown, and R.D. Anderson. 1972. A study of the marine resources of Lynn-Saugus Harbor. Massachusetts Div. Marine Fisheries Monogr. Ser. No. 11. 38 p.

83. Churchill, L.U. 1987. Status of green crabs in Maine-1986. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 8 p.

84. Clayton, G.R., C.F. Cole, S.A. Murawski, and J.D. Parrish. 1978. Common marine fishes of coastal Massachusetts: a literature review. Univ. Massachusetts Inst. Environ. Publ. R-76-16:1-274.

85. Cohen, D.M, T. Inada, T. Iwamoto, and N. Scialabba. 1990. FAO Species Catalogue, Vol. 10, Gadiform fishes of the world. FAO Fisheries Synopsis 125(10). 442 p.

86. Cohen, E.B., and R.W. Langton. 1992. The ecological consequences of fishing in the Gulf of Maine. *In*: The Gulf of Maine: NOAA Coastal Ocean Program Regional Synthesis Series No. 1, pp. 45-70. NOAA Coastal Ocean Program, Washington, DC.

87. Collette, B.B. 1986. Resilience of fish assemblages in New England tidepools. Fish. Bull., U.S. 84(1):200-204.

88. Collette, B., and K.E. Hartel. 1988. Annotated list of fishes of Massachusetts Bay. NOAA Tech. Memo. NMFS-F/NEC-51. 70 p.

89. Collings, W.S., C. Cooper-Sheehan, S.C. Hughes, and J.L. Buckley. 1981. The effects of power generation on some of the living marine resources of the Cape Cod Canal and approaches. Massachusetts Div. Marine Fisheries, Sandwich, MA. 212 p.

90. Collings, W.S., C. Cooper-Sheehan, S.C. Hughes, and J.L. Buckley. 1985. The spatio-temporal distribution of American lobster, *Homarus americanus*, larvae in the Cape Cod Canal and approaches. Northeast Fisheries Center collected reprints 1983, Woods Hole Laboratory, Woods Hole, MA. Vol. III:35-40.

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

92. Compagno, L.J.V. 1984. Sharks of the world: An annotated and illustrated catalogue of shark species known to date: Part 1-Hexanchiformes to Lamniformes. Rome, Italy, Food and Agriculture Organization of the United Nations, FAO Fisheries Synopsis No. 125. Vol. 4, part 1:11-113.

93. Conand, C., and N.A. Sloan. 1989. World fisheries for echinoderms. *In*: Caddy, J.F. (ed.), pp. 647-664. Marine invertebrate fisheries: Their Assessment and Management. John Wiley and Sons, New York, NY.

94. Conover, D.O., and S.A. Murawski. 1982. Offshore winter migration of the Atlantic silverside, *Menidia menidia*. Fish. Bull., U.S. 80(1):145-150.

95. Conover, D.O., and M.R. Ross. 1982. Patterns in seasonal abundance, growth, and biomass of the Atlantic silverside, *Menidia menidia*, in a New England estuary. Estuaries 5(4):275-286.

96. Conover, D.O., and B.E. Kynard. 1984. Field and laboratory observations of spawning periodicity and behavior of a northern population of the Atlantic silverside, *Menidia menidia* (Pisces: Atherinidae). Environ. Biol. Fishes 11(3):161-171.

97. Cooper, R.A., R.A. Clifford, and C.D. Newell. 1975. Seasonal abundance of the American lobster, *Homarus americanus*, in the Boothbay region of Maine. Trans. Am. Fish. Soc. 104:669-674.

98. Cooper, R. A., and J.R. Uzmann. 1980. Ecology of juvenile and adult *Homarus*. *In*: Cobb, J.S., and B.F. Phillips (eds.), pp. 97-142. The biology and management of lobsters, Vol. II: Ecology and management. Academic Press, NH.

99. Corey, S. 1981. The life history of *Crangon septemspinosa* Say (Decapoda: Caridea) in the shallow sublittoral area of Passamaquoddy Bay, New Brunswick, Canada. Crustaceana 41(1):21-28.

100. Corey, S. 1987. Reproductive strategies and comparative fecundity of *Crangon septemspinosa* Say (Decapoda, Caridea). Crustaceana 52(1):25-28.

101. Creaser, E.P., D. A. Libby, and G.D. Speirs. 1984. Seasonal movements of juvenile and adult herring, *Clupea harengus* L., tagged along the Maine coast. J. Northw. Atl. Fish. Sci. 5:71-78.

102. Creaser, E.P., and D.A. Libby. 1988. Seasonal movements of juvenile and adult herring (*Clupea harengus* L.) tagged along the Maine and New Hampshire coasts in 1976-82. J. Northw. Atl. Fish. Sci. 8:33-42.

103. Curley, J.R., R.P. Lawton, D.K. Whittaker, and J.M. Hickey. 1972. A study of the marine resources of Wellfleet Harbor. Massachusetts Div. Marine Fisheries Monogr. Ser. No. 12. 37 p.

104. Dadswell, M.J. 1979. Biology and population characteristics of the shortnose sturgeon, *Acipenser brevirostrum*, LeSueur 1818 (Osteichthtes: Acipenseridae), in the Saint John River Estuary, New Brunswick, Canada. Can. J. Zool. 57:2186-2210.

105. Dadswell, M.J., G.D. Melvin, and P.J. Williams. 1983. Effect of turbidity on the temporal and spatial utilization of the inner Bay of Fundy by American shad (*Alosa sapidissima*)(Pisces: Clupeidae) and its relationship to local fisheries. Can. J. Fish. Aquat. Sci. (Suppl. 1):322-330.

106. Dadswell, M.J., B.D. Taubert, T.S. Squiers, D.Marchette, and J. Buckley. 1984. Synopsis of biological data on shortnose sturgeon, *Acipenser brevirostrum*, LeSueur 1818. NOAA Tech. Rep. NMFS 14/FAO Fisheries Synopsis No. 140. 45 p.

107. Dadswell, M.J., R.A. Chandler, and G.J. Parsons. 1987. Spat settlement and early growth of *Placopecten magellanicus* in Passamaquoddy Bay, Canada. *In*: Abstracts, pp. 153-154. Annual meeting of the National Shellfisheries Association, August 9-13, 1987. Halifax, Nova Scotia.

108. Dadswell, M.J., G.D. Melvin, P.J. Williams, and D.E. Themelis. 1987. Influences of origin, life history, and chance on the Atlantic coast migration of American shad. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 313-330. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

109. Danie, D.S., J.G. Trial, and J.G. Stanley. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—Atlantic salmon. U.S. Fish Wildl. Serv., Biol. Rep. FWS/OBS-82(11.22), 19 p.

110. Daniel, P.C., R.C. Bayer, and C. Waltz. 1989. Egg production of V-notched American lobsters (*Homarus americanus*) along coastal Maine. J. Crustacean Biol. 9(1):77-82.

111. Davis, J.D., and R.A. McGrath. 1984. Some aspects of nearshore benthic macrofauna in western Cape Cod Bay. *In*: Davis, J.D., and D. Merriman (eds.), Observations on the ecology and biology of western Cape Cod Bay, Massachusetts. Springer-Verlag, New York. pp. 77-102.

112. Davis, J.D., and D. Merriman. 1984. Observation on the ecology and biology of western Cape Cod Bay, Massachusetts. Lecture notes on coastal and estuarine studies, vol. II, Springer-Verlag, New York. 289 p.

113. Day, J.W., Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons, New York, NY. 558 p.

114. Deegan, L.A., J.T. Finn, S.C. Murphy, and S.G. Ayvazian. 1991. Are critical habitats determined by life history strategies or habitat availability? NOAA Final Tech. Rep. for Grant No. NA88AA-D-CZ2005. pp. 1-35.

115. Department of Fish and Game. 1981. Inventory of the natural resources of Great Bay estuarine system, Vol. I. New Hampshire Fish and Game Dept., Concord, NH. 254 p.

116. Department of Fish and Game. 1982. Great Bay estuary monitoring survey, 1981-1982. New Hampshire Fish and Game Dept., Concord, NH. 199 p.

117. Department of Fish and Game. 1992. Anadromous fish investigations and marine recreational fishery evaluation January 1, 1991 to December 31, 1991, pp. 1-51. Project No. F-50-R-8. New Hampshire Fish and Game Dept., Concord, NH.

118. Doering, P.H., C.T. Roman, L.L. Beatty, A.A. Keller, C.A. Oviatt, B.D. Zubricki, and L.W. Reed. 1992. Water quality and habitat evaluation of the Bass harbor marsh estuary (Acadia National Park). Progress report. U.S. Natl. Park Serv., Acadia National Park, Bar Harbor, ME. 35 p.

119. Dow, R. 1977. Effects of climatic cycles on the relative abundance and availability of commercial marine and estuarine species. Conseil International pour l'exploration de la mer. J. du Conseil. 37(3):274-280.

120. Dow, R.L., and F.T. Baird. 1960. Scallop resource of the United States Passamaquoddy area. U.S. Fish Wildl. Serv., Spec. Sci. Rep.-Fisheries No. 367. 9 p.

121. Dube, N.R. 1983. The Saco River: An Atlantic salmon river management report, pp. 1-29. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME.

122. Dube, N.R., and J.S. Fletcher. 1982. The East Machias River: An Atlantic salmon river management report, pp. 39-68. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME.

123. Dube, N.R., and R.M. Jordan. 1982. The Pleasant River: An Atlantic salmon river management report, pp. 43-69. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME.

124. Duston, N.M., C.A. Batdorf, and J.P. Schwartz. 1990. Progress report: Metal concentrations in marine fish and shellfish from Boston and Salem Harbors, and coastal Massachusetts. Executive Office of Environmental Affairs/Dept. of Fisheries, Wildlife, and Environmental Law Enforcement/Massachusetts Div. Marine Fisheries. 120 p.

125. Dutil, J.D., J. Munro, C. Audet, and M. Besner. 1992. Seasonal variation in the physiological response of Atlantic cod (*Gadus morhua*) to low salinity. Can. J. Fish. Aquat. Sci. 49:1149-1156.

126. Easte, W. 1990. Study II, Merrimack River anadromous fish investigations: Essex dam fish passage evaluation. Unpublished data. Massachusetts Div. Fish and Wildlife, Boston, MA.

127. Elliott, E.M., D. Jimenez, C.O. Anderson, Jr., and D.J. Brown. 1979. Ichthyoplankton abundance and distribution in Beverly-Salem Harbor, March 1975-February 1977. Massachusetts Div. Marine Fisheries, Salem, MA. 174 p.

128. Elliott, E.M., and I.M. Kushlan. 1980. Annotated bibliography of ichthyoplankton in Massachusetts Bay. Massachusetts Div. Marine Fisheries, Salem, MA. 52 p.

129. Embich, T. R. 1973. Ecology of the sand shrimp, *Crangon septemspinosa*, Say 1818, in the Penobscot River Estuary, Maine. M.S. thesis, Univ. Maine, Orono, ME. 59 p.

130. Ennis, G.P. 1986. Stock definition, recruitment variability, and larval recruitment processes in the American lobster, *Homarus americanus*: A review. Can. J. Fish. Aquat. Sci. 43:2072-2084.

131. ENSR Consulting and Engineering. 1992. Technical memorandum: A review to determine the monitoring of aquatic resources in Boston Harbor. Acton, MA, submitted to Bechtel/Parsons Brinkerhoff, document no. 0850-012-001.

132. Estrella, B.T. 1984. Black gill and shell disease in American lobster (*Homarus americanus*) as indicators of pollution in Massachusetts Bay and Buzzards Bay, Massachusetts. Massachusetts Div. Marine Fisheries, Sandwich, MA. 17 p.

133. Estrella, B.T., and D.J. McKiernan. 1988. Massachusetts coastal commercial lobster trap sampling program, May-November, 1987. Massachusetts Div. Marine Fisheries, Sandwich, MA. 15 p.

134. Estrella, B.T. and S.X. Cadrin. 1989. Massachusetts coastal commercial lobster trap sampling program, May-November, 1988. Massachusetts Div. Marine Fisheries, Sandwich, MA. 23 p.

135. Estrella, B.T., and D.J. McKiernan. 1989. Catch-per-unit-effort and biological parameters from the Massachusetts coastal lobster (*Homarus americanus*) resource: description and trends. NOAA Tech. Rep. NMFS 81. 21 p.

136. Estrella, B.T. and S.X. Cadrin. 1990. Massachusetts coastal commercial lobster trap sampling program, May-November, 1989. Massachusetts Div. Marine Fisheries, Sandwich, MA. 21 p.

137. Facey, D.E., and M.J. Van Den Avyle. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American eel. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.74), 28 p.

138. Fahay, M.P., and K.W. Able. 1988. White hake, *Urophycis tenuis*, in the Gulf of Maine: spawning seasonality, habitat use, and growth in young of the year and relationships to the Scotian Shelf population. Can. J. Zool. 67:1715-1724.

139. Fairbanks, R.B., W.S. Collings and W.T. Sides. 1971. An assessment of the effects of electrical power generation on marine resources in the Cape Cod Canal. Massachusetts Div. Marine Fisheries, Sandwich, MA., 48 p.

140. Fay, C.W., R.J. Neves, and G.B. Pardue. 1983a. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—striped bass. U.S. Fish Wildl. Serv., Biol. Rep. FWS/OBS 82(11.8), 36 p.

141. Fay, C.W., R.J. Neves, and G.B. Pardue. 1983b. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—Atlantic Silverside. U.S. Fish Wildl. Serv., Biol. Rep. FWS/OBS-82(11.10), 15 p.

142. Fefer, S.I., and P.A. Schettig. 1980. An ecological characterization of coastal Maine (north and east of Cape Elizabeth). U.S. Fish Wildl. Serv., FWS/OBS-80/29, vol. 2.

143. Fiske, J.D., C.E. Watson, and P.G. Coates. 1966. A study of the marine resources of the North River. Massachsetts Div. Marine Fisheries Monogr. Ser. No. 3. 53 p.

144. Flagg, L.N. 1972. The anadromous smelt fishery of Maine. Maine Dept. Marine Resources, Augusta, ME. 6 p.

145. Flagg, L.N. 1992. The Maine eel and elver fishery. Maine Dept. Marine Resources, Augusta, ME. 2 p.

146. Flagg, L.N. and C.A. Rushton. 1991. Androscoggin River anadromous fish restoration: program results 1983-1990. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 3 p.

147. Flagg, L.N., T.S. Squiers, M.E. Smith, and C.A. Rushton. 1990. Androscoggin River anadromous fish restoration: 1990 program results. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME.

148. Flagg, L.N., T.S. Squiers, M.E. Smith, and C.A. Rushton. 1992. Androscoggin River anadromous fish restoration: 1991 program results. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME.

149. Fletcher, J.S., R.M. Jordan, and K. Beland. 1982. The Machias River: An Atlantic salmon river management report. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME. pp. 1-38.

150. Fletcher, J.S. and A.L. Meister. 1982. The St. Croix River: An Atlantic salmon river management report. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME. 42 p.

151. Fogarty, M.J., and R. Lawton. 1983. An overview of larval American lobster, *Homarus americanus*, sampling programs in New England during 1974-79. Northeast Fisheries Center collected reprints 1983, Woods Hole Laboratory, Woods Hole, MA. Vol. III:9-14.

152. Ford, T.E., and E. Mercer. 1986. Density, size distribution and home range of American eels, *Anguilla rostrata*, in a Massachusetts salt marsh. Environ. Biol. Fishes 17(4):309-314.

153. Frady, T. (ed.). 1979. Proceedings of the international Pandalid shrimp symposium. Alaska Sea Grant Rep. 81-3, Kodiak, AK.

154. Fried, S.M. 1973. Distribution of demersal fishes in Montsweag Bay-Back River and Lower Sheepscot River estuaries, Wiscasset, Maine. M.S. thesis, Univ. Maine, Orono, ME. 48 p.

155. Fried, S.M., and J.D. McCleave. 1973. Occurence of the shortnose sturgeon (*Acipenser brevirostrum*), an endangered species in Montsweag Bay, Maine. J. Fish. Res. Bd. Can. 30:563-564.

156. Friedland, K. 1993. History of salmon fisheries and management in the North Atlantic. *In*: Ninth ICES dialogue meeting and the tenth annual meeting of the North Atlantic Salmon Conservation Organization: Briefing book. Edinburgh, Scotland. 125 p.

157. Fritzsche, R.A. 1978. Vol. V, Chaetodontidae through Ophidiidae. *In*: Hardy, J.D., Jr. (ed.) Development of fishes of the Mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. U.S. Fish Wildl. Serv., FWS/OBS-78/12, 340 p.

158. Galtsoff, P.S., and W.A. Chipman, Jr. 1940. Oyster investigations in Maine. Maine Dept of Marine Resources, W. Boothbay Harbor, ME. 25 p.

159. Garman, G.C. 1983. Observations on juvenile red hake associated with sea scallops in Frenchman Bay, Maine. Trans. Am. Fish. Soc.112:212-215.

160. Gestring, K. 1992. Great Bay purse seining summary. Unpublished data. Univ. New Hampshire, Durham, NH.

161. Gilbert, C.R. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight)—Atlantic and shortnose sturgeon. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.122), 28 p.

162. Goode, R.E. 1989. An assessment of the biological status of an intertidal sandbar in the harbor of the town of Wells, Maine. Prepared for Timpson, Schepps and Peters, Hallowell, ME. 7 p.

163. Gosner, K.L. 1978. A field guide to the Atlantic seashore. The Peterson Field Guide Series 24. Houghton Mifflin Co., Boston, MA. 329 p.

164. Grabe, S.A., J.W. Shipman, and W.S. Bosworth. 1985. New Hampshire lobster larvae studies. *In*: Northeast Fisheries Center collected reprints 1983, Woods Hole Laboratory, Woods Hole, MA. Vol. III:53-56.

165. Graham, J.J. 1982. Production of larval herring, *Clupea harengus*, along the Maine coast, 1964-1978. J. Northw. Atl. Fish. Sci. 3:63-85.

166. Graham, J.J., B.J. Joule, C.L. Crosby, and D. Townsend. 1984. Characteristics of the Atlantic Herring (*Clupea harengus* L.) spawning population along the Maine coast, inferred from larval studies. J. Northw. Atl. Fish. Sci. 5:131-142.

167. Graham, J.J., and K.M. Sherman. 1987. Recruitment mechanisms of 2-year-old Atlantic herring to the Maine fishery: The larval stage. Amer. Fish. Soc. Symposium 2:61-68. American Fisheries Society, Bethesda, MD.

168. Graham, J.J., D.K. Stevenson, and K.M. Sherman. 1990. Relation between winter temperature and survival of larval Atlantic herring along the Maine coast. Trans. Am. Fish. Soc. 119:730-740.

169. Greene, C.W., G.H. Mittelhauser, J. Jacobs, and L.L. Gregory. 1992. Historical resource inventory for Acadia National Park: Vol. 1. U.S. Dept. Interior, National Park Service Tech. Rep. NPS/NAR/OSS/NRTR-92/01, 623 p.

170. Greenstein D. M., L.C. Alexander, and D.E. Richter. 1983. Abundance and distribution of lobster larvae (*Homarus americanus*) for selected locations in Penobscot Bay, Maine. *In*: Northeast Fisheries Science Center collected reprints 1983, Woods Hole Laboratory, Woods Hole, MA. Vol III:59-61.

171. Groom, W. 1978. Interim investigation of lobster stock, size and migration system of lobster population in the Grand Manan region. New Brunswick Department of Fisheries, Fredericton, New Brunswick. 69 p.

172. Hacunda, J.S. 1981. Trophic relationships among demersal fishes in a coastal area of the Gulf of Maine. Fish. Bull., U.S. 79(4):775-788.

173. Haedrich, R.L., and S.O. Haedrich. 1974. A seasonal survey of the fishes in the Mystic River, a polluted estuary in downtown Boston, Massachusetts. Est. Coast. Mar. Sci. 2:59-73.

174. Haedrich, R.L. 1983. Estuarine fishes. *In*: Ketchum, B.H. (ed.), pp. 183-207. Ecosystems of the world 26: Estuaries and enclosed seas. Elsevier, New York, NY.

175. Haefner, P.A.J. 1977. Aspects of the biology of the jonah crab, *Cancer borealis*, Stimpson 1859, in the mid-Atlantic Bight. J. Nat. Hist. 11:303-320.

176. Haefner, P.A.J. 1979. Comparative review of the biology of North Atlantic Caridean shrimps (*Crangon*), with emphasis on *C. septemspinosa*. Bull. Biol. Soc. Wash. 3:1-40.

177. Halliday, R.G., J. McGlade, R. Mohn, R.N. O'Boyle, and M. Sinclair. 1986. Resource and fishery distributions in the Gulf of Maine area in relation to the subarea 4/5 boundary. NAFO Sci. Coun. Studies 10:67-92.

178. Halliday, R.G., and A.T. Pinhorn. 1990. The delimitation of fishing areas in the Northwest Atlantic. J. Northw. Atl. Fish. Sci. 10:1-51.

179. Halliwell, D.B. 1984. A list of the freshwater fishes of Massachusetts, Third edition. Massachusetts Div. Fisheries and Wildlife, Pub. No. 13594-14-750-4-84-C.R. 12 p.

180. Hardwick-Witman, M.N., and A.C. Mathieson. 1983. Intertidal macroalgae and macroinvertebrates: Seasonal and spatial abundance patterns along an estuarine gradient. Est. Coast. Shelf Sci. 16:113-129.

181. Hardy, J.D., Jr. (ed.). 1978. Development of fishes of the Mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. Vols. I-VI, U.S. Fish Wildl. Serv., FWS/OBS-78/12.

182. Haynes, E.B., and R. L. Wigley. 1969. Biology of the northern shrimp, *Pandalus borealis*, in the Gulf of Maine. Trans. Am. Fish. Soc. 98:60-76.

183. Heck, K.L.J., K.W. Able, M.P. Fahay, and C.T. Roman. 1989. Fishes and decapod crustaceans of Cape Cod eelgrass meadows: Species composition, seasonal abundance patterns and comparison with unvegetated substrates. Estuaries 12(2):59-65.

184. Helfman, G.S., D.E. Facey, L.S. Hales, Jr., and E.L. Bozeman, Jr. 1987. Reproductive ecology of the American eel. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 42-56. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

185. Himmelman, J.H. 1978. Reproductive cycle of the green sea urchin, *Strongylocentrotus droebachiensis*. Can. J. Zool. 56:1828-1836.

186. Himmelman, J.H., Y. Lavergne, F. Axelsen, A. Cardinal, and E. Bourget. 1983. Sea urchins in the Saint Lawrence Estuary: Their abundance, size-structure, and suitability for commercial exploitation. Can. J. Fish. Aquat. Sci., 40:474-486.

187. Hoenig, J.M., and S.H. Gruber. 1990. Life-history patterns in the Elasmobranchs: Implications for fisheries management. *In*: Pratt, H.L. Jr., S.H. Gruber, and T.Taniuchi (eds.), Elasmobranchs as living resources: Advances in the biology, ecology, systematics, and the status of the fisheries, NOAA Tech. Rep. NMFS 90:1-17.

188. Hoopes, T.B. 1990. Massachusetts lobster fishery statistics. Massachusetts Div. Marine Fisheries, Salem, MA. 22 p.

189. Horst, T., R. Lawton, R. Toner, and M. Scherer. 1984. Seasonal abundance and occurrence of some planktonic and ichthyofaunal communities in Cape Cod Bay: Evidence for biogeographical transition. *In*: Davis, J.D., and D. Merriman (eds.), pp. 241-261. Observations on the ecology and biology of western Cape Cod Bay, Massachusetts. Springer-Verlag, New York, NY.

190. Howe, A.B., T.P. Currier, Sass, S.L., and B.C. Kelly. 1987. Coastwide fishery resource assessment, coastal Massachusetts: Final report. Unpublished data. NOAA/NMFS Sub-Project No. 3-375-R-3. Massachusetts Div. Marine Fisheries, Sandwich, MA. 30 p.

191. Howe, A.B., T.P. Currier, S.J. Correia, and D.B. Witherell. 1991. Coastwide fishery resource assessment, coastal Massachusetts: Final report. Unpublished data. NOAA/NMFS Sub-Project No. 3-IJ-3. Massachusetts Div. Marine Fisheries, Sandwich, MA. 50 p.

192. Howell, W.H., A. Vetrovs, and W.H. Watson. In prep. Demographic characteristics of an estuarine lobster population: Abundance, size frequency, molting, growth, maturity, and sex ratio. Univ. New Hampshire, Durham, NH.

193. Hubbard, W.A., J. M. Penko, and T.S. Fleming. 1988. Site evaluation studies of the Massachusetts Bay disposal site for ocean disposal of dredged material. Environmental Resources Section, Impact Analysis Branch, New England Division, U.S. Army Corps of Engineers, Waltham, MA. 384 p.

194. Hubbard, W.A., and R.J. Bellmer. 1989. Biological and chemical composition of Boston Harbor, USA. Mar. Pollution Bull. 20(12):615-621.

195. Hudon, C., and G. Lamarche. 1989. Niche segregation between American lobster *Homarus americanus* and rock crab *Cancer irroratus*. Mar. Ecol. Prog. Ser. 52:155-168.

196. Incze, L.S., and R.A. Wahle. 1991. Recruitment from pelagic to early benthic phase in lobsters *Homarus americanus.* Mar. Ecol. Prog. Ser. 79:77-87.

197. Iwanowicz, R. 1992. Monthly fish passage counts recorded at the Essex Dam, Lawrence MA, 1983-1992. Unpublished data. Massachusetts Div. Marine Fisheries, Salem, MA.

198. Iwanowicz, H.R., R.D. Anderson, and B.A. Ketschke. 1973. A study of the marine resources of Hingham Bay. Massachusetts Div. Marine Fisheries Monogr. Ser. No. 14. 40 p.

199. Iwanowicz, H.R., R.D. Anderson, and B.A. Ketschke. 1974. A study of the marine resources of Plymouth, Kingston and Duxbury Bays. Massachsetts Div. Marine Fisheries Monogr. Ser. No. 17. 37 p.

200. Jackson, C.F. 1944. A biological survey of Great Bay, New Hampshire, Vol. 1. New Hampshire Marine Fisheries Commission, Durham, NH. 61 p.

201. Jeffries, H.P. 1966. Partitioning of the estuarine environment by two species of *Cancer.* Ecology 47(3):477-481.

202. Jensen, A.C. 1966. Life history of the Spiny Dogfish. Fish. Bull., U.S. 65(3):527-554.

203. Jerome, W.C., Jr., A.P. Chesmore, C.O. Anderson, Jr., and F. Grice. 1965. A study of the marine resources of the Merrimack River Estuary. Massachusetts Div. Marine Fisheries Monogr. Ser. No.1. 90 p.

204. Jerome, W.C., Jr., A.P. Chase, and C.O. Anderson, Jr. 1966. A study of the marine resources of Quincy Bay. Massachsetts Div. Marine Fisheries Monogr. Ser. No. 2. 62 p.

205. Jerome, W.C., Jr., A.P. Chesmore, and C.O. Anderson. 1968. A study of the marine resources of the Parker River-Plum Island Sound Estuary. Massachusetts Div. Marine Fisheries Monogr. Ser. No. 6. 79 p.

206. Jessop, B.M., W.E. Anderson, and A.H. Vromans. 1983. Life history data on the alewife and blueback herring of the Saint John River, New Brunswick, 1981. Canadian Data Rep. Fish. Aquat. Sci. 426. Freshwater and Anadromous Division, Fisheries Research Branch, Dept. of Fisheries and Oceans, Halifax, NS. 37 p.

207. Keats, D.W., D.H. Steele, and G.R. South. 1984. Depth-dependent reproductive output of the green sea urchin, *Strongylocentrotus drobachiensis* (O.F. Muller), in relation to the nature and availability of food. J. Exp. Mar. Biol. Ecol. 80:77-91.

208. Kelly, K.H., and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—Atlantic herring. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.38), 22 p.

209. Kieffer, M.C. 1991a. Annual movements of Shortnose and Atlantic sturgeons in the lower Merrimack River. M.S. thesis, Univ. Massachusetts, Amherst, MA.

210. Kieffer, M.C. 1991b. Miscellaneous fish captured in gillnets in the Merrimack River from 8/87-7/90. Unpublished data. Conte Anadromous Fish Lab., Turners Falls, MA.

211. Kindblom, L.C. 1991. The effect of eelgrass (*Zostera marina*) on the distribution and abundance of blue mussel larvae (*Mytilus edulis*) in the Mount Desert Narrows, Maine. M.S. thesis, Univ. Maine, Orono, ME. 102 p.

212. Knowlton, R.E. 1973. Occurrence of grass shrimp, *Palaemonetes pugio*, in southern Maine. Maine Nature, March 1973:3.

213. Knowlton, R.E., and D.F. Kirby. 1984. Salinity tolerance and sodium balance in the prawn *Palaemonetes pugio* Holthuis, in relation to other *Palaemonetes* species. Comp. Biochem. Physiol. 77A(3):425-430.

214. Koch, P. 1974. Distribution of pelagic fishes in a Maine estuary subject to thermal discharge. M.S. thesis, Univ. Maine, Orono, ME. 51 p.

215. Koslow, J.A. 1984. Recruitment patterns in northwest Atlantic fish stocks. Can. J. Fish. Aquat. Sci. 41: 1722-1729.

216. Krouse, J.S. 1972. Some life history aspects of the rock crab, *Cancer irroratus*, in the Gulf of Maine. J. Fish. Res. Bd. Can. 29:1479-1482.

217. Krouse, J. 1973. Maturity, sex ratio, and size composition of the natural population of American lobster, *Homarus americanus*, along the Maine coast. Fish. Bull., U.S. 71(1):165-173.

218. Krouse, J.S. 1976. Size composition and growth of young rock crab, *Cancer irroratus*, on a rocky beach in Maine. Fish. Bull., U.S. 74(4):949-954.

219. Krouse, J.S. 1980. Distribution and catch composition of Jonah crab, *Cancer borealis*, and rock crab, *Cancer irroratus*, near Boothbay Harbor, Maine. Fish. Bull., U.S. 77(3):685-693.

220. Krouse, J.S. 1981. Movement, growth, and mortality of American lobsters, *Homarus americanus*, tagged along the coast of Maine. NOAA NMFS Tech. Rep. SSRF-747. 12 p.

221. Lacalli, T. 1981. Annual spawning cycles and planktonic larvae of benthic invertebrates from Passamaquoddy Bay, New Brunswick. Can. J. Zool. 59:433-440.

222. Lachance, S., P. Magnan, and G.J. FitzGerald. 1987. Temperature preferences of three sympatric sticklebacks (Gasterosteidae). Can. J. Zool. 65:1573-1576.

223. Lamborghini, P.L. 1982. Seasonal abundance, temporal variation and food habits of fishes in a Maine salt marsh creek system. M.S. thesis, Univ. Maine, Orono, ME. 159 p.

224. Langan, R. 1980. Aspects of the ecology of juvenile river herring (*Alosa pseudoharengus*) from the Lamprey River, New Hampshire. M.S. thesis, Univ. New Hampshire, Durham, NH. 54 p.

225. Langton, R.W. 1990. Annual report for project F-34-R4; Ecology of groundfish along the coast of Maine (7/24/89 through 1/30/90). Maine Dept. Marine Resources, West Boothbay Harbor, ME. 200 p.

226. Langton, R.W. 1991. Annual report for project F-34-R4; Ecology of groundfish along the coast of Maine (1/30/90 through 1/30/91). Maine Dept. Marine Resources, West Boothbay Harbor, ME. 200 p.

227. Langton, R.W. 1992a. Annual report for project F-34-R4; Ecology of groundfish along the coast of Maine (1/30/91 through 1/30/92). Maine Dept. Marine Resources, West Boothbay Harbor, ME. 200 p.

228. Langton, R.W. 1992b. Fish distribution patterns in Sheepscot Bay: Effects of habitat, environment, biological factors. Commercial Fisheries News, December 1992.

229. Langton, R.W. 1993. Annual report for project F-34-R4; Ecology of groundfish along the coast of Maine (5/1/92 through 4/30/93). Maine Dept. Marine Resources, West Boothbay Harbor, ME. 200 p.

230. Langton, R.W., and R.E. Bowman. 1980. Food of fifteen northwest Atlantic Gadiform fishes. NOAA NMFS Tech. Rep. SSRF-740. 23 p.

231. Langton, R.W., and R.E. Bowman. 1981. Food of eight northwest Atlantic pleuronectiform fishes. NOAA Tech. Rep. NMFS SSRF 749. 61 p.

232. Langton, R.W., R.K. Knowles, and K.J. Ward. 1989. Examination and ecology of potential nursery areas along coastal Maine for groundfish. Final report Project No. 3-426-R. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 114 p.

233. Langton, R.W., and L. Watling. 1990. The fish-benthos connection: A definition of prey groups in the Gulf of Maine. *In*: Barnes, M., and R.N. Gibson (eds.), pp. 424-438. Trophic relationships in the marine environment, Proceedings of the 24th European Marine Biology Symposium, Aberdeen University Press.

234. Laroche, W.A. 1981. Development of larval smooth flounder, *Liopsetta putnami*, with a redescription of development of winter flounder, *Pseudopleuronectes americanus* (Family Pleuronectidae). Fish. Bull., U.S. 78(4):897-909.

235. Laroche, J.L. 1982. Trophic patterns among larvae of five species of sculpins (Family: Cottidae) in a Maine estuary. Fish. Bull., U.S. 80(4): 827-840.

236. Larsen, P.F., and L.F. Doggett. 1976. The salinity and temperature distributions of selected Maine estuaries. Maine State Planning Office, Maine Coastal Program, Bigelow Laboratory Contrib. No. 2-76.

237. Larsen, P.F., A.C. Johnson, and L.F. Doggett. 1980. Environmental Benchmark Studies in Casco Bay-Portland Harbor, Maine, April 1980. NOAA Tech. Memo. NMFS-F/NEC-19. 173 p.

238. Larsen, P.F., L.F. Doggett, and A.C. Johnson. 1983. The macroinvertebrate fauna associated with five sand flats in the northern Gulf of Maine. Proc. N.S. Inst. Sci. 33:57-63.

239. Larsen, P.F., and L.F. Doggett. 1990. Sand beach macrofauna of the Gulf of Maine with inference on the role of oceanic fronts in determining community composition. J. Coastal Res. 6(4):913-926.

240. Larsen, P.F., and L.F. Doggett. 1991. The macroinvertebrate fauna associated with the mud flats of the Gulf of Maine. J. Coastal Res. 7(2):365-375.

241. Lawton, R.P., R.D. Anderson, P. Brady, C. Sheehan, W. Sides, E. Kouloheras, M. Borgatti, and V. Malkoski. 1984. Fishes of western inshore Cape Cod Bay: Studies in the vicinity of the Rocky Point shoreline. *In*: Davis, J.D., and D. Merriman (eds.), pp. 191-230. Observations on the ecology and biology of western Cape Cod Bay, Massachusetts. Springer-Verlag, New York, NY.

242. Lawton, R., E. Kouloheras, P. Brady, W. Sides, and M. Borgatti. 1985. Distribution and abundance of larval American lobsters, *Homarus americanus* Milne-Edwards, in the western inshore region of Cape Cod Bay, Massachusetts. Northeast Fisheries Center collected reprints 1983, Woods Hole Laboratory Vol. III, pp. 47-52.

243. Lawton, R.P., V. Malkowski, S. Correia, B. Kelly, C.Sheehan, M. Borgatti, and P. Brady. 1987. Final report on marine recreational fishing at the Pilgrim Station shorefront 1973-1975, 1983-1986. Massachusetts Div. Marine Fisheries, Sandwich, MA. 53 p.

244. Lawton, R.P., B.C. Kelly, V.J. Malkowski, and M. Borgatti. 1992. Annual report on environmental impact monitoring of Pilgrim Nuclear Power Station (Characterization of the marine fisheries resources: Project Rep. No. 52). *In*: Anderson, R. (ed.), Marine ecology studies related to operation of Pilgrim Station semi-annual Rep. No. 39. Boston Edison Company, Boston, MA. 48 p.

245. Lawton, R.P., B.C. Kelly, and V.J. Malkowski. 1987-1991. Unpublished data. Environmental impact monitoring of Pilgrim Nuclear Power Station-fisheries data. Prepared by Massachusetts Div. Marine Fisheries for Boston Edison Company, Boston, MA.

246. Lazlo, P.T. 1972. Age-growth, food, and reproduction of the smooth flounder *Liopsetta putnami* (Gill) in Great Bay, New Hampshire. Ph.D. dissertation, Univ. New Hampshire, Durham, NH. 75 p.

247. Lazzari, M.A., K.W. Able, and M.P. Fahay. 1989. Life history and food habits of the grubby, *Myoxocephalus aeneus* (Cottidae), in a Cape Cod estuary. Copeia 1:7-12.

248. Lazzari, M.A., and K.W. Able. 1990. Northern pipefish, *Syngnathus fuscus*, occurrences over the Mid-Atlantic Bight continental shelf: evidence of seasonal migration. Environ. Biol. Fishes 27:177-185.

249. Lazzari, M.A., and D. K. Stevenson. 1992. Spawning origin of small, late-hatched Atlantic herring (*Clupea harengus*) larvae in a Maine estuary. Estuaries 15(3): 282-288.

250. Leim, A.H. 1958. Distribution of herring larvae in the lower Bay of Fundy and adjacent waters. Fish. Res. Bd. Can., Manuscr. Rep. Ser. (Biol.) 652. 8 p.

251. Loesch, J.G. 1987. Overview of life history aspects of anadromous alewife and blueback herring in freshwater habitats. *In* Dadswell, M.J., R.J. Klauda, C.M. Moffitt, R.L. Saunders, R.A. Rulifson, and J.E. Cooper (eds.), pp. 89-103. Common Strategies of Anadromous and Catadromous Fishes. Am. Fish. Soc. Symposium 1. American Fisheries Society, Bethesda, MD. 561 p.

252. Lux, F. and G. Kelly. 1986. Abundance and size composition of fish and invertebrates from coastal otter trawl surveys in Cape Cod and Massachusetts Bay in 1975-1977. Woods Hole Lab. Ref. Doc. No. 82-27. 14 p.

253. MacDonald, B.A., and R.J. Thompson. 1988. Intraspecific variation in growth and reproduction in latitudinally differentiated populations of the giant scallop *Placopecten magellanicus* (Gmelin). Biol. Bull. (Woods Hole) 175:361-371.

254. MacDonald, D.A. 1991. Status and trends in concentrations of selected contaminants in Boston Harbor sediments and biota. NOAA Tech. Memo. NOS OMA 56.

255. MacDonald, J.S., M.J. Dadswell, R.G. Appy, G.D. Melvin, and D.A. Methven. 1984. Fishes, fish assemblages, and their seasonal movements in the lower Bay of Fundy and Passamaquoddy Bay, Canada. Fish. Bull., U.S. 82(1):121-139.

256. MacKay, A., R. Bosien, and B. Wells. 1978. Bay of Fundy resource inventory. Vol. I: St. Croix River-Passamaquoddy Bay. Reference NB77-1A. Final report to New Brunswick Dept. of Fisheries. Marine Research Associates Ltd., Deer Island, N.B. 219 p.

257. MacKenzie, C., and J.R. Moring. 1985. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American lobster. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.33). 19 p.

258. Mahon, R., and R.W. Smith. 1989. Demersal fish assemblages on the Scotian Shelf, Northwest Atlantic: Spatial distribution and persistence. Can. J. Fish. Aquat. Sci. 46:134-152.

259. Maine Dept. Marine Resources. 1993. Inshore trawl survey data, Ipswich Bay to Frenchman's Bay. Unpublished data. Maine Dept. Marine Resources, W. Boothbay Harbor, ME.

260. Maine Yankee Power Company. 1978. Final report: environmental surveillance and studies at the Maine Yankee Nuclear Generating Station 1969-1977. Maine Yankee Atomic Power Company, Wiscassett, ME.

261. Marine Research, Inc. 1990. Aquatic ecology study of the Weymouth Fore River in the vicinity of the proposed Edgar Energy Park Project, February 1989-February 1990. Prepared for United Engineers and Constructors, Philadelphia, PA. 79 p.

262. Marine Research, Inc. 1992a. Aquatic ecology study of the Weymouth Fore River in the vicinity of the proposed Edgar Energy Park Project, September 1990-December 1991. Prepared for Boston Edison Company, Boston, MA. 98 p.

263. Marine Research, Inc. 1992b. Ichthyoplankton entrainment monitoring at Pilgrim Nuclear Power Station. *In*, Anderson, R. (ed.), Marine ecology studies related to operation of Pilgrim Station semi-annual report no. 39. Boston Edison Company, Boston, MA. 35 p.

264. MARITEC. 1978. An inventory of the blue mussel (*Mytilus edulis*) stocks from the Damariscotta River estuary to Jonesport, Maine. Univ. Maine, Orono, ME. 71 p.

265. Markle, D.F., D.A. Methven, and L.J. Coates-Markle. 1982. Aspects of spatial and temporal co-occurrence in the life history stages of the sibling hakes, *Urophycis chuss* (Waldbaum 1792) and *Urophycis tenuis* (Mitchill 1815) (Pisces: Gadidae). Can. J. Zool. 60:2057-2078.

266. Martin, P.D., S.P. Truchon, and L.G. Harris. 1988. *Strongylocentrotus droebachiensis* populations and community dynamics at two depth-related zones over an 11 year period. *In*: Burke et al. (eds.), pp. 475-482. Echinoderm biology. Balkema, Rotterdam, Netherlands.

267. Massachusetts Coastal Zone Management. 1978. Shellfish resources of the Massachusetts coast-1978 (map). Massachusetts Div. Marine Fisheries/Coastal Zone Management, Boston, MA.

268. Matthiessen, G.C., and M.D. Scherer. 1985. Observations on the seasonal occurrence, abundance, and distribution of larval lobsters (*Homarus americanus*) in Cape Cod Bay. Northeast Fisheries Center collected reprints 1983, Vol. III, pp. 41-45. Woods Hole Laboratory, Woods Hole, MA.

269. Mayo, R.K., J.M. McGlade, and S.H. Clark. 1989. Patterns of exploitation and biological status of pollock (*Pollachius virens* L.) in the Scotian Shelf, Georges Bank, and Gulf of Maine area. J. Northw. Atl. Fish. Sci. 9:13-36.

270. McAlice, B.J. 1977. A preliminary oceanographic survey of the Damariscotta River Estuary, Lincoln County, Maine. Univ. Maine, Ira C. Darling Center, Walpole, ME. 17 p.

271. McAlice, B.J., and G.B. Jaeger, Jr. 1983. Circulation changes in the Sheepscot River Estuary, Maine, following removal of a causeway. Estuaries 6(3):190-199.

272. McCleave, J.D., S.M. Fried, and A.K. Towt. 1977. Daily movements of shortnose sturgeon, *Acipenser brevirostrum*, in a Maine estuary. Copeia 1:149-157.

273. McCleese, D.W. 1956. Effects of temperature, salinity and oxygen on the survival of the American lobster. J. Fish. Res. Bd. Can. 13(2):247-272.

274. McCracken, F.D. 1960. Studies of haddock in the Passamaquoddy Bay region. J. Fish. Res. Bd. Can. 17(2):175-180.

275. McCracken, F.D. 1963. Seasonal movements of the winter flounder, *Pseudopleuronectes americanus* (Walbaum), on the Atlantic coast. J. Fish. Res. Bd. Can. 20(2):551-586.

276. McEachran, J.D., and J.A. Musick. 1975. Distribution and relative abundance of seven species of skates (Pisces: Rajidae) which occur between Nova Scotia and Cape Hatteras. Fish. Bull., U.S. 73(1):110-136.

277. McHugh, J.L., and M.W. Sumner. 1988. Annotated bibliography II of the hard clam, *Mercenaria mercenaria*. NOAA Tech. Rep. NMFS 68.

278. McInnes, D. 1986. Interstate fishery management plan for the northern shrimp (*Pandalus borealis* Krøyer) fishery in the western Gulf of Maine. Atlantic States Marine Fisheries Commission, Fish. Manag. Rep. No. 9. 36 p.

279. McIvor, C.C., and W.E. Odum. 1988. Food, predation risk, and microhabitat selection in a marsh fish assemblage. Ecology 69(5):1341-1351.

280. McKenzie, R.A., and B.E. Skud. 1958. Herring migrations in the Passamaquoddy region. J. Fish. Res. Bd. Can. 15(6):1329-1343.

281. McKenzie, R.A. and S.N. Tibbo. 1961. Herring movements in the Bay of Fundy and Gulf of Maine, 1957 and 1958. J. Fish. Res. Bd. Can. 18(6):221-252.

282. McKenzie, R.A. 1964. Smelt life history and fishery in the Mirimichi River, New Brunswick. J. Fish. Res. Bd. Can. 144(ix), 77 p.

283. Meister, A.L. 1982. The Sheepscot River: An Atlantic salmon river management report. State of Maine, Atlantic Sea Run Salmon Commission, Bangor, ME. 67 p.

284. Messier, D.L. 1982. A comparative study of benthic community structure in the Saco and Kennebunk River Estuaries, Maine. M.S. thesis, Univ. Maine, Orono, ME. 62 p.

285. Meyer, T.L., R.A. Cooper, and R.W. Langton. 1979. Relative abundance, behavior, and food habits of the American sand lance, *Ammodytes americanus*, from the Gulf of Maine. Fish. Bull., U.S. 77(1):243-253.

286. Miller, J.M., J.S. Burke, and G.R. Fitzhugh. 1991. Early life history patterns of Atlantic North American flatfish: likely (and unlikely) factors controlling recruitment. Neth. J. Sea Res. 27(3/4):261-275.

287. Moore, C.M. 1989. Fishery management plan for the bluefish fishery. Atlantic States Marine Fisheries Commission, Fish. Manag. Rep. No. 14. 81 p.

288. Moring, J.R. 1990. Seasonal absence of fishes in tidepools of a boreal environment (Maine, USA). Hydrobiologia 194:163-168.

289. Moring, J.R. 1993. Rock gunnels in intertidal waters of Maine. Maine Naturalist 1(1):17-26.

290. Morse, W.W. 1978. Biological and fisheries data on scup, *Stenotomus chrysops* (Linnaeus). NMFS Tech. Ser. Rep. No. 12. 31 p.

292. Morse, W.W. 1989. Catchability, growth, and mortality of larval fishes. Fish. Bull., U.S. 87:417-446.

291. Morse, W.W., M.P. Fahay, and W.G. Smith. 1987. MARMAP surveys of the continental shelf from Cape Hatteras, NC, to Cape Sable, Nova Scotia (1977-1984). Atlas No. 2. Annual distribution patterns of fish larvae. NOAA Tech. Memo. NMFS-F/NEC-47. 215 p.

293. Mottet, M.G. 1976. The fishery biology of sea urchins in the Family Strongylocentrotidae. State of Washington, Dept. of Fisheries, Shellfish Division, Tech. Rep. No. 20. 65 p.

294. Mullen, D.M., C.W. Fay, and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—alewife/blueback herring. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.56), 21 p.

295. Mullen, D.M., and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)- sea scallop. U.S. Fish Wildl. Serv., Biol. Rep. 82 (11.67), 13 p.

296. Murawski, S.A., D.G. Frank, and S. Chang. 1978. Biological and fisheries data on butterfish, *Peprilus triacanthus* (Peck). NOAA NMFS Sandy Hook Lab Tech. Ser. Rep. No. 6. 39 p.

297. Murawski, S.A., and G.T. Waring. 1979. A population assessment of butterfish, *Peprilus triacanthus*, in the northwestern Atlantic ocean. Trans. Am. Fish. Soc. 108:427-439.

298. Murawski, S.A., G.R. Clayton, R.J. Reed, and C.F. Cole. 1980. Movements of spawning rainbow smelt, *Osmerus mordax*, in a Massachusetts estuary. Estuaries 3(4):308-314.

299. Murawski, S.A., and J.T. Finn. 1988. Biological bases for mixed-species fisheries: species co-distibution in relation to environmental and biotic variables. Can. J. Fish. Aquat. Sci. 45:1720-1735.

300. Murchelano, R.A. 1988. Fish as sentinels of environmental health. NOAA Tech. Memo. NMFS F/NEC 61. 15 p.

301. Murphy, S.C. 1991. The ecology of estuarine fishes in southern Maine high salt marshes; Access corridors and movement patterns. M.S. thesis, Univ. Massachusetts, Amherst, MA. 87 p.

302. Musick, J.A. 1974. Seasonal distribution of sibling hakes, *Urophycis chuss* and *U. tenuis* (Pisces: Gadidae) in New England. Fish. Bull., U.S. 72(2):481-495.

303. Naidu, K.S. 1991. Sea scallop, *Placopecten magellanicus*. *In*: Shumway, S.E. (ed.), pp. 861-897. Scallops: biology, ecology and aquaculture. Elsevier, New York, NY.

304. Nammack, M.F., J.A. Musick, and J.A. Colvocoresses. 1985. Life history of spiny dogfish off the northeastern United States. Trans. Am. Fish. Soc. 114:367-376.

305. Neish, L.C. 1973. The distribution of sea urchins in Charlotte County, New Brunswick (reference AMR 73-3B). Prepared by Applied Marine Research Ltd. for New Brunswick Dept. of Fisheries and Environment, Fredericton, N.B. 22 p.

306. Nelson, G.A., and M. Ross. 1991. Biology and population changes of northern sand lance from Gulf of Maine to Middle Atlantic Bight. J. Northw. Atl. Fish. Sci. 11:11-27.

307. Neves, R.J. 1981. Offshore distribution of alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*, along the Atlantic coast. Fish. Bull., U.S. 79(3):473-485.

308. Newell, C.R., and H. Hidu. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—softshell clam. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.53), 17 p.

309. Newell, C.R., H. Hidu, B.J. McAlice, G. Podniesinski, F. Short, and L. Kindblom. 1991. Recruitment and commercial seed procurement of the blue mussel *Mytilus edulis* in Maine. J. World Aquaculture Soc. 22(2):134-152.

310. Newell, R.I.E. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North and Mid-Atlantic)—blue mussel. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.102), 25 p.

311. Newell, R.I.E., T.J. Hilbish, R.K. Koehn, and C.J. Newell. 1982. Temporal variation in the reproductive cycle of *Mytilus edulis* L. (Bivalvia: Mytilidae) from localities on the East Coast of the United States. Biol. Bull. (Woods Hole) 162:299-310.

312. Nixon, S.W., and C.A. Oviatt. 1973. Ecology of a New England salt marsh. Ecol. Monogr. 43:463-498.

313. Norcross, B.L., and R.F. Shaw. 1984. Oceanic and estuarine transport of fish eggs and larvae: A review. Trans. Am. Fish. Soc. 113: 153-165.

314. Normandeau Associates, Inc. 1971. Ecological study: Merrimack River Estuary-Massachusetts, pp. V1-V118. Presented to the U.S. Army Corps of Engineers, Contract No. DACW33-71-C-0077, Project No. NEDSD-P-6.

315. Normandeau Associates, Inc. 1975. Environmental survey of upper Penobscot Bay Maine. Annual Rep. for Central Maine Power. Unpublished data. Central Maine Power, Augusta, ME. 300 p.

316. Normandeau Associates, Inc. 1980. Piscataqua River ecological studies, 1979 monitoring studies, Rep. No. 10. Prepared for Public Service Company of New Hampshire, Bedford, NH. 502 p.

317. Normandeau Associates, Inc. 1991a. Harriman Cove environmental studies April 1990-March 1991: data report. Black and Veatch, Overland Park, KS. 100 p.

318. Normandeau Associates, Inc. 1991b. Seabrook environmental studies, 1990: A characterization of environmental conditions in the Hampton-Seabrook area during the operation of Seabrook Station. Tech. Rep. XXII-II. Prepared for Public Service Company of NH, NH Yankee Division. 479 p.

319. Northeast Fisheries Science Center. 1991a. Report of the twelfth northeast regional stock assessment workshop (12th SAW), Spring 1991. NOAA NMFS Northeast Fisheries Science Center Ref. Doc. No. 91-03. 187 p.

320. Northeast Fisheries Science Center. 1991b. Status of fishery resources off the northeastern United States for 1991. NOAA Tech. Memo. NMFS-F/NEC-86. 128 p.

321. Northeast Fisheries Science Center. 1992. Status of fishery resources off the northeastern United States for 1992. NOAA Tech. Memo. NMFS-F/NEC-95. 133 p.

322. O'Brien, L., and R.K. Mayo. 1988. Sources of variation in catch per unit effort of yellowtail flounder, *Limanda ferruginea* (Storer), harvested off the coast of New England. Fish. Bull., U.S. 86(1):91-107.

323. Odum, W.E., T.J. Smith III, J.K. Hoover, and C.C. McIvor. 1984. The ecology of tidal freshwater marshes of the United States East Coast: a community profile. U.S. Fish Wildl. Serv., FWS/OBS (83/17), 177 p.

324. Ojeda, F.P., and J.H. Dearborn. 1989a. Community structure of macroinvertebrates inhabiting the rocky subtidal zone in the Gulf of Maine: seasonal and bathymetric distribution. Mar. Ecol. Prog. Ser. 57:147-161.

325. Ojeda, F.P. and J.H. Dearborn. 1989b. Diversity, abundance, and spatial distribution of fishes and crustaceans in the rocky subtidal zone of the Gulf of Maine. Fish. Bull., U.S. 88(2):403-410.

326. Ojeda, F.P., and J.H. Dearborn. 1991. Feeding ecology of benthic mobile predators: experimental analyses of their influence in rocky subtidal communities of the Gulf of Maine. J. Exp. Mar. Biol. Ecol. 149:13-44.

327. Oliver, J.D., M.J. Van Den Avyle, and E.L. Bozeman, Jr. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)—bluefish. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.96), 13 p.

328. Olla, B.L., R. Wicklund, and S. Wilk. 1969. Behavior of winter flounder in a natural habitat. Trans. Am. Fish. Soc. 98(4):717-720.

329. Olla, B.L., A.J. Bejda, and A.D. Martin. 1974. Daily activity, movements, feeding, and seasonal occurrences in the tautog, *Tautoga onitis*. Fish. Bull., U.S. 72: 27-35.

330. Overholtz, W.J., R.S. Armstrong, D.G. Mountain, and M. Tercerio. 1991. Factors influencing spring distribution, availability, and recreational catch of Atlantic mackerel (*Scomber scombrus*) in the Middle Atlantic and Southern New England regions. NOAA Tech. Memo. NMFS-F/NEC-85. 13 p.

331. Parsons, D.G., and G.E. Tucker. 1986. Fecundity of northern shrimp, *Pandalus borealis* (Crustacea: Decapoda) in areas of the northwest Atlantic. Fish. Bull., U.S. 84(3):549-558.

332. Parsons, D.G., and J. Frechette. 1989. Fisheries for northern shrimp (*Pandalus borealis*) in the northwest Atlantic from Greenland to the Gulf of Maine. *In*: Caddy, J.F. (ed.), pp. 63-85. Marine invertebrate fisheries: their assessment and management. John Wiley and Sons, New York, NY.

333. Parsons, G., S. Robinson, R.A. Chandler, L. Davidson, M. Lanteigne, and M. Dadswell. 1992. Intra-annual and long-term patterns in the reproductive cycle of giant scallops *Placopecten magellanicus* (Bivalvia: Pectinidae) from Passamaquoddy Bay, New Brunswick, Canada. Mar. Ecol. Progr. Ser. 80:203-214.

334. Penniman, C.A., F. T. Short, and S.M. Adams. 1989. Bibliography of the Great Bay Estuary and adjacent upland region. UNH/UMaine Sea Grant College Program, Durham, NH. 113 p.

335. Perkins, H.C. 1982. Preliminary report on the results of groundfish tagging by the Department of Marine Resources 1978-1981. Research Reference Doc. No. 82/15. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 50 p.

336. Perkins, H.C. 19??. The larvae of Caridean shrimp found in Sheepscot Bay, Maine (Crustacea: Decapoda). Research Reference Doc. No. 91/4. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 144 p.

337. Perkins, L.F., and P.F. Larsen. 1975. A preliminary checklist of marine and estuarine invertebrates of Maine. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 34 p.

338. Peterson, R.H., P.H. Johansen, and J.L. Metcalfe. 1980. Observations on early life stages of Atlantic tomcod, *Microgadus tomcod*. Fish. Bull., U.S. 78(1):147-158.

339. Peterson, S.J. 1976. The seasonal abundance and distribution of fish eggs, larvae, and juveniles in the Merrimack River Estuary, Massachusetts 1974-1975. M.S. thesis, Univ. Massachusetts, Amherst, MA. 170 p.

340. Petraitis, P.S. 1991. Recruitment of the mussel *Mytilus edulis* L. on sheltered and exposed shores in Maine, USA. J. Exp. Mar. Biol. Ecol. 147:65-80.

341. Pett, S., and C.J. McKay. 1990. The resources and uses of Stellwagen Bank. *In*: Archer, J.H. (ed.), Urban Harbors Institute, Univ. Massachusetts, Boston, MA. 133 p.

342. Pierce, D.E., and A.B. Howe. 1977. A further study on winter flounder group identification off Massachusetts. Trans. Am. Fish. Soc. 106(2):131-138.

343. Podniesinski, G.S., and B.J. McAlice. 1986. Seasonality of blue mussel, *Mytilus edulis* L., larvae in the Damariscotta River estuary, Maine, 1969-77. Fish. Bull., U.S. 84(4):995-1001.

344. Proctor, W. 1933. Marine Fauna. *In*: Biological survey of the Mount Desert region, pp. 1-290. The Wistar Institute of Anatomy and Biology, Philadelphia, PA.

345. Recksiek, C.W., and J.D. McCleave. 1973. Distribution of pelagic fishes in the Sheepscot River-Back River Estuary, Wicasset, Maine. Trans. Am. Fish. Soc. 3:541-551.

346. Reynolds, W.W., and M.E. Casterlin. 1985. Vagile macrofauna and the hydrographic environment of the Saco River Estuary and adjacent waters of the Gulf of Maine. Hydrobiologia 128:207-215.

347. Richards, S.W. 1982. Aspects of the biology of *Ammodytes americanus* from the St. Lawrence River to Chesapeake Bay, 1972-75, including a comparison of the Long Island Sound postlarvae with *Ammodytes dubius*. J. Northw. Atl. Fish. Sci. 3:93-104.

348. Robert, G. 1979. Fourth survey of Eel River, N.B. soft-shell clam (*Mya arenaria*) population. Fisheries and Marine Service Manuscr. Rep. 1491. Invertebrates and Marine Plants Div., Resource Branch, Fisheries and Marine Service, Fisheries and Oceans Canada, Halifax, N.S. 14 p.

349. Robert, G. and D.W. Smith. 1980. Surveys of soft-shell clam (*Mya arenaria*) populations in some closed areas of Charlotte County, New Brunswick. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 1567. 59 p.

350. Roberts, S.C. 1978. Biological and fisheries data on northern searobin, *Prionotus carolinus* (Linnaeus). NOAA NMFS Tech. Rep. No. 13. 31 p.

351. Robichaud, D.A., and A. Campbell. 1991. Annual and seasonal size-frequency changes of trap-caught lobsters (*Homarus americanus*) in the Bay of Fundy. J. Northw. Atl. Fish. Sci. 11:29-37.

352. Robinson, S., and A. MacIntyre. 1993. Sea urchin population survey of Campobello Island, Deer Island and Grand Manan Island. Dept. Fisheries and Oceans Biol. Station, St. Andrews, N.B.

353. Rogers, C.A. 1976. Effects of temperature and salinity on the survival of winter flounder embryos. Fish. Bull., U.S. 74(1):52-58.

354. Rogers, S.G., and M.J. Van Den Avyle. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic)—Atlantic menhaden. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.108), 23 p.

355. Ropes, J.W. 1968. The feeding habits of the green crab, *Carcinus maenas* (L.). Fish. Bull., U.S. 67(2): 183-203.

356. Ross, M. 1991. Recreational fisheries of coastal New England. Univ. Massachusetts Press, Amherst, MA. 288 p.

357. Rothschild, B.J. 1965. Production and survival of eggs of the American smelt, *Osmerus mordax* (Mitchill), in Maine. Trans. Am. Fish. Soc. 90(1):42-48.

358. Saunders, R.L. 1981. Atlantic salmon (*Salmo salar*) stocks and management implications in the Canadian Atlantic provinces and New England, USA. Can. J. Fish. Aquat. Sci. 38:1612-1625.

359. Saunders, R.L., and J.H. Gee. 1964. Movements of young Atlantic salmon in a small stream. J. Fish. Res. Bd. Can. 21(1):27-35.

360. Sawyer, P.J. 1967. Intertidal life-history of the rock gunnel, *Pholis gunnellus*, in the western Atlantic. Copeia 1967(1):55-61.

361. Sawyer, T.K., E.J. Lewis, M. Galasso, S. Bodammer, J. Ziskowski, D. Lear, M. O'Malley, and S. Smith. 1983. Black gill conditions in the rock crab, *Cancer irroratus*, as indicators of ocean dumping in Atlantic coastal waters of the United States. Rapp. P.-v. Reun. Conseil International pour l'exploration de la Mer. J. du Conseil 182:91-95.

362. Scarrat, D.J., and R. Lowe. 1972. Biology of rock crab (*Cancer irroratus*) in Northumberland Strait. J. Fish. Res. Board Can. 29:161-166.

363. Scattergood, L.W. 1951. The occurrence of egg capsules in the winter skate (*Raja diaphanes*) in Maine waters. Copeia 1951(2):169.

364. Scattergood, L.W. 1959. New records of Gulf of Maine fish. Maine Field Naturalist 15(4):107-109.

365. Scattergood, L.W. and P.L. Goggins. 1958. Unusual records of Gulf of Maine fishes. Maine Field Naturalist 14(2):40-43.

366. Scherer, M.D. 1984. The ichthyoplankton of Cape Cod Bay. *In*: Davis, J., and D. Merriman (eds.), pp. 151-190. Observations on the ecology and biology of western Cape Cod Bay, Massachusetts. Springer-Verlag, New York, NY.

367. Schick, D.F. 1989. Location of juvenile groundfish in the Gulf of Maine. Research Ref. Doc. No. 89/1. Maine Dept. Marine Resources, W. Boothbay Harbor, ME. 35 p.

368. Scott, J.S. 1980. Occurrence of pollock, *Pollachius virens*, and sand lance, *Ammodytes sp.*, larvae in the Bay of Fundy. J. Northw. Atl. Fish. Sci. 1:45-48.

369. Scott, W.B. 1983. Fishes in marine and coastal systems of the Quoddy region, New Brunswick. *In*: Thomas, M.L.H. (ed.), Chapter 10. Can. Spec. Pub. Fish. Aquat. Sci. 64. 309 p.

370. Scott, W.B., and M.G. Scott. 1988. Atlantic Fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219. 731 p.

371. Sellers, M.A., and J.G. Stanley. 1984. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American Oyster. U.S. Fish Wildl. Serv., Biol. Rep. FWS/OBS-82(11.23), 15 p.

372. Serafy, D.K., and F.J. Fell. 1985. Marine flora and fauna of the northeastern United States. (Echinodermata: Echinoidea). NOAA Tech. Rep. NMFS 33. 27 p.

373. Sheldon, M.R., and J.D. McCleave. 1985. Abundance of glass eels of the American eel, *Anguilla rostrata*, in mid-channel and near shore during estuarine migration. Naturaliste Canadienne. (Rev. Ecol. Syst.) 112:425-430.

374. Shenton, E.H., and D.B. Horton. 1973. Literature review of the marine environmental data for Eastport, Maine. The Research Institute of the Gulf of Maine.

375. Sherman, K., and R.D. Lewis. 1967. Seasonal occurrence of larval lobsters in coastal waters of central Maine. Proc. Natl. Shellfish. Assoc. 57:27-30.

376. Sherman, K., C. Jones, L. Sullivan, W. Smith, P. Berrien, and L. Ejsymont. 1981. Congruent shifts in sand eel abundance in western and eastern North Atlantic ecosystems. Nature 291:486-489.

377. Shorey, W.K. 1973. Macrobenthic ecology of a sawdust-bearing substrate in the Penobscot River Estuary (Maine). J. Fish. Res. Bd. Can. 30:493-497.

378. Short, F. (ed.). 1992. The ecology of the Great Bay Estuary, New Hampshire and Maine: An estuarine profile and bibliography. NOAA Coastal Ocean Program. 222 p.

379. Shumway, S.E. (ed.). 1991. Scallops: biology, ecology and aquaculture. *In*: Developments in aquaculture and fisheries science, Vol. 21. Elsevier, New York, NY. 1095 p.

380. Shumway, S.E., H. Perkins, D. Schick, and A.P. Stickney. 1985. Synopsis of biological data on the pink shrimp, *Pandalus borealis* Krøyer, 1838. NOAA Tech. Rep. NMFS 30/FAO Fisheries Synopsis No. 144. 57 p.

381. Sinclair, M., and T.D. Iles. 1985. Atlantic herring (*Clupea harengus*) distributions in the Gulf of Maine-Scotian Shelf area in relation to oceanographic features. Can. J. Fish. Aquat. Sci. 42:880-887.

382. Smigielski, A.S., T.A. Halavik, L.J. Buckley, S.M. Drew, and G.C. Laurence. 1984. Spawning, embryo development and growth of the American sand lance *Ammodytes americanus* in the laboratory. Mar. Ecol. Prog. Ser. 14:287-292.

383. Smith, W.G., P. Berrien, D.G. McMillan, and A. Wells. 1981. The distribution, abundance, and production of Atlantic cod and haddock larvae off northeastern United States in 1978-1979 and 1979-1980. Int. Counc. Expl. Sea. 16 p.

384. Squiers, T.S. 1982. Evaluation of 1982 spawning run of shortnose sturgeon in Androscoggin River, ME. Final Rep. to Maine Dept. Marine Resources, Augusta, ME. 14 p.

385. Squiers, T.S. 1990. Kennebec River anadromous fish restoration: Annual progress report 1990. Anadromous Fish Division, Maine Dept. Marine Resources, Augusta, ME. 31 p.

386. Squiers, T.S., and M.E. Smith. 1979. Distribution and abundance of shortnose and Atlantic sturgeon in the Kennebec River estuary. Maine Dept. Marine Resources, Augusta, ME. 51 p.

387. Squiers, T.S., M.E. Smith, and L.N. Flagg. 1982. American shad enhancement and status of sturgeon stocks in selected Maine waters. Maine Dept. Marine Resources, Augusta, ME. 72 p.

388. Squires, H.J. 1990. Decapod Crustacea of the Atlantic Coast of Canada. Can. Bull. Fish. Aquat. Sci. 221. 532 p.

389. Stahlnecker, J., L.N. Flagg, and T. Squiers. 1989a. Kennebec River anadromous fish restoration: Annual progress report 1987/1988. Maine Dept. Marine Resources, Augusta, ME. 43 p.

390. Stahlnecker, J., L.N. Flagg, and T. Squiers. 1989b. Kennebec River anadromous fish restoration: Annual progress report 1989. Maine Dept. Marine Resources, Augusta, ME. 31 p.

391. Stahlnecker, J., and T. Squiers. 1991. Kennebec River anadromous fish restoration: Annual progress report 1990. Maine Dept. Marine Resources, Augusta, ME. 31 p.

392. Stanley, J.G., and D.S. Danie. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—white perch. U.S. Fish Wildl. Serv., Biol. Rep. FWS/OBS-82(11.7), 12 p.

393. Stanley, J.G., and R. Dewitt. 1983. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—hard clam. U.S. Fish Wildl. Serv., Biol. Rep. FWS/OBS-82(11.18). 19 p.

394. Stehlik, L.L., C.L. MacKenzie, Jr., and W.W. Morse. 1991. Distribution and abundance of four Brachyuran crabs on the northwest Atlantic shelf. Fish. Bull., U.S. 89:473-492.

395. Stephens, R.E. 1972. Studies on the development of the sea urchin *Strongylocentrotus droebachiensis*. I. Ecology and normal development. Biol. Bull. (Woods Hole)142:132-134.

396. Stevenson, D.K., and R.L. Knowles. 1988. Physical characteristics of herring egg beds on the eastern Maine coast. *In:* Babb, I., and M. DeLuca (eds.), pp. 257-276. Benthic productivity and marine resources of the Gulf of Maine. NOAA National Undersea Research Program.

397. Stevenson, D.K., K.M. Sherman, and J.J. Graham. 1989. Abundance and population dynamics of the 1986 year class of herring along the Maine coast. Rapp. P.-v. Reun. Conseil International pour l'exploration de al Mer. J. du Conseil. 191:345-350.

398. Stewart, L.L., and P.J. Auster. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—Atlantic tomcod. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.76). 8 p.

399. Stickney, A.P. 1959. Ecology of the Sheepscot River Estuary. U.S. Fish Wildl. Serv., Spec. Sci. Rep. Fisheries. No. 309. 21 p.

400. Stickney, A.P. 1967. Orientation of juvenile Atlantic herring (*Clupea harengus* L.) to temperature and salinity. FAO conference on fish behaviour in relation to fishing techniques and tactics, Oct. 19-27, 1967,.Bergen, Norway.

401. Stolte, L. 1981. The forgotten salmon of the Merrimack. U.S. Dept. Interior, Northeast Region, Washington, DC.

402. Stone, H.H., and B.M. Jessop. 1992. Seasonal distribution of river herring *Alosa pseudoharengus* and *A. aestivalis* off the Atlantic coast of Nova Scotia. Fish. Bull., U.S. 90:376-389.

403. Sutcliffe, W.H.J., K. Drinkwater, and B.S. Muir. 1977. Correlations of fish catch and environmental factors in the Gulf of Maine. J. Fish. Res. Bd. Can. 34:19-30.

404. Targett, T.E., and J.D. McCleave. 1974. Summer abundance of fishes in a Maine tidal cove with special reference to temperature. Trans. Am. Fish. Soc. 103(2):325-330.

405. Taub, S.H. 1990. Fishery management plan for Atlantic sturgeon (*Acipenser oxyrhynchus*). Atlantic States Marine Fisheries Commission. Fisheries Manag. Rep. No. 17. 73 p.

406. Teal, J.M. 1986. The ecology of regularly flooded salt marshes of New England: a community profile. U.S. Fish Wildl. Serv., Biol. Rep. 85(7.4). 61 p.

407. Thayer, G.W., and M.S. Fonseca. 1984. The ecology of eelgrass meadows of the Alantic coast: a community profile. U.S. Fish Wildl. Serv., FWS/OBS-84/02.

408. Theroux, R.B., and R.L. Wigley. 1983. Distribution and abundance of east coast bivalve molluscs based on speciments in the National Marine Fisheries Service Woods Hole collection. NOAA Tech. Rep. NMFS SSRF-768. 172 p.

409. Thomas, M.L.H. (ed.). 1983. Marine and coastal systems of the Quoddy Region, New Brunswick. Can. Spec. Pub. Fish. Aquat. Sci. 64. 306 p.

410. Thorpe, L.A. 1991. Aspects of the biology of windowpane flounder, *Scophthalmus aquosus*, in the northwest Atlantic Ocean. M.S. thesis, Univ. Massachusetts, Amherst, MA. 101 p.

411. Tibbo, S.N., J.E.H. Legaré, L.W. Scattergood, and R.F. Temple. 1958. On the occurrence and distribution of larval herring (*Clupea harengus* L.) in the Bay of Fundy and the Gulf of Maine. J. Fish. Res. Bd. Can.15: 1451-1469.

412. Tibbo, S.N., and J.E. Henri Legaré. 1960. Further study of larval herring (*Clupea harengus* L.) in the Bay of Fundy and Gulf of Maine. J. Fish. Res. Bd. Can. 17(6):933-942.

413. Tort, M.J. 1993. Environmental variables influencing species composition and abundance of intertidal fish assemblages in a north temperate estuary. M.S. thesis, Univ. Maine, Orono, ME. 80 p.

414. Townsend, D.W. 1981. Comparative ecology and population dynamics of larval fishes and zooplankton in two hydrographically different areas on the Maine coast. Ph.D. dissertation, Univ. Maine, Orono, ME. 270 p.

415. Townsend, D.W. 1983. The relations between larval fishes and zooplankton in two inshore areas of the Gulf of Maine. J. Plankton Res. 5(2):145-173.

416. Townsend, D.W. 1992. Ecology of larval herring in relation to the oceanography of the Gulf of Maine. J. Plankton Res. 14(4):467-493.

417. Townsend, D.W., R.L. Radtke, M.A. Morrison, and S.D. Folsom. 1989. Recruitment implications of larval herring overwintering distributions in the Gulf of Maine, inferred using a new otolith technique. Mar. Ecol. Prog. Ser. 55: 1-13.

418. Townsend, D.W. and P.F. Larsen (eds.). 1992. The Gulf of Maine. NOAA Coastal Ocean Program, Regional Synthesis Ser. No. 1. NOAA Coastal Ocean Program/Association for Research in the Gulf of Maine, Washington, DC. 135 p.

419. TRIGOM-PARC. 1974. A socio-economic and environmental inventory of the North Atlantic region-including the outer contintental shelf and adjacent waters from Sandy Hook, New Jersey, to Bay of Fundy. Vol. 1, Book 3. The Research Institute of the Gulf of Maine, S. Portland, ME, as partial fulfillment of contract 08550-CT3-8, for the U.S. Bur. Land Management, Marine Minerals Division.

420. Turgeon, D.D. 1976. Distribution of the planktonic larvae of some benthic invertebrates within the Piscataqua-Great Bay Estuary, New Hampshire. Ph.D. dissertation, Univ. New Hampshire, Durham, NH. 166 p.

421. Tyler, A.V. 1971a. Periodic and resident components in communities of Atlantic fishes. J. Fish Res. Bd. Can. 28:935-946.

422. Tyler, A.V. 1971b. Surges of winter flounder, *Pseudopleuronectes americanus*, into the intertidal zone. J. Fish. Res. Bd. Can. 28:1727-1732.

423. Van Guelpen, L., and C.C. Davis. 1979. Seasonal movements of the winter flounder, *Pseudopleuronectes americanus*, in two contrasting inshore locations in Newfoundland. Trans. Am. Fish. Soc. 108:26-37.

424. Various authors. 1956-1959. Scientific reports: collected reprints 1956-1959. International Passamaquoddy Fisheries Board.

425. Vetrovs, A. 1990. The distribution of lobsters (*Homarus americanus*) in the Great Bay Estuary. M.S. thesis, Univ. New Hampshire, Durham, NH.

426. Waldman, J.R., D.J. Dunning, Q.E. Ross, and M.T. Mattson. 1990. Range dynamics of Hudson River striped bass along the Atlantic Coast. Trans. Am. Fish. Soc. 119:910-919.

427. Weiss-Glanz, L.S., J.G. Stanley, and J.R. Moring. 1986. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic)—American shad. U.S. Fish Wildl. Serv., Biol. Rep. 82(11.59). 16 p.

428. Welch, W.R. 1968. Changes in abundance of the green crab, *Carcinus maenas* (L.), in relation to recent temperature changes. Fish. Bull., U.S. 67(2): 337-345.

429. Welsh, B.L. 1975. The role of grass shrimp, *Palaemonetes pugio*, in a tidal marsh ecosystem. Ecology 56:513-530.

430. Westin, D.T., K.J. Abernathy, L.E. Meller, and B.A. Rogers. 1979. Some aspects of biology of the American sand lance, *Ammodytes americanus*. Trans. Am. Fish. Soc. 108:328-331.

431. Whitlatch, R.B. 1982. The ecology of New England tidal flats: a community profile. U.S. Fish Wildl. Serv., FWS/OBS-81/01. 125 p.

432. Wigley, S.E., and W.L. Gabriel. 1991. Distribution of sexually immature components of ten northwest Atlantic groundfish species based on Northeast Fisheries Center bottom trawl surveys, 1968-86. NOAA Tech. Memo. NMFS-F/NEC-80. 17 p.

433. Williams, A.B. 1984. Shrimps, lobsters, and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Inst. Press, Washington, DC.

434. Williams, A.B., and R.L. Wigley. 1977. Distribution of decapod crustacea off northeastern United States based on specimens at the Northeast Fisheries Center, Woods Hole, Massachusetts. NOAA Tech. Rep. NMFS Circ. 407:1-34.

435. Williams, D.D., and J. C. Delbeek. 1989. Biology of the threespine stickleback, *Gasterosteus aculeatus*, and the blackspotted stickleback, *G.wheatlandi*, during their marine pelagic phase in the Bay of Fundy. Environ. Biol. Fishes 24(1):33-41.

436. Winters, G.H. 1989. Life history parameters of sand lances (*Ammodytes spp.*) from the coastal waters of eastern Newfoundland. J. Northw. Atl. Fish. Sci. 9:5-11.

437. Witman, J.D., and K.P. Sebens. 1992. Regional variation in fish predation intensity: a historical perspective in the Gulf of Maine. Oecologia 90:305-315.

438. Wolff, W.J. 1983. Estuarine benthos. *In*: Ketchum, B.H. (ed.), pp. 151-182. Ecosystems of the world 26: Estuaries and enclosed seas. Elsevier, New York, NY.

439. Wooten, R.J. 1976. The biology of the sticklebacks. Academic Press, London.

440. Wooten, R.J. 1984. A functional biology of sticklebacks. *In* Calow, P. (ed.), Functional Biology Series, Univ. California Press, Berkeley and Los Angeles, CA.

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