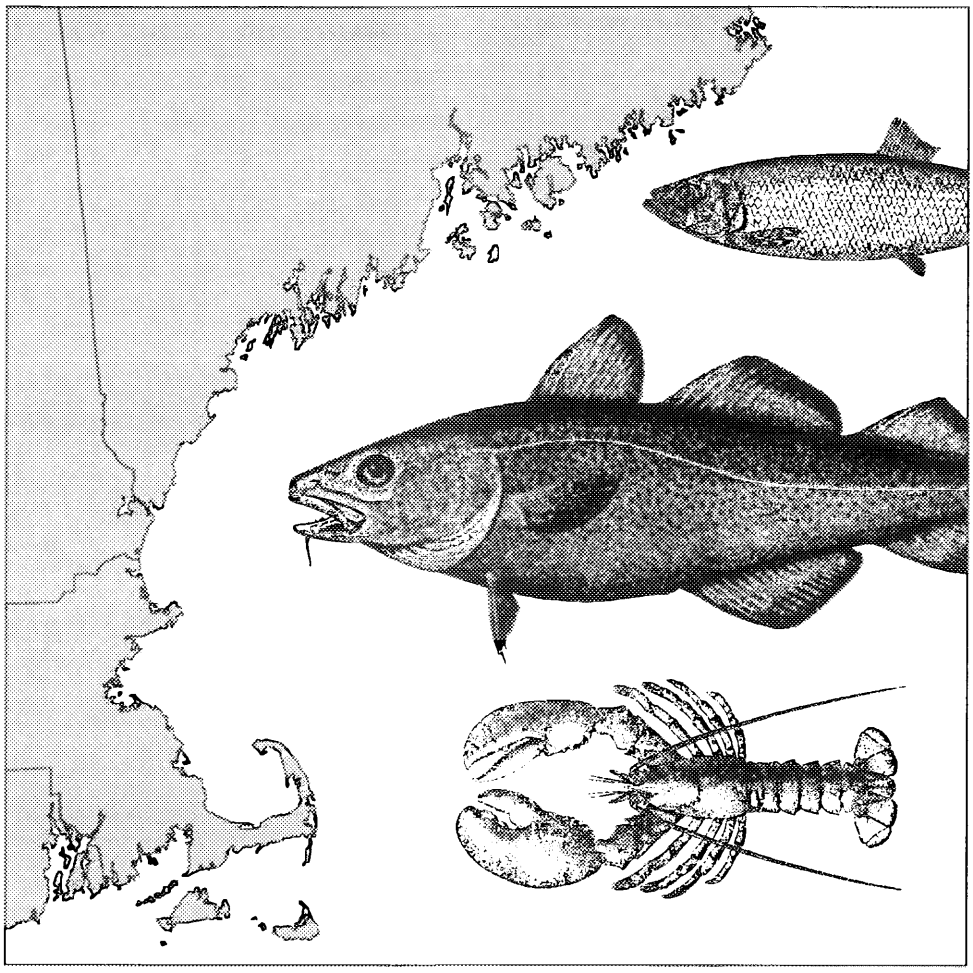
NOAA's Estuarine Living Marine Resources Program

# *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

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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.

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# *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).

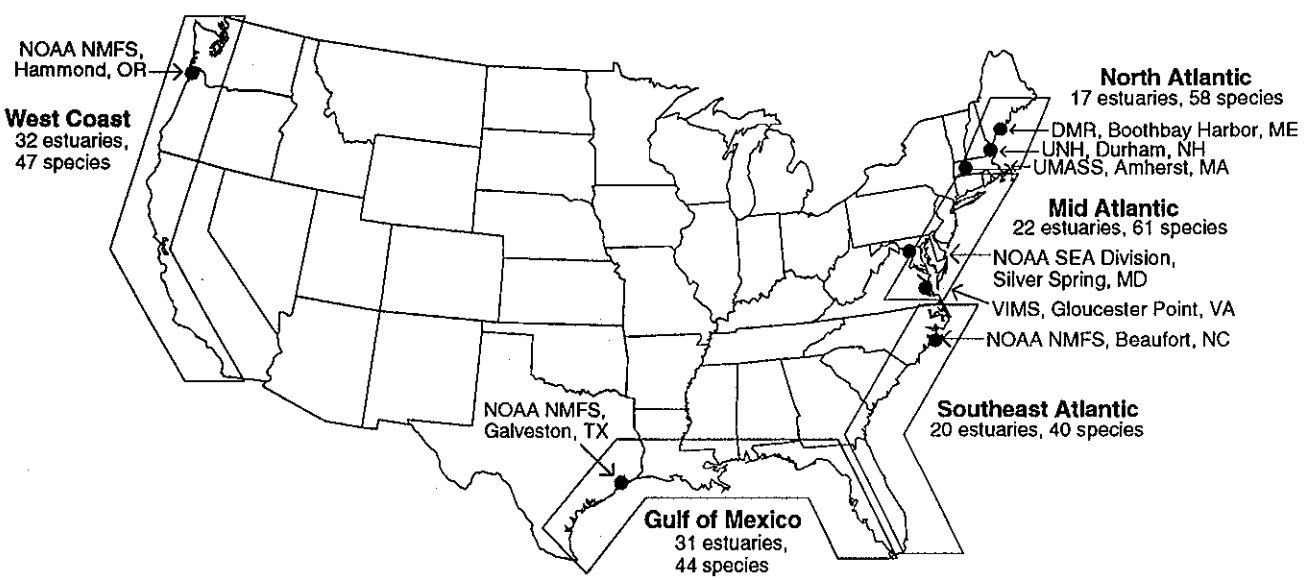
The objective of the ELMR program is to develop a consistent data base on the presence, distribution, relative abundance, and life history characteristics of ecologically and economically important fishes and invertebrates in the nation's estuaries. The data base is divided into five study regions (Figure 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.

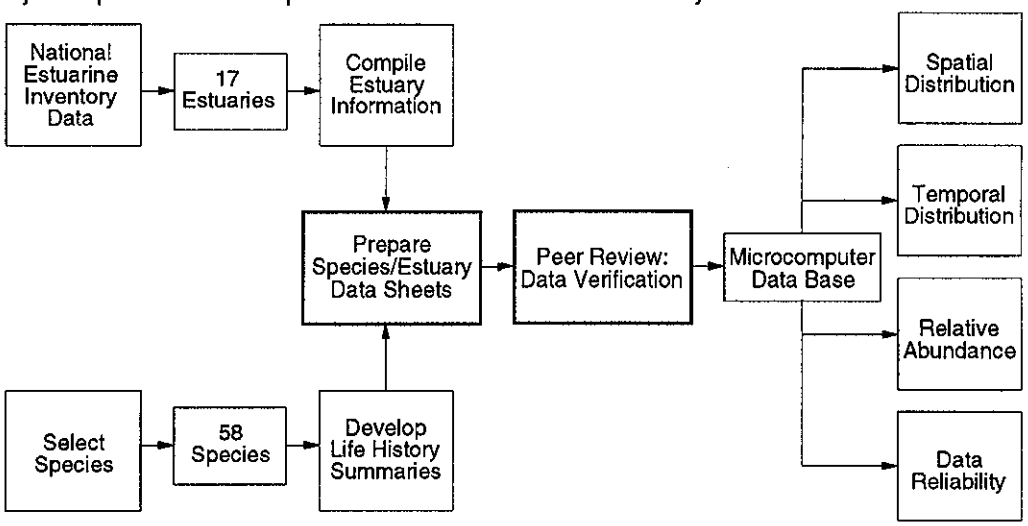
Data on the spatial and temporal distributions of species were compiled for the tidal fresh (0.0-0.5 parts per thousand (ppt)), mixing (0.5-25.0 ppt), and seawater (> 25 ppt) zones delineated for each estuary in the NEI. A representative map and data table for Penobscot Bay from the NEI Data Atlas is 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.



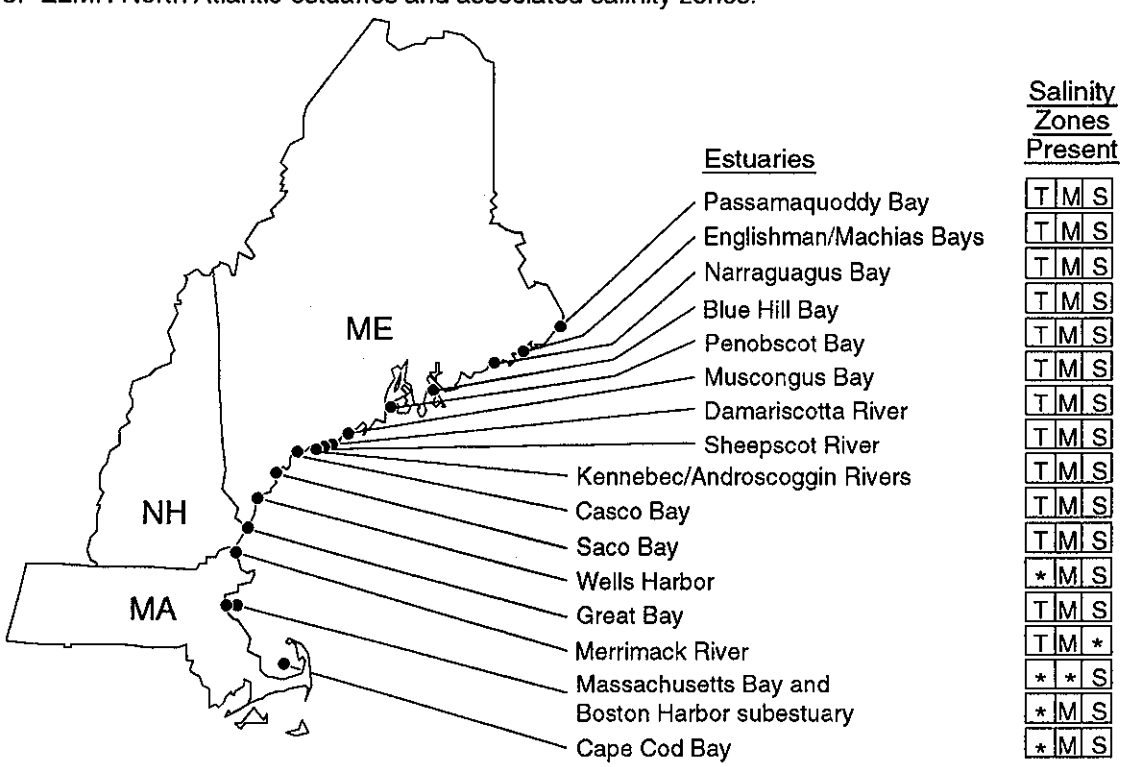
determined by consulting regional experts and NMFS reports, e.g., Atlantic salmon (*Salmo salar*) and striped bass (*Morone saxatilis*).

• 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 |

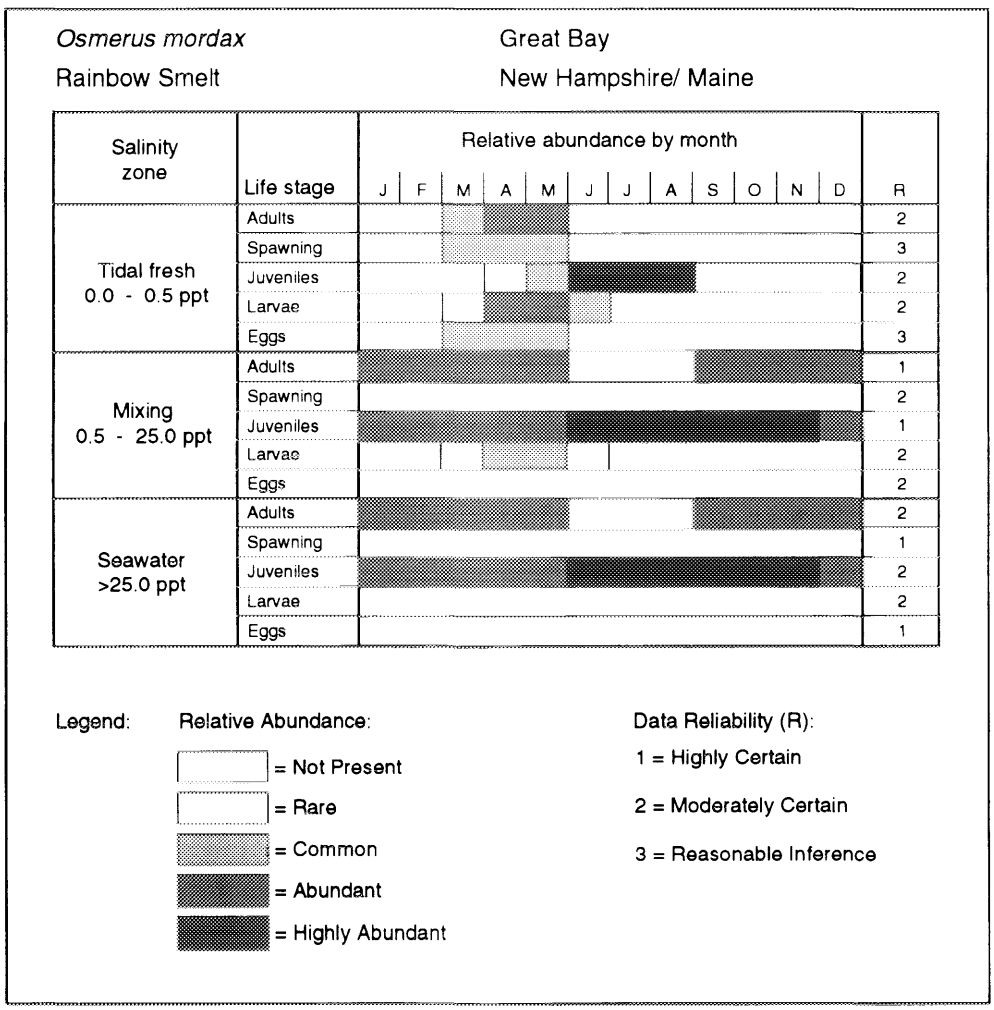
***Data sheet development***. A data sheet was developed for each species in each estuary to facilitate the review and presentation of the information. Data compiled for each species/life stage included: 1) the salinity zone it occupies (seawater, mixing, tidal fresh), 2) its monthly distribution in 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 non-commercial 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

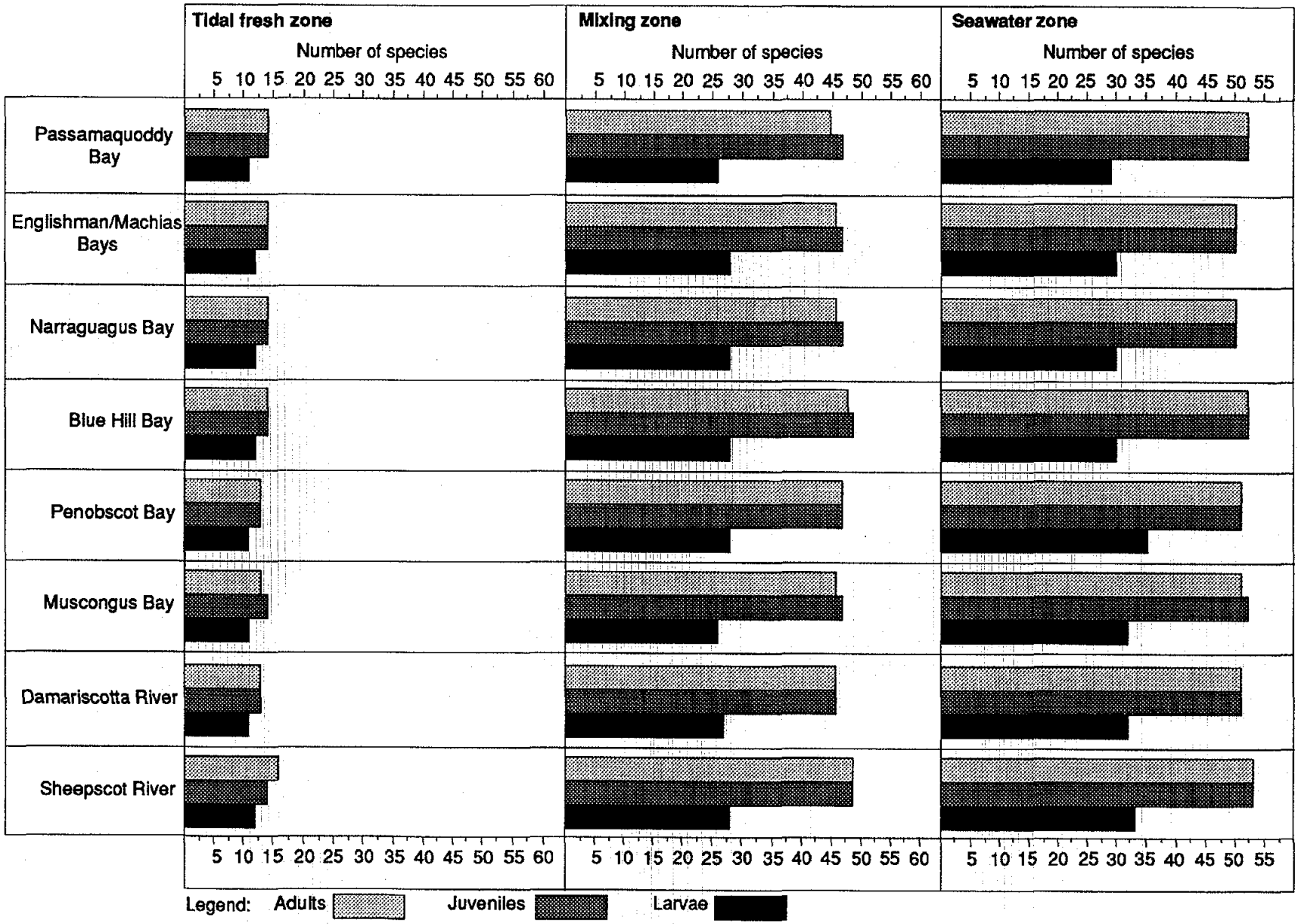


Figure 5, continued. Numbers of ELMR species (with relative abundance of common or greater) in North Atlantic estuaries, by estuary, salinity zone, and life stage.

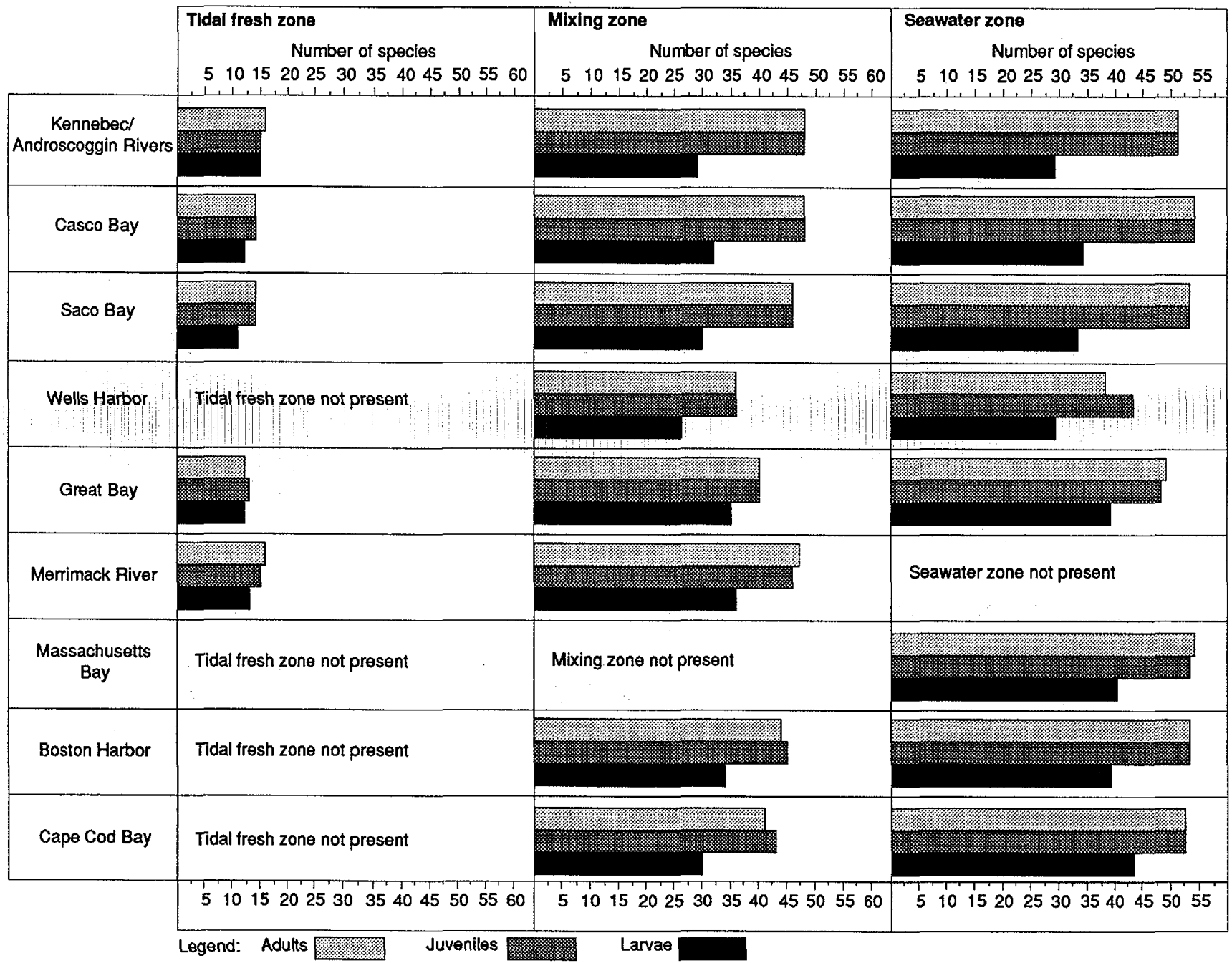
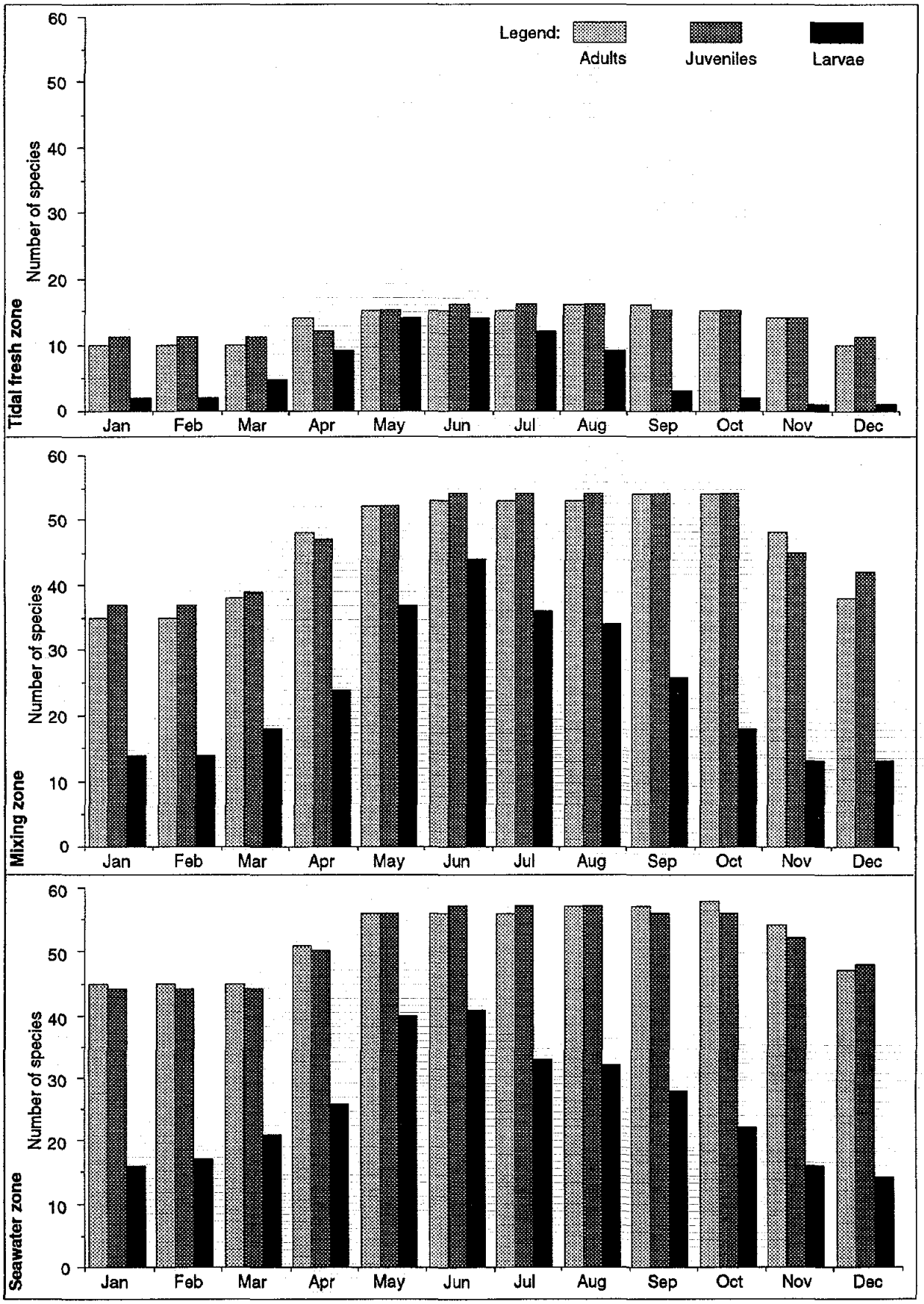


Figure 6. Number of ELMR species* in North Atlantic estuaries, by salinity zone, life stage, and month.




* 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.

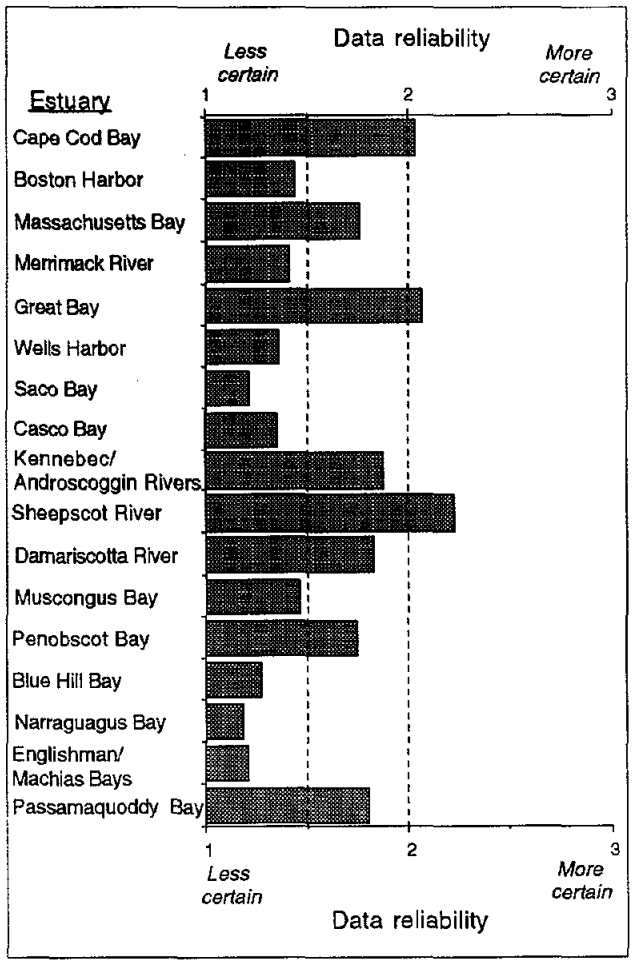
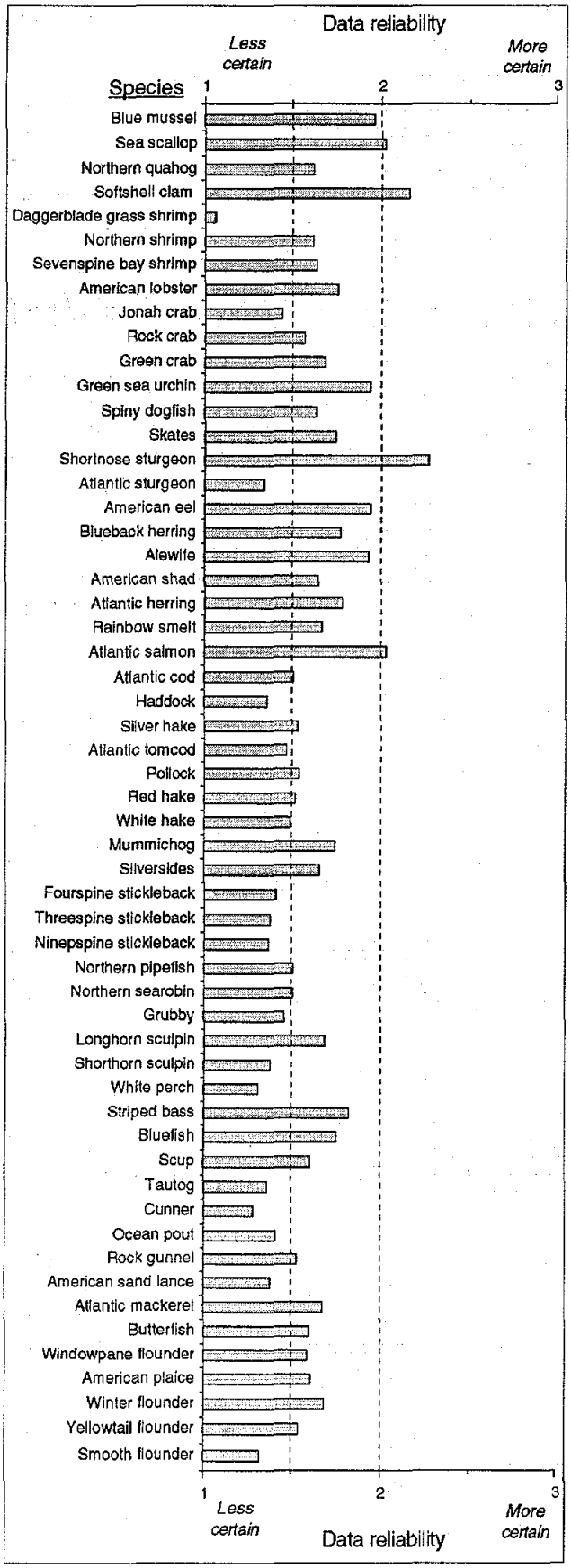


Figure 8. Mean data reliability by species.




## 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).

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

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- * - 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
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- Blank Not Present
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**Salinity Zone**

- T - Tidal Fresh
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**Life Stage**

- A - Adults
- S - Spawning adults
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- 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 | | | | | | | | | | | | | | | | | |

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**Life Stage**

- A - Adults
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- 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 | | | | | | | | | | | | | | |

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- A - Adults
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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 |
| 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 |
| | | Passamaquoddy Bay | | | Englishman Machias Bays | | | Narraguagus Bay | | | Blue Hill Bay | | | Penobscot Bay | | | Muscongus Bay | | |
| | | North Atlantic Estuaries | | | | | | | | | | | | | | | | | |

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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 | | | | | | | | | | | | | | | | | |

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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 | | | | | | | | | | | | | | |

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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 | | | | | | | | | | | | | | | | | |

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- √ Rare
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**Life Stage**

- A - Adults
- S - Spawning adults
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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 | | | | | | | | | | | | | | |

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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 | | | | | | | | | | | | | | | | | |

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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
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- √ Rare
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**Life Stage**

- A - Adults
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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 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 | T | M | S |
| | | Passamaquoddy Bay | | | Englishman Machias Bays | | | Narraguagus Bay | | | Blue Hill Bay | | | Penobscot Bay | | | Muscongus Bay | | |
| | | North Atlantic Estuaries | | | | | | | | | | | | | | | | | |

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- ● Highly Abundant
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**Salinity Zone**

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**Life Stage**

- A - Adults
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- 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 | | | | | | | | | | | | | | | | | |

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- A - Adults
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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 | | | | | | | | | | | | | | |

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- A - Adults
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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
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**Life Stage**

- A - Adults
- S - Spawning adults
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- L - Larvae
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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 | | | | | | | | | | | | | | |

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- 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 | | | | | | | | | | | | | | | | | |

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- ◉ Abundant
- ○ Common
- √ Rare
- Blank Not Present
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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
- 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 |
| 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
- ○ 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 | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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
- √ 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 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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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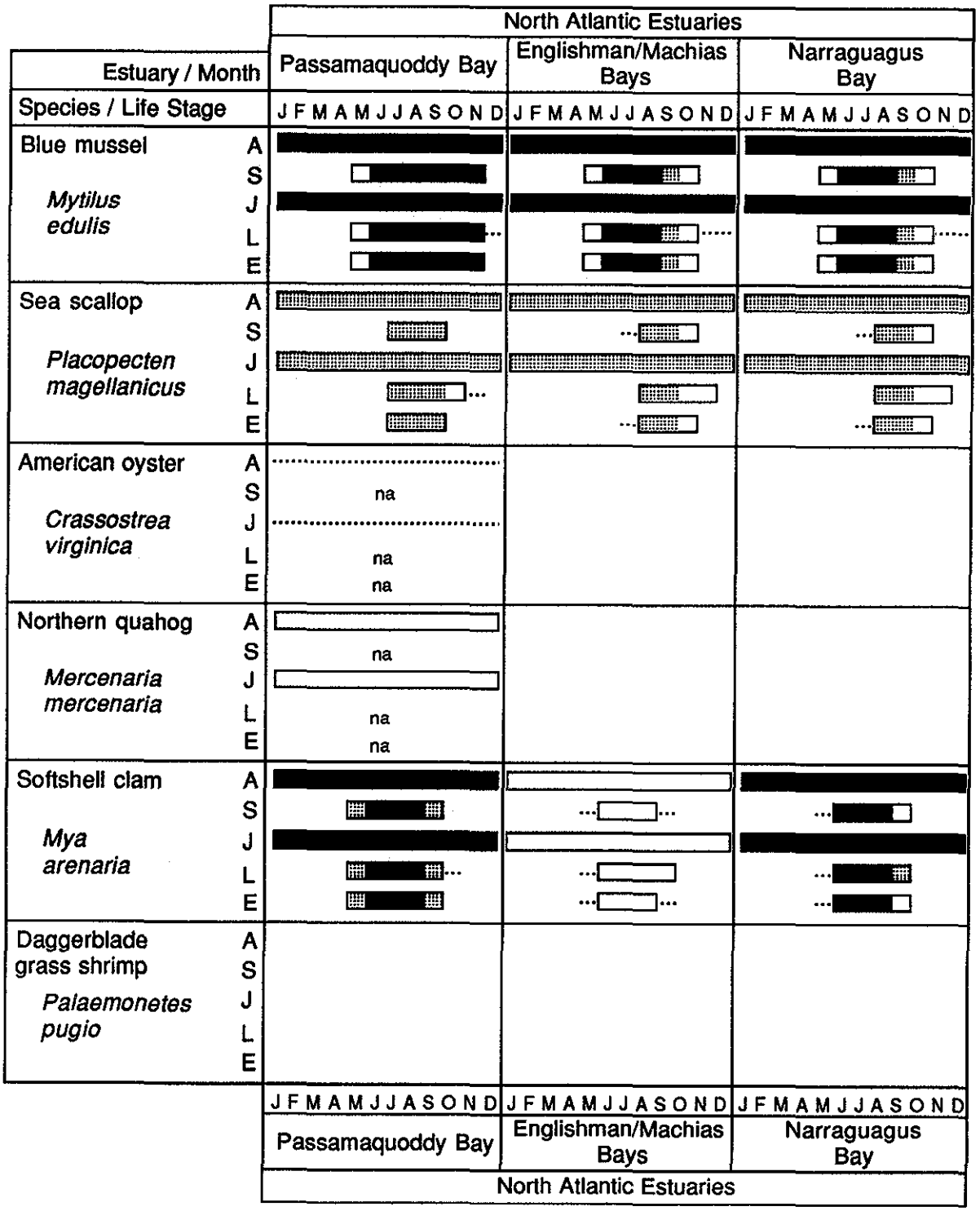
- L - Larvae
- E - Eggs

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

Table 5. Temporal distribution and relative abundance



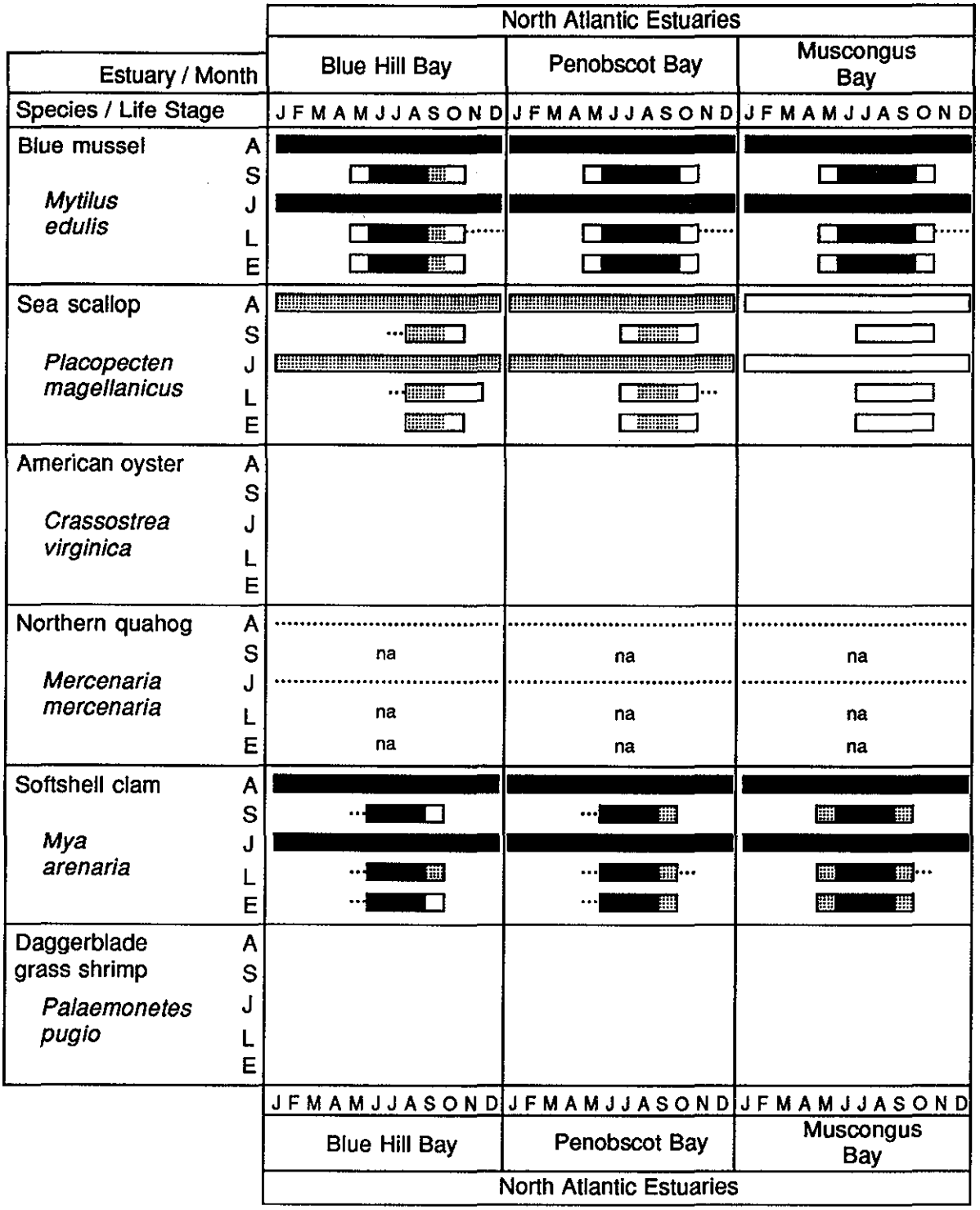

Relative Abundance

- 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

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Life Stage

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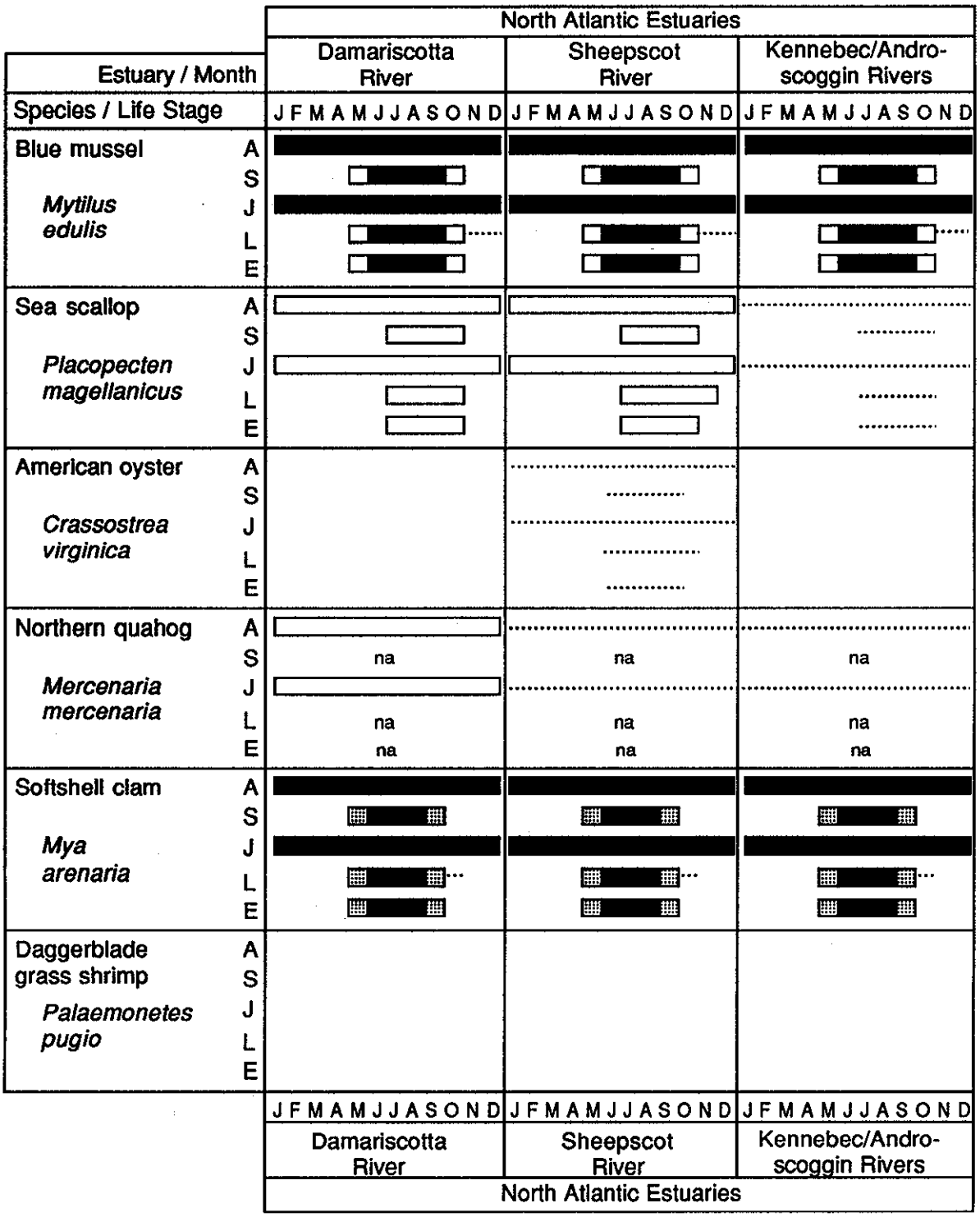
E - Eggs

Table 5 (continued). Temporal distribution and relative abundance

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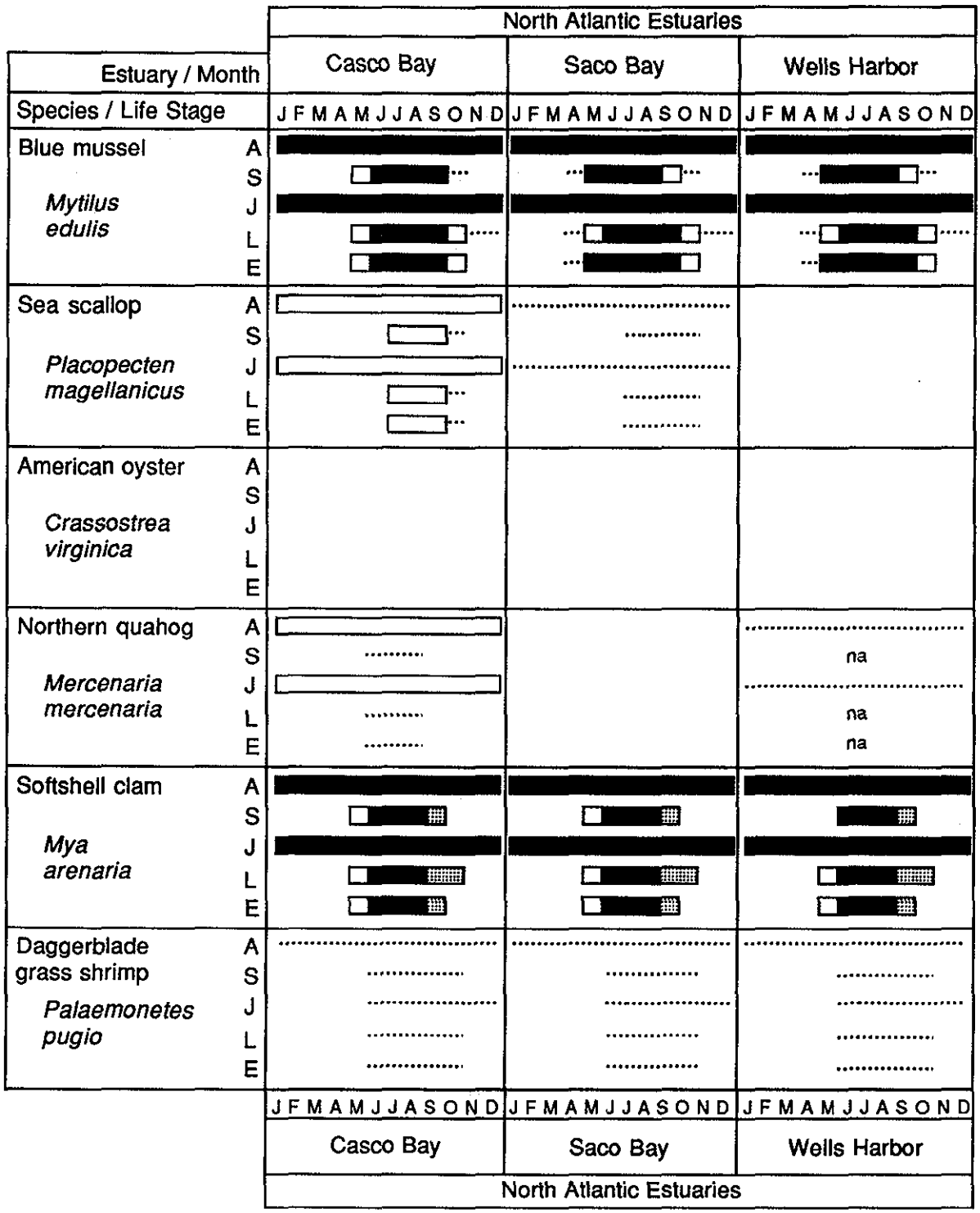


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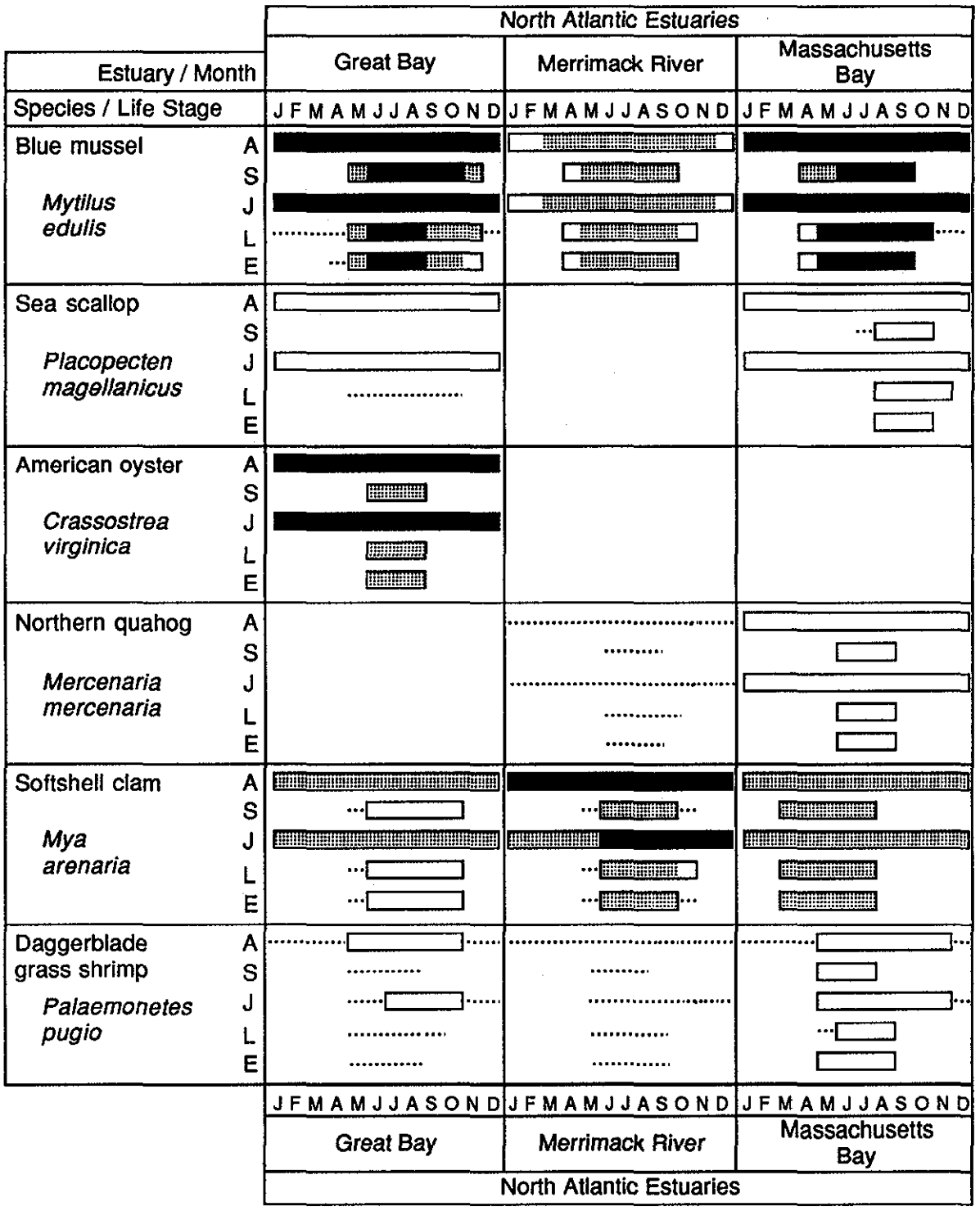


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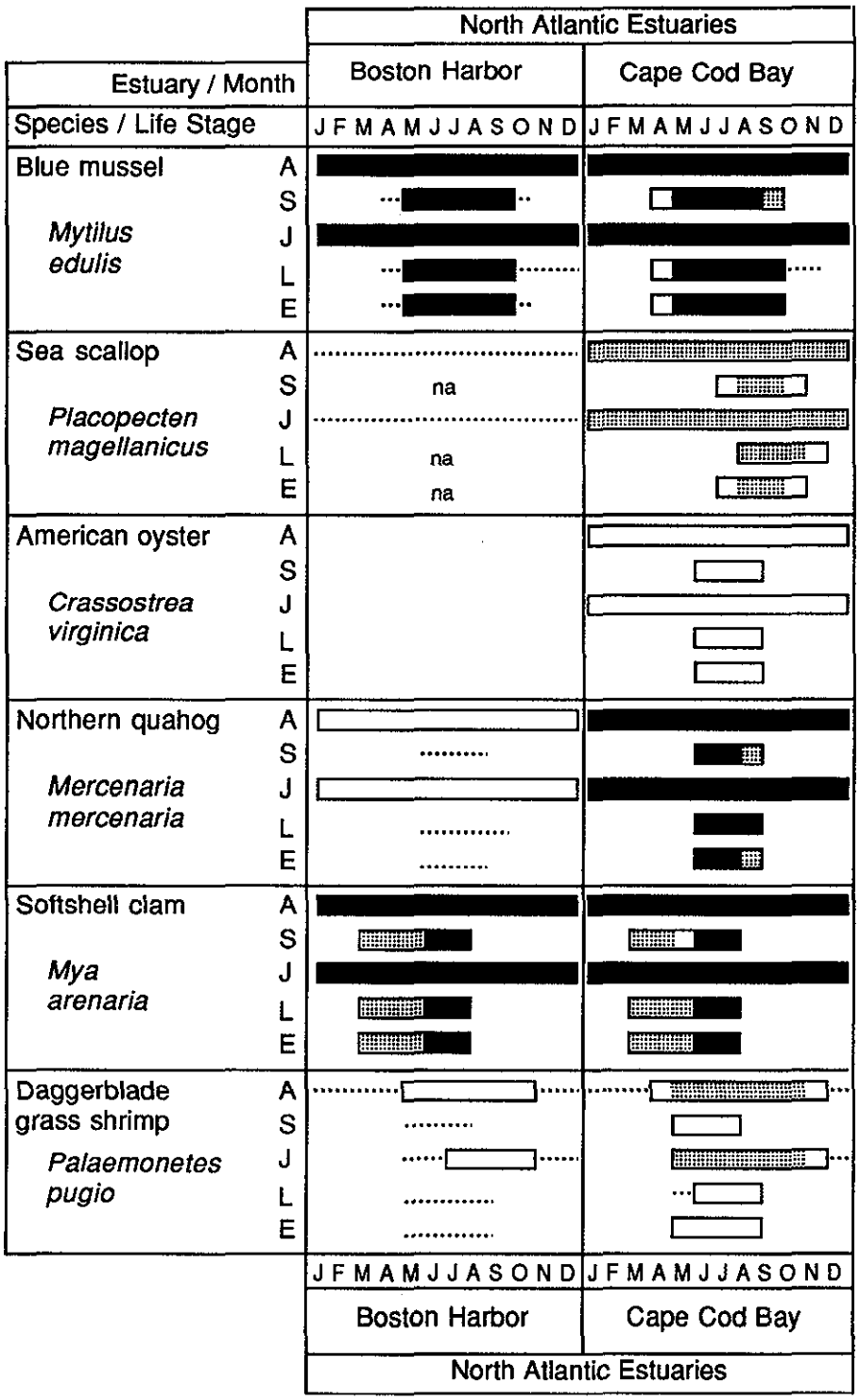


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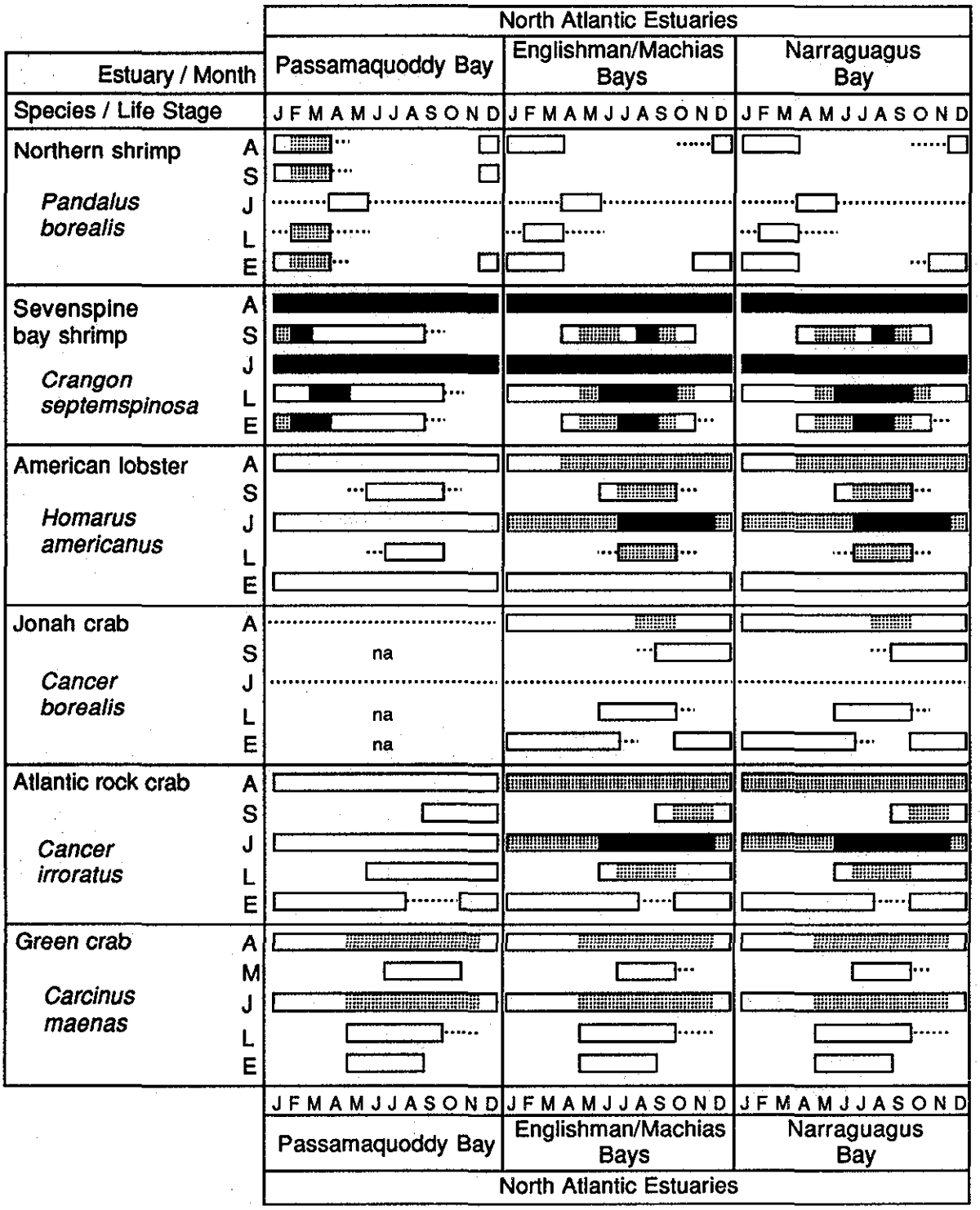


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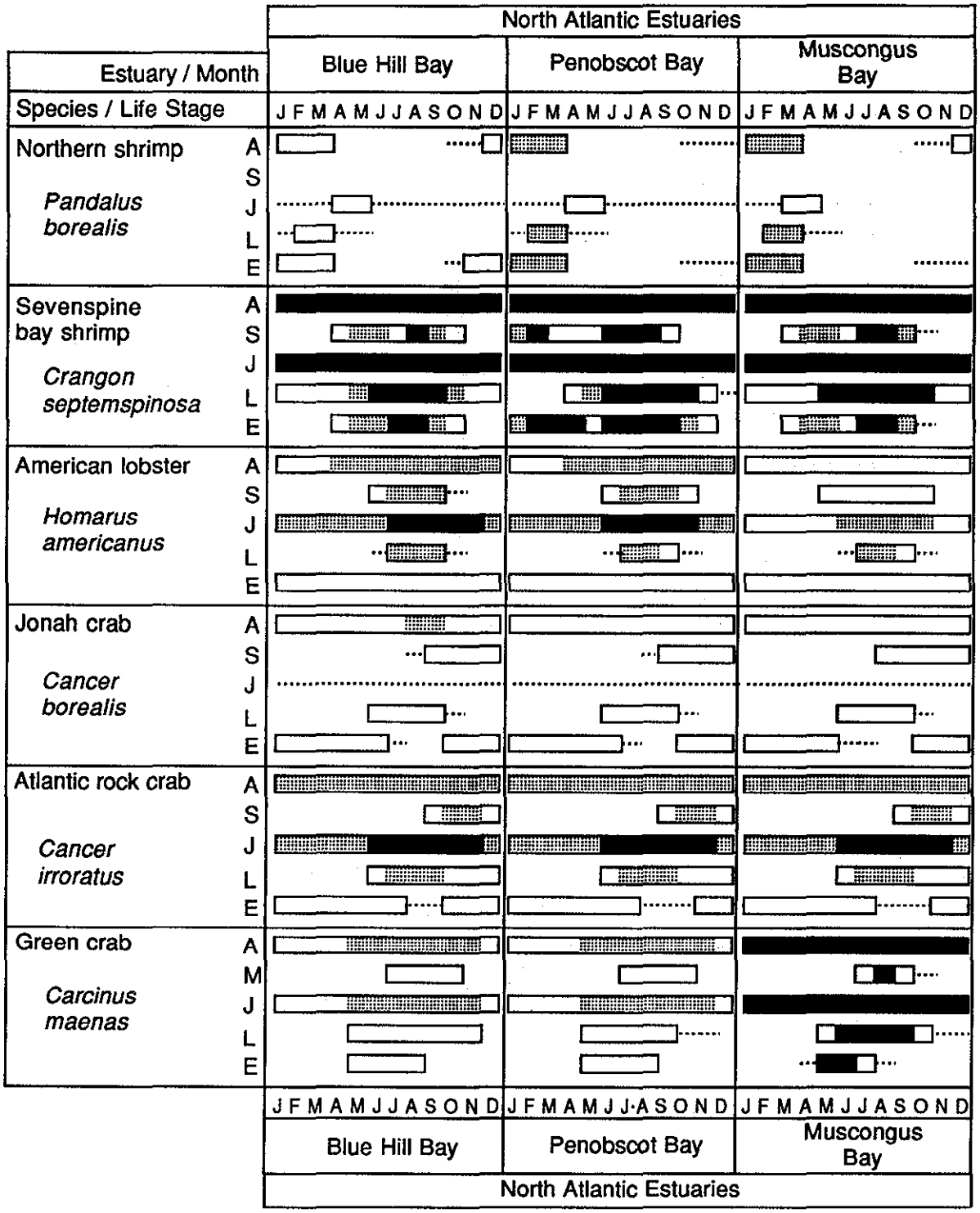


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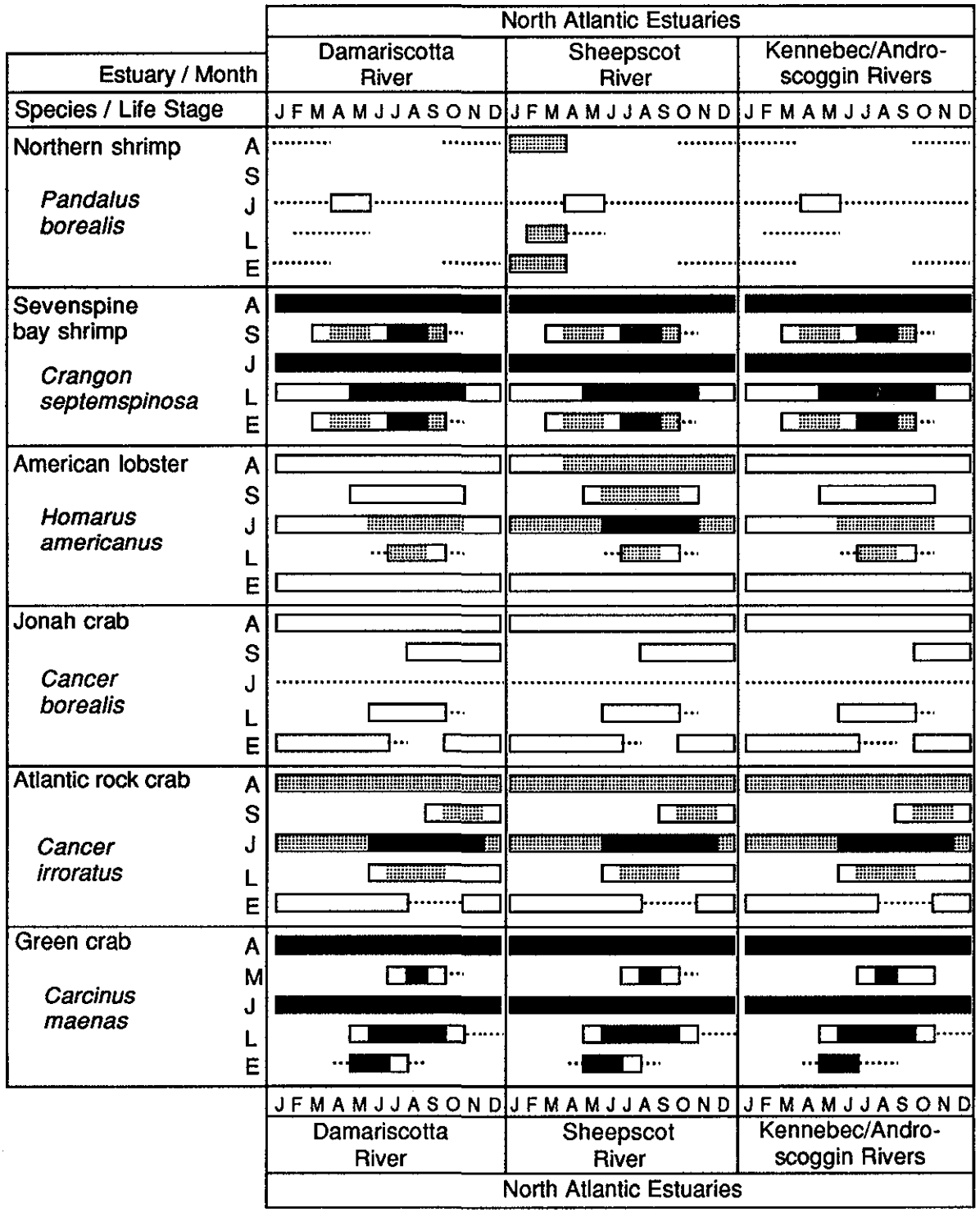


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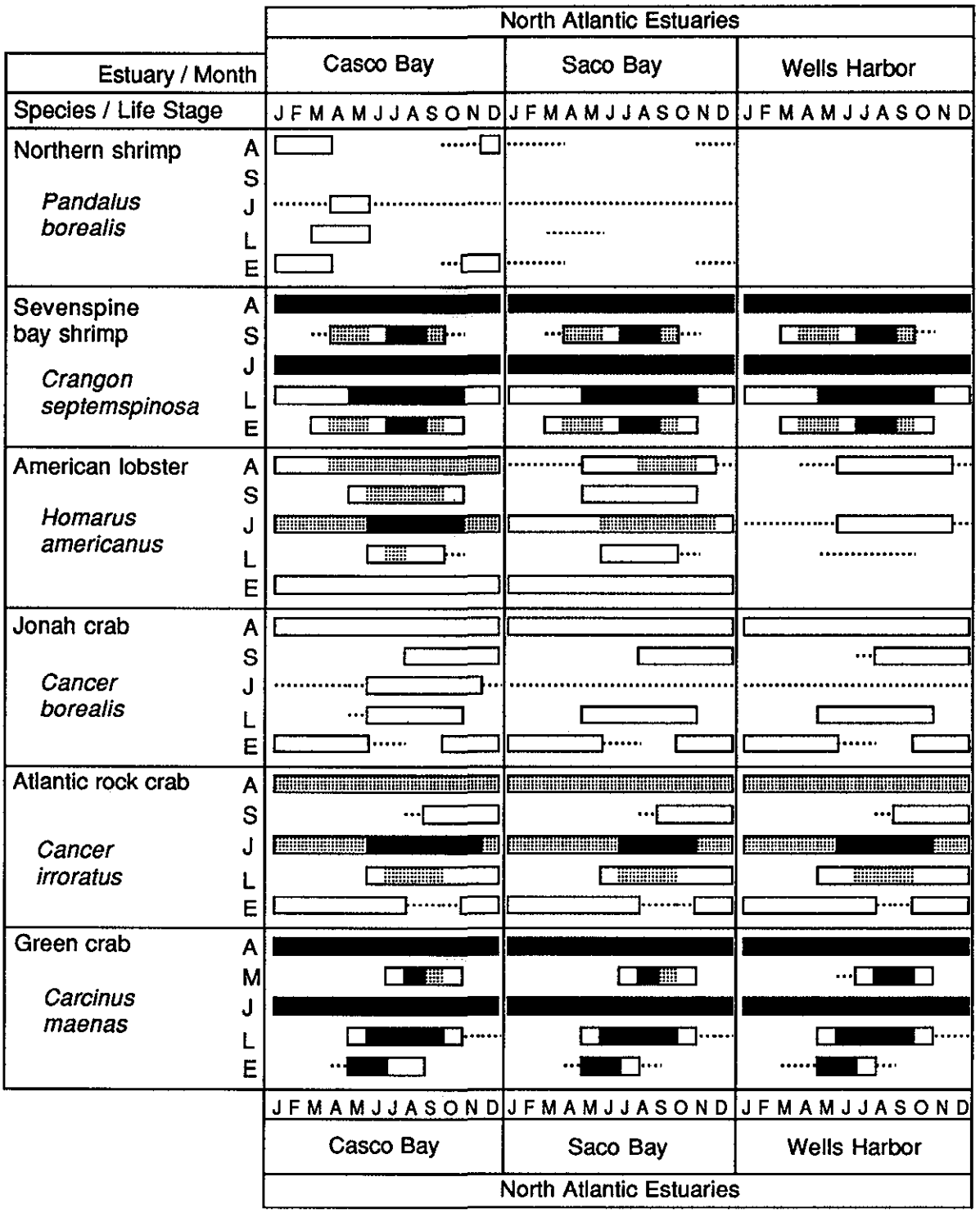


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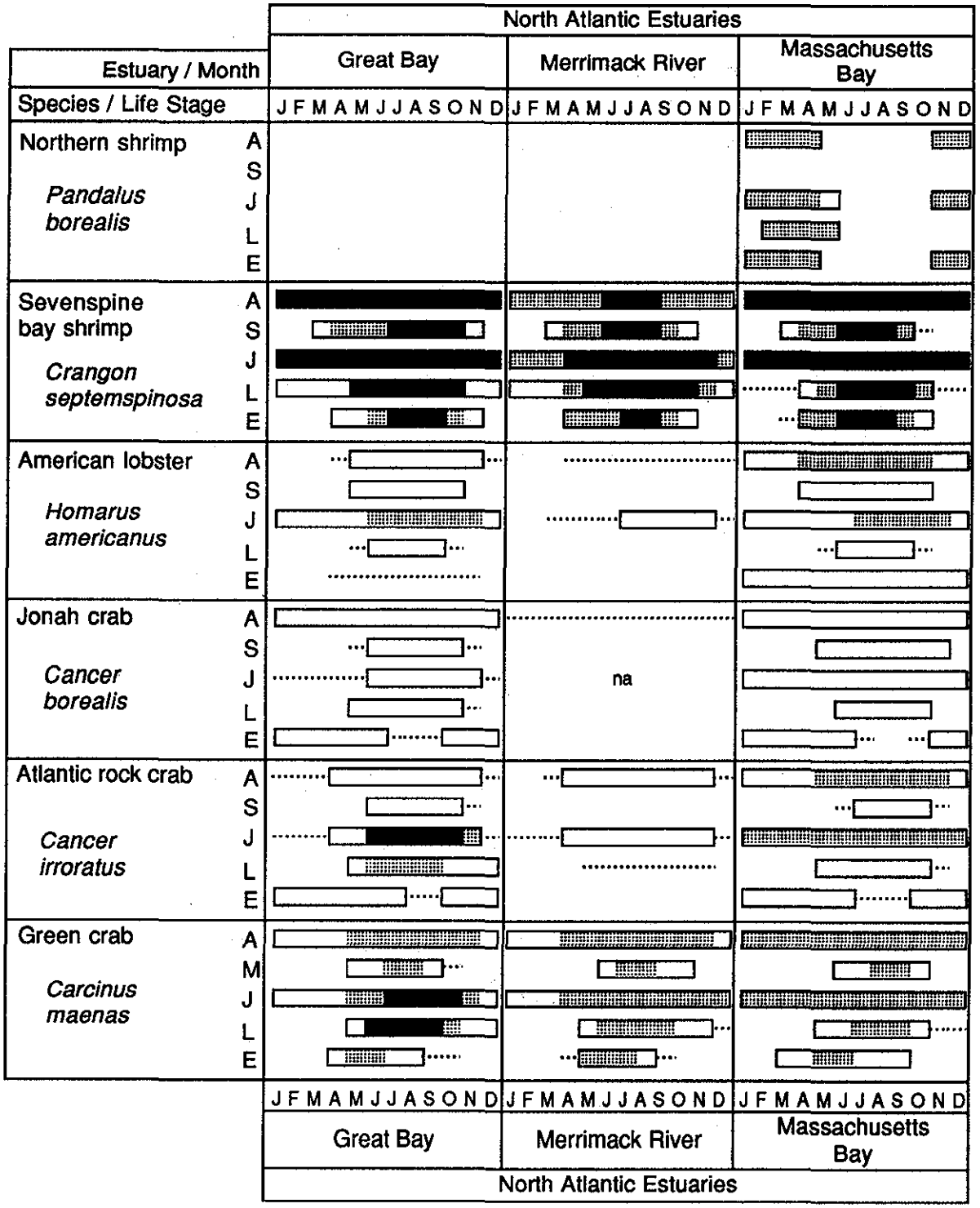


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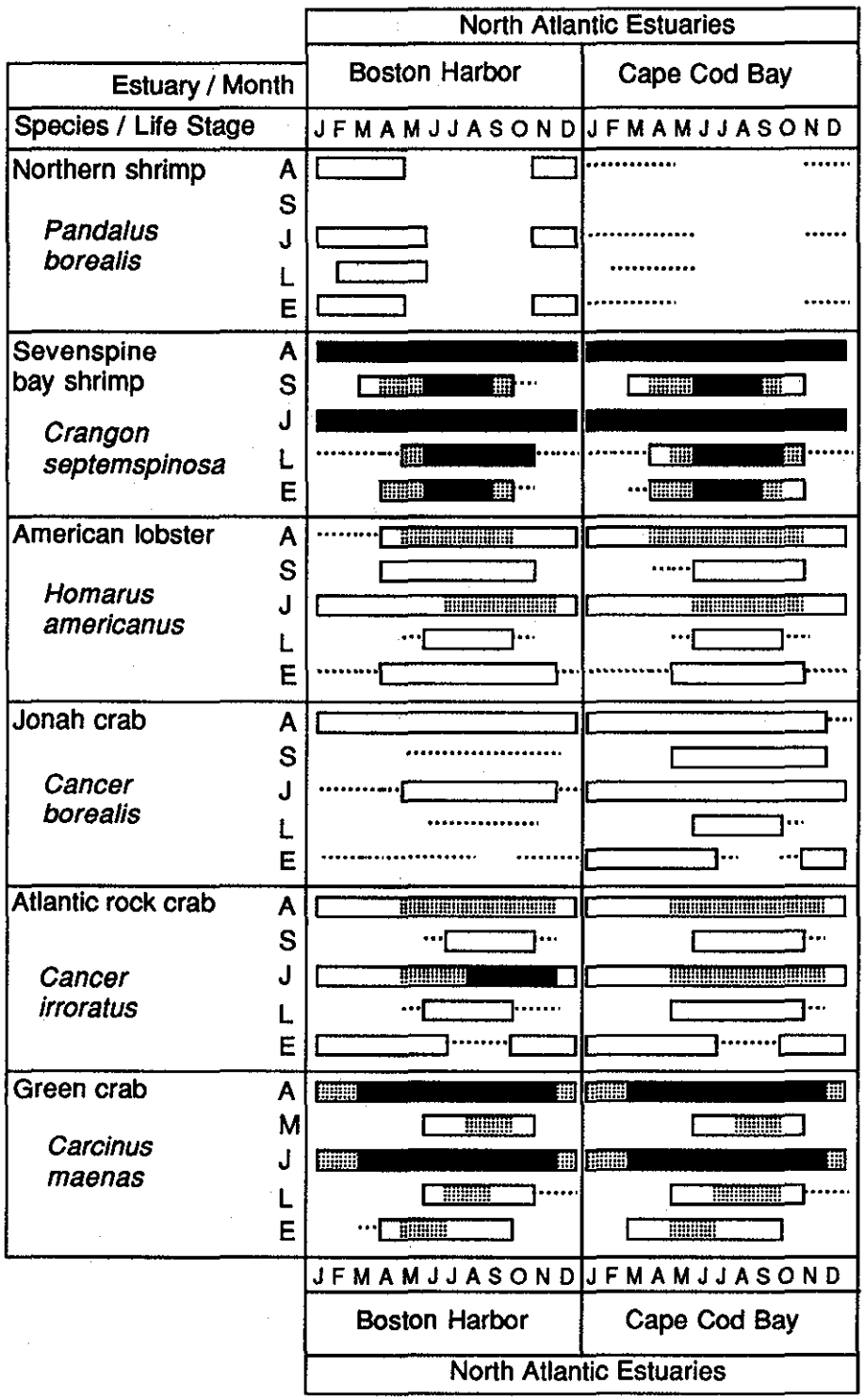


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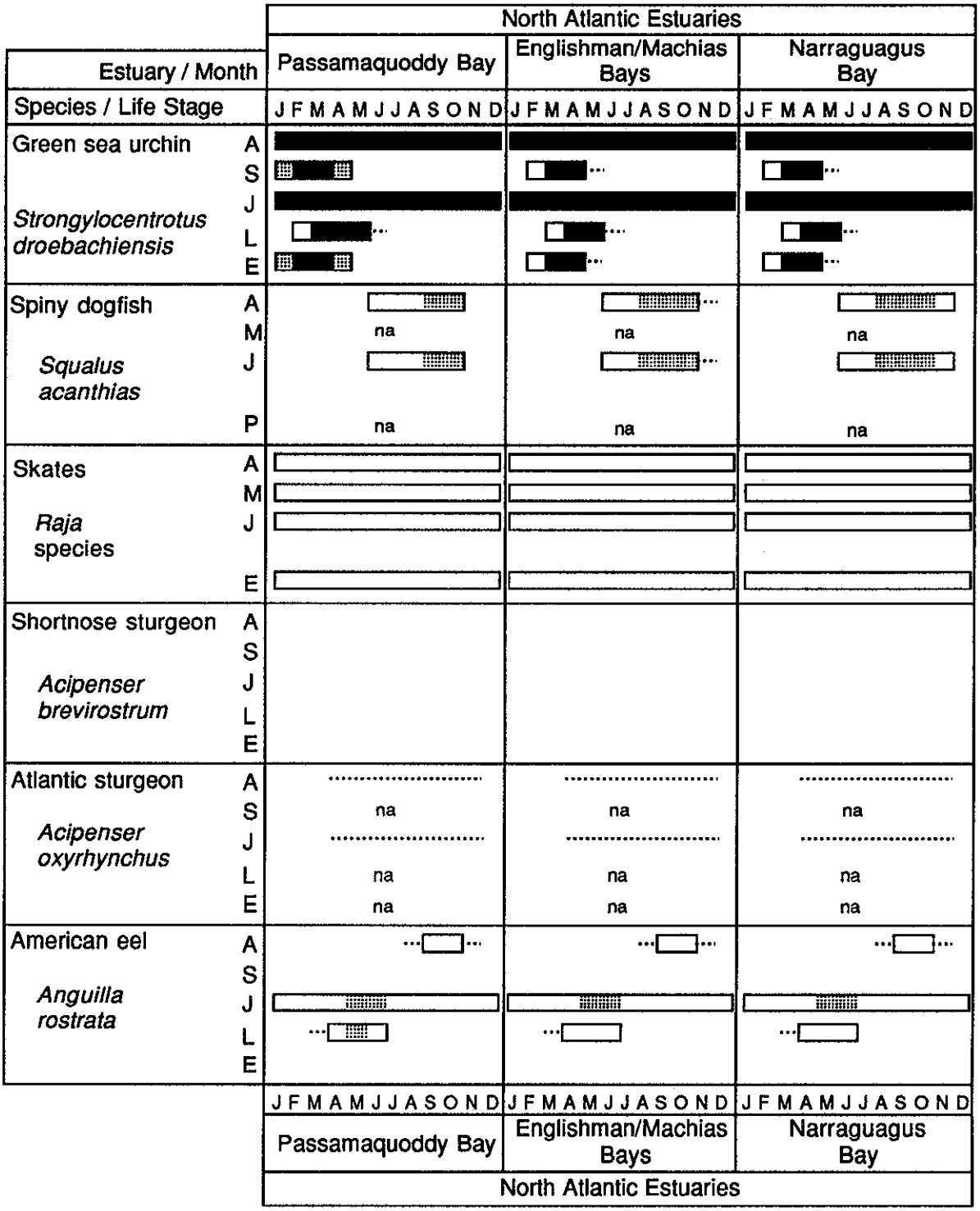


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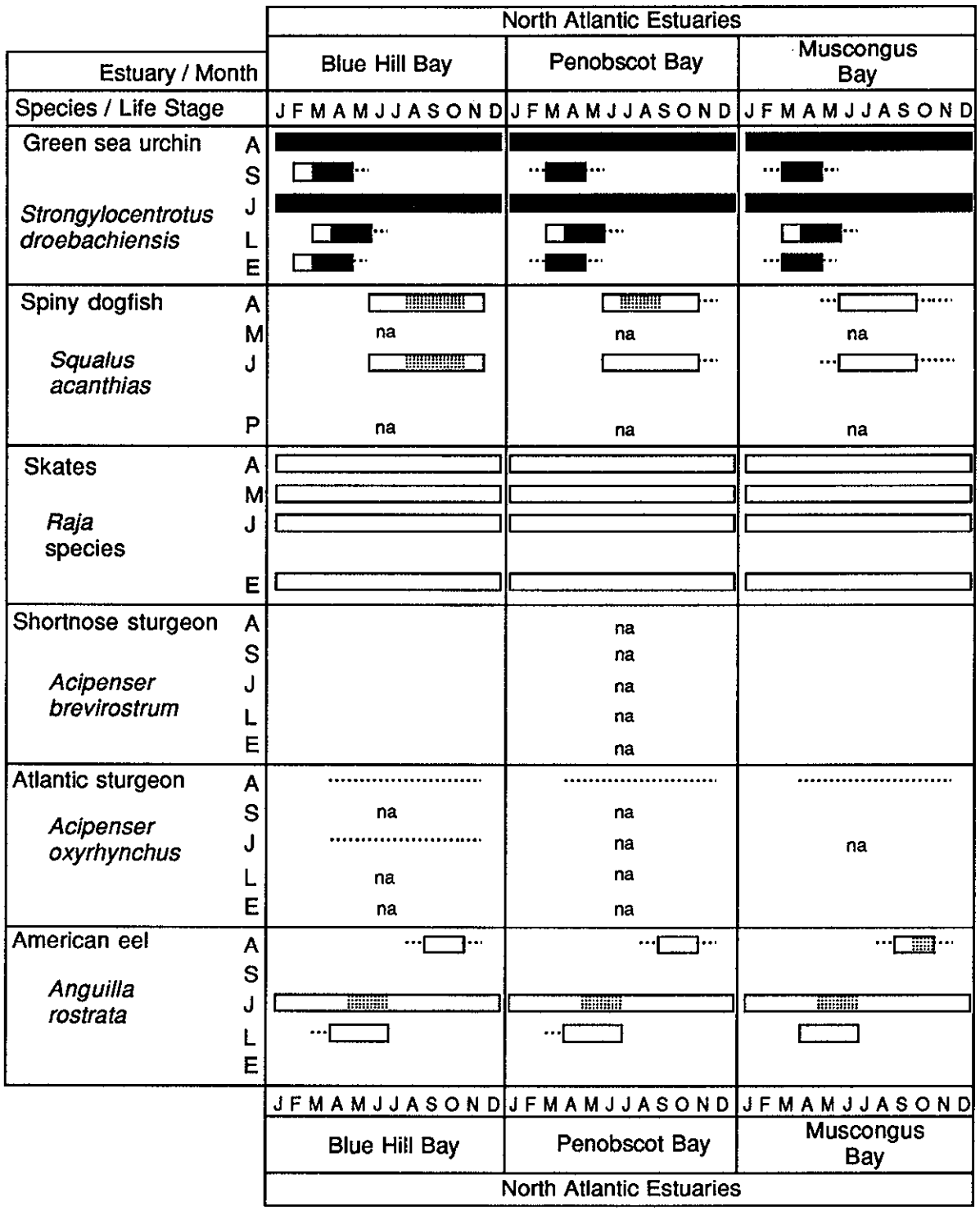


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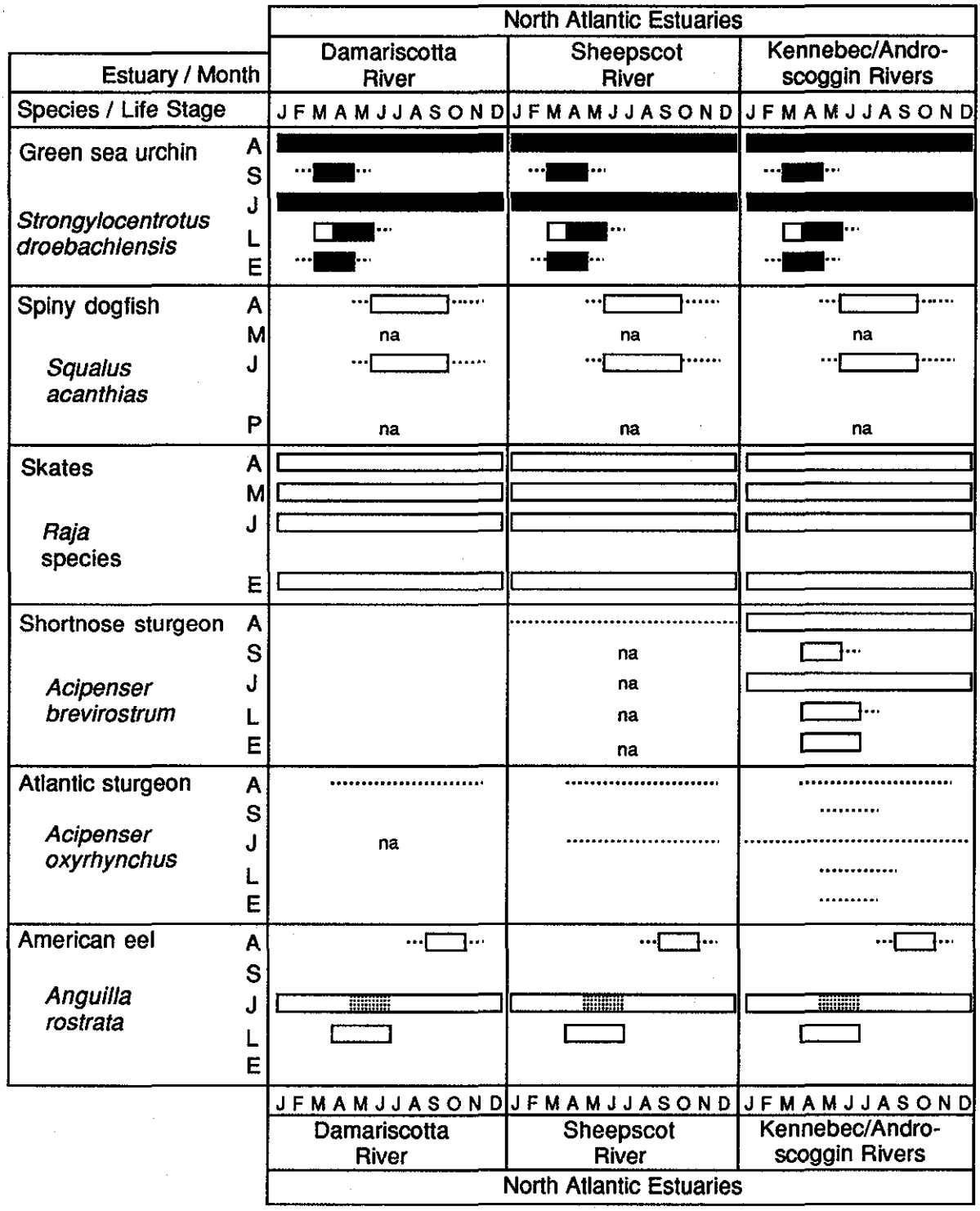


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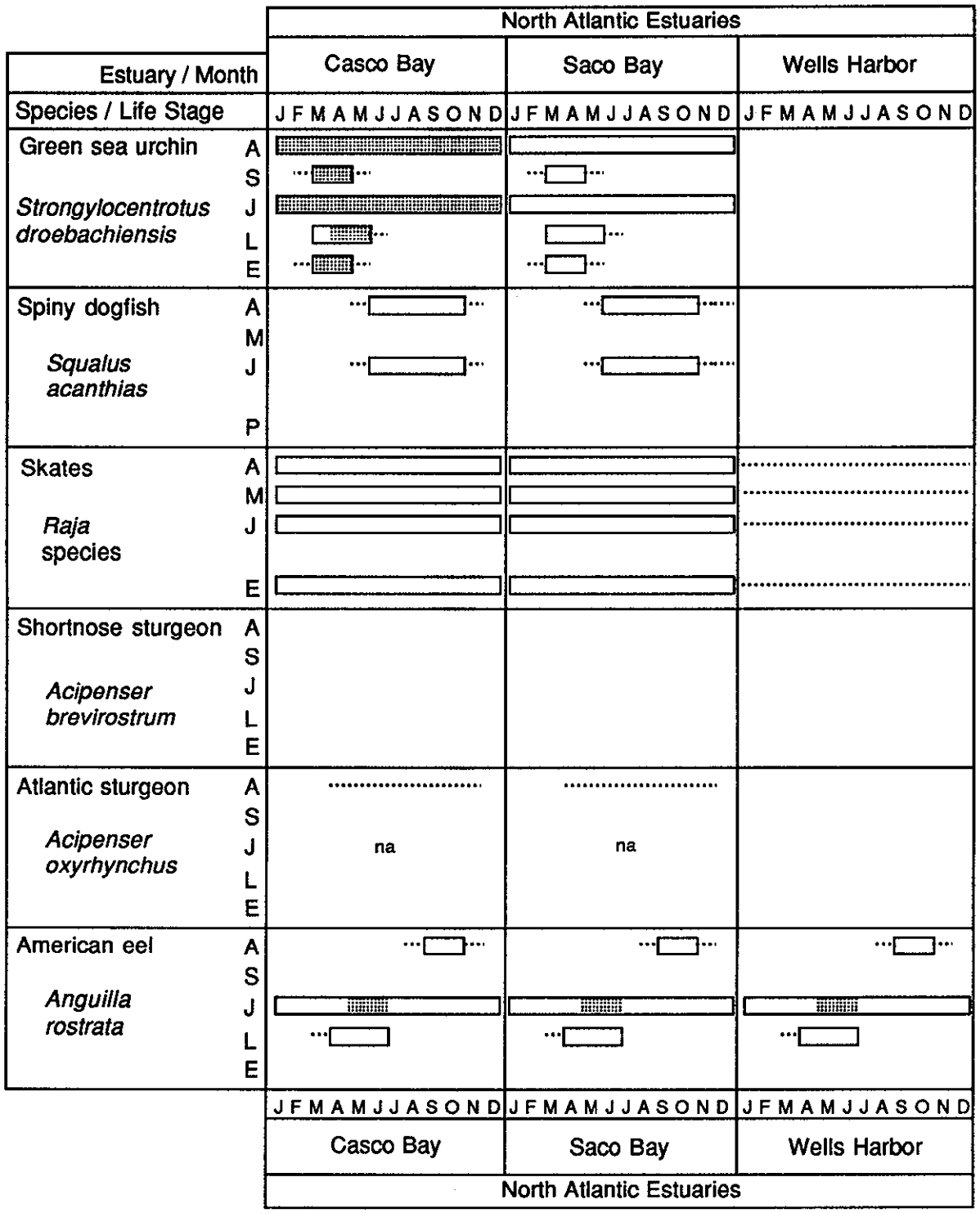


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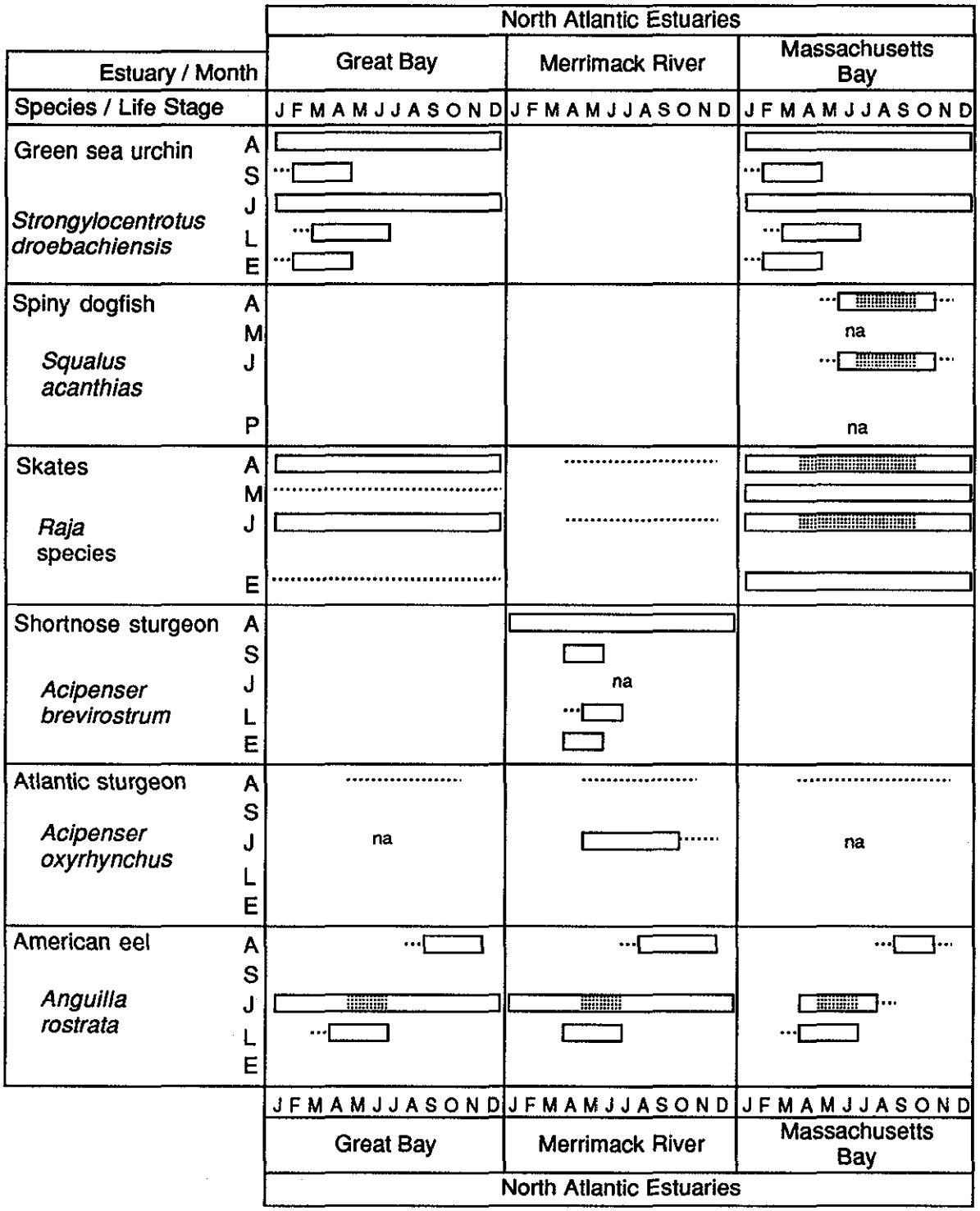


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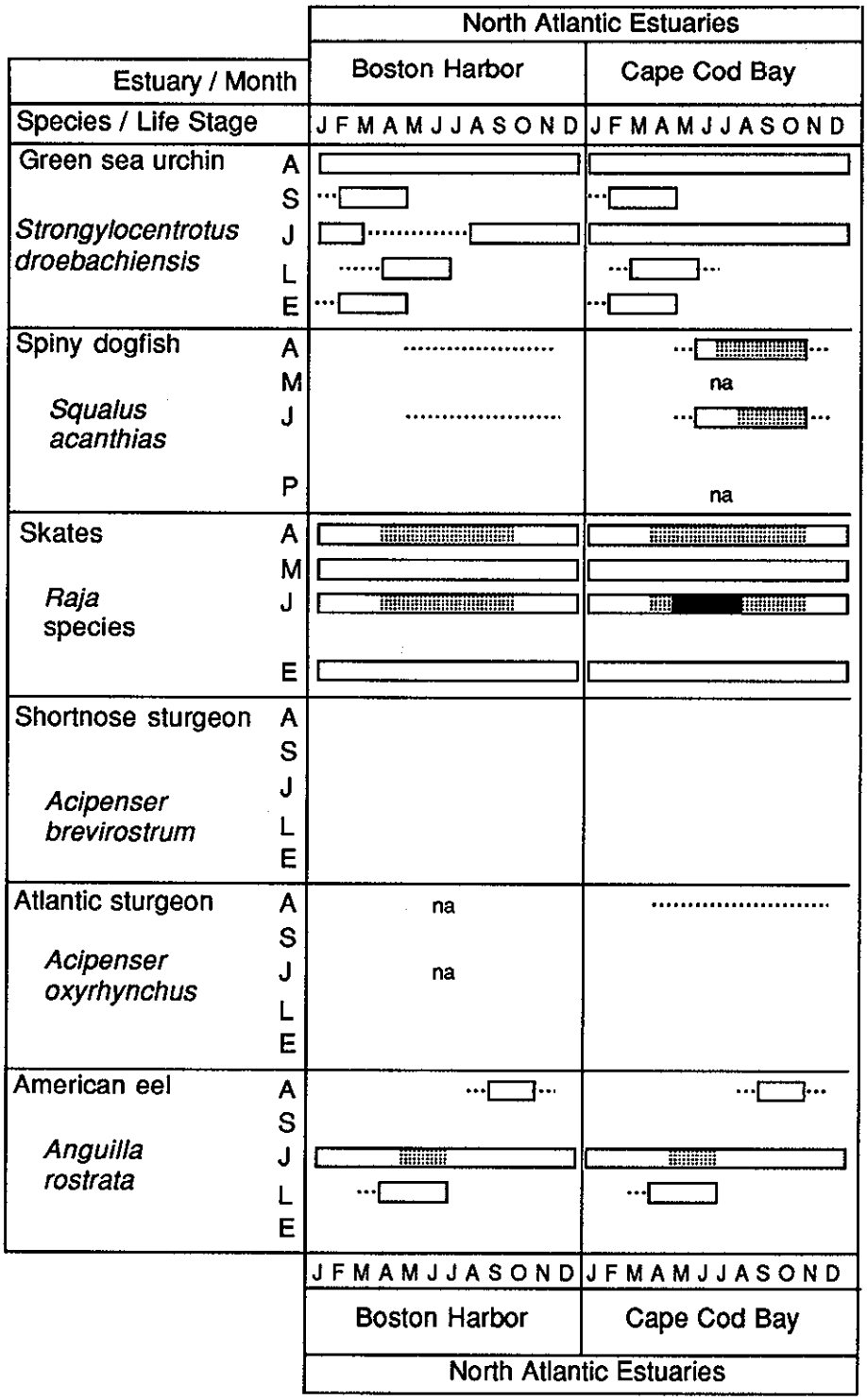


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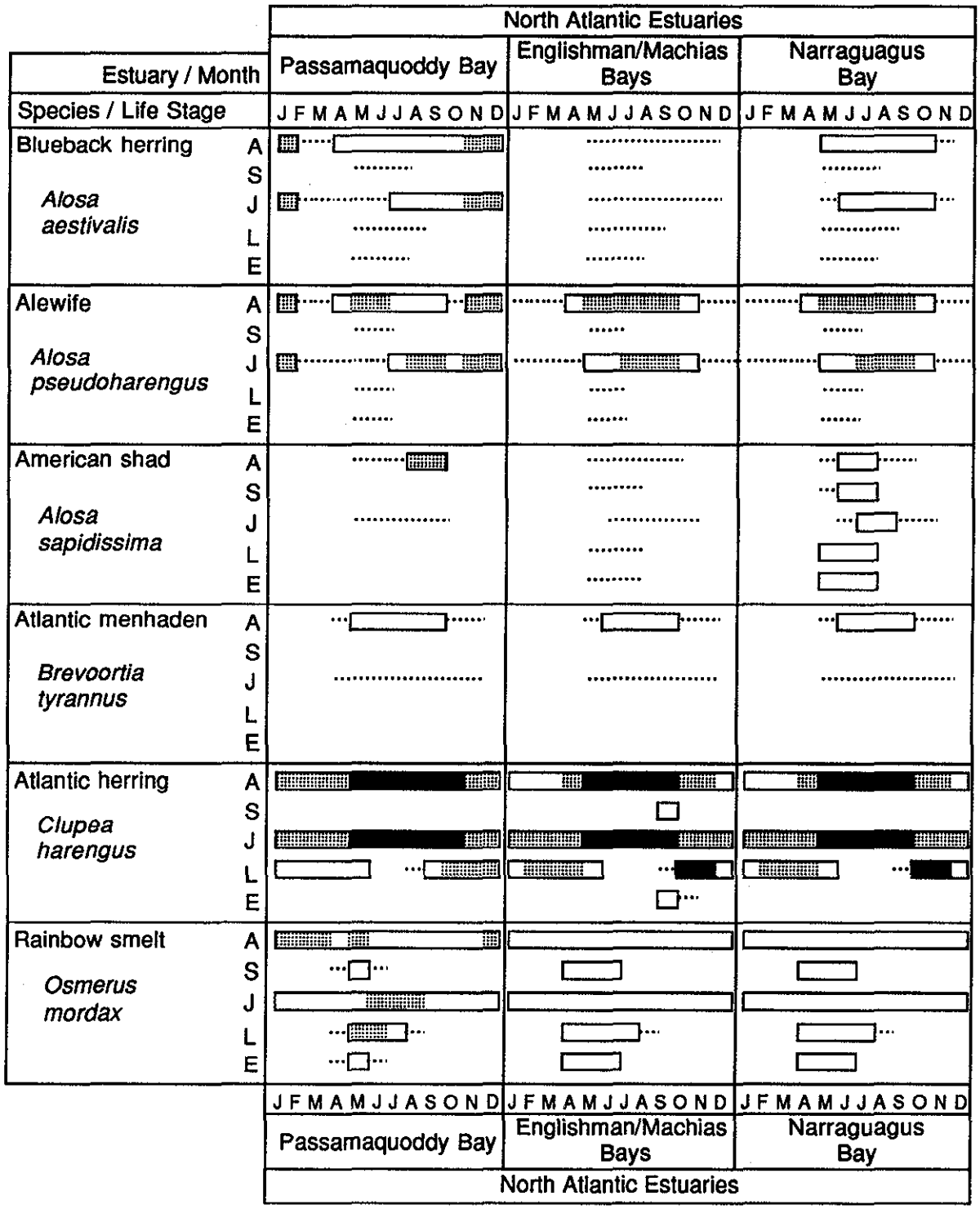


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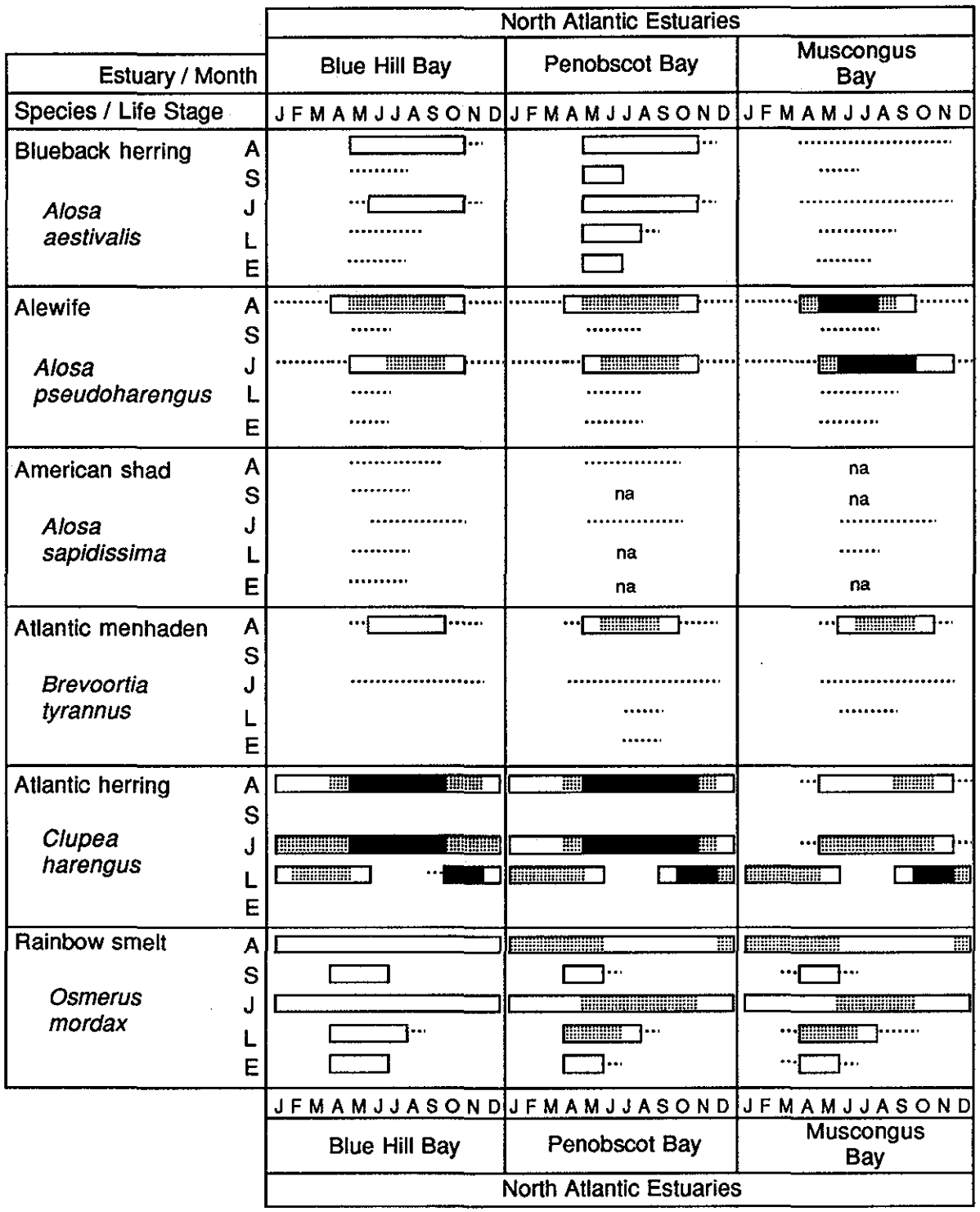


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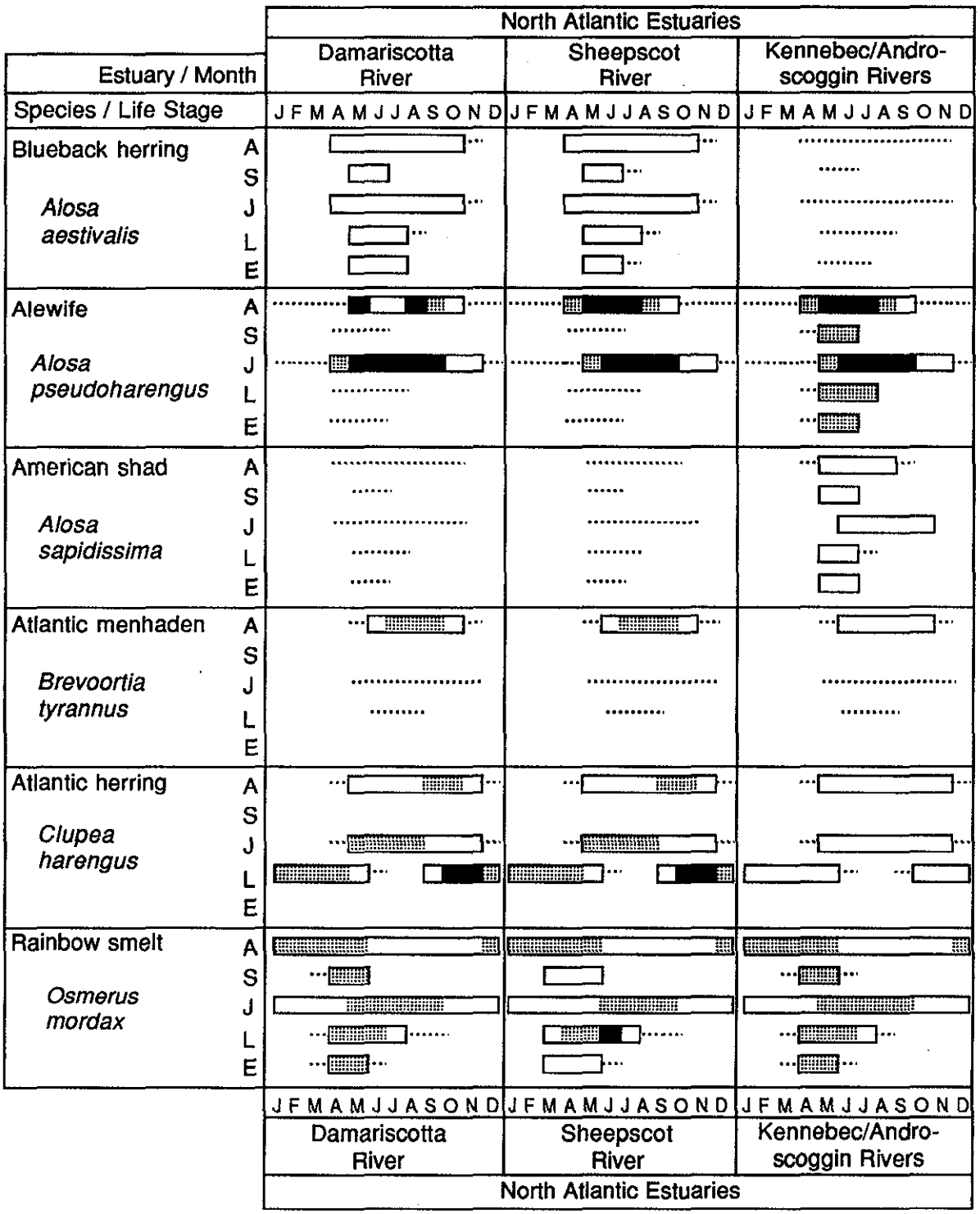


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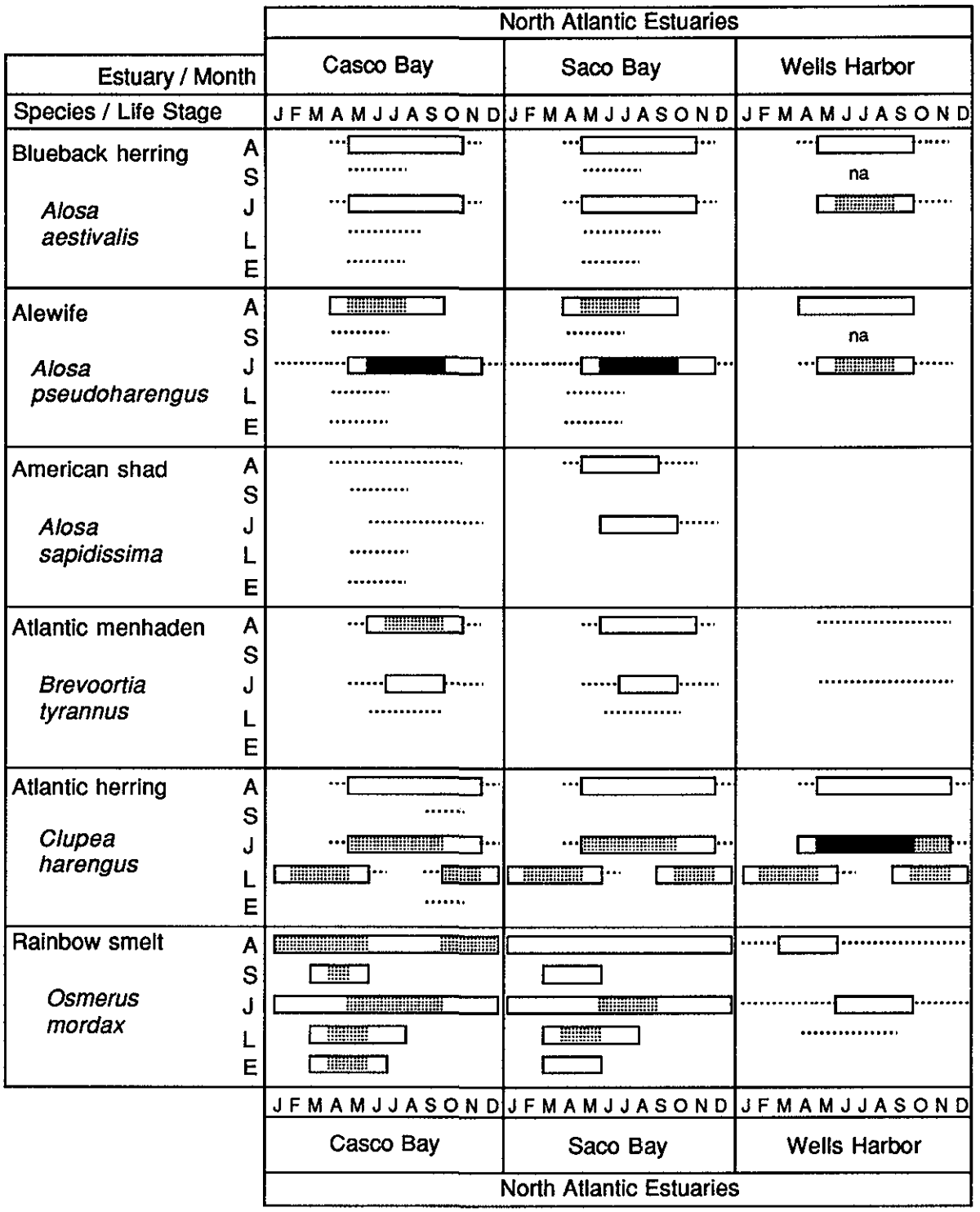


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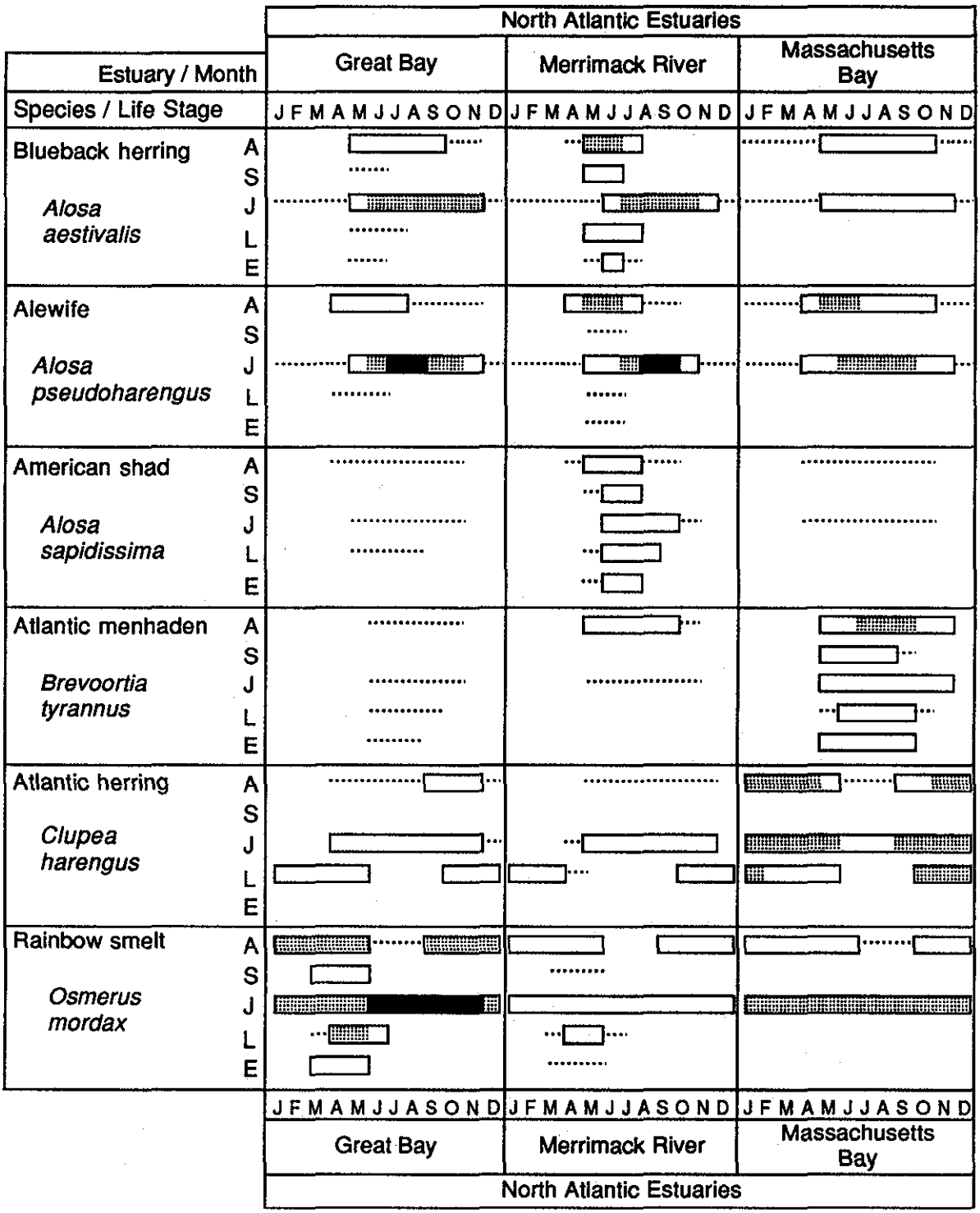


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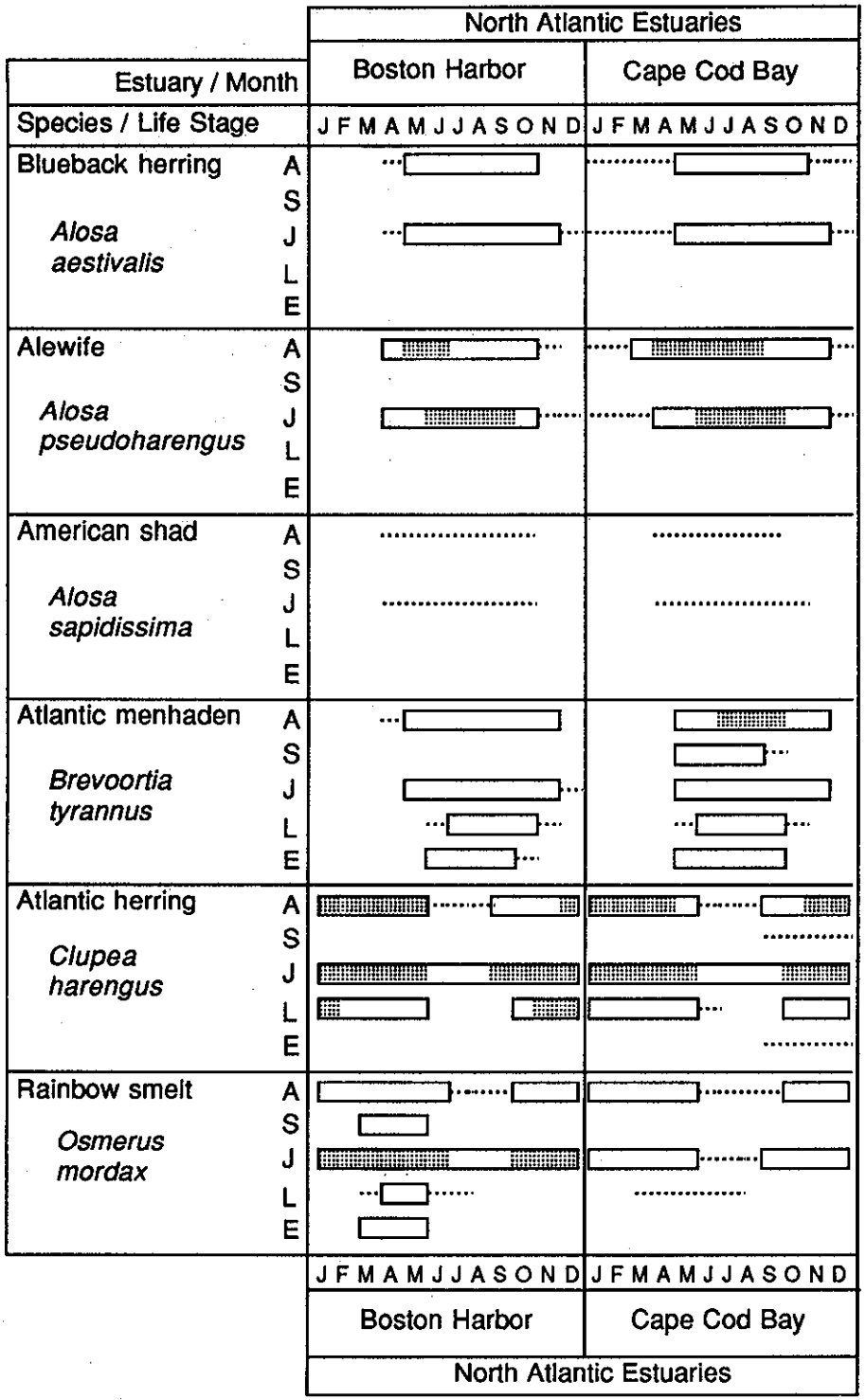


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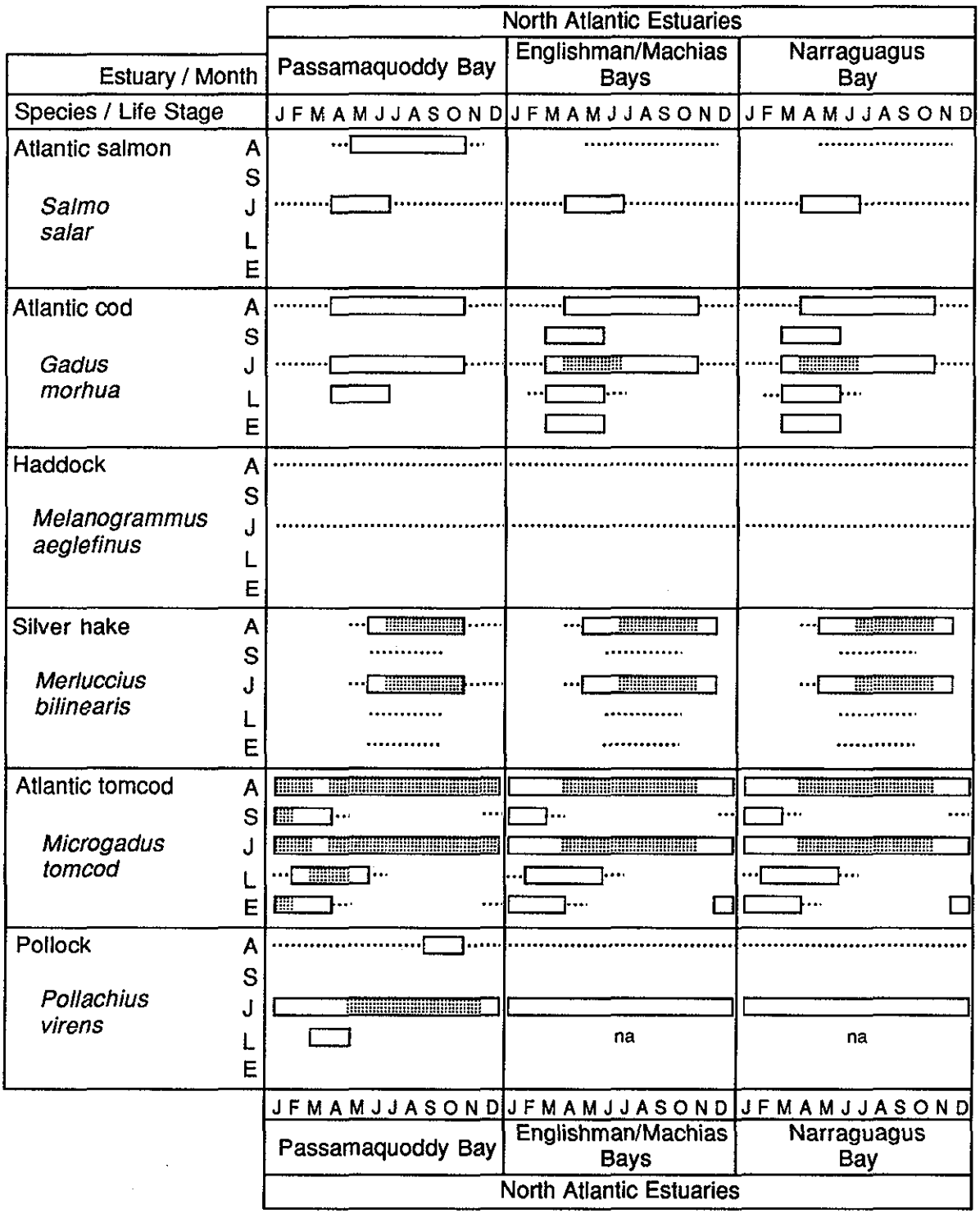


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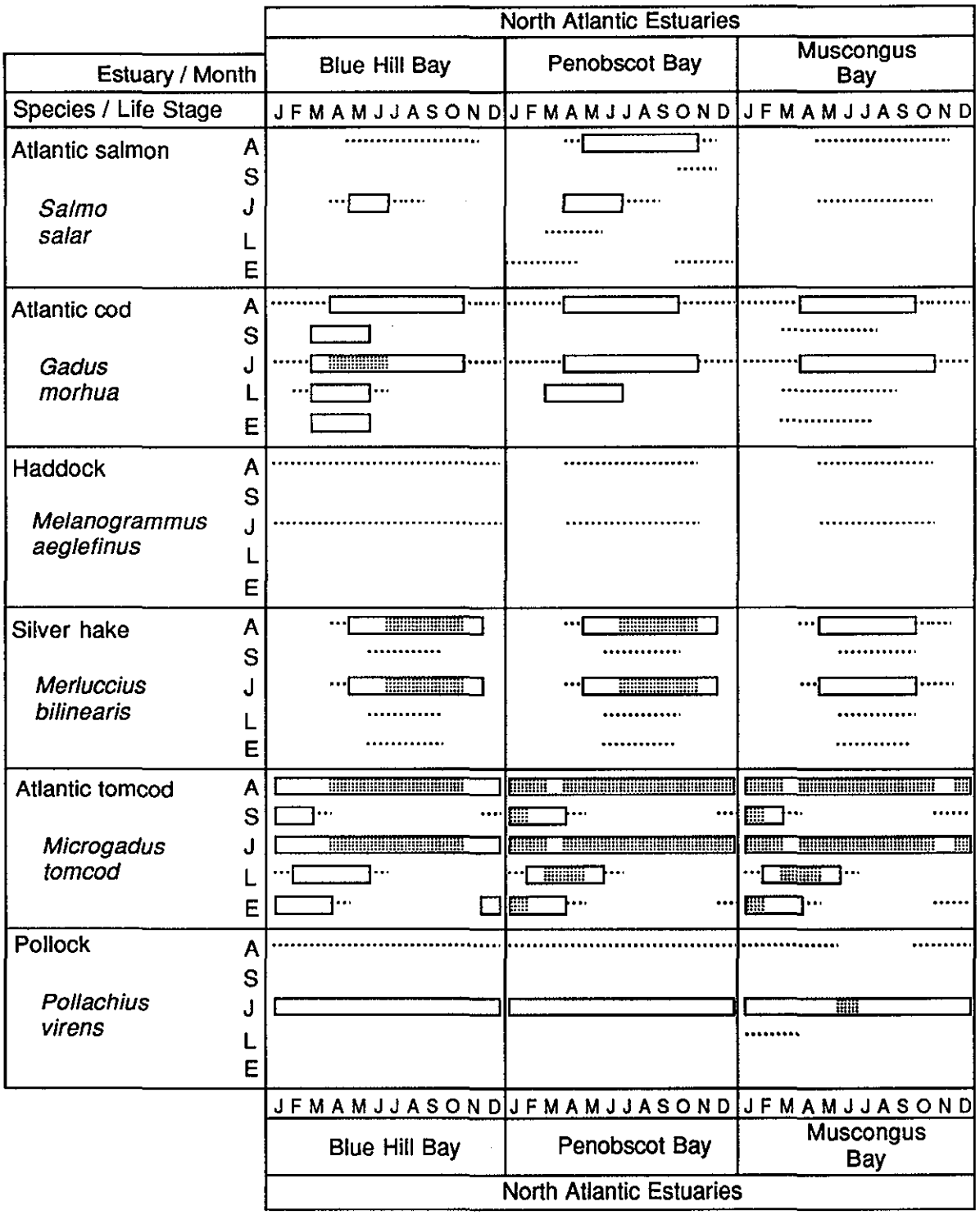


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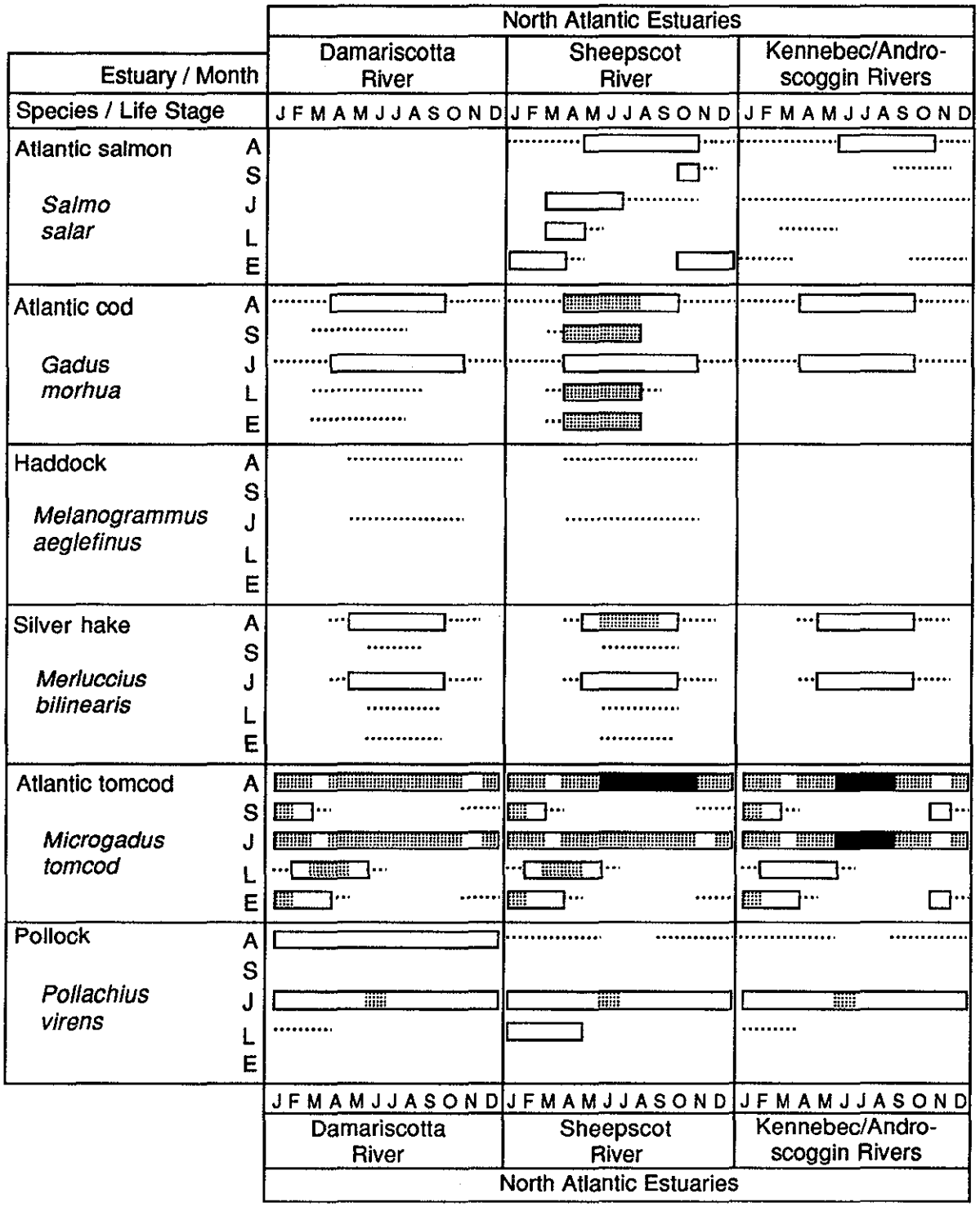


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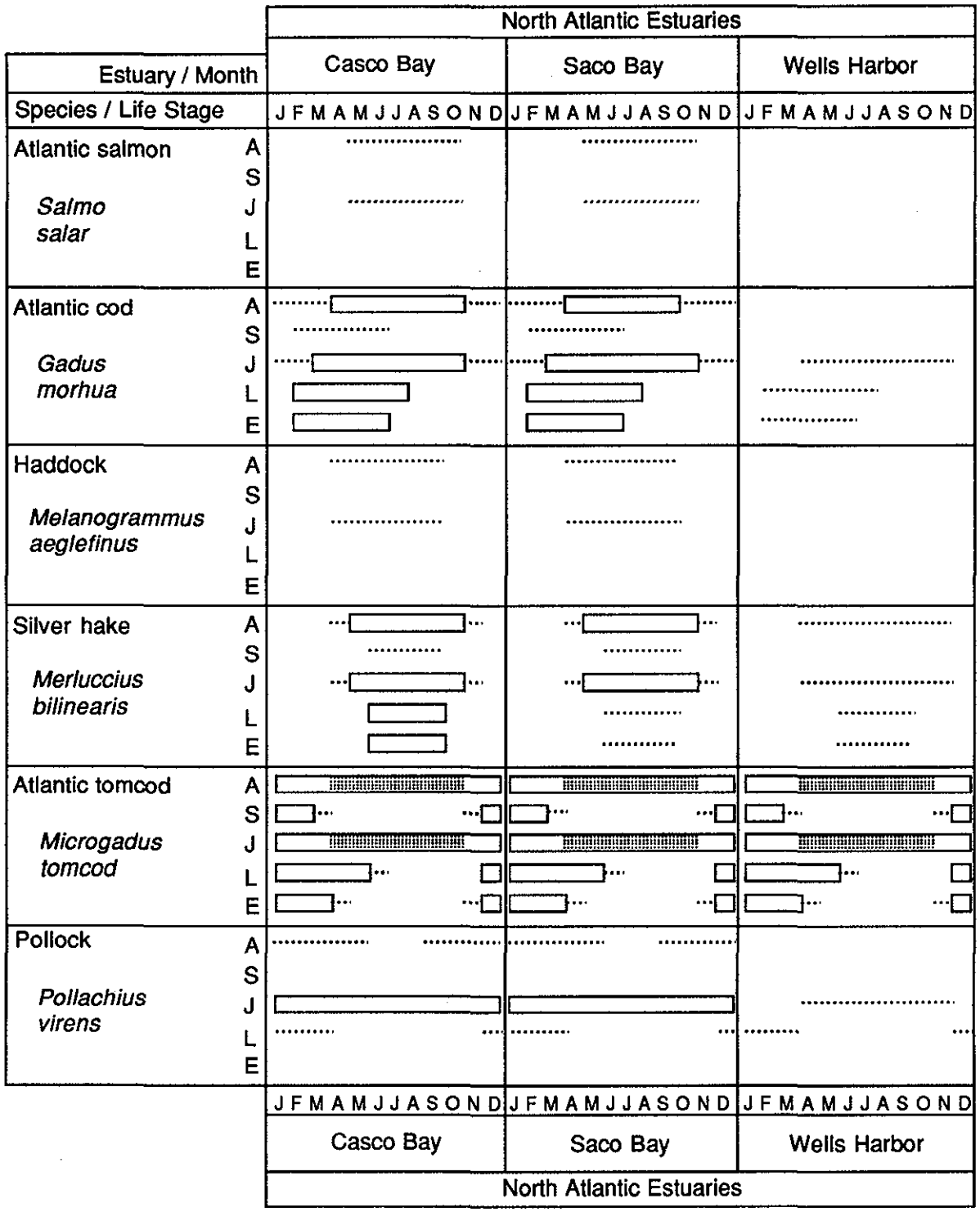


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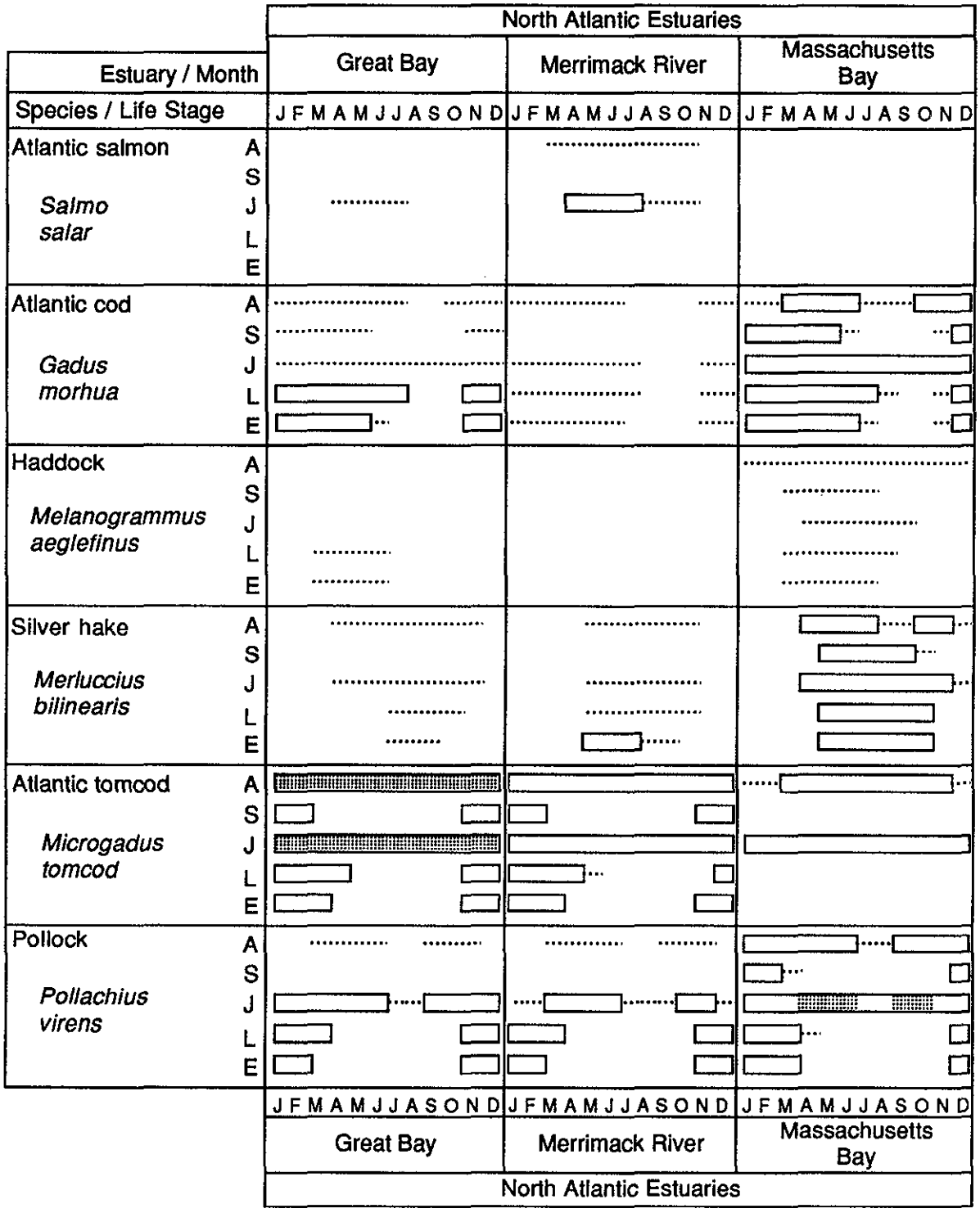


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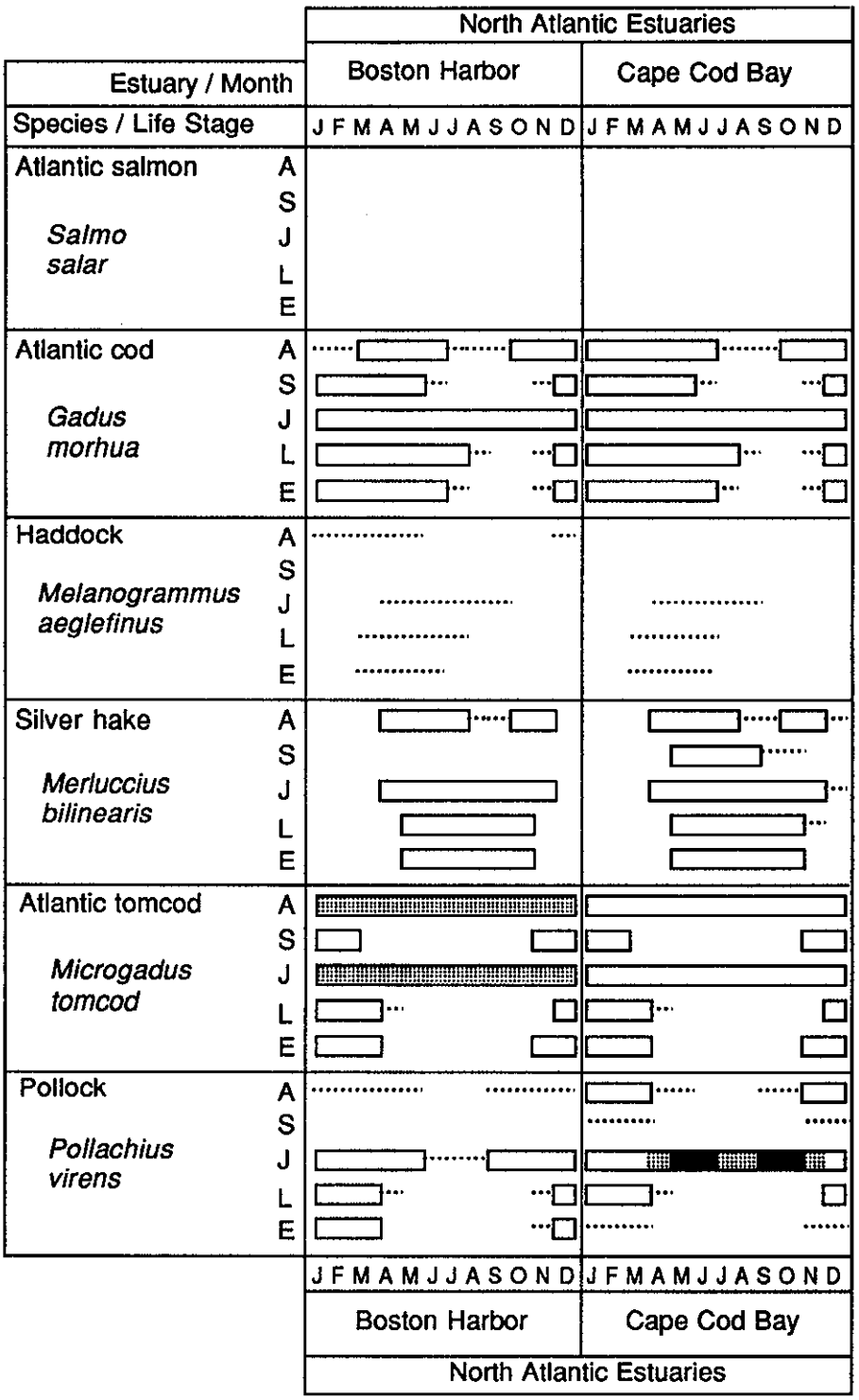


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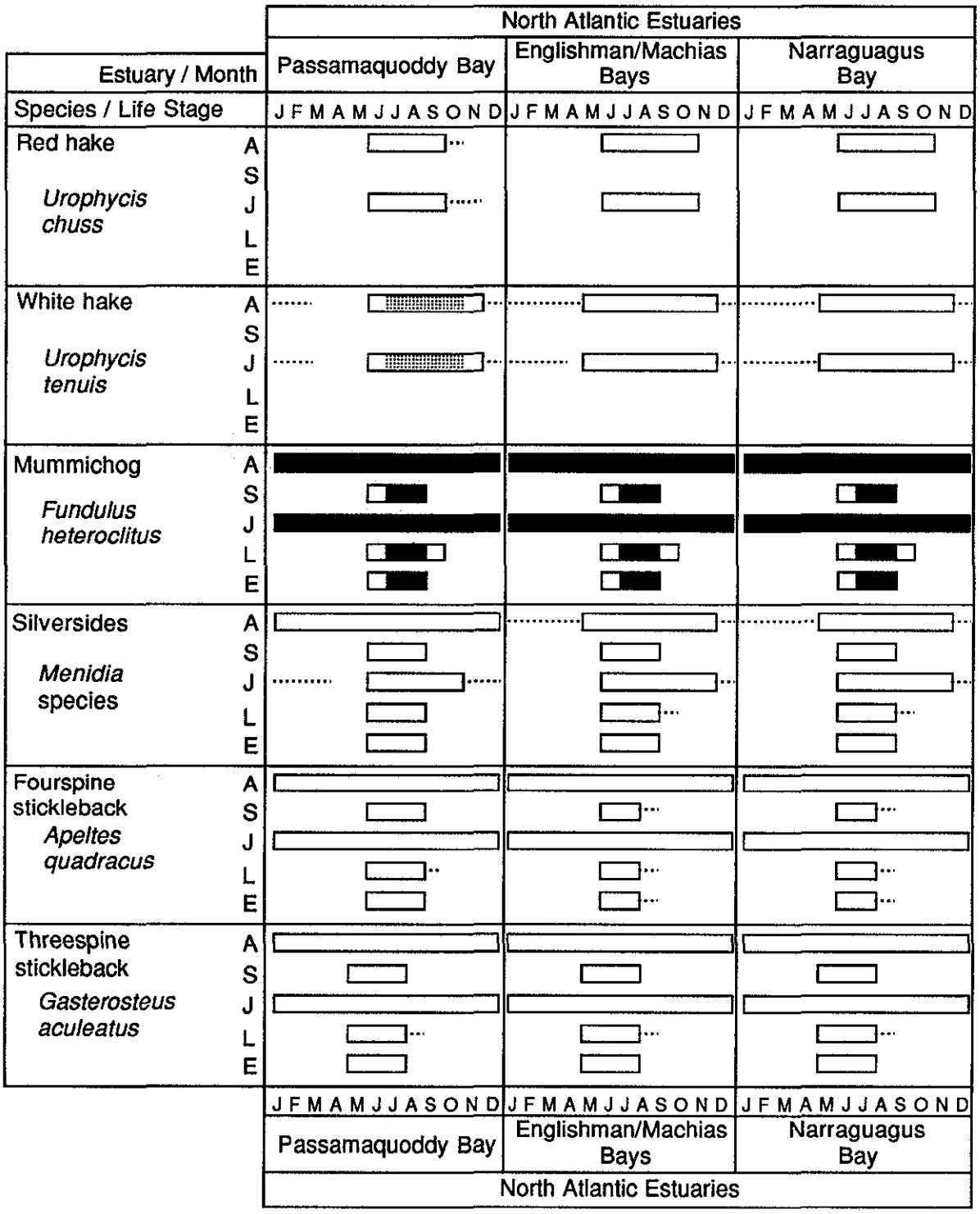


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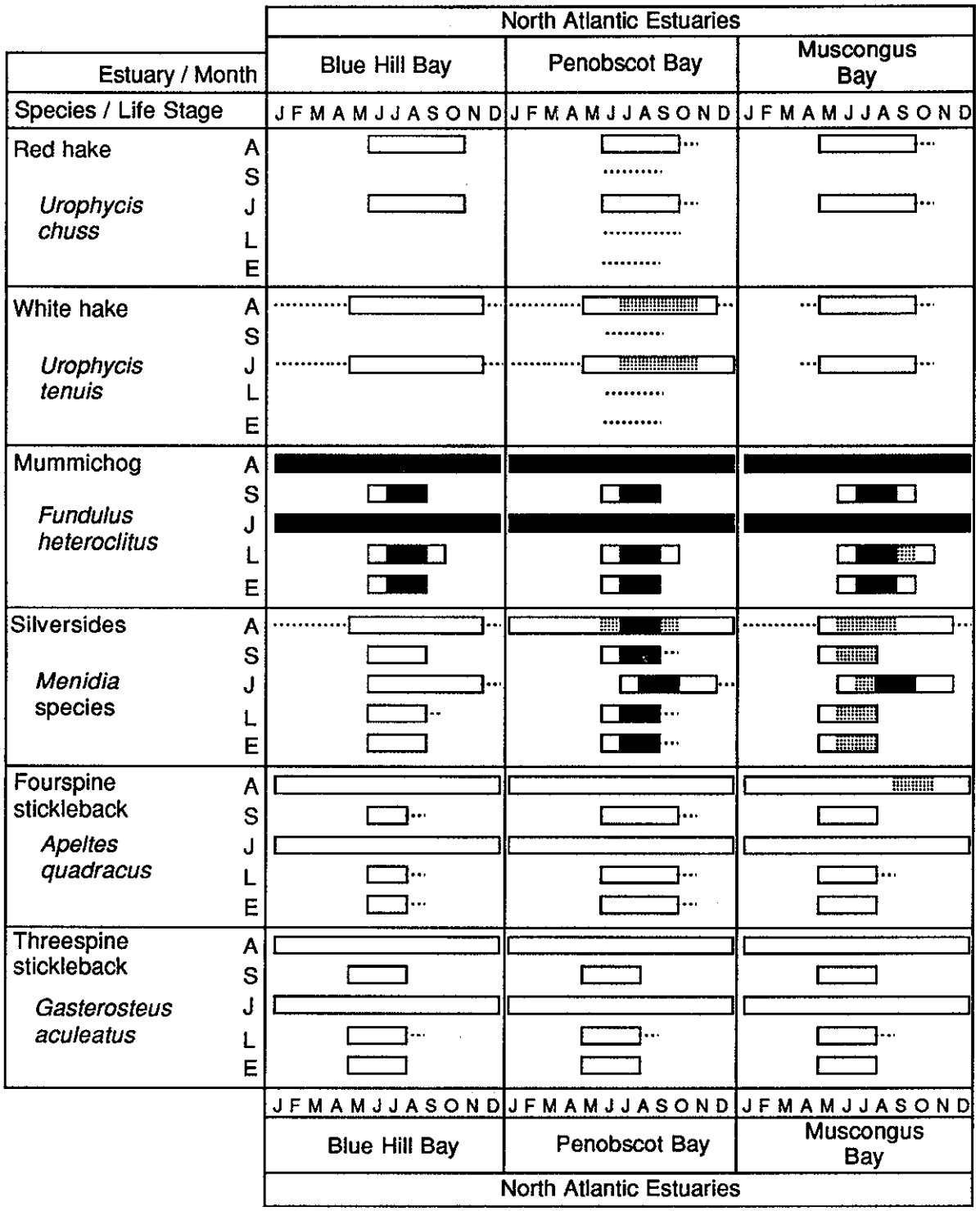


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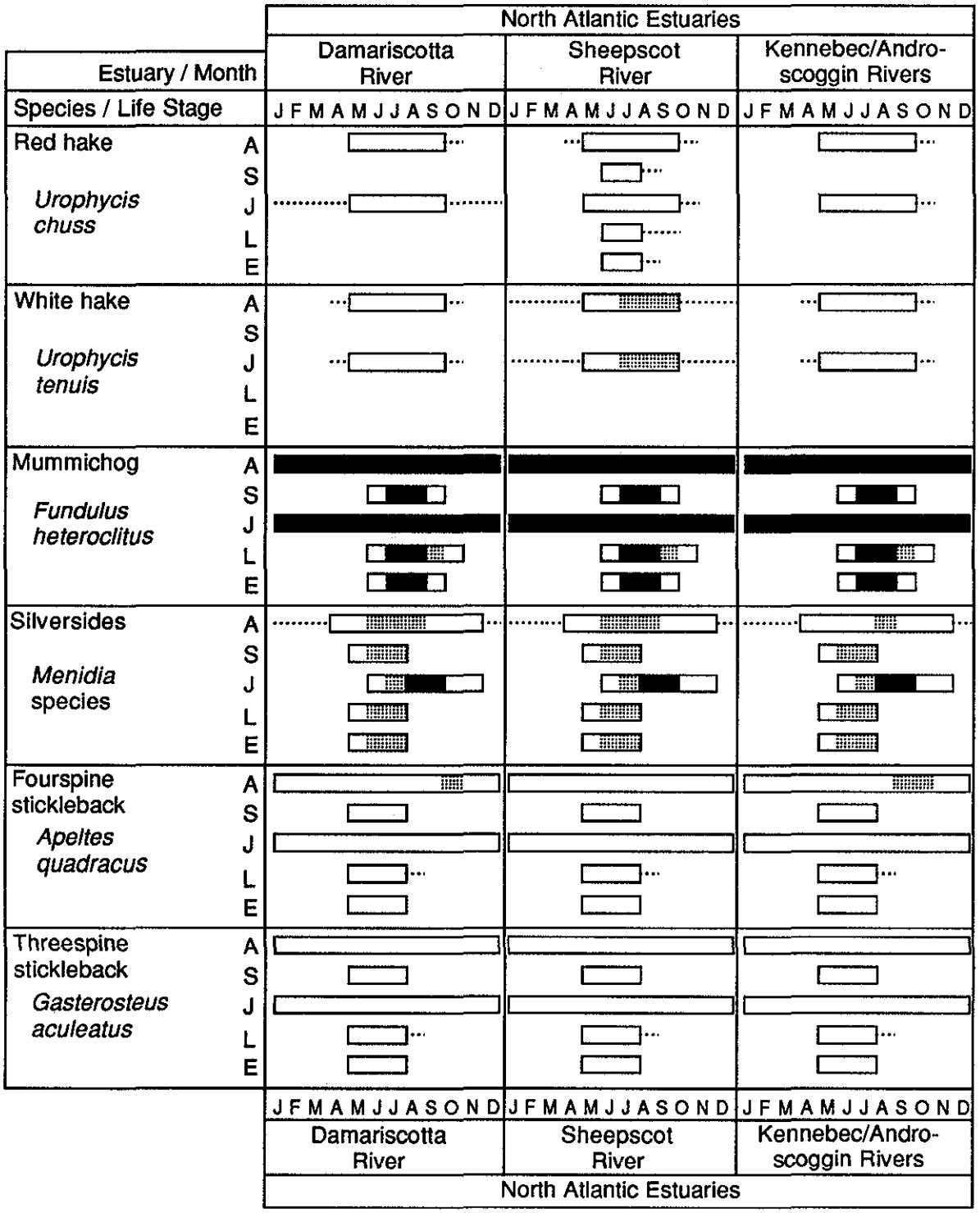


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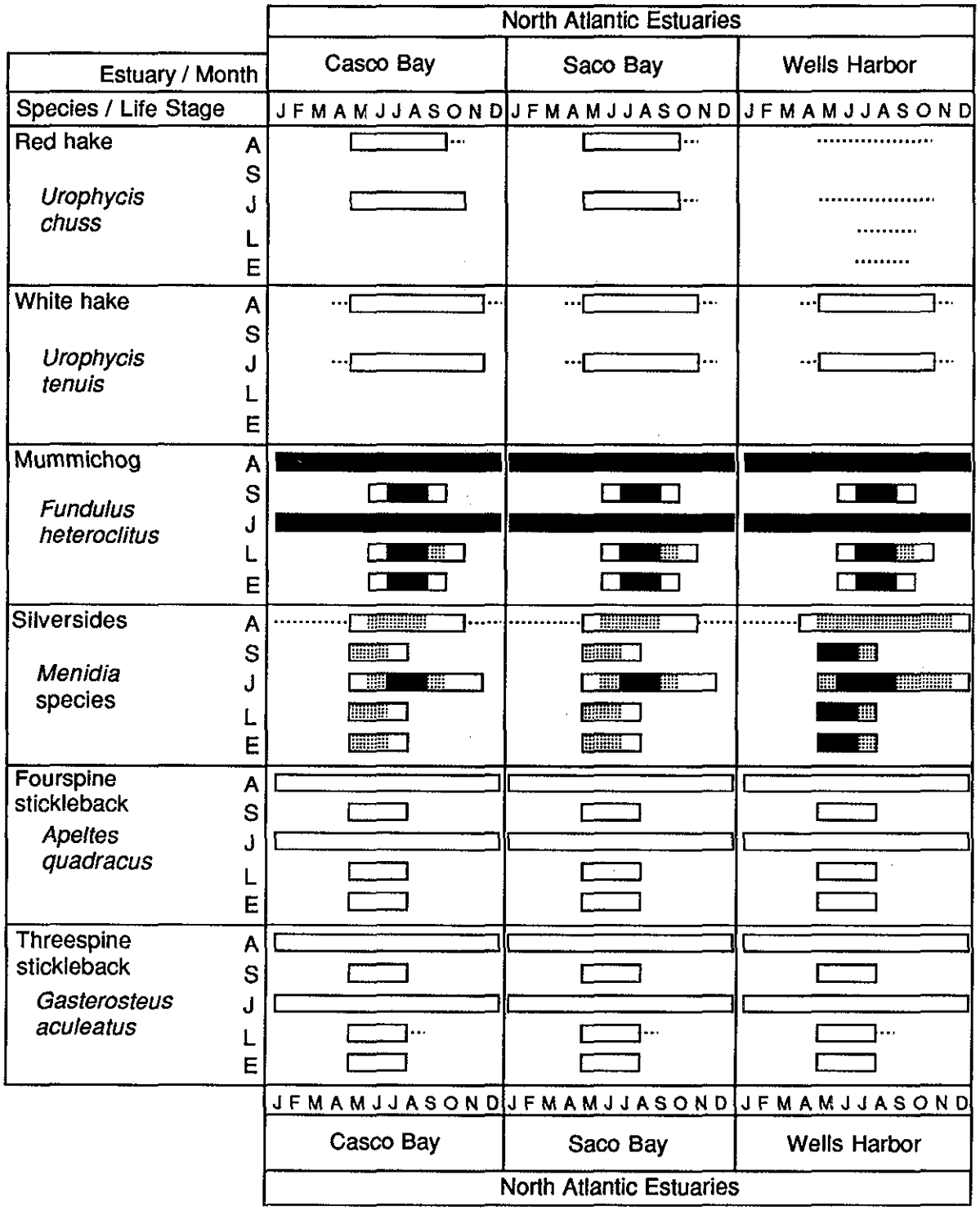


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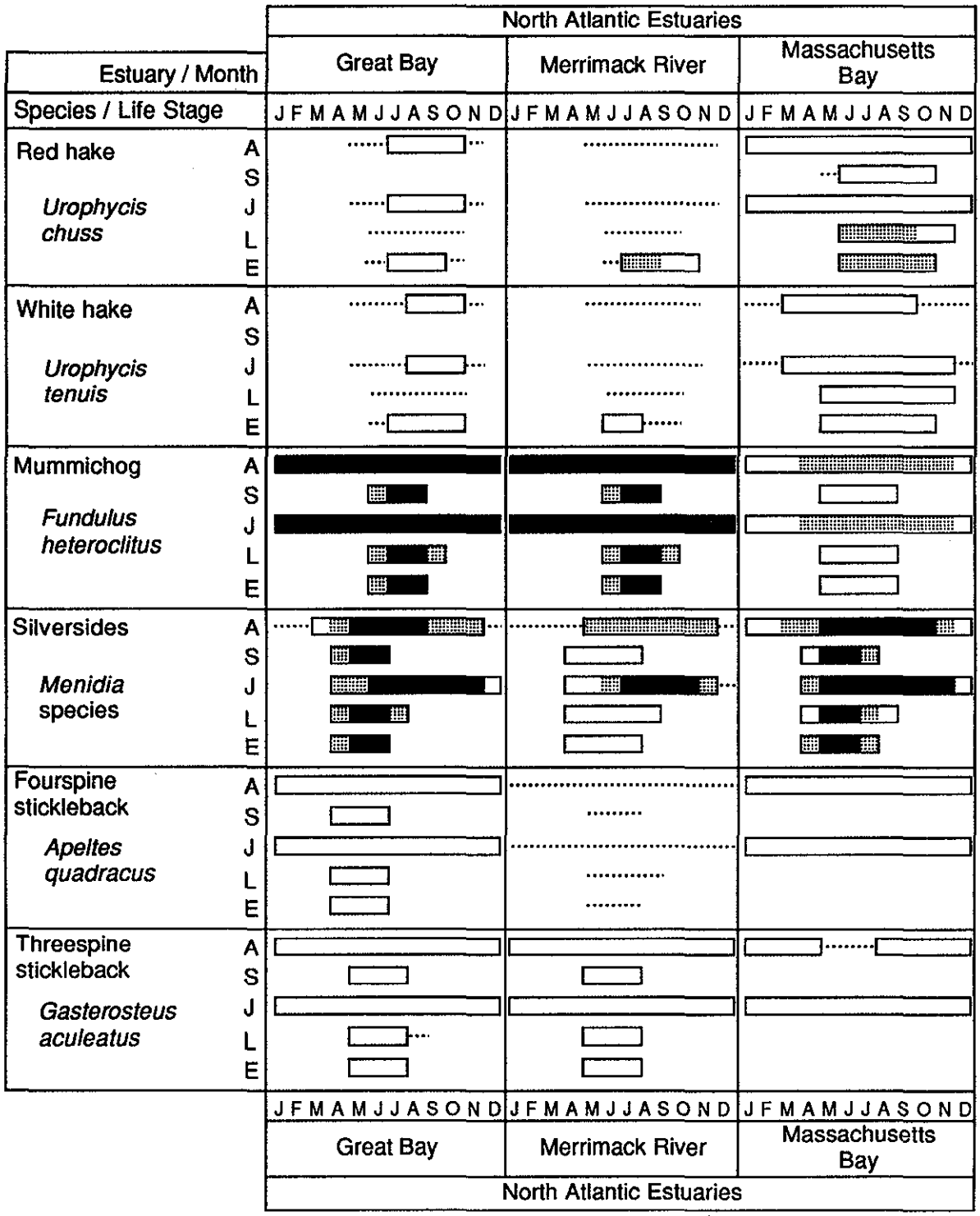


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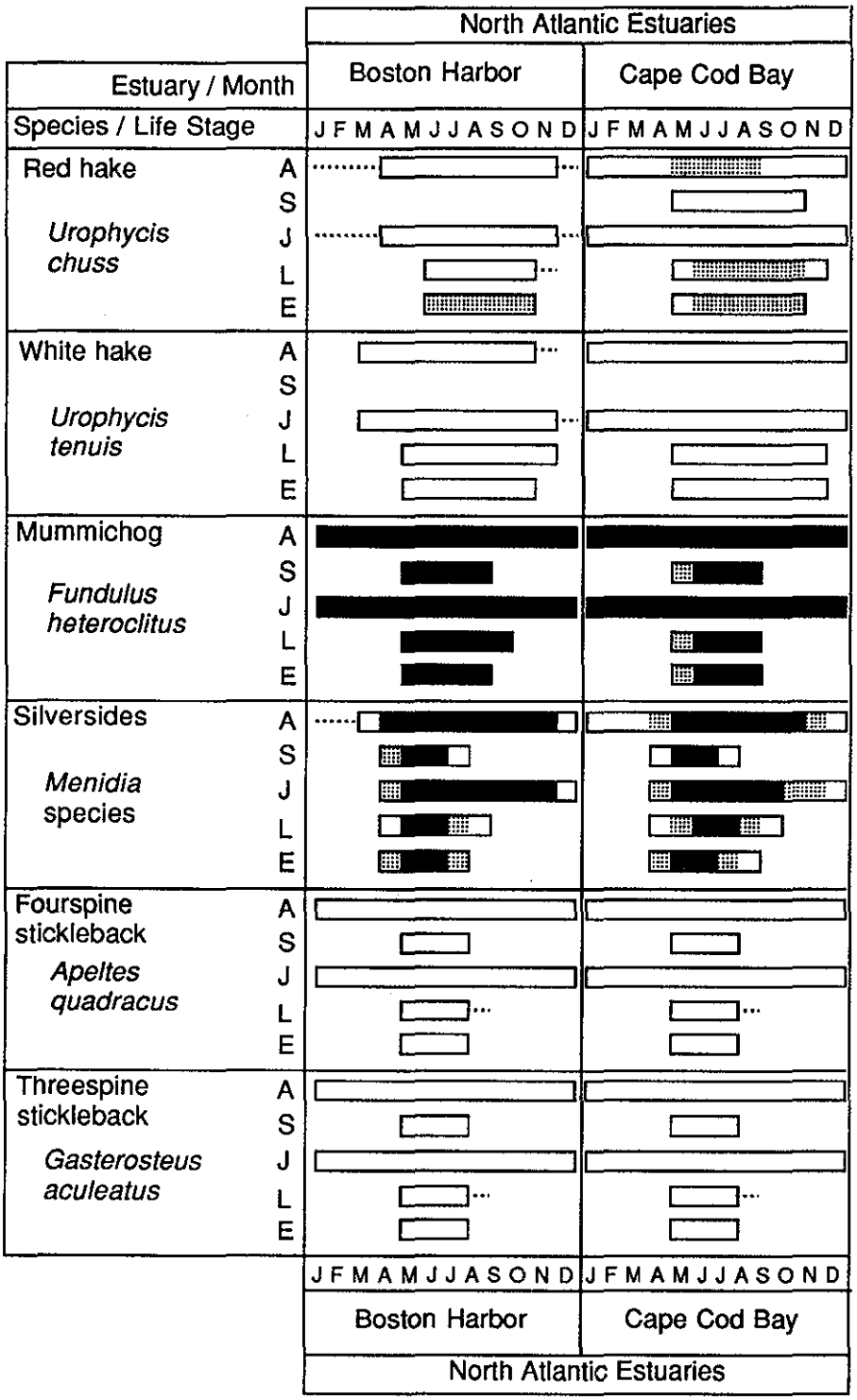


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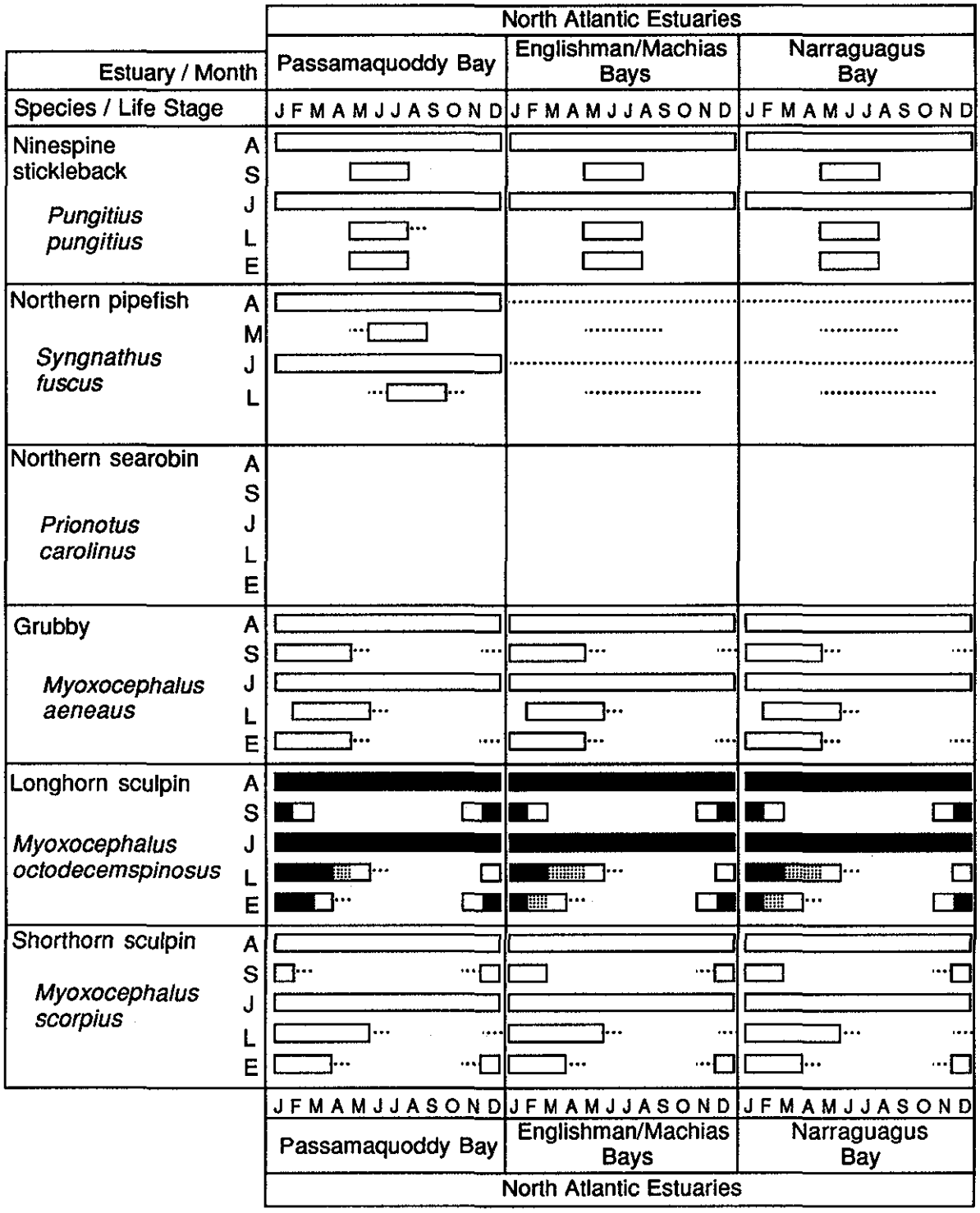


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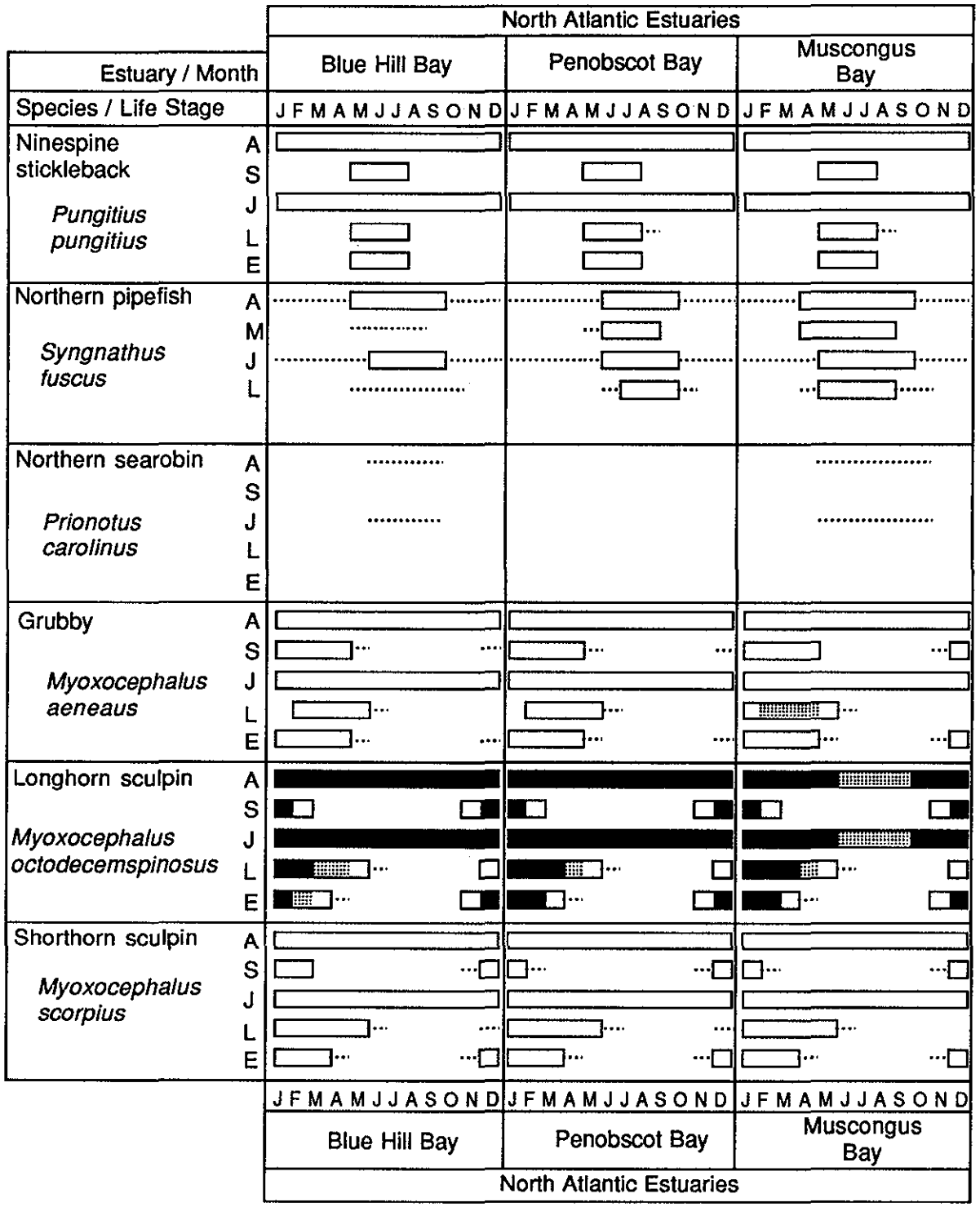


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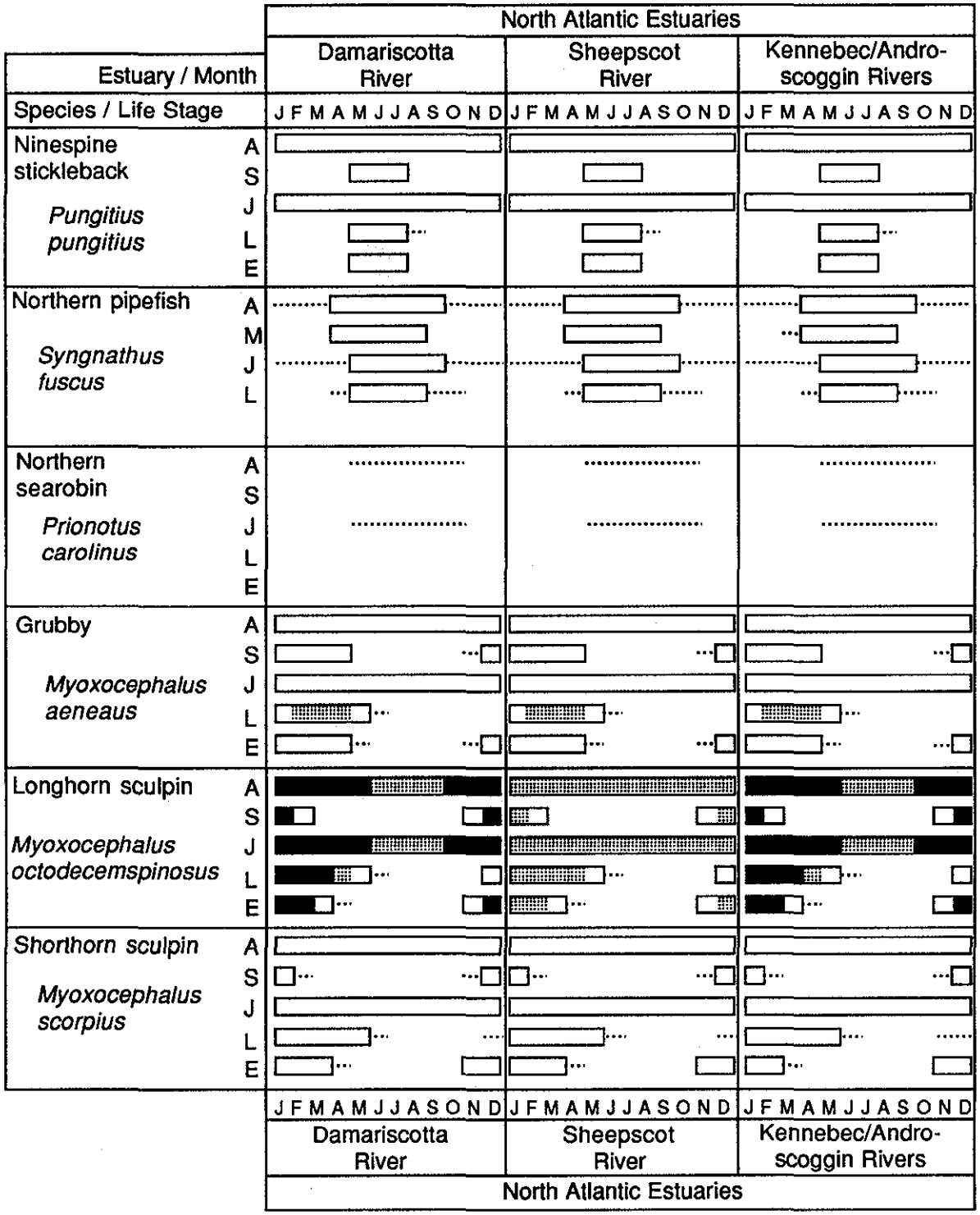


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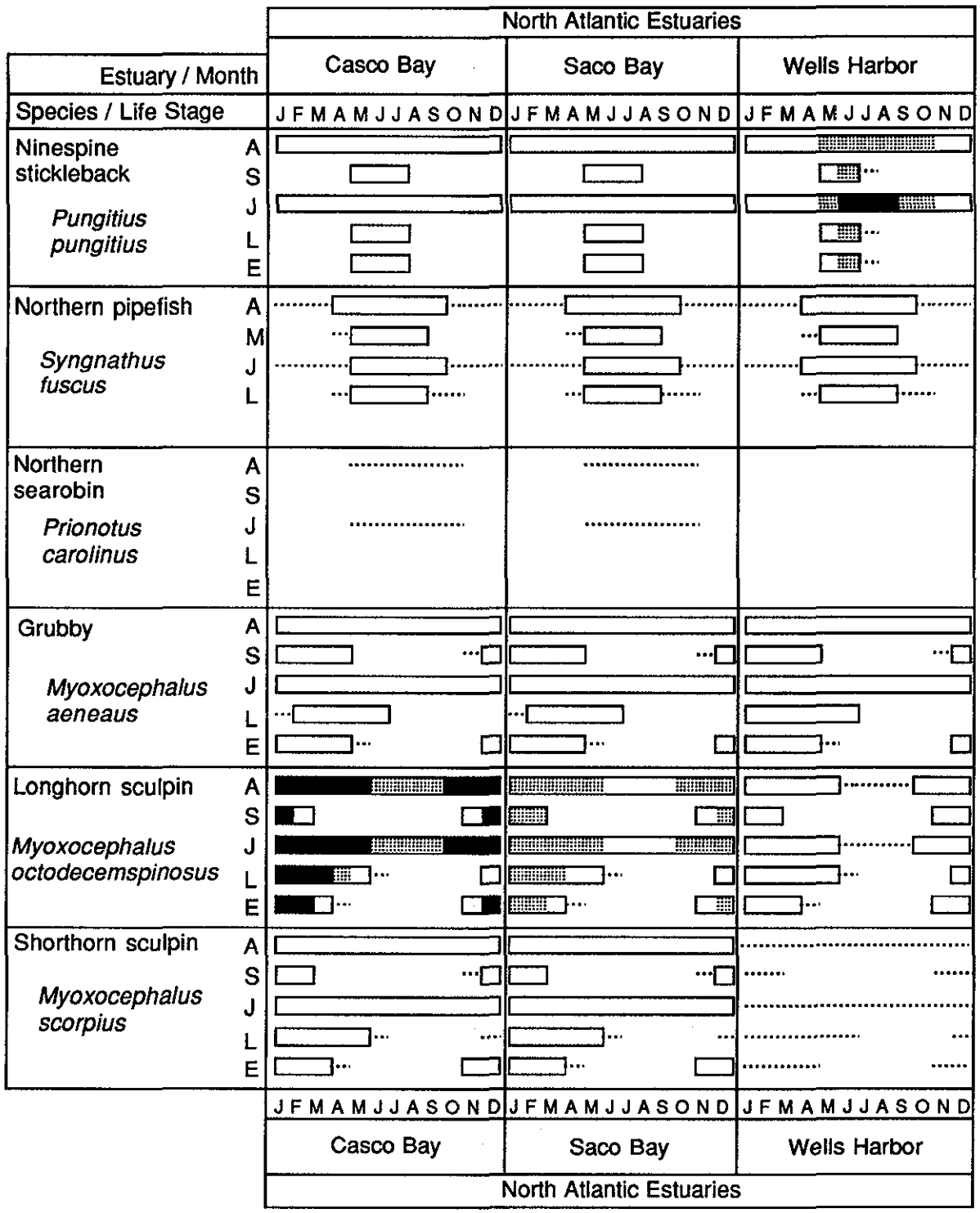
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs
M - Mating

Table 5 (continued). Temporal distribution and relative abundance




Relative Abundance

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

Life Stage

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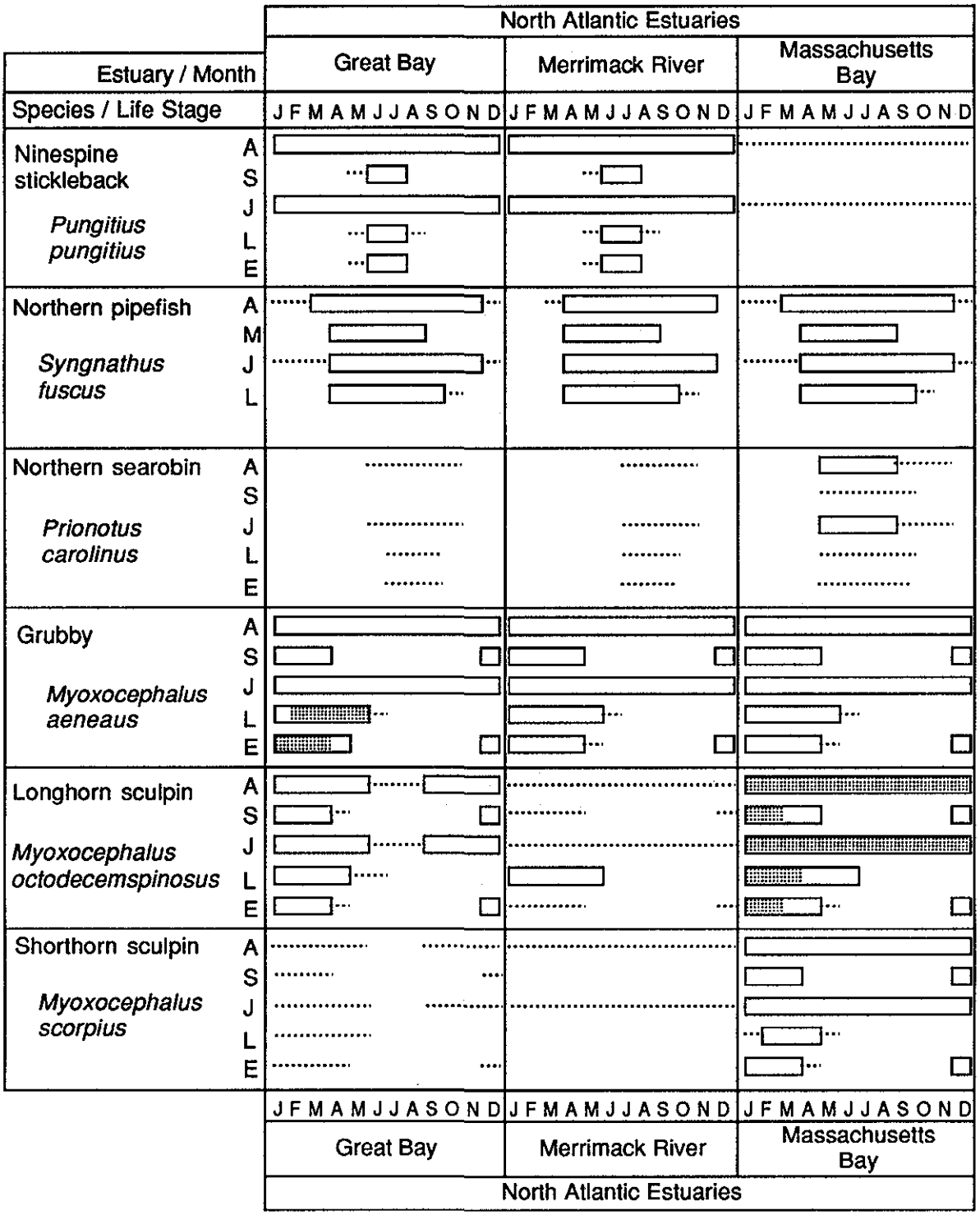
Table 5 (continued). Temporal distribution and relative abundance

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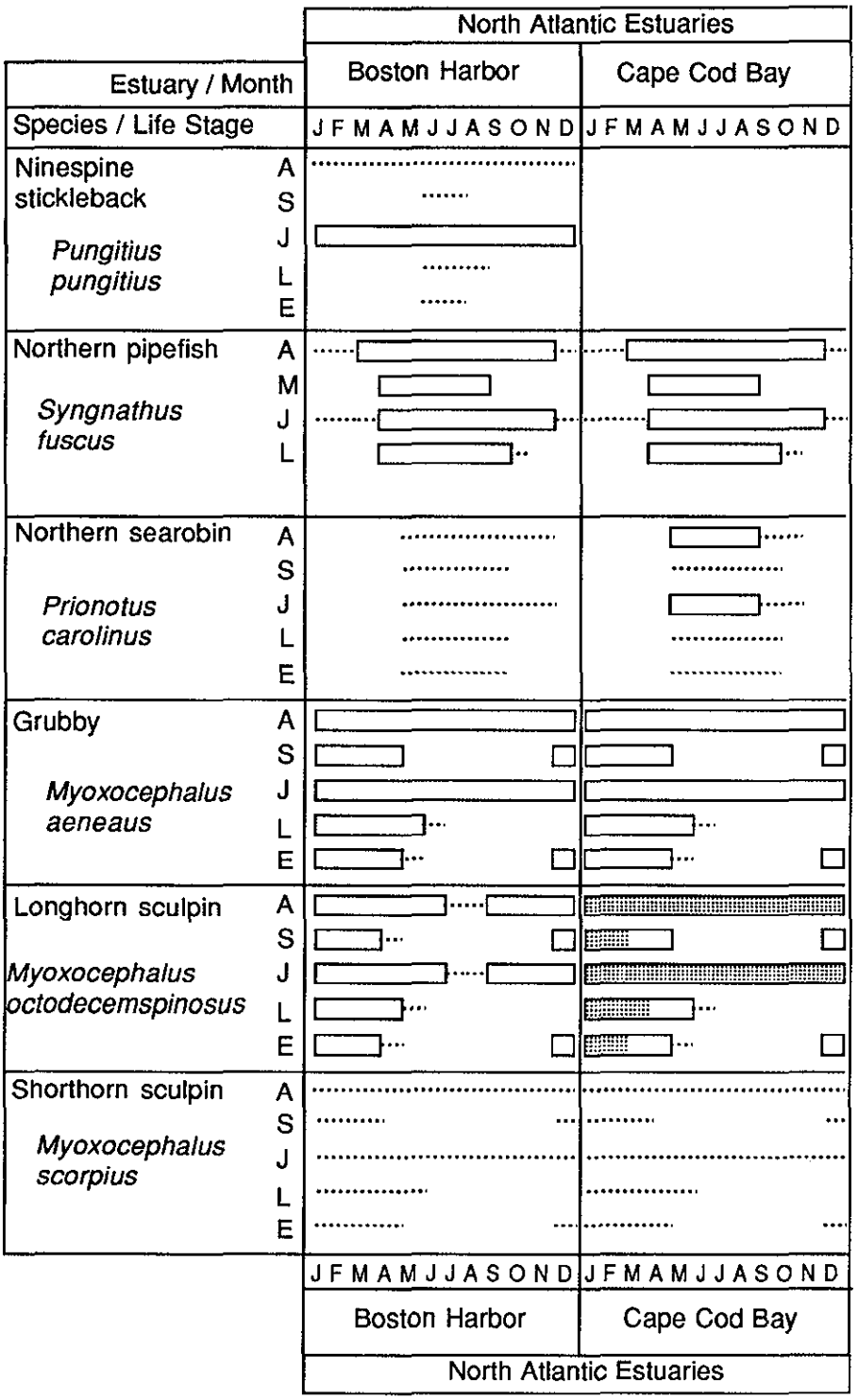


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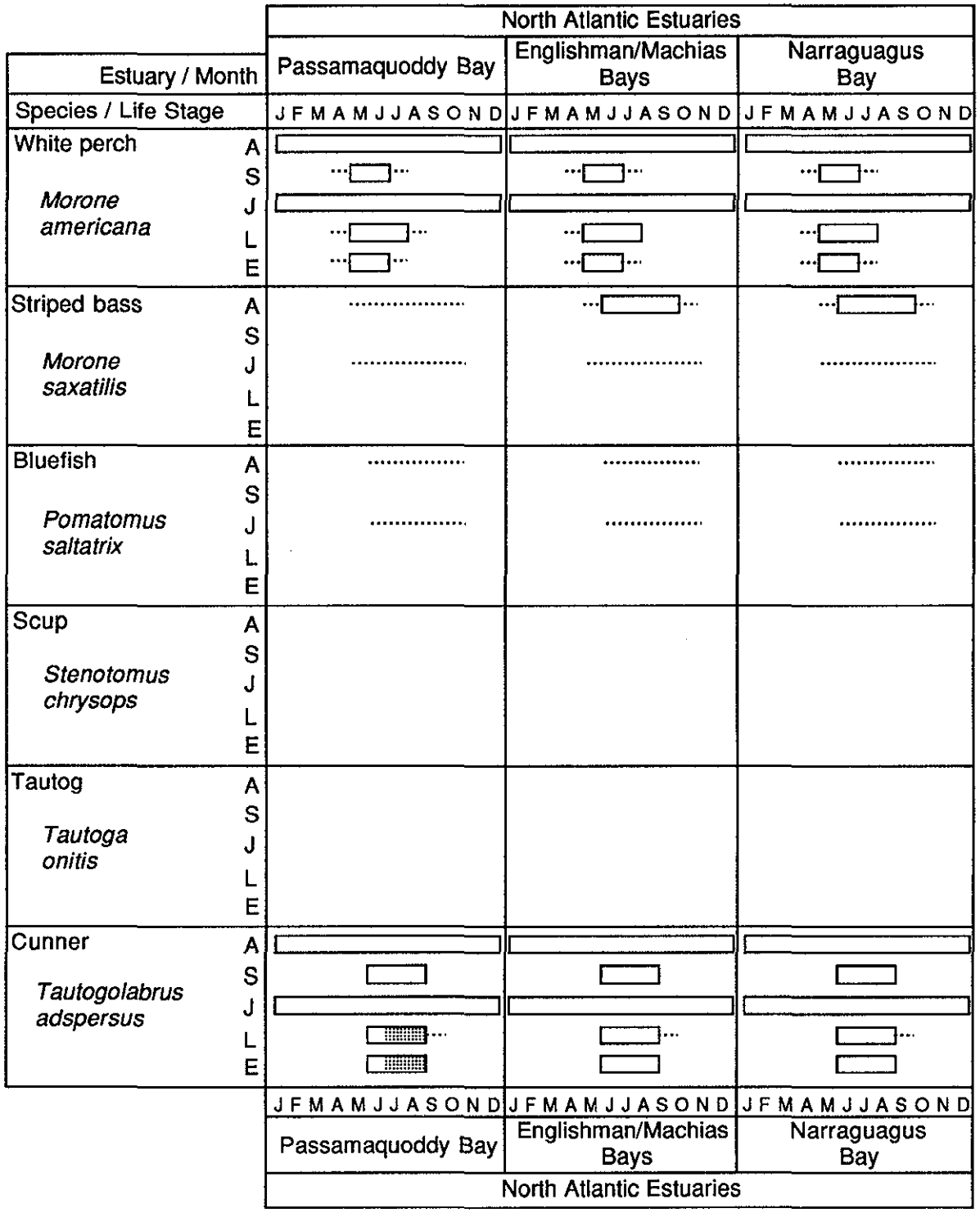


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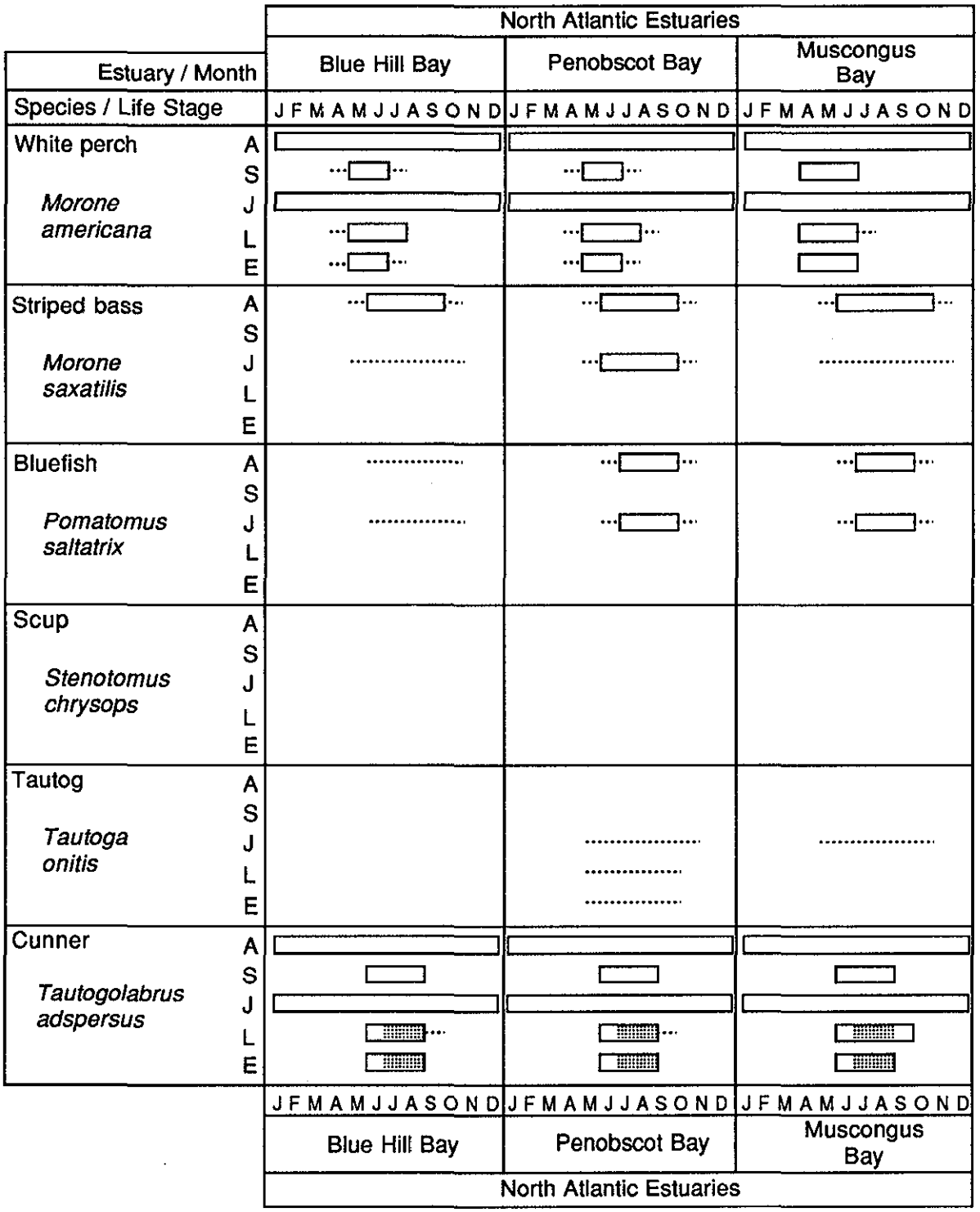


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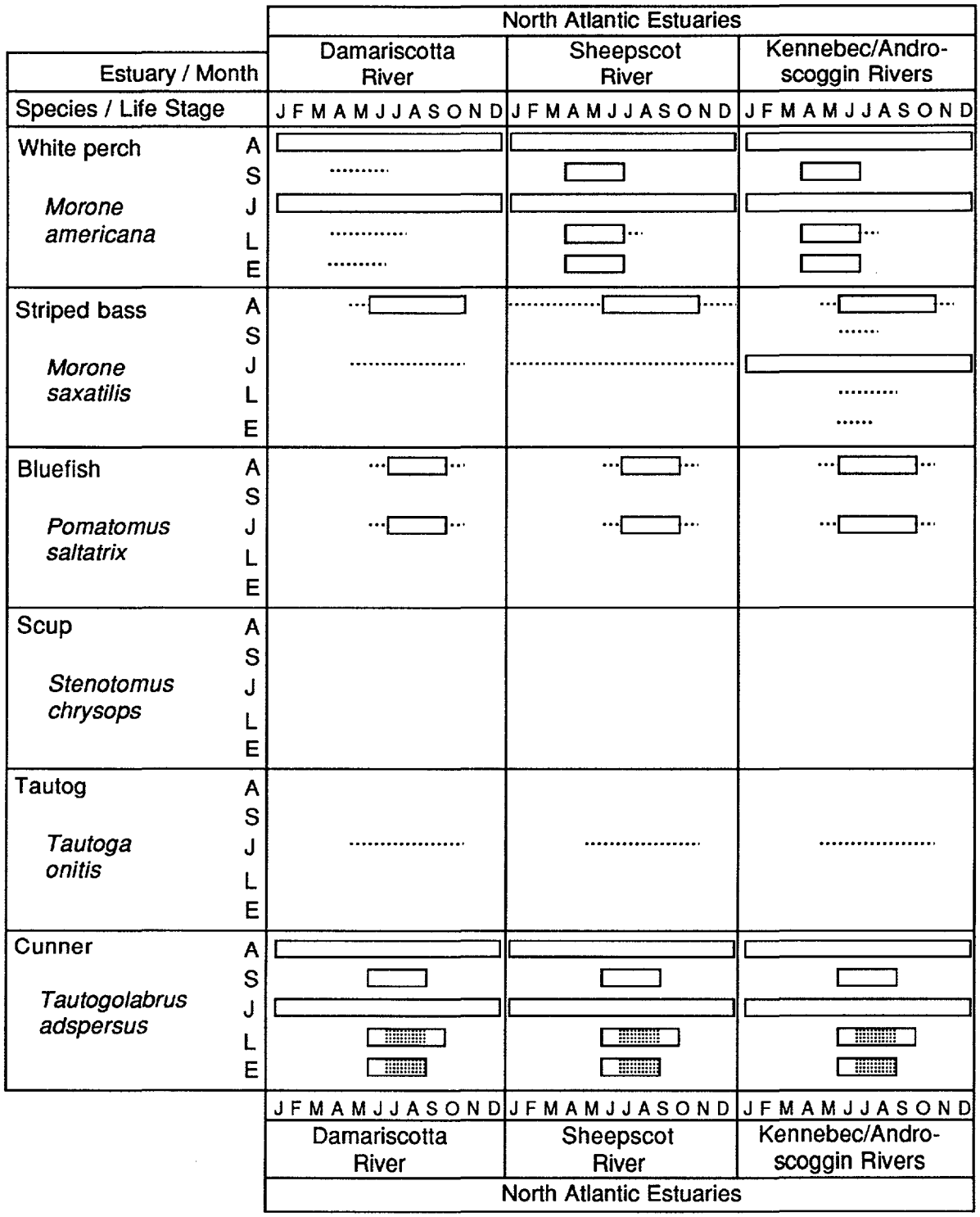


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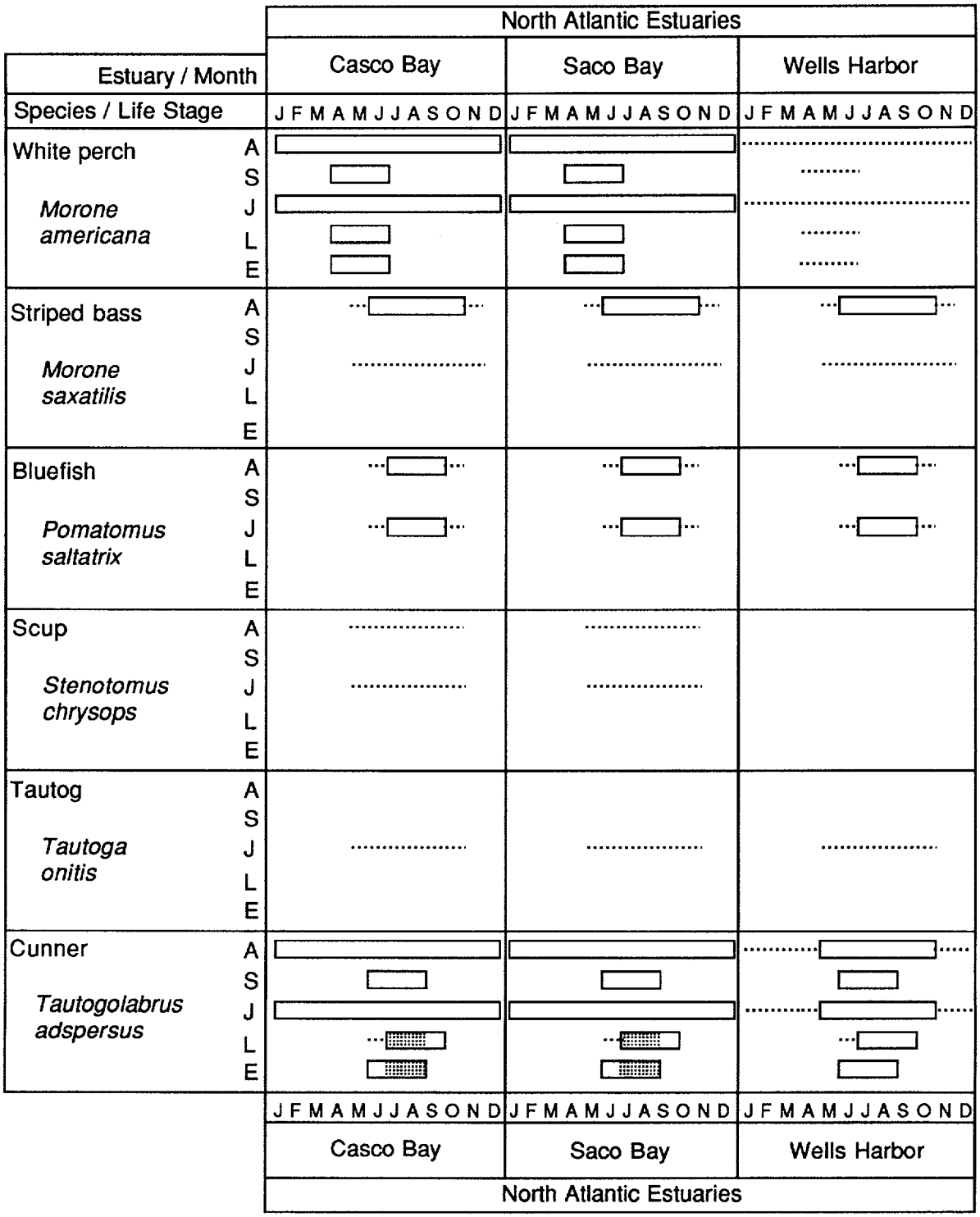


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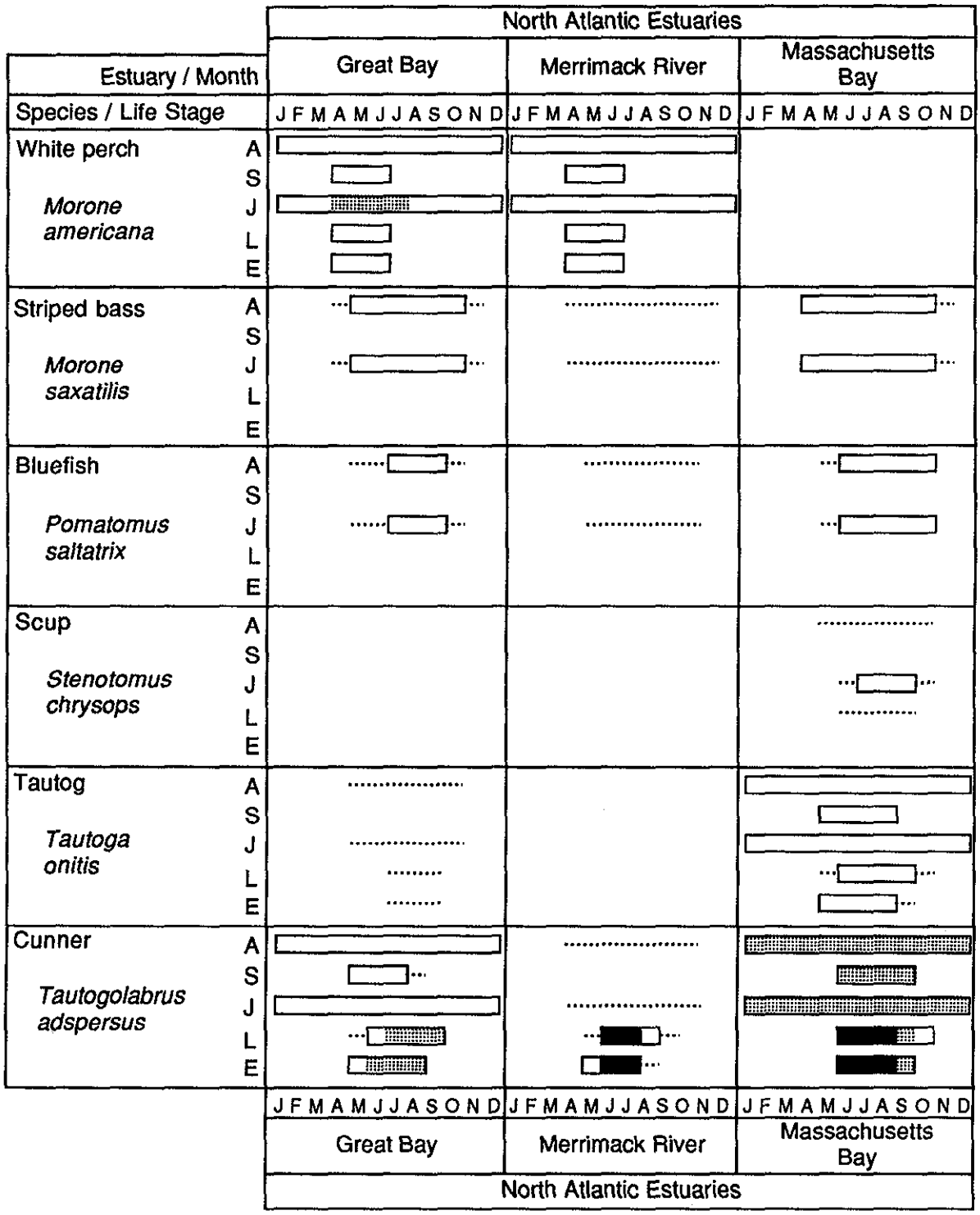


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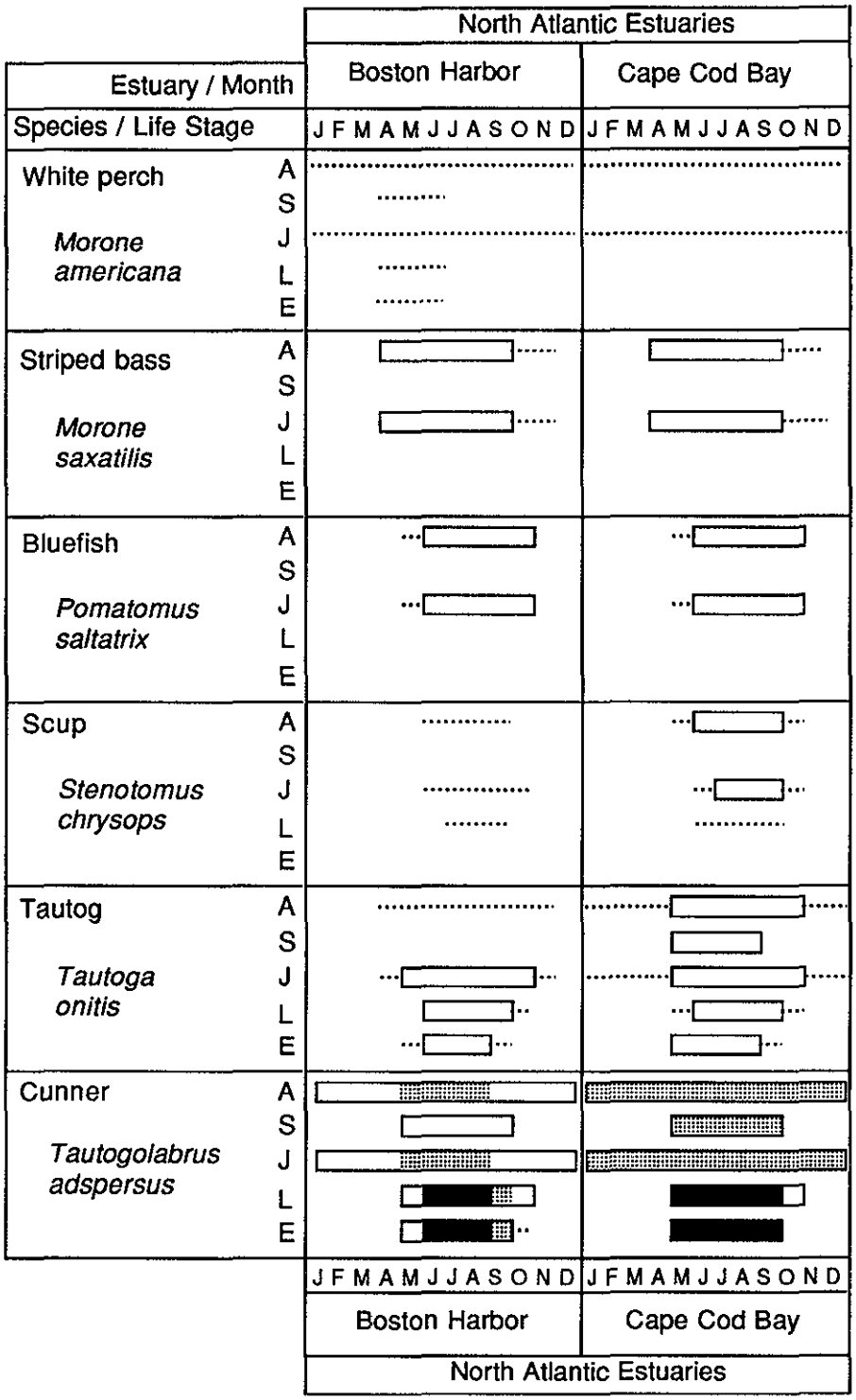


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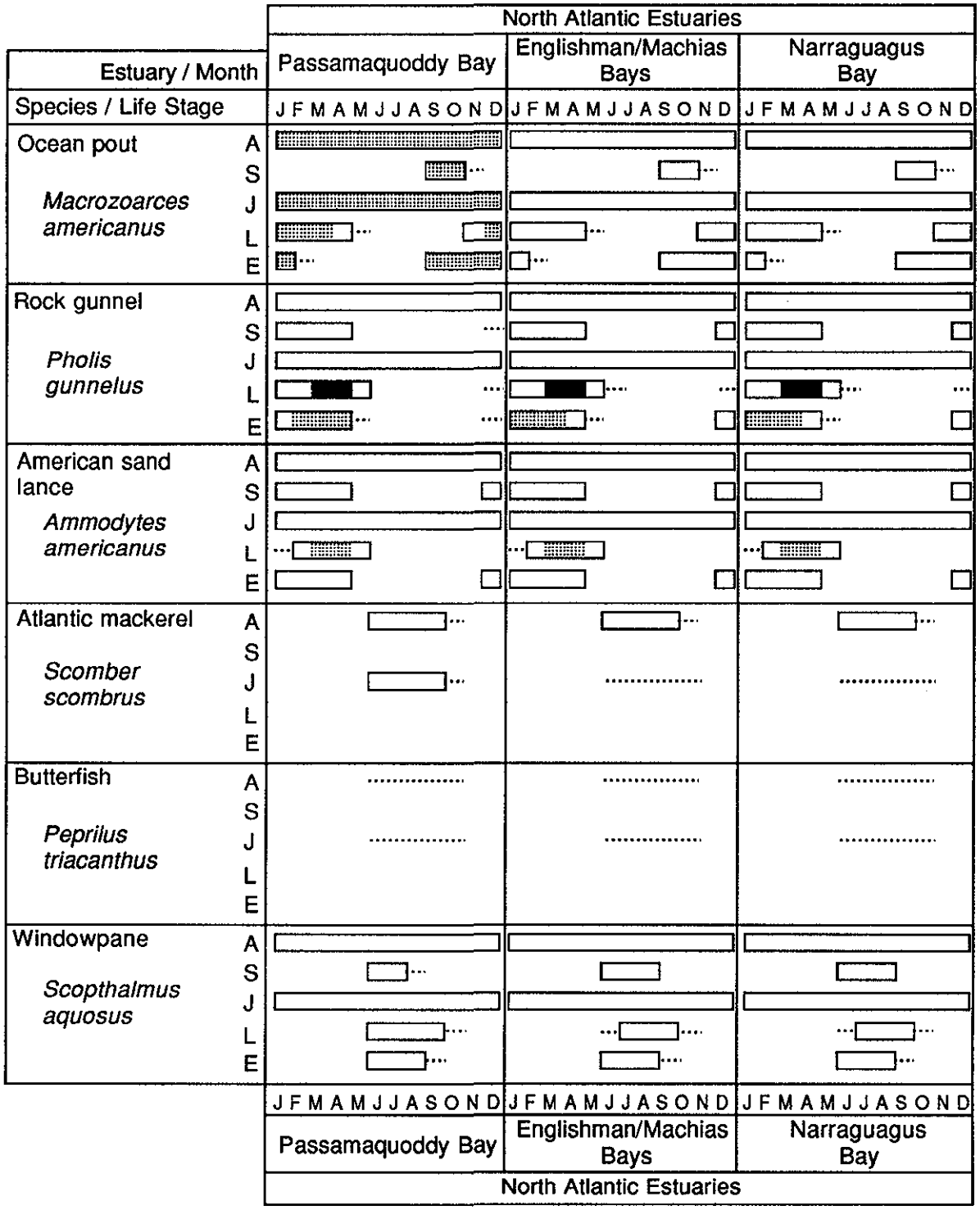


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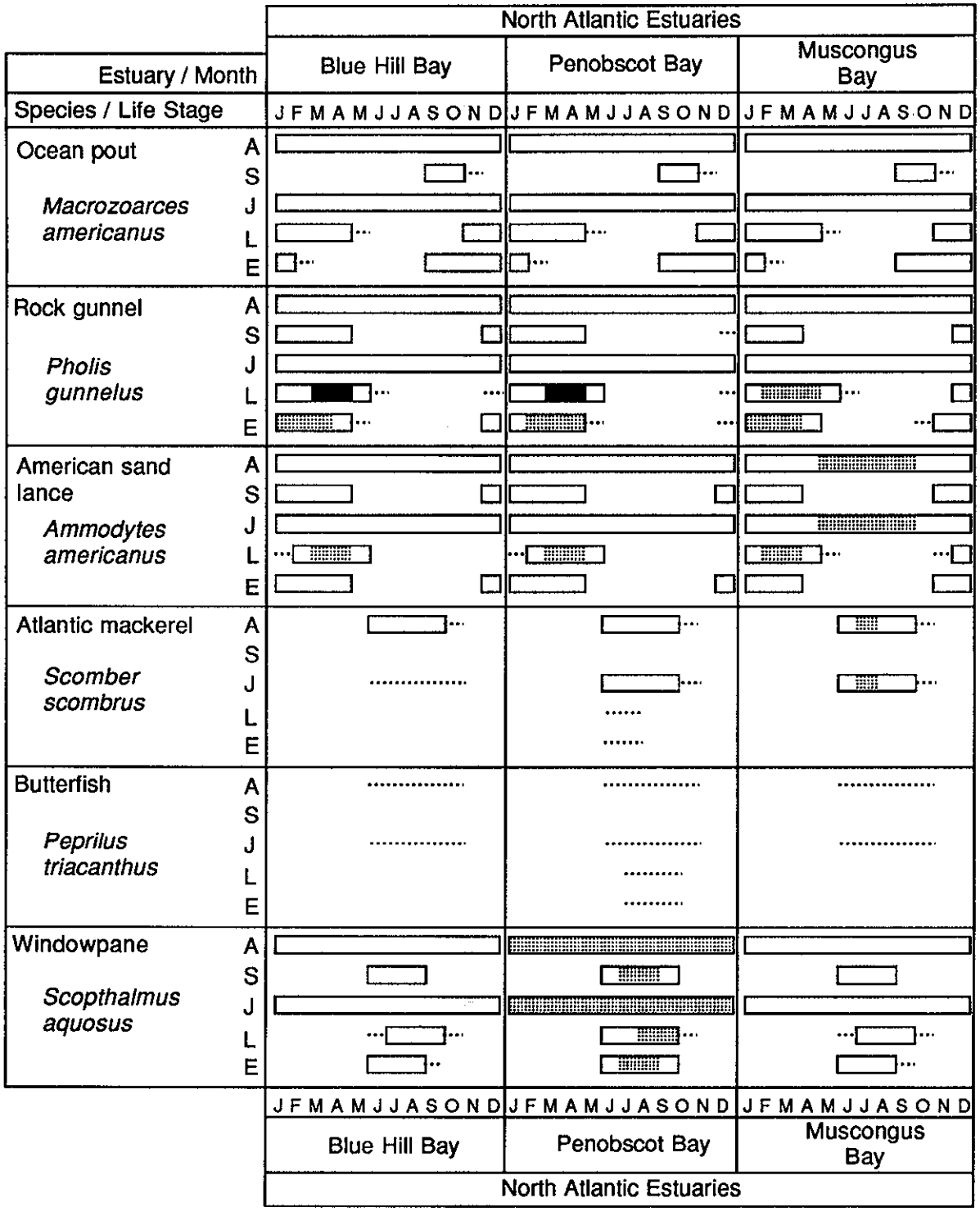


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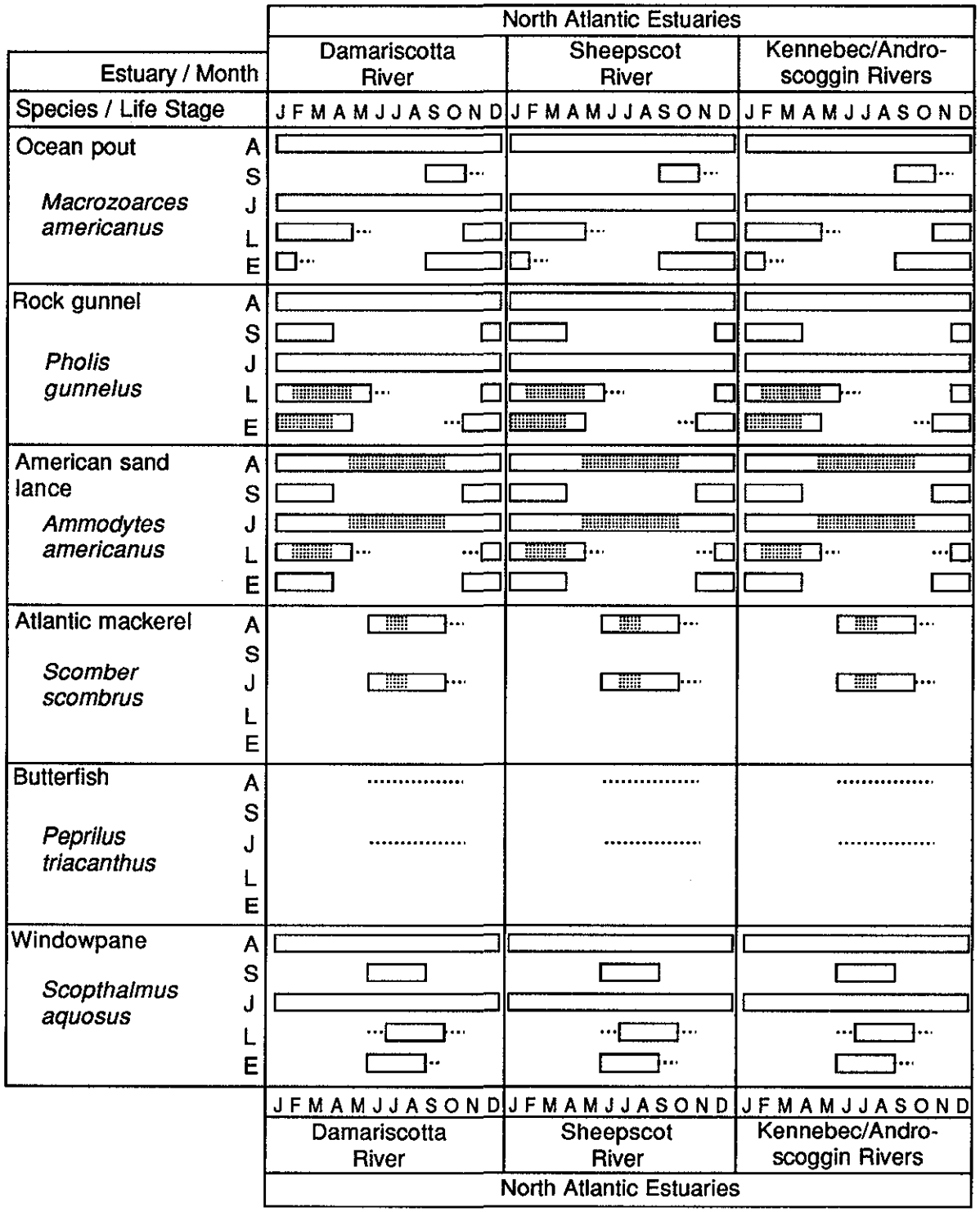


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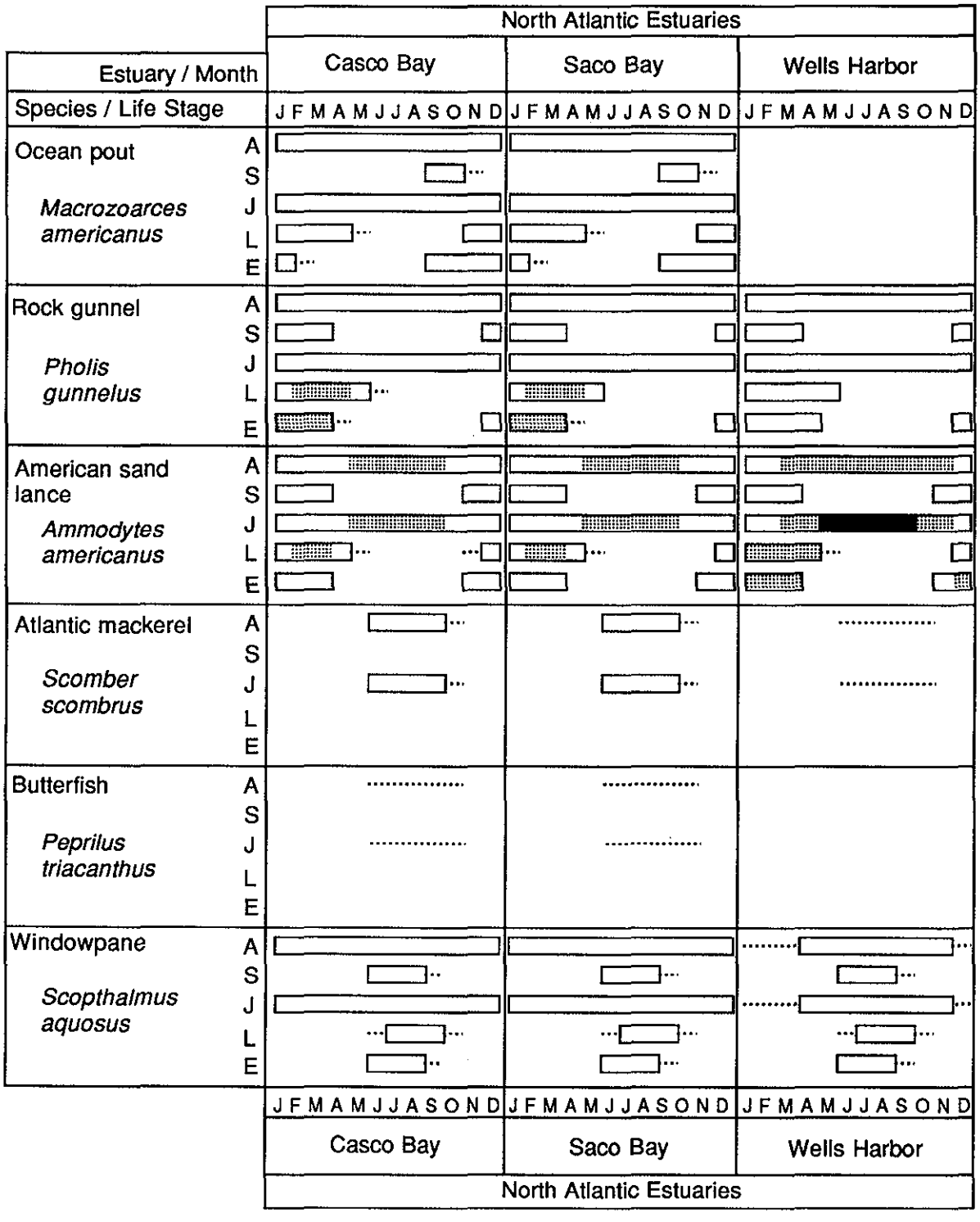


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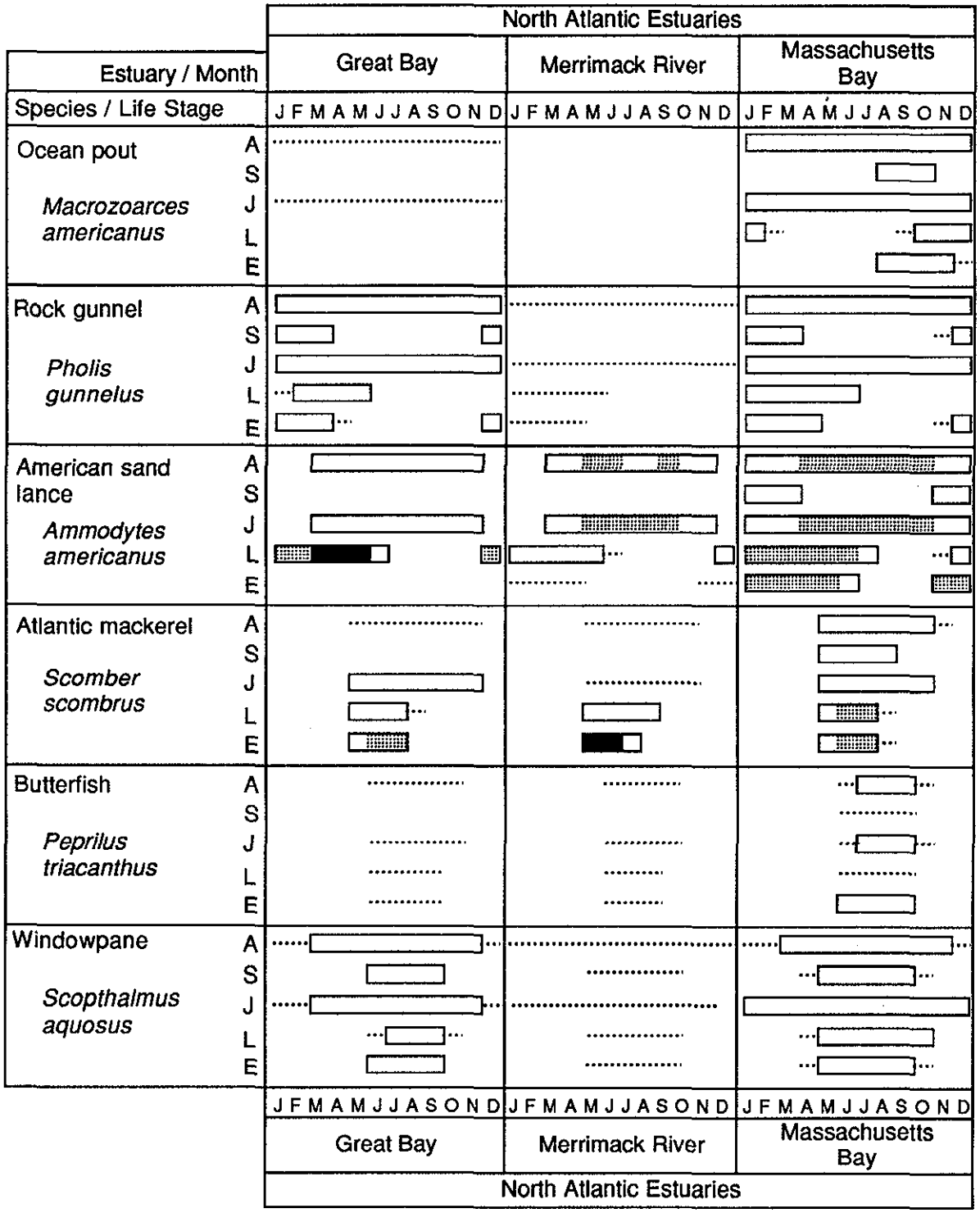


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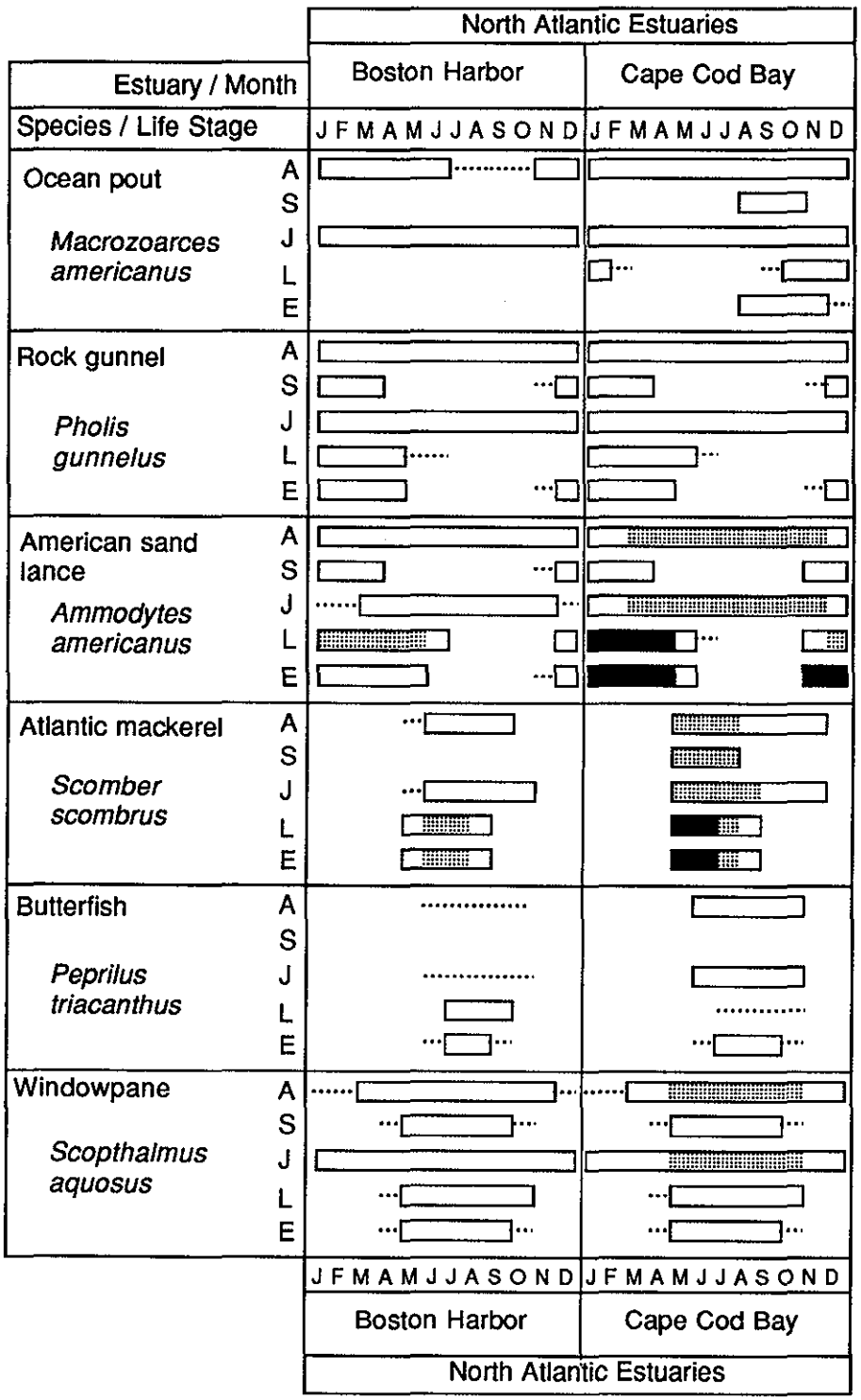


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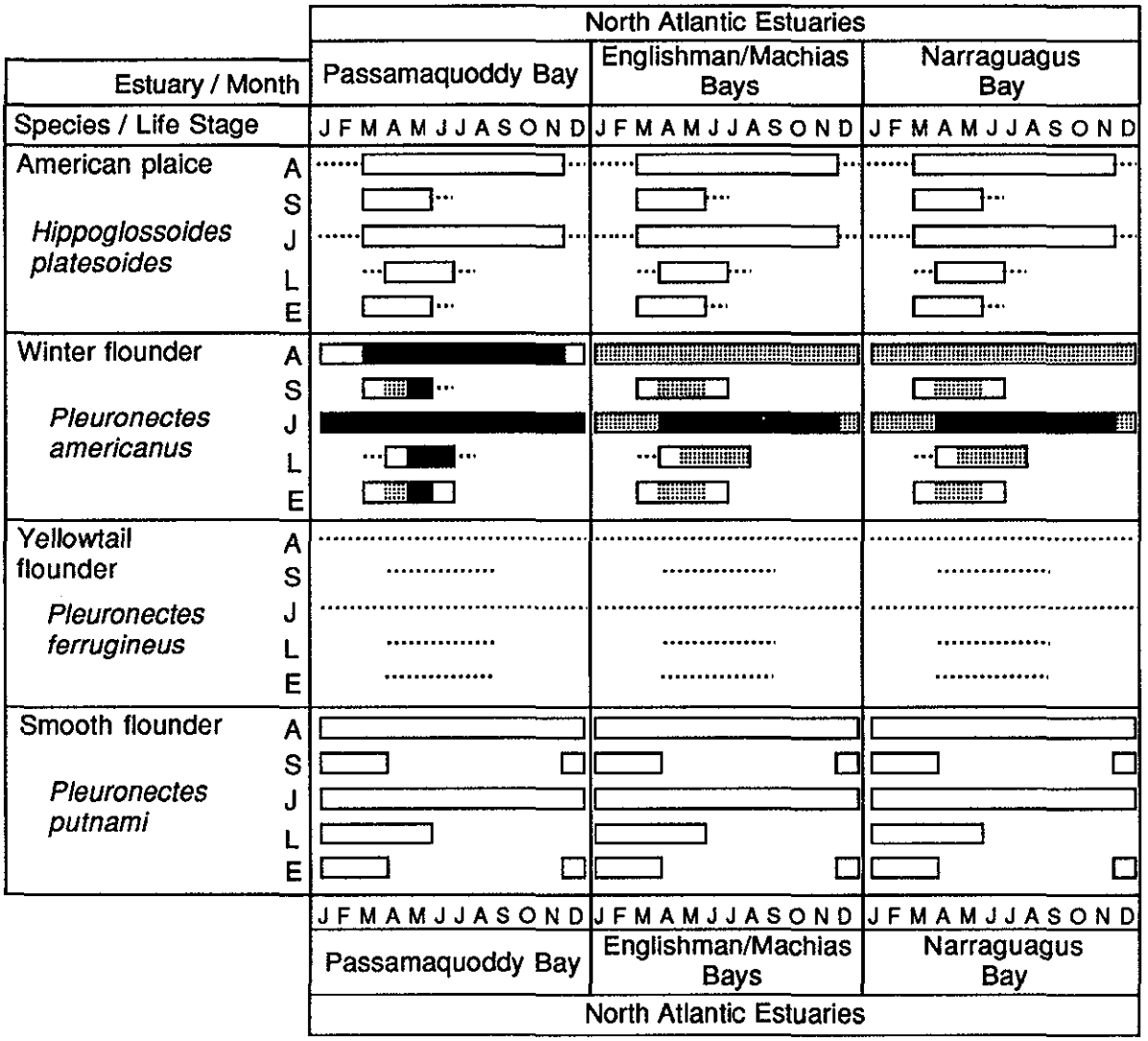


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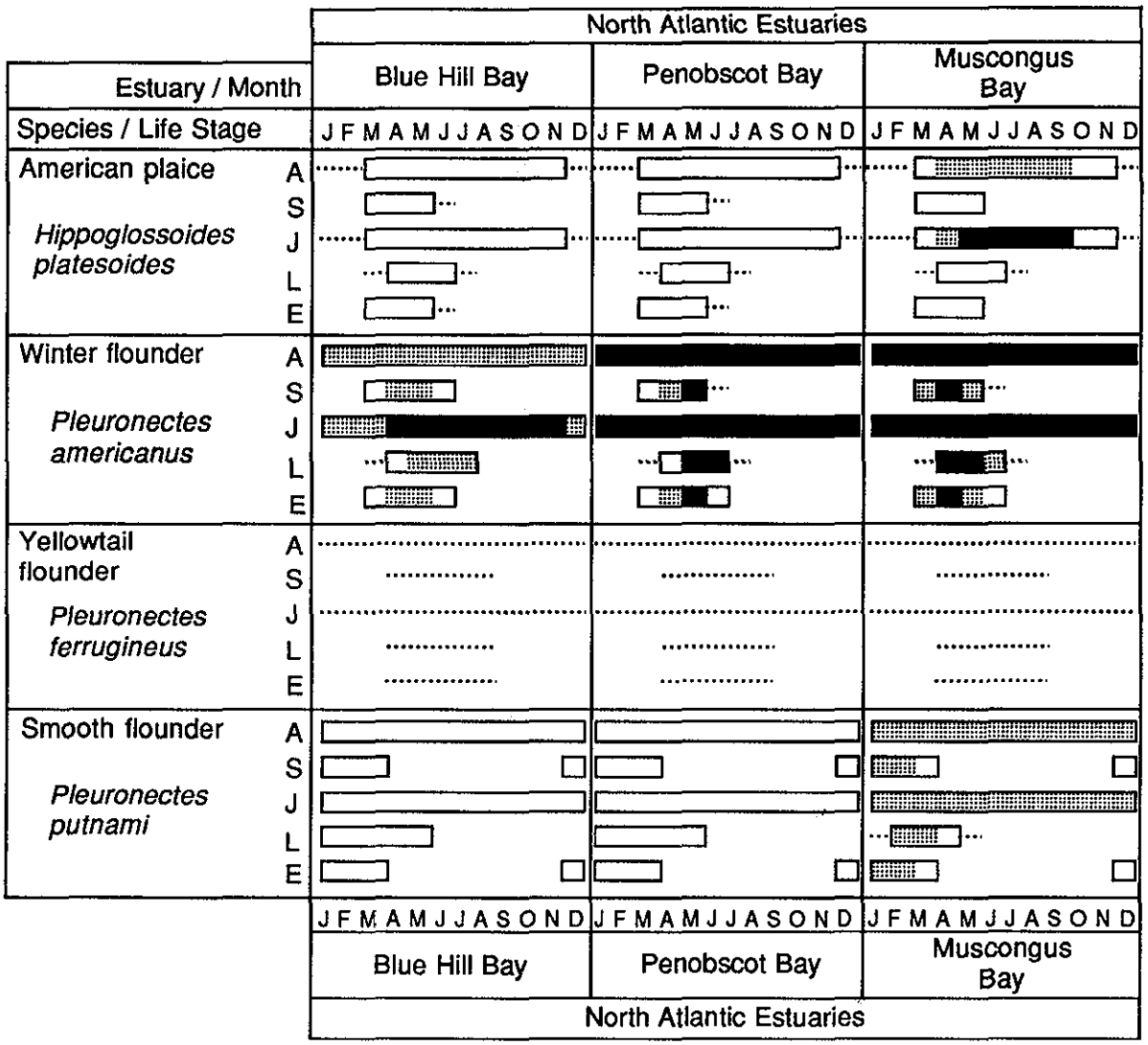


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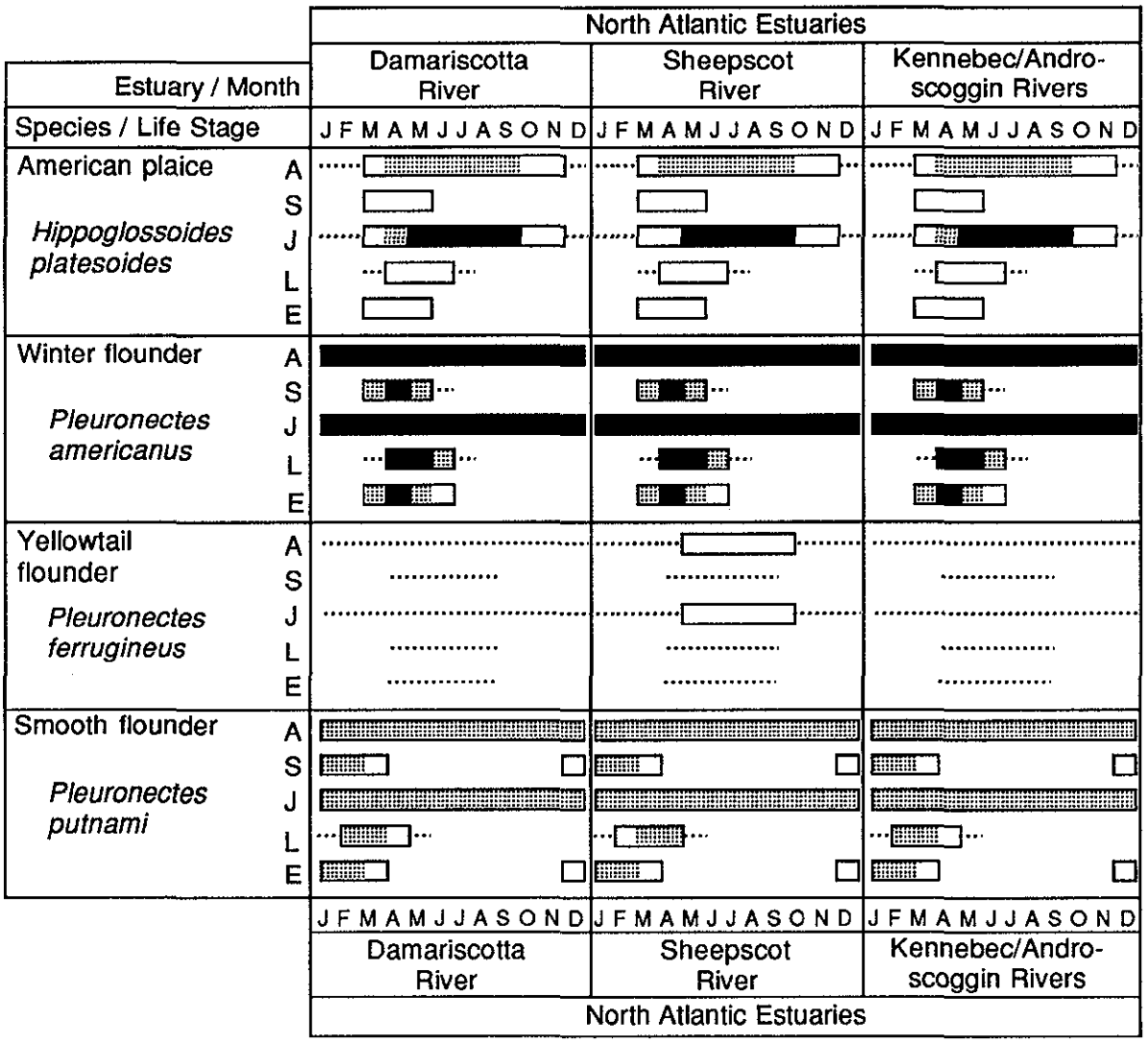


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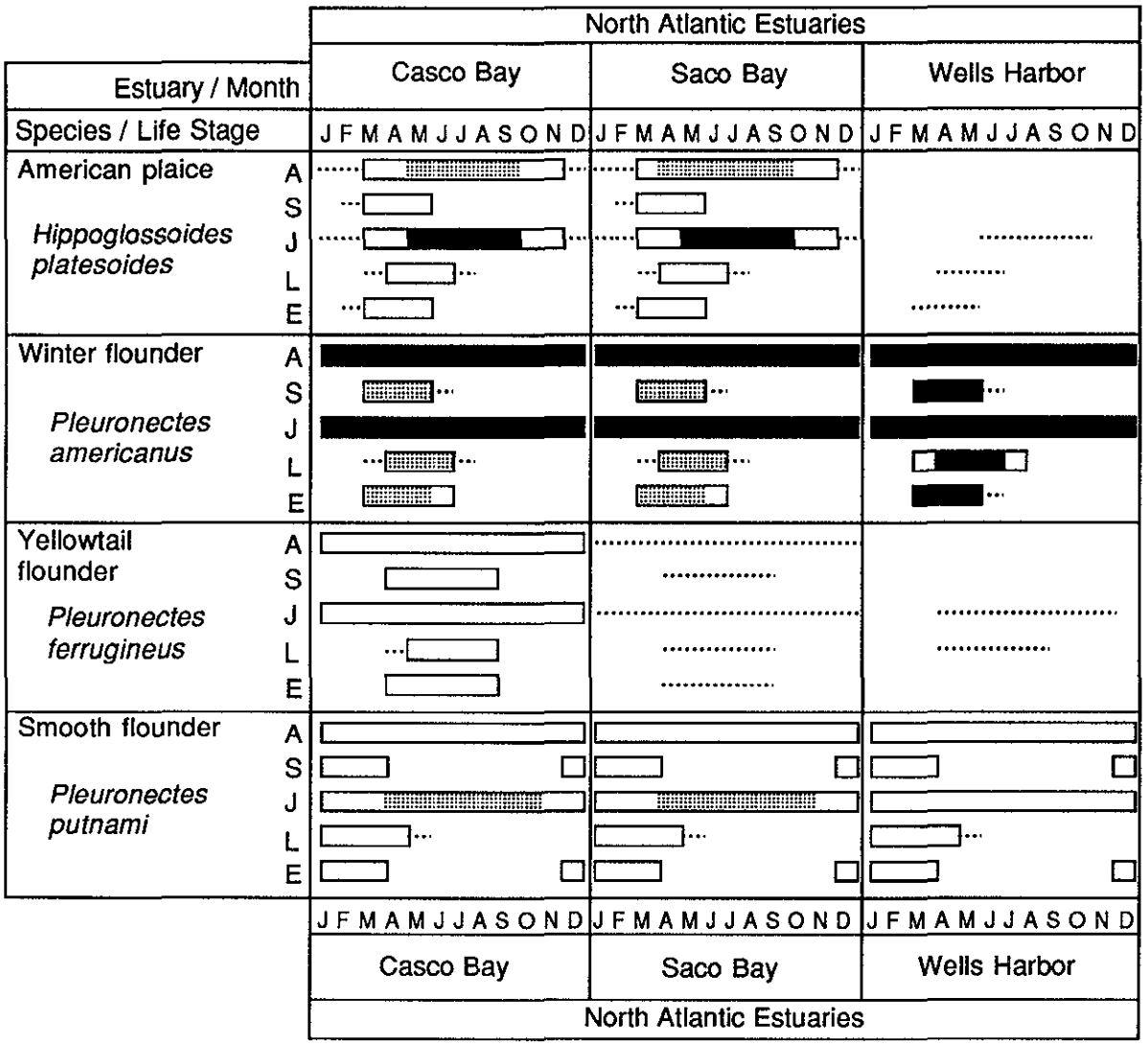


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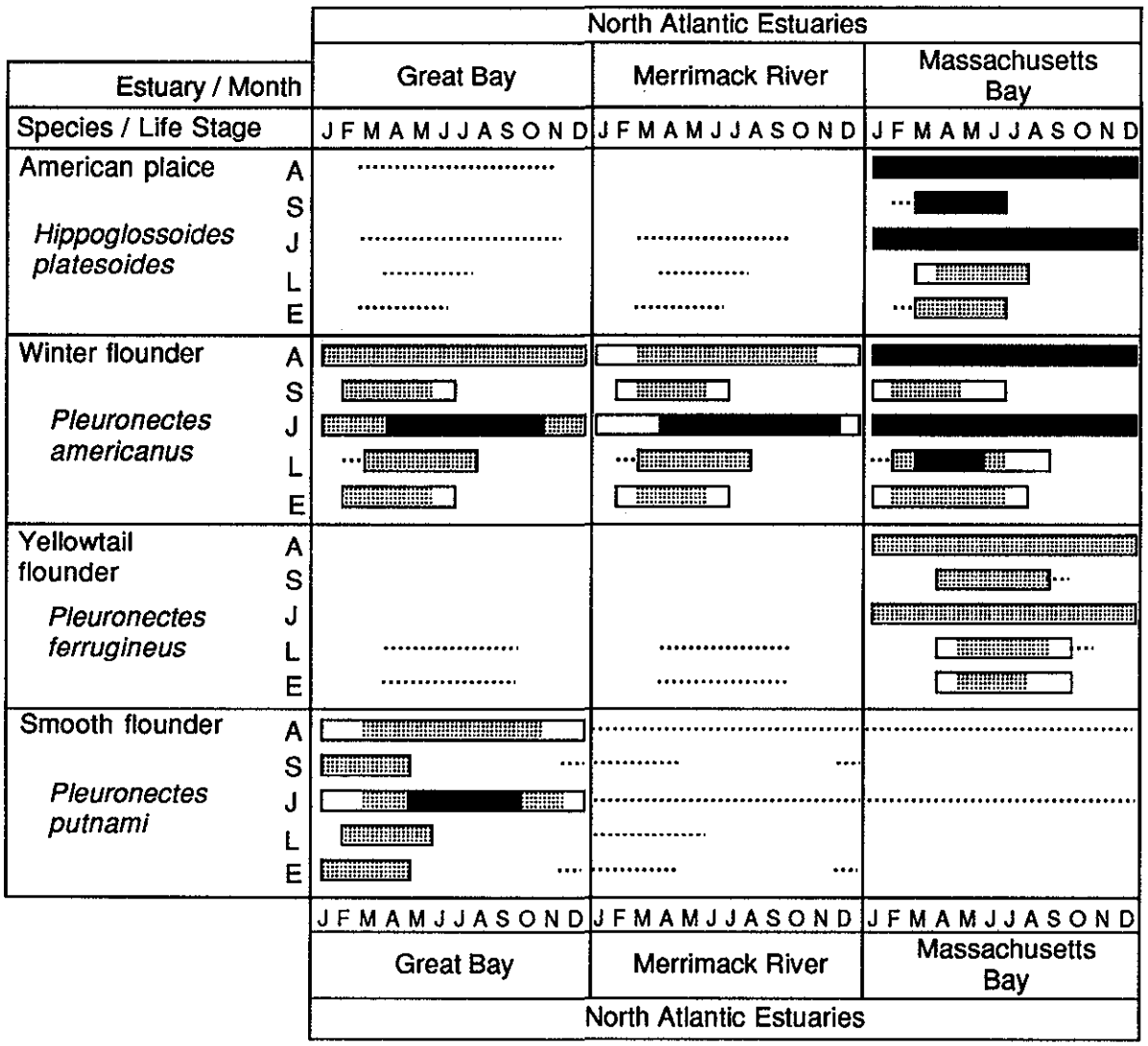


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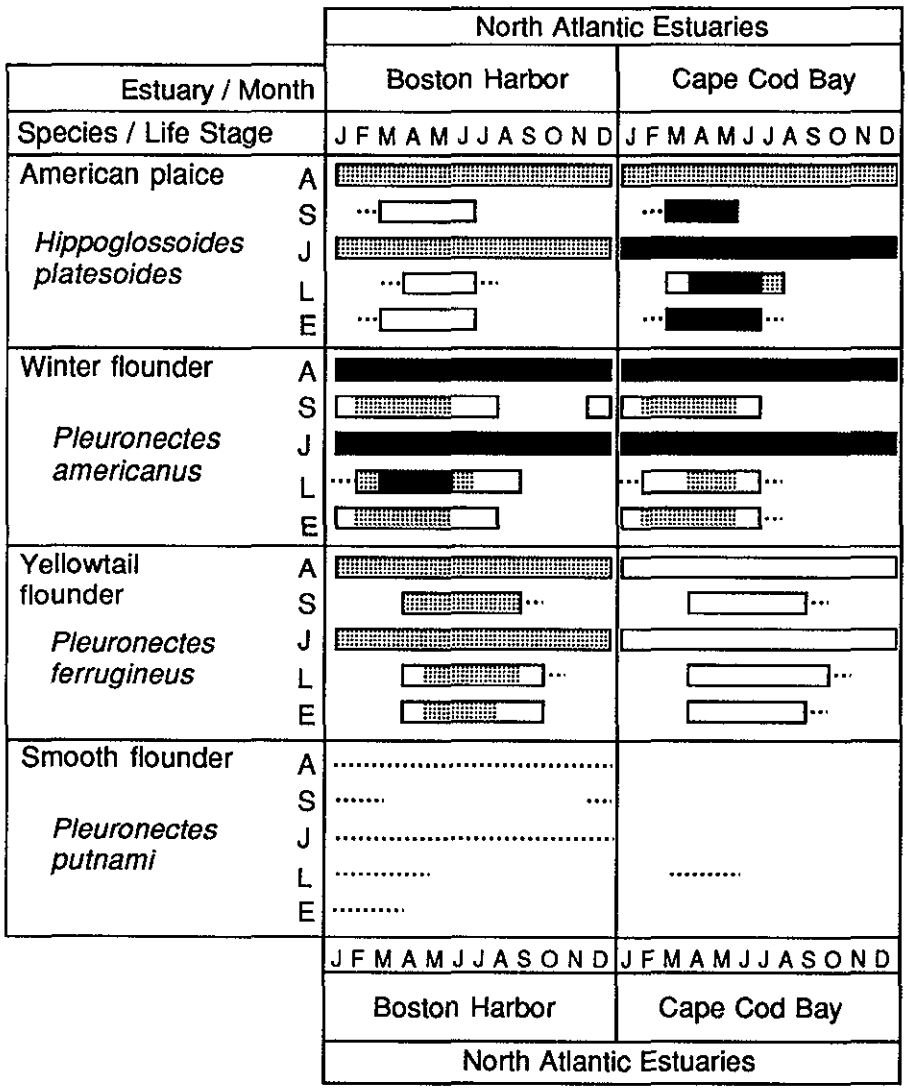


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## Table 6. Data reliability

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

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A - Adults
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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

▣ 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 | English-man/ Machias Bays | Narraguagus Bay | Blue Hill Bay | Penobscot Bay | Muscongus Bay |
|---|---|---|---|---|---|---|---|
| | | North Atlantic Estuaries | | | | | |
| 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 | □ | □ | □ | □ | □ | ▣ |
| | | Passamaquoddy Bay | English-man/ 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 | 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 | ▣ | ▣ | ▣ | □ | □ | □ |
| | | 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 | | North Atlantic Estuaries | | | | | |
|---|---|---|---|---|---|---|---|
| | | Passamaquoddy Bay | Englishman/ Machias Bays | Narraguagus Bay | Blue Hill Bay | Penobscot Bay | Muscongus 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 | □ | □ | □ | □ | □ | □ |
| | | 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 | 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 | □ | □ | □ | □ | □ | □ |
| | | 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 | 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 | □ | □ | □ | □ | □ | □ |
| | | 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 | 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 | □ | □ | □ | □ | □ |
| | | 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

# Appendices

Appendix 1. National Estuarine Inventory map of Penobscot Bay

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Appendix 3. Species life history notes

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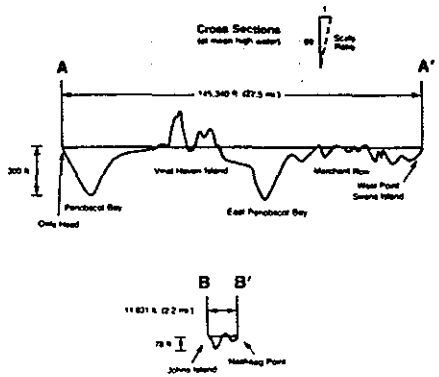
# Appendix 1. National Estuarine Inventory map of Penobscot Bay

## National Estuarine Atlas

**PHYSICAL AND HYDROLOGIC CHARACTERISTICS**

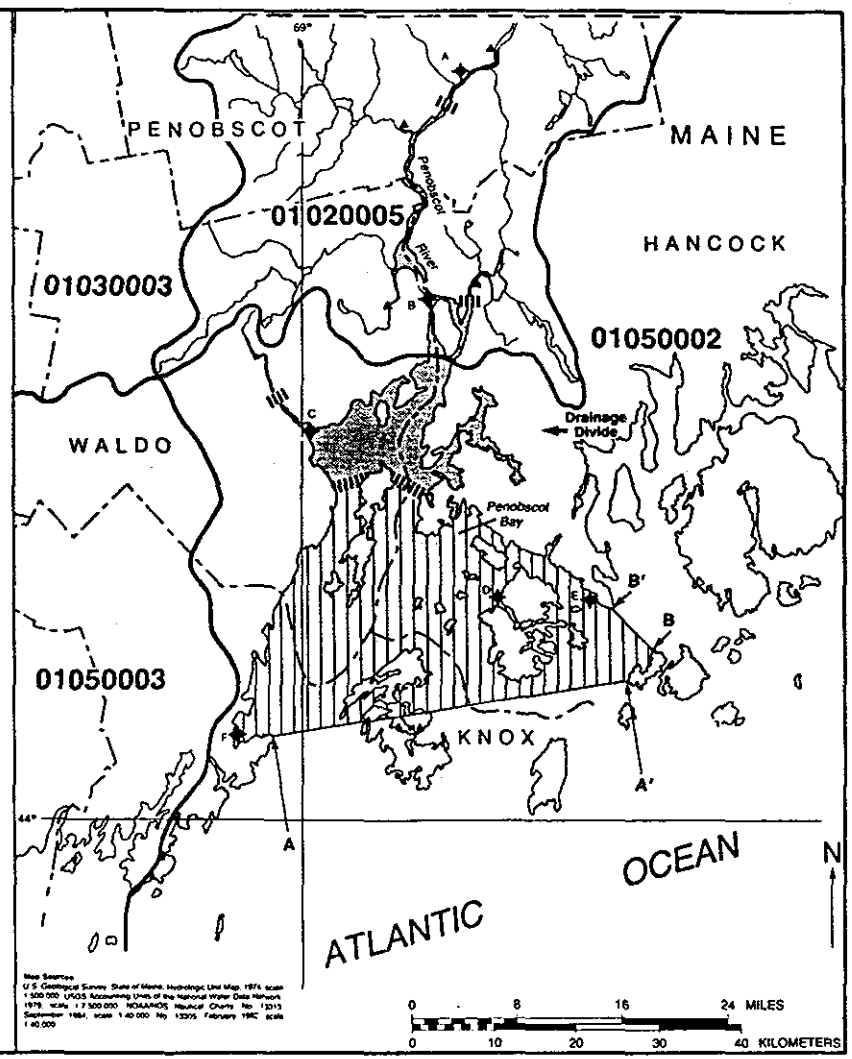
| PHYSICAL | | FRESHWATER INFLOW | | TIDAL DATA | | |
|---|---|---|---|---|---|---|
| Surface Areas (m²) | | Flow Rates (1000 cfs) | | Prevailing Tide Semidiurnal | | |
| Fluvial Drainage | 8,250 | Period of Record | 1902-1980 | Tidal Prism (ft) | 9.9x10⁸ | |
| Estuarine Drainage | 3,180 | | | Phase Range of Tide (ft) | | |
| Estuarine Zones | | Long Term Average Daily | 18.1 | Map Key | Station | Range |
| Tidal Fresh | 45 | Long Term Average Monthly | J 10.8 | A | 767 | 13.0 |
| Mixing Zone | 70 | | F 9.5 | B | 761 | 10.9 |
| Seawater | 248 | | M 14.7 | C | 768 | 9.9 |
| Total | 361 | | A 41.5 | D | 745 | 10.0 |
| Dimensions | | | M 25.8 | E | 731 | 10.0 |
| Length (m) | 62.6 | | J 16.1 | F | 773 | 9.6 |
| Width (m) Average | 7.6 | 7 Day 10 Year Low Flow | 3.7 | | | |
| Minimum | 0.2 | 50 Year Flood | 151.0 | | | |
| Maximum | 27.5 | 100 Year Flood | 169.0 | | | |
| Average Depth (m) | 77.1 | Flow Ratios | | | | |
| Average Depth in Width Ratio | 1.9x10⁻³ | Average Annual | 0.007 | | | |
| Stratification 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



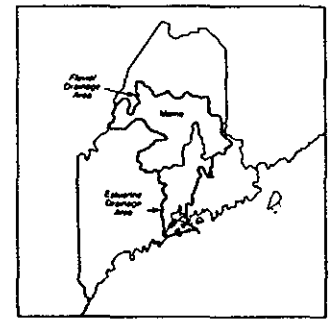

**Notes:**
Approximately 50% of Estuarine Drainage Area is shown on map. Drainage Divide represents portion of Estuarine Drainage Area boundary not coinciding with U.S. Geological Survey cataloging unit boundary.


**References:**
Fink, et al., 1980. Fontaine, 1978. Fontaine, 1981. Fontaine, 1982. Haefner, 1967. Hatch, 1971. Mornill, 1975. Mornill et al., 1982. Muirhead and Wartha, 1971. Parker, 1978. U.S. Department of Commerce, 1983a.


Map Sources
U.S. Geological Survey, State of Maine, Hydrologic Unit Map, 1974, scale 1:500,000. USGS Accounting Units of the National Water Data Network, 1979, scale 1:7,500,000. NOAA/NOS Nautical Charts No. 13313, September 1984, scale 1:40,000. No. 13305, February 1982, 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
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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 mid-western 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.

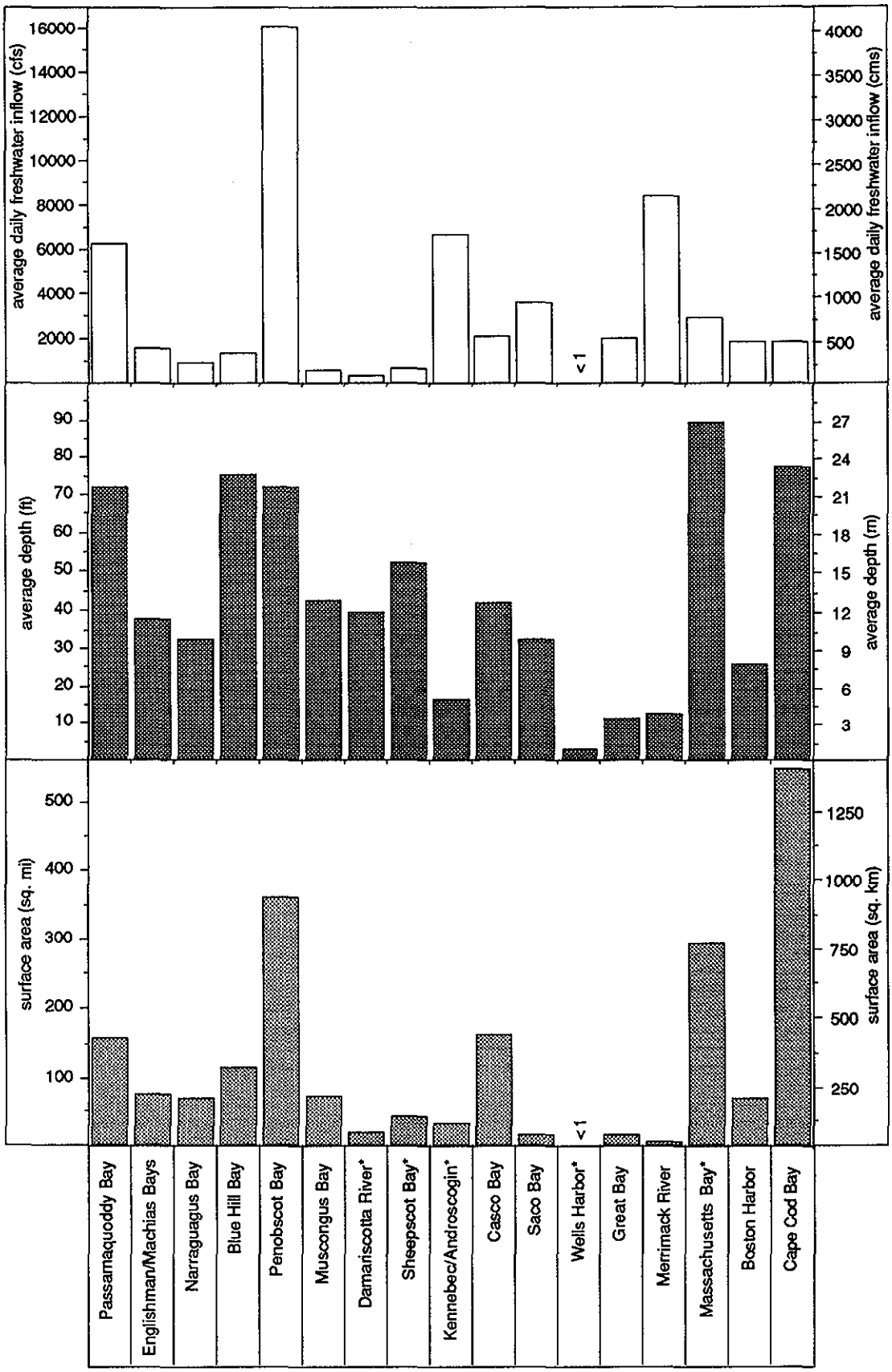


Figure 9. Average flow, depth, and surface area of North Atlantic estuaries. (NOAA 1990, NOAA 1993)
* additions to NEI (NOAA 1985)

• **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.

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## 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).

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## Appendix 4. Table of references and personal communications

| Species | Passamaquoddy Bay |
|---|---|
| Blue mussel<br>*Mytilus edulis* | 59, 77, 264, 311, 419,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Moring |
| Sea scallop<br>*Placopecten magellanicus* | 34, 59, 107, 120, 333, 379,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson |
| American oyster<br>*Crassostrea virginica* | 142, 158, 240, 419,<br>Beal, Clifford, Hargrave, Kraus, Moring |
| Northern quahog<br>*Mercenaria mercenaria* | 59, 419,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson |
| Softshell clam<br>*Mya arenaria* | 59, 142, 348, 349, 419,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson |
| Grass shrimp<br>*Palaemonetes pugio* | 142, 212, 336, 419, 433,<br>Beal, Clifford, Pohle, Hargrave, Kraus, Lawton, Dadswell, Moring |
| Northern shrimp<br>*Pandalus borealis* | 79, 142, 182, 380, 433,<br>Beal, Clifford, Pohle, Hargrave, Kraus, Lawton, Moring |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 99, 100, 176, 419,<br>Beal, Clifford, Hargrave, Kraus, Lawton, Moring |
| American lobster<br>*Homarus americanus* | 16, 59, 64, 142, 171, 196, 217, 351, 433,<br>Beal, Dadswell, Hargrave, Kraus, Krouse, Lawton, Pohle |
| Jonah crab<br>*Cancer borealis* | 142, 219, 362,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Lawton, Pohle |
| Atlantic rock crab<br>*Cancer irroratus* | 142, 216, 218, 219, 362, 419, 433,<br>Clifford, Hargrave, Kraus, Krouse, Lawton, Dadswell, Pohle |
| Green crab<br>*Carcinus maenus* | 4, 50, 83, 419, 433,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Lawton, Moring, Pohle |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 185, 186, 221, 256, 305, 352,<br>Beal, Clifford, Dadswell, Hargrave, Kraus, Moring, Robinson |
| Spiny dogfish<br>*Squalus acanthias* | 51, 255, 421,<br>Clifford, Dadswell, Moring |
| Skates<br>*Raja* species | 51, 255, 421,<br>Clifford, Dadswell, Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 104, 255, 272, 370, 421,<br>Clifford, Dadswell, Jessop, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 42, 51, 150, 255, 370,<br>Clifford, Dadswell, Jessop, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 37, 42, 51, 137, 150, 373,<br>Clifford, Dadswell, Jessop, Peterson, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 42, 150, 206, 255, 370, 421,<br>Beland, Clifford, Dadswell, Jessop, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 42, 59, 150, 206, 255, 370, 421,<br>Beal, Beland, Clifford, Dadswell, Jessop, Kraus, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 42, 59, 105, 150, 370,<br>Clifford, Dadswell, Jessop, Moring, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Atlantic herring<br>*Clupea harengus* | 101, 165, 166, 250, 255, 280, 281, 400, 411, 412,<br>Clifford, Dadswell, Moring, Power, Stephenson |
| Rainbow smelt<br>*Osmerus mordax* | 42, 144, 150, 255, 282, 421,<br>Beal, Clifford, Jessop, Kraus, Dadswell, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 25, 41, 150, 156, 370,<br>Beland, Clifford, Dadswell, Jessop, Kraus, Moring, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 79, 255, 421,<br>Clifford, Dadswell, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 255, 274, 421,<br>Clifford, Dadswell, Moring |
| Silver hake<br>*Merluccius bilinearis* | 51, 255, 421,<br>Clifford, Dadswell, Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 51, 255, 398, 421,<br>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<br>*Pollachius virens* | 51, 79, 255, 368, 421,<br>Clifford, Dadswell, Moring |
| Red hake<br>*Urophycis chuss* | 51, 255, 370,<br>Clifford, Dadswell, Moring |
| White hake<br>*Urophycis tenuis* | 51, 255, 265, 370, 421,<br>Clifford, Dadswell, Moring |
| Mummichog<br>*Fundulus heteroclitus* | 31, 42, 150, 370,<br>Clifford, Dadswell, Moring |
| Silversides<br>*Menidia* species | 31, 42, 150, 255, 370, 421,<br>Clifford, Dadswell, Jessop, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 255, 440,<br>Clifford, Dadswell, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 255, 370, 440,<br>Clifford, Dadswell, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 255, 370, 440,<br>Clifford, Dadswell, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 181, 248, 255, 370,<br>Clifford, Dadswell, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 255, 421,<br>Clifford, Dadswell, Moring |
| White perch<br>*Morone americana* | 42, 51, 150, 255,<br>Clifford, Dadswell, Moring, Squiers |
| Striped bass<br>*Morone saxatilis* | 42, 51, 150, 370,<br>Clifford, Dadswell, Jessop, Moring, Peterson, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 370,<br>Clifford, Dadswell, Moring |
| Scup<br>*Stenotomus chrysops* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Tautog<br>*Tautoga onitis* | 51, 54, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 370,<br>Clifford, Dadswell, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 255, 289, 360, 414,<br>Clifford, Dadswell, Moring |
| American sandlance<br>*Ammodytes americanus* | 51, 255, 288, 368, 436,<br>Clifford, Dadswell, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 255, 370,<br>Clifford, Dadswell, Moring |
| Butterfish<br>*Peprilus triacanthus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 255, 275, 370, 421, 422,<br>Clifford, Dadswell, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 255, 370, 421,<br>Clifford, Dadswell, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 255, 370, 421,<br>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<br>*Mytilus edulis* | 77, 142, 211, 239, 240, 264, 310, 311, 337, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Sea scallop<br>*Placopecten magellanicus* | 34, 47, 142, 253, 295, 333, 337, 379, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| American oyster<br>*Crassostrea virginica* | 142, 158, 337, 371,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Northern quahog<br>*Mercenaria mercenaria* | 142, 337, 393,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Softshell clam<br>*Mya arenaria* | 15, 142, 239, 240, 308, 337, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 337, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Moring |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 331, 380, 419, 433,<br>Barr, Clifford, Dearborn, Knowlton, McGowan, Moring |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 99, 100, 129, 142, 176, 337,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| American lobster<br>*Homarus americanus* | 64, 97, 110, 142, 217, 257, 259, 337, 351, 419,<br>Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Jonah crab<br>*Cancer borealis* | 142, 201, 218, 219, 259, 337, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 142, 216, 218, 219, 362, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Green crab<br>*Carcinus maenus* | 50, 83, 337, 428, 433, 434,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 142, 185, 186, 337, 372, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Spiny dogfish<br>*Squalus acanthias* | 51, 64, 92, 142, 149, 202, 253, 259, 304, 370, 419,<br>Clifford, McGowan, Moring |
| Skates<br>*Raja* species | 51, 64, 142, 255, 259, 276, 370, 419, 421,<br>Clifford, Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 17, 51, 106, 142, 161, 370, 419,<br>Clifford, Marancik, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 17, 51, 142, 161, 255, 370, 405,<br>Clifford, Marancik, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 17, 42, 51, 122, 137, 142, 145, 149, 184, 255, 288, 370, 414,<br>Beal, Clifford, Kraus, Marancik, McGowan, Moring, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 17, 42, 51, 122, 142, 149, 251, 255, 259, 294, 402, 419,<br>Beland, Clifford, Marancik, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 17, 42, 51, 122, 142, 149, 251, 255, 259, 294, 402, 419, 421,<br>Beal, Clifford, Kraus, Marancik, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 17, 42, 51, 108, 122, 142, 149, 255, 419, 427,<br>Beland, Clifford, Marancik, McGowan, Moring, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 118, 142, 354, 419,<br>Clifford, McGowan, Moring, Squiers |
| Atlantic herring<br>*Clupea harengus* | 64, 68, 80, 101, 102, 166, 167, 168, 208, 381, 396, 414, 415, 416, 417,<br>Beal, Clifford, Kraus, McGowan, Moring, Squiers |
| Rainbow smelt<br>*Osmerus mordax* | 17, 42, 51, 64, 122, 142, 149, 169, 255, 259, 414, 419, 421,<br>Beal, Clifford, Kraus, McGowan, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 17, 24, 25, 42, 42, 109, 122, 142, 149, 358,<br>Beal, Beland, Clifford, Kraus, Marancik, McGowan, Moring, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 64, 142, 255, 259, 370, 419, 421,<br>Clifford, McGowan, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 142, 255, 259, 370, 419, 421,<br>Clifford, Moring |
| Silver hake<br>*Merluccius bilinearis* | 8, 51, 64, 142, 255, 259, 370, 419, 421,<br>Clifford, Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 42, 51, 122, 142, 149, 255, 338, 398, 414,<br>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<br>*Pollachius virens* | 51, 64, 118, 142, 255, 259, 269, 288, 419, 421,<br>Clifford, Moring |
| Red hake<br>*Urophycis chuss* | 51, 142, 159, 255, 259, 265, 302, 419,<br>Clifford, Moring |
| White hake<br>*Urophycis tenuis* | 51, 64, 138, 142, 255, 259, 265, 288, 302, 419, 421,<br>Clifford, McGowan, Moring |
| Mummichog<br>*Fundulus heteroclitus* | 2, 42, 51, 118, 122, 142, 149, 169, 255, 288, 419,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Silversides<br>*Menidia* species | 51, 94, 118, 141, 142, 255, 288, 419,<br>Clifford, McGowan, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 118, 142, 169, 255, 288, 439, 440,<br>Clifford, McGowan, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 42, 51, 118, 122, 142, 149, 169, 255, 288, 435, 439, 440,<br>Clifford, McGowan, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 42, 51, 118, 122, 142, 149, 169, 288, 439, 440,<br>Clifford, McGowan, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 51, 142, 248, 255,<br>Beal, Clifford, Kraus, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 142, 350,<br>Clifford, Kraus, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 142, 255, 259, 288, 414,<br>Clifford, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 64, 142, 255, 259, 288, 414, 415, 419, 421,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 64, 142, 255, 259, 288, 414, 415,<br>Beal, Clifford, Kraus, McGowan, Moring |
| White perch<br>*Morone americana* | 42, 51, 122, 142, 149, 169, 392,<br>Clifford, Marancik, McGowan, Moring |
| Striped bass<br>*Morone saxatilis* | 17, 42, 56, 122, 140, 142, 149, 419, 426,<br>Clifford, Marancik, McGowan, Moring |
| Bluefish<br>*Pomatomus saltatrix* | 42, 51, 122, 142, 149, 287, 327, 419,<br>Clifford, McGowan, Moring |
| Scup<br>*Stenotomus chrysops* | 51, 142, 290, 419,<br>Clifford, McGowan, Moring |
| Tautog<br>*Tautoga onitis* | 29, 51, 142, 419,<br>Clifford, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 142, 288, 419,<br>Clifford, McGowan, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 64, 142, 255, 259, 419, 421,<br>Clifford, McGowan, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 142, 255, 288, 289, 360, 414, 415,<br>Beal, Clifford, Kraus, McGowan, Moring |
| American sandlance<br>*Ammodytes americanus* | 30, 51, 142, 255, 288, 306, 382, 414, 419, 436,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 42, 51, 64, 122, 142, 149, 255, 259, 419,<br>Beal, Clifford, Kraus, Moring |
| Butterfish<br>*Peprilus triacanthus* | 51, 64, 142, 255, 259, 296, 419,<br>Clifford, Moring |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 64, 142, 255, 259,<br>Clifford, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 142, 255, 259, 419, 421,<br>Clifford, McGowan, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 63, 64, 142, 255, 259, 275, 288, 414, 419, 421, 422,<br>Clifford, McGowan, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 64, 118, 142, 255, 259, 419,<br>Clifford, McGowan, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 27, 51, 142, 255, 414,<br>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<br>*Mytilus edulis* | 77, 142, 211, 239, 264, 310, 311, 337, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Sea scallop<br>*Placopecten magellanicus* | 34, 47, 142, 253, 295, 333, 337, 379, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| American oyster<br>*Crassostrea virginica* | 142, 158, 337, 371,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Northern quahog<br>*Mercenaria mercenaria* | 142, 337, 393,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Softshell clam<br>*Mya arenaria* | 142, 239, 240, 308, 337, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 336, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Moring |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 331, 380, 419, 433,<br>Barr, Clifford, Dearborn, Knowlton, McGowan, Moring |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 99, 100, 129, 142, 176, 337,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| American lobster<br>*Homarus americanus* | 64, 97, 110, 142, 217, 257, 259, 337, 351, 419,<br>Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Jonah crab<br>*Cancer borealis* | 142, 201, 218, 219, 259, 337, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 142, 216, 218, 219, 337, 362, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Green crab<br>*Carcinus maenus* | 50, 83, 337, 428, 433, 434,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 142, 185, 186, 337, 372, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Spiny dogfish<br>*Squalus acanthias* | 39, 51, 64, 92, 142, 202, 255, 259, 304, 370, 419,<br>Clifford, McGowan, Moring |
| Skates<br>*Raja* species | 51, 64, 142, 255, 259, 276, 370, 419, 421,<br>Clifford, Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 17, 51, 106, 142, 161, 370, 419,<br>Clifford, Marancik, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 17, 51, 142, 161, 255, 370, 405,<br>Clifford, Marancik, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 17, 39, 51, 123, 137, 142, 145, 184, 255, 288, 370, 414,<br>Beal, Clifford, Kraus, Marancik, McGowan, Moring, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 17, 39, 51, 123, 142, 251, 255, 259, 294, 402, 419,<br>Beland, Clifford, Marancik, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 17, 39, 51, 123, 142, 251, 255, 259, 294, 402, 419, 421,<br>Beal, Clifford, Kraus, Marancik, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 17, 39, 51, 108, 123, 142, 255, 419, 427,<br>Beland, Clifford, Marancik, McGowan, Moring, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 118, 142, 354, 419,<br>Clifford, McGowan, Moring, Squiers |
| Atlantic herring<br>*Clupea harengus* | 51, 68, 80, 101, 102, 165, 166, 167, 168, 208, 396, 414, 415, 416, 417,<br>Beal, Clifford, Kraus, McGowan, Moring, Squiers |
| Rainbow smelt<br>*Osmerus mordax* | 17, 39, 51, 64, 64, 123, 142, 144, 169, 255, 259, 414, 419, 421,<br>Beal, Clifford, Kraus, McGowan, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 17, 24, 25, 39, 40, 42, 51, 109, 123, 142, 255, 358, 419,<br>Beal, Beland, Clifford, Kraus, Marancik, McGowan, Moring, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 64, 142, 255, 259, 370, 419, 421,<br>Clifford, McGowan, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 142, 255, 259, 370, 419, 421,<br>Clifford, Moring |
| Silver hake<br>*Merluccius bilinearis* | 8, 51, 64, 142, 255, 259, 370, 419, 421,<br>Clifford, Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 40, 51, 123, 142, 255, 338, 398, 414,<br>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<br>*Pollachius virens* | 51, 64, 118, 142, 255, 259, 269, 288, 419, 421,<br>Clifford, Moring |
| Red hake<br>*Urophycis chuss* | 51, 142, 159, 255, 259, 265, 302, 419,<br>Clifford, Moring |
| White hake<br>*Urophycis tenuis* | 51, 64, 138, 142, 255, 259, 265, 288, 302, 419, 421,<br>Clifford, McGowan, Moring |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 39, 51, 118, 123, 142, 169, 255, 288, 419,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Silversides<br>*Menidia* species | 51, 94, 118, 141, 142, 255, 288, 419,<br>Clifford, McGowan, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 118, 142, 169, 255, 288, 439, 440,<br>Clifford, McGowan, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 39, 51, 118, 123, 142, 169, 255, 288, 435, 439, 440,<br>Clifford, McGowan, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 39, 51, 118, 123, 142, 169, 288, 439, 440,<br>Clifford, McGowan, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 51, 142, 248, 255,<br>Beal, Clifford, Kraus, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 142, 350,<br>Clifford, Kraus, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 142, 255, 259, 288, 414,<br>Clifford, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 64, 142, 255, 259, 288, 414, 415, 419, 421,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 64, 142, 255, 259, 288, 414, 415,<br>Beal, Clifford, Kraus, McGowan, Moring |
| White perch<br>*Morone americana* | 39, 51, 123, 142, 169, 392,<br>Clifford, Marancik, McGowan, Moring |
| Striped bass<br>*Morone saxatilis* | 17, 40, 56, 123, 140, 142, 419, 426,<br>Clifford, Marancik, McGowan, Moring |
| Bluefish<br>*Pomatomus saltatrix* | 40, 51, 123, 142, 287, 327, 419,<br>Clifford, McGowan, Moring |
| Scup<br>*Stenotomus chrysops* | 51, 142, 290, 419,<br>Clifford, McGowan, Moring |
| Tautog<br>*Tautoga onitis* | 29, 51, 142, 419,<br>Clifford, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 142, 288, 419,<br>Clifford, McGowan, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 64, 142, 255, 259, 419, 421,<br>Clifford, McGowan, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 142, 253, 288, 289, 360, 414, 415,<br>Beal, Clifford, Kraus, McGowan, Moring |
| American sandlance<br>*Ammodytes americanus* | 30, 51, 142, 255, 288, 306, 382, 414, 419, 436,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 40, 51, 64, 123, 142, 255, 259, 419,<br>Beal, Clifford, Kraus, Moring |
| Butterfish<br>*Peprilus triacanthus* | 51, 64, 142, 255, 259, 296, 419,<br>Clifford, Moring |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 64, 142, 255, 259,<br>Clifford, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 142, 255, 259, 419, 421,<br>Clifford, McGowan, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 63, 64, 142, 255, 259, 275, 288, 414, 419, 421, 422,<br>Clifford, McGowan, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 64, 118, 142, 255, 259, 419,<br>Clifford, McGowan, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 27, 51, 142, 255, 414,<br>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<br>*Mytilus edulis* | 77, 142, 211, 239, 240, 264, 310, 311, 337, 344, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Sea scallop<br>*Placopecten magellanicus* | 34, 47, 142, 253, 295, 333, 337, 344, 379, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| American oyster<br>*Crassostrea virginica* | 142, 158, 337, 371,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Northern quahog<br>*Mercenaria mercenaria* | 142, 337, 393,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Softshell clam<br>*Mya arenaria* | 142, 239, 240, 308, 337, 344, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 337, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Moring |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 331, 380, 419, 433,<br>Barr, Clifford, Dearborn, Knowlton, McGowan, Moring |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 99, 100, 129, 142, 176, 337, 344,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| American lobster<br>*Homarus americanus* | 64, 97, 110, 142, 217, 257, 259, 337, 351, 419,<br>Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Jonah crab<br>*Cancer borealis* | 142, 201, 218, 219, 259, 337, 344, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 142, 216, 218, 219, 337, 344, 362, 433,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, Krouse, McGowan, Moring |
| Green crab<br>*Carcinus maenus* | 50, 83, 337, 428, 433, 434,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 142, 185, 186, 337, 344, 372, 419,<br>Barr, Beal, Clifford, Dearborn, Knowlton, Kraus, McGowan, Moring |
| Spiny dogfish<br>*Squalus acanthias* | 36, 51, 64, 92, 142, 202, 255, 259, 304, 344, 370, 419,<br>Clifford, McGowan, Moring |
| Skates<br>*Raja* species | 51, 64, 142, 255, 259, 276, 344, 370, 419, 421,<br>Clifford, Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 17, 51, 106, 142, 161, 370, 419,<br>Clifford, Marancik, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 17, 51, 142, 161, 255, 370, 405,<br>Clifford, Marancik, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 17, 36, 51, 137, 142, 145, 184, 255, 288, 344, 370, 414,<br>Beal, Clifford, Kraus, Marancik, McGowan, Moring, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 17, 36, 51, 142, 251, 255, 259, 294, 402, 419,<br>Beland, Clifford, Marancik, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 17, 36, 51, 142, 251, 255, 259, 294, 402, 419, 421,<br>Beal, Clifford, Kraus, Marancik, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 17, 36, 51, 108, 142, 255, 419, 427,<br>Beland, Clifford, Marancik, McGowan, Moring, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 118, 142, 354, 419,<br>Clifford, McGowan, Moring, Squiers |
| Atlantic herring<br>*Clupea harengus* | 51, 64, 69, 80, 101, 102, 118, 165, 166, 167, 168, 208, 381, 396, 414, 415, 416, 417,<br>Beal, Clifford, Kraus, McGowan, Moring, Squiers |
| Rainbow smelt<br>*Osmerus mordax* | 17, 36, 51, 62, 64, 142, 144, 169, 255, 259, 414, 419, 421,<br>Beal, Clifford, Kraus, McGowan, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 17, 24, 25, 36, 39, 42, 51, 109, 142, 255, 358, 419,<br>Beal, Beland, Clifford, Kraus, Marancik, McGowan, Moring, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 64, 142, 255, 259, 344, 370, 419, 421,<br>Clifford, McGowan, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 142, 255, 259, 344, 370, 419, 421,<br>Clifford, Moring |
| Silver hake<br>*Merluccius bilinearis* | 8, 51, 64, 142, 255, 259, 370, 419, 421,<br>Clifford, Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 36, 51, 142, 255, 338, 398, 414,<br>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<br>*Pollachius virens* | 51, 64, 118, 142, 255, 259, 269, 288, 419, 421,<br>Clifford, Moring |
| Red hake<br>*Urophycis chuss* | 51, 142, 159, 255, 259, 265, 302, 419,<br>Clifford, Moring |
| White hake<br>*Urophycis tenuis* | 51, 64, 138, 142, 255, 259, 265, 288, 302, 344, 419, 421,<br>Clifford, McGowan, Moring |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 36, 51, 118, 142, 169, 255, 288, 344, 419,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Silversides<br>*Menidia* species | 51, 94, 118, 141, 142, 255, 288, 344, 419,<br>Clifford, McGowan, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 118, 142, 169, 255, 288, 344, 439, 440,<br>Clifford, McGowan, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 36, 51, 118, 142, 169, 255, 288, 344, 435, 439, 440,<br>Clifford, McGowan, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 36, 51, 118, 142, 169, 288, 344, 439, 440,<br>Clifford, McGowan, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 51, 142, 248, 255, 344,<br>Beal, Clifford, Kraus, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 142, 350,<br>Clifford, Kraus, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 142, 255, 259, 288, 414,<br>Clifford, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 64, 142, 255, 259, 288, 344, 414, 415, 419, 421,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 64, 142, 255, 259, 288, 414, 415,<br>Beal, Clifford, Kraus, McGowan, Moring |
| White perch<br>*Morone americana* | 36, 51, 142, 169, 392,<br>Clifford, Marancik, McGowan, Moring |
| Striped bass<br>*Morone saxatilis* | 17, 36, 56, 140, 142, 419, 426,<br>Clifford, Marancik, McGowan, Moring |
| Bluefish<br>*Pomatomus saltatrix* | 36, 51, 142, 287, 327, 419,<br>Clifford, McGowan, Moring |
| Scup<br>*Stenotomus chrysops* | 51, 142, 290, 419,<br>Clifford, McGowan, Moring |
| Tautog<br>*Tautoga onitis* | 29, 51, 142, 419,<br>Clifford, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 142, 288, 419,<br>Clifford, McGowan, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 64, 142, 255, 259, 419, 421,<br>Clifford, McGowan, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 142, 255, 288, 289, 344, 360, 414, 415,<br>Beal, Clifford, Kraus, McGowan, Moring |
| American sandlance<br>*Ammodytes americanus* | 30, 51, 142, 255, 288, 306, 382, 414, 419, 436,<br>Beal, Clifford, Kraus, McGowan, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 36, 51, 64, 142, 255, 259, 419,<br>Beal, Clifford, Kraus, Moring |
| Butterfish<br>*Peprilus triacanthus* | 51, 64, 142, 255, 259, 296, 419,<br>Clifford, Moring |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 64, 142, 255, 259,<br>Clifford, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 142, 255, 259, 419, 421,<br>Clifford, McGowan, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 63, 64, 142, 255, 259, 275, 288, 344, 414, 419, 421, 422,<br>Clifford, McGowan, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 64, 118, 142, 255, 259, 419,<br>Clifford, McGowan, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 27, 51, 142, 255, 414,<br>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<br>*Mytilus edulis* | 21, 77, 264, 311, 315, 317,<br>Barr, Knowlton, McGowan, Moring |
| Sea scallop<br>*Placopecten magellanicus* | 23, 34, 315, 317, 379,<br>Dearborn, Knowlton, McGowan, Moring |
| American oyster<br>*Crassostrea virginica* | 142, 158, 240, 419,<br>Barr, Knowlton, McGowan, Moring |
| Northern quahog<br>*Mercenaria mercenaria* | 21, 315, 317, 419,<br>Barr, Knowlton, McGowan, Moring |
| Softshell clam<br>*Mya arenaria* | 21, 142, 315, 317,<br>Barr, Knowlton, McGowan, Moring |
| Grass shrimp<br>*Palaemonetes pugio* | 21, 142, 419, 433,<br>Barr, Dearborn, Knowlton |
| Northern shrimp<br>*Pandalus borealis* | 79, 142, 182, 380, 433,<br>Barr, Knowlton, McGowan, Moring |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 129, 176, 419, 433,<br>Barr, Dearborn, Knowlton, McGowan, Moring |
| American lobster<br>*Homarus americanus* | 16, 64, 142, 170, 196, 217, 433,<br>Barr, Dearborn, Knowlton, Krouse, McGowan, Moring |
| Jonah crab<br>*Cancer borealis* | 142, 219, 362,<br>Barr, Dearborn, Knowlton, Krouse, McGowan, Moring |
| Atlantic rock crab<br>*Cancer irroratus* | 142, 218, 362, 419, 433,<br>Barr, Knowlton, Krouse, McGowan, Moring |
| Green crab<br>*Carcinus maenus* | 4, 50, 83, 419, 433,<br>Barr, Dearborn, Knowlton, McGowan, Moring |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 21, 78, 185, 315, 317,<br>Barr, Dearborn, Knowlton, McGowan, Moring |
| Spiny dogfish<br>*Squalus acanthias* | 7, 21, 51, 317,<br>Dearborn, McGowan, Moring |
| Skates<br>*Raja* species | 7, 21, 51, 317,<br>Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 142, 272, 370, 386, 387,<br>Marancik, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 7, 37, 51, 386,<br>Marancik, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 37, 51, 137, 373,<br>Marancik, McGowan, Moring |
| Blueback herring<br>*Alosa aestivalis* | 7, 21, 37, 315, 317,<br>Fay, Marancik, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 7, 37, 64, 259, 315, 317,<br>Fay, Marancik, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 7, 37, 259, 317, 387,<br>Baum, Marancik, McGowan, Moring, Spencer, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 7, 64, 259, 315, 421,<br>McGowan, Moring |
| Atlantic herring<br>*Clupea harengus* | 7, 64, 101, 165, 166, 259, 315, 317, 400, 421,<br>McGowan, Moring |
| Rainbow smelt<br>*Osmerus mordax* | 7, 21, 144, 282, 315, 317,<br>Marancik, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 25, 37, 38, 41, 156,<br>Baum, Beland, Fay, McGowan, Moring, Spencer, Squiers |
| Atlantic cod<br>*Gadus morhua* | 7, 21, 51, 79, 315, 317, 335, 421,<br>McGowan, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 7, 51, 64, 259, 315, 317,<br>Moring |
| Silver hake<br>*Merluccius bilinearis* | 7, 21, 51, 64, 259, 315, 317,<br>Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 7, 21, 51, 315, 317, 398,<br>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<br>*Pollachius virens* | 7, 21, 51, 64, 79, 259, 315, 317,<br>Moring |
| Red hake<br>*Urophycis chuss* | 7, 21, 51, 64, 79, 315, 317,<br>Moring |
| White hake<br>*Urophycis tenuis* | 7, 21, 51, 64, 79, 315, 317,<br>McGowan, Moring |
| Mummichogs<br>*Fundulus heteroclitus* | 7, 21, 31, 37, 317,<br>Dearborn, McGowan, Moring |
| Silversides<br>*Menidia* species | 7, 21, 31, 315, 317,<br>Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 7, 21, 28, 315, 317, 440,<br>McGowan, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 7, 21, 28, 315, 317, 440,<br>McGowan, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 7, 28, 315, 317, 440,<br>McGowan, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 7, 181, 248, 315,<br>Moring |
| Northern searobin<br>*Prionotus carolinus* | 7, 51, 64, 315, 317, 421,<br>Moring |
| Grubby<br>*Myoxocephalus aeneus* | 7, 21, 51, 315, 317,<br>Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 7, 21, 51, 64, 259, 315, 317,<br>McGowan, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 7, 21, 51, 64, 315, 317,<br>McGowan, Moring |
| White perch<br>*Morone americana* | 7, 37, 51,<br>Marancik, McGowan, Moring, Squiers |
| Striped bass<br>*Morone saxatilis* | 7, 37,<br>Baum, Marancik, Moring, Spencer, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 7, 21, 51, 315,<br>McGowan, Moring |
| Scup<br>*Stenotomus chrysops* | 7, 21, 51, 259, 315, 317,<br>Moring |
| Tautog<br>*Tautoga onitis* | 7, 21, 51, 315, 317,<br>Blackwell, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 7, 29, 51,<br>McGowan, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 7, 21, 64, 259, 315, 317, 421,<br>McGowan, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 7, 21, 51, 289, 315, 360, 414,<br>McGowan, Moring |
| American sandlance<br>*Ammodytes americanus* | 7, 21, 51, 288, 315, 317, 436,<br>McGowan, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 7, 21, 51, 291, 315,<br>McGowan, Moring |
| Butterfish<br>*Peprilus triacanthus* | 7, 51, 64, 79, 259, 315,<br>Moring |
| Windowpane flounder<br>*Scophthalmus aquosus* | 7, 21, 315,<br>Moring |
| American plaice<br>*Hippoglossoides platessoides* | 7, 21, 64, 79, 259, 315,<br>McGowan, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 7, 64, 79, 259, 315,<br>Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 7, 21, 64, 79, 259, 315, 421,<br>McGowan, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 7, 51, 79, 259, 315, 317, 421,<br>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<br>*Mytilus edulis* | 77, 260, 311, 343,<br>Chenoweth, Larsen, Moring, Shumway |
| Sea scallop<br>*Placopecten magellanicus* | 34, 142, 264, 295, 379,<br>Chenoweth, Larsen, Moring, Schick, Shumway |
| American oyster<br>*Crassostrea virginica* | 142, 158, 240, 419,<br>Chenoweth, Larsen, Moring, Shumway |
| Northern quahog<br>*Mercenaria mercenaria* | 71, 239, 393, 419,<br>Chenoweth, Larsen, Moring, Shumway |
| Softshell clam<br>*Mya arenaria* | 71, 142, 260, 419,<br>Chenoweth, Larsen, Moring, Shumway |
| Grass shrimp<br>*Palaemonetes pugio* | 142, 163, 336, 399, 419, 433,<br>Chenoweth, Larsen, Moring, Shumway |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 259, 380, 419, 433,<br>Chenoweth, Larsen, Moring, Schick, Shumway |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 129, 176, 419, 433,<br>Chenoweth, Larsen, Moring, Shumway |
| American lobster<br>*Homarus americanus* | 16, 142, 196, 217, 220, 419, 433,<br>Chenoweth, Krouse, Larsen, Moring, Shumway |
| Jonah crab<br>*Cancer borealis* | 142, 218, 260, 362, 399, 419, 433,<br>Chenoweth, Krouse, Larsen, Moring, Shumway |
| Atlantic rock crab<br>*Cancer irroratus* | 142, 216, 218, 219, 260, 362, 399, 419, 433,<br>Chenoweth, Krouse, Larsen, Moring, Shumway |
| Green crab<br>*Carcinus maenus* | 4, 50, 83, 419, 433,<br>Chenoweth, Krouse, Larsen, Moring, Shumway |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 186, 325, 419,<br>Chenoweth, Larsen, Moring, Shumway |
| Spiny dogfish<br>*Squalus acanthias* | 51, 154, 172, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Skates<br>*Raja* species | 51, 154, 227, 259, 260,<br>Chenoweth, Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 142, 155, 272, 386, 399, 419,<br>Chenoweth, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 142, 155, 272, 386, 399, 419,<br>Chenoweth, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 51, 76, 260, 283, 373,<br>Chenoweth, Moring, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 142, 260, 345, 419,<br>Chenoweth, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 142, 260, 345, 419,<br>Chenoweth, Libby, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 260, 345, 387,<br>Chenoweth, Moring, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 76, 142, 260, 345, 419,<br>Chenoweth, Moring, Nutting, Stevenson |
| Atlantic herring<br>*Clupea harengus* | 51, 76, 142, 345, 404, 419,<br>Chenoweth, Moring, Nutting, Stevenson |
| Rainbow smelt<br>*Osmerus mordax* | 51, 76, 144, 260, 282, 345, 370,<br>Chenoweth, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 41, 260, 283,<br>Chenoweth, Moring, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 335, 345,<br>Chenoweth, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 76, 225, 226, 227, 228, 229, 232, 259, 335, 383,<br>Chenoweth, Moring |
| Silver hake<br>*Merluccius bilinearis* | 51, 142, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 31, 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 398,<br>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<br>*Pollachius virens* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Moring |
| Red hake<br>*Urophycis chuss* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Moring |
| White hake<br>*Urophycis tenuis* | 31, 76, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Moring |
| Mummichogs<br>*Fundulus heteroclitus* | 31, 223, 260, 283, 413, 419,<br>Chenoweth, Moring |
| Silversides<br>*Menidia* species | 31, 51, 76, 95, 223, 260, 404, 413,<br>Chenoweth, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 76, 223, 260, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 181, 223, 248, 260, 404, 413,<br>Chenoweth, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404,<br>Chenoweth, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259,<br>Chenoweth, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 76, 154, 172, 225, 226, 227, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| White perch<br>*Morone americana* | 51, 260, 283, 345, 404,<br>Chenoweth, Moring |
| Striped bass<br>*Morone saxatilis* | 23, 51, 56, 260, 283, 426,<br>Chenoweth, Moring, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 76, 260, 325, 419,<br>Chenoweth, Moring, Squiers |
| Scup<br>*Stenotomus chrysops* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Tautog<br>*Tautoga onitis* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 232, 259, 260, 419,<br>Chenoweth, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 76, 154, 260, 288, 289, 360, 419,<br>Chenoweth, Moring |
| American sandlance<br>*Ammodytes americanus* | 51, 76, 260, 288, 325, 404, 436,<br>Chenoweth, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 76, 260, 325, 345, 419,<br>Chenoweth, Moring, Nutting, Squiers, Stevenson |
| Butterfish<br>*Peprilus triacanthus* | 51, 76, 260, 296, 325, 345, 419,<br>Chenoweth, Moring, Nutting, Squiers |
| Windowpane flounder<br>*Scophthalmus aquosus* | 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 154, 225, 226, 227, 228, 229, 232, 259, 260, 275, 419,<br>Chenoweth, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>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<br>*Mytilus edulis* | 343, 77, 311, 260,<br>Moring, Chenoweth, Shumway, Hurst, Larsen |
| Sea scallop<br>*Placopecten magellanicus* | 379, 295, 142, 264,<br>Schick, Chenoweth, Shumway, Hurst, Moring, Larsen |
| American oyster<br>*Crassostrea virginica* | 142, 419, 240, 158,<br>Hurst, Shumway, Moring, Chenoweth, Creaser, Larsen |
| Northern quahog<br>*Mercenaria mercenaria* | 419, 393, 71, 240,<br>Hurst, Chenoweth, Moring, Shumway, Creaser, Larsen |
| Softshell clam<br>*Mya arenaria* | 419, 142, 71, 260,<br>Hurst, Shumway, Chenoweth, Moring, Larsen, Moring |
| Grass shrimp<br>*Palaemonetes pugio* | 433, 399, 419, 142, 336, 163,<br>Larsen, Shumway, Moring, Perkins, Chenoweth |
| Northern shrimp<br>*Pandalus borealis* | 433, 419, 182, 142, 380, 259,<br>Shumway, Larsen, Schick, Moring, Chenoweth |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 176, 433, 419, 129,<br>Larsen, Moring, Chenoweth, Perkins, Shumway |
| American lobster<br>*Homarus americanus* | 142, 220, 419, 433, 16, 196, 217,<br>Krouse, Larsen, Moring, Chenoweth |
| Jonah crab<br>*Cancer borealis* | 260, 433, 219, 419, 399, 362, 142,<br>Krouse, Moring, Chenoweth, Shumway, Larsen |
| Atlantic rock crab<br>*Cancer irroratus* | 433, 218, 260, 419, 142, 399, 362, 219, 216,<br>Krouse, Larsen, Chenoweth, Moring |
| Green crab<br>*Carcinus maenus* | 50, 419, 433, 83, 4,<br>Moring, Chenoweth, Larsen |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 419, 78, 325, 186,<br>Moring, Chenoweth, Larsen |
| Spiny dogfish<br>*Squalus acanthias* | 51, 419, 260, 154, 172,<br>Perkins, Moring, Chenoweth |
| Skates<br>*Raja* species | 51, 227, 154, 260,<br>Moring, Chenoweth |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 142, 399, 419, 272, 155,<br>Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 142, 399, 419, 272, 155,<br>Squiers |
| American eel<br>*Anguilla rostrata* | 51, 260, 283, 76, 373,<br>Moring, Squiers, Chenoweth |
| Blueback herring<br>*Alosa aestivalis* | 260, 345, 419, 142,<br>Squiers, Moring |
| Alewife<br>*Alosa pseudoharengus* | 345, 260,<br>Libby, Squiers |
| American shad<br>*Alosa sapidissima* | 387, 345, 260,<br>Squiers, Moring |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 345, 76, 260, 142, 419, 51,<br>Stevenson, Moring, Chenoweth |
| Atlantic herring<br>*Clupea harengus* | 419, 51, 345, 76, 404, 142,<br>Stevenson, Moring, Chenoweth |
| Rainbow smelt<br>*Osmerus mordax* | 282, 260, 51, 370, 144, 345, 76,<br>Squiers |
| Atlantic salmon<br>*Salmo salar* | 24, 25, 109,<br>Squiers, Moring |
| Atlantic cod<br>*Gadus morhua* | 76, 51, 260, 154, 345, 335, 232, 225, 226, 227, 228, 229, 259,<br>Langton, Moring, Chenoweth |
| Haddock<br>*Melanogrammus aeglefinus* | 53 335, 383, 76, 51, 232, 225, 226, 227, 228, 229, 259,<br>Langton, Chenoweth, Moring |
| Silver hake<br>*Merluccius bilinearis* | 260, 154, 51, 419, 142, 232, 225, 226, 227, 228, 229, 259,<br>Langton, Moring, Chenoweth |
| Atlantic tomcod<br>*Microgadus tomcod* | 398, 51, 31, 154, 260, 232, 225, 226, 227, 228, 229,<br>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<br>*Pollachius virens* | 260, 76, 419, 154, 51, 66, 259,<br>Schick, Moring, Langton, Chenoweth |
| Red hake<br>*Urophycis chuss* | 51,419, 260, 154, 232, 225, 226, 227, 228, 229, 259,<br>Schick, Chenoweth, Moring |
| White hake<br>*Urophycis tenuis* | 419, 76, 260, 232, 225, 226, 227, 228, 229, 259,<br>Chenoweth, Moring |
| Mummichogs<br>*Fundulus heteroclitus* | 31, 223, 260, 283, 413, 419,<br>Chenoweth, Moring |
| Silversides<br>*Menidia* species | 31, 51, 76, 95, 223, 260, 404, 413,<br>Chenoweth, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 76, 223, 260, 288, 404, 413, 440,<br>Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 181, 223, 248, 260, 404, 413,<br>Chenoweth, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404,<br>Chenoweth, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259,<br>Chenoweth, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| White perch<br>*Morone americana* | 51, 260, 283, 345, 404,<br>Chenoweth, Moring |
| Striped bass<br>*Morone saxatilis* | 23, 51, 56, 260, 283, 426,<br>Chenoweth, Moring, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 76, 260, 325, 419,<br>Chenoweth, Moring, Squiers |
| Scup<br>*Stenotomus chrysops* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Tautog<br>*Tautoga onitis* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 76, 154, 260, 288, 289, 360, 419,<br>Chenoweth, Moring |
| American sandlance<br>*Ammodytes americanus* | 51, 76, 260, 288, 325, 404, 436,<br>Chenoweth, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 76, 260, 325, 345,<br>Chenoweth, Moring, Squiers |
| Butterfish<br>*Peprilus triacanthus* | 51, 76, 260, 296, 325, 345, 419,<br>Chenoweth, Moring, Squiers |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 154, 225, 226, 227, 228, 229, 232, 259, 260, 275, 419,<br>Chenoweth, Langton, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>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<br>*Mytilus edulis* | 77, 260, 311, 343,<br>Chenoweth, Creaser, Moring, Shumway |
| Sea scallop<br>*Placopecten magellanicus* | 34, 142, 295, 379,<br>Chenoweth, Creaser, Schick, Shumway |
| American oyster<br>*Crassostrea virginica* | 142, 158, 240, 419,<br>Chenoweth, Creaser, Moring, Shumway |
| Northern quahog<br>*Mercenaria mercenaria* | 71, 239, 393, 419,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| Softshell clam<br>*Mya arenaria* | 71, 142, 260, 419,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| Grass shrimp<br>*Palaemonetes pugio* | 142, 163, 399, 419, 433,<br>Chenoweth, Larsen, Perkins |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 380, 419, 433,<br>Chenoweth, Perkins, Schick, Shumway |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 129, 176, 419, 433,<br>Chenoweth, Creaser, Larsen, Perkins |
| American lobster<br>*Homarus americanus* | 16, 142, 196, 217, 220, 419, 433,<br>Chenoweth, Creaser, Krouse, Moring |
| Jonah crab<br>*Cancer borealis* | 142, 219, 260, 362, 399, 419, 433,<br>Chenoweth, Krouse, Larsen, Moring |
| Atlantic rock crab<br>*Cancer irroratus* | 142, 216, 218, 219, 260, 362, 399, 419, 433,<br>Chenoweth, Krouse, Larsen, Shumway |
| Green crab<br>*Carcinus maenus* | 4, 50, 83, 419, 433,<br>Chenoweth, Moring |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 186, 325, 419,<br>Chenoweth, Creaser, Larsen |
| Spiny dogfish<br>*Squalus acanthias* | 51, 154, 172, 225, 226, 227, 228, 229, 232, 259, 260, 345, 419,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| Skates<br>*Raja* species | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 142, 272, 386,<br>McCleave, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 142, 155, 272, 386, 399, 419,<br>Squiers |
| American eel<br>*Anguilla rostrata* | 18, 19, 20, 51, 76, 146, 147, 148, 260, 373, 385, 389, 390, 391,<br>Squiers |
| Blueback herring<br>*Alosa aestivalis* | 18, 19, 20, 146, 147, 148, 260, 345, 385, 389, 390, 391,<br>McCleave, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 18, 19, 20, 146, 260, 345, 385, 389, 390, 391,<br>McCleave, Squiers |
| American shad<br>*Alosa sapidissima* | 18, 19, 20, 108, 146, 147, 148, 260, 345, 385, 389, 391, 391,<br>McCleave, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 76, 142, 260, 345, 419,<br>Chenoweth, McCleave, Moring, Nutting, Stevenson |
| Atlantic herring<br>*Clupea harengus* | 51, 76, 142, 345, 404, 419,<br>Chenoweth, McCleave, Moring, Nutting, Stevenson |
| Rainbow smelt<br>*Osmerus mordax* | 51, 76, 144, 260, 282, 345, 370,<br>McCleave, Squiers |
| Atlantic salmon<br>*Salmo salar* | 18, 19, 20, 41, 146, 147, 148, 260, 283, 385, 389, 390, 391,<br>Beland, McCleave, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 76, 79, 154, 225, 226, 227, 228, 229, 232, 259, 260, 335, 345,<br>Chenoweth, Langton, Moring, Perkins |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 76, 225, 226, 227, 228, 229, 232, 259, 335, 383,<br>Chenoweth, Langton, Moring, Perkins |
| Silver hake<br>*Merluccius bilinearis* | 51, 142, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| Atlantic tomcod<br>*Microgadus tomcod* | 31, 51, 154, 225, 226, 227, 228, 229, 232, 260, 398,<br>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<br>*Pollachius virens* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, McCleave, Moring |
| Red hake<br>*Urophycis chuss* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| White hake<br>*Urophycis tenuis* | 76, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| Mummichogs<br>*Fundulus heteroclitus* | 31, 223, 260, 283, 413, 419,<br>Chenoweth, McCleave, Moring |
| Silversides<br>*Menidia* species | 31, 51, 76, 95, 223, 260, 404, 413,<br>Chenoweth, McCleave, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 76, 223, 260, 288, 404, 413, 440,<br>Chenoweth, McCleave, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, McCleave, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, McCleave, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 181, 223, 248, 260, 404, 413,<br>Chenoweth, McCleave |
| Northern searobin<br>*Prionotus carolinus* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404,<br>Chenoweth, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, McCleave, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, 370,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259,<br>Chenoweth, Langton, McCleave, Moring |
| White perch<br>*Morone americana* | 18, 19, 20, 51, 146, 147, 148, 260, 283, 345, 385, 391, 391, 404,<br>McCleave |
| Striped bass<br>*Morone saxatilis* | 18, 19, 20, 51, 56, 146, 147, 148, 260, 283, 385, 389, 390, 391, 426,<br>McCleave, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 76, 260, 325, 419,<br>McCleave, Moring, Nutting, Squiers |
| Scup<br>*Stenotomus chrysops* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, McCleave, Moring |
| Tautog<br>*Tautoga onitis* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, McCleave, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, McCleave, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, McCleave, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 76, 154, 260, 289, 360, 419,<br>Chenoweth, McCleave, Moring |
| American sandlance<br>*Ammodytes americanus* | 51, 76, 260, 288, 325, 404, 436,<br>Chenoweth, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 76, 260, 325, 345,<br>Chenoweth, McCleave, Moring, Nutting, Squiers, Stevenson |
| Butterfish<br>*Peprilus triacanthus* | 51, 76, 260, 296, 325, 345, 419,<br>Chenoweth, McCleave, Moring, Nutting, Squiers |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, McCleave, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 154, 225, 226, 227, 228, 229, 232, 259, 260, 275, 419,<br>Chenoweth, Langton, McCleave, Moring, Perkins |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring, Perkins |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>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<br>*Mytilus edulis* | 77, 260, 311, 343,<br>Creaser, Larsen, Moring, Shumway |
| Sea scallop<br>*Placopecten magellanicus* | 34, 142, 295, 379,<br>Chenoweth, Creaser, Larsen, Moring, Schick, Shumway |
| American oyster<br>*Crassostrea virginica* | 142, 158, 240, 419,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| Northern quahog<br>*Mercenaria mercenaria* | 71, 240, 393, 419,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| Softshell clam<br>*Mya arenaria* | 71, 142, 260, 419,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| Grass shrimp<br>*Palaemonetes pugio* | 142, 163, 212, 336, 399, 419, 433,<br>Chenoweth, Creaser, Larsen, Moring, Perkins, Shumway |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 259, 380, 419, 433,<br>Chenoweth, Creaser, Larsen, Moring, Shumway, |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 129, 176, 419, 433,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| American lobster<br>*Homarus americanus* | 16, 142, 196, 217, 220, 419, 433,<br>Chenoweth, Creaser, Krouse, Larsen, Moring |
| Jonah crab<br>*Cancer borealis* | 142, 218, 260, 362, 399, 419, 433,<br>Chenoweth, Creaser, Krouse, Larsen, Moring, Shumway |
| Atlantic rock crab<br>*Cancer irroratus* | 142, 216, 218, 219, 260, 362, 399, 419, 433,<br>Chenoweth, Creaser, Krouse, Larsen, Moring, Shumway |
| Green crab<br>*Carcinus maenus* | 4, 50, 83, 419, 433,<br>Chenoweth, Creaser, Krouse, Larsen, Moring, Shumway |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 185, 325, 419,<br>Chenoweth, Creaser, Larsen, Moring, Shumway |
| Spiny dogfish<br>*Squalus acanthias* | 51, 154, 172, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Skates<br>*Raja* species | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 142, 155, 272, 384, 386, 399, 419,<br>Chenoweth, Moring, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 142, 155, 272, 384, 386, 399, 419,<br>Chenoweth, Moring, Squiers |
| American eel<br>*Anguilla rostrata* | 18, 19, 20, 76, 146, 147, 148, 260, 283, 373, 385, 389, 390, 391,<br>Chenoweth, Moring, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 18, 19, 20, 146, 147, 148, 260, 345, 385, 389, 390, 391,<br>Chenoweth, Moring, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 18, 19, 20, 146, 147, 148, 385, 389, 390, 391,<br>Chenoweth, Libby, Moring, Squiers |
| American shad<br>*Alosa sapidissima* | 18, 19, 20, 108, 146, 147, 148, 260, 345, 385, 389, 390, 391,<br>Chenoweth, Moring, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 76, 142, 260, 345, 419,<br>Chenoweth, Moring, Nutting, Stevenson |
| Atlantic herring<br>*Clupea harengus* | 51, 76, 142, 345, 404, 419,<br>Chenoweth, Moring, Stevenson |
| Rainbow smelt<br>*Osmerus mordax* | 51, 76, 144, 260, 282, 345, 370,<br>Chenoweth, Moring, Squiers |
| Atlantic salmon<br>*Salmo salar* | 18, 19, 20, 41, 146, 147, 148, 260, 283, 385, 389, 390, 391,<br>Chenoweth, Moring, Squiers |
| Atlantic cod<br>*Gadus morhua* | 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 335, 345,<br>Chenoweth, Langton, Moring |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 76, 225, 226, 227, 228, 229, 232, 259, 335, 383,<br>Chenoweth, Langton, Moring |
| Silver hake<br>*Merluccius bilinearis* | 51, 142, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Atlantic tomcod<br>*Microgadus tomcod* | 31, 51, 154, 225, 226, 227, 228, 229, 232, 260, 398,<br>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<br>*Pollachius virens* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Red hake<br>*Urophycis chuss* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| White hake<br>*Urophycis tenuis* | 31, 76, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Mummichogs<br>*Fundulus heteroclitus* | 31, 223, 260, 283, 413, 419,<br>Chenoweth, Moring |
| Silversides<br>*Menidia* species | 31, 51, 76, 95, 223, 260, 404, 413,<br>Chenoweth, Moring |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 76, 223, 260, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 51, 223, 260, 283, 288, 404, 413, 440,<br>Chenoweth, Moring |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 181, 223, 248, 260, 404, 413,<br>Chenoweth, Moring |
| Northern searobin<br>*Prionotus carolinus* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260, 404,<br>Chenoweth, Moring |
| Grubby<br>*Myoxocephalus aeneus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259, 370,<br>Chenoweth, Langton, Moring |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 76, 154, 172, 225, 226, 227, 228, 229, 232, 259,<br>Chenoweth, Langton, Moring |
| White perch<br>*Morone americana* | 51, 260, 283, 345, 404,<br>Chenoweth, Moring |
| Striped bass<br>*Morone saxatilis* | 18, 19, 20, 56, 146, 147, 148, 260, 385, 389, 390, 391, 426,<br>Chenoweth, Moring, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 76, 260, 324, 419,<br>Chenoweth, Moring, Nutting, Squiers, Stevenson |
| Scup<br>*Stenotomus chrysops* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Moring |
| Tautog<br>*Tautoga onitis* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Ocean pout<br>*Macrozoarces americanus* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Rock gunnel<br>*Pholis gunnellus* | 51, 76, 154, 260, 288, 289, 360, 419,<br>Chenoweth, Moring |
| American sandlance<br>*Ammodytes americanus* | 51, 76, 260, 288, 325, 404, 436,<br>Chenoweth, Moring |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 76, 260, 325, 345,<br>Chenoweth, Moring, Nutting, Squiers |
| Butterfish<br>*Peprilus triacanthus* | 51, 76, 260, 296, 325, 345, 419,<br>Chenoweth, Moring, Nutting, Squiers |
| Windowpane flounder<br>*Scophthalmus aquosus* | 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| American plaice<br>*Hippoglossoides platessoides* | 51, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>Chenoweth, Langton, Moring |
| Winter flounder<br>*Pleuronectes americanus* | 154, 225, 226, 227, 228, 229, 232, 232, 259, 260, 275, 419,<br>Chenoweth, Langton, Moring |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 76, 154, 225, 226, 227, 228, 229, 232, 259, 260, 419,<br>Chenoweth, Langton, Moring |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 76, 154, 225, 226, 227, 228, 229, 232, 259, 260,<br>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<br>*Mytilus edulis* | 70, 74, 142, 238, 309, 310, 311, 343, 419,<br>Creaser, Doggett, Goode, Larsen, Shumway, Sterl |
| Sea scallop<br>*Placopecten magellanicus* | 70, 142, 295, 379, 419,<br>Creaser, Doggett, Goode, Larsen, Shumway, Sterl |
| American oyster<br>*Crassostrea virginica* | 142, 158, 371,<br>Creaser, Doggett, Goode, Larsen, Shumway, Sterl |
| Northern quahog<br>*Mercenaria mercenaria* | 142, 393, 419,<br>Creaser, Doggett, Goode, Larsen, Shumway, Sterl |
| Softshell clam<br>*Mya arenaria* | 67, 142, 238, 308, 419,<br>Creaser, Doggett, Goode, Larsen, Shumway, Sterl |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 73, 213, 433,<br>Creaser, Doggett, Larsen, Perkins, Shumway, Sterl |
| Northern shrimp<br>*Pandalus borealis* | 73, 74, 142, 182, 278, 332, 380, 419, 433,<br>Creaser, Doggett, Goode, Larsen, Perkins, Shumway, Sterl |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 73, 100, 176, 433,<br>Creaser, Doggett, Goode, Larsen, Perkins, Shumway, Sterl |
| American lobster<br>*Homarus americanus* | 70, 73, 97, 142, 217, 324, 325, 419,<br>Creaser, Doggett, Goode, Krouse, Larsen, Perkins, Shumway, Sterl |
| Jonah crab<br>*Cancer borealis* | 73, 75, 142, 175, 201, 219, 238, 325, 433,<br>Creaser, Doggett, Goode, Krouse, Larsen, Perkins, Shumway, Sterl |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 73, 75, 142, 201, 216, 219, 238, 325, 433,<br>Creaser, Doggett, Goode, Krouse, Larsen, Perkins, Shumway, Sterl |
| Green crab<br>*Carcinus maenus* | 50, 73, 83, 355, 428, 433,<br>Creaser, Doggett, Goode, Larsen, Perkins, Shumway, Sterl |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 185, 186, 238, 293, 372, 419,<br>Creaser, Doggett, Goode, Larsen, Shumway, Sterl |
| Spiny dogfish<br>*Squalus acanthias* | 51, 70, 73, 142, 202, 304, 325, 345, 419,<br>Goode, Langton, Perkins |
| Skates<br>*Raja* species | 51, 70, 73, 142, 232, 260, 276, 370, 419,<br>Goode, Langton, Perkins |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 106, 142, 161, 370, 419,<br>Goode, Langton, Perkins, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 142, 161, 370, 405,<br>Goode, Langton, Perkins, Squiers |
| American eel<br>*Anguilla rostrata* | 31, 51, 76, 137, 142, 184, 370,<br>Goode, Langton, Perkins, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 31, 51, 70, 142, 251, 260, 294, 345, 370, 419,<br>Goode, Squiers, |
| Alewife<br>*Alosa pseudoharengus* | 31, 51, 70, 74, 142, 251, 294, 370, 404, 419,<br>Goode, Squiers |
| American shad<br>*Alosa sapidissima* | 51, 108, 142, 260, 345, 370, 419, 427,<br>Goode, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 70, 74, 142, 260, 345, 354, 370, 419,<br>Chenoweth, Goode |
| Atlantic herring<br>*Clupea harengus* | 31, 70, 73, 76, 101, 102, 142, 166, 167, 168, 208, 381, 404, 419,<br>Chenoweth, Goode |
| Rainbow smelt<br>*Osmerus mordax* | 31, 51, 62, 70, 73, 76, 142, 260, 345, 370, 419,<br>Goode, Squiers |
| Atlantic salmon<br>*Salmo salar* | 24, 25, 41, 51, 109, 142,<br>Goode, Squiers, |
| Atlantic cod<br>*Gadus morhua* | 51, 70, 73, 74, 76, 142, 320, 321, 325, 335, 370, 419,<br>Goode, Langton, Perkins |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 74, 142, 320, 321, 335, 370, 419,<br>Goode, Langton, Perkins |
| Silver hake<br>*Merluccius bilinearis* | 51, 70, 73, 74, 76, 142, 232, 260, 321, 370, 419,<br>Goode, Langton, Perkins |
| Atlantic tomcod<br>*Microgadus tomcod* | 31, 51, 70, 73, 142, 260, 370, 398, 404,<br>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<br>*Pollachius virens* | 51, 70, 73, 74, 142, 269, 325, 370, 419,<br>Goode, Langton, Perkins |
| Red hake<br>*Urophycis chuss* | 51, 70, 73, 74, 142, 232, 260, 265, 302, 370,<br>Goode, Langton, Perkins |
| White hake<br>*Urophycis tenuis* | 31, 51, 70, 73, 74, 138, 142, 260, 265, 302, 370, 419,<br>Goode, Langton, Perkins |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 31, 51, 121, 142, 370, 404, 419,<br>Chenoweth, Goode |
| Silversides<br>*Menidia* species | 31, 51, 73, 94, 121, 141, 142, 370, 404, 419,<br>Chenoweth, Goode |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 142, 370, 404, 439, 440,<br>Chenoweth, Goode |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 31, 51, 121, 142, 370, 404, 439, 440,<br>Chenoweth, Goode |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 31, 51, 121, 142, 370, 404, 439, 440,<br>Chenoweth, Goode |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 73, 76, 142, 248, 370,<br>Chenoweth, Goode |
| Northern searobin<br>*Prionotus carolinus* | 51, 142, 350, 370,<br>Goode, Langton, Perkins |
| Grubby<br>*Myoxocephalus aeneus* | 31, 51, 73, 142, 247, 260, 370,<br>Goode, Langton, Perkins |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 70, 73, 76, 142, 232, 235, 260, 325, 370, 419,<br>Goode, Langton, Perkins |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 70, 76, 142, 235, 325, 370,<br>Goode, Langton, Perkins |
| White perch<br>*Morone americana* | 51, 121, 142, 260, 370, 392,<br>Chenoweth |
| Striped bass<br>*Morone saxatilis* | 51, 56, 121, 140, 142, 260, 370, 419, 426,<br>Chenoweth, Goode, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 70, 73, 121, 142, 260, 287, 327, 370, 419,<br>Chenoweth, Goode, Squiers |
| Scup<br>*Stenotomus chrysops* | 51, 74, 142, 290, 370, 419,<br>Langton, Perkins |
| Tautog<br>*Tautoga onitis* | 29, 51, 142, 370, 419,<br>Goode, Langton, Perkins |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 70, 76, 142, 325, 370, 419,<br>Goode, Langton, Perkins |
| Ocean pout<br>*Macrozoarces americanus* | 51, 70, 73, 142, 232, 260, 370, 419,<br>Goode, Langton, Perkins |
| Rock gunnel<br>*Pholis gunnellus* | 31, 51, 70, 73, 76, 142, 360, 370,<br>Goode, Langton, Perkins |
| American sandlance<br>*Ammodytes americanus* | 30, 31, 51, 76, 121, 142, 306, 347, 370, 382, 419,<br>Chenoweth |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 70, 73, 74, 142, 260, 325, 345, 370, 419,<br>Chenoweth, Goode, Squiers |
| Butterfish<br>*Peprilus triacanthus* | 51, 70, 73, 142, 296, 297, 370, 419,<br>Chenoweth, Goode, Squiers |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 70, 73, 74, 76, 142, 232, 260, 370,<br>Goode, Langton, Perkins |
| American plaice<br>*Hippoglossoides platessoides* | 51, 70, 74, 142, 232, 320, 321, 335, 370, 419,<br>Goode, Langton, Perkins |
| Winter flounder<br>*Pleuronectes americanus* | 27, 31, 51, 63, 70, 74, 142, 260, 275, 370, 404, 419,<br>Goode, Langton, Perkins |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 70, 74, 76, 142, 232, 320, 321, 321, 370, 419,<br>Goode, Langton, Perkins |
| Smooth flounder<br>*Pleuronectes putnami* | 27, 31, 51, 142, 234, 260, 370, 404,<br>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<br>*Mytilus edulis* | 70, 74, 142, 309, 310, 311, 343, 419,<br>Creaser, Goode, Larsen, Shumway, Sterl |
| Sea scallop<br>*Placopecten magellanicus* | 70, 142, 295, 379, 419,<br>Creaser, Goode, Larsen, Shumway, Sterl |
| American oyster<br>*Crassostrea virginica* | 142, 158, 371,<br>Creaser, Goode, Larsen, Shumway, Sterl |
| Northern quahog<br>*Mercenaria mercenaria* | 393, 419,<br>Creaser, Goode, Larsen, Shumway, Sterl |
| Softshell clam<br>*Mya arenaria* | 142, 308, 419,<br>Creaser, Goode, Larsen, Shumway, Sterl |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 213, 433,<br>Creaser, Larsen, Perkins, Shumway, Sterl |
| Northern shrimp<br>*Pandalus borealis* | 74, 142, 182, 278, 332, 380, 419, 433,<br>Creaser, Goode, Larsen, Perkins, Shumway, Sterl |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 100, 176, 284, 346, 433,<br>Creaser, Goode, Larsen, Perkins, Shumway, Sterl |
| American lobster<br>*Homarus americanus* | 70, 97, 142, 217, 324, 325, 346, 419,<br>Creaser, Goode, Krouse, Larsen, Perkins, Shumway, Sterl |
| Jonah crab<br>*Cancer borealis* | 75, 142, 175, 201, 219, 284, 324, 325, 346, 433,<br>Creaser, Goode, Krouse, Larsen, Perkins, Shumway, Sterl |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 75, 142, 201, 216, 219, 324, 325, 346, 433,<br>Creaser, Goode, Krouse, Larsen, Perkins, Shumway, Sterl |
| Green crab<br>*Carcinus maenus* | 50, 83, 284, 346, 355, 428, 433,<br>Creaser, Goode, Larsen, Perkins, Shumway, Sterl |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 185, 186, 293, 346, 372, 419,<br>Creaser, Larsen, Shumway |
| Spiny dogfish<br>*Squalus acanthias* | 51, 70, 142, 202, 260, 304, 324, 325, 345, 370, 419,<br>Goode, Langton, Perkins |
| Skates<br>*Raja* species | 51, 70, 72, 142, 232, 260, 276, 346, 370, 419,<br>Goode, Langton, Perkins |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 17, 51, 106, 142, 161, 370, 419,<br>Goode, Langton, Perkins, Squiers |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 17, 51, 142, 161, 370, 405,<br>Goode, Langton, Perkins, Squiers |
| American eel<br>*Anguilla rostrata* | 31, 51, 72, 76, 137, 142, 184, 346, 370,<br>Goode, Langton, Perkins, Squiers |
| Blueback herring<br>*Alosa aestivalis* | 17, 31, 51, 70, 121, 142, 251, 260, 294, 345, 370, 419,<br>Goode, Squiers |
| Alewife<br>*Alosa pseudoharengus* | 17, 31, 51, 70, 74, 121, 142, 251, 294, 345, 370, 404, 419,<br>Goode, Squiers |
| American shad<br>*Alosa sapidissima* | 17, 51, 72, 108, 121, 142, 260, 345, 370, 419, 427,<br>Goode, Squiers |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 70, 74, 121, 142, 260, 345, 354, 370, 419,<br>Chenoweth, Goode |
| Atlantic herring<br>*Clupea harengus* | 31, 51, 70, 74, 102, 121, 142, 208, 249, 370, 404, 419,<br>Chenoweth, Goode |
| Rainbow smelt<br>*Osmerus mordax* | 17, 31, 51, 62, 70, 76, 121, 142, 260, 345, 370, 419,<br>Goode, Squiers |
| Atlantic salmon<br>*Salmo salar* | 17, 24, 25, 41, 51, 109, 142, 346,<br>Goode, Squiers |
| Atlantic cod<br>*Gadus morhua* | 51, 70, 74, 76, 142, 320, 321, 324, 325, 335, 346, 370, 419,<br>Goode, Langton, Perkins |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 74, 142, 320, 321, 335, 370, 419,<br>Goode, Langton, Perkins |
| Silver hake<br>*Merluccius bilinearis* | 51, 70, 74, 76, 142, 232, 260, 320, 321, 346, 370, 419,<br>Goode, Langton, Perkins |
| Atlantic tomcod<br>*Microgadus tomcod* | 31, 51, 70, 121, 142, 260, 346, 370, 398, 404,<br>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<br>*Pollachius virens* | 51, 70, 74, 121, 142, 269, 324, 325, 346, 370, 419,<br>Goode, Langton, Perkins |
| Red hake<br>*Urophycis chuss* | 51, 70, 72, 74, 142, 232, 260, 265, 302, 346, 370,<br>Goode, Langton, Perkins |
| White hake<br>*Urophycis tenuis* | 31, 51, 70, 74, 138, 142, 227, 260, 265, 302, 370, 419,<br>Goode, Langton, Perkins |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 31, 51, 72, 121, 142, 346, 370, 404, 419,<br>Chenoweth, Goode |
| Silversides<br>*Menidia* species | 31, 51, 72, 94, 121, 141, 142, 370, 404, 419,<br>Chenoweth, Goode |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 72, 142, 346, 370, 404, 439, 440,<br>Chenoweth, Goode |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 31, 51, 72, 121, 142, 346, 370, 404, 439, 440,<br>Chenoweth, Goode |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 31, 51, 121, 142, 346, 370, 404, 439, 440,<br>Chenoweth, Goode |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 72, 76, 142, 248, 370,<br>Chenoweth |
| Northern searobin<br>*Prionotus carolinus* | 51, 142, 350, 370,<br>Goode, Langton, Perkins |
| Grubby<br>*Myoxocephalus aeneus* | 31, 51, 142, 247, 260, 370,<br>Goode, Langton, Perkins |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 70, 76, 142, 232, 235, 260, 325, 370, 419,<br>Goode, Langton, Perkins |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 70, 76, 142, 235, 325, 370,<br>Goode, Langton, Perkins |
| White perch<br>*Morone americana* | 51, 121, 142, 260, 370, 392,<br>Chenoweth |
| Striped bass<br>*Morone saxatilis* | 17, 51, 56, 121, 140, 142, 260, 370, 419, 426,<br>Chenoweth, Goode, Squiers |
| Bluefish<br>*Pomatomus saltatrix* | 51, 70, 121, 142, 260, 287, 327, 370, 419,<br>Chenoweth, Goode, Squiers |
| Scup<br>*Stenotomus chrysops* | 51, 74, 142, 290, 370, 419,<br>Goode, Langton, Perkins |
| Tautog<br>*Tautoga onitis* | 29, 51, 142, 370, 419,<br>Goode, Langton, Perkins |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 70, 76, 142, 325, 346, 370, 419,<br>Goode, Langton, Perkins |
| Ocean pout<br>*Macrozoarces americanus* | 51, 70, 142, 232, 260, 370, 419,<br>Goode, Langton, Perkins |
| Rock gunnel<br>*Pholis gunnellus* | 31, 51, 70, 76, 142, 360, 370,<br>Goode, Langton, Perkins |
| American sandlance<br>*Ammodytes americanus* | 30, 31, 51, 72, 76, 121, 142, 306, 346, 347, 370, 419,<br>Chenoweth |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 70, 74, 121, 142, 260, 324, 325, 345, 346, 370, 419,<br>Chenoweth, Goode, Squiers |
| Butterfish<br>*Peprilus triacanthus* | 51, 70, 142, 296, 297, 370, 419,<br>Chenoweth, Goode, Squiers |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 70, 74, 76, 142, 232, 260, 346, 370,<br>Goode, Langton, Perkins |
| American plaice<br>*Hippoglossoides platessoides* | 51, 70, 74, 142, 232, 335, 370, 419,<br>Goode, Langton, Perkins |
| Winter flounder<br>*Pleuronectes americanus* | 27, 31, 51, 63, 70, 74, 142, 275, 346, 370, 404, 419,<br>Goode, Langton, Perkins |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 70, 74, 76, 142, 232, 320, 321, 370, 419,<br>Goode, Langton, Perkins |
| Smooth flounder<br>*Pleuronectes putnami* | 27, 31, 51, 142, 234, 260, 370, 404,<br>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<br>*Mytilus edulis* | 142, 238, 309, 310, 311, 343, 419,<br>Dionne, Sterl |
| Sea scallop<br>*Placopecten magellanicus* | 142, 295, 379, 419,<br>Dionne, Sterl |
| American oyster<br>*Crassostrea virginica* | 142, 158, 371,<br>Dionne, Sterl |
| Northern quahog<br>*Mercenaria mercenaria* | 393, 419,<br>Sterl |
| Softshell clam<br>*Mya arenaria* | 142, 162, 238, 308, 419,<br>Dionne, Sterl |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 213, 312, 429, 433,<br>Dionne, Sterl |
| Northern shrimp<br>*Pandalus borealis* | 142, 182, 278, 332, 380, 419, 433,<br>Dionne, Sterl |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 100, 162, 176, 433,<br>Dionne, Sterl |
| American lobster<br>*Homarus americanus* | 1, 97, 142, 162, 217, 257, 419,<br>Dionne, Sterl |
| Jonah crab<br>*Cancer borealis* | 75, 142, 175, 201, 219, 433,<br>Dionne, Sterl |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 75, 142, 201, 216, 219, 433,<br>Dionne, Sterl |
| Green crab<br>*Carcinus maenus* | 50, 83, 162, 355, 428, 433,<br>Dionne, Sterl |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 78, 185, 186, 293, 372, 419,<br>Dionne, Sterl |
| Spiny dogfish<br>*Squalus acanthias* | 51, 142, 202, 304, 345, 370, 419,<br>Dionne, Sterl |
| Skates<br>*Raja* species | 51, 142, 232, 276, 370, 419,<br>Dionne, Sterl |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 106, 142, 161, 370, 419,<br>Dionne, Sterl |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 142, 161, 370, 405,<br>Dionne, Sterl |
| American eel<br>*Anguilla rostrata* | 31, 51, 76, 114, 137, 142, 184, 370,<br>Dionne, Sterl |
| Blueback herring<br>*Alosa aestivalis* | 31, 51, 114, 142, 251, 294, 345, 370, 419,<br>Dionne, Sterl |
| Alewife<br>*Alosa pseudoharengus* | 31, 51, 114, 142, 251, 294, 345, 370, 404, 419,<br>Dionne, Sterl |
| American shad<br>*Alosa sapidissima* | 51, 108, 142, 345, 370, 419, 427,<br>Dionne, Sterl |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 142, 345, 354, 370, 419,<br>Dionne, Sterl |
| Atlantic herring<br>*Clupea harengus* | 31, 51, 102, 114, 142, 166, 208, 249, 370, 404, 419,<br>Dionne, Sterl |
| Rainbow smelt<br>*Osmerus mordax* | 31, 51, 62, 76, 114, 142, 345, 370, 419,<br>Dionne, Sterl |
| Atlantic salmon<br>*Salmo salar* | 24, 25, 41, 51, 109, 142,<br>Dionne |
| Atlantic cod<br>*Gadus morhua* | 51, 76, 142, 335, 370, 419,<br>Dionne, Sterl |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 53, 142, 335, 370, 419,<br>Dionne, Sterl |
| Silver hake<br>*Merluccius bilinearis* | 51, 76, 142, 232, 370, 419,<br>Dionne, Sterl |
| Atlantic tomcod<br>*Microgadus tomcod* | 31, 51, 114, 142, 370, 398, 404,<br>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<br>*Pollachius virens* | 51, 142, 162, 269, 370, 419,<br>Dionne, Sterl |
| Red hake<br>*Urophycis chuss* | 51, 142, 232, 265, 302, 370,<br>Sterl |
| White hake<br>*Urophycis tenuis* | 31, 51, 114, 138, 142, 232, 265, 302, 370, 419,<br>Sterl |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 31, 51, 114, 142, 301, 370, 404, 419,<br>Dionne, Sterl |
| Silversides<br>*Menidia* species | 31, 51, 94, 114, 141, 142, 370, 404, 419,<br>Dionne, Sterl |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 31, 51, 114, 142, 370, 404, 439, 440,<br>Dionne, Sterl |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 31, 51, 114, 142, 370, 404, 439, 440,<br>Dionne, Sterl |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 31, 51, 114, 142, 370, 404, 439, 440,<br>Dionne, Sterl |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 76, 114, 142, 248, 370,<br>Dionne, Sterl |
| Northern searobin<br>*Prionotus carolinus* | 51, 142, 350, 370,<br>Dionne, Sterl |
| Grubby<br>*Myoxocephalus aeneus* | 31, 51, 114, 142, 370,<br>Sterl |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 76, 142, 232, 235, 370, 419,<br>Dionne, Sterl |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 76, 142, 235, 370,<br>Dionne, Sterl |
| White perch<br>*Morone americana* | 51, 142, 370, 392,<br>Dionne, Sterl |
| Striped bass<br>*Morone saxatilis* | 51, 56, 140, 142, 162, 370, 419, 426,<br>Dionne, Sterl |
| Bluefish<br>*Pomatomus saltatrix* | 51, 142, 287, 327, 370, 419,<br>Dionne, Sterl |
| Scup<br>*Stenotomus chrysops* | 51, 142, 290, 370, 419,<br>Sterl |
| Tautog<br>*Tautoga onitis* | 29, 51, 142, 370, 419,<br>Sterl |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 76, 142, 370, 419,<br>Sterl |
| Ocean pout<br>*Macrozoarces americanus* | 51, 142, 232, 370, 419,<br>Dionne, Sterl |
| Rock gunnel<br>*Pholis gunnellus* | 31, 51, 76, 142, 289, 360, 370,<br>Sterl |
| American sandlance<br>*Ammodytes americanus* | 30, 31, 51, 76, 114, 142, 162, 347, 370, 382, 419,<br>Dionne, Sterl |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 142, 162, 345, 370, 419,<br>Dionne, Sterl |
| Butterfish<br>*Peprilus triacanthus* | 51, 142, 296, 297, 370, 419,<br>Dionne, Sterl |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 76, 114, 142, 232, 370,<br>Dionne, Sterl |
| American plaice<br>*Hippoglossoides platessoides* | 51, 142, 232, 335, 370, 419,<br>Dionne, Sterl |
| Winter flounder<br>*Pleuronectes americanus* | 27, 31, 51, 63, 114, 142, 232, 275, 370, 404, 419,<br>Dionne, Sterl |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 76, 114, 142, 232, 370, 419,<br>Dionne, Sterl |
| Smooth flounder<br>*Pleuronectes putnami* | 27, 31, 51, 114, 142, 370, 404,<br>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<br>*Mytilus edulis* | 22, 115, 116, 180, 309, 310, 311, 318, 343, 378, 420,<br>Armstrong, Bowen, Grizzle, Harris, Howell, Nelson, Short |
| Sea scallop<br>*Placopecten magellanicus* | 142, 295, 318, 379, 420,<br>Armstrong, Bowen, Grizzle, Harris, Howell, Nelson |
| American oyster<br>*Crassostrea virginica* | 22, 115, 116, 180, 200, 371, 378, 420,<br>Armstrong, Bowen, Grizzle, Howell, Nelson, Short |
| Northern quahog<br>*Mercenaria mercenaria* | 115, 116, 378, 393,<br>Armstrong, Bowen, Grizzle, Howell, Nelson |
| Softshell clam<br>*Mya arenaria* | 22, 61, 115, 116, 180, 200, 308, 318, 378, 420,<br>Armstrong, Bowen, Grizzle, Howell, Nelson, Short |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 213, 312, 433,<br>Armstrong, Bowen, Gestring, Howell, Nelson, Short |
| Northern shrimp<br>*Pandalus borealis* | 182, 278, 332, 380, 433,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 22, 99, 100, 115, 116, 176, 318, 420, 433,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| American lobster<br>*Homarus americanus* | 22, 115, 116, 164, 192, 257, 318, 378, 420, 425, 433,<br>Armstrong, Bowen, Howell, Nelson, Short |
| Jonah crab<br>*Cancer borealis* | 75, 115, 116, 175, 201, 318, 378, 420, 433,<br>Armstrong, Bowen, Harris, Howell, Nelson, Short |
| Atlantic rock crab<br>*Cancer irroratus* | 22, 52, 75, 115, 116, 201, 216, 318, 378, 420, 433,<br>Armstrong, Bowen, Harris, Howell, Nelson, Short |
| Green crab<br>*Carcinus maenus* | 50, 115, 116, 180, 318, 355, 378, 420, 428, 433,<br>Armstrong, Bowen, Harris, Howell, Nelson, Short |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 180, 372, 420,<br>Armstrong, Bowen, Harris, Howell, Nelson |
| Spiny dogfish<br>*Squalus acanthias* | 51, 92, 115, 202, 304, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Skates<br>*Raja* species | 51, 115, 116, 276, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 106, 161, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 115, 161, 200, 370, 378, 405,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| American eel<br>*Anguilla rostrata* | 51, 115, 116, 137, 184, 200, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Blueback herring<br>*Alosa aestivalis* | 22, 51, 115, 116, 117, 160, 251, 294, 316, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Alewife<br>*Alosa pseudoharengus* | 3, 22, 51, 115, 116, 117, 160, 224, 251, 294, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| American shad<br>*Alosa sapidissima* | 51, 108, 115, 117, 370, 378, 427,<br>Armstrong, Bowen, Howell, Nelson |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 115, 116, 316, 318, 354, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Atlantic herring<br>*Clupea harengus* | 22, 31, 51, 102, 115, 116, 208, 316, 318, 370, 378, 381, 416,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Rainbow smelt<br>*Osmerus mordax* | 22, 51, 62, 115, 116, 117, 160, 200, 298, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Atlantic salmon<br>*Salmo salar* | 22, 24, 25, 51, 109, 115, 116, 117, 200, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Atlantic cod<br>*Gadus morhua* | 51, 115, 116, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Haddock<br>*Melanogrammus aeglefinus* | 22, 51, 53, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Silver hake<br>*Merluccius bilinearis* | 51, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Atlantic tomcod<br>*Microgadus tomcod* | 22, 51, 115, 116, 160, 200, 316, 318, 338, 370, 378, 398,<br>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<br>*Pollachius virens* | 22, 51, 115, 116, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Red hake<br>*Urophycis chuss* | 22, 51, 115, 116, 265, 302, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| White hake<br>*Urophycis tenuis* | 22, 51, 115, 116, 138, 265, 302, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 22, 31, 51, 115, 116, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Silversides<br>*Menidia* species | 22, 31, 51, 95, 96, 115, 116, 141, 160, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Fourspine stickleback<br>*Apeltes quadracus* | 22, 28, 31, 51, 115, 116, 160, 316, 318, 370, 378, 440,<br>Armstrong, Bowen, Gestring, Howell, Nelson, Short |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 22, 28, 31, 51, 115, 116, 160, 316, 318, 370, 378, 440,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Ninespine stickleback<br>*Pungitius pungitius* | 22, 28, 31, 51, 115, 116, 160, 316, 318, 370, 378, 440,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Northern pipefish<br>*Syngnathus fuscus* | 31, 51, 115, 116, 160, 248, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Northern searobin<br>*Prionotus carolinus* | 22, 51, 316, 350, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Grubby<br>*Myoxocephalus aeneus* | 22, 51, 115, 116, 160, 247, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 22, 51, 115, 116, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 22, 51, 316, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| White perch<br>*Morone americana* | 51, 115, 116, 160, 370, 378, 392,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Striped bass<br>*Morone saxatilis* | 51, 56, 116, 117, 140, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Bluefish<br>*Pomatomus saltatrix* | 51, 117, 287, 327, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson, Short |
| Scup<br>*Stenotomus chrysops* | 51, 290, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Tautog<br>*Tautoga onitis* | 22, 29, 51, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson, Short |
| Cunner<br>*Tautogolabrus adspersus* | 22, 29, 51, 115, 116, 160, 316, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Ocean pout<br>*Macrozoarces americanus* | 51, 116, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Rock gunnel<br>*Pholis gunnellus* | 22, 51, 115, 116, 316, 318, 360, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| American sandlance<br>*Ammodytes americanus* | 22, 30, 31, 51, 160, 306, 316, 318, 347, 370, 378, 382,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Atlantic mackerel<br>*Scomber scombrus* | 22, 51, 117, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Butterfish<br>*Peprilus triacanthus* | 22, 51, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 115, 116, 318, 370, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| American plaice<br>*Hippoglossoides platessoides* | 22, 51, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Winter flounder<br>*Pleuronectes americanus* | 22, 27, 63, 115, 116, 160, 275, 316, 318, 378,<br>Armstrong, Bowen, Gestring, Howell, Nelson, Short |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 22, 51, 316, 318, 370,<br>Armstrong, Bowen, Gestring, Howell, Nelson |
| Smooth flounder<br>*Pleuronectes putnami* | 22, 27, 51, 115, 116, 234, 246, 316, 318, 370, 378,<br>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<br>*Mytilus edulis* | 203, 205, 267, 310, 311, 314, 318, 343,<br>Bowen, Deegan, Iwanowicz |
| Sea scallop<br>*Placopecten magellanicus* | 203, 267, 295, 303, 314, 318,<br>Bowen, Deegan, Iwanowicz |
| American oyster<br>*Crassostrea virginica* | 203, 205, 267, 314, 318, 371,<br>Bowen, Deegan, Iwanowicz |
| Northern quahog<br>*Mercenaria mercenaria* | 203, 205, 267, 314, 393,<br>Bowen, Deegan, Iwanowicz |
| Softshell clam<br>*Mya arenaria* | 61, 203, 205, 267, 308, 314, 318,<br>Bowen, Deegan, Iwanowicz |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 213, 312, 433,<br>Bowen, Iwanowicz |
| Northern shrimp<br>*Pandalus borealis* | 26, 182, 332, 380, 433,<br>Bowen, Iwanowicz |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 99, 100, 176, 318,<br>Deegan, Iwanowicz |
| American lobster<br>*Homarus americanus* | 135, 151, 188, 203, 205, 257, 314, 318,<br>Bowen, Deegan, Iwanowicz |
| Jonah crab<br>*Cancer borealis* | 75, 203, 205, 314, 318, 433,<br>Iwanowicz |
| Atlantic rock crab<br>*Cancer irroratus* | 52, 75, 203, 205, 314, 318, 433,<br>Deegan, Iwanowicz |
| Green crab<br>*Carcinus maenus* | 50, 203, 314, 318, 355, 428, 433,<br>Bowen, Deegan, Iwanowicz |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 314, 372,<br>Bowen, Iwanowicz, |
| Spiny dogfish<br>*Squalus acanthias* | 51, 84, 92, 202, 205, 304, 320, 321, 356, 370,<br>Bowen, Iwanowicz, |
| Skates<br>*Raja* species | 51, 84, 205, 318, 320, 321, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 84, 106, 161, 209, 210, 370,<br>Deegan, Iwanowicz, Keiffer |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 84, 161, 205, 209, 210, 370, 405,<br>Deegan, Iwanowicz, Keiffer |
| American eel<br>*Anguilla rostrata* | 137, 184, 205, 314, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Blueback herring<br>*Alosa aestivalis* | 51, 84, 197, 203, 205, 251, 294, 314, 339, 370,<br>Bowen, Iwanowicz, Keiffer, Stolte |
| Alewife<br>*Alosa pseudoharengus* | 51, 84, 203, 205, 251, 294, 314, 339, 370,<br>Bowen, Iwanowicz, Keiffer, Stolte |
| American shad<br>*Alosa sapidissima* | 51, 108, 126, 197, 314, 320, 321, 356, 370, 427,<br>Bowen, Deegan, Iwanowicz, Keiffer, Stolte |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 51, 339, 354, 370,<br>Bowen, Deegan, Iwanowicz, Keiffer |
| Atlantic herring<br>*Clupea harengus* | 51, 102, 208, 249, 318, 339, 370, 381, 416,<br>Bowen, Iwanowicz |
| Rainbow smelt<br>*Osmerus mordax* | 51, 62, 84, 203, 205, 298, 314, 318, 339, 370,<br>Bowen, Iwanowicz, Keiffer |
| Atlantic salmon<br>*Salmo salar* | 24, 25, 51, 84, 109, 126, 197, 314, 370, 401,<br>Bowen, Deegan, Iwanowicz, Keiffer, Stolte |
| Atlantic cod<br>*Gadus morhua* | 51, 84, 205, 318, 320, 321, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 84, 203, 320, 321, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Silver hake<br>*Merluccius bilinearis* | 51, 84, 318, 320, 321, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Atlantic tomcod<br>*Microgadus tomcod* | 84, 205, 338, 339, 356, 370, 398,<br>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<br>*Pollachius virens* | 51, 84, 203, 269, 318, 339, 370,<br>Bowen, Deegan, Iwanowicz |
| Red hake<br>*Urophycis chuss* | 51, 84, 203, 205, 265, 318, 320, 321, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| White hake<br>*Urophycis tenuis* | 51, 84, 203, 205, 265, 318, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 51, 84, 203, 205, 318, 370,<br>Bowen, Deegan, Iwanowicz |
| Silversides<br>*Menidia* species | 51, 84, 95, 96, 141, 203, 205, 370,<br>Bowen, Deegan, Iwanowicz |
| Fourspine stickleback<br>*Apeltes quadracus* | 28, 51, 84, 205, 318, 370, 439, 440,<br>Bowen, Iwanowicz |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 28, 51, 203, 205, 339, 370, 434, 439, 440,<br>Bowen, Iwanowicz |
| Ninespine stickleback<br>*Pungitius pungitius* | 28, 51, 84, 203, 205, 370, 439, 440,<br>Bowen, Iwanowicz |
| Northern pipefish<br>*Syngnathus fuscus* | 51, 84, 203, 205, 248, 339, 370,<br>Bowen, Deegan, Iwanowicz |
| Northern searobin<br>*Prionotus carolinus* | 51, 84, 339, 350,<br>Bowen, Iwanowicz |
| Grubby<br>*Myoxocephalus aeneus* | 51, 84, 247, 339,<br>Bowen, Deegan, Iwanowicz |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 84, 205, 235, 339, 370,<br>Bowen, Deegan, Iwanowicz |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 84, 235, 339, 356, 370,<br>Bowen, Iwanowicz |
| White perch<br>*Morone americana* | 51, 84, 203, 205, 370, 392,<br>Bowen, Iwanowicz, Keiffer |
| Striped bass<br>*Morone saxatilis* | 51, 56, 84, 140, 197, 203, 320, 321, 370, 426,<br>Bowen, Deegan, Iwanowicz, Keiffer |
| Bluefish<br>*Pomatomus saltatrix* | 51, 84, 320, 321, 327,<br>Bowen, Deegan, Iwanowicz |
| Scup<br>*Stenotomus chrysops* | 51, 84, 290, 318, 320, 321,<br>Bowen, Deegan, Iwanowicz |
| Tautog<br>*Tautoga onitis* | 29, 51, 84, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Cunner<br>*Tautogolabrus adspersus* | 29, 51, 84, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Ocean pout<br>*Macrozoarces americanus* | 51, 84, 318, 370,<br>Bowen, Iwanowicz |
| Rock gunnel<br>*Pholis gunnellus* | 51, 84, 339, 370,<br>Bowen, Deegan, Iwanowicz |
| American sandlance<br>*Ammodytes americanus* | 30, 84, 203, 205, 314, 318, 339, 347, 370, 430,<br>Bowen, Deegan, Iwanowicz |
| Atlantic mackerel<br>*Scomber scombrus* | 51, 84, 203, 314, 318, 320, 321, 339, 370,<br>Bowen, Iwanowicz |
| Butterfish<br>*Peprilus triacanthus* | 51, 84, 296, 297, 318, 320, 321, 370,<br>Bowen, Iwanowicz |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 205, 318, 320, 321, 339, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| American plaice<br>*Hippoglossoides platessoides* | 51, 84, 203, 320, 321, 339, 370,<br>Bowen, Iwanowicz |
| Winter flounder<br>*Pleuronectes americanus* | 51, 63, 84, 203, 205, 275, 314, 318, 320, 321, 328, 339, 353, 356, 370,<br>Bowen, Deegan, Iwanowicz |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 84, 203, 205, 318, 320, 321, 339, 370,<br>Bowen, Iwanowicz |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 203, 318, 370,<br>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<br>*Mytilus edulis* | 10, 13, 82, 112, 143, 190, 191, 310,<br>Chase, Deegan, Lawton, Robinson, Toner |
| Sea scallop<br>*Placopecten magellanicus* | 10, 13, 74, 82, 143, 190, 191, 193, 295, 320, 321,<br>Chase, Deegan, Robinson |
| American oyster<br>*Crassostrea virginica* | 10, 13, 82, 143, 371,<br>Chase, Deegan, Robinson, Toner |
| Northern quahog<br>*Mercenaria mercenaria* | 10, 13, 82, 143, 393,<br>Chase, Deegan |
| Softshell clam<br>*Mya arenaria* | 10, 13, 82, 143, 308,<br>Chase, Deegan, Robinson, Toner |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 10, 112, 213, 312, 429, 433,<br>Chase, Deegan |
| Northern shrimp<br>*Pandalus borealis* | 10, 74, 112, 182, 193, 320, 321, 380, 433,<br>Chase |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 10, 112, 176, 433,<br>Chase, Lawton, Scherer |
| American lobster<br>*Homarus americanus* | 11, 13, 74, 82, 132, 133, 134, 135, 136, 143, 190, 191, 193, 320, 321, 433,<br>Chase, Deegan, Estrella, Lawton, Scherer |
| Jonah crab<br>*Cancer borealis* | 13, 82, 143, 175, 190, 191, 193, 394, 433,<br>Chase, Scherer |
| Atlantic rock crab<br>*Cancer irroratus* | 10, 13, 52, 82, 143, 190, 191, 193, 394, 433,<br>Chase, Deegan, Scherer |
| Green crab<br>*Carcinus maenus* | 50, 112, 433,<br>Chase, Deegan |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 10, 112, 372, 395,<br>Chase |
| Spiny dogfish<br>*Squalus acanthias* | 10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 202, 356,<br>Carriea, Chase, Deegan, Ross |
| Skates<br>*Raja* species | 10, 13, 51, 74, 82, 84, 127, 143, 190, 191, 193, 356,<br>Carriea, Chase, Deegan, Lawton, Ross |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 13, 51, 82, 84, 88, 106, 127, 143, 161, 190, 191,<br>Brady, Carriea, Chase, Deegan, Ross |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 13, 51, 82, 127, 143, 190, 191,<br>Brady, Carriea, Chase, Deegan, Ross |
| American eel<br>*Anguilla rostrata* | 13, 51, 82, 84, 88, 127, 137, 143, 152, 184, 190, 191, 356,<br>Brady, Carriea, Chase, Chisholm, Deegan, Ross |
| Blueback herring<br>*Alosa aestivalis* | 13, 19, 51, 74, 82, 84, 127, 143, 190, 191, 193, 320, 356,<br>Boreman, Carriea, Chase, Deegan, Ross |
| Alewife<br>*Alosa pseudoharengus* | 13, 51, 74, 82, 84, 127, 143, 190, 191, 193, 320, 356,<br>Boreman, Carriea, Chase, Deegan, Ross |
| American shad<br>*Alosa sapidissima* | 13, 51, 82, 84, 88, 127, 143, 190, 191, 193, 320, 321,<br>Boreman, Carriea, Chase, Deegan, Ross |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 13, 51, 82, 112, 127, 143, 190, 191, 193,<br>Carriea, Chase, Deegan, Lawton, Ross |
| Atlantic herring<br>*Clupea harengus* | 13, 51, 82, 84, 112, 127, 143, 190, 191, 193, 320,<br>Carriea, Chase, Deegan, Lawton, Ross |
| Rainbow smelt<br>*Osmerus mordax* | 13, 51, 62, 82, 84, 88, 127, 143, 190, 191, 356,<br>Carriea, Chase, Deegan, Ross |
| Atlantic salmon<br>*Salmo salar* | 13, 24, 25, 51, 82, 84, 88, 109, 127, 143, 320, 321, 356,<br>Boreman, Carriea, Chase, Deegan, Ross |
| Atlantic cod<br>*Gadus morhua* | 10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193,<br>Carriea, Chase, Deegan, Lawton, Ross |
| Haddock<br>*Melanogrammus aeglefinus* | 11, 13, 51, 53, 74, 82, 84, 88, 127, 143, 190, 191, 193, 193, 320, 321, 356,<br>Carriea, Chase, Deegan, Ross |
| Silver hake<br>*Merluccius bilinearis* | 10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 356,<br>Carriea, Chase, Deegan, Ross |
| Atlantic tomcod<br>*Microgadus tomcod* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 356, 398,<br>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<br>*Pollachius virens* | 10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193,<br>Carriea, Chase, Deegan, Lawton, Ross |
| Red hake<br>*Urophycis chuss* | 10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 199, 320,<br>Carreia, Chase, Deegan, Ross |
| White hake<br>*Urophycis tenuis* | 10, 13, 51, 74, 82, 84, 88,127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Ross |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 10, 13, 51, 82, 84, 88, 127, 143, 190, 191,<br>Carreia, Chase, Chisholm, Deegan, Scherer |
| Silversides<br>*Menidia* species | 10, 13, 51, 82, 84, 88, 94, 127, 143, 190, 191, 193,<br>Carreia, Chase, Lawton, Deegan, Scherer |
| Fourspine stickleback<br>*Apeltes quadracus* | 10, 13, 51, 82, 84, 88, 127, 143, 439, 440,<br>Carreia, Chase, Chisholm, Deegan |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 10, 13, 51, 82, 84, 88, 127, 143, 439, 440,<br>Carreia, Chase, Chisholm, Deegan |
| Ninespine stickleback<br>*Pungitius pungitius* | 10, 13, 51, 82, 84, 88, 127, 143, 439, 440,<br>Carreia, Chase, Chisholm, Deegan |
| Northern pipefish<br>*Syngnathus fuscus* | 10, 13, 51, 82, 84, 88, 127, 143, 190,191,<br>Carreia, Chase, Deegan |
| Northern searobin<br>*Prionotus carolinus* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Ross |
| Grubby<br>*Myoxocephalus aeneus* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191,<br>Carreia, Chase, Deegan, Ross |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Ross |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Ross |
| White perch<br>*Morone americana* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 356,<br>Boreman, Carreia, Chase, Deegan, Ross |
| Striped bass<br>*Morone saxatilis* | 10, 13, 51, 82, 84, 127, 143, 190, 191,<br>Boreman, Carreia, Chase, Deegan, Ross |
| Bluefish<br>*Pomatomus saltatrix* | 10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 199, 320,<br>Boreman, Carreia, Chase, Deegan, Lawton, Ross |
| Scup<br>*Stenotomus chrysops* | 10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 320, 321,<br>Carreia, Chase, Deegan, Ross |
| Tautog<br>*Tautoga onitis* | 10, 13, 51, 74, 82, 84, 88, 127, 143, 190, 191,<br>Carreia, Chase, Deegan, Ross |
| Cunner<br>*Tautogolabrus adspersus* | 10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Lawton, Ross |
| Ocean pout<br>*Macrozoarces americanus* | 10, 13, 74, 82, 88, 112, 127, 143, 190, 191, 193, 320, 321,<br>Carreia, Chase, Deegan, Lawton, Ross |
| Rock gunnel<br>*Pholis gunnellus* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, |
| American sandlance<br>*Ammodytes americanus* | 10, 13, 51, 82, 84, 88, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, |
| Atlantic mackerel<br>*Scomber scombrus* | 10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 320, 321,<br>Carreia, Chase, Deegan, Lawton, Ross |
| Butterfish<br>*Peprilus triacanthus* | 10, 13, 51, 82, 84, 127, 143, 190, 191, 193, 320, 321,<br>Carreia, Chase, Deegan, Ross |
| Windowpane flounder<br>*Scophthalmus aquosus* | 10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Lawton, Ross |
| American plaice<br>*Hippoglossoides platessoides* | 10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 320, 321,<br>Carreia, Chase, Deegan, Ross |
| Winter flounder<br>*Pleuronectes americanus* | 10, 13, 51, 82, 84, 112, 127, 143, 190, 191, 193,<br>Carreia, Chase, Deegan, Lawton, Ross |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 10, 13, 51, 74, 82, 88, 127, 143, 190, 191, 193, 320, 321,<br>Carreia, Chase, Deegan, Ross |
| Smooth flounder<br>*Pleuronectes putnami* | 10, 13, 51, 82, 88, 127, 143, 370,<br>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<br>*Mytilus edulis* | 14, 81, 131, 190, 191, 198, 204, 310,<br>Chase, Hubbard, Robinson, Truchon, Toner |
| Sea scallop<br>*Placopecten magellanicus* | 14, 81, 131, 190, 191, 198, 204, 295,<br>Chase, Hubbard, Robinson, Truchon |
| American oyster<br>*Crassostrea virginica* | 14, 81, 131, 198, 204, 371,<br>Chase, Hubbard, Toner |
| Northern quahog<br>*Mercenaria mercenaria* | 14, 81, 131, 198, 204, 393,<br>Chase, Hubbard, Toner |
| Softshell clam<br>*Mya arenaria* | 14, 81, 131, 198, 204, 308,<br>Chase, Hubbard, Truchon |
| Grass shrimp<br>*Palaemonetes pugio* | 14, 112, 131, 194, 213, 312, 433, 9, 429,<br>Chase, Hubbard |
| Northern shrimp<br>*Pandalus borealis* | 112, 131, 182, 194, 380, 433,<br>Hubbard, Chase |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 10, 112, 131, 176, 194, 433,<br>Chase, Hubbard |
| American lobster<br>*Homarus americanus* | 10, 112, 131, 133, 134, 135, 136, 188, 190, 191, 194, 257, 433,<br>Chase, Estrella, Hubbard, Scherer, Truchon |
| Jonah crab<br>*Cancer borealis* | 10, 112, 131, 190, 191, 194, 433,<br>Chase, Hubbard, Scherer |
| Atlantic rock crab<br>*Cancer irroratus* | 10, 52, 112, 131, 190, 191, 194, 433,<br>Chase, Hubbard, Scherer |
| Green crab<br>*Carcinus maenus* | 10, 50, 112, 131, 194, 433,<br>Chase, Hubbard, Scherer, Truchon |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 10, 81, 131, 198, 204, 372,<br>Chase, Hubbard, Truchon |
| Spiny dogfish<br>*Squalus acanthias* | 51, 81, 84, 92, 127, 131, 173, 194, 198, 202, 204,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Skates<br>*Raja* species | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 51, 81, 84, 127, 131, 161, 173, 194, 198, 204,<br>Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 51, 81, 84, 127, 131, 161, 173, 194, 198, 204, 405,<br>Brady, Chase, Howe, Hubbard, Ross, Scherer |
| American eel<br>*Anguilla rostrata* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Blueback herring<br>*Alosa aestivalis* | 11, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Boreman, Brady, Chase, Howe, Hubbard, Scherer |
| Alewife<br>*Alosa pseudoharengus* | 11, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Boreman, Brady, Chase, Howe, Hubbard, Scherer |
| American shad<br>*Alosa sapidissima* | 11, 51, 81, 84, 127, 131, 173, 191, 194, 198, 204, 261, 262,<br>Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 11, 81, 127, 131, 173, 194, 198, 204, 261,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Atlantic herring<br>*Clupea harengus* | 11, 81, 127, 131, 173, 194, 198, 204, 261,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Rainbow smelt<br>*Osmerus mordax* | 11, 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Atlantic salmon<br>*Salmo salar* | 24, 25, 51, 81, 84, 127, 131, 173, 194, 198, 204,<br>Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Atlantic cod<br>*Gadus morhua* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Haddock<br>*Melanogrammus aeglefinus* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Silver hake<br>*Merluccius bilinearis* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Atlantic tomcod<br>*Microgadus tomcod* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>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<br>*Pollachius virens* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Red hake<br>*Urophycis chuss* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| White hake<br>*Urophycis tenuis* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Mummichogs<br>*Fundulus heteroclitus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Hubbard, Scherer, Howe , |
| Silversides<br>*Menidia* species | 11, 81, 84, 127, 131, 173, 194, 198, 204, 261, 262, 51,<br>Chase, Hubbard, Scherer, Howe , |
| Fourspine stickleback<br>*Apeltes quadracus* | 11, 51, 81, 84, 127, 131, 173, 194, 198, 204,<br>Chase, Howe, Hubbard, Scherer |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 11, 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Hubbard, Scherer, Howe |
| Ninespine stickleback<br>*Pungitius pungitius* | 11, 51, 81, 84, 127, 131, 173, 194, 198, 204,<br>Chase, Howe, Hubbard |
| Northern pipefish<br>*Syngnathus fuscus* | 51, 81, 84, 87, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Scherer |
| Northern searobin<br>*Prionotus carolinus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard |
| Grubby<br>*Myoxocephalus aeneus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Scherer |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Scherer |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Scherer |
| White perch<br>*Morone americana* | 11, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Striped bass<br>*Morone saxatilis* | 11, 81, 127, 131, 173, 194, 198, 204, 262,<br>Boreman, Brady, Chase, Howe, Hubbard, Ross, Scherer |
| Bluefish<br>*Pomatomus saltatrix* | 11, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Boreman, Chase, Howe, Hubbard, Ross, Scherer |
| Scup<br>*Stenotomus chrysops* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Scherer |
| Tautog<br>*Tautoga onitis* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Cunner<br>*Tautogolabrus adspersus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Ocean pout<br>*Macrozoarces americanus* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Rock gunnel<br>*Pholis gunnellus* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Chase, Howe, Hubbard, Scherer |
| American sandlance<br>*Ammodytes americanus* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Chase, Howe, Hubbard, Scherer |
| Atlantic mackerel<br>*Scomber scombrus* | 11, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Butterfish<br>*Peprilus triacanthus* | 11, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Windowpane flounder<br>*Scophthalmus aquosus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| American plaice<br>*Hippoglossoides platessoides* | 51, 81, 84, 127, 131, 173, 191, 194, 198, 204,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Winter flounder<br>*Pleuronectes americanus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Hubbard, Ross, Scherer, Truchon, Howe |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 51, 81, 127, 131, 173, 194, 198, 204, 261, 262,<br>Chase, Howe, Hubbard, Ross, Scherer |
| Smooth flounder<br>*Pleuronectes putnami* | 51, 81, 84, 127, 131, 173, 194, 198, 204, 370,<br>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<br>*Mytilus edulis* | 11, 103, 112, 190, 191, 199, 310,<br>Collings, Deegan, Kelly, Lawton, Toner |
| Sea scallop<br>*Placopecten magellanicus* | 11, 74, 103, 112, 190, 191, 199, 295, 321, 320,<br>Kelly |
| American oyster<br>*Crassostrea virginica* | 11, 103, 112, 199, 371,<br>Kelly, Toner |
| Northern quahog<br>*Mercenaria mercenaria* | 11, 103, 112, 199, 393,<br>Deegan, Kelly, Toner |
| Softshell clam<br>*Mya arenaria* | 11, 103, 112, 199, 308,<br>Deegan, Kelly, Toner |
| Grass shrimp<br>*Palaemonetes pugio* | 9, 11, 112, 213, 312, 429, 433,<br>Deegan, Kelly |
| Northern shrimp<br>*Pandalus borealis* | 11, 74, 112, 182, 320, 321, 380, 433<br>Collings, Kelly |
| Sevenspine bay shrimp<br>*Crangon septemspinosa* | 11, 74, 112, 176, 183, 433,<br>Deegan, Kelly |
| American lobster<br>*Homarus americanus* | 1, 11, 89, 103, 112, 133, 134, 135, 136, 183, 188, 190, 191, 199, 242, 257, 268, 320, 321,<br>433, Scherer, Estrella, Kelly, Collings |
| Jonah crab<br>*Cancer borealis* | 11, 103, 112, 190, 191, 199, 245, 394, 433,<br>Kelly |
| Atlantic rock crab<br>*Cancer irroratus* | 11, 52, 103, 112, 183, 190, 191, 199, 245, 394, 433,<br>Kelly |
| Green crab<br>*Carcinus maenus* | 11, 103, 112, 183, 199, 245, 433,<br>Kelly, Deegan |
| Green sea urchin<br>*Strongylocentrotus droebachiensis* | 11, 112, 372, 395,<br>Kelly |
| Spiny dogfish<br>*Squalus acanthias* | 11, 51, 74, 84, 92, 103, 112, 190, 191, 199, 202, 245, 304, 320, 321,<br>Currier, Deegan, Kelly, Ross |
| Skates<br>*Raja* species | 11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 276, 320, 321,<br>Currier, Deegan, Kelly, Ross |
| Shortnose sturgeon<br>*Acipenser brevirostrum* | 11, 51, 84, 103, 106, 112, 161, 199, 245,<br>Brady, Currier, Deegan, Kelly, Ross |
| Atlantic sturgeon<br>*Acipenser oxyrhynchus* | 11, 103, 112, 199, 245, 161, 405, 51, 84, 320, 321,<br>Brady, Currier, Deegan, Kelly, Ross |
| American eel<br>*Anguilla rostrata* | 11, 51, 84, 103, 112, 137, 152, 183, 184, 190, 191, 199, 245,<br>Brady, Currier, Deegan, Kelly, Ross, Scherer |
| Blueback herring<br>*Alosa aestivalis* | 11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 294, 320, 321,<br>Boreman, Brady, Currier, Deegan, Kelly, Scherer |
| Alewife<br>*Alosa pseudoharengus* | 11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 294, 320, 321,<br>Boreman, Currier, Deegan, Kelly, Scherer |
| American shad<br>*Alosa sapidissima* | 11, 51, 84, 103, 108, 112, 190, 191, 199, 320, 321, 427,<br>Boreman, Brady, Deegan, Currier, Kelly, Ross |
| Atlantic menhaden<br>*Brevoortia tyrannus* | 11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321, 354,<br>Deegan, Collings, Currier, Kelly, Ross, Scherer |
| Atlantic herring<br>*Clupea harengus* | 11, 51, 74, 84, 103, 112, 183, 190, 191, 199, 208, 245, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Rainbow smelt<br>*Osmerus mordax* | 11, 51, 62, 84, 103, 112, 190, 191, 199, 245,<br>Brady, Currier, Deegan, Kelly, Ross, Scherer |
| Atlantic salmon<br>*Salmo salar* | 11, 24, 25, 51, 84, 103, 109, 112, 199, 245,<br>Boreman, Brady, Currier, Kelly, Ross, Scherer |
| Atlantic cod<br>*Gadus morhua* | 11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Haddock<br>*Melanogrammus aeglefinus* | 11, 51, 53, 74, 84, 103, 112, 190, 191, 199, 245, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Silver hake<br>*Merluccius bilinearis* | 11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Atlantic tomcod<br>*Microgadus tomcod* | 11, 51, 84, 103, 112, 183, 190, 191, 199, 245, 398,<br>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<br>*Pollachius virens* | 11, 51, 84, 103, 112, 183, 190, 191, 199, 243, 245, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Red hake<br>*Urophycis chuss* | 11, 51, 74, 84, 89, 103, 112, 183, 190, 191, 199, 245, 265, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| White hake<br>*Urophycis tenuis* | 11, 51, 74, 84, 103, 112, 183, 190, 191, 199, 245, 265, 320, 321,<br>Currier, Deegan, Kelly, Ross, Scherer |
| Mummichogs<br>*Fundulus heteroclitus* | 2, 11, 51, 84, 103, 112, 183, 199, 245,<br>Deegan, Currier, Kelly, Scherer |
| Silversides<br>*Menidia* species | 11, 51, 84, 94, 103, 112, 141, 183, 190, 191, 199, 245,<br>Deegan, Currier, Kelly, Scherer |
| Fourspine stickleback<br>*Apeltes quadracus* | 11, 51, 84, 103, 112, 183, 199, 245, 439, 440,<br>Currier , Deegan, Kelly |
| Threespine stickleback<br>*Gasterosteus aculeatus* | 11, 51, 84, 103, 112, 183, 199, 245, 439, 440,<br>Currier, Deegan, Kelly |
| Ninespine stickleback<br>*Pungitius pungitius* | 11, 51, 84, 103, 112, 199, 439, 440,<br>Currier, Kelly |
| Northern pipefish<br>*Syngnathus fuscus* | 11, 51, 84, 103, 112, 183, 199, 245, 248,<br>Currier, Deegan, Kelly, Scherer |
| Northern searobin<br>*Prionotus carolinus* | 11, 51, 84, 89, 103, 112, 190, 191, 199, 245, 350,<br>Collings, Currier, Deegan, Kelly, Scherer |
| Grubby<br>*Myoxocephalus aeneus* | 11, 51, 84, 89, 103, 112, 190, 191, 199, 245, 247,<br>Collings, Currier, Deegan, Kelly, Scherer |
| Longhorn sculpin<br>*Myoxocephalus octodecemspinosus* | 11, 51, 84, 89, 103, 112, 190, 191, 199, 245,<br>Collings, Currier, Deegan, Kelly, Scherer |
| Shorthorn sculpin<br>*Myoxocephalus scorpius* | 11, 51, 84, 89, 103, 112, 190, 191, 199, 245,<br>Collings, Currier, Deegan, Kelly, Scherer |
| White perch<br>*Morone americana* | 11, 51, 84, 103, 112, 199, 245, 392,<br>Brady, Currier, Kelly, Ross, Scherer |
| Striped bass<br>*Morone saxatilis* | 11, 51, 56, 84, 103, 112, 140, 199, 245, 243, 320, 321,<br>Boreman, Brady, Currier, Deegan, Kelly, Ross, Scherer |
| Bluefish<br>*Pomatomus saltatrix* | 11, 51, 74, 84, 103, 112, 199, 243, 245, 320, 321, 327,<br>Boreman, Currier, Deegan, Kelly, Ross, Scherer |
| Scup<br>*Stenotomus chrysops* | 11, 51, 74, 84, 103, 112, 190, 191, 183, 199, 245, 290, 320, 321,<br>Collings, Currier, Deegan, Kelly, Scherer |
| Tautog<br>*Tautoga onitis* | 11, 29, 51, 74, 84, 89, 103, 112, 190, 191, 183, 199, 243, 245, 329,<br>Collings, Currier, Deegan, Kelly, Lawton, Ross, Scherer |
| Cunner<br>*Tautogolabrus adspersus* | 11, 29, 51, 84, 89, 103, 112, 183, 190, 191, 199, 243, 245,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Ocean pout<br>*Macrozoarces americanus* | 11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 320, 321,<br>Currier, Deegan, Kelly, Scherer |
| Rock gunnel<br>*Pholis gunnellus* | 11, 51, 84, 89, 103, 112, 190, 191, 199, 245, 360,<br>Collings, Currier, Deegan, Kelly, Scherer |
| American sandlance<br>*Ammodytes americanus* | 11, 30, 51, 84, 89, 103, 112, 183, 190, 191, 199, 245, 382,<br>Currier, Deegan, Kelly, Scherer |
| Atlantic mackerel<br>*Scomber scombrus* | 11, 49, 51, 74, 84, 89, 91, 103, 112, 190, 191, 199, 245, 320, 321, 330,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Butterfish<br>*Peprilus triacanthus* | 11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 296, 320, 321,<br>Currier, Deegan, Kelly, Ross, Scherer |
| Windowpane flounder<br>*Scophthalmus aquosus* | 11, 51, 74, 84, 89, 103, 112, 183, 190, 191, 199, 245, 320, 321, 410,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| American plaice<br>*Hippoglossoides platessoides* | 11, 51, 74, 84, 103, 112, 190, 191, 199, 245, 89, 320, 321,<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Winter flounder<br>*Pleuronectes americanus* | 11, 51, 63, 74, 84, 89, 103, 112, 183, 190, 191, 199, 245, 275, 320, 321, 342<br>Collings, Currier, Deegan, Kelly, Ross, Scherer |
| Yellowtail flounder<br>*Pleuronectes ferrugineus* | 11, 51, 74, 84, 89, 103, 112, 190, 191, 199, 245, 320, 321, 322,<br>Collings, Currier, Deegan, Kelly, Lawton, Ross, Scherer |
| Smooth flounder<br>*Pleuronectes putnami* | 11, 51, 103, 112, 199, 370,<br>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

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