NOAA Technical Memorandum NMFS-F/NEC-45

This TM series is used for documentation and timely communication of preliminary results, interim reports, or special purpose information, and has not received complete formal review, editorial control, or detailed editing.

Food and Distribution of Juveniles of Seventeen Northwest Atlantic Fish Species, 1973-1976

Ray E. Bowman[1], Thomas R. Azarovitz[1], Esther S. Howard[2], and Brian P. Hayden[1]

[1]*Woods Hole Lab., National Marine Fisheries Serv., Woods Hole, MA 02543*
[2]*Antioch College, Yellow Springs, OH 45383*

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary
National Oceanic and Atmospheric Administration
Anthony J. Calio, Administrator
National Marine Fisheries Service
William E. Evans, Assistant Administrator for Fisheries
Northeast Fisheries Center
Woods Hole, Massachusetts
May 1987

NOAA Technical Memorandum NMFS-F/NEC-45

Food and Distribution of Juveniles of Seventeen Northwest Atlantic Fish Species, 1973-1975

Ray E. Bowman, Thomas R. Azarovitz, Esther S. Howard, and Brian P. Hayden

Woods Hole Lab., National Marine Fisheries Serv., Woods Hole, MA 02543
Antioch College, Yellow Springs, OH 45387

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary
National Oceanic and Atmospheric Administration
Anthony J. Calio, Administrator
National Marine Fisheries Service
William E. Evans, Assistant Administrator for Fisheries
Northeast Fisheries Center
Woods Hole, Massachusetts
May 1987

ABSTRACT

Juveniles of 17 fish species were caught by bottom trawl in offshore waters from Cape Hatteras, North Carolina, to Nova Scotia during 1973 through 1976. Relatively few prey species or prey groups accounted for a large portion of the food of juveniles compared to the food of adults of the same species. The smallest fishes sampled had fed mostly on copepods, amphipods, mysids, euphausiids, chaetognaths, and decapod shrimps. When approximately one-year old, most fish fed on a more diverse assortment of organisms of relatively larger size such as decapods, polychaetes, fishes, and echinoderms. Stomachs of the smaller fish contained proportionately more food in terms of percentage body weight than the larger fish.

Catches of most species were greatest in either shoal regions or areas close to shore. However, some species tended to concentrate around the 100-m depth contour. Also noted were inshore-offshore and north-south differences in distribution depending on season.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF TABLES (continued)

LIST OF FIGURES

INTRODUCTION

The first year of a fish's life is a critical period. Environmental conditions, available food, and predation are believed to be the principal factors which determine if a fish will survive to age-one. One current hypothesis is that recruitment variability is determined in the juvenile life stage and that prerecruit mortality is likely controlled more by predation than any other factor (Sissenwine 1984). Consequently, knowledge of where juvenile fish are located and their principal prey will lead to a better understanding of their behavior and factors which may affect their survival.

The food and distribution of many northwest Atlantic fish species is well documented (Bigelow and Schroeder 1953, Edwards and Bowman 1979, Grosslein and Azarovitz 1982, Bowman and Michaels 1984). However, most of this information is for the adult stage. Juvenile fish food as well as behavior and habitat are known to differ from adults (Arntz 1974, Bowman 1981a, 1981b, Steiner et al. 1982, Luczkovich and Olla 1983). Changes in preferred prey and degree of association with the bottom as fish grow have been adequately described for species such as haddock (Melanogrammus aeglefinus), Atlantic cod (Gadus morhua), and winter flounder (Pseudopleuronectes americanus) (Graham 1956, Pearcy 1962, Bowman 1981a). However, comprehensive data on specific prey organisms and areas of juvenile fish concentrations are lacking for most species. Consequently, the objective of this study was to describe the prey, distribution and relative abundance of the juveniles of 17 species of commercial and or biological importance in the study area (Table 1). Juveniles were classified as fish approximately one year old or younger for the purpose of this study.

This work is a component of the Marine Monitoring, Assessment, and Prediction Program (MARMAP) of the National Oceanic and Atmospheric Administration.

METHODS

Data on 17 species were gathered during eight Northeast Fisheries Center (NEFC) bottom trawl surveys conducted in the spring (March-May) and autumn (September-November) of the years 1973-1976. The area surveyed included continental shelf waters (27-366 m, bottom water depth) from Cape Hatteras, North Carolina, to Nova Scotia (Fig. 1). The number of each species collected, approximate length at age-one, geographic areas sampled, and general distribution (based on the results presented herein) are given in Table 1. The surveys are based on a stratified random design and the strata sampled constitute different depth zones within various geographic areas of the northwest Atlantic. A modified No. 41 Yankee trawl was used during spring surveys, and a No. 36 Yankee during autumn cruises (both trawls were outfitted with rollers and the cod end and upper belly were lined with 13 mm mesh netting to retain smaller fish). Fishing continued over 24 h and all tows were 30 min in duration at a vessel speed of 3.5 kn in the direction of the next station. A study by Sissenwine and Bowman (1978) established a No. 41 Yankee generally catches larger quantities of fish than a No. 36 Yankee trawl. No adjustment has been made to the catch data to account for the potential difference in catchability of juveniles between the two types of trawls. Further information on survey methods may be found in Grosslein and Azarovitz (1982).

Stomach content data

During each cruise technicians were instructed to sample 50 juveniles of a selected subset (Table 1) of the 17 species from each geographic area (Fig. 1). Generally no more than 10 fish of each species were taken at any one station, and usually samples of a given species were not taken at two consecutive stations in order to spread the spatial distribution of collections. All species present in each area could not be collected because of limited manpower. The maximum length of each species to be sampled was based on the approximate length at age-one reported in Bigelow and Schroeder 1953, NEFC lab data, and Barans 1972. Fish were preserved whole in 3.7 percent formaldehyde (vol).

In the laboratory fish stomachs were excised and their contents emptied onto a 0.25 mm mesh opening screen sieve to permit rinsing with tap water to remove the formaldehyde. Stomach contents were sorted, identified, counted, and weighed (wet weight to nearest 0.001 g) with a Mettler PI63[1] balance (sensitivity of 1 mg). A stomach was considered empty when no food items could be identified and the material in the stomach weighed less than 0.001 g.

---

[1] Reference to trade names does not imply endorsement by the National Marine Fisheries Service.

For convenience, in Tables 2-18 all stomach content data were summarized according to five cm fish length intervals (e.g., 1-5 , 6-10, 11-15 cm, etc.). Generally, the upper limit of the largest length category seen in a particular table is about the maximum length attained (plus or minus three cm) by that species at age-one. Exceptions are scup, Acadian redfish[2], longhorn sculpin and fourspot flounder. In the case of scup, length at age-one is about 11 cm (11-15 cm category is given in Table 11). Acadian redfish are about six cm at the end of their first year of life. However, since no redfish less than 11 cm were sampled, the stomach contents of 11-15 cm fish (two of which were sampled) are presented (Table 13). Longhorn sculpin grow to about six cm by age-one, the stomach contents of 6-10 cm fish are given in Table 14. Fourspot flounder are approximately 12 cm long when one year old. Since no fourspot 6-15 cm long were sampled, only the stomach content data for the single five cm fish sampled are presented (Table 15).

Importance of prey is based on weight, and the percentage of the total weight of all stomach contents made up by the particular prey is given in the tables and text. Percentages in brackets signify totals for major prey categories (generally phylum or class), and percentages in parentheses are the next lower taxonomic category subtotals (usually order) within the major prey categories. At the bottom of the tables are given the number of fish examined, number of empty stomachs, mean stomach content weight (g), mean fish length (fork length, FL, or total length, TL, in cm), mean fish weight (g), and percentage body weight of stomach contents (%BW). Mean fish weights were calculated from mean fish lengths using length-weight equations for each species given in Bowman and Michaels 1984.

Catch data

Cumulative distribution plots (Figs 2-10) of catches were made for juveniles of each species using lengths corresponding to those selected for stomach content analysis (Table 1). Catch data (no./tow) were retrieved from computer files at the NEFC for little skate, Atlantic cod, haddock, silver hake, pollock, red hake, spotted hake, white hake, and yellowtail flounder up to and including 20 cm in length (either FL or TL depending on species). The maximum length retrieved for ocean pout, scup, and butterfish was 15 cm. Acadian redfish, longhorn sculpin, fourspot flounder, witch flounder, and American plaice retrieved were < 11 cm. The data were summarized by separately plotting spring and autumn catches according to location and number caught per tow (e.g., 1-10, 10-100, 100-500, 500-1000, and 1000 or greater per tow, each being represented by a different size solid circle in Figs. 2-10).

---

[2] Acadian redfish is the approved common name for Sebastes fasciatus (Robins et al. 1986).

RESULTS

Little skate, Raja erinacea

A total of 168 little skate up to 20 cm TL were sampled in Southern New England and on Georges Bank for stomach content examination (Table 2). Crustaceans such as amphipods, cumaceans, and decapods were the predominant prey of all skate sampled (>60% by weight of the total stomach contents of fish in each length category). The stomachs of 6-10 cm fish contained mostly amphipods (29%, and principally unidentified Gammaridae, 16%, and Monoculodes sp., 13%), cumaceans (23%), and decapods (5%, and almost all Crangon septemspinosa). A large portion of the stomach contents of these small little skate was unidentified animal remains (36%). Skates 11-15 cm preyed intensively on amphipods (38%) and decapods (24%). The most notable amphipods were Unciola irrorata (10%), Oedicerotidae (8%), Gammaridae (6%), and Leptocheirus pinguis (4%). Two species of decapods were identified, namely Crangon septemspinosa (14%) and Dichelopandalus leptocerus (2%). Cumaceans accounted for 4% of the stomach contents and most were identified as Leptocuma minor (3%). The largest little skate (16-20 cm) also fed mostly on amphipods (39%) and decapods (33%). Among the amphipods, Unciola irrorata (14%), Gammaridae (6%), Ampeliscidae (5%), Monoculodes intermedius and Ericthonius rubricornis (both 3%) were the most notable. Crangon septemspinosa (30%) was the only decapod (33%) of consequence. Polychaetes made up 5% of the food of the 16-20 cm skate.

Overall, the largest quantities of juvenile little skate were caught during spring (Fig. 2). The largest catches were in Southern New England (primarily off Long Island, N.Y.) with lesser amounts being obtained in the Middle Atlantic and on Georges Bank. In autumn the largest concentration was located on southern Georges Bank; only sparse catches were obtained in all other areas.

Atlantic cod, Gadus morhua

One hundred and eighty-two Atlantic cod up to 20 cm FL were obtained from Georges Bank, the Gulf of Maine, and Western Nova Scotia for stomach content analysis (Table 3). Various types of crustaceans (e.g., copepods, mysids, euphausiids, amphipods, and decapods) dominated the diet of juvenile cod. Only 13 cod 1-5 cm long were sampled. The only food identified in their stomachs was unclassified copepods (6%). Guts of cod 6-10 cm contained decapods (52%, and mainly Dichelopandalus leptocerus, 40%), mysids (17%, of which 11% was Mysis mixta), amphipods (8%, and half were caprellids), and 6% fish (mostly fish eggs, 4%). Fish 11-15 cm ate amphipods (25%) such as Unciola irrorata (10%), Rhachotropis aculeata (5%), and caprellids (3%). Euphausiids (19%, and almost totally Meganyctiphanes norvegica, 17%), copepods (12%), and decapods (10%) such as Dichelopandalus leptocerus (4%) and crangonid shrimps (2%) were also of dietary importance. Fish accounted for 6% of their diet and was mostly identifed as fish eggs (3%). Food of the largest cod (16-20 cm) sampled was primarily decapods (43%, and mostly Crangon sp., 16%, Dichelopandalus leptocerus, 9%, and hermit crabs, 3%).

Other crustaceans such as euphausiids (13%) and amphipods (10%) were also identified in their diet. Sand and rock accounted for 5% of their stomach contents.

The greatest numbers of juvenile cod were obtained in autumn at the vicinity of Stellwagon Bank, the Great South Channel, and on or near various banks off Nova Scotia (e.g., Browns Bank)(Fig. 2). Small catches also occurred just west of the Northeast Peak of Georges Bank. In spring catches were largest off southeastern Nova Scotia. Sparse numbers were caught along the 100 m contour of the Gulf of Maine and Georges Bank (near the Northeast Peak).

Haddock, Melanogrammus aeglefinus

Three hundred and twenty-seven haddock up to 20 cm FL were sampled from Georges Bank, the Gulf of Maine, and Western Nova Scotia (Table 4). The stomachs of haddock 6-10 cm long contained large quantities of euphausiids (62%) along with some polychaetes (9%) and amphipods (7%). The prey listing for haddock 11-15 cm FL was extensive. Various species, genera, and families of amphipods and polychaetes accounted for about one-half of the number of identified prey of all length categories. Euphausiids (20%, with 9% identified as Meganyctiphanes norvegica) were the single most important prey by weight. Among the amphipods (16%), Unciola irrorata (5%) and Leptocheirus pinguis (2%) were the largest contributors. Decapods (16%) such as Pagurus pubescens (2%) and pandalid shrimps (3%) were also taken as food. Polychaetes accounted for 19% of the diet with Nephtyidae (3%) and Sabellidae (2%) being most notable. The food of haddock 16-20 cm FL was a mixture of amphipods (22%, and mostly Unciola irrorata, 9%, Gammaridae, 4%, and Leptocheirus pinguis, 2%), decapods (21%, with 5% identified as Dichelopandalus leptocerus, 4% hermit crabs, and 8% unidentified shrimps), and polychaetes (12%, and most unidentified). Echinoderms (8%, and mainly Ophiura sarsi, 6%) were also of some importance as a food.

During spring large numbers of juvenile haddock were caught in waters off southern Nova Scotia (Fig. 3). Smaller quantities were obtained along the 100 m depth contour of the Gulf of Maine. In autumn they were caught almost along the entire perimeter of Georges Bank (just inside the 100 m contour), in the western portion of the Gulf of Maine, and on most of the Scotian Shelf.

Silver hake, Merluccius bilinearis

A total of 1293 silver hake up to 20 cm FL was sampled in the Middle Atlantic, Southern New England, and on Georges Bank for gut content examination (Table 5). Various types of crustaceans accounted for more than 75% of the food of all juvenile silver hake. The smallest fish (1-5 cm) preyed intensively on amphipods (59%) such as Parathemisto sp. (38%), Byblis serrata (4%), Ampeliscidae (4%), and Hyperiidae (4%). Other crustaceans included in their diet were decapods (12%, and mostly crangonid shrimps, 8%, and other unidentified shrimps, 3%) and mysids (4%, with 2% identified as Neomysis americana). Silver hake 6-10 cm in

length fed principally on decapod shrimps (24%, and mostly Crangon septemspinosa, 15%, and Dichelopandalus leptocerus, 2%), mysids (22%, and almost exclusively Neomysis americana), and a wide assortment of amphipods (19%). Also notable in their diet was fish (14%) which was identified, in part, as the American sand lance, Ammodytes americanus, (6%), and silver hake, Merluccius bilinearis, (2%). Decapods (31%) were the single most important prey group for fish 11-15 cm FL. Crangon septemspinosa (18%) and Dichelopandalus leptocerus (5%) were the only species of decapods identified. Euphausiids (24%, of which 22% was identified as Meganyctiphanes norvegica) and mysids (13%, with Neomysis americana accounting for 10%) were also important food. Amphipods only made up 6% of their diet and most were classified as unidentified Oedicerotidae (4%). Fish prey (14%) was identified as Merluccius bilinearis,(4%), and Ammodytes americanus, (2%). Silver hake 16-20 cm FL consumed substantial quantities of Euphausiacea (64%, and all identified were Meganyctiphanes norvegica, 63%). Fish (20%) was also an important prey of these silver hake, but all of it was to well digested to be identified. The only other notable prey was decapods (7%, and mainly Crangon septemspinosa, 3%, and Dichelopandalus leptocerus, 2%), and mysids (4%, and primarily Neomysis americana).

Silver hake were ubiquitous in both spring and fall (Fig. 3). However, catches during spring were greater in the Gulf of Maine and Middle Atlantic areas than during autumn. Also, in autumn more were caught on central Georges Bank than in spring.

Pollock, Pollachius virens

Only 16 juvenile pollock were sampled from the Gulf of Maine and Western Nova Scotia (Table 6). The stomach of the one fish obtained in the 11-15 cm FL category contained solely the euphausiid Meganyctiphanes norvegica (100%). Meganyctiphanes norvegica (84%) was also the only major prey taken by fish in the 16-20 cm length category.

Pollock were principally caught in the Western Nova Scotia area during spring (Fig. 4). Catches were sparse or non-existent in all other areas during both spring and autumn.

Red hake, Urophycis chuss

Two hundred and eight red hake up to 20 cm TL were obtained in Southern New England waters for stomach content analyses (Table 7). The smallest red hake (1-5 cm) ate significant amounts of chaetognaths (49%). Amphipods (17%) such as Hyperiidae (7%), Gammaridae (7%), and Unciola irrorata (3%) were also of dietary importance, along with the mysid, Neomysis americana (11%). Fish 6-10 cm TL ingested large quantities of two decapod species, namely Dichelopandalus leptocerus (22%) and Crangon septemspinosa (5%). Also of consequence as a food were amphipods (29%, and mainly Gammaridae, 8%, Leptocheirus pinguis, 6%, Lysianassidae, 6%, Unciola irrorata, 5%, and Monoculodes edwardsi, 4%), polychaetes (15%), and chaetognaths (6%). The euphausiid, Meganyctiphanes norvegica (27%) was the single most important prey of red hake 11-15 cm TL. Other notable food was Amphipoda (24%, and mainly

Leptocheirus pinguis, 10%, and Gammaridae, 5%), Decapoda (24%, and mostly Crangon septemspinosa, 12%, and Dichelopandalus leptocerus, 5%), and Polychaeta (6%). The food of fish 16-20 cm was primarily amphipods (62%, e.g., Gammaridae, 33%, and Anonyx sarsi, 24%) but also included some decapods (11%, and mostly Crangon septemspinosa, 2%) and mysids (4%, and exclusively Neomysis americana).

Juvenile red hake were caught in all sampling areas during both spring and autumn (Fig. 4). The largest catches during both seasons were in Southern New England and on Georges Bank.

Spotted hake, Urophycis regia

A total of 244 spotted hake was sampled in the Middle Atlantic for stomach content examination (Table 8). Various types of crustaceans accounted for more than 75% of the food for all length categories sampled. The stomachs of the two fish 1-5 cm TL contained only the amphipod, Byblis serrata (77%), unidentified copepods (14%), and unidentified crustacean remains (9%). Juveniles 6-10 cm TL consumed large quantities of amphipods (50%, e.g., Parathemisto sp., 30%, and Byblis serrata, 18%), euphausiids (13%), and unidentified fish (21%). Dominant prey of the 11-15 cm long fishes was amphipods (35%, and mostly Parathemisto sp., 16%, and Byblis serrata, 12%), decapods (23%, and primarily Crangon septemspinosa, 16%, and Dichelopandalus leptocerus, 3%), and euphausiids (19%), especially Meganyctiphanes norvegica (12%). Fish (7%), mainly Myctophidae (5%), was also a notable food. Spotted hake 16-20 cm in length fed for the most part on euphausiids (Meganyctiphanes norvegica, 37%) and decapods (e.g., Crangon septemspinosa, 18%, Dichelopandalus leptocerus, 12%, and Munida iris, (3%). An assortment of amphipods made up 6% of their diet.

Spotted hake were principally caught in the Middle Atlantic during both spring and autumn cruises (Fig. 5). Of interest is that in spring catches were largest close to shore, while in autumn they occurred more to the north (e.g., into Southern New England) and were greatest along the 100 m depth contour.

White hake, Urophycis tenuis

White hake were sampled in the Gulf of Maine, but only 23 fish up to 20 cm TL were obtained for examination (Table 9). No prey was identified for 6-10 cm long fish. The diet of 11-15 cm TL white hake included, in part, Polychaeta (22%), Amphipoda (13%) such as Unciola irrorata (6%), and Leptocheirus pinguis (4%), and unidentified animal remains (66%). Crustacea (85%) accounted for the majority of the diet of 16-20 cm TL fish. Principal contributors were Neomysis americana (34%), Crangon septemspinosa (8%), and Amphipoda (4%).

Juvenile white hake catches were sparse in all areas during both spring and fall (Fig. 5). The few fish caught were located for the most part in the Gulf of Maine.

Ocean pout, Macrozoarces americanus

A total of eight ocean pout 11-15 cm TL was obtained from Southern New England and Georges Bank waters for gut content analysis (Table 10). Their primary food was amphipods (i.e., Unciola irrorata, 40%, Gammaridae, 31%, and Melita dentata, 11%). The only other item identified in their stomachs (other than sand, 16%) was Ophiuroidea (2%).

Most juvenile ocean pout were caught in the Gulf of Maine and Western Nova Scotia during spring and autumn (Fig. 6). Catches in Southern New England and on Georges Bank were sparse for the entire sampling period.

Scup, Stenotomus chrysops

The stomachs of 367 scup 6-15 cm FL from the Middle Atlantic and Southern New England were examined (Table 11). Both 6-10 and 11-15 cm fish fed on substantial quantities of polychaetes (31% and 32%, respectively). The 6-10 cm scup also ate an assortment of amphipods (in total, 16%) and decapods (10%, and mostly Cancer irroratus, 7%) along with lesser amounts of mysids (9%, of which 8% were identified as Neomysis americana) and copepods (4%). Larger scup (11-15 cm FL) fed on mollusks (18%) such as squid (12%) and to a lesser degree on amphipods (6%) and decapods (2%).

The greatest numbers of juvenile scup were caught relatively close to shore during autumn in the Middle Atlantic and Southern New England (Fig. 6). In spring, catches occurred both close to shore and along the 100 m depth contour in the Middle Atlantic, but almost totally inshore in Southern New England.

Butterfish, Peprilus triacanthus

Gut contents from 734 butterfish up to 15 cm FL from Middle Atlantic and Southern New England waters were analyzed (Table 12). Well digested animal remains accounted for 100%, 78%, and 48% of the contents of the 1-5, 6-10, and 11-15 cm FL categories respectively. The stomachs of the 6-10 cm fish also contained, in part, 8% Larvacea, 4% Thaliacea, 2% Amphipoda, and 2% Gastropoda. Butterfish 11-15 cm FL consumed mainly Larvacea (13%), Polychaeta (11%), Thaliacea (9%), Amphipoda (5%), Copepoda (5%), and Ctenophora (3%).

Catches of juvenile butterfish were greatest in autumn in all areas (Fig. 7). The largest numbers were caught along the 100 m depth contour and close to shore in the Middle Atlantic and Southern New England. During springtime large catches were obtained along the coast and 100 m depth contour of the Middle Atlantic, but in Southern New England and on southern Georges Bank the majority of fish were obtained only in the vicinity of the 100 m contour.

Acadian redfish, Sebastes fasciatus

Two juvenile Acadian redfish (11-15 cm FL) were obtained from the Gulf of Maine for stomach content examination (Table 13). Only one of the fish stomachs contained food (i.e., copepods, 41%, animal remains, 59%).

The largest numbers of redfish, in both spring and autumn, were caught in Western Nova Scotia (Fig. 7). None or only a few were obtained in other areas sampled.

Longhorn sculpin, Myoxocephalus octodecimspinosus

The stomach contents of 199 longhorn sculpin up to 10 cm TL from Georges Bank were examined (Table 14). Predators in the 1-5 and 6-10 cm TL categories preyed on very similar organisms. Amphipods (26% and 30%), decapods (50% and 51%, and mostly Crangonidae and Pandalidae), and isopods (5% and 3%) made up most of the food of the 1-5 cm and 6-10 cm fish, respectively.

Slightly more juvenile longhorn sculpin were obtained in spring than in autumn in all areas surveyed (except in the Middle Atlantic where none were caught)(Fig. 8). Catches were higher, by far, on Georges Bank than in any other area.

Fourspot flounder, Paralichthys oblongus

Only one juvenile fourspot flounder (5 cm TL) was obtained in the Middle Atlantic for analysis (Table 15). The only prey identified was the amphipod, Ampelisca sp. (67%).

Trawl catches of fourspot were greatest during autumn in the Middle Atlantic, Southern New England, and Georges Bank areas (Fig. 8). In springtime only a few fourspot in total were caught, and they occurred in Middle Atlantic and Southern New England waters.

Witch flounder, Glyptocephalus cynoglossus

Fifteen witch flounder (up to 10 cm TL) were sampled in the Gulf of Maine and Western Nova Scotia to determine dietary preferences (Table 16). The diet of the smallest witch flounder (1-5 cm) included amphipods (87%) and mysids (13%, and all were identified as Neomysis americana). Fish 6-10 cm TL ate mostly polychaetes (38%), the decapod shrimp, Crangon septemspinosa (35%), and amphipods (6%).

Overall, few witch flounder were caught in any area (Fig. 9). The ones caught were mostly located in the Gulf of Maine during spring and autumn. A few were also identified in the trawl catches for the Middle Atlantic (along the 100 m contour during spring), and Georges Bank and Western Nova Scotia (during autumn).

American plaice, Hippoglossoides platessoides

A total of 138 American plaice 6-10 cm TL were obtained from the Gulf of Maine and Western Nova Scotia for food habits studies (Table 17). Polychaeta (60%) was by far the dominant prey group. Some of the more important families identified as prey were Ampharetidae (9%), Nephtyidae (8%), and Sabellidae (3%). Crustacea (25%) identified in the diet included, in part, Amphipoda (12%) such as Ericthonius rubricornis (3%), Unciola sp. (3%), Gammaridae (3%), and Corophiidae (3%) along with some Mysidacea (6%).

Catches of juvenile American plaice were greatest in Gulf of Maine and Western Nova Scotia waters during springtime (Fig. 9). Most catches occurred at the western section of the Gulf of Maine. Some plaice were also obtained on Georges Bank during both spring and autumn.

Yellowtail flounder, Limanda ferruginea

One hundred and sixty yellowtail flounder (up to 20 cm TL) were sampled in Southern New England and on Georges Bank for stomach content analysis (Table 18). More than one-half of the diet of all length categories was Crustacea. Fish 1-5 cm long preyed intensively on Crangon septemspinosa (41%, and the only major prey identified). Yellowtail 6-10 cm ate substantial quantities of amphipods (33%, and mainly Ampeliscidae, 15%, Aoridae, 5%, and Gammaridae, 4%). Mysids made up 15% of the food and all were identified as Neomysis americana. The decapod, Crangon septemspinosa, accounted for 9% of their diet. Polychaetes (23%) were also an important prey and were mostly identified as Spiophanes bombyx (12%). Predators 11-15 cm TL fed mainly on decapods (48%) such as Dichelopandalus leptocerus (32%) and Crangon septemspinosa (12%), along with some fish (18%), amphipods (14%), and polychaetes (12%). The food of 16-20 cm fish was primarily amphipods (32%, and mainly Unciola irrorata, 15%, and Leptocheirus pinguis, 9%), decapods (15%, and mostly Pasiphaea multidentata, 13%), polychaetes (14%), fish (5%), and mysids (exclusively Neomysis americana, 4%).

Juvenile yellowtail flounder catches were highest in Southern New England and on Georges Bank during springtime and autumn (Fig. 10). Small catches were also obtained in the Middle Atlantic, Gulf of Maine, and Western Nova Scotia (in spring and autumn).

SYNOPSIS AND DISCUSSION

A summary of the prey groups identified for northwest Atlantic juvenile fishes examined herein is given in Table 19. Overall, relatively few prey groups (or species) made up a large portion of the food of all fish sampled. Similar results have been described for at least some of these juvenile fishes caught in the same geographic areas during earlier years (i.e., 1969-1972; Bowman 1981a). The results presented here confirm as well as expand on what we know of the foods of juvenile fishes in the northwest Atlantic. Smaller size prey such as copepods (principally calanoids), amphipods (e.g., Parathemisto sp., Byblis serrata, Pontogeneiidae, Unciola irrorata, and Ampelisca sp.), mysids (Neomysis americana), euphausiids (Meganyctiphanes norvegica), decapod shrimp (Crangon septemspinosa), and chaetognaths were the most important food of fishes 1-5 cm in length (i.e., silver hake, red hake, spotted hake, longhorn sculpin, fourspot flounder, witch flounder, and yellowtail flounder). Juveniles 6-10 cm long (little skate, Atlantic cod, haddock, silver hake, red hake, spotted hake, scup, longhorn sculpin, witch flounder, American plaice, and yellowtail flounder) fed chiefly on amphipods (Monoculodes sp., Eusirus sp., Parathemisto sp., Leptocheirus pinguis, Unciola irrorata, Byblis serrata, Ericthonius rubricornis, and Ampeliscidae), mysids (Neomysis americana), euphausiids (Meganyctiphanes norvegica), decapod shrimps (Crangon septemspinosa and Dichelopandalus leptocerus), and polychaetes (Eunice sp., Nephtyidae, Sabellidae, and Ampharetidae). The stomach contents of 11-15 cm fish (little skate, Atlantic cod, haddock, silver hake, pollock, red hake, spotted hake, white hake, ocean pout, scup, butterfish, Acadian redfish, and yellowtail founder) provided evidence they fed (depending on the particular species) intensively on copepods, polychaetes, amphipods (e.g., Unciola irrorata, Oedicerotidae, Leptocheirus pinguis, Rhachotropis aculeata, Byblis serrata, and Parathemisto sp.), mysids (almost totally Neomysis americana), euphausiids (mainly Meganyctiphanes norvegica), decapod shrimps (Crangon septemspinosa and Dichelopandalus leptocerus), and some fish or squid (taken by silver hake, scup, and yellowtail flounder). The largest fishes (i.e., those ranging 16-20 cm in length and including little skate, Atlantic cod, haddock, silver hake, pollock, red hake, spotted hake, white hake, and yellowtail flounder) ate substantial amounts of amphipods (especially Ampeliscidae, Unciola irrorata, Monoculodes sp., Anonyx sarsi, and Leptocheirus pinguis), the mysid, Neomysis americana, the euphausiid, Meganyctiphanes norvegica, decapod shrimps (Crangon septemspinosa and Dichelopandalus leptocerus), polychaetes, echinoderms (fed on only by haddock), and fish.

Also noteworthy is that in most instances the average %BW of the stomach contents decreased as fish length increased. The exceptions were little skate, white hake, and longhorn sculpin. Two possible reasons the smaller fish have proportionally more food, on average, in their stomachs may be that they tend to eat larger quantities of food relative to their body weight (in the case of haddock and silver hake their stomachs are also proportionally larger, therefore they are capable of holding more food; Bowman 1980, 1984), or they may eat more than one meal per day, whereas many larger size fish eat only one meal

in 24 hr (Edwards and Bowman 1979).

Bottom trawl catches of the juvenile fishes studied here provide an indication that the juveniles of many species tend to be concentrated at certain locations depending on the species and time of year. For example, catches of little skate, silver hake, red hake, scup, and yellowtail flounder were highest during spring off Long Island, New York (Southern New England). Concentrations of Atlantic cod and haddock were found along the 100 m depth contour in the Gulf of Maine (most in waters off Boston, Massachusetts, and on southwestern Georges Bank near the Great South Channel). Species such as spotted hake, scup and butterfish were caught most often either close to shore and or at approximately 100 m bottom water depth in the Middle Atlantic and Southern New England. Although we have not investigated why catches differed among seasons and species, availability of prey, preferred habitat, and bottom water temperature have been identified as major factors which cause fishes to concentrate in certain areas (Pacheco 1973, Steiner et al. 1982, Macdonald et al. 1984)

ACKNOWLEDGMENTS

We especially thank the scientists from the Northeast Fisheries Center, and volunteers from other institutions who participated on the bottom trawl survey cruises. We also thank William Michaels, James Myette, and Beth Hiler for assisting in stomach content analyses and auditing, Loretta O'Brien for retrieving the catch data, and Marvin Grosslein for his critical review of the manuscript.

LITERATURE CITED

Arntz, W.E.
1974. A contribution to the feeding ecology of juvenile cod (Gadus morhua L.) in the Western Baltic. Rapp. P.-v. Reun. Cons. int. Explor. Mer. 166:13-19.

Barans, C.A.
1972. Spotted hake, Urophycis regius, of the York River and Lower Chesapeake Bay. Chesapeake Sci. 13(1):59-68.

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

Bowman, R.E.
1980. Food of northwest Atlantic juvenile haddock. MA thesis. (Biology) Bridgewater State College, Bridgewater, MA. 95 p.

1981a. Food of 10 species of northwest Atlantic juvenile groundfish. Fish. Bull. 79(1):200-206.

1981b. Food and feeding of 0-group haddock in the northwest Atlantic. Rapp. P.-v. Reun. Cons. int. Explor. Mer. 178:322-323.

1984. Food of silver hake, Merluccius bilinearis. Fish. Bull. 82(1):21-35.

Bowman, R.E., and W.L. Michaels.
1984. Food of seventeen species of northwest Atlantic fish. NOAA Tech. Mem. NMFS-F/NEC-28. 183 p.

Edwards, R.L., and R.E. Bowman.
1979. Food consumed by continental shelf fishes. p. 387-406. IN H. Clepper (editor), Predator-prey systems in fish communities and their role in fisheries management. Sport Fish Inst., Publ., Wash., D.C.

Graham, M. (editor)
1956. Sea fisheries, their investigation in the United Kingdom. Edward Arnold, Lond. 487 p.

Grosslein, M.D., and T.R. Azarovitz.
1982. Fish distribution. MESA New York Bight atlas monograph 15. New York Sea Grant Inst., Albany, N.Y. 182 p.

Luczkovich, J.J., and B.L. Olla.
1983. Feeding behavior, prey consumption, and growth of juvenile red hake. Trans. Amer. Fish. Soc. 112:629-637.

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

Pacheco, A.L. (editor)
1973. Proceedings of a workshop on egg, larval, and juvenile stages of fish in Atlantic coast estuaries. Tech. Publ. No. 1. N.M.F.S. Middle Atl. Coast. Fish. Ctr., Highlands, New Jersey.

Pearcy, W.G.
1962. Ecology of an estuarine population of winter flounder, Pseudopleuronectes americanus (Walbaum). IV. Food habits of larvae and juveniles. Bull. Bingham Oceanogr. Collect. Yale Univ. 18(1):65-78.

Robins, R. C., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott.
1986. Names of the Atlantic redfishes, genus Sebastes. Fisheries. 11(1):28-29.

Sissenwine, M.P.
1984. Why do fish populations vary? Northw. Atl. Fish. Org., Sci.Coun.Meeting-June 1984. Ser.No. N846. NAFO SCR Doc. 84/IV/58.

Sissenwine, M.P., and E.W. Bowman.
1978. An analysis of some factors affecting the catchability of fish by bottom trawls. ICNAF Res. Bull. 13:81-87.

Steiner, W.W., J.J. Luczkovich, and B.L. Olla.
1982. Activity, shelter usage, growth and recruitment of juvenile red hake Urophycis chuss. Mar. Ecol. Prog. Ser. 7:125-135.

Table 1. Total number, approximate length at age-one, areas sampled, and principal distribution of catches of juvenile fishes collected for stomach content analyses in the northwest Atlantic for the years 1973-1976. Areas surveyed were Middle Atlantic (MA), Southern New England (SNE), Georges Bank (GB), Gulf of Maine (GOM), and Western Nova Scotia (WNS).

SPECIES	LENGTH (CM)	AREAS SAMPLED	DISTRIBUTION	NO.
Little skate	20 TL	SNE-GB	SNE-GB	168
Atlantic cod	20 FL	GB-GOM-WNS	GB-GOM-WNS	182
Haddock	18 FL	GB-GOM-WNS	GB-GOM-WNS	327
Silver hake	19 FL	MA-SNE-GB	MA-SNE-GB-GOM-WNS	1293
Pollock	18 FL	GOM-WNS	GOM-WNS	16
Red hake	20 TL	SNE	SNE-GB	208
Spotted hake	20 TL	MA	MA	244
White hake	22 TL	GOM	GOM-WNS	23
Ocean pout	13 TL	SNE-GB	GOM-WNS	8
Scup	11 FL	MA-SNE	MA-SNE	367
Butterfish	13 FL	MA-SNE	MA-SNE	734
Acadian redfish	6 FL	GOM	GOM-WNS	2
Longhorn sculpin	6 TL	GB	GB	199
Fourspot flounder	12 TL	MA	MA-SNE-GB	1
Witch flounder	12 TL	GOM-WNS	GOM	15
American plaice	8 TL	GOM-WNS	GB-GOM-WNS	138
Yellowtail flounder	18 TL	SNE-GB	SNE-GB-GOM	160
			TOTAL	4085

Table 3. Composition of the stomach contents of juvenile Atlantic cod, Gadus morhua, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)			
	1-5	6-10	11-15	16-20
COELENTERATA	[-]	[0.7]	[-]	[-]
Hydrozoa	-	0.7	-	-
CESTODA	[-]	[-]	[0.1]	[-]
TREMATODA	[-]	[<0.1]	[<0.1]	[0.1]
NEMERTEA	[-]	[-]	[0.2]	[0.1]
NEMATODA	[-]	[-]	[0.1]	[<0.1]
POLYCHAETA	[-]	[-]	[-]	[0.6]
CRUSTACEA	[5.8]	[89.0]	[78.9]	[81.0]
Amphipoda	(-)	(8.4)	(24.9)	(9.5)
Ampelisca sp.	-	1.8	-	-
Ampeliscidae	-	-	0.9	-
Aoridae	-	-	-	0.1
Aeginella spinosa	-	1.2	-	-
Aeginella longicornis	-	-	-	0.6
Caprellidae	-	2.7	2.6	0.1
Ericthonius rubricornis	-	-	0.5	0.1
Ericthonius sp.	-	-	0.2	-
Unciola irrorata	-	-	10.1	2.7
Unciola sp.	-	-	-	1.1
Corophiidae	-	-	-	<0.1
Rhachotropis aculeata	-	-	5.0	-
Gammaridae	-	0.5	3.2	3.4
Anonyx liljeborgi	-	0.2	-	-
Hippomedon serratus	-	-	-	0.3
Orchomenella minuta	-	0.2	-	-
Tmetonyx nobilis	-	-	-	0.5
Lysianassidae	-	0.1	-	0.1
Monoculodes edwardsi	-	-	-	0.1
Leptocheirus pinguis	-	<0.1	0.4	0.4
Leucothoe spinicarpa	-	1.7	1.7	-
Other Amphipoda	-	-	0.3	-
Decapoda	(-)	(51.9)	(10.3)	(42.9)
Cancridae	-	-	-	0.1
Crangon septemspinosa	-	1.7	0.5	2.8
Crangonidae	-	-	1.9	13.3
Eualus pusiolus	-	-	-	0.3

Pages 18 & 19 Blank

Table 3. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm)			
	1-5	6-10	11-15	16-20
Lebbeus groenlandicus	-	-	0.4	-
Spirontocaris sp.	-	-	1.2	-
Paguridae	-	-	-	2.8
Dichelopandalus leptocerus	-	40.1	3.7	8.9
Pandalidae	-	-	-	4.4
Unidentified shrimps	-	9.5	2.5	9.9
Other Decapoda	-	0.6	0.1	0.4
Isopoda	(-)	(-)	(<0.1)	(1.4)
Cirolana sp.	-	-	-	1.4
Other Isopoda	-	-	<0.1	-
Euphausiacea	(-)	(2.0)	(19.4)	(13.3)
Meganyctiphanes norvegica	-	1.8	17.1	6.9
Thysanoessa sp.	-	-	-	0.2
Other Euphausiacea	-	0.2	2.3	6.2
Mysidacea	(-)	(17.4)	(1.9)	(-)
Mysis mixta	-	11.0	-	-
Neomysis americana	-	-	1.9	-
Other Mysidacea	-	6.4	-	-
Copepoda	(5.8)	(0.5)	(12.1)	(0.8)
Calanoid Copepoda	-	-	-	0.8
Other Copepoda	5.8	0.5	12.1	-
Other Crustacea	(-)	(8.8)	(10.3)	(13.1)
CHAETOGNATHA	[-]	[-]	[1.8]	[2.0]
PISCES	[-]	[6.3]	[5.6]	[1.8]
Osteichthyes eggs	-	4.1	3.4	1.8
Other Pisces	-	2.2	2.2	-
ANIMAL REMAINS	[94.2]	[3.1]	[13.3]	[9.0]
SAND AND ROCK	[-]	[0.9]	[-]	[5.4]
Number of fish examined	13	35	83	51
Number of empty stomachs	1	8	14	10
Mean stomach content weight (g)	0.100	0.035	0.081	0.142
Mean fish FL (cm)	5	8	12	18
Mean fish weight (g)	1.1	4.7	16.7	58.5
% BW of stomach contents	9.05	0.74	0.49	0.24

Table 4. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm) 6-10	11-15	16-20
Mysidacea	(-)	(-)	(0.1)
Other Mysidacea	-	-	0.1
Copepoda	(-)	(<0.1)	(<0.1)
Calanoid Copepoda	-	<0.1	<0.1
Other Copepoda	-	<0.1	<0.1
Ostracoda	(-)	(<0.1)	(<0.1)
Tanaidacea	(-)	(<0.1)	(-)
Other Crustacea	(7.9)	(4.0)	(2.6)
MOLLUSCA	[-]	[0.2]	[0.3]
Polyplacophora	-	-	0.3
Bivalvia	-	0.1	-
Gastropoda	-	0.1	-
CHAETOGNATHA	[-]	[0.9]	[-]
ECHINODERMATA	[-]	[2.7]	[8.0]
Ophiuroidea	(-)	(2.7)	(8.0)
Ophiura sarsi	-	1.4	5.5
Ophiura sp.	-	0.3	<0.1
Other Ophiuroidea	-	1.0	2.5
PISCES	[-]	[2.8]	[1.8]
Pleuronectiformes	-	-	0.7
Pisces bones	-	2.0	-
Other Pisces	-	0.8	1.1
UNIDENTIFIED EGGS	[-]	[-]	[0.7]
ANIMAL REMAINS	[12.1]	[15.3]	[19.6]
ROCK AND SAND	[1.7]	[1.1]	[2.7]
Number of fish examined	17	208	102
Number of empty stomachs	4	13	3
Mean stomach content weight (g)	0.031	0.078	0.132
Mean fish FL (cm)	9	13	16
Mean fish weight (g)	13.0	36.5	65.3
% BW of stomach contents	0.24	0.21	0.20

Pages 22 & 23 Blank

Table 5. Composition of the stomach contents of juvenile silver hake, Merluccius bilinearis, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)			
	1-5	6-10	11-15	16-20
CESTODA	[-]	[<0.1]	[-]	[<0.1]
TREMATODA	[-]	[<0.1]	[<0.1]	[<0.1]
ACANTHOCEPHALA	[-]	[<0.1]	[-]	[-]
NEMATODA	[-]	[<0.1]	[<0.1]	[<0.1]
POLYCHAETA	[-]	[<0.1]	[0.5]	[-]
CRUSTACEA	[89.6]	[80.6]	[81.6]	[77.3]
Amphipoda	(58.9)	(18.9)	(6.0)	(1.2)
Caprellidae	-	<0.1	-	-
Ampelisca agassizi	0.2	1.4	-	0.5
Ampelisca vadorum	1.9	-	-	-
Byblis serrata	4.2	1.5	0.1	-
Byblis sp.	1.0	0.8	-	-
Ampeliscidae	3.8	1.2	0.1	<0.1
Aoridae	-	0.1	-	-
Ericthonius sp.	0.3	-	-	-
Unciola irrorata	-	-	<0.1	<0.1
Corophiidae	-	<0.1	-	-
Eusirus sp.	-	<0.1	-	-
Eusiridae	-	<0.1	-	-
Gammaridae	2.2	3.5	1.2	0.2
Lysianassidae	-	0.4	0.1	-
Parathemisto sp.	38.3	4.0	-	0.2
Hyperiidae	3.8	2.2	0.3	0.2
Monoculodes edwardsi	2.0	0.9	0.5	-
Monoculodes intermedius	-	<0.1	-	-
Monoculodes sp.	-	1.0	-	-
Oedicerotidae	1.1	1.5	3.6	0.1
Leptocheirus pinguis	0.1	-	<0.1	-
Phoxocephalus holbolli	-	0.1	<0.1	-
Phoxocephalidae	-	<0.1	-	-
Syrrhoe crenulata	-	<0.1	0.1	-
Tiron acanthurus	-	0.2	-	-
Other Amphipoda	-	0.1	-	-
Decapoda	(11.8)	(24.0)	(31.1)	(7.0)
Crangon septemspinosa	3.7	14.6	18.3	2.9
Sclerocrangon boreas	-	-	-	0.7
Crangonidae	4.0	1.4	0.4	0.1
Dichelopandalus leptocerus	-	1.7	5.3	2.1
Decapoda larvae	0.1	0.1	-	-

Table 7. Composition of the stomach contents of juvenile red hake, Urophycis chuss, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)			
	1-5	6-10	11-15	16-20
TREMATODA	[<0.1]	[<0.1]	[<0.1]	[<0.1]
NEMERTEA	[-]	[-]	[-]	[0.2]
POLYCHAETA	[-]	[14.9]	[5.7]	[-]
Nephtyidae	-	3.2	-	-
Sigalionidae	-	0.9	-	-
Maldanidae	-	-	3.1	-
Other Polychaeta	-	10.8	2.6	-
CRUSTACEA	[48.7]	[77.7]	[83.7]	[84.3]
Amphipoda	(16.8)	(29.3)	(23.5)	(62.4)
Caprellidae	-	0.2	-	0.3
Ampelisca macrocephala	-	-	0.5	-
Ampelisca sp.	-	-	-	0.9
Ampeliscidae	-	-	0.2	<0.1
Aoridae	-	-	0.6	-
Argissa sp.	-	-	0.7	-
Corophium sp.	-	0.1	-	-
Ericthonius rubricornis	-	0.4	-	-
Unciola irrorata	3.0	4.9	1.7	-
Maera sp.	-	-	-	4.2
Melita dentata	-	0.3	-	-
Gammaridae	7.0	8.0	5.2	32.9
Haustoriidae	-	-	3.1	-
Hyperiidae	6.6	-	-	0.1
Anonyx sarsi	-	-	-	24.0
Lysianassidae	-	5.7	-	-
Monoculodes edwardsi	-	3.7	1.6	-
Oedicerotidae	-	-	0.2	-
Leptocheirus pinguis	-	6.0	9.5	-
Pontogeneia inermis	0.2	<0.1	-	-
Phoxocephalidae	-	-	<0.1	-
Dulichia porrecta	-	-	<0.1	-
Other Amphipoda	-	-	0.2	-
Decapoda	(3.0)	(36.7)	(24.3)	(10.5)
Cancridae	-	1.6	-	-
Crangon septemspinosa	1.3	5.4	12.4	2.2
Crangonidae	1.7	0.5	1.3	4.0
Eualus pusiolus	-	4.1	-	-
Hippolytidae	-	1.9	-	-
Dichelopandalus leptocerus	-	22.3	4.6	-

Table 7. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm) 1-5	6-10	11-15	16-20
Pandalidae	-	-	3.0	-
Unidentified crabs	-	<0.1	-	-
Unidentified shrimps	-	0.9	2.8	4.3
Other Decapoda	-	-	0.2	-
Isopoda	(-)	(<0.1)	(-)	(-)
Chiridotea sp.	-	<0.1	-	-
Cumacea	(-)	(0.5)	(1.5)	(1.2)
Petalosarsia sp.	-	-	0.9	1.0
Other Cumacea	-	0.5	0.6	0.2
Euphausiacea	(-)	(0.6)	(26.5)	(-)
Meganyctiphanes norvegica	-	<0.1	-	-
Other Euphausiacea	-	0.6	26.5	-
Mysidacea	(11.4)	(3.1)	(1.0)	(4.1)
Neomysis americana	11.4	3.0	0.5	4.1
Other Mysidacea	<0.1	0.1	0.5	-
Copepoda	(<0.1)	(<0.1)	(-)	(-)
Other Crustacea	(17.5)	(7.5)	(6.9)	(6.1)
CHAETOGNATHA	[48.7]	[6.3]	[2.7]	[-]
ANIMAL REMAINS	[1.1]	[1.1]	[7.7]	[15.5]
ROCK	[1.5]	[-]	[0.2]	[-]
Number of fish examined	76	73	44	15
Number of empty stomachs	18	12	4	2
Mean stomach content weight (g)	0.006	0.031	0.089	0.176
Mean fish TL (cm)	4	7	12	17
Mean fish weight (g)	0.3	1.9	10.1	30.3
% BW of stomach contents	1.89	1.68	0.88	0.58

Table 9. Composition of the stomach contents of juvenile white hake, Urophycis tenuis, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)		
	6-10	11-15	16-20
TREMATODA	[-]	[0.3]	[<0.1]
NEMATODA	[-]	[-]	[1.0]
POLYCHAETA	[-]	[21.5]	[3.2]
CRUSTACEA	[-]	[12.5]	[85.1]
Amphipoda	(-)	(12.5)	(3.8)
Ampeliscidae	-	-	1.2
Caprellidae	-	2.3	-
Unciola irrorata	-	5.8	0.9
Gammaridae	-	-	0.3
Leptocheirus pinguis	-	4.4	1.4
Decapoda	(-)	(-)	(7.6)
Crangon septemspinosa	-	-	7.6
Euphausiacea	(-)	(-)	(33.5)
Meganyctiphanes norvegica	-	-	33.5
Mysidacea	(-)	(-)	(40.2)
Neomysis americana	-	-	40.2
ANIMAL REMAINS	[100.0]	[65.7]	[10.7]
Number of fish examined	1	13	9
Number of empty stomachs	0	7	3
Mean stomach content weight (g)	0.012	0.026	0.197
Mean fish TL (cm)	9	13	19
Mean fish weight (g)	4.0	13.3	45.4
% BW of stomach contents	0.30	0.20	0.43

Pages 30 & 31 Blank

Table 10. Composition of the stomach contents of juvenile ocean pout, Macrozoarces americanus, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)
	11-15
CRUSTACEA	[82.4]
Amphipoda	(82.4)
Unciola irrorata	40.2
Melita dentata	11.3
Gammaridae	30.9
ECHINODERMATA	[2.1]
Ophiuroidea	2.1
SAND	[15.5]
Number of fish examined	8
Number of empty stomachs	5
Mean stomach content weight (g)	0.012
Mean fish TL (cm)	14
Mean fish weight (g)	10.0
% BW of stomach contents	0.12

Table 11. Composition of the stomach contents of juvenile scup, Stenotomus chrysops, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm) 6-10	11-15
NEMERTEA	[0.5]	[0.1]
NEMATODA	[-]	[0.3]
POLYCHAETA	[31.1]	[32.0]
Spiophanes bombyx	0.7	-
Spionidae	0.4	-
Cirratulidae	-	0.6
Flabelligeridae	-	0.6
Maldanidae	1.2	2.0
Ammotrypane sp.	0.8	0.1
Travisia sp.	1.7	-
Opheliidae	-	<0.1
Oweniidae	0.2	-
Ampharetidae	1.2	2.3
Terebellidae	-	<0.1
Sabellidae	4.8	-
Glyceridae	1.2	0.4
Lumbrineridae	1.6	4.1
Nephtyidae	5.7	0.7
Onuphidae	-	0.7
Phyllodocidae	0.9	<0.1
Polynoidae	0.3	0.5
Sigalionidae	0.5	6.6
Polychaeta tubes	0.4	0.3
Other Polychaeta	9.5	13.1
SIPUNCULIDA	[0.5]	[-]
CRUSTACEA	[44.4]	[11.7]
Amphipoda	(15.6)	(6.4)
Ampelisca agassizi	-	0.2
Byblis serrata	0.4	1.0
Ampeliscidae	0.6	0.3
Caprellidae	1.2	1.3
Ericthonius rubricornis	0.2	0.1
Ericthonius sp.	0.2	-
Unciola irrorata	3.6	1.2
Gammarus sp.	2.2	-
Gammaridae	3.6	1.0
Hyperiidae	0.2	<0.1
Leptocheirus pinguis	3.4	1.3
Other Amphipoda	<0.1	-
Decapoda	(9.8)	(2.1)
Cancer irroratus	6.8	-
Crangon septemspinosa	0.8	0.3

Table 11. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm) 6-10	11-15
Pagurus acadianus	-	0.1
Pagurus sp.	1.1	1.4
Paguridae	0.2	0.1
Unidentified crabs	0.6	0.2
Unidentified shrimps	0.3	-
Isopoda	(0.1)	(0.3)
Cirolana sp.	0.1	0.3
Cumacea	(<0.1)	(-)
Euphausiacea	(0.6)	(-)
Meganyctiphanes norvegica	0.6	-
Mysidacea	(9.4)	(0.3)
Neomysis americana	8.0	0.2
Other Mysidacea	1.4	0.1
Copepoda	(3.8)	(<0.1)
Calanoid Copepoda	0.7	-
Other Copepoda	3.1	<0.1
Other Crustacea	(5.1)	(2.6)
MOLLUSCA	[0.1]	[17.9]
Bivalvia	(0.1)	(0.4)
Acoela	(-)	(2.9)
Cephalopoda	(-)	(12.4)
Decapoda squid	-	0.9
Other Cephalopoda	-	11.5
Other Mollusca	(-)	(2.2)
CHAETOGNATHA	[-]	[0.1]
ECHINODERMATA	[-]	[0.9]
Echinoidea	(-)	(<0.1)
Aceste sp.	-	<0.1
Other Echinodermata	(-)	(0.9)
PISCES	[-]	[0.3]
Osteichthyes	(-)	(<0.1)
Osteichthyes eggs	-	<0.1
Other Pisces	(-)	(0.3)
ANIMAL REMAINS	[23.4]	[36.6]
SAND	[-]	[0.1]
Number of fish examined	154	213
Number of empty stomachs	52	84
Mean stomach content weight (g)	0.043	0.131
Mean fish FL (cm)	8	12
Mean fish weight (g)	10.2	36.9
% BW of stomach contents	0.42	0.36

Table 12. Composition of the stomach contents of juvenile butterfish, Peprilus triacanthus, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)		
	1-5	6-10	11-15
COELENTERATA	[-]	[1.5]	[1.5]
CTENOPHORA	[-]	[-]	[3.2]
TREMATODA	[-]	[<Ø.1]	[Ø.2]
NEMATODA	[-]	[-]	[<Ø.1]
POLYCHAETA	[-]	[Ø.3]	[11.1]
Spionidae	-	-	<Ø.1
Glyceridae	-	-	1.1
Goniadidae	-	-	4.8
Lumbrineridae	-	-	Ø.2
Nephtyidae	-	-	Ø.9
Tomopteris helgolandica	-	-	2.2
Tomopteridae	-	-	1.Ø
Other Polychaeta	-	Ø.3	Ø.9
CRUSTACEA	[<Ø.1]	[4.7]	[13.1]
Amphipoda	(<Ø.1)	(2.Ø)	(5.3)
Ampeliscidae	-	-	<Ø.1
Caprellidae	-	-	<Ø.1
Gammaridae	-	-	<Ø.1
Haustoriidae	-	-	<Ø.1
Parathemisto sp.	-	1.5	5.2
Hyperiidae	<Ø.1	Ø.5	Ø.1
Decapoda	(-)	(<Ø.1)	(1.4)
Axiidae	-	-	1.4
Crangon septemspinosa	-	-	<Ø.1
Lucifer faxoni	-	<Ø.1	-
Decapoda larvae	-	-	<Ø.1
Unidentified crabs	-	-	<Ø.1
Unidentified shrimps	-	<Ø.1	<Ø.1
Euphausiacea	(-)	(-)	(Ø.1)
Meganyctiphanes norvegica	-	-	Ø.1
Other Euphausiacea	-	-	<Ø.1
Mysidacea	(-)	(1.4)	(<Ø.1)
Neomysis americana	-	1.4	-
Other Mysidacea	-	<Ø.1	<Ø.1
Copepoda	(-)	(Ø.1)	(5.3)
Temora sp.	-	<Ø.1	-
Pseudocalanus sp.	-	<Ø.1	-

Table 12. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm) 1-5	6-10	11-15
Calanoid Copepoda	-	<0.1	2.2
Other Copepoda	-	<0.1	3.1
Other Crustacea	(<0.1)	(1.3)	(1.0)
MOLLUSCA	[-]	[2.3]	[0.5]
Gastropoda	(-)	(2.3)	(0.5)
Limacina retroversa	-	2.3	0.4
Pteropoda	-	-	<0.1
Other Gastropoda	-	-	0.1
CHAETOGNATHA	[-]	[1.6]	[0.2]
LARVACEA	[-]	[7.6]	[12.8]
Oikopleura sp.	-	-	<0.1
Other Larvacea	-	7.6	12.8
THALIACEA	[-]	[4.4]	[9.1]
Salpidae	(-)	(-)	(3.1)
Salpa sp.	-	-	0.1
Other Salpidae	-	-	3.0
Other Thaliacea	(-)	(4.4)	(6.0)
PISCES	[-]	[-]	[0.4]
Pisces larvae	-	-	0.1
Other Pisces	-	-	0.3
ANIMAL REMAINS	[100.0]	[77.6]	[47.8]
SAND	[-]	[-]	[0.1]
Number of fish examined	23	160	551
Number of empty stomachs	2	23	156
Mean stomach content weight (g)	0.013	0.042	0.091
Mean fish FL (cm)	4	8	13
Mean fish weight (g)	1.2	10.3	45.4
% BW of stomach contents	10.57	4.09	2.01

Table 13. Composition of the stomach contents of juvenile Acadian redfish, Sebastes fasciatus expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)
	11-15
CRUSTACEA	[41.2]
Copepoda	41.2
ANIMAL REMAINS	[58.8]
Number of fish examined	2
Number of empty stomachs	1
Mean stomach content weight (g)	0.017
Mean fish FL (cm)	9
Mean fish weight (g)	12.1
% BW of stomach contents	0.14

Table 14. Composition of the stomach contents of juvenile longhorn sculpin, Myoxocephalus octodecemspinosus, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)	
	1-5	6-10
FORAMINIFERA	[0.6]	[-]
NEMATODA	[-]	[<0.1]
POLYCHAETA	[0.6]	[0.2]
Polynoidae	-	0.1
Other Polychaeta	0.6	0.1
CRUSTACEA	[84.0]	[89.6]
Amphipoda	(26.3)	(29.5)
Ampelisca sp.	-	0.2
Byblis serrata	-	0.3
Aoridae	-	2.3
Calliopius laeviusculus	-	0.8
Aeginina longicornis	-	0.1
Caprellidae	-	<0.1
Ericthonius rubricornis	1.8	<0.1
Ericthonius sp.	0.6	0.1
Unciola irrorata	7.0	2.2
Unciola sp.	-	1.9
Corophiidae	<0.1	-
Melita dentata	2.7	0.5
Gammaridae	1.2	10.2
Tmetonyx nobilis	-	3.1
Psammonyx nobilis	-	0.6
Lysianassidae	-	0.8
Monoculodes edwardsi	-	0.2
Monoculodes sp.	-	0.5
Oedicerotidae	-	0.6
Leptocheirus pinguis	2.4	1.9
Pontogeneia inermis	-	1.8
Pontogeneiidae	8.2	1.1
Tiron sp.	0.6	-
Other Amphipoda	1.8	0.3
Decapoda	(49.5)	(50.8)
Cancer irroratus	-	0.1
Cancridae	-	1.5
Crangon septemspinosa	20.2	29.1
Crangonidae	10.3	4.0
Eualus pusiolus	-	0.6
Pagurus acadianus	-	0.3
Pagurus sp.	-	0.3

Table 14. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm) 1-5	6-10
Dichelopandalus leptocerus	-	7.3
Pandalidae	10.3	3.0
Pasiphaea multidentata	-	2.0
Unidentified crabs	1.2	0.1
Unidentified shrimps	7.5	1.9
Other Decapoda	-	0.6
Isopoda	(4.8)	(2.5)
Chiridotea sp.	4.8	2.5
Other Isopoda	-	<0.1
Cumacea	(<0.1)	(0.4)
Mysidacea	(-)	(1.5)
Neomysis americana	-	1.5
Cirripedia	(-)	(<0.1)
Other Crustacea	(3.4)	(4.9)
PISCES	[-]	[1.6]
ANIMAL REMAINS	[14.8]	[8.5]
SAND AND ROCK	[-]	[0.1]
Number of fish examined	36	163
Number of empty stomachs	8	34
Mean stomach content weight (g)	0.009	0.050
Mean fish TL (cm)	4	7
Mean fish weight (g)	0.7	3.9
% BW of stomach contents	1.27	1.30

Table 15. Composition of the stomach contents of juvenile fourspot flounder, Paralichthys oblongus, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)
	1-5
CRUSTACEA	[100.0]
Amphipoda	(66.7)
Ampelisca sp.	66.7
Other Crustacea	(33.3)
Number of fish examined	1
Number of empty stomachs	0
Mean stomach content weight (g)	0.012
Mean fish TL (cm)	5
Mean fish weight (g)	0.9
% BW of stomach contents	1.32

Table 16. Composition of the stomach contents of juvenile witch flounder, Glyptocephalus cynoglossus, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm) 1-5	6-10
COELENTERATA	[-]	[<0.1]
Anthozoa	-	<0.1
NEMATODA	[-]	[1.7]
POLYCHAETA	[<0.1]	[38.2]
Maldanidae	-	<0.1
Ampharetidae	-	17.8
Sabellidae	-	17.8
Lumbrineridae	-	<0.1
Polychaeta tubes	<0.1	-
Other Polychaeta	-	2.6
CRUSTACEA	[100.0]	[42.4]
Amphipoda	(87.3)	(5.9)
Gammaridae	87.3	5.9
Other Amphipoda	<0.1	-
Decapoda	(-)	(34.8)
Crangon septemspinosa	-	34.8
Cumacea	(-)	(<0.1)
Mysidacea	(12.7)	(1.7)
Neomysis americana	12.7	-
Other Mysidacea	-	1.7
Copepoda	(-)	(<0.1)
ANIMAL REMAINS	[-]	[17.7]
Number of fish examined	4	11
Number of empty stomachs	1	3
Mean stomach content weight (g)	0.016	0.011
Mean fish TL (cm)	5	7
Mean fish weight (g)	0.2	0.8
% BW of stomach contents	6.70	1.39

Table 17. Composition of the stomach contents of juvenile American plaice, Hippoglossoides platessoides, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm) 6-10
TREMATODA	[<0.1]
NEMATODA	[5.8]
POLYCHAETA	[59.8]
Oweniidae	0.5
Ampharetidae	9.2
Sabellidae	3.0
Polychaeta tubes	4.8
Nephtyidae	7.6
Polynoidae	0.7
Other Polychaeta	34.0
CRUSTACEA	[25.3]
Amphipoda	(11.7)
Caprellidae	<0.1
Ericthonius rubricornis	2.6
Unciola irrorata	1.6
Unciola serrata	1.3
Corophiidae	2.6
Gammaridae	3.1
Leptocheirus pinguis	0.5
Decapoda	(<0.1)
Unidentified shrimps	<0.1
Mysidacea	(5.9)
Erythrops erythrophthalma	0.8
Other Mysidacea	5.1
Copepoda	(0.7)
Other Crustacea	(7.0)
MOLLUSCA	[0.5]
Bivalvia	0.5
ANIMAL REMAINS	[8.4]
FECAL REMAINS	[<0.1]
SAND	[0.2]
Number of fish examined	138
Number of empty stomachs	59
Mean stomach content weight (g)	0.004
Mean fish TL (cm)	8
Mean fish weight (g)	2.6
% BW of stomach contents	0.16

Table 18. Composition of the stomach contents of juvenile yellowtail flounder, Limanda ferruginea, expressed as a percentage of the total stomach contents weight versus fish length for samples collected in the northwest Atlantic for the years 1973-1976.

STOMACH CONTENTS	LENGTH CATEGORY (cm)			
	1-5	6-10	11-15	16-20
NEMERTEA	[-]	[-]	[-]	[0.5]
NEMATODA	[-]	[-]	[<0.1]	[-]
POLYCHAETA	[-]	[22.6]	[11.9]	[13.6]
Spiophanes bombyx	-	11.74	-	-
Flabelligeridae	-	-	-	6.2
Goniadidae	-	-	-	0.2
Lumbrineridae	-	-	-	<0.1
Other Polychaeta	-	10.8	11.9	7.3
CRUSTACEA	[100.0]	[60.9]	[61.8]	[50.8]
Amphipoda	(<0.1)	(32.7)	(13.6)	(31.5)
Byblis serrata	-	1.7	-	2.0
Ampelisca sp.	-	0.1	0.4	-
Ampeliscidae	-	14.7	0.4	1.8
Aoridae	-	5.0	-	-
Calliopius laeviusculus	-	0.7	-	-
Caprellidae	-	-	-	<0.1
Ericthonius rubricornis	-	1.9	1.2	0.9
Ericthonius sp.	-	2.1	2.1	-
Unciola irrorata	<0.1	2.2	3.6	15.3
Unciola sp.	-	<0.1	-	-
Gammaridae	<0.1	3.8	5.0	1.5
Monoculodes edwardsi	-	-	-	0.3
Leptocheirus pinguis	<0.1	-	-	8.5
Phoxocephalidae	-	<0.1	-	-
Pleustes panoplus	-	-	-	0.3
Dulichia porrecta	-	-	0.9	-
Amphipoda tubes	-	-	-	0.9
Other Amphipoda	-	0.5	-	-
Decapoda	(41.4)	(9.1)	(47.5)	(14.7)
Cancer irroratus	-	-	-	0.5
Crangon septemspinosa	41.4	9.1	12.0	-
Crangonidae	-	-	0.3	-
Pagurus sp.	-	-	-	0.6
Dichelopandalus leptocerus	-	-	31.8	-
Pasiphaea multidentata	-	-	-	13.2
Unidentified crabs	-	-	-	0.4
Other Decapoda	-	-	3.4	-
Isopoda	(-)	(-)	(-)	(0.2)
Cumacea	(-)	(0.9)	(0.4)	(0.4)

Table 18. (continued)

STOMACH CONTENTS	LENGTH CATEGORY (cm)			
	1-5	6-10	11-15	16-20
Mysidacea	(-)	(15.2)	(-)	(4.0)
Neomysis americana	-	15.2	-	4.0
Other Crustacea	(58.6)	(3.0)	(0.3)	(-)
MOLLUSCA	[-]	[0.2]	[-]	[-]
Bivalvia	-	0.2	-	-
PISCES	[-]	[-]	[18.4]	[4.9]
ANIMAL REMAINS	[<0.1]	[15.4]	[7.3]	[28.4]
SAND AND ROCK	[-]	[0.9]	[0.6]	[1.8]
Number of fish examined	39	77	21	23
Number of empty stomachs	22	25	6	9
Mean stomach content weight (g)	0.001	0.021	0.072	0.103
Mean fish TL (cm)	3	8	12	18
Mean fish weight (g)	0.2	4.0	14.2	50.6
% BW of stomach contents	5.88	0.52	0.51	0.20

Table 19. Stomach content groups making up the majority of prey taken by northwest Atlantic juvenile fishes. Prey categories are Copepoda (COP), Amphipoda (AMP), Mysidacea (MYS), Euphausiacea (EUP), Decapoda shrimps (SHR), Decapoda crabs (CRA), Polychaeta (POL), Chaetognatha (CHA), Pisces and Cephalopoda (F+S), and all other groups (O). Prey data are given as the percentage of the total stomach contents made up by a particular prey group (a "+" within the table indicates present in the diet but <1%).

			CRUSTACEA						MISCELLANEOUS			
PREDATOR	LENGTH RANGE	NO.	COP	AMP	MYS	EUP	SHR	CRA	POL	CHA	F+S	O
Little skate	6-10	43	-	29	-	-	5	-	+	-	-	66
	11-15	52	+	38	-	-	23	1	1	-	1	36
	16-20	73	+	39	1	-	32	1	5	-	+	22
Atlantic cod	1-5	13	6	-	-	-	-	-	-	-	-	94
	6-10	35	1	8	17	2	51	-	-	-	6	15
	11-15	83	12	25	2	19	10	-	-	2	6	24
	16-20	51	1	10	-	13	40	3	1	2	2	28
Haddock	6-10	17	-	7	-	62	-	-	9	-	-	22
	11-15	208	+	17	-	21	11	4	19	1	3	24
	16-20	102	+	22	+	3	15	6	16	-	2	36
Silver hake	1-5	356	2	59	4	2	11	+	-	1	5	16
	6-10	624	+	19	22	6	22	-	+	1	14	16
	11-15	224	+	6	13	24	29	-	1	+	14	13
	16-20	89	-	1	4	64	7	-	-	-	20	4
Pollock	11-15	1	-	-	-	100	-	-	-	-	-	0
	16-20	15	-	+	-	91	-	-	-	-	-	9
Red hake	1-5	76	+	17	11	-	3	-	-	49	-	20
	6-10	73	+	29	3	1	35	2	15	6	-	9
	11-15	44	-	24	1	27	24	-	6	3	-	15
	16-20	15	-	62	4	-	11	-	-	-	-	23
Spotted hake	1-5	2	14	77	-	-	-	-	-	-	-	9
	6-10	53	+	50	1	13	4	-	1	-	21	10
	11-15	50	-	35	-	19	23	+	+	-	7	16
	16-20	139	-	6	-	37	37	2	1	-	3	14

Table 19. (continued)

PREDATOR	LENGTH RANGE	NO.	CRUSTACEA						MISCELLANEOUS			
			COP	AMP	MYS	EUP	SHR	CRA	POL	CHA	F+S	O
White hake	6-10	1	-	-	-	-	-	-	-	-	-	100
	11-15	13	-	13	-	-	-	-	22	-	-	65
	16-20	9	-	4	40	34	8	-	3	-	-	11
Ocean pout	11-15	8	-	82	-	-	-	-	-	-	-	18
Scup	6-10	154	4	16	9	1	1	9	31	-	-	29
	11-15	213	+	6	+	-	+	2	32	+	13	47
Butterfish	1-5	23	-	+	-	-	-	-	-	-	-	100
	6-10	160	+	2	1	-	+	-	+	2	-	95
	11-15	551	5	5	+	-	+	+	11	+	+	79
Acadian redfish	11-15	2	41	-	-	-	-	-	-	-	-	59
Longhorn sculpin	1-5	36	-	26	-	-	48	1	1	-	-	24
	6-10	163	-	30	2	-	48	2	+	-	2	16
Fourspot flounder	1-5	1	-	67	-	-	-	-	-	-	-	33
Witch flounder	1-5	4	-	87	13	-	-	-	+	-	-	0
	6-10	11	+	6	2	-	35	-	38	-	-	19
American plaice	6-10	138	1	12	6	-	+	-	60	-	-	21
Yellowtail fldr.	1-5	39	-	+	-	-	41	-	-	-	-	59
	6-10	77	-	33	15	-	9	-	23	-	-	20
	11-15	21	-	14	-	-	44	-	12	-	18	12
	16-20	23	-	32	4	-	13	2	14	-	5	30

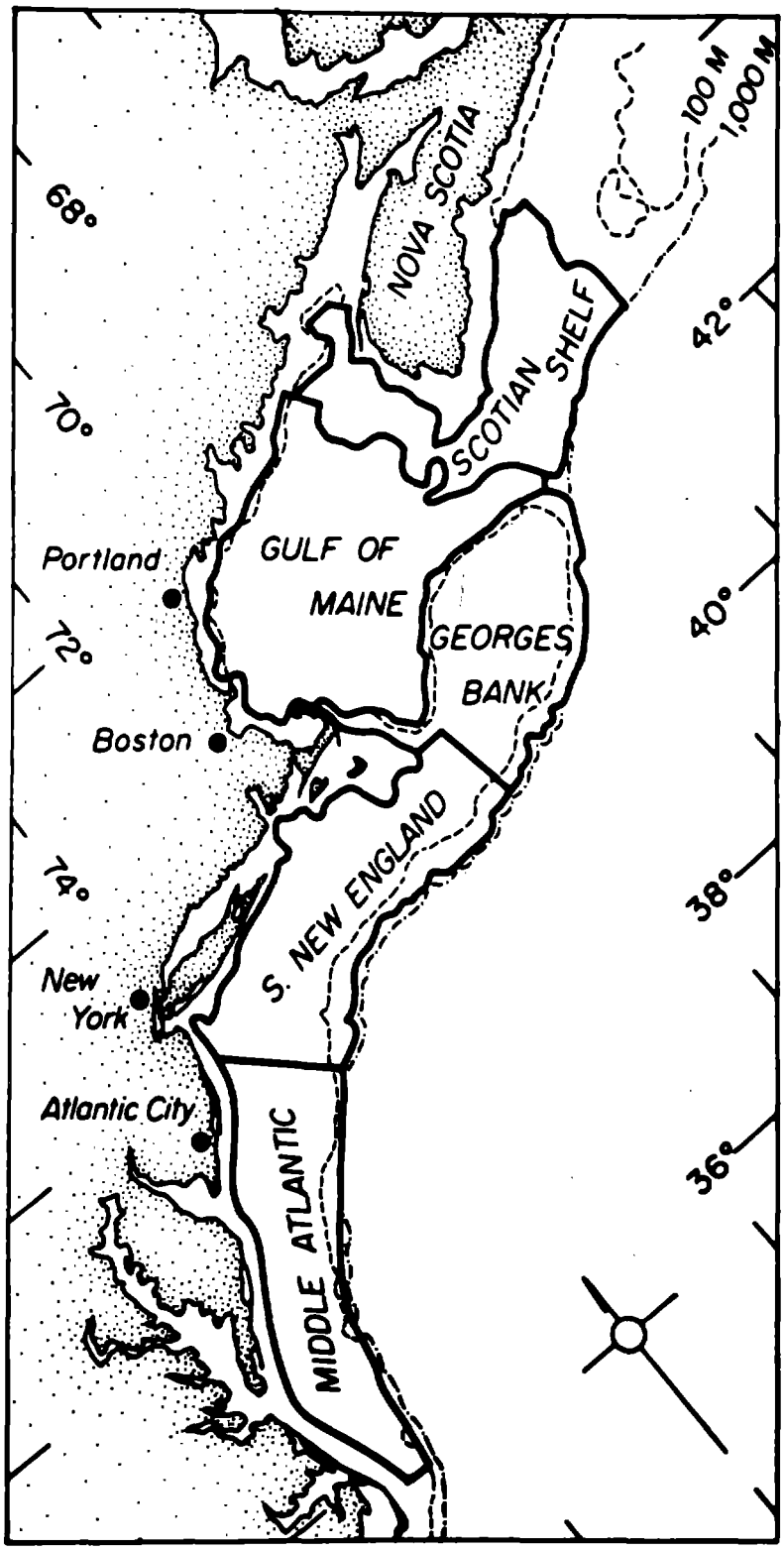

Figure 1. Geographic areas of the northwest Atlantic surveyed by the Northeast Fisheries Center during the years 1973-1976.

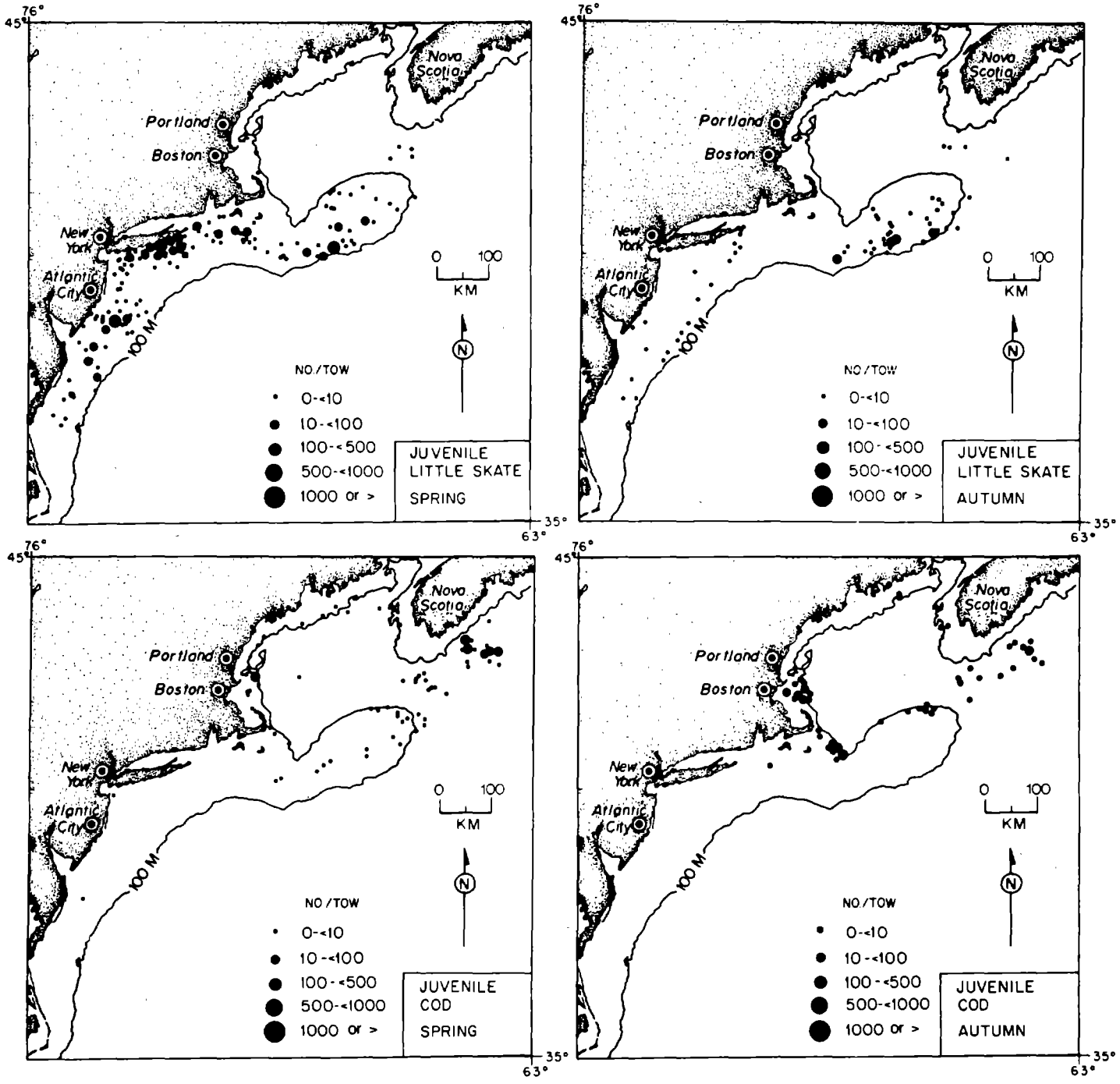

Figure 2. Cumulative distribution plots of bottom trawl catches of juvenile little skate (<21 cm) and Atlantic cod (<21 cm) during the spring and autumn for the years 1973-1976.

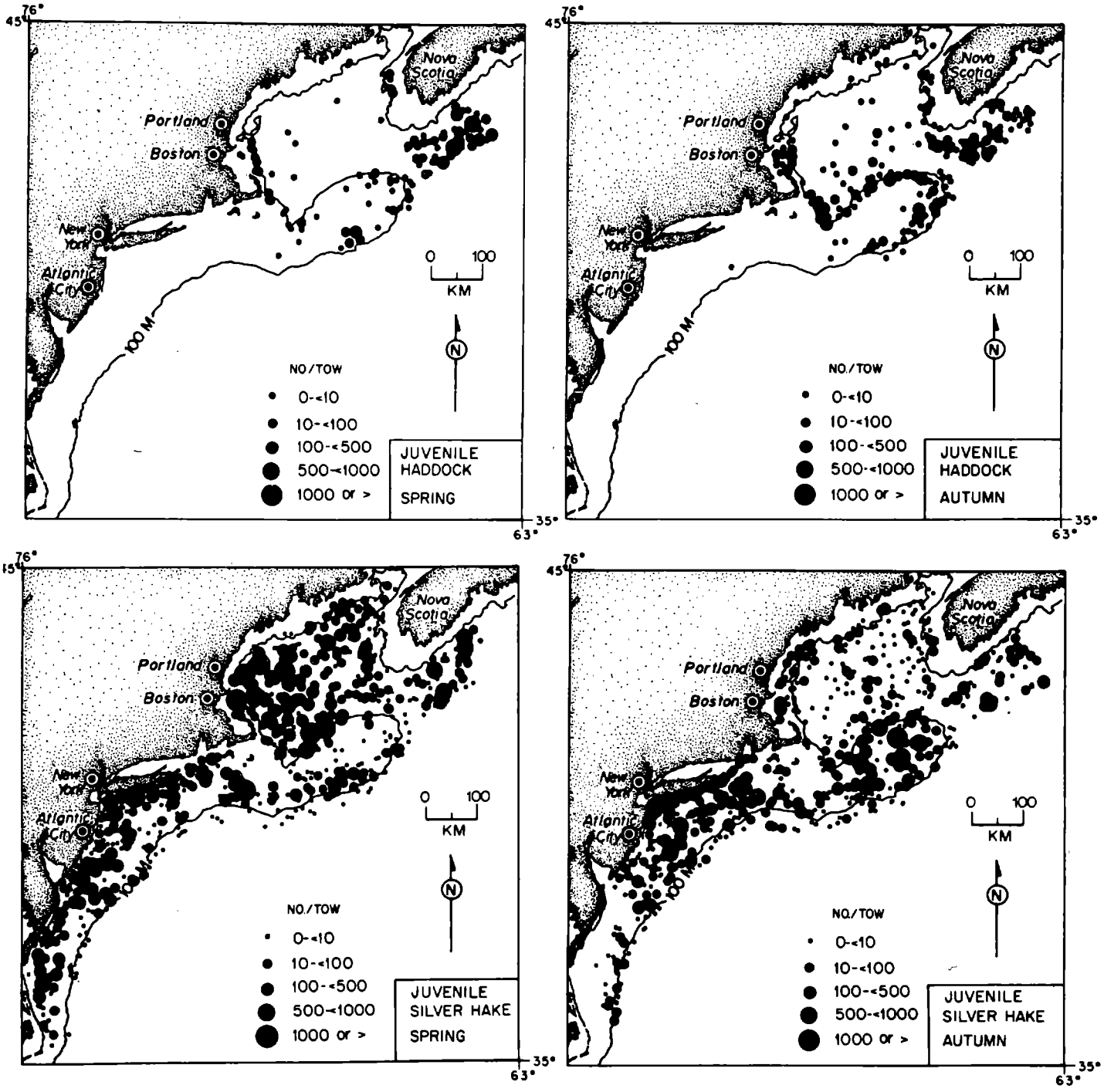

Figure 3. Cumulative distribution plots of bottom trawl catches of juvenile haddock (<21 cm) and silver hake (<21 cm) during the spring and autumn for the years 1973-1976.

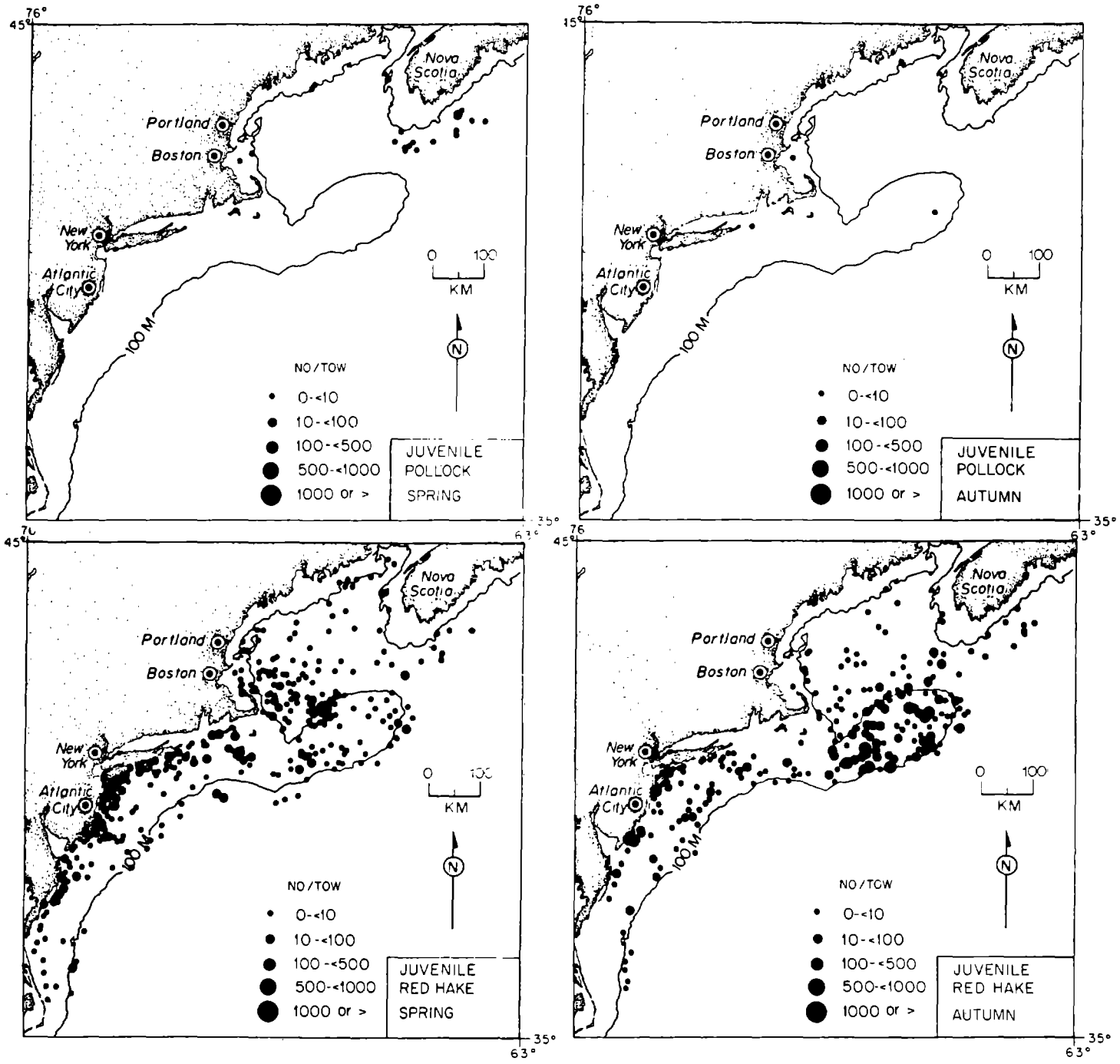

Figure 4. Cumulative distribution plots of bottom trawl catches of juvenile pollock (<21 cm) and red hake (<21 cm) during the spring and autumn for the years 1973-1976.

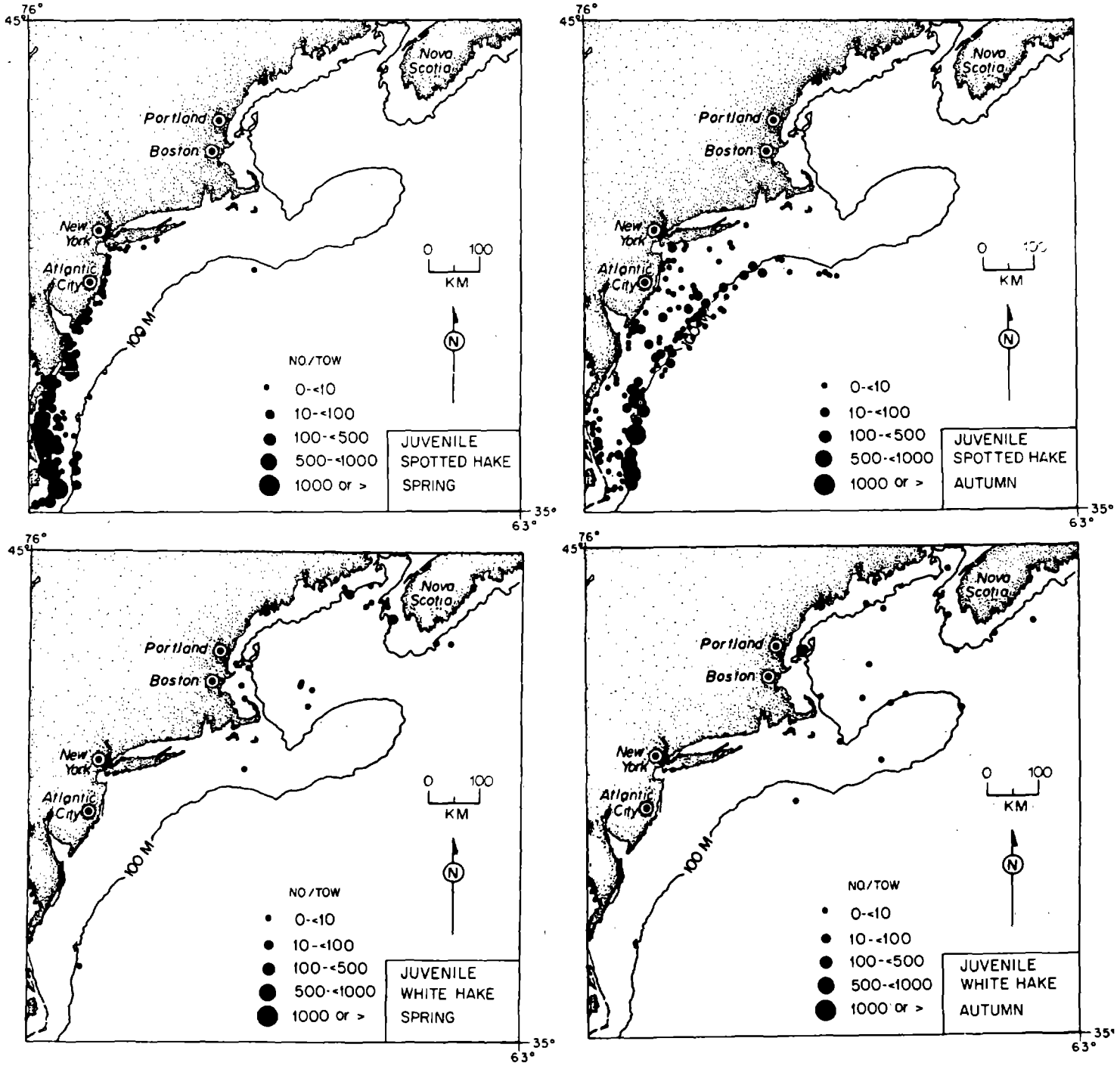

Figure 5. Cumulative distribution plots of bottom trawl catches of juvenile spotted hake (<21 cm) and white hake (<21 cm) during the spring and autumn for the years 1973-1976.

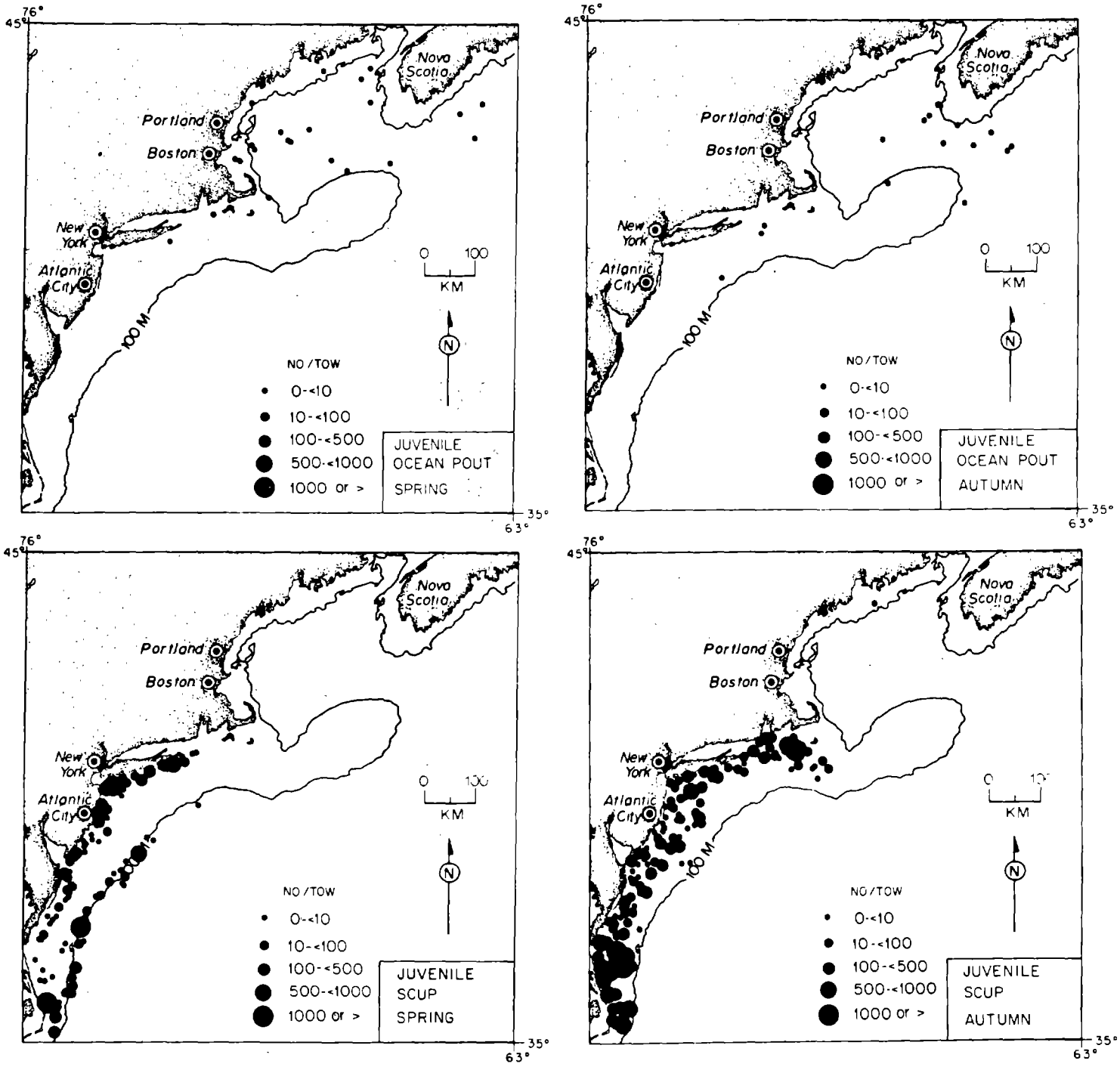

Figure 6. Cumulative distribution plots of bottom trawl catches of juvenile ocean pout (<16 cm) and scup (<16 cm) during the spring and autumn for the years 1973-1976.

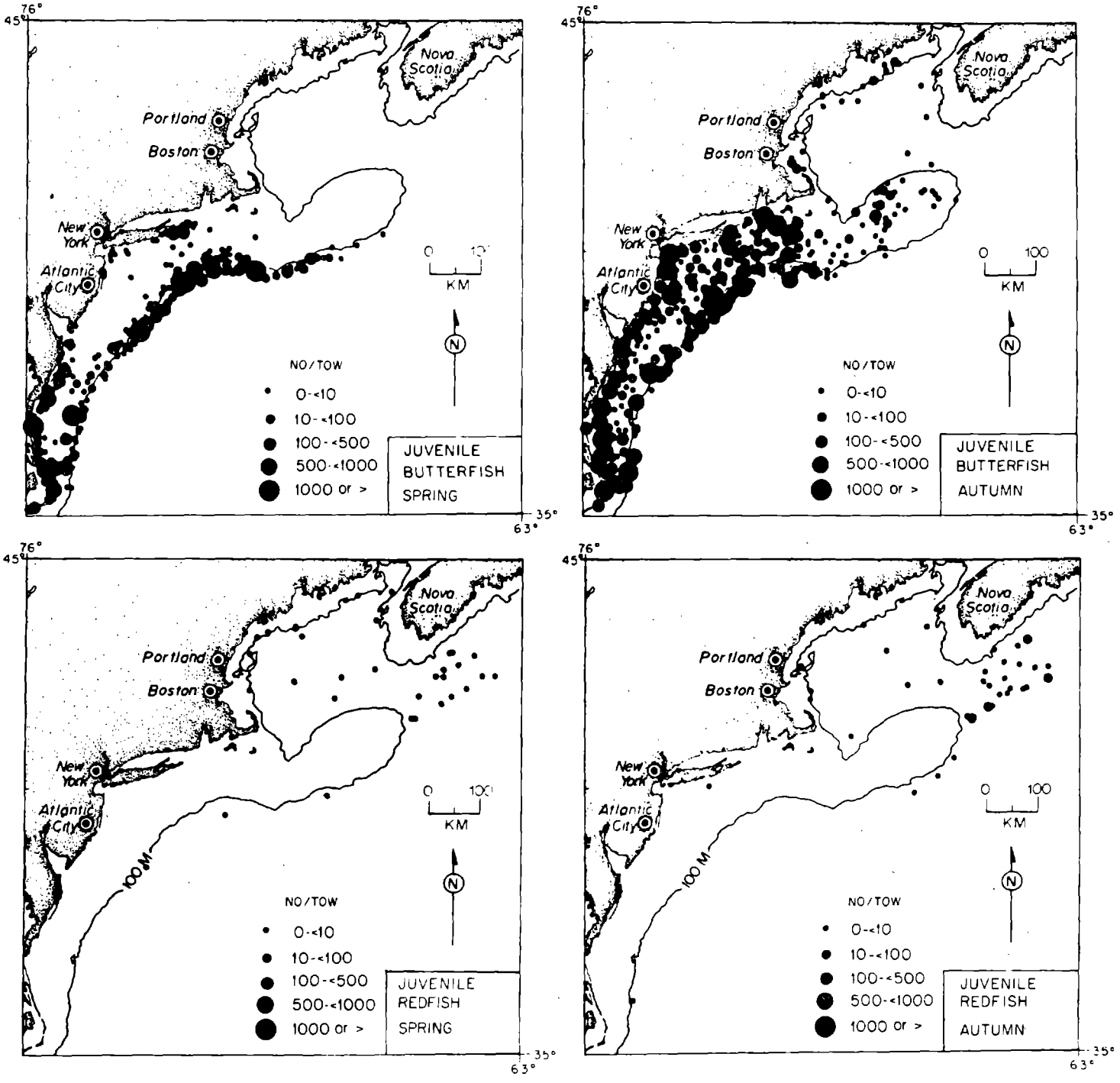

Figure 7. Cumulative distribution plots of bottom trawl catches of juvenile butterfish (<16 cm) and Acadian redfish (<11 cm) during the spring and autumn for the years 1973-1976.

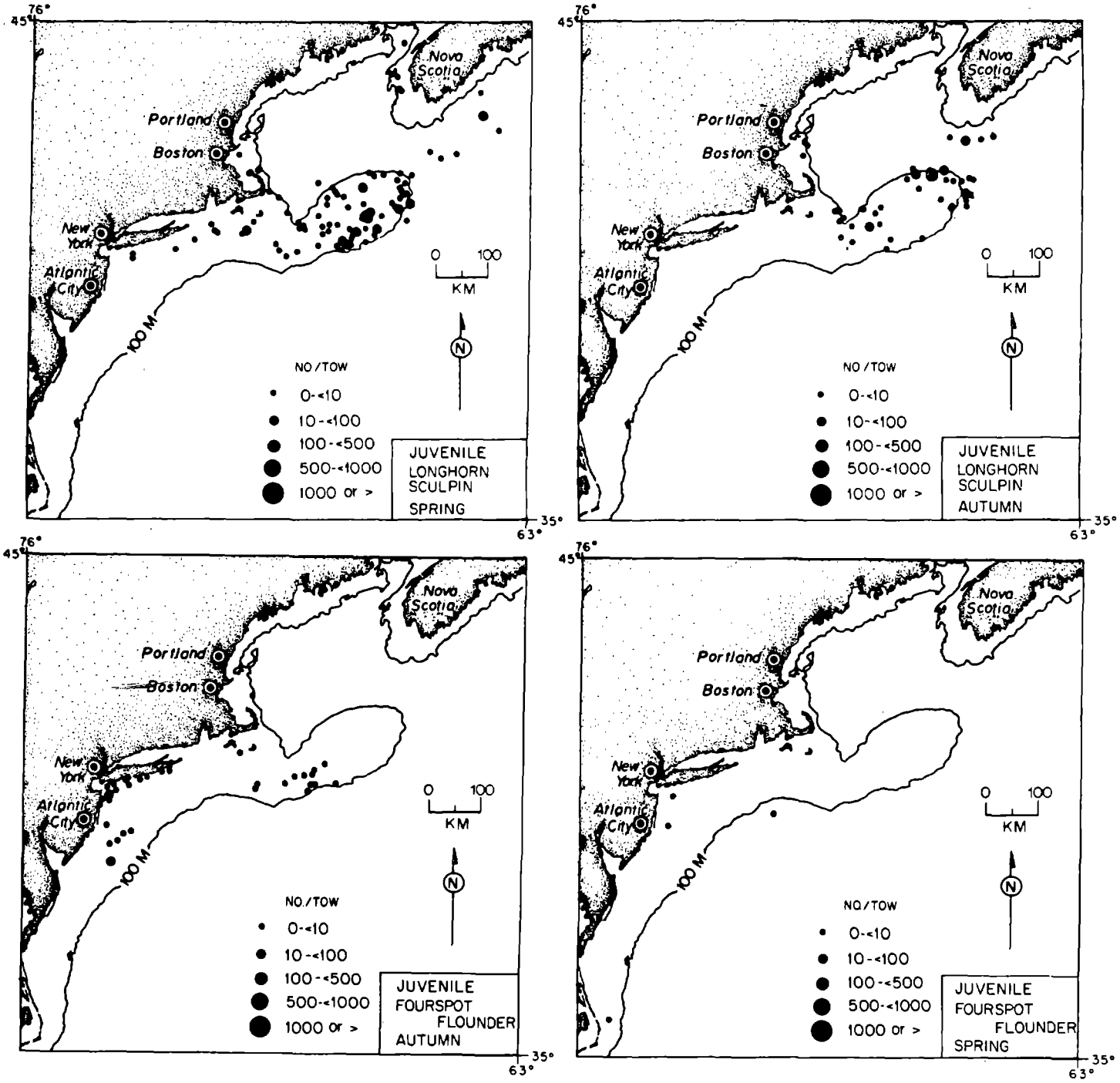

Figure 8. Cumulative distribution plots of bottom trawl catches of juvenile longhorn sculpin (<11 cm) and fourspot flounder (<11 cm) during the spring and autumn for the years 1973-1976.

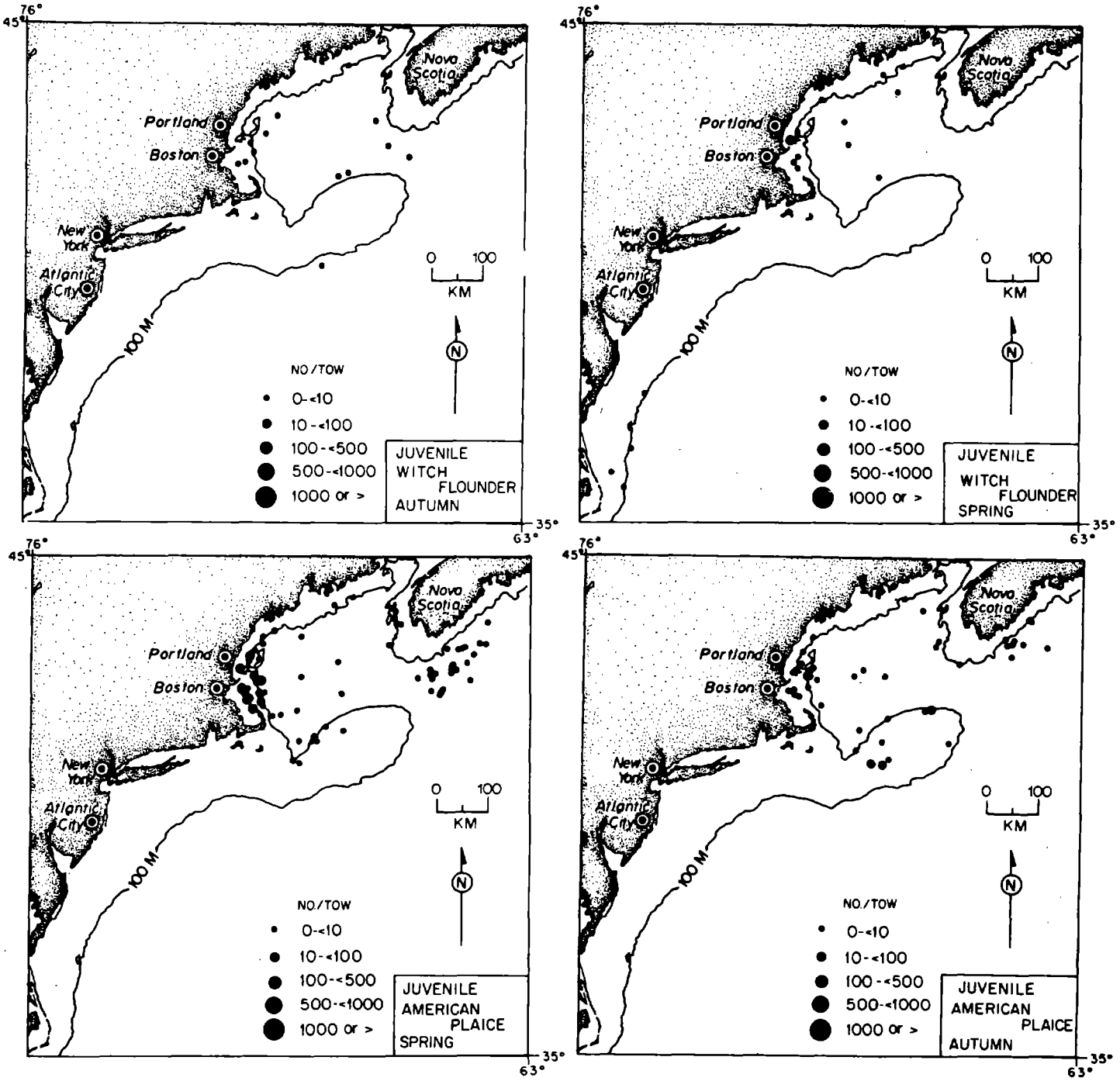

Figure 9. Cumulative distribution plots of bottom trawl catches of juvenile witch flounder (<11 cm) and American plaice (<11 cm) during the spring and autumn for the years 1973-1976.

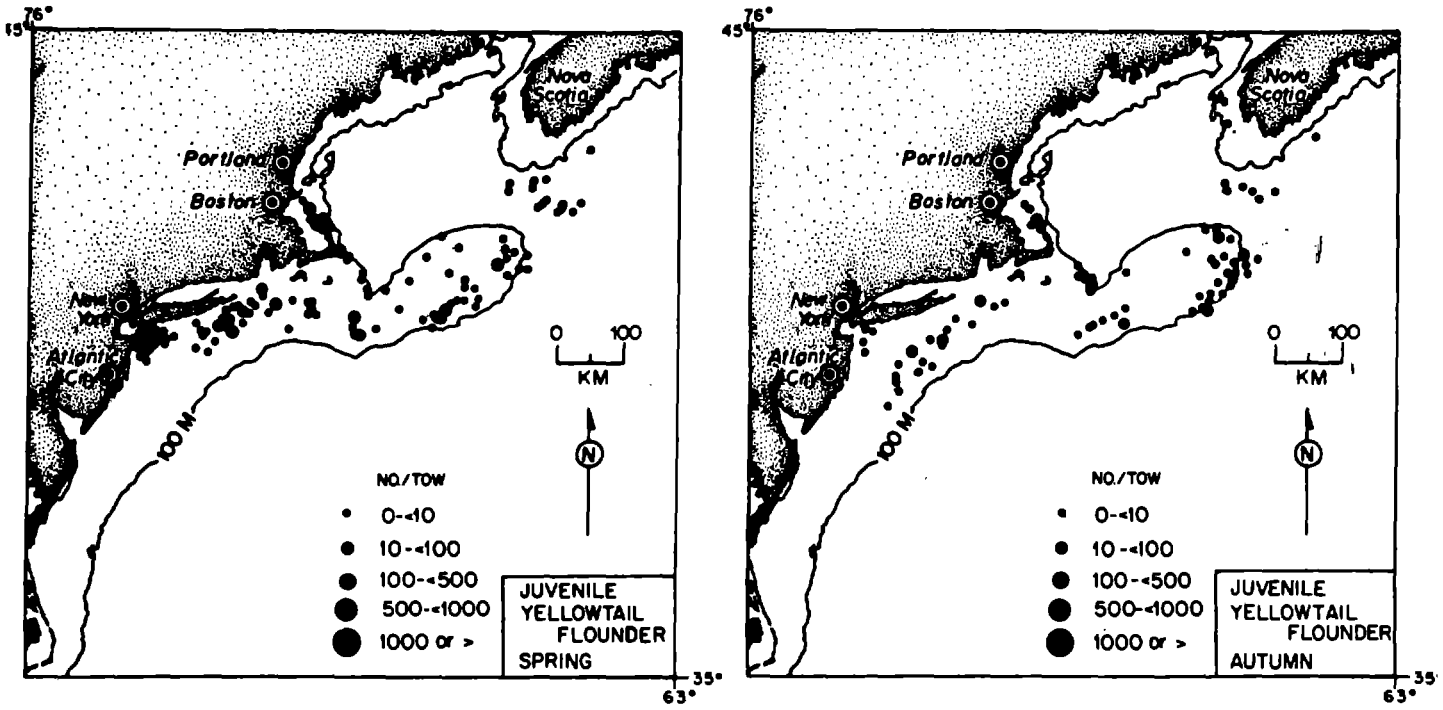

Figure 10. Cumulative distribution plots of bottom trawl catches of juvenile yellowtail flounder (<21 cm) during the spring and autumn for the years 1973-1976.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1987--701-959--60,038

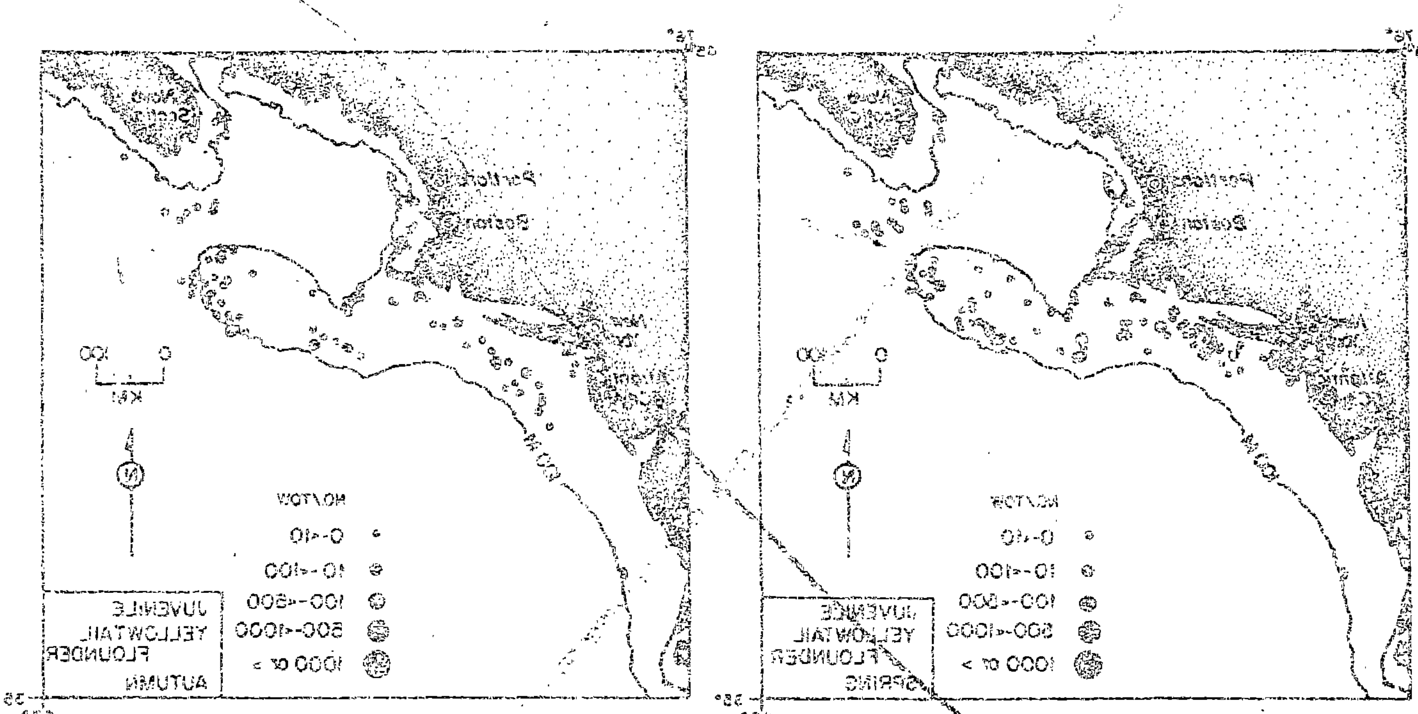

Figure 10. Cumulative distribution plots of bottom trawl catches of juvenile yellowtail flounder (<21 cm) during the spring and autumn for the years 1973-1976.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1987--761-059--60,058