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Seasonal Distribution Patterns of Commercial Landings of 45 Species off the Northeastern United States during 1977-88

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ABSTRACT

Seasonal distribution patterns of commercial landings of 45 finfish and shellfish species off the northeastern United States are analyzed using commercial weighout landings statistics collected by the Northeast Fisheries Center (NEFC) during 1977-88. Plots of the average quarterly commercial landings of each species are presented, with each plot showing the seasonal distribution of average landings over the 12-year period within 10-minute squares of latitude and longitude. Landings reported only to 30 minutes of latitude and longitude are prorated to 10-minute squares based on the distribution of landings that were reported to the finer scale. Comparisons are made with similar plots which are based on NEFC bottom trawl survey catch data, and which were previously published by others. Suggestions are made for the preparation of additional plots which would facilitate other comparisons between the commercial and survey data.

INTRODUCTION

The collection of fisheries statistics from the Northwest Atlantic traces back to 1887. The present statistical collection program of the National Marine Fisheries Service (NMFS), NEFC, originates from the haddock sampling program of the 1930s when sampling areas were defined as the fishing grounds for haddock, and sampling was conducted at major fishing ports (Rounsefell 1948). This haddock sampling program expanded gradually in the 1940s and 1950s to include other species such as Atlantic cod, redfish, silver hake, and yellowtail flounder. Sampling activities obtained several statistics: landings; days or hours spent fishing on each fishing ground (effort); number of days or hours lost to bad weather, gear damage, or other unusual circumstances (time lost); and certain biological information such as length frequencies, age structures, sex ratios, and fecundity. When the program further expanded in the 1960s to include additional ports, species, and areas, port agents assumed responsibility for collecting both weighout statistics and biological information on the landings (Burns *et al.* 1983).

The NEFC's present statistical collection program provides necessary information for assessing the status of stocks to support the management of fisheries, as well as for meeting specific Congressional mandates with respect to federal marine fishery management plans. The basic structure of the present program was developed in 1980 by the Northeast Fishery Management Task Force, made up of members of the New England and Mid-Atlantic Fishery Management Councils, commercial fishing industry, and NMFS. The task force developed guidelines for reporting fisheries statistics for stock assessments by outlining a three-tier system for collecting fisheries information (Chang *et al.* 1987; Schultz 1989).

The first tier calls for determination of landings by species and vessel trips. Port agents employed by, or contracted by, the NMFS use weighout records which are copies of the receipts that fishermen receive from buyers when they sell their fish. These records, as they are obtained from the buyers, contain the date of purchase, name of vessel or fisherman that sold the fish, species and market category, pounds, and value or price paid.

The second tier depends on data obtained from fishing trip logbooks, or from dockside interviews of vessel operators by port agents. Data collected in such interviews include date sailed and landed, gears fished, quantity of fish landed, fishing locations (at a resolution of 10 minutes of latitude and longitude, or a 10-minute square), days fished, days absent, mesh sizes, number of tows, duration of tows, depths fished, time lost, and species and quantity of fish discarded.

The third tier depends on samples of selected trips from which detailed tow-by-tow information is collected for stock assessment and fisheries management. This information comes from port agents, fishing trip logbooks kept by fishermen, or at-sea observers on board vessels during fishing operations. The third tier has been implemented for selected fisheries (*i.e.*, the domestic sea sampling program and the experimental whiting fishery program in 1988-89). There is still no tow-by-tow logbook system on a regionwide basis.

After port agents collect weighout records for the first- and second-tier data, the records for trips for which dockside interviews were conducted are coded. The weighout records for trips for which interviews were not conducted are also coded. In the latter case, certain data (*e.g.*, area fished to 30 minutes of latitude and longitude and days fished) are estimated based on those trips that were interviewed.

Data collection under the three-tier system follows a direct line from port agents to the NEFC. Data are entered into computer files and audited by port agents. The data receive a final audit at the NEFC before being entered into NEFC data bases. These data bases are subsequently forwarded to NMFS in Washington, D.C., for archiving and for the annual publishing of U.S. fisheries statistics.

METHODS

Landings statistics for each species covered in this report come from the commercial weighout landings data bases which are based on data collected by port agents from Maine to Virginia. The data are primarily first- and second-tier data. All statistics represent fish landed in U.S. ports, or joint ventures with foreign countries.

Proration schemes to apportion non-interviewed weighout landings statistics for each species to appropriate 10-minute squares are based on interviewed weighout landings statistics. The non-interviewed, first-tier landings statistics for each species, reported by 30-minute squares, are prorated to 10-minute squares using detailed second-tier landings statistics obtained from dockside interviews of fishermen and vessel operators by port agents (Wigley 1987). After proration, landings statistics for each species are averaged over the 1977-88 period, and tabulated by season.

Plots have been prepared of average landings by 10-minute square in each of the four seasons during 1977-88. Average landings statistics for some species, mostly from southern waters, are not based on the full 12-year period of 1977-88, but rather begin with the year either when landings were first reported by states to the NEFC, or were first collected by the NEFC. For croaker, this was 1980; for American shad, spot, striped bass, and blue mussel, 1981; for alewife and red deepsea crab, 1982; and for blueback herring and blue crab, 1983.

RESULTS AND DISCUSSION

Results of statistical analyses of the seasonal distributions of commercial weighout landings of 45 finfish and shellfish species/species groups are presented in Figures W1-W45, with each figure having four seasonal plots. The figures are arranged in six categories of species/species groups according to commonly distinguishable characteristics of species: shape, habitat, and taxonomy. The categories are: (1) 11 roundfish species from northern waters (Gulf of Maine and Georges Bank), (2) six flatfish species, (3) five pelagic species, (4) 11 roundfish species from southern waters (Southern New England and Mid-Atlantic), (5) two elasmobranch species/species groups, and (6) 10 shellfish species. Based on these plots, average quarterly landings distributions can be compared within each category, and general patterns among related species sharing common habitats and ecosystems can be easily seen.

Such patterns can also be compared with the distributional patterns based on NEFC bottom trawl survey catch data collected during 1965-78 (Almeida *et al.* 1984). Their seasonal (spring and autumn) distribution plots of bottom trawl survey catches for the 33 finfish and shellfish species also covered in this document are presented in the appendix as Figures S1-S33. Spring distributional plots are based on surveys during 1968-74, 1976, and 1978; autumn distributional plots are based on surveys during 1965-75 and 1977. The survey catch plots are separated into the same six categories of species as the weighout landings plots. Since the bottom trawl surveys are conducted primarily in spring and autumn, with a relatively few years of additional summer surveys (1977-81), the differences in seasonal resolution of the plots make some comparisons difficult. Additionally, consistent distributional plots have not been prepared for survey catch data since 1978, making comparisons difficult across time periods.

The general patterns of landings distributions for the 11 roundfish species from northern waters (Figures W1-W11) during 1977-88 show wide dispersal throughout the northern portion of the study area, with extended distributions further south for silver hake (Figure W4), red hake (Figure W5), and goosefish (Figure W10). The weighout landings distributions generally are not much different from the survey catch distributions (Figures S1-S11) during 1965-78. In the spring surveys, however, silver hake (Figure S4) and red hake (Figure S5) were generally more prevalent in the Southern New England and Mid-Atlantic regions than is indicated in the commercial weighouts. This earlier distribution by silver hake and red hake may reflect a greater abundance of these species in the 1960s and 1970s.

The patterns of landings distributions for the six flatfish species (Figures W12-W17) also show wide dispersal throughout the study area. Except for yellowtail flounder, the weighout landings distributions are similar to the survey catch distributions (Figures S12-S17). The difference for yellowtail flounder (Figures W12 and S12) may be attributable to its low abundance in recent years, particularly in the Mid-Atlantic region.

The patterns of landings distributions for the five pelagic species (Figures W18-W22) show wide dispersal throughout southern waters with the exceptions of Atlantic herring (Figure W19) and Atlantic menhaden (Figure W22). Comparisons of weighout landings distributions with survey catch distributions (Figures S18-S21) for pelagic species are quite different from such comparisons for groundfish (*i.e.*, demersal roundfish and flatfish) species. Such comparisons for pelagic species are very difficult not only because the pelagic species are not captured consistently in the surveys, but also because most of the weighout records of pelagic species (*e.g.*, Atlantic menhaden) do not have designations of areas fished. Also, some of the commercial landings of Atlantic herring and Atlantic mackerel are taken by inshore weir and trap gear. The patterns of landings distributions of the pelagic species may also reflect species abundance and migratory movement (*e.g.*, bluefish). Butterfish weighout landings distributions (Figure W21) are matched closely with survey catch distributions (Figure S21) in spring. In general, data for the distributional patterns of pelagic species fail to provide as clear a picture as do data for the distributional patterns of groundfish species.

Most roundfish species from southern waters treated in this document have extensive migratory movements, and the dynamics of their movements are only partly known (Figures W23-W33). With respect to alewives and blueback herring, there is little relationship between the weighout landings distributions (Figures W23 and W24) and the survey catch distributions (Figures S22 and S23) of either species. This minimal relationship may be, in part, the

result of the few weighout landings of either species, but the many survey catches of both species. This is particularly so for alewife in spring. Black sea bass (Figure W26) and scup (Figure W28) weighout landings distributions are matched closely with survey catch distributions (Figures S24 and S25) in both spring and autumn.

Weighout landings distributions of elasmobranch species (Figures W34 and W35) differ totally from the survey catch distributions of this species/species group category (Figures S26-S29). This difference may be, in part, the result of the little commercial value of these species, and, consequently, the little commercial fishing for them. Demand for spiny dogfish and skates, however, has increased in recent years at certain New England ports.

The patterns of landings distributions of invertebrate species are shown in Figures W36-W45. The weighout landings distributions of northern shortfin squid (Figure W36) are completely different from the survey catch distributions (Figure S30) of this species. Nonetheless, the weighout landings distributions of longfin squid, American lobster, and sea scallop (Figures W37, W38, and W42) match, in general, the survey catch distributions of these species (Figures S31-S33). Weighout landings distributions of northern shrimp, Atlantic surfclam, and ocean quahog (Figures W41, W43, and W44) are consistent over the years.

Additional comparisons of the seasonal distributions of these species would benefit from the preparation of plots of bottom trawl survey catch data from 1979-88, similar to those already prepared for 1965-78. Such comparisons could test for possible changes in distributions and abundances of commercially important species. It may also be useful to prepare monthly plots of weighout landings data for selected species, as well as plots of survey catch data for juvenile fishes, in particular, those of commercially important species. Such plots could be very useful in evaluating the utility of area closures or size limits for achieving fisheries management goals. Together with what is reported here, such additional analyses might provide further valuable insight into, and lead to a better understanding of, fisheries resources and the fisheries off the northeastern United States.

ACKNOWLEDGEMENTS

I would like to acknowledge the contributions of scientists from the Fisheries Statistics & Economics Branch, Conservation & Utilization Division, Northeast Fisheries Center. Their efforts and perseverance in the collection of weighout landings data and the maintenance of the weighout landings data system have produced an extensive data base. I would like to express very special thanks to Jon Gibson, editor of NEFC publications, who provided thorough editorial comments and suggested the inclusion of survey plots to make the document more presentable. I also wish to thank the following colleagues who provided valuable time and information to make this document possible: Frank Almeida, Janeen Cox, Otis Jackson, Arlene Longwell, Ralph Mayo, Cathy Noonan, Jack Pearce, Bob Pikanowski, Ronnee Schultz, Malcolm Silverman, Tim Smith, Alyce Wells, Susan Wigley, and Paul Wood.

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NOTES ON FIGURES AND APPENDIX

There are two sets of figures. The first set of figures represents the average seasonal distributions of commercial weighout landings. Each of the 45 figures in the first set -- one for each species/species group -- is composed of four quarterly plots. The four plots for each figure are placed two per page on facing pages so that the reader can see, at a glance, all four quarterly plots for each species. The legend for the figures in the first set is self-explanatory except for "GE" and "LT" which stand for "greater than or equal to" and "less than," respectively. For example, 5.00 GE x LT 25.00 means that the average landings per year are greater than or equal to 5.00 tons, inclusively, but less than 25.00 tons, exclusively.

The second set of figures comprises the appendix. The appendix figures are taken unabridged from Almeida *et al.* (1984) and represent the average seasonal distributions of bottom trawl survey catches. Each of the 33 figures in the appendix is composed of two plots -- one for the spring surveys and one for the autumn surveys. The two plots for each figure are placed on the same page.

To ensure a distinction between the first and second sets of figures, all figure numbers in the first set are preceded by a "W," and all figure numbers in the second set -- the appendix -- are preceded by an "S."

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Figure W1-1. Atlantic cod (*Gadus morhua*) commercial weighout landings distributions -- first quarter.

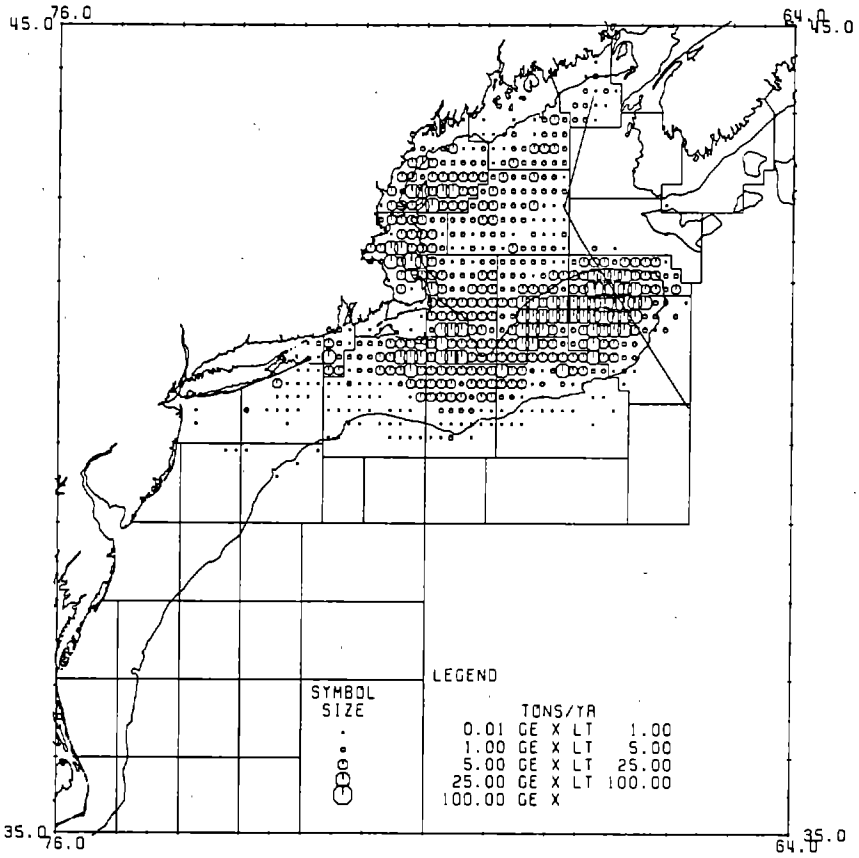
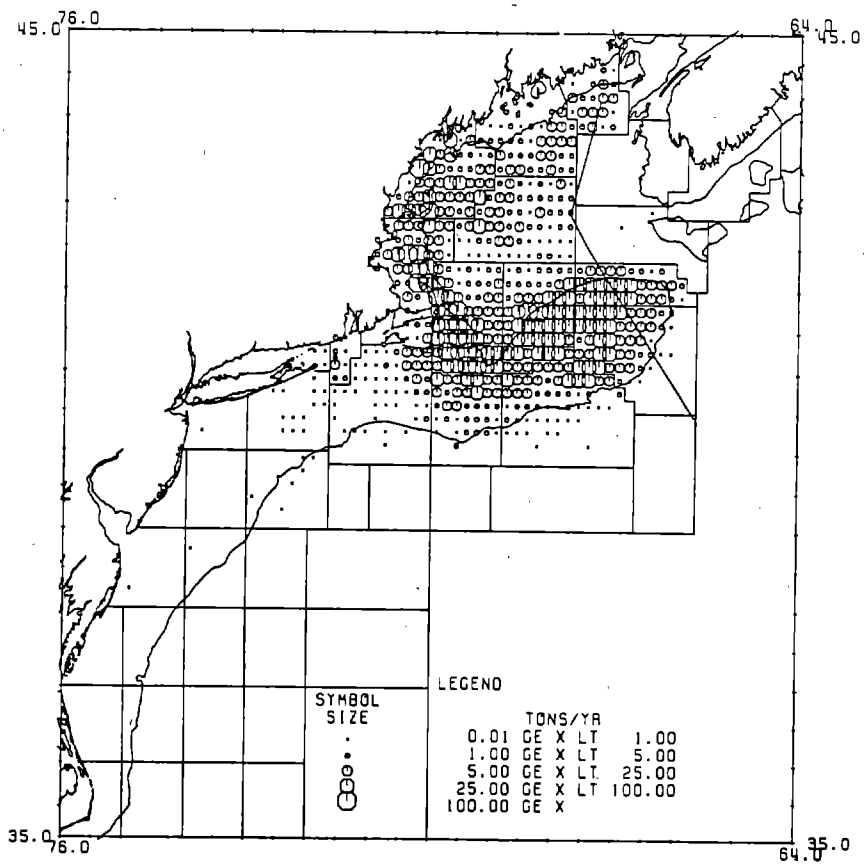


Figure W1-2. Atlantic cod (*Gadus morhua*) commercial weighout landings distributions -- second quarter.



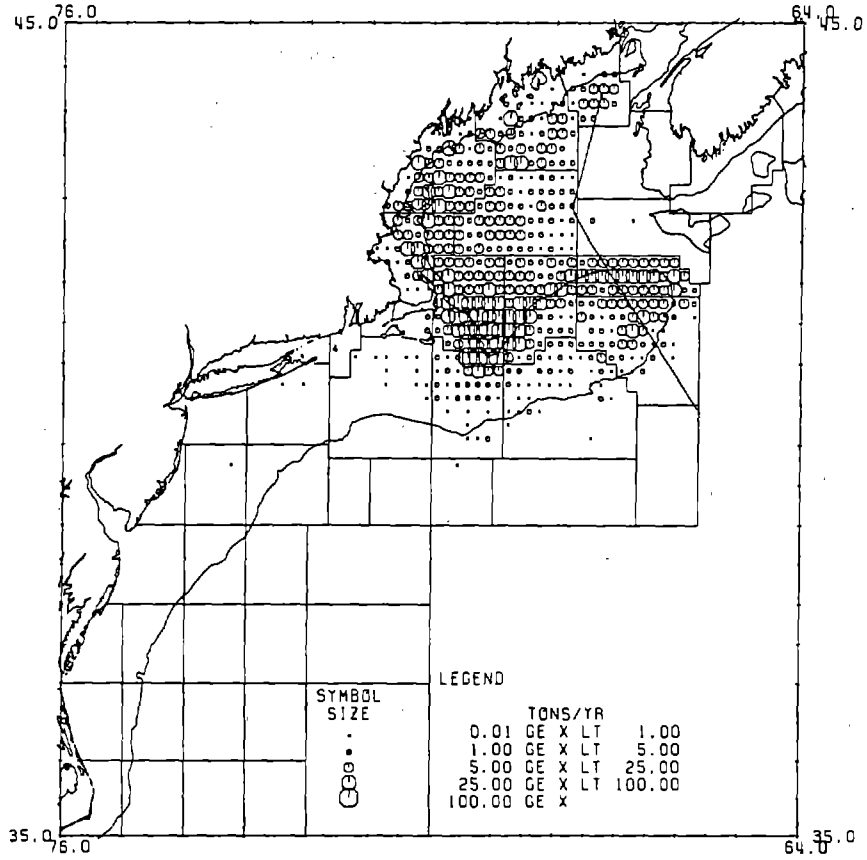


Figure W1-3. Atlantic cod (*Gadus morhua*) commercial weighout landings distributions -- third quarter.

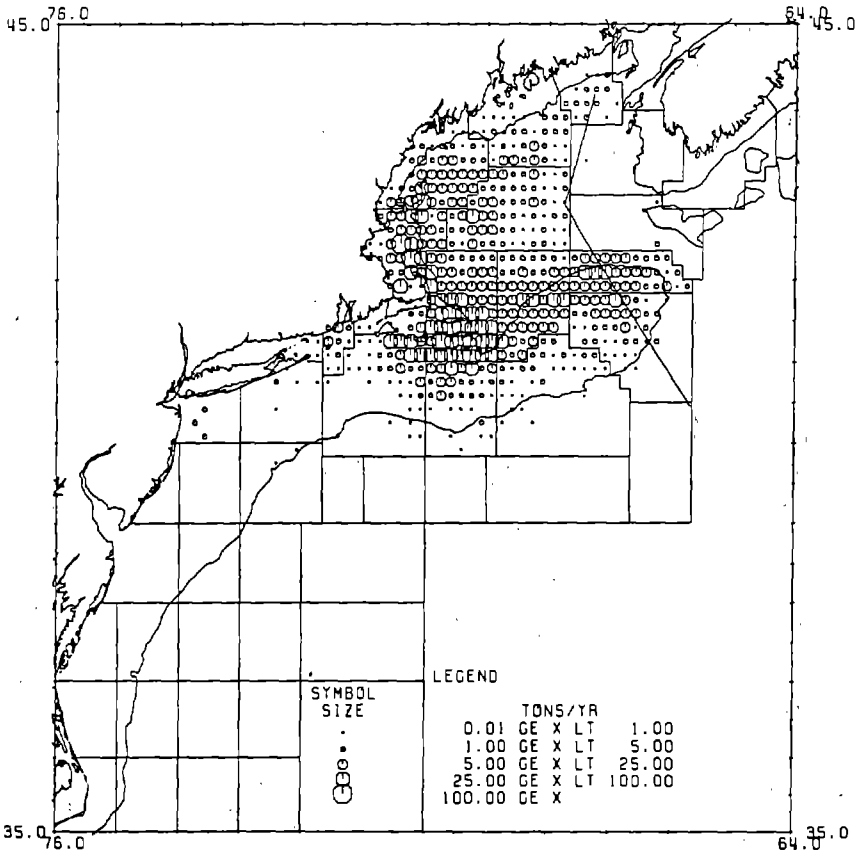


Figure W1-4. Atlantic cod (*Gadus morhua*) commercial weighout landings distributions -- fourth quarter.-

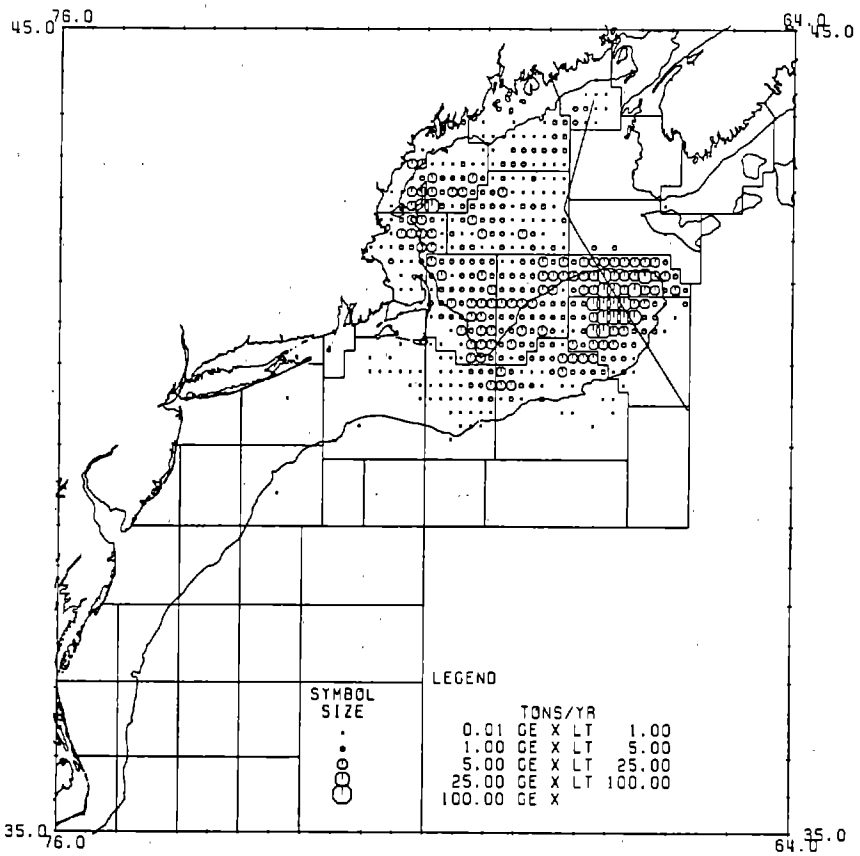


Figure W2-1. Haddock (*Melanogrammus aeglefinus*) commercial weighout landings distributions -- first quarter.

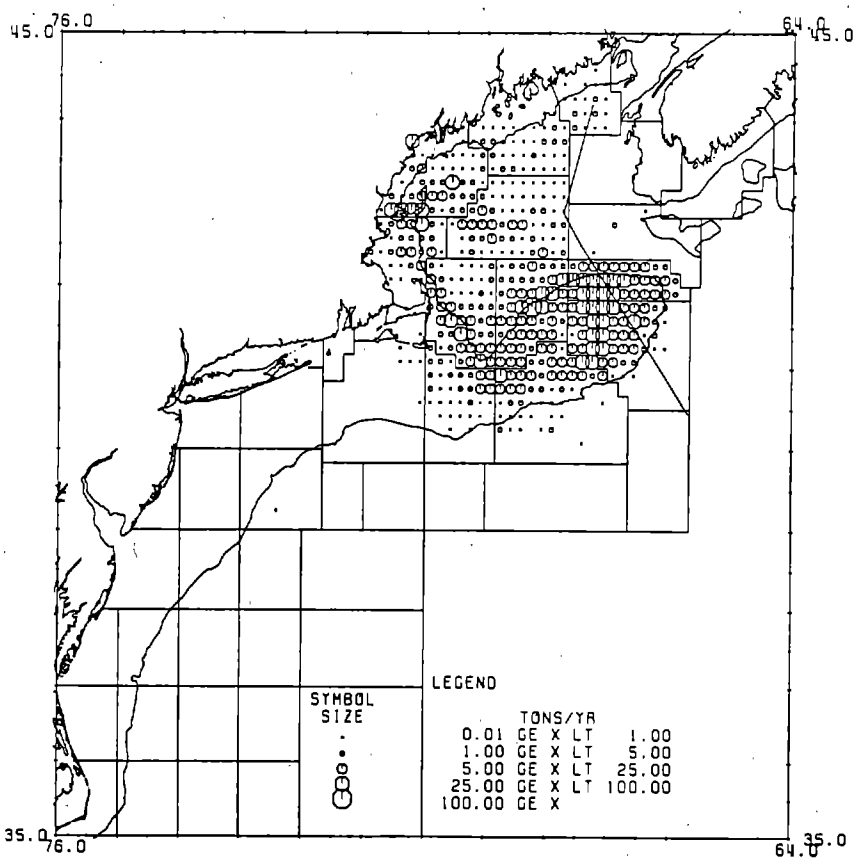


Figure W2-2. Haddock (*Melanogrammus aeglefinus*) commercial weighout landings distributions -- second quarter.

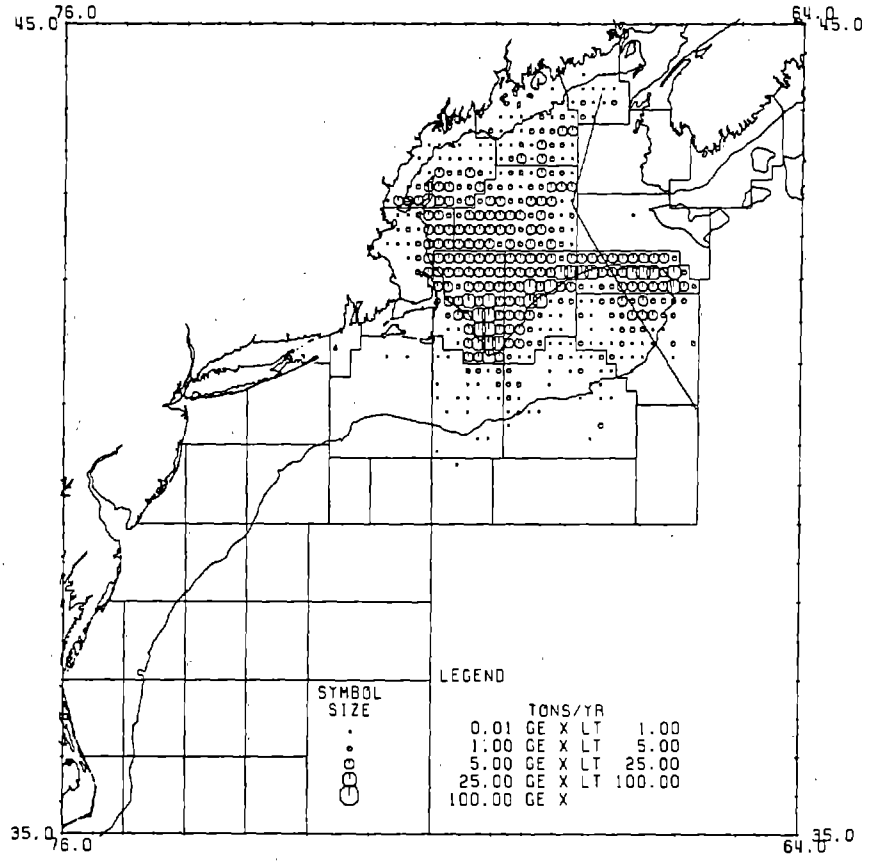


Figure W2-3. Haddock (*Melanogrammus aeglefinus*) commercial weighout landings distributions -- third quarter.

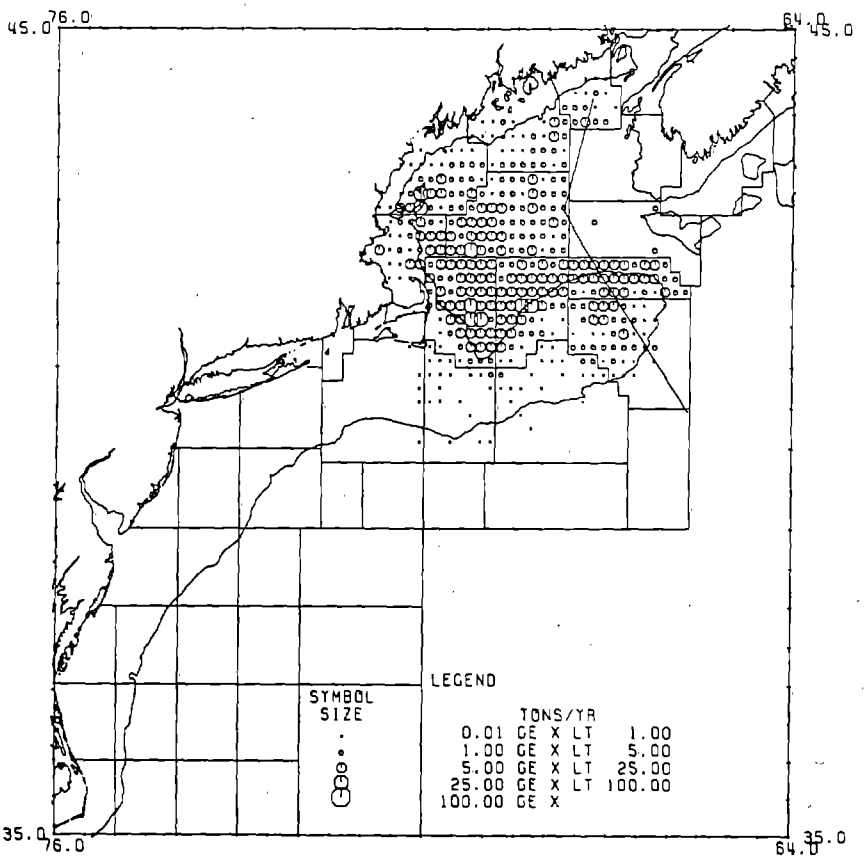
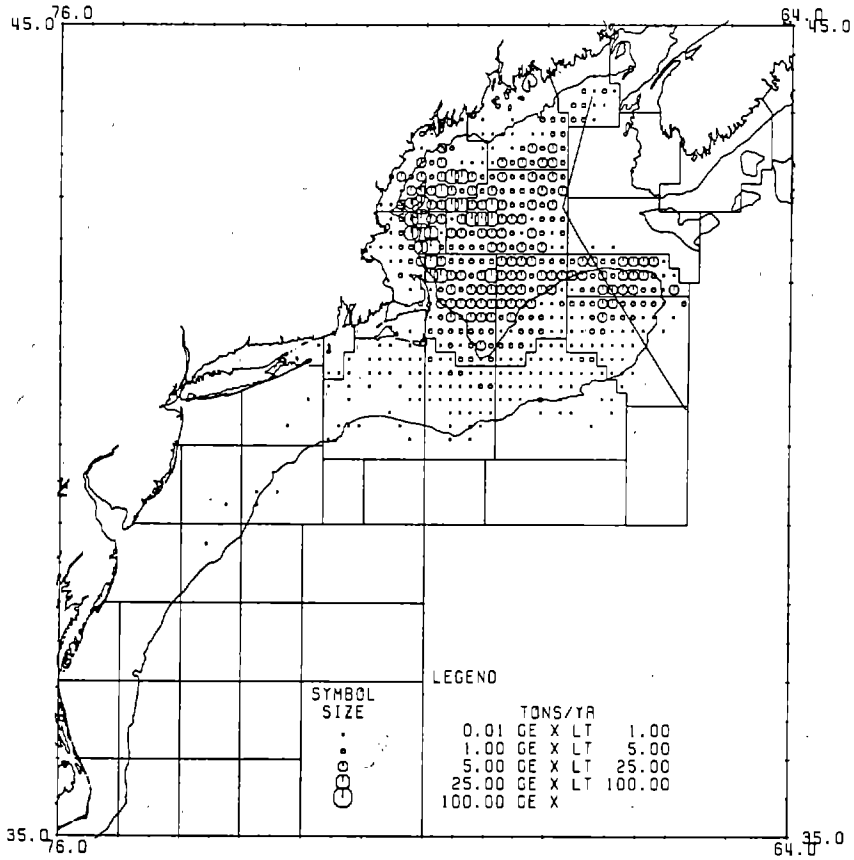


Figure W2-4. Haddock (*Melanogrammus aeglefinus*) commercial weighout landings distributions -- fourth quarter.

Figure W3-1. Pollock (*Pollachius virens*) commercial weighout landings distributions -- first quarter.



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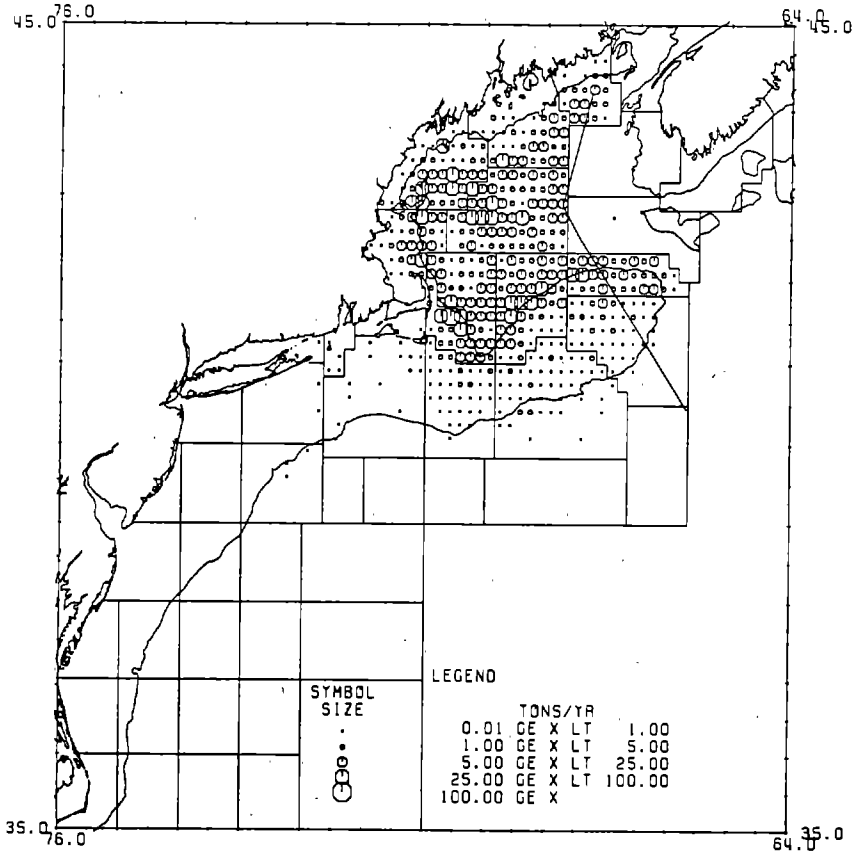

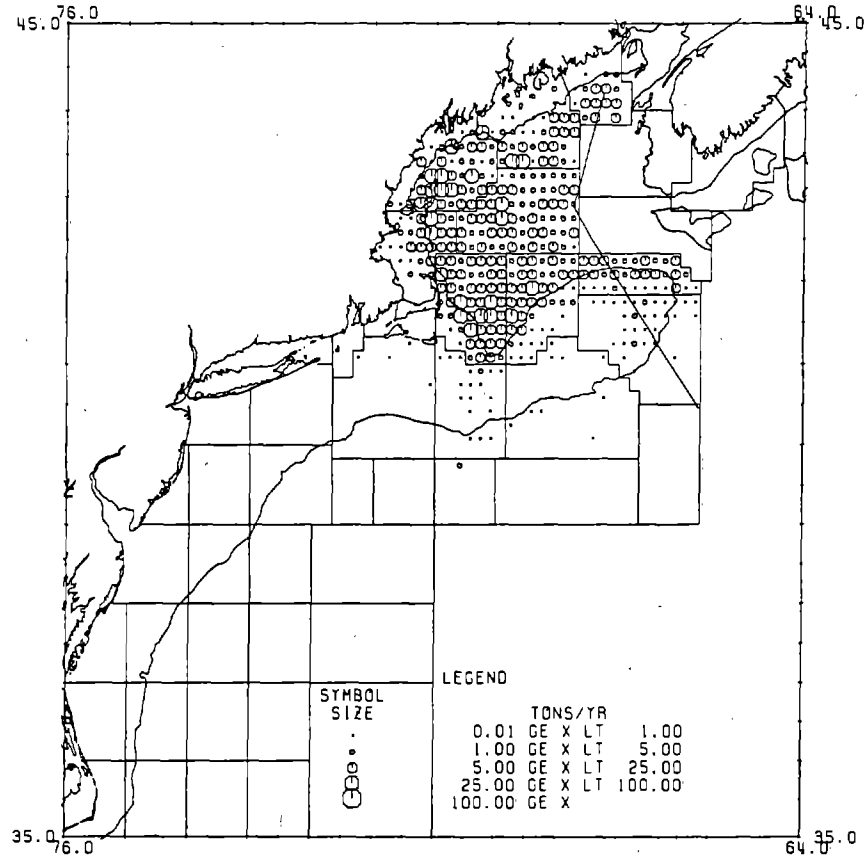

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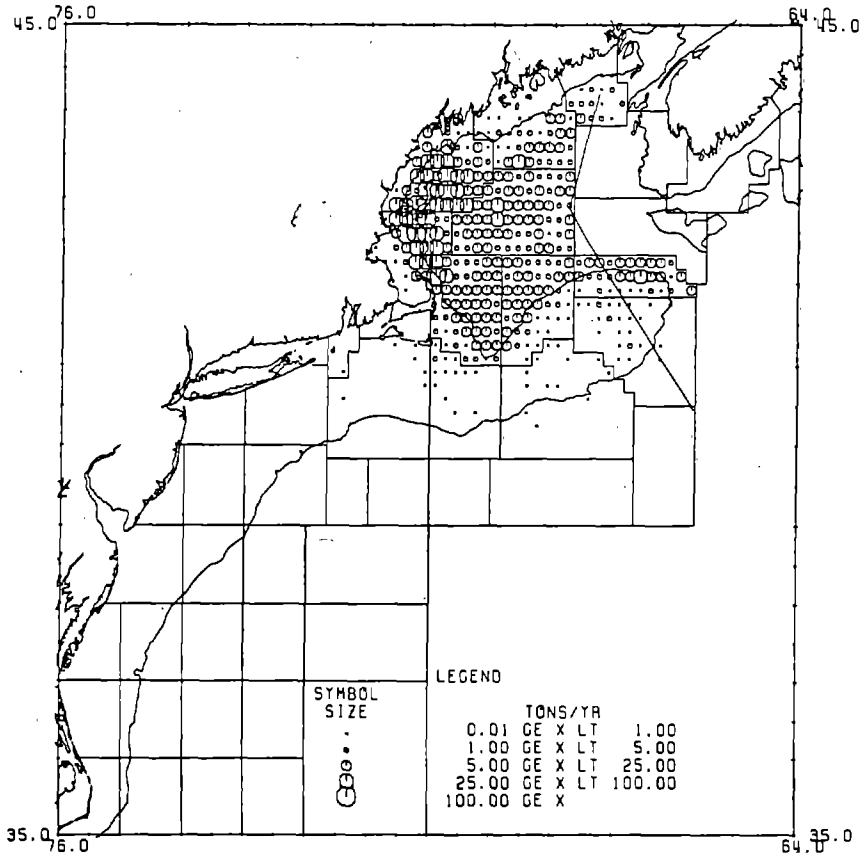

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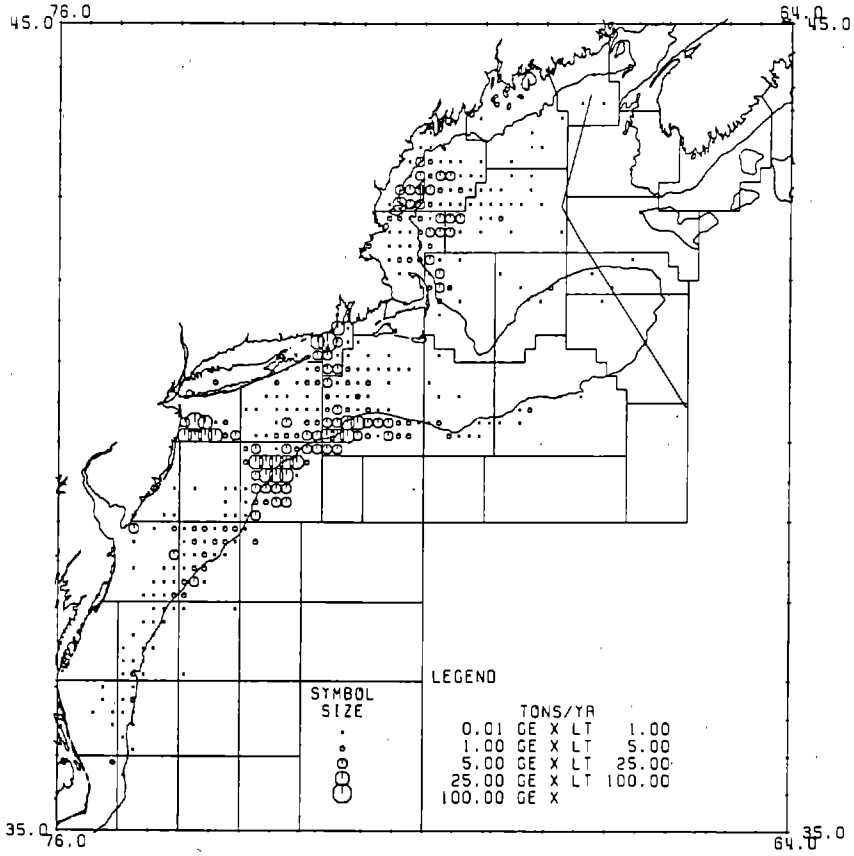


Figure W4-1. Silver hake (*Merluccius bilinearis*) commercial weighout landings distributions -- first quarter.

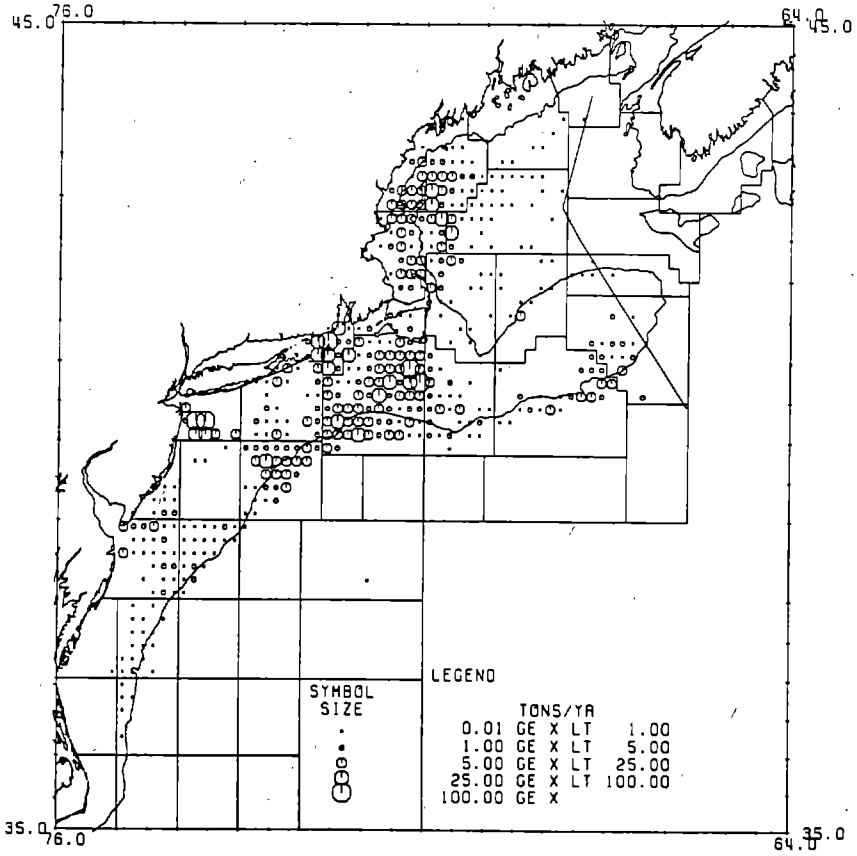


Figure W4-2. Silver hake (*Merluccius bilinearis*) commercial weighout landings distributions -- second quarter.

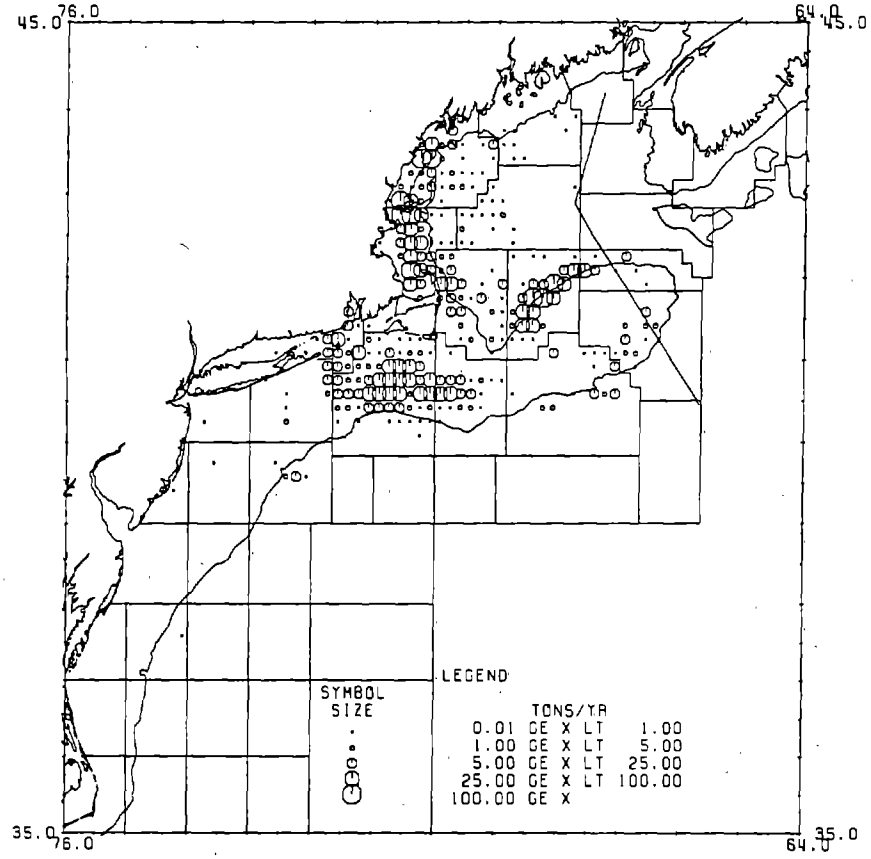


Figure W4-3. Silver hake (*Merluccius bilinearis*) commercial weighout landings distributions -- third quarter.

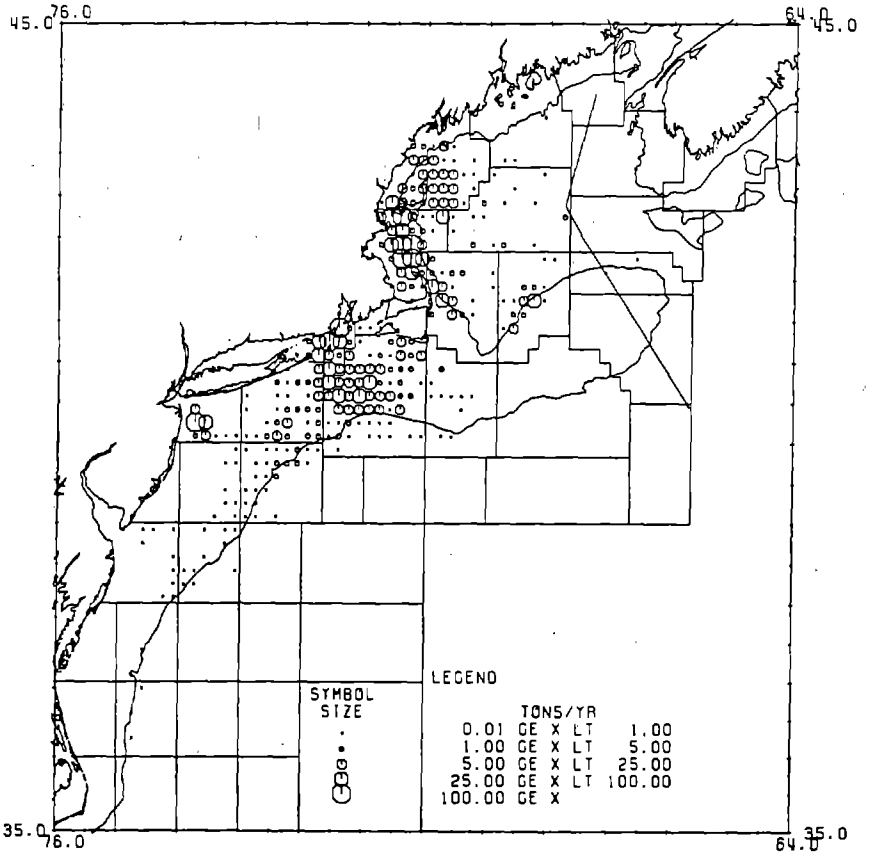


Figure W4-4. Silver hake (*Merluccius bilinearis*) commercial weighout landings distributions -- fourth quarter.

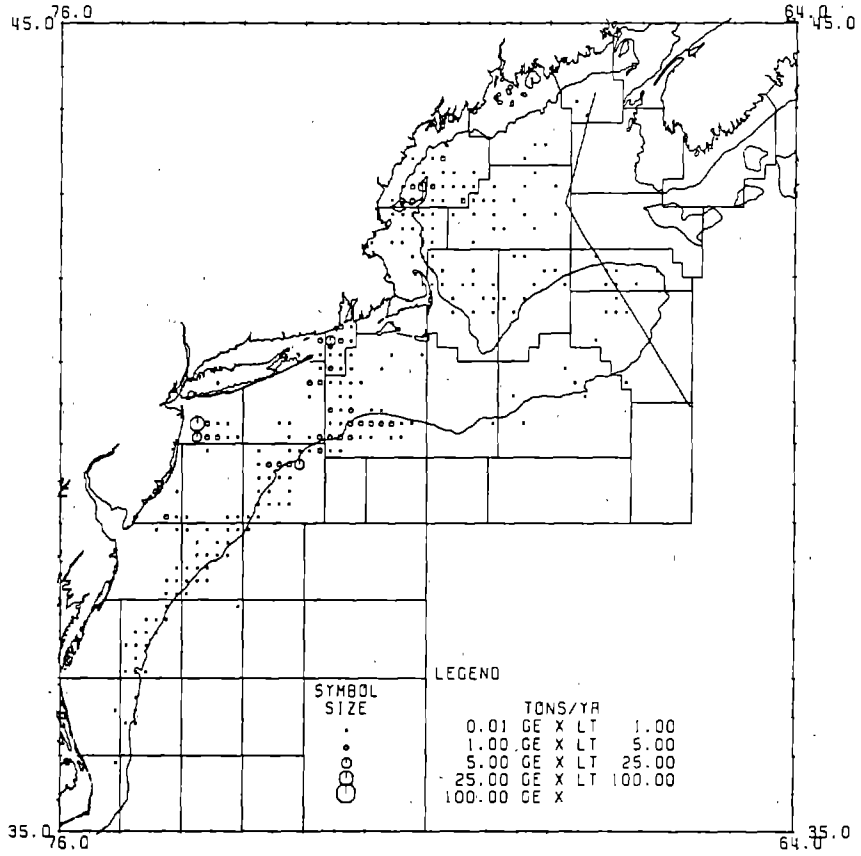


Figure W5-1. Red hake (*Urophycis chuss*) commercial weighout landings distributions -- first quarter.

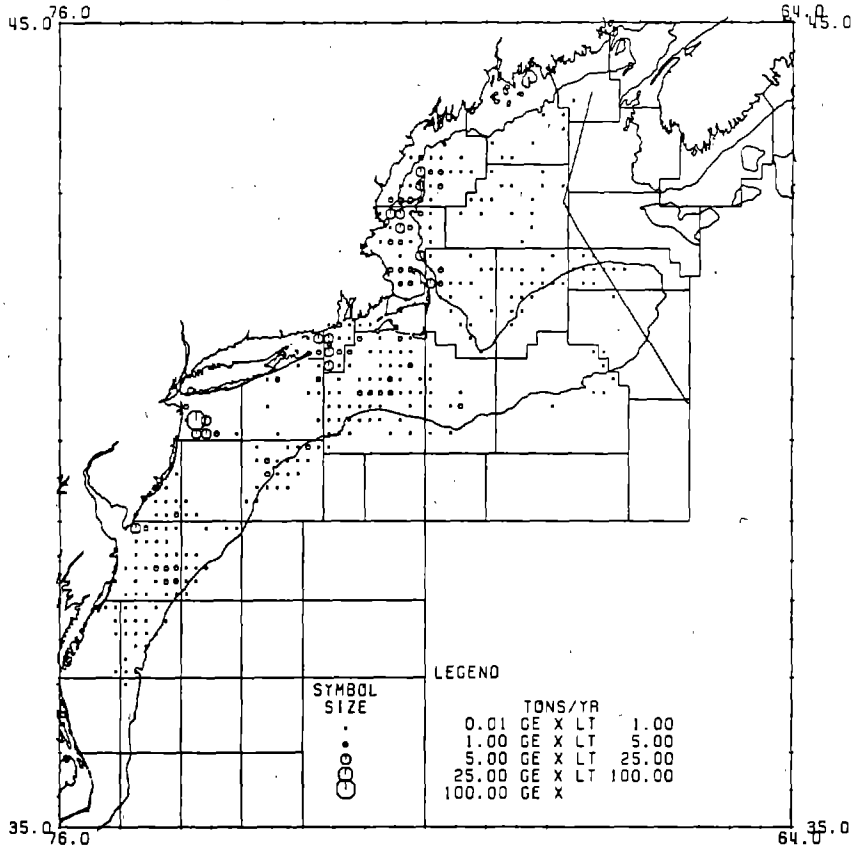


Figure W5-2. Red hake (*Urophycis chuss*) commercial weighout landings distributions -- second quarter.

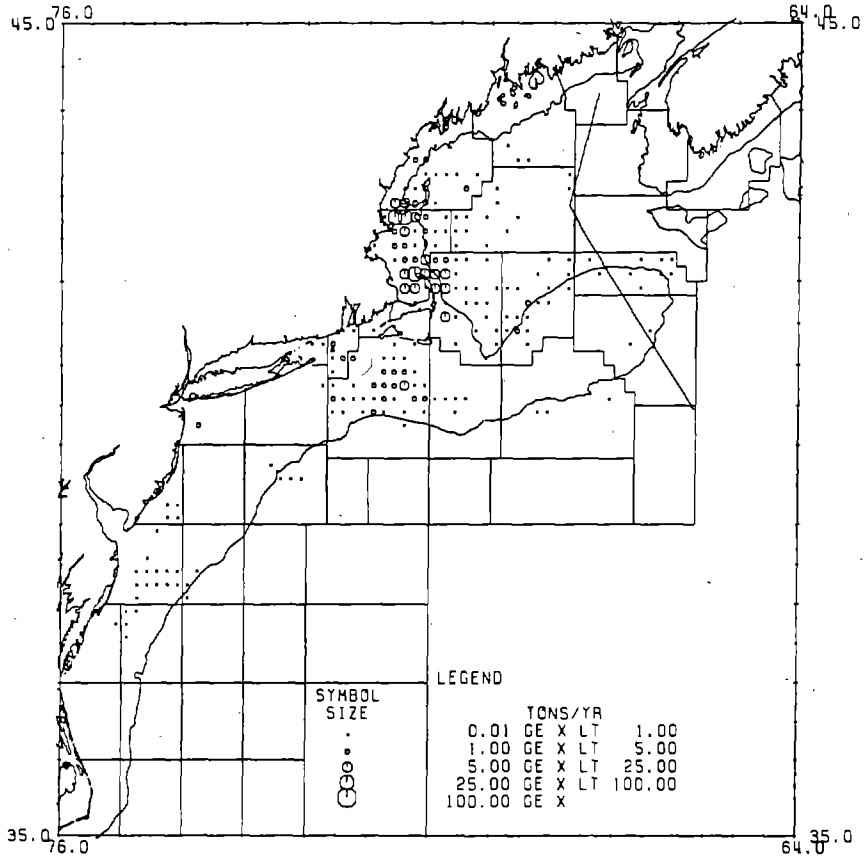


Figure W5-3. Red hake (*Urophycis chuss*) commercial weighout landings distributions -- third quarter.

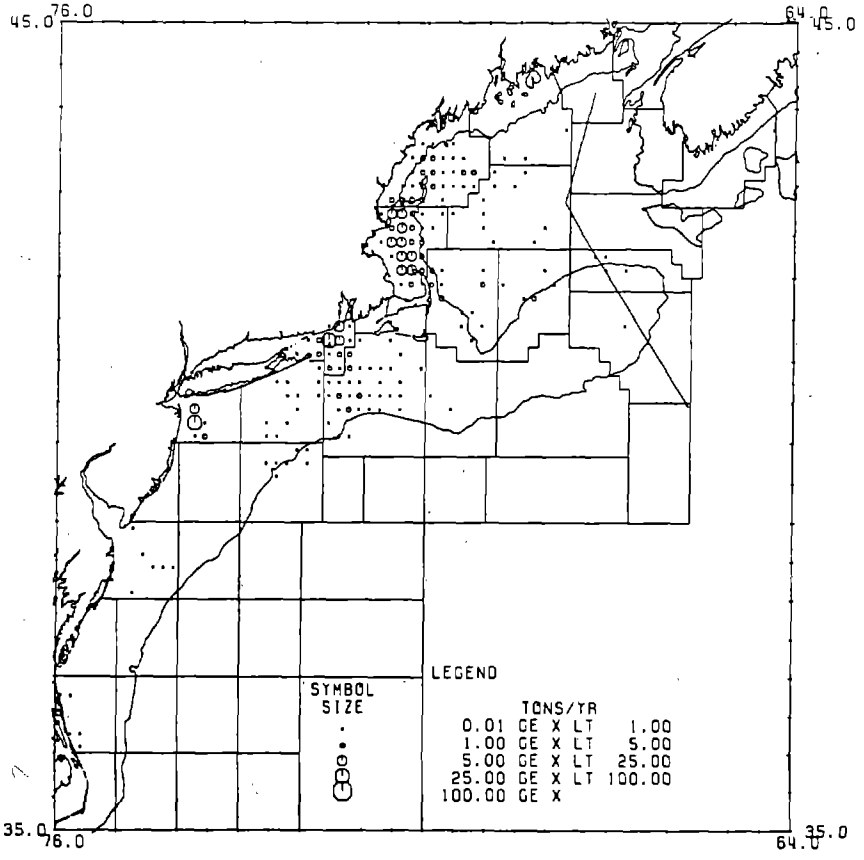
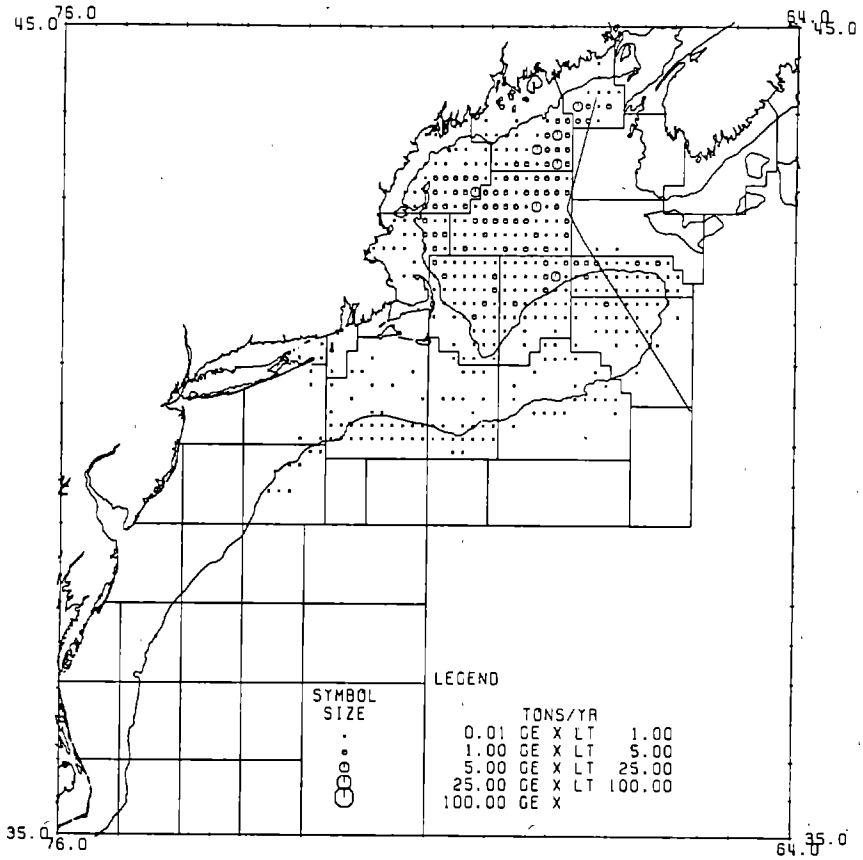


Figure W5-4. Red hake (*Urophycis chuss*) commercial weighout landings distributions -- fourth quarter.

Figure W6-1. White hake (*Urophycis tenuis*) commercial weighout landings distributions -- first quarter.



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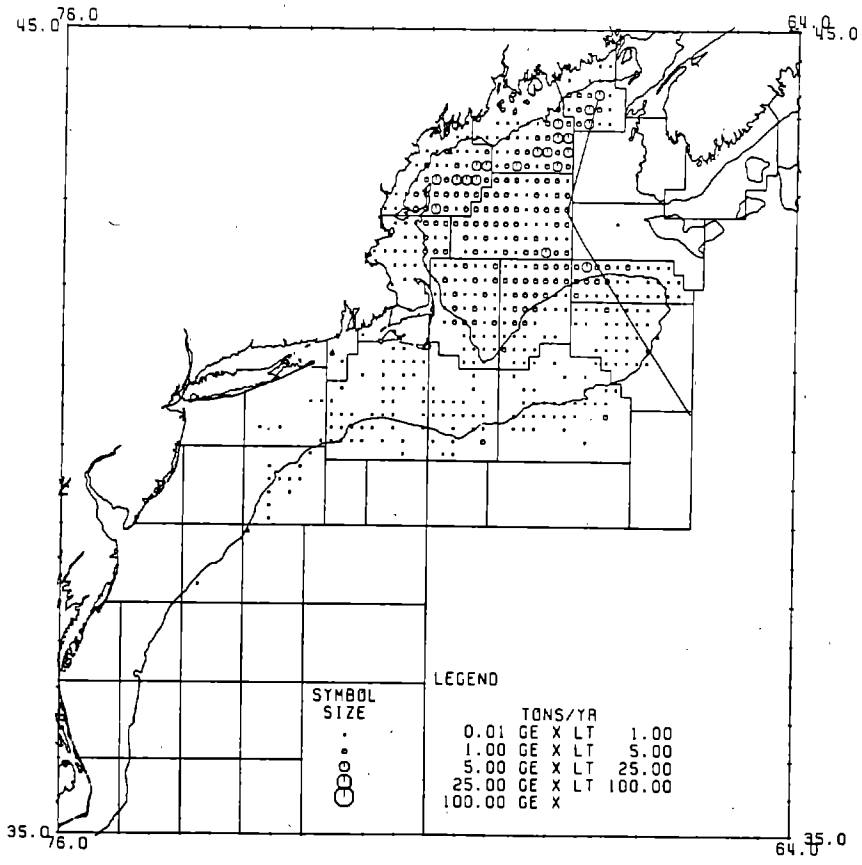

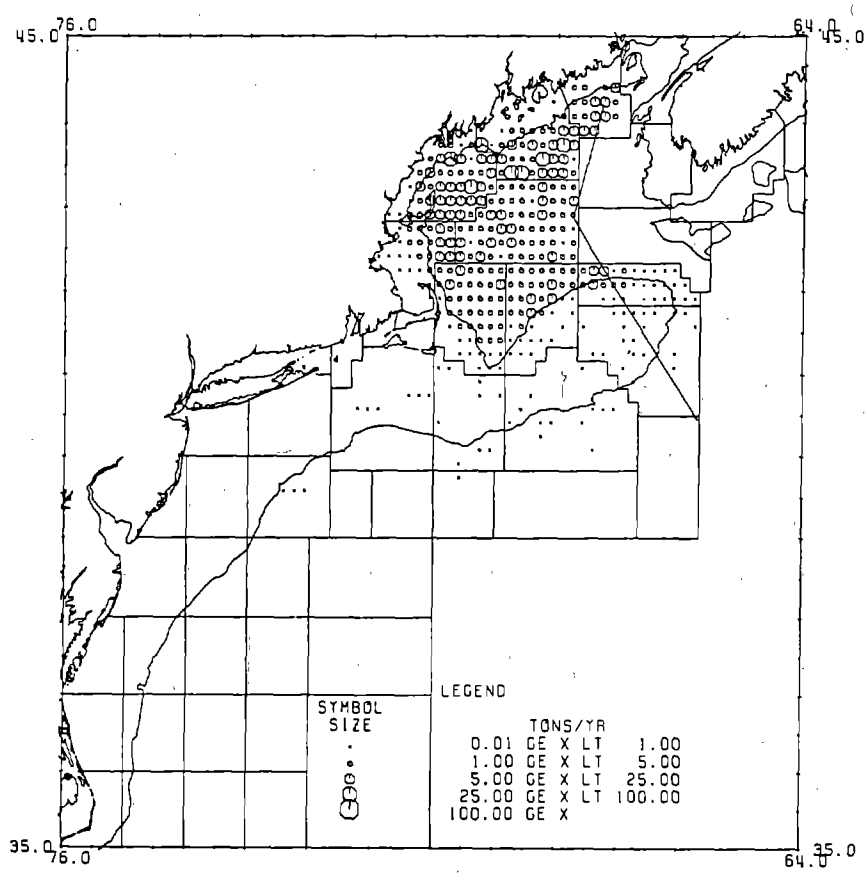

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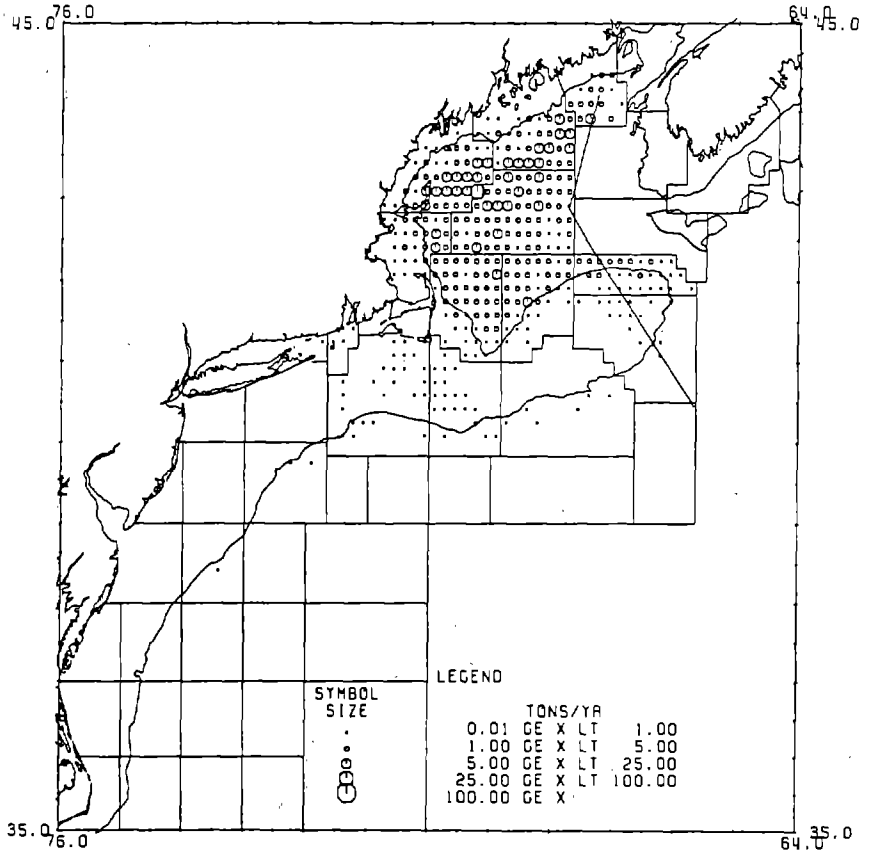


Figure W6-4. White hake (*Urophycis tenuis*) commercial weighout landings distributions -- fourth quarter.

Figure W7-1. Redfish (*Sebastes marinus*) commercial weighout landings distributions -- first quarter.

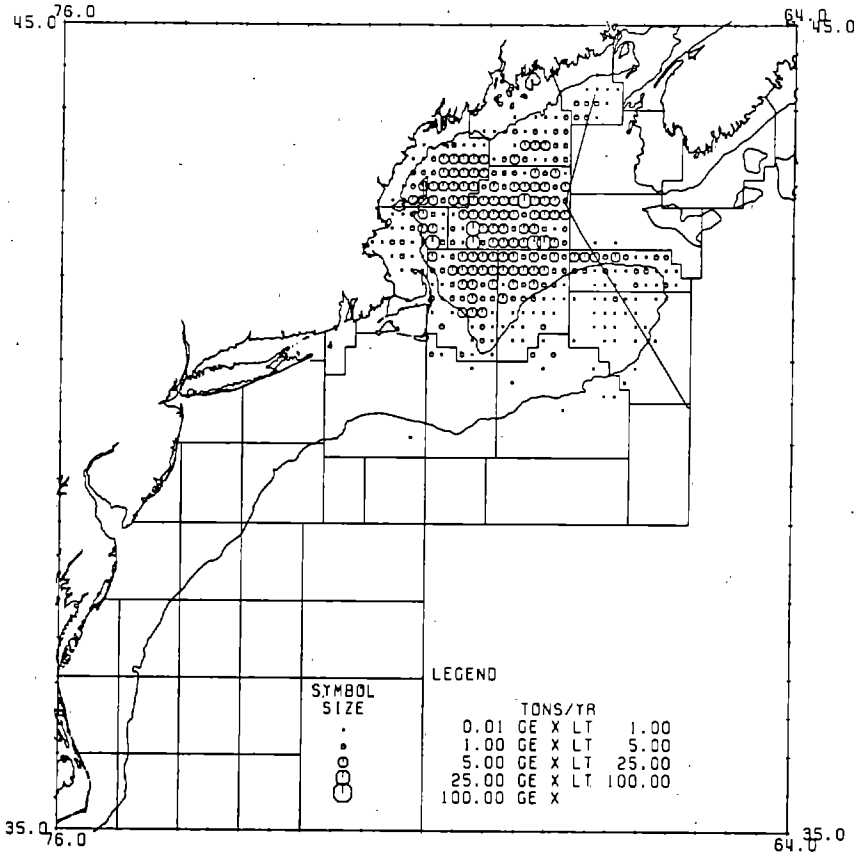
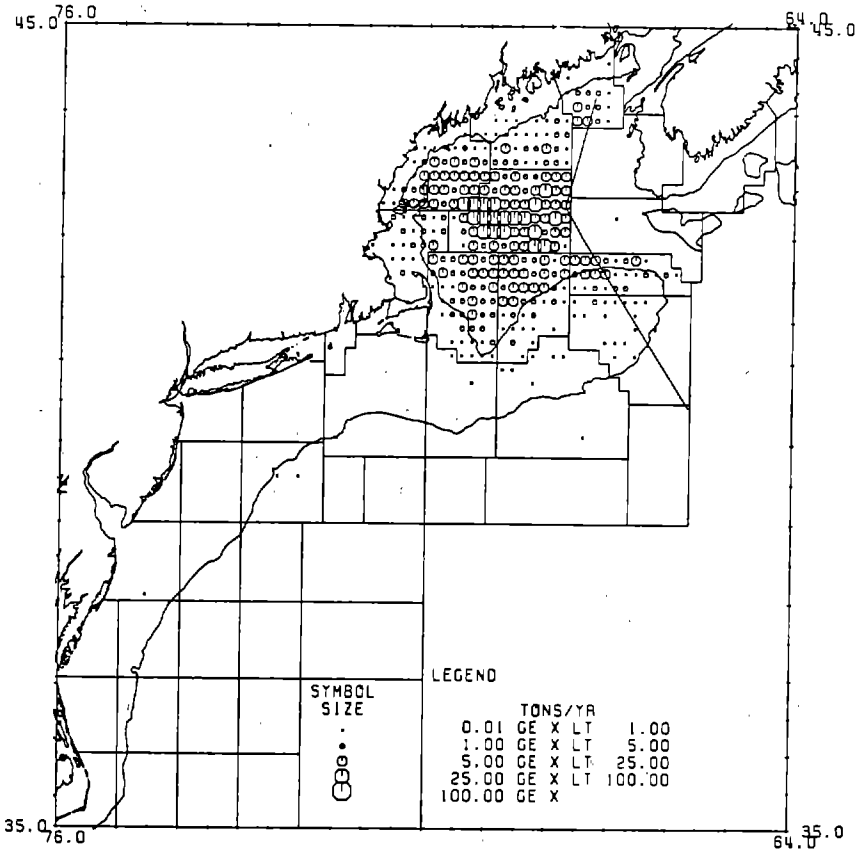


Figure W7-2. Redfish (*Sebastes marinus*) commercial weighout landings distributions -- second quarter.



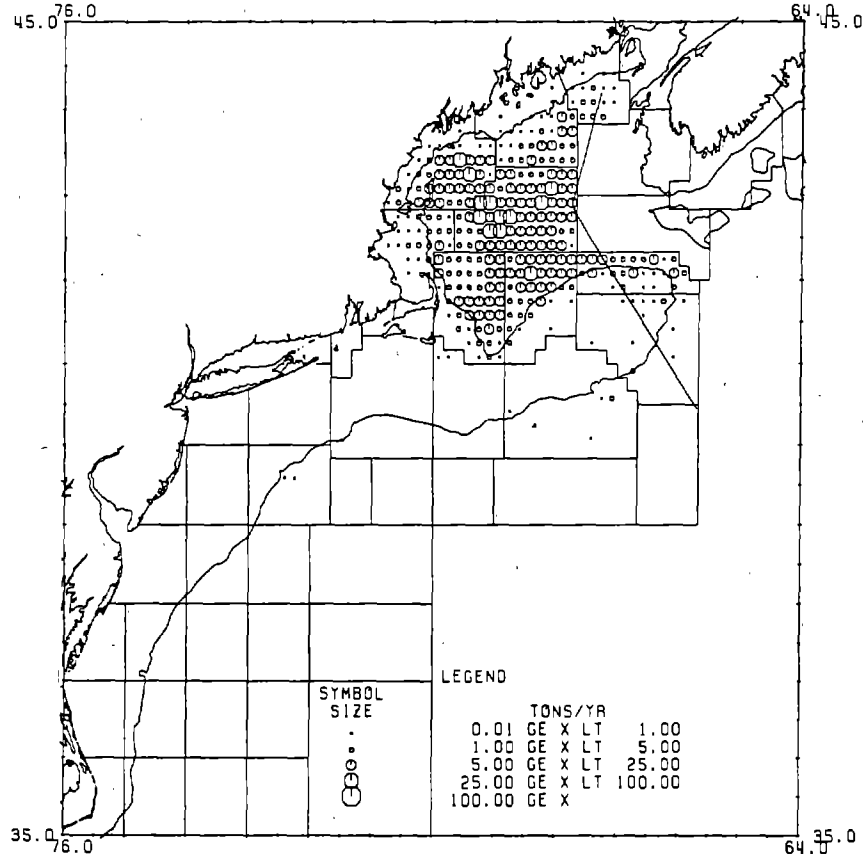


Figure W7-3. Redfish (*Sebastes marinus*) commercial weighout landings distributions -- third quarter.

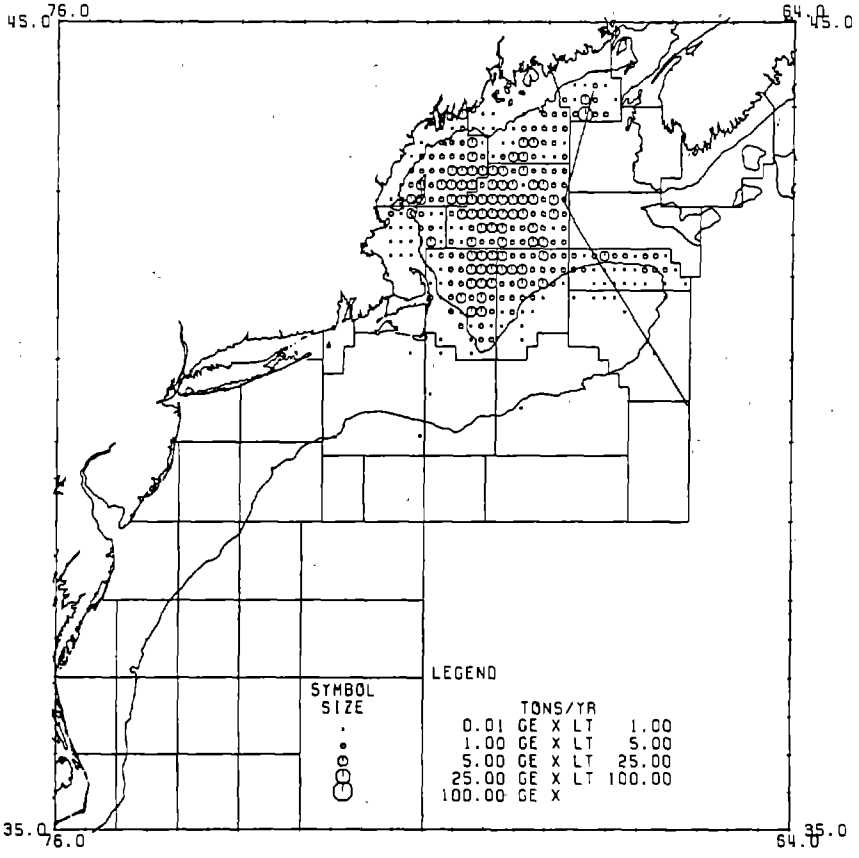


Figure W7-4. Redfish (*Sebastes marinus*) commercial weighout landings distributions -- fourth quarter.

Figure W8-1. Cusk (*Brosme brosme*) commercial weighout landings distributions -- first quarter.

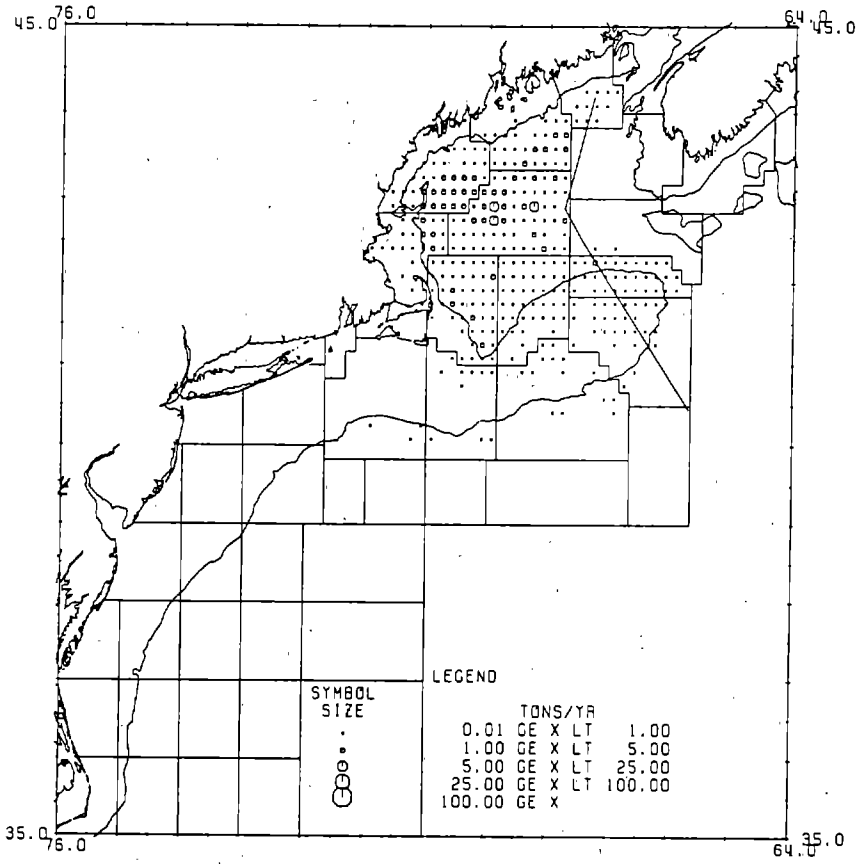
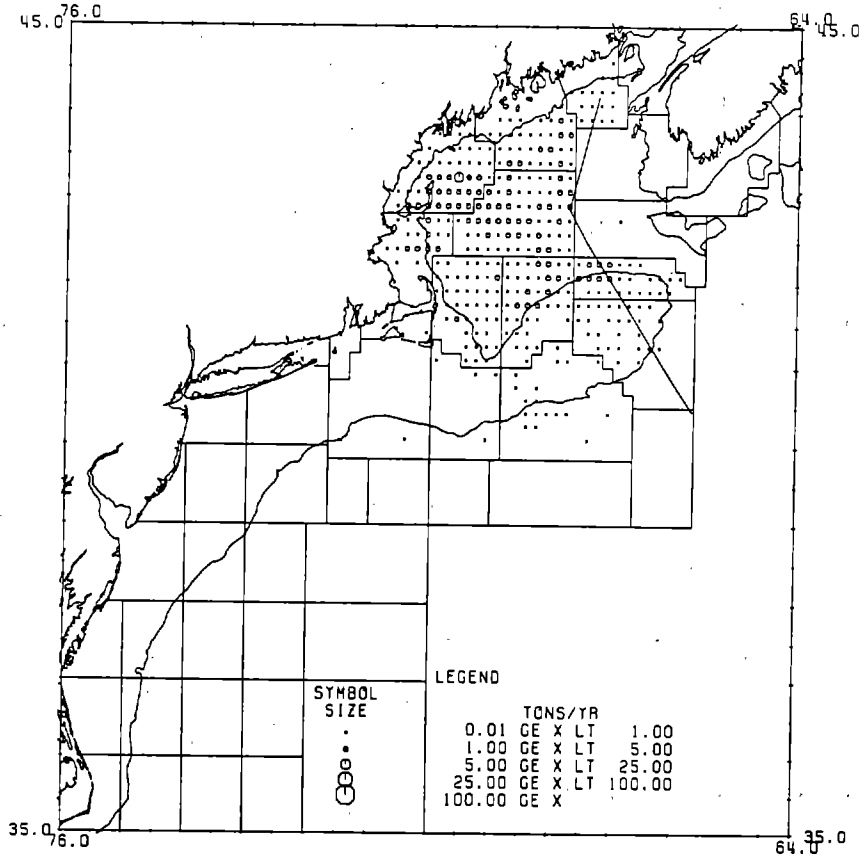


Figure W8-2. Cusk (*Brosme brosme*) commercial weighout landings distributions -- second quarter.



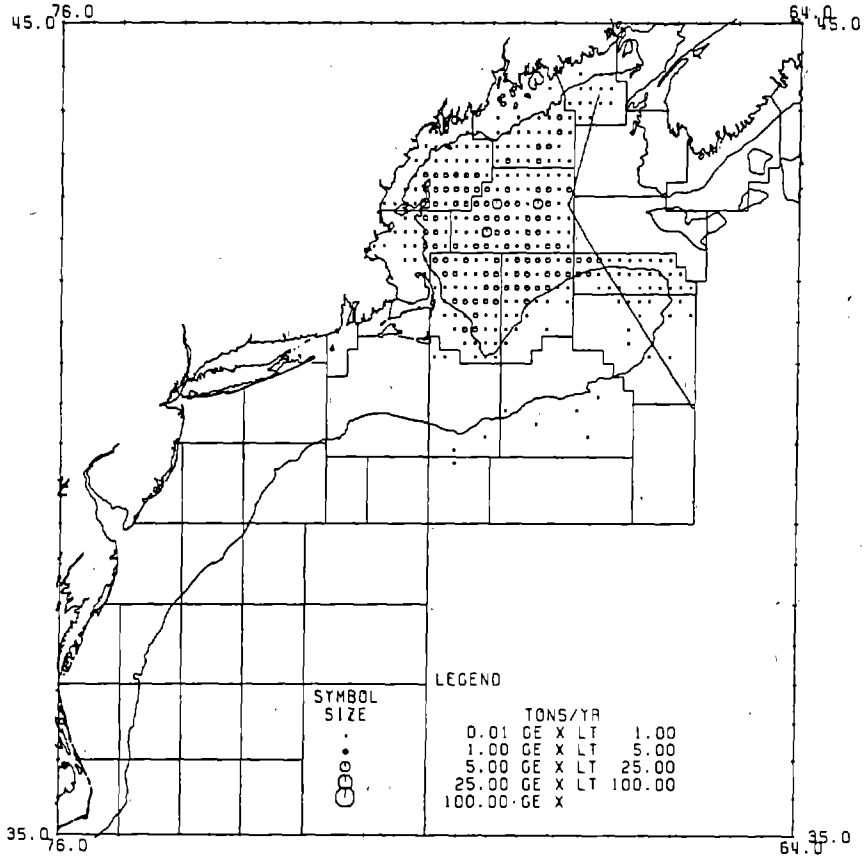


Figure W8-3. Cusk (*Brosme brosme*) commercial weighout landings distributions -- third quarter.

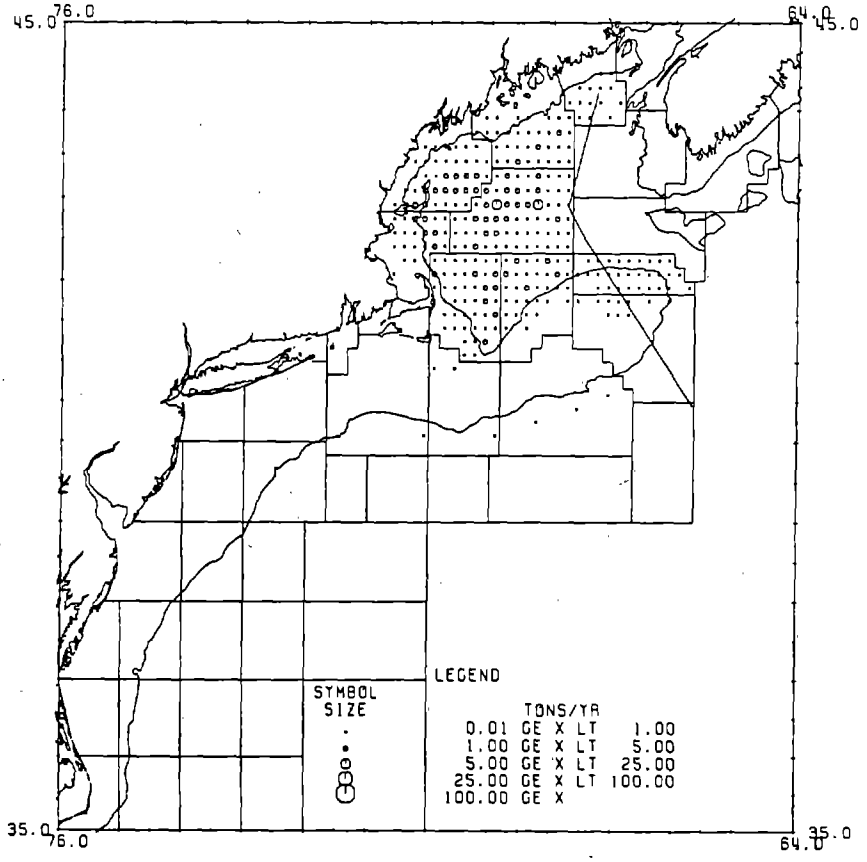


Figure W8-4. Cusk (*Brosme brosme*) commercial weighout landings distributions -- fourth quarter.

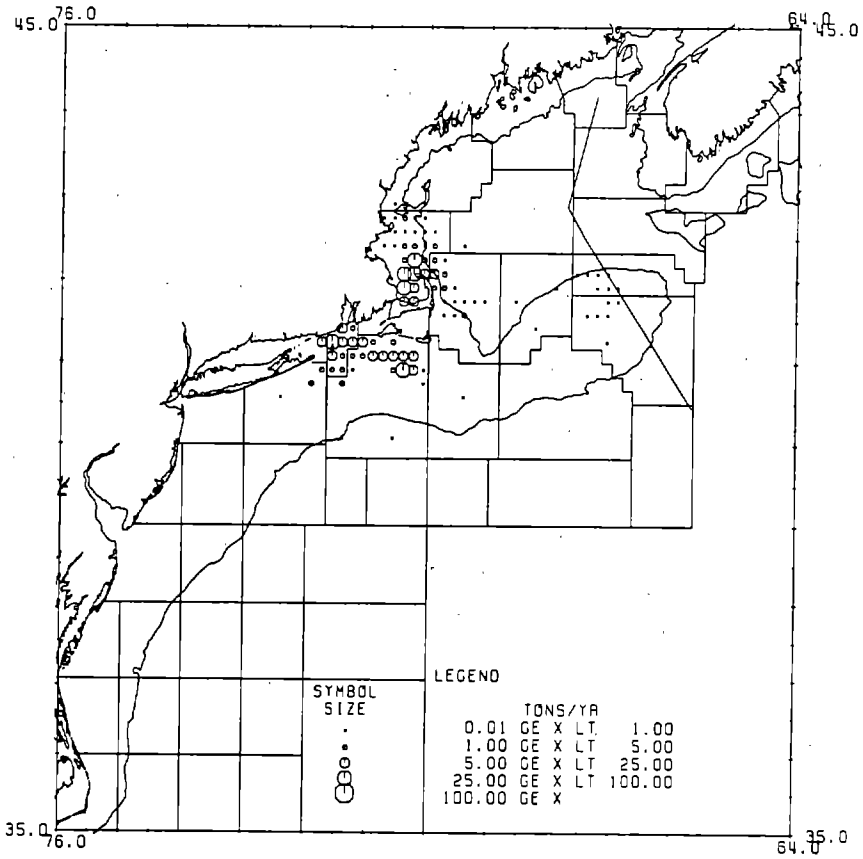


Figure W9-1. Ocean pout (*Macrozoarces americanus*) commercial weighout landings distributions -- first quarter.

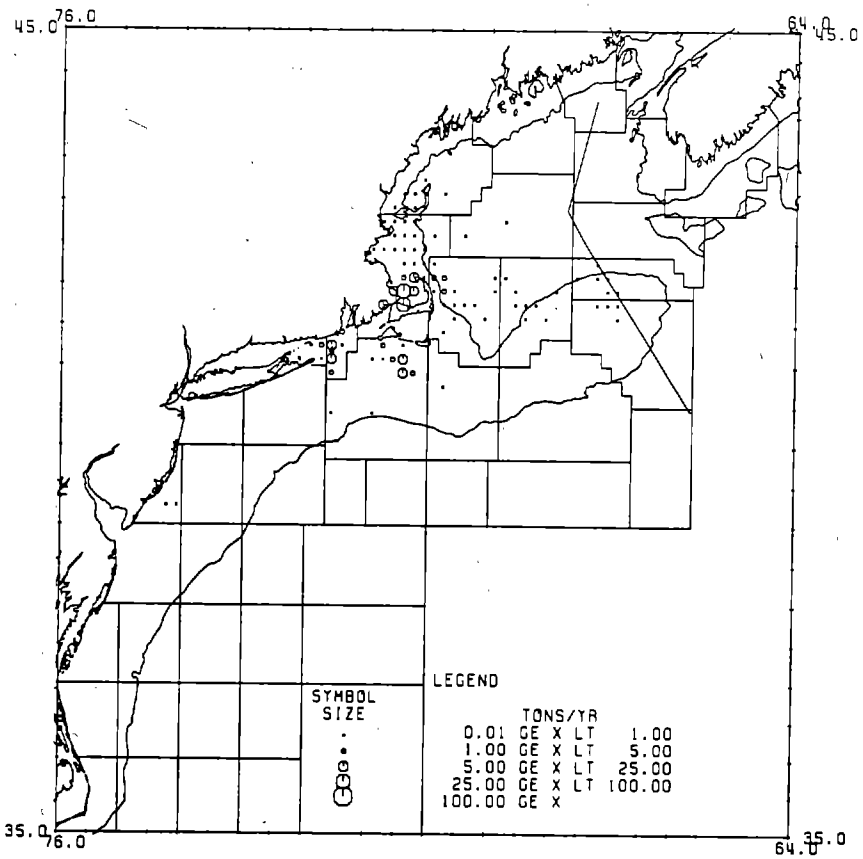


Figure W9-2. Ocean pout (*Macrozoarces americanus*) commercial weighout landings distributions -- second quarter.

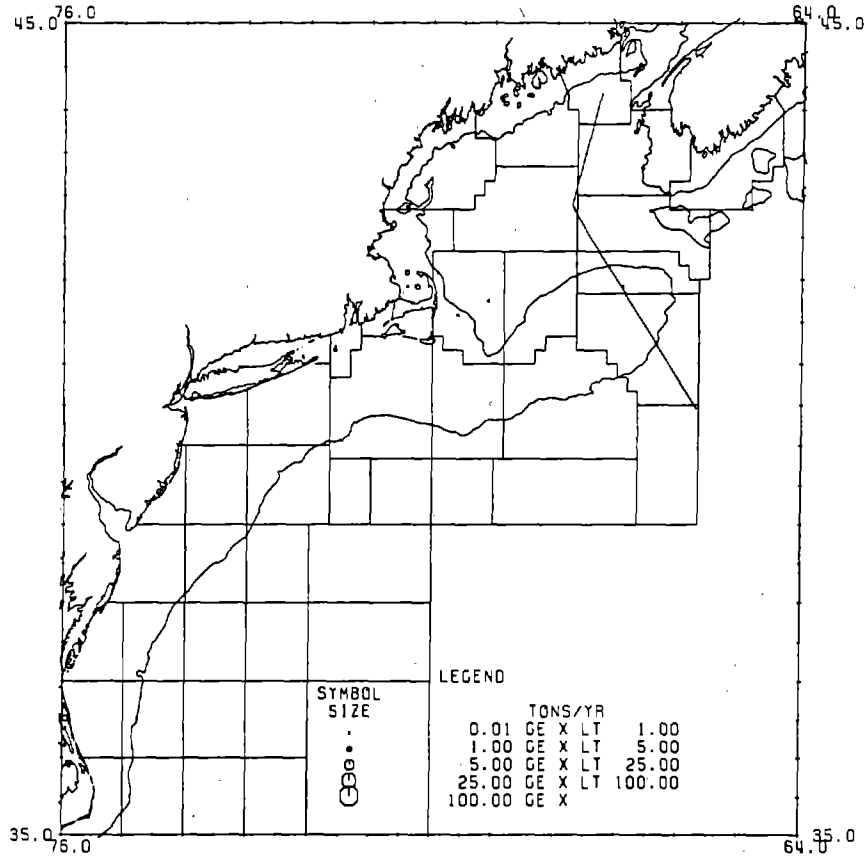


Figure W9-3. Ocean pout (*Macrozoarces americanus*) commercial weighout landings distributions -- third quarter.

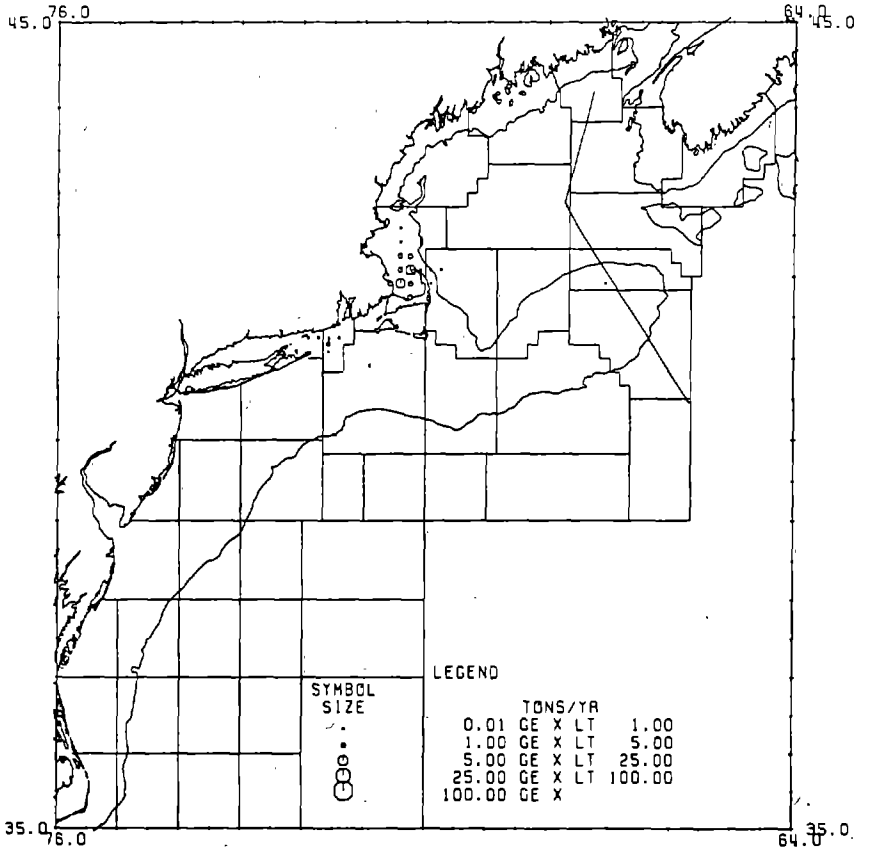


Figure W9-4. Ocean pout (*Macrozoarces americanus*) commercial weighout landings distributions -- fourth quarter.

Figure W10-1. Goosefish (*Lophius americanus*) commercial weighout landings distributions -- first quarter.

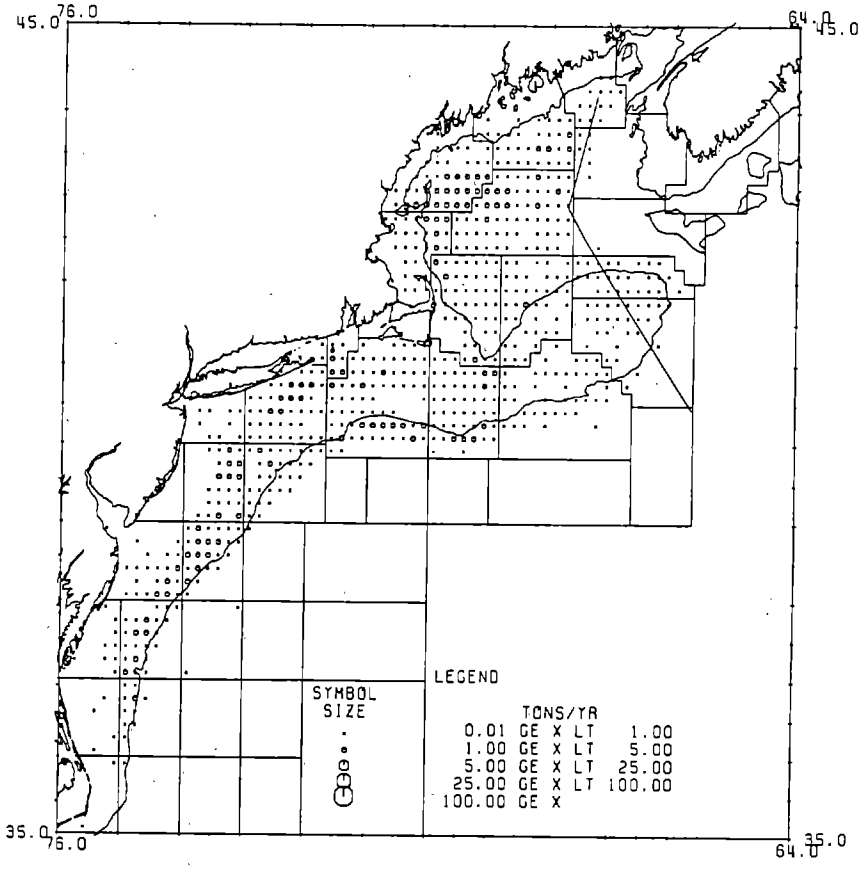
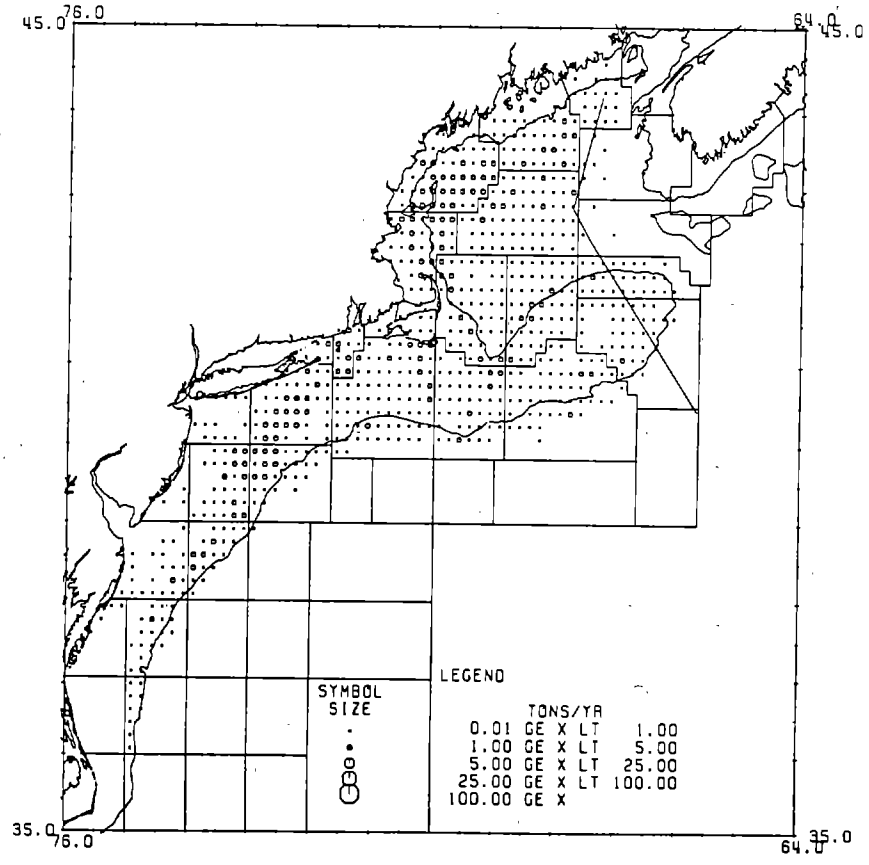


Figure W10-2. Goosefish (*Lophius americanus*) commercial weighout landings distributions -- second quarter.



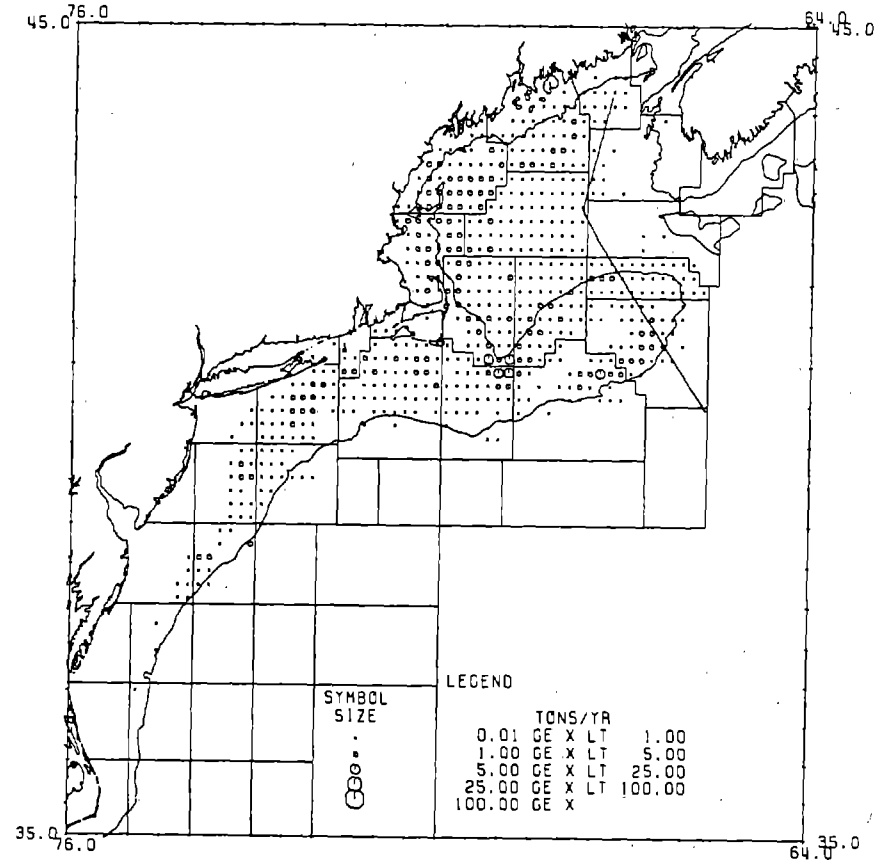


Figure W10-3. Goosefish (*Lophius americanus*) commercial weighout landings distributions -- third quarter.

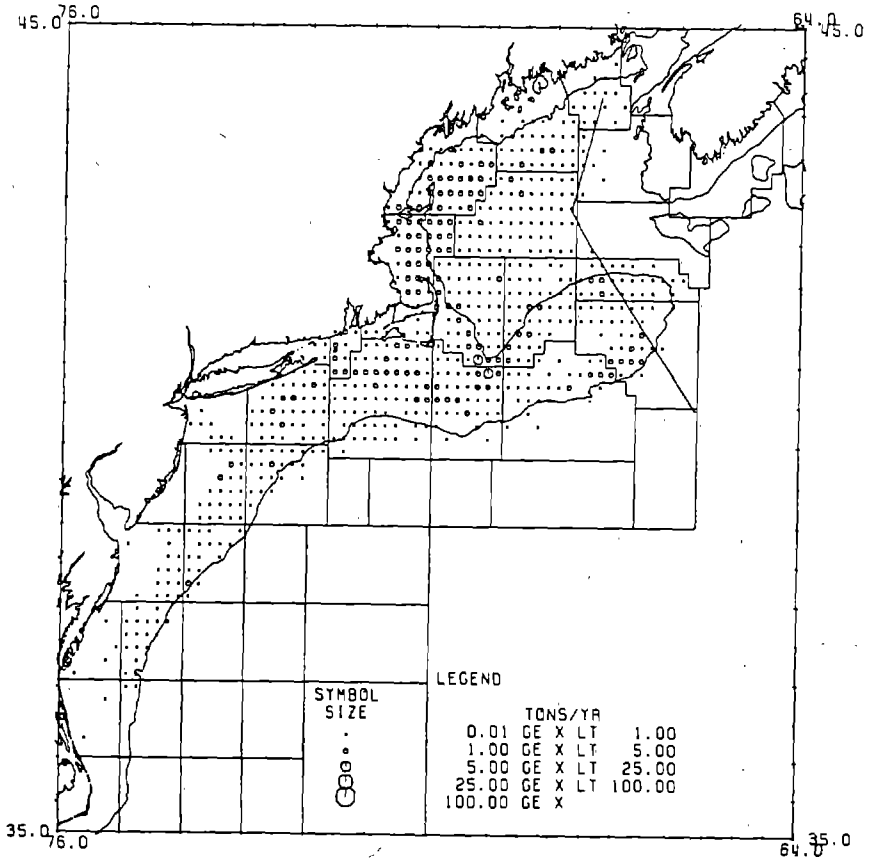


Figure W10-4. Goosefish (*Lophius americanus*) commercial weighout landings distributions -- fourth quarter.

Figure W11-1. Atlantic wolffish (*Anarhichas lupus*) commercial weighout landings distributions -- first quarter.

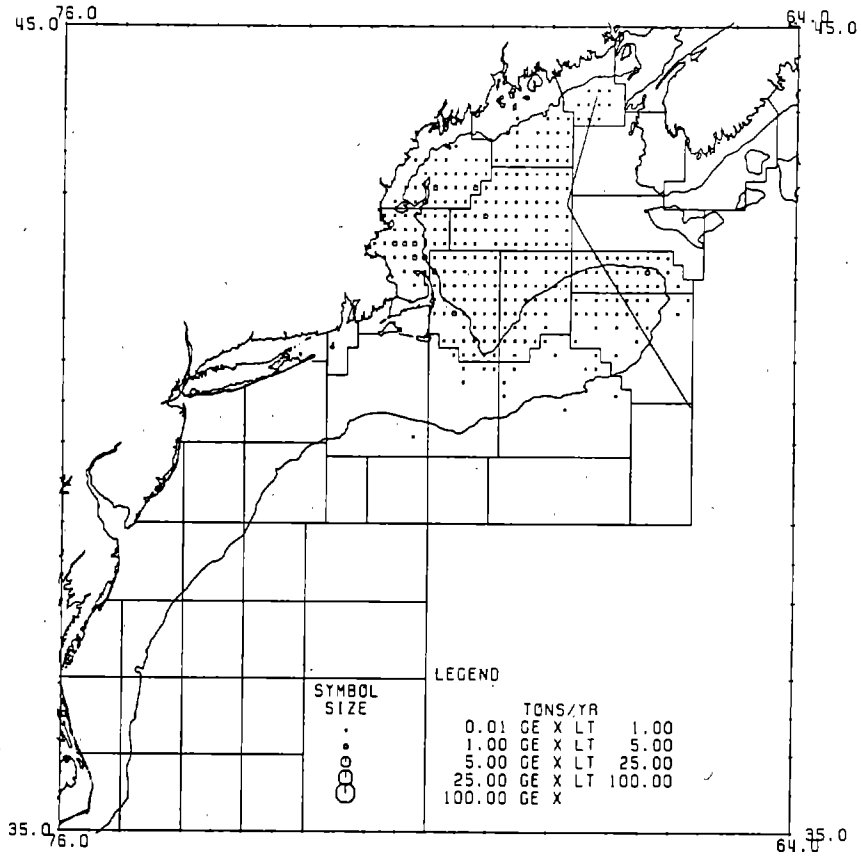
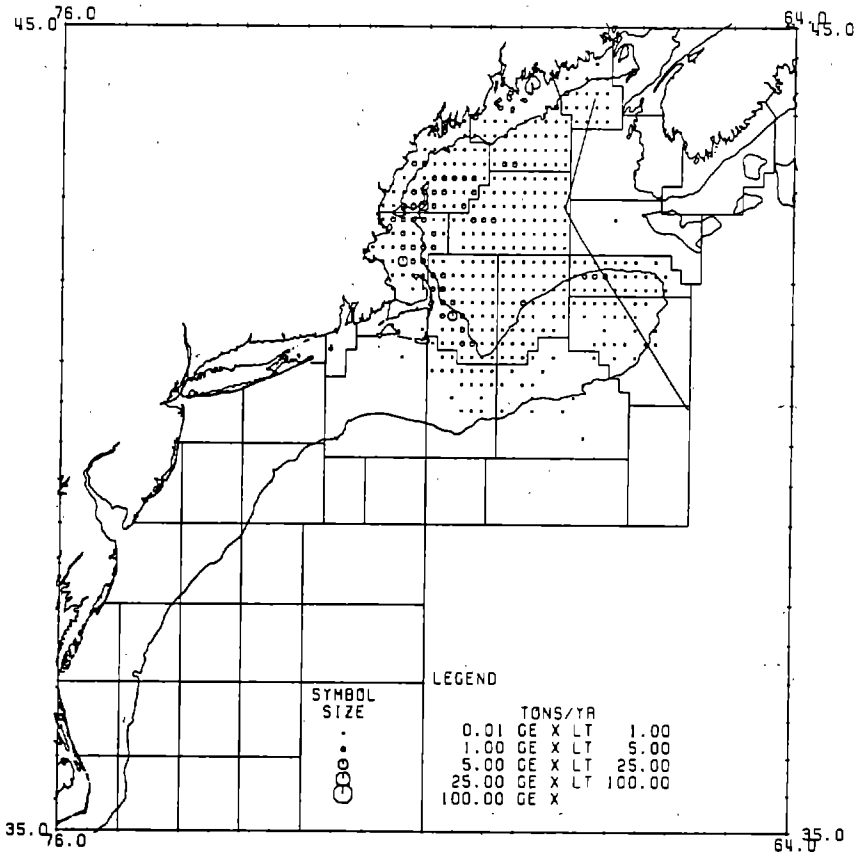


Figure W11-2. Atlantic wolffish (*Anarhichas lupus*) commercial weighout landings distributions -- second quarter.



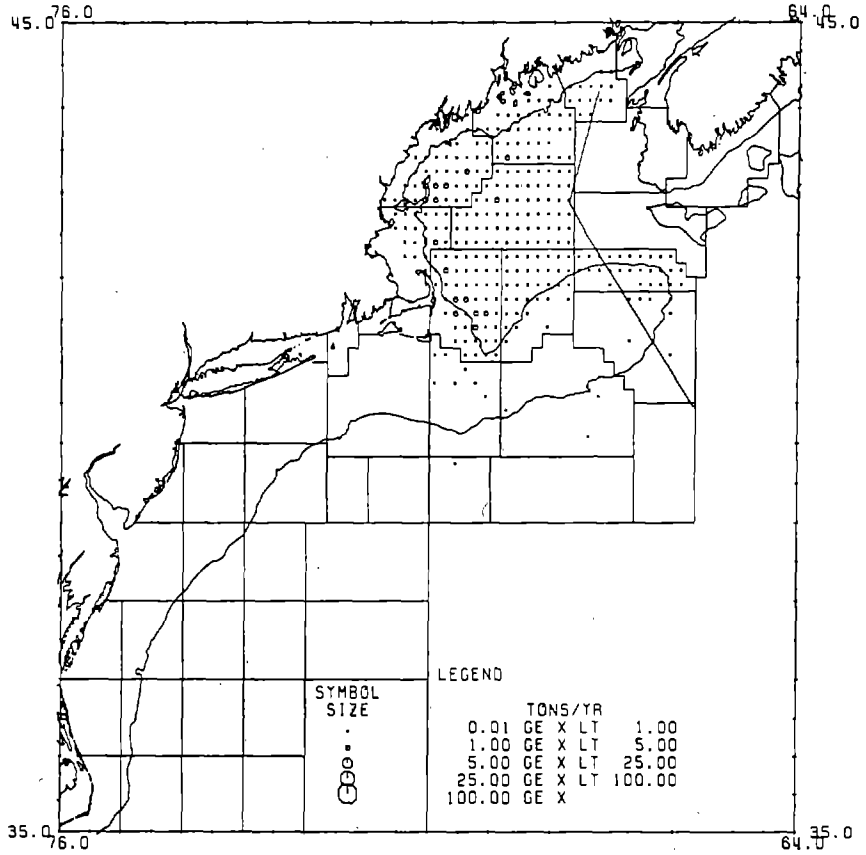


Figure W11-3. Atlantic wolffish (*Anarhichas lupus*) commercial weighout landings distributions -- third quarter.

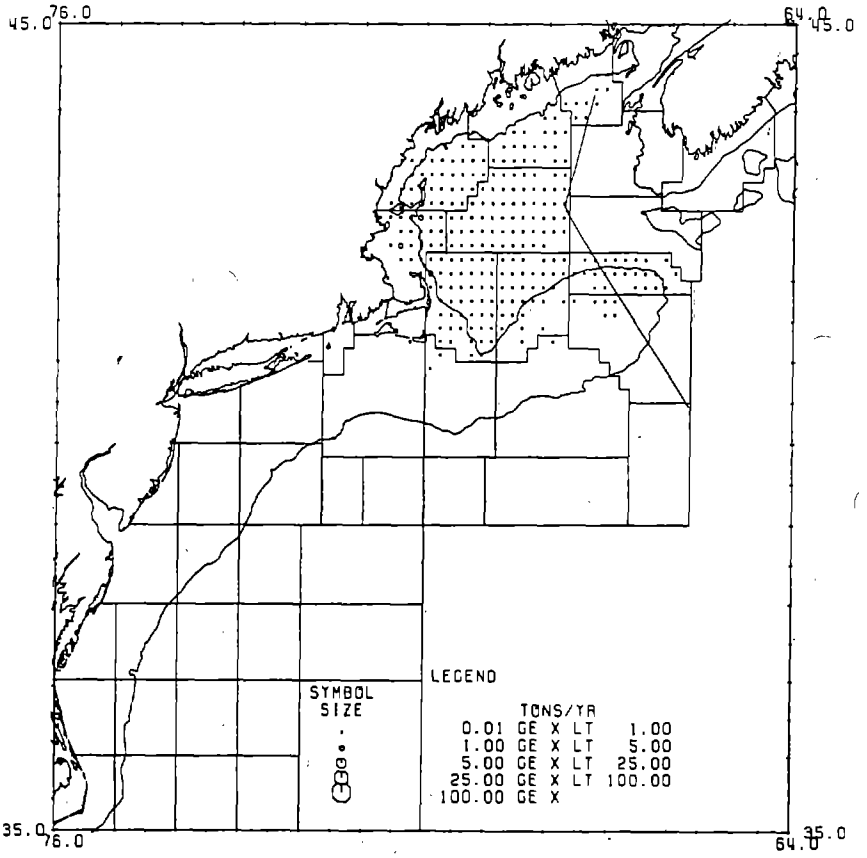


Figure W11-4. Atlantic wolffish (*Anarhichas lupus*) commercial weighout landings distributions -- fourth quarter.

Figure W12-1. Yellowtail flounder (*Limanda ferruginea*) commercial weighout landings distributions -- first quarter.

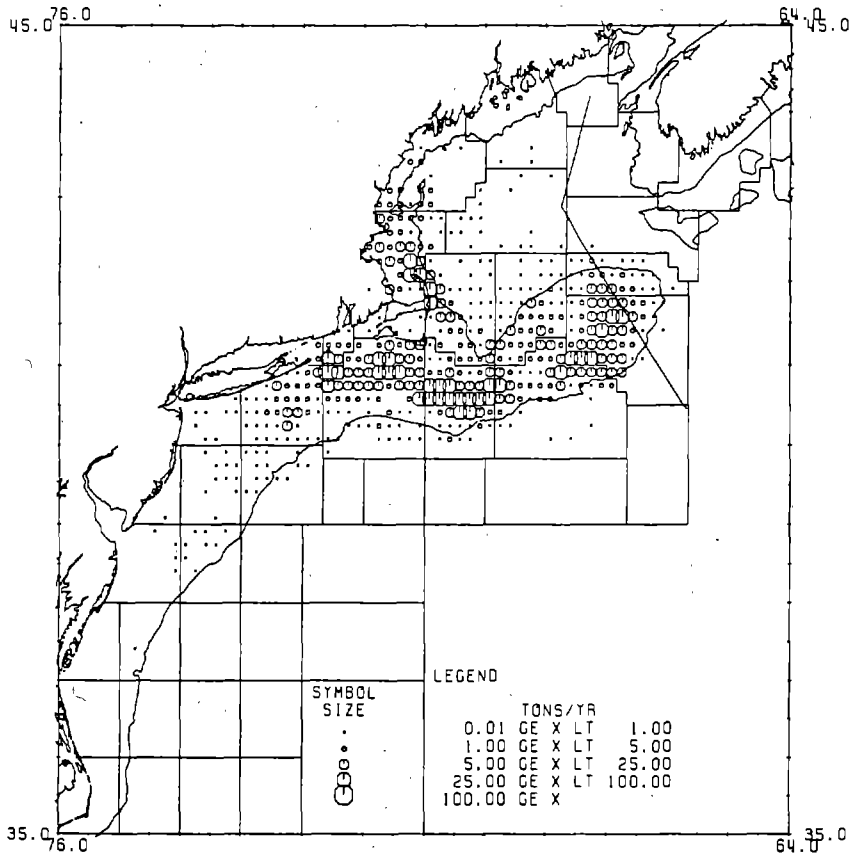
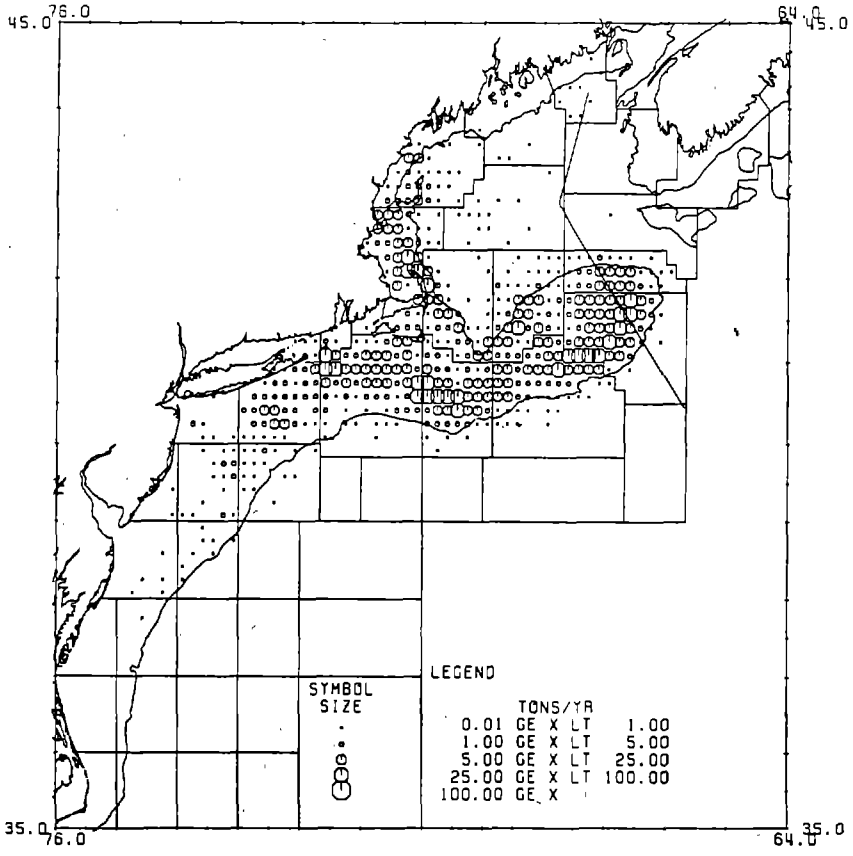


Figure W12-2. Yellowtail flounder (*Limanda ferruginea*) commercial weighout landings distributions -- second quarter.



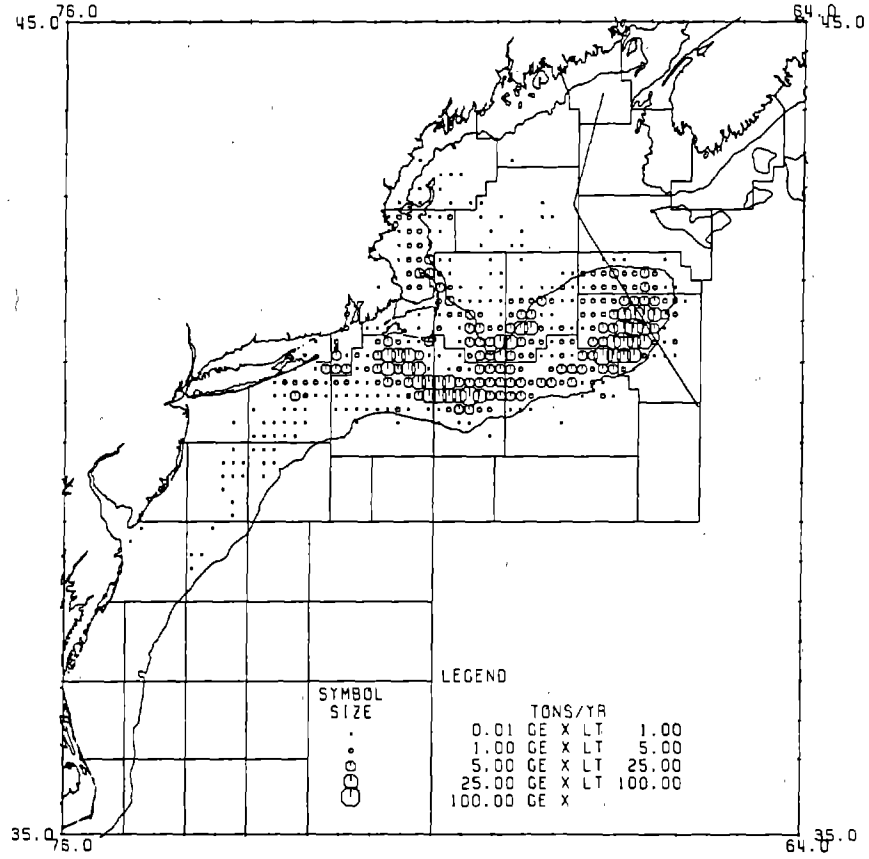


Figure W12-3. Yellowtail flounder (*Limanda ferruginea*) commercial weighout landings distributions -- third quarter.

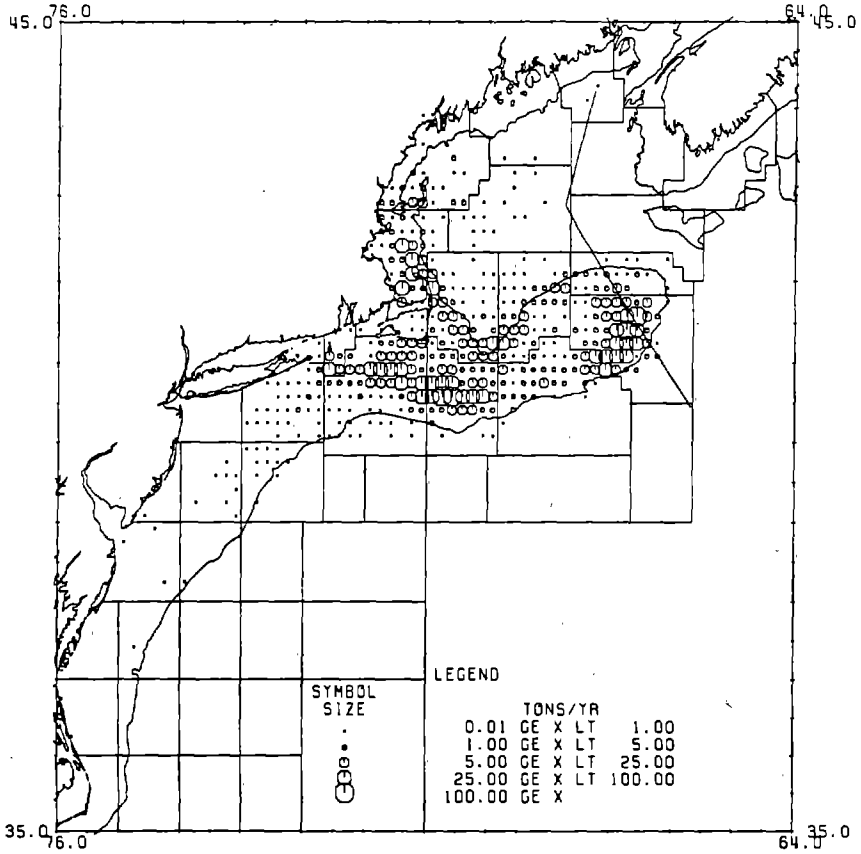


Figure W12-4. Yellowtail flounder (*Limanda ferruginea*) commercial weighout landings distributions -- fourth quarter.

Figure W13-1. American plaice (*Hippoglossoides platessoides*) commercial weighout landings distributions -- first quarter.

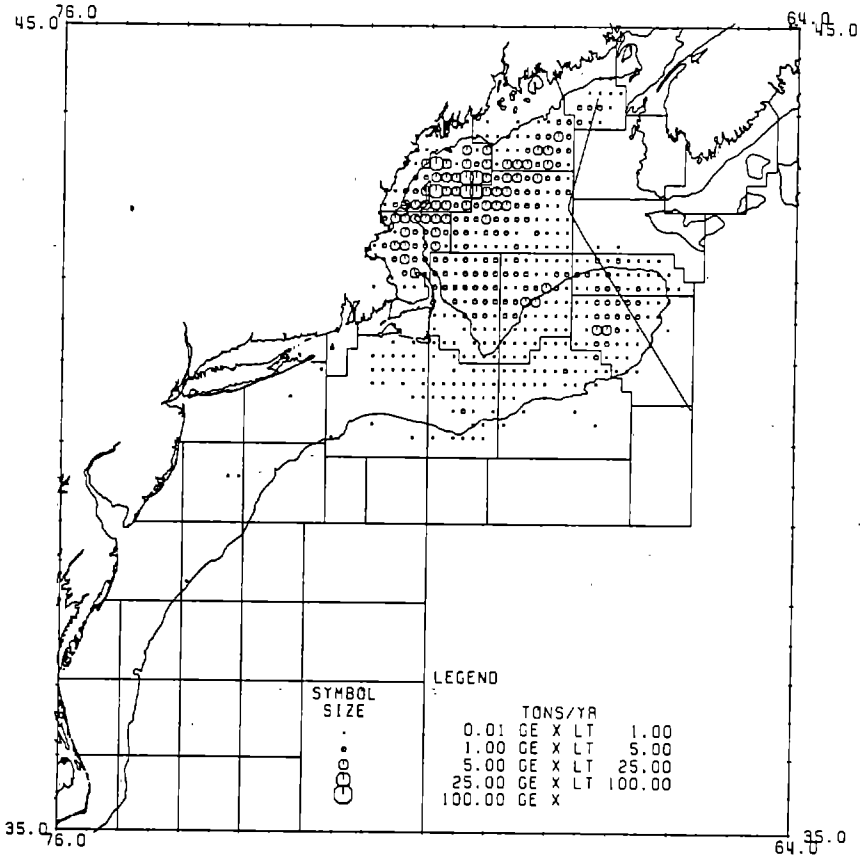
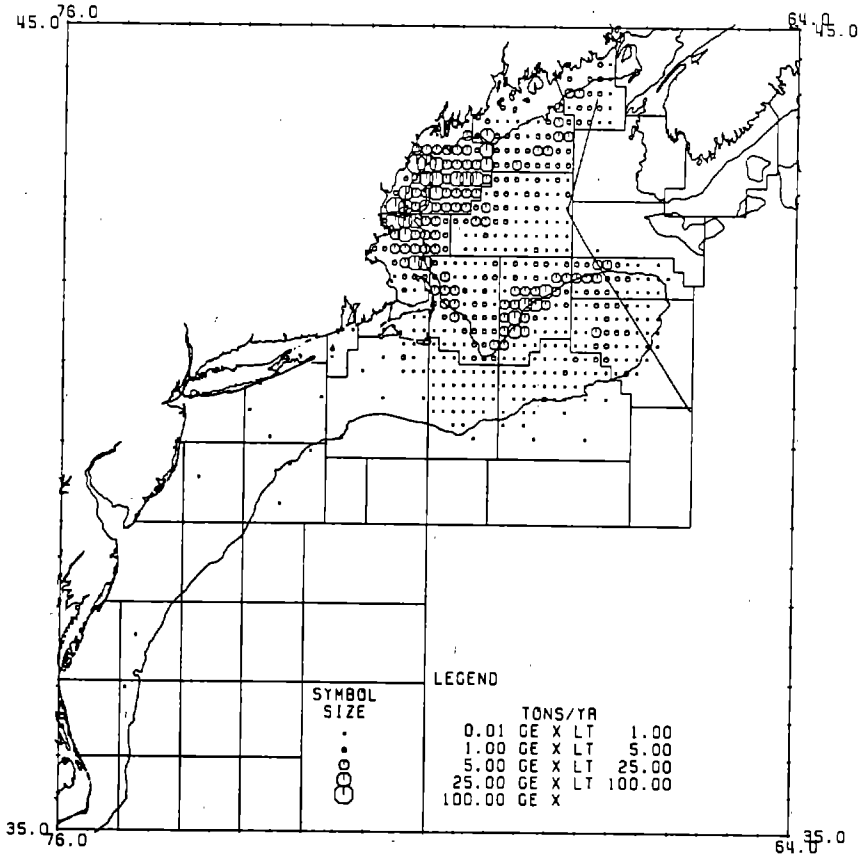


Figure W13-2. American plaice (*Hippoglossoides platessoides*) commercial weighout landings distributions -- second quarter.



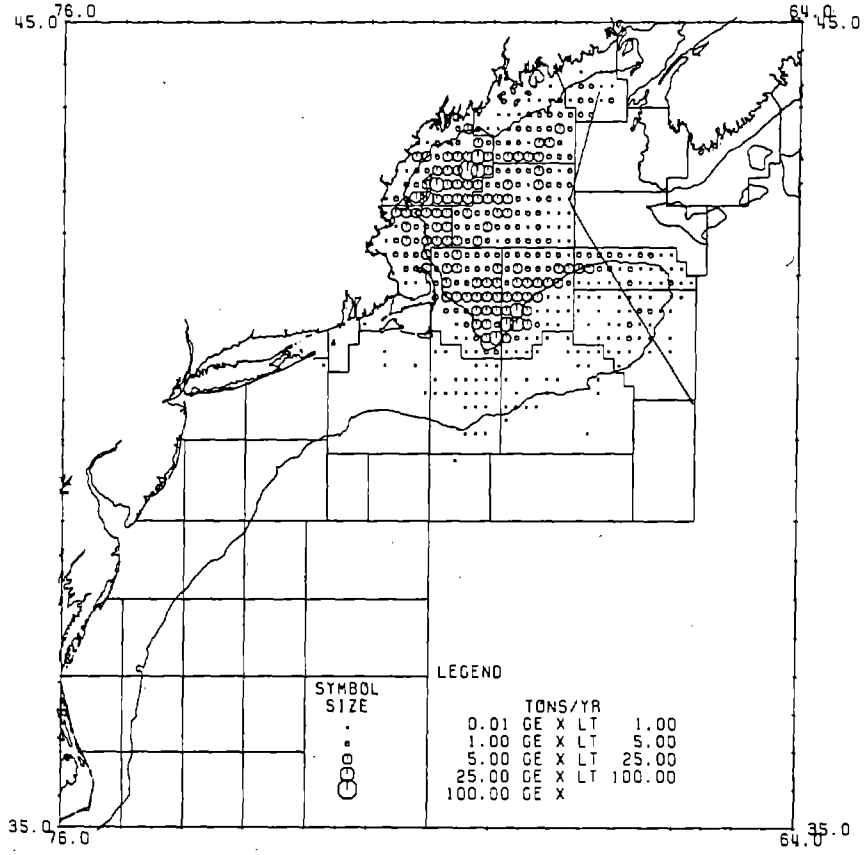


Figure W13-3. American plaice (*Hippoglossoides platessoides*) commercial weighout landings distributions -- third quarter.

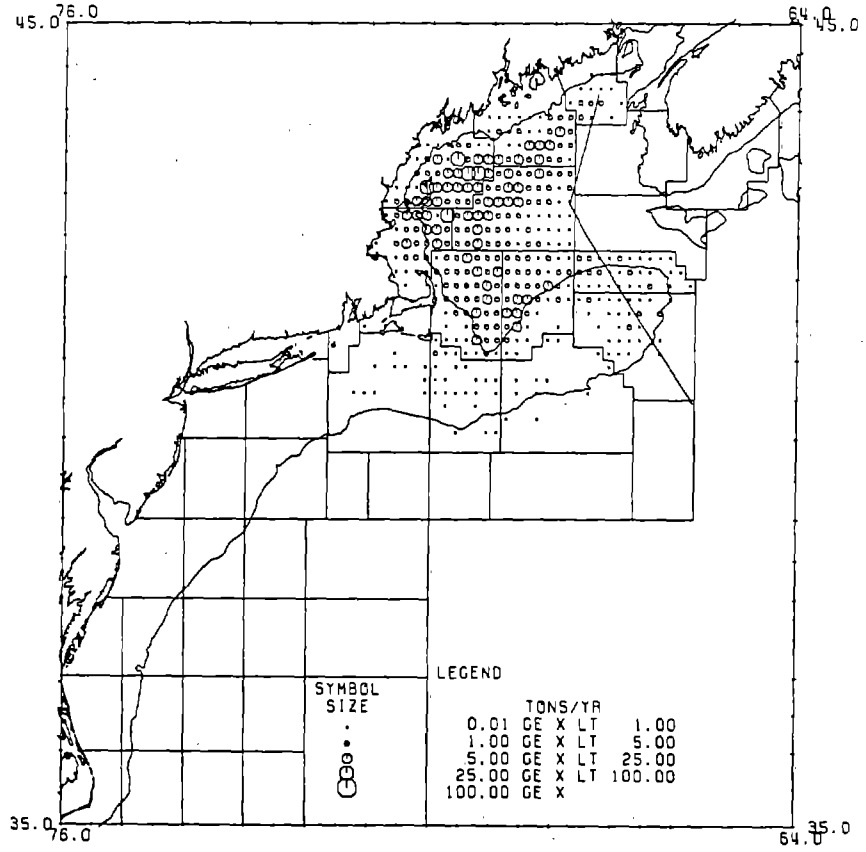


Figure W13-4. American plaice (*Hippoglossoides platessoides*) commercial weighout landings distributions -- fourth quarter.

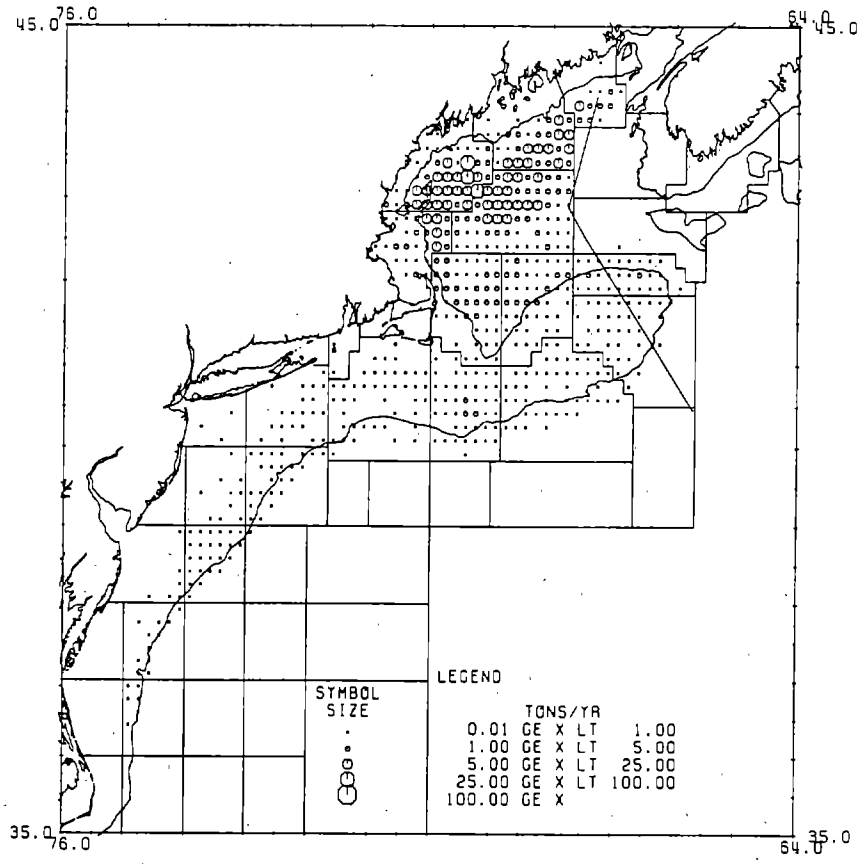


Figure W14-1. Witch flounder (*Glyptocephalus cynoglossus*) commercial weighout landings distributions -- first quarter.

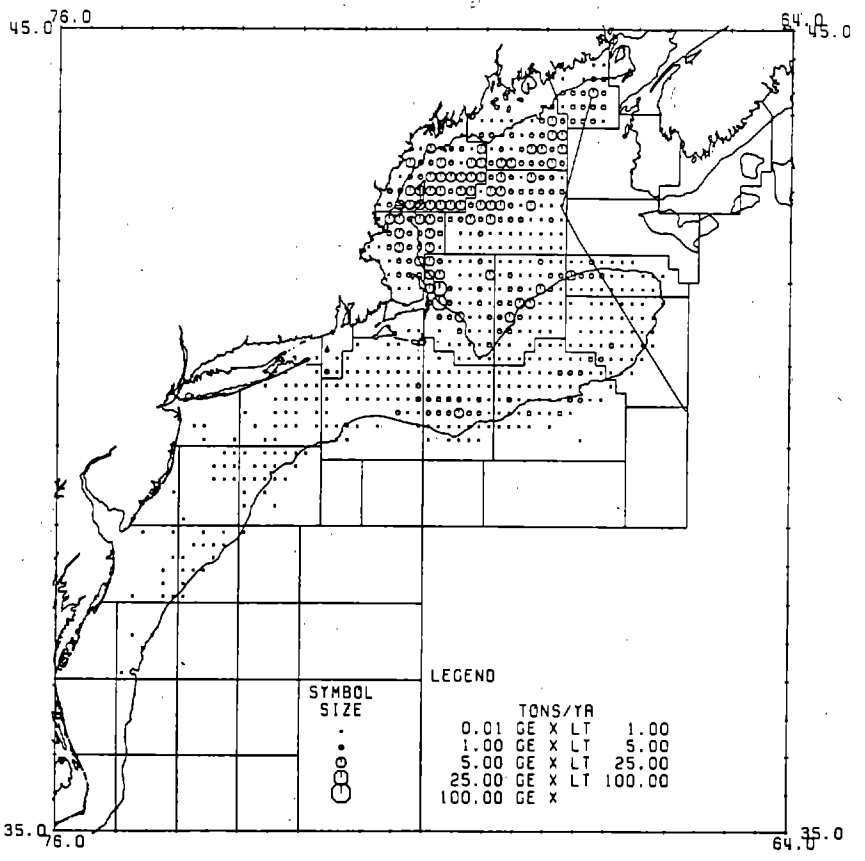


Figure W14-2. Witch flounder (*Glyptocephalus cynoglossus*) commercial weighout landings distributions -- second quarter.

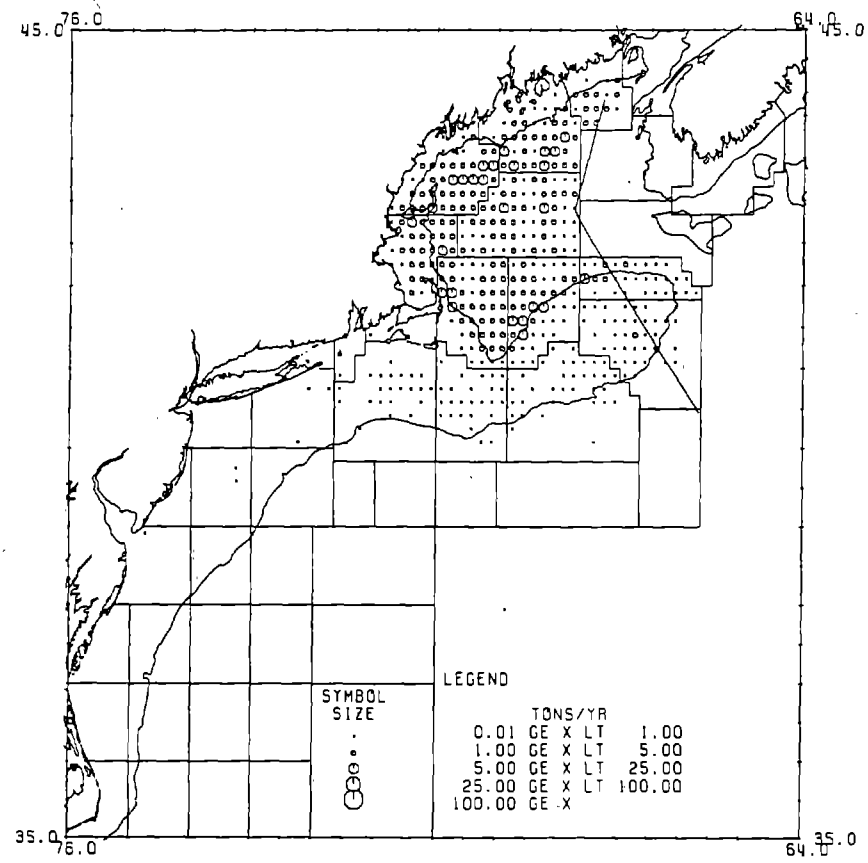


Figure W14-3. Witch flounder (*Glyptocephalus cynoglossus*) commercial weighout landings distributions -- third quarter.

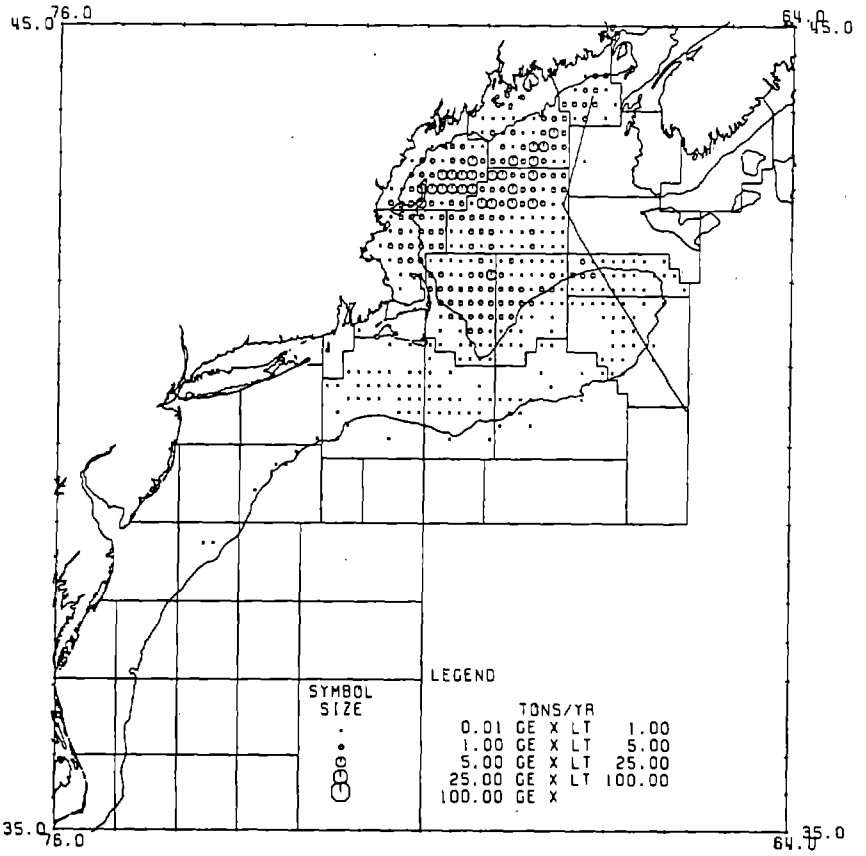


Figure W14-4. Witch flounder (*Glyptocephalus cynoglossus*) commercial weighout landings distributions -- fourth quarter.

Figure W15-1. Windowpane (*Scophthalmus aquosus*) commercial weighout landings distributions -- first quarter.

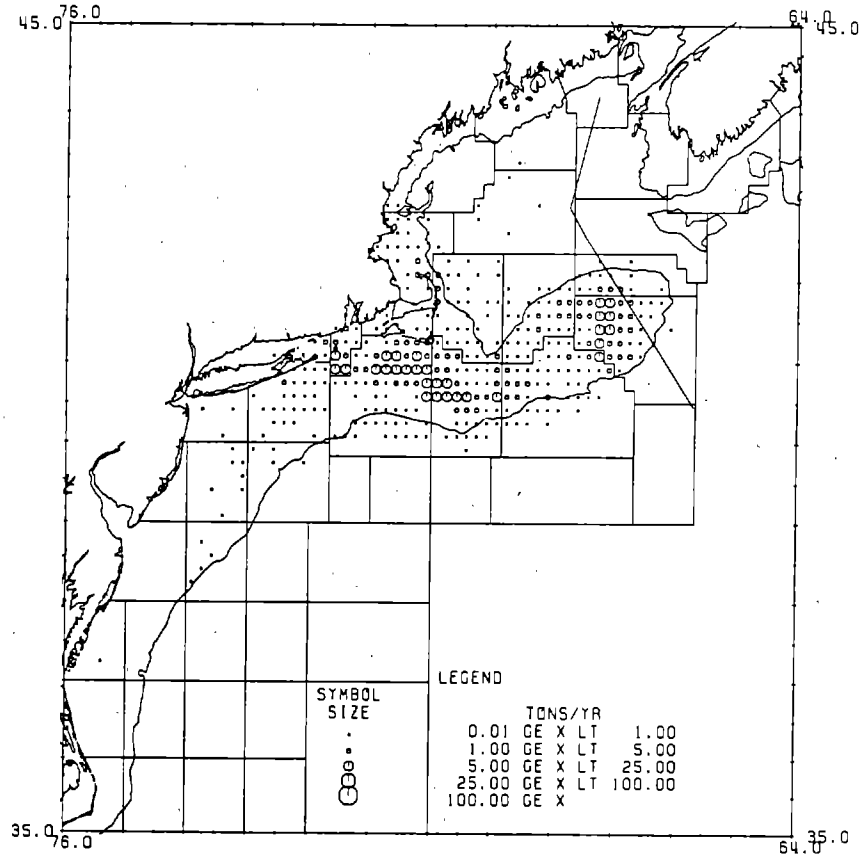
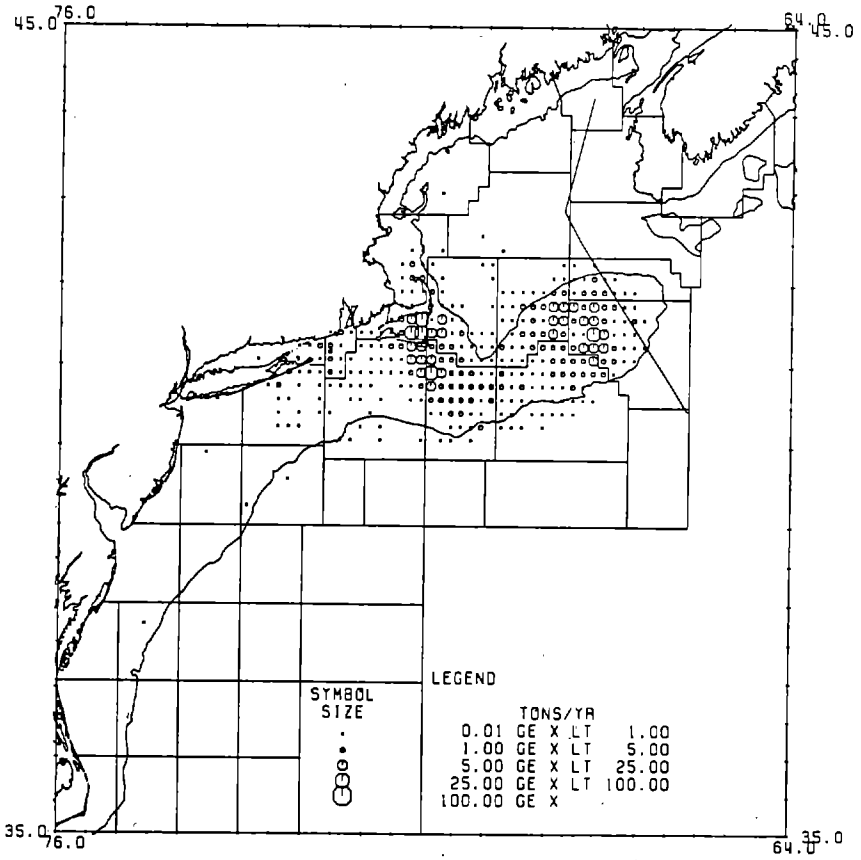


Figure W15-2. Windowpane (*Scophthalmus aquosus*) commercial weighout landings distributions -- second quarter.



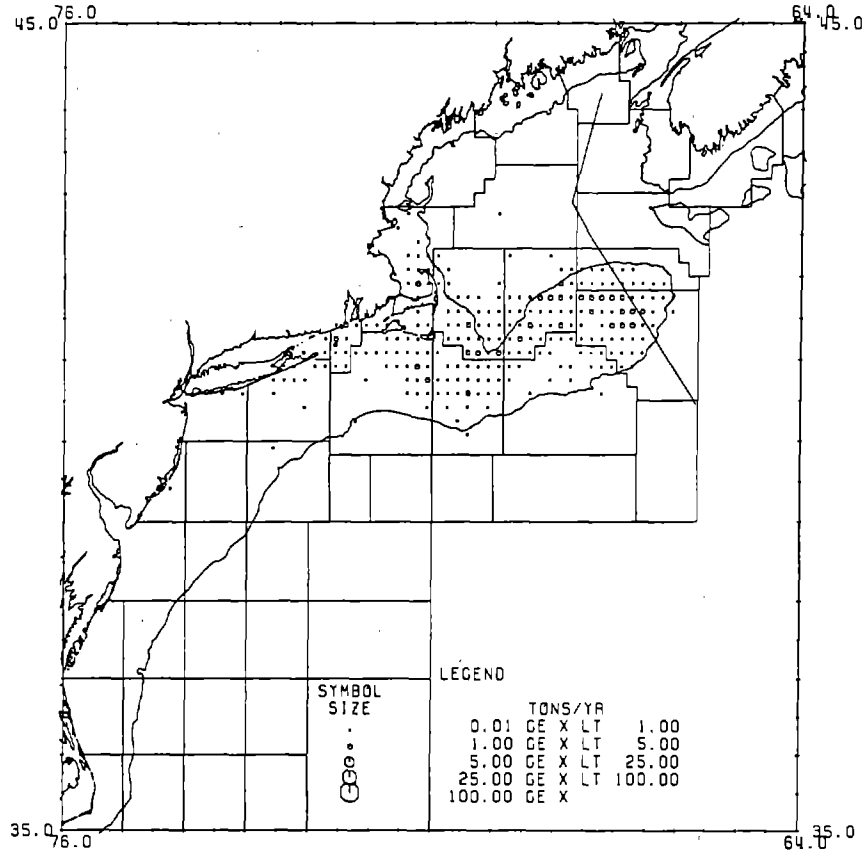


Figure W15-3. Windowpane (*Scophthalmus aquosus*) commercial weighout landings distributions -- third quarter.

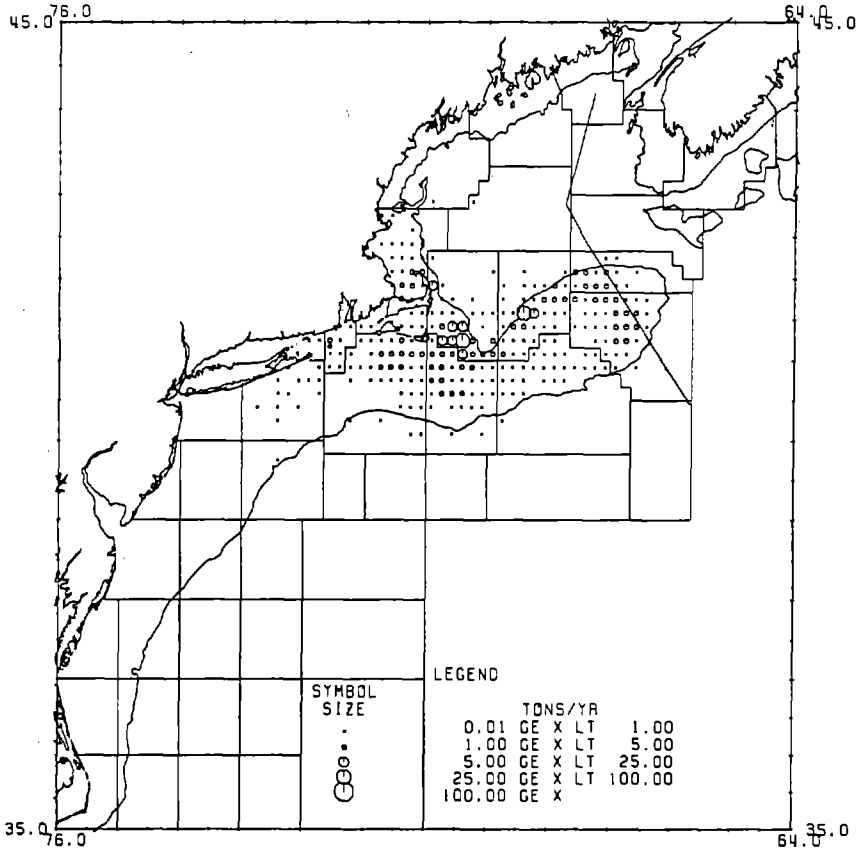


Figure W15-4. Windowpane (*Scophthalmus aquosus*) commercial weighout landings distributions -- fourth quarter.

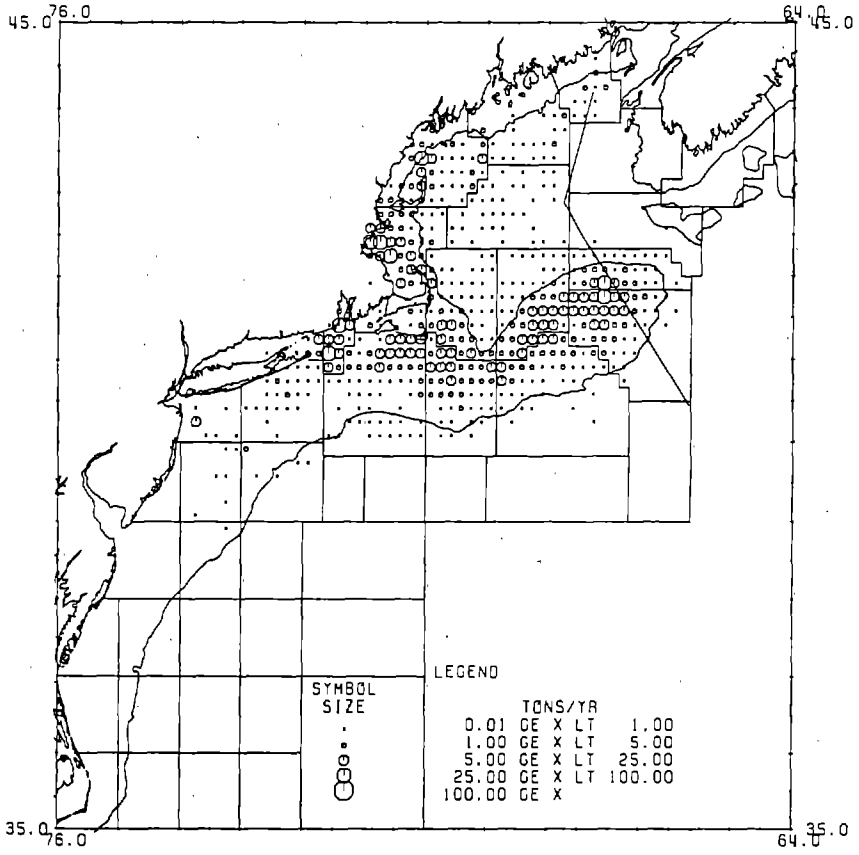


Figure W16-1. Winter flounder (*Pseudopleuronectes americanus*) commercial weighout landings distributions -- first quarter.

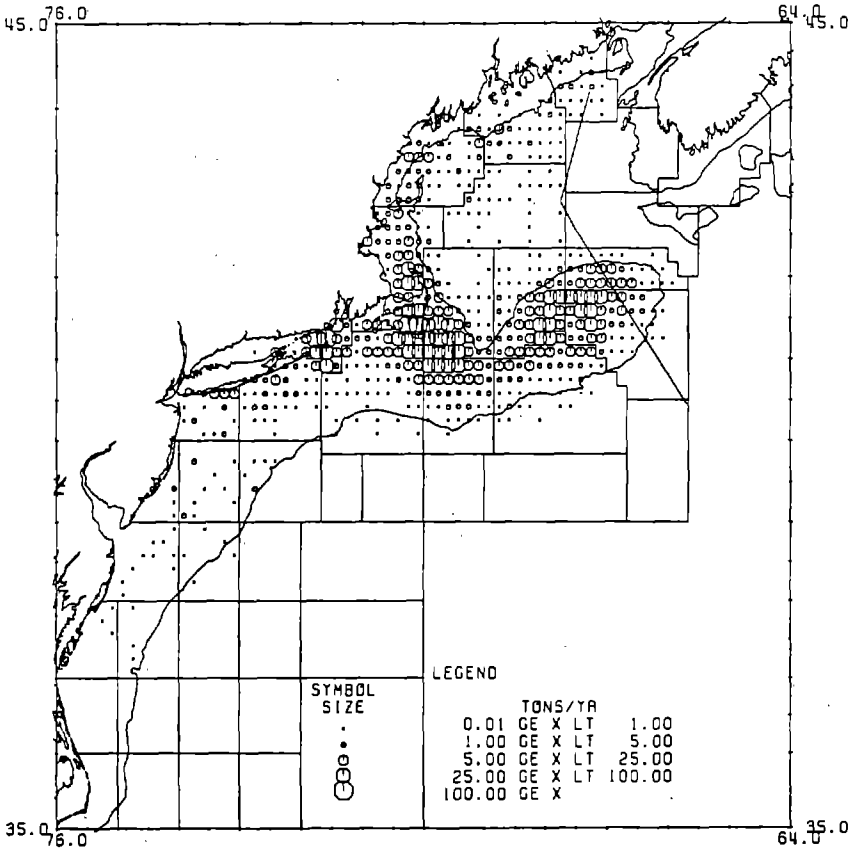


Figure W16-2. Winter flounder (*Pseudopleuronectes americanus*) commercial weighout landings distributions -- second quarter.

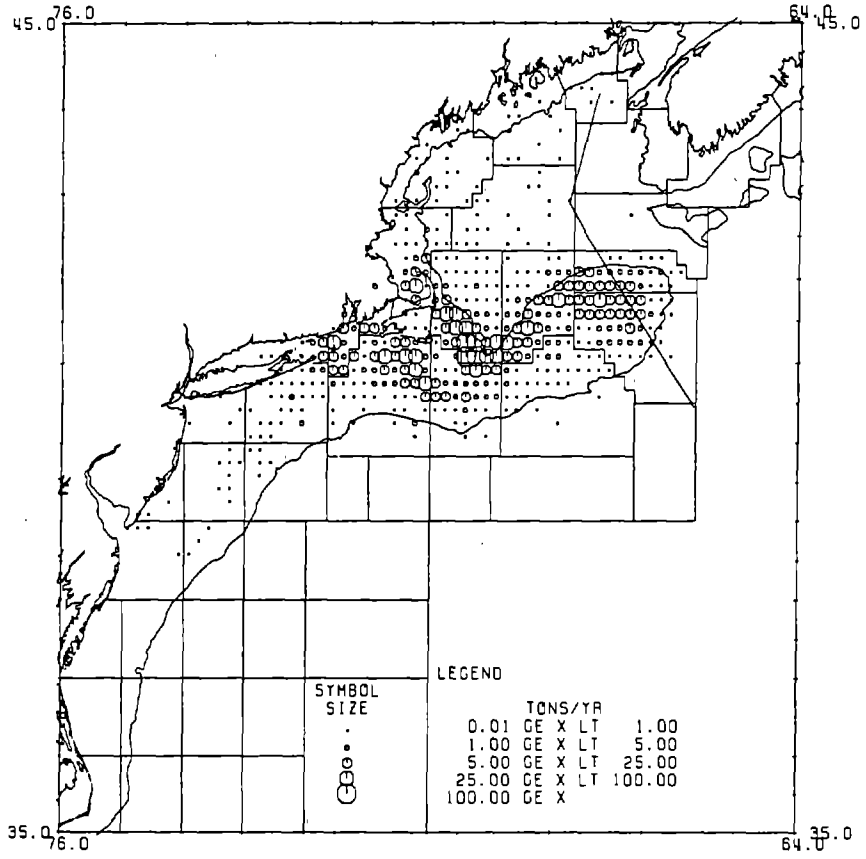


Figure W16-3. Winter flounder (*Pseudopleuronectes americanus*) commercial weighout landings distributions -- third quarter.

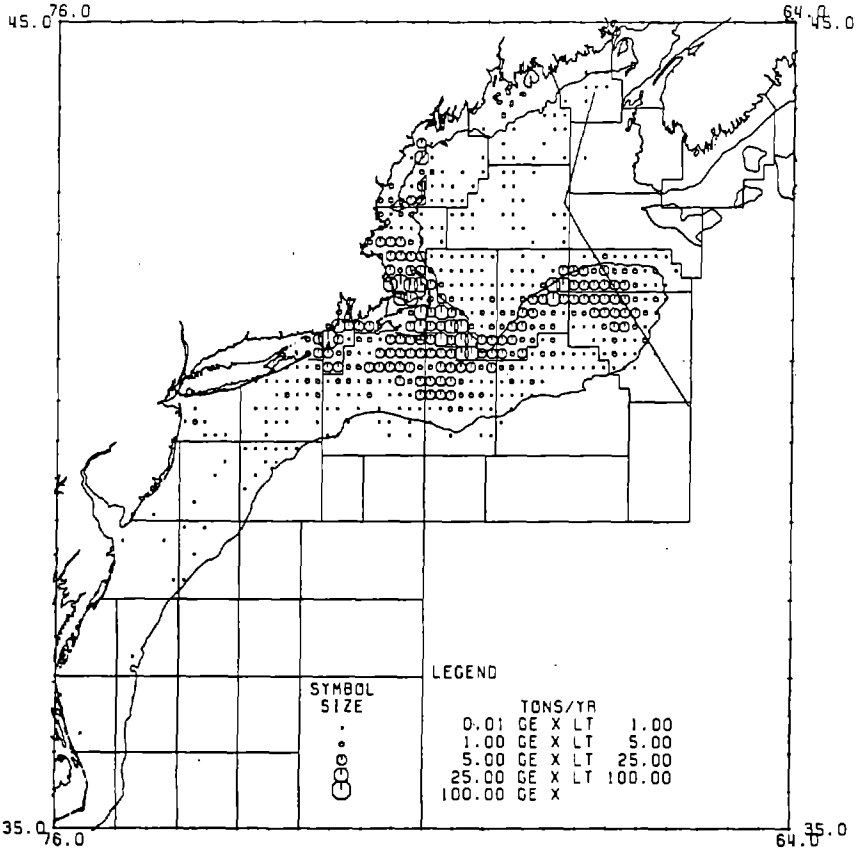


Figure W16-4. Winter flounder (*Pseudopleuronectes americanus*) commercial weighout landings distributions -- fourth quarter.

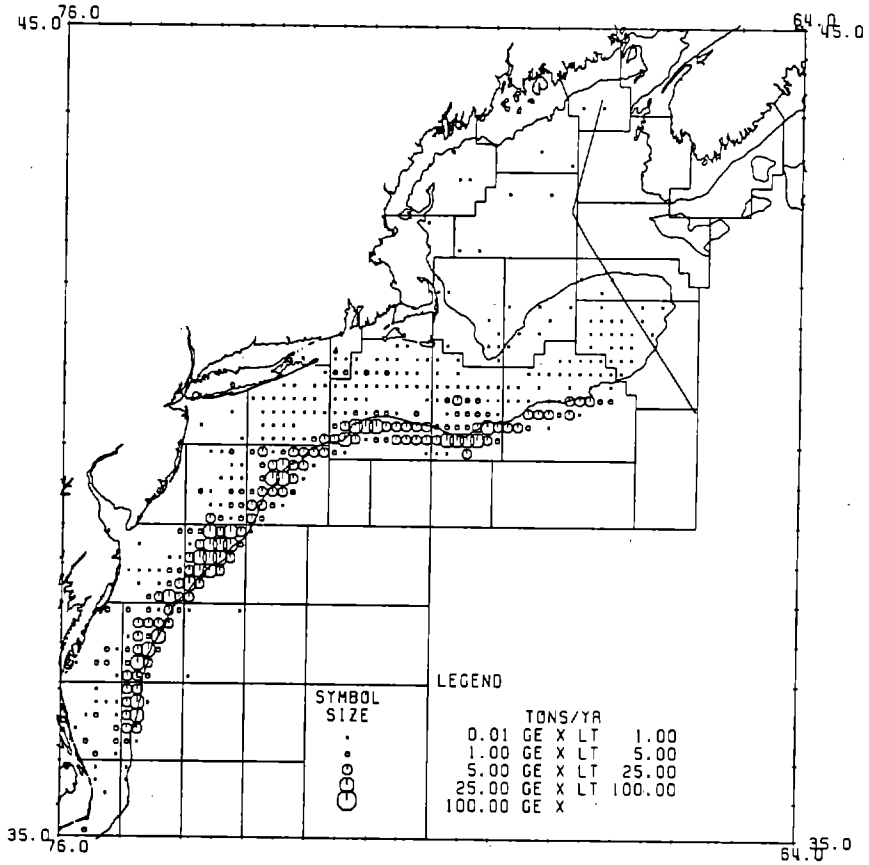


Figure W17-1. Summer flounder (*Paralichthys dentatus*) commercial weighout landings distributions -- first quarter.

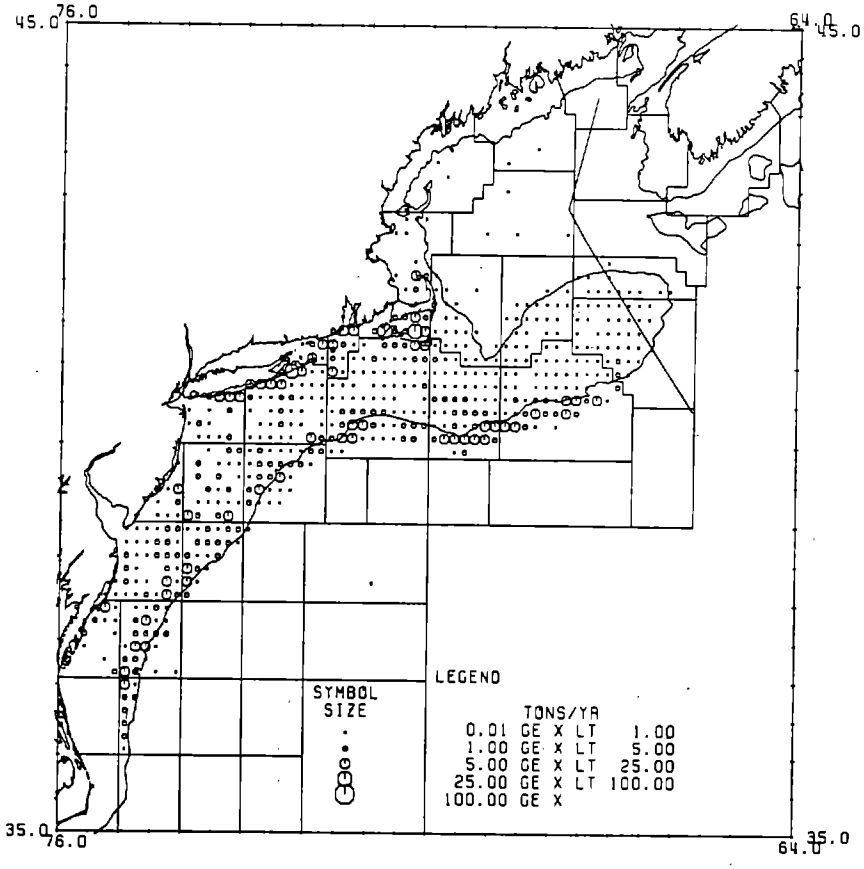


Figure W17-2. Summer flounder (*Paralichthys dentatus*) commercial weighout landings distributions -- second quarter.

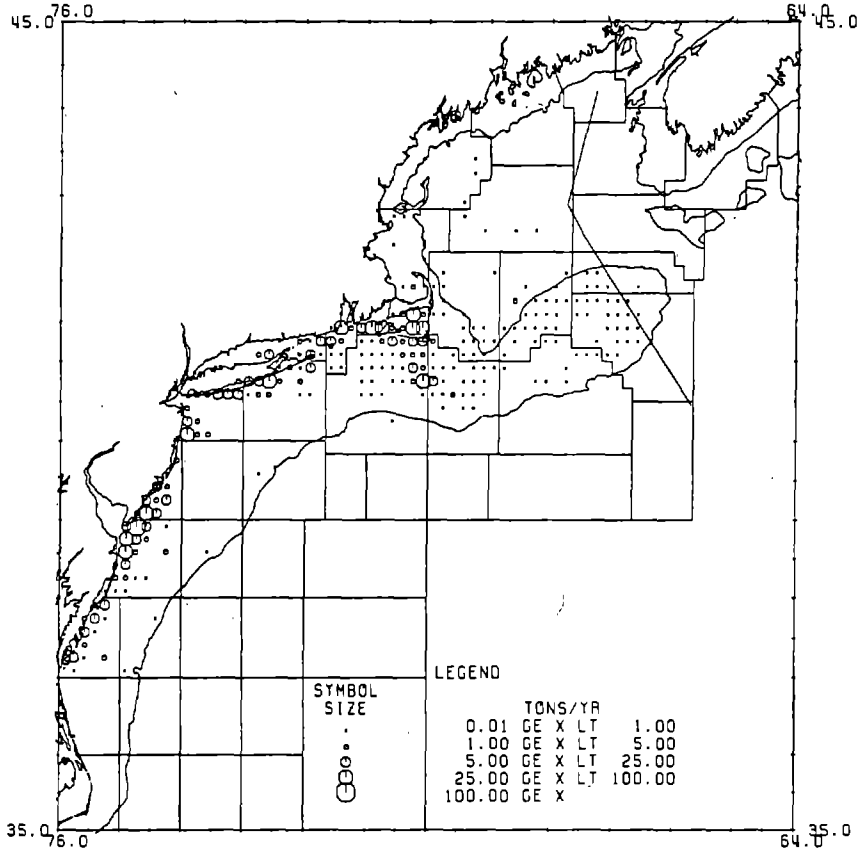


Figure W17-3. Summer flounder (*Paralichthys dentatus*) commercial weighout landings distributions -- third quarter.

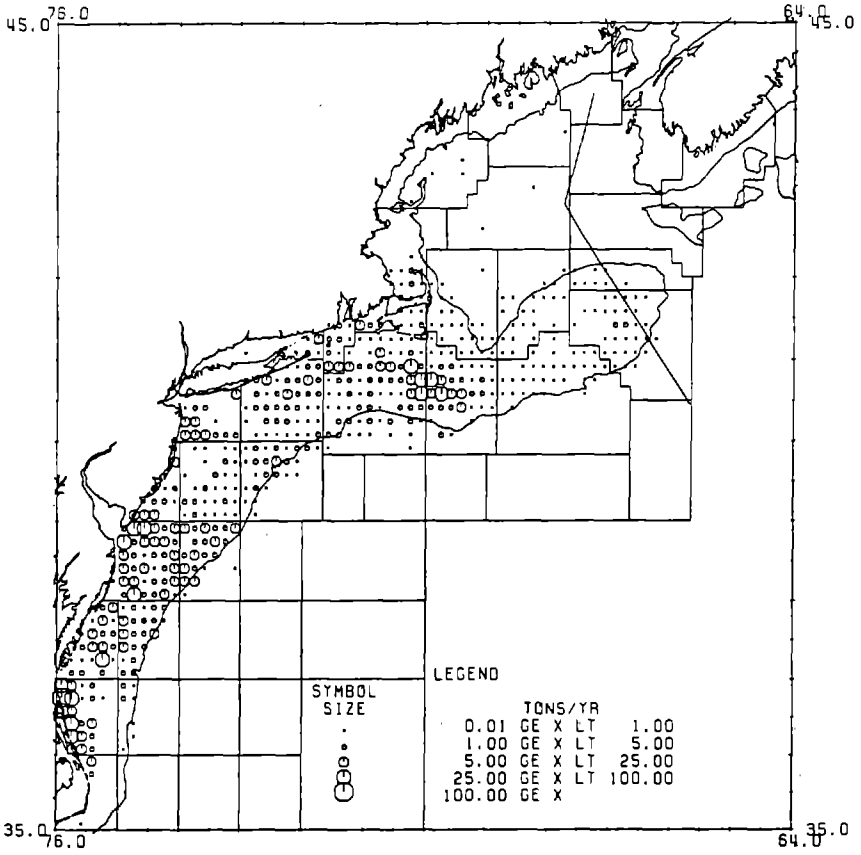


Figure W17-4. Summer flounder (*Paralichthys dentatus*) commercial weighout landings distributions -- fourth quarter.

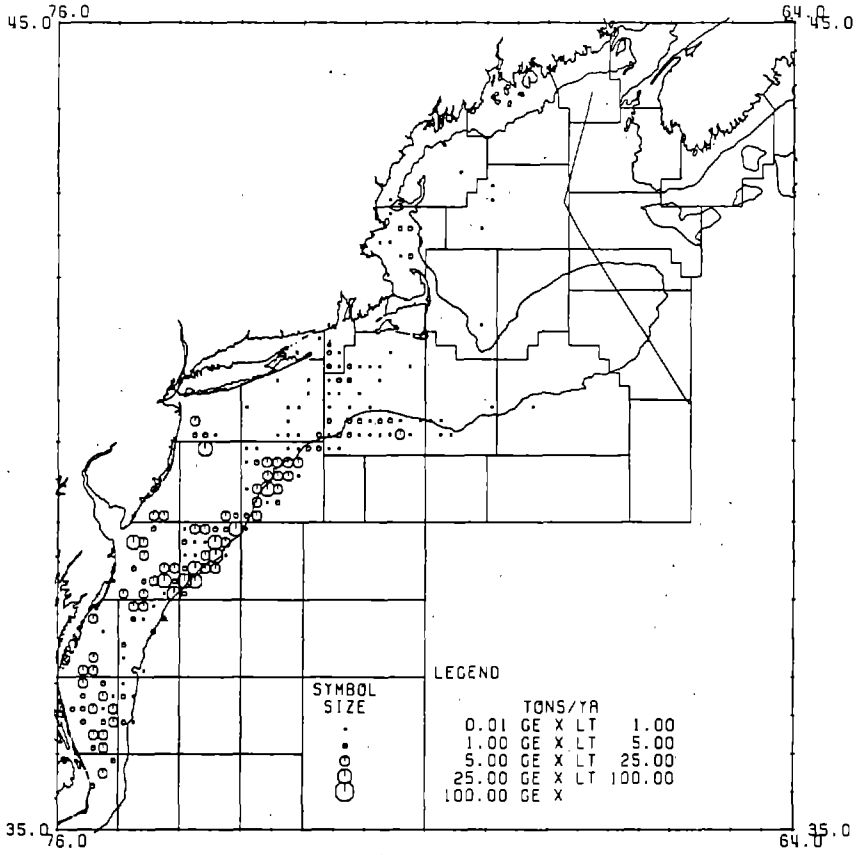


Figure W18-1. Atlantic mackerel (*Scomber scombrus*) commercial weighout landings distributions -- first quarter.

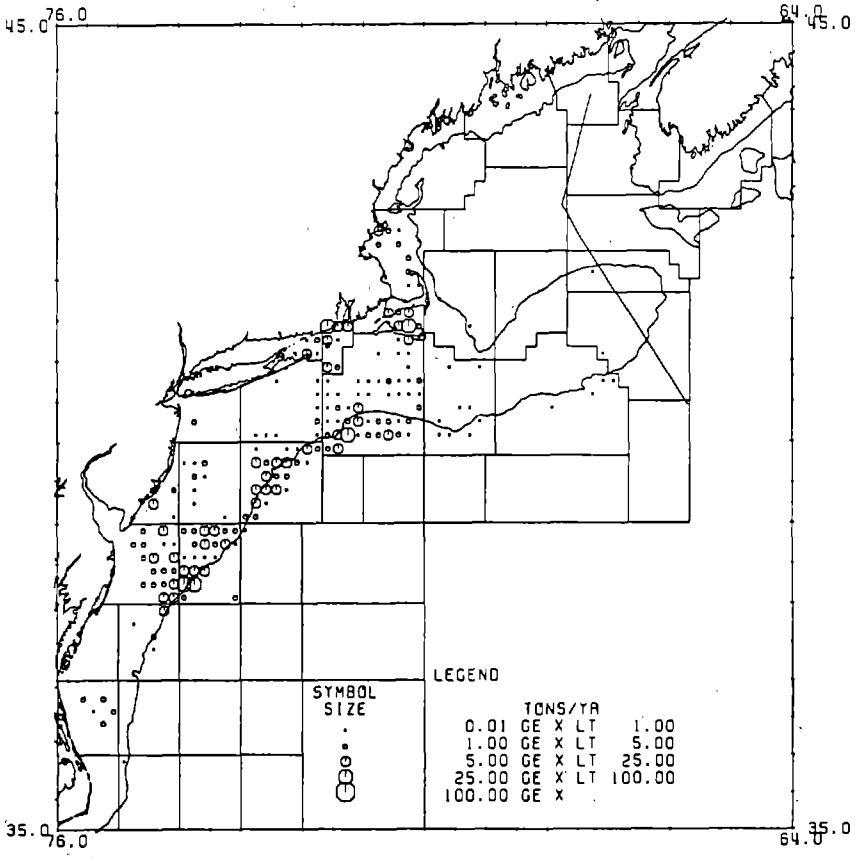


Figure W18-2. Atlantic mackerel (*Scomber scombrus*) commercial weighout landings distributions -- second quarter.

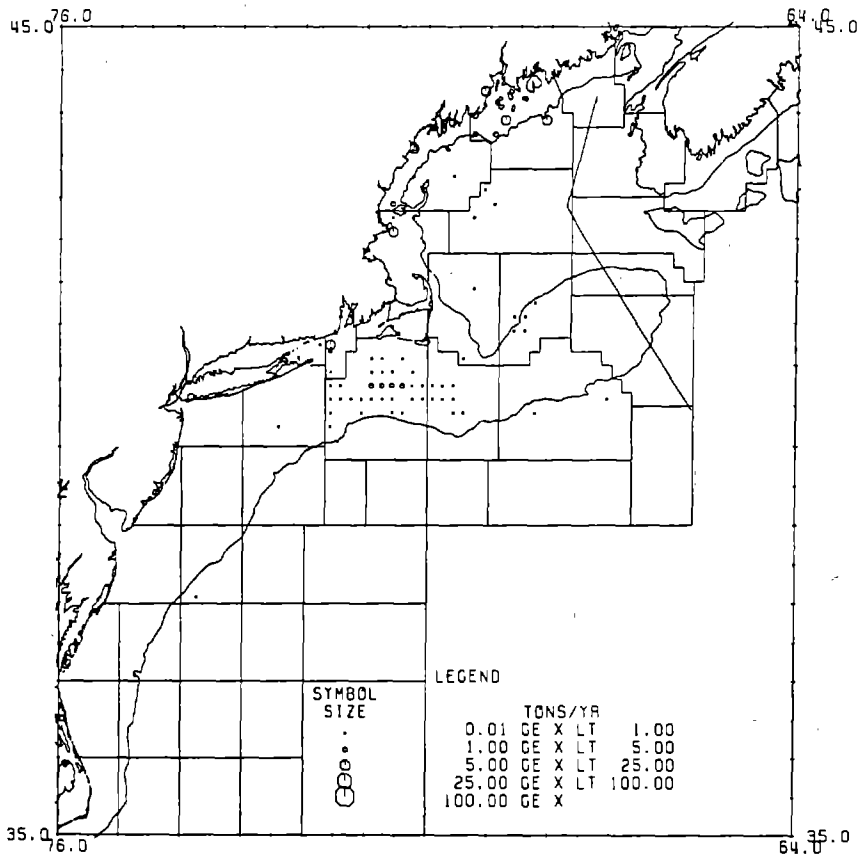


Figure W18-3. Atlantic mackerel (*Scomber scombrus*) commercial weighout landings distributions -- third quarter.

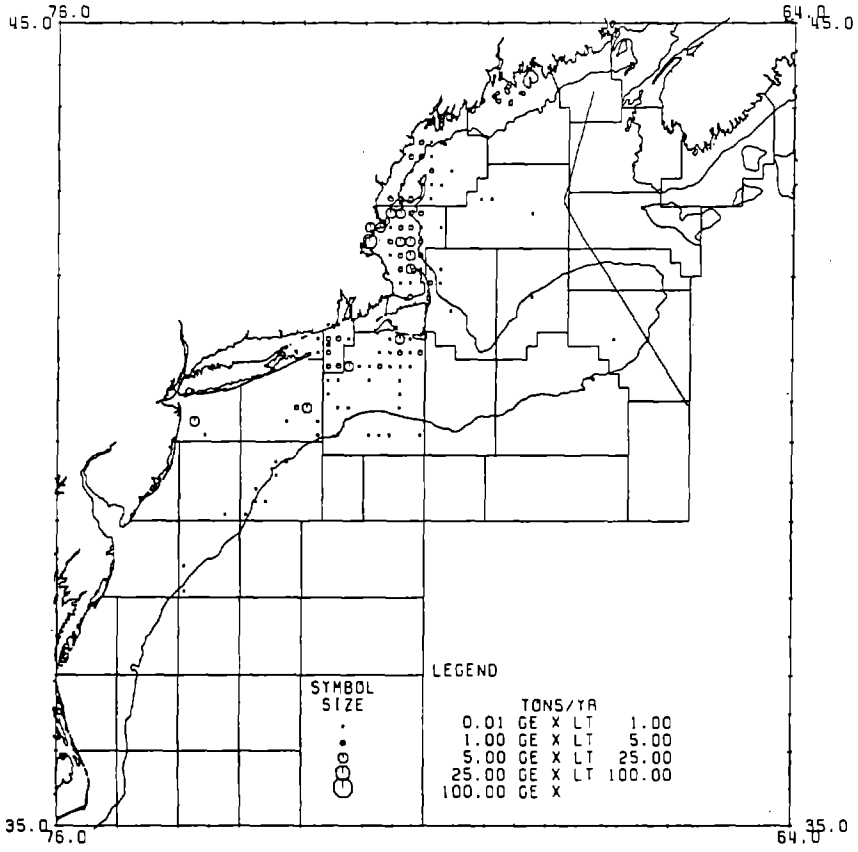


Figure W18-4. Atlantic mackerel (*Scomber scombrus*) commercial weighout landings distributions -- fourth quarter.

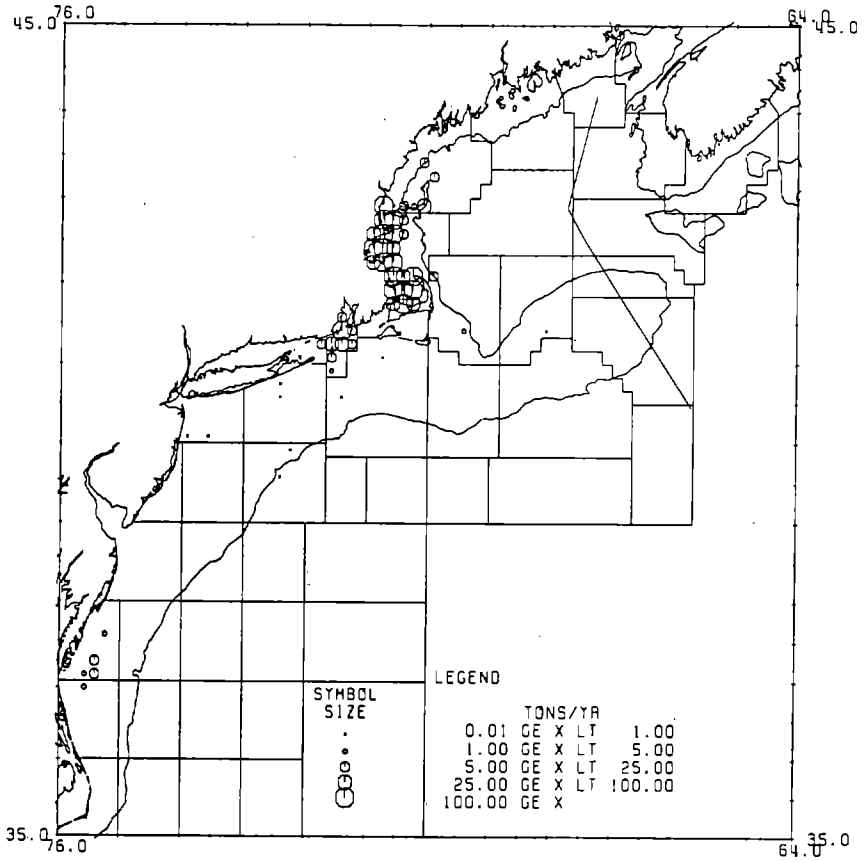


Figure W19-1. Atlantic herring (*Clupea harengus harengus*) commercial weighout landings distributions -- first quarter.

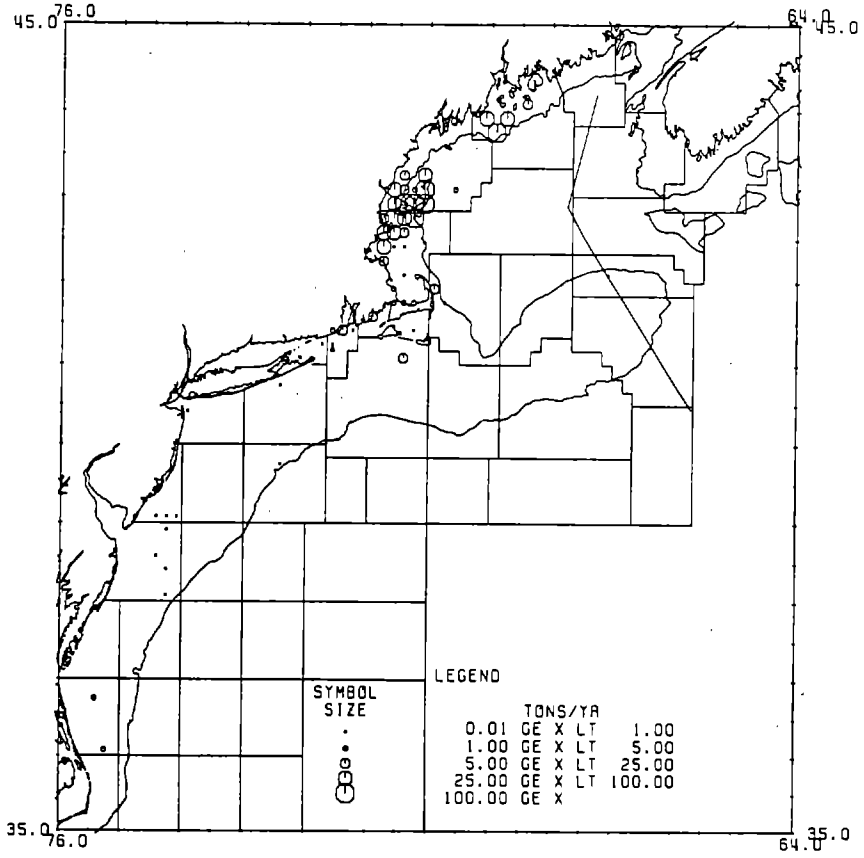


Figure W19-2. Atlantic herring (*Clupea harengus harengus*) commercial weighout landings distributions -- second quarter.

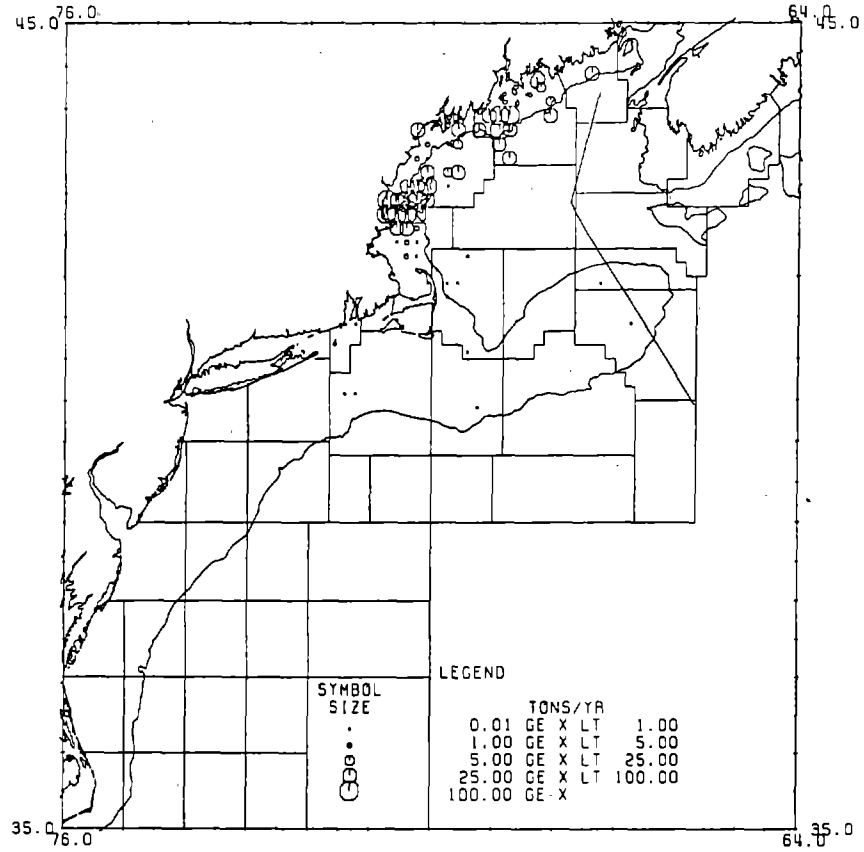


Figure W19-3. Atlantic herring (*Clupea harengus harengus*) commercial weighout landings distributions -- third quarter.

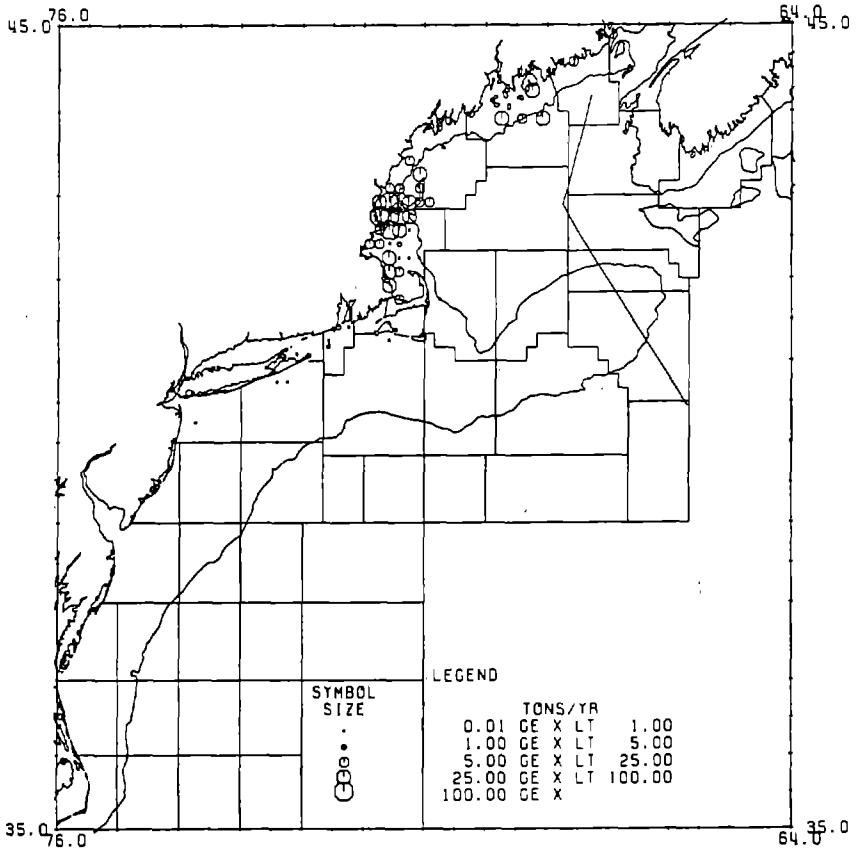


Figure W19-4. Atlantic herring (*Clupea harengus harengus*) commercial weighout landings distributions -- fourth quarter.

Figure W20-1. Bluefish (*Pomatomus saltatrix*) commercial weighout landings distributions -- first quarter.

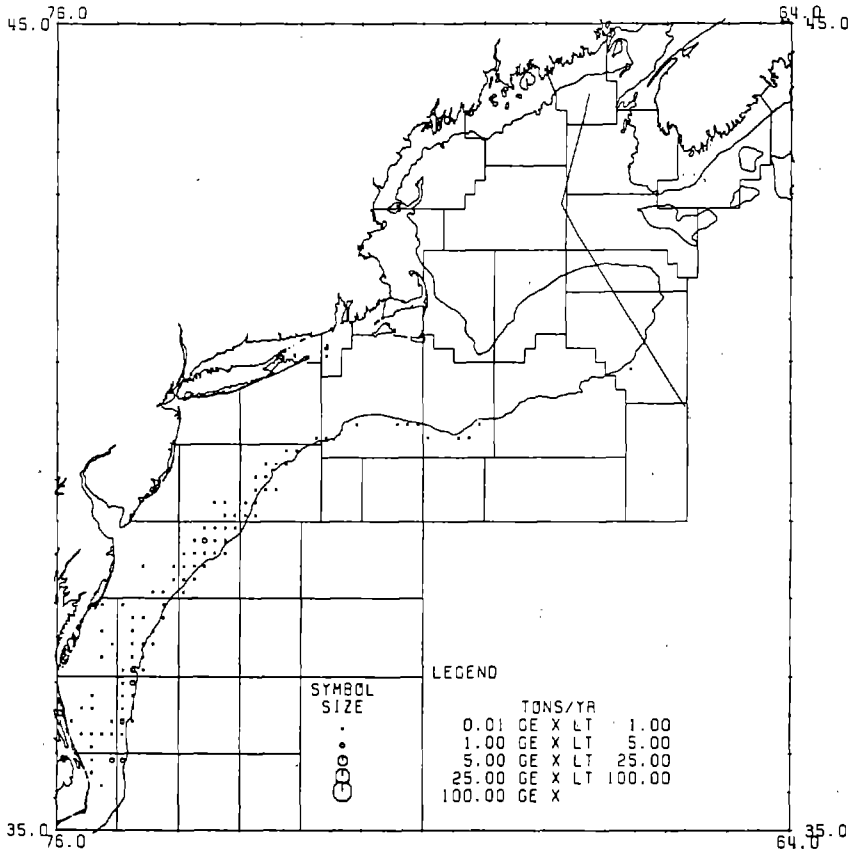
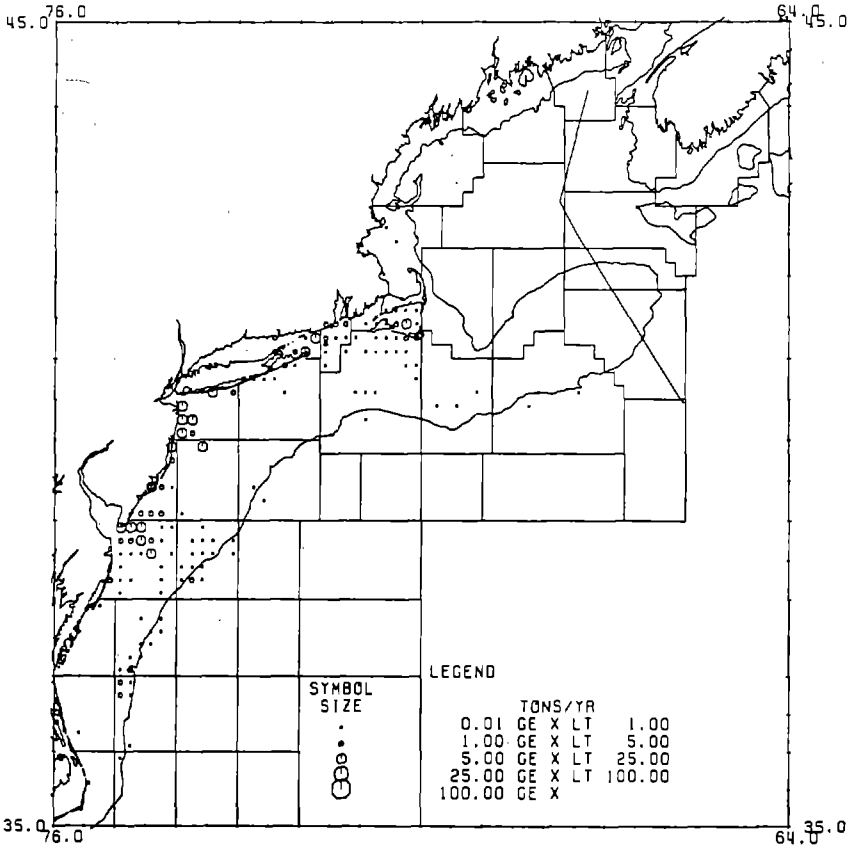


Figure W20-2. Bluefish (*Pomatomus saltatrix*) commercial weighout landings distributions -- second quarter.



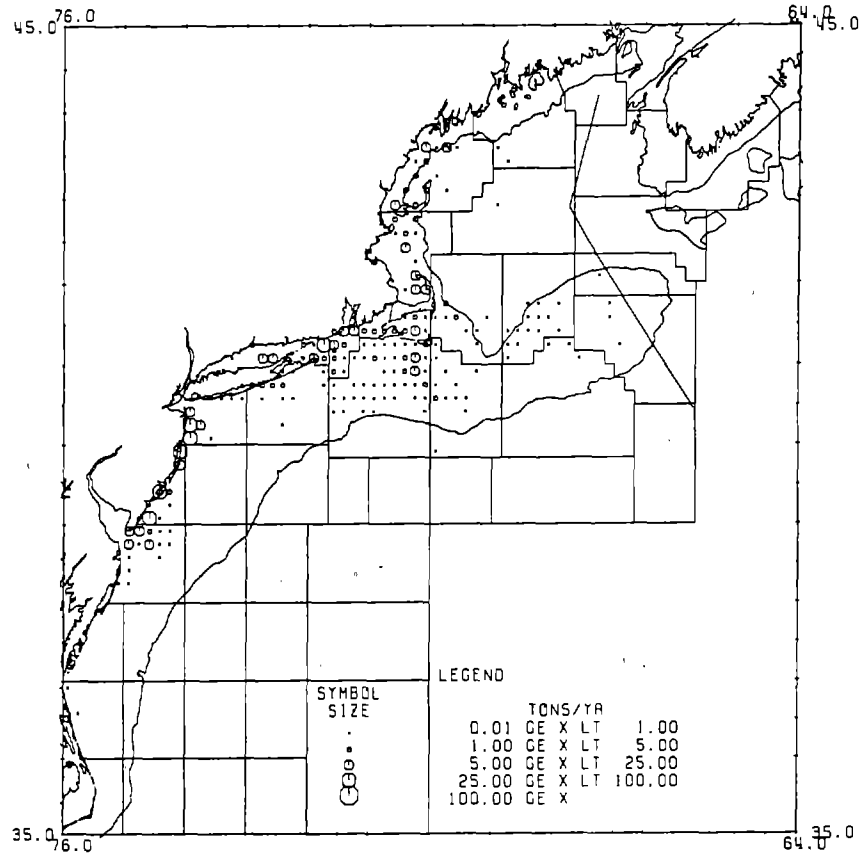


Figure W20-3. Bluefish (*Pomatomus saltatrix*) commercial weighout landings distributions -- third quarter.

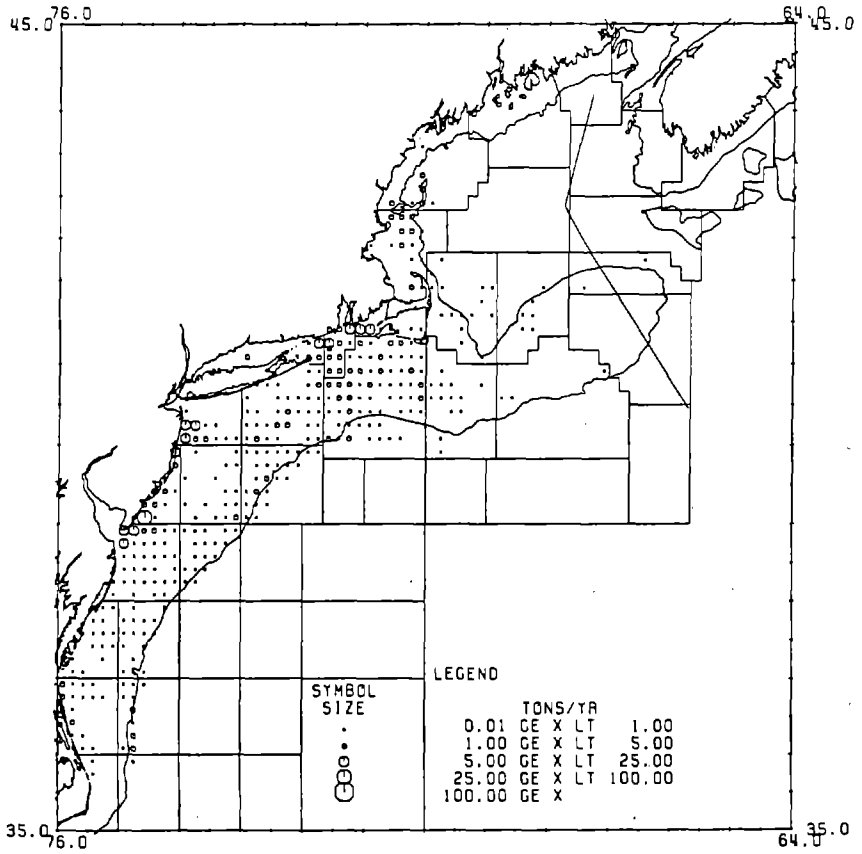


Figure W20-4. Bluefish (*Pomatomus saltatrix*) commercial weighout landings distributions -- fourth quarter.

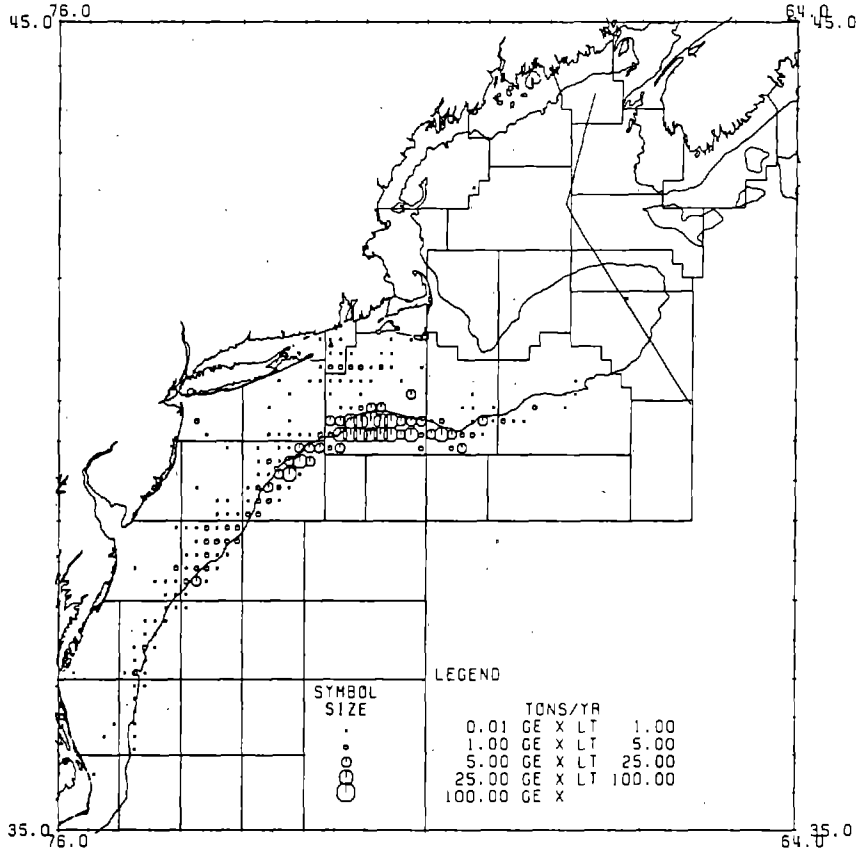


Figure W21-1. Butterfish (*Peprilus triacanthus*) commercial weighout landings distributions -- first quarter.

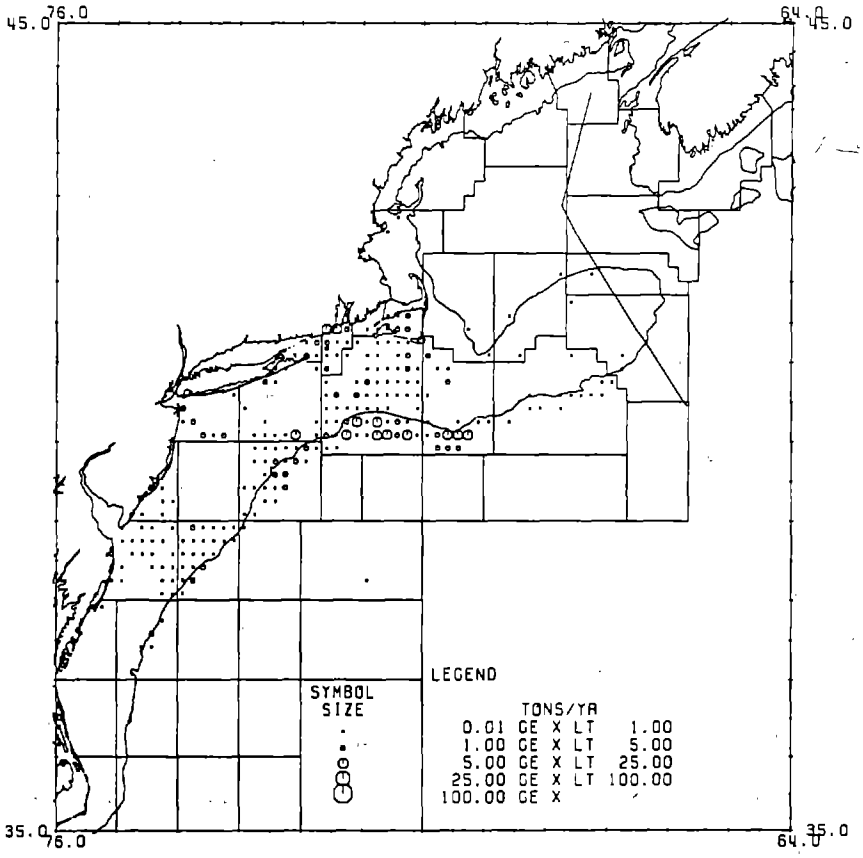


Figure W21-2. Butterfish (*Peprilus triacanthus*) commercial weighout landings distributions -- second quarter.

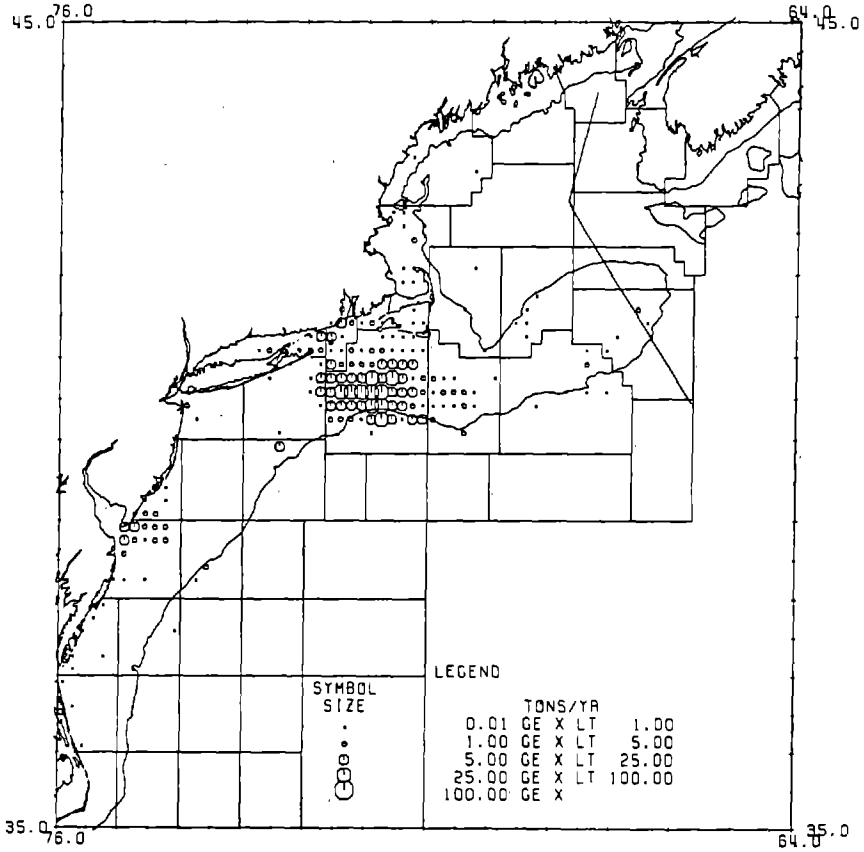


Figure W21-3. Butterfish (*Peprilus triacanthus*) commercial weighout landings distributions -- third quarter.

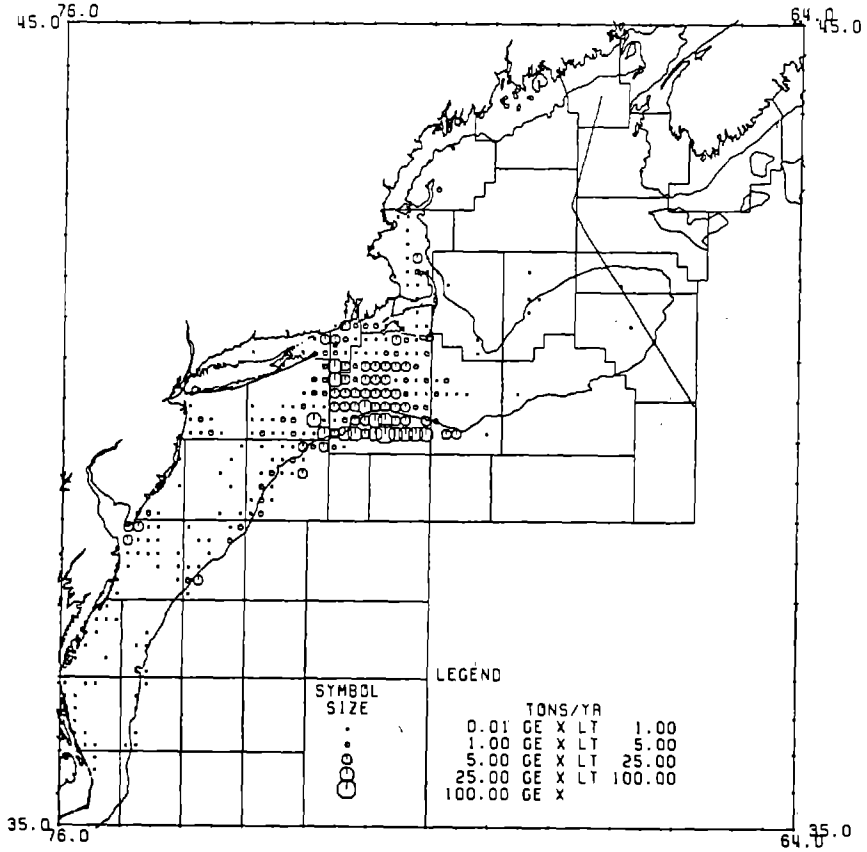


Figure W21-4. Butterfish (*Peprilus triacanthus*) commercial weighout landings distributions -- fourth quarter.

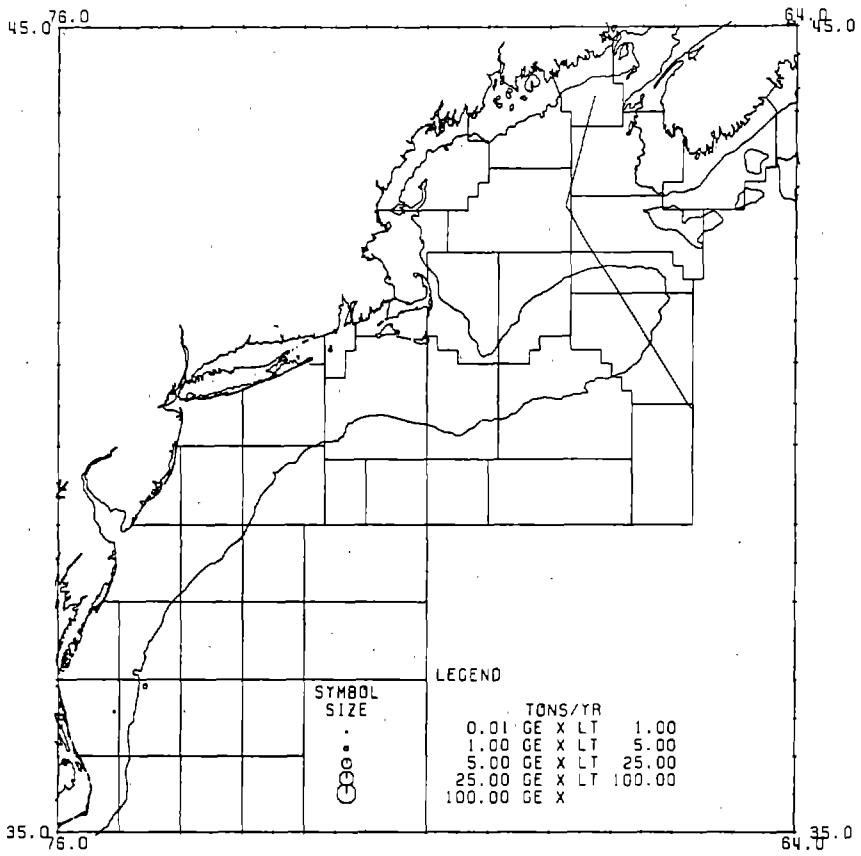


Figure W22-1. Atlantic menhaden (*Brevoortia tyrannus*) commercial weighout landings distributions -- first quarter.

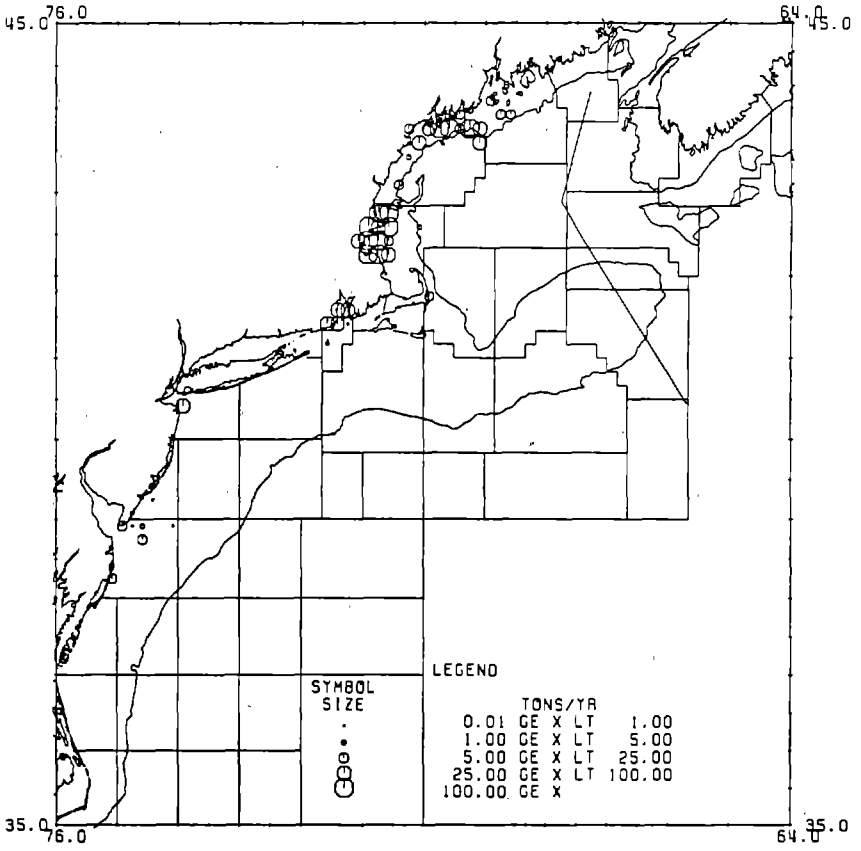


Figure W22-2. Atlantic menhaden (*Brevoortia tyrannus*) commercial weighout landings distributions -- second quarter.

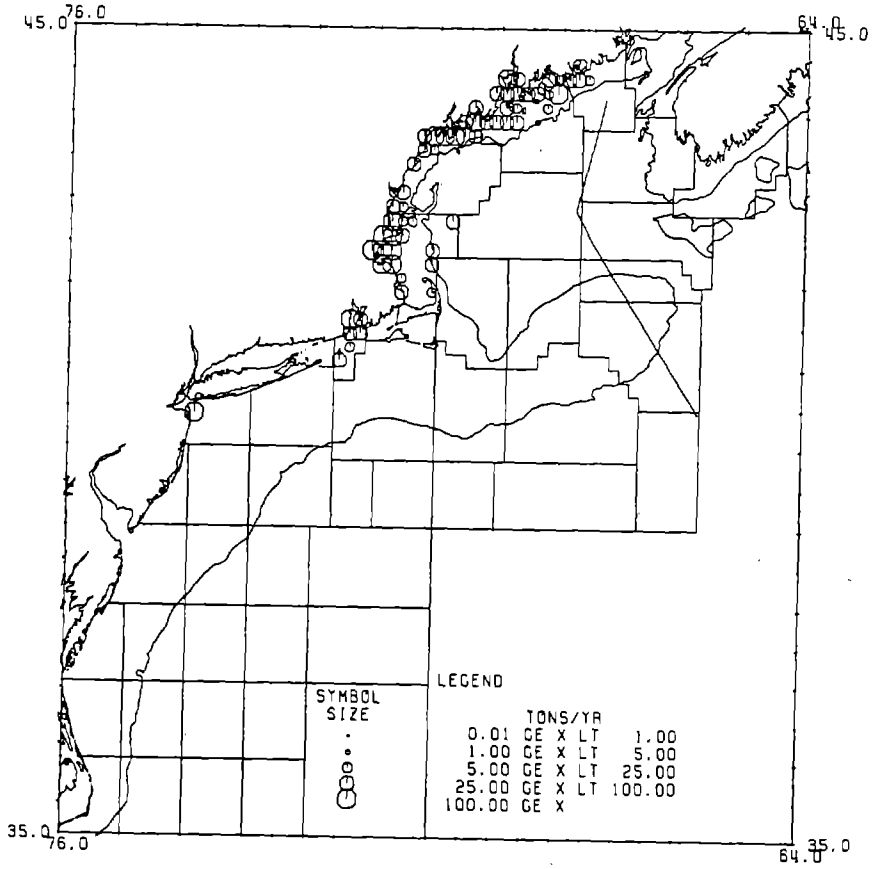


Figure W22-3. Atlantic menhaden (*Brevoortia tyrannus*) commercial weighout landings distributions -- third quarter.

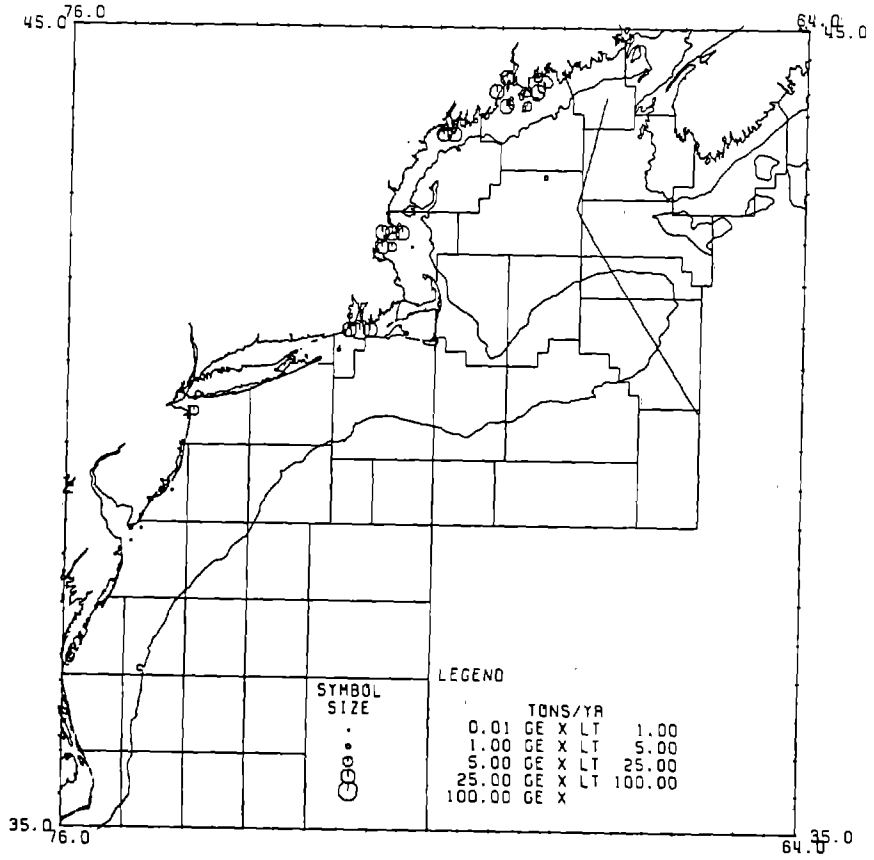


Figure W22-4. Atlantic menhaden (*Brevoortia tyrannus*) commercial weighout landings distributions -- fourth quarter.

Figure W23-1. Alewife (*Alosa pseudoharengus*) commercial weighout landings distributions -- first quarter.

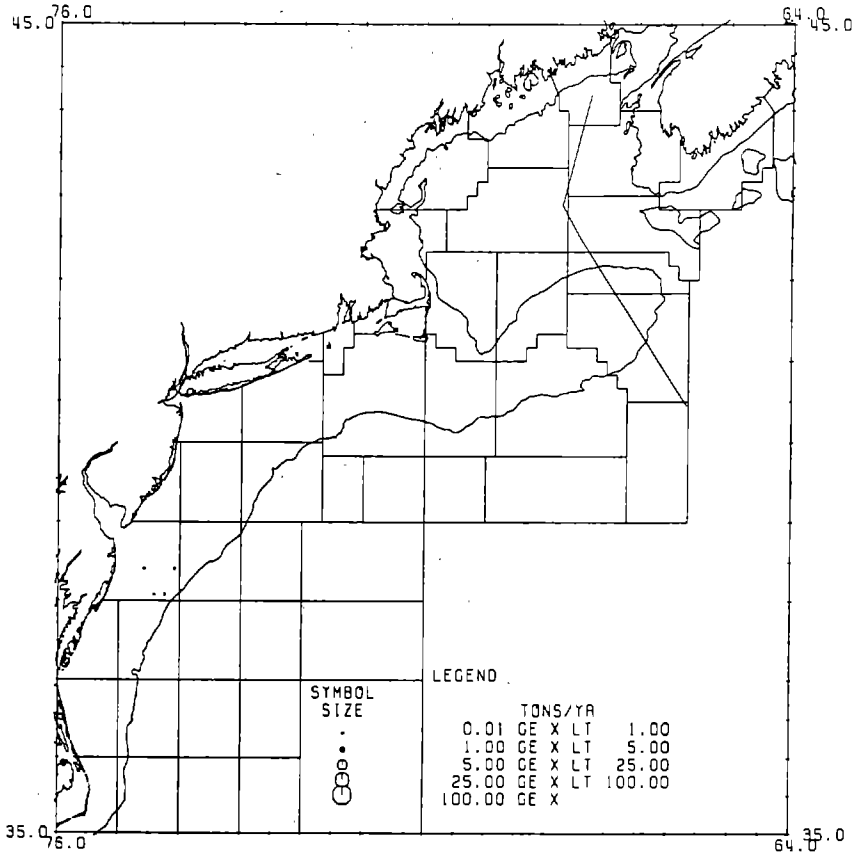
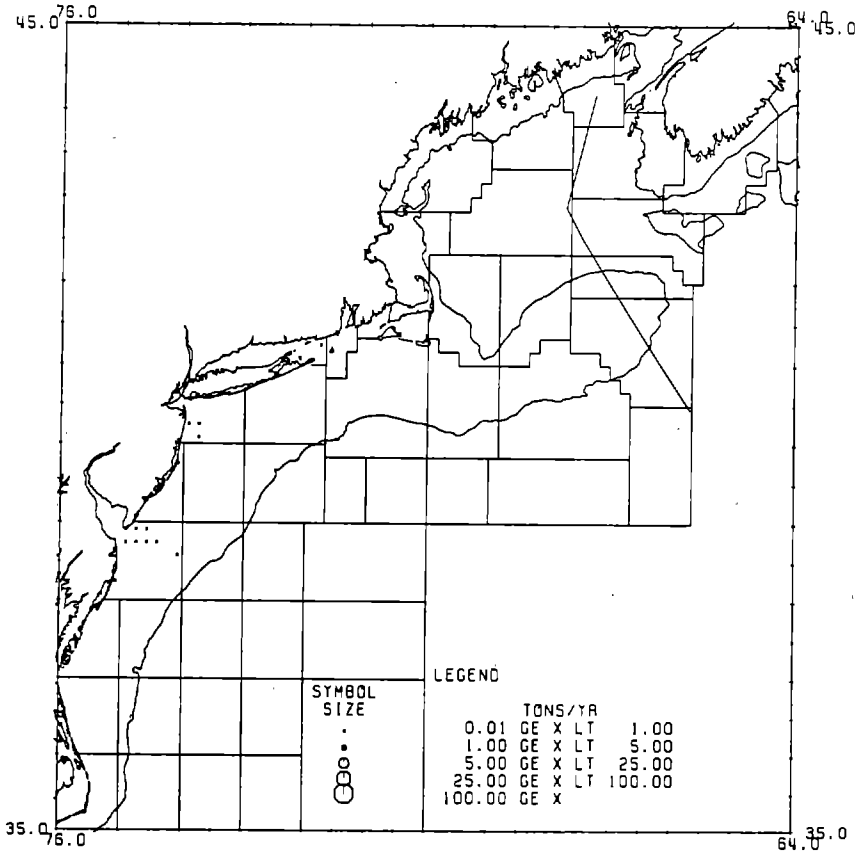


Figure W23-2. Alewife (*Alosa pseudoharengus*) commercial weighout landings distributions -- second quarter.



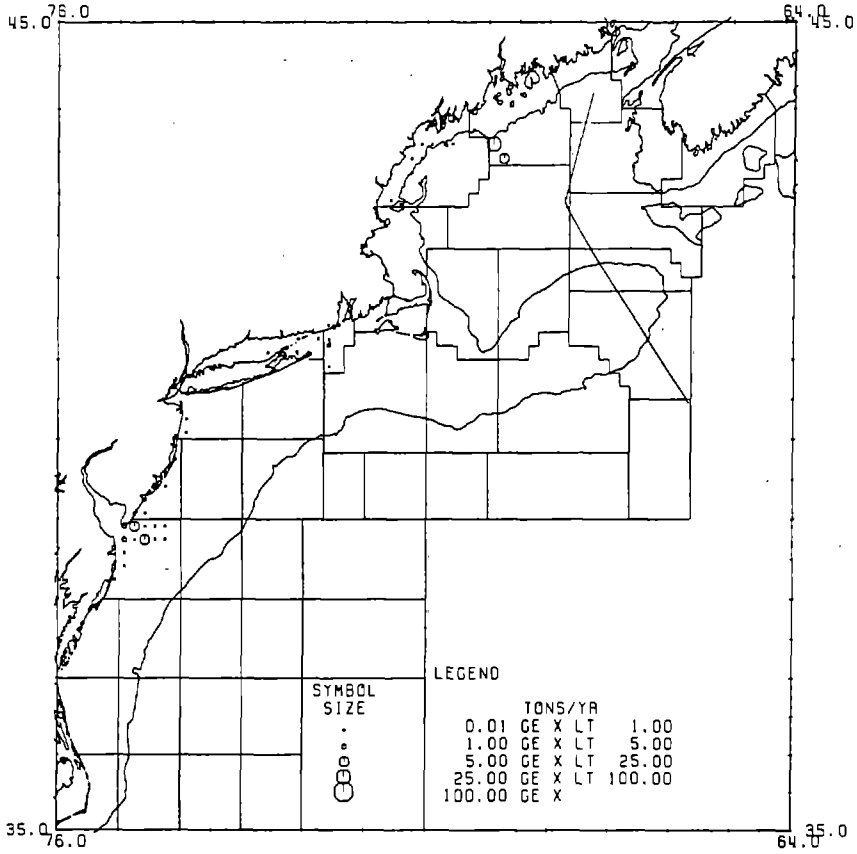


Figure W23-3. Alewife (*Alosa pseudoharengus*) commercial weighout landings distributions -- third quarter.

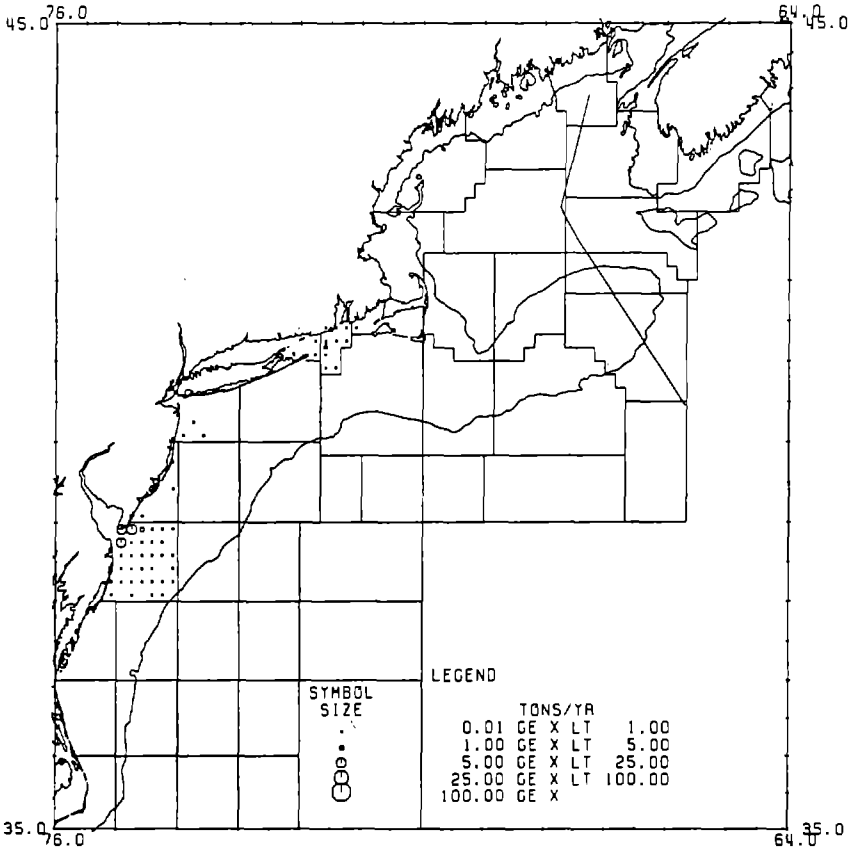


Figure W23-4. Alewife (*Alosa pseudoharengus*) commercial weighout landings distributions -- fourth quarter.

Figure W24-1. Blueback herring (*Alosa aestivalis*) commercial weighout landings distributions -- first quarter.

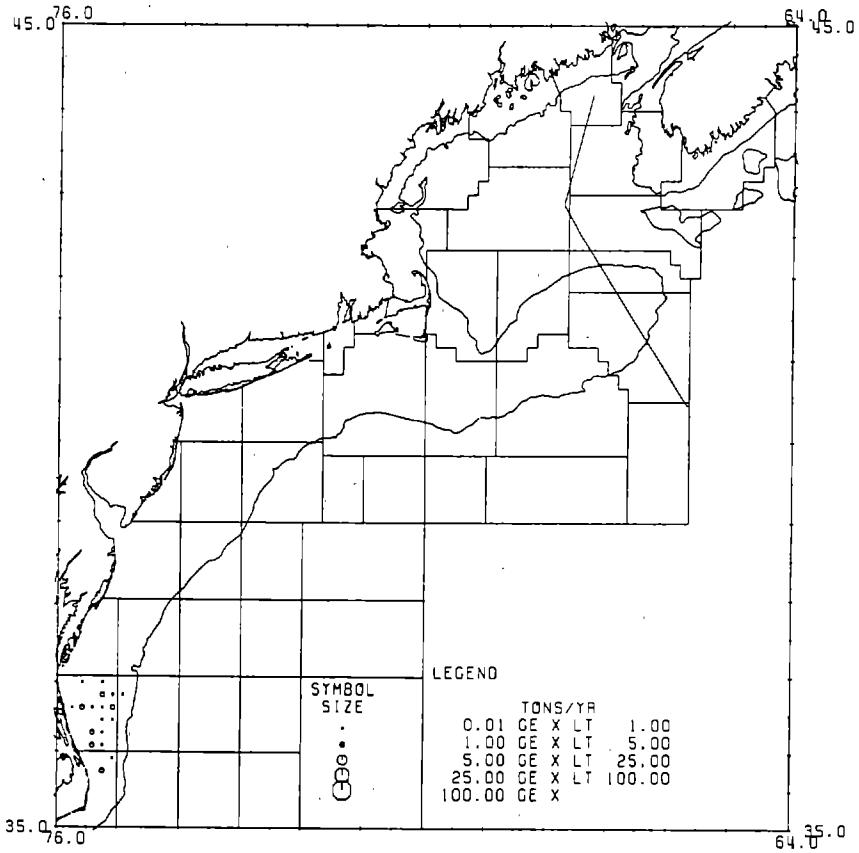
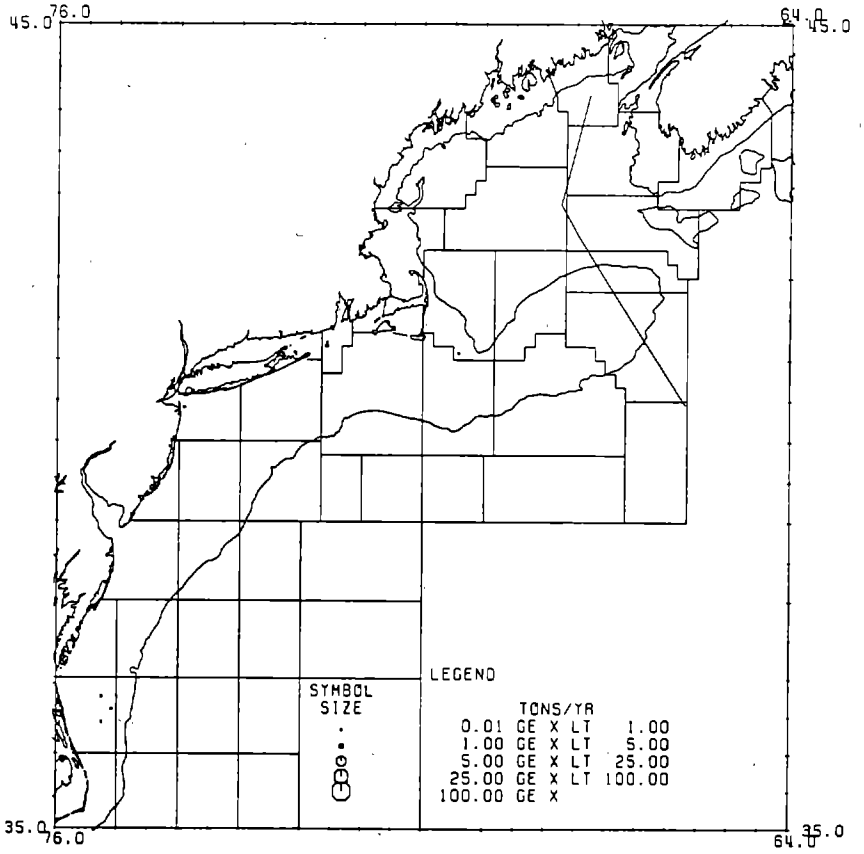


Figure W24-2. Blueback herring (*Alosa aestivalis*) commercial weighout landings distributions -- second quarter.



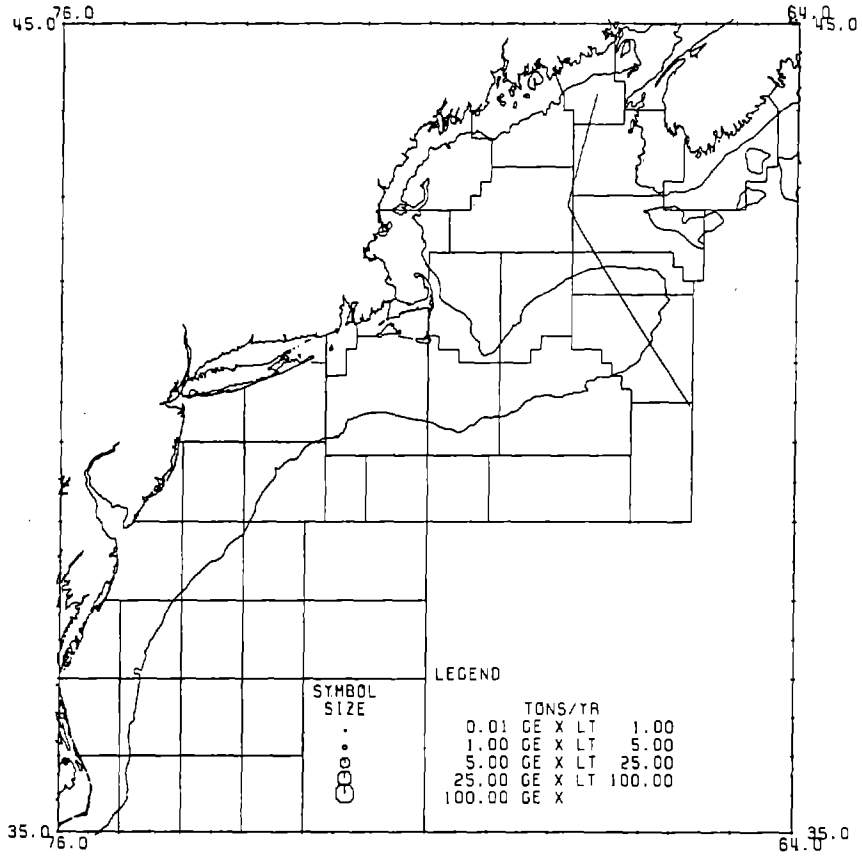


Figure W24-3. Blueback herring (*Alosa aestivalis*) commercial weighout landings distributions -- third quarter.

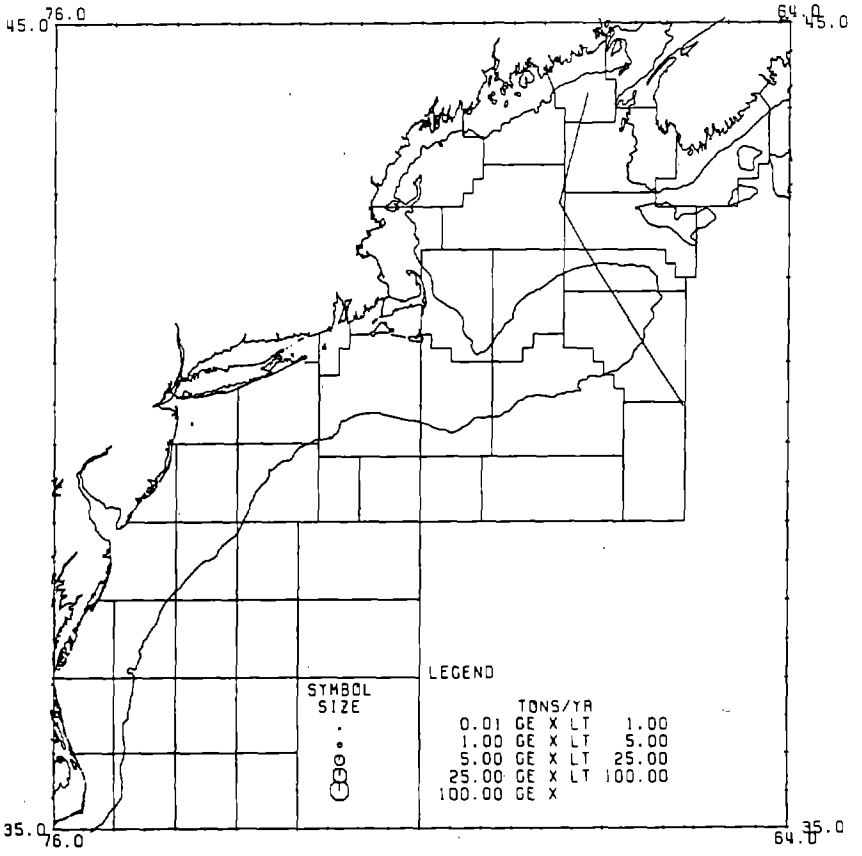


Figure W24-4. Blueback herring (*Alosa aestivalis*) commercial weighout landings distributions -- fourth quarter.

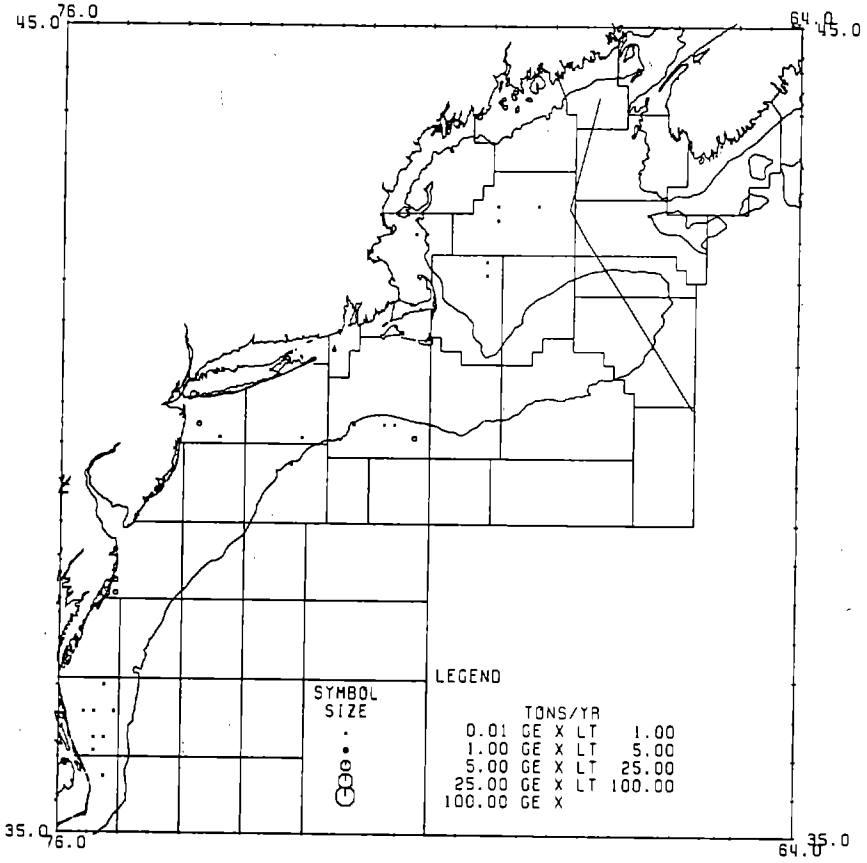


Figure W25-1. American shad (*Alosa sapidissima*) commercial weighout landings distributions -- first quarter.

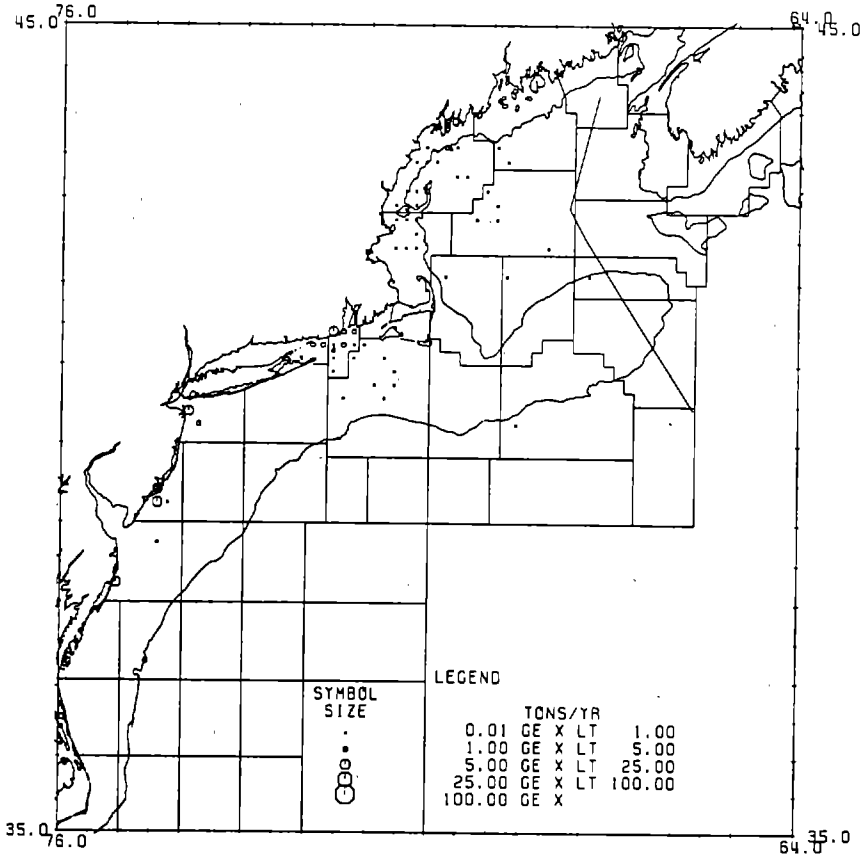


Figure W25-2. American shad (*Alosa sapidissima*) commercial weighout landings distributions -- second quarter.

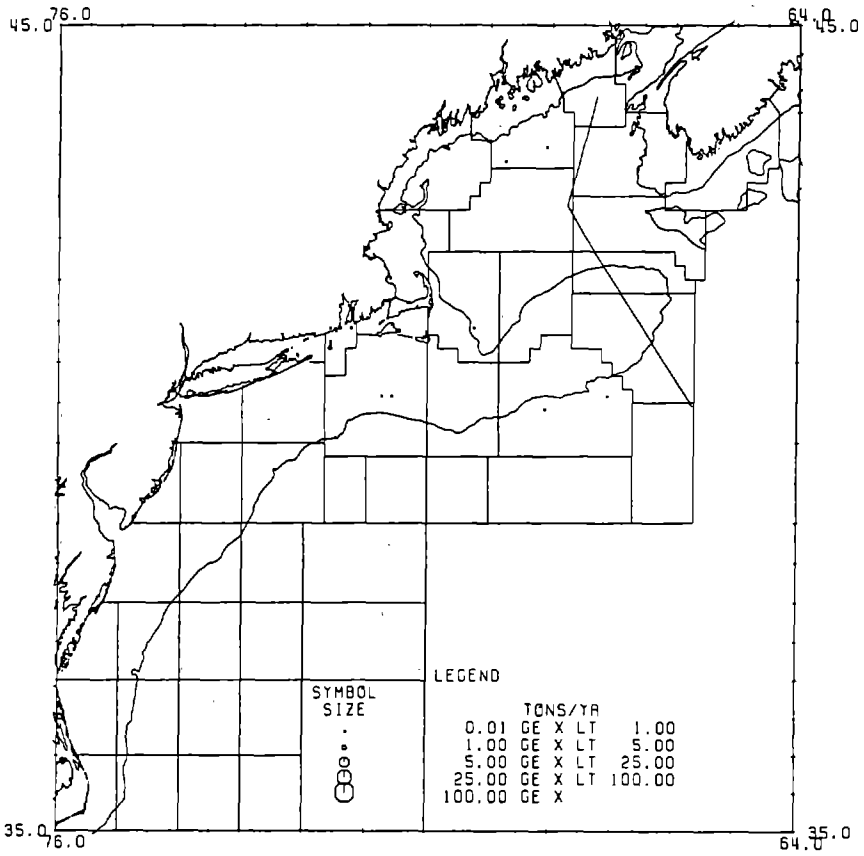


Figure W25-3. American shad (*Alosa sapidissima*) commercial weighout landings distributions -- third quarter.

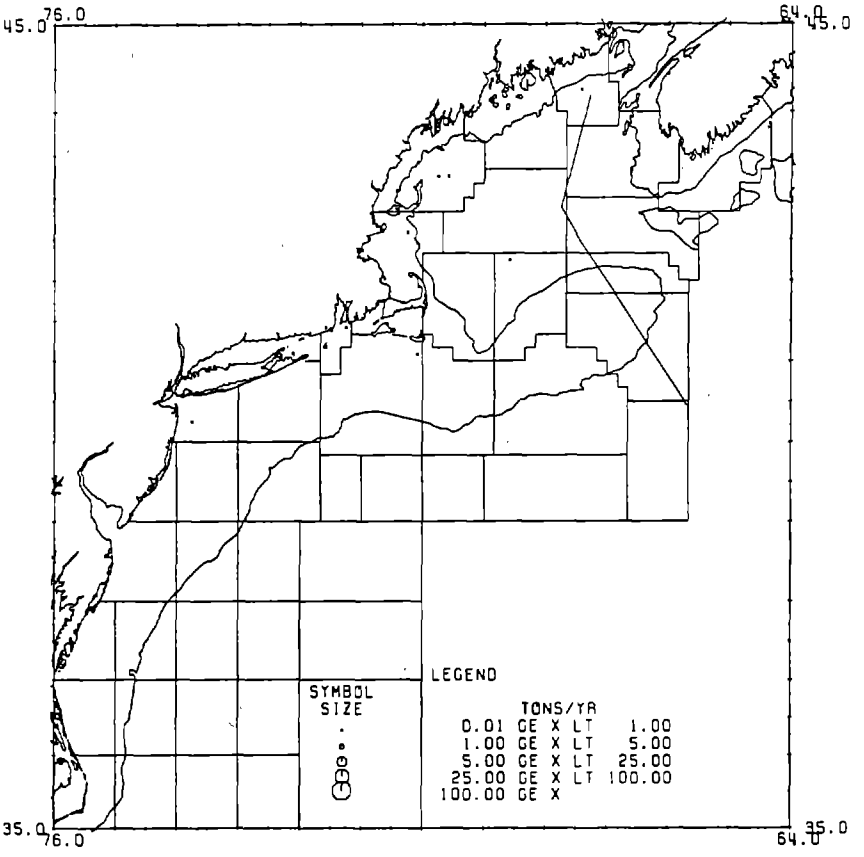


Figure W25-4. American shad (*Alosa sapidissima*) commercial weighout landings distributions -- fourth quarter.

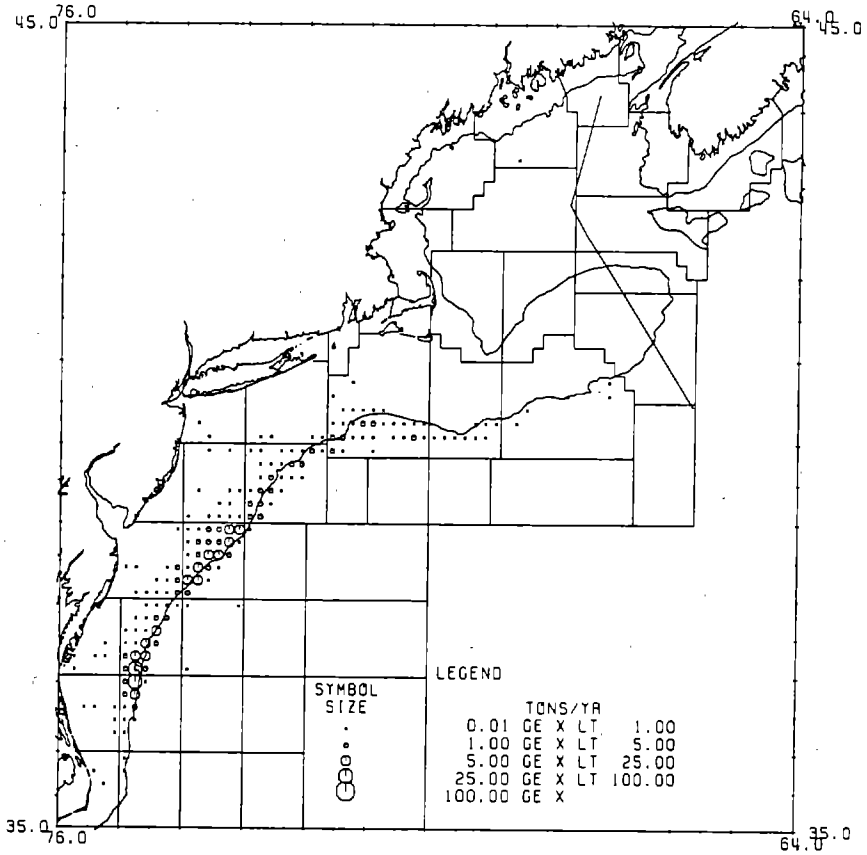


Figure W26-1. Black sea bass (*Centropristes striatus*) commercial weighout landings distributions -- first quarter.

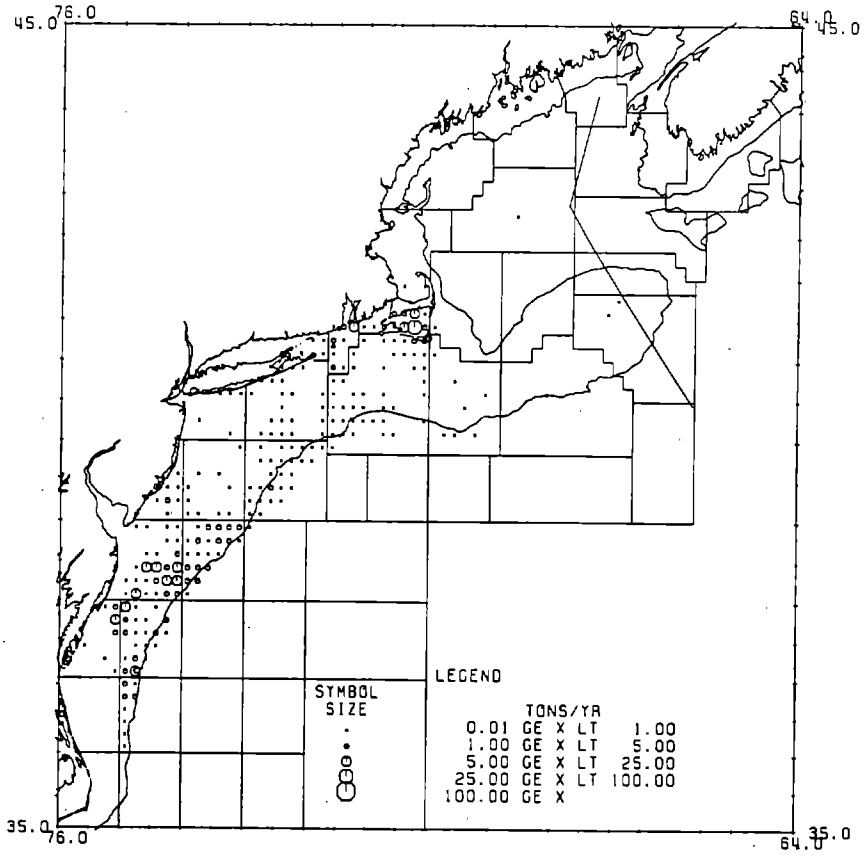


Figure W26-2. Black sea bass (*Centropristes striatus*) commercial weighout landings distributions -- second quarter.

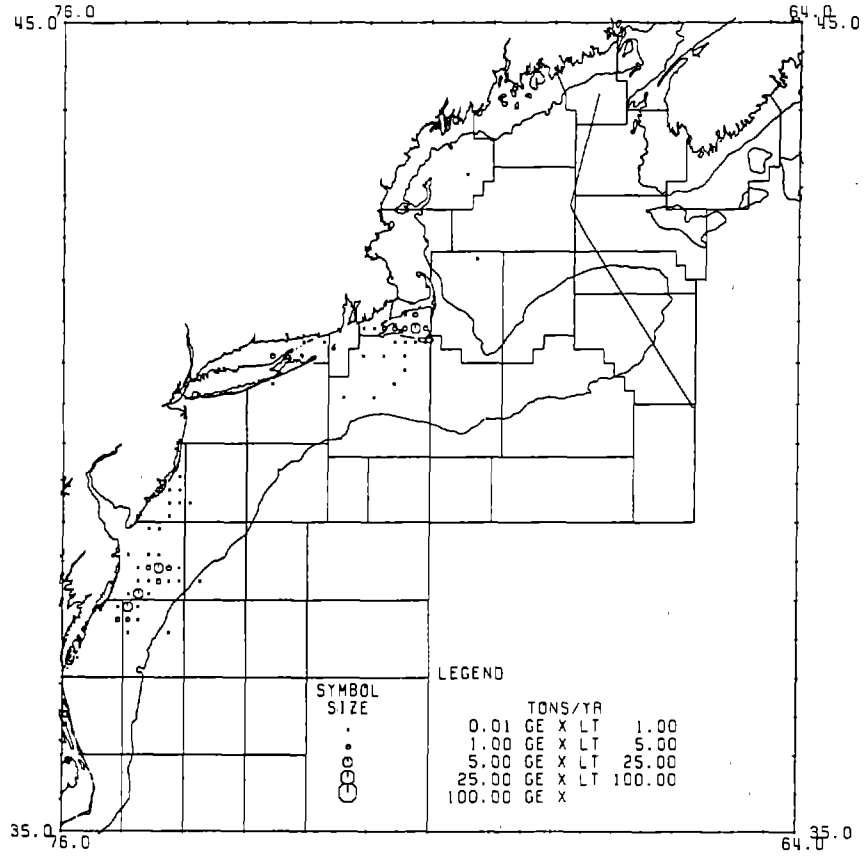


Figure W26-3. Black sea bass (*Centropristes striatus*) commercial weighout landings distributions -- third quarter.

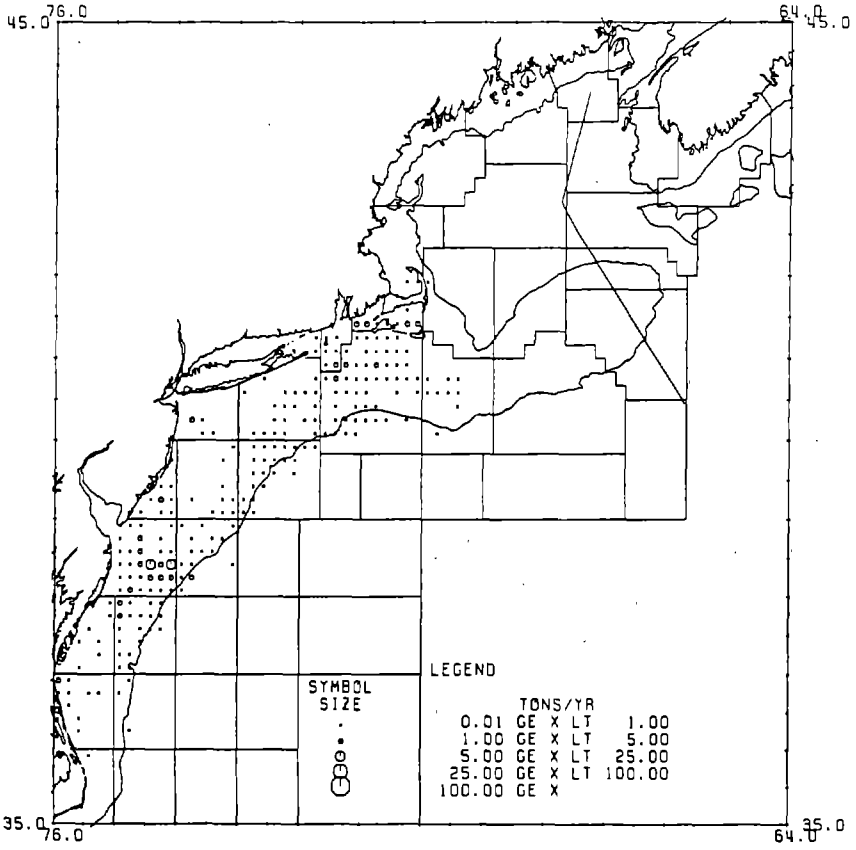


Figure W26-4. Black sea bass (*Centropristes striatus*) commercial weighout landings distributions -- fourth quarter.

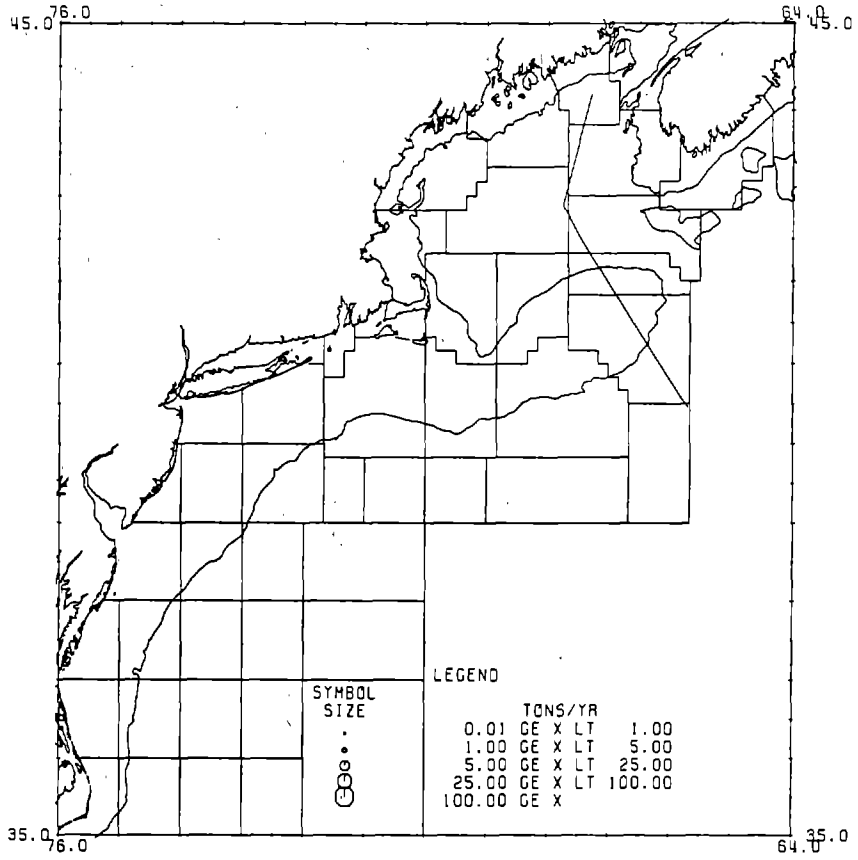


Figure W27-1. Striped bass (*Morone saxatilis*) commercial weighout landings distributions -- first quarter.

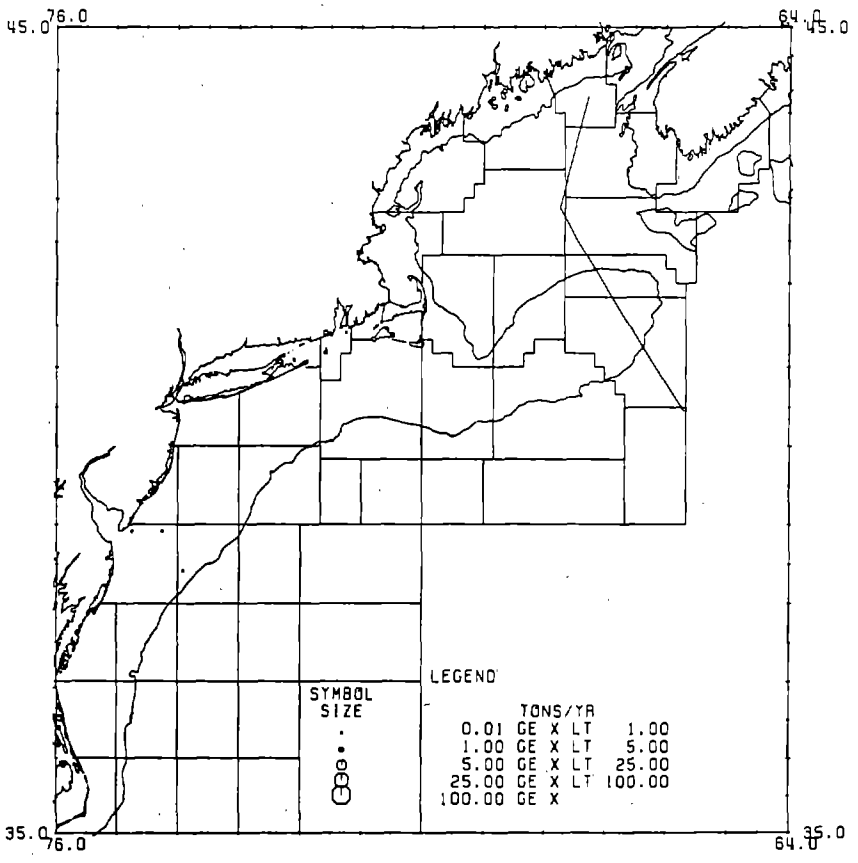


Figure W27-2. Striped bass (*Morone saxatilis*) commercial weighout landings distributions -- second quarter.

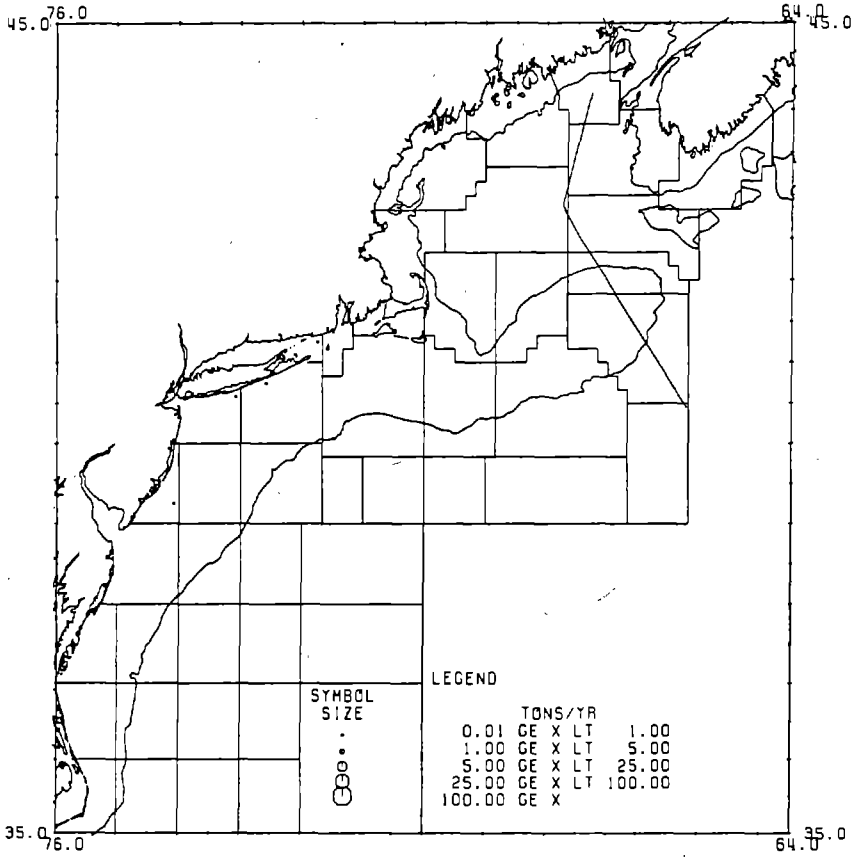


Figure W27-3. Striped bass (*Morone saxatilis*) commercial weighout landings distributions -- third quarter.

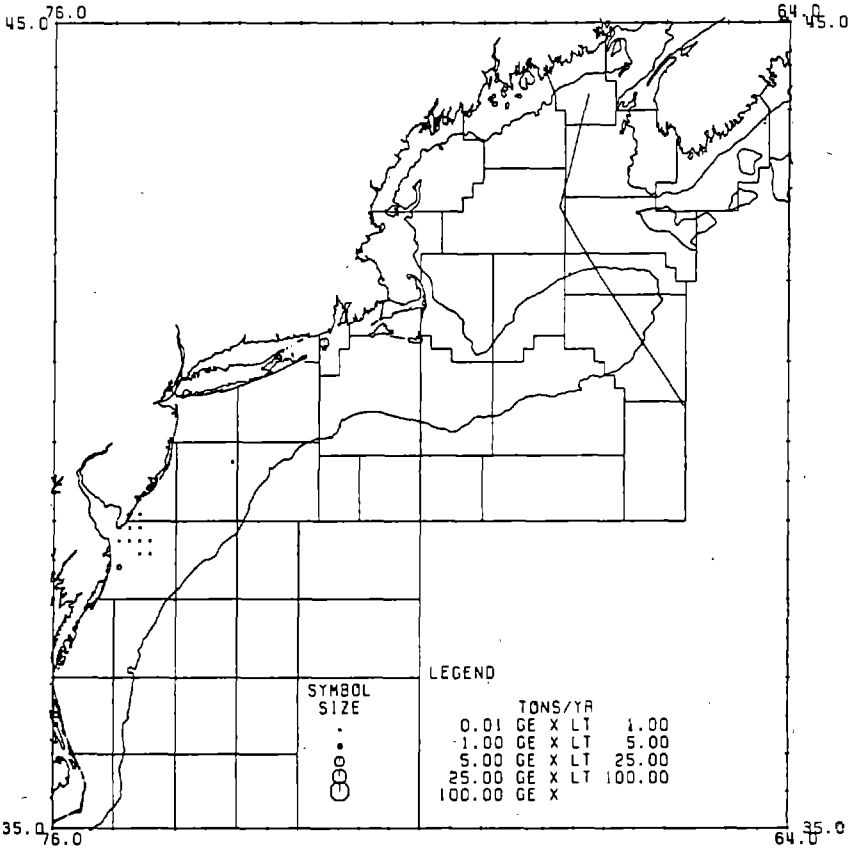


Figure W27-4. Striped bass (*Morone saxatilis*) commercial weighout landings distributions -- fourth quarter.

Figure W28-1. Scup (*Stenotomus chrysops*) commercial weighout landings distributions -- first quarter.

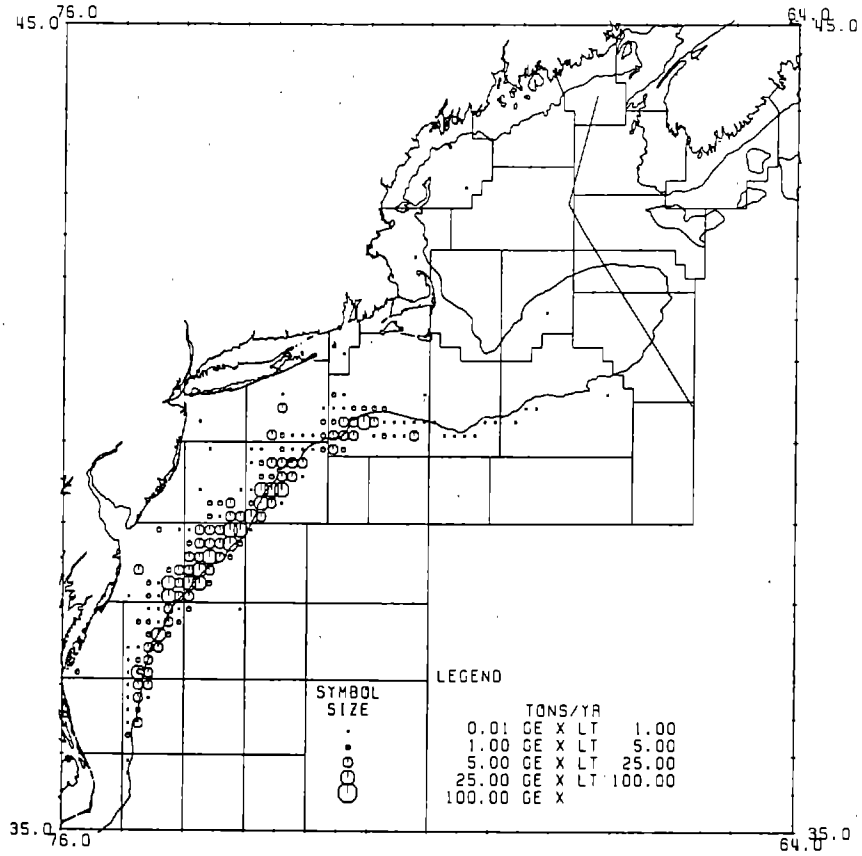
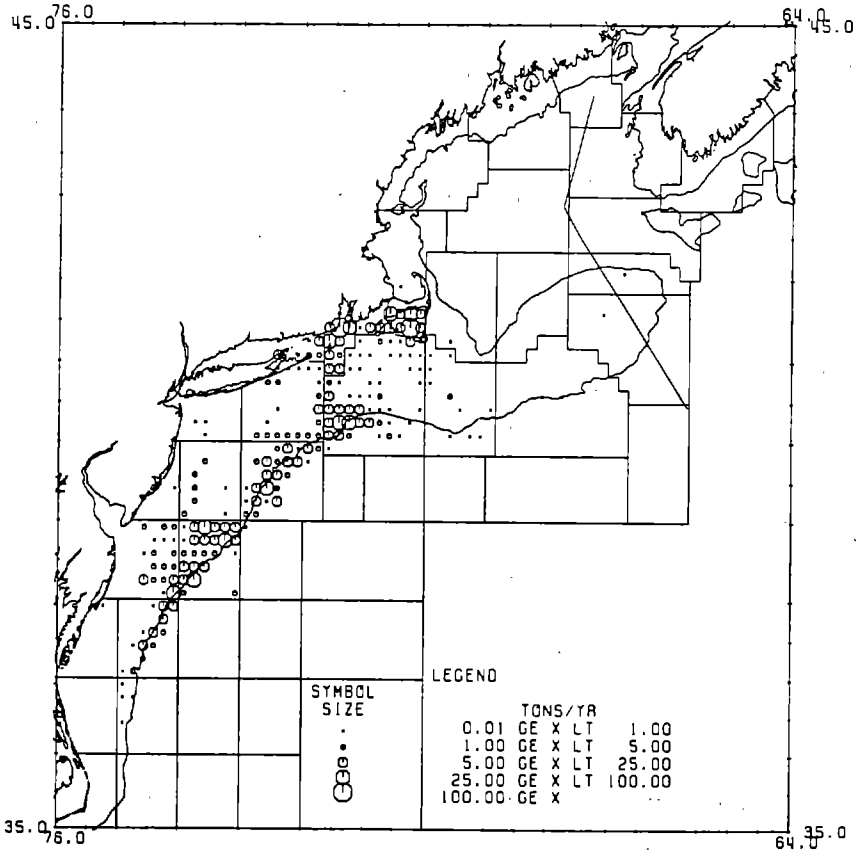


Figure W28-2. Scup (*Stenotomus chrysops*) commercial weighout landings distributions -- second quarter.



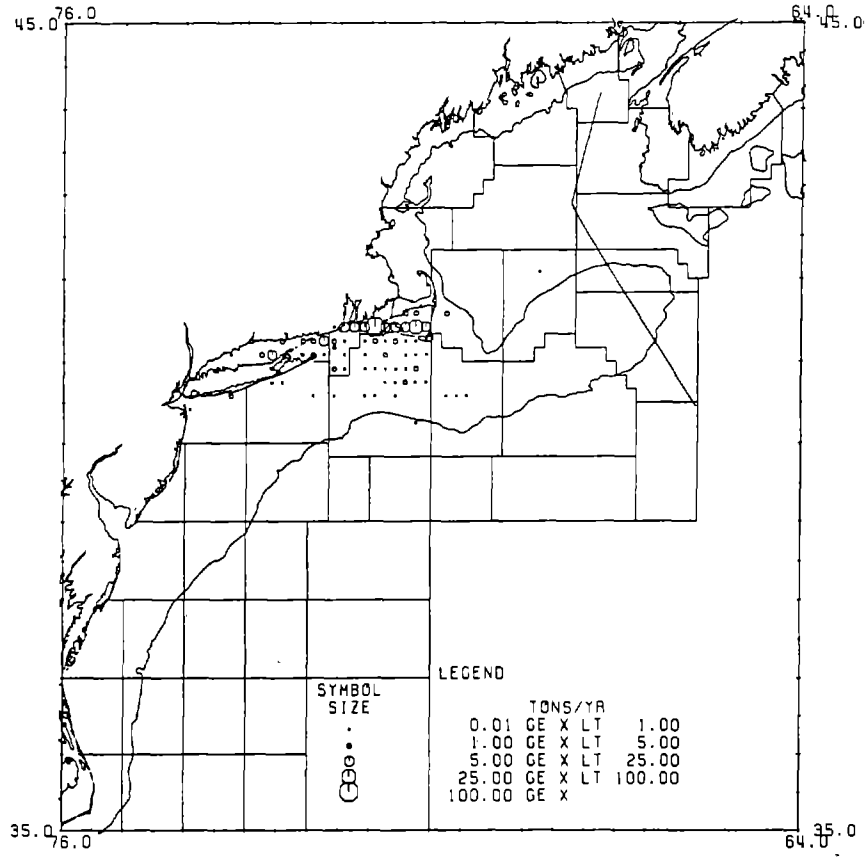


Figure W28-3. Scup (*Stenotomus chrysops*) commercial weighout landings distributions -- third quarter.

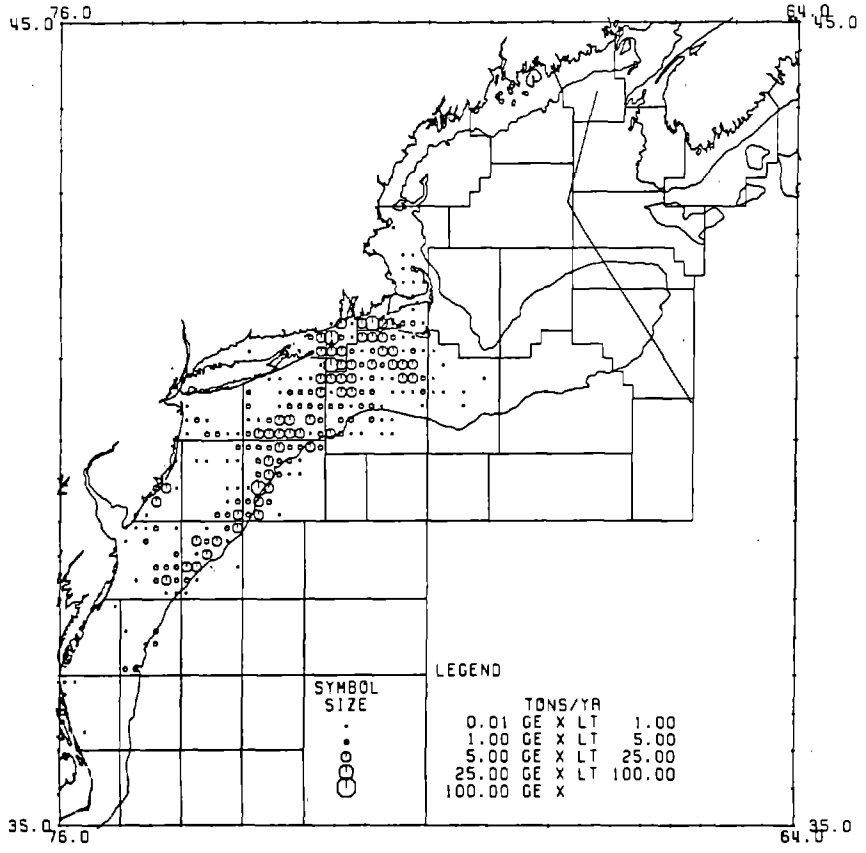


Figure W28-4. Scup (*Stenotomus chrysops*) commercial weighout landings distributions -- fourth quarter.

Figure W29-1. Weakfish (*Cynoscion regalis*) commercial weighout landings distributions -- first quarter.

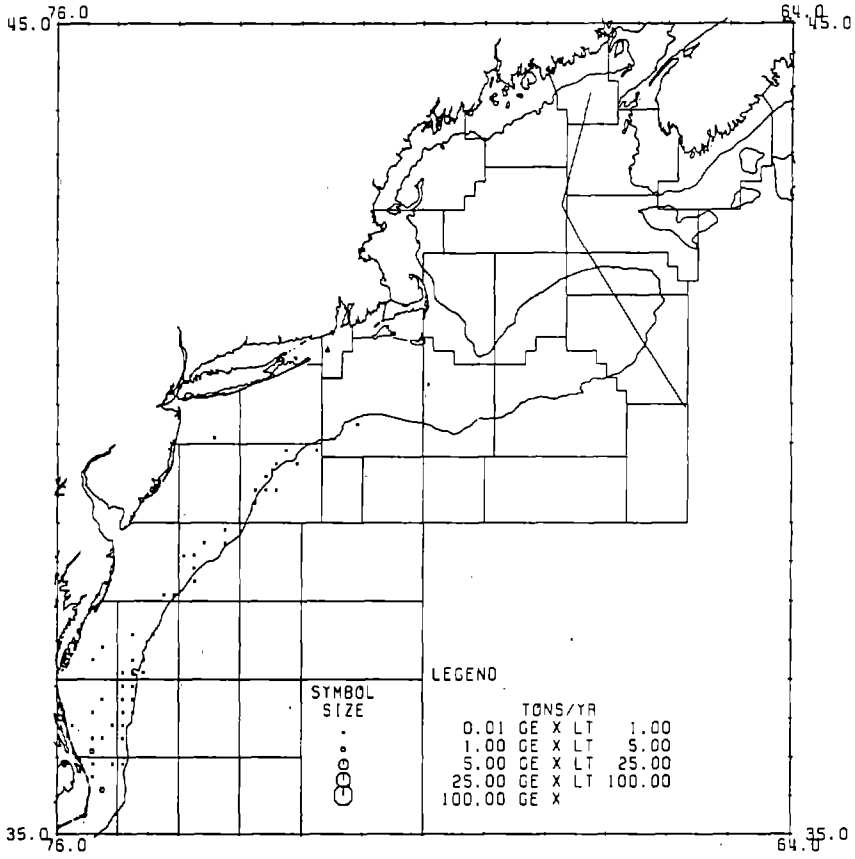
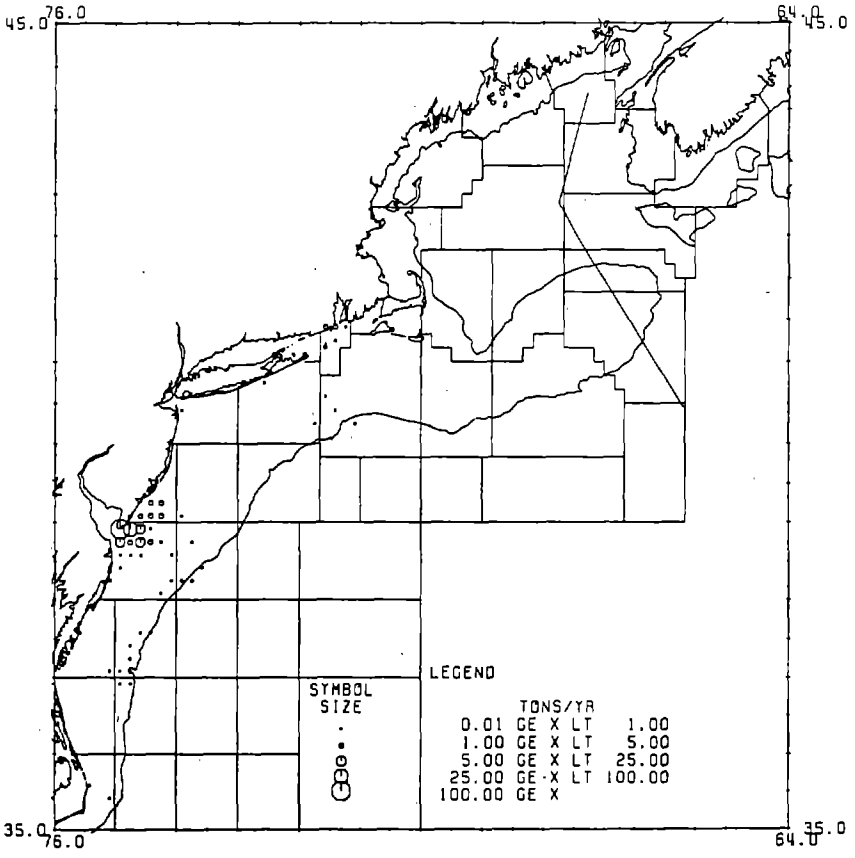


Figure W29-2. Weakfish (*Cynoscion regalis*) commercial weighout landings distributions -- second quarter.



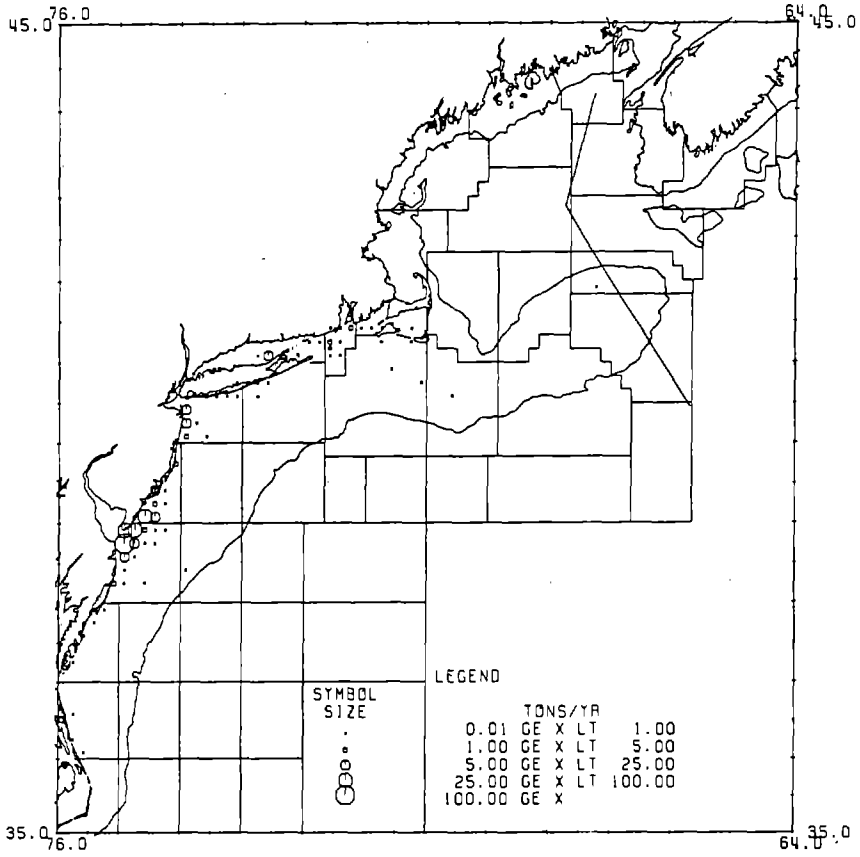


Figure W29-3. Weakfish (*Cynoscion regalis*) commercial weighout landings distributions -- third quarter.

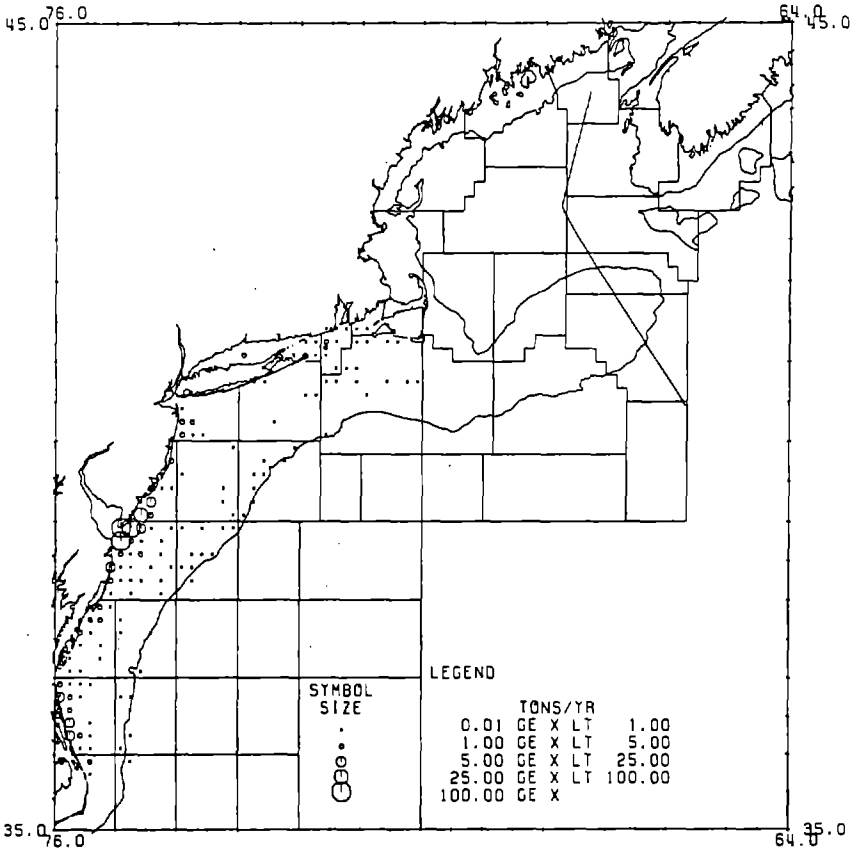


Figure W29-4. Weakfish (*Cynoscion regalis*) commercial weighout landings distributions -- fourth quarter.

Figure W30-1. Spot (*Leiostomus xanthurus*) commercial weighout landings distributions -- first quarter.

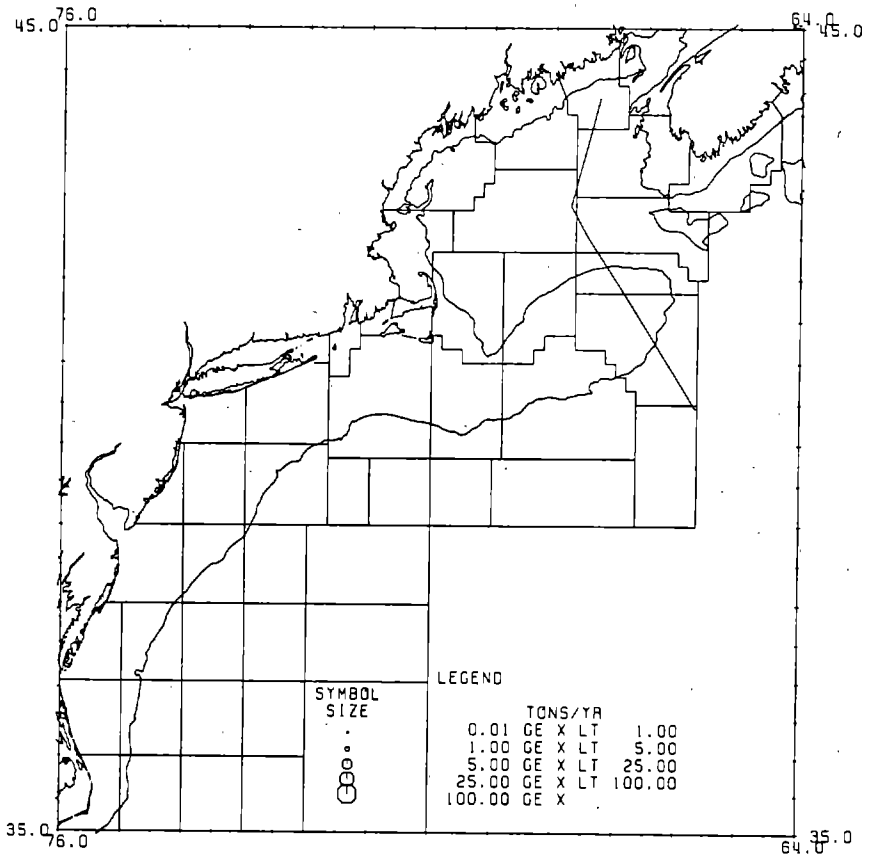
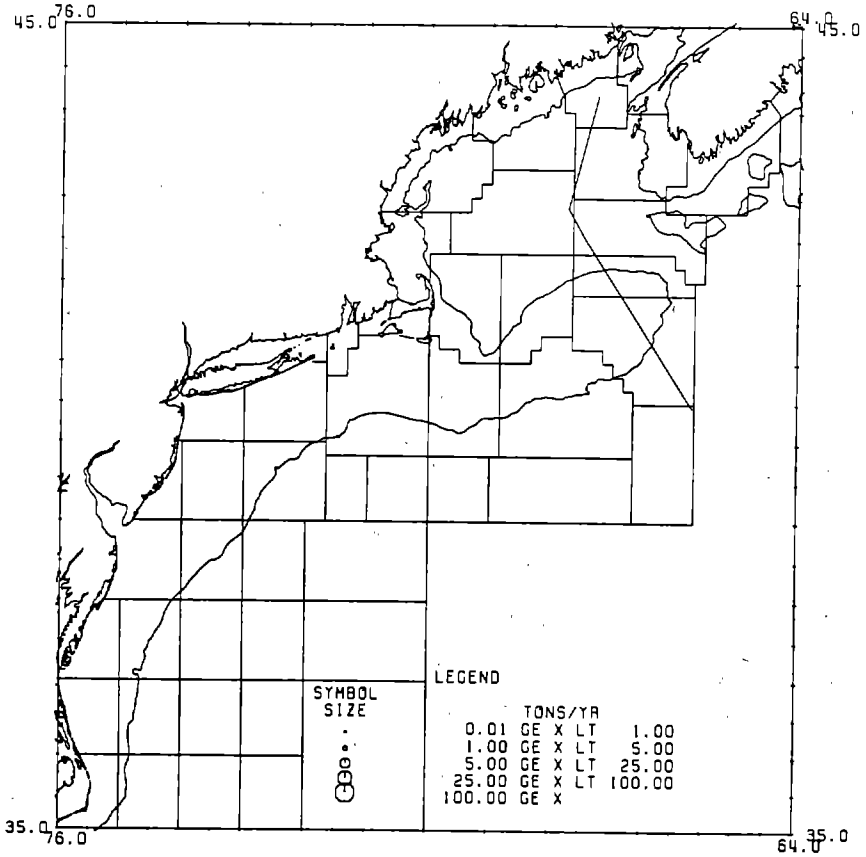


Figure W30-2. Spot (*Leiostomus xanthurus*) commercial weighout landings distributions -- second quarter.



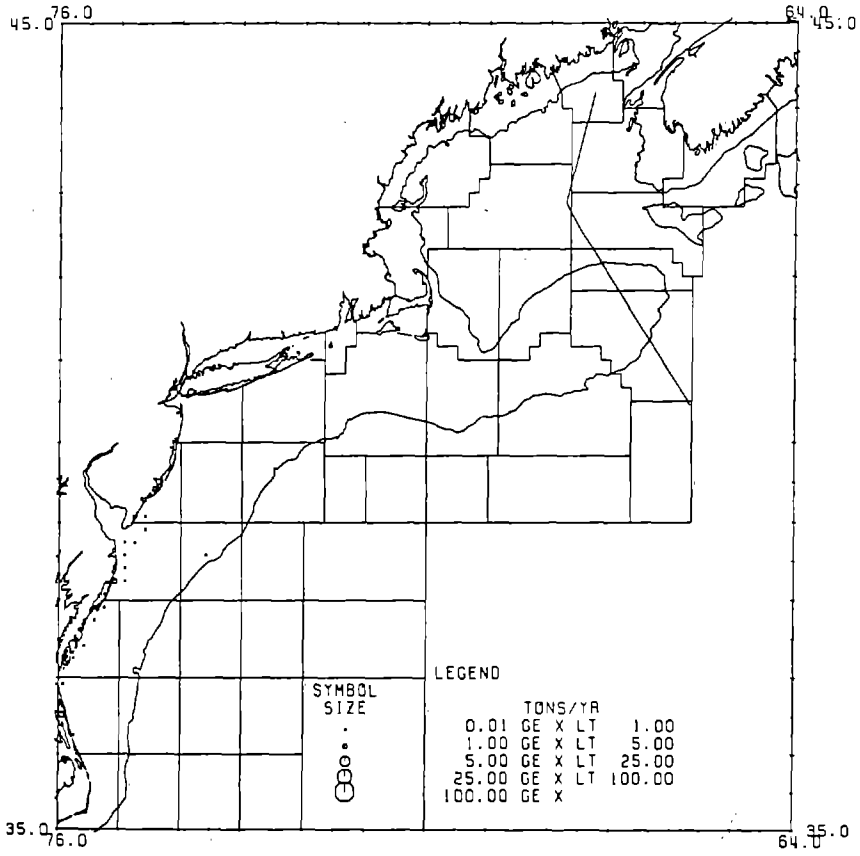


Figure W30-3. Spot (*Leiostomus xanthurus*) commercial weighout landings distributions -- third quarter.

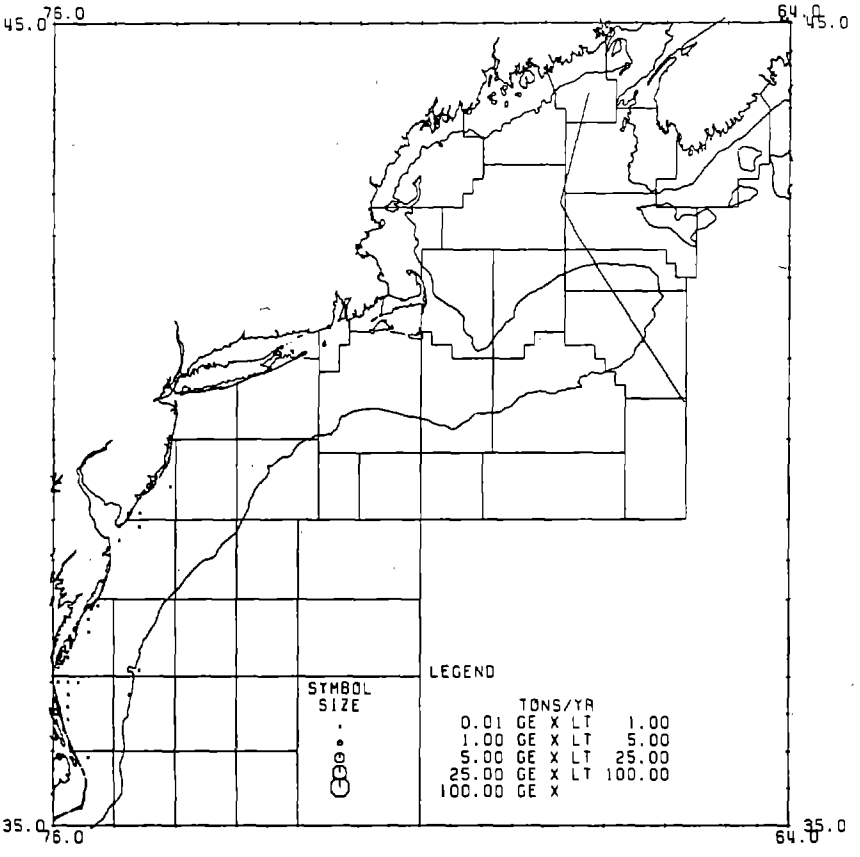


Figure W30-4. Spot (*Leiostomus xanthurus*) commercial weighout landings distributions -- fourth quarter.

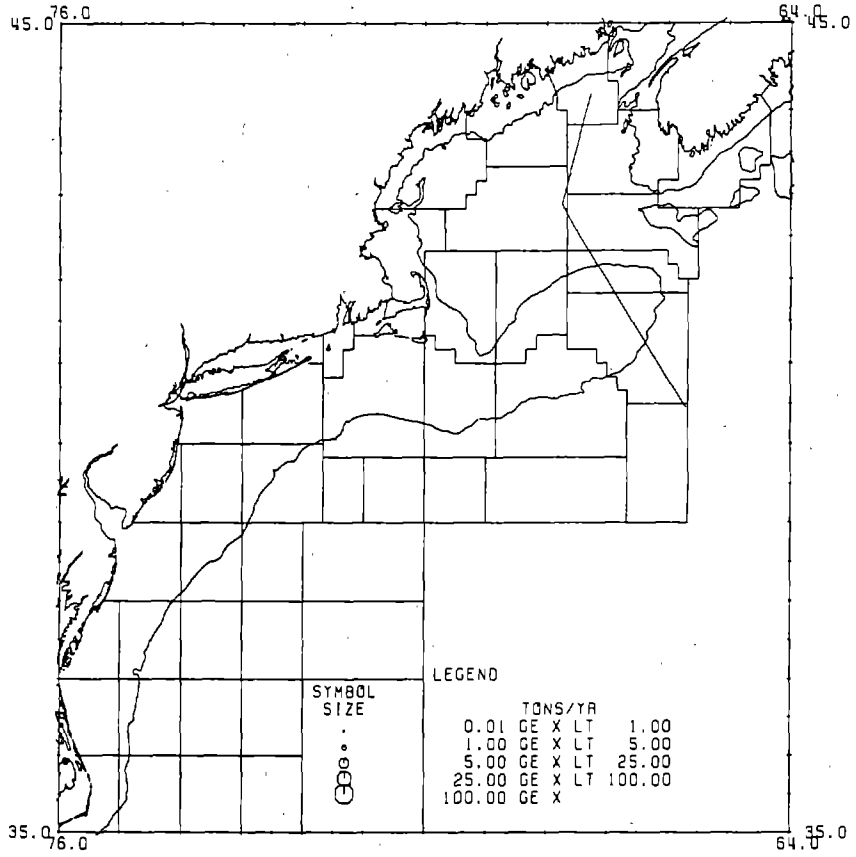


Figure W31-1. Croaker (*Micropogon undulatus*) commercial weighout landings distributions -- first quarter.

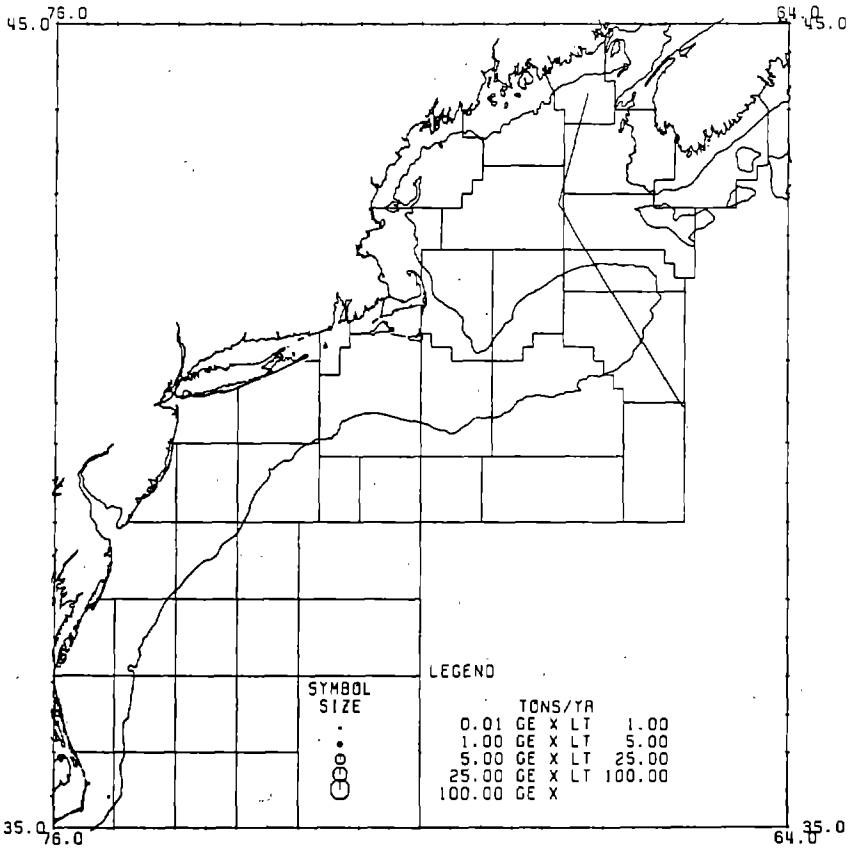


Figure W31-2. Croaker (*Micropogon undulatus*) commercial weighout landings distributions -- second quarter.

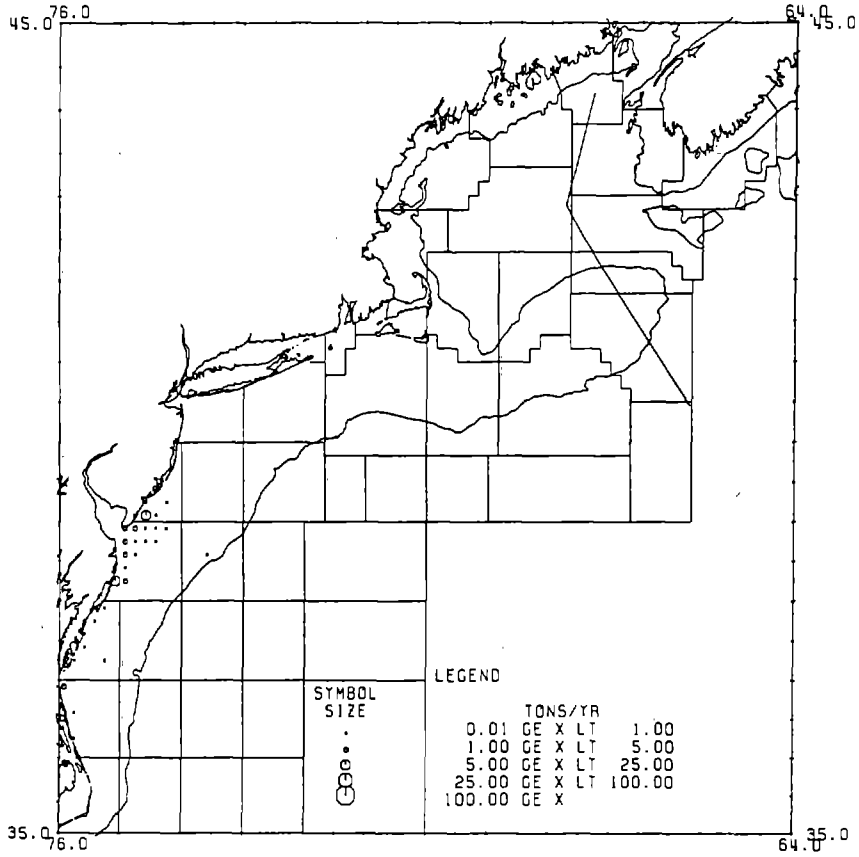


Figure W31-3. Croaker (*Micropogon undulatus*) commercial weighout landings distributions -- third quarter.

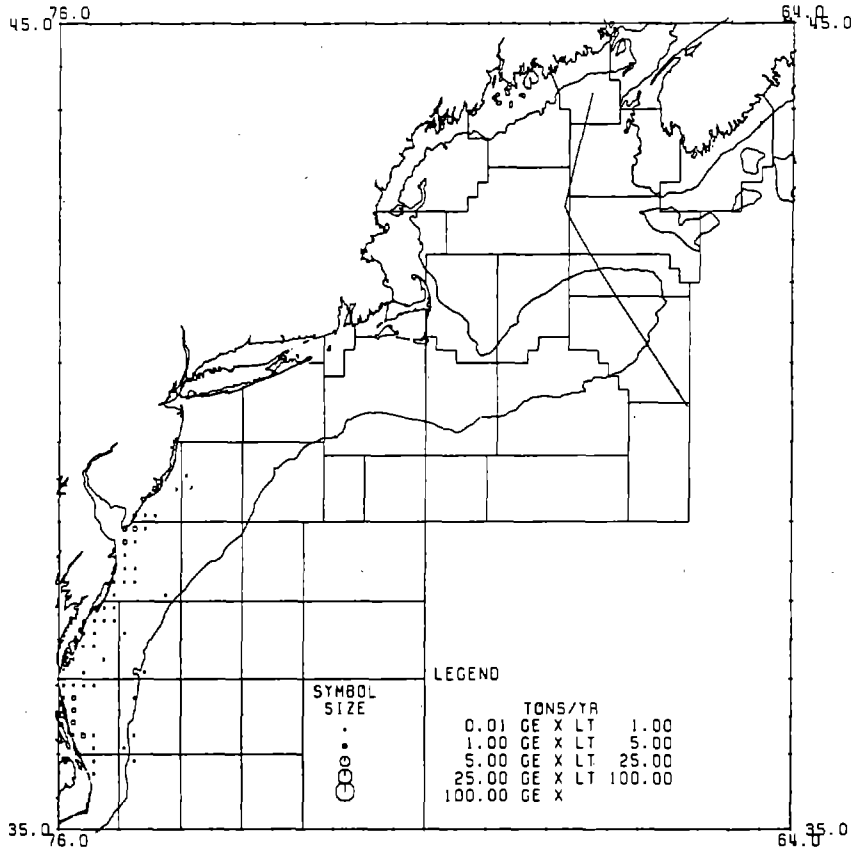


Figure W31-4. Croaker (*Micropogon undulatus*) commercial weighout landings distributions -- fourth quarter.

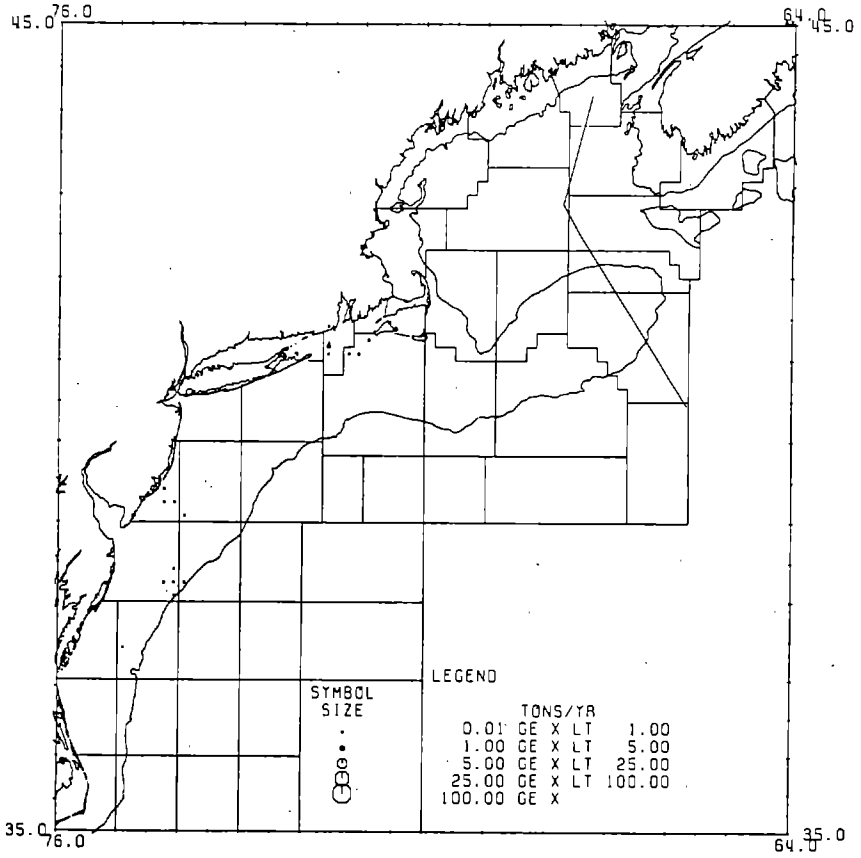


Figure W32-1. Tautog (*Tautoga onitis*) commercial weighout landings distributions -- first quarter.

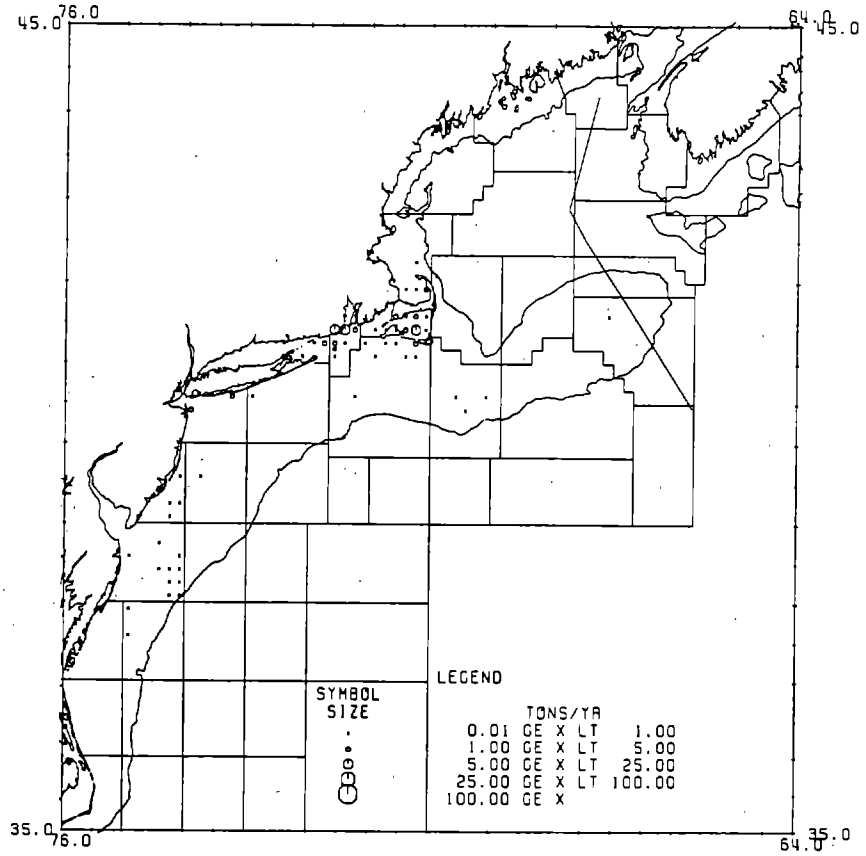


Figure W32-2. Tautog (*Tautoga onitis*) commercial weighout landings distributions -- second quarter.

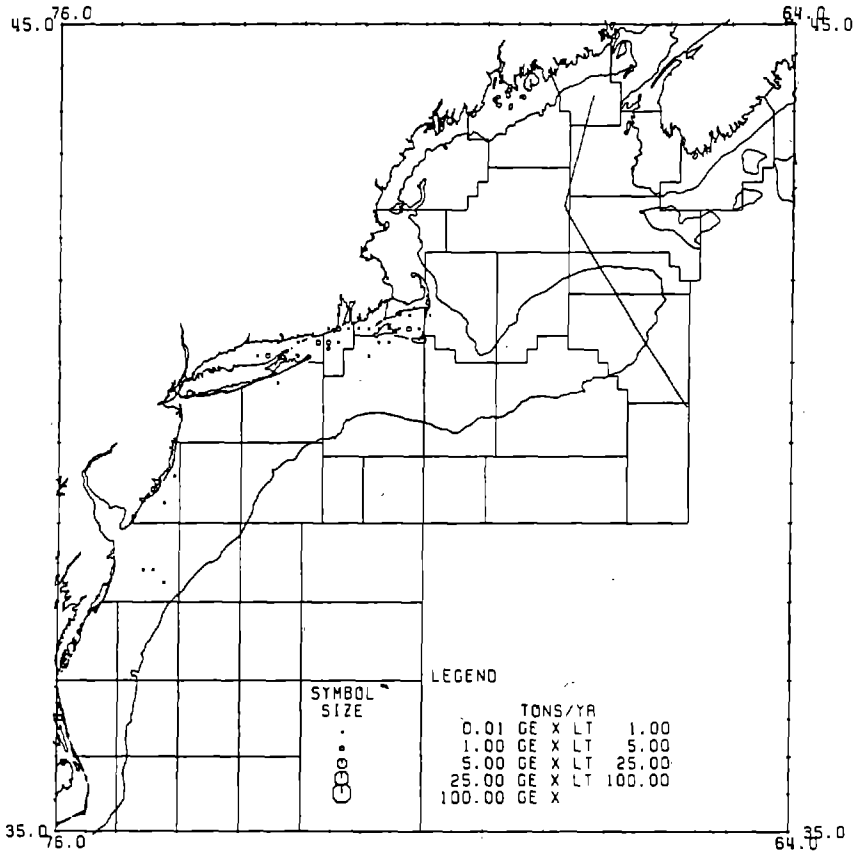


Figure W32-3. Tautog (*Tautoga onitis*) commercial weighout landings distributions -- third quarter.

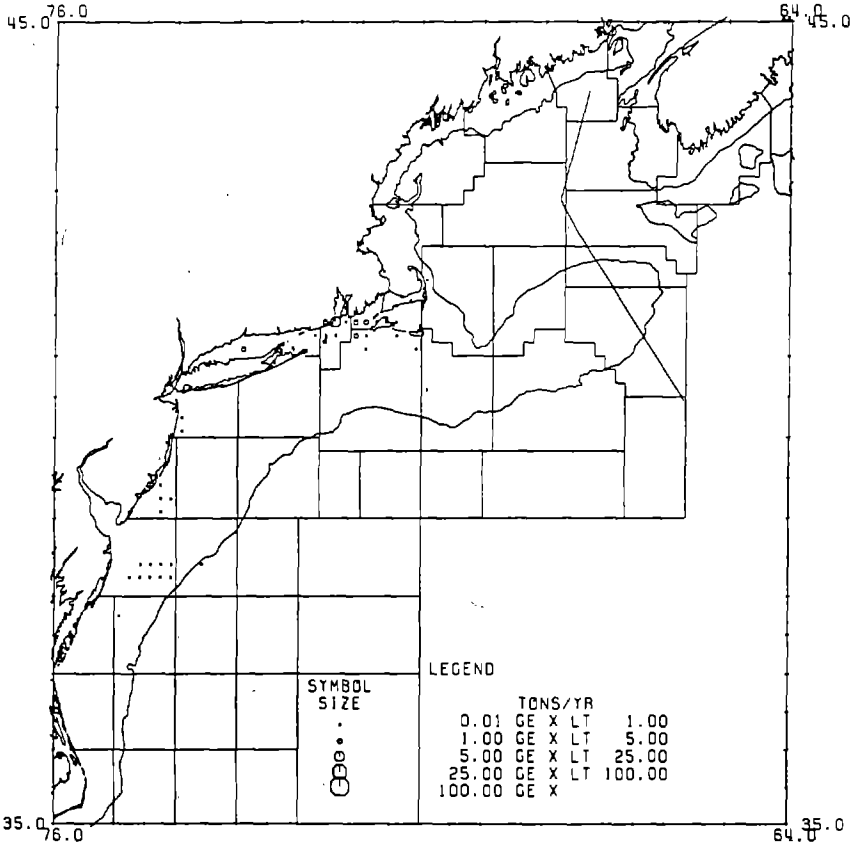


Figure W32-4. Tautog (*Tautoga onitis*) commercial weighout landings distributions -- fourth quarter.

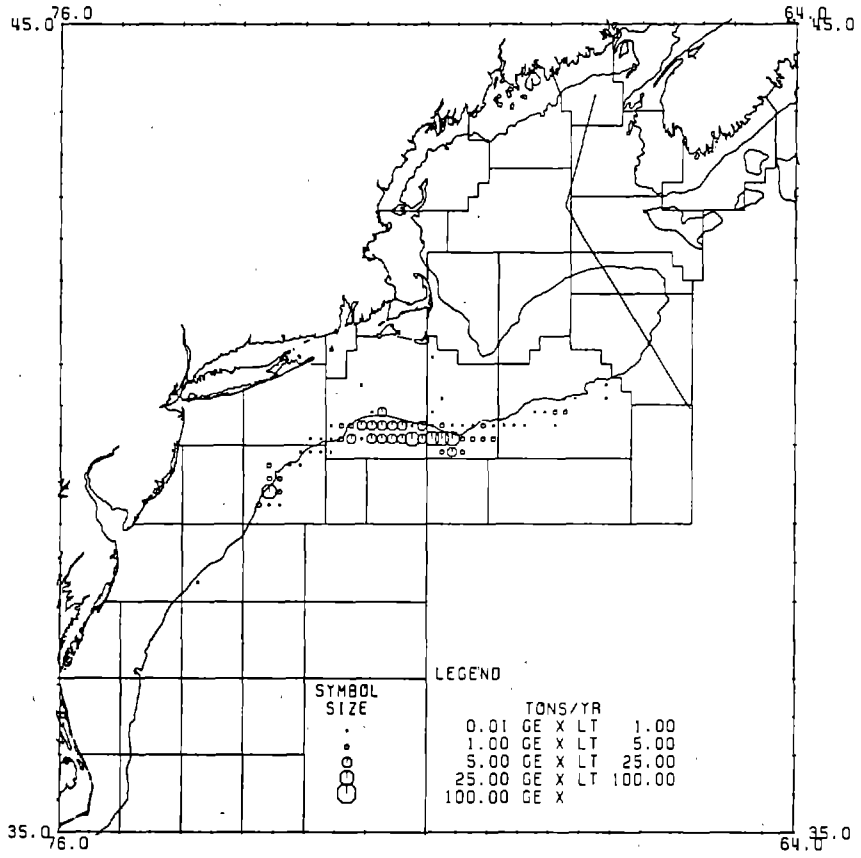


Figure W33-1. Tilefish (*Lopholatilus chamaeleonticeps*) commercial weighout landings distributions -- first quarter.

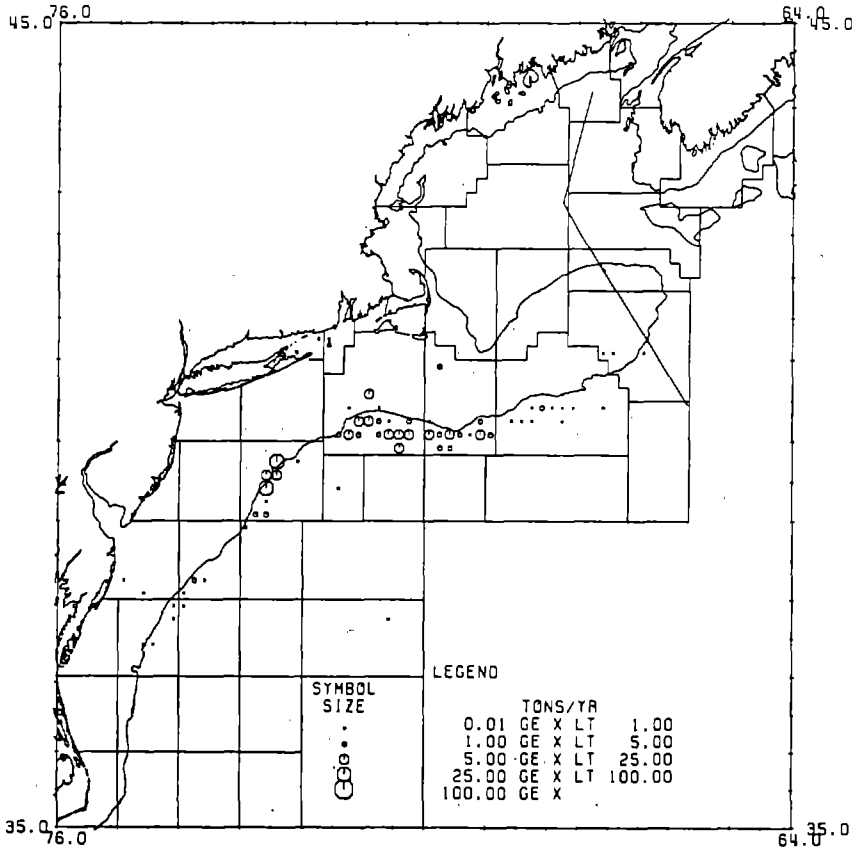


Figure W33-2. Tilefish (*Lopholatilus chamaeleonticeps*) commercial weighout landings distributions -- second quarter.

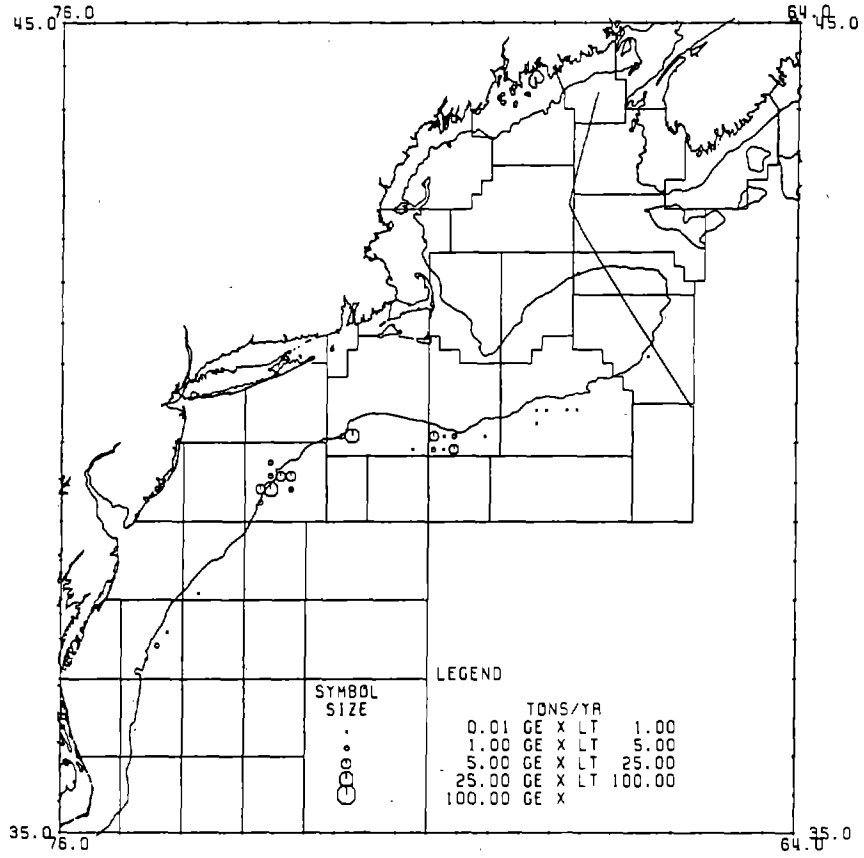


Figure W33-3. Tilefish (*Lopholatilus chamaeleonticeps*) commercial weighout landings distributions -- third quarter.

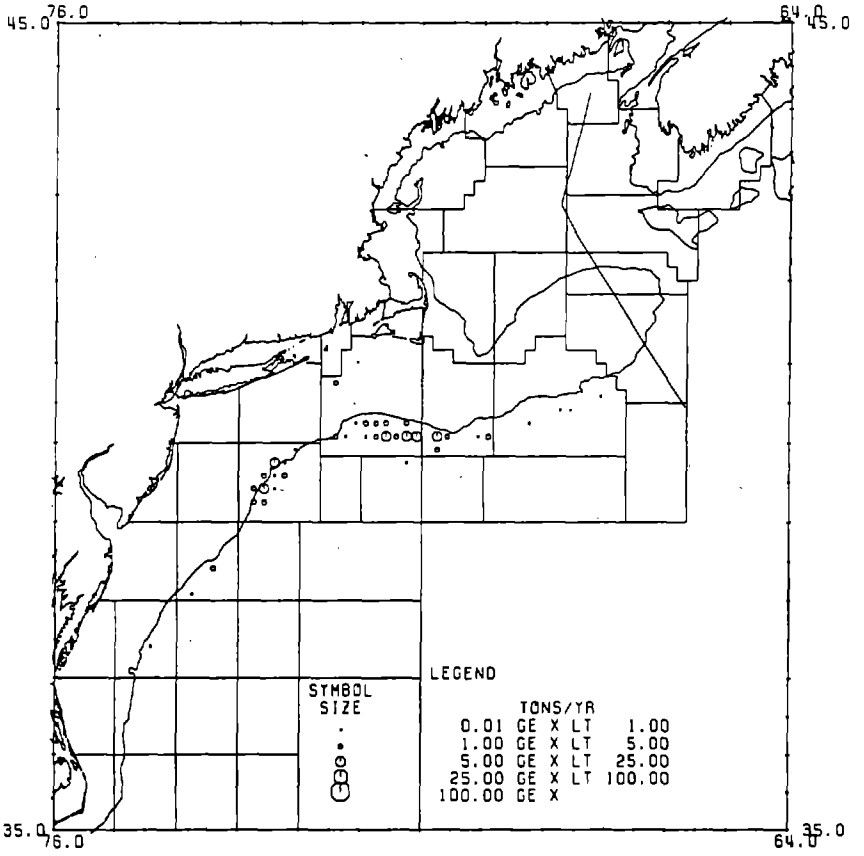


Figure W33-4. Tilefish (*Lopholatilus chamaeleonticeps*) commercial weighout landings distributions -- fourth quarter.

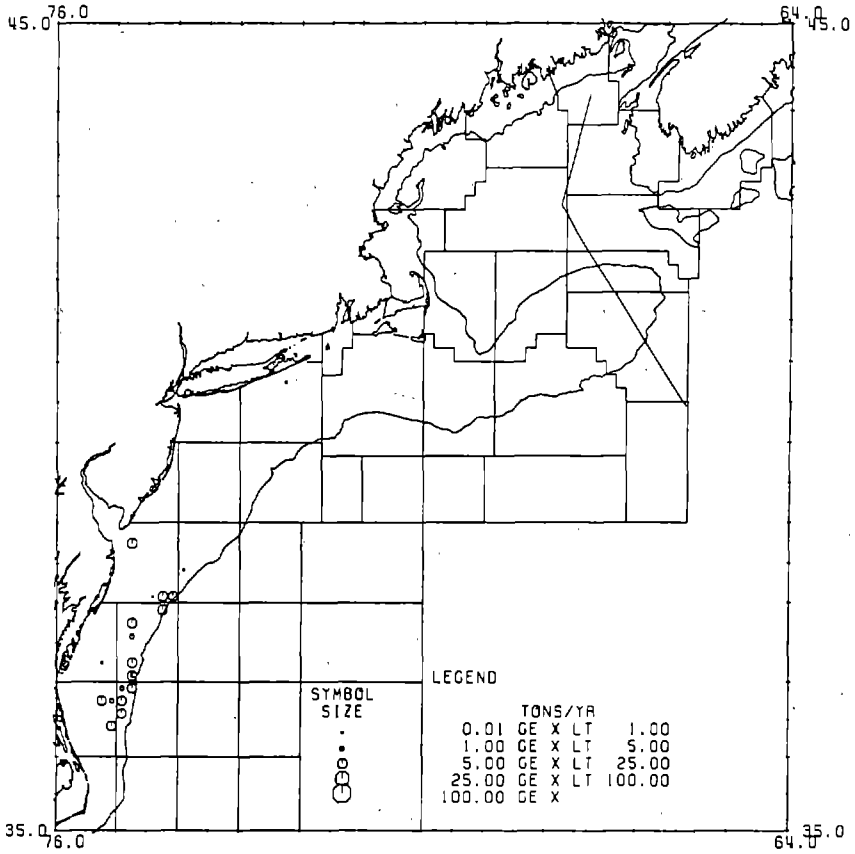


Figure W34-1. Spiny dogfish (*Squalus acanthias*) commercial weighout landings distributions -- first quarter.

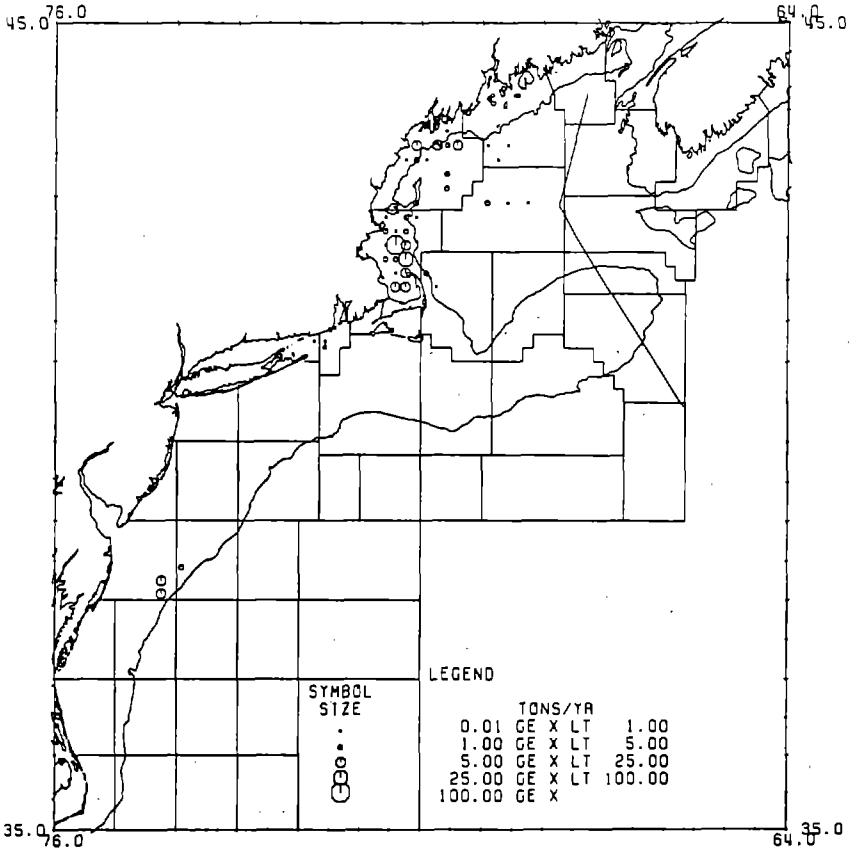


Figure W34-2. Spiny dogfish (*Squalus acanthias*) commercial weighout landings distributions -- second quarter.

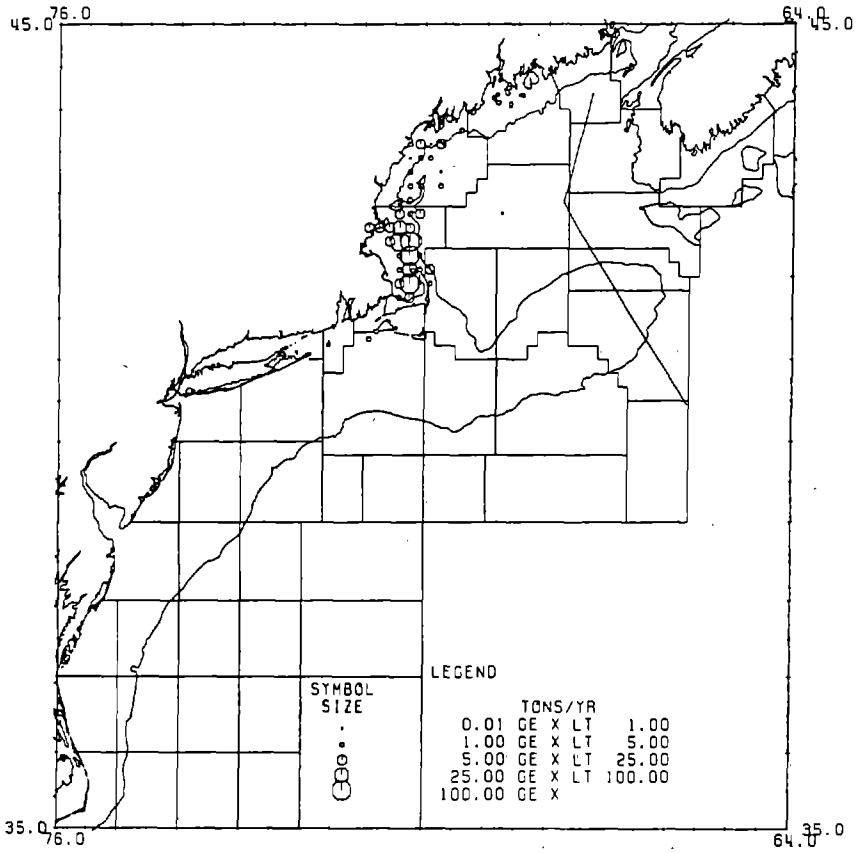


Figure W34-3. Spiny dogfish (*Squalus acanthias*) commercial weighout landings distributions -- third quarter.

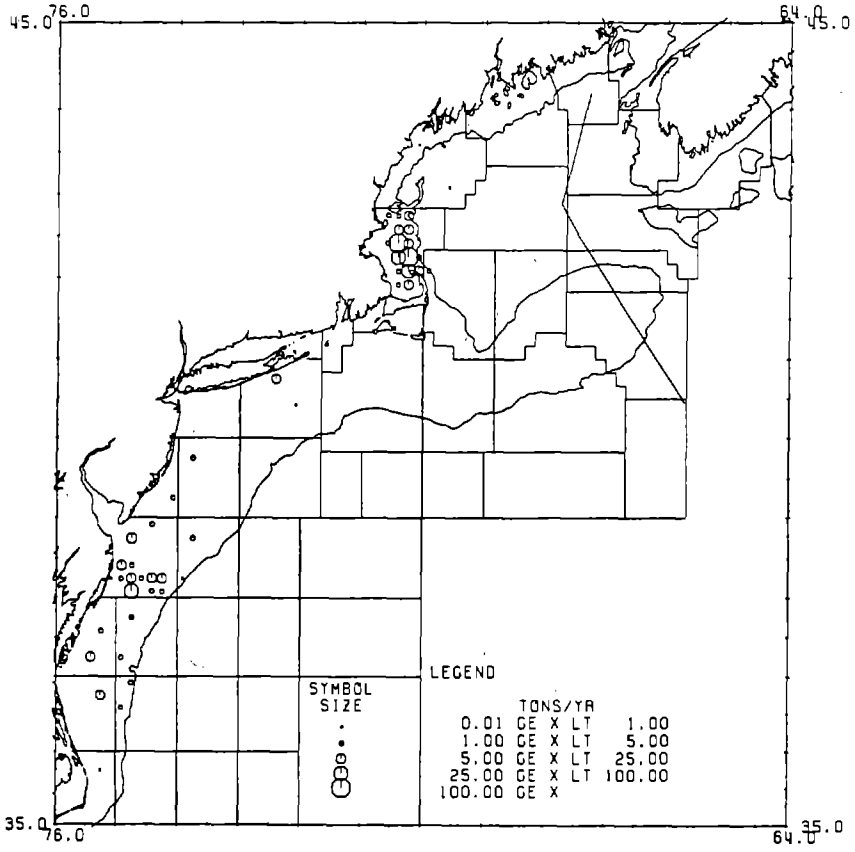


Figure W34-4. Spiny dogfish (*Squalus acanthias*) commercial weighout landings distributions -- fourth quarter.

Figure W35-1. Skates (*Raja* spp.) commercial weighout landings distributions -- first quarter.

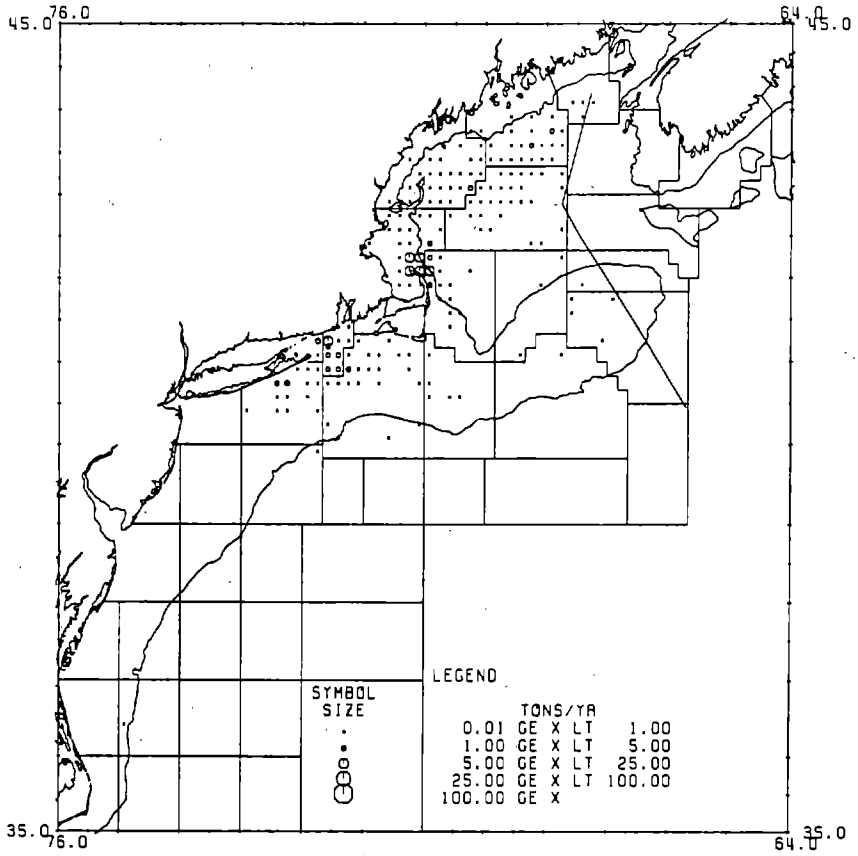
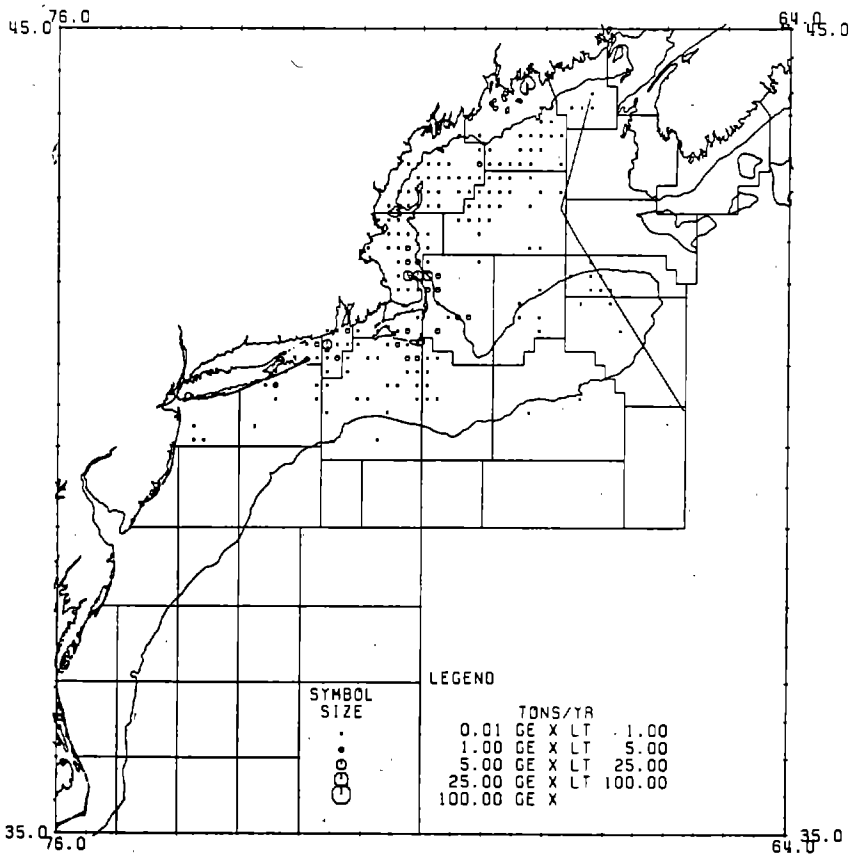


Figure W35-2. Skates (*Raja* spp.) commercial weighout landings distributions -- second quarter.



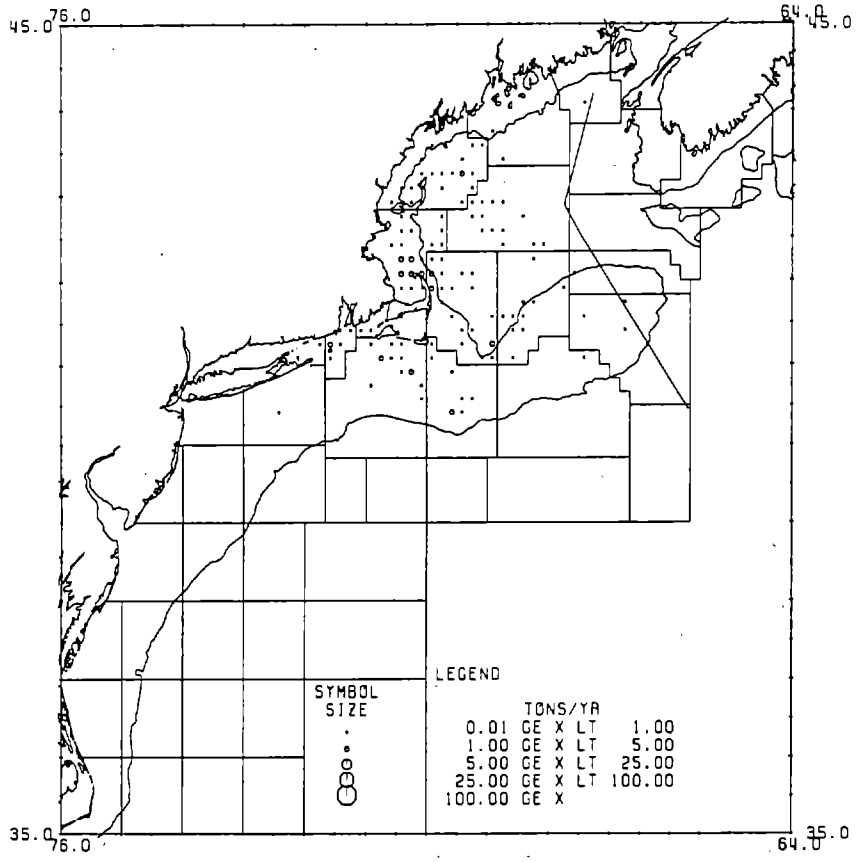


Figure W35-3. Skates (*Raja* spp.) commercial weighout landings distributions -- third quarter.

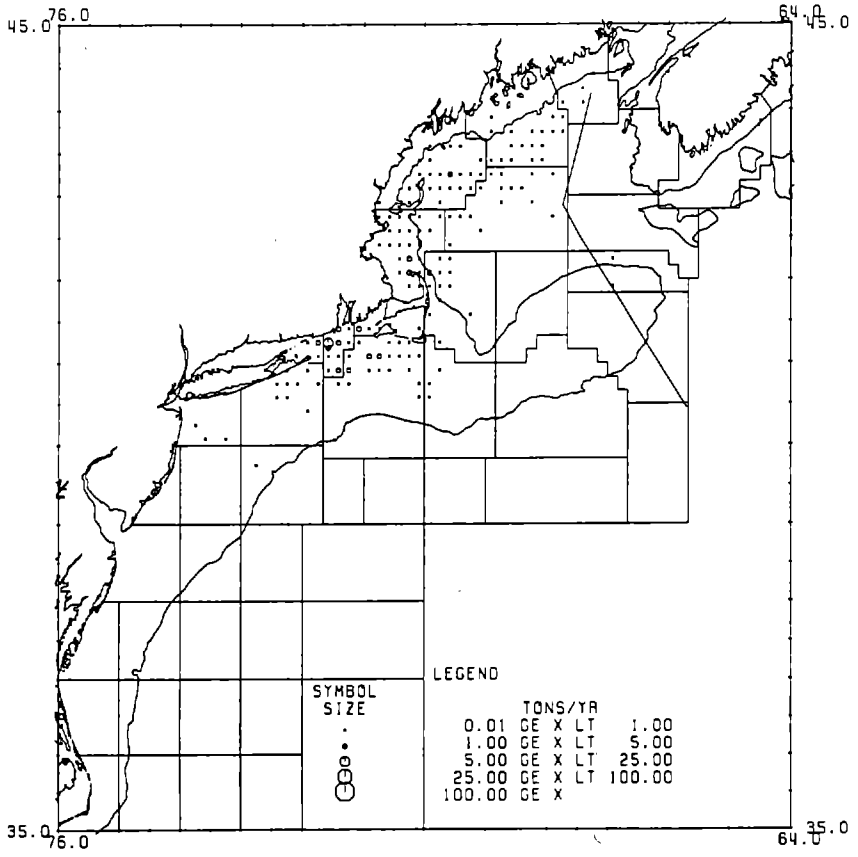


Figure W35-4. Skates (*Raja* spp.) commercial weighout landings distributions -- fourth quarter.

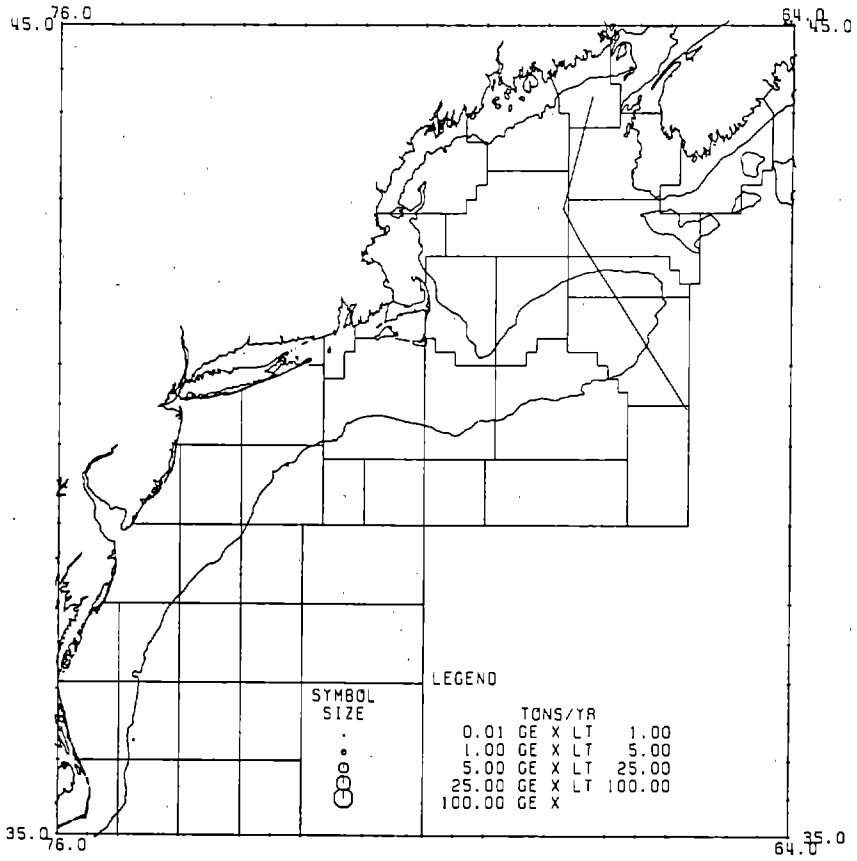


Figure W36-1. Northern shortfin squid (*Illex illecebrosus*) commercial weighout landings distributions -- first quarter.

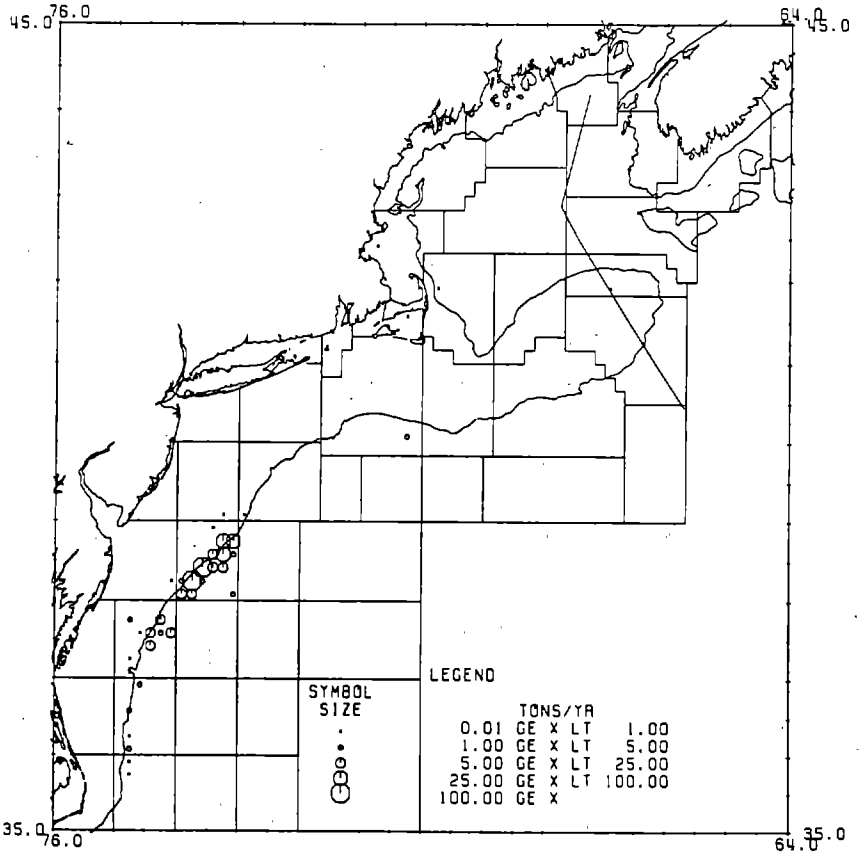


Figure W36-2. Northern shortfin squid (*Illex illecebrosus*) commercial weighout landings distributions -- second quarter.

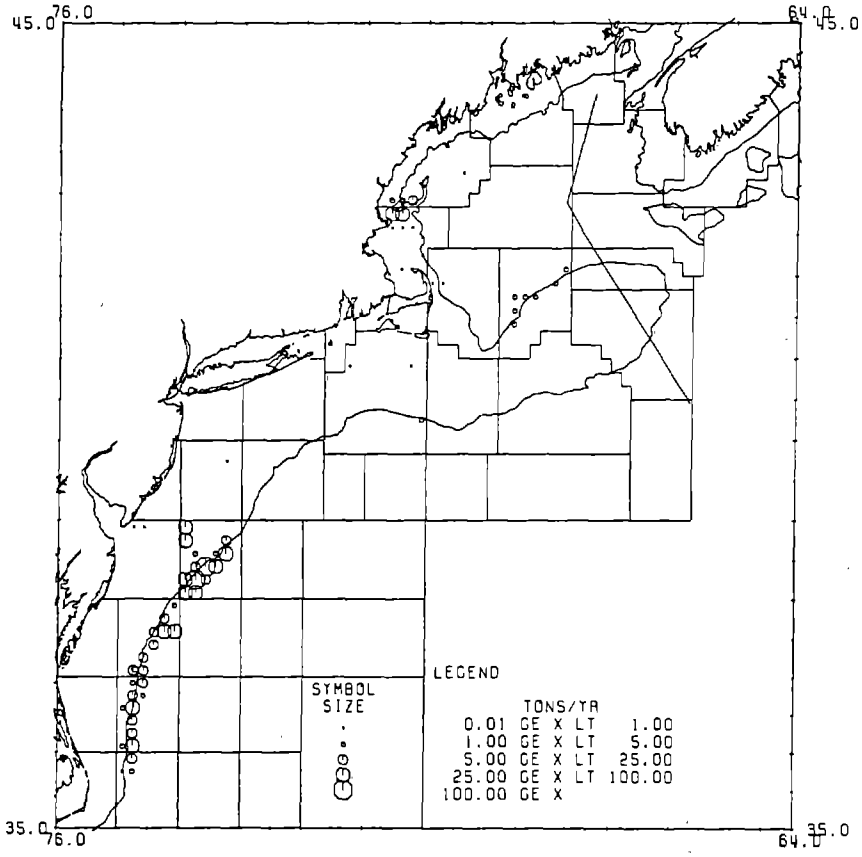


Figure W36-3. Northern shortfin squid (*Illex illecebrosus*) commercial weighout landings distributions -- third quarter.

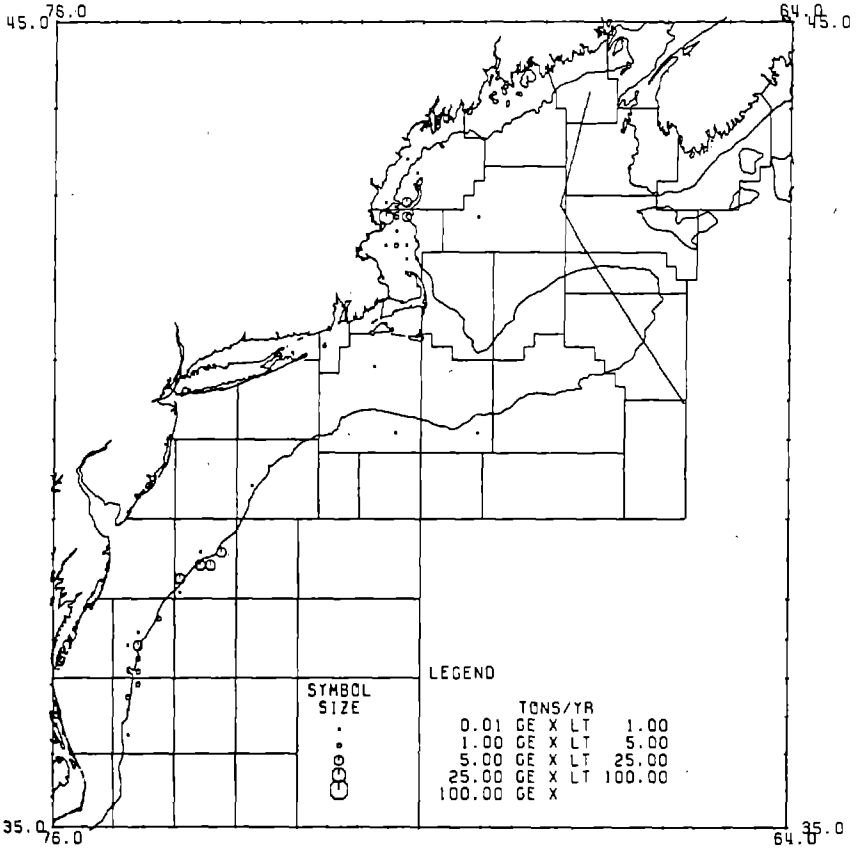


Figure W36-4. Northern shortfin squid (*Illex illecebrosus*) commercial weighout landings distributions -- fourth quarter.

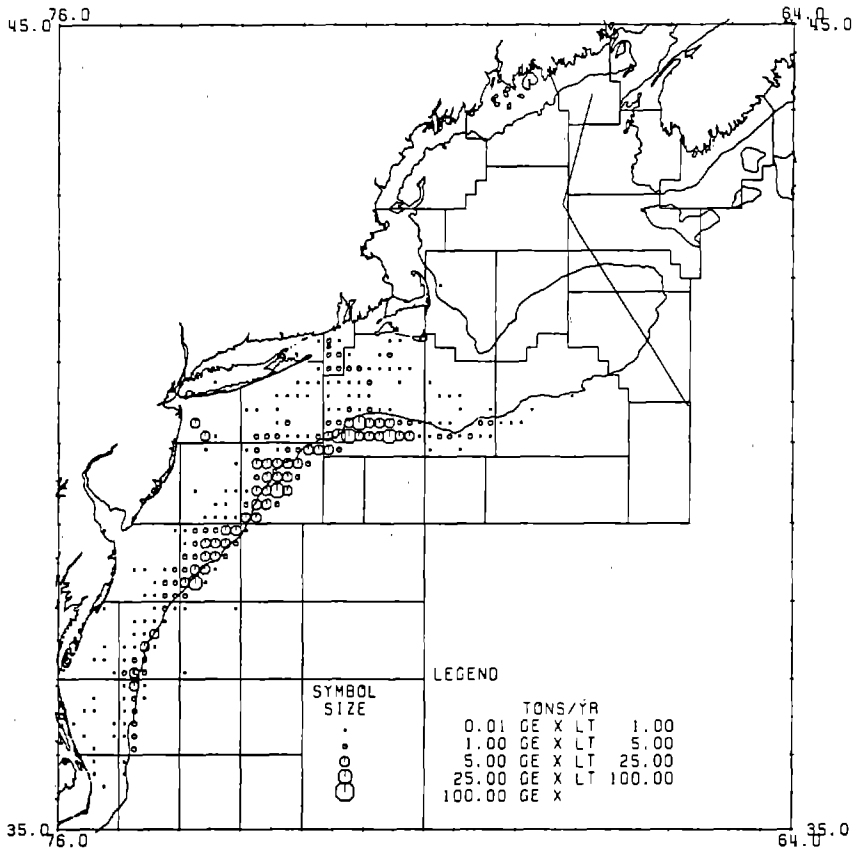


Figure W37-1. Longfin squid (*Loligo pealei*) commercial weighout landings distributions -- first quarter.

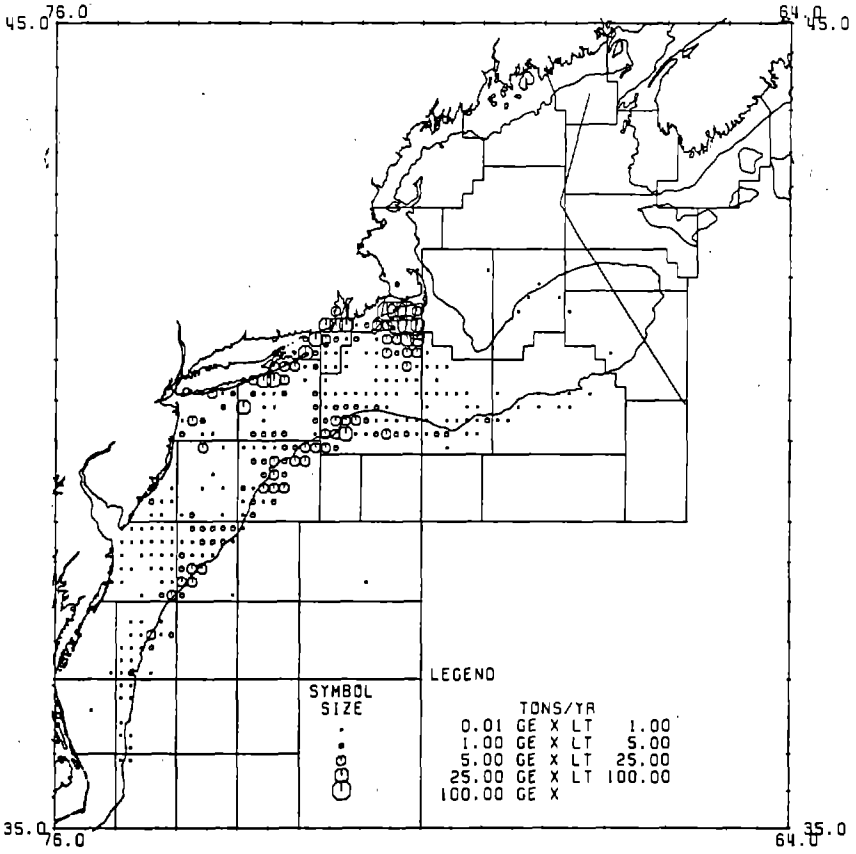


Figure W37-2. Longfin squid (*Loligo pealei*) commercial weighout landings distributions -- second quarter.

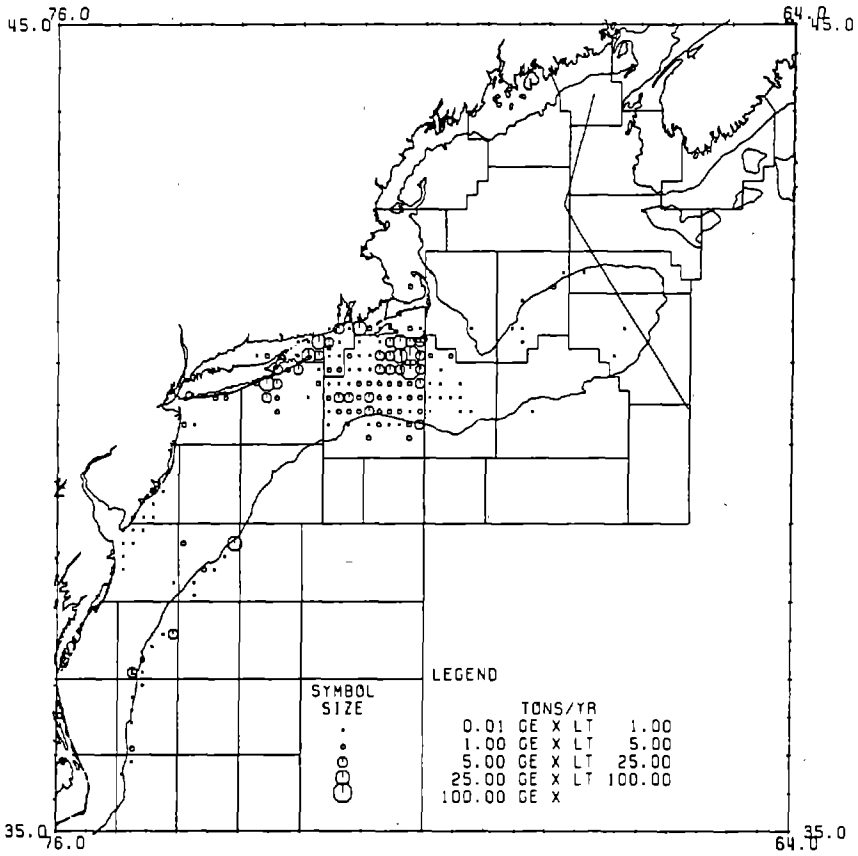


Figure W37-3. Longfin squid (*Loligo pealei*) commercial weighout landings distributions -- third quarter.

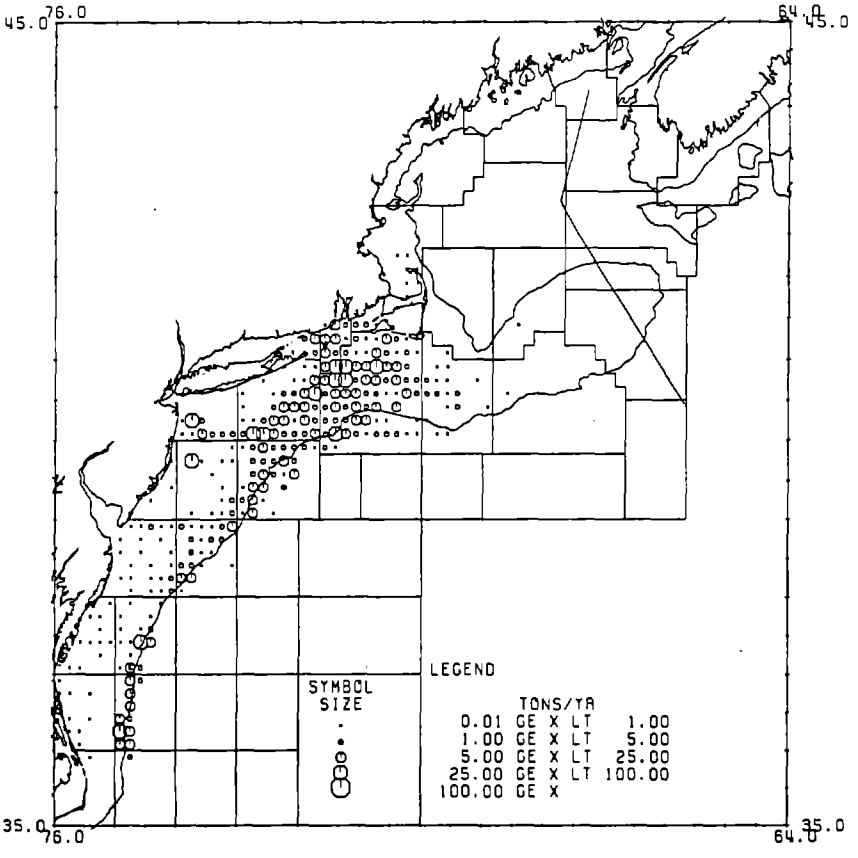


Figure W37-4. Longfin squid (*Loligo pealei*) commercial weighout landings distributions -- fourth quarter.

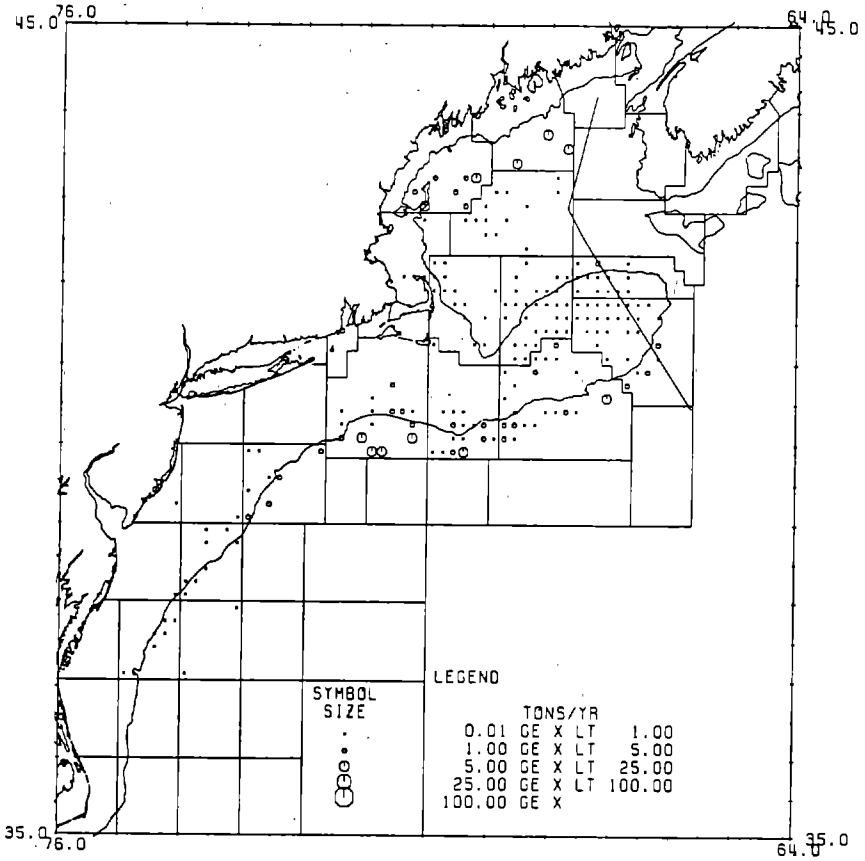


Figure W38-1. American lobster (*Homarus americanus*) commercial weighout landings distributions -- first quarter.

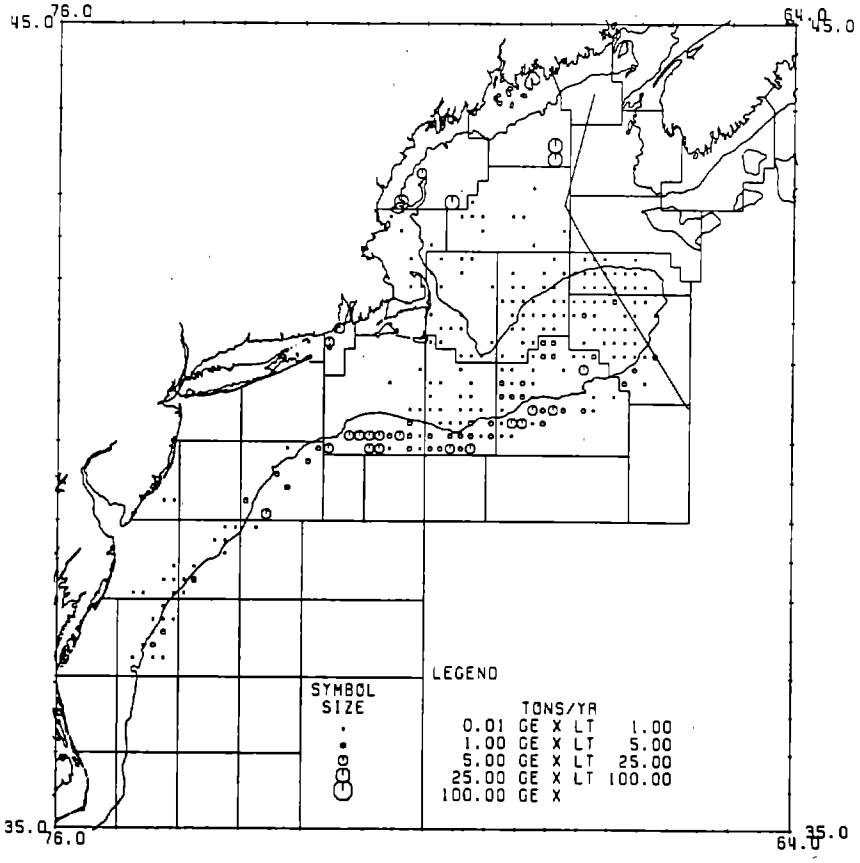


Figure W38-2. American lobster (*Homarus americanus*) commercial weighout landings distributions -- second quarter.

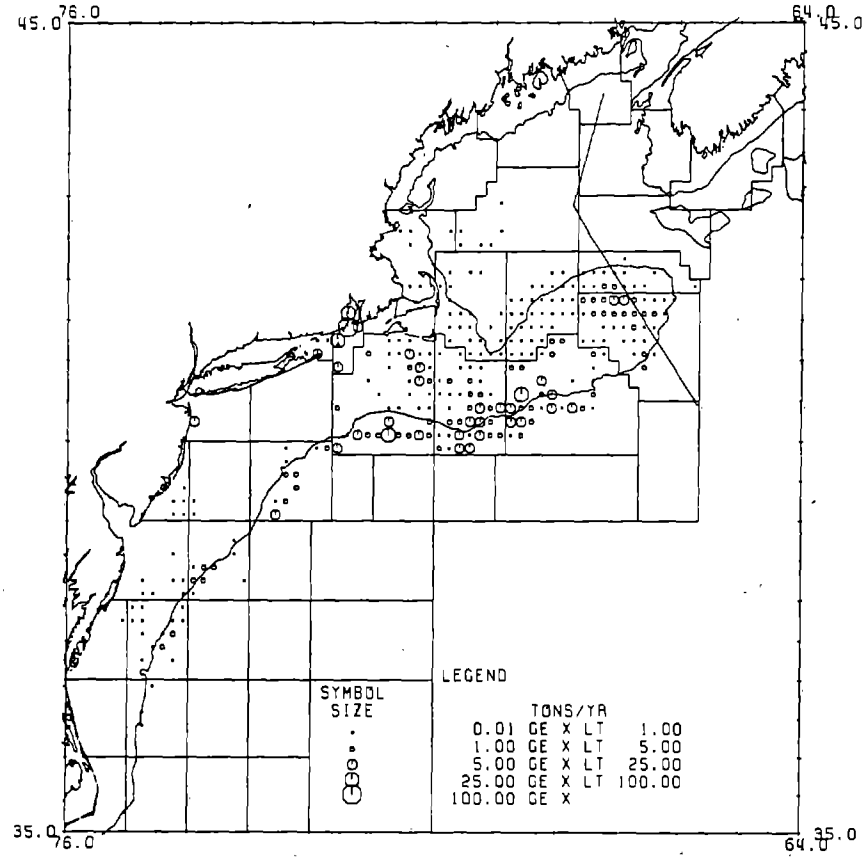


Figure W38-3. American lobster (*Homarus americanus*) commercial weighout landings distributions -- third quarter.

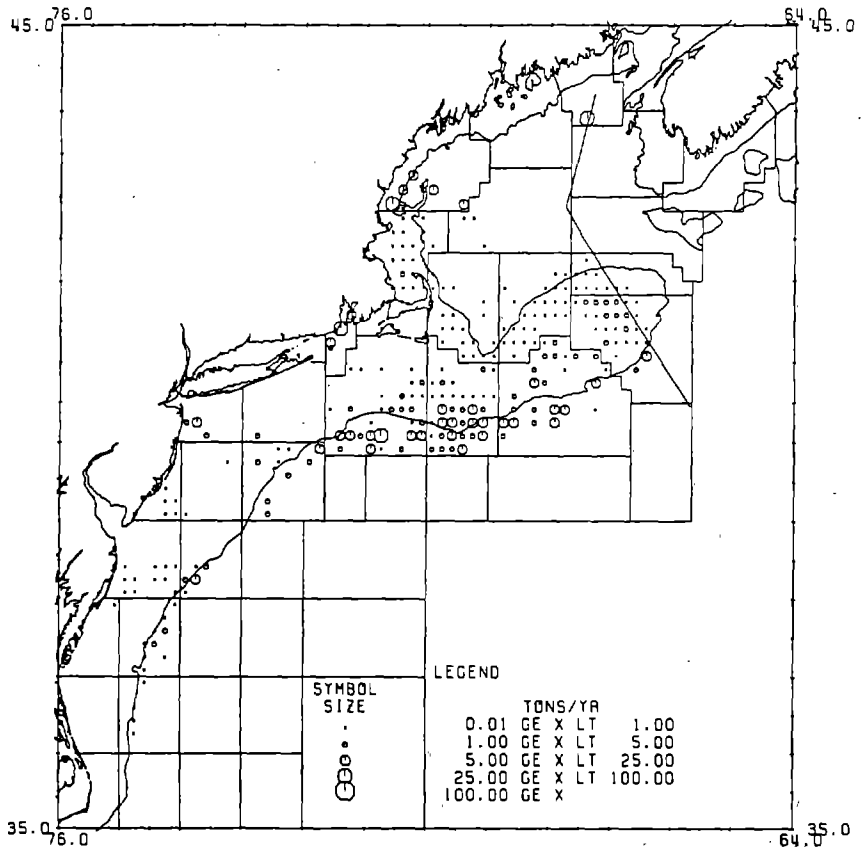


Figure W38-4. American lobster (*Homarus americanus*) commercial weighout landings distributions -- fourth quarter.

Figure W39-1. Blue crab (*Callinectes sapidus*) commercial weighout landings distributions -- first quarter.

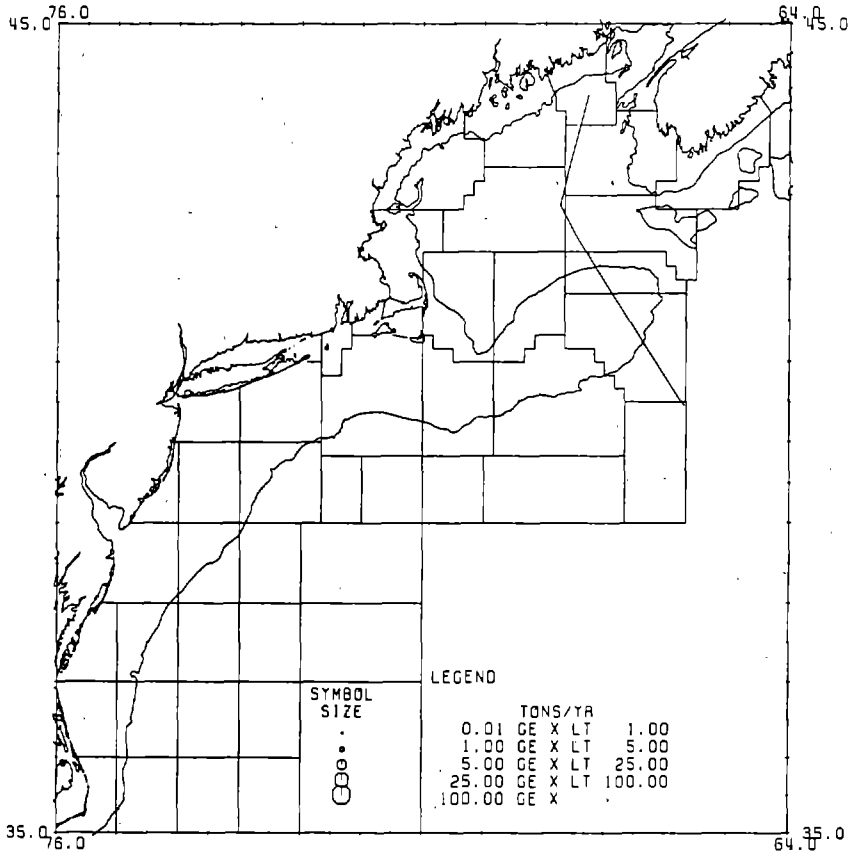
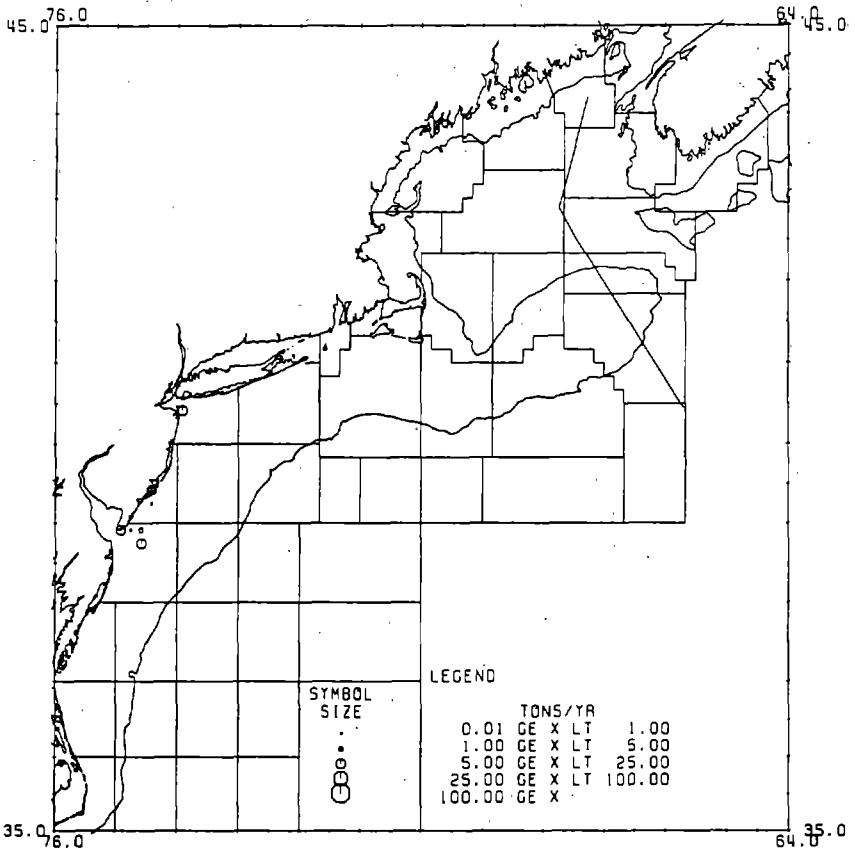


Figure W39-2. Blue crab (*Callinectes sapidus*) commercial weighout landings distributions -- second quarter.



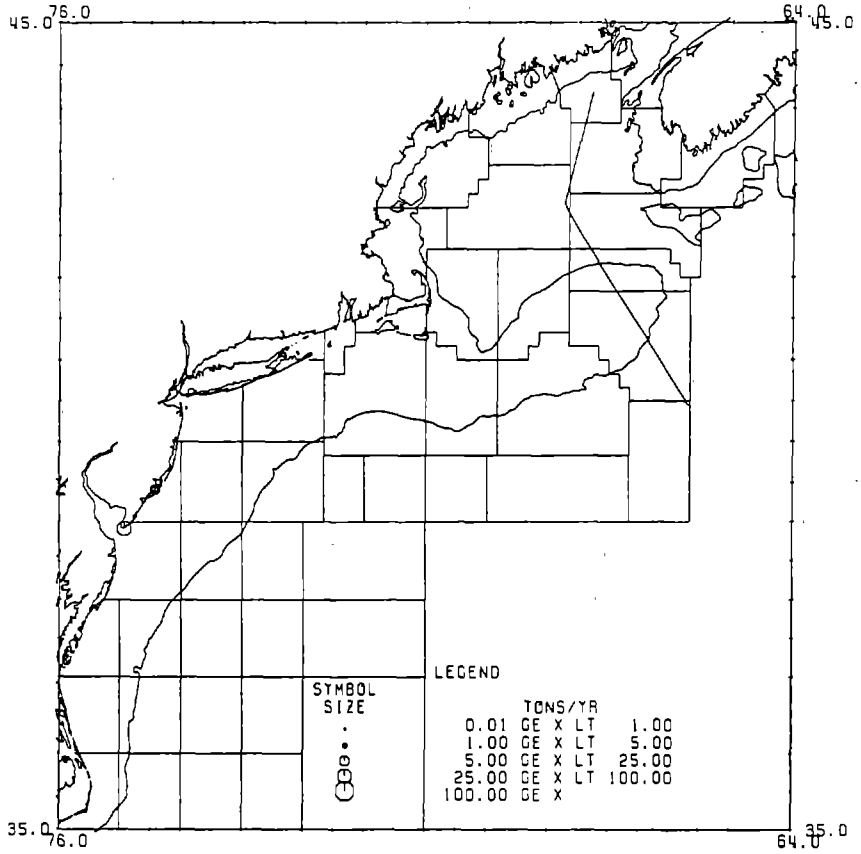


Figure W39-3. Blue crab (*Callinectes sapidus*) commercial weighout landings distributions -- third quarter.

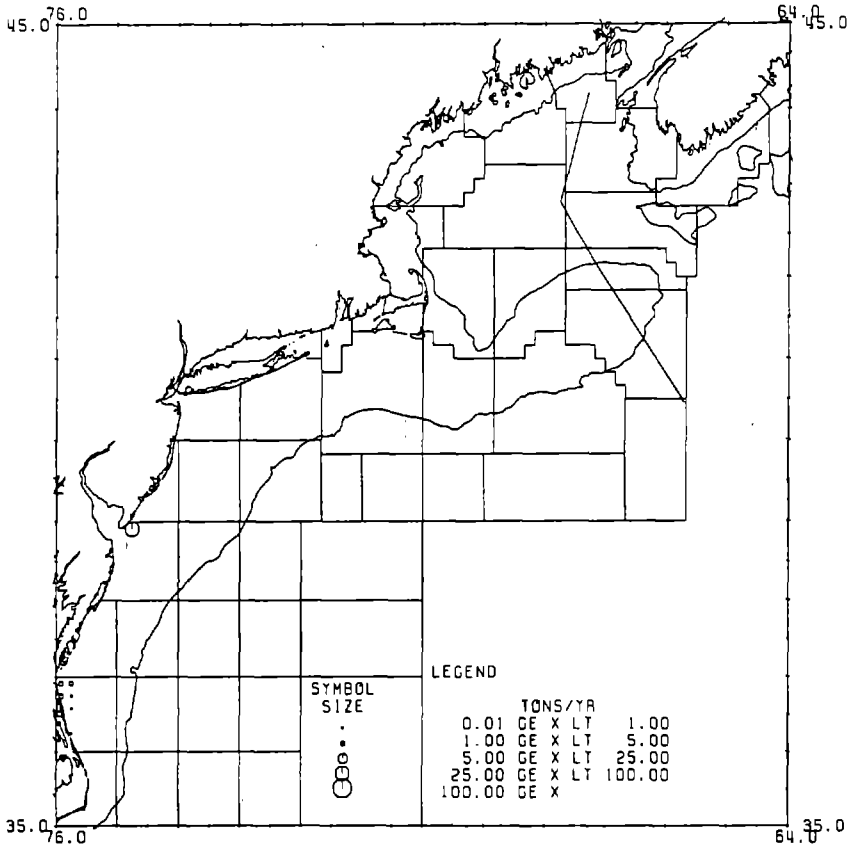


Figure W39-4. Blue crab (*Callinectes sapidus*) commercial weighout landings distributions -- fourth quarter.

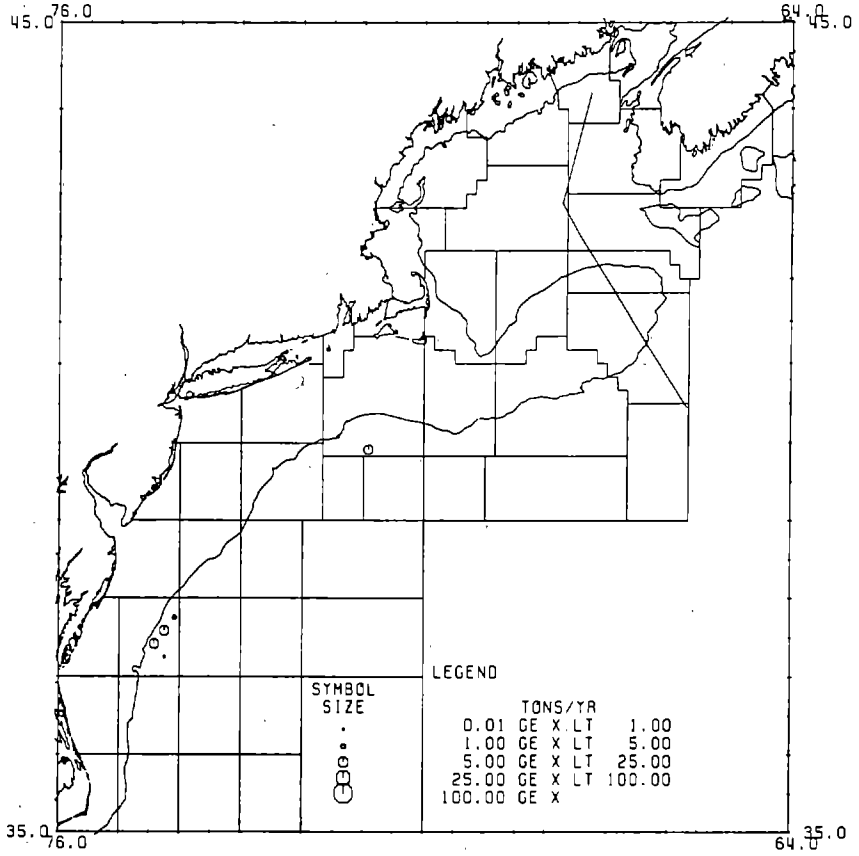


Figure W40-1. Red deepsea crab (*Geryon quinquedens*) commercial weighout landings distributions -- first quarter.

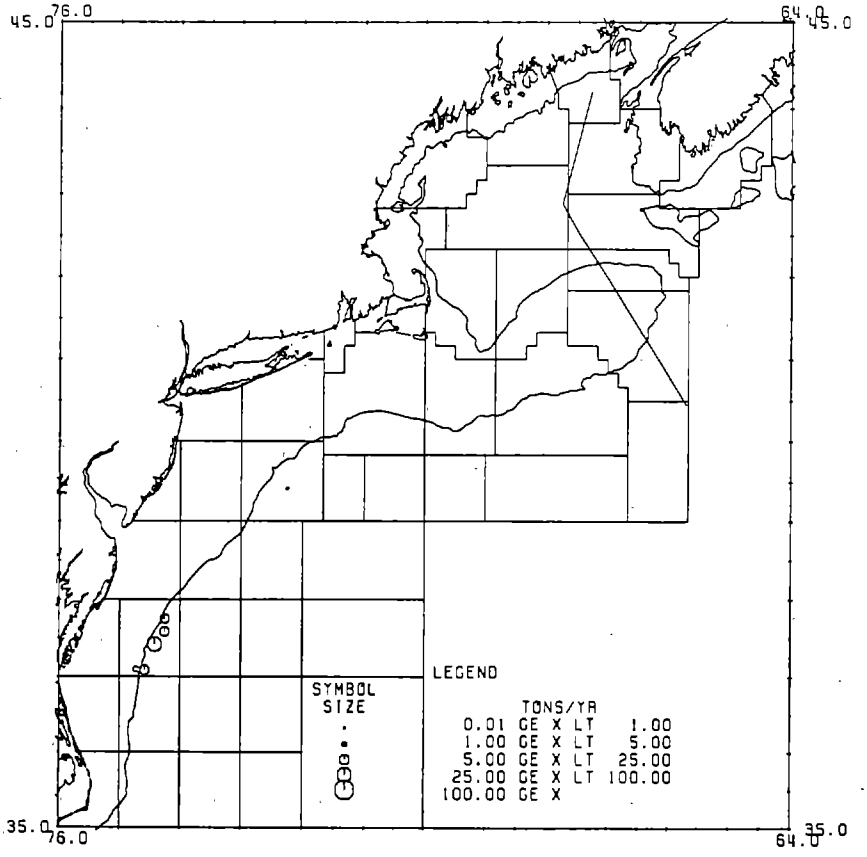


Figure W40-2. Red deepsea crab (*Geryon quinquedens*) commercial weighout landings distributions -- second quarter.

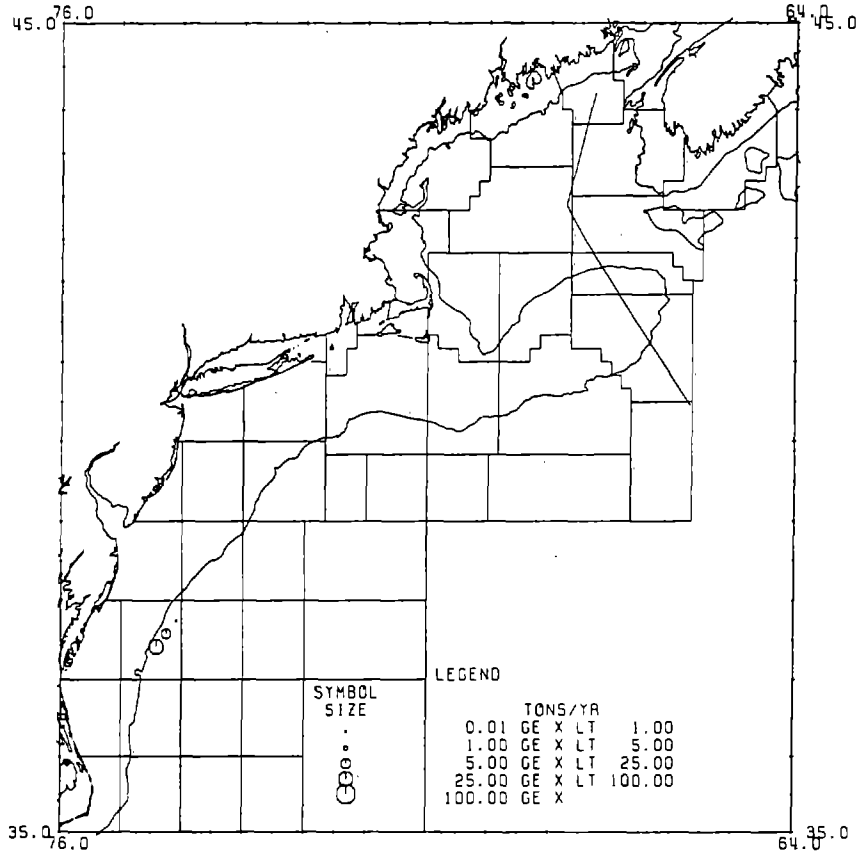


Figure W40-3. Red deepsea crab (*Geryon quinquedens*) commercial weighout landings distributions -- third quarter.

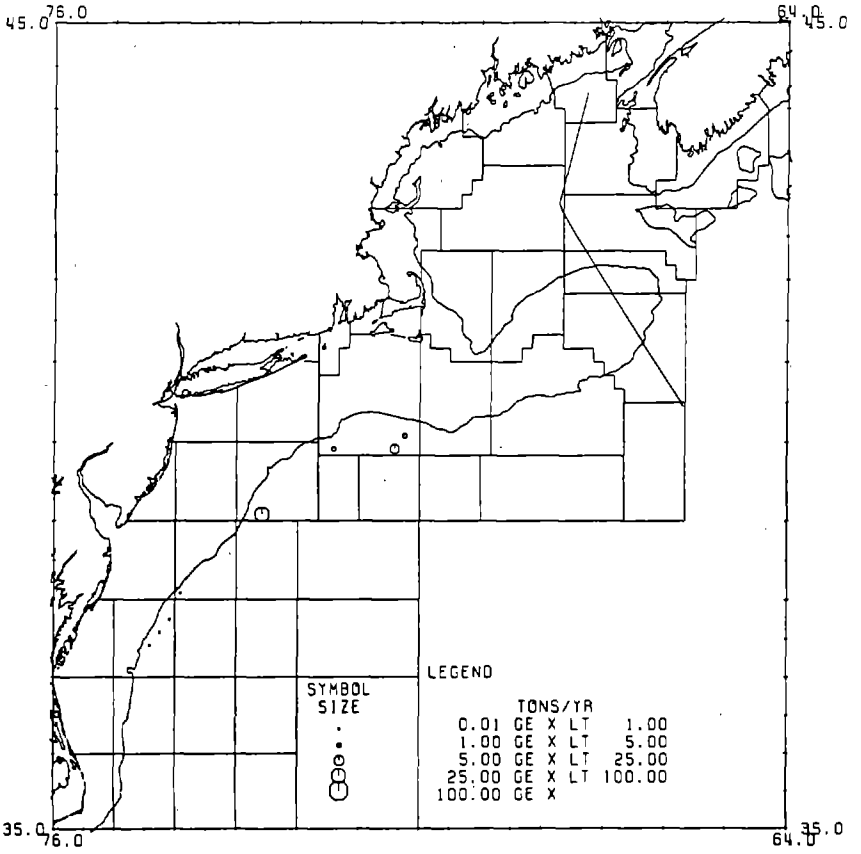


Figure W40-4. Red deepsea crab (*Geryon quinquedens*) commercial weighout landings distributions -- fourth quarter.

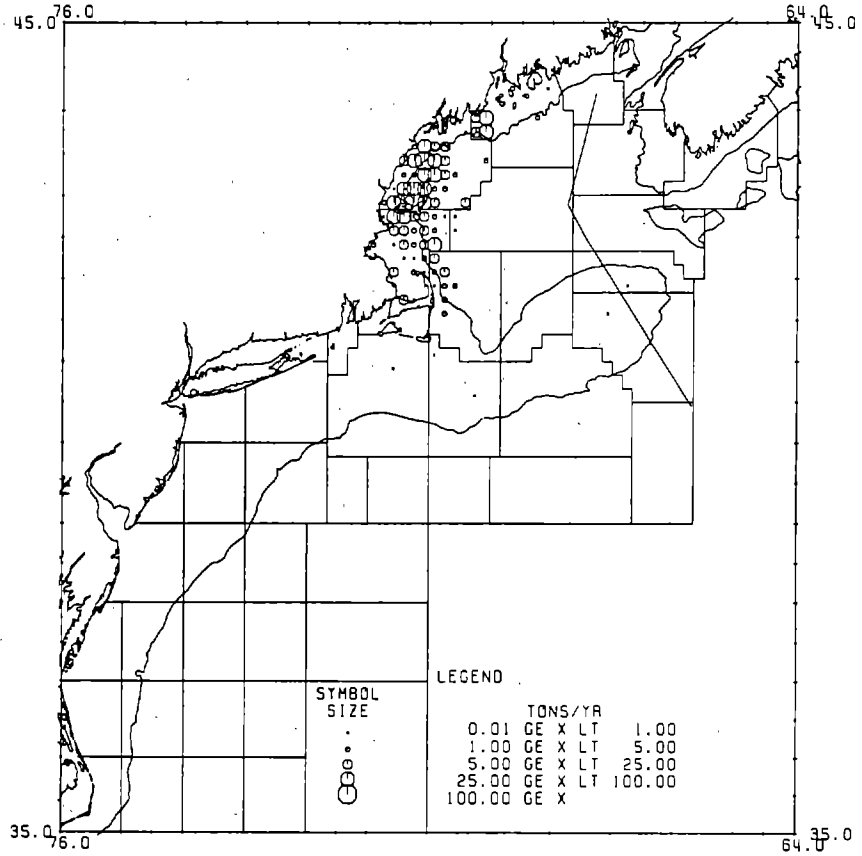


Figure W41-1. Northern shrimp (*Pandalus borealis*) commercial weighout landings distributions -- first quarter.

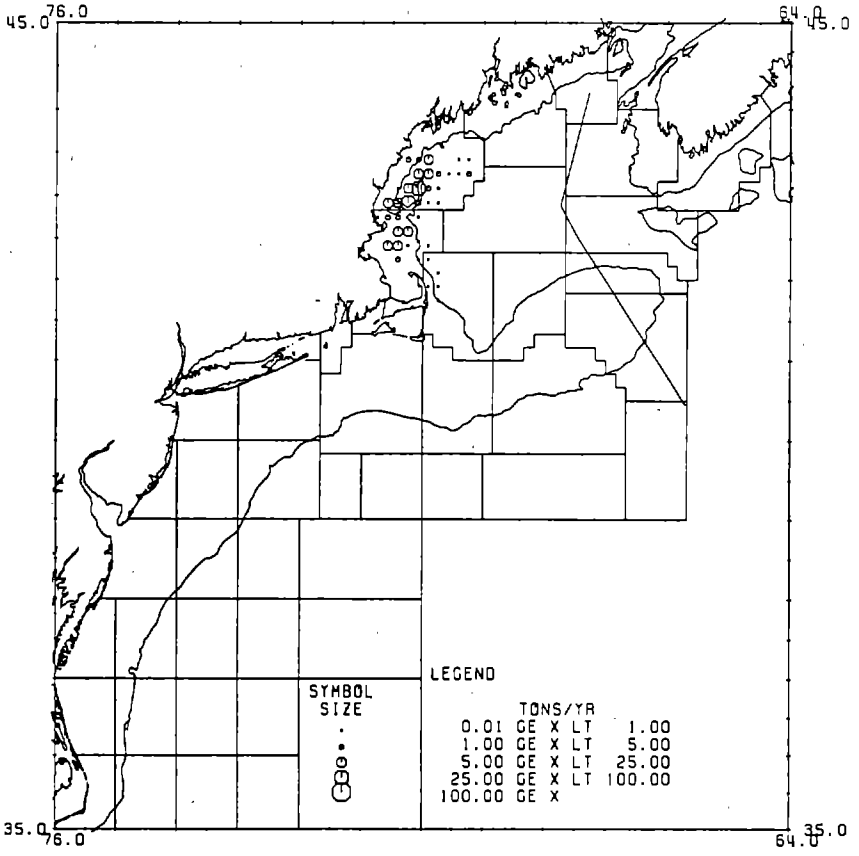


Figure W41-2. Northern shrimp (*Pandalus borealis*) commercial weighout landings distributions -- second quarter.

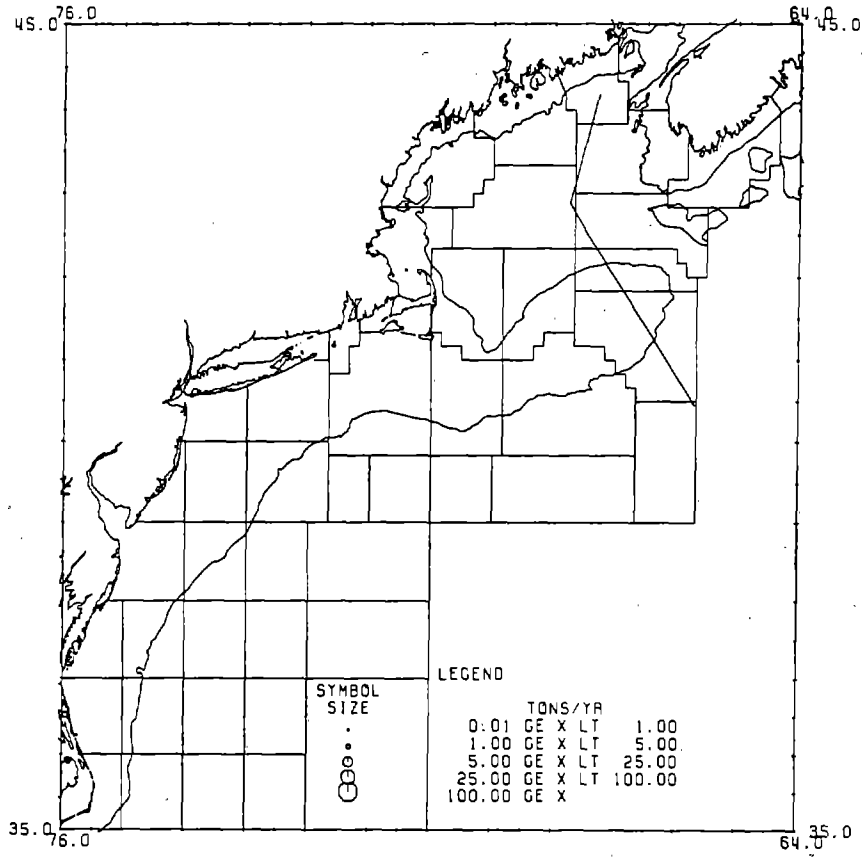


Figure W41-3. Northern shrimp (*Pandalus borealis*) commercial weighout landings distributions -- third quarter.

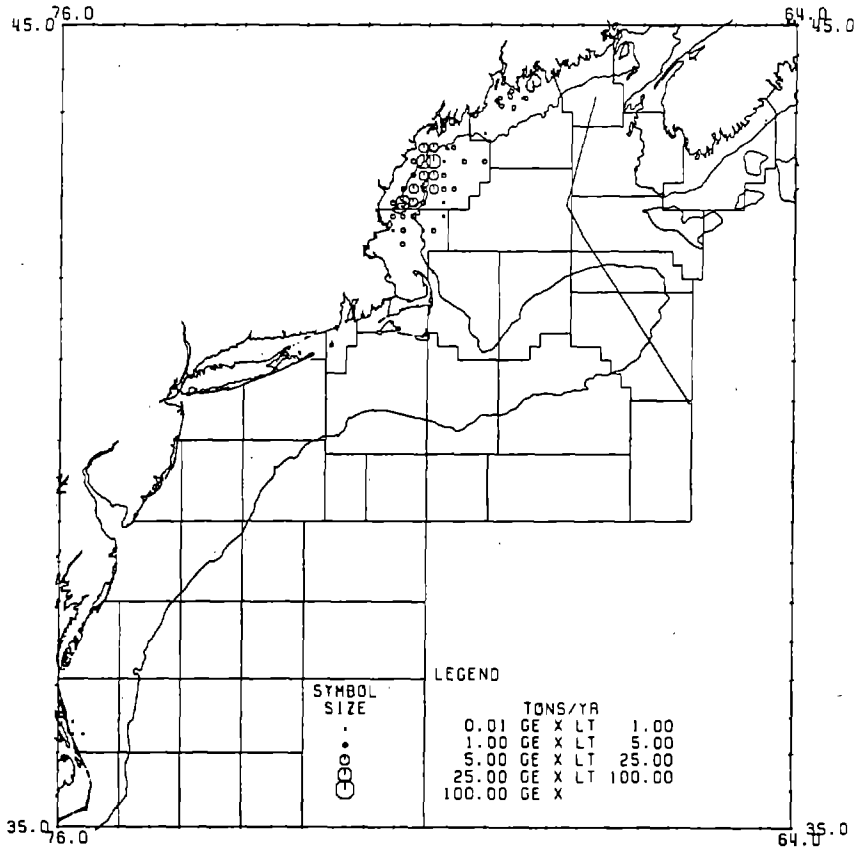


Figure W41-4. Northern shrimp (*Pandalus borealis*) commercial weighout landings distributions -- fourth quarter.

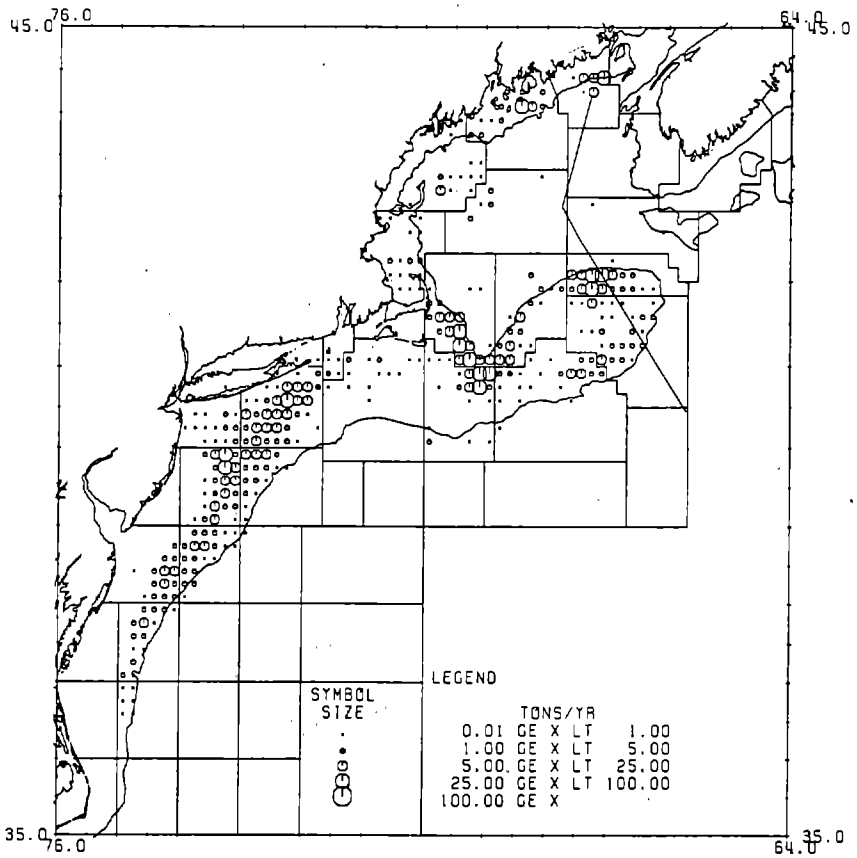


Figure W42-1. Sea scallop (*Placopecten magellanicus*) commercial weighout landings distributions -- first quarter.

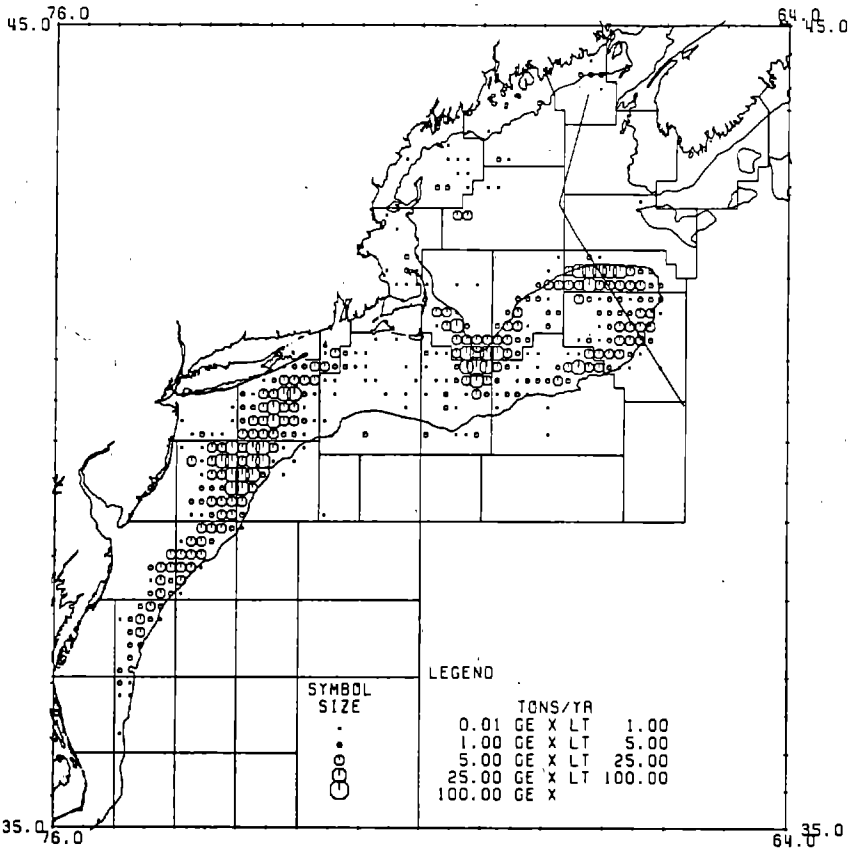


Figure W42-2. Sea scallop (*Placopecten magellanicus*) commercial weighout landings distributions -- second quarter.

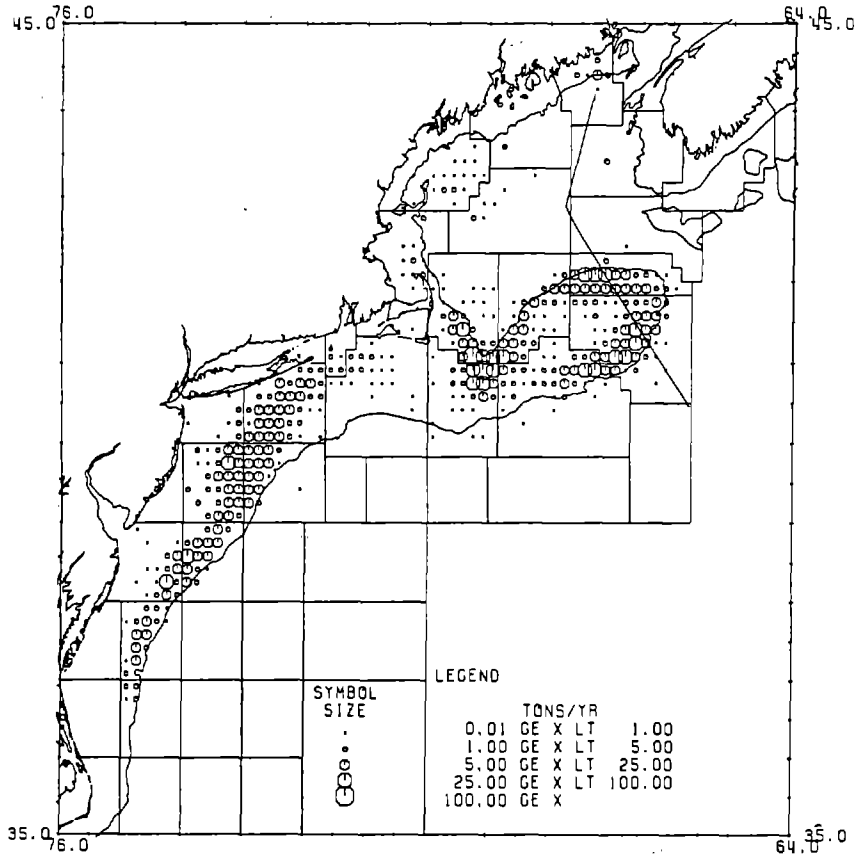


Figure W42-3. Sea scallop (*Placopecten magellanicus*) commercial weighout landings distributions -- third quarter.

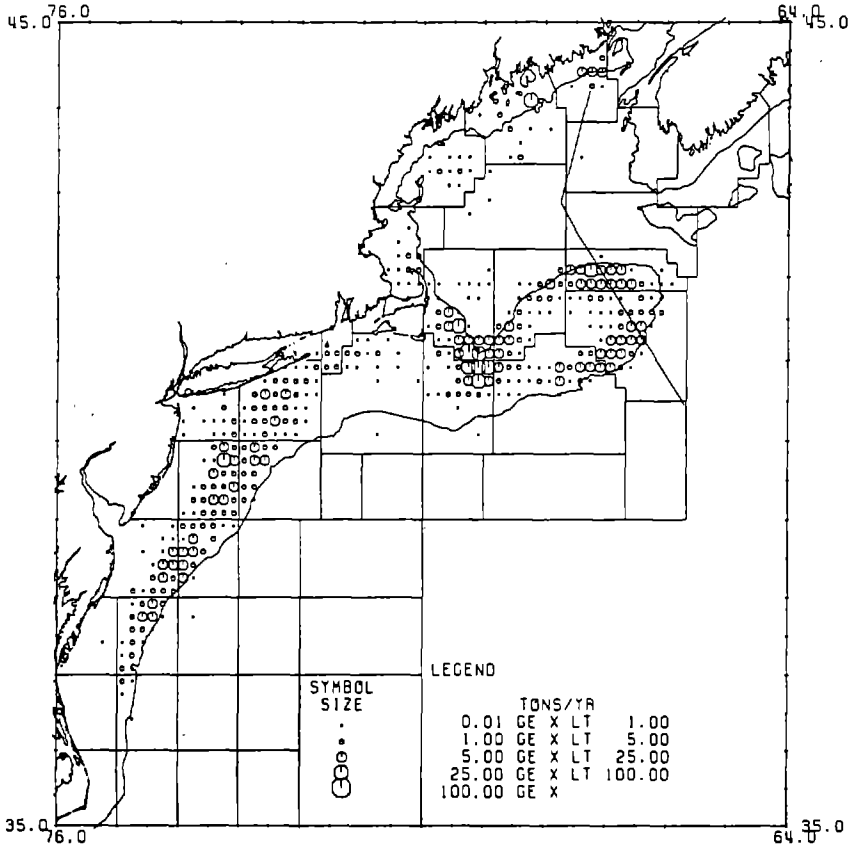


Figure W42-4. Sea scallop (*Placopecten magellanicus*) commercial weighout landings distributions -- fourth quarter.

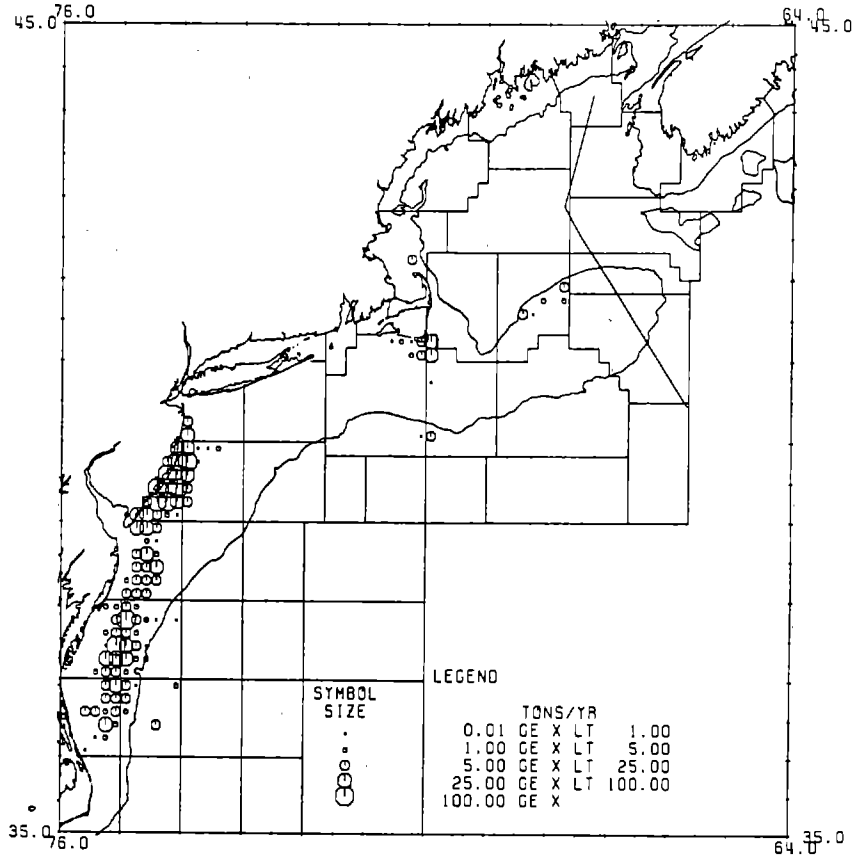


Figure W43-1. Atlantic surfclam (*Spisula solidissima*) commercial weighout landings distributions -- first quarter.

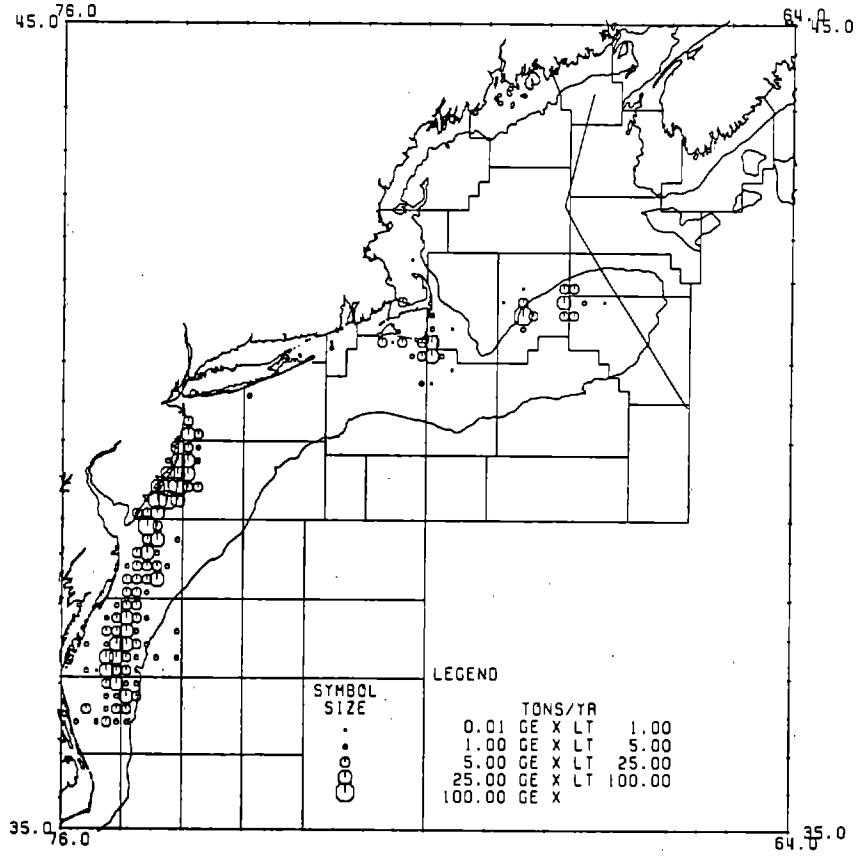


Figure W43-2. Atlantic surfclam (*Spisula solidissima*) commercial weighout landings distributions -- second quarter.

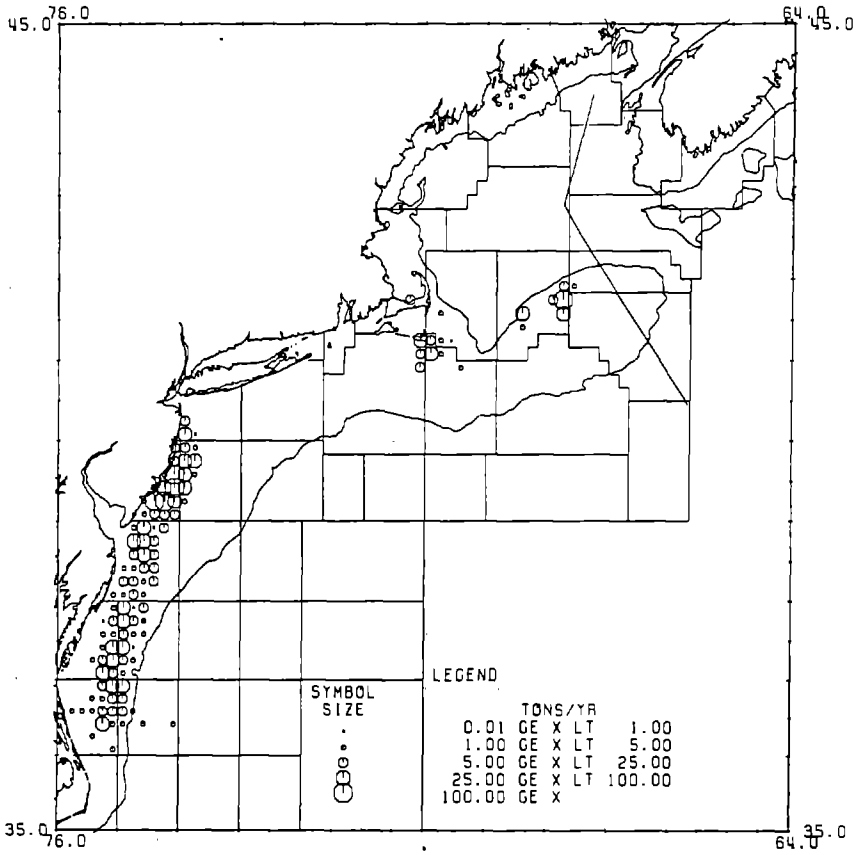


Figure W43-3. Atlantic surfclam (*Spisula solidissima*) commercial weighout landings distributions -- third quarter.

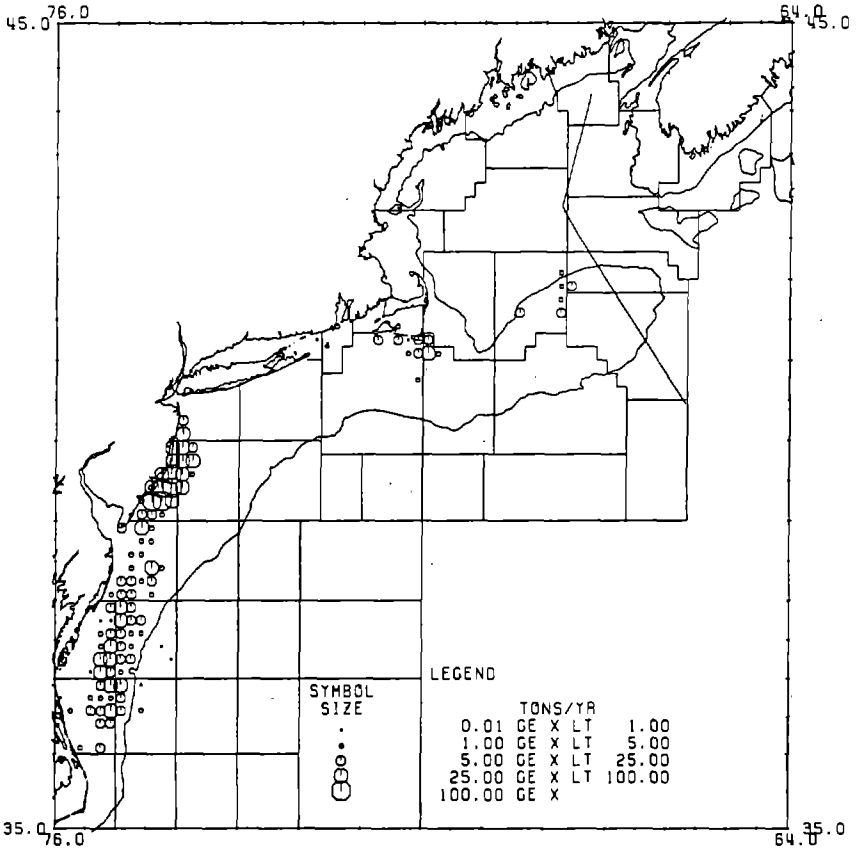


Figure W43-4. Atlantic surfclam (*Spisula solidissima*) commercial weighout landings distributions -- fourth quarter.

Figure W44-1. Ocean quahog (*Arctica islandica*) commercial weighout landings distributions -- first quarter.

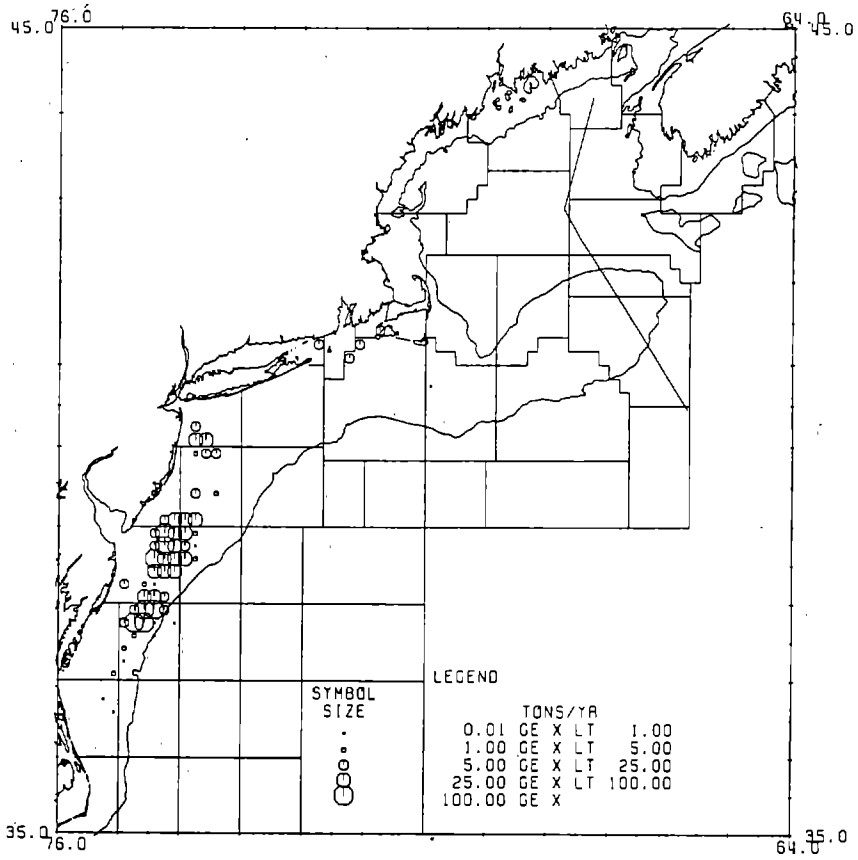
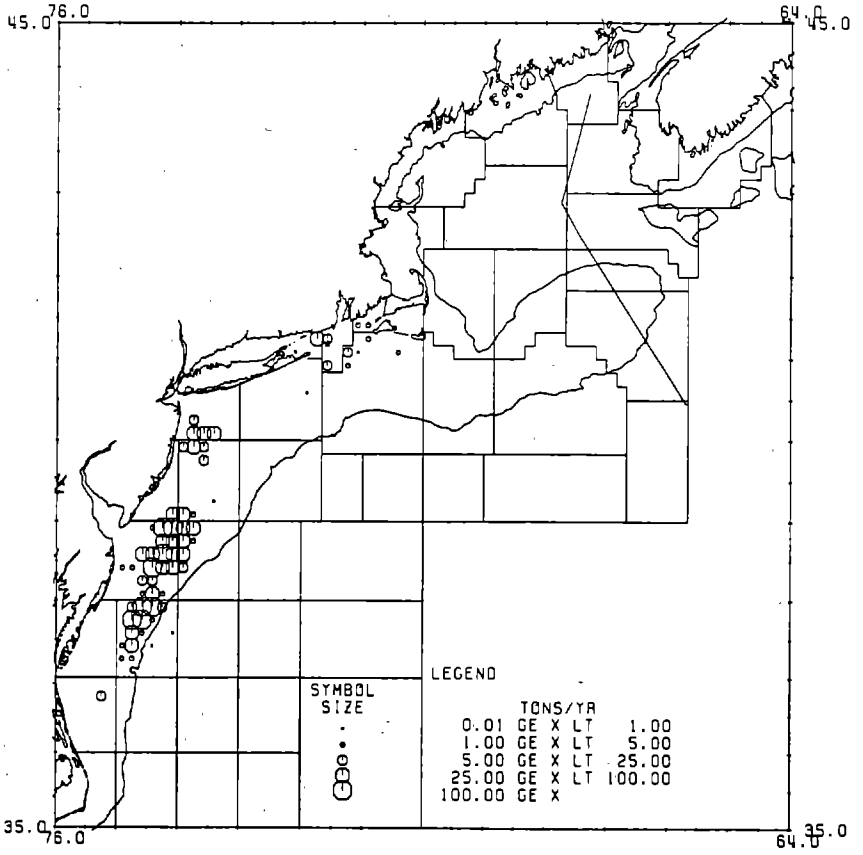


Figure W44-2. Ocean quahog (*Arctica islandica*) commercial weighout landings distributions -- second quarter.



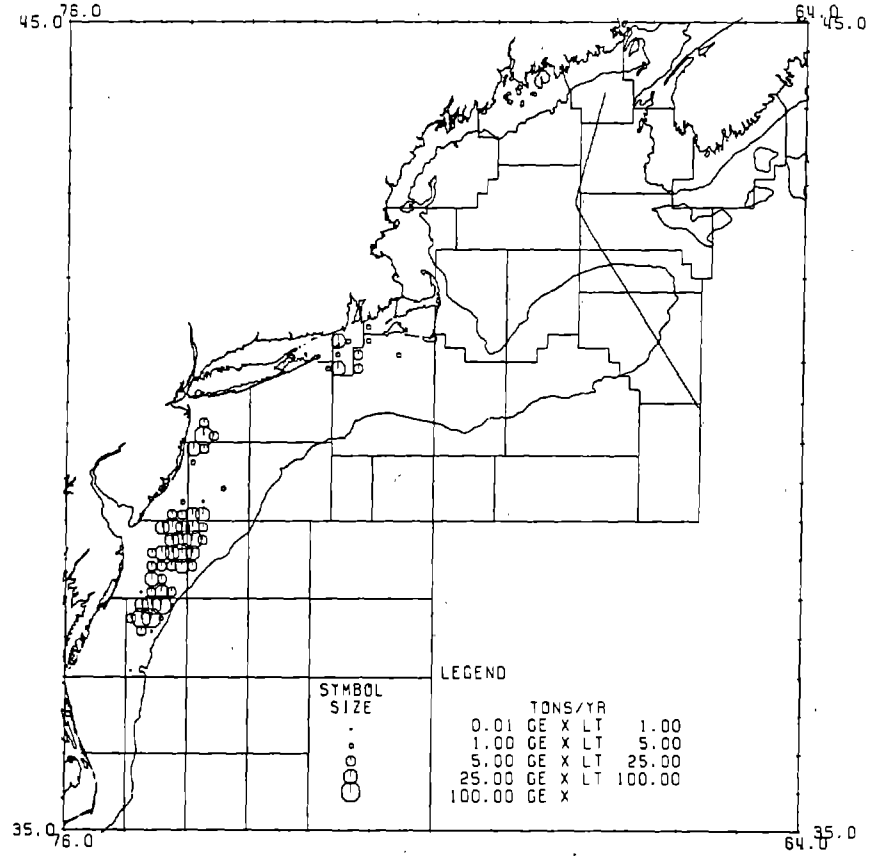


Figure W44-3. Ocean quahog (*Arctica islandica*) commercial weighout landings distributions -- third quarter.

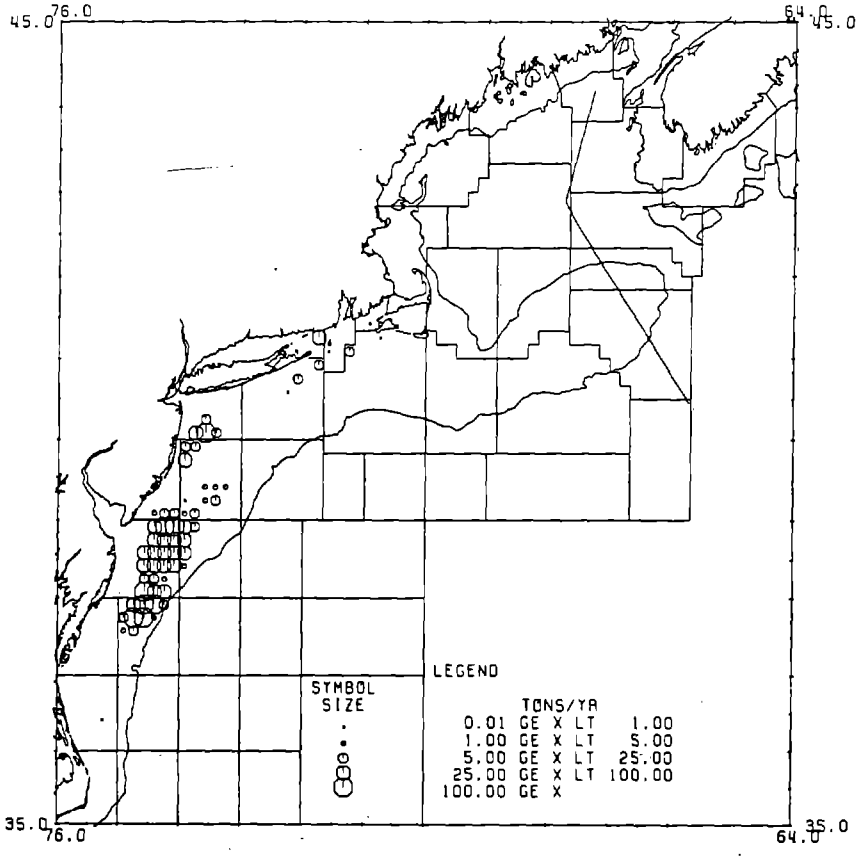


Figure W44-4. Ocean quahog (*Arctica islandica*) commercial weighout landings distributions -- fourth quarter.

Figure W45-1. Blue mussel (*Mytilus edulis*) commercial weighout landings distributions -- first quarter.

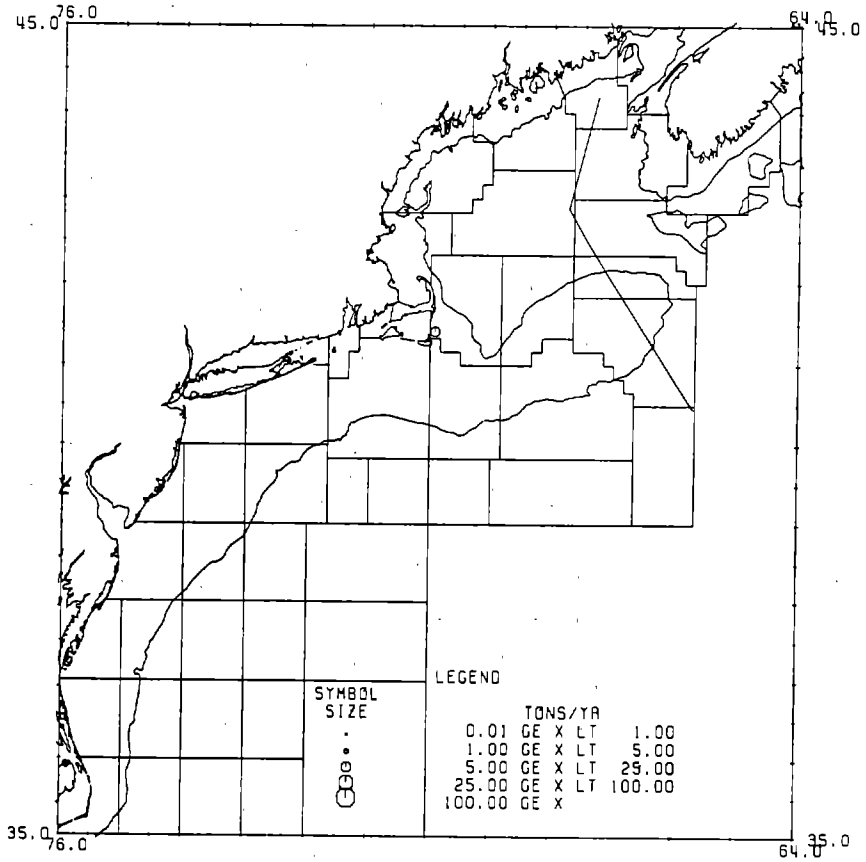
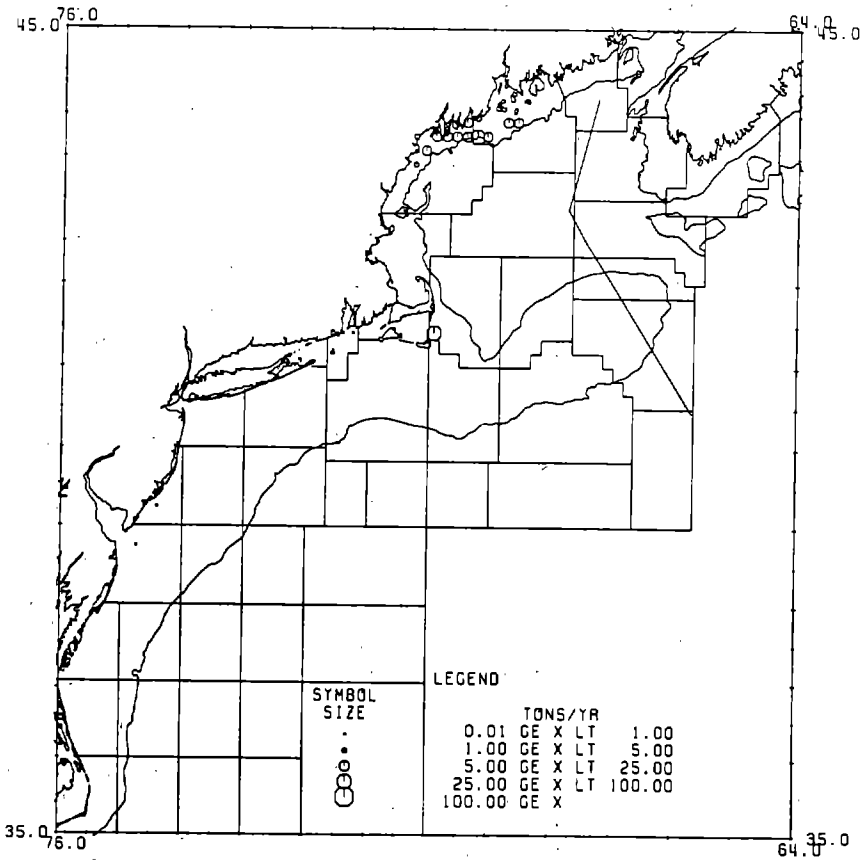


Figure W45-2. Blue mussel (*Mytilus edulis*) commercial weighout landings distributions -- second quarter.



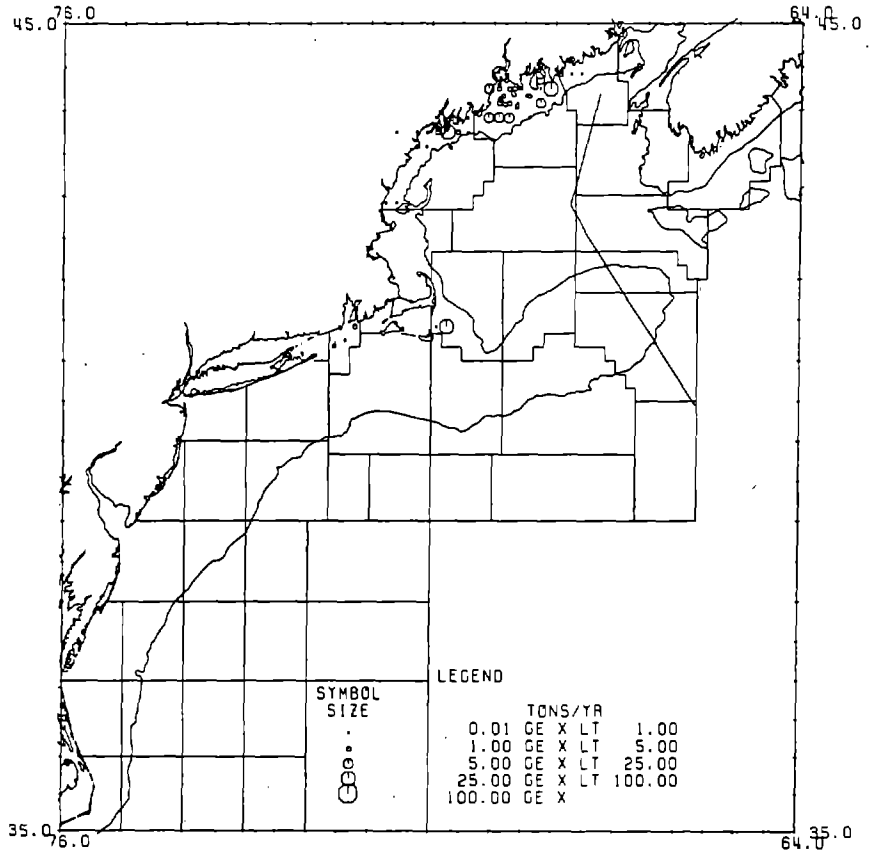


Figure W45-3. Blue mussel (*Mytilus edulis*) commercial weighout landings distributions -- third quarter.

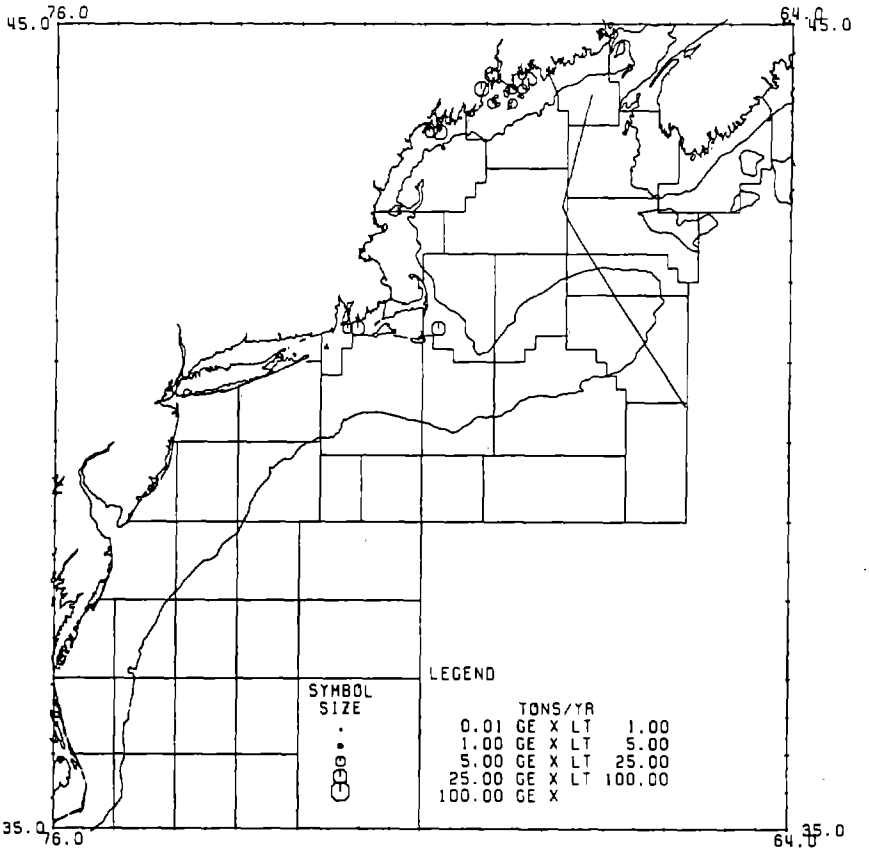


Figure W45-4. Blue mussel (*Mytilus edulis*) commercial weighout landings distributions -- fourth quarter.

APPENDIX

Average Seasonal Distributions of Bottom Trawl Survey Catches

(taken unabridged from Almeida *et al.* 1984)

Figure S1-1. Atlantic cod (*Gadus morhua*) bottom trawl survey catch distributions -- spring surveys.

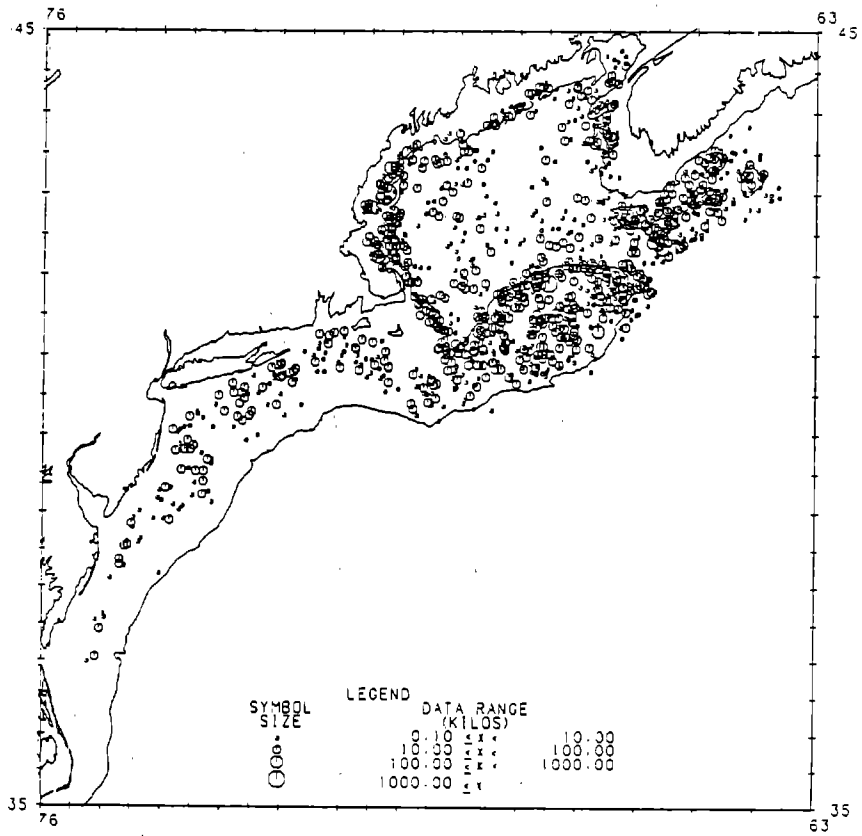
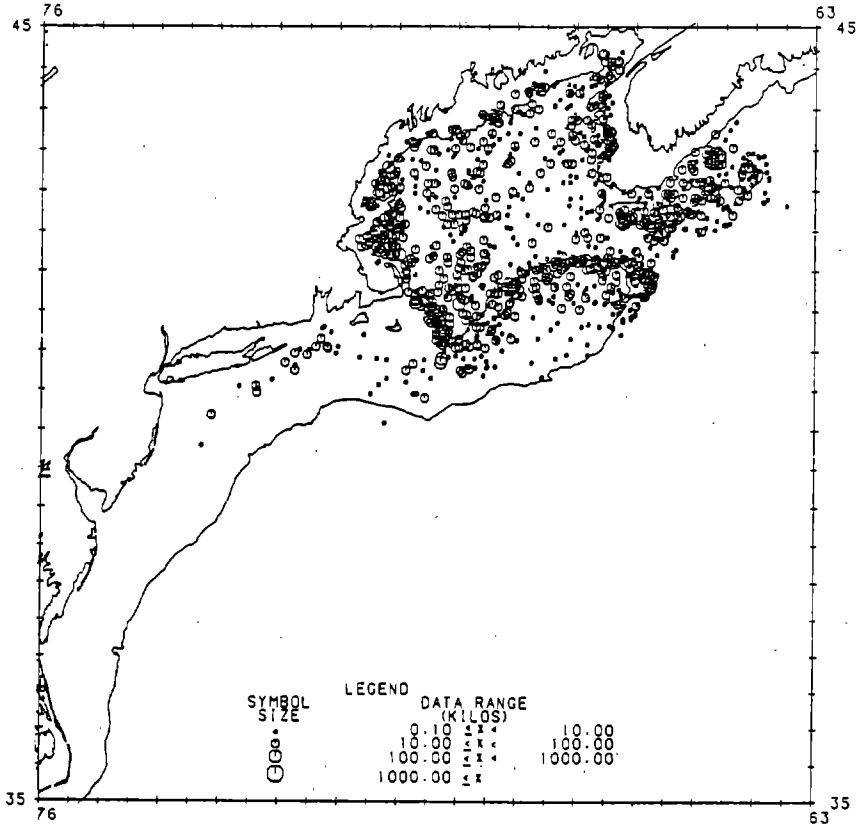


Figure S1-2. Atlantic cod (*Gadus morhua*) bottom trawl survey catch distributions -- autumn surveys.



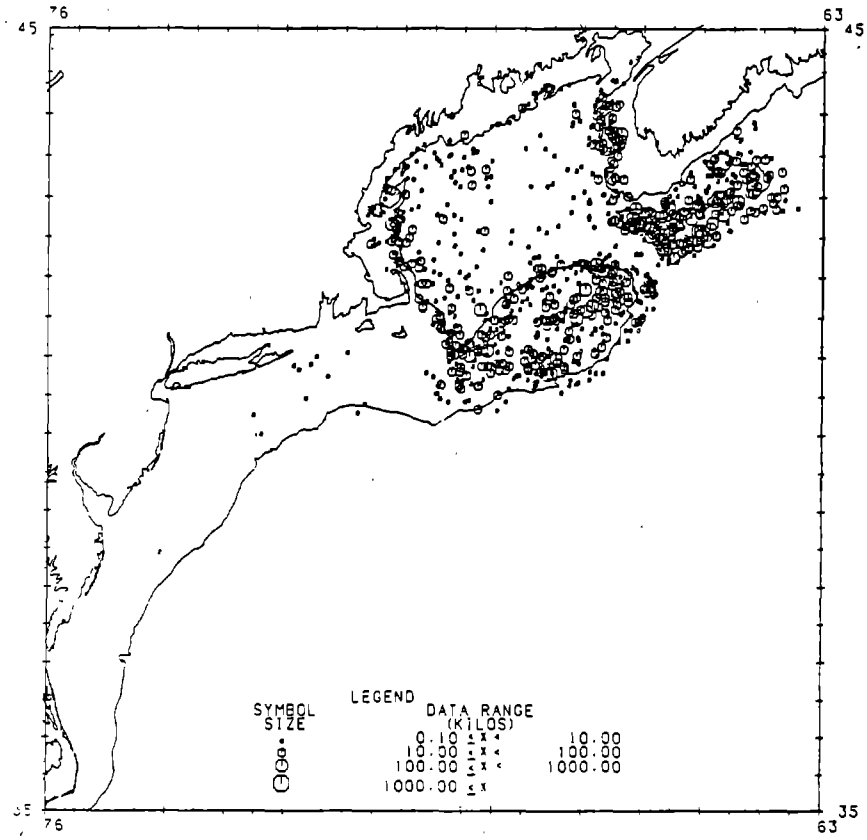


Figure S2-1. Haddock (*Melanogrammus aeglefinus*) bottom trawl survey catch distributions -- spring surveys.

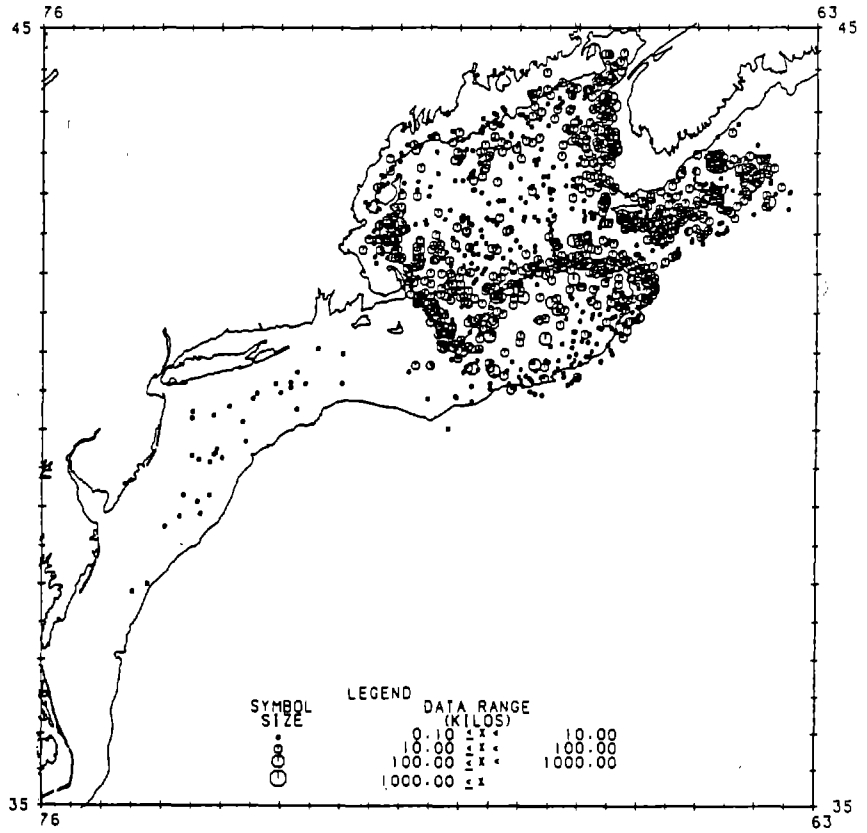


Figure S2-2. Haddock (*Melanogrammus aeglefinus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S3-1. Pollock (*Pollachius virens*) bottom trawl survey catch distributions -- spring surveys.

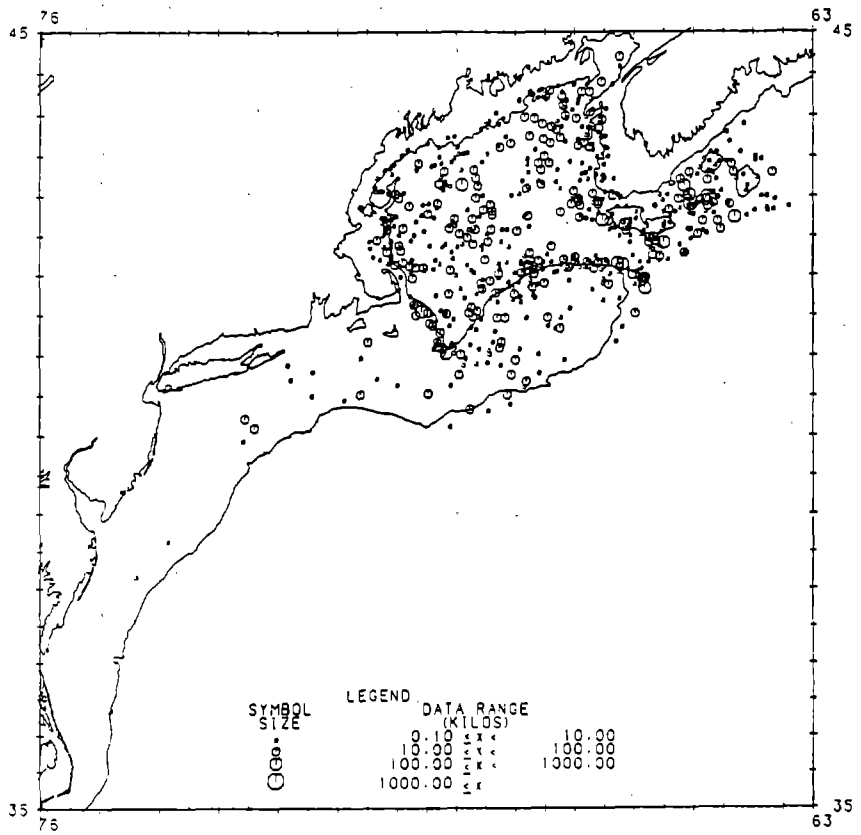
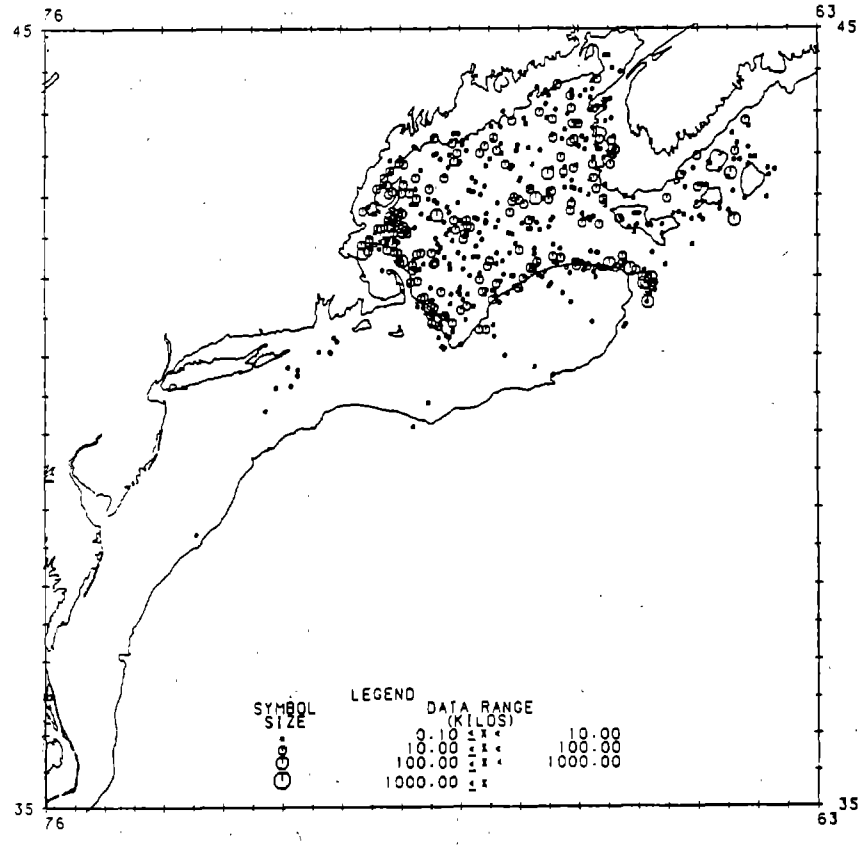


Figure S3-2. Pollock (*Pollachius virens*) bottom trawl survey catch distributions -- autumn surveys.



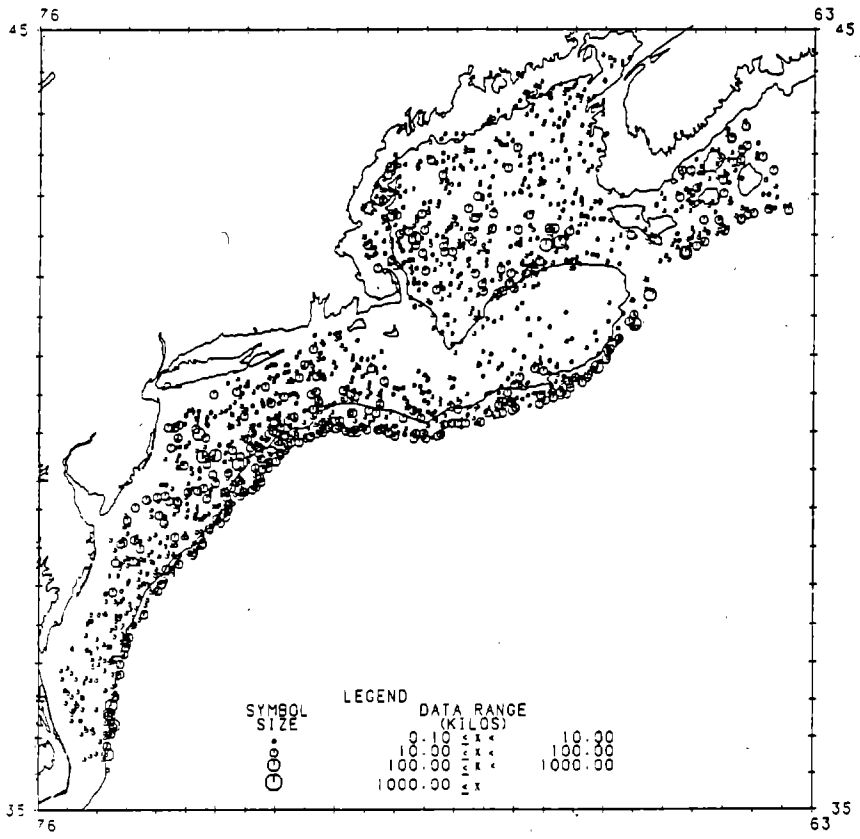


Figure S4-1. Silver hake (*Merluccius bilinearis*) bottom trawl survey catch distributions -- spring surveys.

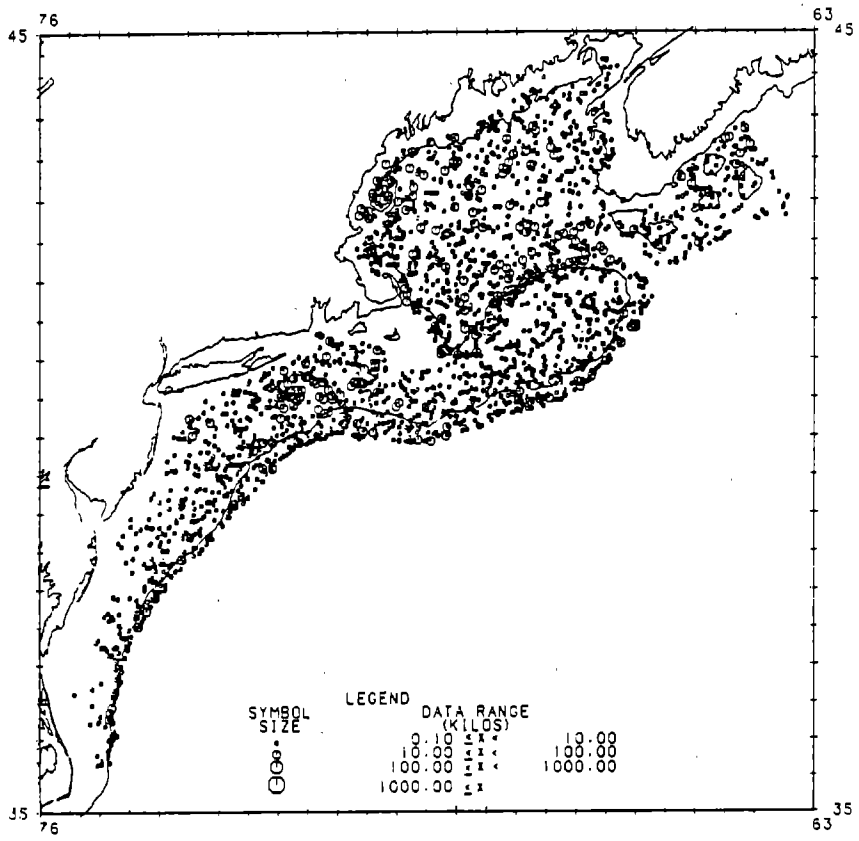


Figure S4-2. Silver hake (*Merluccius bilinearis*) bottom trawl survey catch distributions -- autumn surveys.

Figure S5-1. Red hake (*Urophycis chuss*) bottom trawl survey catch distributions -- spring surveys.

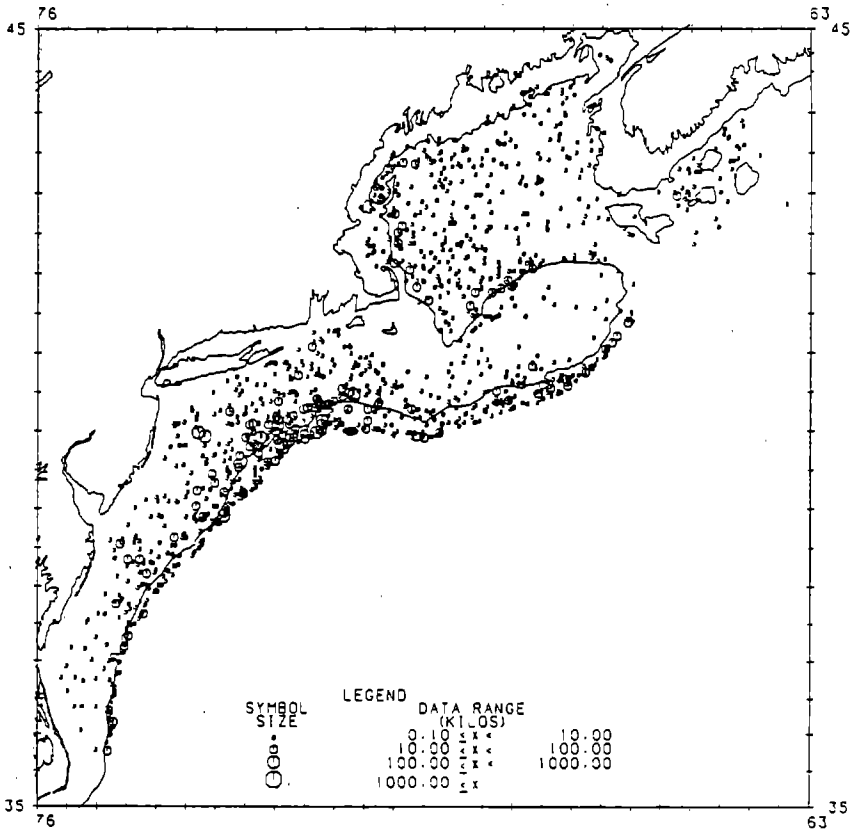
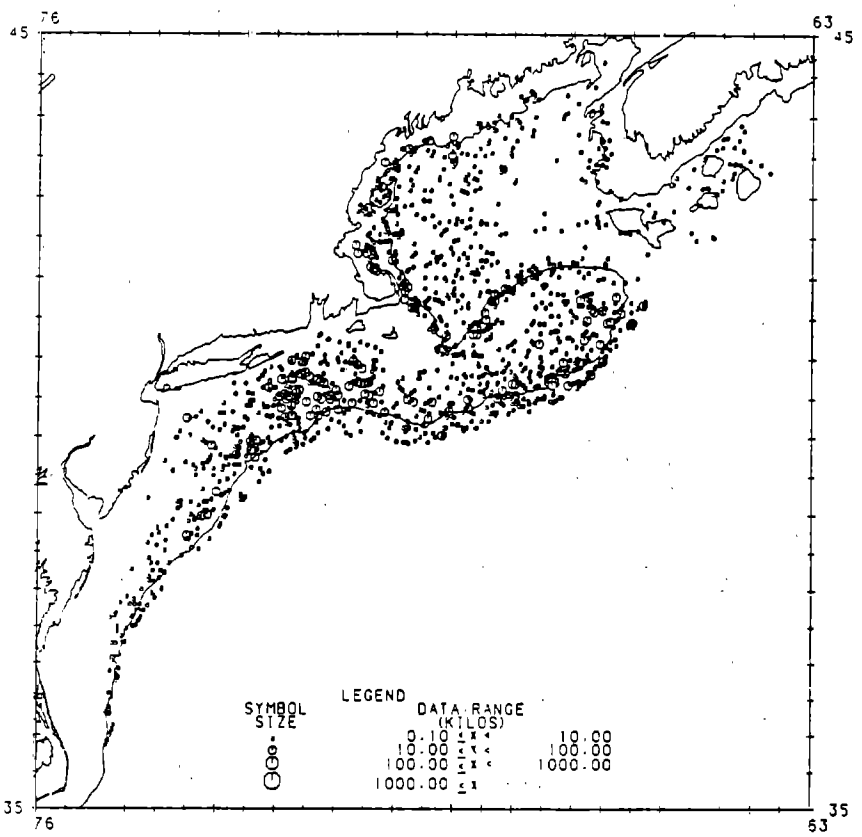


Figure S5-2. Red hake (*Urophycis chuss*) bottom trawl survey catch distributions -- autumn surveys.



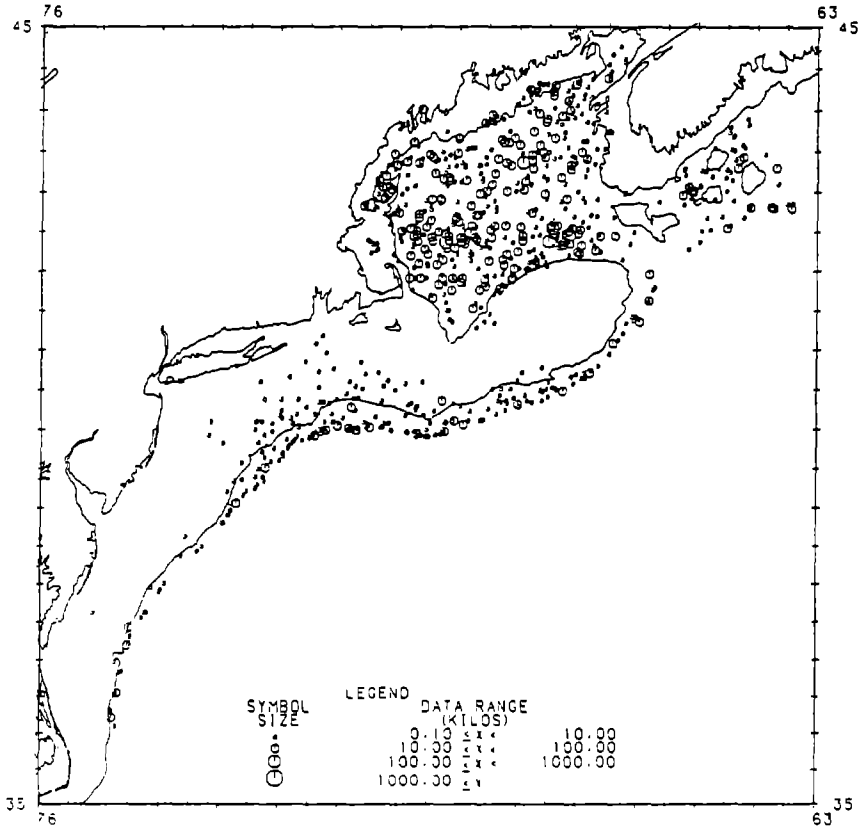


Figure S6-1. White hake (*Urophycis tenuis*) bottom trawl survey catch distributions -- spring surveys.

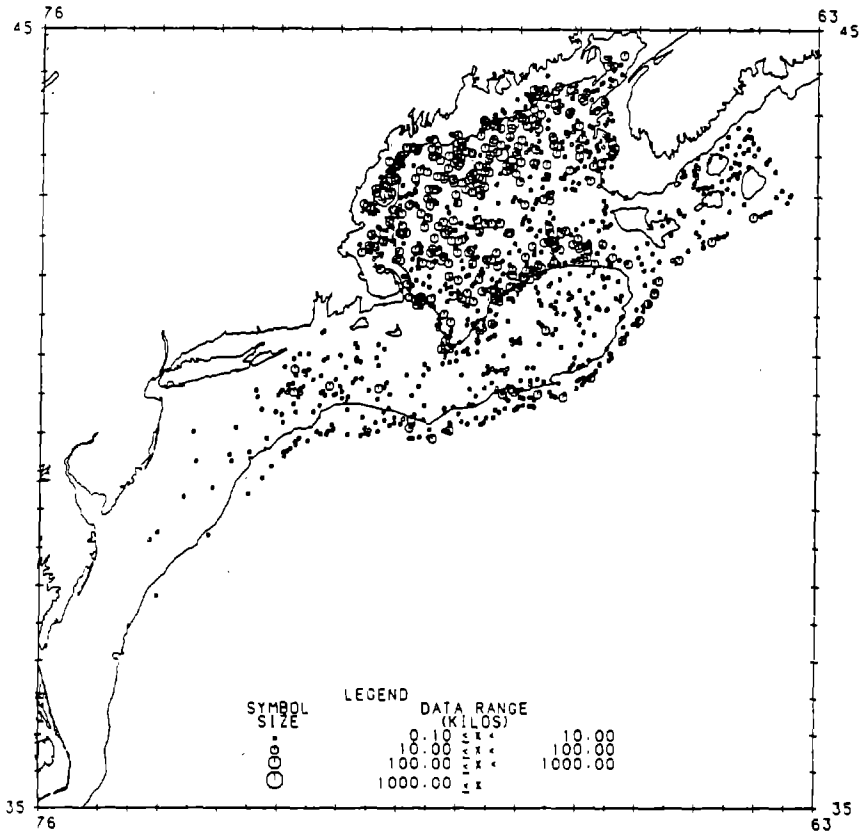


Figure S6-2. White hake (*Urophycis tenuis*) bottom trawl survey catch distributions -- autumn surveys.

Figure S7-1. Redfish (*Sebastes marinus*) bottom trawl survey catch distributions -- spring surveys.

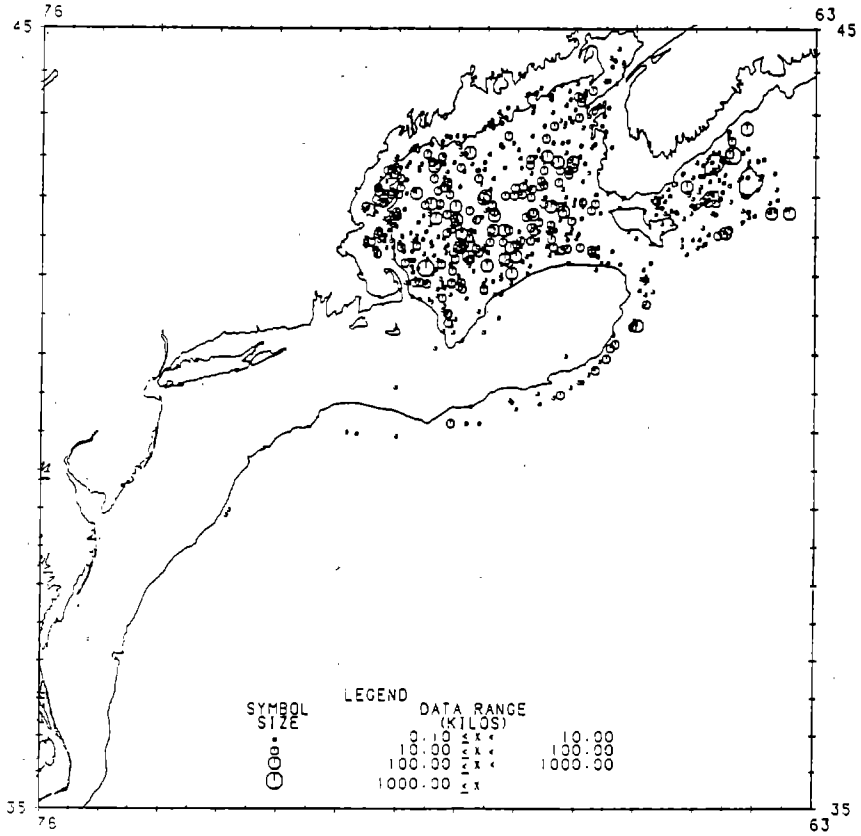
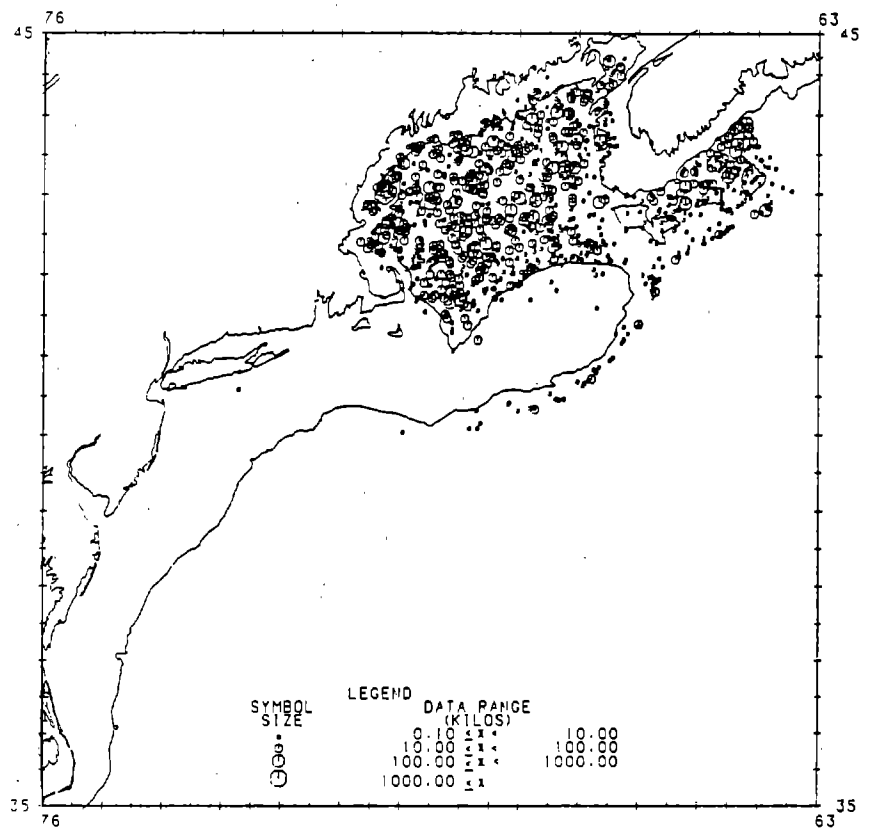


Figure S7-2. Redfish (*Sebastes marinus*) bottom trawl survey catch distributions -- autumn surveys.



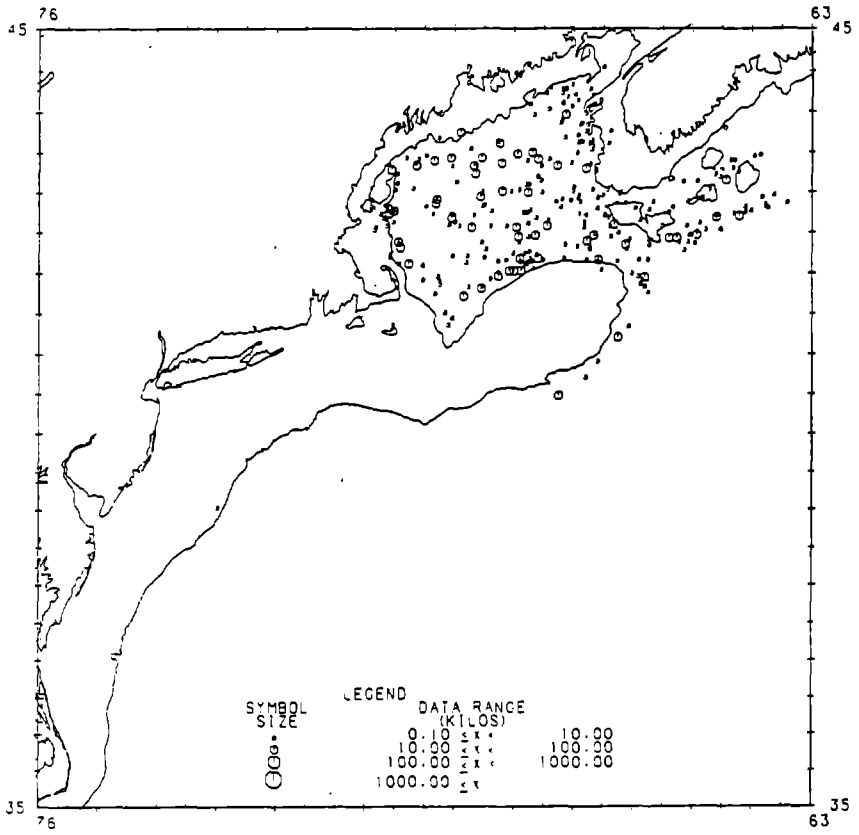


Figure S8-1. Cusk (*Brosme brosme*) bottom trawl survey catch distributions -- spring surveys.

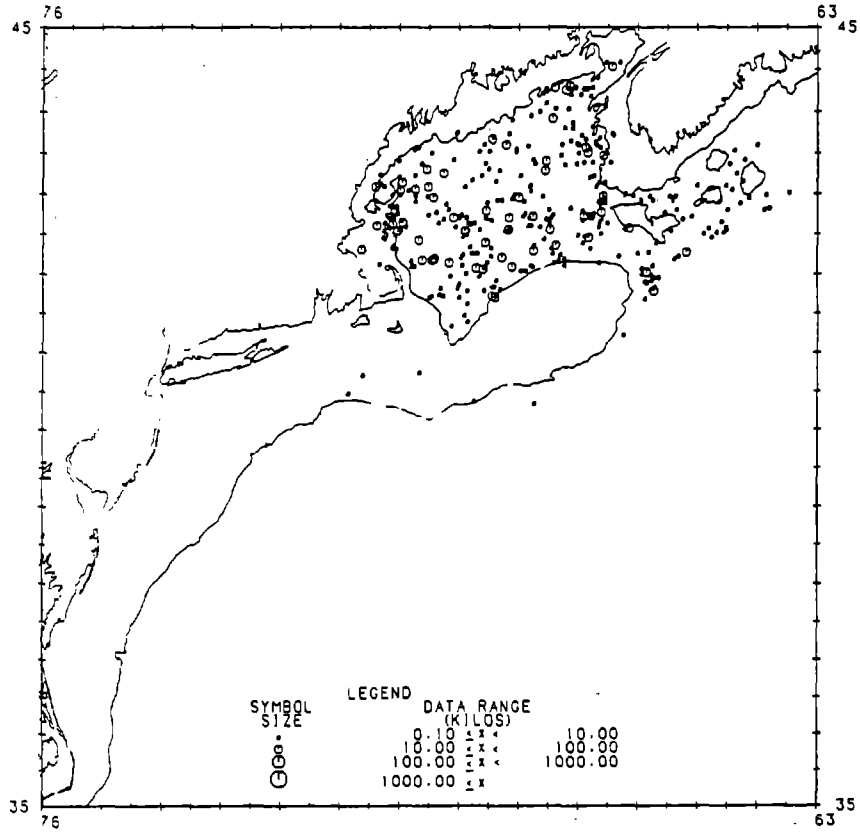


Figure S8-2. Cusk (*Brosme brosme*) bottom trawl survey catch distributions -- autumn surveys.

Figure S9-1. Ocean pout (*Macrozoarces americanus*) bottom trawl survey catch distributions -- spring surveys.

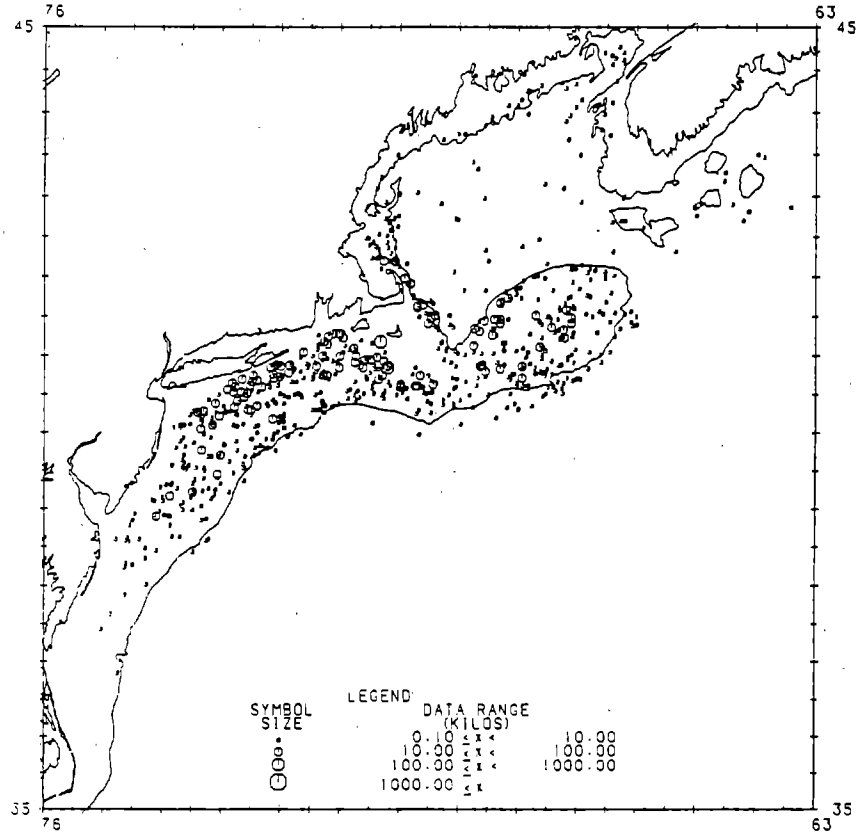
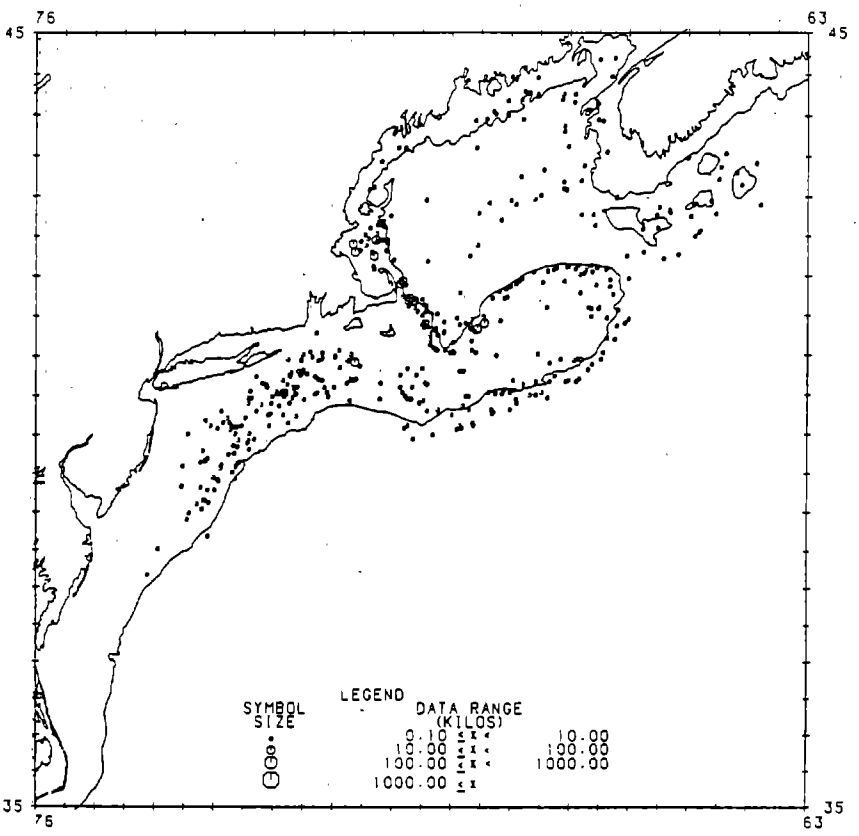


Figure S9-2. Ocean pout (*Macrozoarces americanus*) bottom trawl survey catch distributions -- autumn surveys.



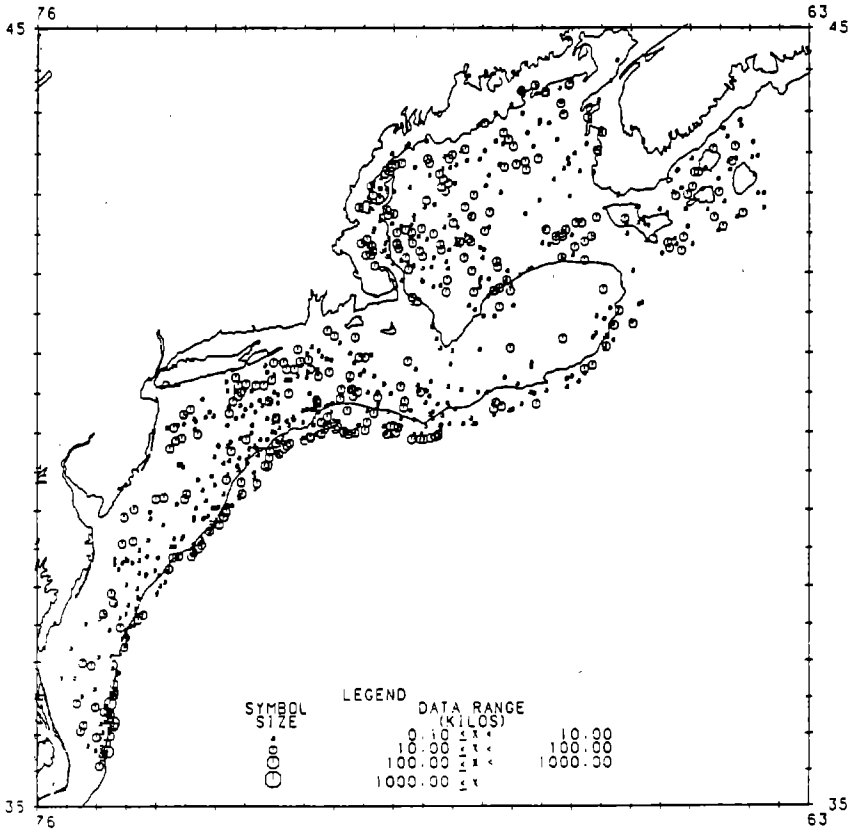


Figure S10-1. Goosefish (*Lophius americanus*) bottom trawl survey catch distributions -- spring surveys.

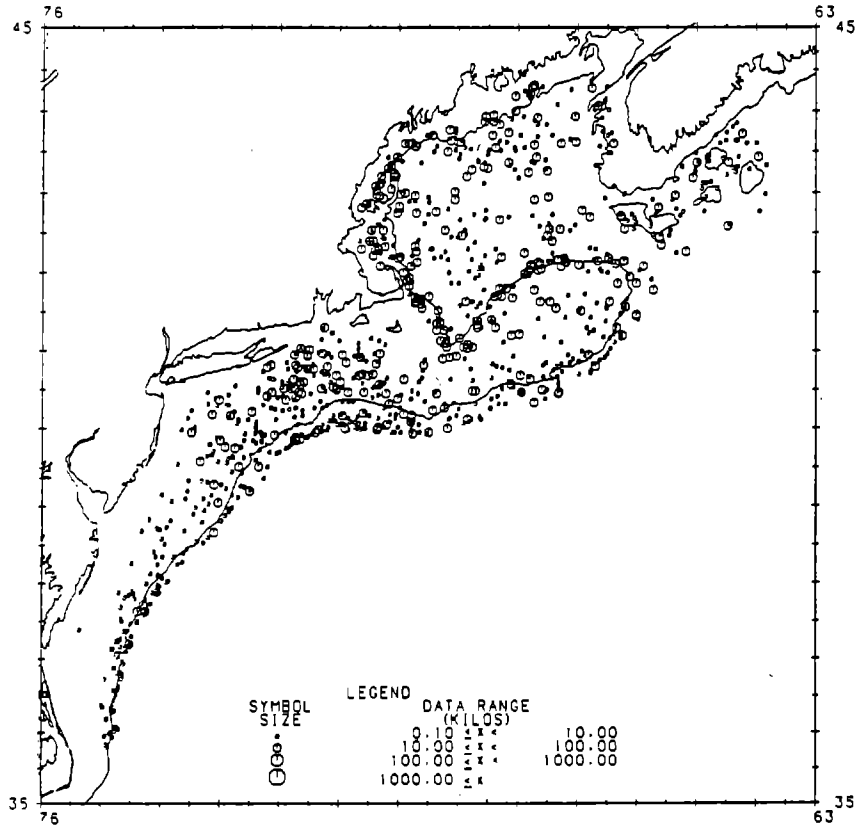


Figure S10-2. Goosefish (*Lophius americanus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S11-1. Atlantic wolffish (*Anarhichas lupus*) bottom trawl survey catch distributions -- spring surveys.

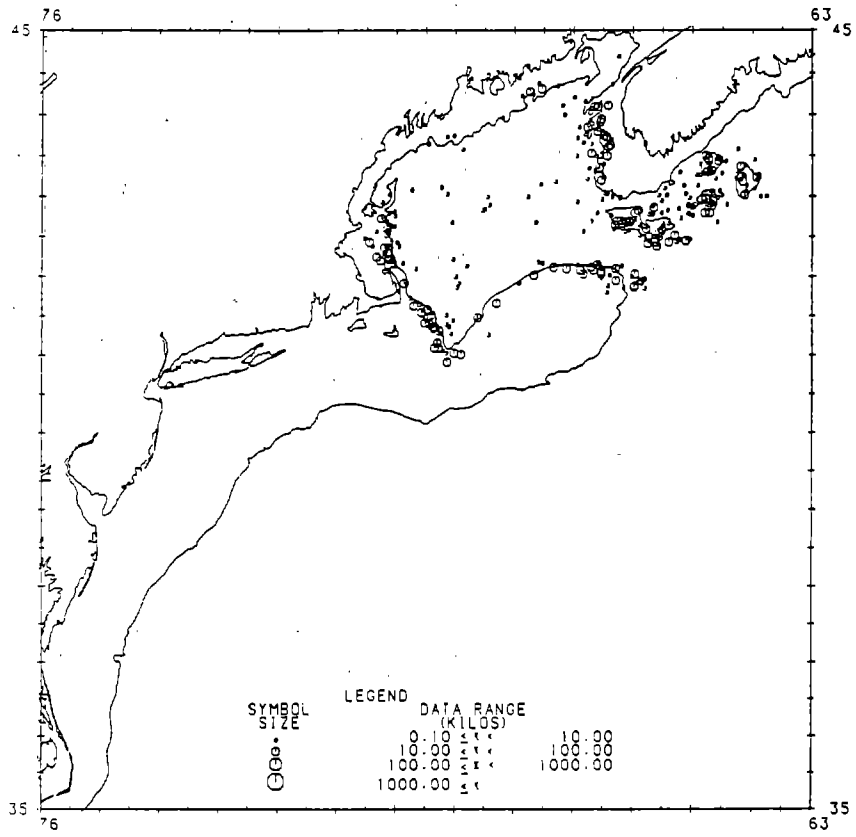
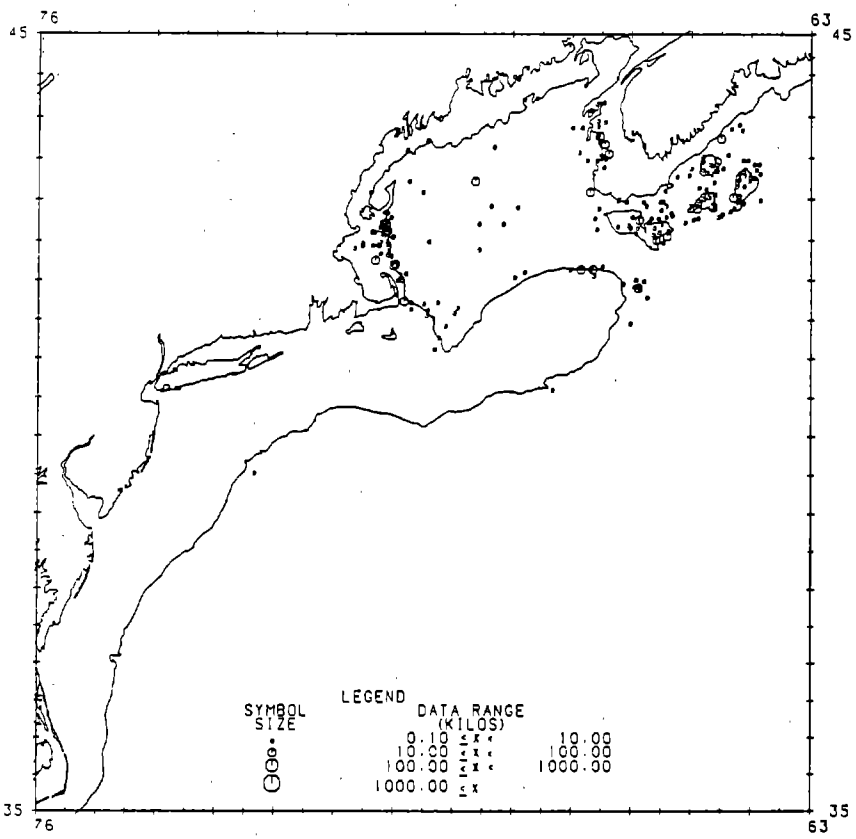


Figure S11-2. Atlantic wolffish (*Anarhichas lupus*) bottom trawl survey catch distributions -- autumn surveys.



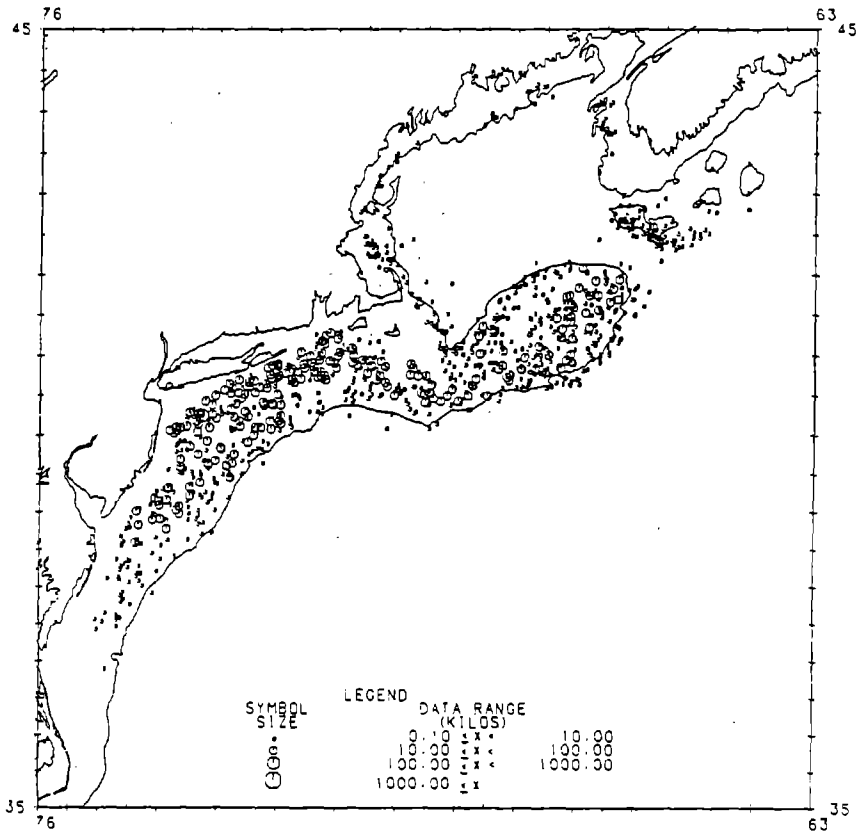


Figure S12-1. Yellowtail flounder (*Limanda ferruginea*) bottom trawl survey catch distributions -- spring surveys.

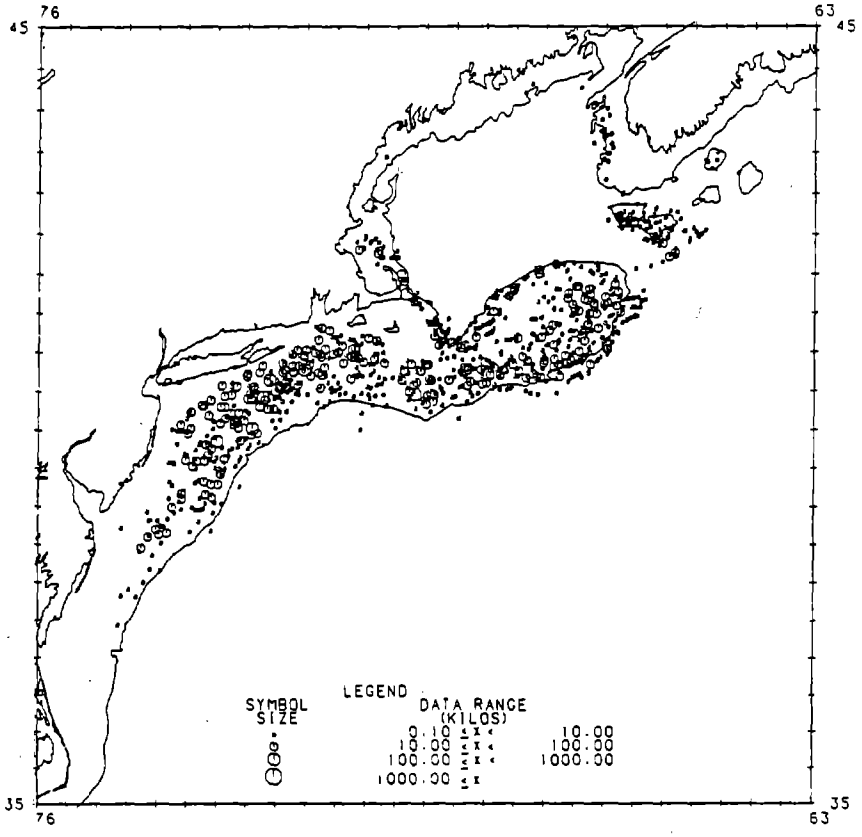


Figure S12-2. Yellowtail flounder (*Limanda ferruginea*) bottom trawl survey catch distributions -- autumn surveys.

Figure S13-1. American plaice (*Hippoglossoides platessoides*) bottom trawl survey catch distributions -- spring surveys.

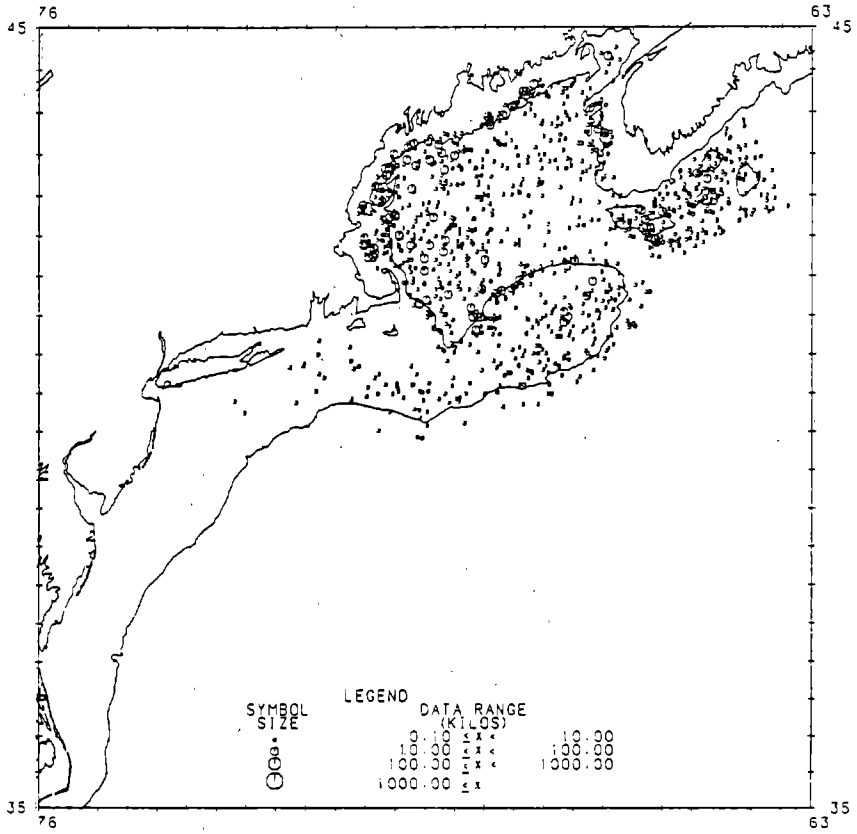
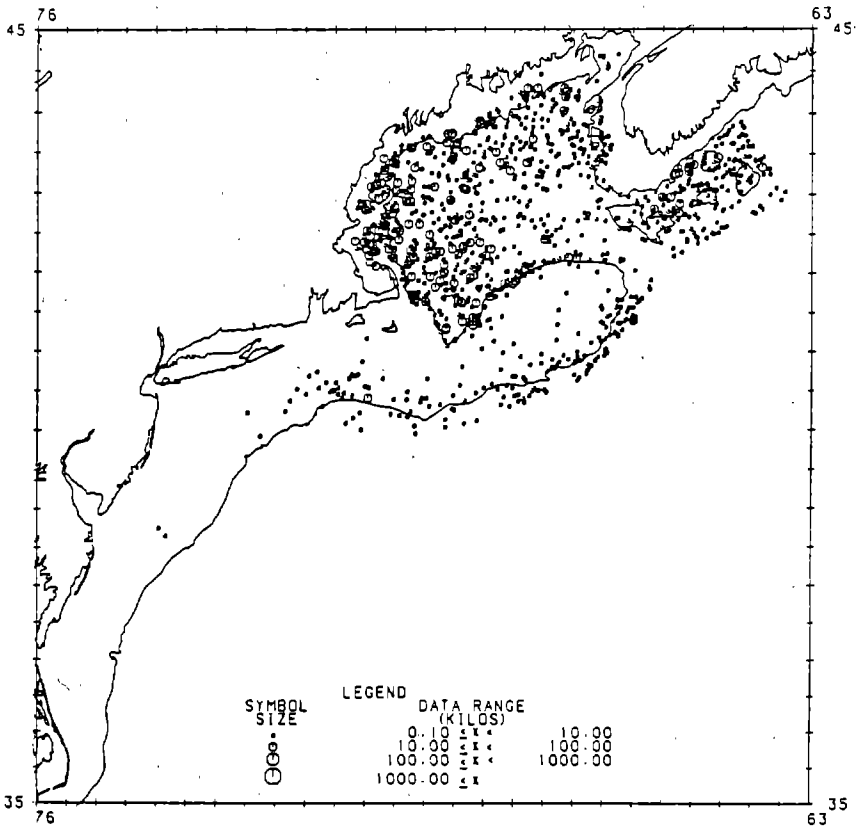


Figure S13-2. American plaice (*Hippoglossoides platessoides*) bottom trawl survey catch distributions -- autumn surveys.



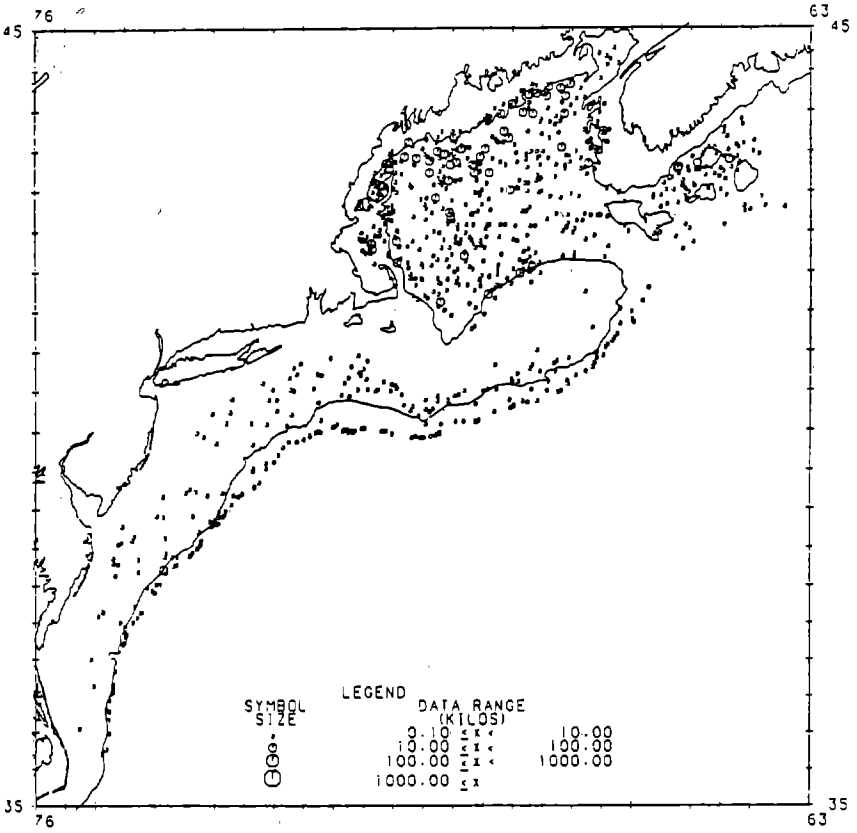


Figure S14-1. Witch flounder (*Glyptocephalus cynoglossus*) bottom trawl survey catch distributions -- spring surveys.

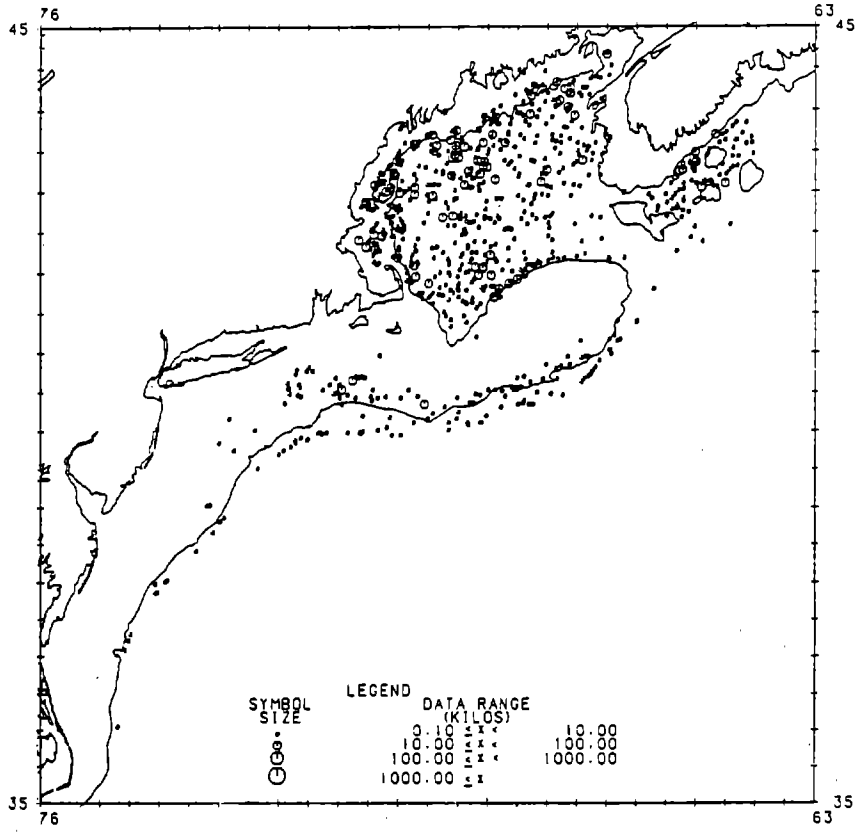


Figure S14-2. Witch flounder (*Glyptocephalus cynoglossus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S15-1. Windowpane (*Scophthalmus aquosus*) bottom trawl survey catch distributions -- spring surveys.

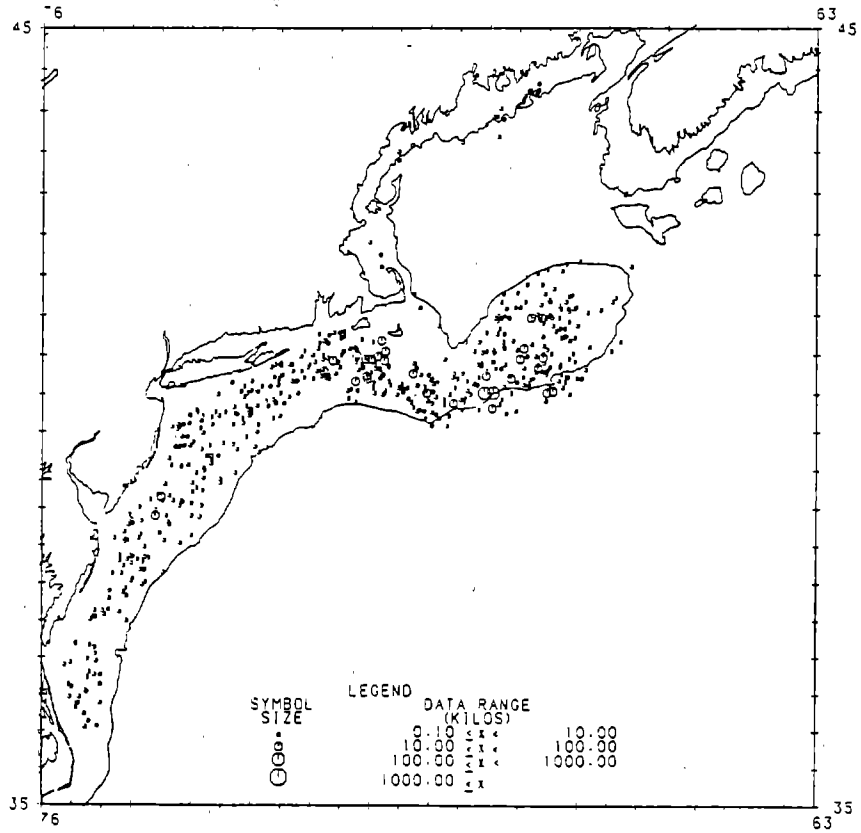
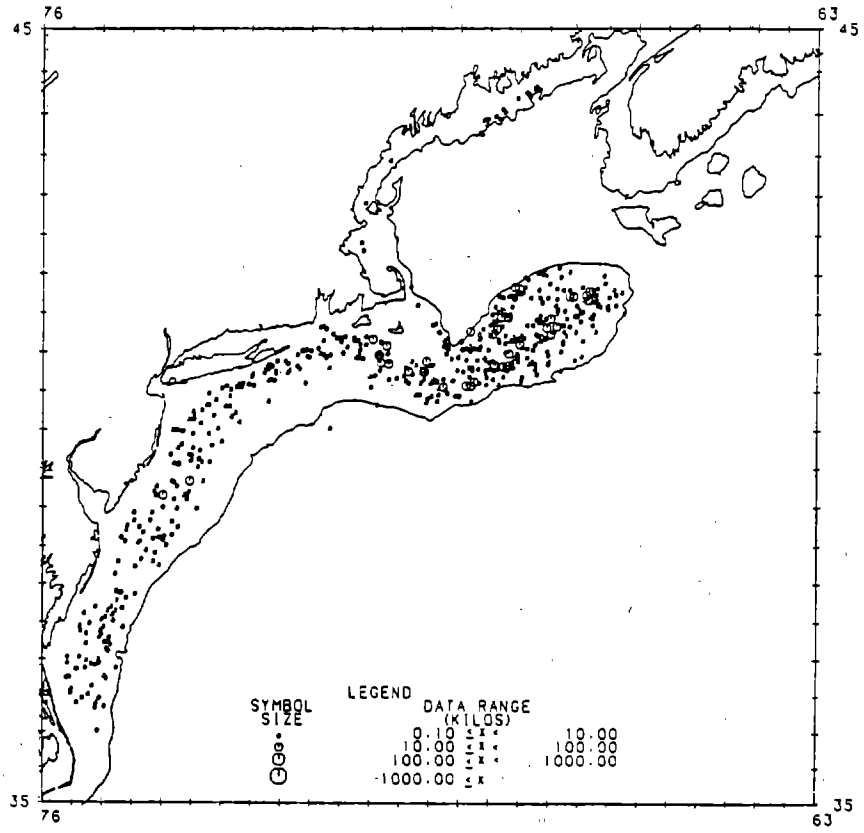


Figure S15-2. Windowpane (*Scophthalmus aquosus*) bottom trawl survey catch distributions -- autumn surveys.



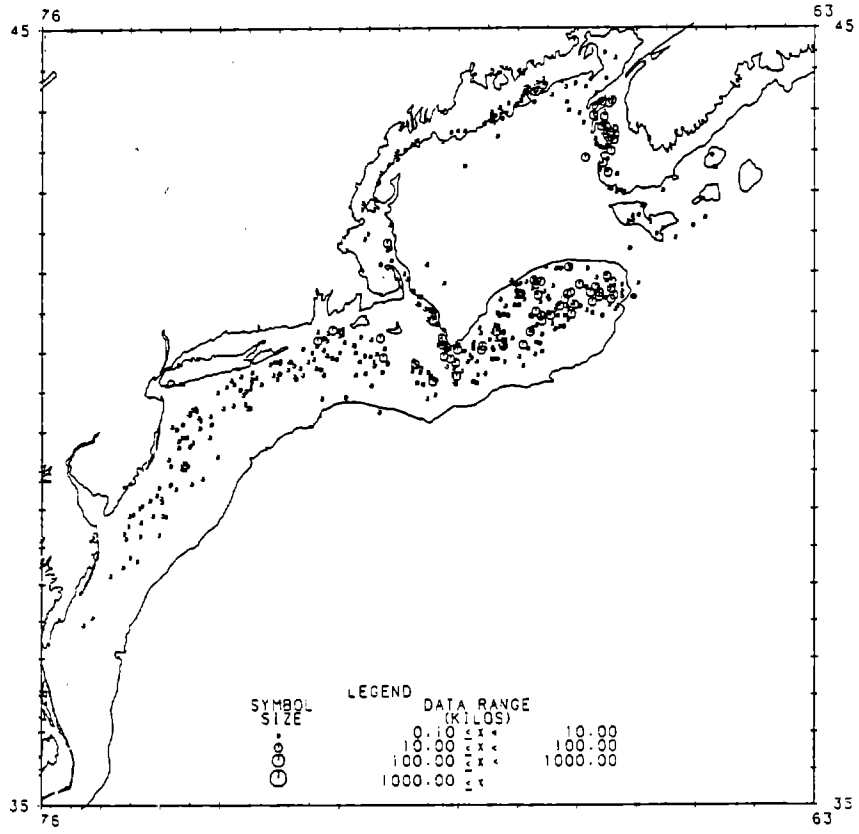


Figure S16-1. Winter flounder (*Pseudopleuronectes americanus*) bottom trawl survey catch distributions -- spring surveys.

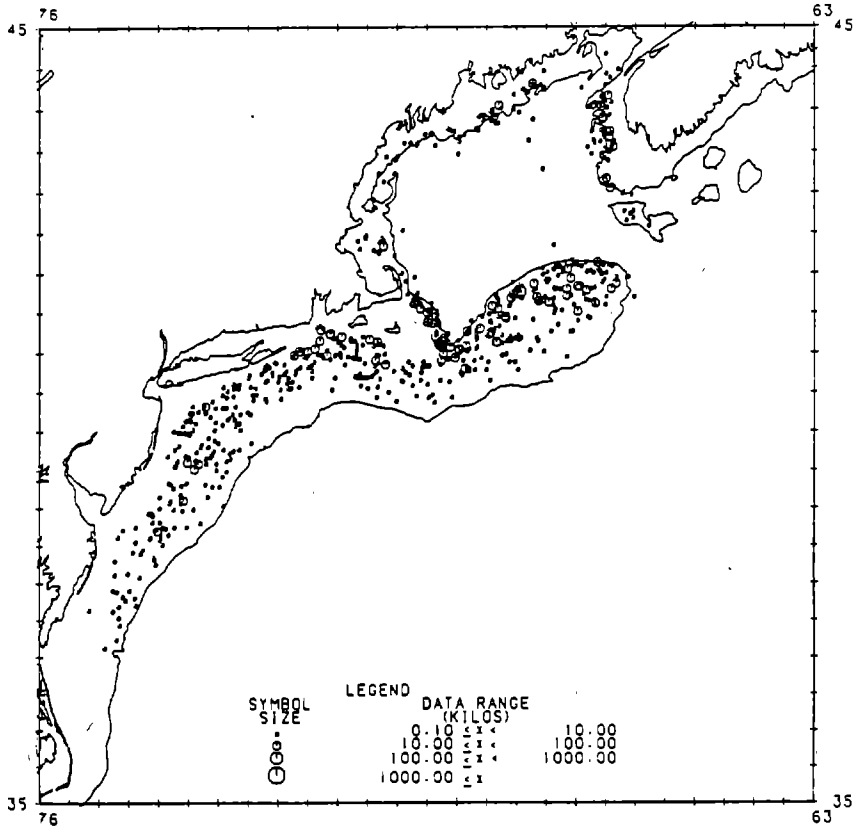


Figure S16-2. Winter flounder (*Pseudopleuronectes americanus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S17-1. Summer flounder (*Paralichthys dentatus*) bottom trawl survey catch distributions -- spring surveys.

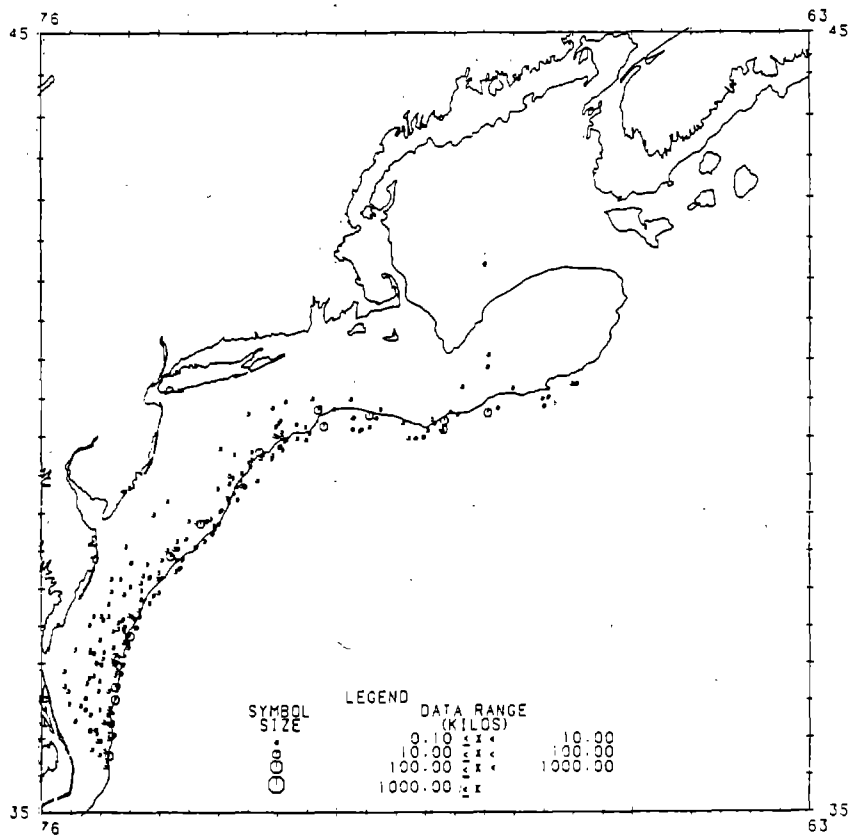
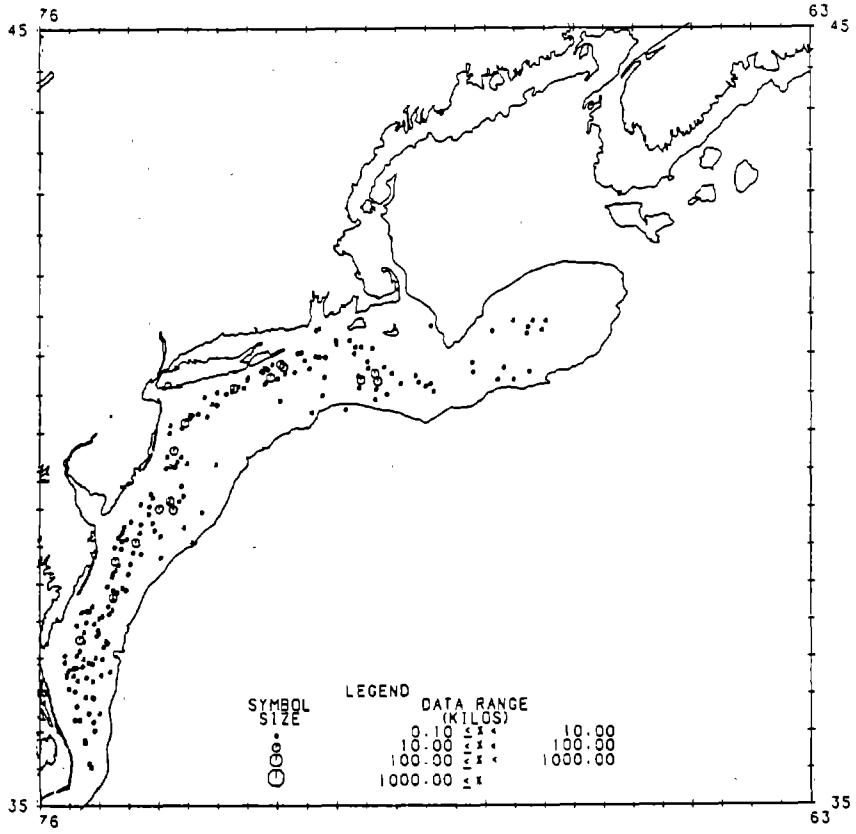


Figure S17-2. Summer flounder (*Paralichthys dentatus*) bottom trawl survey catch distributions -- autumn surveys.



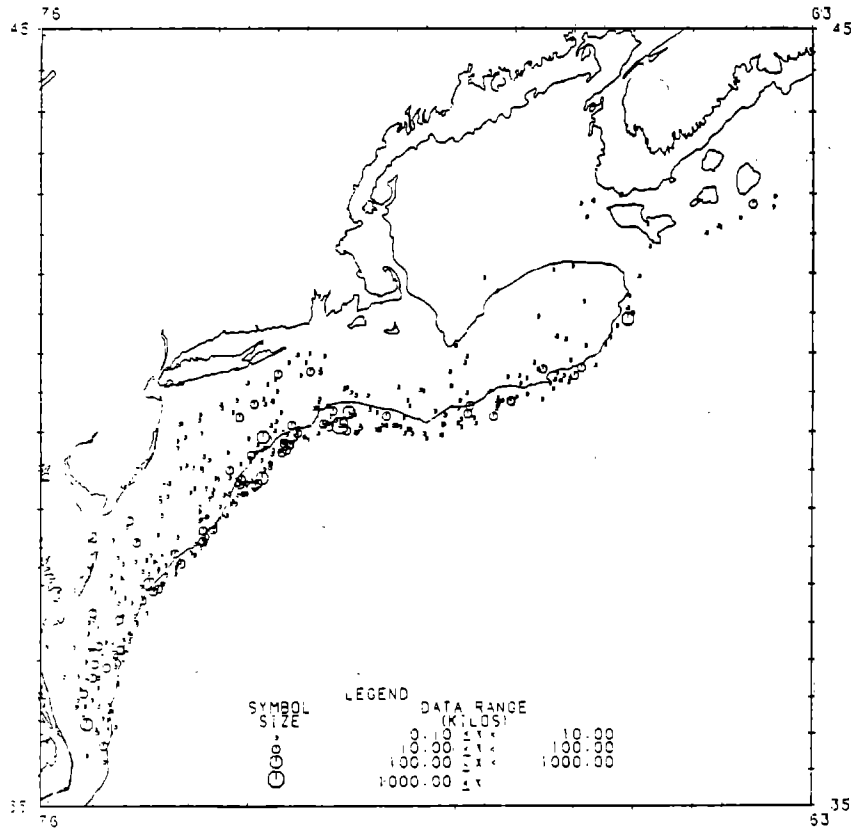


Figure S18-1. Atlantic mackerel (*Scomber scombrus*) bottom trawl survey catch distributions -- spring surveys.

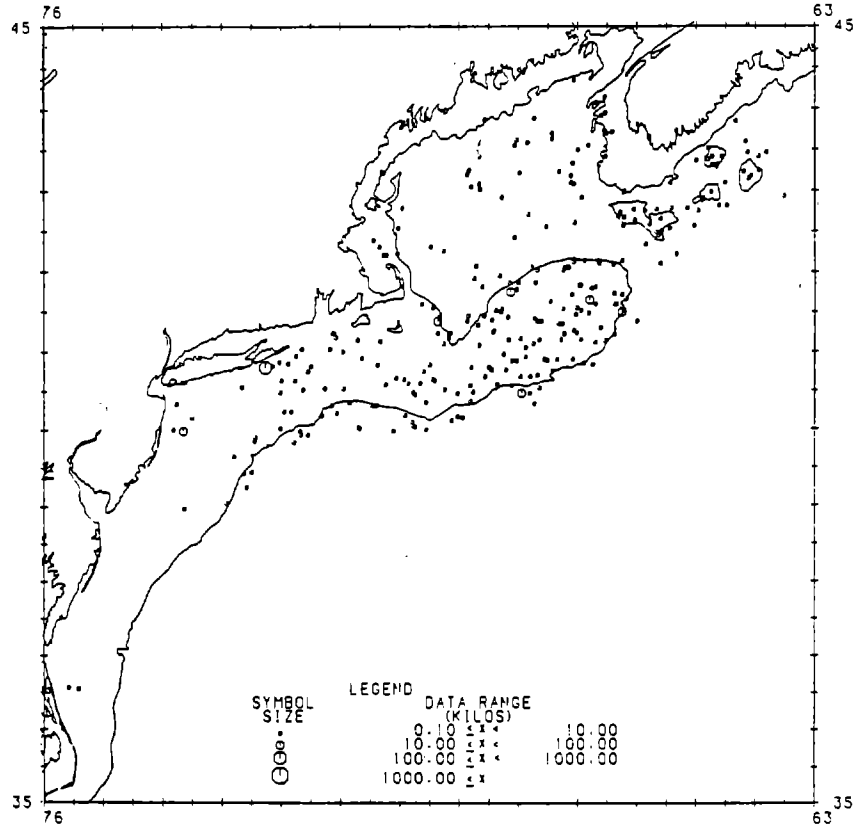


Figure S18-2. Atlantic mackerel (*Scomber scombrus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S19-1. Atlantic herring (*Clupea harengus harengus*) bottom trawl survey catch distributions -- spring surveys.

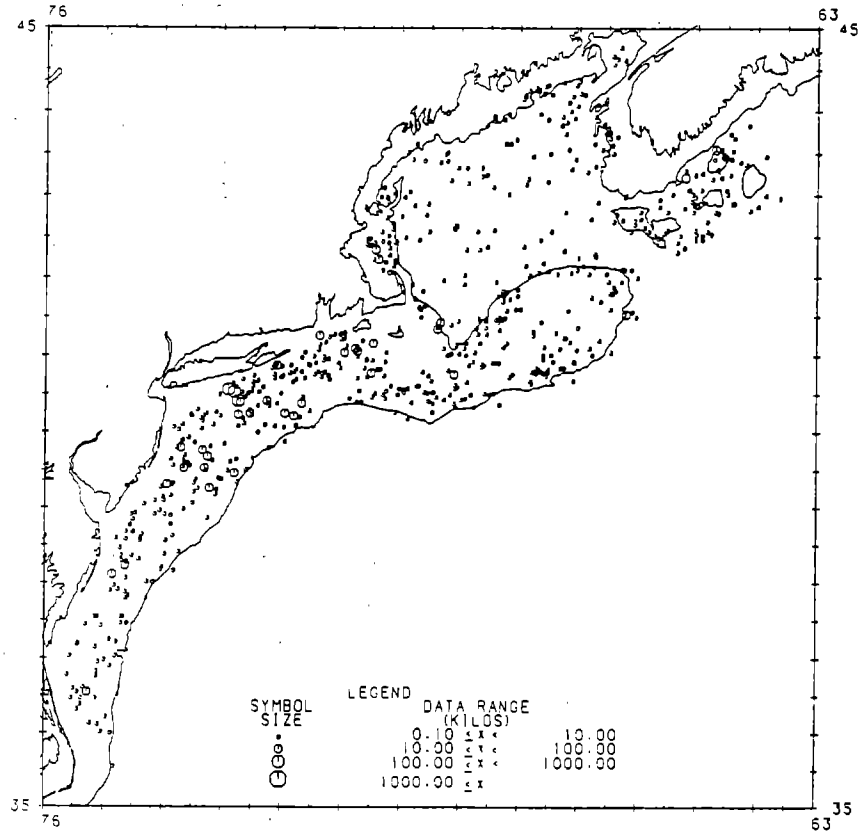
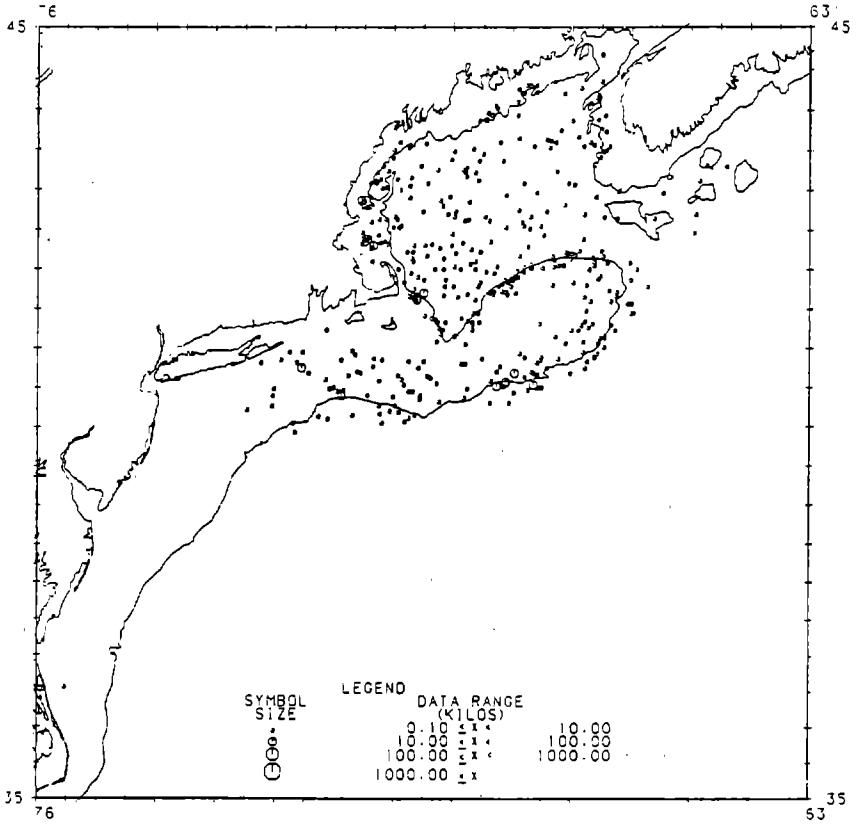


Figure S19-2. Atlantic herring (*Clupea harengus harengus*) bottom trawl survey catch distributions -- autumn surveys.



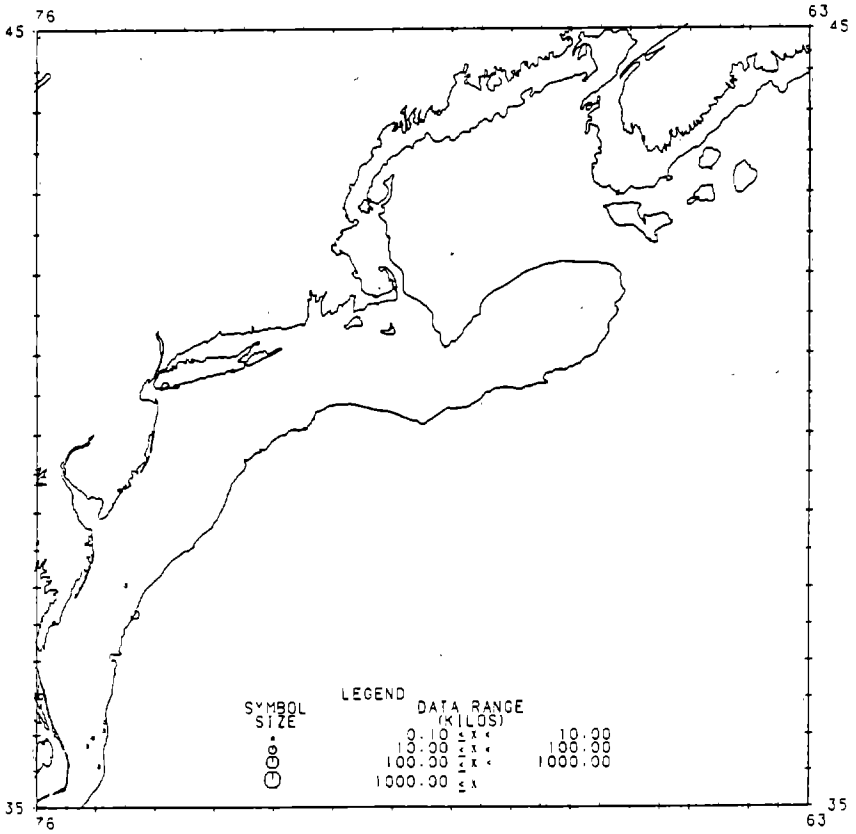


Figure S20-1. Bluefish (*Pomatomus saltatrix*) bottom trawl survey catch distributions -- spring surveys.

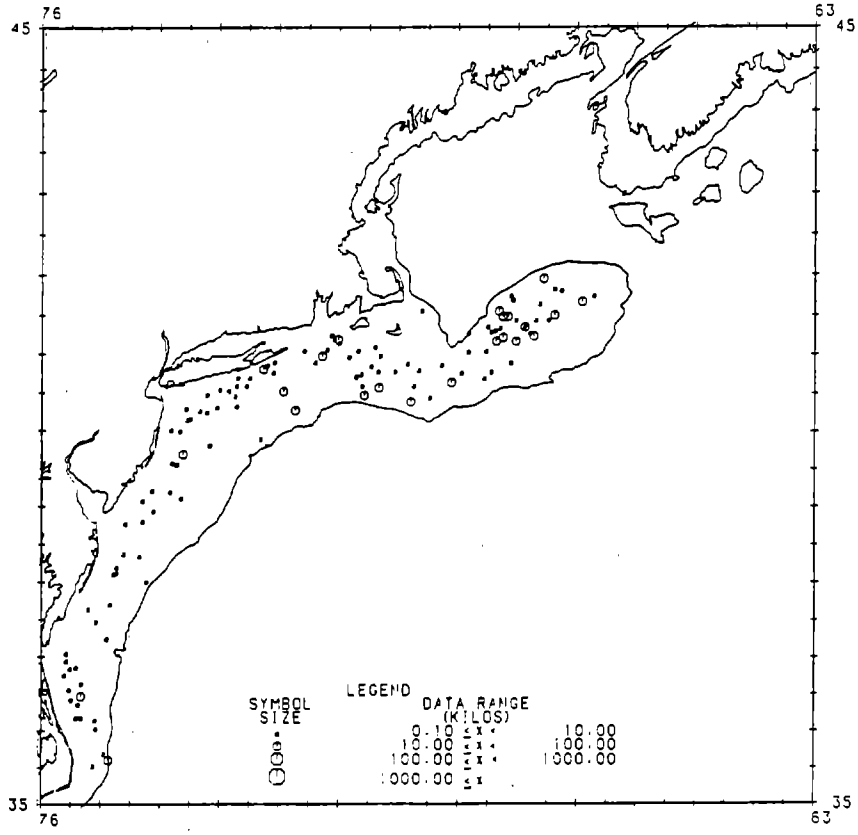


Figure S20-2. Bluefish (*Pomatomus saltatrix*) bottom trawl survey catch distributions -- autumn surveys.

Figure S21-1. Butterfish (*Peprilus triacanthus*) bottom trawl survey catch distributions -- spring surveys.

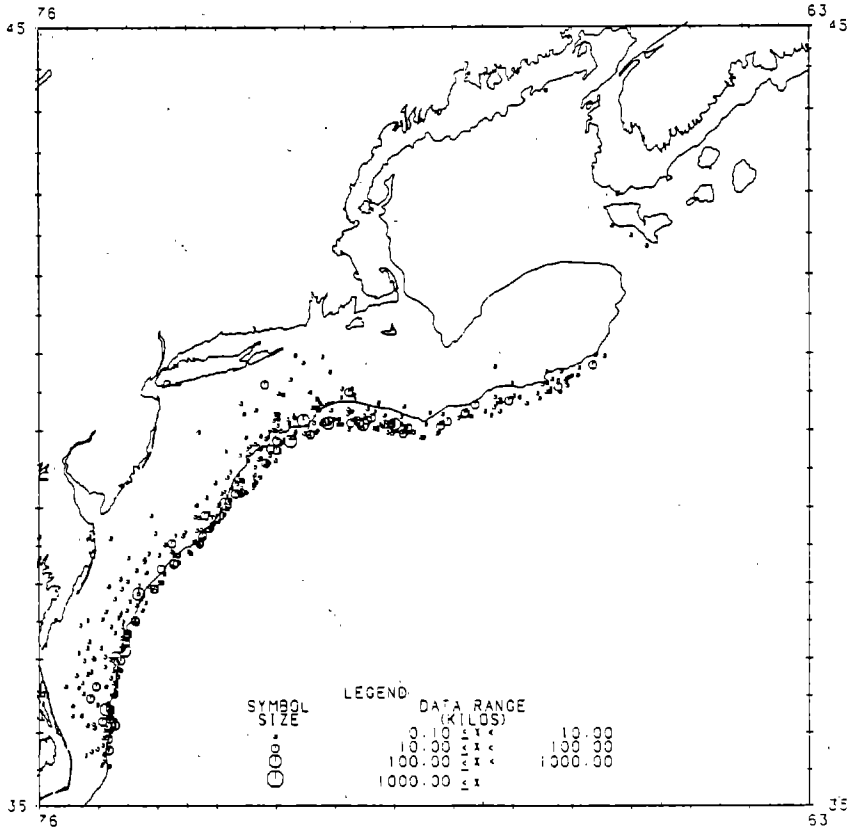
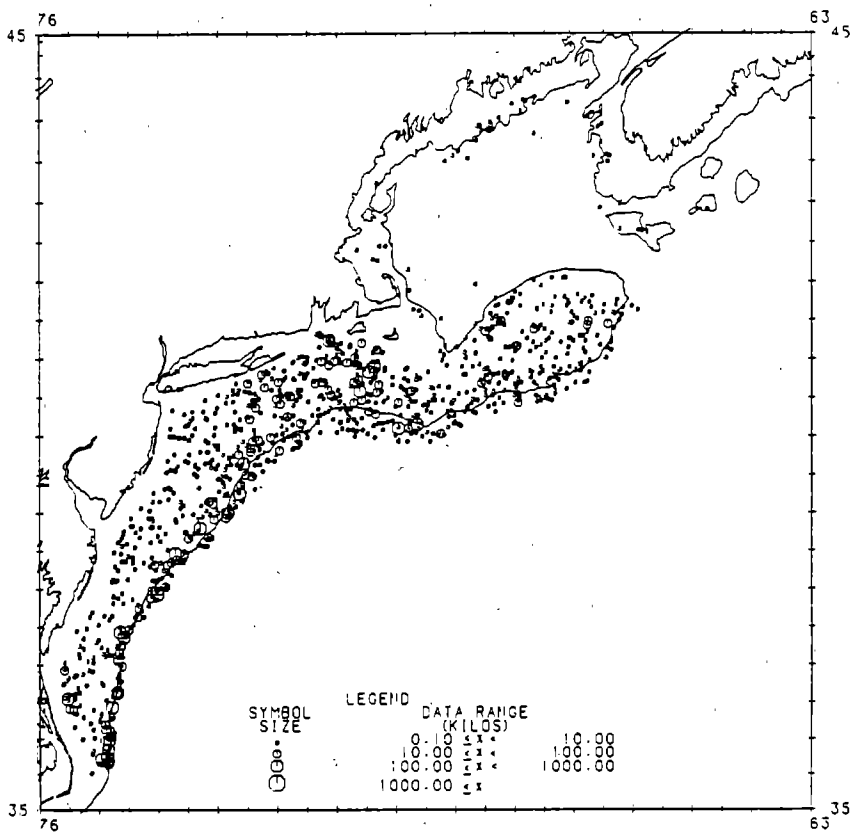


Figure S21-2. Butterfish (*Peprilus triacanthus*) bottom trawl survey catch distributions -- autumn surveys.



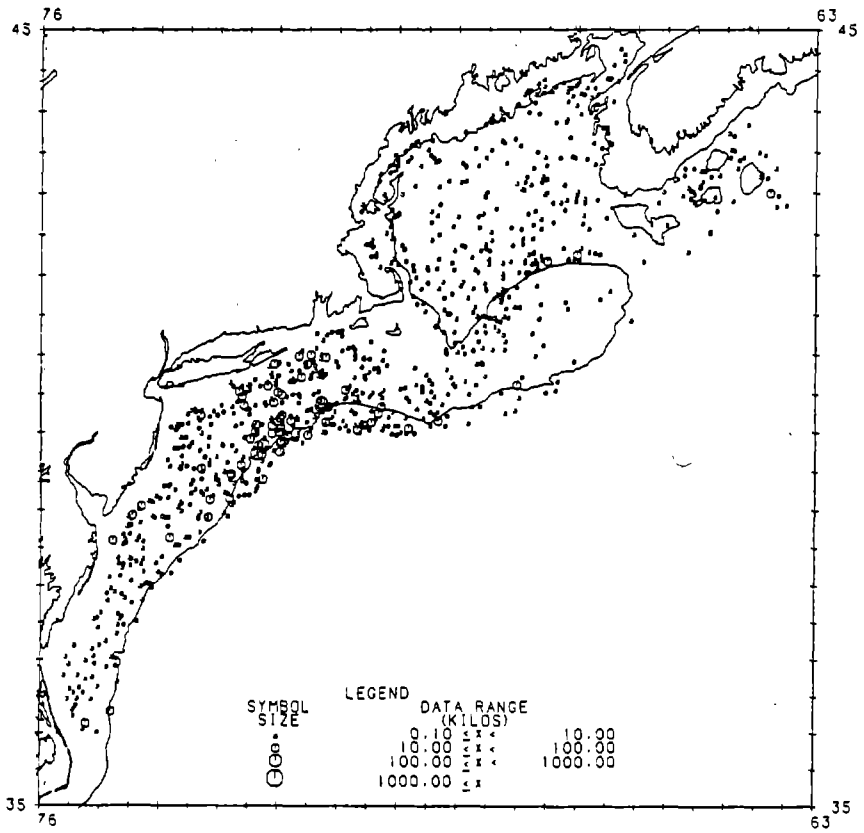


Figure S22-1. Alewife (*Alosa pseudoharengus*) bottom trawl survey catch distributions -- spring surveys.

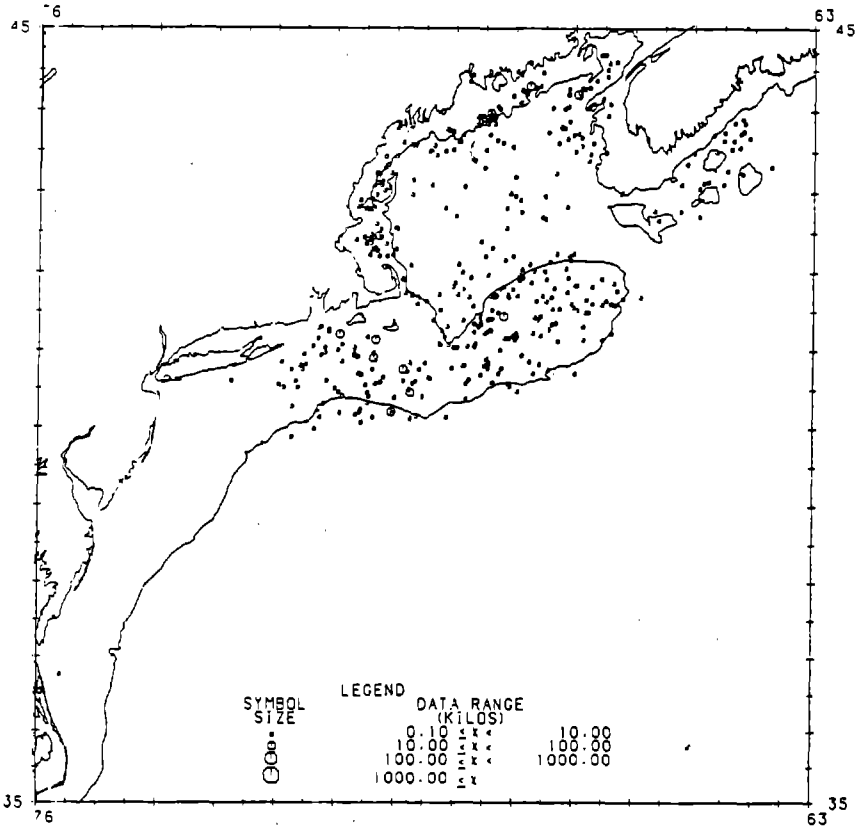


Figure S22-2. Alewife (*Alosa pseudoharengus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S23-1. Blueback herring (*Alosa aestivalis*) bottom trawl survey catch distributions -- spring surveys.

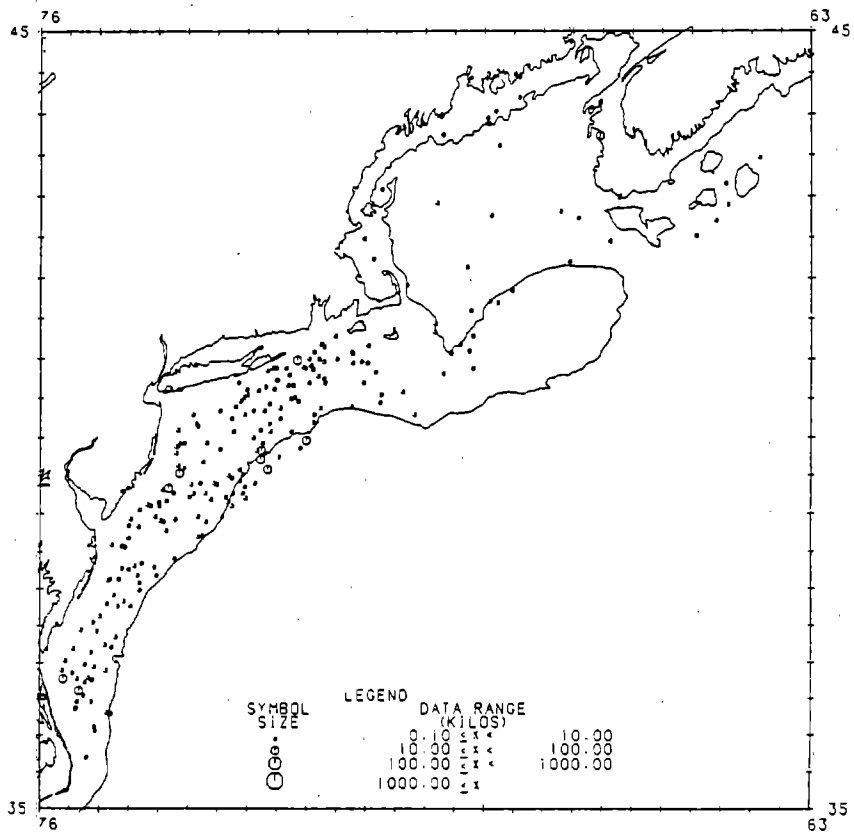
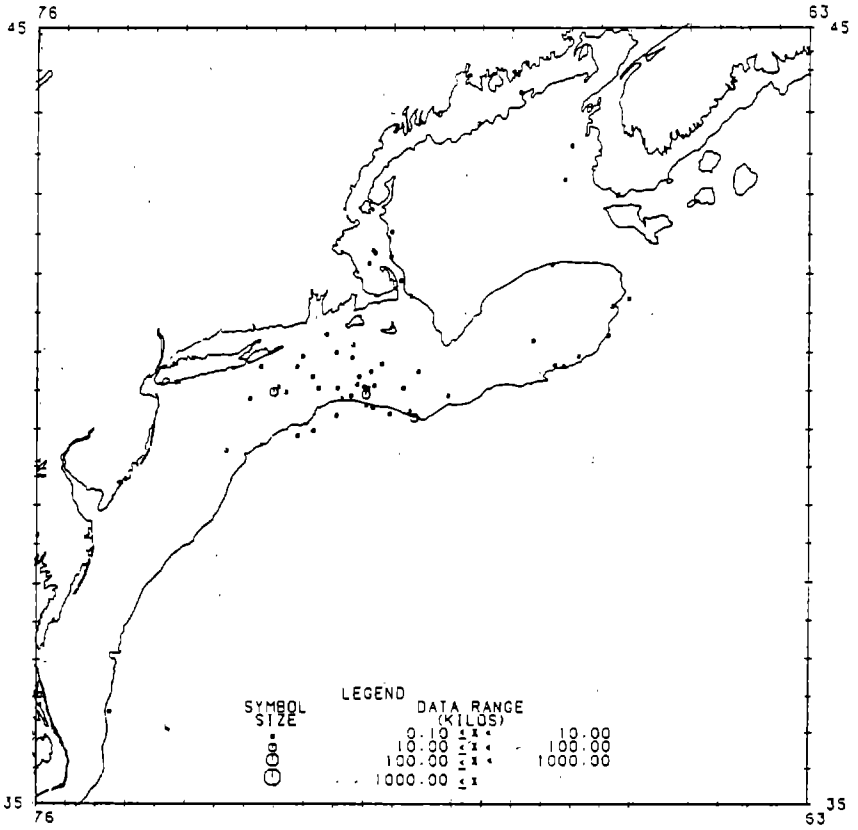


Figure S23-2. Blueback herring (*Alosa aestivalis*) bottom trawl survey catch distributions -- autumn surveys.



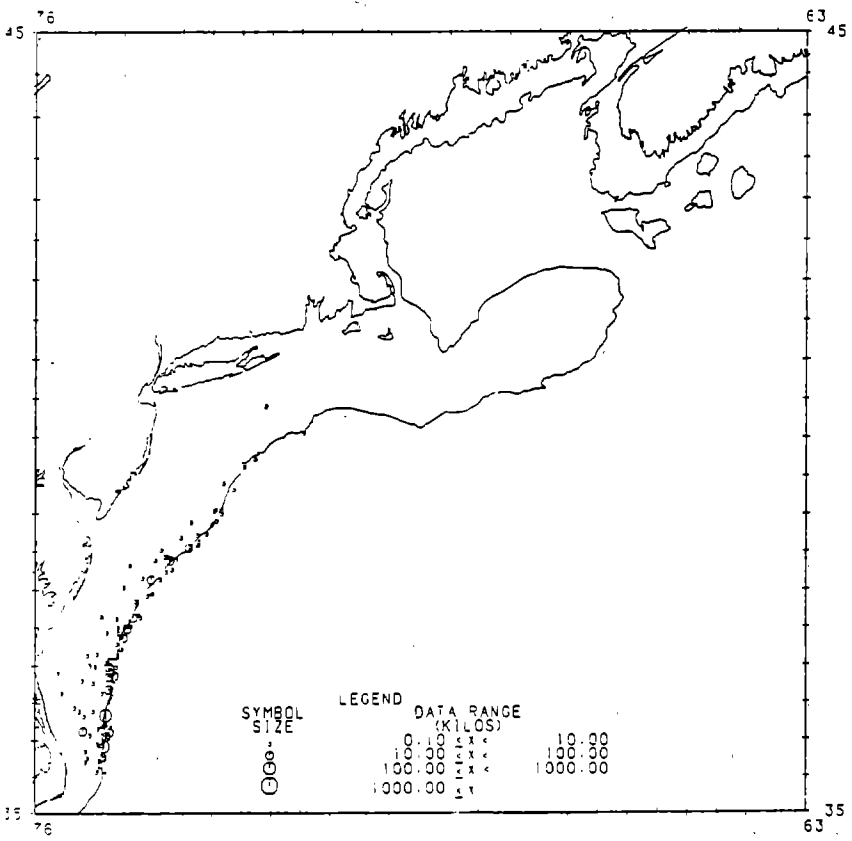


Figure S24-1. Black sea bass (*Centropristes striatus*) bottom trawl survey catch distributions -- spring surveys.

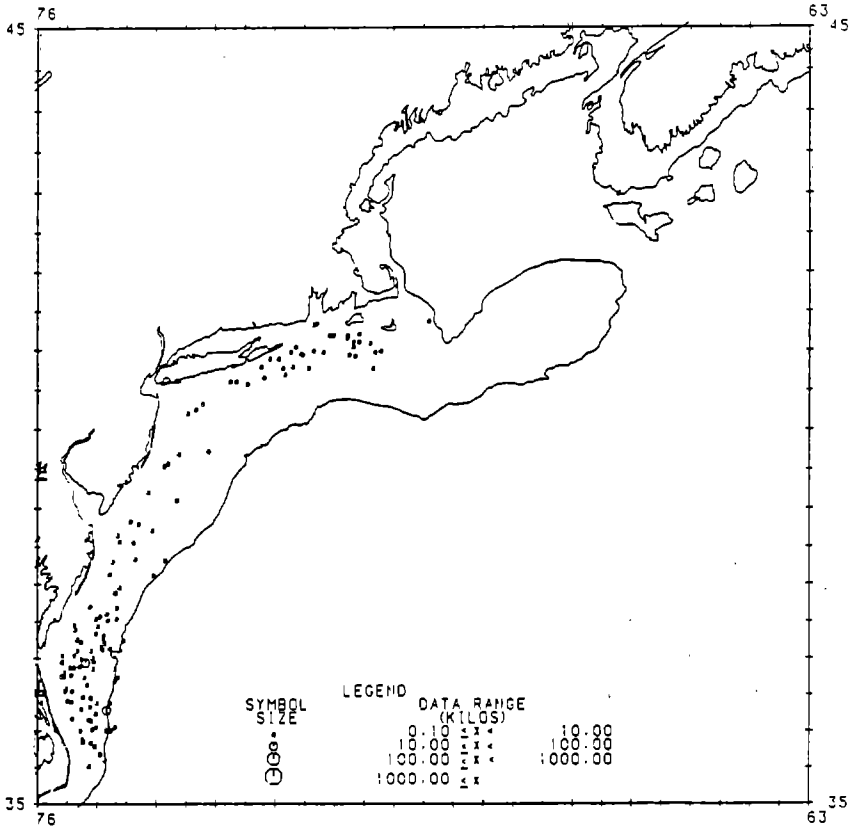


Figure S24-2. Black sea bass (*Centropristes striatus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S25-1. Scup (*Stenotomus chrysops*) bottom trawl survey catch distributions -- spring surveys.

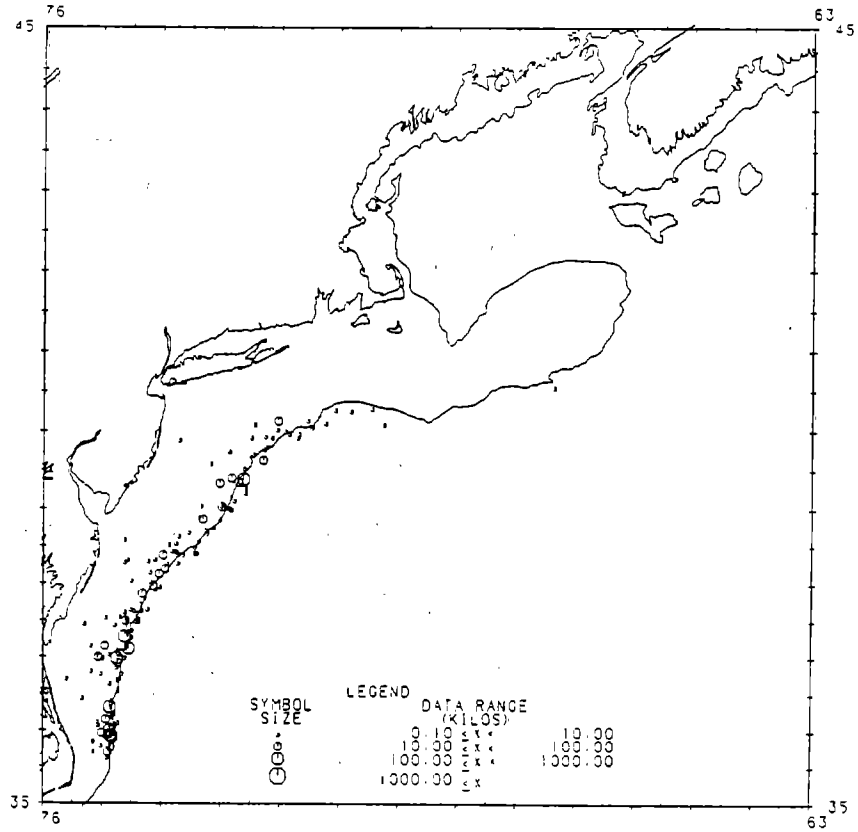
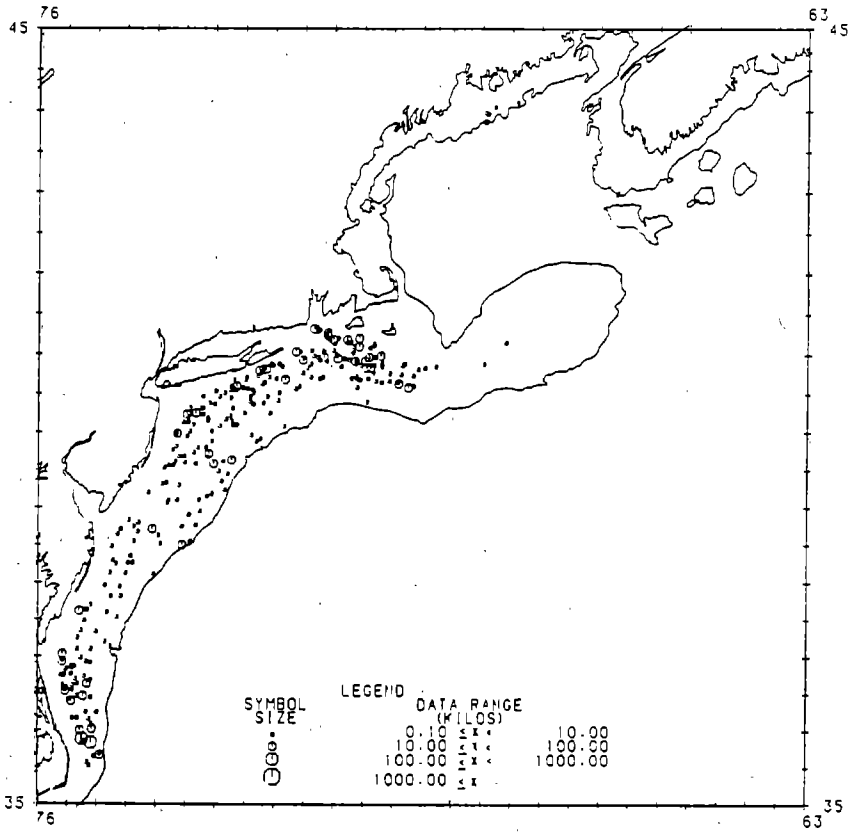


Figure S25-2. Scup (*Stenotomus chrysops*) bottom trawl survey catch distributions -- autumn surveys.



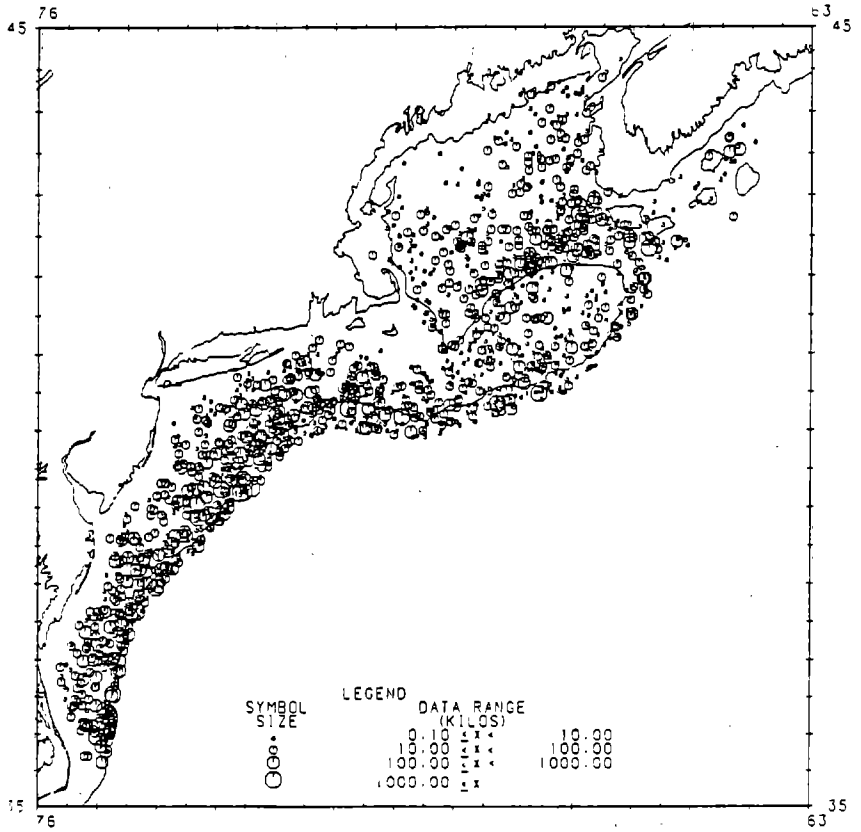


Figure S26-1. Spiny dogfish (*Squalus acanthias*) bottom trawl survey catch distributions -- spring surveys.

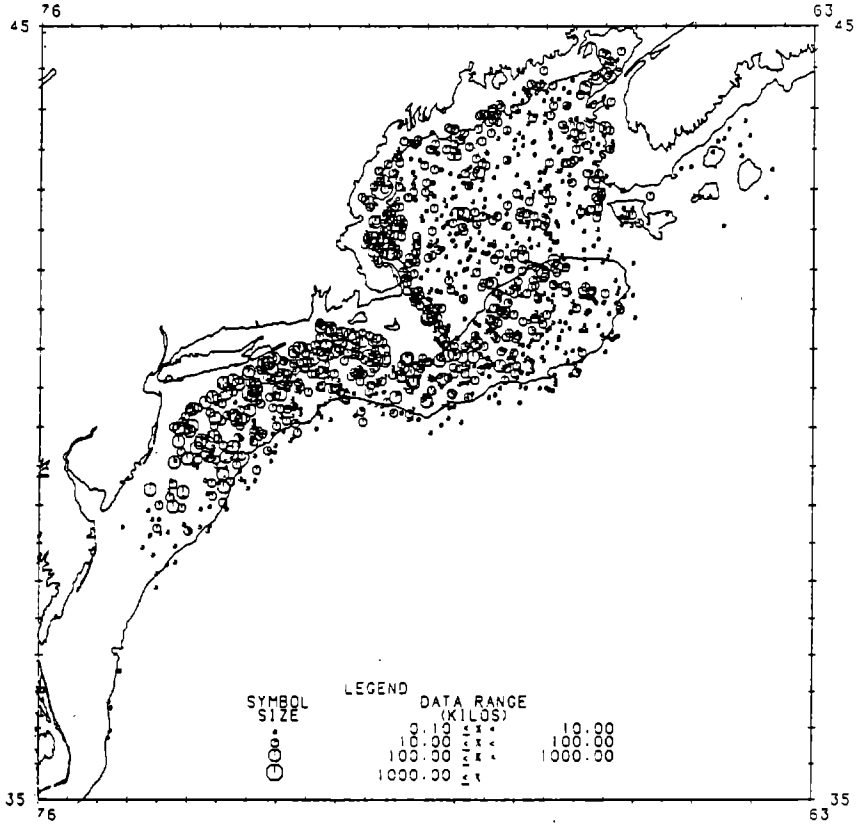


Figure S26-2. Spiny dogfish (*Squalus acanthias*) bottom trawl survey catch distributions -- autumn surveys.

Figure S27-1. Little skate (*Raja erinacea*) bottom trawl survey catch distributions -- spring surveys.

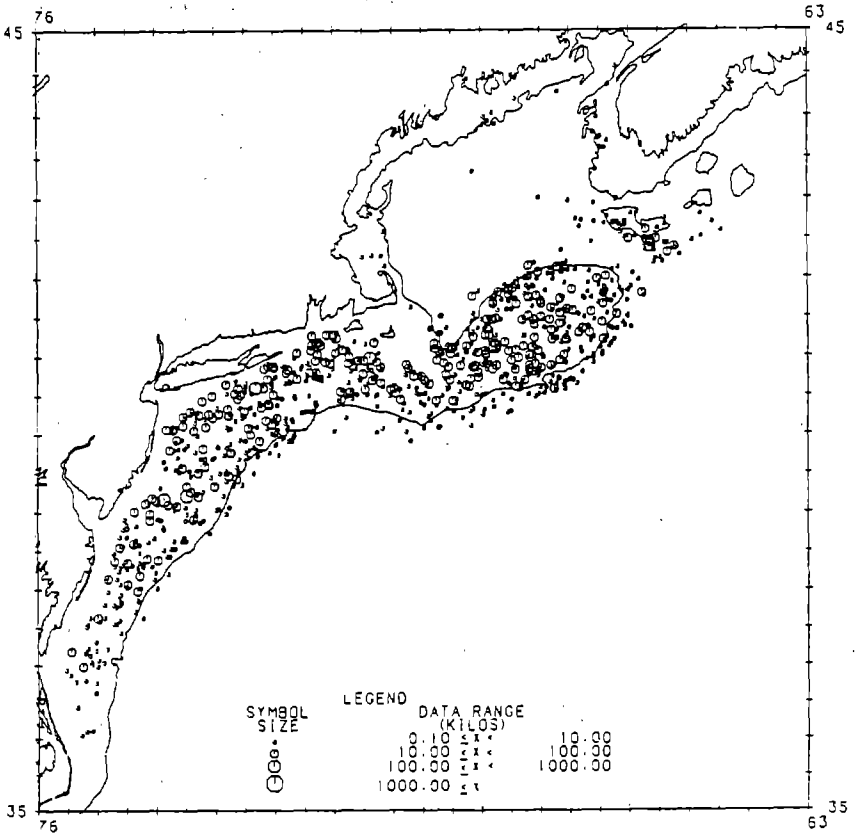
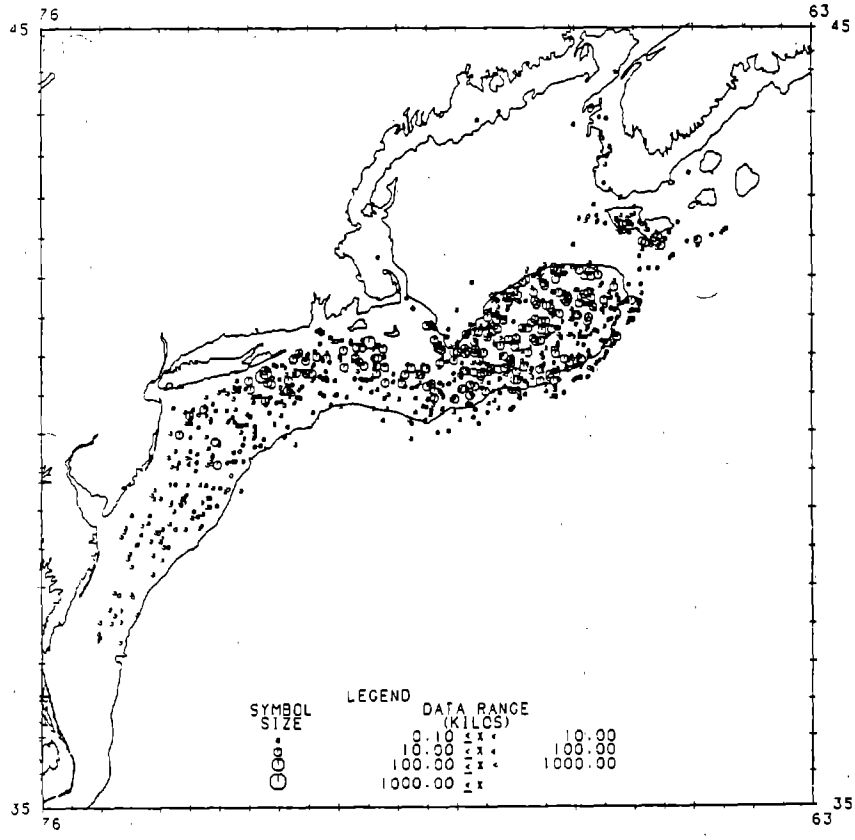


Figure S27-2. Little skate (*Raja erinacea*) bottom trawl survey catch distributions -- autumn surveys.



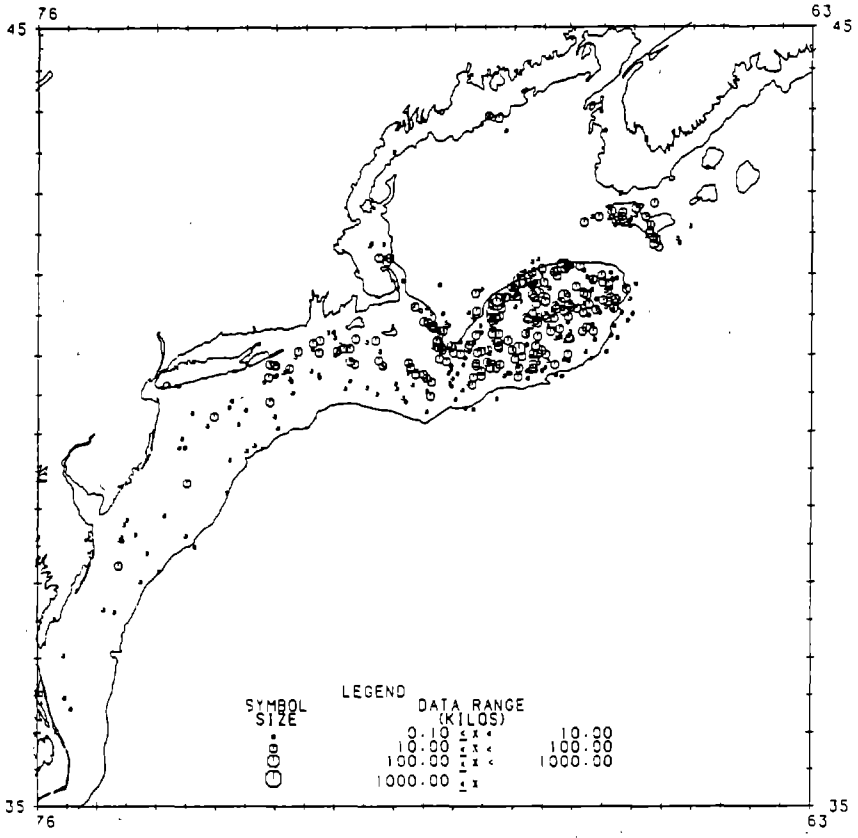


Figure S28-1. Winter skate (*Raja ocellata*) bottom trawl survey catch distributions -- spring surveys.

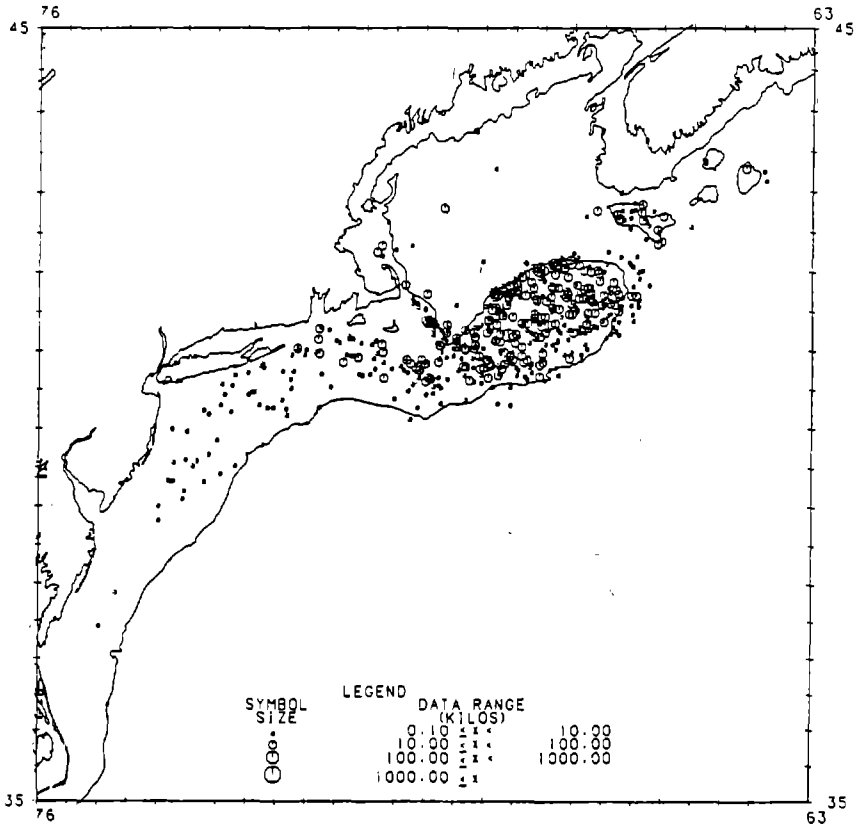


Figure S28-2. Winter skate (*Raja ocellata*) bottom trawl survey catch distributions -- autumn surveys.

Figure S29-1. Thorny skate (*Raja radiata*) bottom trawl survey catch distributions -- spring surveys.

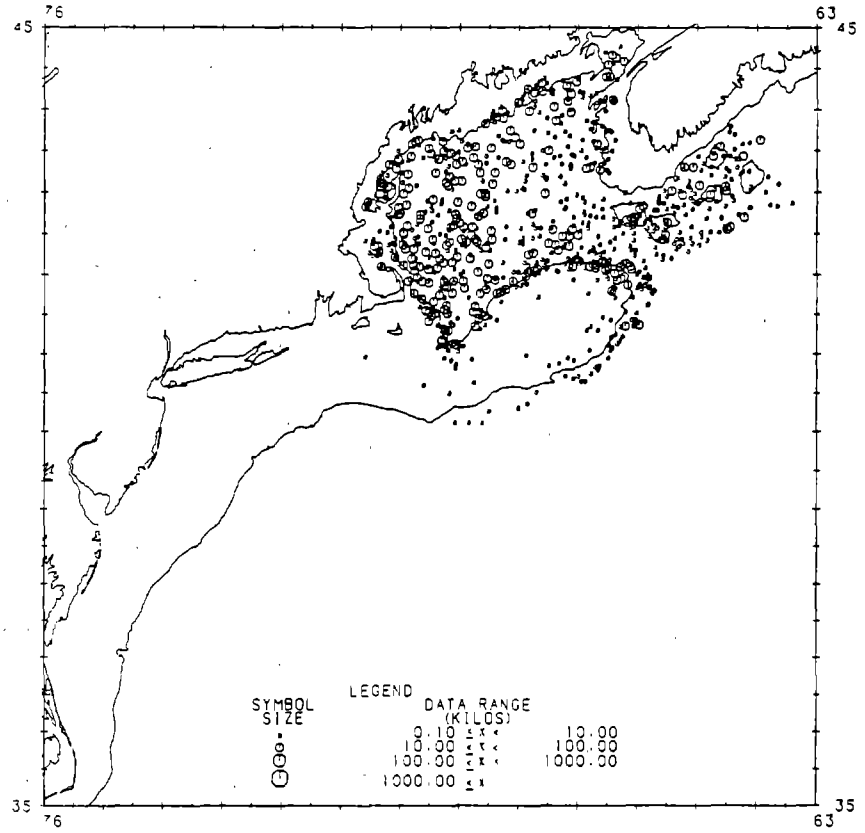
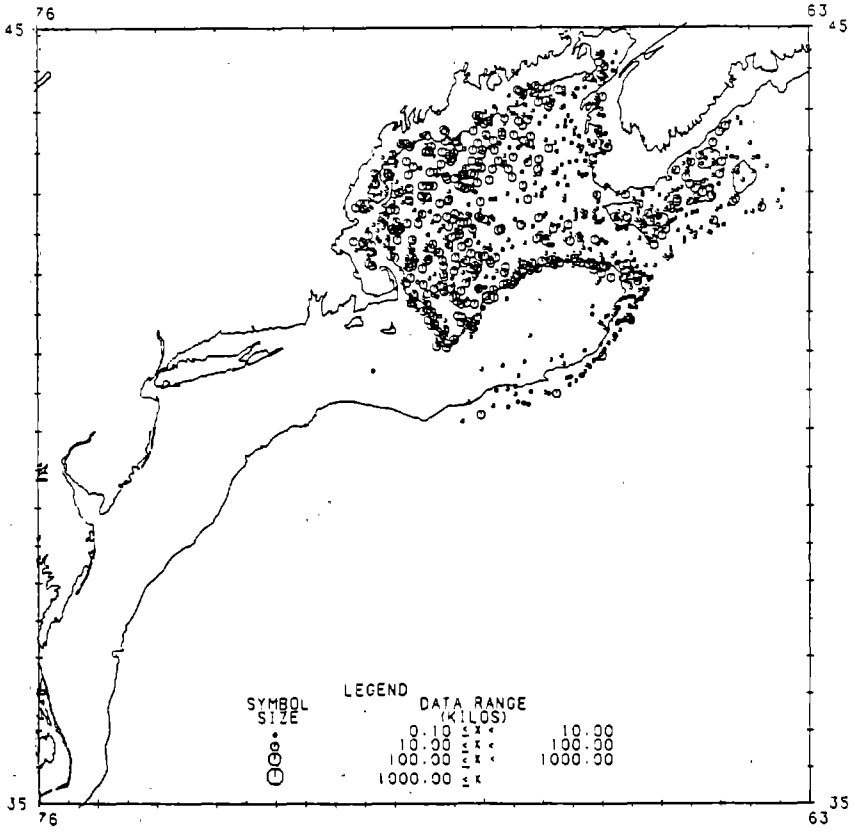


Figure S29-2. Thorny skate (*Raja radiata*) bottom trawl survey catch distributions -- autumn surveys.



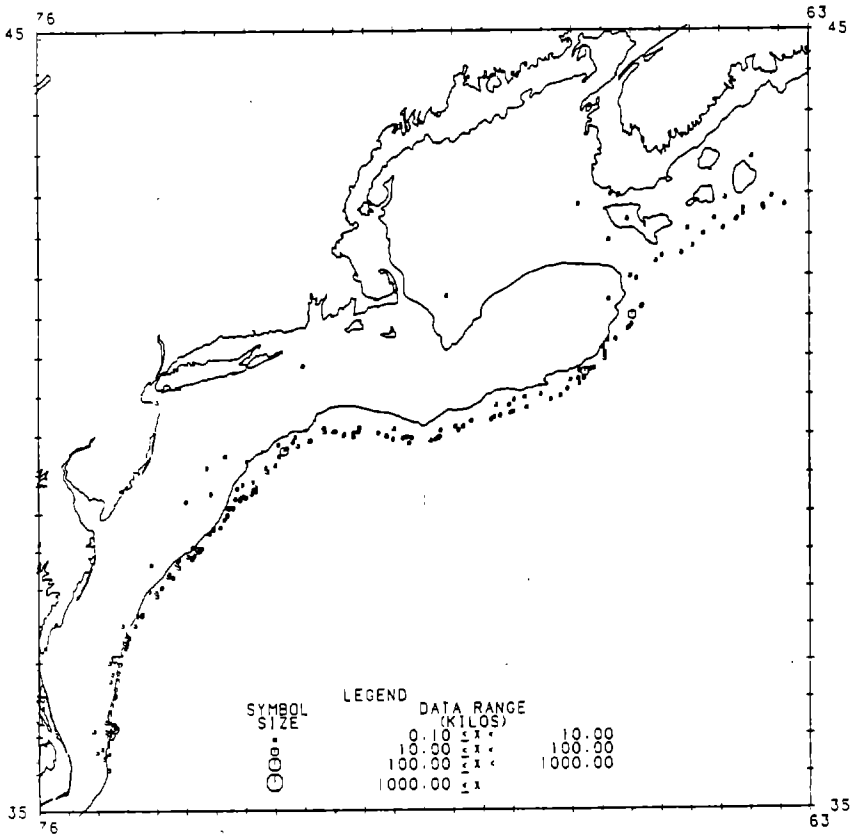


Figure S30-1. Northern shortfin squid (*Illex illecebrosus*) bottom trawl survey catch distributions -- spring surveys.

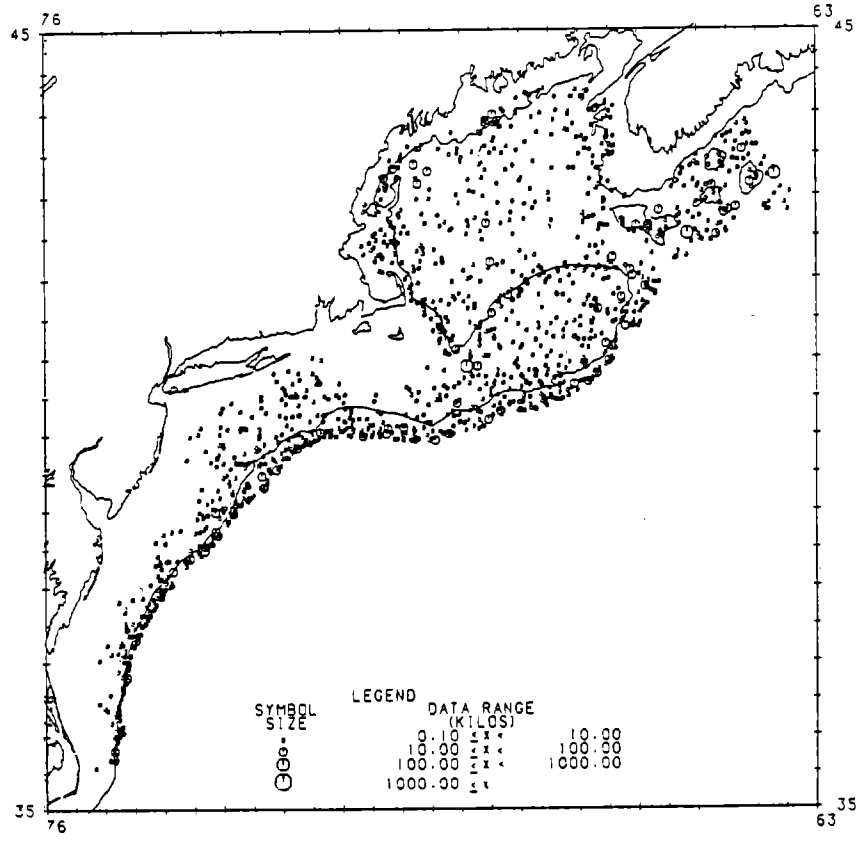


Figure S30-2. Northern shortfin squid (*Illex illecebrosus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S31-1. Longfin squid (*Loligo pealei*) bottom trawl survey catch distributions -- spring surveys.

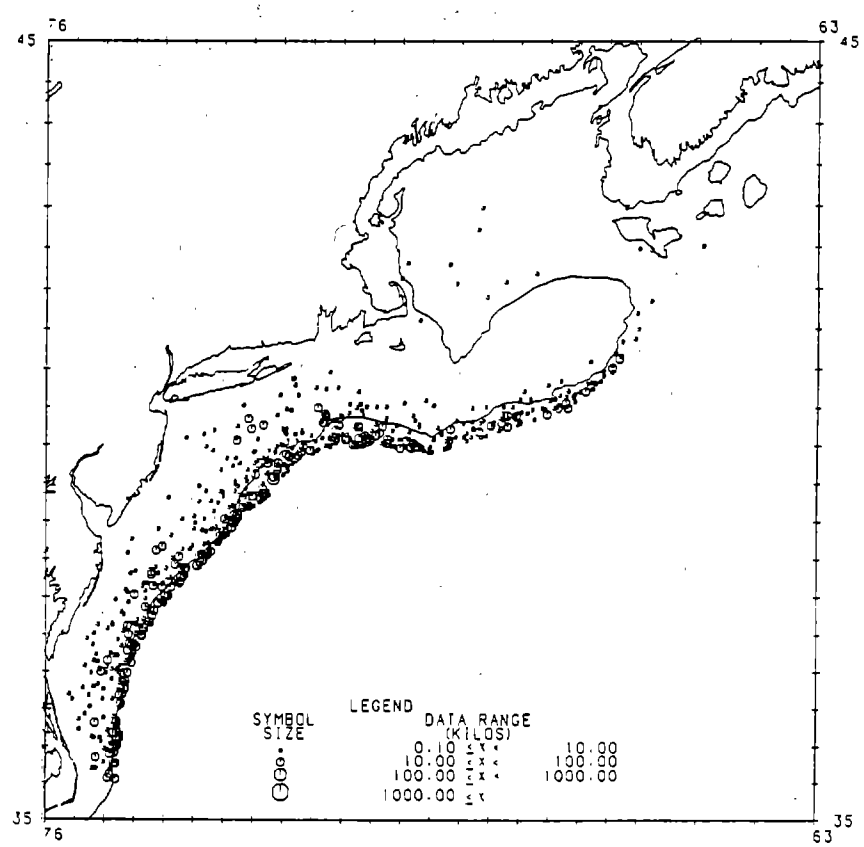
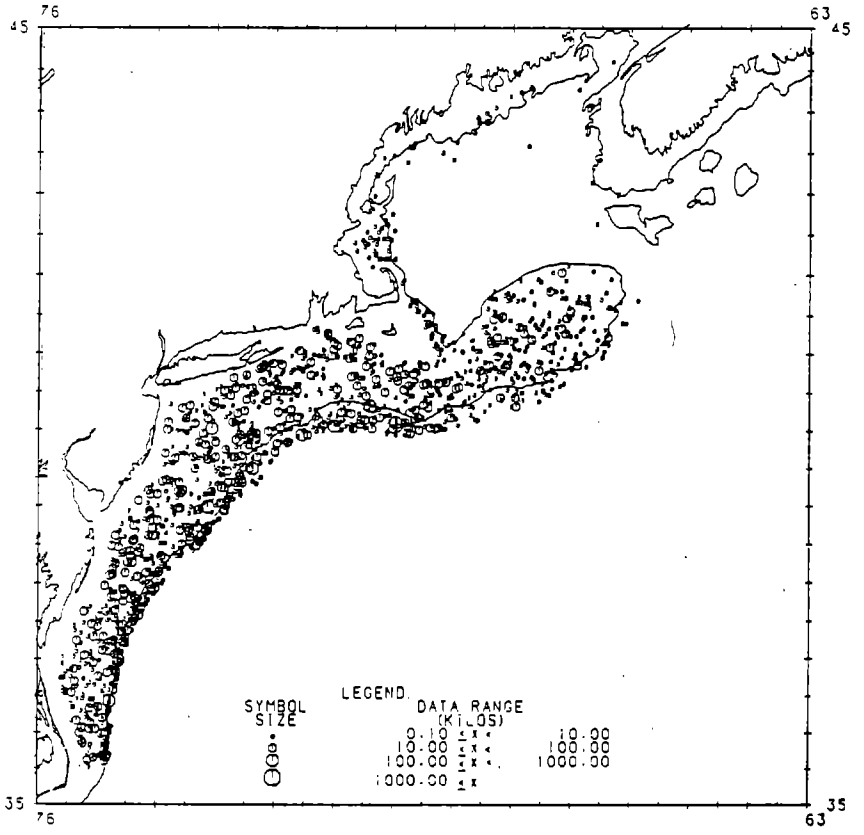


Figure S31-2. Longfin squid (*Loligo pealei*) bottom trawl survey catch distributions -- autumn surveys.



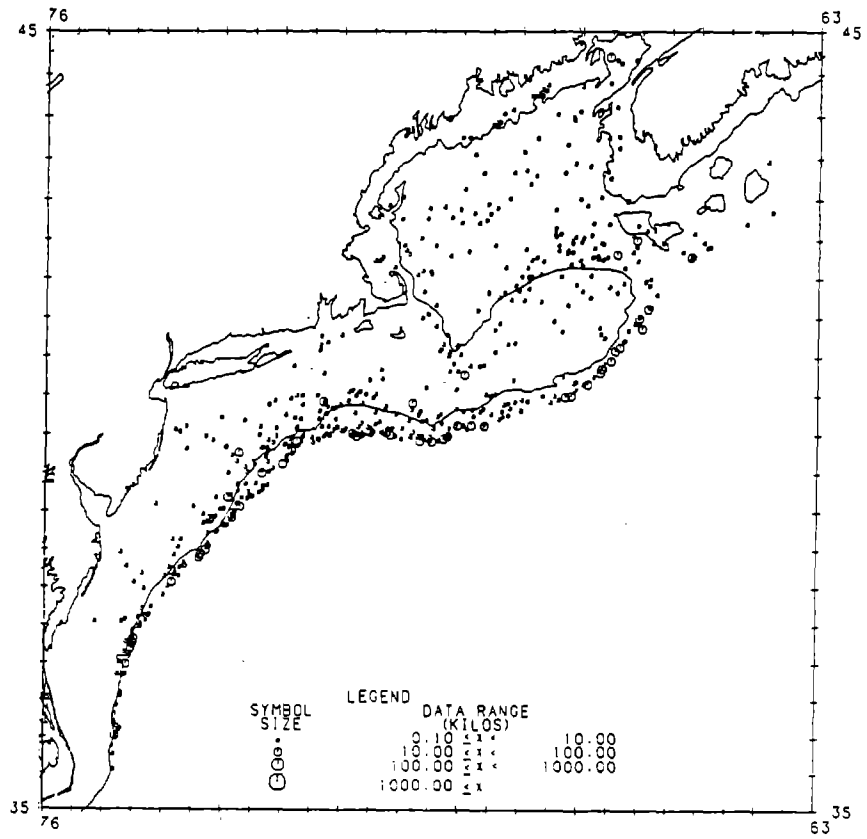


Figure S32-1. American lobster (*Homarus americanus*) bottom trawl survey catch distributions -- spring surveys.

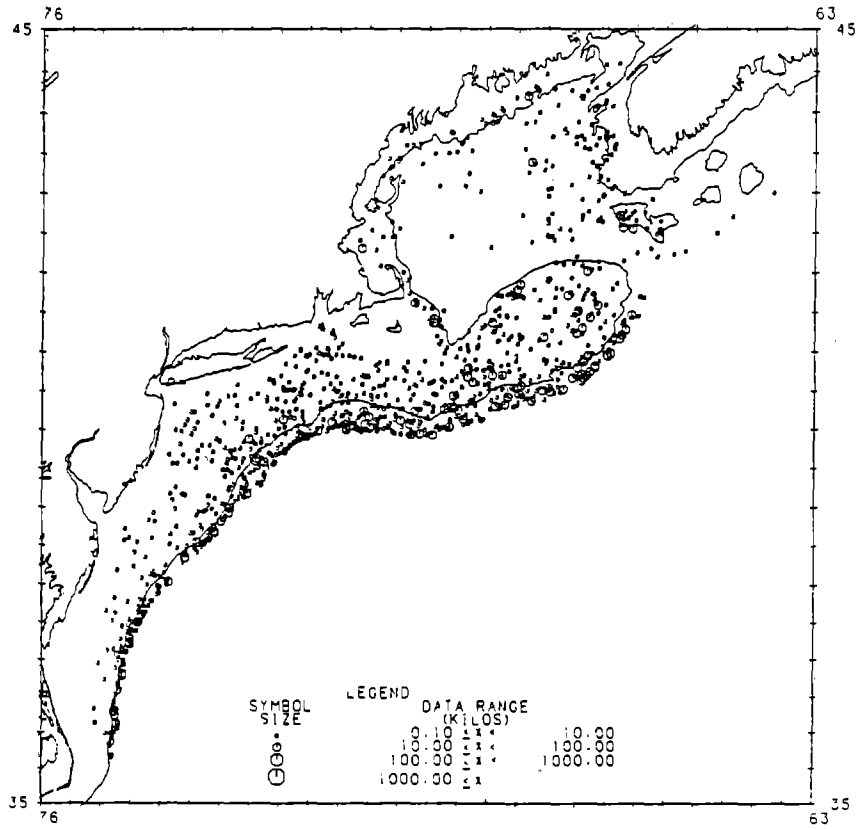


Figure S32-2. American lobster (*Homarus americanus*) bottom trawl survey catch distributions -- autumn surveys.

Figure S33-1. Sea scallop (*Placopecten magellanicus*) bottom trawl survey catch distributions -- spring surveys.

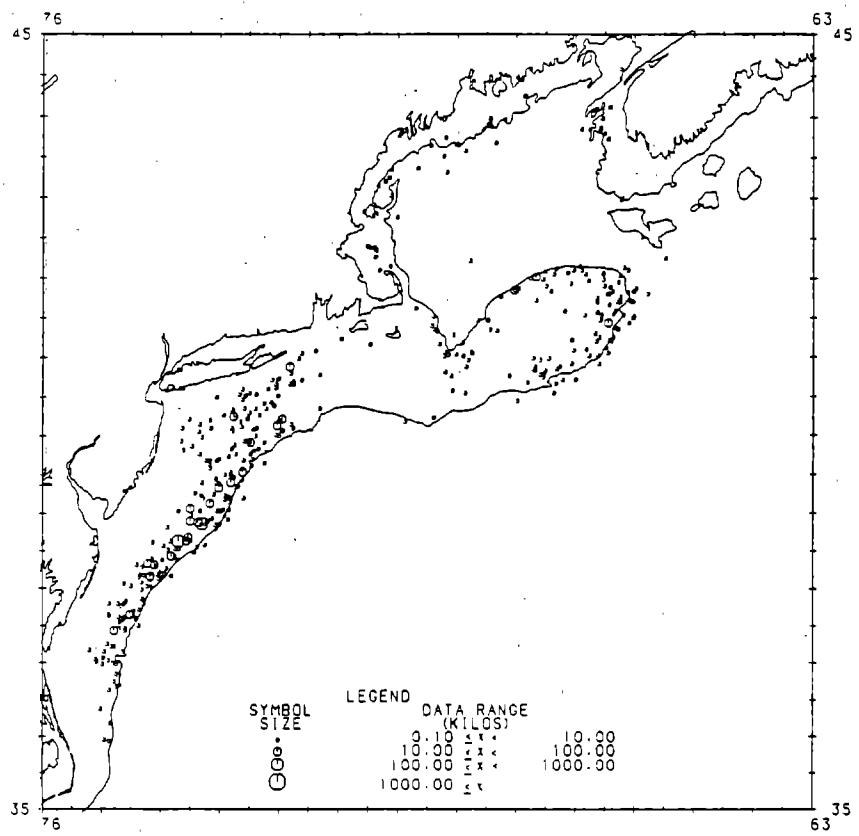
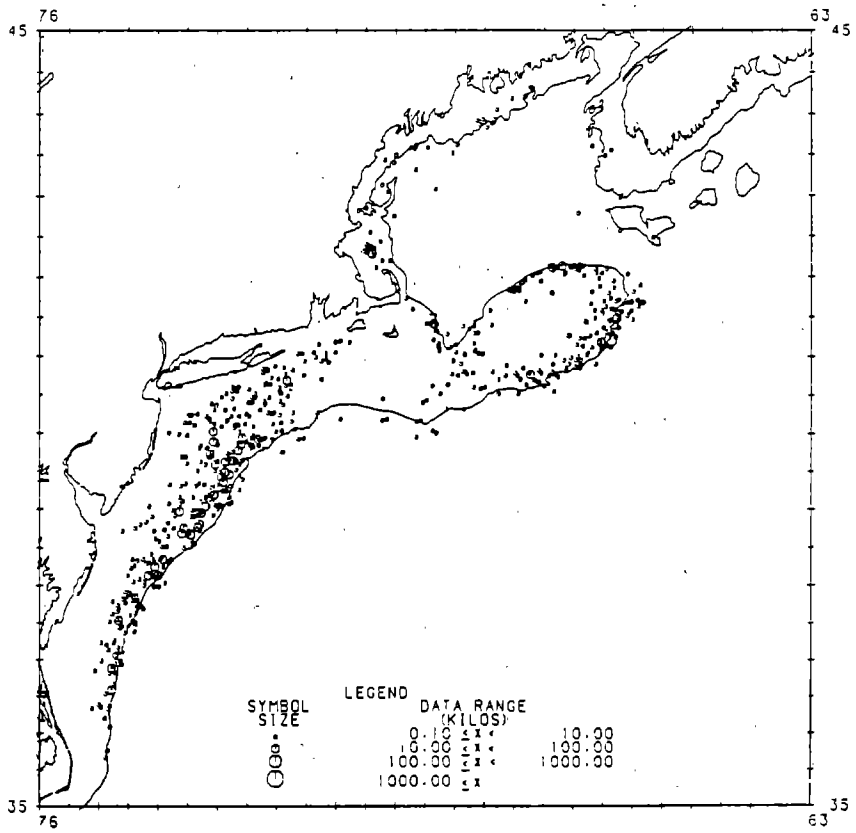


Figure S33-2. Sea scallop (*Placopecten magellanicus*) bottom trawl survey catch distributions -- autumn surveys.



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