WOODS HOLE LABORATORY REFERENCE DOCUMENT NO. 84-21

The Distribution of Major Finfish and Shellfish Species Collected during NEFC Bottom Trawl Surveys, 1965-1978

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(APPROVING OFFICIAL)

Aug 7, 1984
(DATE)

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INTRODUCTION

Synoptic bottom trawl surveys of the offshore fishery resources of the Northwest Atlantic continental shelf have been conducted by the Northeast Fisheries Center since the autumn of 1963. These surveys provided the data for examining the temporal and spatial distribution of 46 finfish and shellfish species occurring on the shelf.

MATERIALS AND METHODS

The bottom trawl surveys initially covered the area extending from Nova Scotia south to the Hudson Canyon in depths of 27 m to approximately 366 m, although greater depths were occasionally encountered in the deep canyons along the continental shelf break. In the autumn of 1967, coverage was extended southward to include the area from New Jersey to Cape Hatteras, NC. The survey program was again expanded in 1968 with the addition of spring surveys covering the same area.

Trawl stations during each of the surveys were selected utilizing a stratified random design. The entire survey area was stratified, with the major stratum boundaries determined by depth and biological considerations (Figure 1). The number of stations allocated to each stratum was roughly proportional to its area. However, to permit the calculation of within-stratum variance, at least two stations were sampled in each stratum. Therefore, in the

smaller strata, sampling intensity was greater than in larger strata. Each stratum was divided into 5 by 10 minute areas, with each of these areas further subdivided into 2 by 2.5 minute blocks which are numbered throughout the stratum. Numbers were drawn at random (subject to the constraint that only one number was chosen from any given 5 by 10 minute area) until the required number of 5 by 10 minute areas was selected. This sampling scheme provided for about one station for each 200 square nautical miles (Grosslein 1974, Azarovitz 1981).

During surveys conducted in the autumn, a No. 36 Yankee bottom trawl, rigged with 41 cm rollers and a 1.25 cm stretched mesh codend, was towed at each station for 30 minutes at an average speed of 3.5 knots. Operations were conducted 24 hr/day. The No. 36 Yankee trawl was also used during the 1968-1972 spring surveys but was replaced by a larger, high-opening No. 41 Yankee trawl in 1973.

At each station during all surveys, all fish and major invertebrate species were sorted by species, weighed, measured, and sampled for other analyses such as age and growth studies, food habits, and other special studies. A complete log for each station, including total catch of each species by weight and number, length frequency data by species, location, depth, and surface and bottom temperature, was prepared and processed ashore for later computer analysis.

Data from only those surveys which sampled the entire area from Nova Scotia to Cape Hatteras were used in this analysis, including the 1968-1974, 1976 and 1978 spring surveys and the 1965-1975 and 1977 autumn surveys (Table 1). A total of 2,605 and 3,321 stations were occupied during these spring and autumn surveys, respectively.

Catches (kilograms) of each of 46 species from each survey were pooled by season (all years combined) and plotted. Catch data were not adjusted to account for trawl efficiency in capturing each species (catchability) nor for the difference between trawls used during the spring and autumn surveys. Therefore, the density distributions are not directly comparable between species, due to varying catchabilities, or directly comparable between spring and autumn for a given species, due to trawl differences. However, the distributional plots of the pooled data over all years for each season are representative of the relative density distribution for each species.

RESULTS

The figures that follow include cumulative plots of station locations (Figures 2 and 3), and the distribution of catches for each species (Figures 4-95) during the spring and autumn surveys.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the contributions of the sea-going scientists and technicians from the Northeast Fisheries Center and other institutions who have participated in the bottom trawl survey program through the years. Their efforts and perseverance in data collection, ofttimes under 'less than optimum' conditions have produced the most extensive data base of any marine ecosystem in the world.

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Azarovitz, T.R. 1981. A brief historical review of the Woods Hole Laboratory trawl survey time series, p. 62-67 In: W.G. Doubleday and D. Rivard [eds.] Bottom trawl surveys. Can. Spec. Publ. Fish. Aquat. Sci. 58.

Grosslein, M.D. 1974. Bottom trawl survey methods of the Northeast Fisheries Center, Woods Hole, MA, USA. Int. Comm. Northw. Atlant. Fish. Res. Doc. No. 74/96. Ser. No. 3332 (mimeo), 27 p.

Table 1. Research vessel bottom trawl surveys conducted off the northeast coast of the US during 1965-1978 utilized in the distributional plots.

Vessel	Date	Trawl Type	No. of Stations
	Spring		
Albatross IV	6 Mar - 22 Apr 1968	#36 Yankee	262
Albatross IV	3 Mar - 10 Apr 1969	#36 Yankee	266
Albatross IV	13 Mar - 30 Apr 1970	#36 Yankee	289
Albatross IV	9 Mar - 5 May 1971	#36 Yankee	301
Albatross IV	8 Mar - 28 Apr 1972	#36 Yankee	303
Albatross IV -Delaware II	19 Mar - 16 May 1973	#41 Yankee	314
Albatross IV	12 Mar - 5 May 1974	#41 Yankee	251
Albatross IV -Delaware II	4 Mar - 8 May 1976	#41 Yankee	300
Albatross IV	20 Mar - 26 May 1978	#41 Yankee	319
	Autumn		
Albatross IV	6 Oct - 9 Nov 1965	#36 Yankee	193
Albatross IV	12 Oct - 13 Nov 1966	#36 Yankee	193
Albatross IV	17 Oct - 10 Dec 1967	#36 Yankee	270
Albatross IV	10 Oct - 26 Nov 1968	#36 Yankee	275
Albatross IV	8 Oct - 23 Nov 1969	#36 Yankee	276
Albatross IV -Delaware II	3 Sep - 21 Nov 1970	#36 Yankee	294
Albatross IV	29 Sep - 19 Nov 1971	#36 Yankee	303
Albatross IV	28 Sep - 20 Nov 1972	#36 Yankee	295
Albatross IV	26 Sep - 20 Nov 1973	#36 Yankee	286
Albatross IV	23 Sep - 10 Nov 1974	#36 Yankee	293
Albatross IV -Delaware II	7 Oct - 18 Nov 1975	#36 Yankee	304
Albatross IV	26 Sep - 5 Dec 1977	#36 Yankee	339

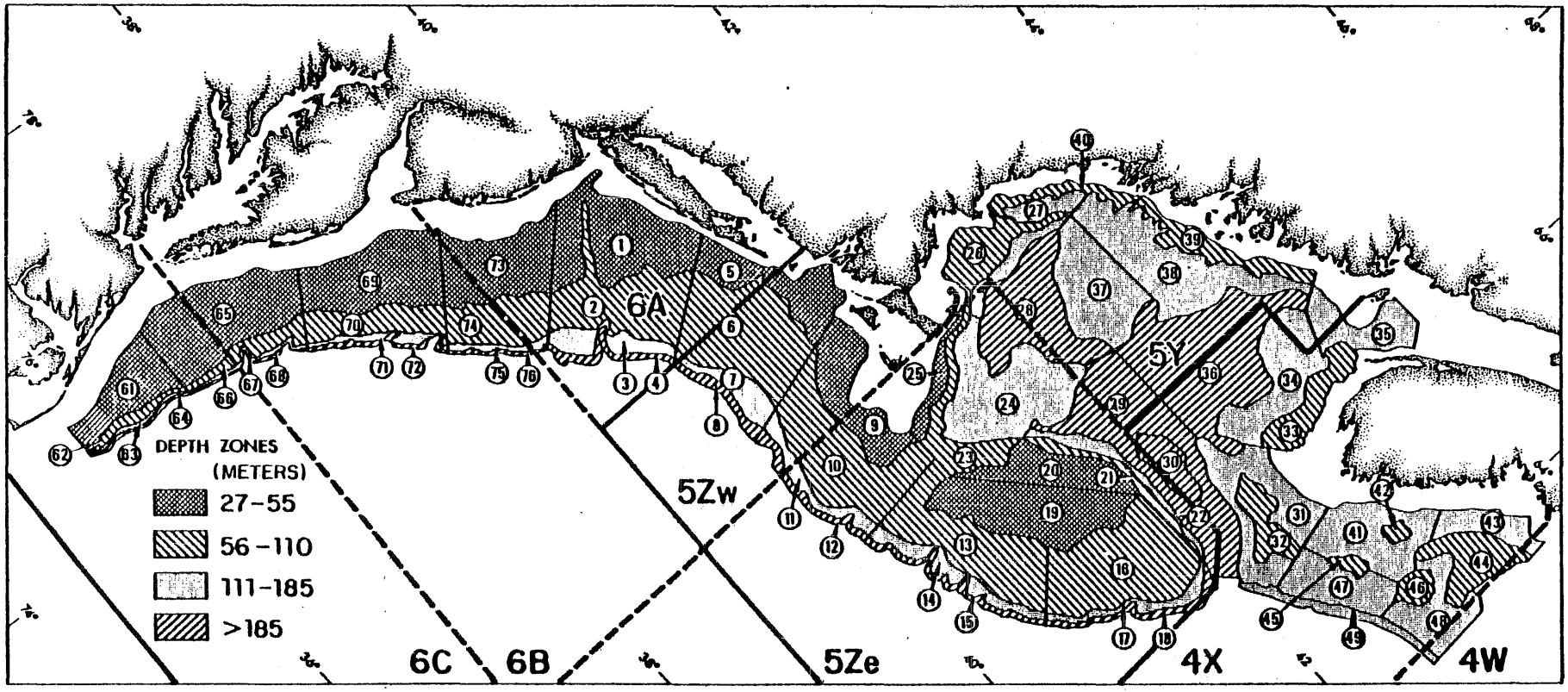

Figure 1. Research vessel bottom trawl survey sampling strata.

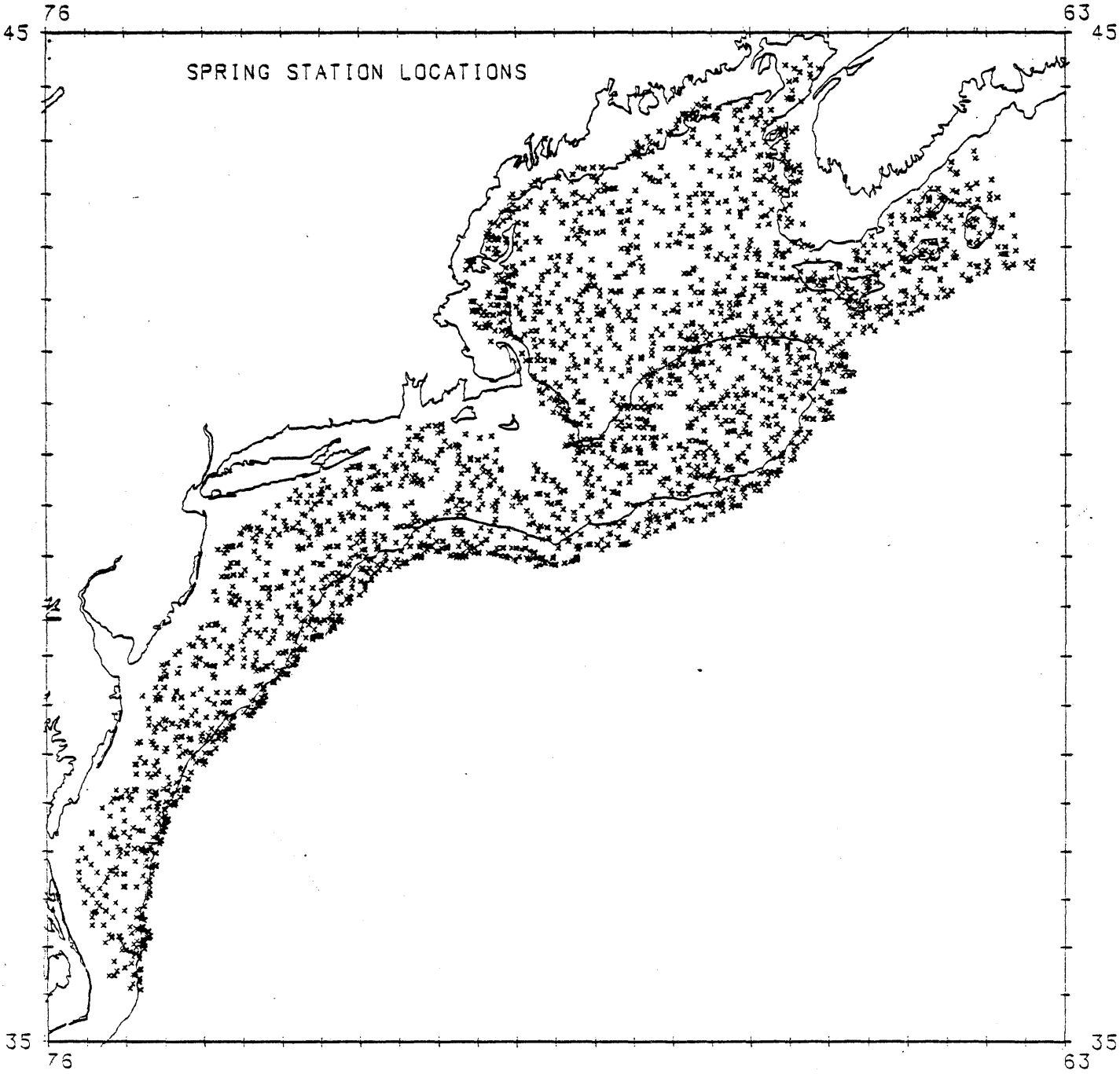

Figure 2. Cumulative plot of station locations during 1964-1974, 1976 and 1978 spring surveys.

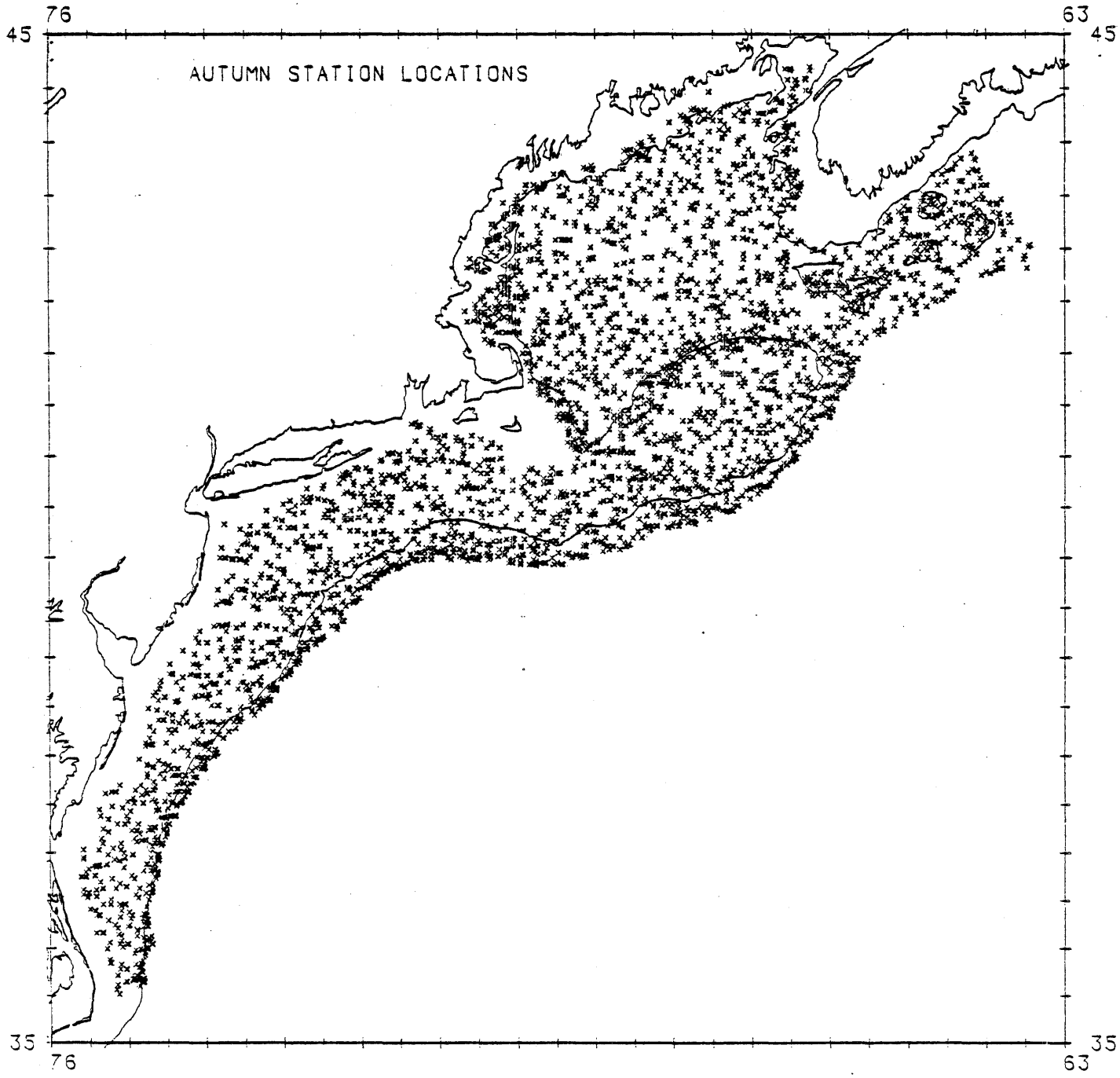

Figure 3. Cumulative plot of station locations during 1965-1975 and 1977 autumn surveys.

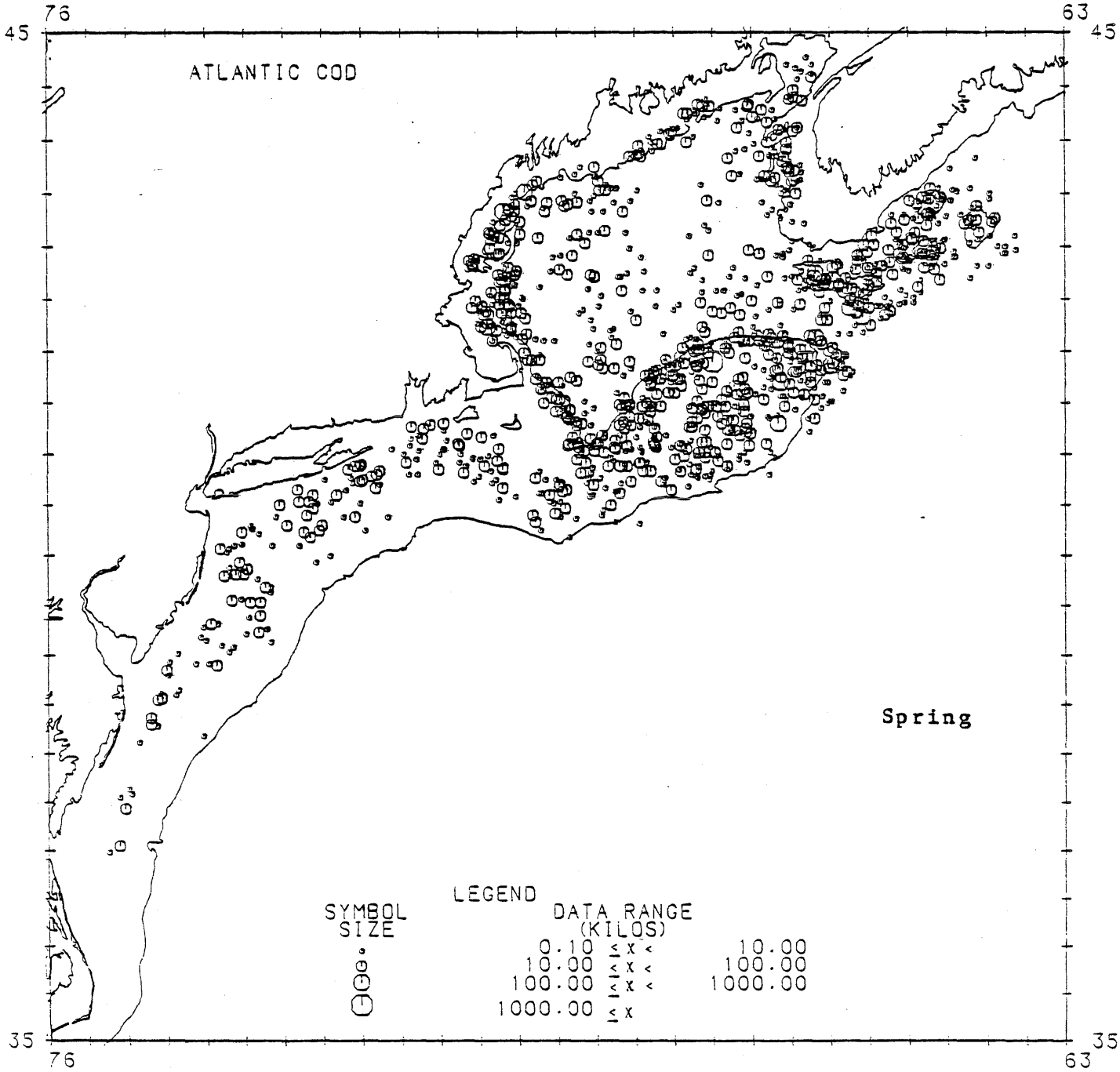

Figure 4. Distribution of Atlantic cod catches during 1964-1974, 1976 and 1978 spring surveys.

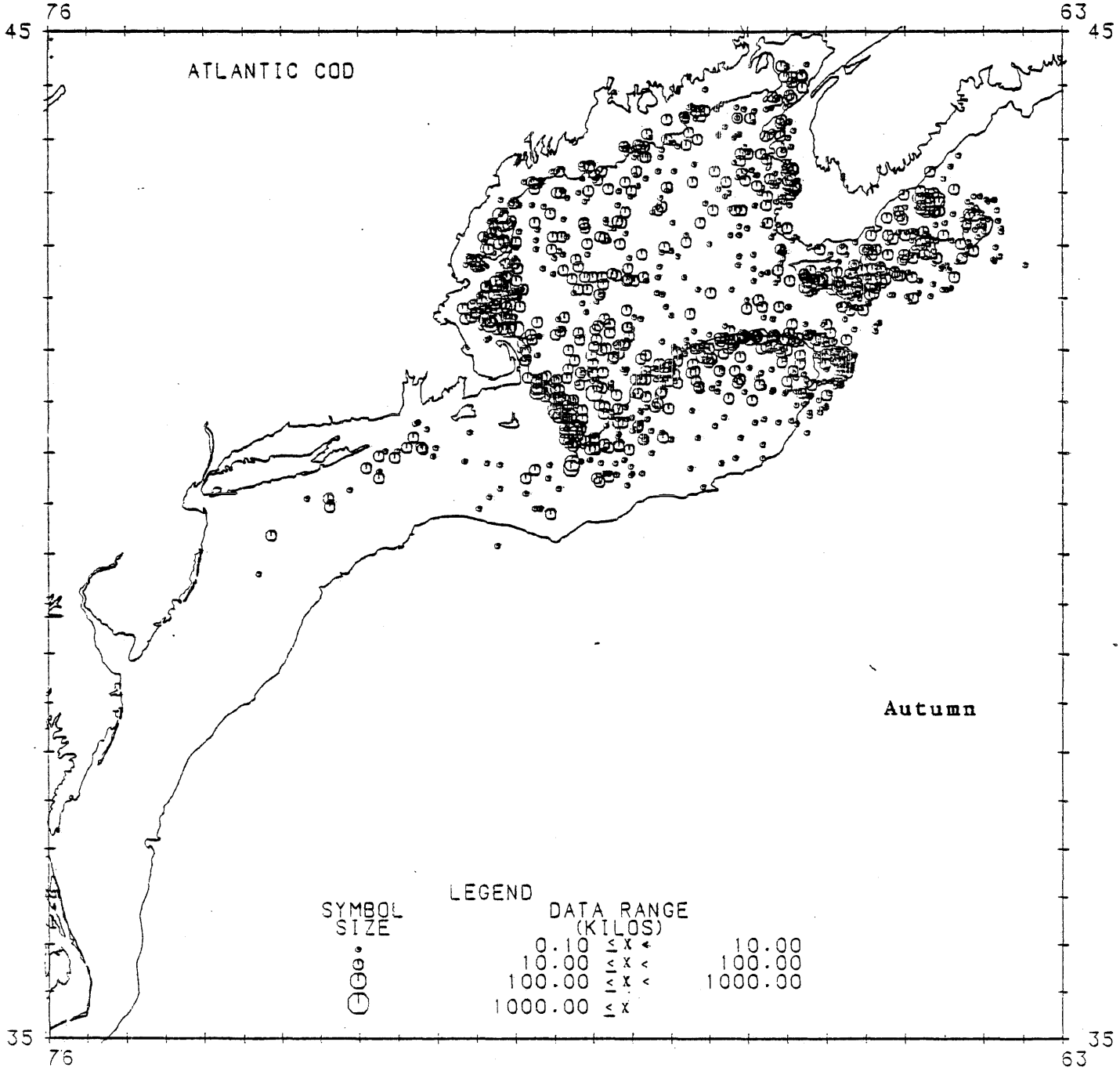

Figure 5. Distribution of Atlantic cod catches during 1965-1975 and 1977 autumn surveys.

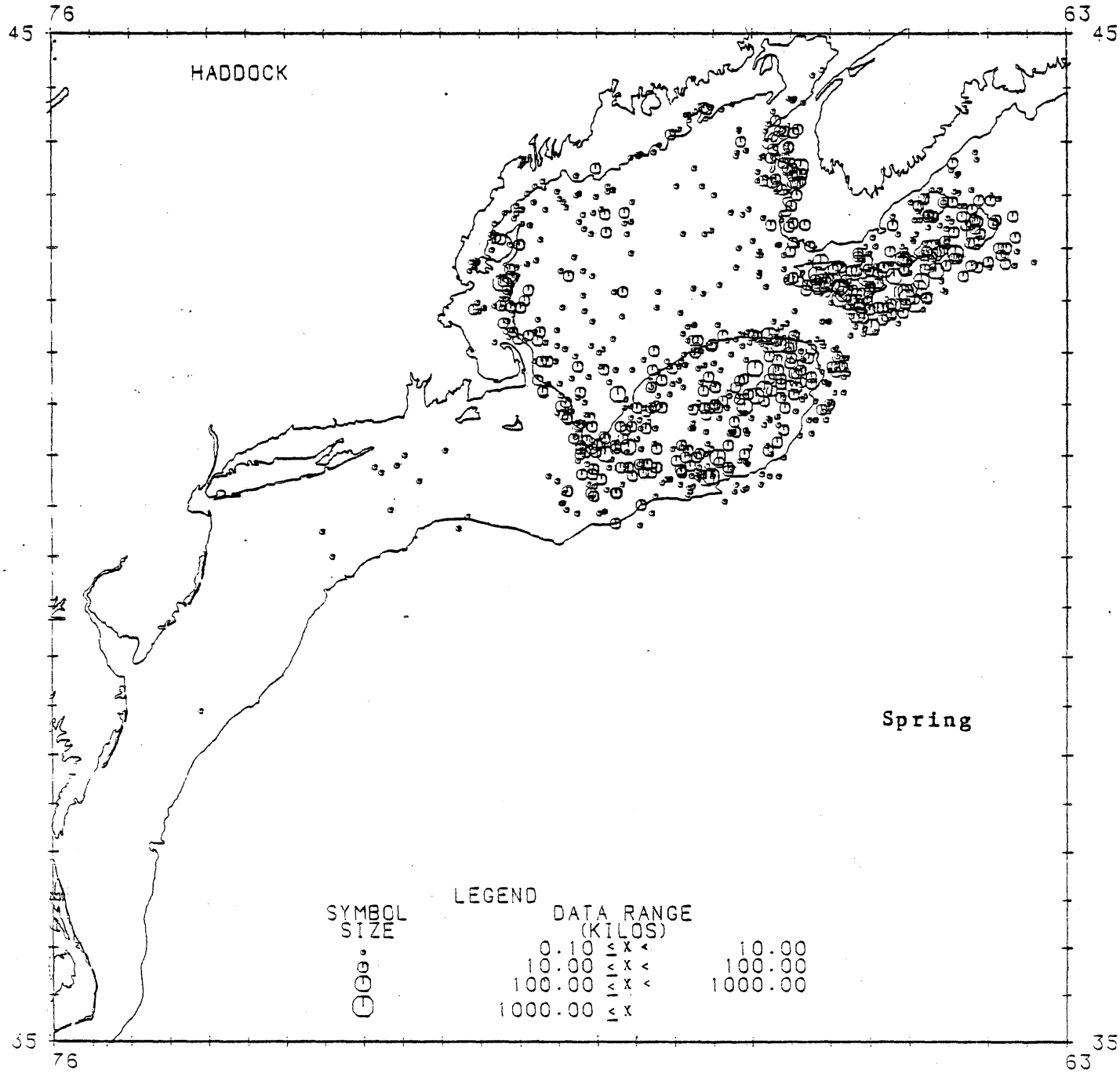

Figure 6. Distribution of haddock catches during 1964-1974, 1976 and 1978 spring surveys.

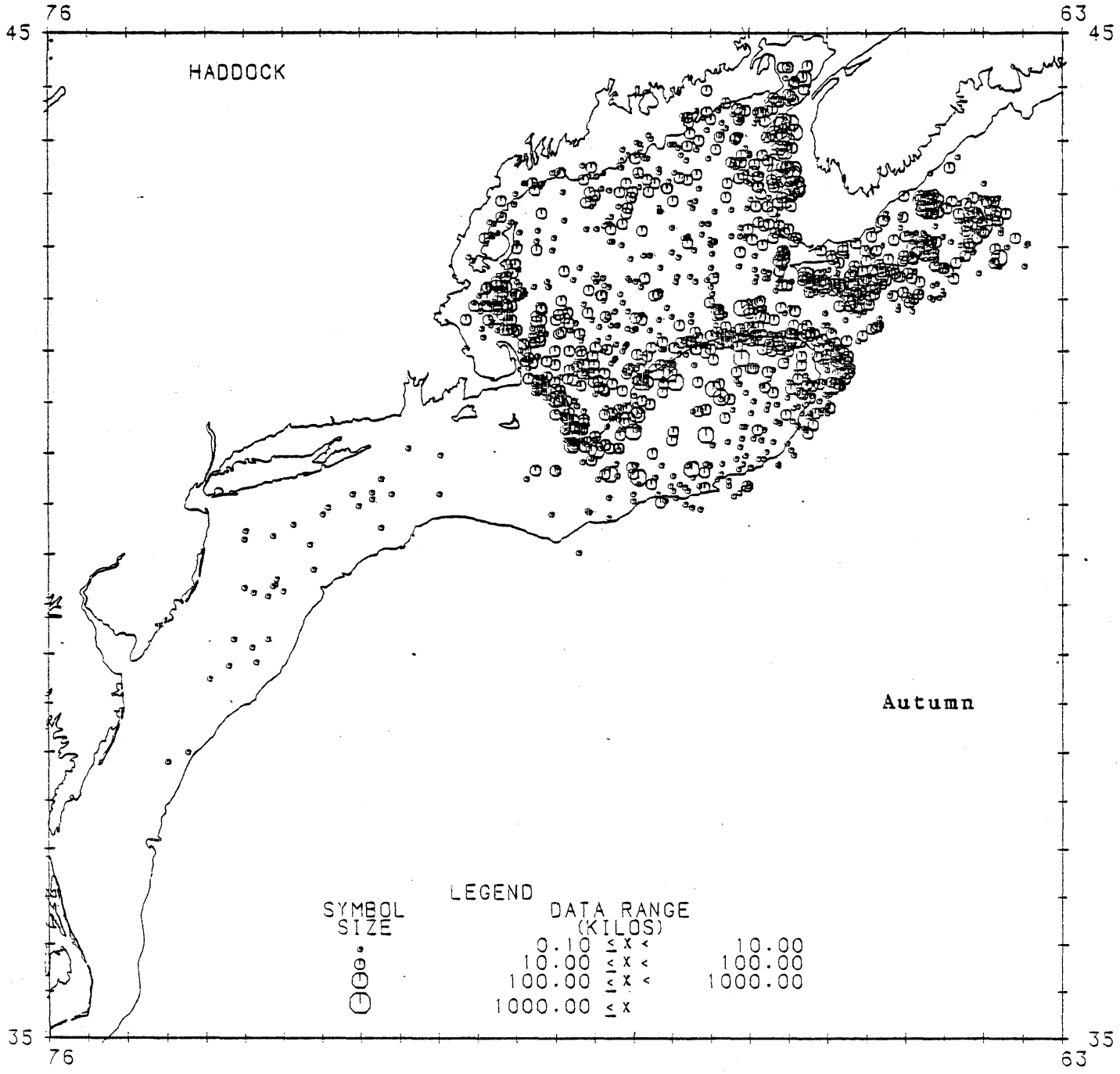

Figure 7. Distribution of haddock catches during 1965-1975 and 1977 autumn surveys.

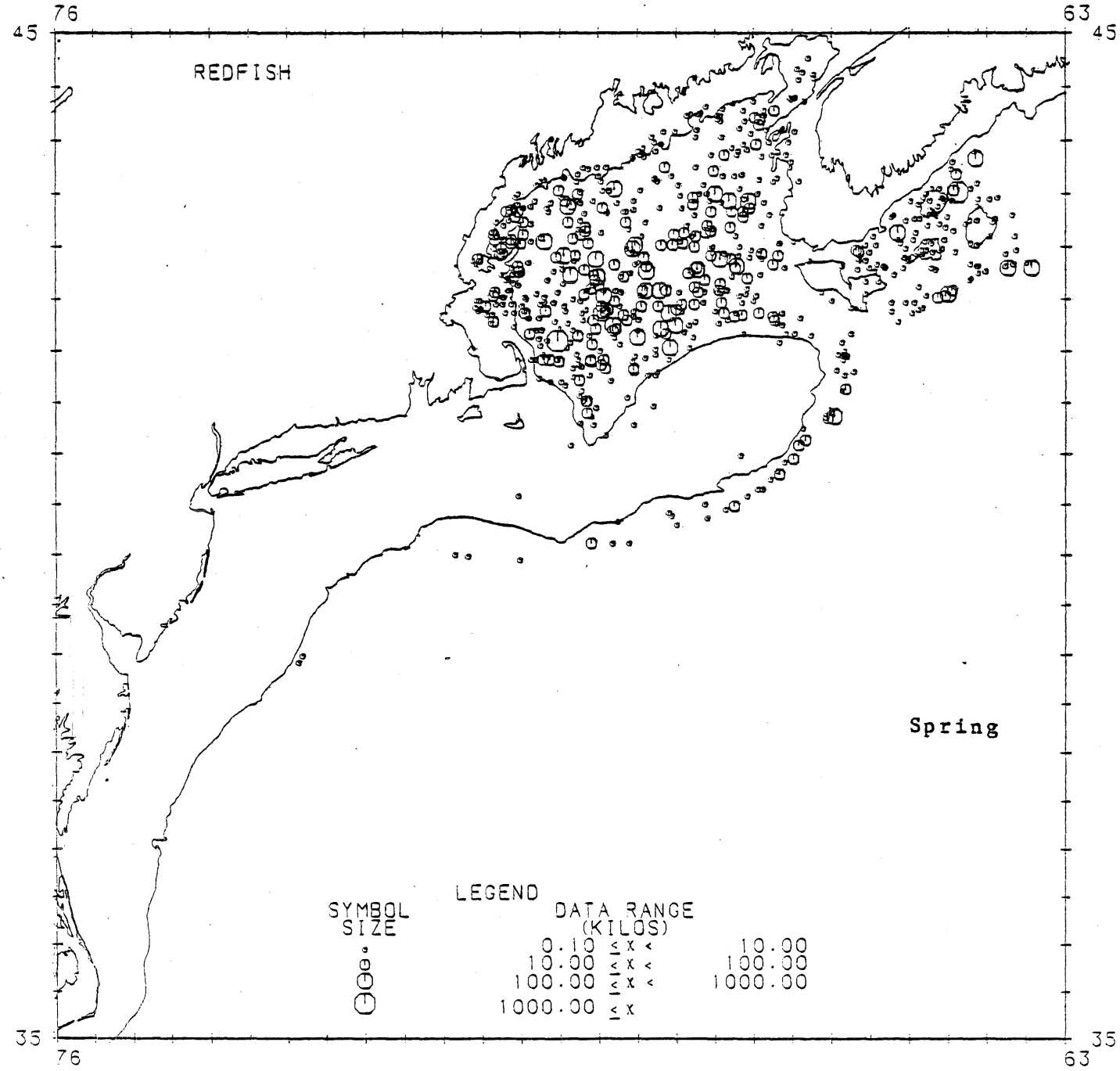

Figure 8. Distribution of redfish catches during 1964-1974, 1976 and 1978 spring surveys.

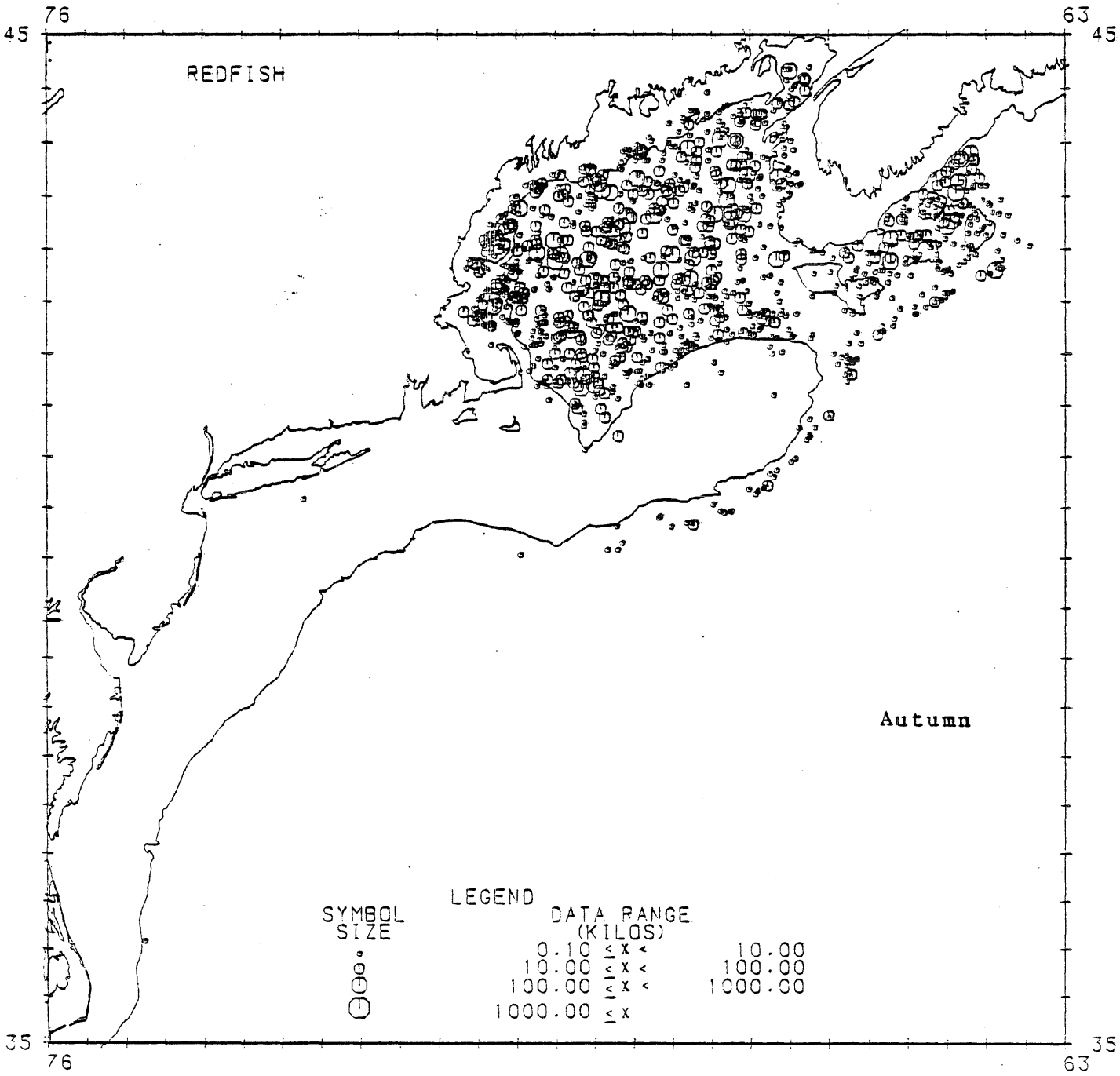

Figure 9. Distribution of redfish catches during 1965-1975 and 1977 autumn surveys.

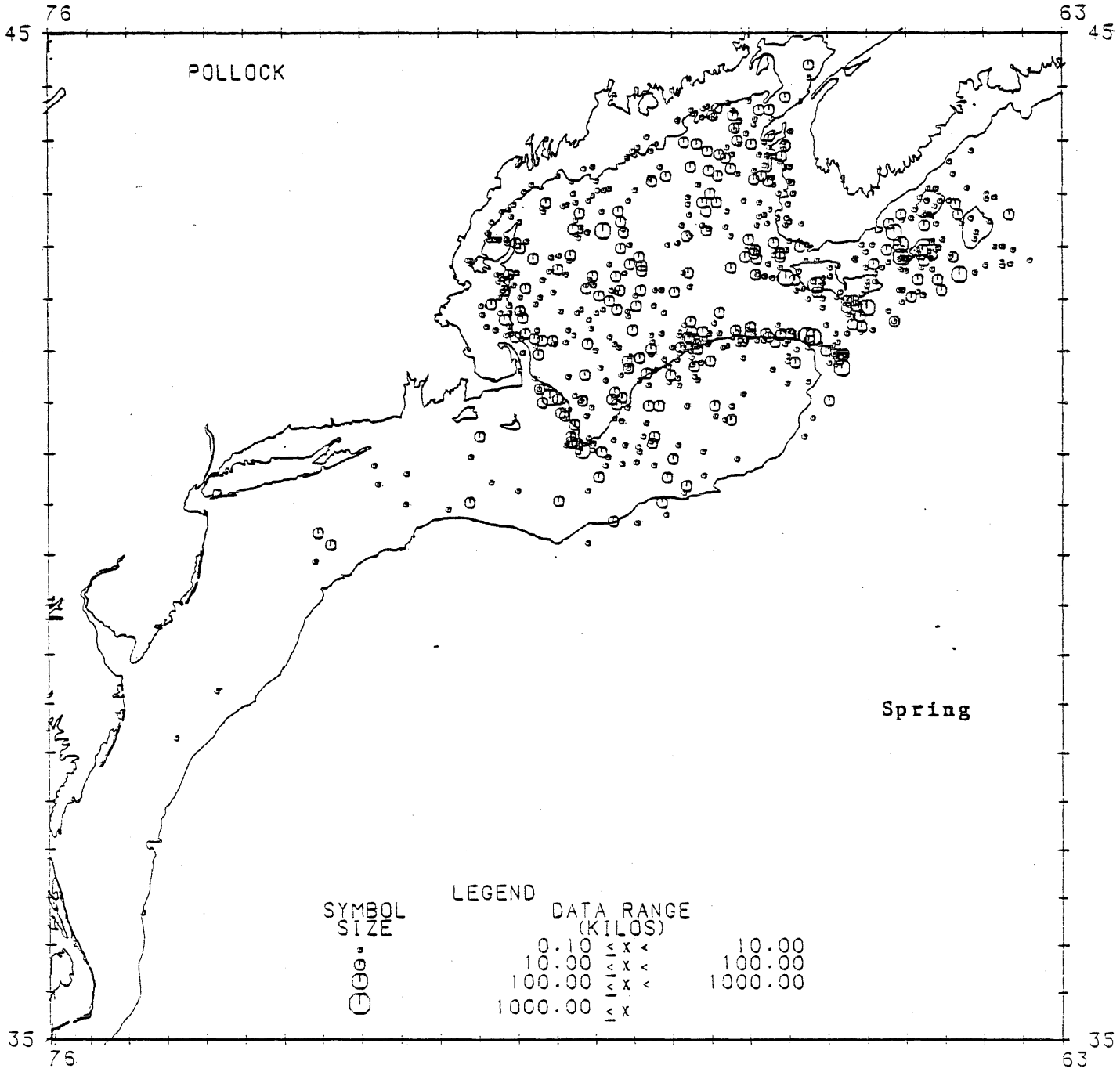

Figure 10. Distribution of pollock catches during 1964-1974, 1976 and 1978 spring surveys.

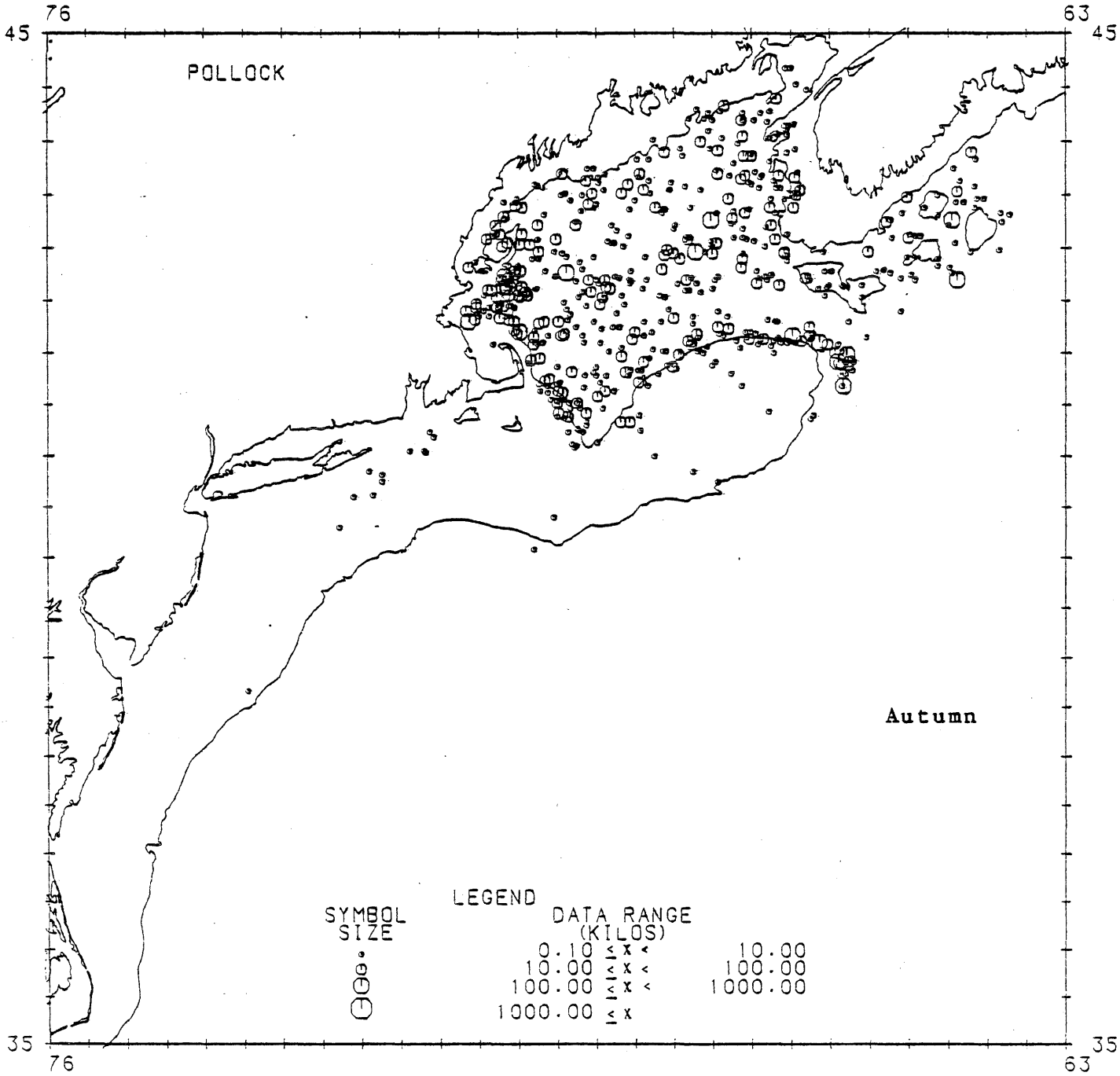

Figure 11. Distribution of pollock catches during 1965-1975 and 1977 autumn surveys.

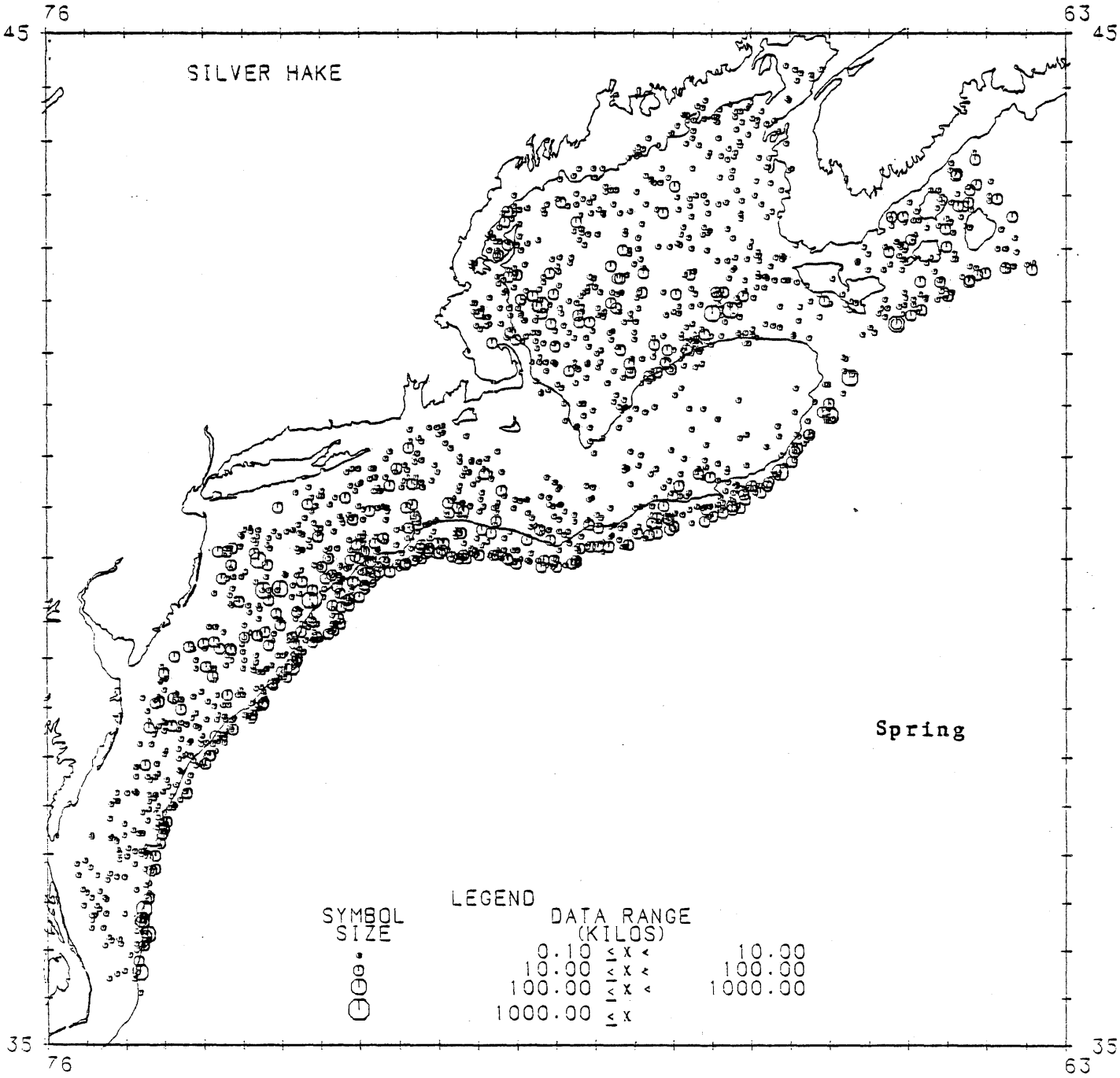

Figure 12. Distribution of silver hake catches during 1964-1974, 1976 and 1978 spring surveys.

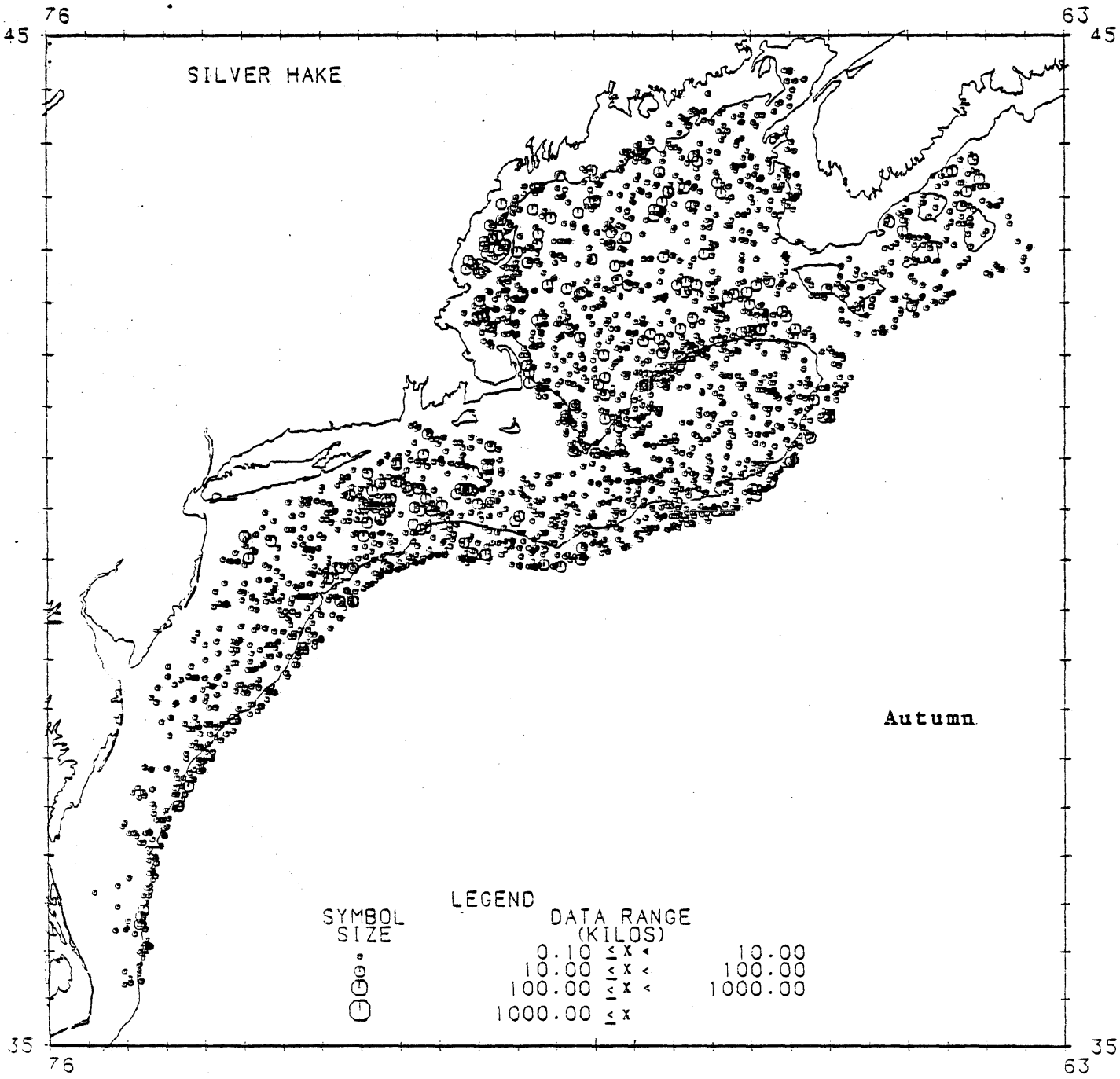

Figure 13. Distribution of silver hake catches during 1965-1975 and 1977 autumn surveys.

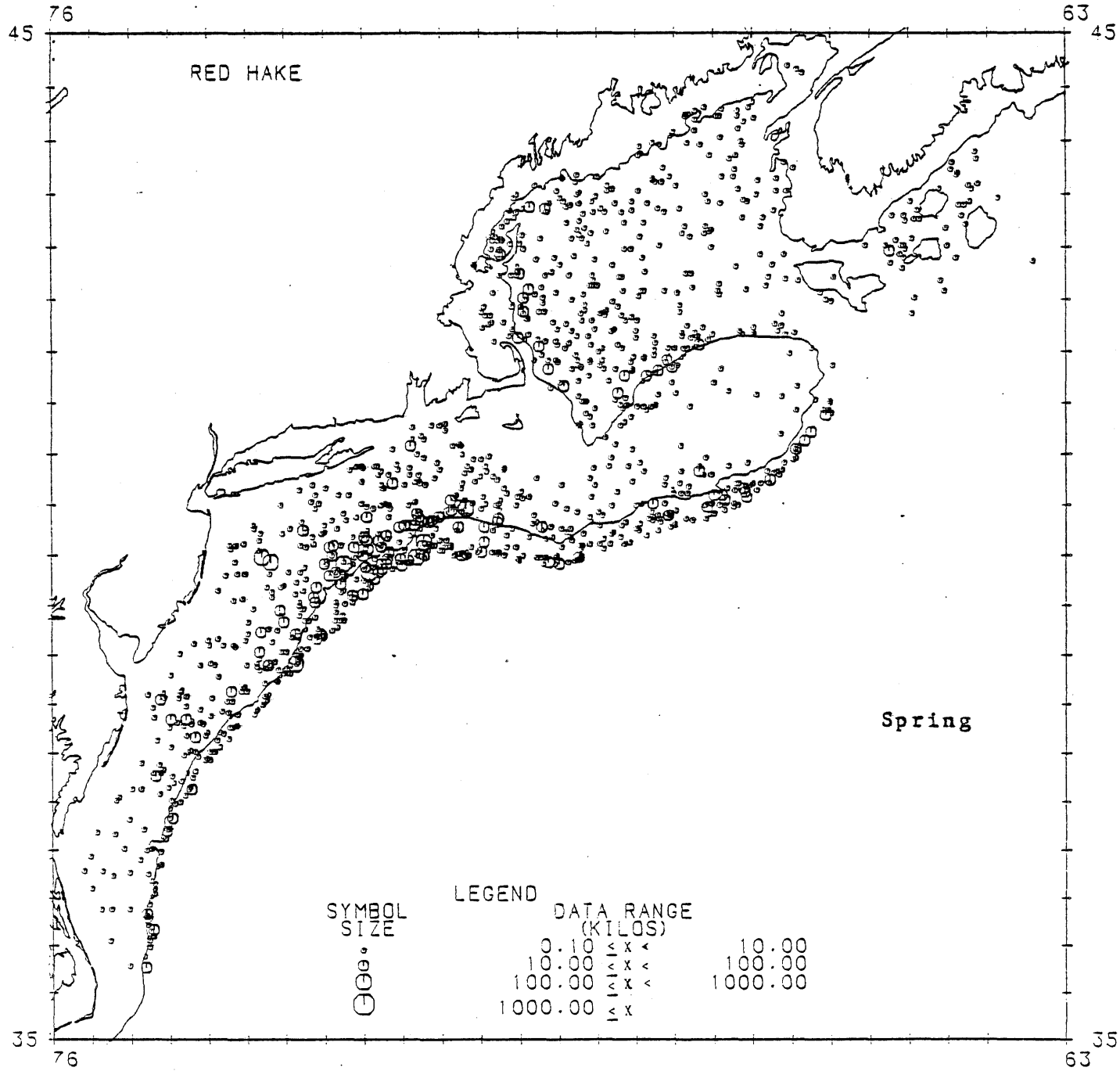

Figure 14. Distribution of red hake catches during 1964-1974, 1976 and 1978 spring surveys.

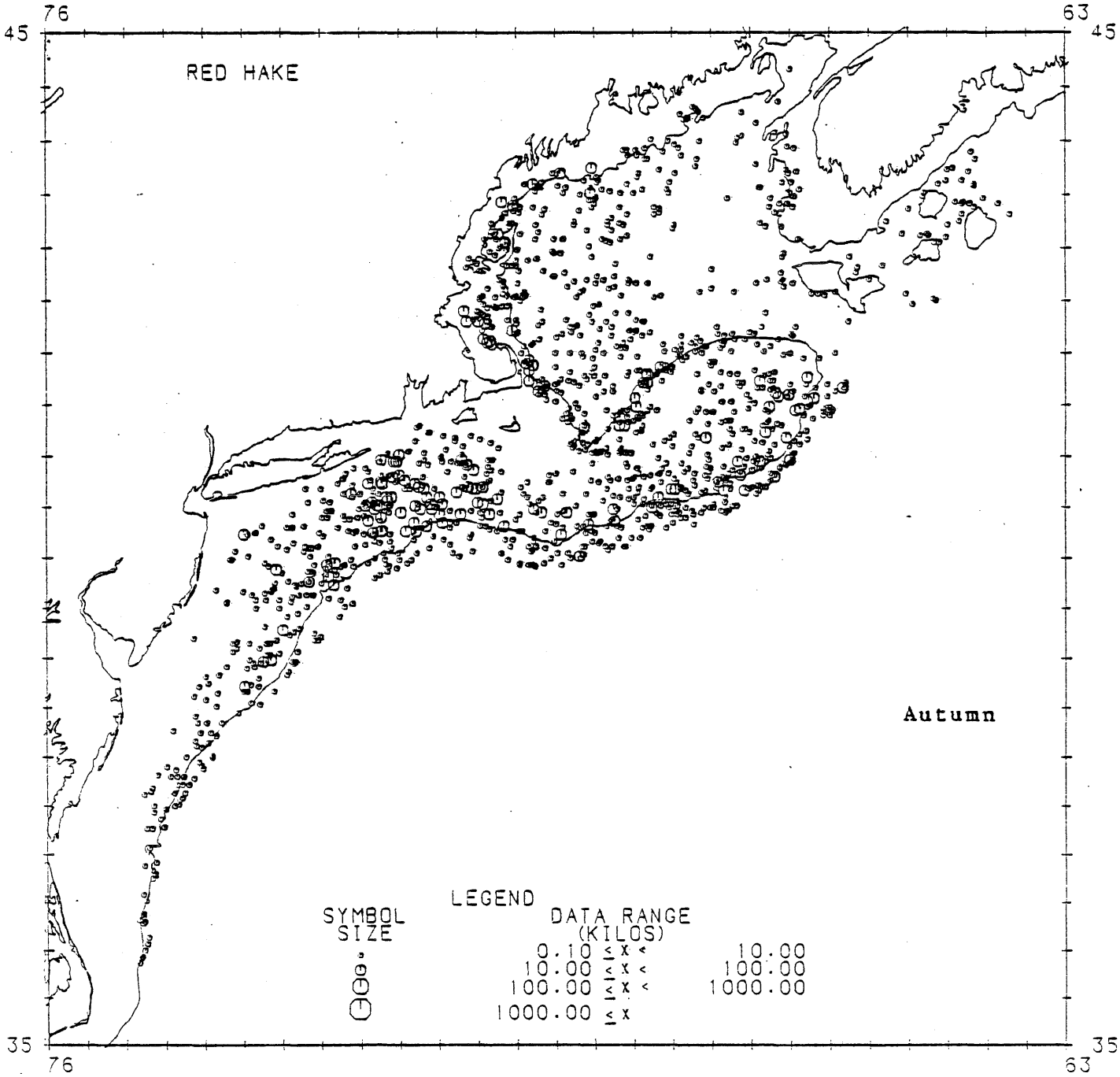

Figure 15. Distribution of red hake catches during 1965-1975 and 1977 autumn surveys.

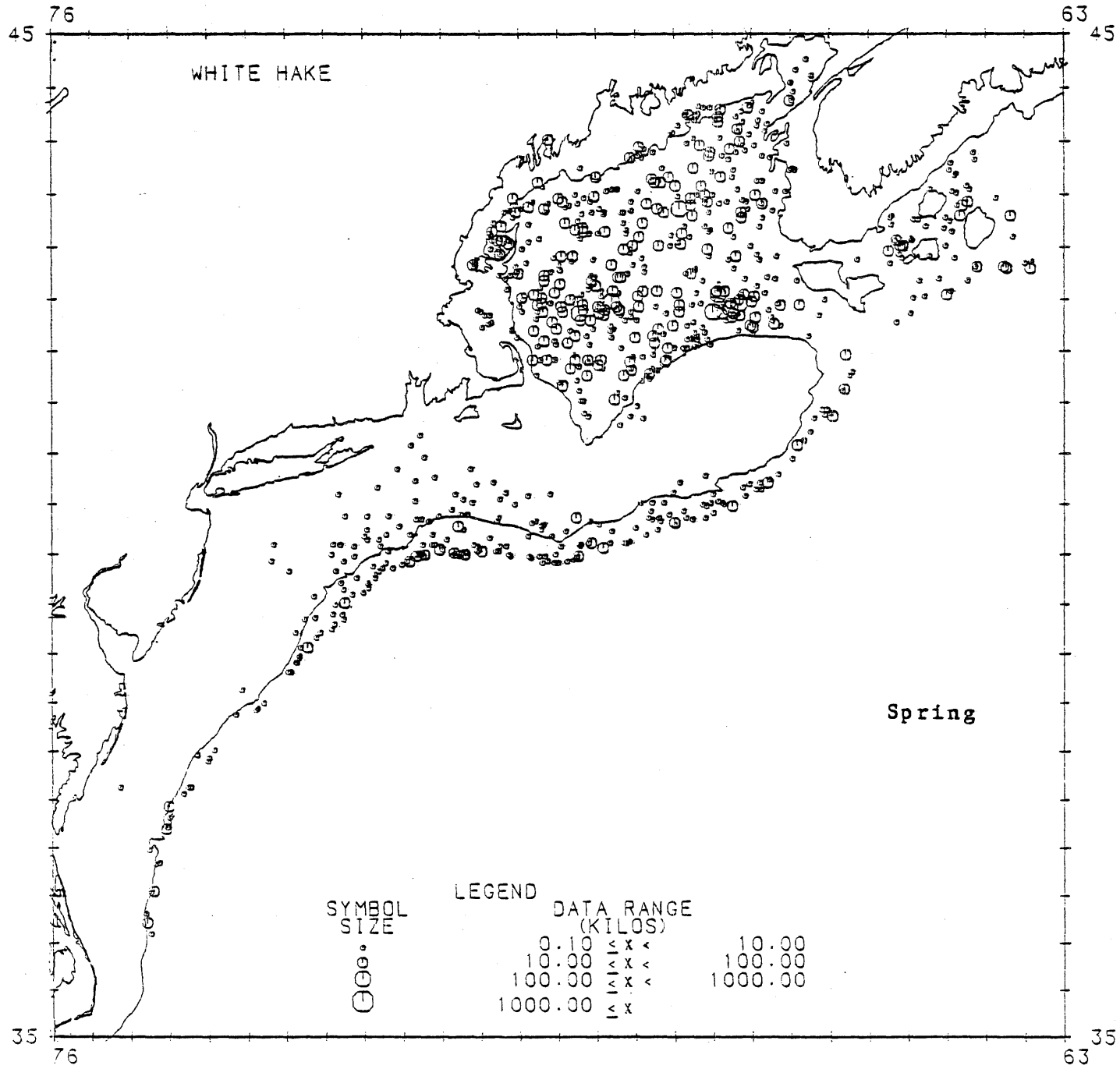

Figure 16. Distribution of white hake catches during 1964-1974, 1976 and 1978 spring surveys.

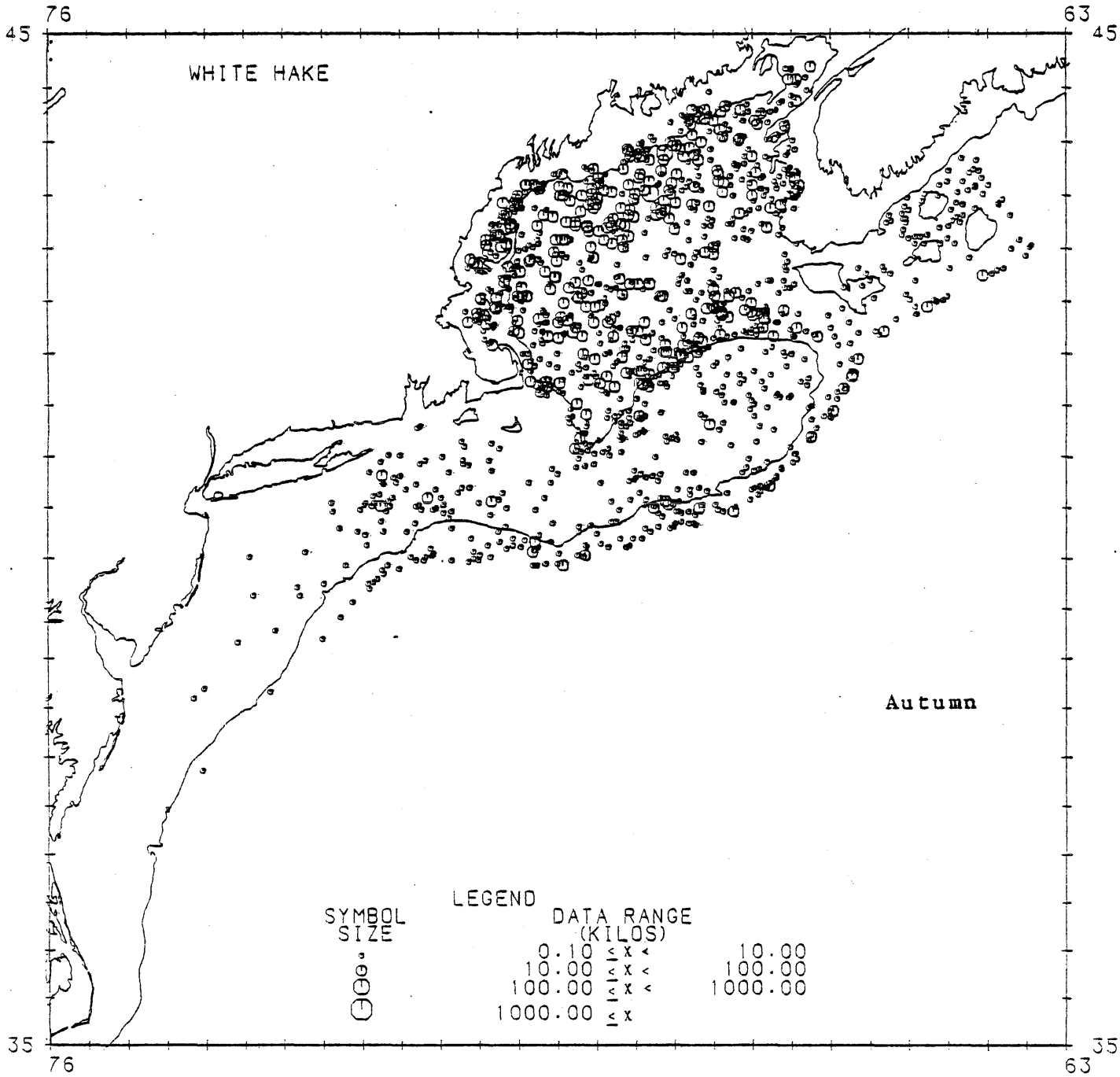

Figure 17. Distribution of white hake catches during 1965-1975 and 1977 autumn surveys.

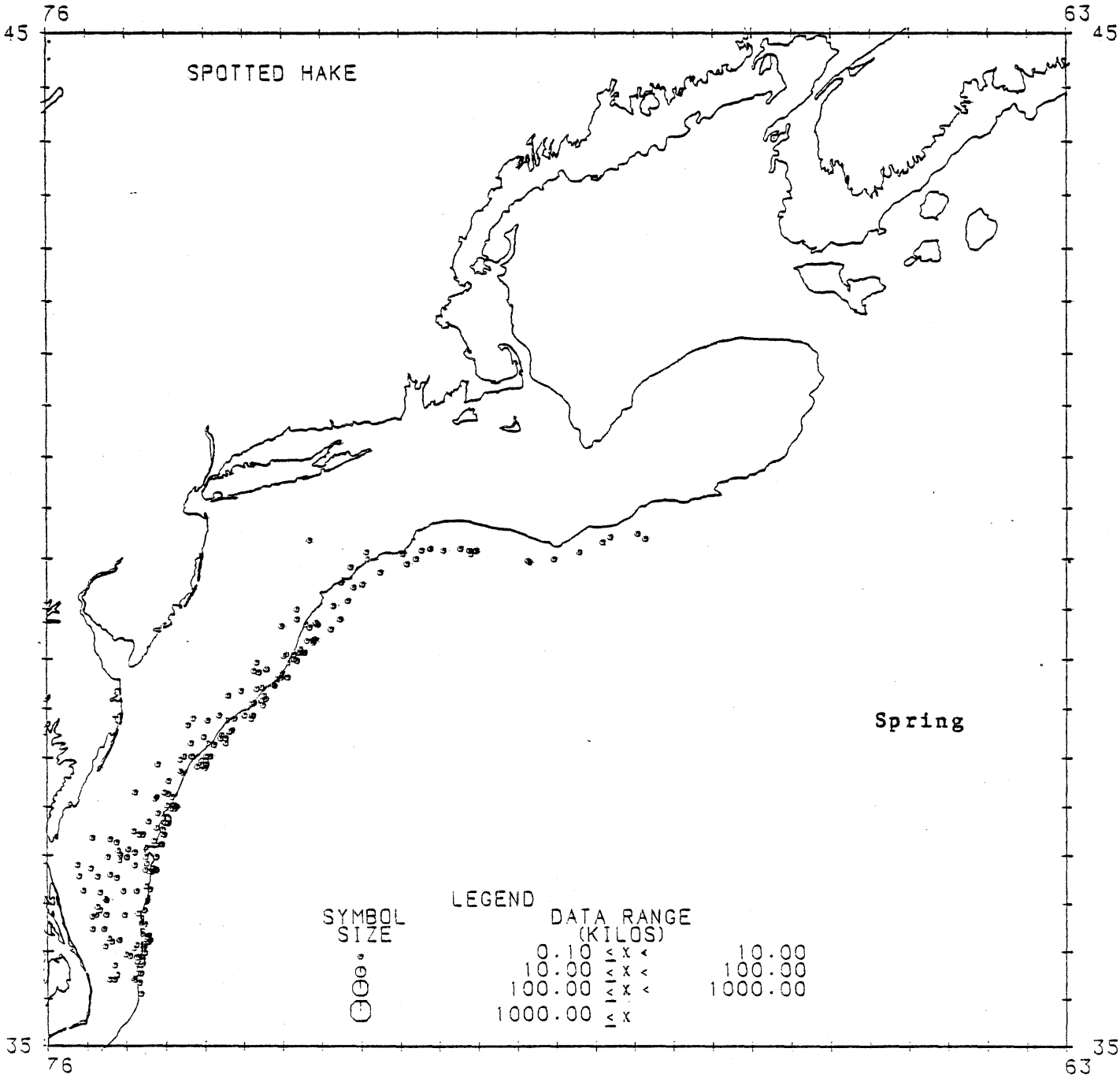

Figure 18. Distribution of spotted hake catches during 1964-1974, 1976 and 1978 spring surveys.

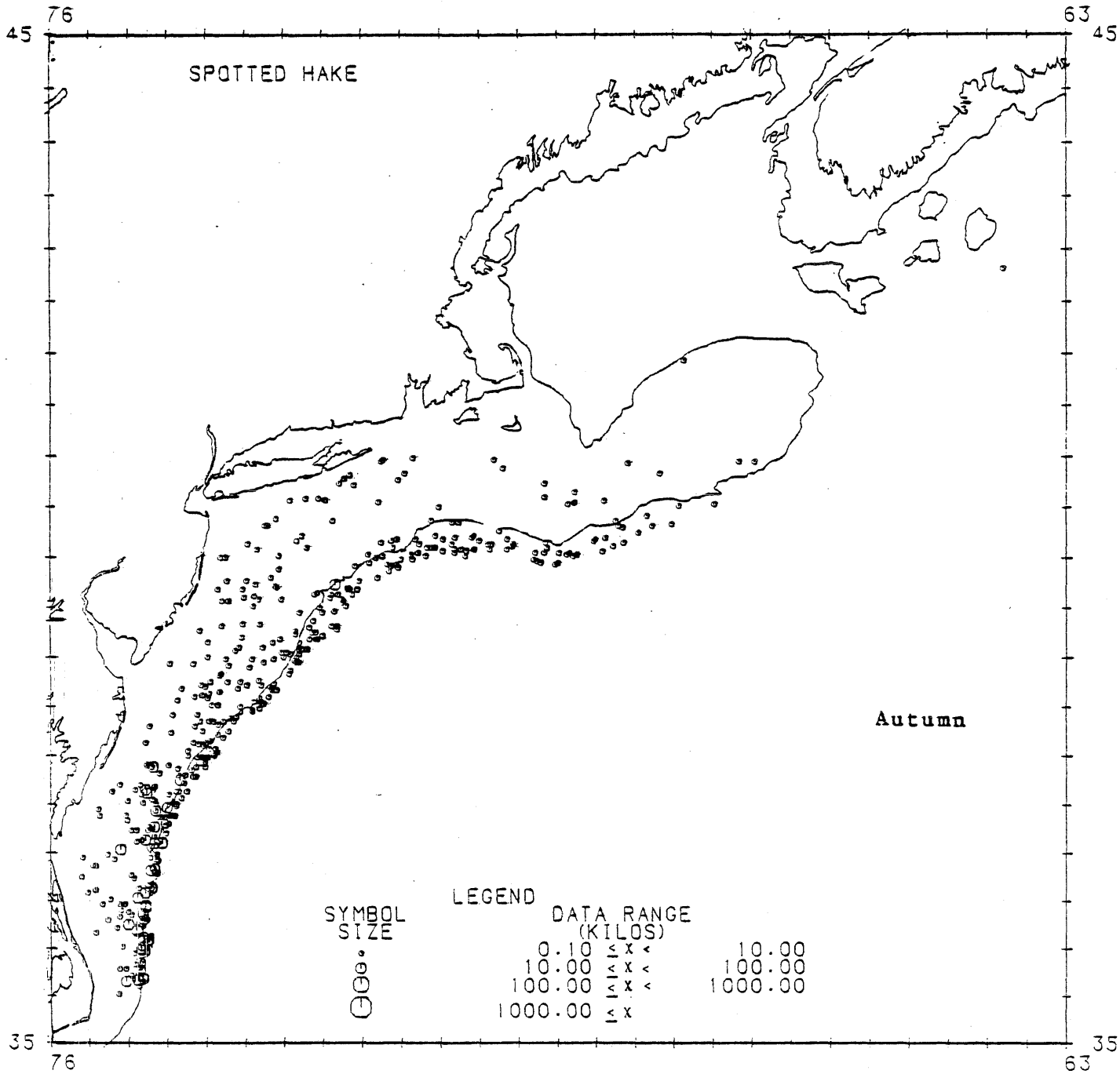

Figure 19. Distribution of spotted hake catches during 1965-1975 and 1977 autumn surveys.

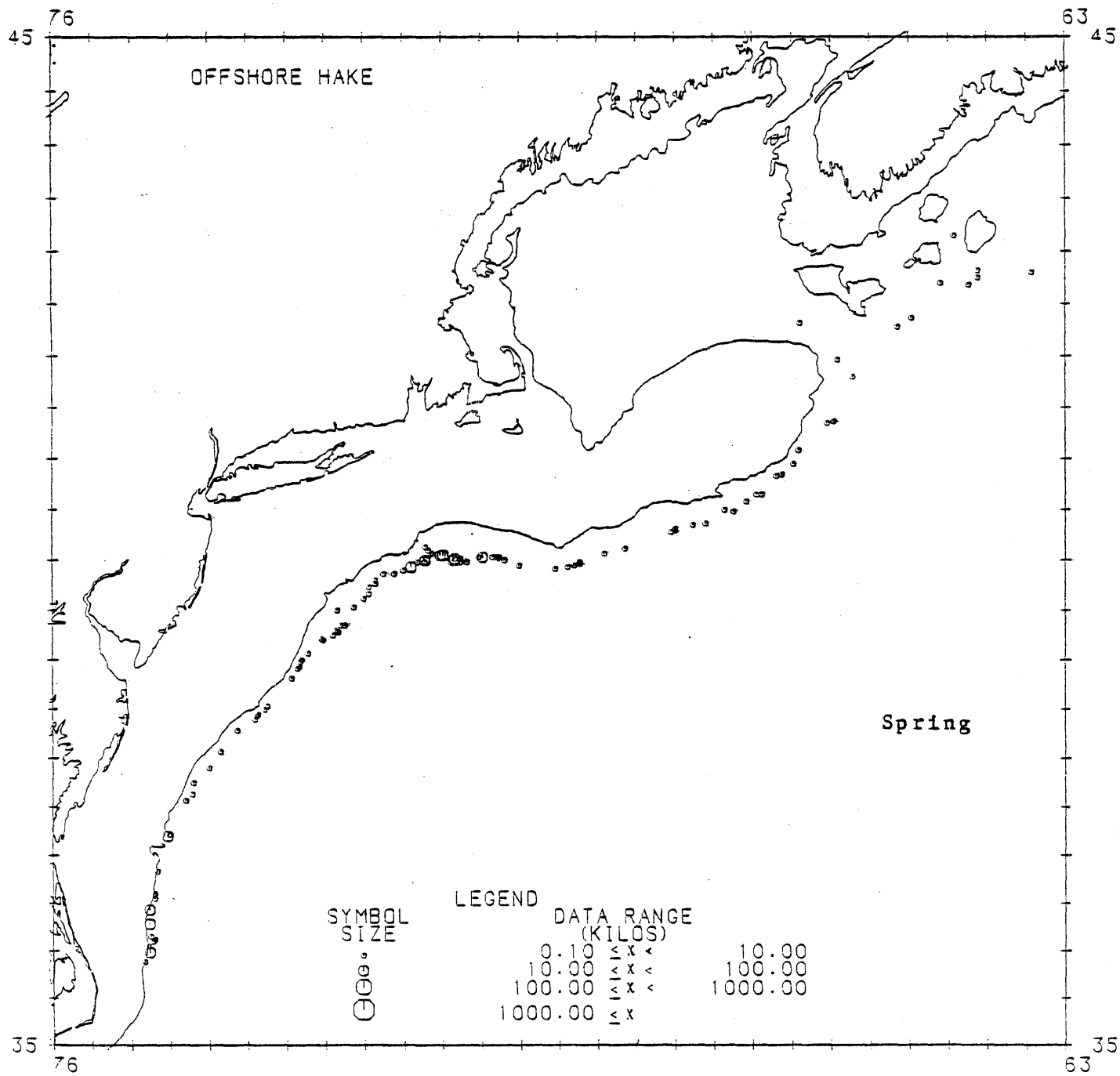

Figure 20. Distribution of offshore hake catches during 1964-1974, 1976 and 1978 spring surveys.

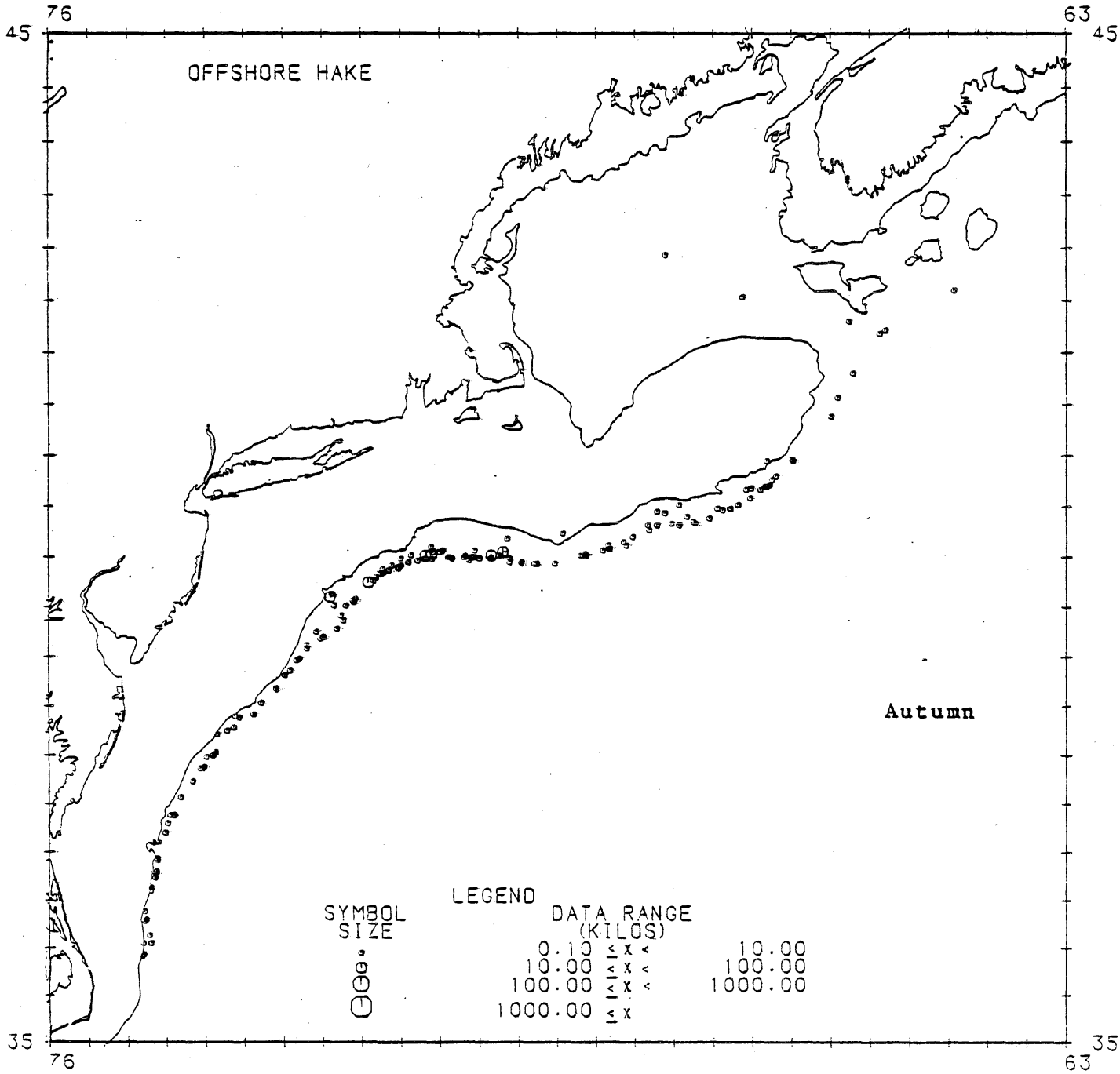

Figure 21. Distribution of offshore hake catches during 1965-1975 and 1977 autumn surveys.

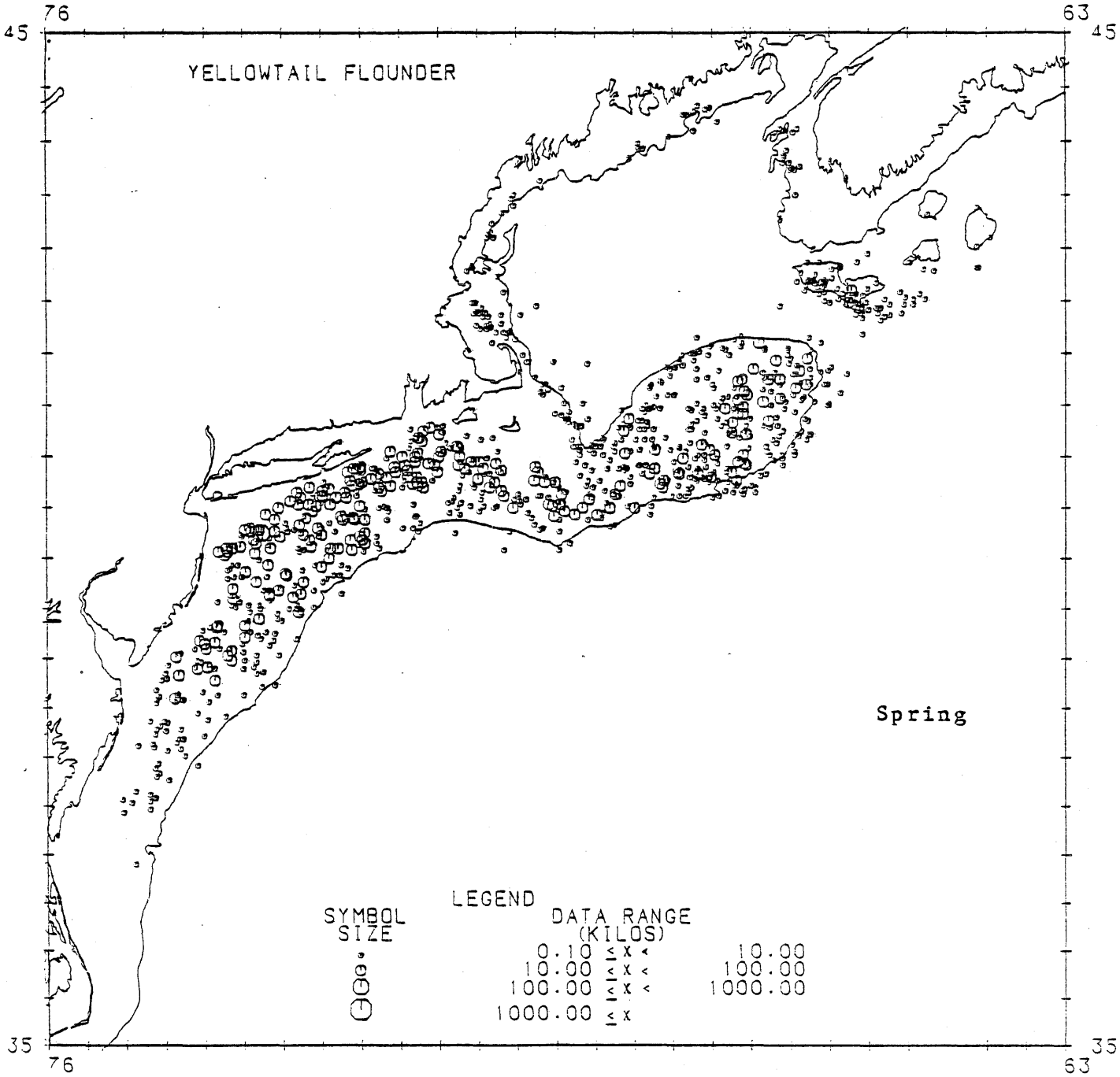

Figure 22. Distribution of yellowtail flounder catches during 1964-1974, 1976 and 1978 spring surveys.

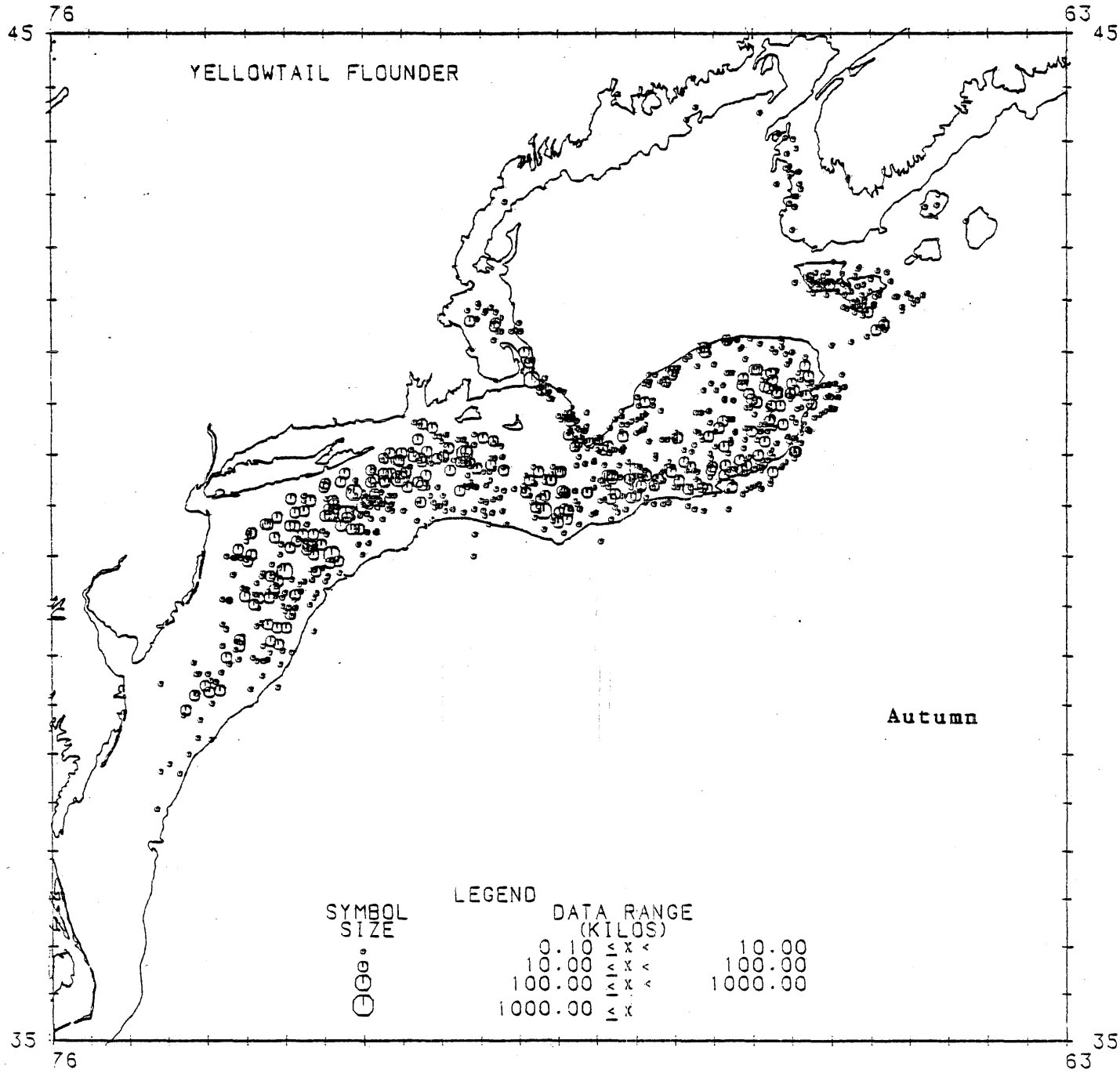

Figure 23. Distribution of yellowtail flounder catches during 1965-1975 and 1977 autumn surveys.

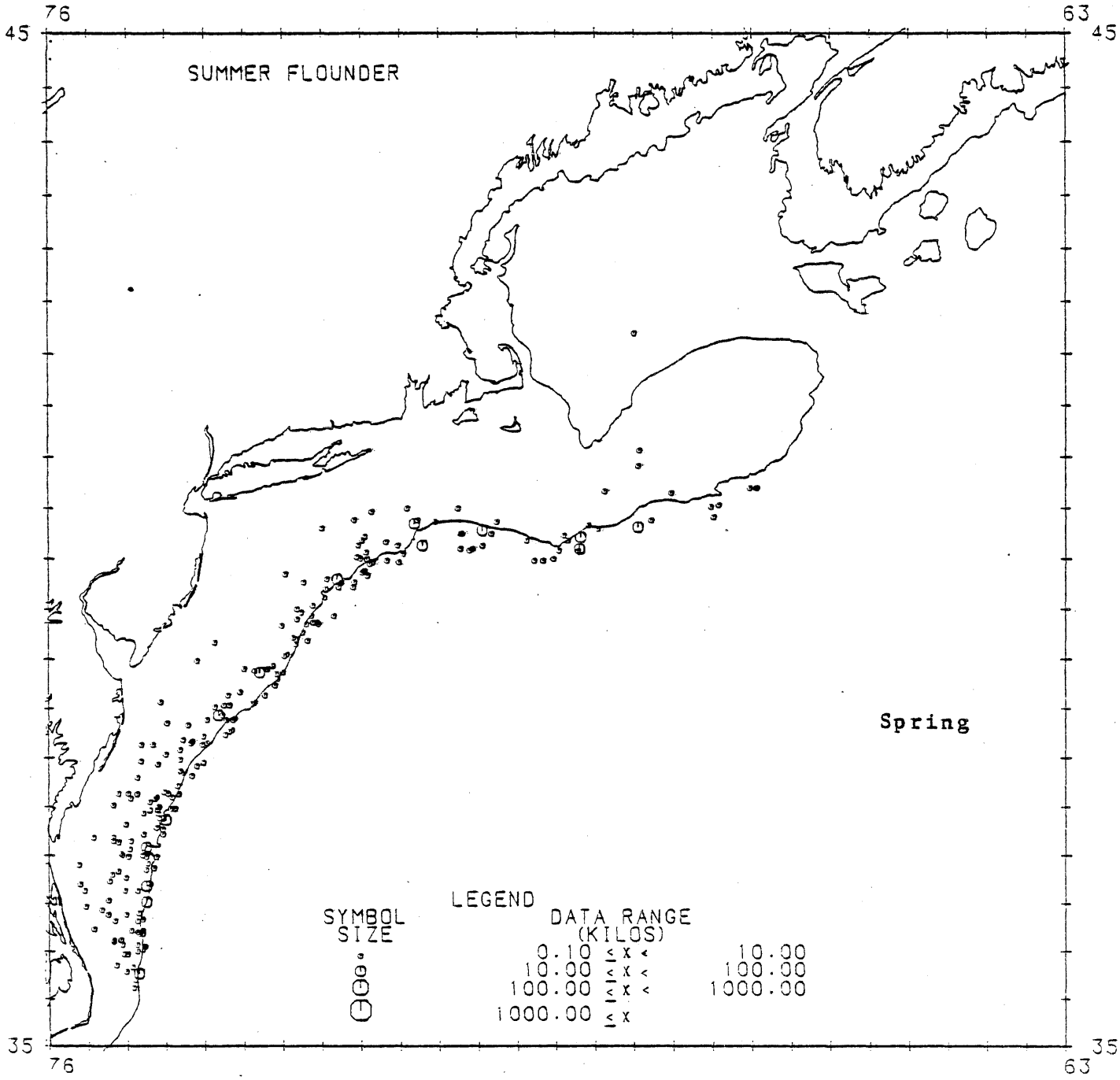

Figure 24. Distribution of summer flounder catches during 1964-1974, 1976 and 1978 spring surveys.

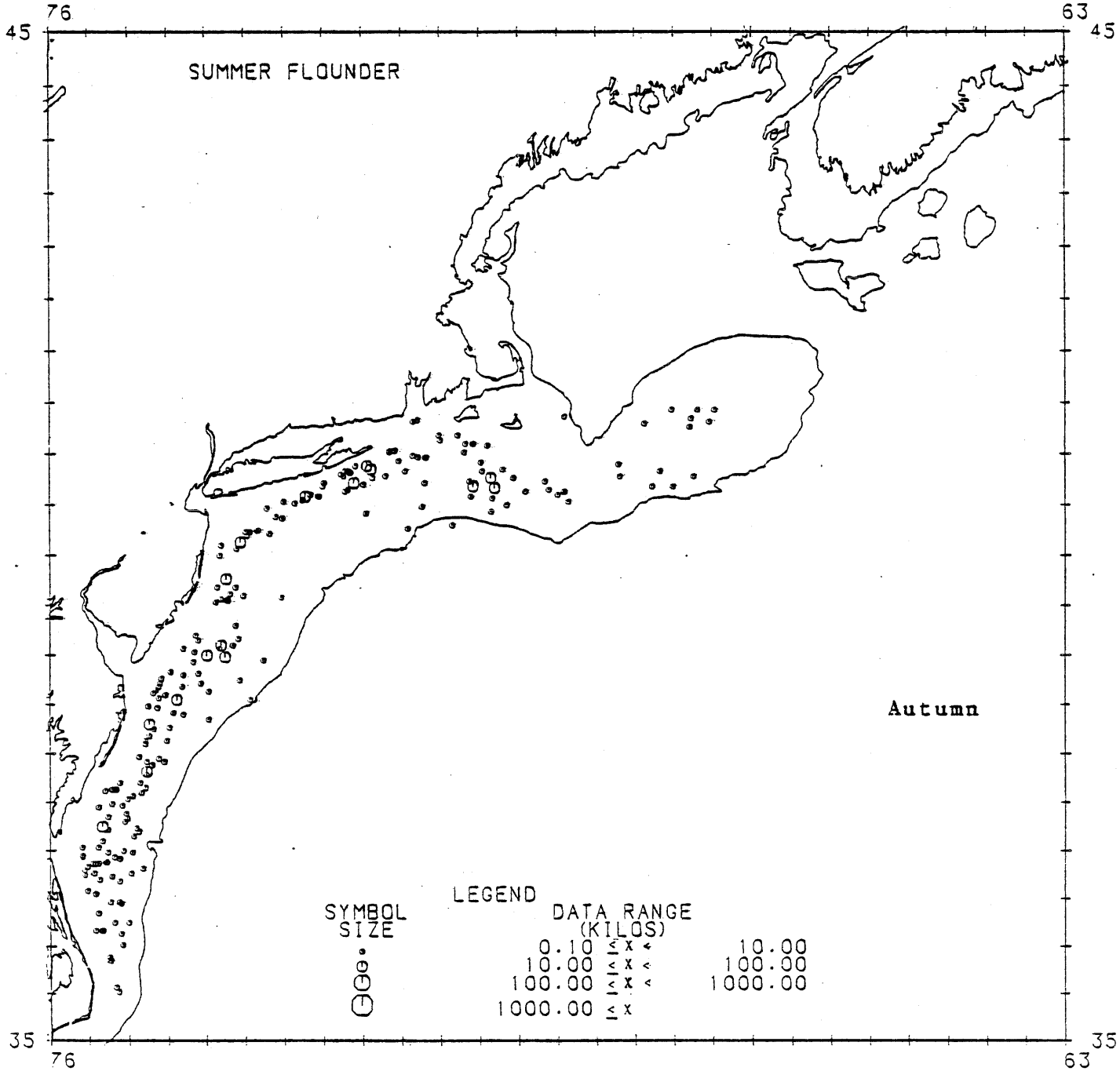

Figure 25. Distribution of summer flounder catches during 1965-1975 and 1977 autumn surveys.

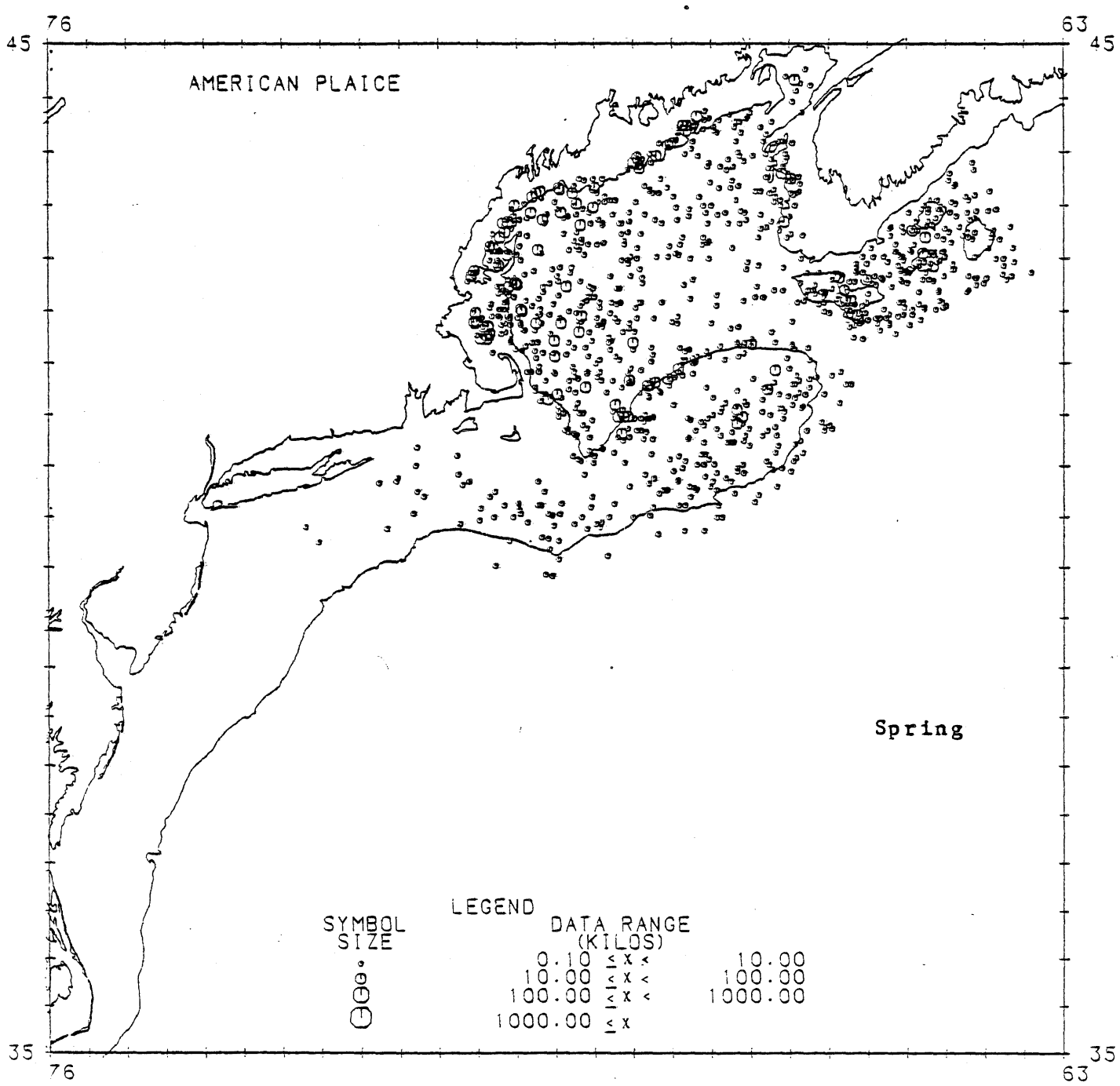

Figure 26. Distribution of American plaice catches during 1964-1974, 1976 and 1978 spring surveys.

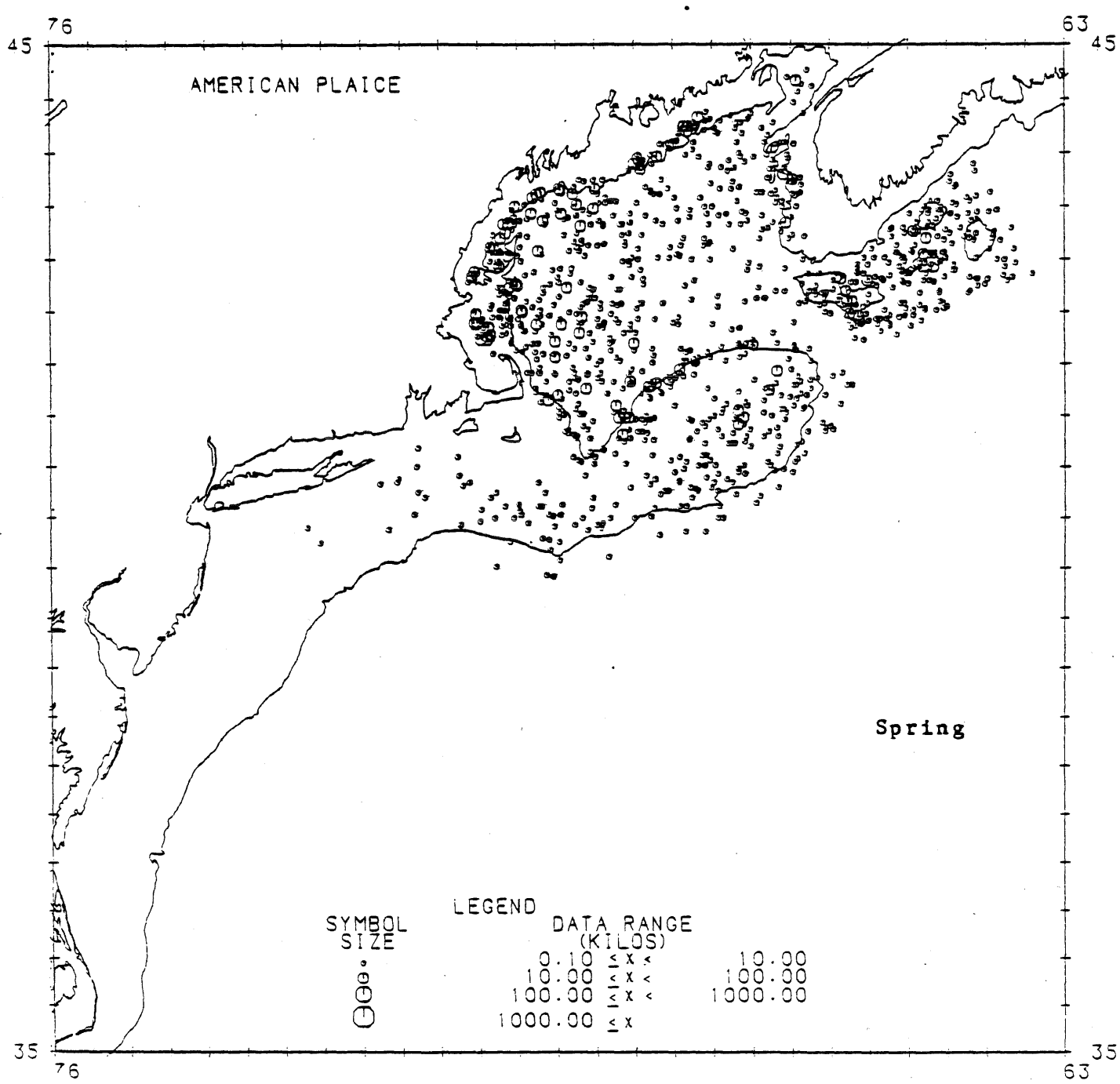

Figure 26. Distribution of American plaice catches during 1964-1974, 1976 and 1978 spring surveys.

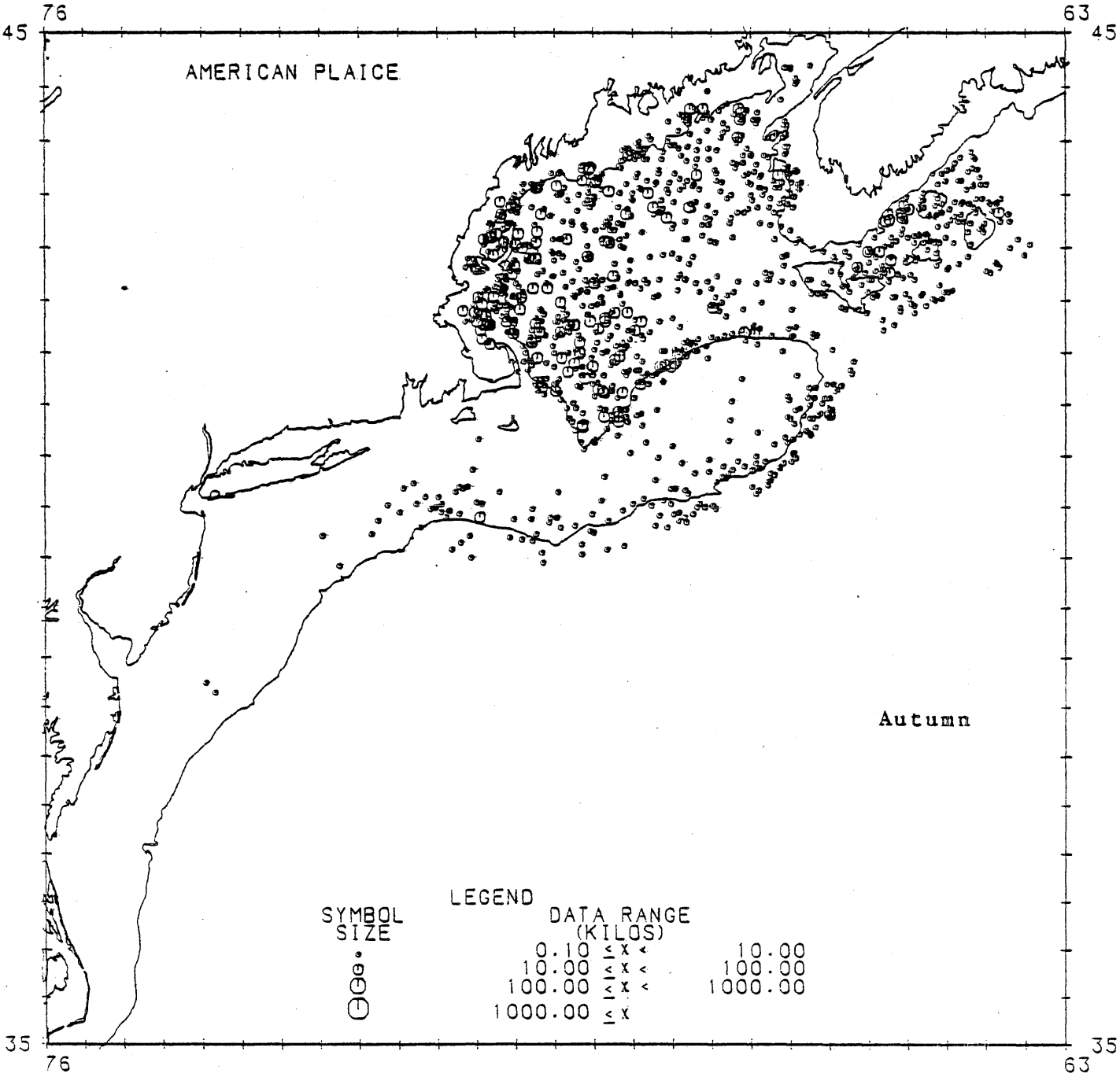

Figure 27. Distribution of American plaice catches during 1965-1975 and 1977 autumn surveys.

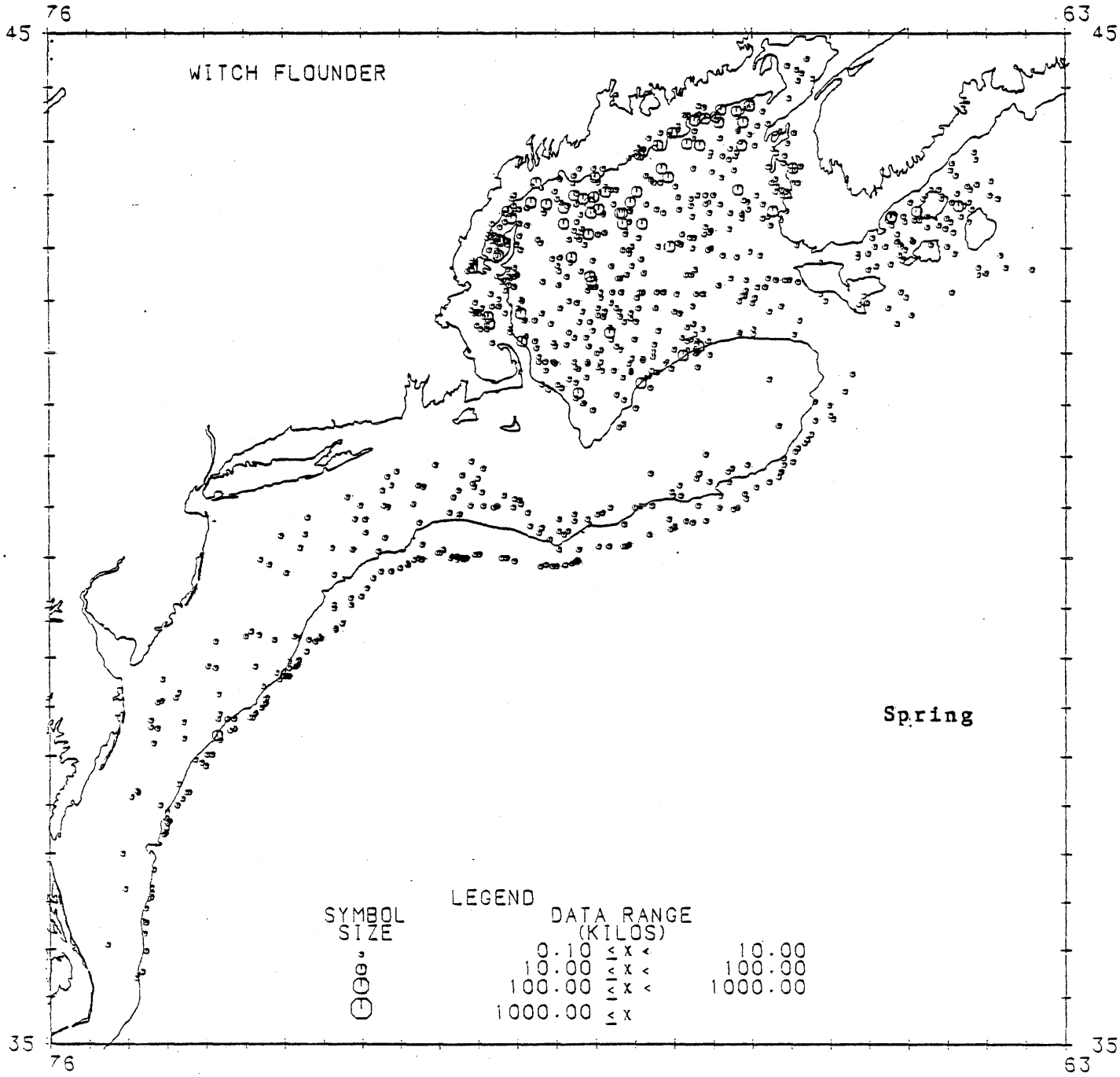

Figure 28. Distribution of witch flounder catches during 1964-1974, 1976 and 1978 spring surveys.

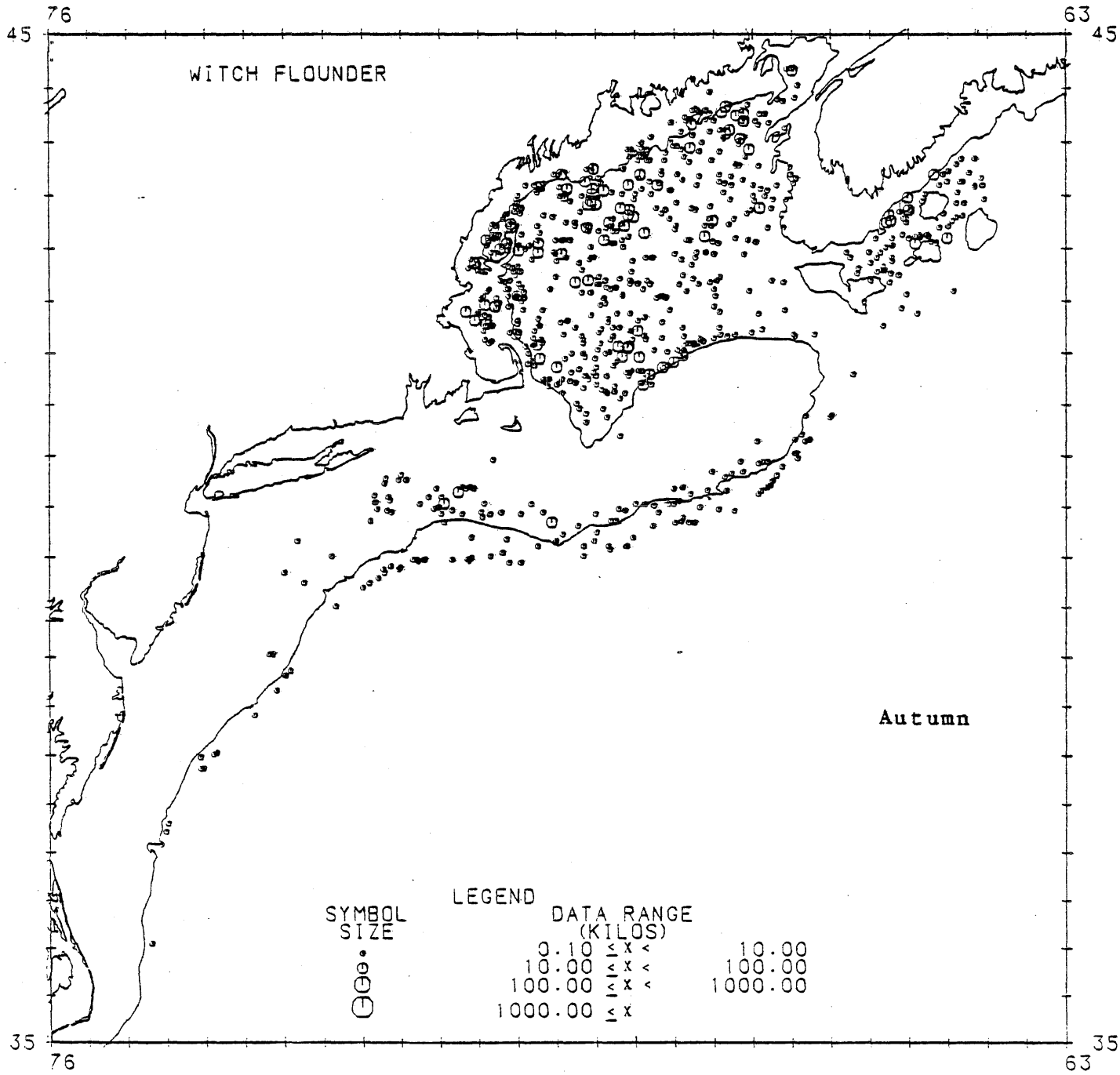

Figure 29. Distribution of witch flounder catches during 1965-1975 and 1977 autumn surveys.

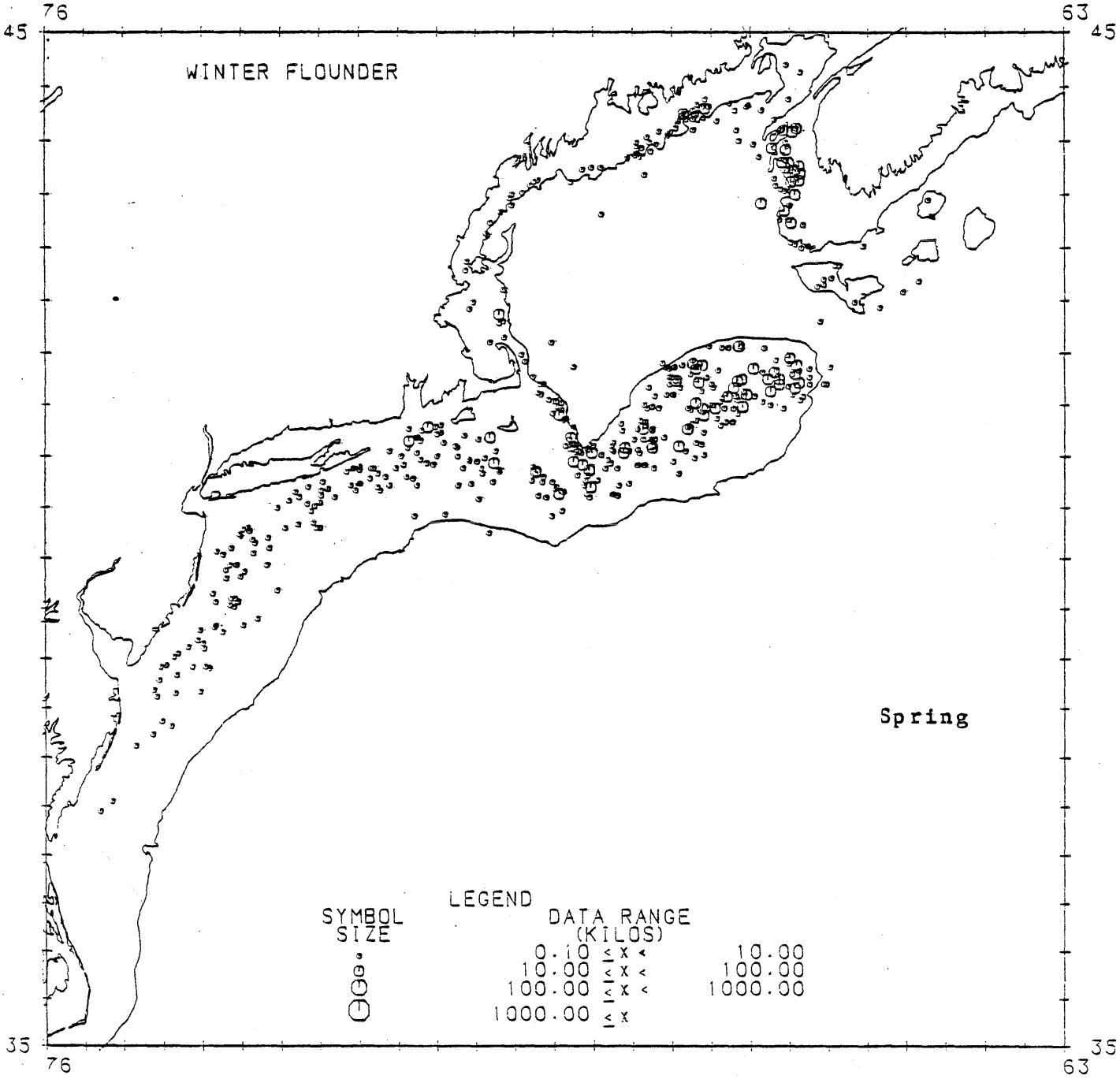

Figure 30. Distribution of winter flounder catches during 1964-1974, 1976 and 1978 spring surveys.

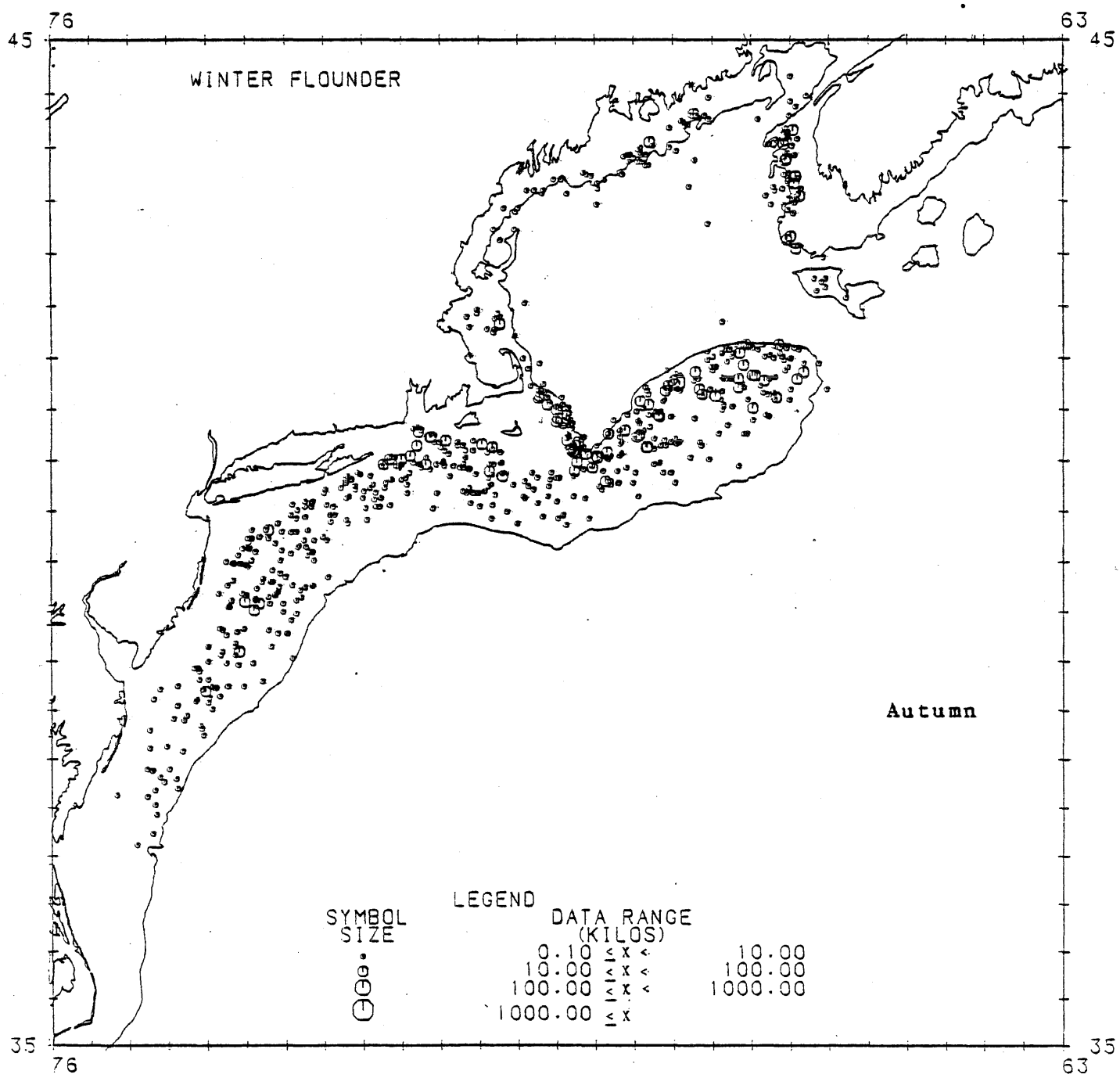

Figure 31. Distribution of winter flounder catches during 1965-1975 and 1977 autumn surveys.

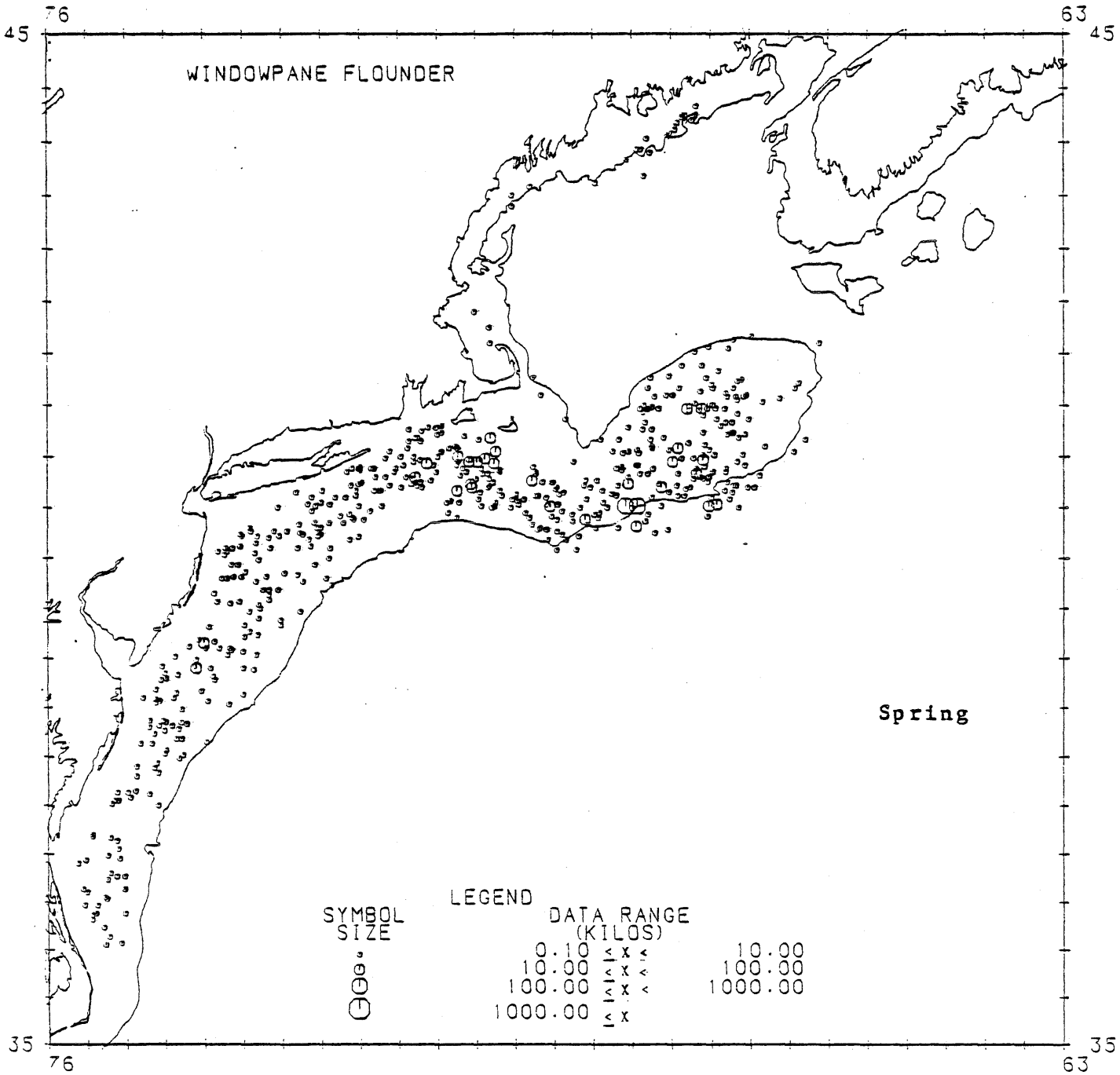

Figure 32. Distribution of windowpane flounder catches during 1964-1974, 1976 and 1978 spring surveys.

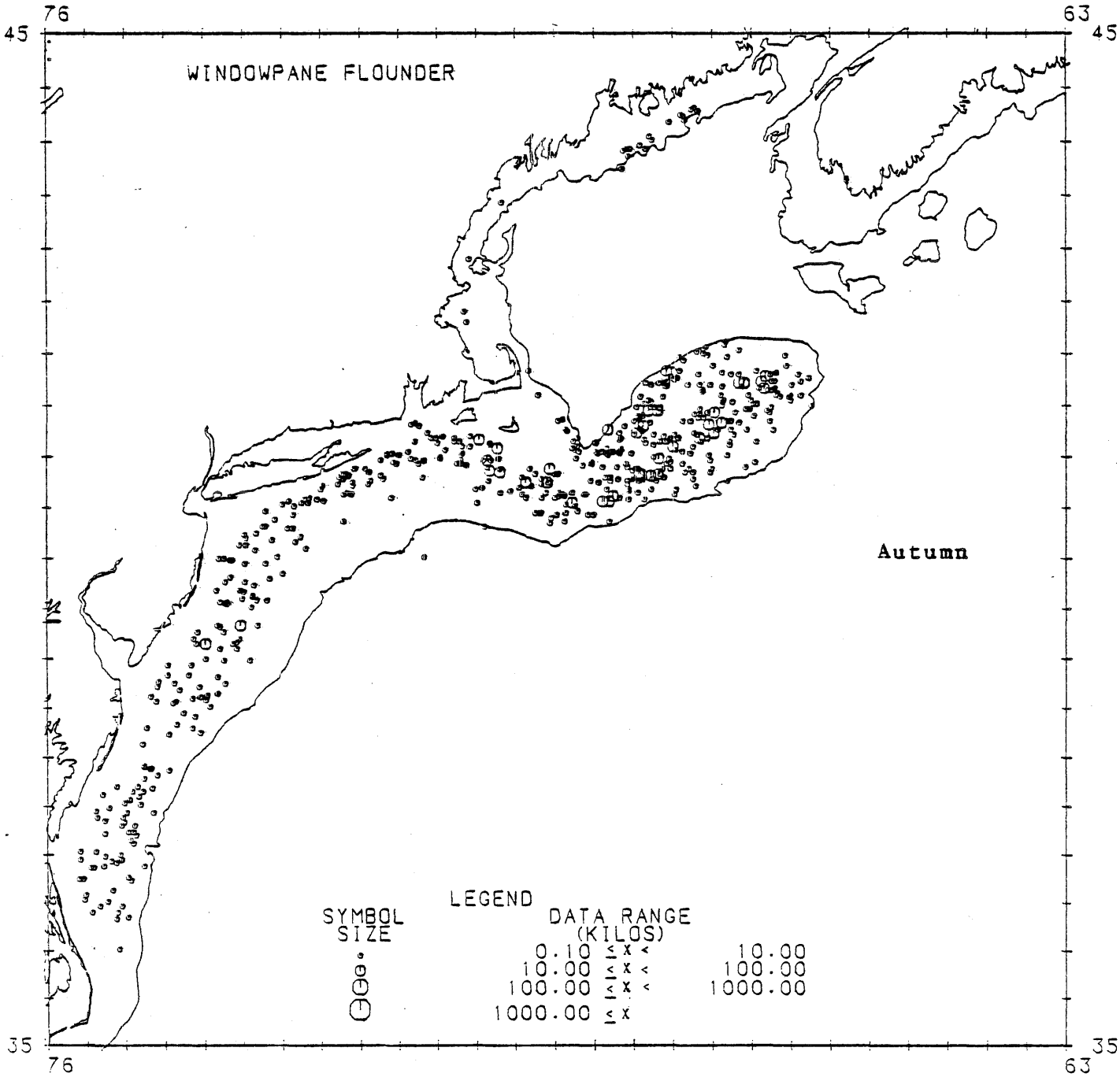

Figure 33. Distribution of windowpane flounder catches during 1965-1975 and 1977 autumn surveys.

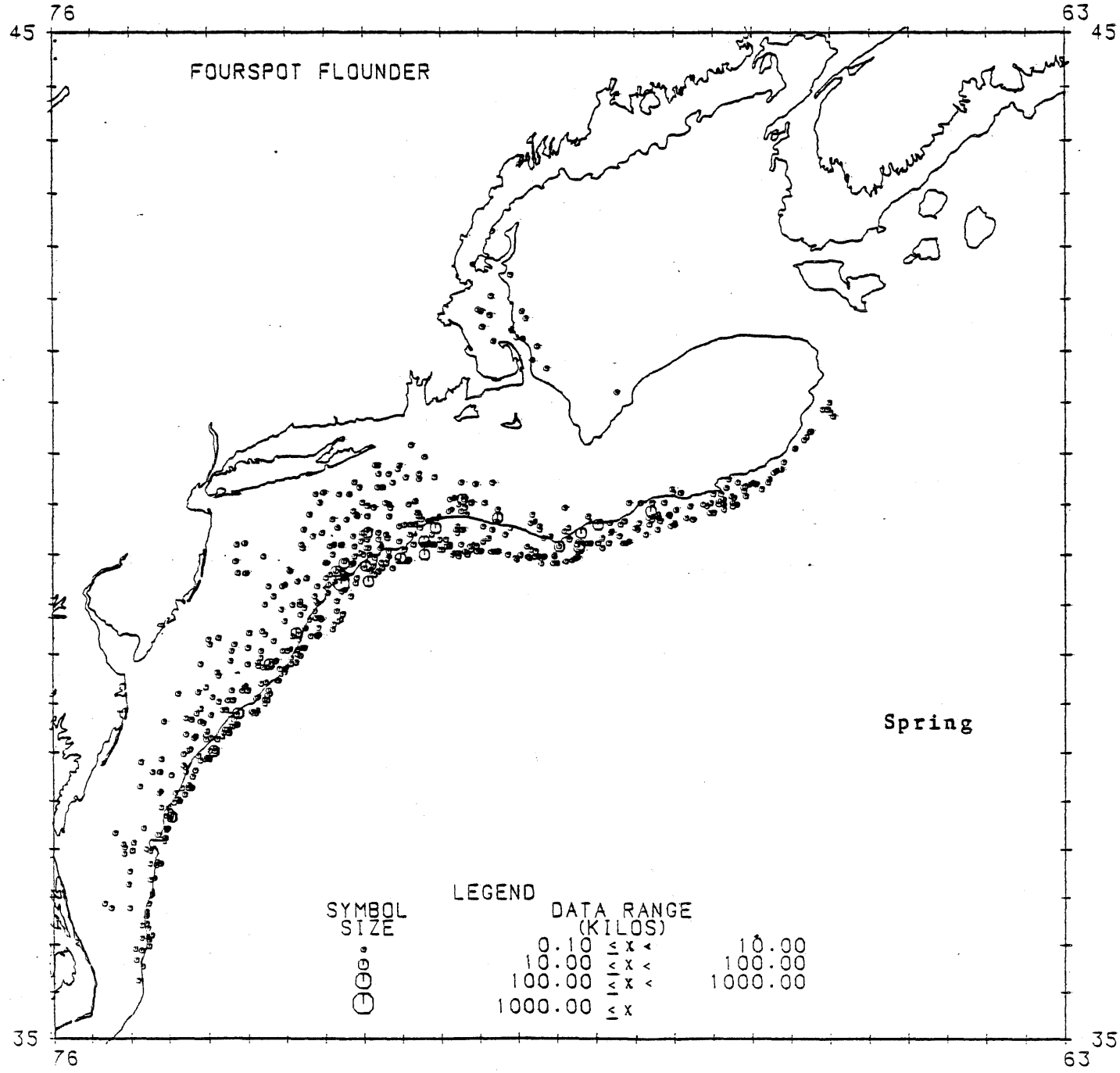

Figure 34. Distribution of fourspot flounder catches during 1964-1974, 1976 and 1978 spring surveys.

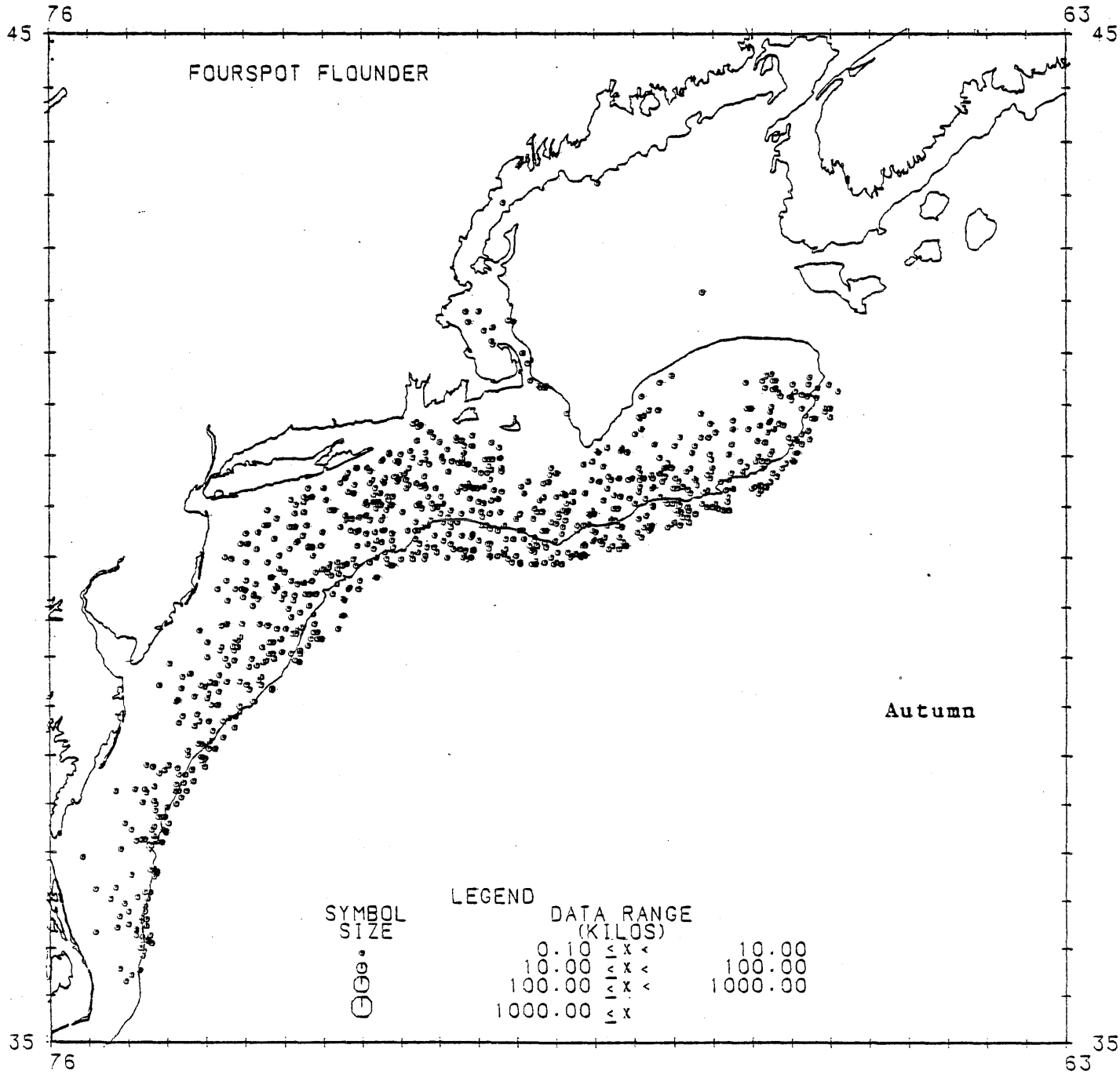

Figure 35. Distribution of fourspot flounder catches during 1965-1975 and 1977 autumn surveys.

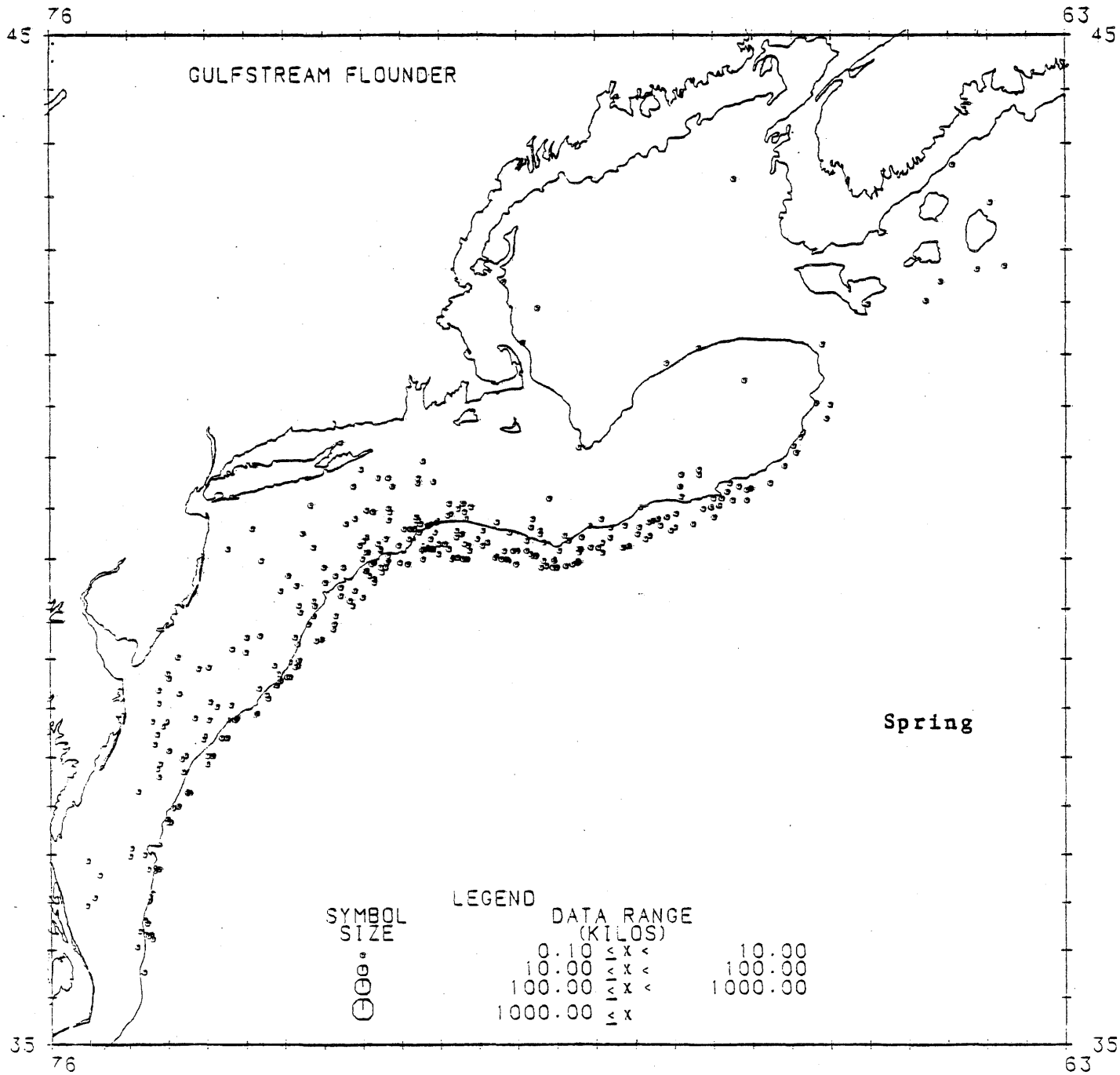

Figure 36. Distribution of Gulfstream flounder catches during 1964-1974, 1976 and 1978 spring surveys.

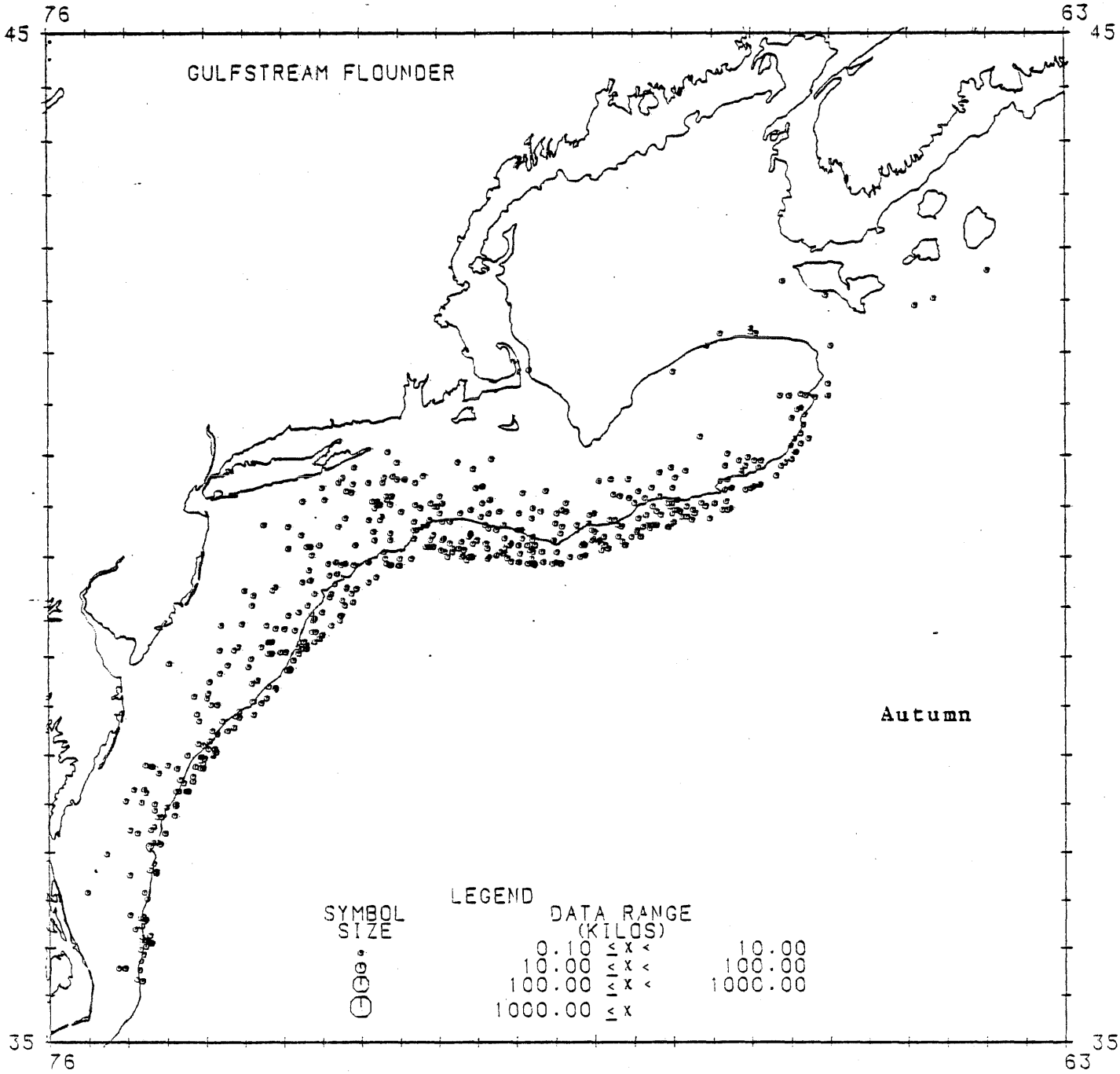

Figure 37. Distribution of Gulfstream flounder catches during 1965-1975 and 1977 autumn surveys.

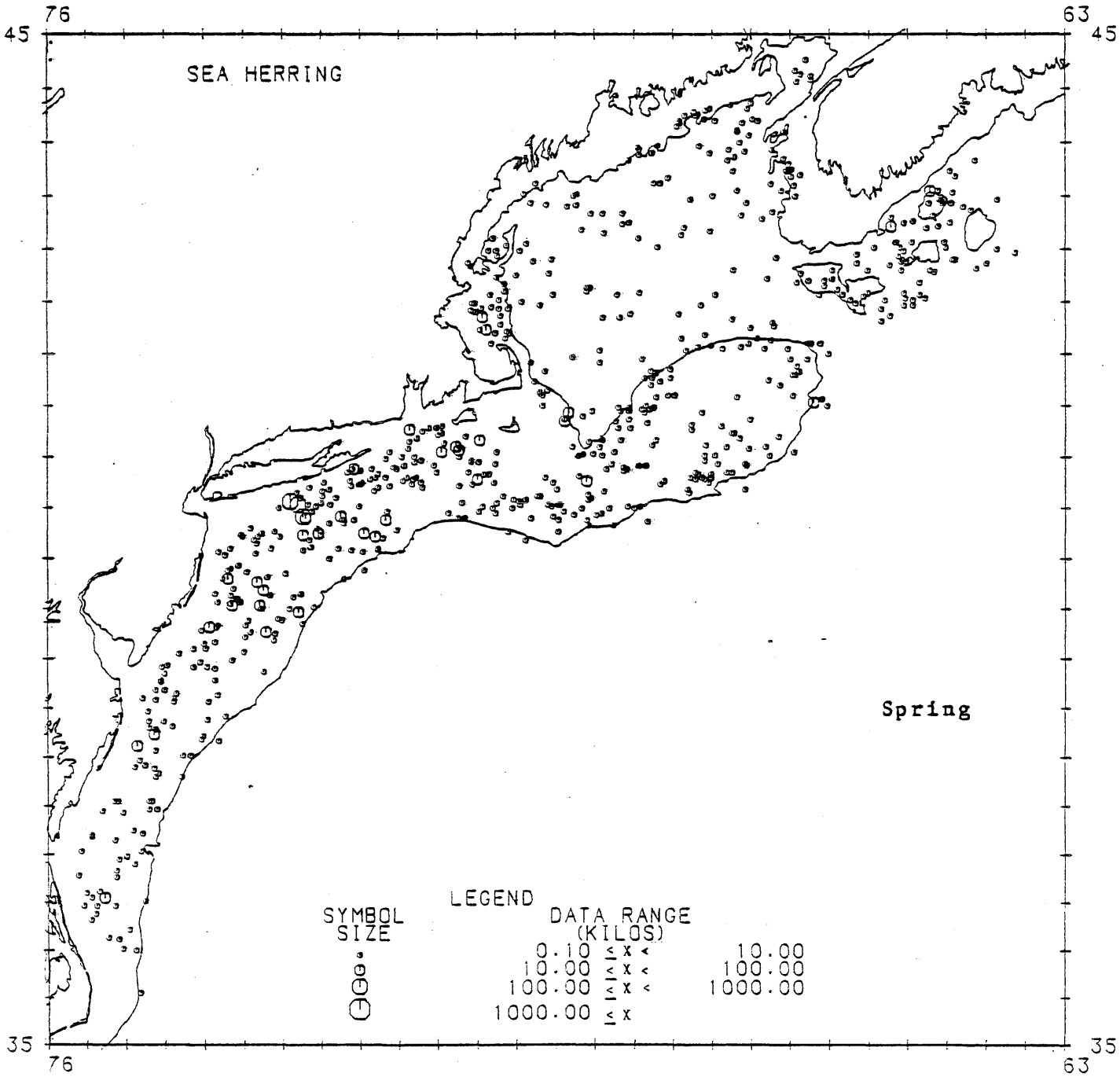

Figure 38. Distribution of Atlantic herring catches during 1964-1974, 1976 and 1978 spring surveys.

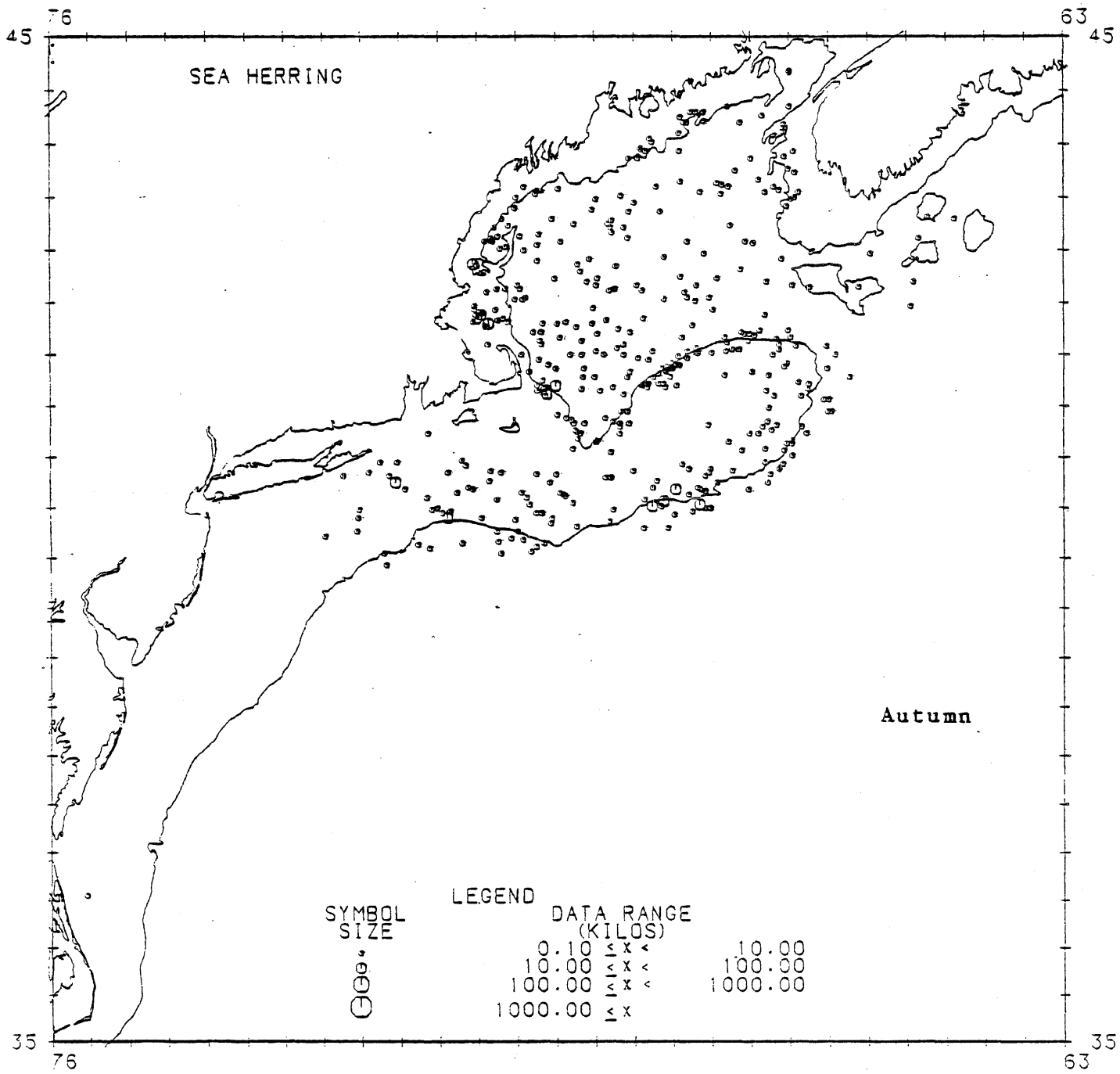

Figure 39. Distribution of Atlantic herring catches during 1965-1975 and 1977 autumn surveys.

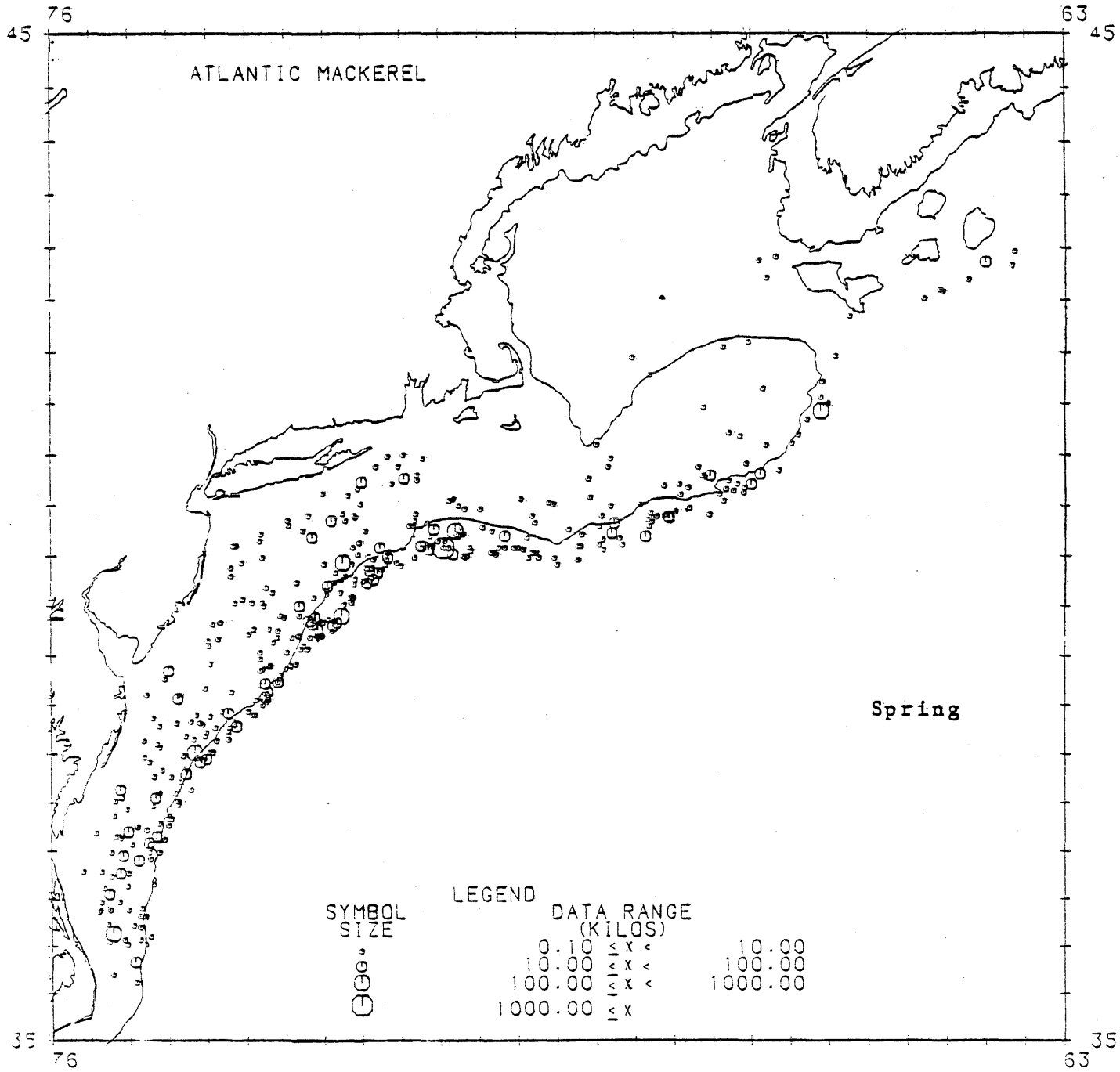

Figure 40. Distribution of Atlantic mackerel catches during 1964-1974, 1976 and 1978 spring surveys.

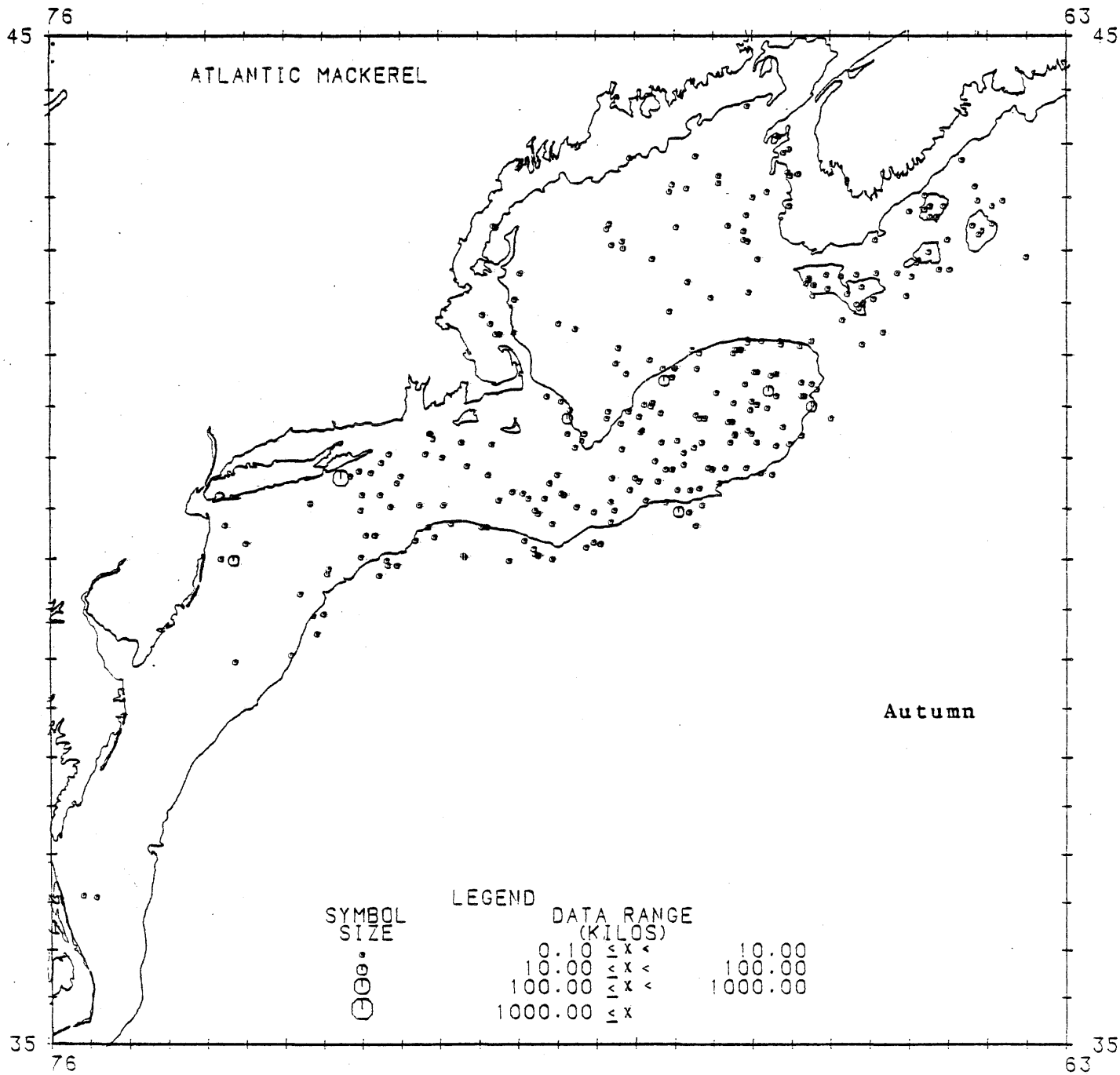

Figure 41. Distribution of Atlantic mackerel catches during 1965-1975 and 1977 autumn surveys.

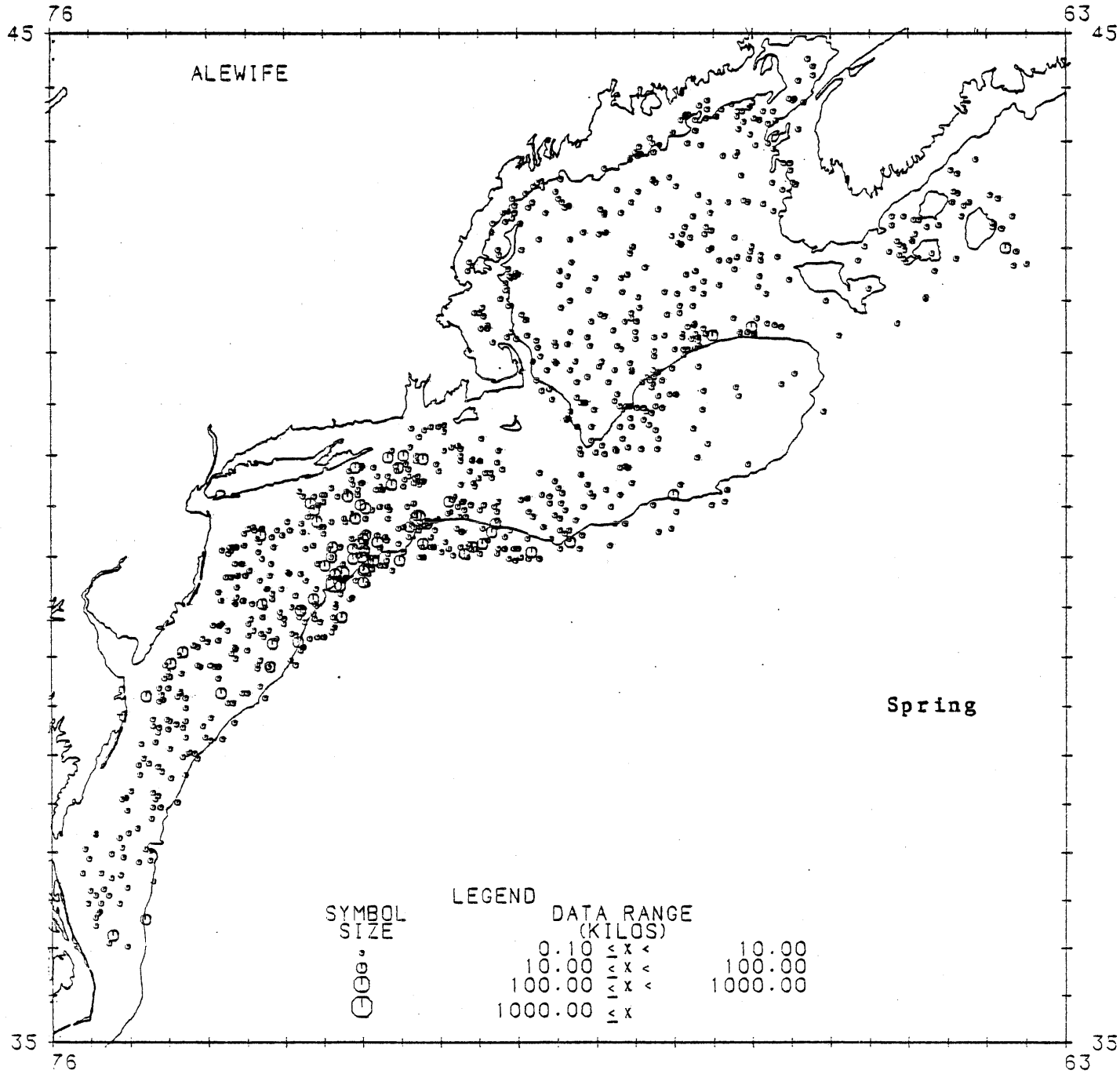

Figure 42. Distribution of alewife catches during 1964-1974, 1976 and 1978 spring surveys.

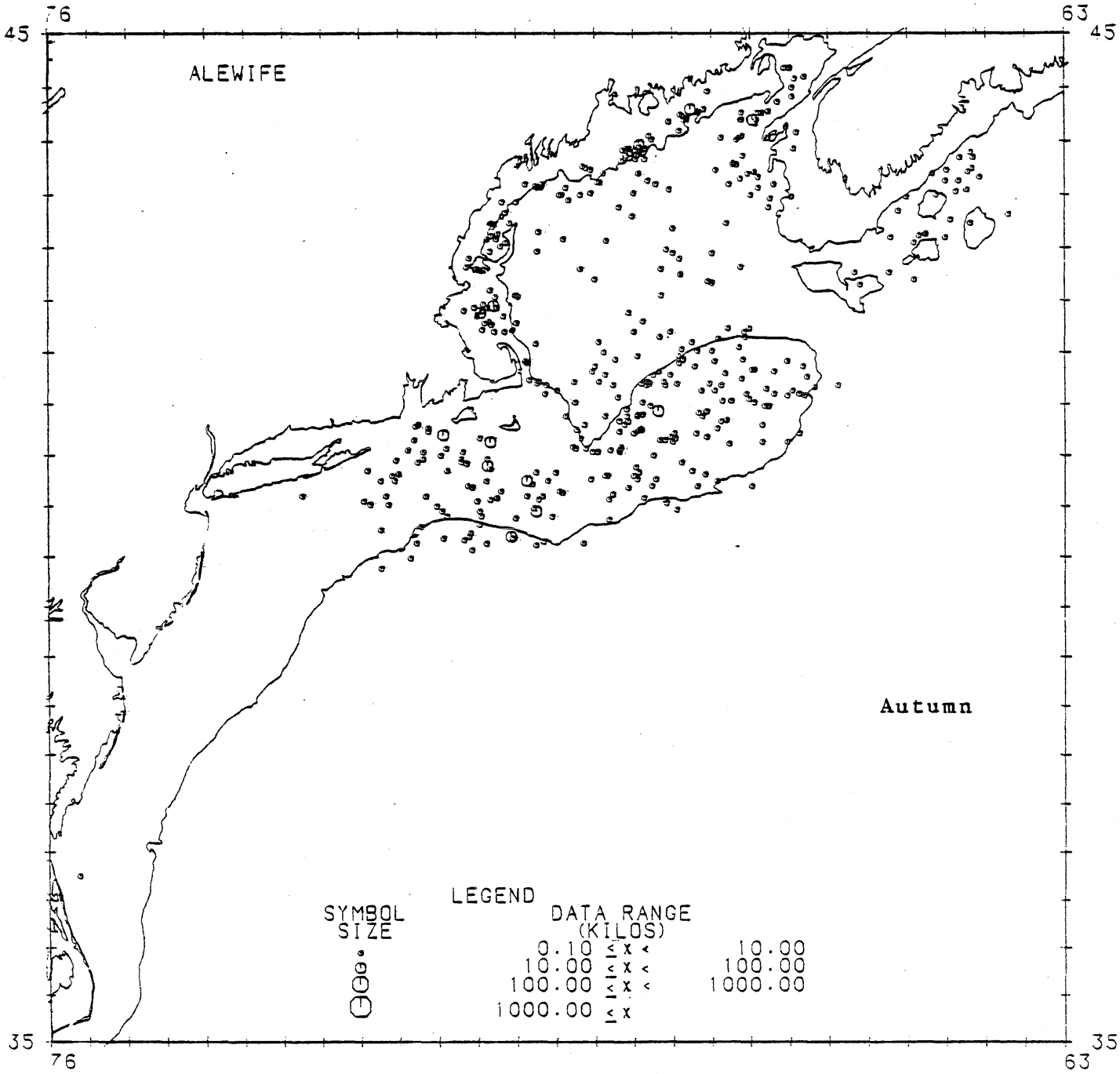

Figure 43. Distribution of alewife catches during 1965-1975 and 1977 autumn surveys.

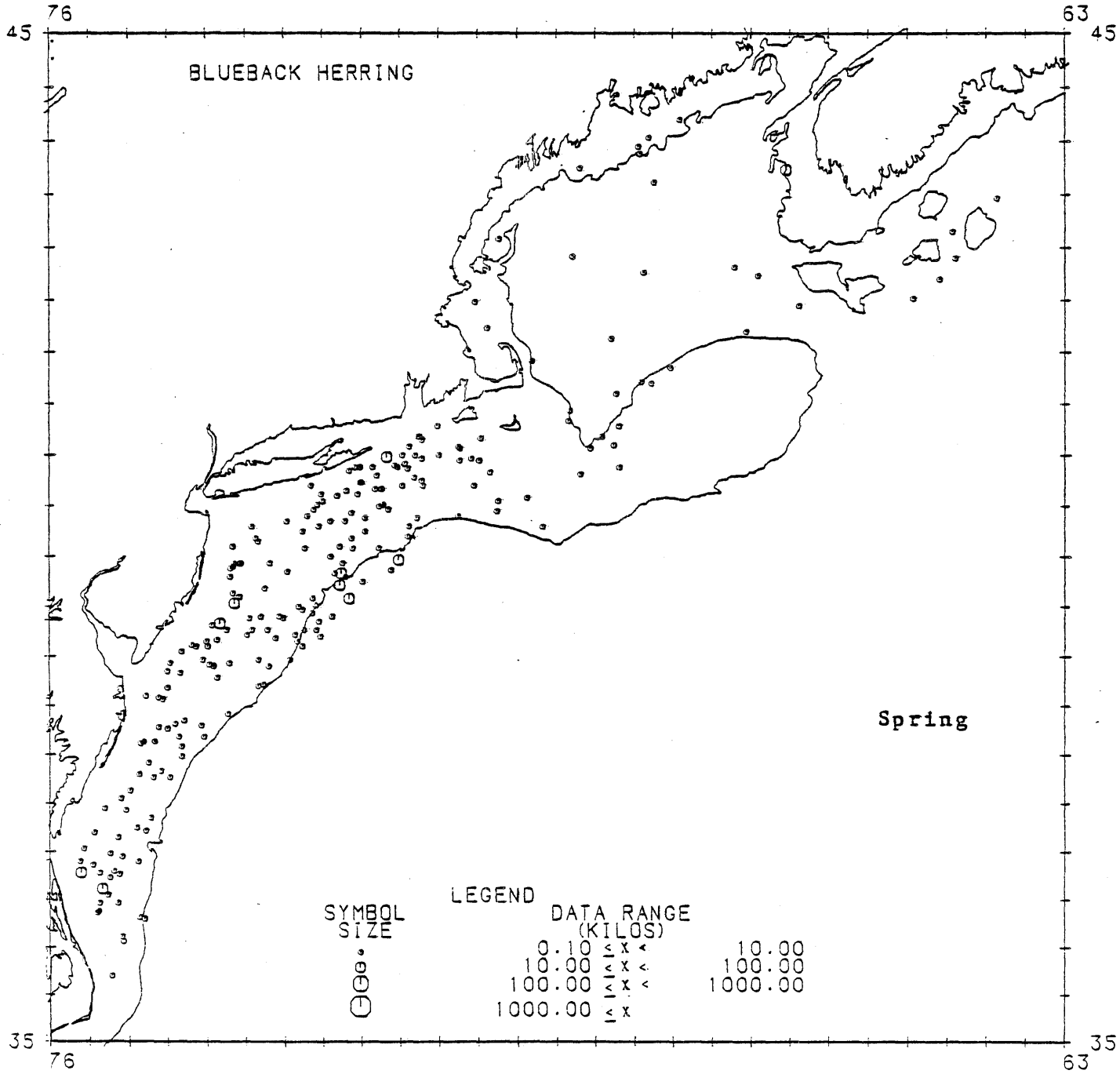

Figure 44. Distribution of blueback herring catches during 1964-1974, 1976 and 1978 spring surveys.

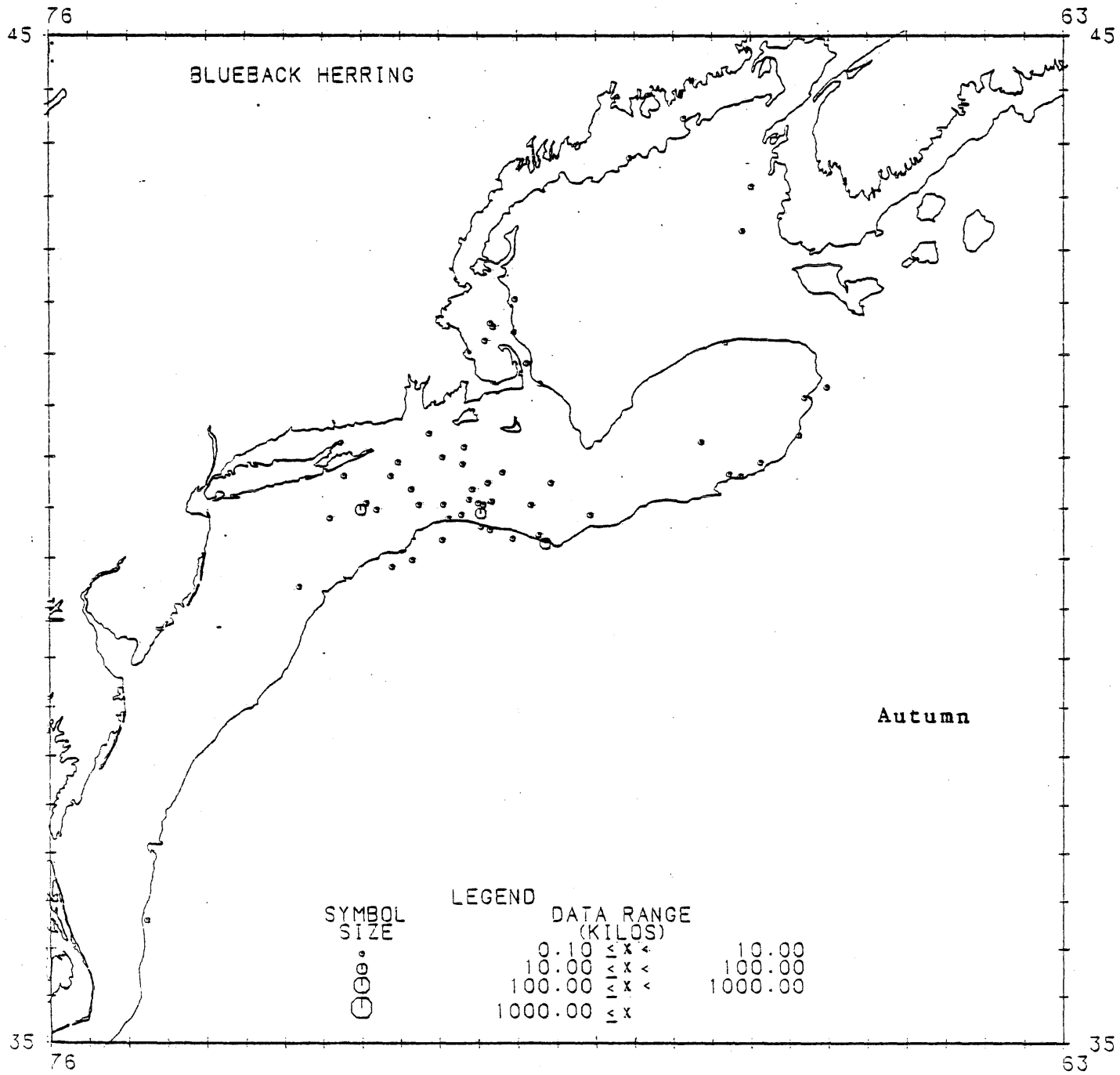

Figure 45. Distribution of blueback herring catches during 1965-1975 and 1977 autumn surveys.

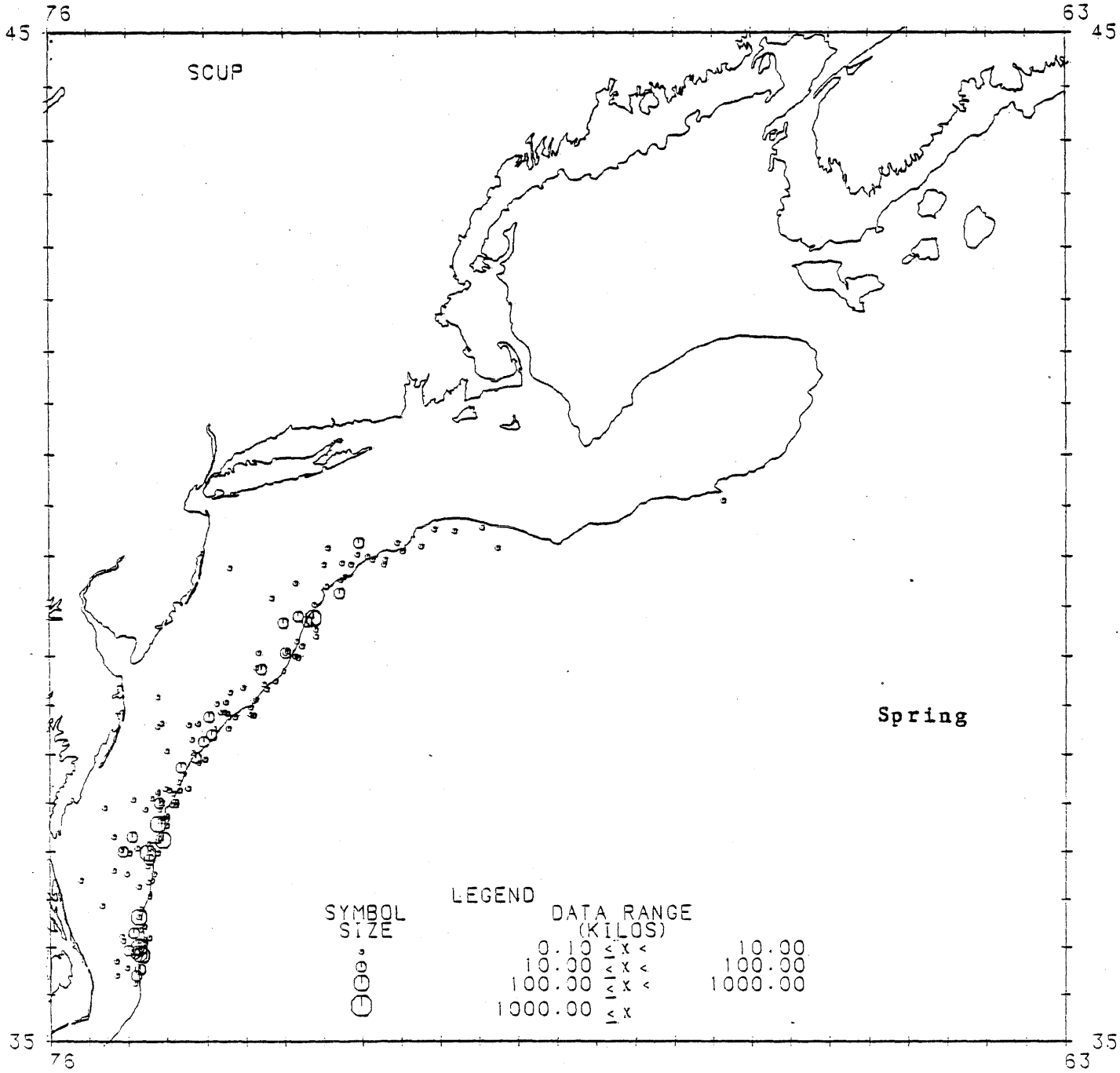

Figure 46. Distribution of scup catches during 1964-1974, 1976 and 1978 spring surveys.

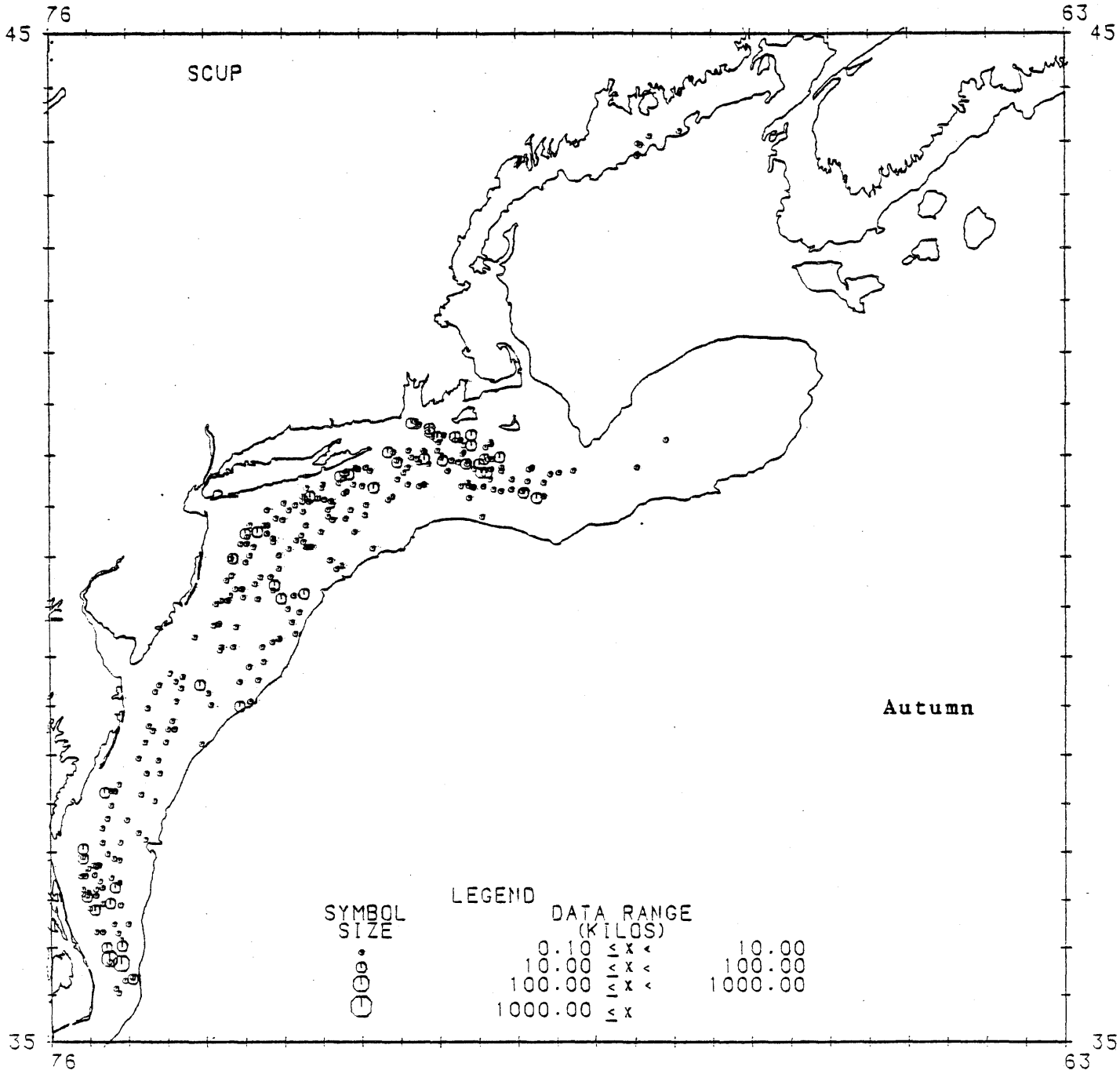

Figure 47. Distribution of scup catches during 1965-1975 and 1977 autumn surveys.

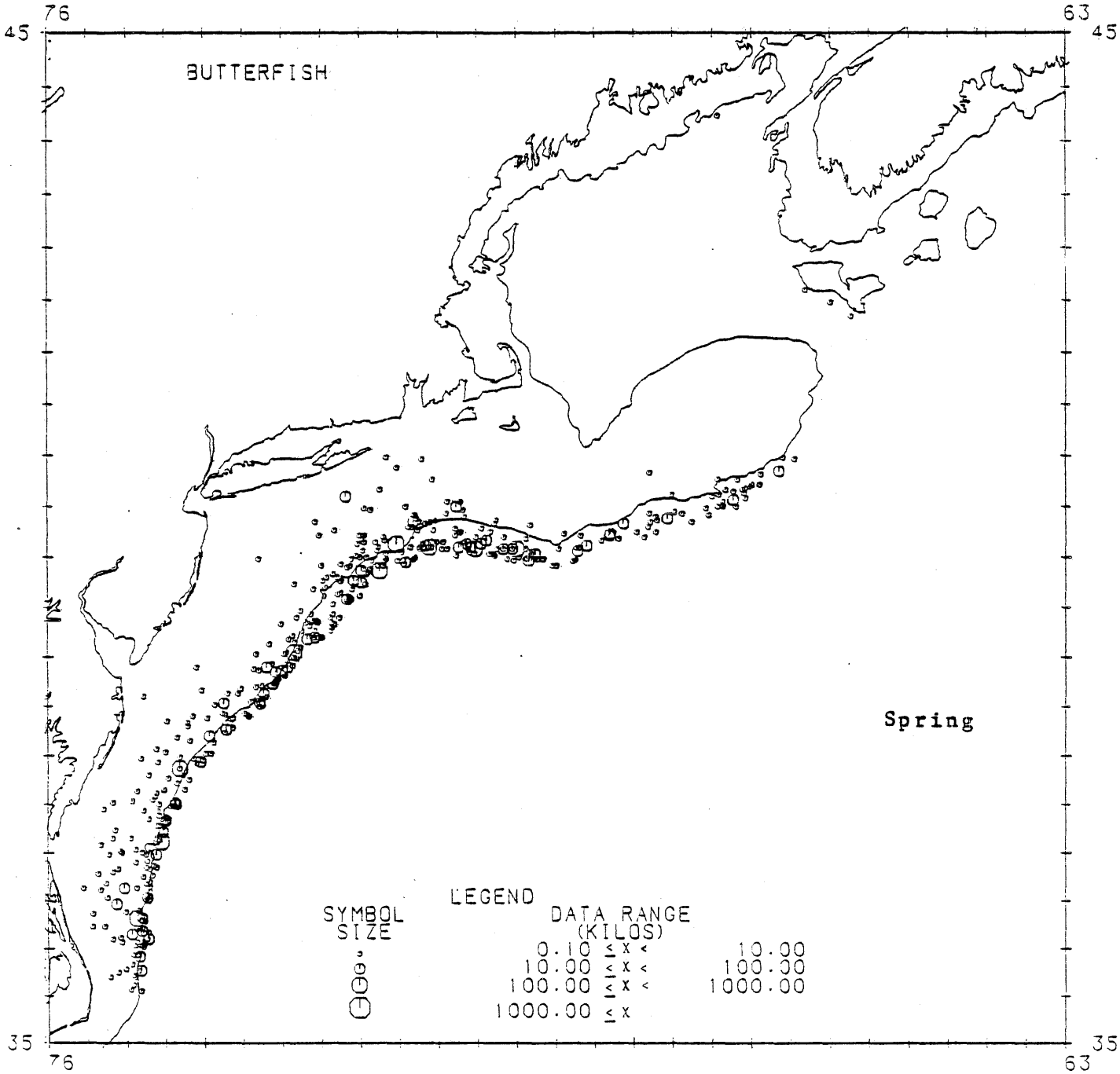

Figure 48. Distribution of butterfish catches during 1964-1974, 1976 and 1978 spring surveys.

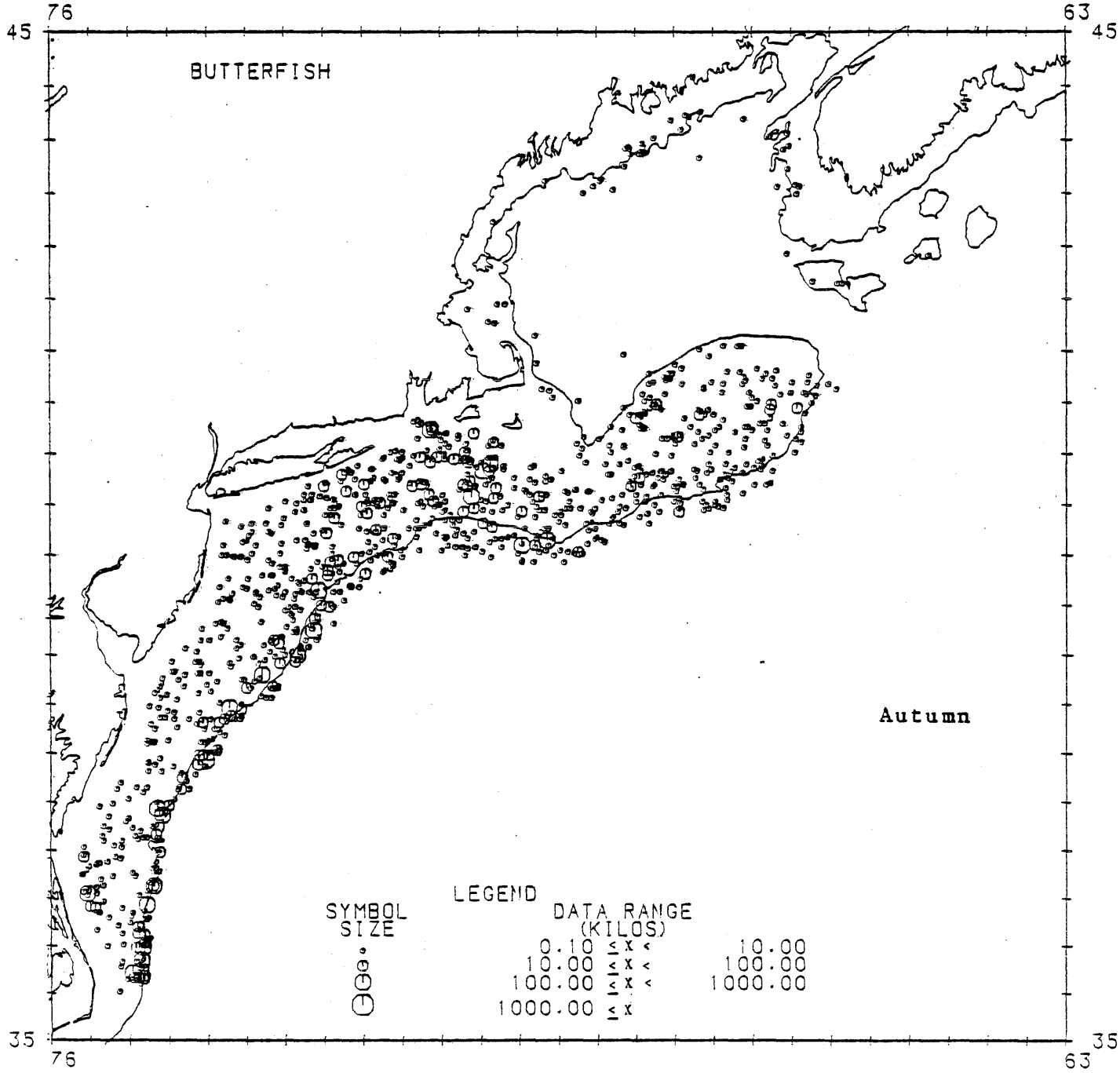

Figure 49. Distribution of butterfish catches during 1965-1975 and 1977 autumn surveys.

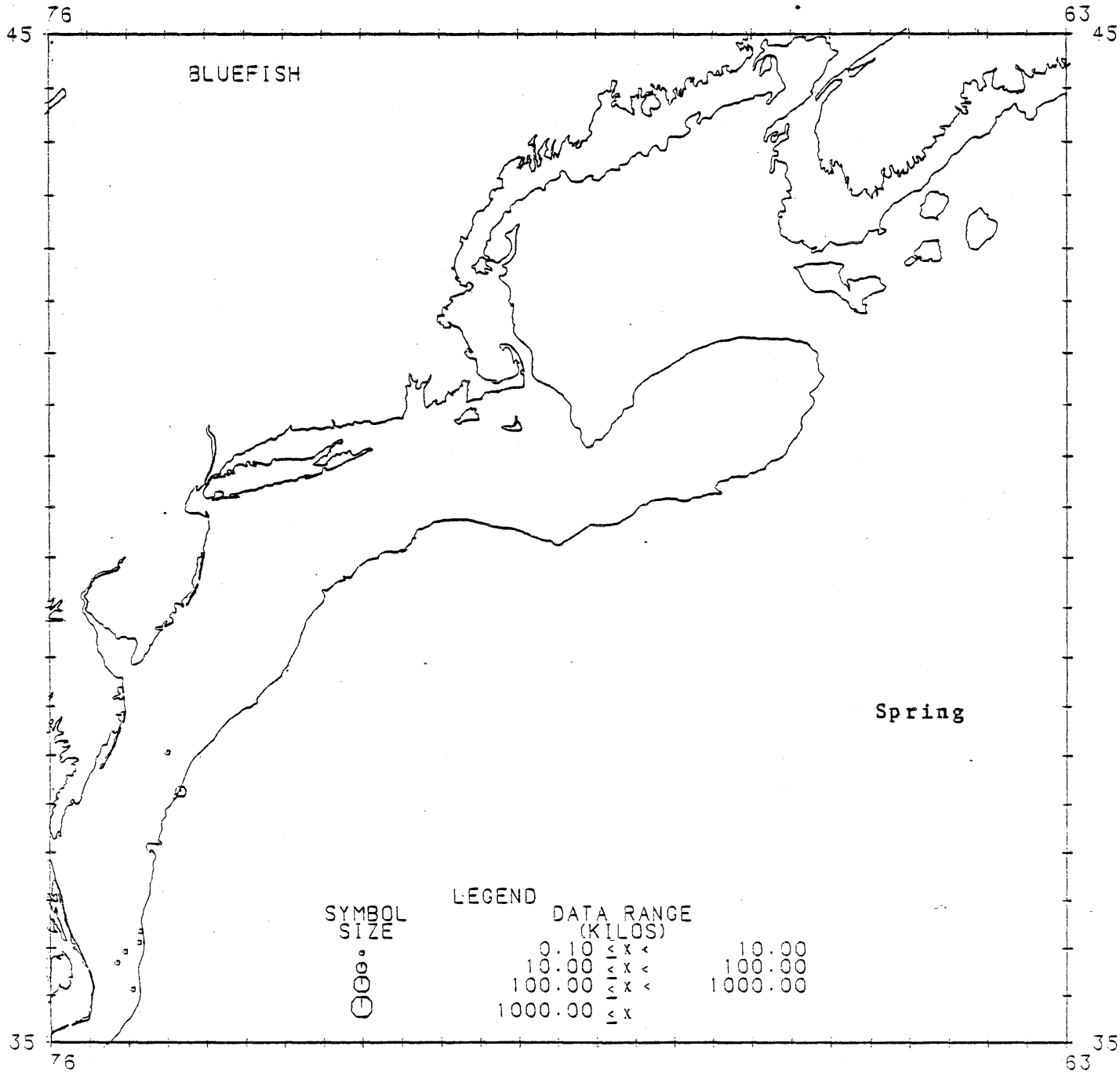

Figure 50. Distribution of bluefish catches during 1964-1974, 1976 and 1978 spring surveys.

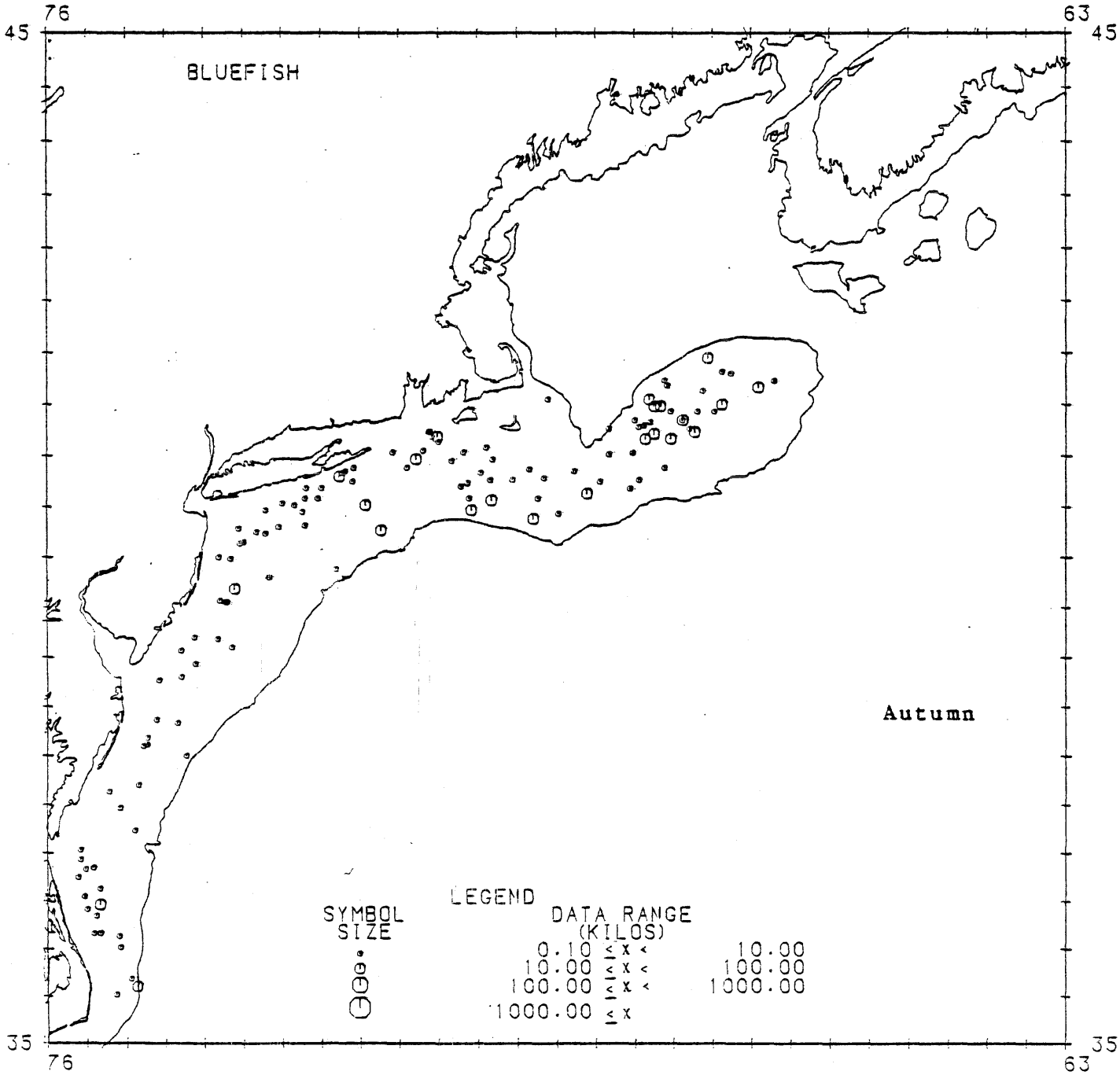

Figure 51. Distribution of bluefish catches during 1965-1975 and 1977 autumn surveys.

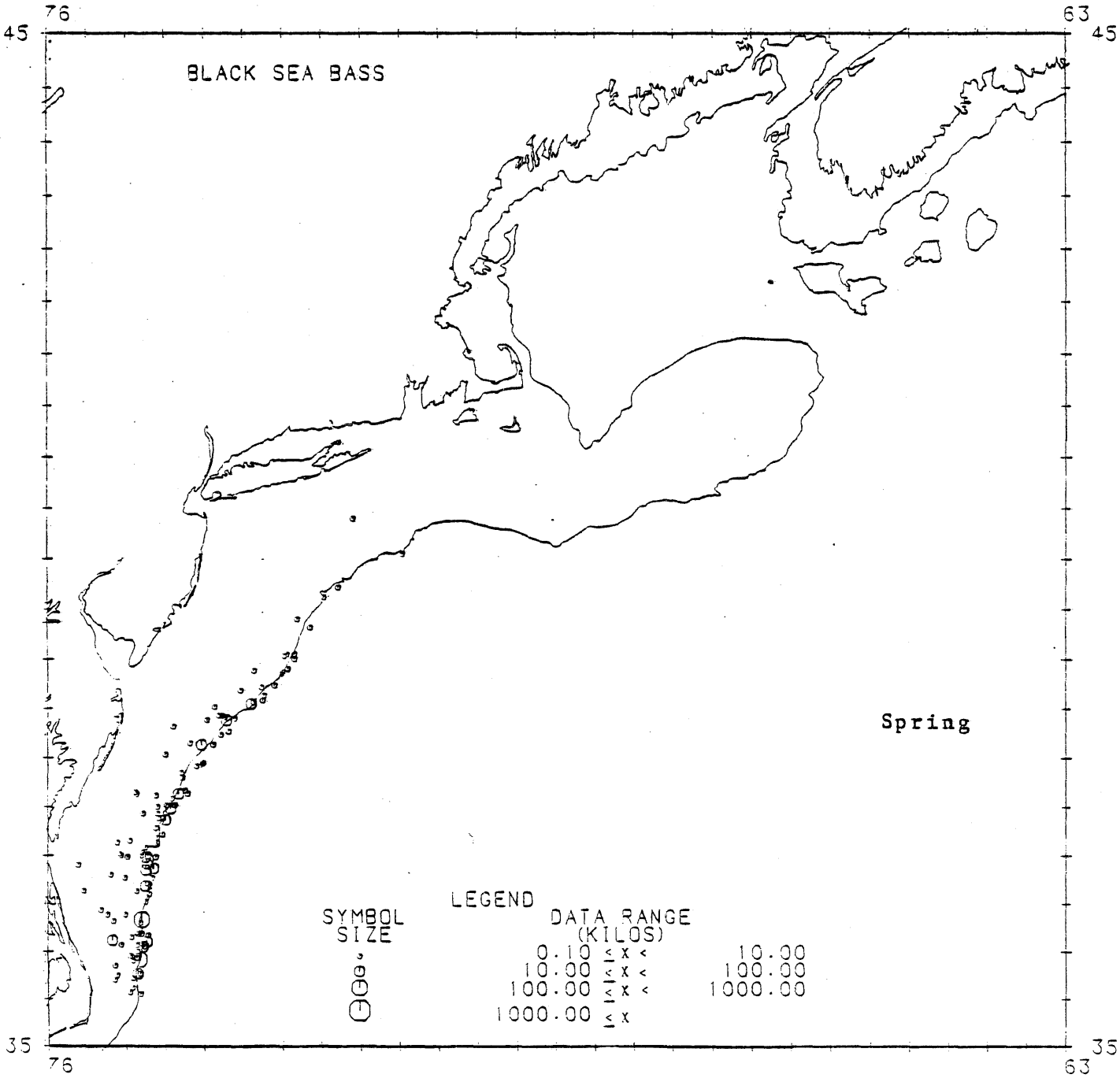

Figure 52. Distribution of black sea bass catches during 1964-1974, 1976 and 1978 spring surveys.

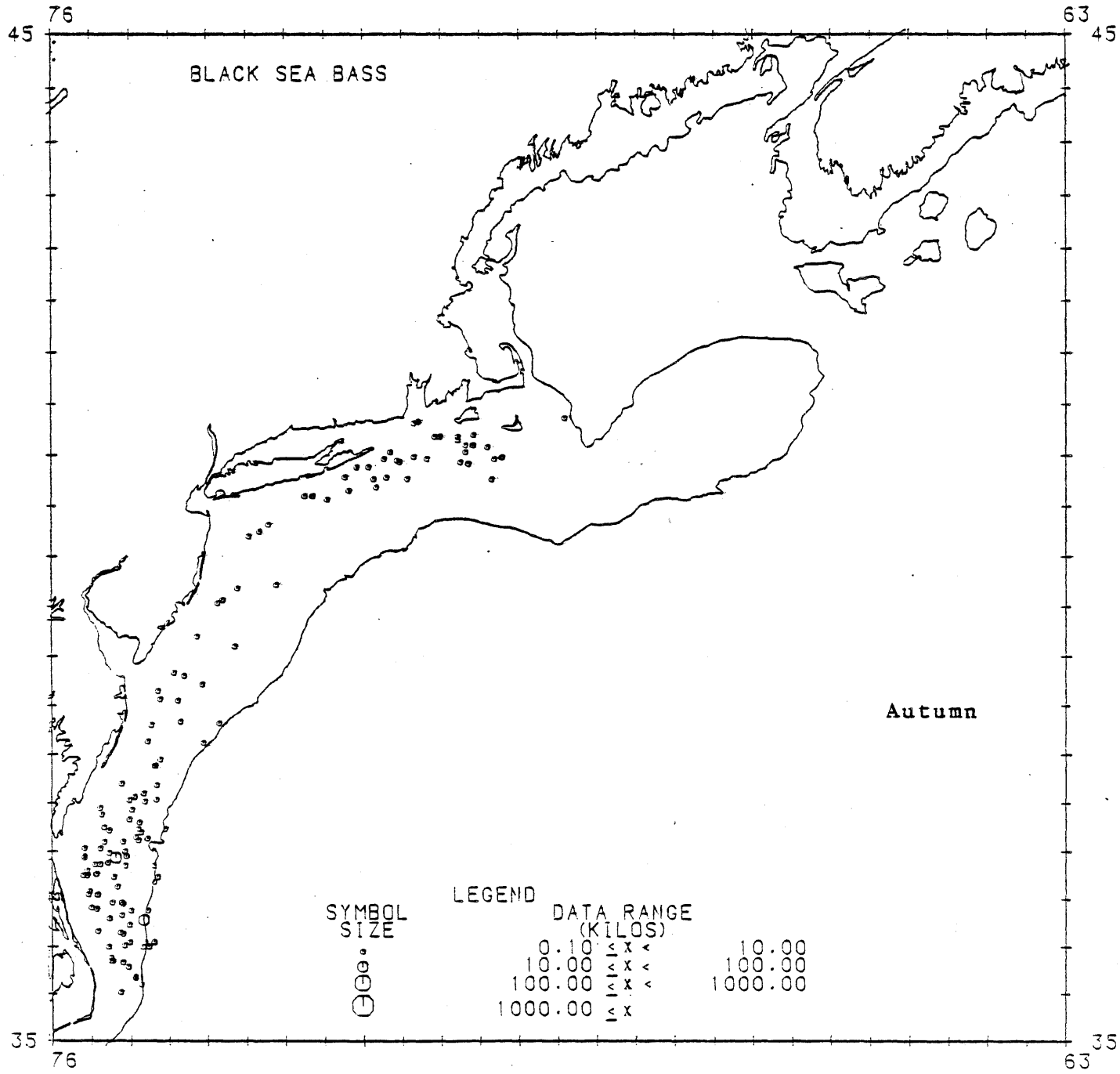

Figure 53. Distribution of black sea bass catches during 1965-1975 and 1977 autumn surveys.

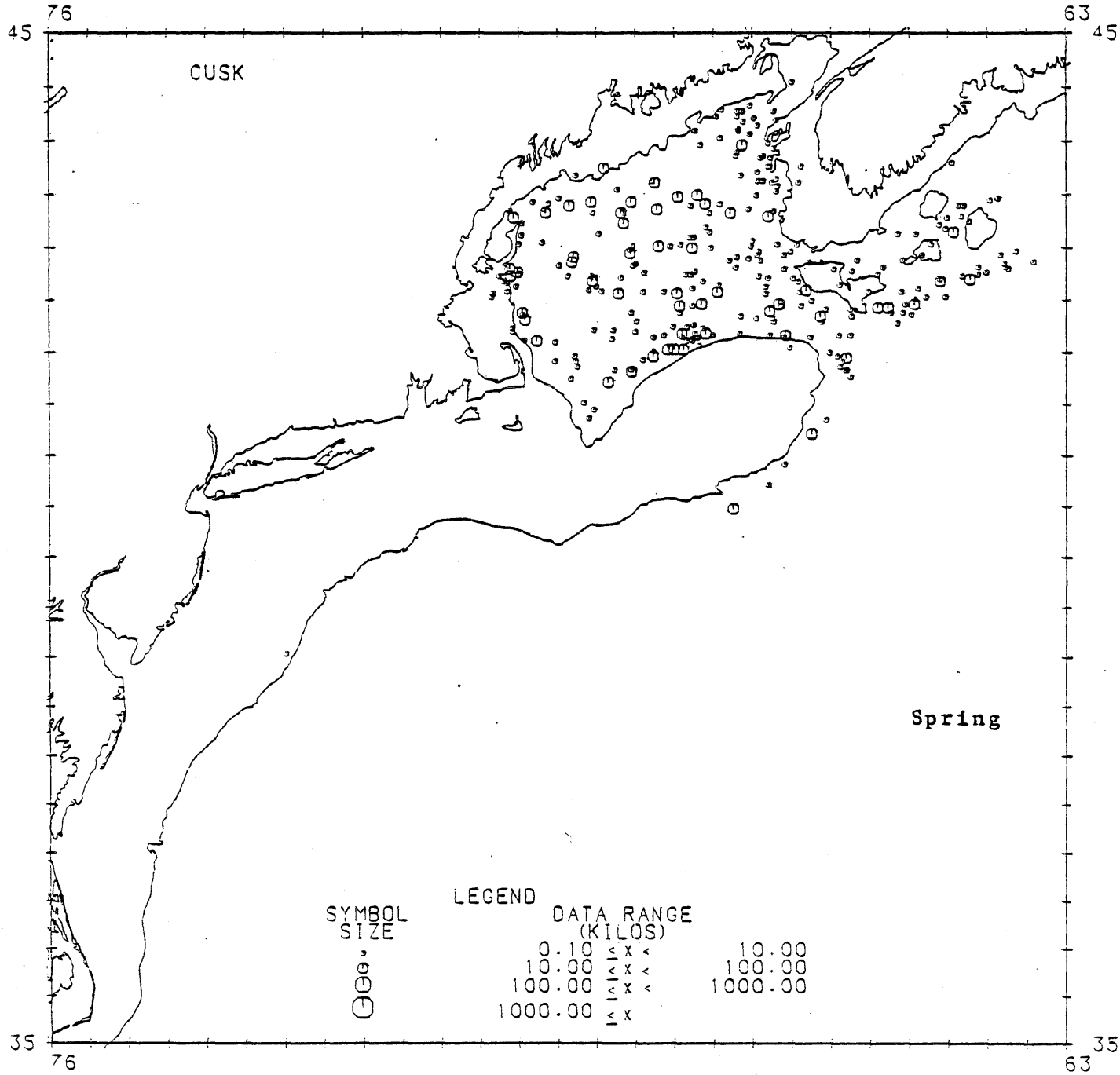

Figure 54. Distribution of cusk catches during 1964-1974, 1976 and 1978 spring surveys.

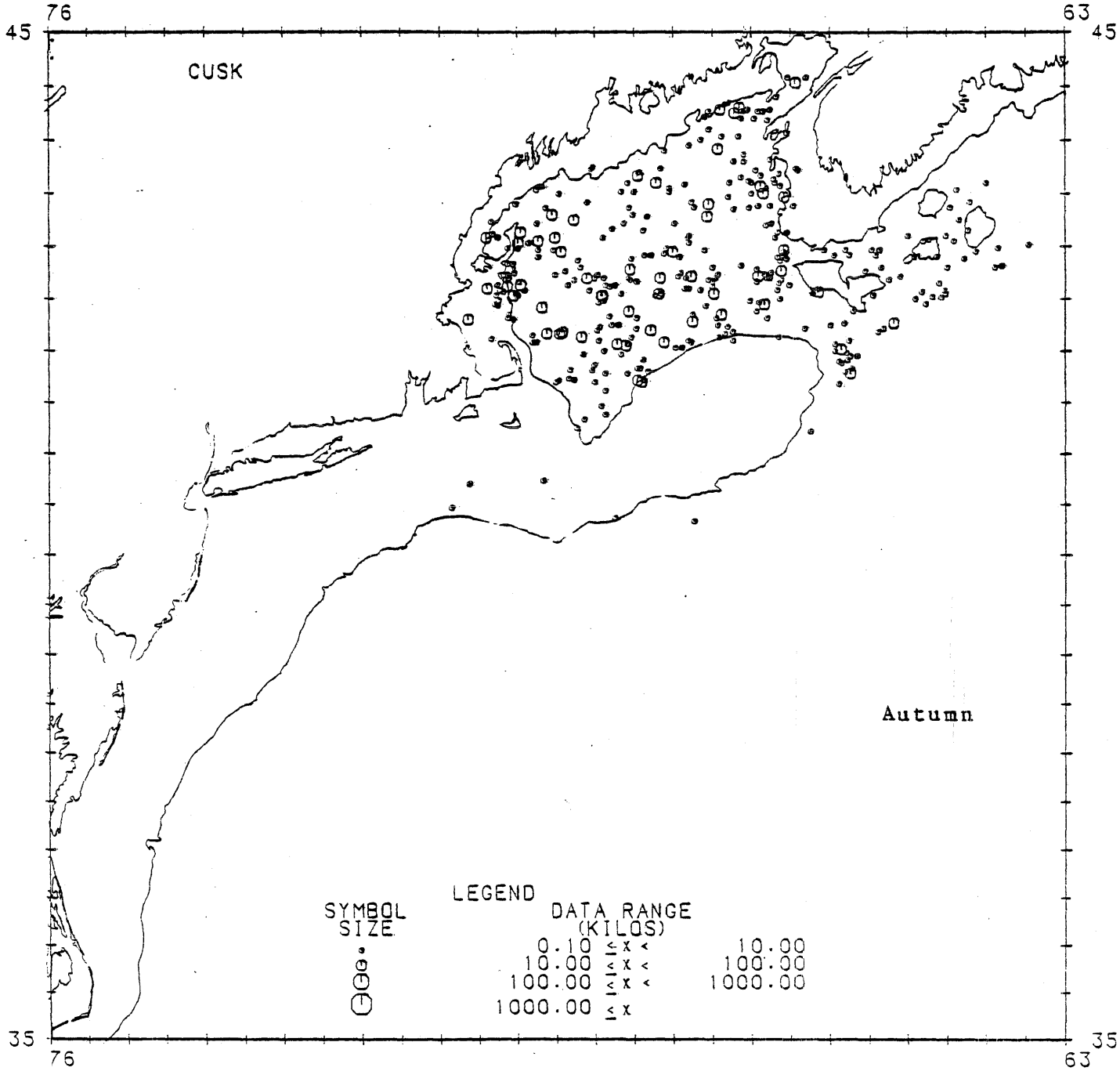

Figure 55. Distribution of cusk catches during 1965-1975 and 1977 autumn surveys.

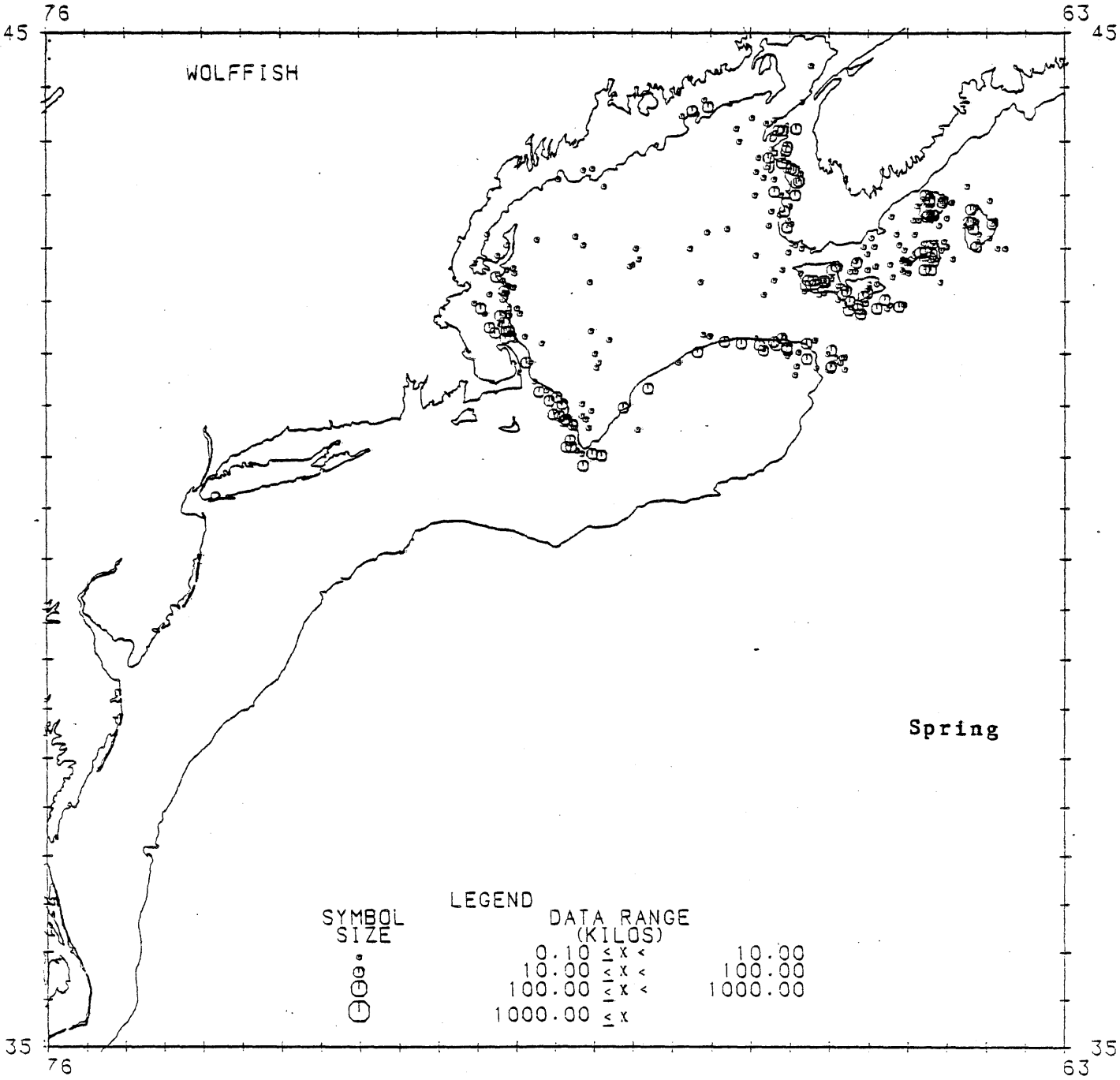

Figure 56. Distribution of Atlantic wolffish catches during 1964-1974, 1976 and 1978 spring surveys.

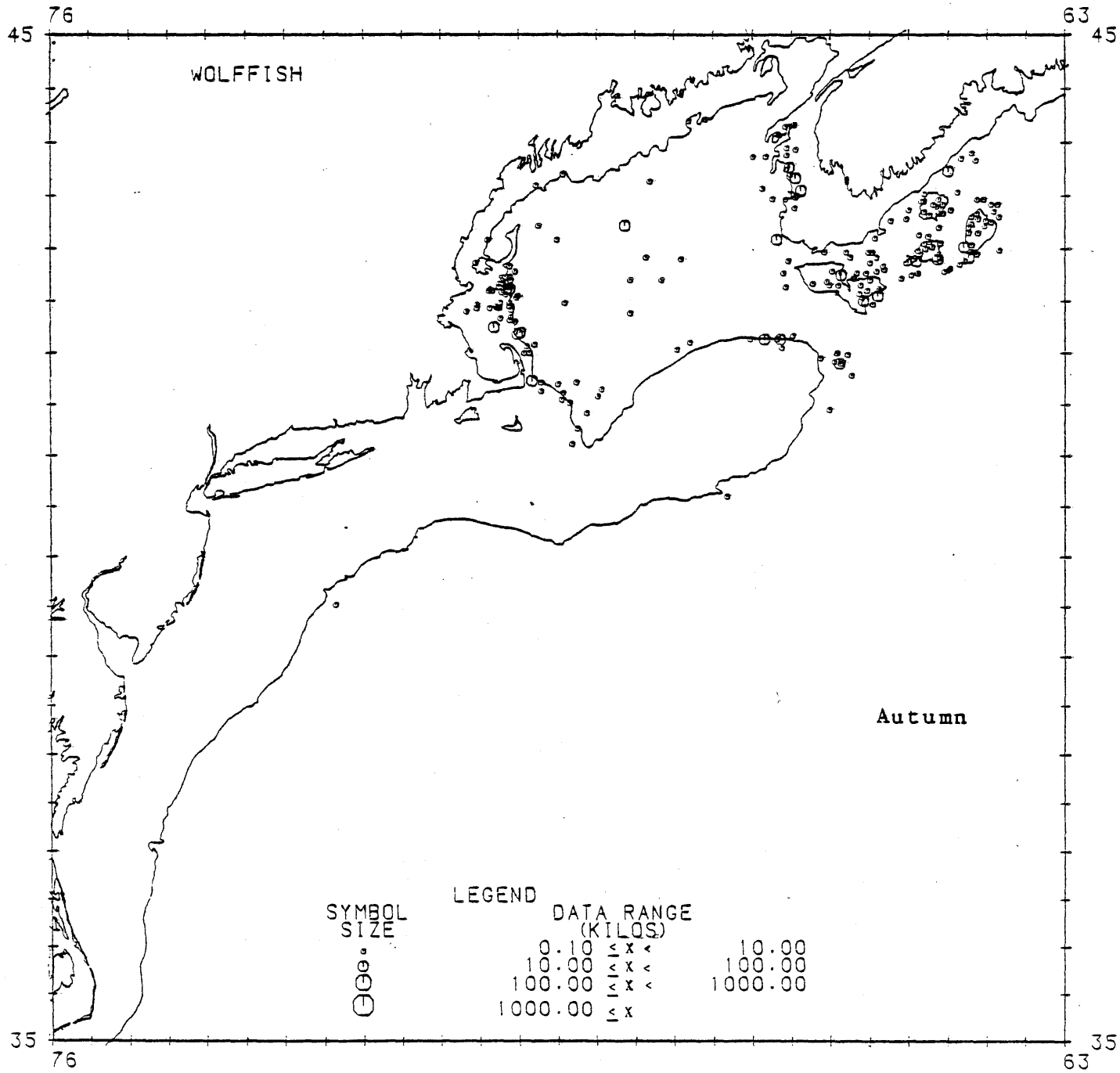

Figure 57. Distribution of Atlantic wolffish catches during 1965-1975 and 1977 autumn surveys.

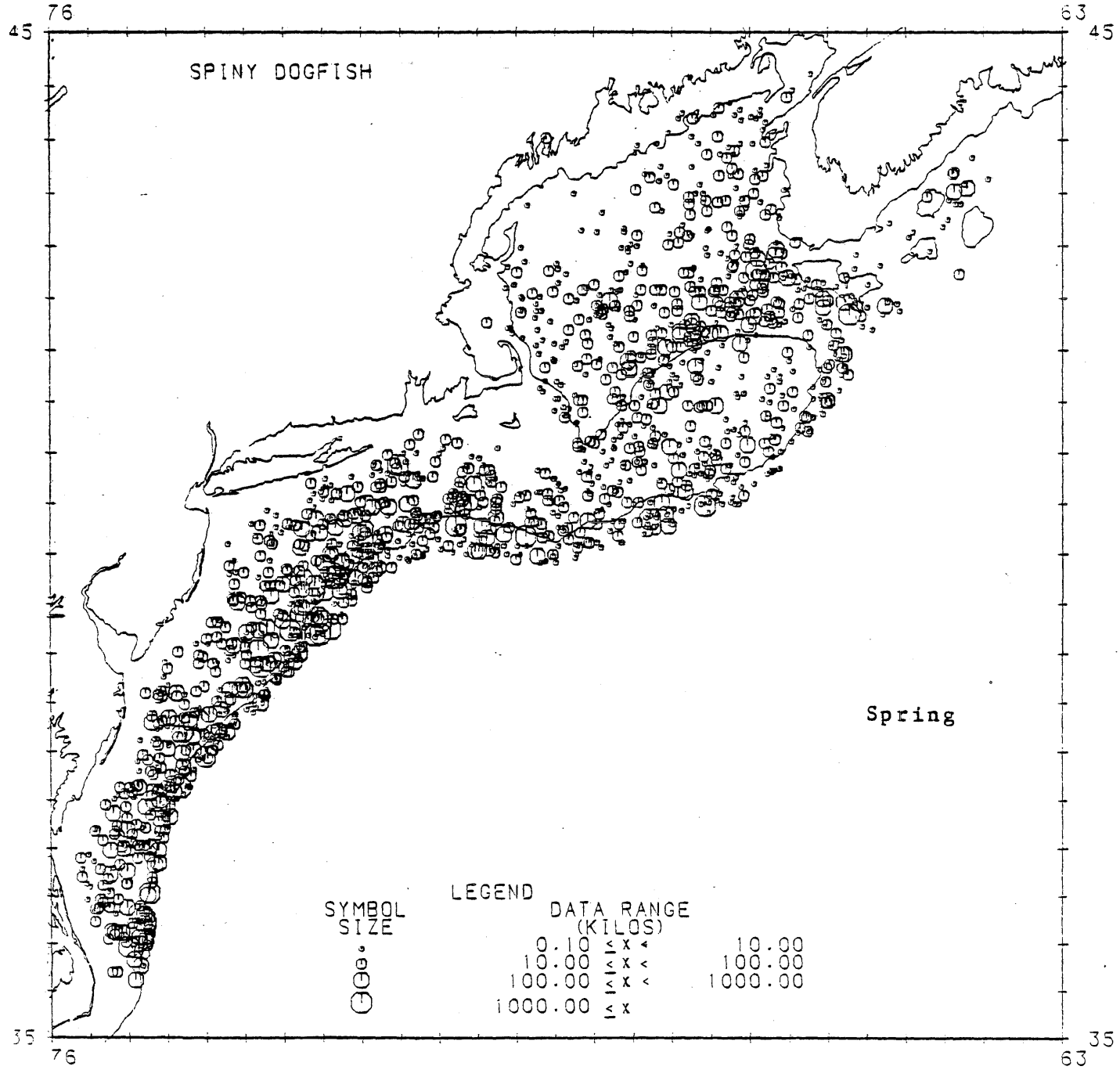

Figure 58. Distribution of spiny dogfish catches during 1964-1974, 1976 and 1978 spring surveys.

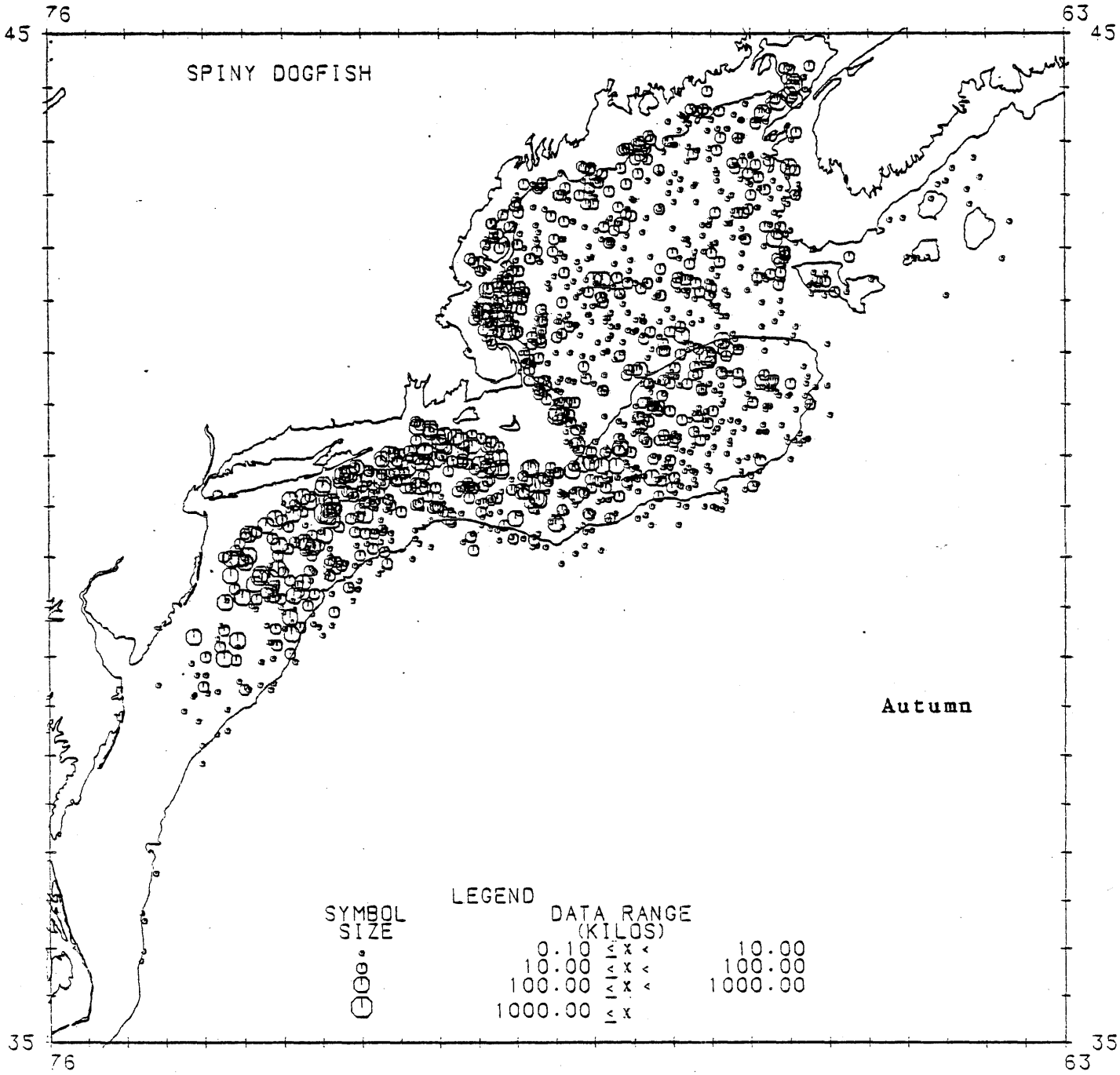

Figure 59. Distribution of spiny dogfish catches during 1965-1975 and 1977 autumn surveys.

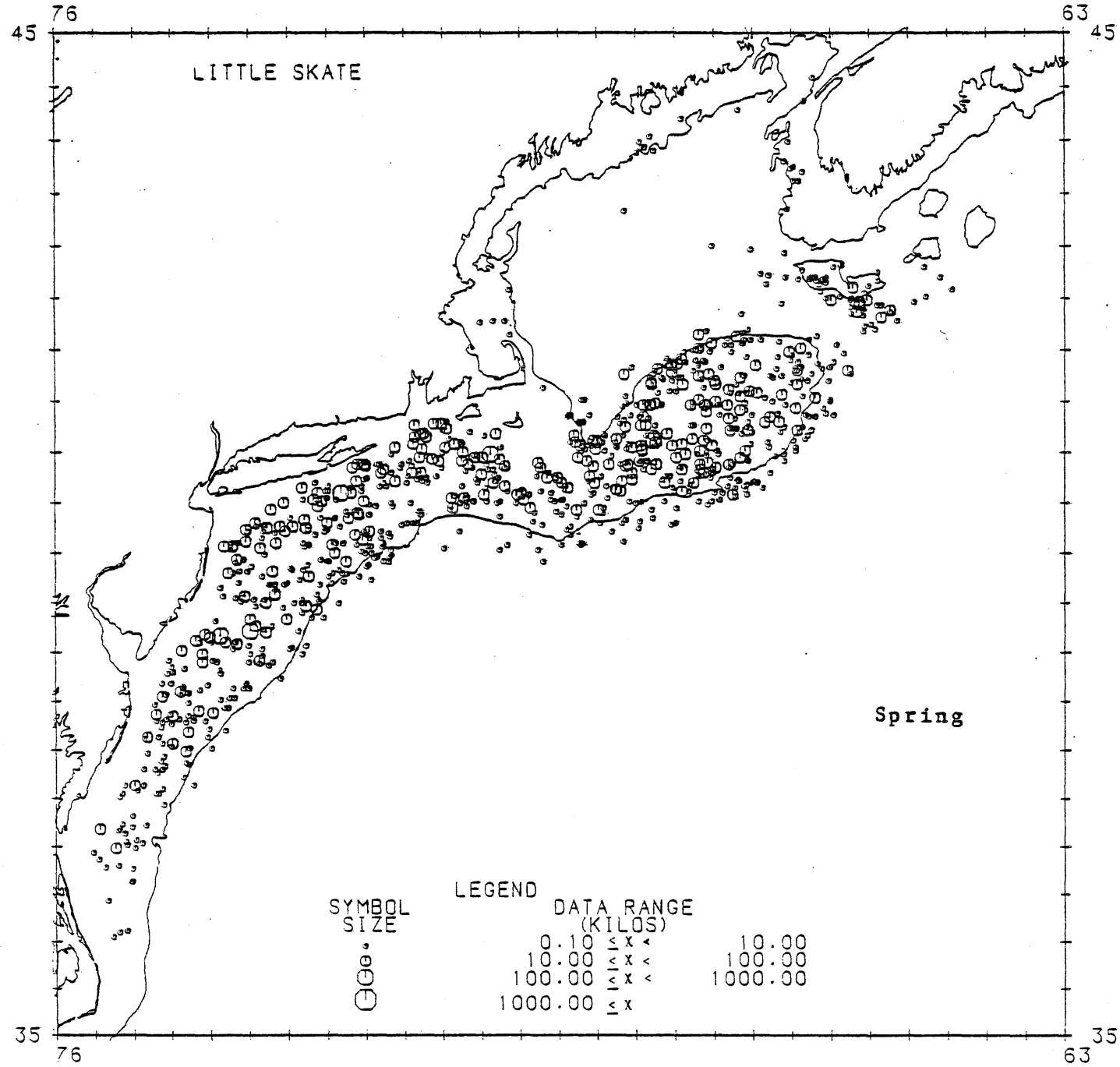

Figure 60. Distribution of little skate catches during 1964-1974, 1976 and 1978 spring surveys.

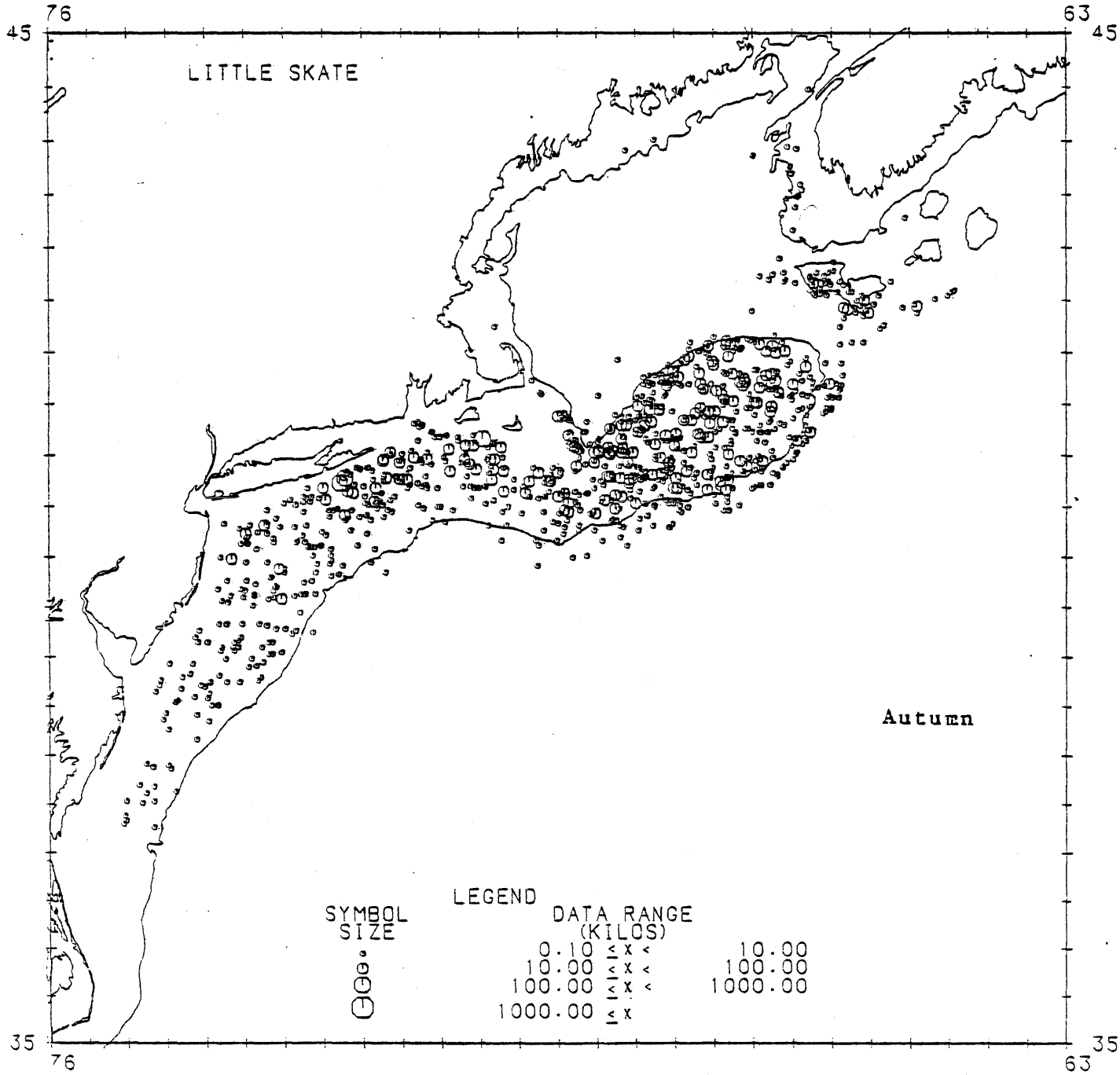

Figure 61. Distribution of little skate catches during 1965-1975 and 1977 autumn surveys.

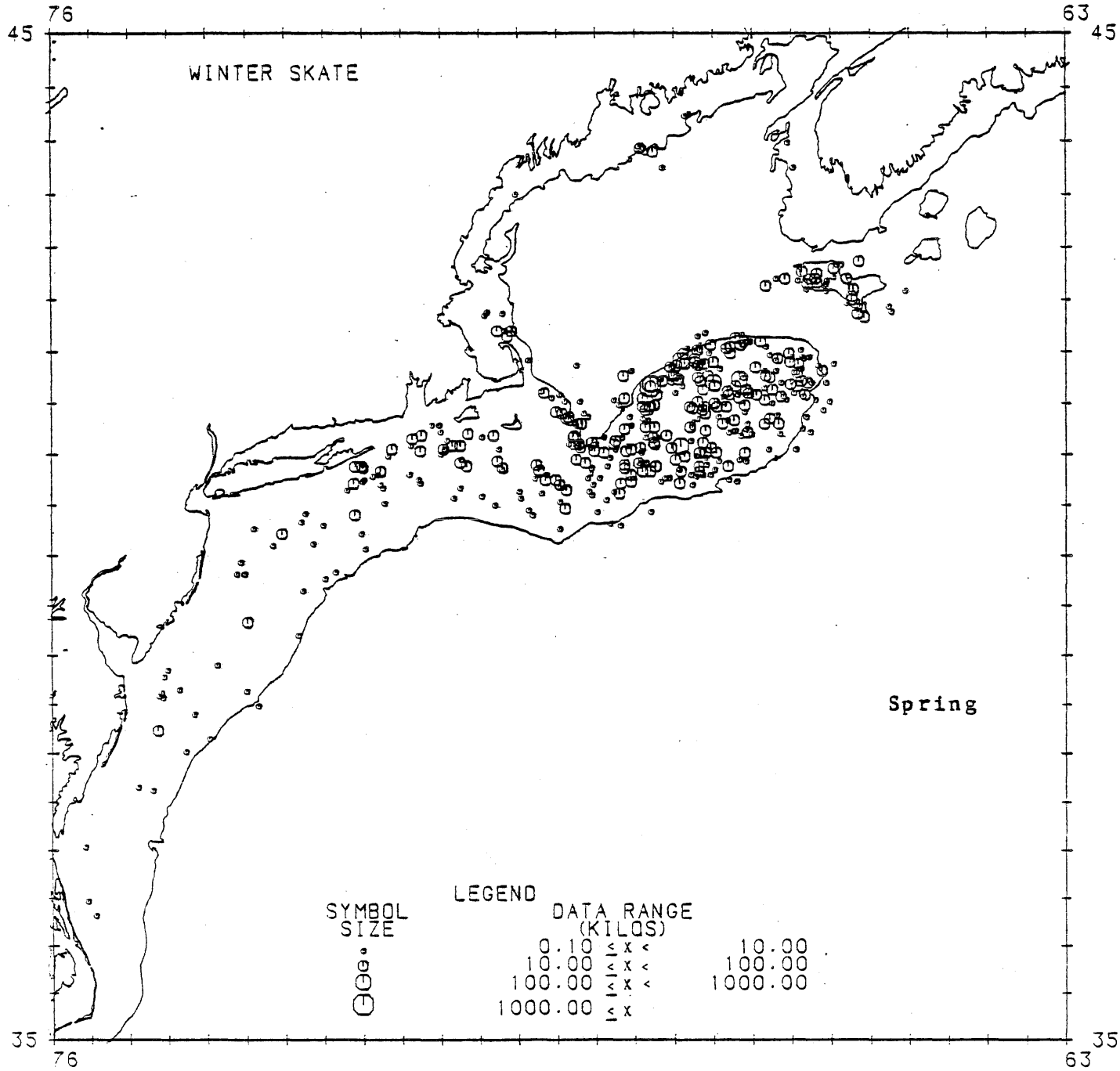

Figure 62. Distribution of winter skate catches during 1964-1974, 1976 and 1978 spring surveys.

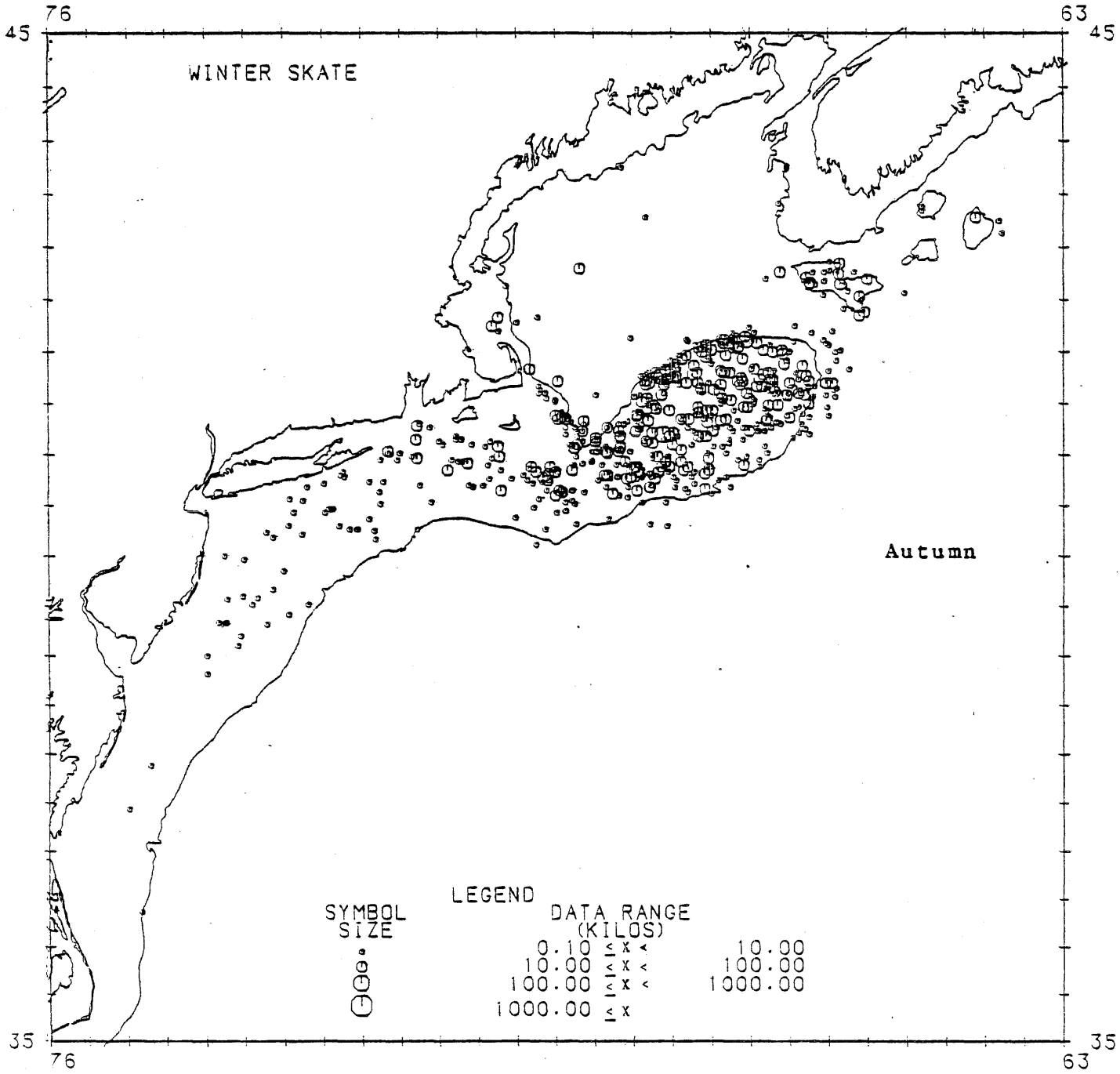

Figure 63. Distribution of winter skate catches during 1965-1975 and 1977 autumn surveys.

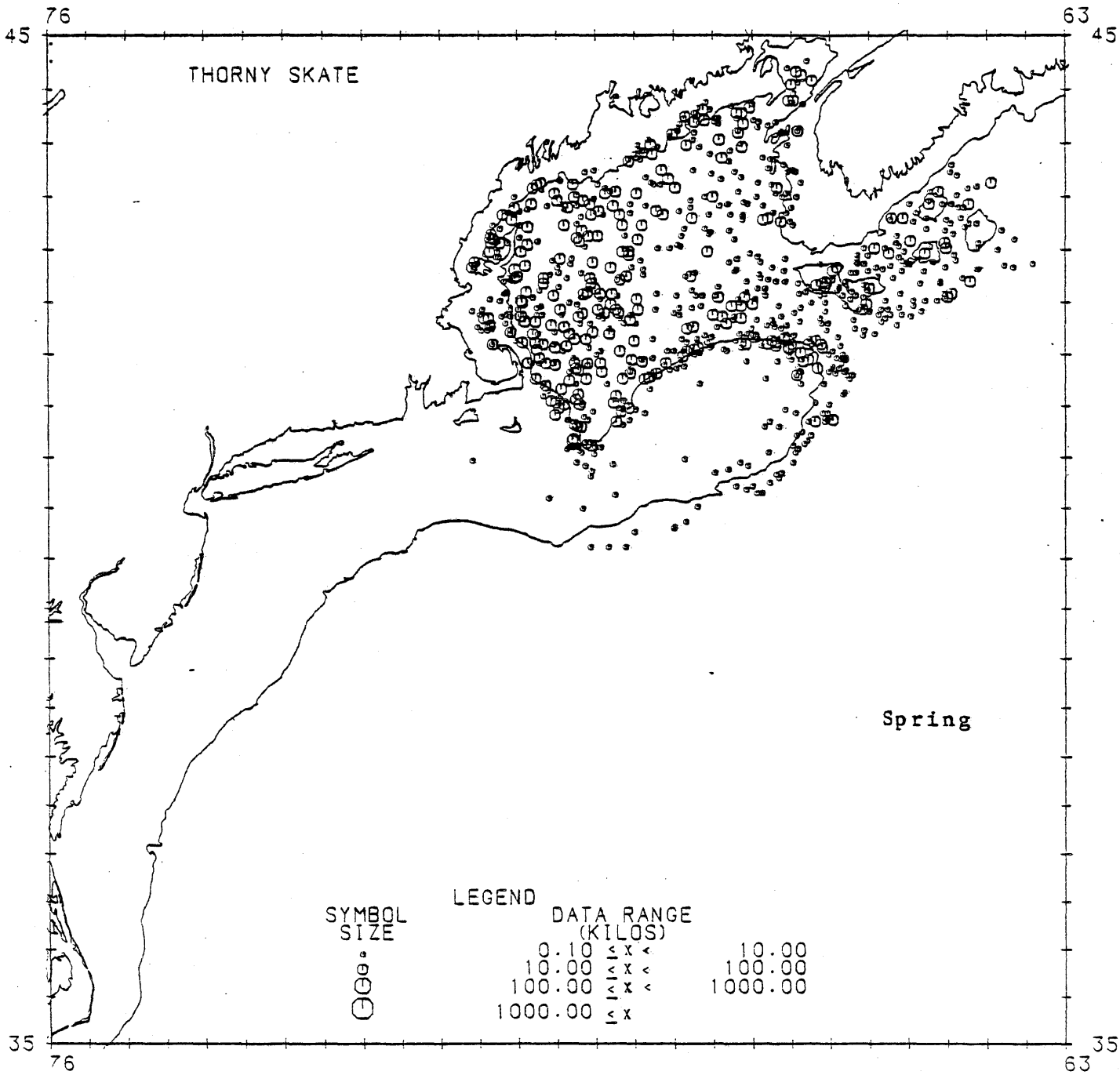

Figure 64. Distribution of thorny skate catches during 1964-1974, 1976 and 1978 spring surveys.

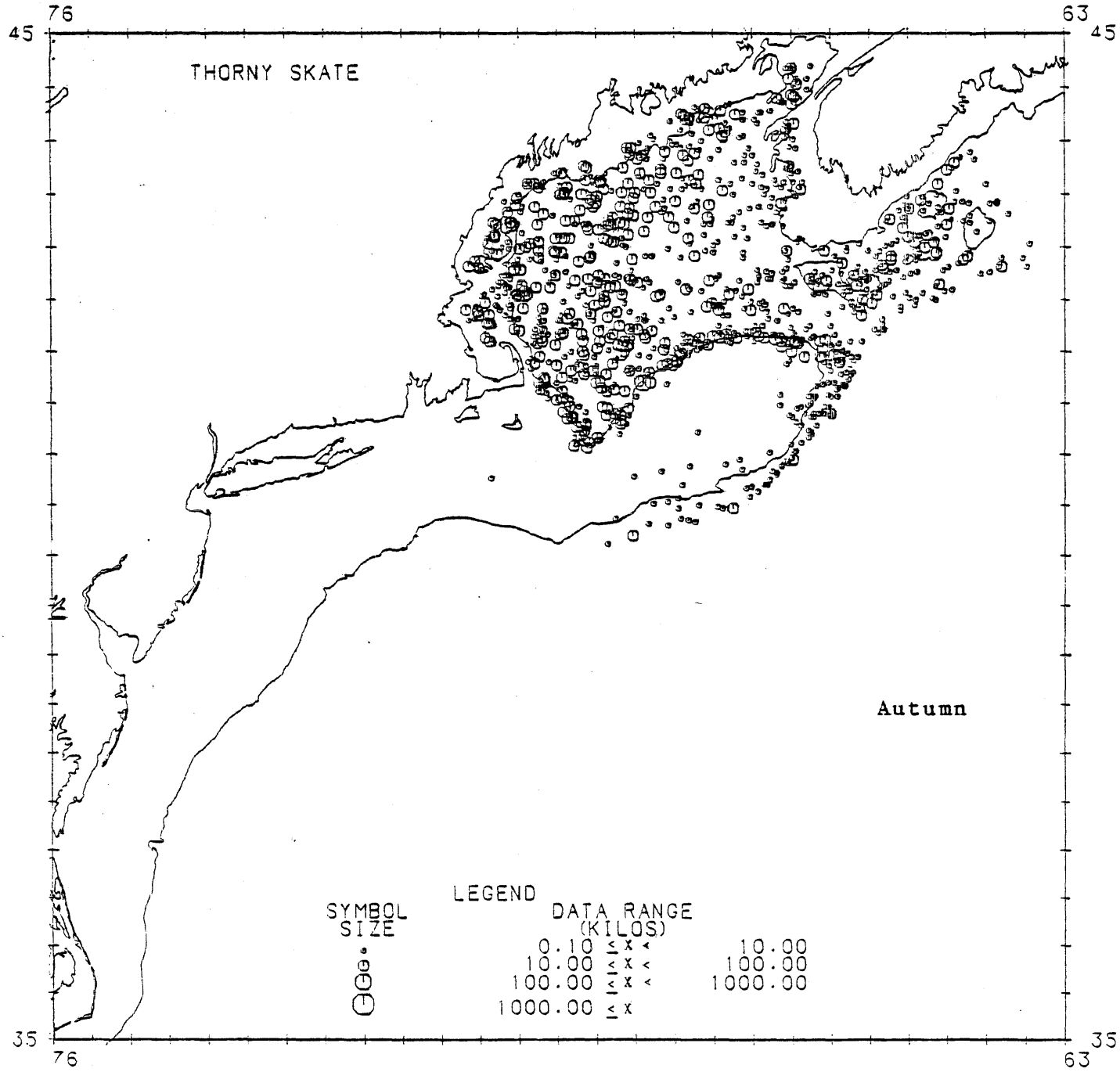

Figure 65. Distribution of thorny skate catches during 1965-1975 and 1977 autumn surveys.

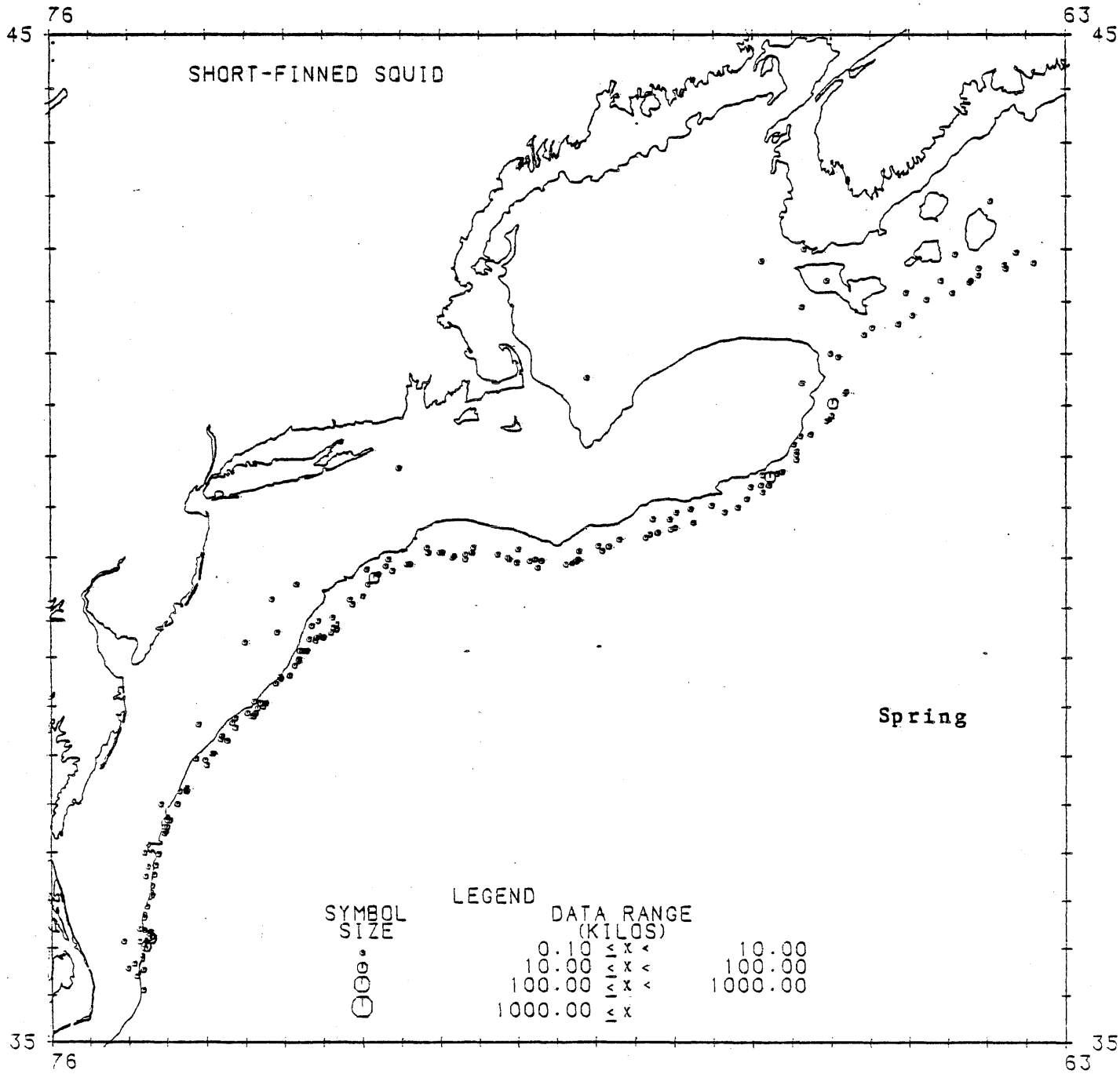

Figure 66. Distribution of short-finned squid catches during 1964-1974, 1976 and 1978 spring surveys.

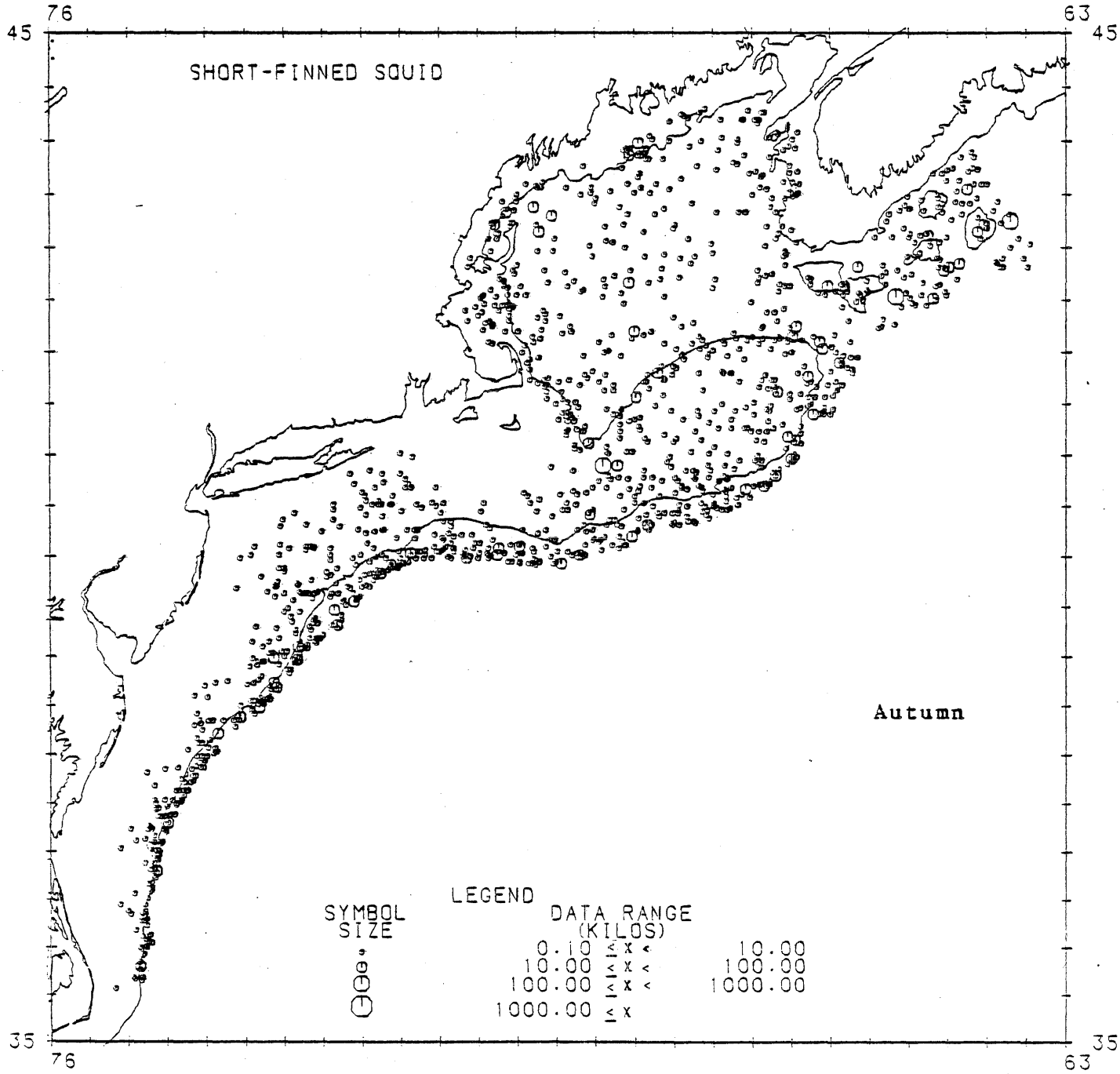

Figure 67. Distribution of short-finned squid catches during 1965-1975 and 1977 autumn surveys.

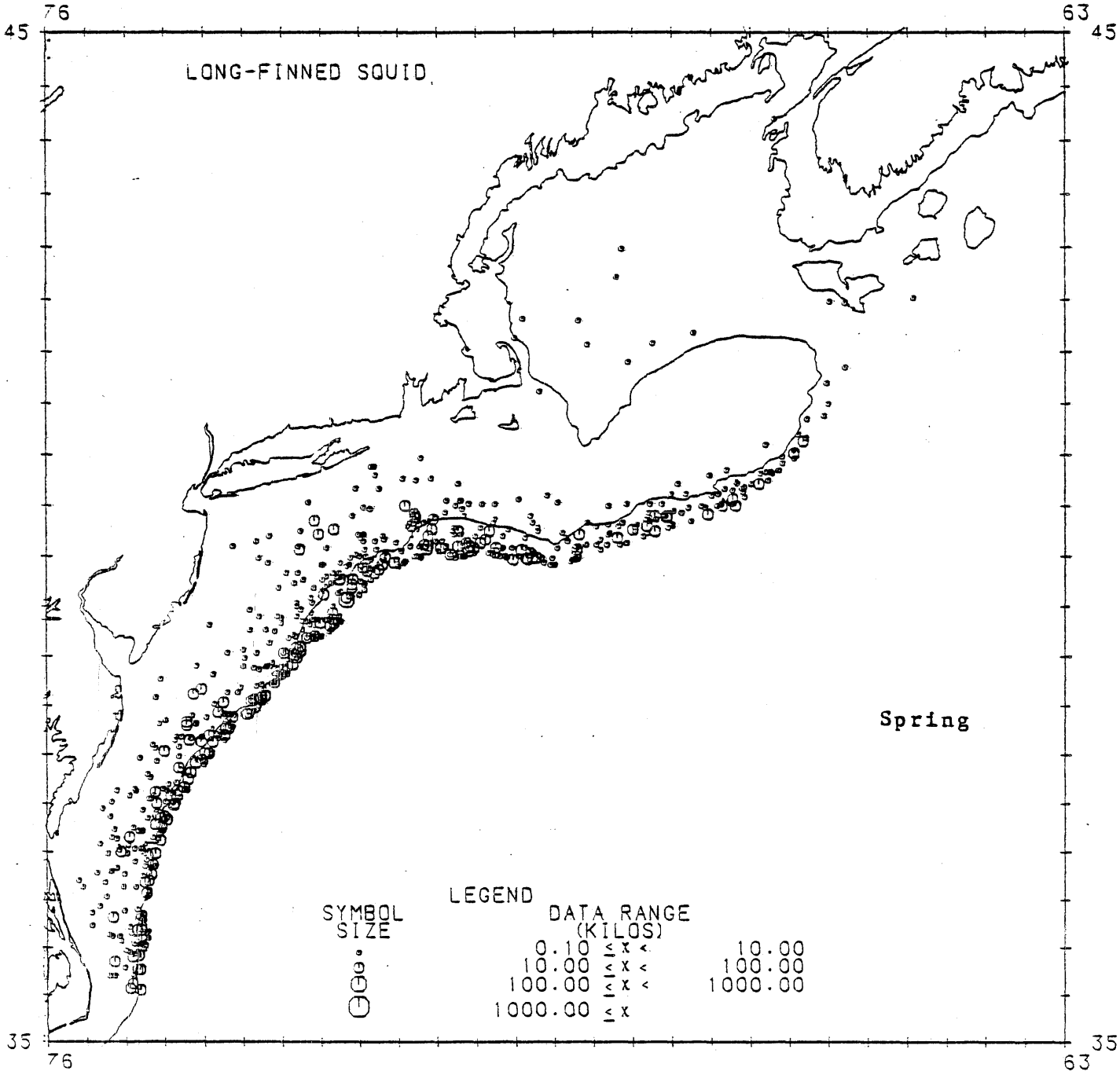

Figure 68. Distribution of long-finned squid catches during 1964-1974, 1976 and 1978 spring surveys.

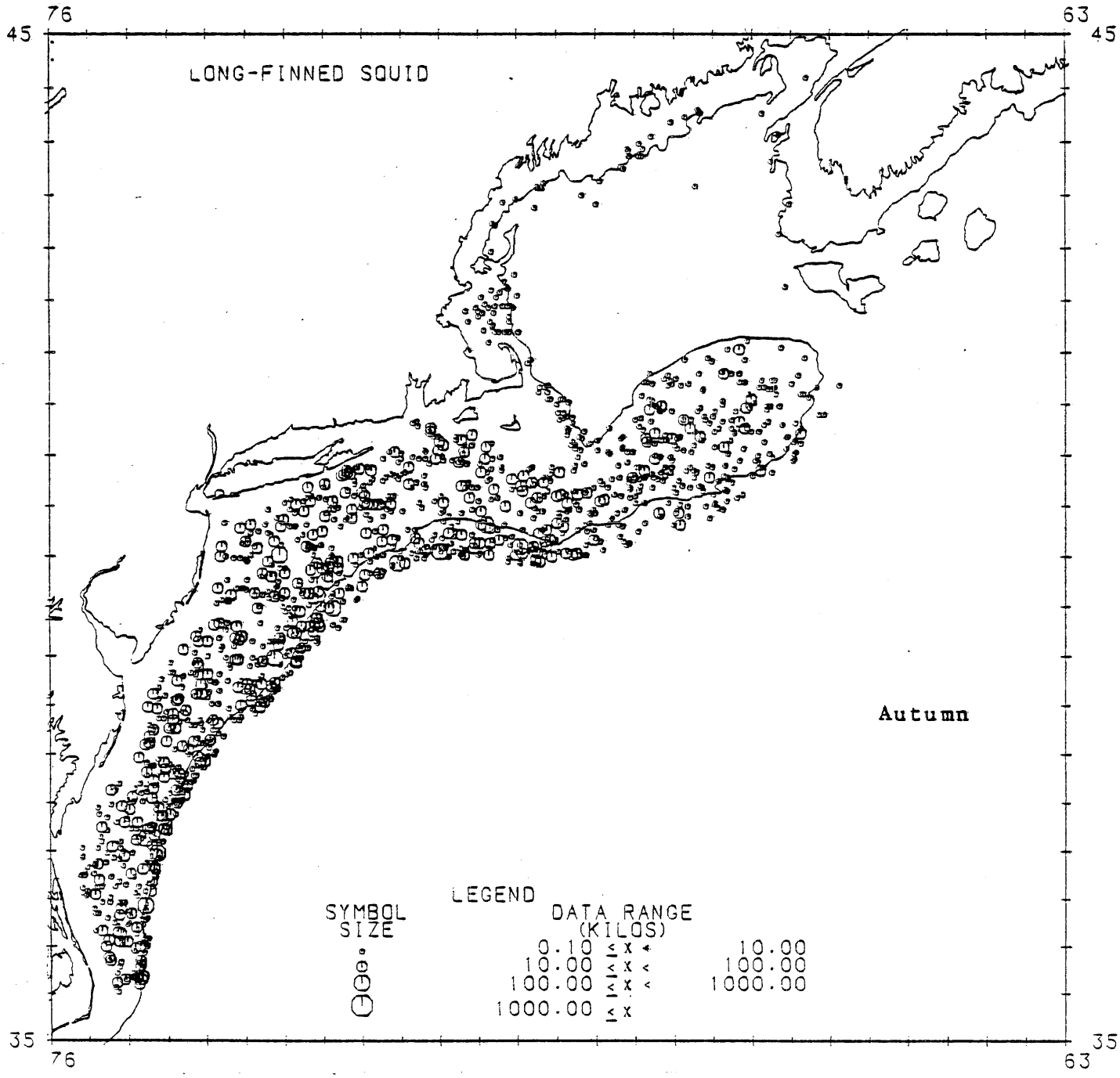

Figure 69. Distribution of long-finned squid catches during 1965-1975 and 1977 autumn surveys.

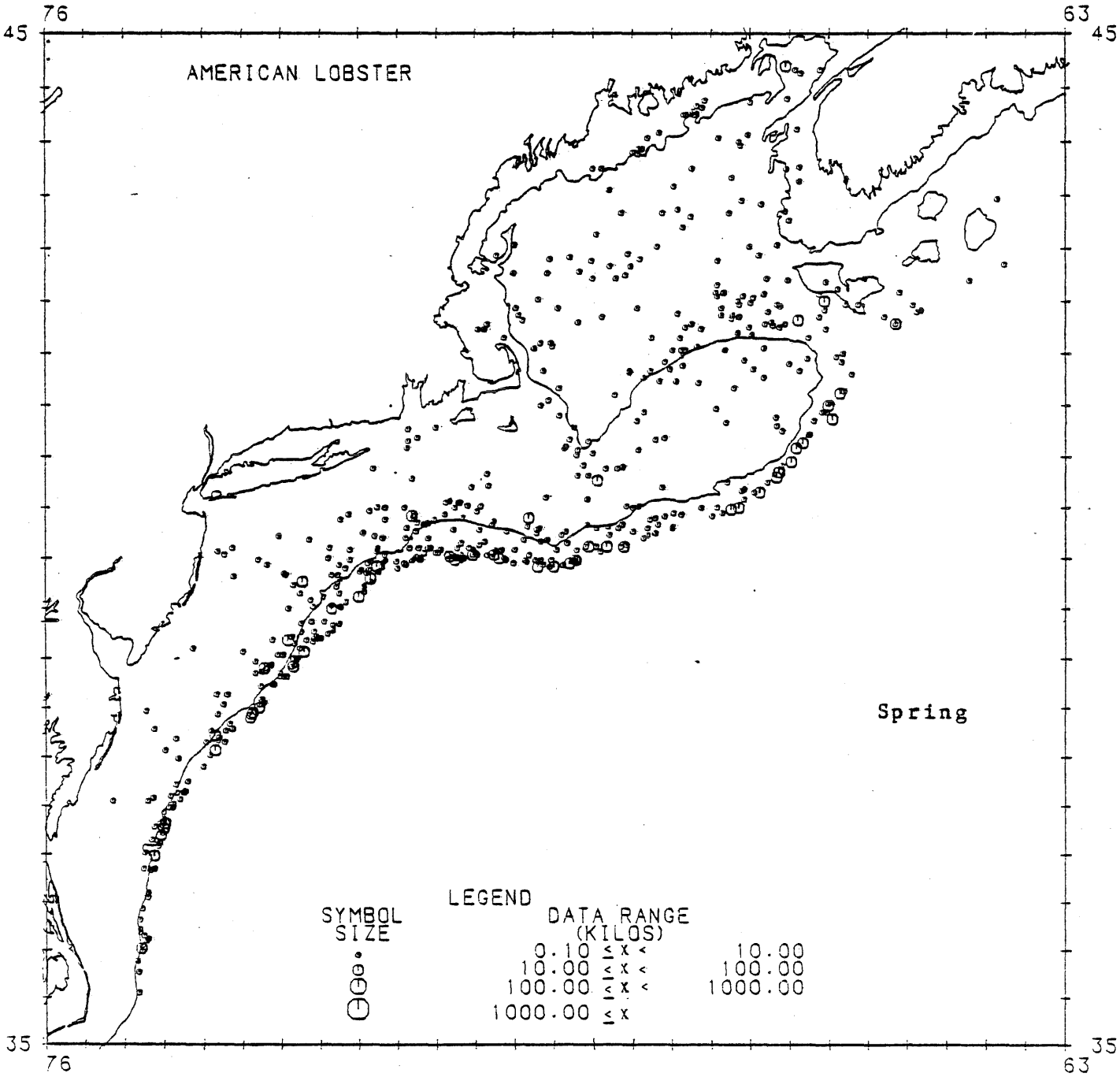

Figure 70. Distribution of American lobster catches during 1964-1974, 1976 and 1978 spring surveys.

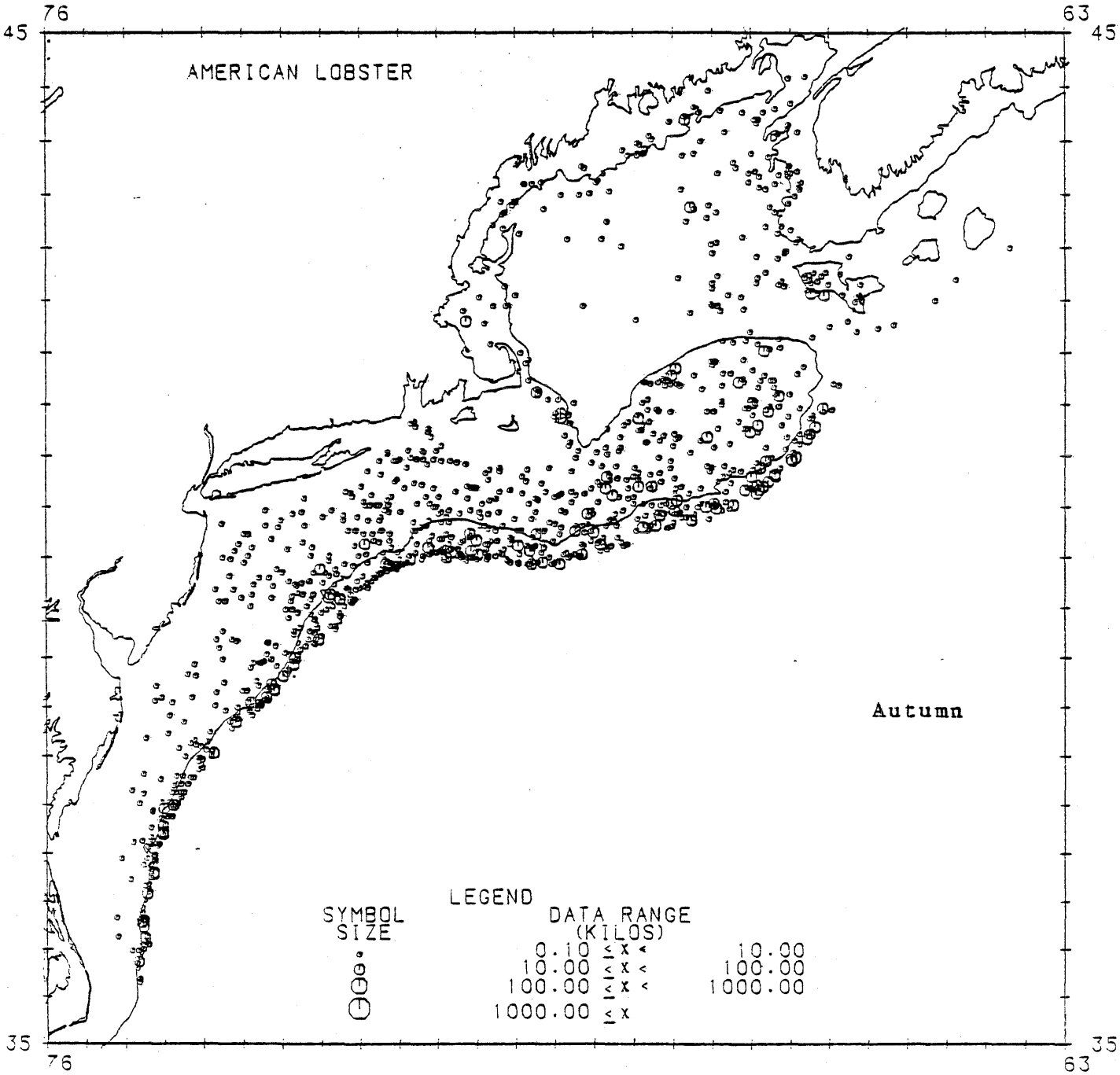

Figure 71. Distribution of American lobster catches during 1965-1975 and 1977 autumn surveys.

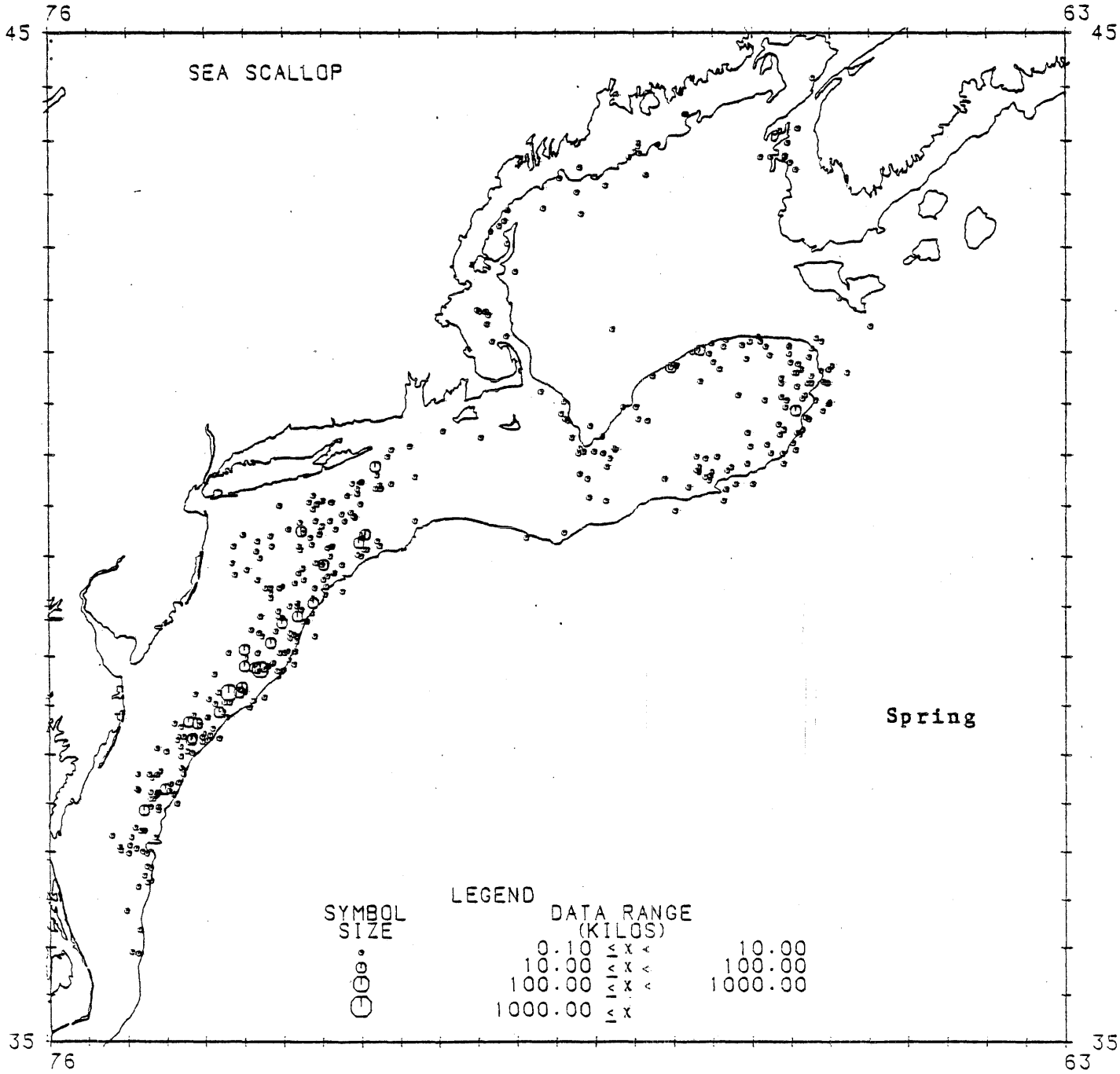

Figure 72. Distribution of sea scallop catches during 1964-1974, 1976 and 1978 spring surveys.

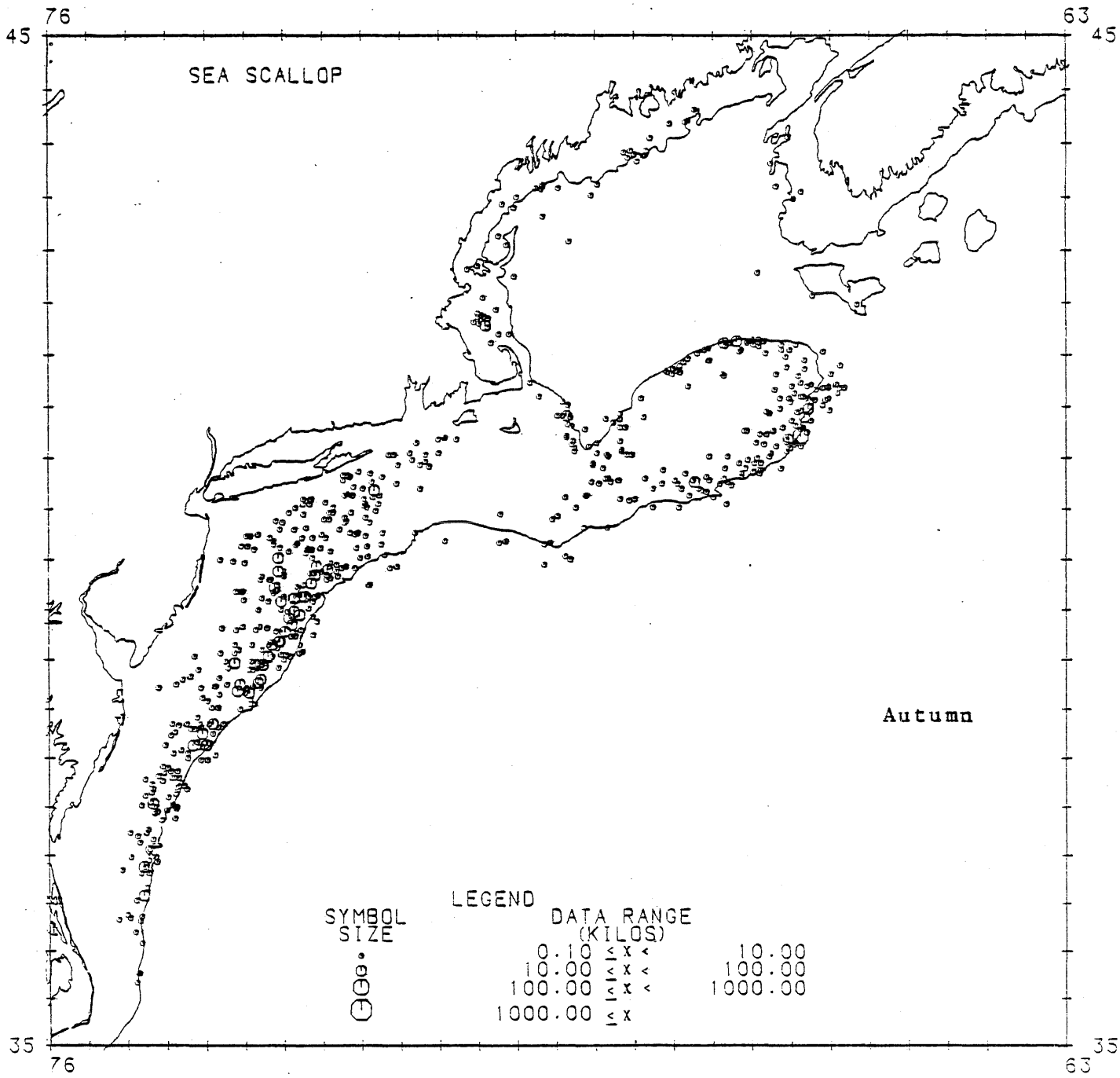

Figure 73. Distribution of sea scallop catches during 1965-1975 and 1977 autumn surveys.

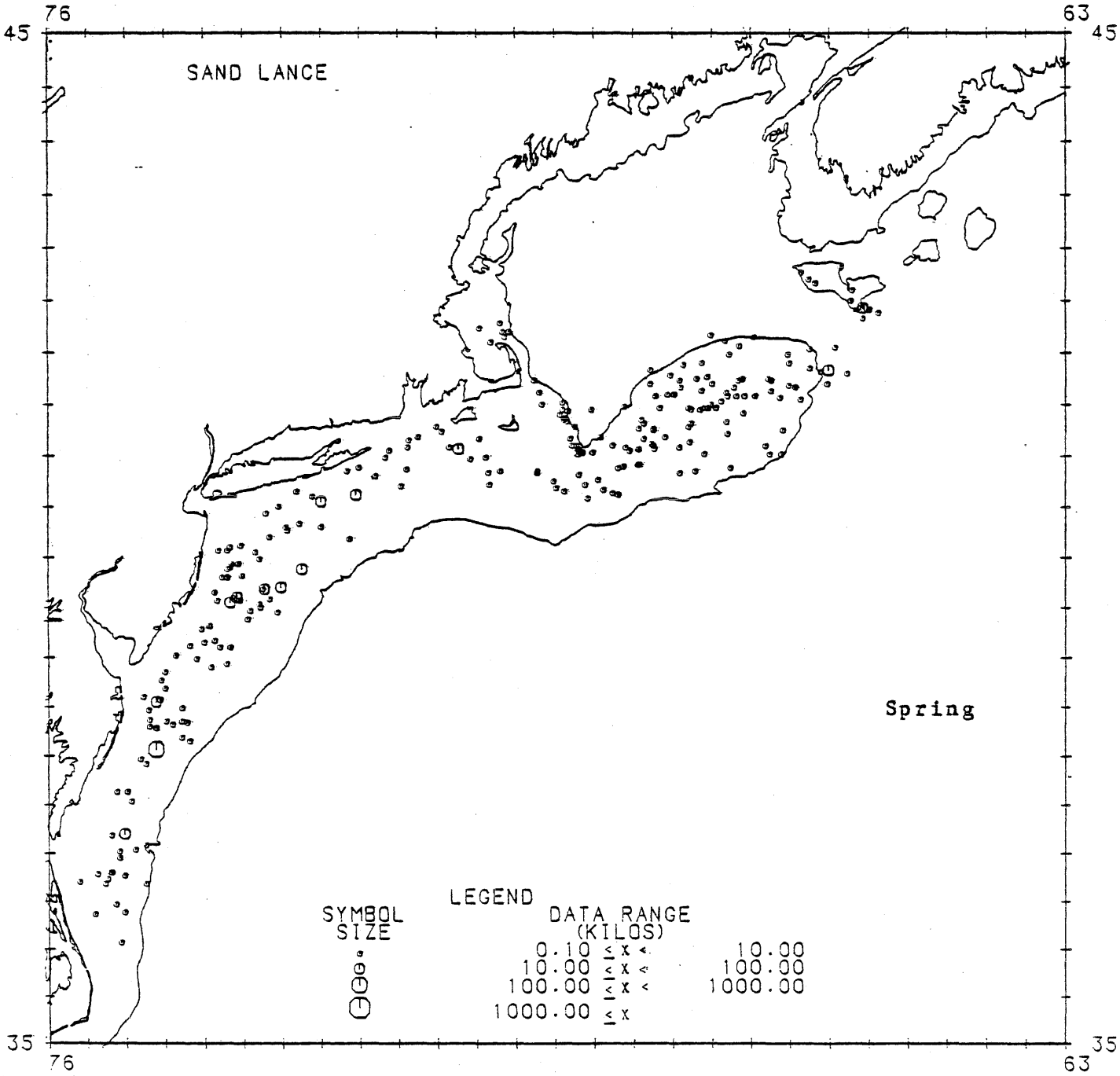

Figure 74. Distribution of sand lance catches during 1964-1974, 1976 and 1978 spring surveys.

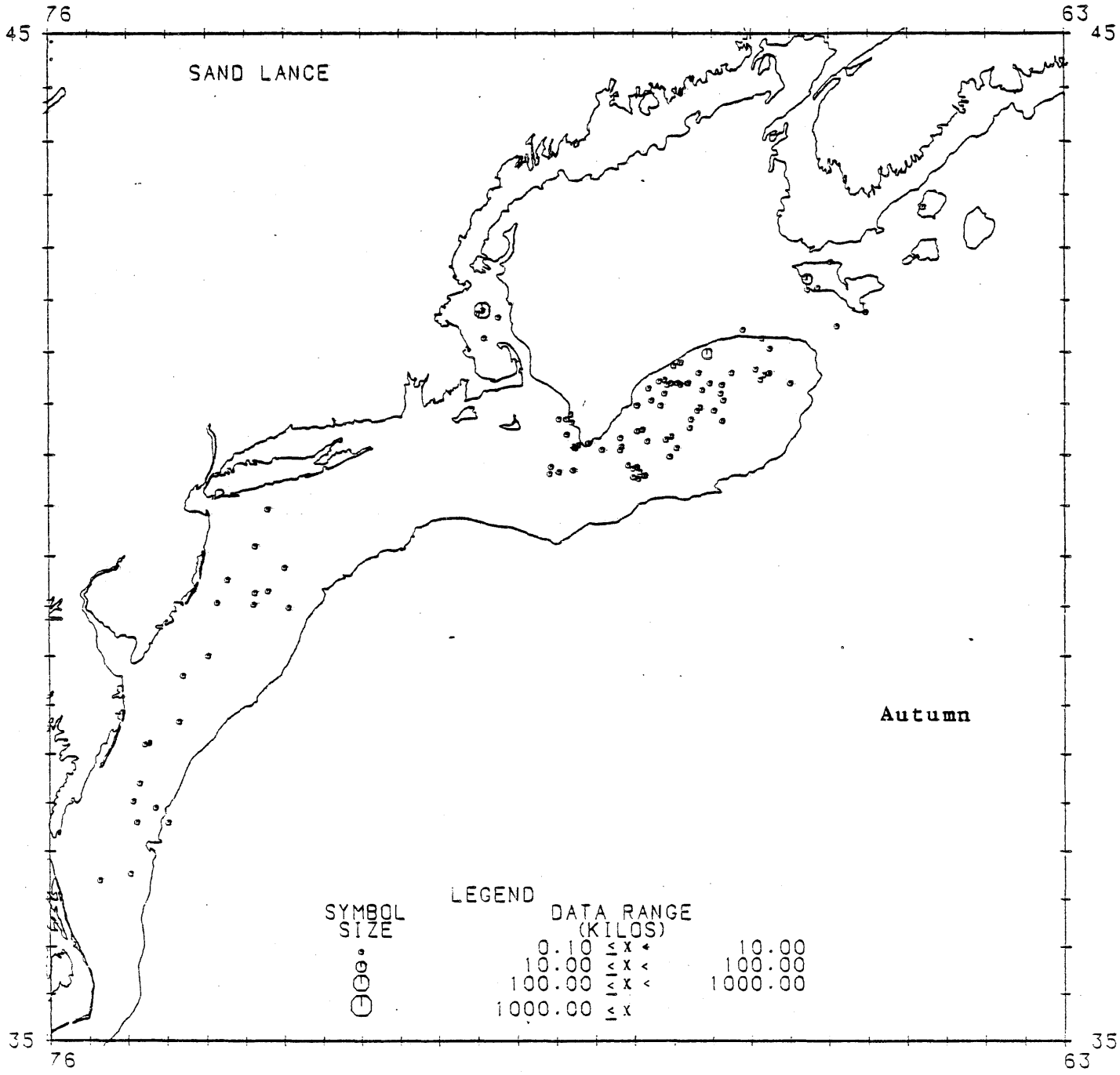

Figure 75. Distribution of sand lance catches during 1965-1975 and 1977 autumn surveys.

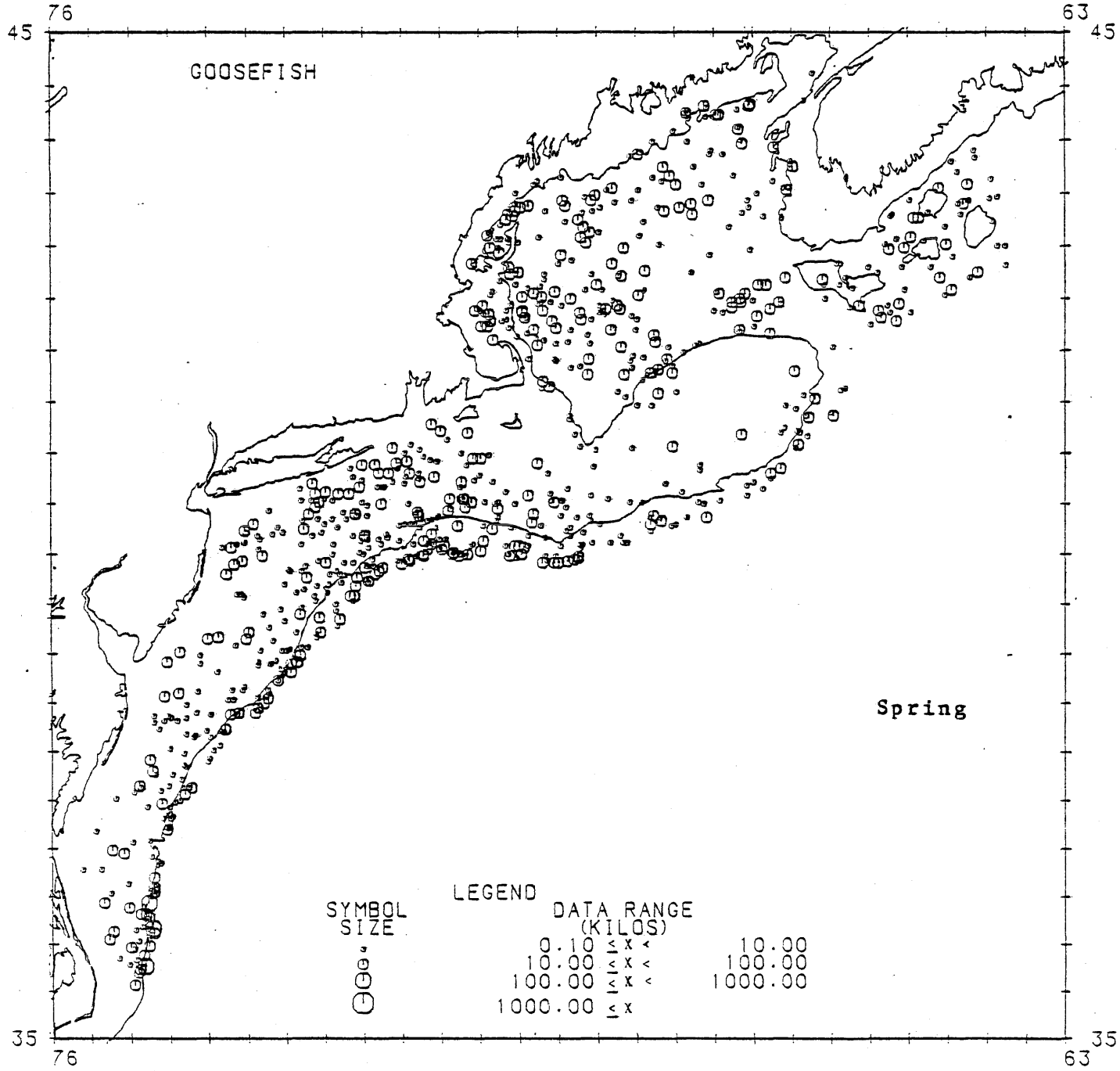

Figure 76. Distribution of goosefish catches during 1964-1974, 1976 and 1978 spring surveys.

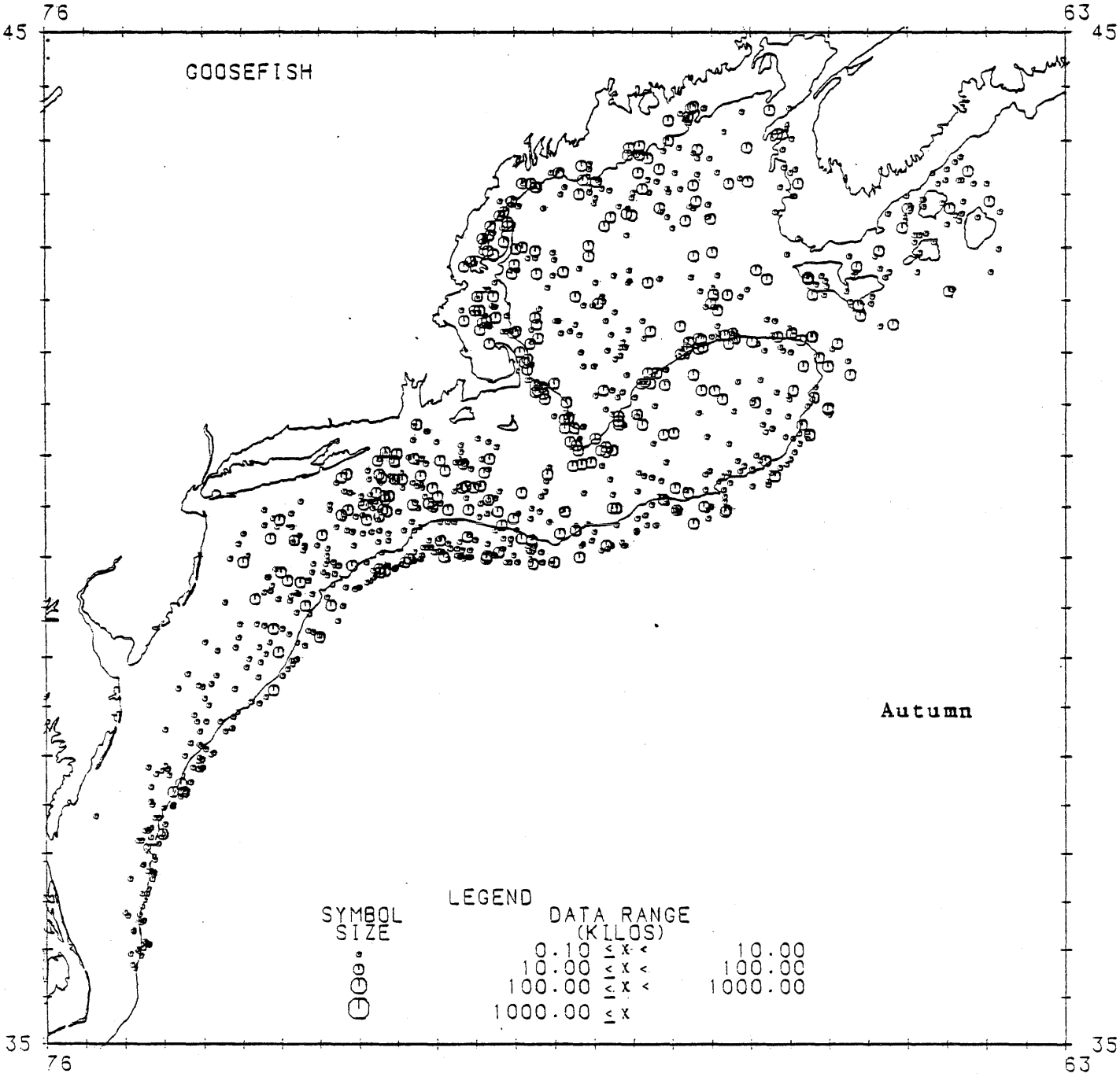

Figure 77. Distribution of goosefish catches during 1965-1975 and 1977 autumn surveys.

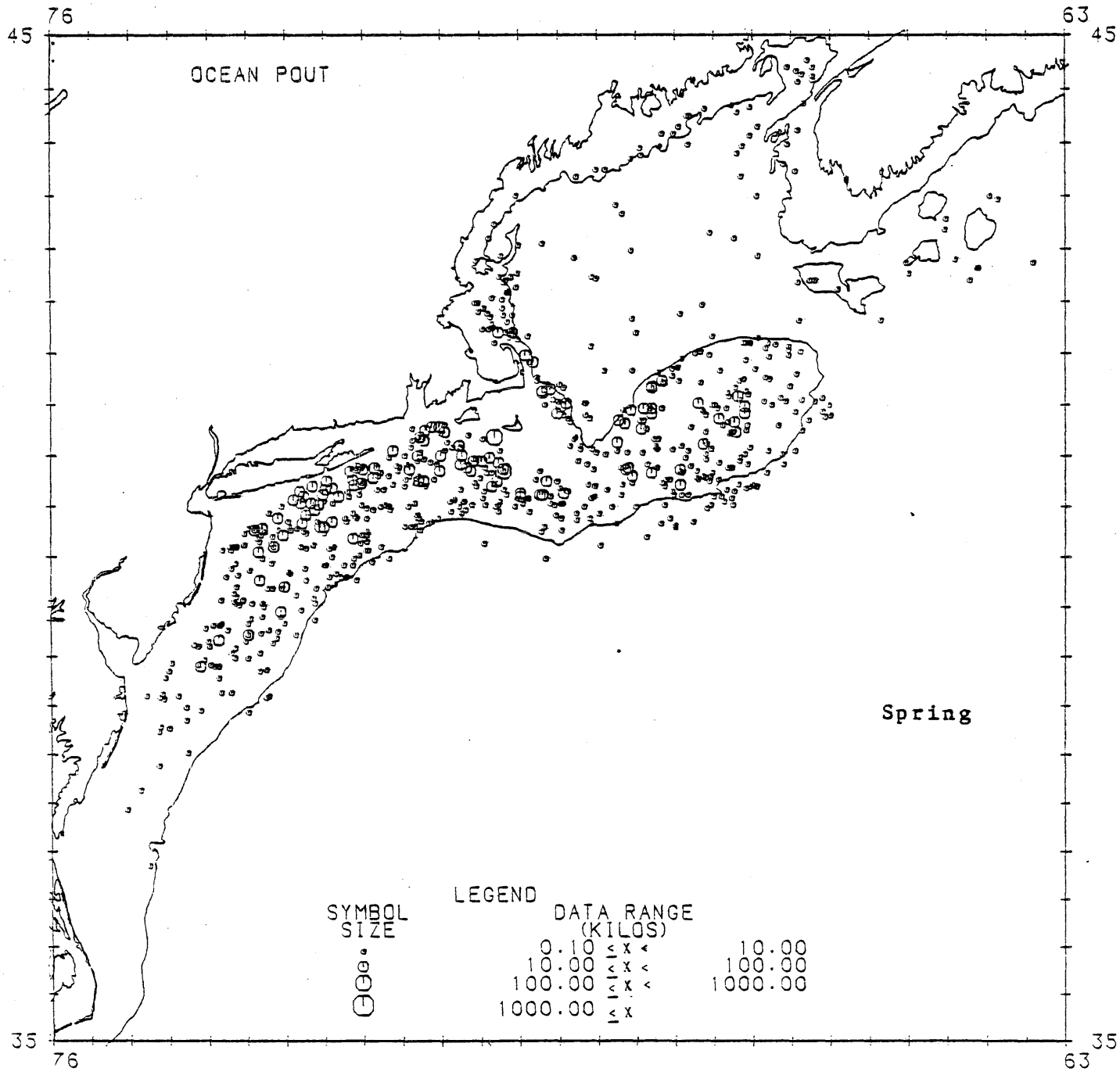

Figure 78. Distribution of ocean pout catches during 1964-1974, 1976 and 1978 spring surveys.

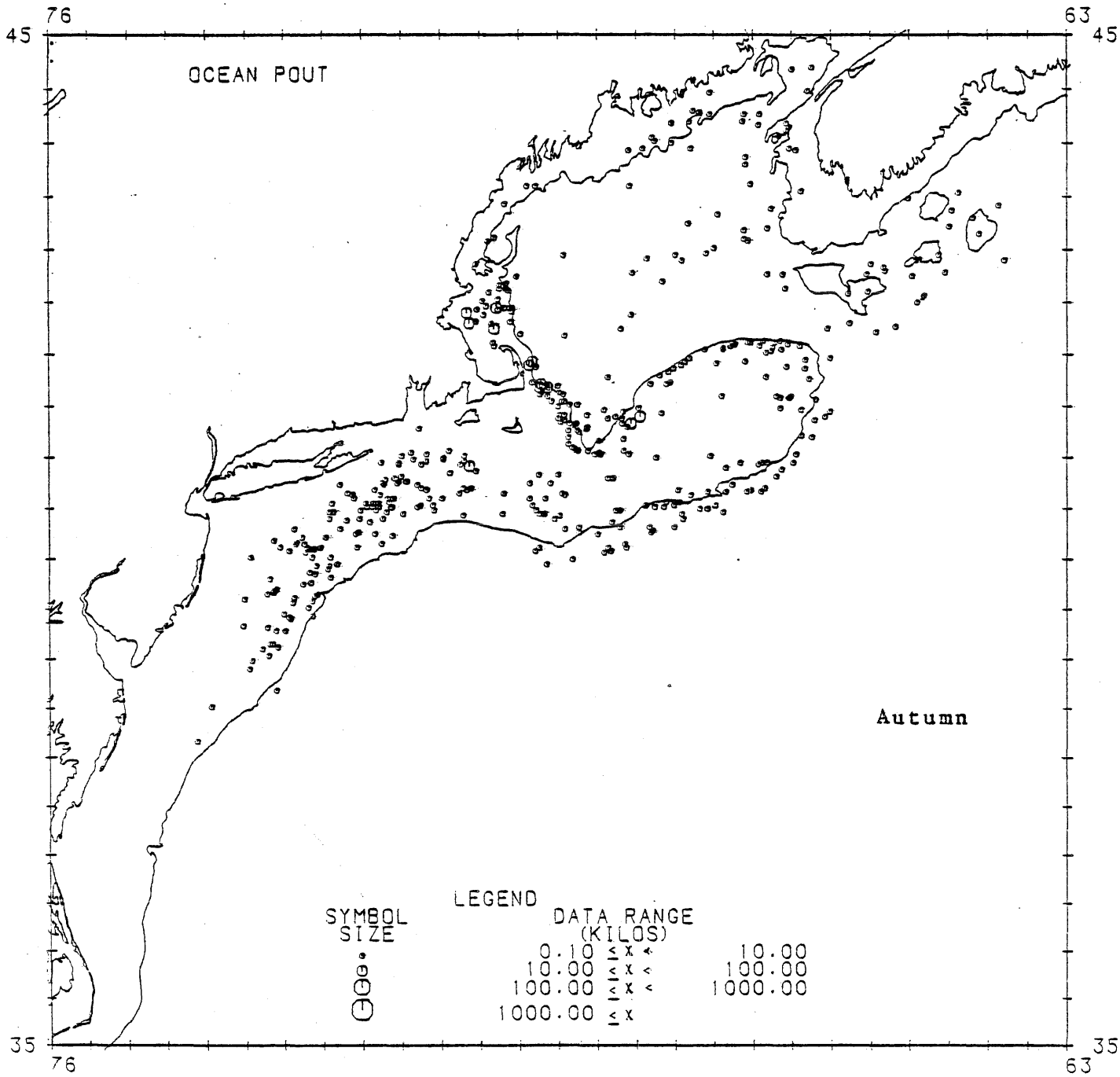

Figure 79. Distribution of ocean pout catches during 1965-1975 and 1977 autumn surveys.

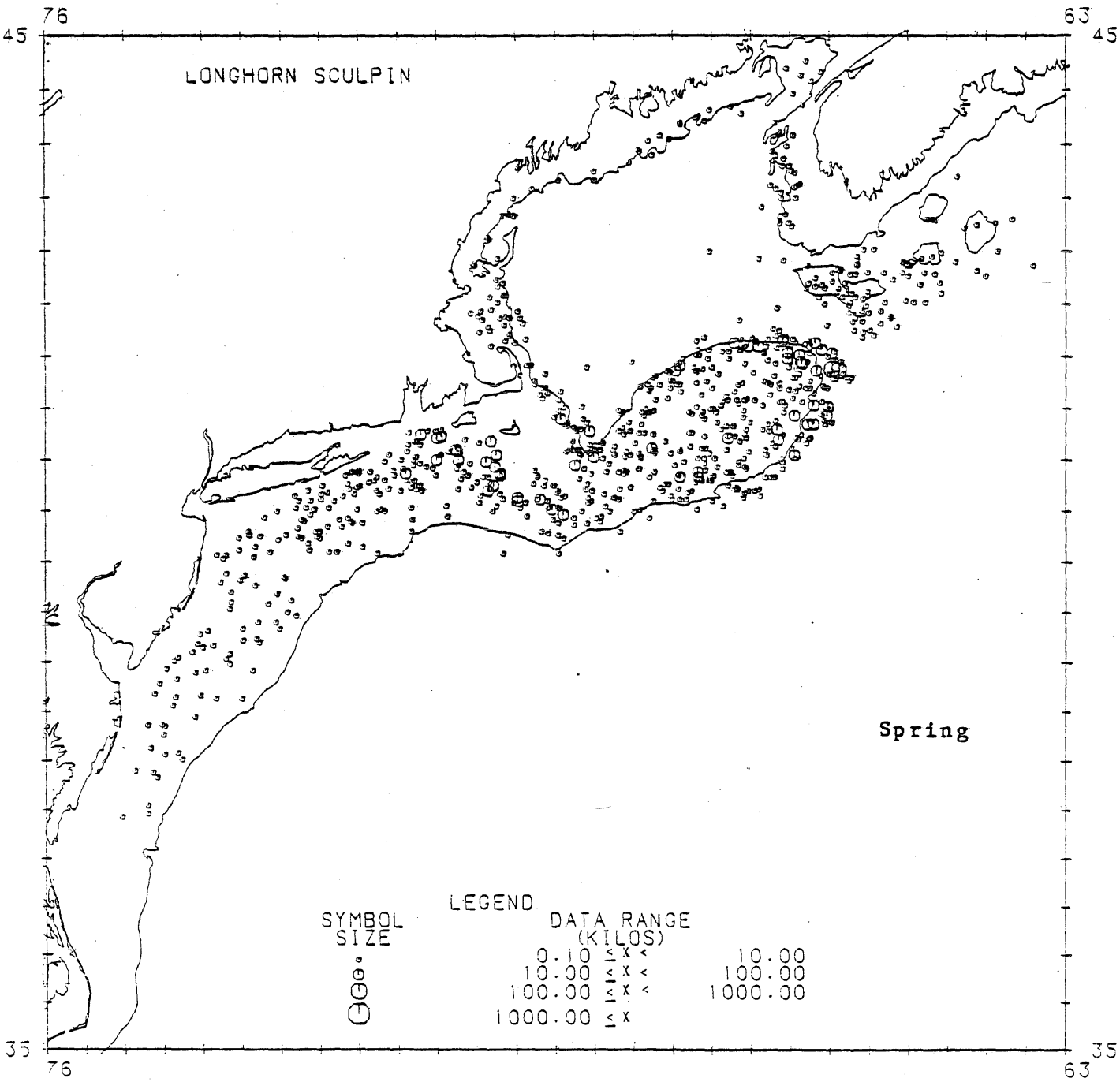

Figure 80. Distribution of longhorn sculpin catches during 1964-1974, 1976 and 1978 spring surveys.

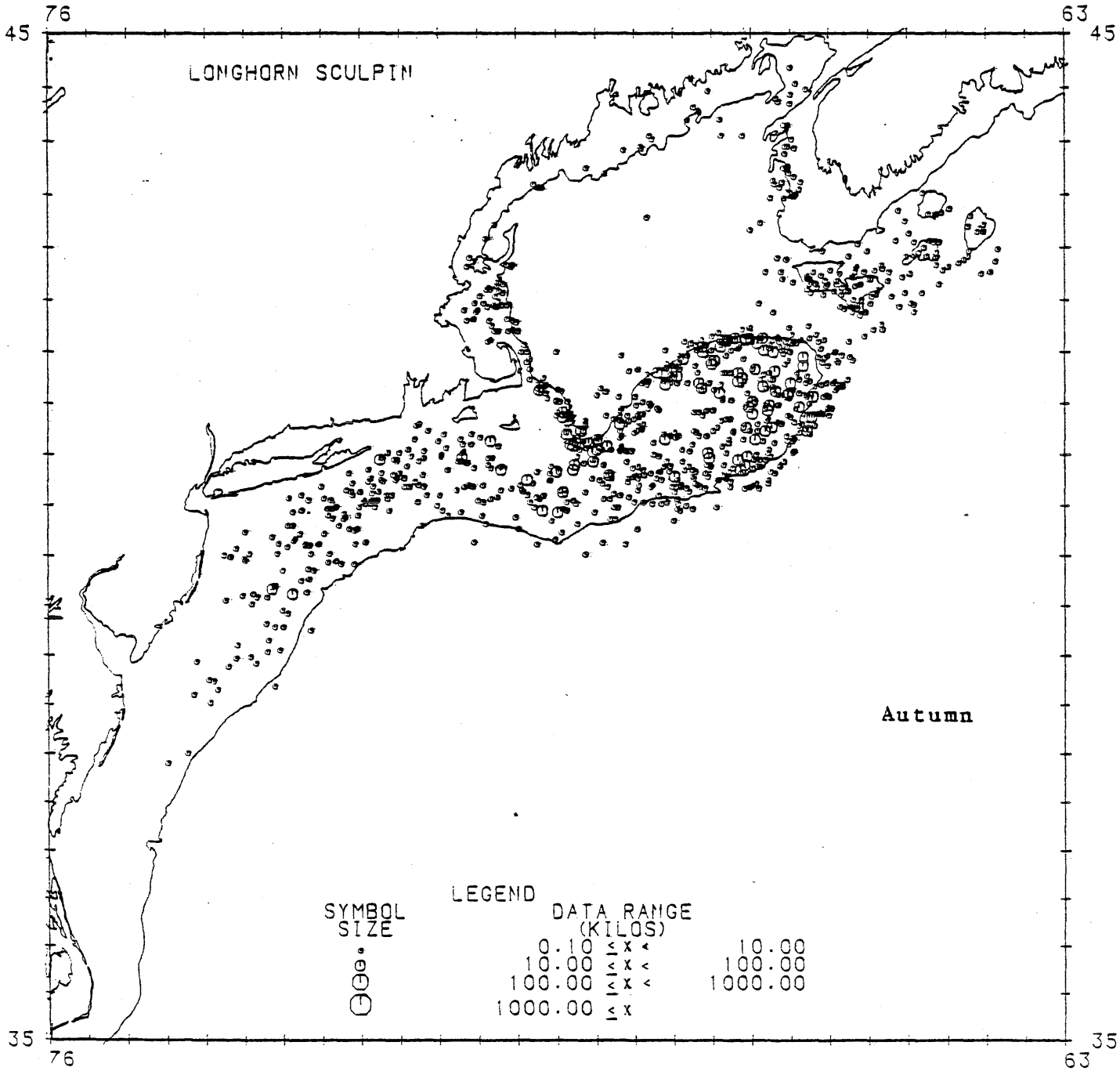

Figure 81. Distribution of longhorn sculpin catches during 1965-1975 and 1977 autumn surveys.

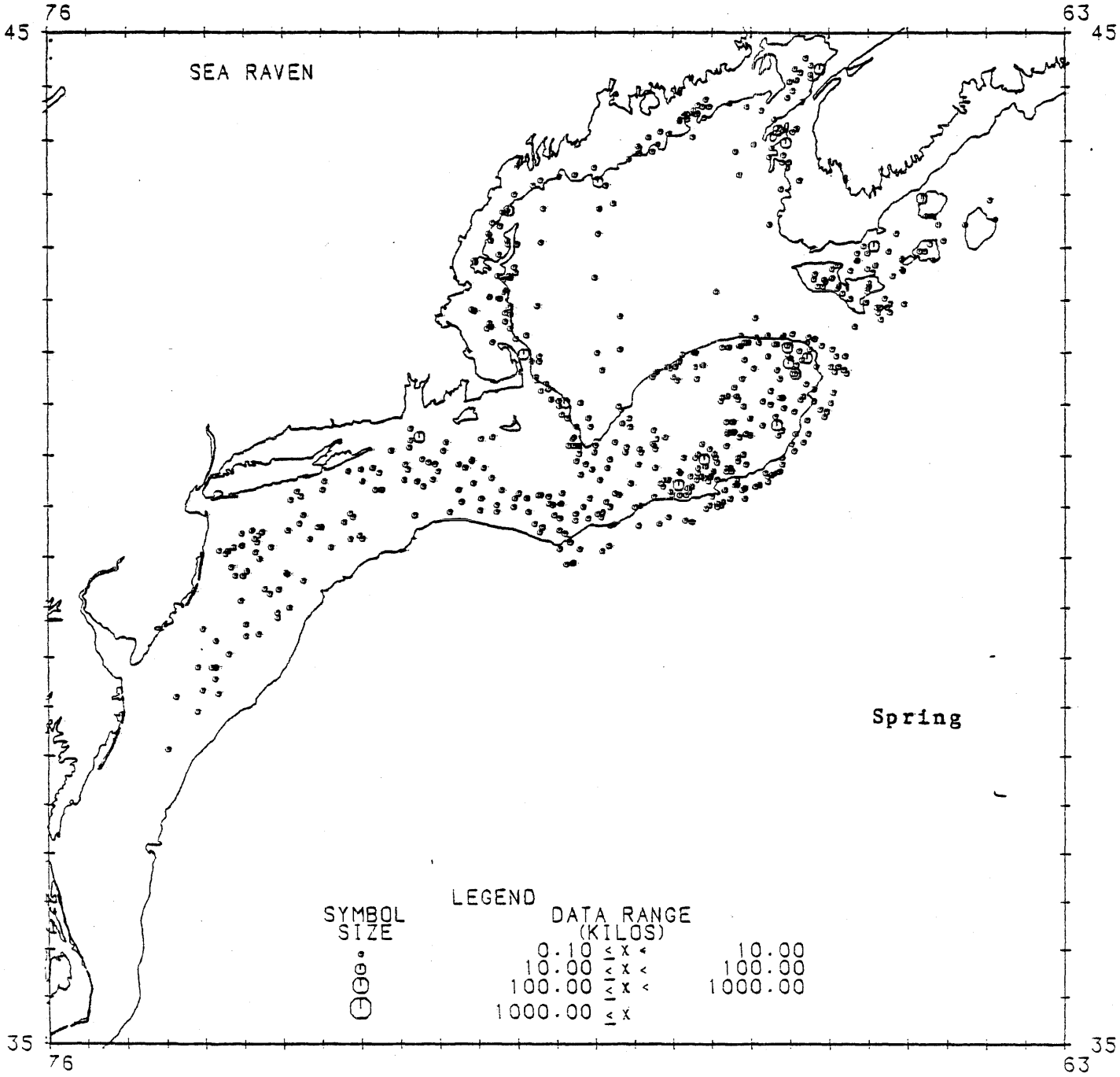

Figure 82. Distribution of sea raven catches during 1964-1974, 1976 and 1978 spring surveys.

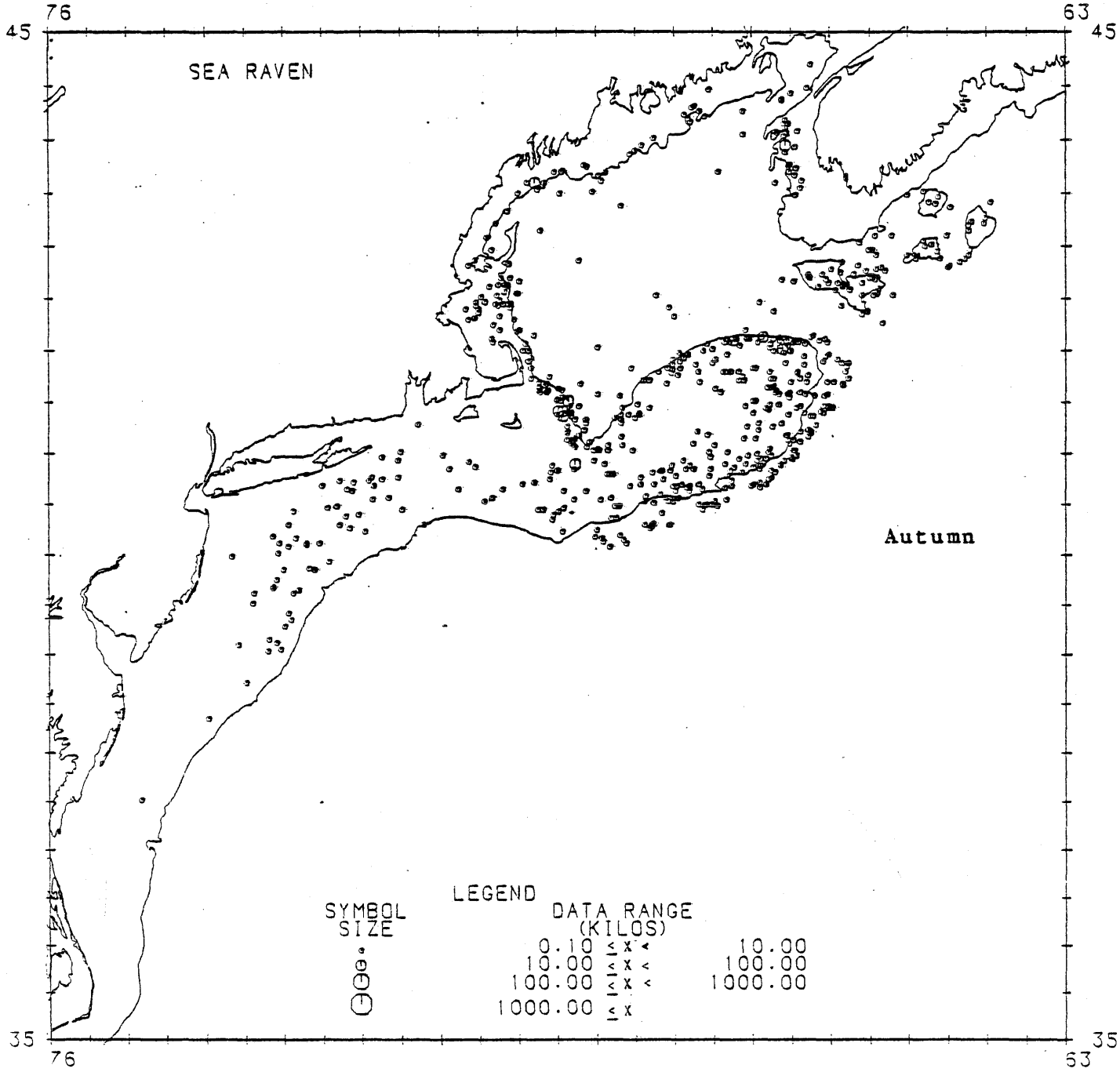

Figure 83. Distribution of sea raven catches during 1965-1975 and 1977 autumn surveys.

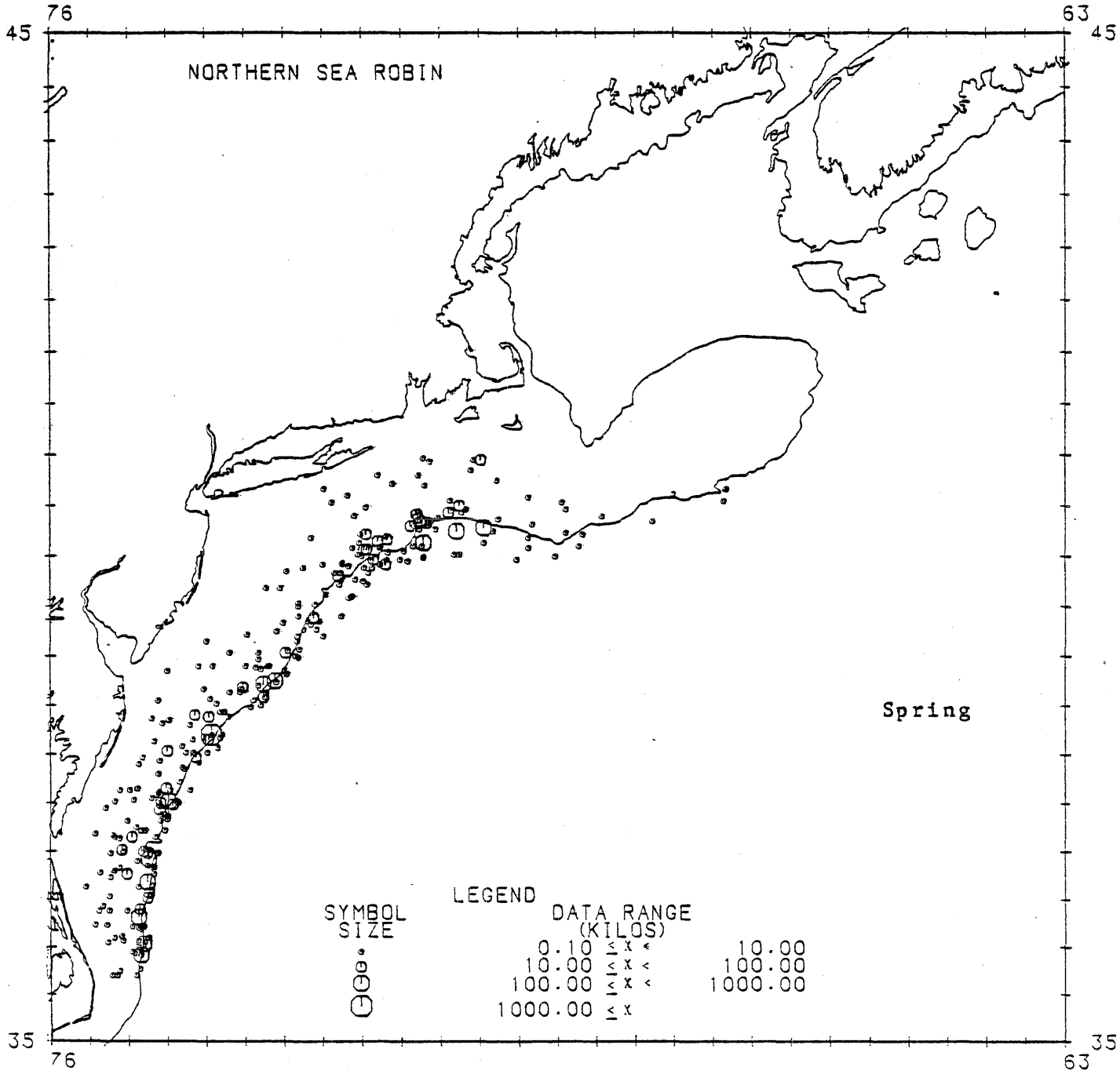

Figure 84. Distribution of northern sea robin catches during 1964-1974, 1976 and 1978 spring surveys.

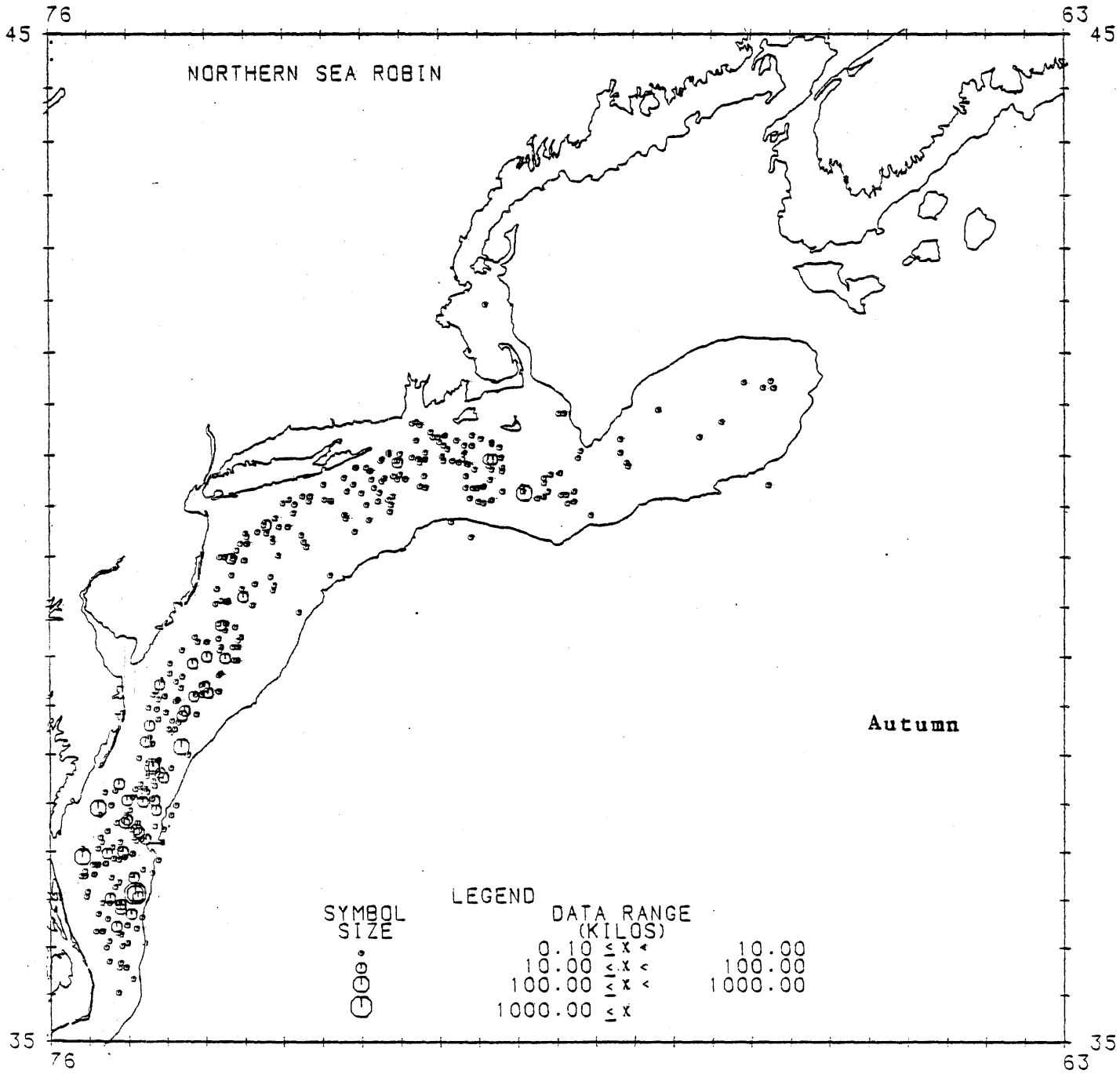

Figure 85. Distribution of northern sea robin catches during 1965-1975 and 1977 autumn surveys.

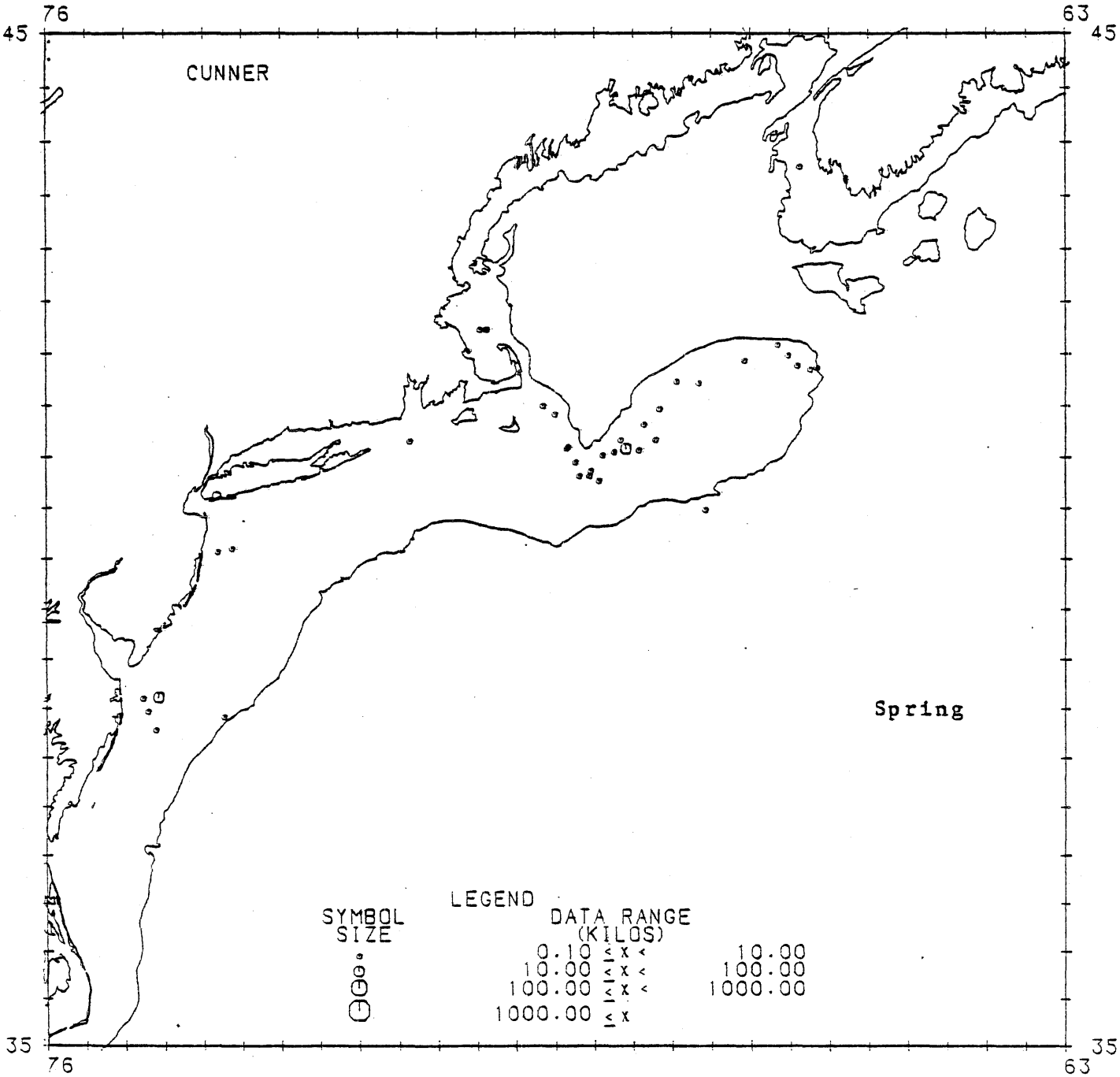

Figure 86. Distribution of cunner catches during 1964-1974, 1976 and 1978 spring surveys.

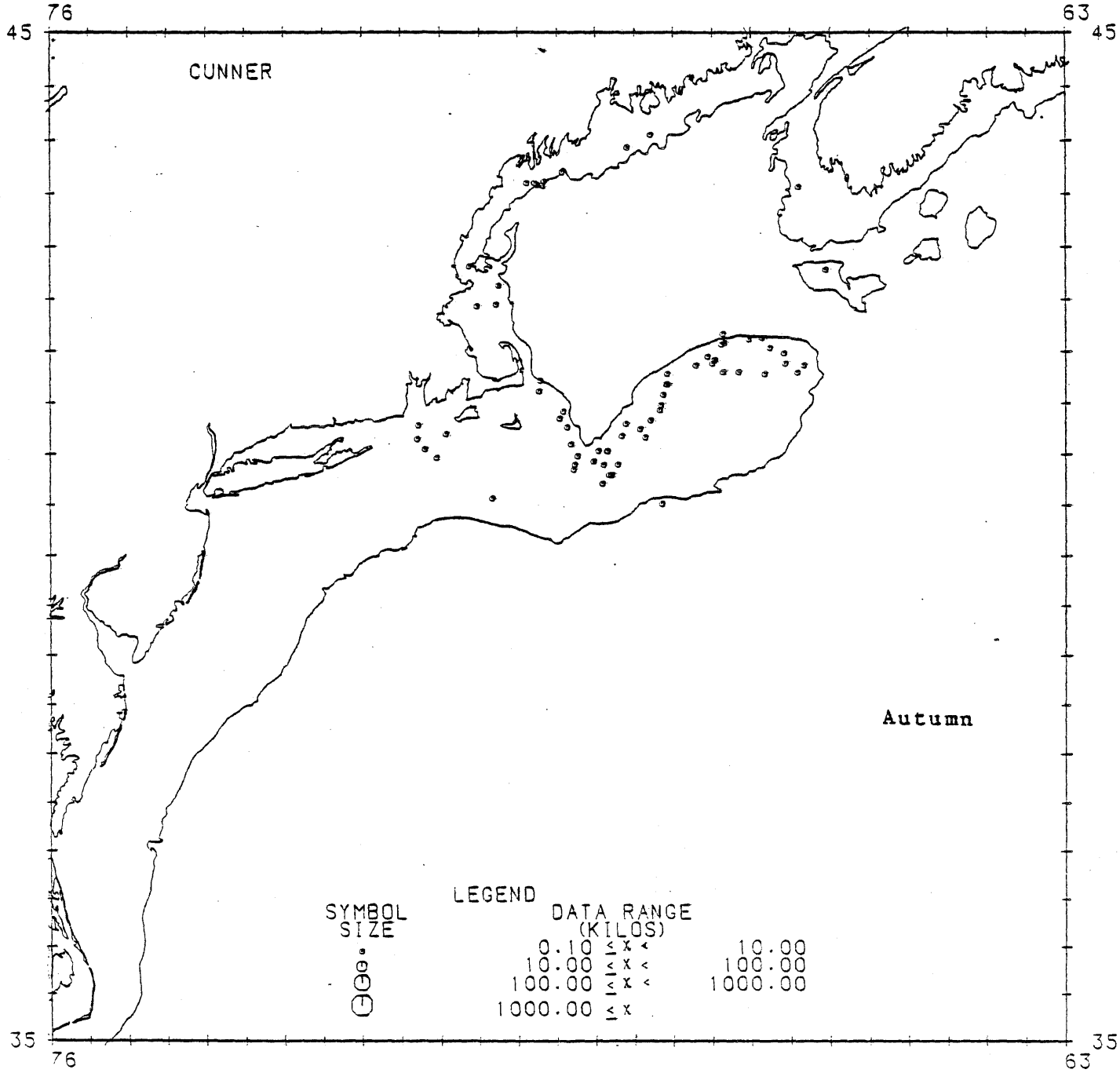

Figure 87. Distribution of cunner catches during 1965-1975 and 1977 autumn surveys.

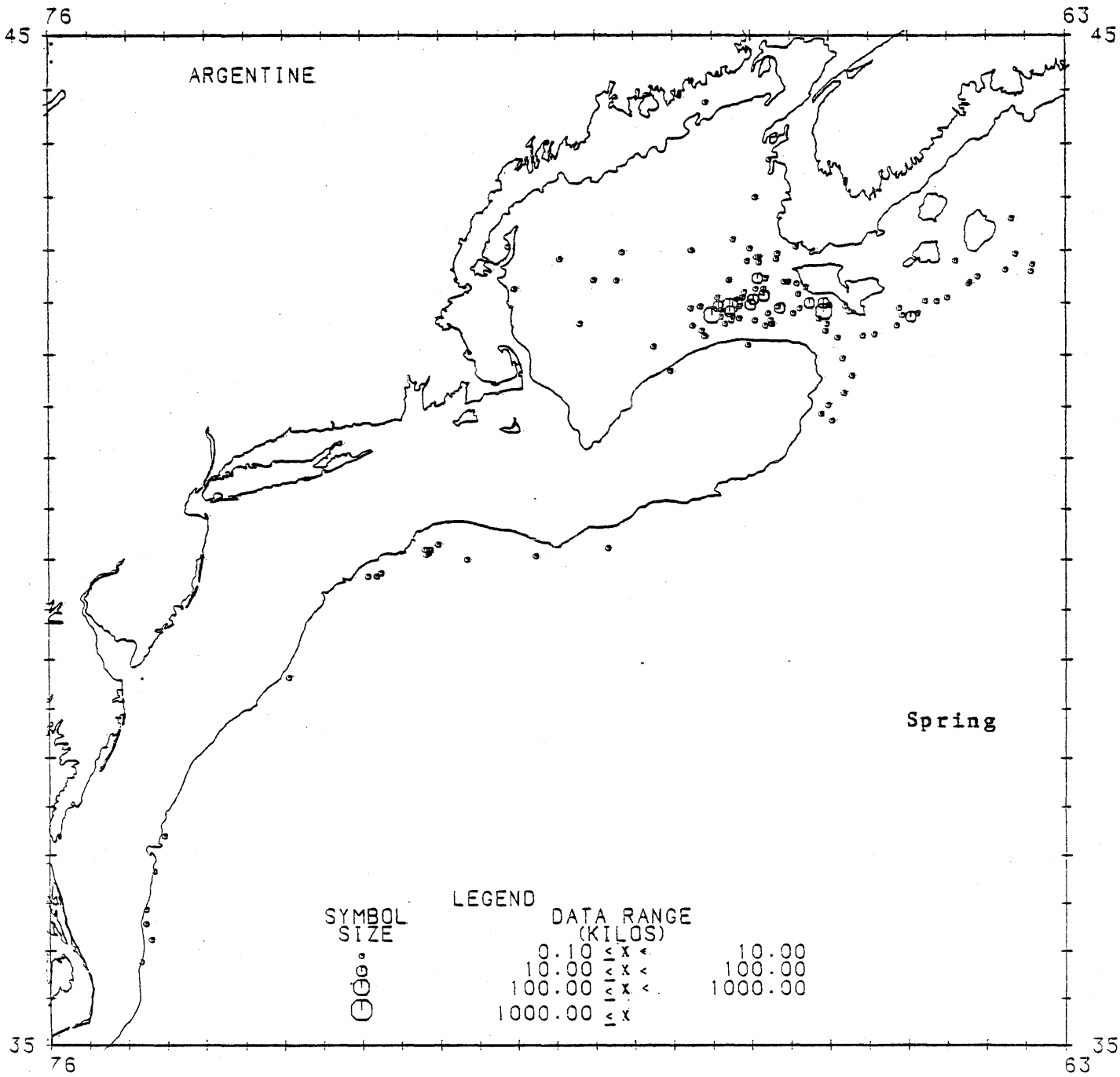

Figure 88. Distribution of argentine catches during 1964-1974, 1976 and 1978 spring surveys.

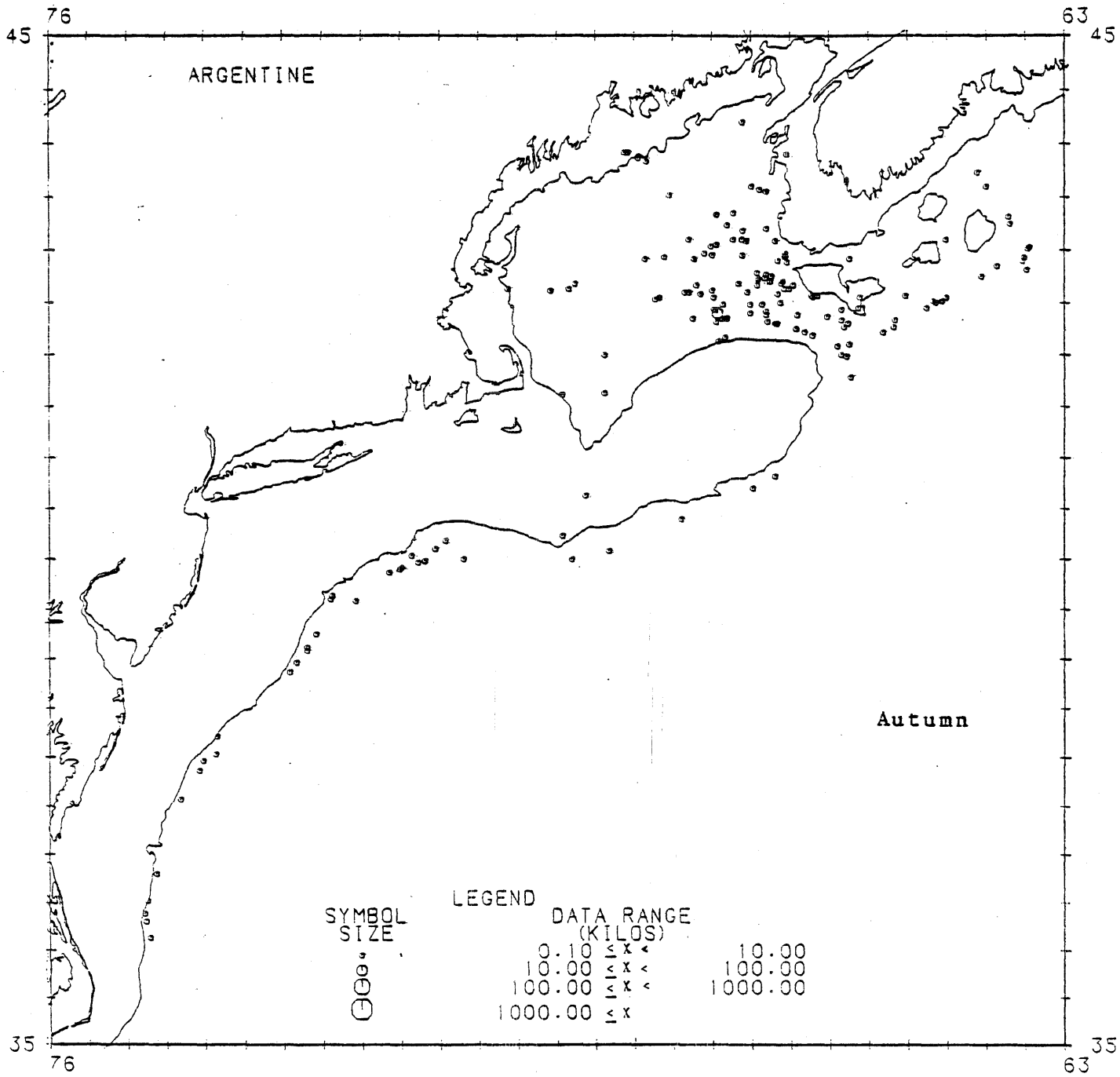

Figure 89. Distribution of argentine catches during 1965-1975 and 1977 autumn surveys.

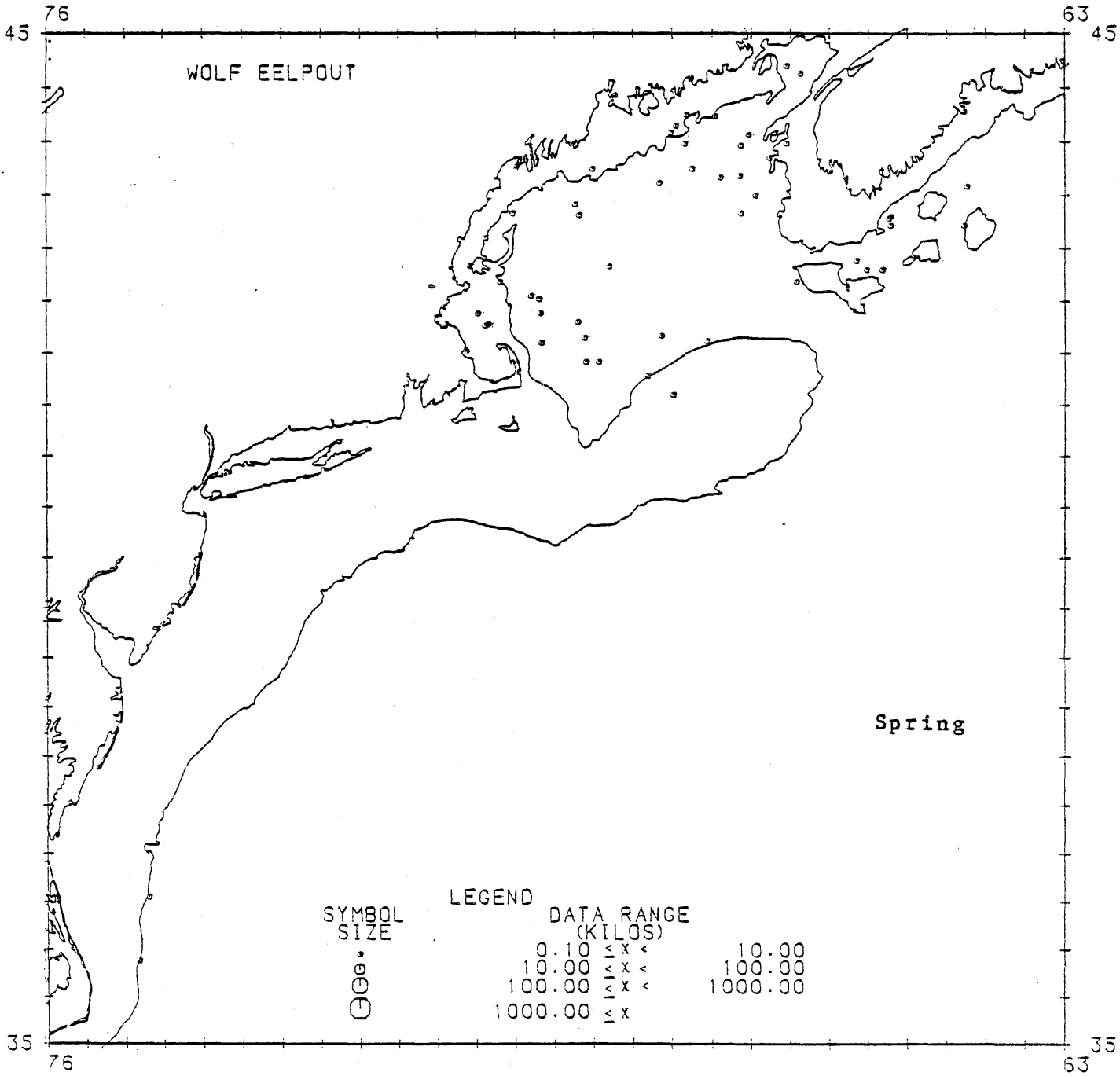

Figure 90. Distribution of wolf eel pout catches during 1964-1974, 1976 and 1978 spring surveys.

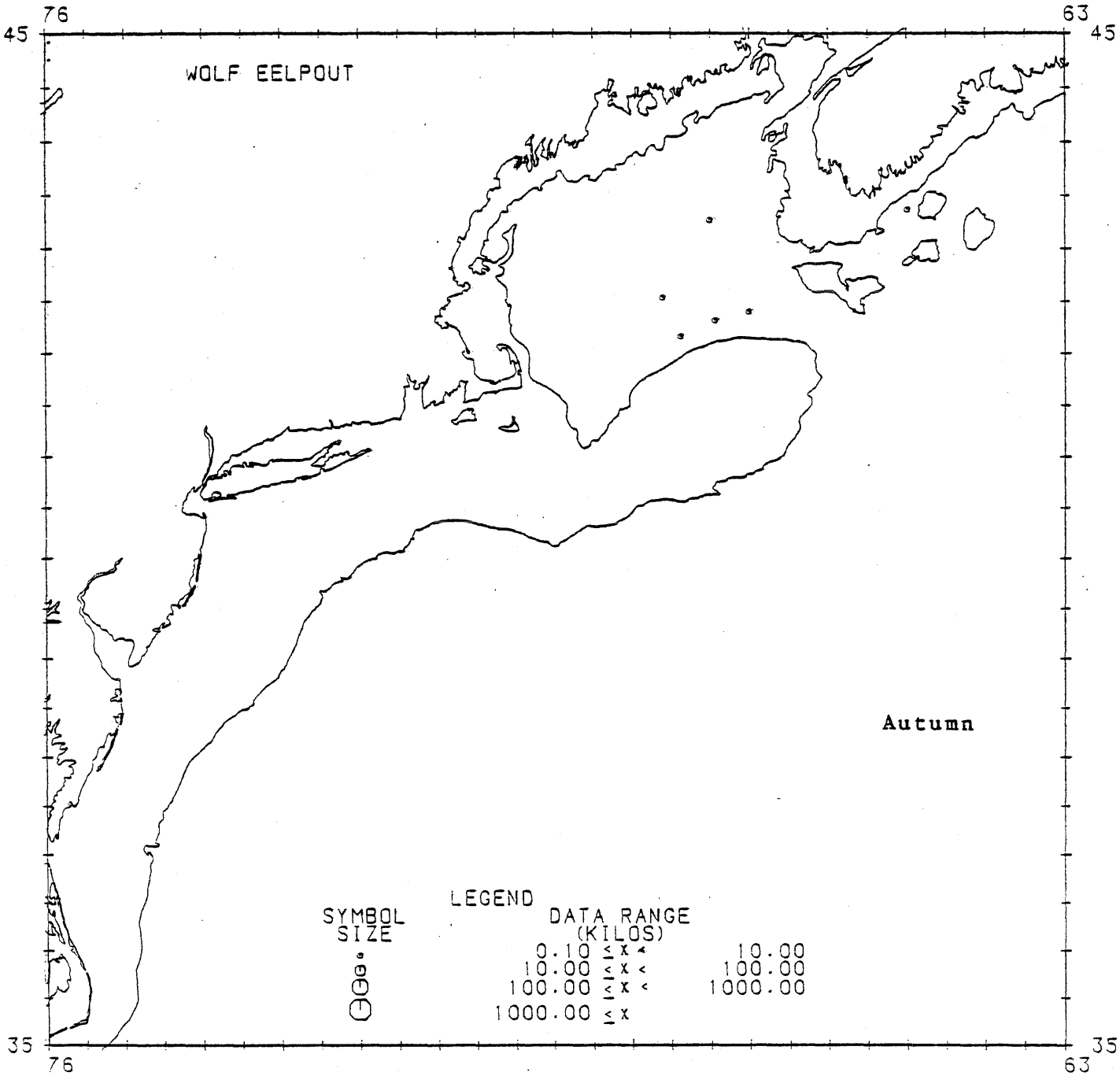

Figure 91. Distribution of wolf eel pout catches during 1965-1975 and 1977 autumn surveys.

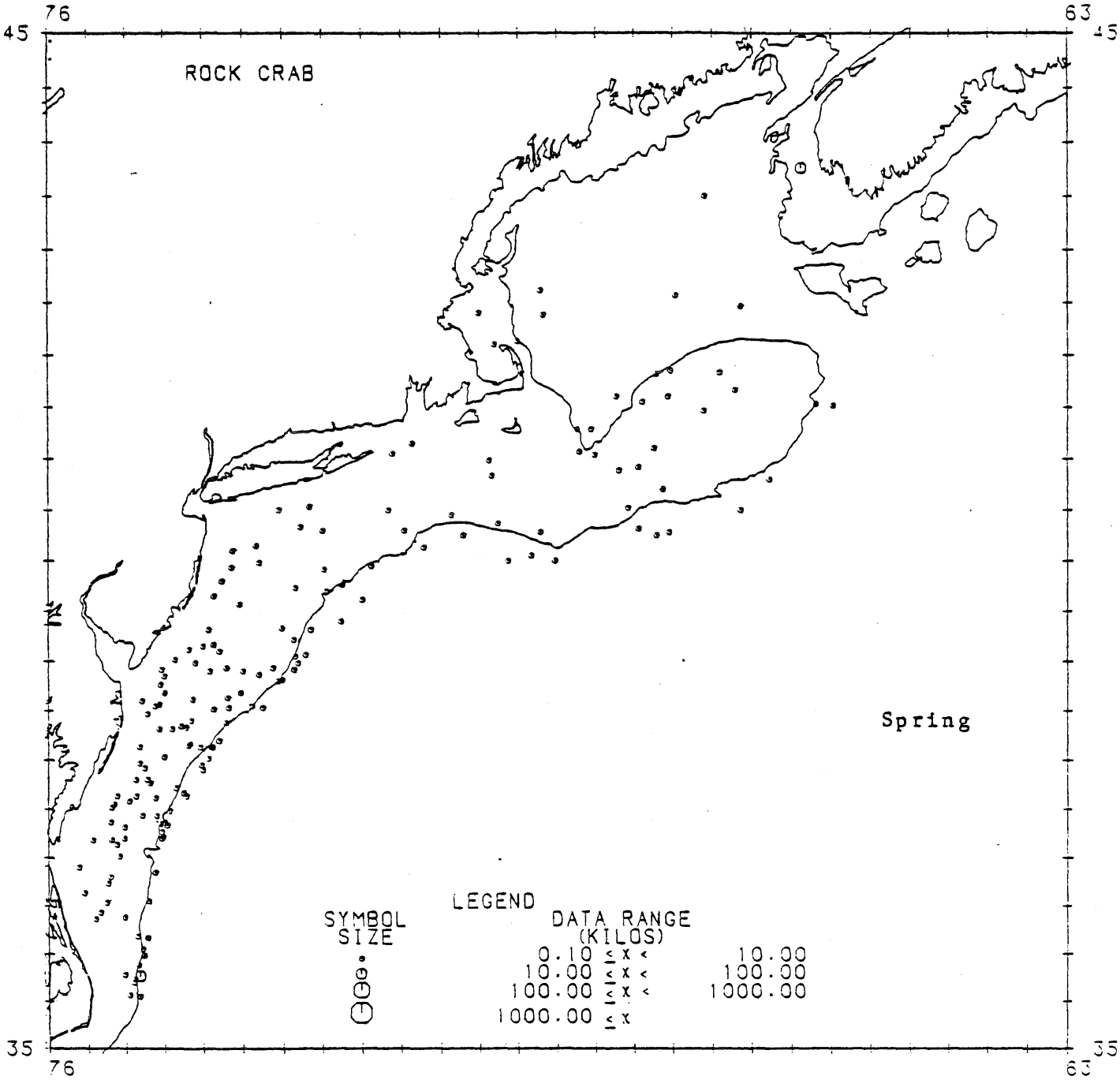

Figure 92. Distribution of rock crab catches during 1964-1974, 1976 and 1978 spring surveys.

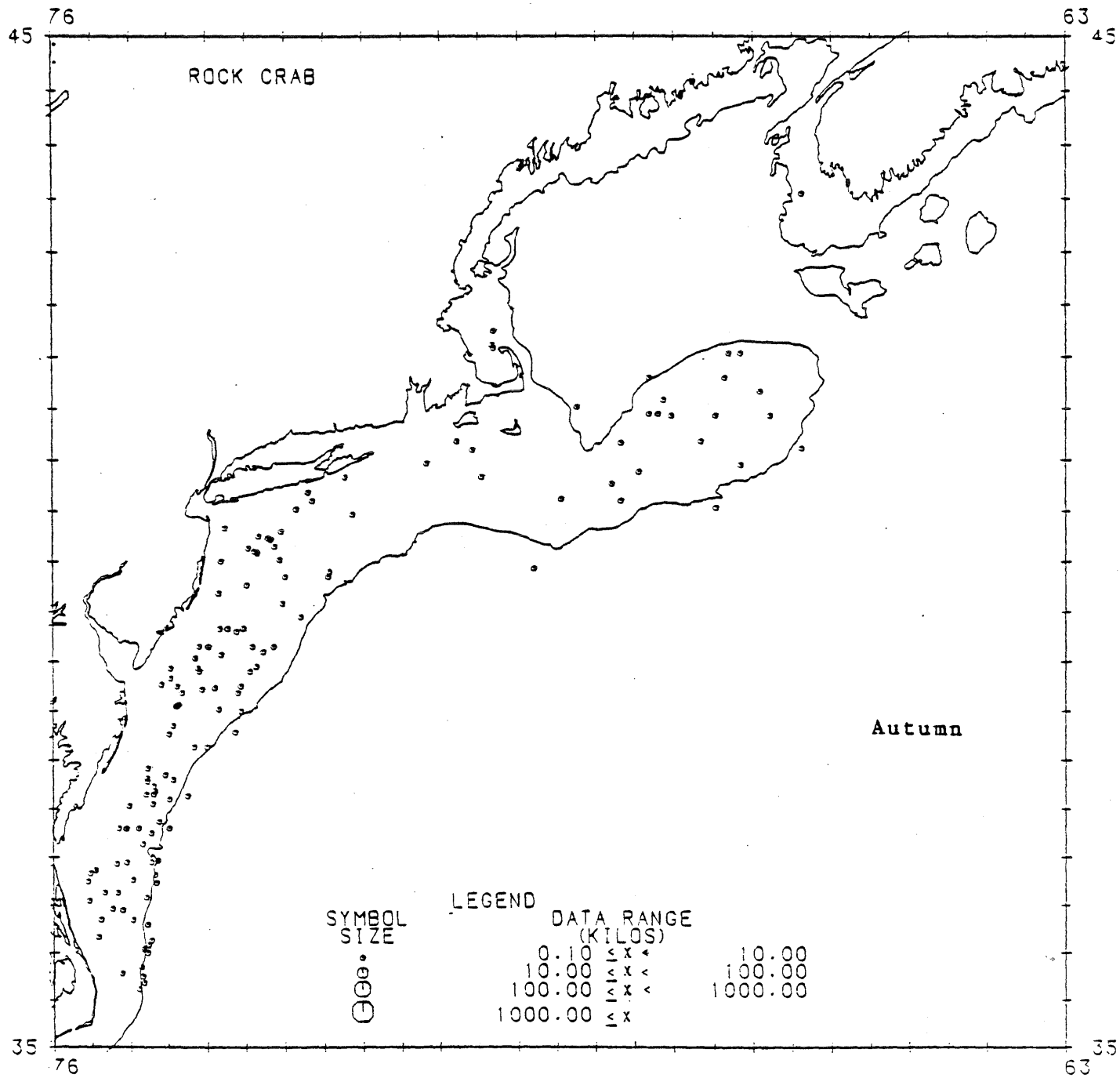

Figure 93. Distribution of rock crab catches during 1965-1975 and 1977 autumn surveys.

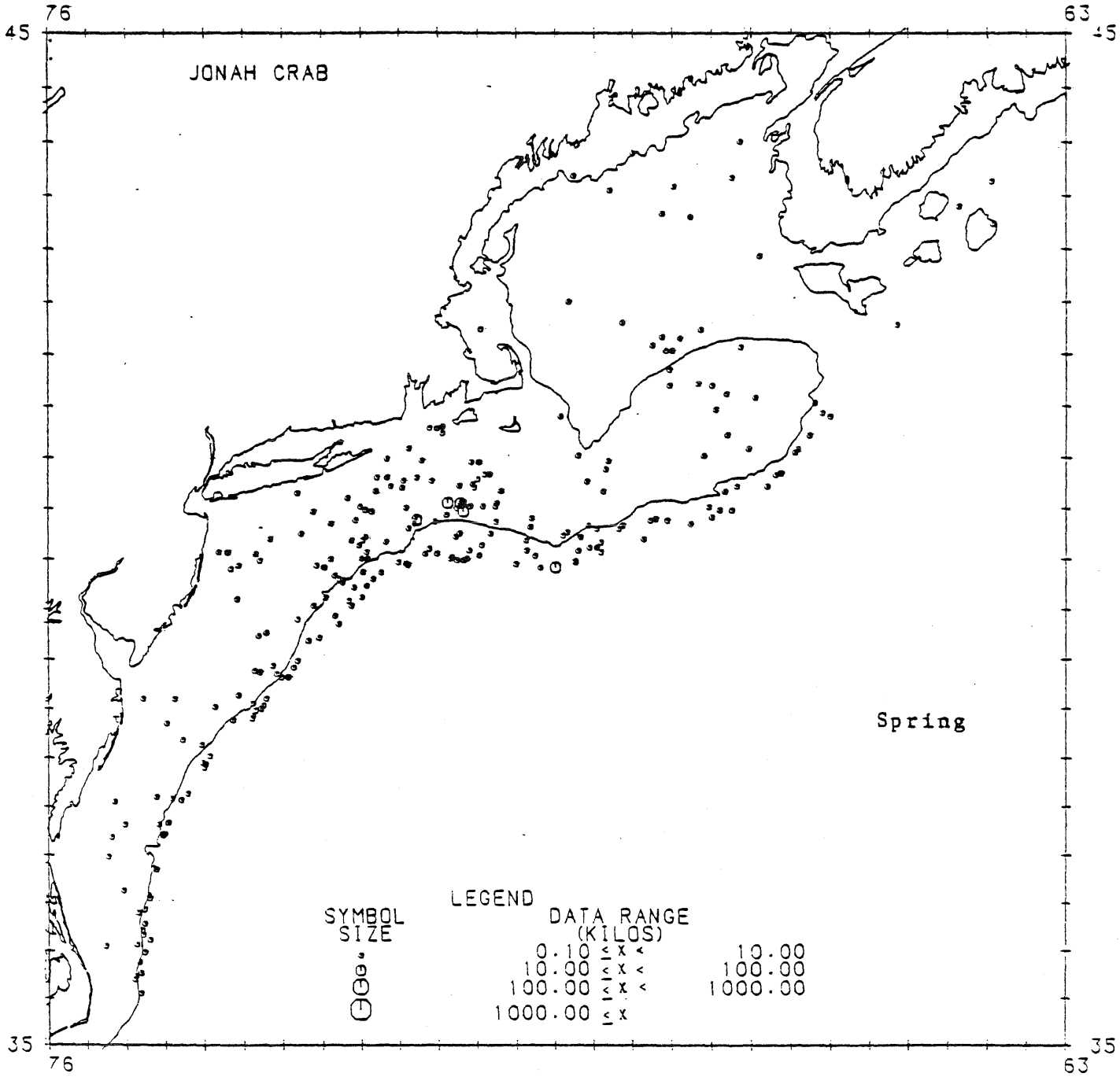

Figure 94. Distribution of Jonah crab catches during 1964-1974, 1976 and 1978 spring surveys.

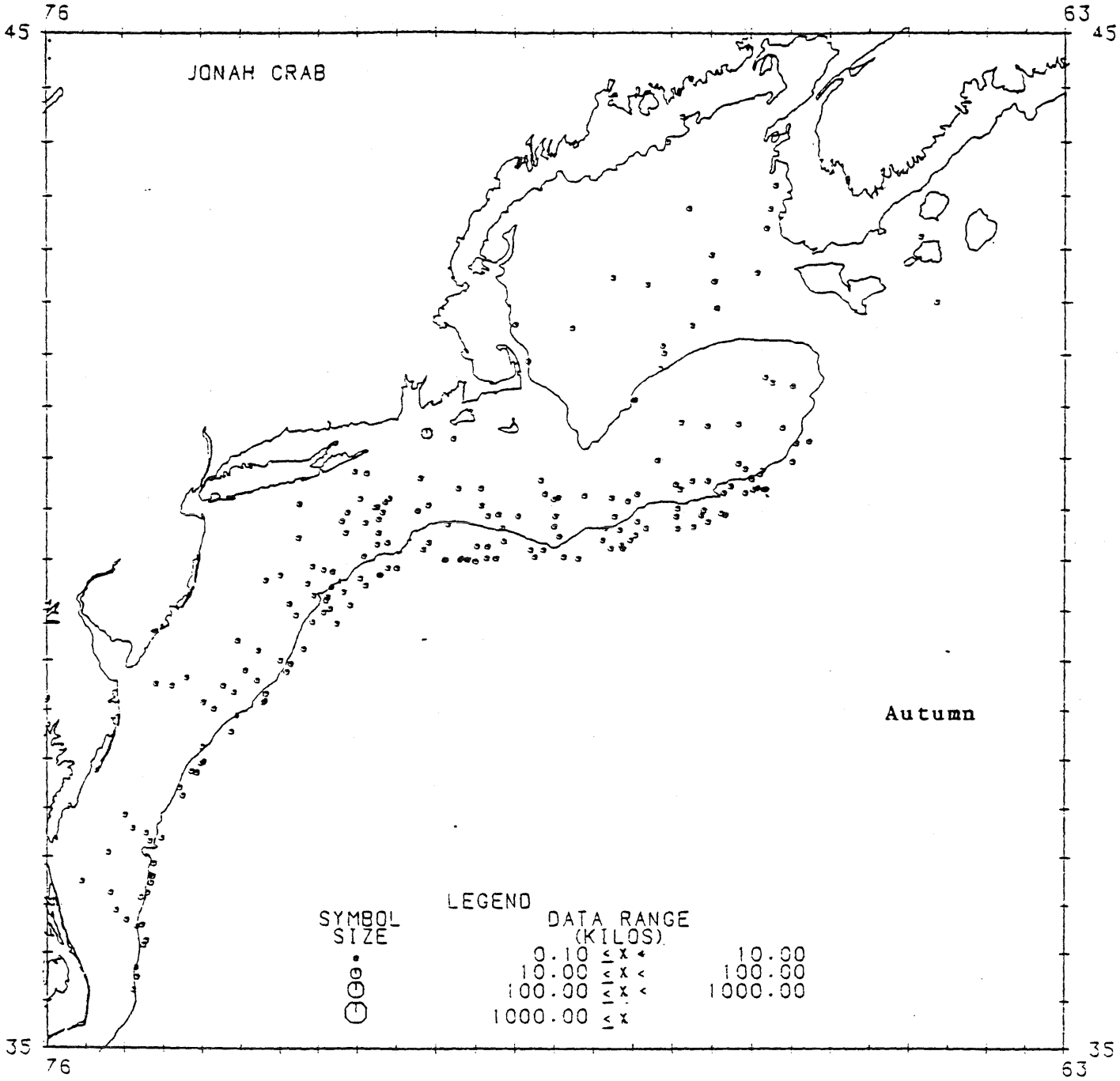

Figure 95. Distribution of Jonah crab catches during 1965-1975 and 1977 autumn surveys.