7.0 Fish and Fisheries

7.1 Finfish and Selected Invertebrates

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7.1.1 Introduction

The purpose of this document is to describe and analyze the scientific observations on fish and fisheries occurring in the Gully and adjacent waters, and to contrast and compare these analyses to those for the eastern Scotian Shelf as a whole. The data will be presented in two major sections, the first describing the distribution, diversity and abundance of finfish and some selected invertebrate species occurring in these areas and the second describing the nature of the fisheries which occur in the area.

For purposes of this presentation we adopted the following definition of the Gully and surrounding areas. The Gully proper is considered to be defined by the 200 fathom contour of summer survey groundfish stratum 452 (Fig. 7.1.1). The Gully trough is the area of mixed depths defined by depth stratum 457 just to the north and west of the Gully proper, and the Gully slope is defined as the continental slope immediately adjacent to the Gully and extending to a depth of 5000 m. G. Fader indicated the presence of an old river bed which extends from the Gully proper down the slope and onto the upper reaches of the abyssal plain, this features should probably be considered a part of the Gully as a whole. The above features are considered to comprise the Gully and adjacent waters. In the body of the paper this area will be referred to simply as the Gully.

There are a number of recent documents which summarize, to some degree, the state of scientific knowledge of this area. The first and most comprehensive was commissioned by the World Wildlife Fund of Canada (Shackell *et al.*, 1996). This document presents a preamble outlining the form and benefits of a biophysical description of the area based on a survey of the published literature. In terms of the description of the ichthyofauna of the area these authors present a sketch of the recently published results (Simon and Comeau, 1994; Strong and Hanke, 1995). A more detailed description based on both the literature and more recent (unpublished) data was in order and to some extent prompted the present document. The second was prepared by D. Fenton (Oceans Act Coordination Office, DFO) termed *"The Gully" Overview of Biophysical Characteristics and Resource Use*. This author also reports on the results of Simon and Comeau (1994), Strong and Hanke (1995), and refers to some of the preliminary results of East Coast of North America Strategic Assessment project (published as Brown *et al.,* 1996).

7.1.2 Finfish

Descriptions of the finfish of the Scotian Shelf based mainly on the results of DFO trawl survey data include (Scott, 1976; Scott *et al.,* 1982; Mahon *et al.*, 1984; Mahon and Smith, 1989; Mahon, 1985; Brown *et al.*, 1996; and Mahon *et al.,* 1997 MS), although none of these focus on a description of the Gully itself. Strong and Hanke (1995) examine the trawl survey stratum 452 which encompasses the 100 to 200 fathom (180 to 360m) isobaths within the Gully area. The latter authors also looked at seasonal distribution of finfish in the stratum. Their results indicate the presence of some 45 species (below) over the period 1970 - 1993 with about one third of these species present all year. Information on the species composition of surrounding strata are also presented for this time period. Strata of particular interest because they represent the shallower banks which are likely ecologically connected with the Gully and approaches are 448 (Western Banquereau), 455 and 456 (Western Sable Island), and 458 (Middle Bank). Given the complicated bathymetry of the system of channels leading into the Gully proper (Fig. 7.1.1) we also examined the species composition of the mixed depth stratum 457.

Species Occurring in the 100 - 200 Fathom isobaths of the Gully (1970 - 1993, from Strong and Hanke 1995) in order of the frequency of occurrence over the time period. Note the unidentified Stomiatioid (38) and unidentified fish (42) in the table.

1. Redfish	10. Winter Skate	19. Yellowtail Fl.	28. Ocean Pout	37. Mackerel
2. A. Plaice	11. Haddock	20. Ar. Hr Sculpin	29. N. Sand Lance	38. Unid Stomatio.
3. White Hake	12. Marlins. Gren.	21. N. Hagfish	30. Capelin	39. Rosefish
4. Witch Fl.	13. Smooth Skate	22. Cusk	31. Lanternfish	40. Arctic Eelpout
5. Thorny Skate	14. Monkfish	23. Herring	32. Rck Grenadier	41. Mailed Sculpin
6. Cod	15. Pollock	24. A. Argentine	33. Offshore Hake	42. Unid Fish
7. Silver Hake	16. Str Wolffish	25. Wrymouth	34. Spiny Dogfish	43. Shortt. Eelpout
8. Longfin Hake	17. Turbot	26. Lhrn Sculpin	35. Sea Raven	44. Ogrefish
9. A. Halibut	18. Frb Rockling	27. Red Hake	36. Little Skate	45. Rghnose Gren.

Strong and Hanke report that stratum 452 was also an area of relatively high species diversity during the period 1986-1993, the final two of six time periods. It must however be noted that this refers to stratum 452 only.

7.1.3 Ichthyoplankton

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Data from the Scotian Shelf Ichthyoplankton Program (SSIP) was examined to determine the importance of the Gully as a spawning area for marine fishes. SSIP was a fixed station survey with reasonably good seasonal coverage that was conducted from 1978-1982. Ten stations were identified as representative of the Gully area and data from oblique bongo hauls were extracted for the analysis (Fig. 7.1.2). One should bear in mind that

conclusions drawn from historical data may not provide an accurate representation of the current situation and that the sampling intensity for this relatively small geographic area was low. In total, the ten stations were sampled 124 times during the conduct of SSIP.

Twelve species of fish eggs were encountered in the Gully area (Table 7.1.1). Out of these twelve species silver hake was the most abundant followed by pollock, American plaice and cod. At the earliest stages of egg development exact identification to species is not possible, therefore many categories represent groupings of two or more species types. For example, early stage cod, haddock and witch eggs cannot be discriminated from one another and are lumped together into one category. For the top four species, the temporal distribution of abundance is shown in Fig. 7.1.3. Silver hake eggs were collected in the Gully area from July to October with peak abundances evident in August and September. Pollock eggs were most abundant during November to January. American plaice eggs were encountered from March to June with peak abundance in March to May. The temporal occurrence of cod eggs in the Gully area appeared to be bi-modal with peaks in November/December and May.

Table 7.1.1. Listing of all species of fish eggs contained within the Gully and approaches with information on frequency of occurrence (n_{max}=124) and abundance (number per m3). (This information was derived from the Scotian Shelf Ichthyoplankton Program (SSIP) database. Complex[1] refers to silver hake, longfin hake, white hake, butterfish and four-bear).

common name	n	minimum	maximum	average
unidentified	16	0.0007	0.0977	0.0123
cod	16	0.0017	0.2764	0.0379
haddock	3	0.0016	0.0077	0.0047
plaice	17	0.0038	0.3629	0.0734
mackerel	2	0.0026	0.0240	0.0133
witch	1			0.0045
four-beard rockling	3	0.0045	0.0162	0.0077
yellowtail flounder	4	0.0045	0.0073	0.0056
cusk	6	0.0014	0.0073	0.0046
complex[1]	19	0.0015	0.2972	0.0266
cod/haddock	6	0.0046	0.6256	0.2799
silver hake	27	0.0015	1.1285	0.1145
cod/haddock/witch	38	0.0014	1.8434	0.1341
cusk/mackerel	6	0.0008	0.0878	0.0206
cunner/yellowtail	13	0.0019	0.3448	0.0526
offshore hake	3	0.0046	0.0207	0.0118
hake (Urophycis sp.)	6	0.0020	0.0401	0.0112
pollock	14	0.0018	1.0361	0.0980
Atlantic halibut	1			0.0017
brill/windowpane	1			0.0087

Nearly thirty fish species were collected in the Gully area at the larval stage, which is about three- fold greater than the number of species collected at the egg stage (Table 7.1.2). Part of this difference is due to the fact that certain species do not have pelagic

eggs (*i.e.* sand lance) or the adults bear live young (*i.e.* redfish). The most abundant species at the larval stage was silver hake. Given that this species was also most abundant in the area at the egg stage, it is probably reasonable to conclude that silver hake spawn in the area defined as the Gully. The second most abundant species collected at the larval stage was sand lance followed by cod, windowpane flounder, redfish, witch flounder and American plaice. The temporal pattern of occurrence for four out of five of the most abundant species in shown in Fig. 7.1.4. Peak abundances of silver hake larvae occurred in August to October, offset by about one month from the peak abundance of their eggs. Sand lance larvae were collected from January to June with a peak evident in April. Cod larvae were abundant in two time periods, November/December and May/June reflecting the temporal pattern of distribution at the egg stage. Redfish larvae were encountered from March to August with a peak in abundance in April. It should be noted that pollock and American plaice, species that were relatively abundant in the Gully area during the egg stage, were encountered infrequently in the survey area during the larval stage.

Table 7.1.2. Listing of all larval fish species contained within the Gully and approaches with information on frequency of occurrence (nmax= 124) and abundance (number per m^3). (This information was derived from the Scotian Shelf Ichthyoplankton Program (SSIP) database.)

common name	n	minimum	maximum	average
Bothus sp.	1			0.0015
cod	9	0.0030	0.2172	0.0390
silver hake	29	0.0009	1.4539	0.3423
pollock	1			0.0054
redfish	23	0.0018	0.2825	0.0305
American plaice	3	0.0188	0.0225	0.0197
witch flounder	12	0.0049	0.0936	0.0242
yellowtail flounder	10	0.0017	0.0546	0.0144
Gulf Stream flounder	1			0.0026
wolffish	1			0.0033
herring	1			0.0030
mackerel	4	0.0019	0.0054	0.0031
unidentified	16	0.0020	0.1047	0.0143
four-beard rockling	5	0.0019	0.0169	0.0071
windowpane flounder	4	0.0131	0.0565	0.0312
laternfish species	10	0.0017	0.0856	0.0143
glacier laternfish	23	0.0008	0.0722	0.0145
horned laternfish	1			0.0007
spotted laternfish	1			0.0018
hake (Urophysis sp.)	14	0.0020	0.0642	0.0158
protomyctomphum	1			0.0021
Bathylagus compsus	1			0.0016
longhorn sculpin	2	0.0035	0.0054	0.0044
sculpin (Triglops sp.)	1			0.0030
sculpin (Cottidae)	1			0.0145
monkfish	3	0.0034	0.0178	0.0085
sandlance	30	0.0016	1.6499	0.1074
wrymouth	1			0.0025
coral dragonet	1			0.0007
Argyropelecus	1			0.0017
barracudina	1			0.0022
cardinalfish	1			0.0007
un i.d. gobies	1			0.0007

7.1.4 Pelagic Fish

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The distribution and abundance of these species is not well estimated by groundfish trawls which are the primary sampling tool used by DFO since the late 1940's. Although pelagic species are encountered and caught by the trawl, their overall catchability is considered to be low. The data are usually interpreted to indicate presence or absence of species or to give very general trends in abundance over long time periods. There has also been work carried out in the past which made use of commercial catch data to estimate the distribution and abundance of at least the commercially exploited pelagic species.

Small Pelagics

Kulka and Stobo (1981) report on the results of an exploratory survey for mackerel (*Scomber scombrus*) using both bottom trawl and midwater trawls (see Appendices). They found no mackerel in the Gully during the winter months. The results indicated that juvenile mackerel do stay on the shelf during the winter but that adults migrate south. During the summer these adults migrate from the south into the Gulf of St. Lawrence. The Gully is not considered an important area for mackerel feeding or spawning.

Large Pelagics

Heath Stone provided an overview of the Canadian large pelagics fisheries on the Scotian Shelf in relation to the Gully area (See Appendices). He states that a longline fisheries for swordfish does occur in the Gully and adjacent areas. Based on catch rate information the Gully does not appear to be an area of high swordfish abundance. He also reports that tuna by-catches from the swordfish fishery are low in the Gully area relative to other areas.

7.1.5 Deepwater Species I - Mesopelagics (Data provided by R. Halliday and D. Themelis)

The data on these species, which complete their life histories within the top 1000 m of the water column, were extracted from the meso-pelagic data base compiled by Ralph Halliday and Daphne Themelis. Sampling for these species was by IGYPT and Tucker trawls and ranged over bottom depths of 1000 - 4000 m at various points along the slope of the Scotian Slope (Fig. 7.1.5). The findings indicate the occurrence of more than 200 species of mesopelagic fish in the area. The Gully slope is bathed primarily by Labrador Slope water whereas further west warm slope water from the Gulf Stream is a more common occurrence. Many of the 200 species of mesopelagic fishes are southern in distribution, with quite a large number being expatriates from tropical waters. The mesopelagic ichthyofauna of the Labrador Slope water is composed mainly of Sub-arctic-Temperate species. Given this, only a small fraction of the 200 species of mesopelagic

fishes (Table 7.1.3) is of common occurrence off the Gully, and none are endemic (Halliday *et al*., 1995).

Table 7.1.3. Mesopelagic Species Composition Off the Scotian Shelf and Southern Grand Banks collected by IGYPT and Tucker trawls during the mesopelagic surveys conducted 1984 - 1989 (Data provided by R. G. Halliday and D. Themelis)

Family	Number of Species	Rank (Numerical Abundance)
Myctophidae	68	1-5,7-9,12,15-17,19,21,25
Gonostomatidae	8	6,10
Chauliodontidae	2	13
Sternotychthidae	11	14
Stomiidae	3	18
Serrivomeridae	2	20
Photichtydae	5	22,24
Nemichthyidae	3	23
Squalidae	1	>25
Derichtyidae	2	>25
Eupharyngidae	1	>25
Bathylagidae	7	
Astronesthidae	10	
Melanostomiidae	29	
Malacosteidae	6	
Idiacanthidae	1	
Scopelarchidae	3	
Paralepidae	13	
Evermanellidae	3	
Omosudidae	1	
Gadidae	1	
Melanonidae	1	
Trachipteridae	1	
Regalecidae	1	
Stylephoridae	1	
Diretmidae	1	
Anoplogasteridae	1	
Melamphaeidae	11	
Rondeletiidae	1	
Zeniontidae	1	
Zeidae	1	
Grammicolepidae	1	
Caproidae	1	
Liparidae	1	
Apogonidae	2	
Perchichthyidae	3	
Bramiidae	1	
Caristiidae	1	
Chiasmodontidae	2	
Scombrolabracidae	1	
Gempylidae	5	
Trichiuridae	2	
Stromateidae	7	
Total	227	

These results show clearly that myctophids (lanternfish) dominate the mesopelagic ichthyofauna of this area. This large family also contains the largest number of species (68) making up about 30% of the 227 species encountered.

7.1.6 Deepwater Species II - Epipelagic and Bathypelagic Species (Data provided by R. Halliday and D. Themelis)

Species composition and a general idea of relative abundance of the epipelagic (life history completed in the upper 100 meters of the water column over oceanic depths), bathypelagic (life history completed deeper than 1000 m but not on the bottom) and neritic (those

species which generally reside on the shallower waters of the shelves), are presented below (Table 7.1.4). These data were also gathered during the IGYPT and Tucker trawl surveys reported for the mesopelagic species above, and give only a general impression of the composition of the ichthyofauna at these depths in these regions.

Table 7.1.4. Epipelagic, bathypelagic, and neritic species caught during the IGYPT, and Tucker Trawl mesopelagic trawl surveys conducted adjacent to the Scotian Shelf and Southern Grand Banks 1984 - 1989. ** The indicated species occur only in the mesopelagic data set, while those which are not marked occur both in the mesopelagic data set and the summer survey results conducted in waters < 360 m.

Species	Unique**	Frequency	Total
Acanthurus sp	*	14	41
Ahlia egmontis	*	7	21
Ahliesaurus berryi	*	4	5
Albula vulpes	*	1	1
Aldrovandia phalacra	*	1	1
Alepocephalus sp	*	2	2
Aleposaurus ferox	*	6	7
Anguilla rostrata	*	17	41
Antennarius sp	*	3	3
Anthias sp	*	11	22
Ariosoma balearicum	*	1	1
Ariosoma sp	*	16	49
Beryx Dedecadactylus	*	2	2
Beryx splendens	*	2	2
Bothus sp		48	121
Bregmaceros sp	*	50	83
Callionymid sp		2	3
Callionymus agassizi		5	5
Caranx hippos	*	1	1
Caranx sp	*	3	5
Carapid sp	*	8	11
Chaetodon sp	*	6	7
Citharhicthys arctifrons		8	11
Congrid sp	*	134	723
Cookeolus boops	*	1	1
Cryptopsaras couesi	*	55	80
Cryptopsaras sp	*	1	1
Danaphryne nigrifilis	*	1	1
Decapterus sp	*	2	2
Dibranchus atlanticus		3	3
Echiodon dawsoni	*	6	6
Ectreposebastes imus	*	2	3
Edriolychnus schmidti	*	5	5
Eineria edentula	*	1	1
Engraulis eurystole	*	3	3
Epinephelus sp	*	7	14
Etmopterus princeps		4	4
Etremeus teres	*	1	45
Etropus microstomus	*	1	1
Facciolella sp.	*	5	5
Fistularia tabacaria	*	5	5
Gadus morhua		2	2
Glossanodon sp	*	8	10
Glyptocephalus cynoglossus		2	3
Gonioplectrus sp	*	1	1
Gymnothorax sp	*	4	4
Halosaurid sp.	*	1	1
Helicolenus dactylopterus		20	42
Hildebrandia sp	*	1	2
Himantolophus sp	*	5	5
Hippocampus erectus	*	5	6
Histrio histrio	*	2	2
Holocanthus sp	*	13	26
Holtbyrnia anomala	*	3	3
Hoplunnis sp.	*	5	6
Labrid sp	*	5	5
Laemonema barbatula	*	5	7
Lasiognathus beebei	*	1	1
Species	**Unique****	**Frequency**	**Total**
Linophryne brevibarbis	*	1	1
Linophryne coronata	*	1	1
Linophryne macrodon	*	1	1
Linophryne sp	*	1	1
Linophrynid sp	*	2	3
Lophodolus acanthognathus	*	2	2
Lopholatilus chamaeleonticeps	*	1	1
Macrorhamphosus scolopax	*	1	1
Macrourid sp		10	12
Melanocetus johnsoni	*	5	5
Melanocetus murrayi	*	2	2
Melanostigma atlanticaum		1	5
Monolene sessilicauda		1	1
Morid sp	*	6	9
Mugil cephalus	*	1	1
Mugil curema	*	1	1
Muraenid sp.	*	1	1
Myrophis punctatus	*	3	8
Naucrates ductor	*	1	1
Nettastoma sp	*	1	1
Nezumia bairdi		3	3
Normichthys operosus	*	13	24
Notacanthid sp.	*	1	1
Oneirodes sp	*	1	1
Oneirodid sp	*	4	6
Ophichthus cruentifer	*	5	8
Paraxenomystax sp	*	18	27
Peprilus triacanthus		5	8
Percoid sp		49	252
Petromyzon marinus	*	3	3
Photostylus pycnopterus	*	2	2
Phycis chesteri		29	63
Polymmixia lowei		5	6
Priacanthus arenatus	*	6	12
Roulenia maderensis	*	1	1
Rypticus sp	*	2	2
Scombresox saurus		7	10
Scopelosaurus argenteus	*	1	1
Scopelosaurus lepidus	*	33	53
Scopelosaurus mauli	*	1	2
Scopelosaurus smithii	*	5	11
Scorpaenid sp		4	5
Searsia koefoedi	*	4	4
Sebastes mentella		1	1
Sebastes sp		18	69
Selar boops	*	1	1
Selar crumenophtalmus	*	1	1
Selene vomer	*	9	14
Serranid sp	*	2	3
Serranus sp	*	1	1
Sphoeroides maculatus		3	3
Stephanolepis hispidus	*	15	19
Svetovidovia sp	*	19	59
Symphurus sp		2	2
Symphysanodon sp	*	2	3
Synodontid sp	*	5	103
Taractes asper	*	1	1
Taractes sp	*	1	1
Species	**Unique****	**Frequency**	**Total**
Taractichthys longipinnis	*	2	2

Tetragonurus atlanticus	*	3	3	Uroconger sp	*	1	5
Trachinocephalus myops	*	6	8	Urophycis sp		1	2
Trichopsetta sp	*	3	4	Urophyics tenuis		6	10
Species	**Unique****	**Frequency**	**Total**	Xenodermichthys copei	*	1	1

These data show that some 75 species of epipelagic and neritic fauna occur in the Scotian Slope and adjacent abyssal plain fauna. They also indicate a relatively low degree of overlap between the neritic fauna (shallow species as characterized by the results of the summer trawl surveys) and the bathypelagic and epipelagic fauna. Of 125 species encountered only 25 occur in both data sets. The data indicate that these fauna are dominated numerically by conger eels. It is likely that this fauna is composed of a mixture of resident species, migrants and vagrants from more southerly or oceanic populations. The spatial and temporal resolution of these data do not allow us to draw conclusions about whether or not particular species are restricted to the Gully.

7.1.7 Demersal Fish

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7.1.7.1 Scotian Slope

Species composition for the lower reaches of the slopes of the Gully (below) 300 m is presently not well defined. Some previous publications of the species composition of these deep waters include: Marckle and Musick (1974), Marckle *et al.* (1988), and Pohle *et al.* (1992).

A series of redfish directed trawl surveys were carried out annually from 1982 to 1987 and extended to depths of 500 fm (900 m). The observations made along the shelf edge between 58 and 60 W were used to characterize the slope ichthyofauna for the shelf slope portions of the Gully. Preliminary analyses indicate the presence of 63 species of fish caught by the bottom trawl in depths ranging from 100 to 900 meters (Table 7.1.5). The numerically most abundant at depths less than 180m was Winter Skate, while at depths greater than 180m redfish was most numerous.

Table 7.1.5. Species composition by depth zone as estiamted by bottom trawl surveys of the Scotian Slope between 58 and 60W. Species are shown as the percentage of the total numbers of fish caught in that depth zone (each column sums to 100%).

Species	*Depth Zone*				
	<180m	*180-360m*	*360-540m*	*540-720m*	*720-900m*
AMERICAN LOBSTER	0.012	0.054	0.000	0.000	0.000
AMERICAN PLAICE	3.092	0.836	0.065	0.023	0.239
AMERICAN STRAPTAIL GRENADIER	0.000	0.000	0.003	0.000	0.000
APRISTURUS LAURUSSONI	0.000	0.000	0.006	0.000	0.000
ARCTIC EELPOUT	0.000	0.000	0.003	0.000	0.000
ARGENTINE(ATLANTIC)	0.004	0.109	0.145	0.051	0.000
BACKFIN TAPIRFISH	0.000	0.000	0.027	0.000	0.000

Species	Depth Zone				
	<180m	*180-360m*	*360-540m*	*540-720m*	*720-900m*
BARNDOOR SKATE	0.000	0.000	0.063	0.000	0.000
BLACK DOGFISH	0.000	0.000	0.174	1.871	9.988
BLUE ANTIMORA/HAKE	0.000	0.000	0.000	0.059	0.246
BOA DRAGONFISH	0.000	0.000	0.000	0.000	0.123
COD(ATLANTIC)	18.999	6.310	0.360	0.000	0.000
CUSK	0.000	0.242	0.233	0.000	0.000
DEEPSEA CAT SHARK	0.000	0.000	0.000	0.000	0.123
EELPOUTS(NS)	0.000	0.004	0.000	0.032	0.000
FRECKLED SKATE	0.000	0.004	0.000	0.000	0.000
GRAY'S CUTTHROAT EEL	0.000	0.000	0.000	0.059	0.000
HADDOCK	12.329	5.362	0.090	0.000	0.000
HALIBUT(ATLANTIC)	0.959	1.498	0.357	0.237	13.212
HERRING(ATLANTIC)	0.500	0.221	0.000	0.000	0.000
JENSEN'S SKATE	0.000	0.000	0.000	0.028	0.000
KNIFENOSE CHIMERA	0.000	0.000	0.000	0.063	0.000
LANTERNFISH (NS)	0.000	0.000	0.002	0.000	0.000
LITTLE SKATE	0.004	0.007	0.000	0.000	0.000
LONGFIN HAKE	0.073	0.715	1.138	1.754	1.176
LONGHORN SCULPIN	0.038	0.007	0.000	0.000	0.000
LONGNOSE CHIMERA	0.000	0.000	0.000	0.078	0.233
LONGNOSE GRENADIER	0.000	0.000	0.000	0.028	0.000
LUMPFISH	0.369	0.000	0.000	0.000	0.000
MACKEREL(ATLANTIC)	0.080	0.000	0.000	0.000	0.000
MARLIN-SPIKE GRENADIER	0.000	0.035	0.044	0.238	0.726
MONKFISH,GOOSEFISH,ANGLER	0.201	1.188	0.934	0.118	0.000
NORTHERN HAGFISH	0.008	0.014	0.004	0.000	0.000
NORTHERN STONE	0.011	0.052	0.025	0.054	0.000
NORTHERN WOLFFISH	0.029	0.032	0.033	0.703	0.000
OCEAN POUT(COMMON)	0.000	0.004	0.000	0.000	0.000
OFF-SHORE HAKE	0.008	0.051	0.570	0.854	0.349
PANDALUS SP.	0.000	0.000	0.000	0.032	0.000
POLLOCK	18.513	17.584	0.102	0.000	0.000
REDFISH UNSEPARATED	1.875	**36.842**	**93.405**	**88.338**	**67.618**
ROCK GRENADIER(ROUNDNOSE)	0.000	0.000	0.012	0.028	0.116
ROUGHHEAD GRENADIER	0.000	0.000	0.005	0.028	2.210
ROUGHNOSE GRENADIER	0.000	0.000	0.010	0.000	0.000
ROUND SKATE	0.000	0.000	0.004	0.000	0.000
SEA RAVEN	0.051	0.000	0.000	0.000	0.000
SHORT-FIN SQUID	0.000	0.015	0.003	0.000	0.000
SHORTSPINE TAPIRFISH	0.000	0.000	0.000	0.028	0.000
SILVER HAKE	6.253	8.440	0.219	0.061	0.000
SMOOTH SKATE	0.353	0.160	0.003	0.000	0.000
SNOW CRAB (QUEEN)	0.008	0.027	0.000	0.000	0.000
SNUBNOSE SLIME EEL	0.000	0.000	0.003	0.000	0.000
SPIDER CRAB (NS)	0.000	0.010	0.014	0.000	0.000
SPIDER/(QUEEN,SNOW)UNID	0.008	0.035	0.004	0.032	0.000
SPINY DOGFISH	0.071	0.151	0.013	0.000	0.000
SPINY EEL	0.000	0.000	0.063	0.123	0.131
SPINY EELS (NS)	0.000	0.004	0.000	0.000	0.000
SPINY SPIDER CRAB	0.013	0.069	0.003	0.000	0.000
SPINYTAIL SKATE	0.000	0.000	0.000	1.276	0.000
SPOTTED WOLFFISH	0.040	0.046	0.050	0.028	0.000
SQUID (NS)	0.022	0.102	0.000	0.000	0.110
SQUIRREL OR RED HAKE	0.005	0.036	0.013	0.000	0.000
STRIPED ATLANTIC WOLFFISH	1.405	0.572	0.087	0.000	0.349
THORNY SKATE	4.124	1.705	0.209	0.158	0.000
TRUNKFISH	0.000	0.000	0.016	0.000	0.000
TURBOT,GREENLAND HALIBUT	0.021	0.021	0.177	2.266	2.583
WHITE HAKE	2.426	12.316	1.060	1.055	0.349
WINTER SKATE	**27.025**	2.112	0.137	0.000	0.000
WITCH FLOUNDER	0.903	2.974	0.107	0.297	0.116
WRYMOUTH	0.017	0.000	0.003	0.000	0.000
YELLOWTAIL FLOUNDER	0.153	0.036	0.003	0.000	0.000

An analysis of species abundance by depth zone of the slope waters in and adjacent to the Gully, showed that the continental slope represents distributional boundaries for a large number of the demersal species. Over the range of depth sampled (100 - 900 m) some species are 1) shallow water inhabitants in that their abundance is highest in the shallows depths, some are 2) upper slope dwellers with numbers declining abruptly with depth, some are 3) true slope dwellers with the highest numbers at the mid range depths and declining abundance in either deeper or shallower waters, and some 4) deepwater species whose increasing abundance at the lower limits of the survey indicates that they may be most abundant at depths beyond 900 m (Fig. 7.1.6). The table below groups species into these categories and shows their relative abundance within each of the depth zones examined. For each species we list the total numbers caught in the depth zone by the surveys.

Shallow Water Species (Decreasing abundance beyond 180 m)

	LT180	**LT360**	**LT540**	**LT 720**	**LT900**
AMERICAN PLAICE	778.24	242.93	23.93	0.92	2.00
COD(ATLANTIC)	4781.17	1833.4	133.34	0.00	0.00
HADDOCK	3102.76	1558.1	33.52	0.00	0.00
LONGHORN SCULPIN	9.48	2.12	0.00	0.00	0.00
LUMPFISH	92.96	0.00	0.00	0.00	0.00
MACKEREL(ATLANTIC)	20.20	0.00	0.00	0.00	0.00
SEA RAVEN	12.93	0.00	0.00	0.00	0.00
SMOOTH SKATE	88.79	46.37	0.97	0.00	0.00
STRIPED ATLANTIC WOLFFISH	353.55	166.29	32.39	0.00	2.92
THORNY SKATE	1037.75	495.45	77.44	6.25	0.00
WINTER SKATE	6801.12	613.79	50.85	0.00	0.00
YELLOWTAIL FLOUNDER	38.45	10.51	1.09	0.00	0.00

This group contains 12 species and most of the presently commercially exploited species The results indicate that the summer surveys used to monitor their abundance, and which fish only to 360 m, sample the largest portion of their depth ranges. These survey results do however indicated that some of these species do occur in small numbers to depths of up to 720 m.

Upper Slope (Decreasing abundance beyond 360 m)

	LT180	**LT360**	**LT540**	**LT 720**	**LT900**
FRECKLED SKATE	0.00	1.03	0.00	0.00	0.00
LITTLE SKATE	0.97	2.12	0.00	0.00	0.00
MONKFISH,GOOSEFISH,ANGLER	50.53	345.07	346.12	4.67	0.00
NORTHERN HAGFISH	2.09	3.95	1.59	0.00	0.00
OCEAN POUT(COMMON)	0.00	1.03	0.00	0.00	0.00
POLLOCK	4659.01	5109.73	37.75	0.00	0.00
SHORT-FIN SQUID	0.00	4.25	1.09	0.00	0.00
	LT180	**LT360**	**LT540**	**LT 720**	**LT900**

SILVER HAKE	1573.69	2452.44	81.04	2.42	0.00
SPINY DOGFISH	17.94	43.79	4.67	0.00	0.00
SPINY EELS (NS)	0.00	1.03	0.00	0.00	0.00
SQUIRREL OR RED HAKE	1.17	10.50	5.00	0.00	0.00
WHITE HAKE	610.43	3578.83	393.00	41.59	2.92
WITCH FLOUNDER	227.17	864.27	39.60	11.73	0.97
WRYMOUTH	4.18	0.00	0.97	0.00	0.00

This group contains 14 species of which are half are presently commercially exploited. The results show that significant numbers of monkfish, white hake, and witch flounder occur beyond the limits of our regular summer groundfish surveys.

Slope (most abundant >360 <900)

	LT180	**LT360**	**LT540**	**LT 720**	**LT900**
AMERICAN STRAPTAIL GRENADIER	0.00	0.00	1.09	0.00	0.00
APRISTURUS LAURUSSONI	0.00	0.00	2.33	0.00	0.00
ARCTIC EELPOUT	0.00	0.00	1.09	0.00	0.00
ARGENTINE(ATLANTIC)	0.92	31.65	53.70	2.01	0.00
BACKFIN TAPIRFISH	0.00	0.00	9.99	0.00	0.00
BARNDOOR SKATE	0.00	0.00	23.33	0.00	0.00
CUSK	0.00	70.40	86.34	0.00	0.00
EELPOUTS(NS)	0.00	1.03	0.00	1.25	0.00
GRAY'S CUTTHROAT EEL	0.00	0.00	0.00	2.34	0.00
HALIBUT(ATLANTIC)	241.27	435.29	132.43	9.36	110.42
JENSEN'S SKATE	0.00	0.00	0.00	1.09	0.00
KNIFENOSE CHIMERA	0.00	0.00	0.00	2.50	0.00
LANTERNFISH (NS)	0.00	0.00	0.80	0.00	0.00
LONGFIN HAKE	18.34	207.88	421.79	69.16	9.83
LONGNOSE GRENADIER	0.00	0.00	0.00	1.09	0.00
MARLIN-SPIKE GRENADIER	0.00	10.09	16.34	9.38	6.07
NORTHERN WOLFFISH	7.37	9.26	12.27	27.73	0.00
OFF-SHORE HAKE	1.93	14.82	211.32	33.67	2.92
REDFISH UNSEPARATED	471.81	10705.77	34622.05	3483.81	565.13
ROCK GRENADIER (ROUNDNOSE)	0.00	0.00	4.37	1.09	0.97
ROUGHNOSE GRENADIER	0.00	0.00	3.67	0.00	0.00
ROUND SKATE	0.00	0.00	1.59	0.00	0.00
SHORTSPINE TAPIRFISH	0.00	0.00	0.00	1.09	0.00
SNUBNOSE SLIME EEL	0.00	0.00	1.17	0.00	0.00
SPINY EEL	0.00	0.00	23.25	4.84	1.09
SPINYTAIL SKATE	0.00	0.00	0.00	50.31	0.00
SPOTTED WOLFFISH	10.07	13.38	18.57	1.09	0.00
TRUNKFISH	0.00	0.00	5.83	0.00	0.00
TURBOT,GREENLAND HALIBUT	5.25	6.18	65.56	89.36	21.59

We found 29 species which were at their highest abundance over this range of depths. The overall most abundant was redfish (*Sebastes* sp) with significant numbers occurring to

depths of over 700 m. Atlantic halibut (*Hippoglossus hippoglossus*) which do not appear to be very effectively sampled by trawls, occur in significant numbers to depths of 900 m.

Deep Slope (most abundant at or beyond 900)

	LT180	LT360	LT540	LT 720	LT900
ROUGHHEAD GRENADIER	0.00	0.00	2.01	1.09	18.47
LONGNOSE CHIMERA	0.00	0.00	0.00	3.09	1.94
DEEPSEA CAT SHARK	0.00	0.00	0.00	0.00	1.03
BOA DRAGONFISH	0.00	0.00	0.00	0.00	1.03
BLUE ANTIMORA/HAKE	0.00	0.00	0.00	2.34	2.06
BLACK DOGFISH	0.00	0.00	64.45	73.79	83.48

The abundance of these species increased to the limits of the surveyed depths likely indicating that the center of their distribution lies deeper. The most abundant of these are black dogfish (*Centroscylliun fabricii*).

It is unlikely that the species composition of the shelf slope in the Gully is unique. The Gully represent only a small portion of the slope of the Scotian Shelf and it is likely that this composition is indistinguishable from the species composition from adjacent areas of the slope. The unique bathymetric features of the Gully (rapid changes in bathymetry analogous to terrestrial cliff walls hundreds of meters high) may attract certain of the species observed. Redfish appear to prefer areas of rapid changes in bathymetry at depths >360 m and are therefore relatively abundant in the Gully relative to adjacent areas. Halibut (*Hippoglossus hippoglossus*) also appear to be relatively abundant in the Gully relative to adjacent areas. There are active fisheries for both these species in the area.

Beyond 900 m

The data in the Table 7.1.6 below augments the data presented for the deepwater redfish surveys above in that it describes the species composition of demersal fish inhabiting depths of 900 - 2700 m. It is noteworthy that these data are relatively consistent with the depth distributions for the species encountered in the redfish surveys. Black dogfish (*Centroscyllium fabricii*), Portuguese shark (*Centroscymus coelolepis*) Roughhead grenadier (*Macrourus berglax*), Longnose chimeara (Harriotta raleighana), Blue hake (*Antimora rostrata*) were all reported from the redfish surveys as having distributions with maximum numbers occurring at or beyond 900 m. Greenland Halibut (*Rheinhardtius hippoglossoides*), Deepwater chimaera (*Hydrolagus affinis*), Atlantic halibut (*Hippoglossus hippoglosoides*), Jensen's skate, snubnosed eels, and spinytale skates all had maximum abundances between 360 and 720 m. These data show that for depths from 900 to 1800 m, black dogfish are most numerous near bottom dwelling fish followed by roughhead grenadier and Portuguese shark. Beyond 1800 m Deepwater Chimaera become most abundant followed by Blue hake and Portuguese shark.

Table 7.1.6. Species Ranking for the slope off Emerald Bank, and the Gully for two depth zones

Species	Common Name	E	G1	G2
Centroscyllium fabricii	black dogfish	1	1	-
Centroscymnus coelolepis	Portuguese shark	2	3	3
Hydrolagus affinis	deepwater chimaera	3	5	1
Etmopterus princeps	rough sagre	4	+	-
Reinhardtius hippoglossoides	Greenland halibut	5	4	5
Antimora rostrata	blue hake	+	+	2
Macrourus berglax	roughhead grenadier	+	2	4
Urophycis tenuis	white hake	+	-	-
Harriotta raleighana	longnose chimaera	+	+	-
Hippoglossus hippoglossus	Atlantic halibut	+	-	-
Raja jenseni	Jensen's skate	+	+	+
Alepocephalus sp.	slickhead	+	-	-
Simenchelys parasiticus	snubnose eel	+	-	-
Raja spinicaudata	spinytail skate	-	-	+
E = Off Emerald Bank				
G1 = Gully 900 - 1800 m				
G2 = Gully 1800 - 2700 m				

7.1.7.2 Eastern Scotian Shelf

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Simon and Comeau (1994) report on the results of summer trawl survey results for the period 1970-1992. These authors show trends in abundance for the top 90% of the species caught. Although these authors did not examine data for the Gully specifically, their results indicate that this area appears to represent a preferred area of distribution for a number of species as evidenced by their relative concentration in this area relative to that observed in adjacent waters. These species include American Plaice, Atlantic Halibut, Atlantic Cod, Haddock, Herring (late 1980's and early 1990's), Longfin Hake, Monkfish, Pollock (mid to late 1980's), Redfish, Smooth Skate, White Hake (especially 1982 - 1992), Winter Skate, and Witch. Their results also indicate the presence of a number of the species in the Gully area which are caught at relatively low frequency (less that 10% of tows) by the trawl survey in general.

Based on the results of summer groundfish surveys conducted between 1970 and 1997, species composition and abundance for the Gully and Gully trough and for the Eastern Scotian Shelf excluding these two areas were compared. The Eastern Scotian Shelf was sampled over depths ranging from 50 - 200 fathoms (100 - 400 m). For the time series examined this area has had a relatively low sampling rates with less than 100 observations falling within the bounds of the Gully and Gully trough. For the period 1970 - 1997 a total of 140 species of fish were encountered (Table 7.1.7). Results indicate that the fish fauna of this area is numerically dominated by redfish. Overall mean catch rate for this species is about 160 fish per tow. The top 20 species (numerically) for this period were redfish, silver hake, squid, haddock, halibut, cod, yellowtail, capelin, sand lance, herring, white hake, longfin hake, thorny skate, pollock, witch flounder, longhorn sculpin,

argentine, mackerel, red hake, and dogfish with catch rates ranging from about 50 to less than 1 individual per tow (Fig. 7.1.7).

The Gully and Gully trough are also dominated numerically by redfish (Fig. 7.1.8) with mean catch per tow values for this species about three times higher in the Gully than in the Gully trough. Excluding redfish (Fig. 7.1.9) the top 10 species in the Gully were white hake, witch flounder, squid, longfin hake, halibut, silver hake, haddock, cod, pollock, and herring over the period 1970-1997. For the Gully trough (Fig. 7.1.9) the top ten species over the same period were squid, cod, halibut, haddock, silver hake, herring, yellowtail, thorny skate, witch flounder, and capelin.

Summer surveys have captured a total of 55 species of fish in the Gully and Gully trough over the period 1970 - 1997 (Table 7.1.8). Only the ogrefish (*Anoplogaster cornuta*) was caught in the Gully and not elsewhere on the eastern Scotian Shelf. This is a deepwater species which has been encountered elsewhere on the Scotian Slope as reported from the mesopelagic survey results above.

Table 7.1.7. Fish species (including squid) caught on the Eastern Scotian during summer groundfish surveys conducted between 1970 and 1996

AGONIDAE F.	GAIDROPSARUS ENSIS
AGONUS DECAGONUS	GAIDROPSARUS SP.
ALOSA PSEUDOHARENGUS	GLYPTOCEPHALUS CYNOGLOSSUS
ALOSA SAPIDISSIMA	GONOSTOMA ELONGATUM
AMMODYTES DUBIUS	GYMNELIS VIRIDIS
AMMODYTES SP.	HAKE UNID.
ANARHICHAS DENTICULATUS	HELICOLENUS DACTYLOPTERUS
ANARHICHAS LUPUS	HEMITRIPTERUS AMERICANUS
ANARHICHAS MINOR	HIPPOGLOSSOIDES PLATESSOIDES
ARGENTINA SILUS	HIPPOGLOSSUS HIPPOGLOSSUS
ARGYROPELECUS ACULEATUS	HYPEROGLYPHE PERCIFORMIS
ARTEDIELLUS ATLANTIC	ICELUS BICORNIS
ARTEDIELLUS UNCINATUS	ICELUS SPATULA
ASPIDOPHOROIDES MONOPTERYGIUS	ILLEX ILLECEBROSUS
ASPIDOPHOROIDES OLRIKI	LIMANDA FERRUGINEA
BLENNIOIDEI S.O.	LIPARIS ATLANTICUS
BLENNIOIDEI S.O.-OBS	LIPARIS COHENI
BOTHIDAE F.	LIPARIS FABRICII
BROSME BROSME	LIPARIS GIBBUS
CALLIONYMUS AGASSIZI	LIPARIS INQUILINUS
CAREPROCTUS LONGIPINNIS	LIPARIS LIPARIS
CAREPROCTUS REINHARDTI	LIPARIS SP.
CENTROSCYLLIUM FABRICII	LOPHIUS AMERICANUS
CERATOSCOPELUS MADER	LUMPENIDAE F.
CHAULIODUS SLOANI	LUMPENUS FABRICII
CHLOROPHTHALMUS AGASSSIZI	LUMPENUS LUMPRETAEFORMES
CITHARICHTHYS ARCTIFRONS	LUMPENUS MACULATUS
CLUPEA HARENGUS	LYCENCHELYS PAXILLUS
CORYPHAENOIDES RUPESTRIS	LYCENCHELYS VERRILLI
COTTIDAE F.	LYCODES ESMARKI
COTTUNCULUS MICROPS	LYCODES LAVALAEI
COTTUNCULUS THOMPSON	LYCODES RETICULATUS
CRYPTACANTHODES MACULATUS	LYCODES SP.
CYCLOPTERUS LUMPUS	LYCODES TERRAENOVA
CYTTUS ROSEUS	LYCODES VAHLII
DIBRANCHUS ATLANTICUS	MACROURIDAE F.
ENCHELYOPUS CIMBRIUS	MACROZOARCES AMERICANUS
ETMOPTERUS PRINCEPS	MALACOCEPHALUS OCCIDENTALIS
EUMESOGRAMMUS PRAECISUS	MALLOTUS VILLOSUS
EUMICROTREMUS SPINOSUS	MAUROLICUS MUELLERI
GADUS MORHUA	MELANOGRAMMUS AEGLEFINUS
GADUS OGAC	MELANOSTIGMA ATLANTICUS

MERLUCCIUS ALBIDUS	POLYMIXIA NOBILIS
MERLUCCIUS BILINEARIS	PRIONOTUS CAROLINUS
MICROMESISTIUS POUTASSOU	PSEUDOPLEURONECTES AMERICANUS
MONOLENE SESSILICAUDA	RAJA ERINACEA
MYCTOPHIDAE	RAJA LAEVIS
MYCTOPHUM PUNCTATUM	RAJA OCELLATA
MYCTOPHUM SP.	RAJA RADIATA
MYOXOCEPHALUS AENEUS	RAJA SENTA
MYOXOCEPHALUS OCTODEDECMSPINOSUS	RAJA SPINICAUDA
MYOXOCEPHALUS SCORPIDUS	REINHARDTIUS HIPPOGLOSSOIDES
MYOXOCEPHALUS SCORPIOIDES	SCOMBER SCOMBRUS
MYXINE GLUTINOSA	SCOMBERESOX SAURUS
NEMICHTHYS SCOLOPACEUS	SCOPHTHALMUS AQUOSUS
NEZUMIA BAIRDI	SEBASTES SP.
NOTOLEPIS RISSOI	SPHOEROIDES MACULATUS
NOTOLEPIS RISSOI KROYERI	SQUALUS ACANTHIAS
OGCOCEPHALIDAE F.	STERNOPTYCHIDAE F.
OSMERUS MORDAX	STOMIAS BOA FEROX
PARALEPIDIDAE F.	STOMIATIDAE
PARALEPIS ATLANTICA	SYMPHURUS SP.
PARALICHTHYS DENTATUTUS	SYNAPHOBRANCHUS KAUPII
PARALICHTHYS OBLONGUS	TAUTOGOLABRUS ADSPER
PARASUDIS TRUCULENTA	TRACHYRHYNCHUS MURRAYI
PEPRILUS TRIACANTHUS	TRIGLOPS MURRAYI
PHOLIS GUNNELLUS	UROPHYCIS CHUSS
PHYCIS CHESTERI	UROPHYCIS REGIUS
POLLACHIUS VIRENS	UROPHYCIS TENUIS
POLYMIXIA LOWEI	ZENOPSIS OCELLATA

Table 7.1.8. Fish Species (including squid) caught in the Gully (strata 452 and 457) during summer groundfish surveys conducted between 1970 and 1997 (indicates species not caught on the remainder of the eastern Scotian Shelf).**

AGONIDAE F.	LYCODES TERRAENOVA
AGONUS DECAGONUS	LYCODES VAHLII
AMMODYTES DUBIUS	MACROZOARCES AMERICANUS
ANARHICHAS LUPUS	MALLOTUS VILLOSUS
ANOPLOGASTER CORNUTA **	MELANOGRAMMUS AEGLEFINUS
ARGENTINA SILUS	MERLUCCIUS ALBIDUS
ARTEDIELLUS ATLANTICUS	MERLUCCIUS BILINEARIS
ARTEDIELLUS UNCINATUS	MYCTOPHIDAE
ASPIDOPHOROIDES MONOPTERYGIUS	MYOXOCEPHALUS OCTODECEMSPINOSUS
BROSME BROSME	MYXINE GLUTINOSA
CLUPEA HARENGUS	NEZUMIA BAIRDI
CORYPHAENOIDES RUPESTRIS	PHYCIS CHESTERI
CRYPTACANTHODES MACULATUS	POLLACHIUS VIRENS
ENCHELYOPUS CIMBRIUS	PSEUDOPLEURONECTES AMERICANUS
EUMICROTREMUS SPINOSUS	RAJA ERINACEA
GADUS MORHUA	RAJA OCELLATA
GLYPTOCEPHALUS CYNOGLOSSUS	RAJA RADIATA
HELICOLENUS DACTYLOPTERUS	RAJA SENTA
HEMITRIPTERUS AMERICANUS	REINHARDTIUS HIPPOGLOSSOIDES
HIPPOGLOSSOIDES PLATESSOIDES	SCOMBER SCOMBRUS
HIPPOGLOSSUS HIPPOGLOSSUS	SEBASTES SP.
ILLEX ILLECEBROSUS	SQUALUS ACANTHIAS
LIMANDA FERRUGINEA	STOMIATIDAE
LOPHIUS AMERICANUS	TRACHYRHYNCHUS MURRAYI
LUMPENUS LUMPRETAEFORMIS	TRIGLOPS MURRAYI
LUMPENUS MACULATUS	UROPHYCIS CHUSS
LYCODES RETICULATUS	UROPHYCIS TENUIS
LYCODES SP.	

Trends in Abundance

A comparison of the density distribution of the ten most abundant fish species in the Gully to those in the Gully trough and the eastern Scotian Shelf as a whole (Fig. 7.1.10) showed some intriguing patterns: Squid (*Illex illecebrosus*), American Plaice (*Hippoglossus platessoides*), Silver Hake (*Merlucius bilinearis*), Haddock, (*Melanogrammus*

aeglefinus), and pollock (*Pollachius virens*) all occurred in highest overall density (mean numbers per standard survey tow) in areas of the eastern Scotian Shelf outside the Gully. Redfish (Sebastes spp.), Witch flounder (*Glyptocephalus cynoglossus*), Cod (*Gadus morhua*), White Hake (*Urophycis tenuis*), and Longfin Hake (*Urophycis chesteri*) occurred at their highest densities in the Gully

Trends abundance for redfish (*Sebastes spp*) are broadly similar in all areas (Fig. 7.1.10). For squid (*Illex Illecebrosus*) the dynamics are again roughly similar except for the most recent years where they have increased in the Gully and continue to decline elsewhere. Dynamics of American plaice (*Hippoglossus platessoides*) show declines for both the eastern shelf and Gully trough but an variable increase for the Gully proper.

There are a group of species who's dynamics show a significant similarity for the eastern shelf in general but whose dynamics in the Gully differ from this overall pattern. The pattern for the shelf is characterized by a relatively rapid increase until the mid 1980's followed by a decline. For some the decline continues to the present (Haddock, Cod, and Longfin Hake) while for Silver and White Hake abundance increases again after 1992. Except for White Hake in the Gully proper, the dynamics of these species in the Gully do not show the period of increase to the mid 1980'

7.1.8 Fisheries

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The Gully and adjacent waters have had a long history as an important fishing area. During the previous 5 years, with the closure or severe restrictions of many of the fisheries on the Scotian Shelf, the Gully has been increasingly fished, both for traditional species and for non-traditional species. A report commissioned by the WWF (Milewski 1996) reports on both the fishing activities and other stakeholders in the area.

DFO has a wealth of both catch and effort information available from which to describe the fishing history of the Scotian Shelf. Unfortunately, the spatial resolution of much of these data is low relative to the dimensions of the Gully and adjacent waters. The finest resolution of catch and effort data is found in the Observer Program database. This data set consists of geo-referenced set by set information on catch composition, and trawling effort spanning the period 1978 to present. For the domestic Canadian fleet this represents only a small fraction of the total effort (<20% per year?). However, all of the foreign fisheries effort operating inside the 200 mile economic zone are represented in this data set. These data should be carefully examined to determine both the history of the fishery in this area (at least during the last 20 or so years), and to augment the descriptions of species compositions of these shelf slope areas, particularly from the catches realized by Cuban and former Soviet vessels fishing for silver hake and Japanese vessels fishing for redfish and large pelagic species.

The difficulties associated with trawling in much of the area both in the steep sided canyons of the Gully and the adjacent deep waters (> 300m seaward, and stratum 457 landward) have likely contributed to the relatively low sampling rate for the area. However, this area has been important to the fishing industry (both mobile gear and fixed gear) over an extended period. The detailed catch and effort information gathered by the members of the Fishermen and Scientists Research Society would be an additional source of information, however we must appreciate the potential sensitivities associated with these data if they are to be used in what could be viewed by members of the industry, as an argument to restrict fishing activities in the area.

We examined the general catch and effort data collected by DFO for the past three years (1995 - 1997) to get an indication of present fishing effort in the Gully and adjacent waters. The resolution of these recent data is by geo-referenced location of each set. Prior to 1992, the highest level of resolution was to unit area. Since the Gully is bisected by the boundaries of two NAFO unit areas, it is difficult to use these earlier data to gain an understanding of fishing effort in the area. There is a complicating factor to these analyses in that the major fisheries in this area have been essentially closed since 1993 with the declaration of a moratorium on the Eastern Scotian Shelf cod stock.

Fig. 7.1.11 shows that since 1995 the bulk of trawler effort has moved progressively eastward in the past three years. It is likely that this trawler effort was mainly directed at redfish, especially the effort along the edge of the continental shelf and along the slopes of the deep holes on the shelf proper. In 1995 we observe that there were several hundred sets in the mouth of the Gully and the waters immediately adjacent and to the east.

Shrimp trawls (Fig. 7.1.12) were active on the eastern Scotian Shelf during the period 1995 - 1997, but concentrated their efforts in the mixed depth areas to the north and east of the Gully. Only a very few sets were made in the Gully trough in the past two years. Effort by Danish Seiners (Fig. 7.1.13) has been more or less restricted to the shallowest portion of Banquereau Bank and none has been expended in the Gully.

Longline effort (Fig. 7.1.14) represents by far the most significant portion of all the fishing effort in the area. This effort is focused to a large extent on Atlantic halibut (*Hippoglossus hippoglossus*) and White hake (*Urophycis tenuis*). Over the past three years this effort has amounted to hundreds of sets annually.

These preliminary analyses indicate that the Gully presently represents an area of significant longline effort but that trawler effort is presently low. Indication from industry representatives are that the Gully has in the past been an area of significant trawler activity and that the current lack of activity is due to the moratorium in effect.

7.1.9 Conclusions

Based on the analyses presented above we conclude that the Gully and adjacent waters, as defined above, is an area of relatively high demersal finfish diversity relative to the eastern Scotian Shelf as a whole. There is no evidence for any endemic demersal species of fish, however, given the low sampling rate and the potentially low efficiency of the trawl in areas of rapid changes in bathymetry such as occur in the area, this does not rule out the possibility that such species occur.

The slope waters of the Gully, as is the case for the Scotian Slope in general, is an area of faunal boundaries. The upper reaches of the slope (less than 360 m) represent the lower boundaries of distribution for the shelf dwelling species and the upper limits for those species which are truly slope dwellers. The slope itself down to depths of about 900 m has it's own ichthyofauna. Beyond these depths the demersal fish fauna changes again to represent that of the lower slope and abyssal rise. It is difficult to draw conclusions about the uniqueness of the fish occurring in the slope waters of the Gully given the relative paucity of like data from other areas suitable for comparison. A more exhaustive survey of the literature on this subject is warranted before drawing firm conclusions.

The area does not appear to be important for shelf dwelling pelagic species although these do occur there as migrants.

The pelagic species occurring over the shelf slope and abyssal plain adjacent to the Gully are numerous (> 200). Given the broad geographic distributions of many of these species it is unlikely that any are unique to the Gully. A more detailed examination of the existing data by sampling location may help to resolve this issue.

The Gully is an area of high density for redfish, squid, cod, witch flounder, white hake, and longfin hake, relative to the remainder of the eastern Scotian Shelf.

The top nine species of demersal fish occurring in the Gully can be split into those whose dynamics are relatively similar to that demonstrated by that species elsewhere on the eastern Scotian Shelf (redfish, squid and witch flounder) and those whose dynamics show different patterns in the Gully relative to the eastern shelf (American Plaice, haddock, cod, silver hake, white hake and pollock). The underlying causes of the different dynamic in theses areas has not been investigated.

Although at present the fisheries on the Eastern Scotian Shelf are severely restricted relative to the recent past, the Gully continues to be an actively fished area. Longline effort directed at Atlantic halibut and White hake is presently the most common. In the past there has also been significant trawler effort in both the Gully and the adjacent slope waters.

7.1.10 References

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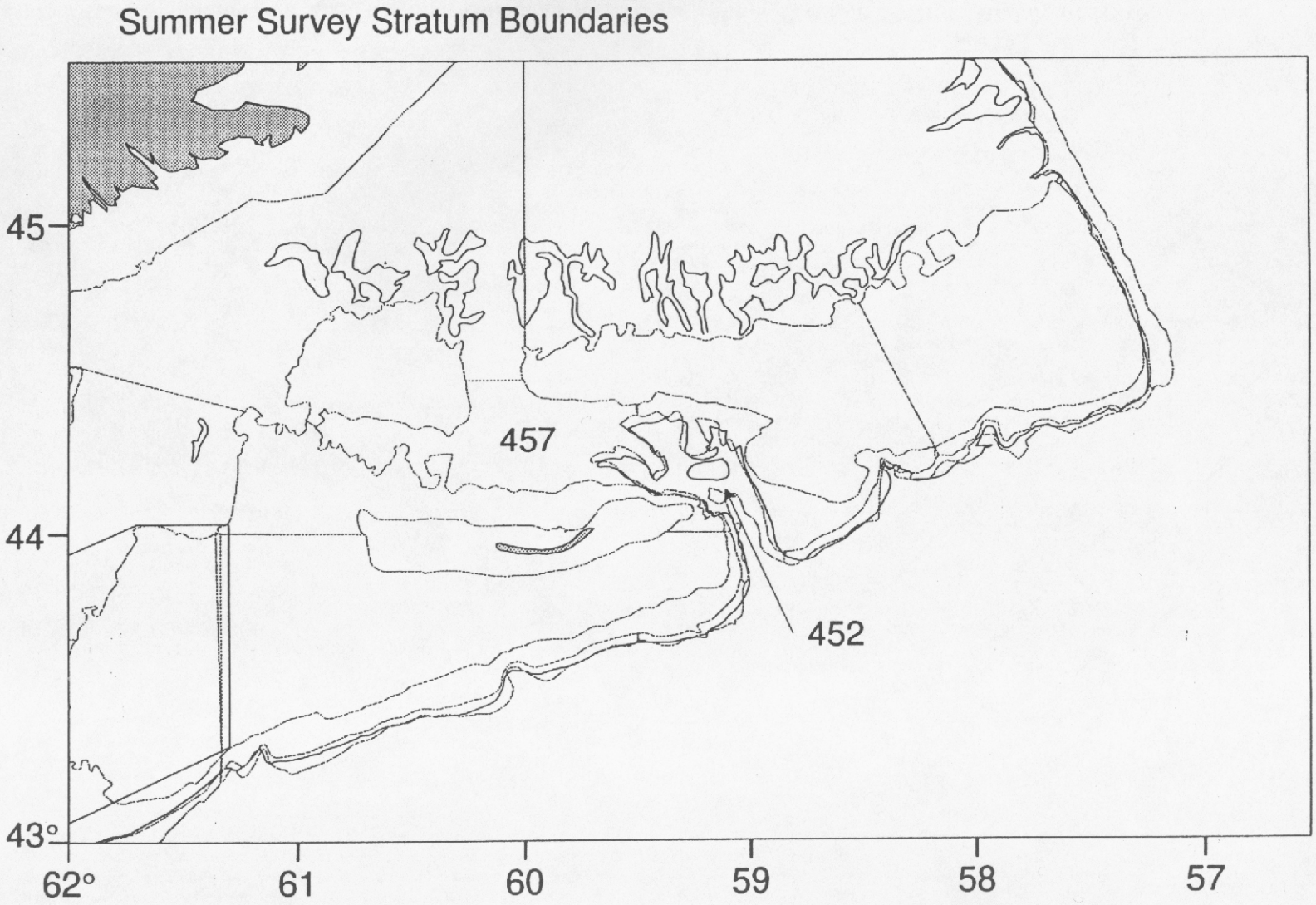


Fig. 7.1.1. Map of the Eastern Scotian shelf showing both the 100 m and 200 m isobaths and the boundary of summer survey stratas 452 and 457, as discussed in the paper.

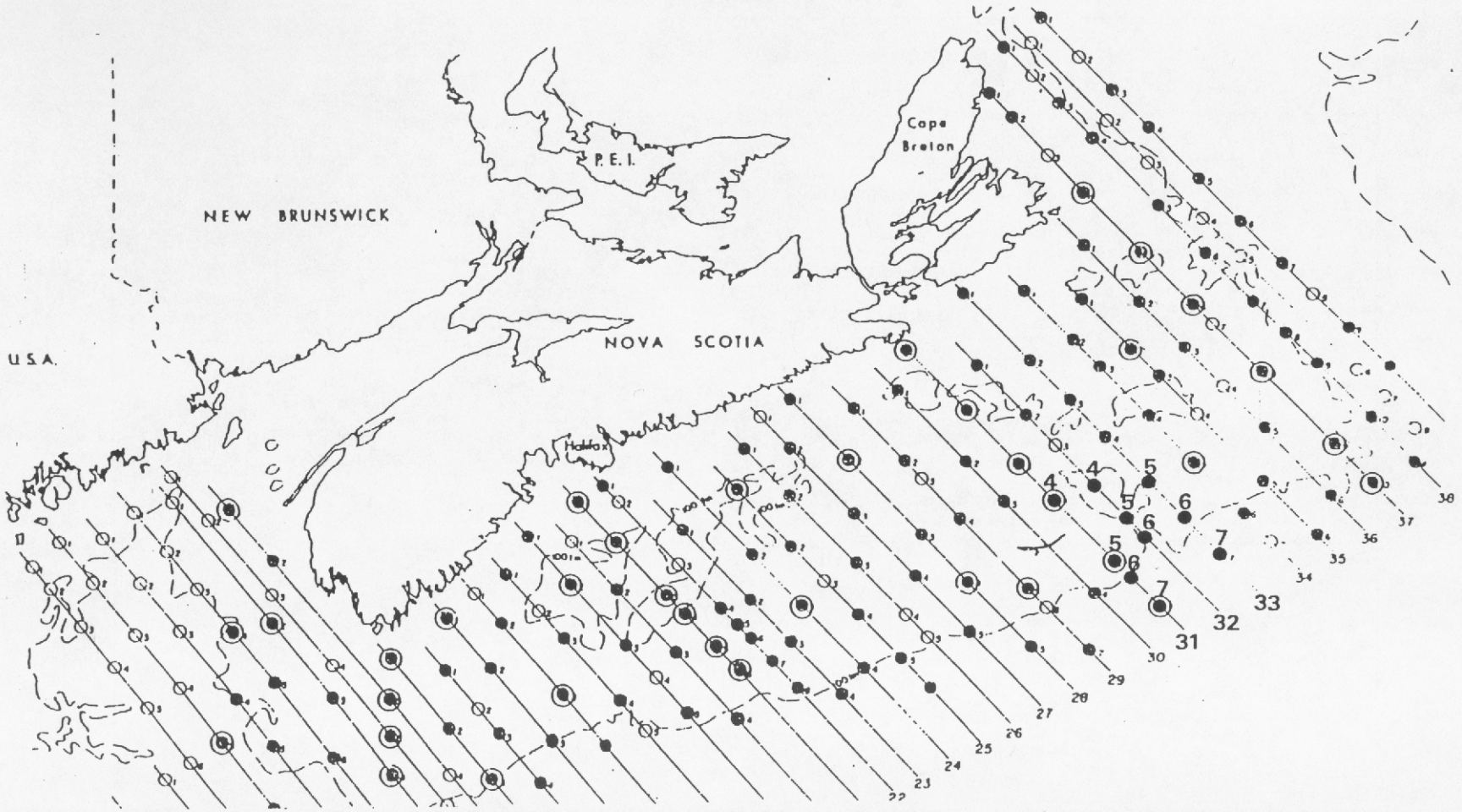


Fig. 7.1.2. Sampling grid used for the Scotian Shelf Ichthyoplankton Program (SSIP). Highlighted are the lines and stations in the area defined as the Gully adjacent to Sable island. Egg and larval fish data were extracted from ten line/station combinations (line 31 stations 4, 5, 6, and 7; line 32 stations 4, 5, and 6; line 33 stations 5, 6, and 7) from the SSIP database to address the question of the importance of this area for spawning.

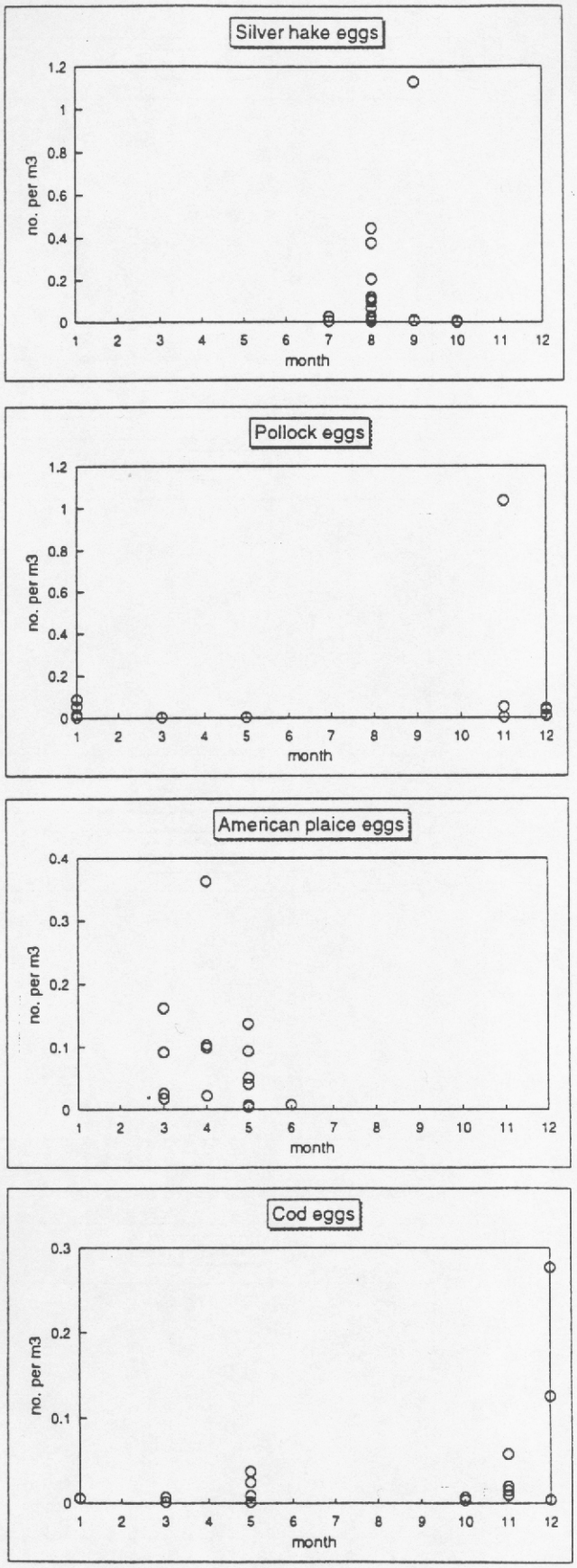


Fig. 7.1.3. Temporal pattern of abundance of the most abundant fish egg types encountered in the Gully area.

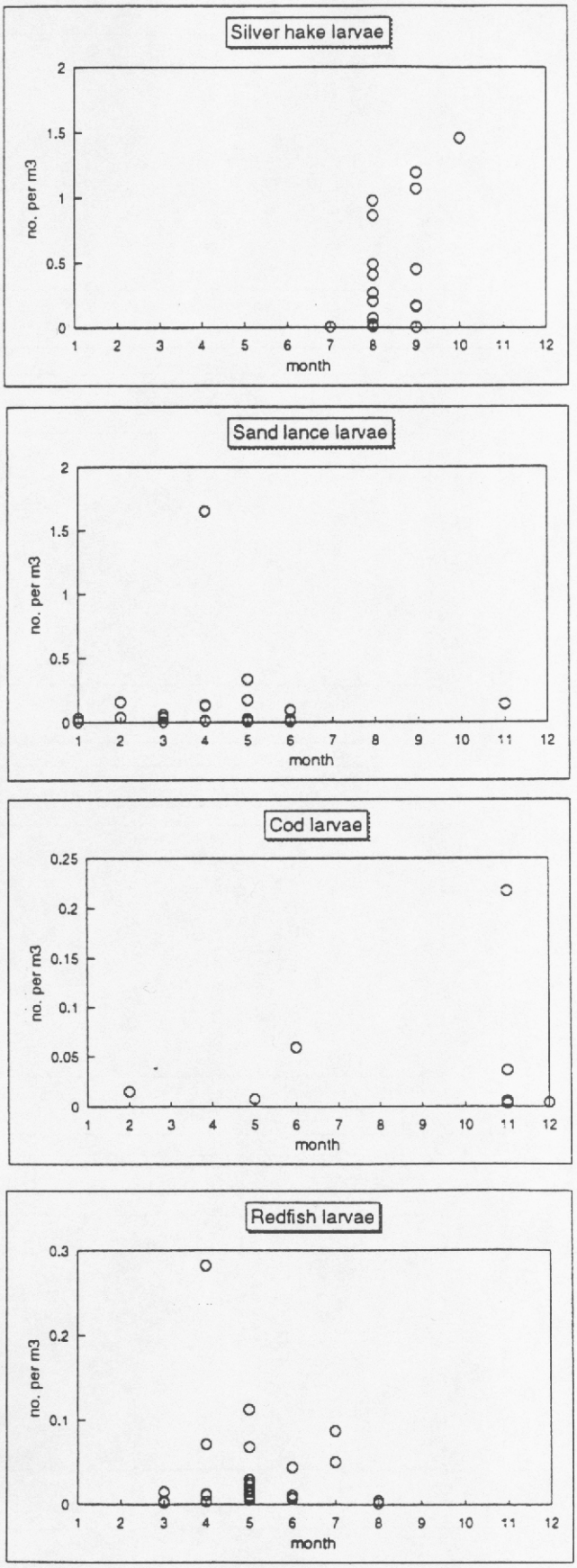


Fig. 7.1.4. Temporal pattern of abundance of the most abundant fish types encountered in the Gully area.

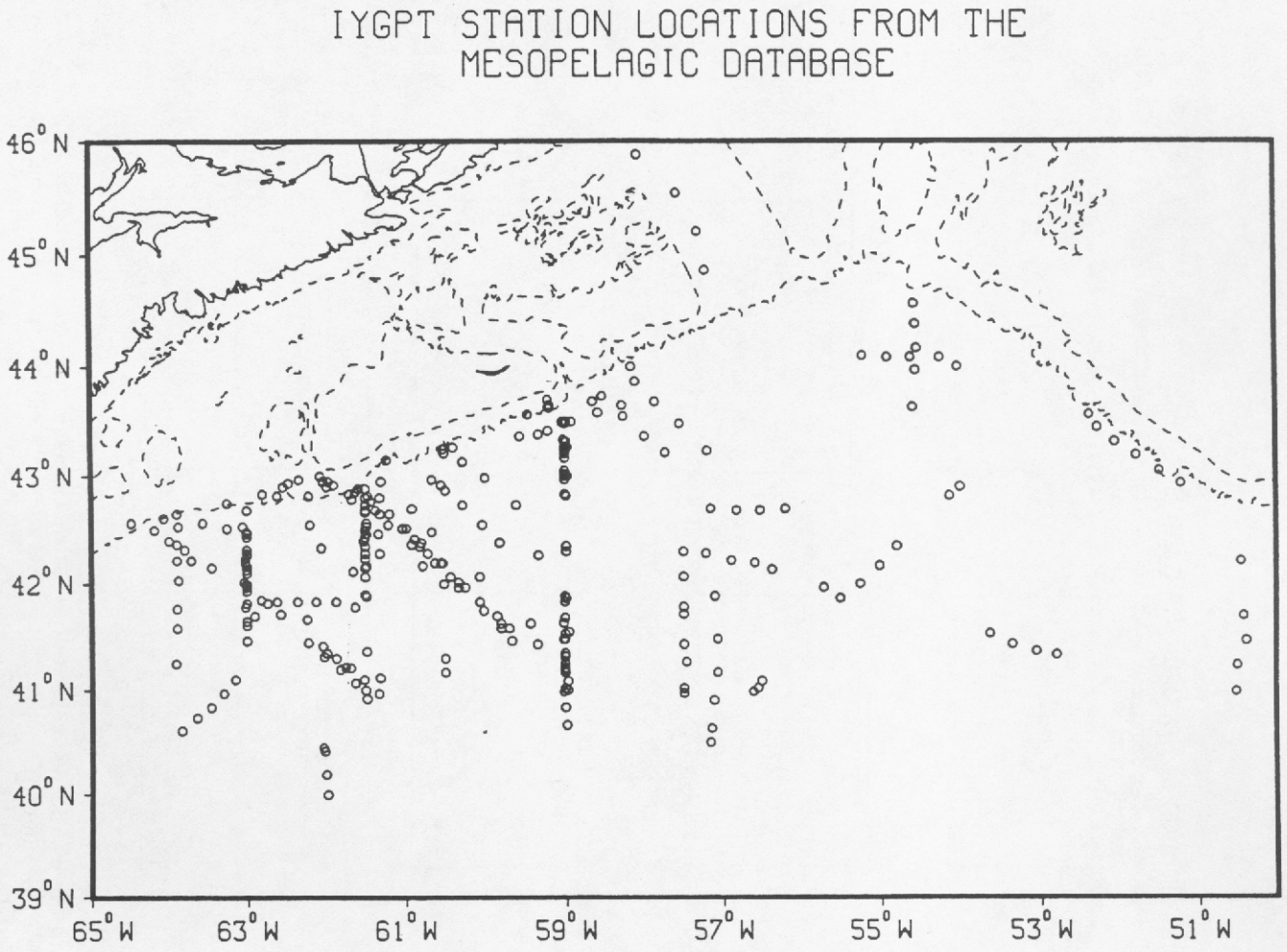


Fig. 7.1.5. Location of the stations at which sets were made to sample mesopelagic fishes along the Scotian Shelf and southern Grand Banks. All tows were made using an IGYPT trawl (International Young Gadoid Pelagic Trawl).

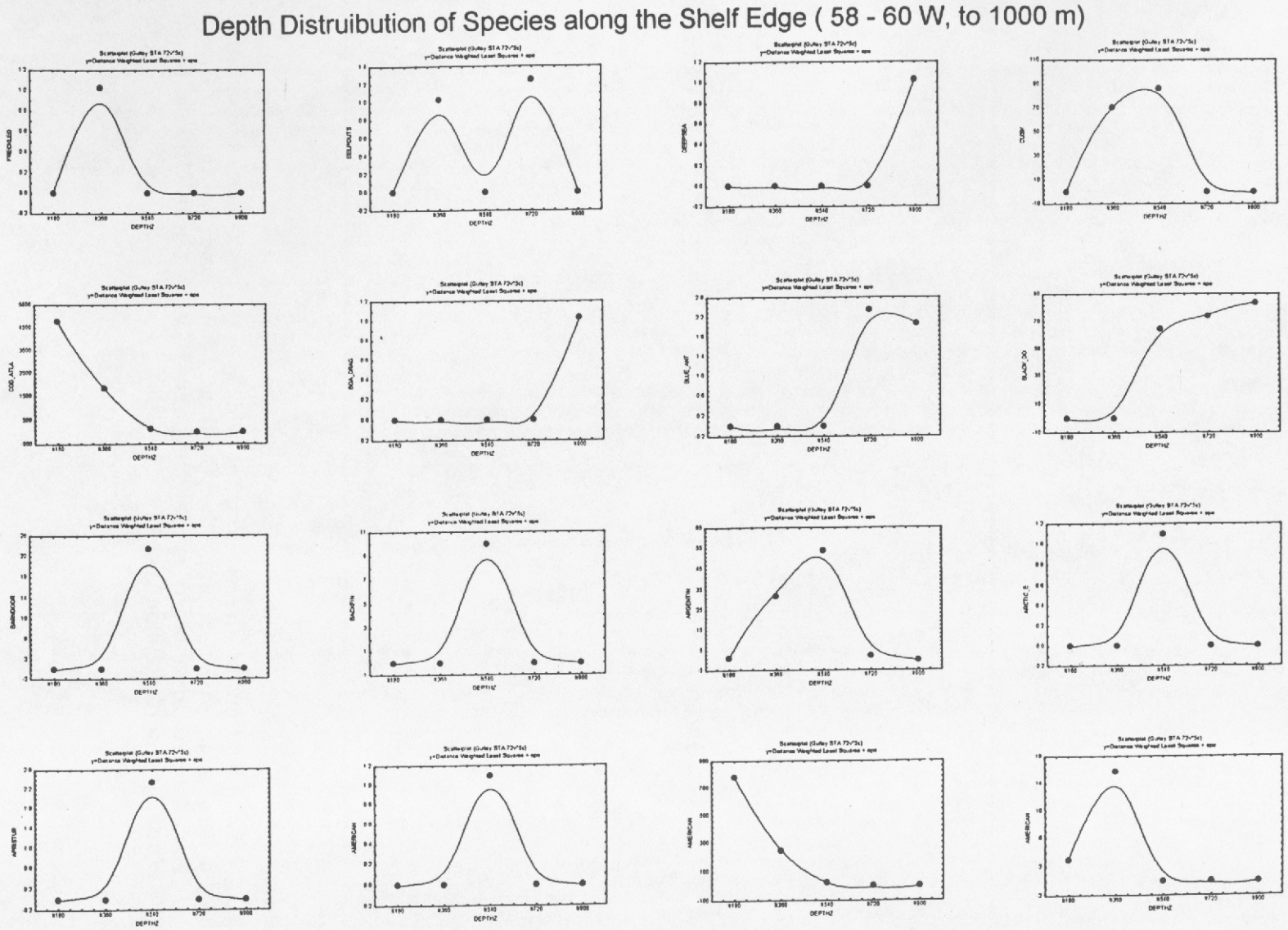
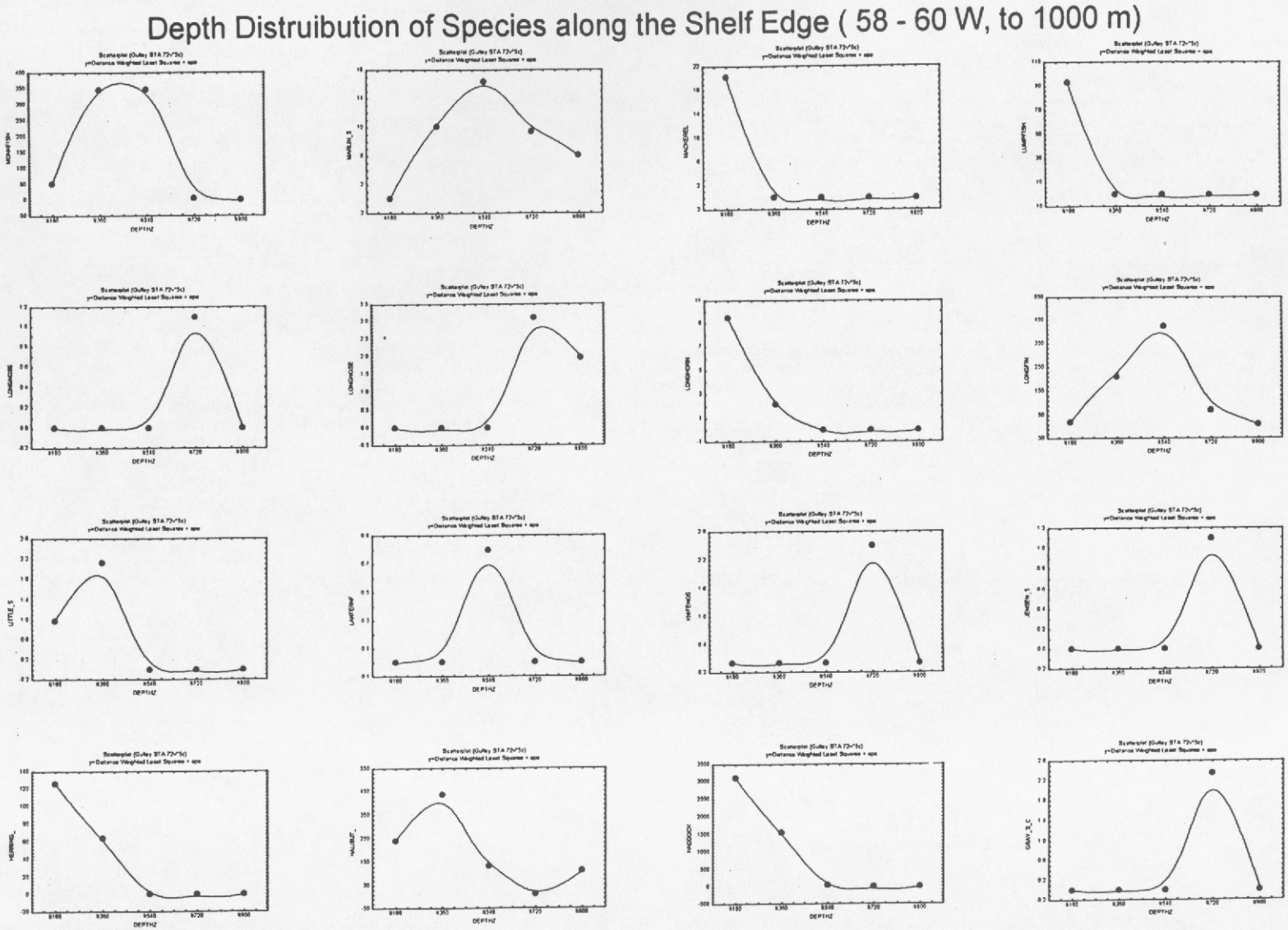


Fig. 7.1.6. Depth distribution of species caught by redfish directed surveys conducted along the Scotian Shelf between 58 and 60W. The data plotted are the total numbers caught by depth zone, the line for each plot is the distance weighted least square line.



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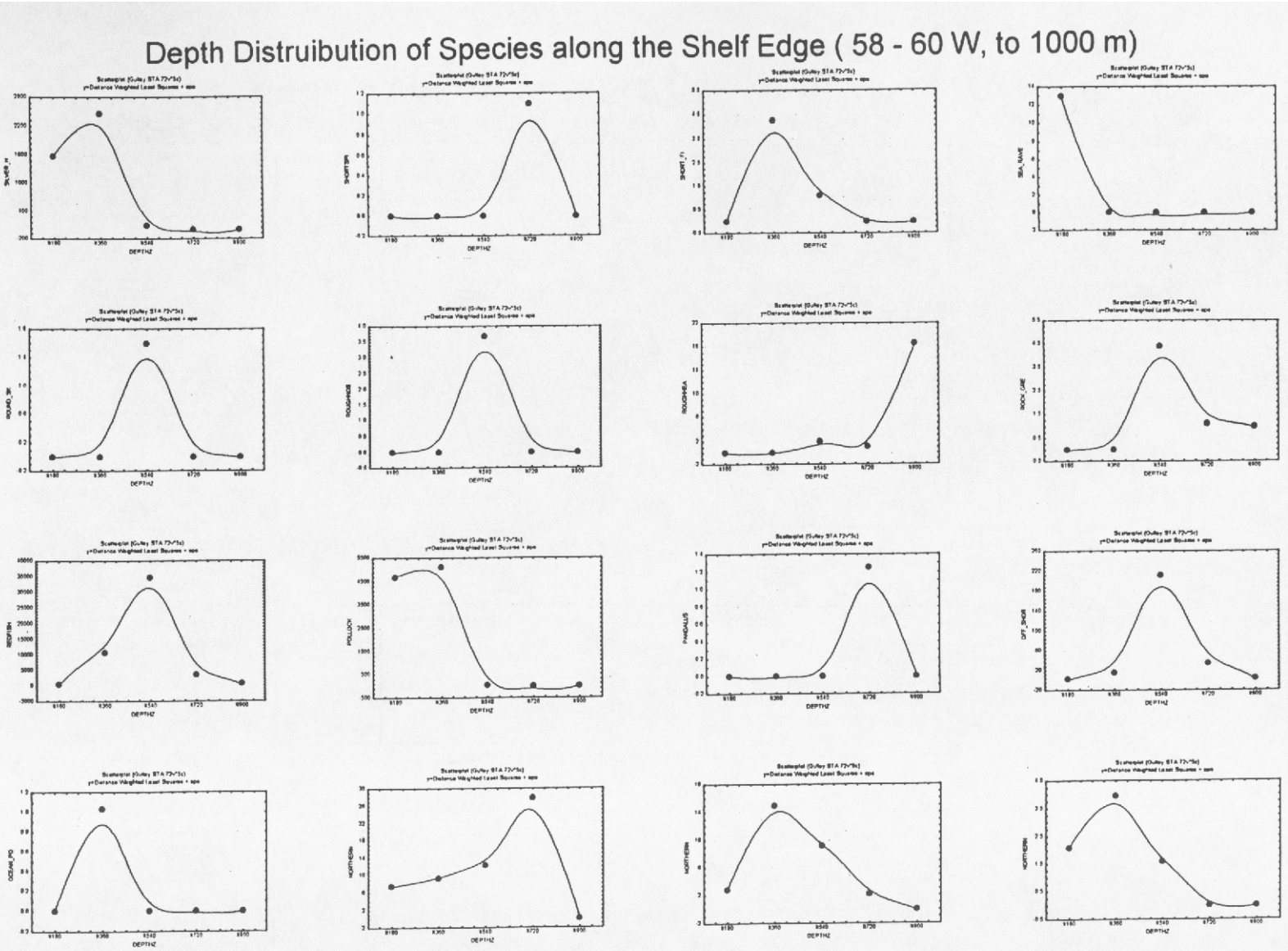

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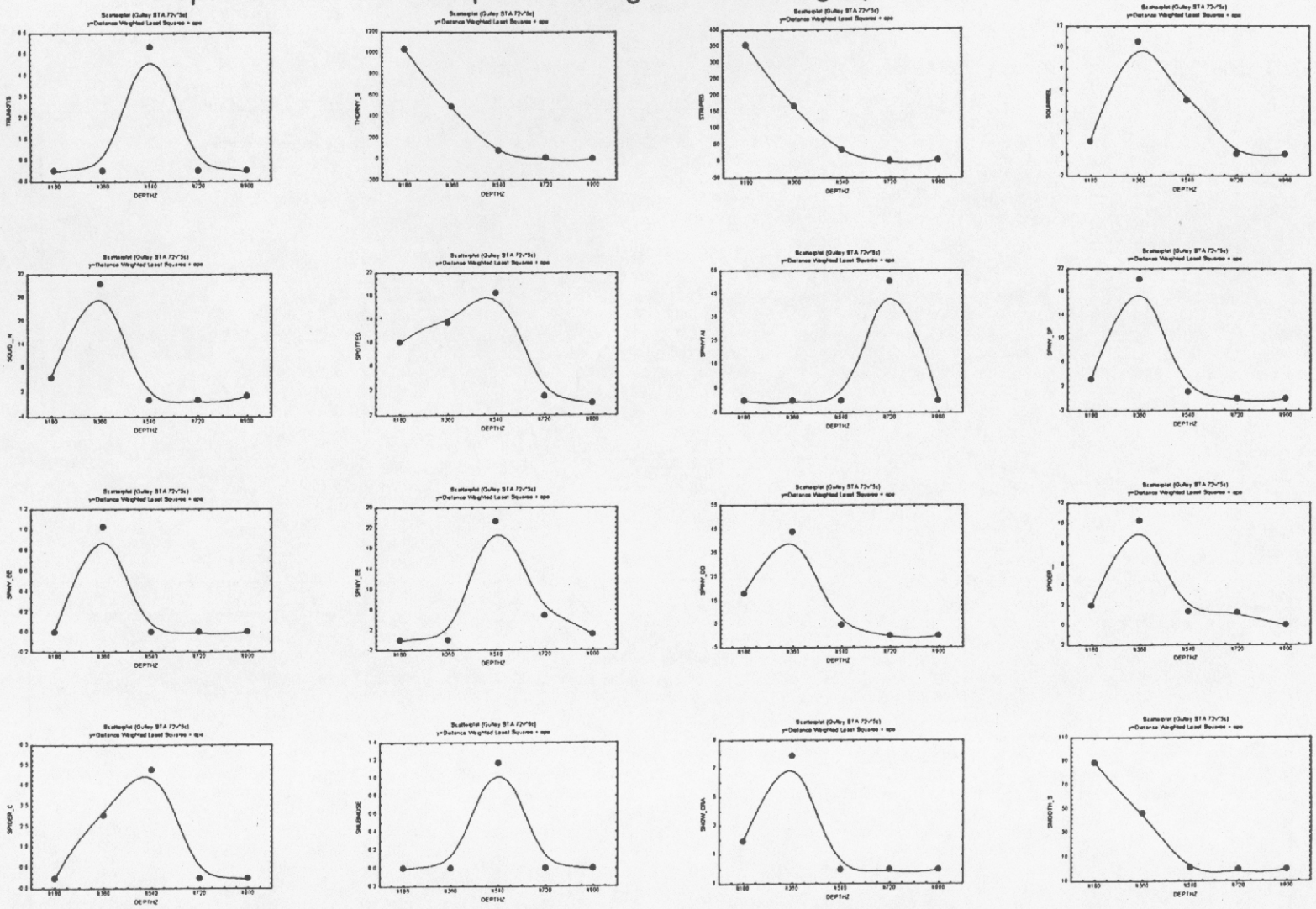

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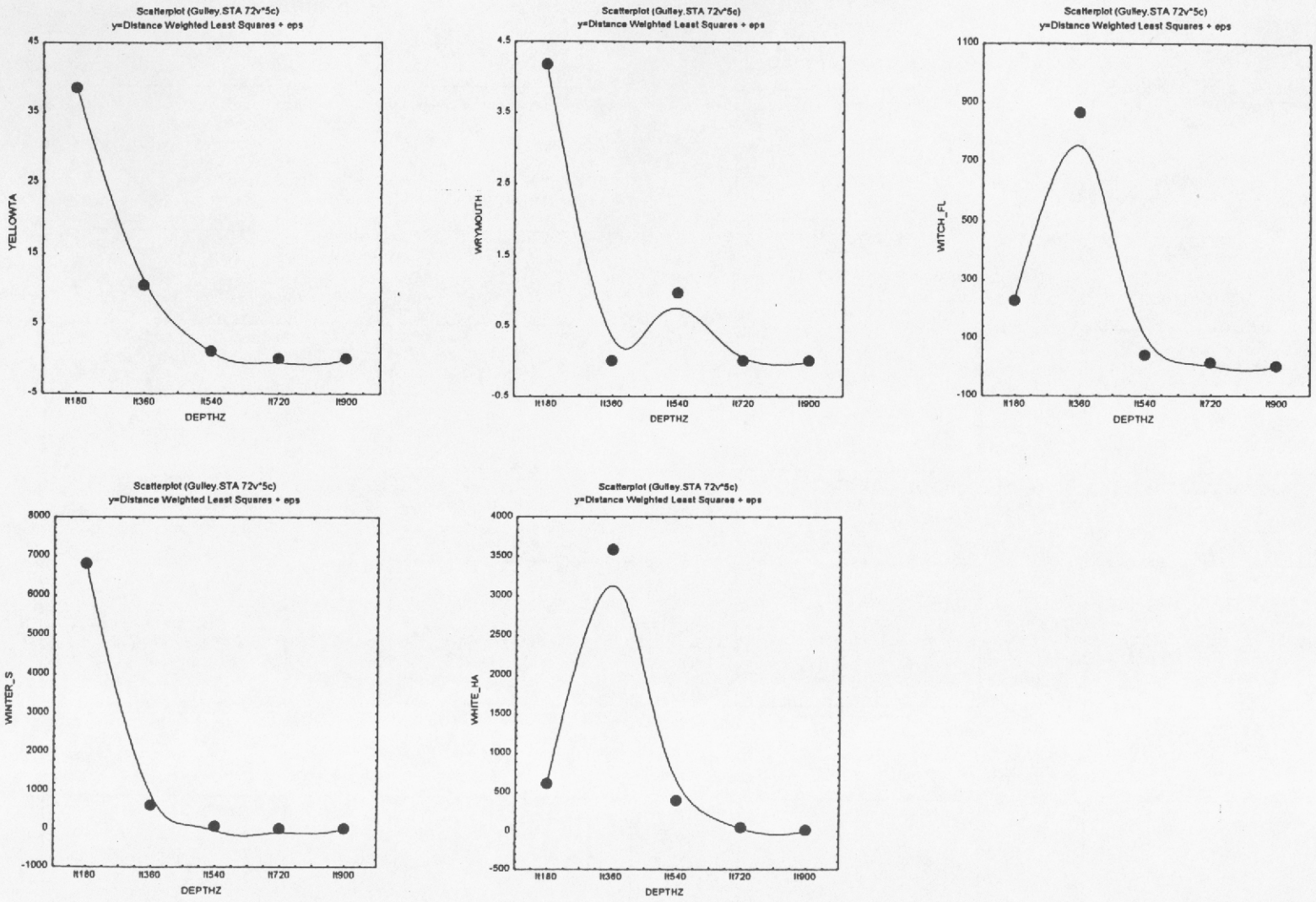

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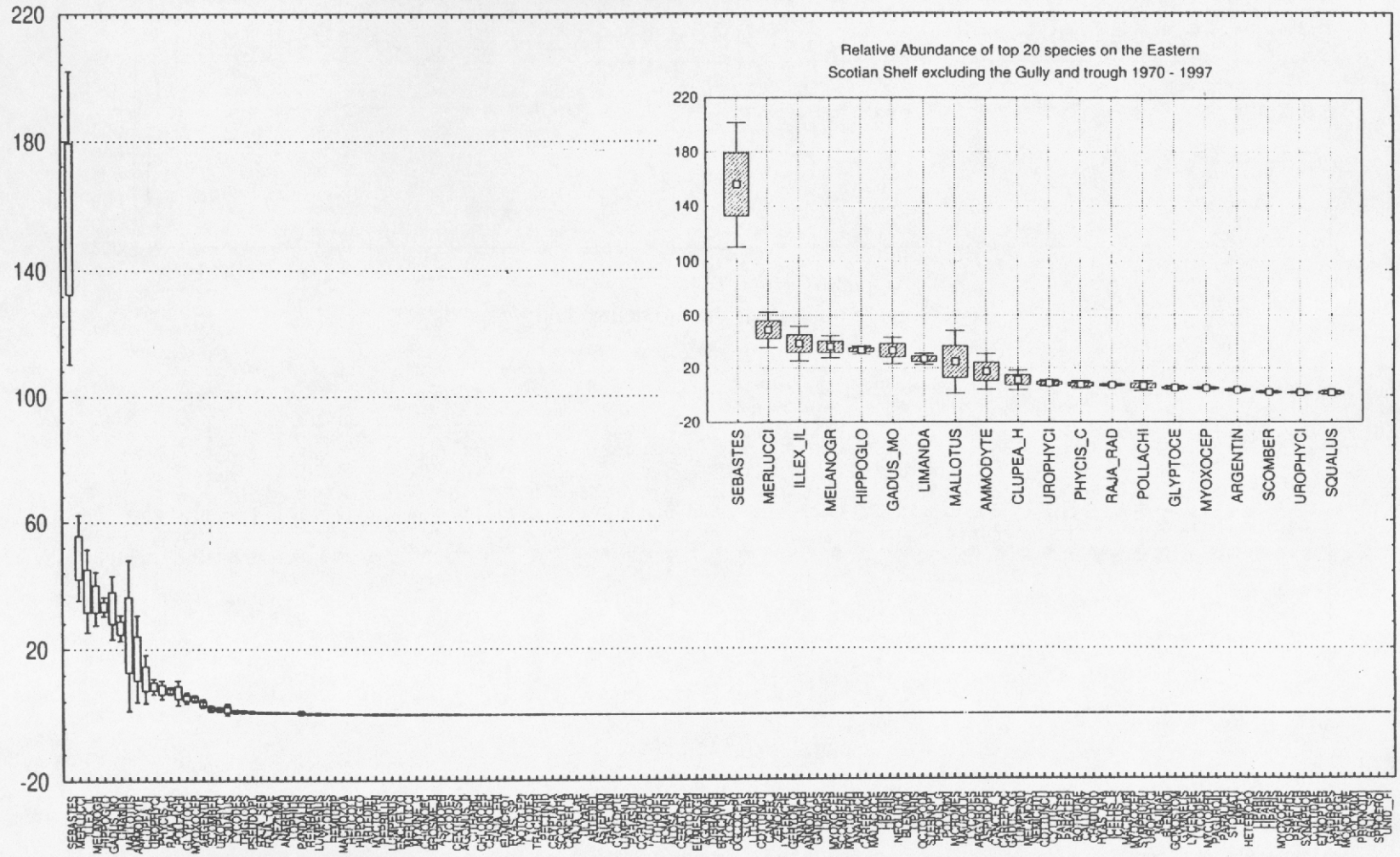


Fig. 7.1.7. Species composition of the Eastern Scotian Shelf excluding the Gully and the Gully trough for the period 1970-1996. The inserted box and whisker plot shows an expanded section of the overall plot for the top 20 species.

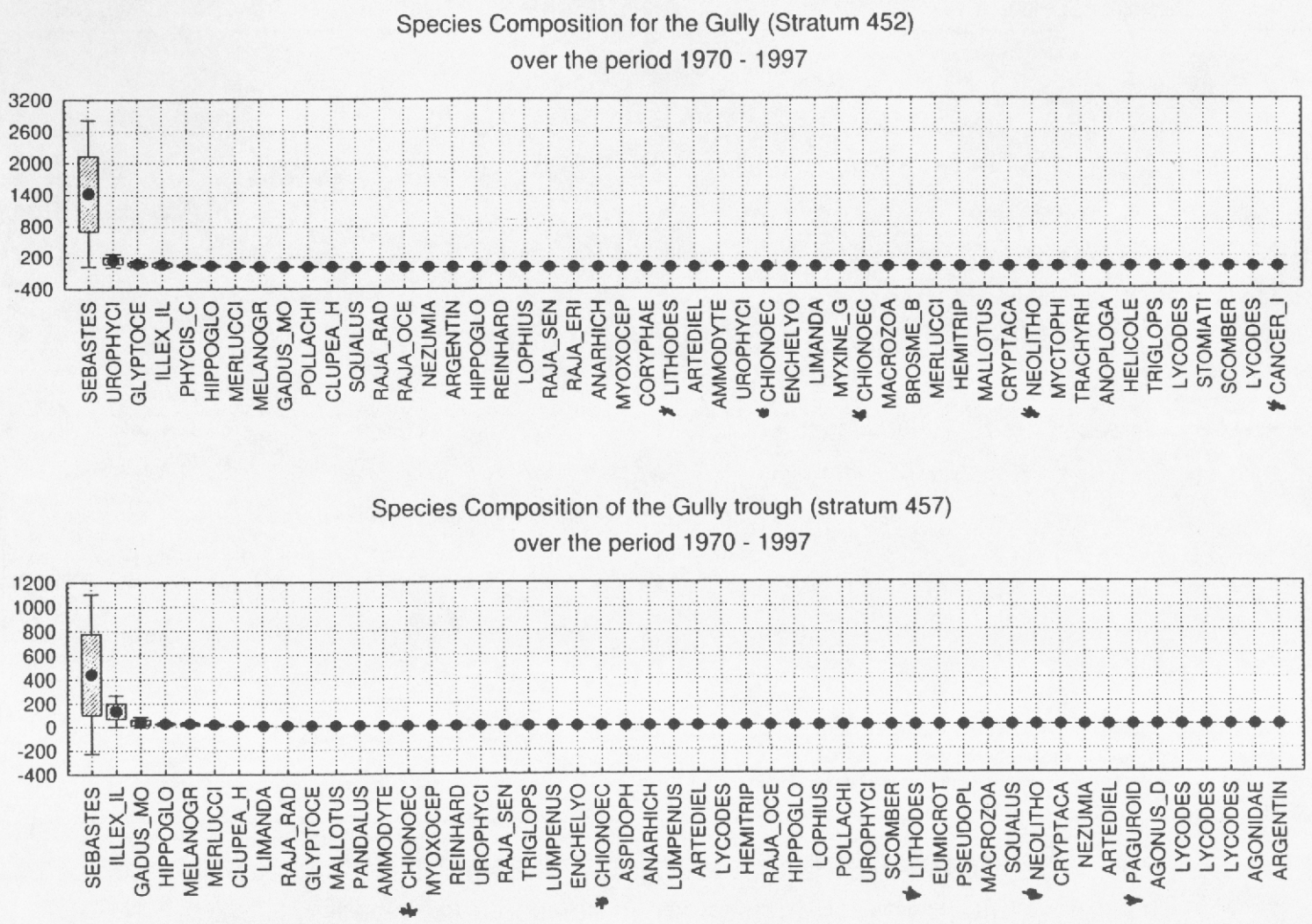


Fig. 7.1.8. Species composition of the Gully an Gully trough for the period 1970-1996. Those species indicated with an "*" are invertebrate species.

* INVERTERATES

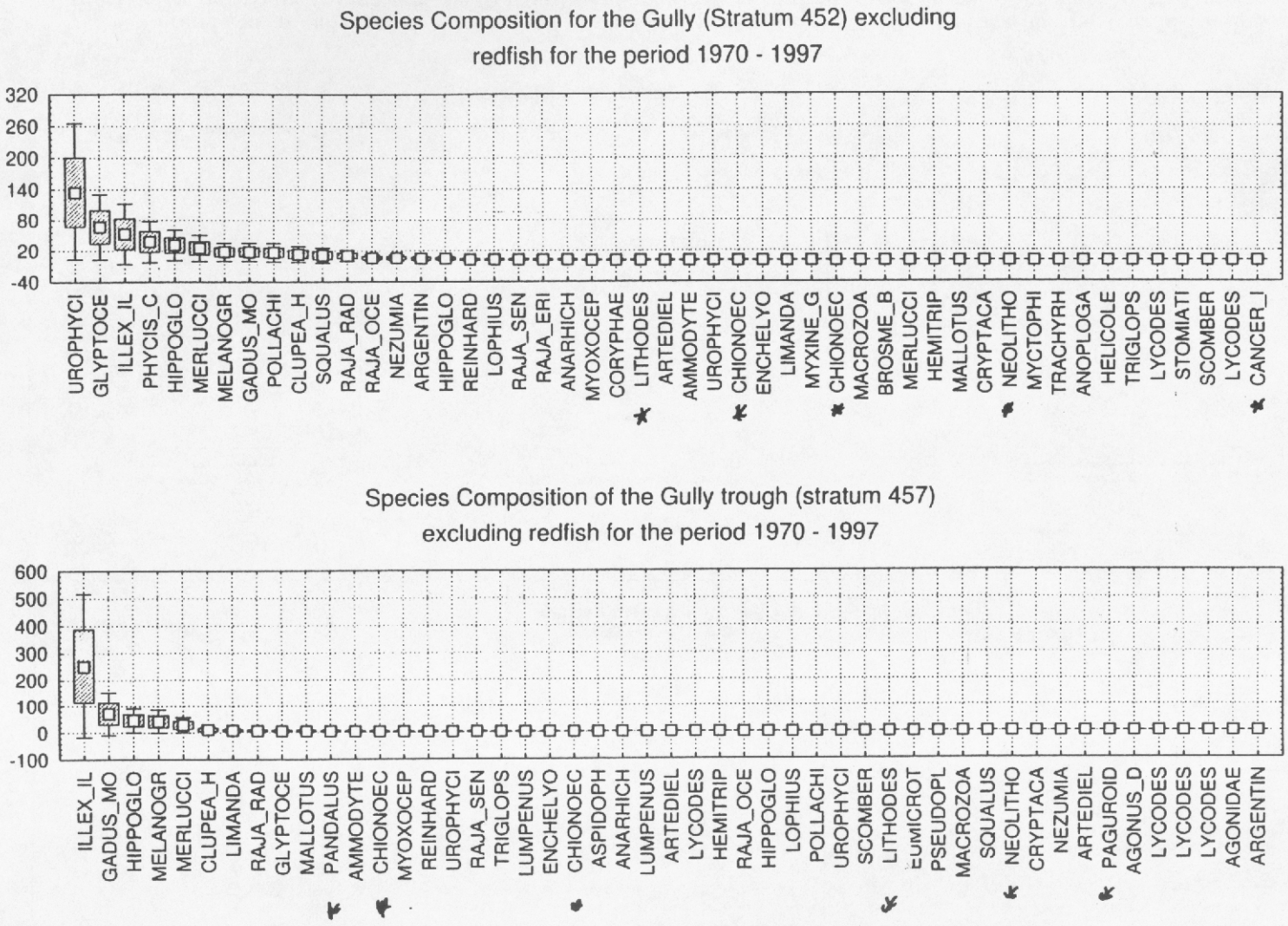


Fig. 7.1.9. Species composition of the Gully and Gully trough for the period 1970-1996, excluding redfish. Those species indicated with an "*" are invertebrate species.

* INVERTEBRATES

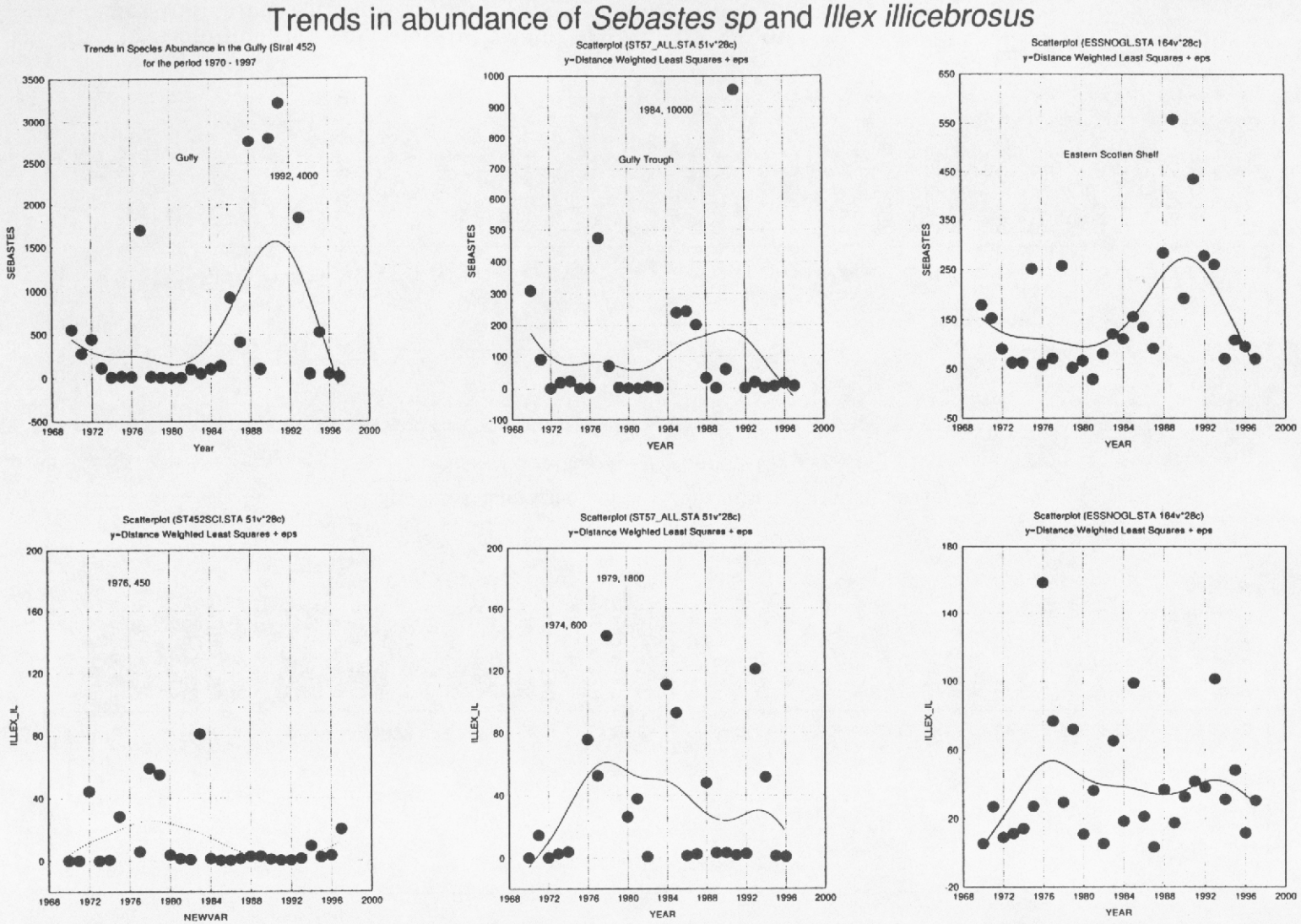
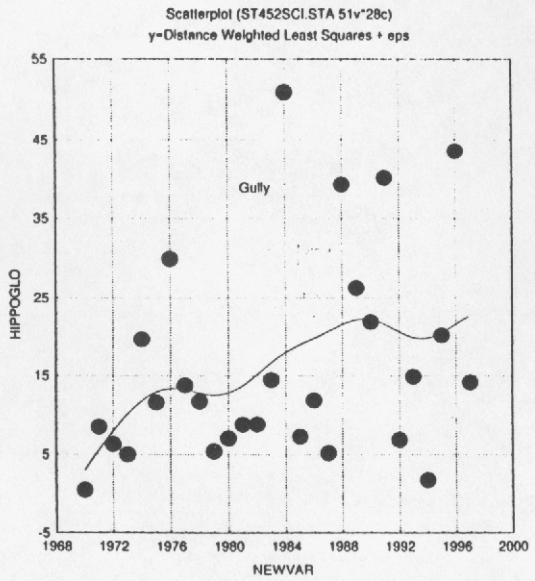
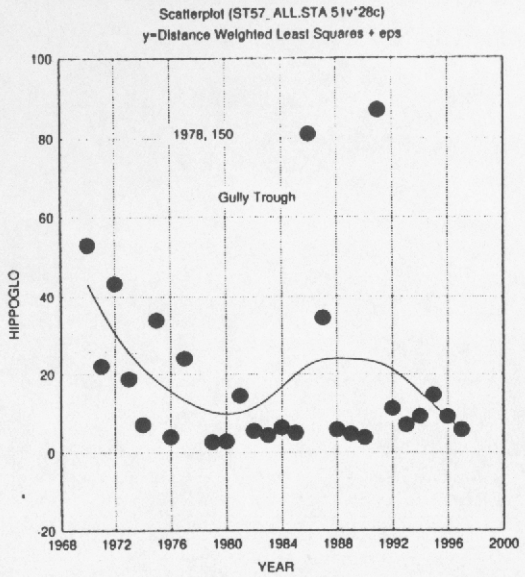
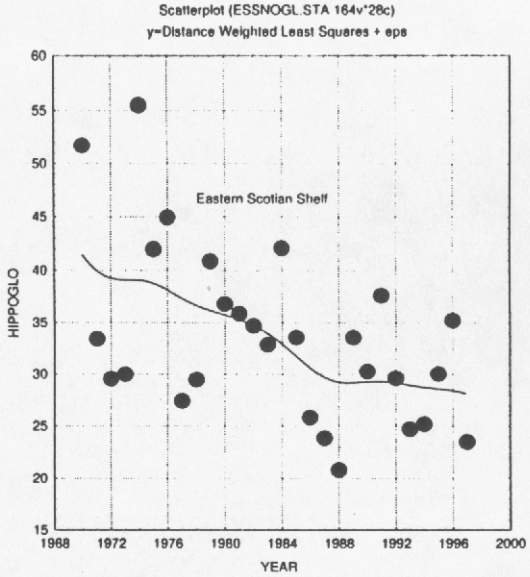
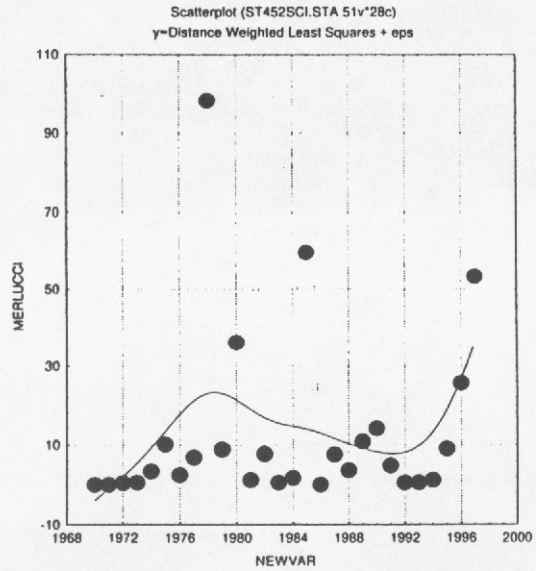


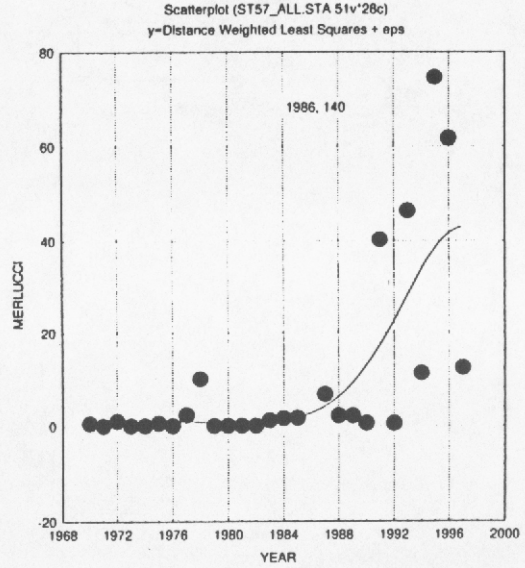
Fig. 7.1.10. Trends in abundance of the 20 most abundant species in the Gully relative to the trends in these species for the Gully trough and the Eastern Scotian Shelf excluding these areas. The data plotted are the stratified mean numbers caught per standard research tow for the year indicated. The line through the points is the distanced weighted least square estimated line.











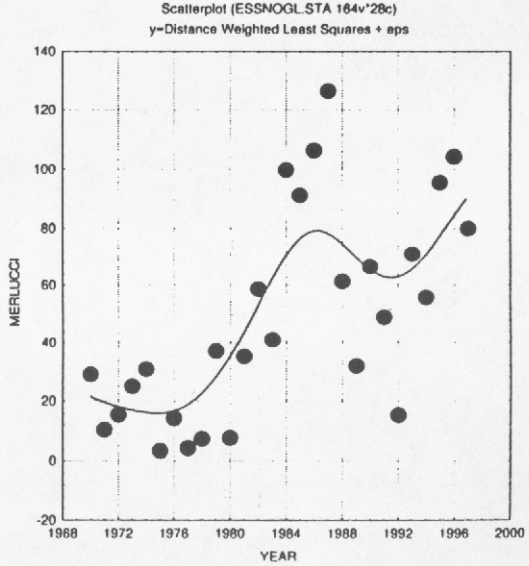
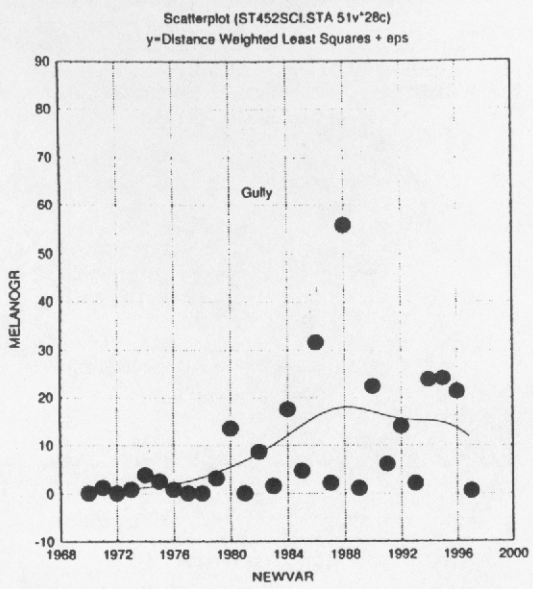
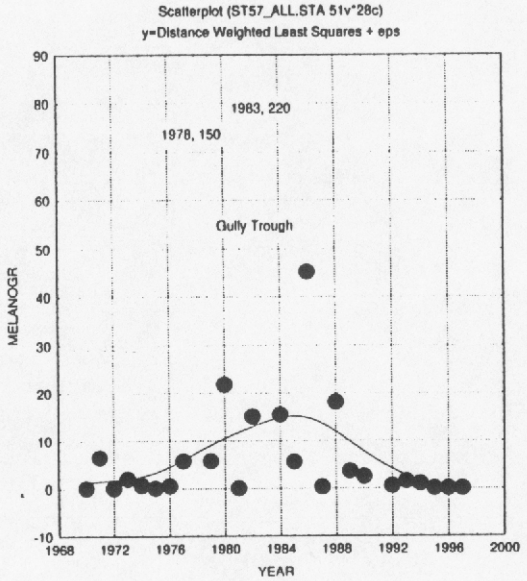
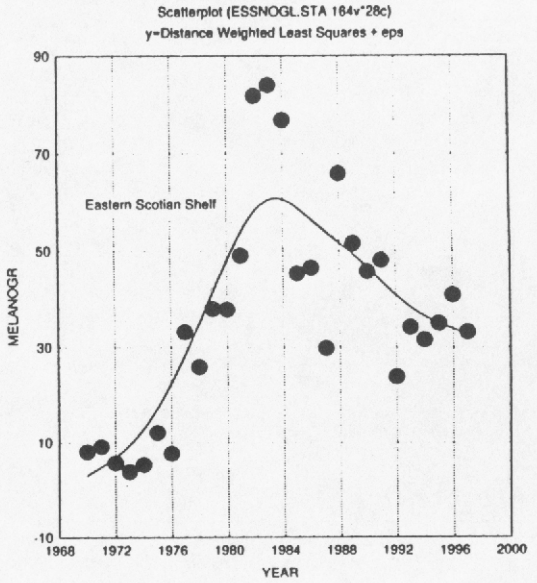


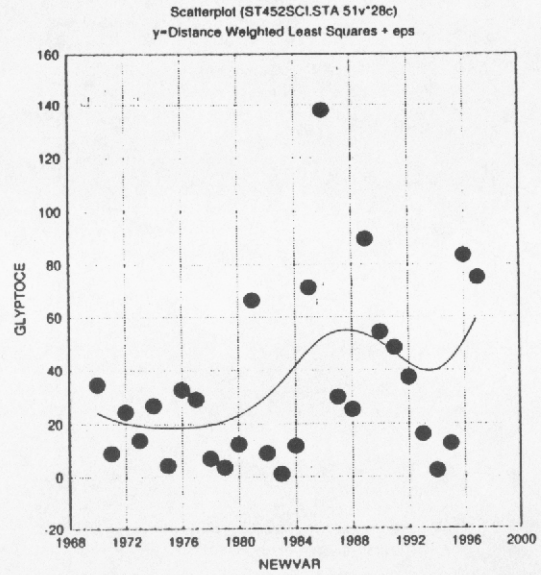
Fig. 7.1.10. (Continued)

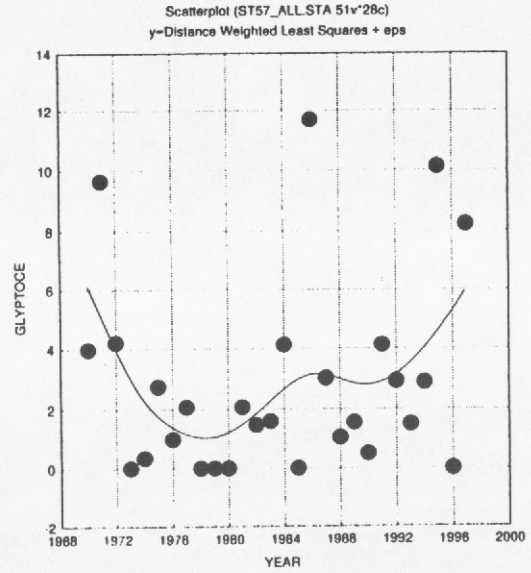
Abundance of *Melanogrammus aeglefinnus* and *Glyptocepahalus cynoglossus*











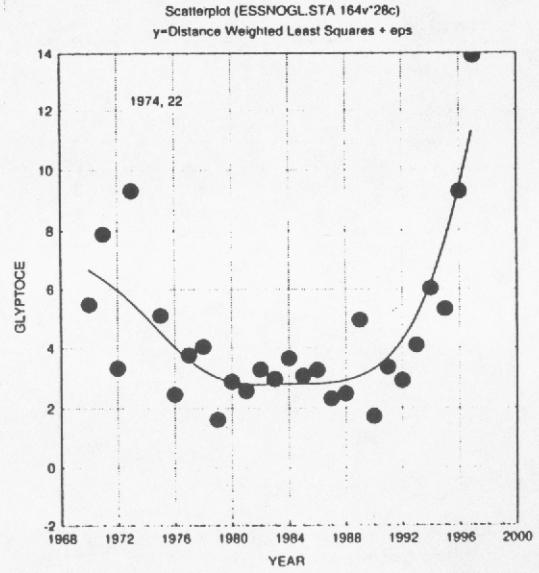
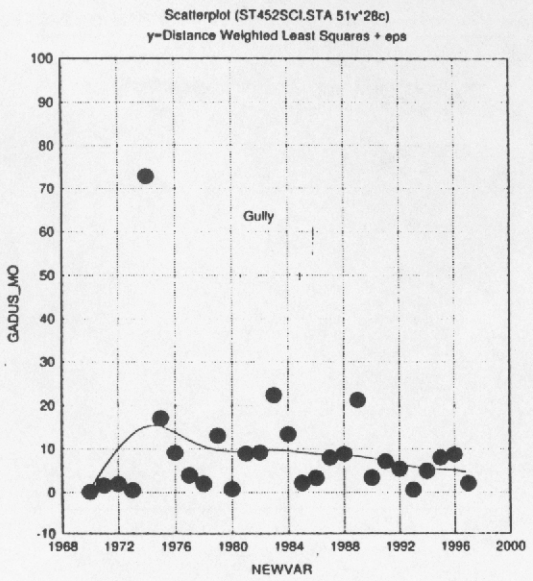
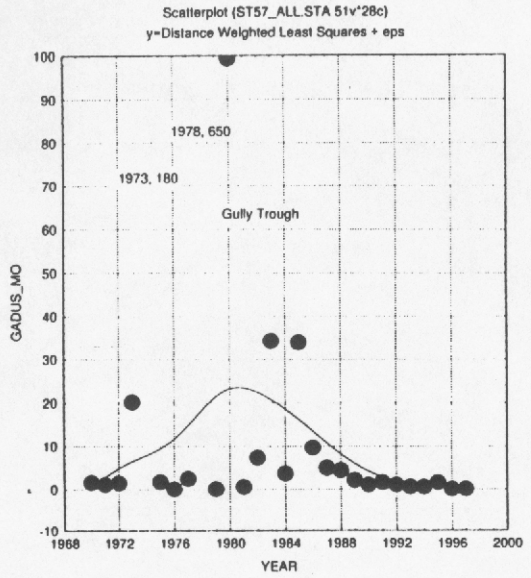
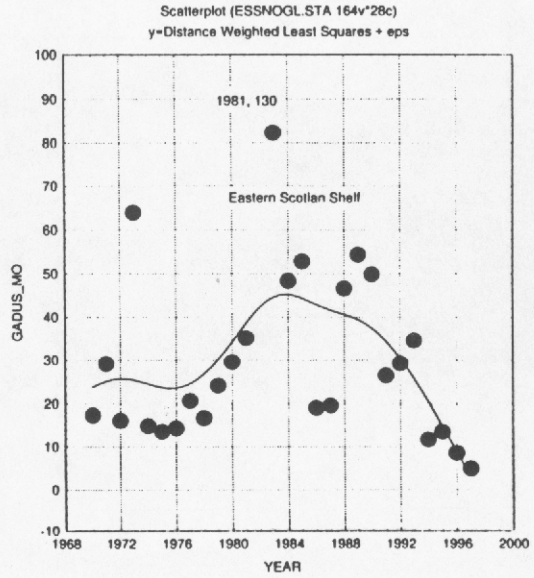


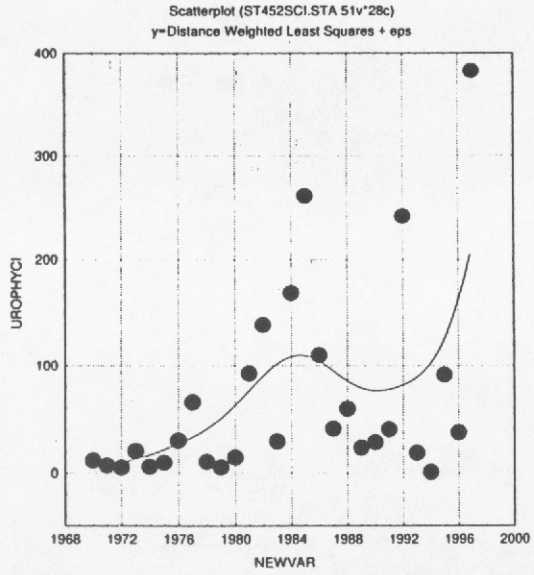
Fig. 7.1.10. (Continued)

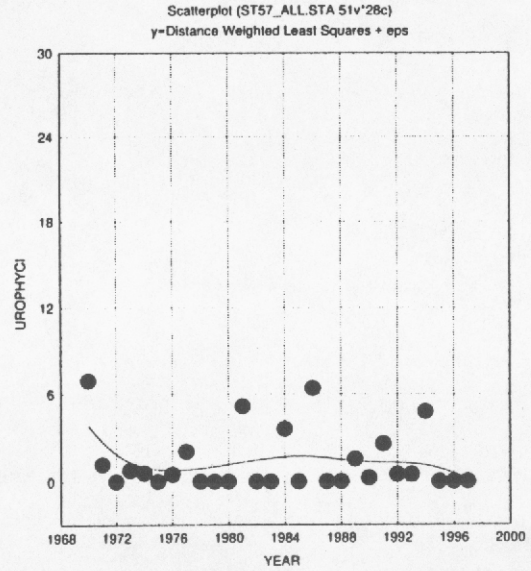
Trends in abundance of *Gadus morhua* and *Urophycis tenuis*

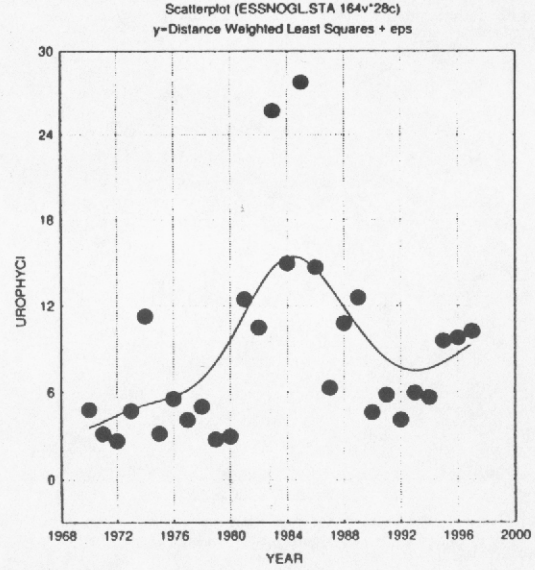












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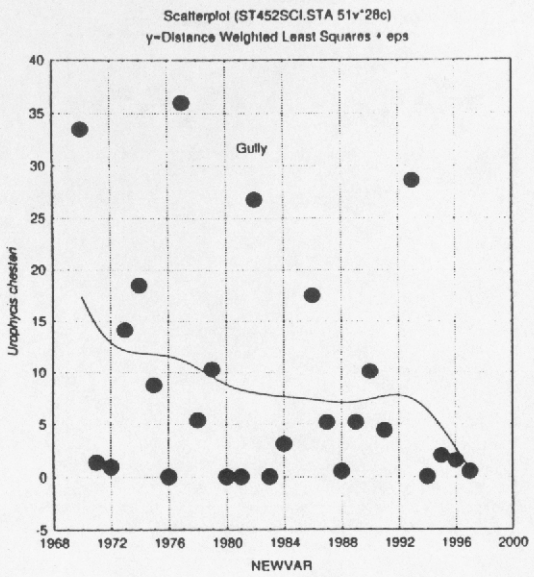
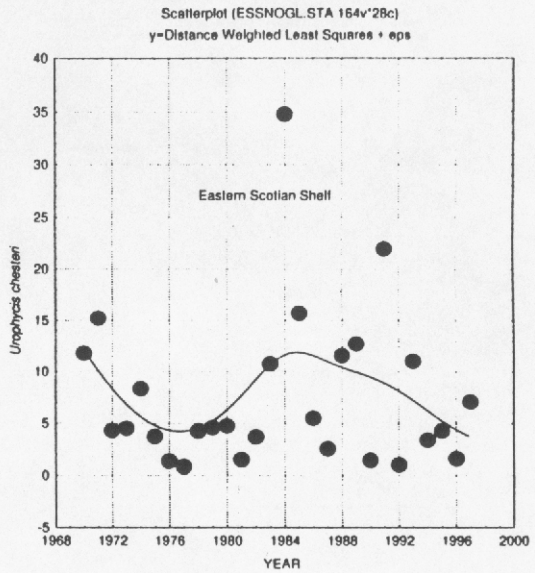
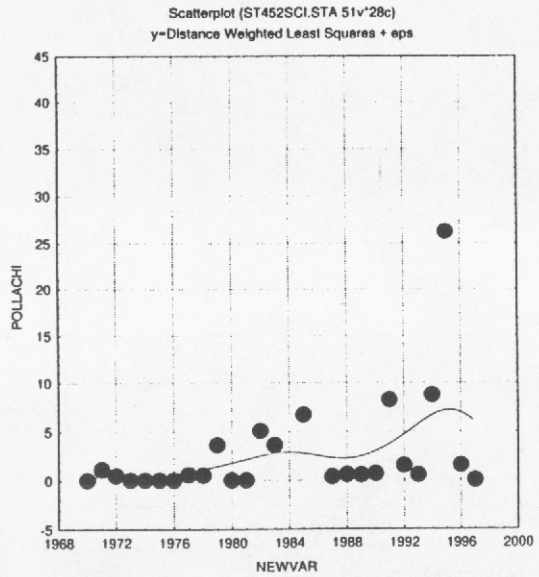
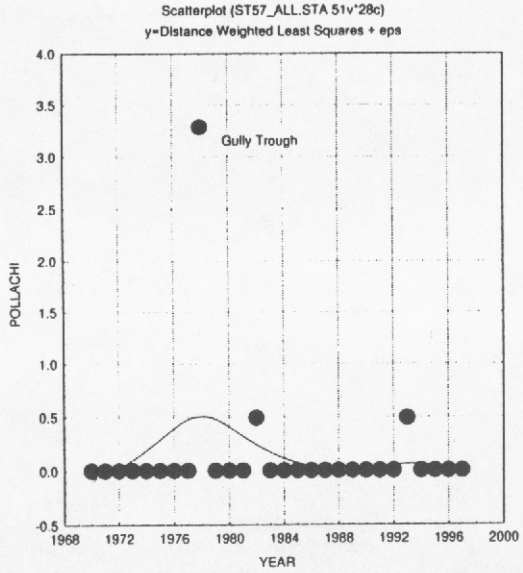
Trends in Abundance of *Urophycis chesteri* and *Pollachius virens*

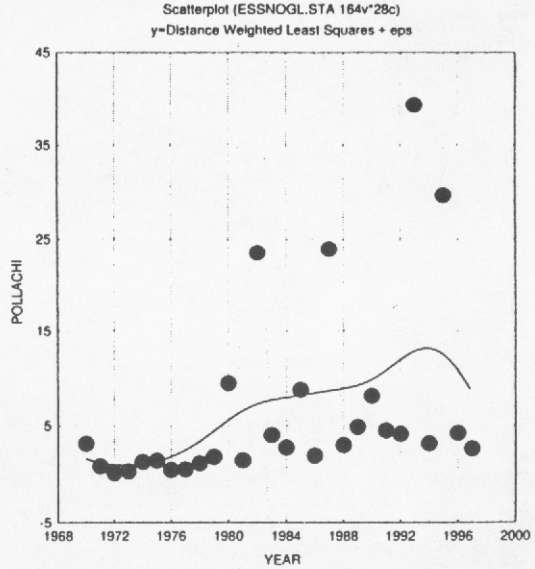


Urophycis chesteri not encounterd in this area









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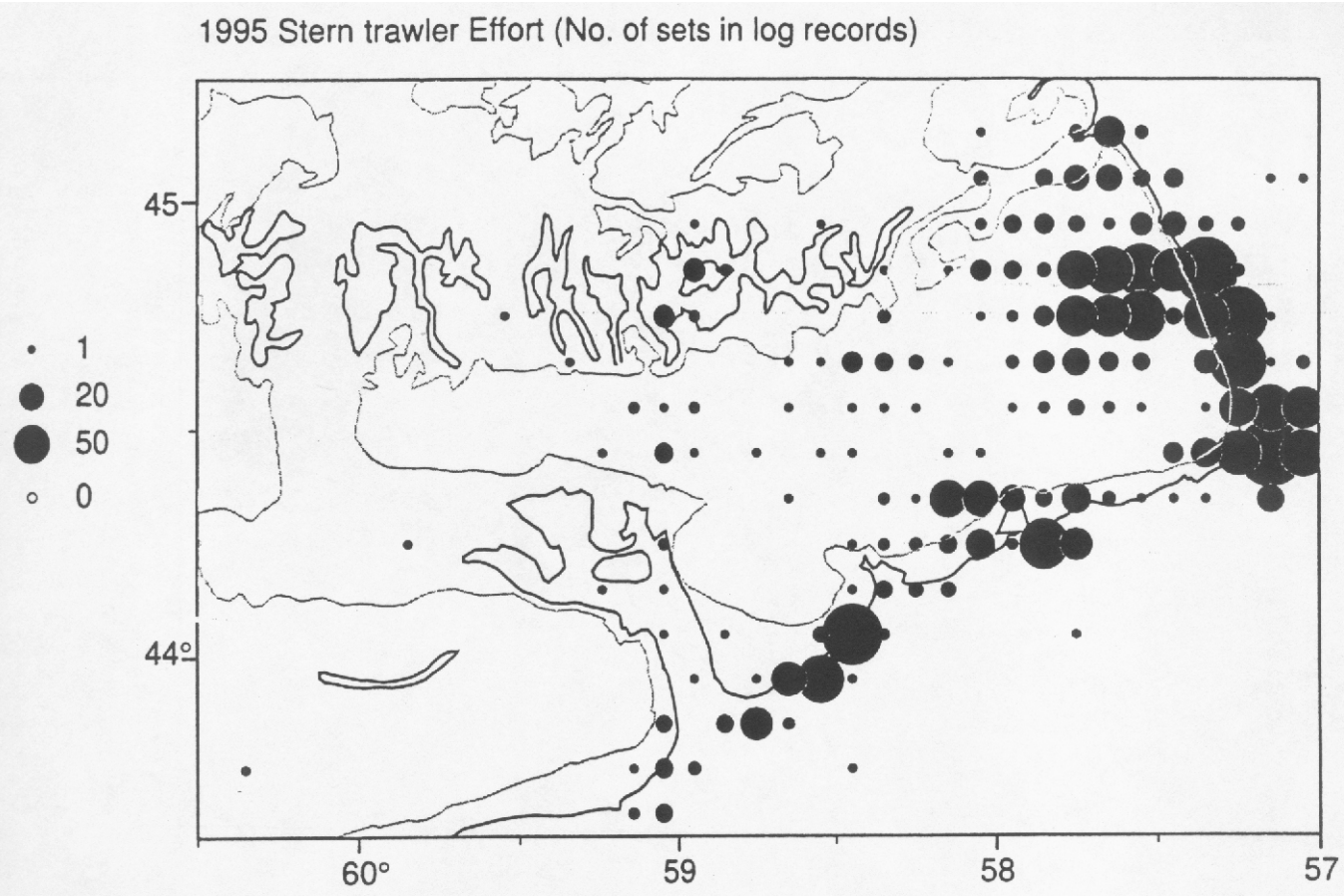
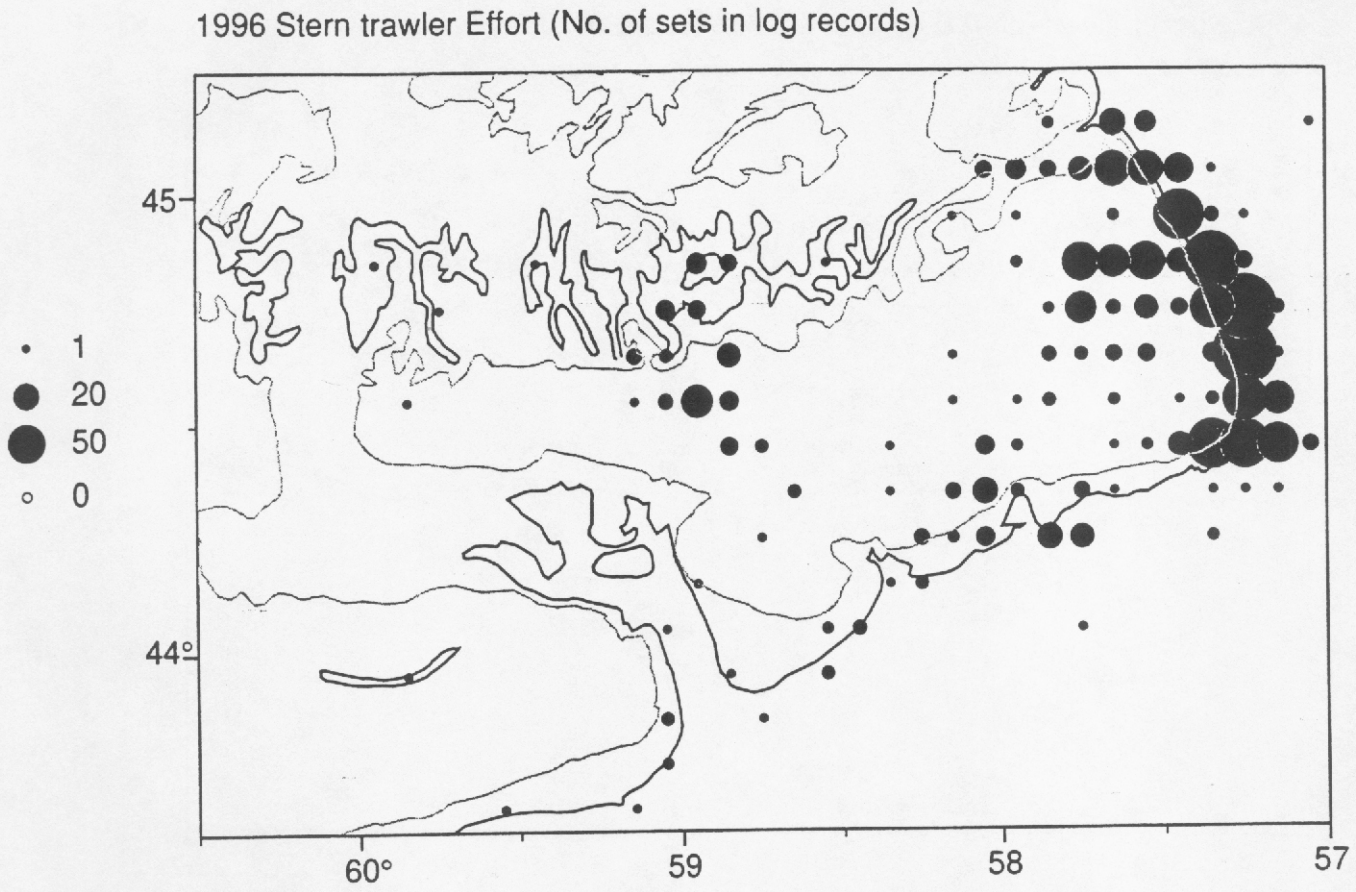


Fig. 7.1.11. Stern trawler effort distribution shown as the total number of sets recorded by 10 min square for the years 1995-1997.



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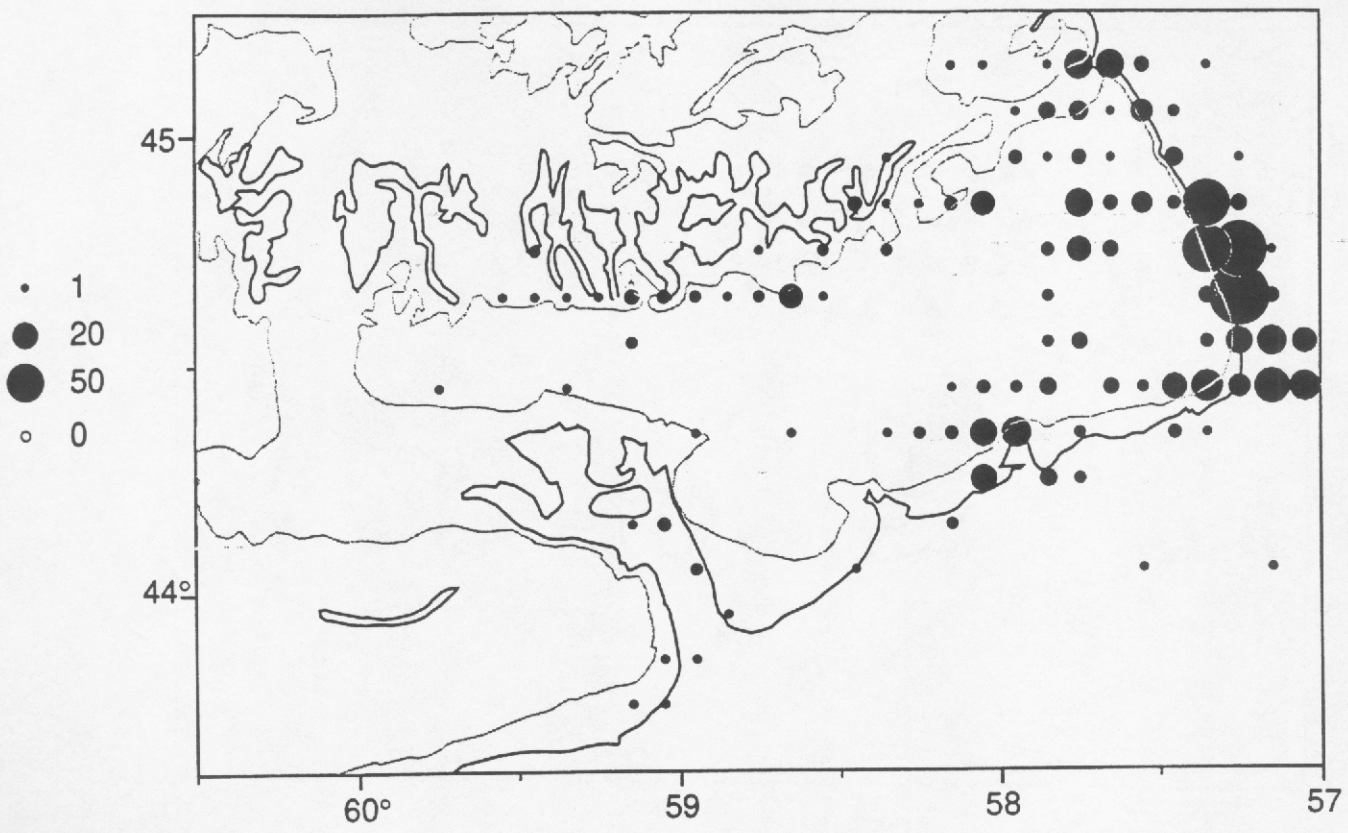

Fig. 7.1.11. (Continued)

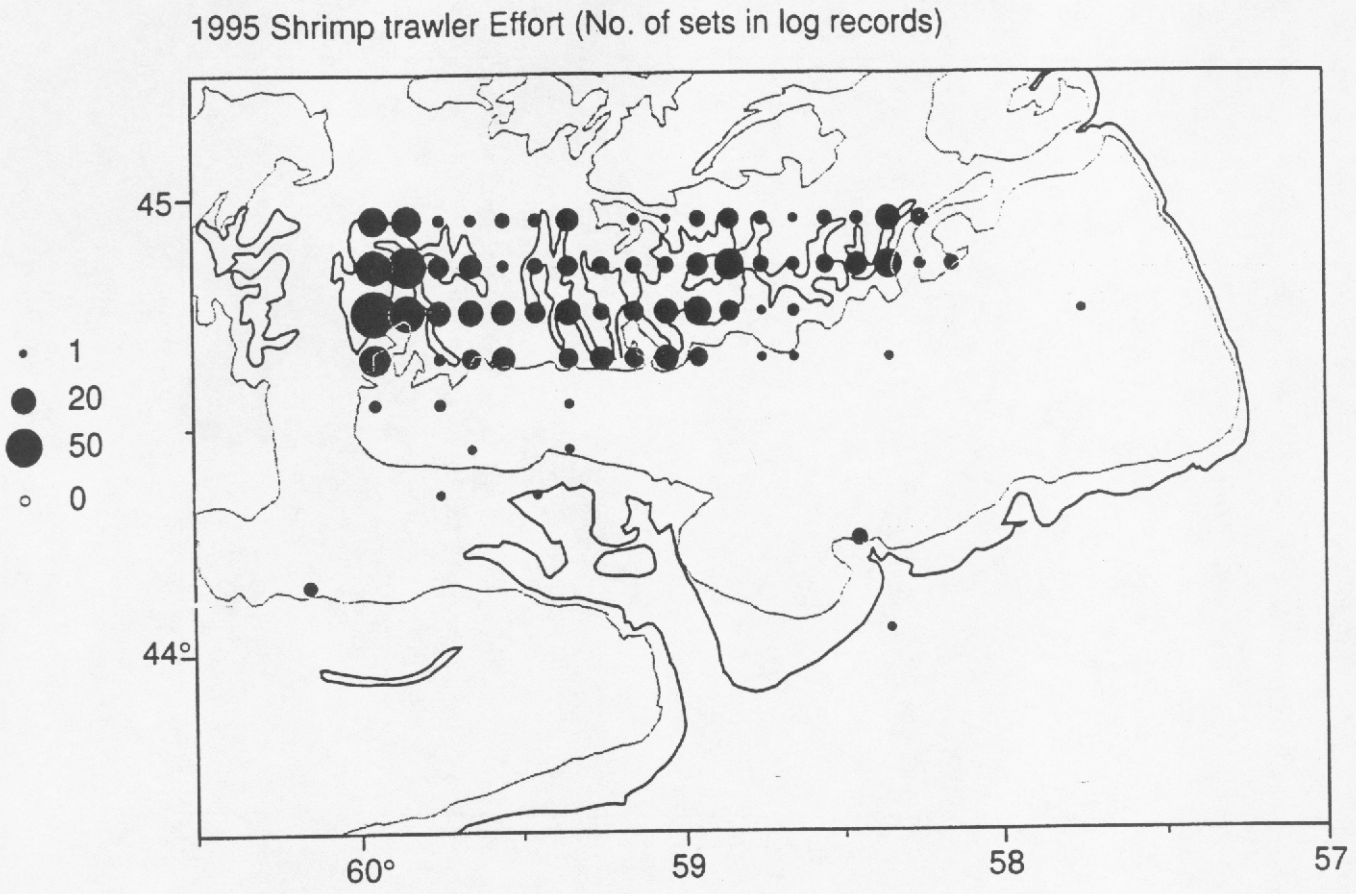

Fig. 7.1.12. Shrimp trawler effort distribution shown as the total number of sets recorded by 10 min square for the years 1995-1997.

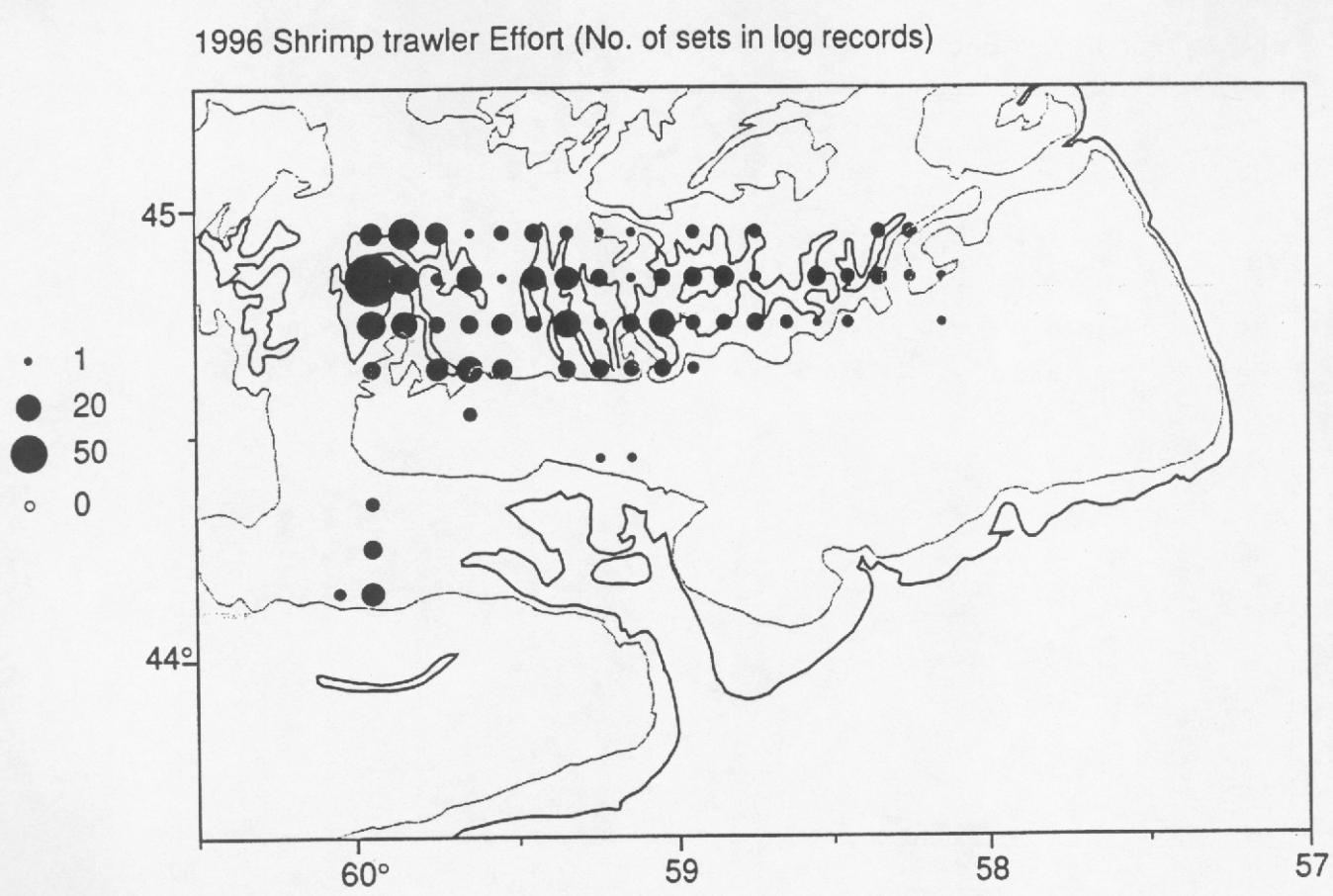

Fig. 7.1.12. (Continued)

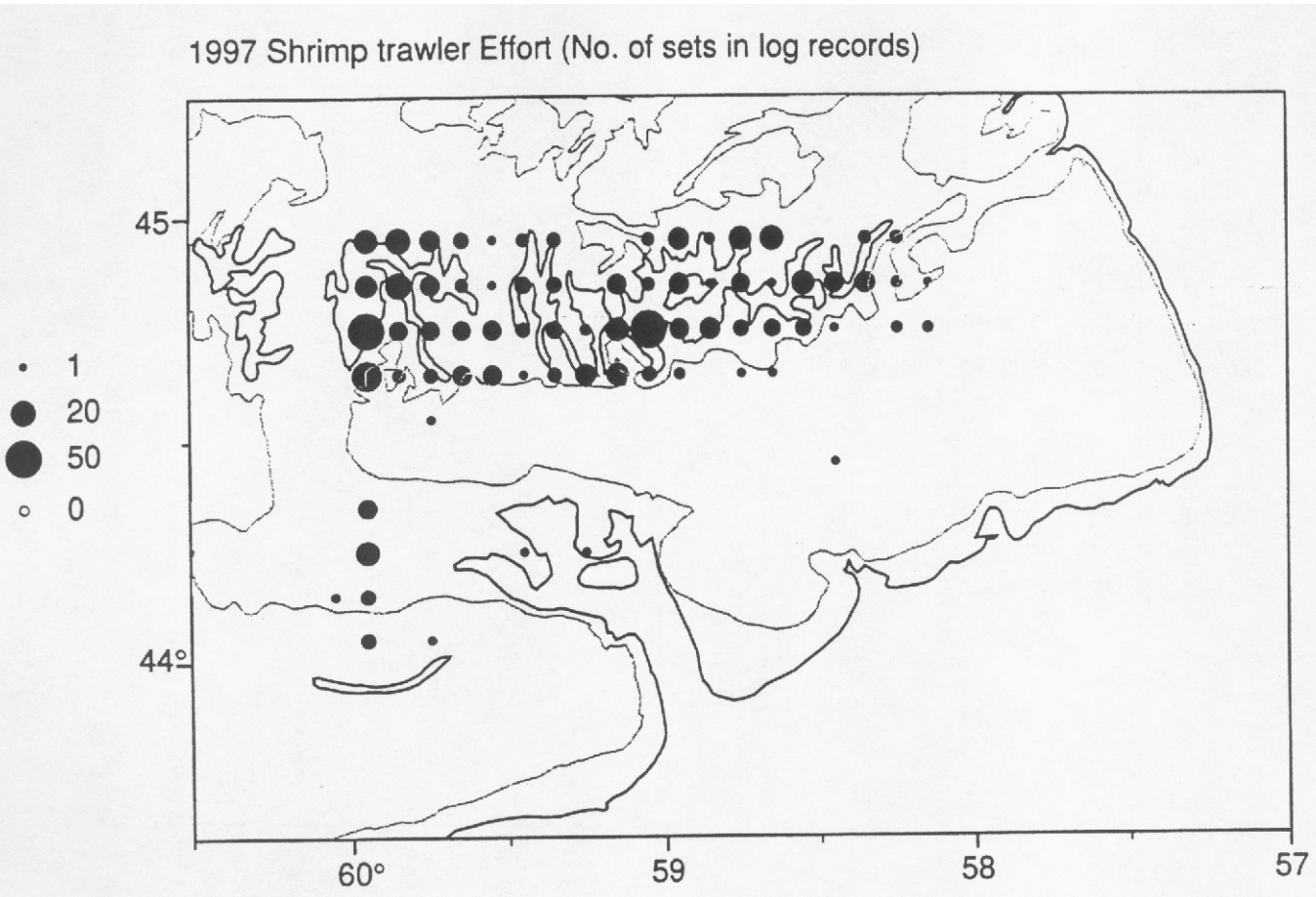

Fig. 7.1.12. (Continued)

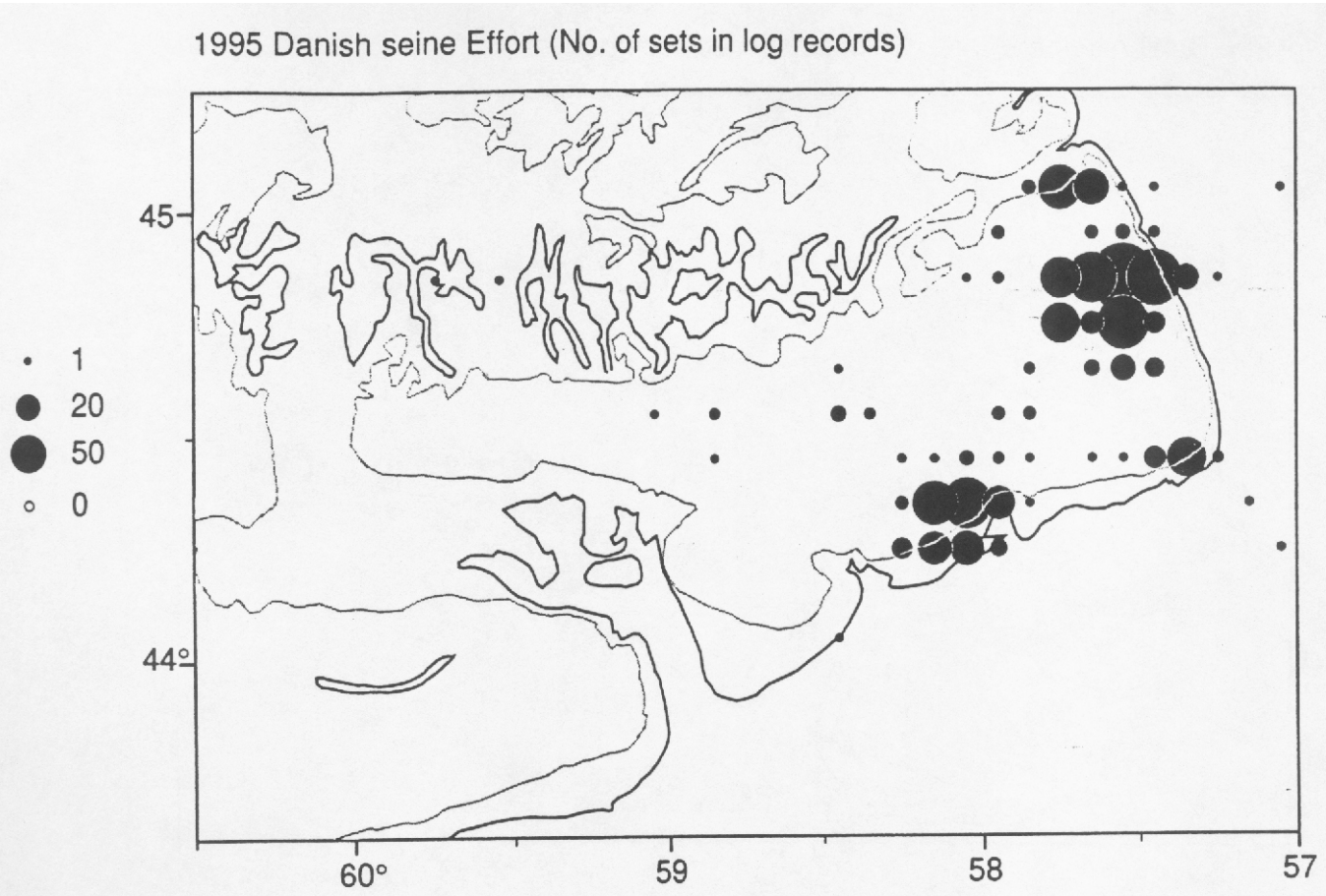

Fig. 7.1.13. Danish Seiner effort distribution shown as the total number of sets recorded by 10 min square for the years 1995-1997.

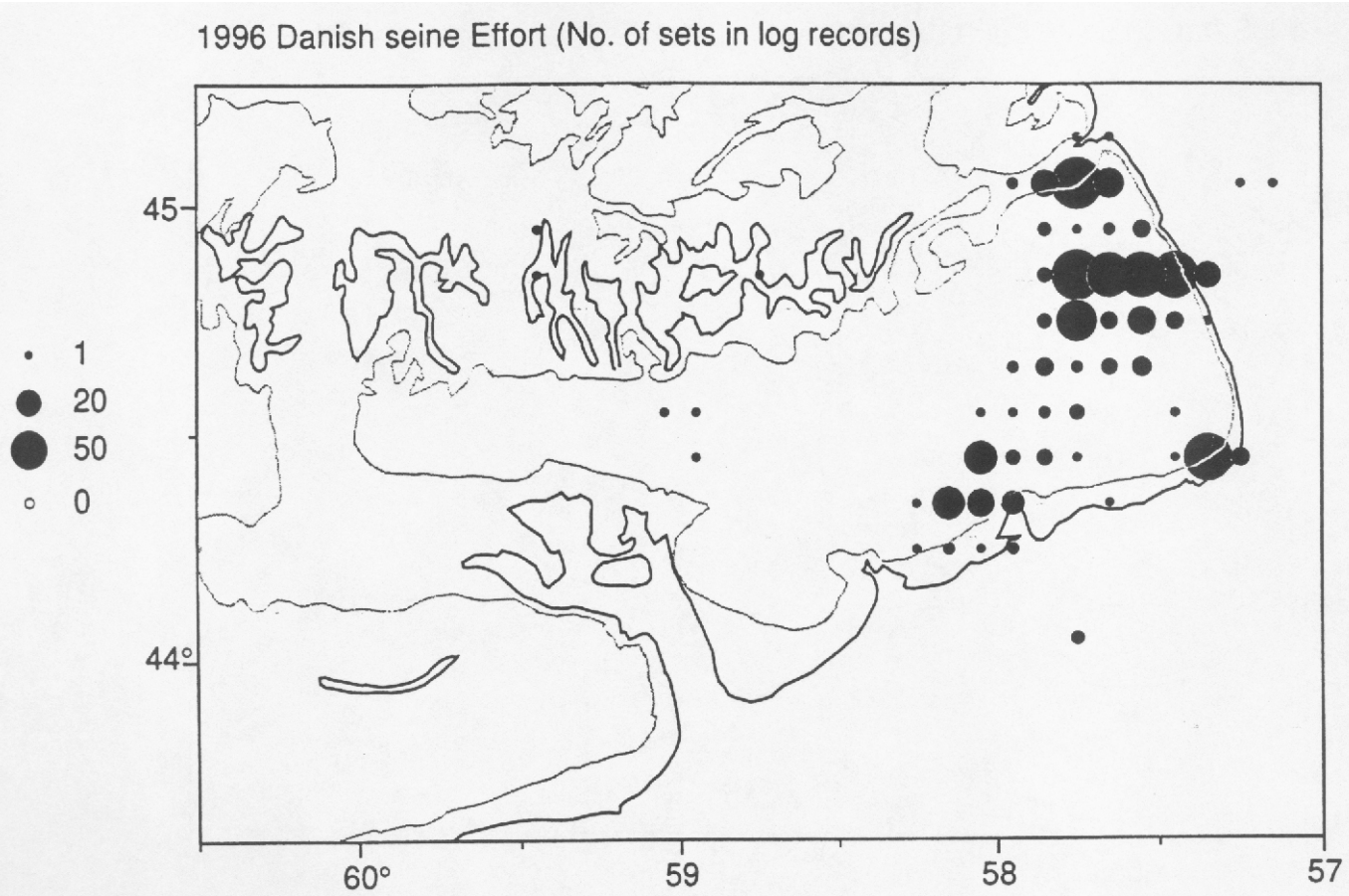

Fig. 7.1.13. (Continued)

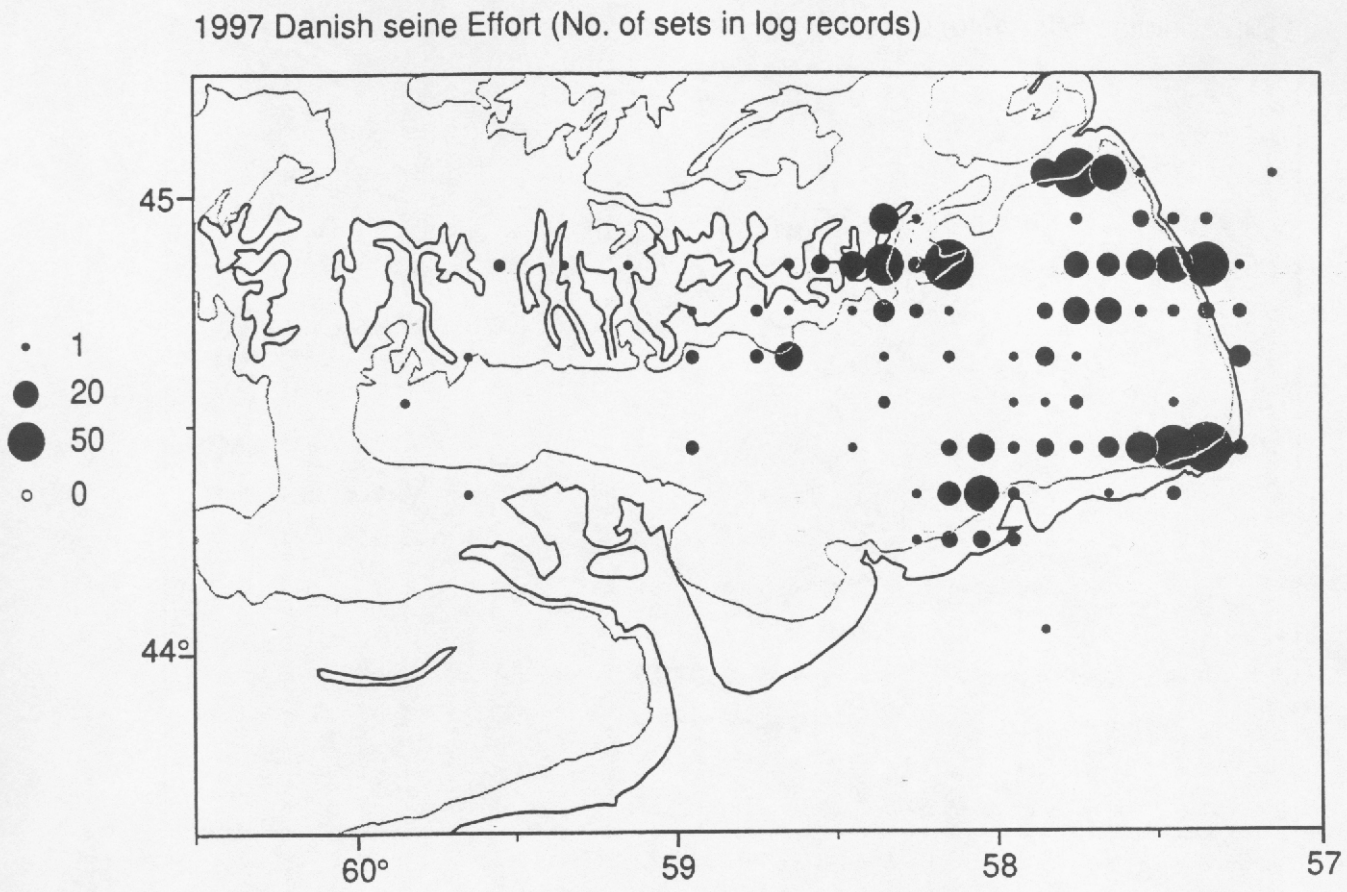

Fig. 7.1.13. (Continued)

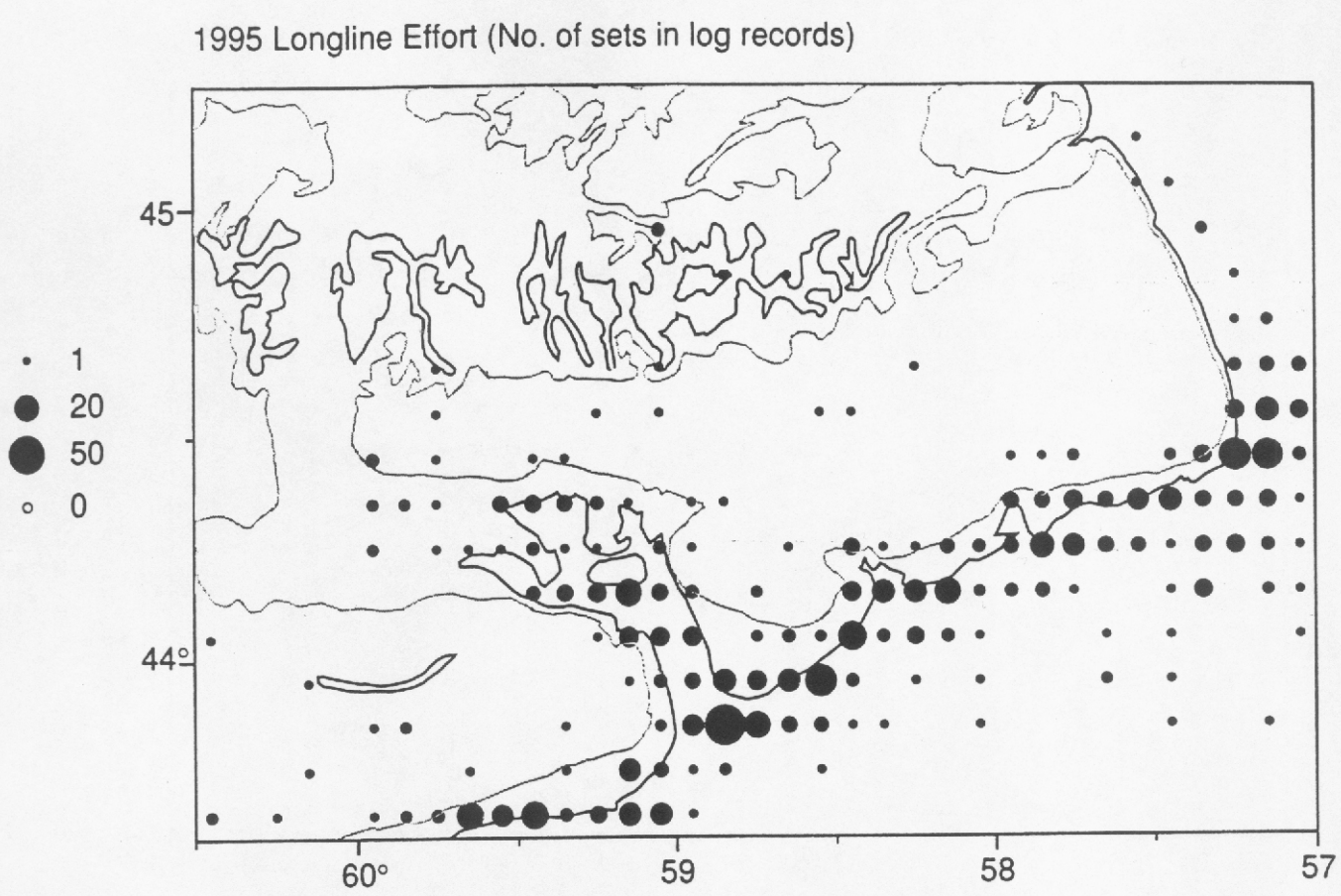

Fig.7.1.14. Longline effort distribution shown as the total number of sets recorded by 10 min square for the years 1995-1997.

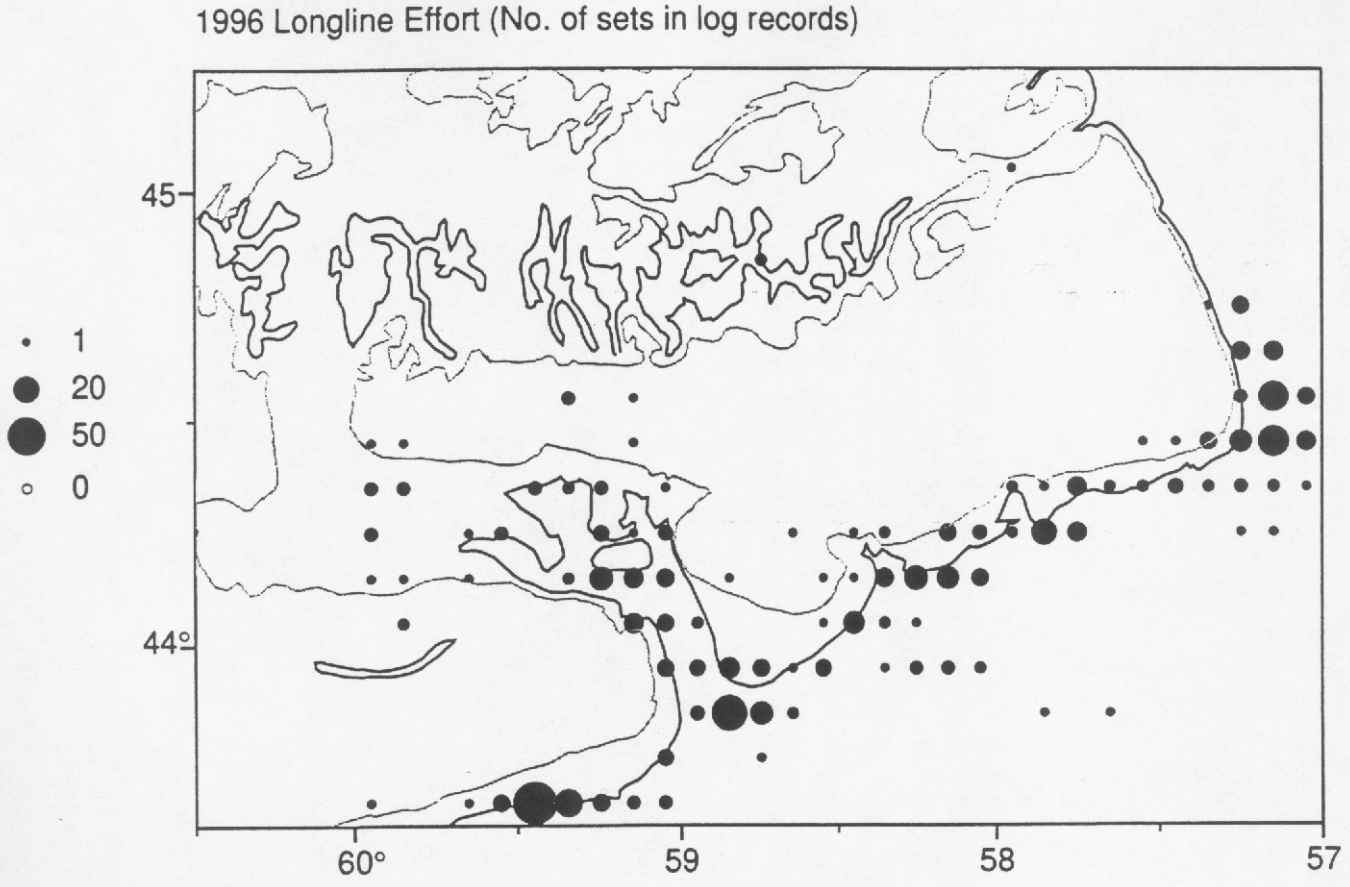

Fig. 7.1.14. (Continued)

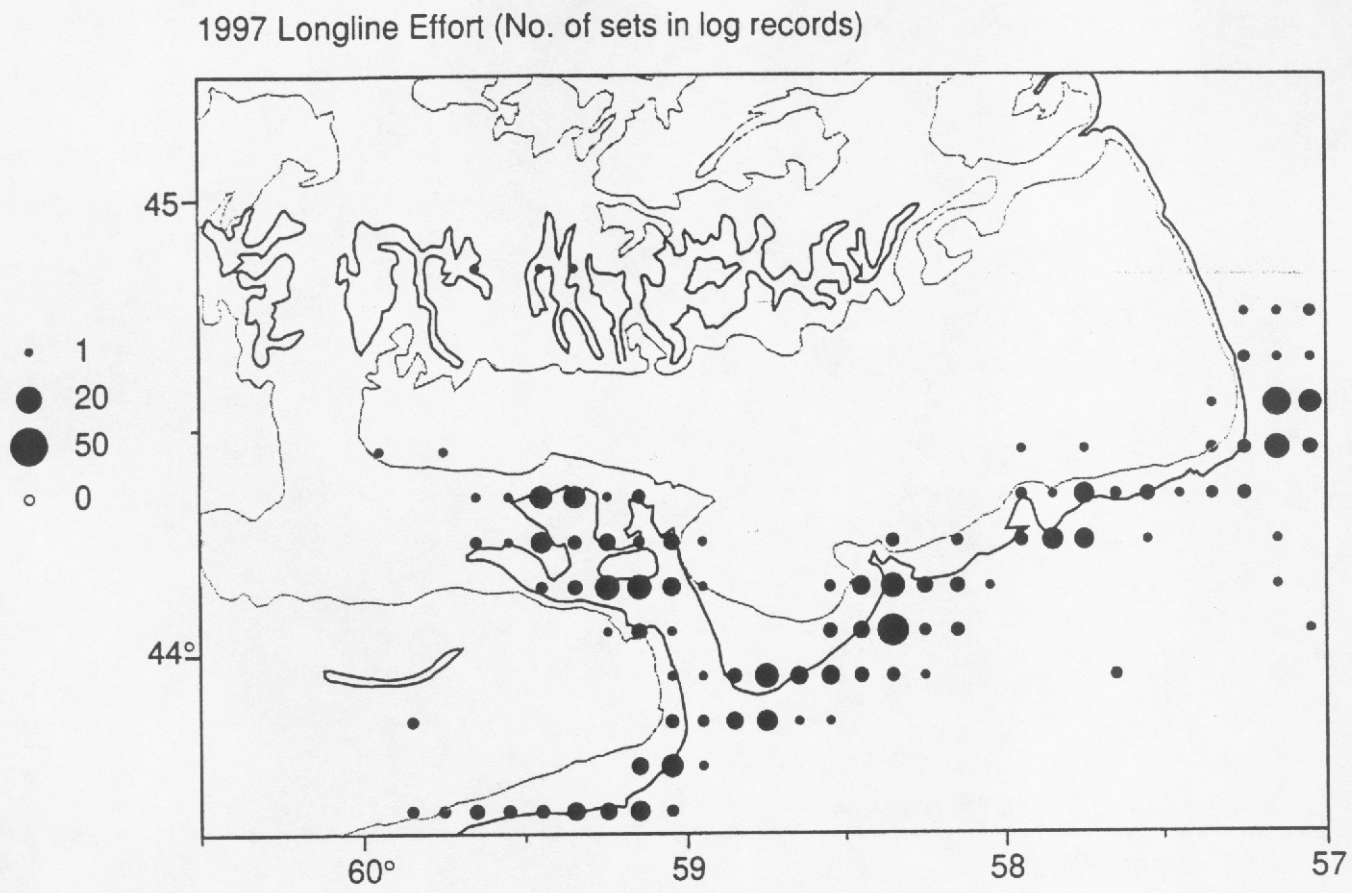

Fig. 7.1.14. (Continued)