Trawl Surveys for Juvenile Groundfish in the Sable Island Area, Nova Scotia, 1981-85

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TRAWL SURVEYS FOR JUVENILE GROUNDFISH IN THE SABLE ISLAND AREA, NOVA SCOTIA, 1981-85

by

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ABSTRACT

Scott, J. S. 1987. Trawl surveys for juvenile groundfish in the Sable Island area, Nova Scotia, 1981-85. Can. Tech. Rep. Fish. Aquat. Sci. 1532: iii + 16 p.

Annual groundfish trawling surveys for juvenile ($\leq$2 yr) fish in the shallow waters (8-30 fath; 15-55 m) around Sable Island from 1981 to 1985 yielded 36 fish species of which the combined totals of haddock, silver hake, cod and yellowtail flounder alone comprised 98, 95, 90, 66 and 78% of the total catches in the respective years. 0-group haddock, abundant in 1981 and 1982, were virtually absent from 1983-85. This corresponded to diminution of abundance of age-1 and age-2 fish in the subsequent years. Juvenile cod were also an important constituent of catches but 0-group cod were rarely caught in all years. Silver hake, yellowtail flounder and winter flounder were common but not as juveniles. Length-frequency distributions showed year-by-year changes in relative year-class strength and were also used with catch rates to show that there was no absolute segregation of age-groups in relation to depth or geographic sector but catch rates indicated differences in geographic distributions between age-groups, which varied in most cases from year to year.

Catch rates of 0-group haddock did not show good correlation with estimated population size from independent sources, but age-1 haddock and age-2 cod catches did. Such correlation indicates the value of the surveys as a possible means of providing indices of abundance of haddock and cod stocks of the central Scotian Shelf.

RÉSUMÉ

Scott, J. S. 1987. Trawl surveys for juvenile groundfish in the Sable Island area, Nova Scotia, 1981-85. Can. Tech. Rep. Fish. Aquat. Sci. 1532: iii + 16 p.

Au cours des relevés au chalut annuels du poisson de fond juvénile ($\leq$2 ans) effectués dans les eaux peu profondes (entre 8 et 30 brasses; 15 à 55 mètres) autour de l'île des Sables entre 1981 et 1985, on a relevé 36 espèces de poissons dont le total combiné d'aiglefin, de merlu argenté, de morue et de limande à queue jaune composait respectivement pour ces cinq années 98, 95, 90, 66 et 78% des prises globales. Entre 1981 et 1982, l'aiglefin de moins d'un an abondait parmi les prises, mais il y était pratiquement inexistant de 1983 à 1985. Ceci correspondait à une diminution de l'abondance des poissons d'un an et de deux ans au cours des années subséquentes. La morue juvénile constituait également un élément important des prises mais la morue de moins d'un an n'a pratiquement jamais été capturée et ce, dans toutes les années. Le merlu argenté, la limande à queue jaune et la plie rouge étaient très souvent présents dans les prises, mais il s'agissait rarement de juvéniles. Les distributions de la fréquence des longueurs de poisson indiquent que l'abondance des diverses classes d'âge change d'une année à l'autre. De plus, ces distributions ont été utilisées avec les taux de capture pour montrer qu'il n'y avait pas de séparation absolue des groupes d'âge relativement à la profondeur de l'eau ou au secteur géographique. Cependant, les taux de capture ont fait ressortir des différences au niveau de la répartition géographique des divers groupes d'âge et dans la plupart des cas, ces différences variaient d'une année à l'autre.

Les taux de capture de l'aiglefin de moins d'un an, déterminés dans la présente étude, ne correspondaient pas à la taille de la population estimée dans d'autres sources de renseignements indépendantes, mais les données sur l'aiglefin d'un an et de deux ans correspondaient. Une telle corrélation semble indiquer que ces relevés pourraient constituer un outil valable pour déterminer l'indice d'abondance des stocks d'aiglefin et de morue dans la zone centrale de la Plate-forme Scotian.

INTRODUCTION

In 1981 a bottom trawl survey was carried out in the shallow waters (0-30 fath; 0-55 m) around Sable Island, about 100 mi (161 km) off the coast of Nova Scotia (Fig. 1). The objective was to investigate the distribution and abundance of juvenile (age≤2 yr) groundfish and to determine the value of the area as a nursery for young fish, with flatfishes the expected main constituent. The area of the survey was of special interest as it was little known and was a centre of exploration for oil and gas, with the obvious possibility of spills which might cause environmental damage and endanger fish populations.

The first survey proved disappointing so far as juvenile flatfish were concerned, but extremely interesting as it revealed the presence of large concentrations of juvenile haddock as well as an assortment of other fish species (Table 1), some of which were poorly represented in deeper water surveys. On the basis of the first survey, a proposal was drawn up to carry out a 5-yr series of annual surveys to (i) see if there was a correlation between juvenile haddock catches from the Sable Island area and population estimates of the central Scotian Shelf haddock stock (Northwest Atlantic Fisheries Organization (NAFO) Division 4VW) which were derived from commercial catch data and research surveys, (ii) study the distribution and day/night behavior of the young fish and (iii) examine catches of other species to see if they would be useful as indicators of population strength. Subsequently, as a result of the importance of cod in the catches and as a resource on the Scotian Shelf, catches of young cod were also examined in detail. The study was completed in 1985. A summary of results is presented here.

MATERIALS AND METHODS

The surveys were based on a predetermined grid of stations (Fig. 1) at each of which a ½-h tow was planned. The actual number of stations occupied varied from year to year, depending on time available (Table 2) but only the data from stations occupied in the initial grid of 57 stations were used and replicates were not included, such as multiple tows in the same location for day/night experiments. All standard tows were made during daylight hours (0600-2000). Vessels and gears varied to some extent (Table 2), depending on availability.

Catches were sorted by species, weighed and length frequencies (L/F) recorded for all species; subsamples were taken when catches were inconveniently large. Date, time, depth at beginning and end of set and position (Loran C) were recorded for each tow.

Allocation of haddock and cod to age-groups was determined by examination of L/F distributions. It was limited to 0-group, age-1 and age-2 fish, which were fairly readily identifiable from the modes in the L/F distributions, and was confirmed by comparison with age-length keys derived from standard research survey data (Fig. 2).

Differential depth selection by young haddock and cod according to length (age) was examined by considering L/F distributions of fish taken in bottom depths in 5-fath (9 m) intervals (5-9, 10-14...30+; 9-17, 18-26...55+ m) in each year. Possible geographic preferences were examined similarly by considering L/F distributions of the fish in six sectors (Fig. 1).

RESULTS

Thirty-six fish species (including squid, Illex illecebrosus) were caught during the surveys (Table 1). Haddock, silver hake, cod and yellowtail flounder were consistently the most important species (in terms of numbers) with the sole exceptions of dollarfish and longhorn sculpin which yielded outstandingly high catches in 1983 and 1984, respectively. The four principal species combined yielded 98, 95, 90, 66 and 78% of the catches in each of the respective years from 1981 to 1985. Notable species, because of their comparative rarity in groundfish catches on the Scotian Shelf, were dollarfish, brill, filefish, round scad, electric ray, cunner and moonfish. Juvenile flatfish were absent from catches.

There was considerable variation in catches of the various species, both between vessels and between years (Table 1). Data from other surveys indicate that, in the case of haddock, this was probably due to changes in abundance. However, both for haddock and other species the situation was complicated by changes in vessels and gear in the survey series (Table 2). The OCEAN SWELL, in 1983, made relatively high catches of several minor species, notably dollarfish, sandlance and winter flounder in addition to a number of species which were rare or absent in other years.

Between-year variation was particularly evident in haddock catches which ranged from means of 5.4 per tow in 1984 to 1321.8 in 1981. Catch rates for silver hake and cod were erratic, with a general decrease throughout the surveys, and yellowtail flounder catch rates fluctuated with no overall trend. The other species showed low and fairly uniform catch rates with occasional comparatively high levels: herring in 1981; squid in 1982; dollarfish in 1983; longhorn sculpin in 1984; winter flounder and little skate in 1985.

Percent frequency of occurrence of the different species in the catches also varied (Table 1). In haddock, the variation was more or less in accordance with catch rate but this was not the case with cod in which relatively low catch rates were still associated with high percent frequency of occurrence. Yellowtail flounder and silver hake, among the most important species, occurred with fairly uniform frequency in the different years.

Examination of L/F distributions of the principal species (Fig. 2) revealed that the annual variation in catch rates of haddock and, to some degree, cod were related to strength of particular length groups (year-classes) in the catches. In the cases of silver hake and yellowtail and winter flounders, however, the fish were generally of moderate length and different age groups were not readily distinguishable.

For haddock, comparison of the L/F distributions for each year (Fig. 2) shows that in 1981 and 1982 the 0-group fish, with length modes

about 8-10 cm, were of major importance although in 1981 age-1 fish were predominant, representing a strong 1980 year-class. In 1983 and 1984, however, 0-group fish were virtually absent and the strong 1982 year-class predominated as 1-yr-olds in 1983 and 2-yr-olds in 1984. In 1985, the catch rate of all three age groups improved slightly over that of 1984 and there was a better representation of 0-group fish.

Examination of L/F distributions of haddock in relation to depth of capture (Fig. 3) does not reveal any degree of segregation by length (age) group. In 1981 and 1982, there was a preponderance of age-1 fish in the shallowest (5-9 fath; 9-16.5 m) and of 0-group fish in the deepest (30+ fath; 55 + m) depth zones, contrary to what might be expected. Between these extremes there was no consistent pattern. Catch-per-tow data (Table 3) show that best catch rates for 0-group and age-1 haddock were in the intermediate 15- to 19-fath (27-35 m) range, whereas age-2 fish showed a less consistent pattern with considerable fluctuation between depth zones.

Similarly, there was no complete segregation by geographic sector (Fig. 4) but, in both 1981 and 1982 0-group, haddock formed a higher proportion of the catches in the southern sectors than in the northern and, in 1981, showed increasing proportions from the southeast to the southwest sectors. There were some differences in distribution between 0-group and age-1 fish as shown by different proportions of each in different sectors.

Catch-per-tow data (Table 4) also indicate that the area south of Sable Island was preferred by 0-group haddock in 1981 and 1982. Age-1 fish also preferred this sector in 1981 but appeared to be concentrated in the northeast in 1982 and in the northwest in 1983. The northwest and northeast sectors had consistently high catch-per-tow levels of age-1 fish and low levels of 0-group fish from 1981-83.

Compared to haddock, cod abundance was low in 1981-83 but about the same in 1984 and 1985 (Table 1). An obvious difference between the two species is the virtual absence of 0-group cod throughout the surveys (Fig. 2). The L/F distributions also show that cod were distributed over a wider length range than haddock, with good representation of larger fish. In 1983, age-1 cod were well represented, suggesting a good 1982 year-class, but this was not evident in the Sable Island area from the L/F distribution in 1982. The 1982 year-class was also evident in the 1984 L/F distribution as 2-yr-olds at a modal length of 25-27 cm. The 1982 L/F distribution was unique in that it did not show any notably strong year-class, with the fish fairly evenly distributed throughout the length range.

Analysis of L/F distributions by depth of capture (Fig. 5) suggests that the smaller (age-1) cod tend to frequent intermediate depths while the larger occupy a wider depth range. This is shown particularly well in the 1981 L/F distributions (Fig. 5) in which the age-1 fish (19-21 cm mode) are preponderant in the 15- to 24-fath (27-44 m) depth range while proportions of larger fish are higher on either side of this range. This pattern is repeated to a lesser extent in 1982 and 1983 but is not obvious in the low catches of 1984 and 1985. Best catch rates for age-1 cod were in the intermediate 20- to 24-fath (37-44 m) depth zone while age-2 fish appeared to occupy slightly deeper water (Table 5).

There was no consistent pattern of L/F distributions of cod in relation to area to indicate size segregation (Fig. 6). The absence of cod in certain sectors (northeast in 1981 and southeast in 1983 and 1984) suggests that there is a preference for some localities, which is also indicated by the higher catch rates of age-1 cod in the southeast and central sectors.

Silver hake L/F distributions showed that the fish were concentrated in intermediate depths (10-24 fath; 18-44 m) but with no strong differences within that range (Fig. 7). There was evidence of geographic preference as the fish were concentrated in all years to the south of Sable Island, and particularly in the southwestern and south-central sectors (Fig. 8).

DISCUSSION

The virtual absence of juvenile (0-2-yr-old) flatfish in the surveys was surprising as the sandy, gently shelving bottom and warm summer temperatures of the water would appear to be ideal as a nursery, particularly for the large population of yellowtail flounder on Sable Island Bank. However, surveys in lesser depths, as part of an environmental impact assessment related to oil/gas exploration, did not reveal significant numbers of young flatfish (G. Hurley, Hurley Fisheries Consulting, Ltd., Halifax, N.S., pers. comm.), so, on present evidence the area cannot be considered to be a major nursery for flatfish. Further surveys using special gear (e.g. beam trawl, beach seine) in very shallow water might yield different results.

The relationships between the Sable Island survey catches of 0-group, age-1 and age-2 haddock and cod, and population estimates of the fishes in the central and northeastern Scotian Shelf (NAFO Div. 4VsW) were examined by comparing the survey data with population numbers of haddock age-groups given by Mahon et al. (1985) and cod by Sinclair and Gavaris (1985).

For haddock (Fig. 9A), there were no estimates of population numbers of 0-group fish. In age-1 fish there was a close correspondence in the patterns of the Sable Island mean catch-per-tow data and the estimated population numbers from year to year, but the ratio of one to the other varied greatly. In age-2 fish there was little correspondence between the two estimates. Although the population estimates (Mahon et al. 1985) showed close correspondence in relative year-class strength in successive years, i.e. a change in year-class strength could be followed through successive age-groups, this was not the case with the Sable Island mean catch-per-tow data. In the 1981 year-class, the high level in 1981 was followed by a low level in the 1982 year-class but this decrease was followed by a contradictory increase in the 1981 year-class in 1982-83. Similarly, changes in age-2 catch rates showed little correspondence with age-1. The extremely poor catches of 0-group haddock in 1983 and 1984 were followed by negligible catches of age-1 and age-2 fish in 1984-85 and 1985, respectively. On present evidence, if it is assumed that estimates of population numbers provided by Mahon et al. (1985) are correct, or even if only as a relative indicator of year-to-year variation, then the 0-group and age-2 catch estimates from Sable Island do not reflect moderate changes in the 4VW

population. The age-1 results do reflect the pattern of change, although not the magnitude. It does not appear that the results of the Sable Island surveys can be used as an absolute index of abundance of 4VW haddock. It would be useful, however, to continue the surveys for a further period until another strong year-class similar to those of 1981 and 1982 appears. The results could then be correlated with recruitment to the fisheries of 3- and 4-yr-old haddock.

For cod, there are two sources of information on numbers-at-age with which to compare the Sable Island survey results. The first (Gavaris and Sinclair 1985) gives estimated numbers-at-age from research vessel surveys and includes age-1 and age-2 fish. Comparison of these estimates with the Sable Island results (Fig. 9B) shows no correlation in age-1 cod except in 1984 when levels were virtually zero for both estimates. In age-2 fish, however, pattern of change through the years 1981-84 was similar for both estimates but, as for haddock, the ratios of one estimate to the other for each year varied so that the Sable Island results might be an indicator of population change, but not an index.

The second source of information (Sinclair and Gavaris, 1985) gives estimates of cod population numbers from cohort analysis but does not include 0-group, age-1 or age-2 fish. Comparison of all three cohort sizes with age-2 catch per tow from the Sable Island results shows good correspondence between the two sources (Fig. 9B) but does not include the lag between the year-classes, i.e. for true comparison the age-3 graph should be shifted 1 yr to the left. However, this is still sufficient correspondence to suggest that the age-2 data from Sable Island might serve as an indicator of future trends in the fishery, if not an actual measure of abundance. Again, continuation of the surveys would be interesting in order to confirm the relationship between age-2 fish around Sable Island and recruitment to the 4VsW cod fishery.

The great abundance of 0-group and age-1 haddock around Sable Island in 1981 in particular, and the rapid decline in catch rates in the two subsequent years, were not matched by such drastic changes in the 4VW population estimates. It is possible that the Sable Island shallows form an "overspill" area which is colonized by 0-group and age-1 fish in years of exceptional abundance only. Alternatively, hydrographic conditions may play a part in effecting changes in geographic distribution of the young fish.

The lack of 0-group cod in the Sable Island area and relatively greater abundance of age-1 and age-2 fish suggests that the area is not a suitable habitat for 0-group cod.

Depth did not appear to be a critical factor in determining distribution of young haddock within the range of the standard grid of stations occupied during the surveys (8-30 fath; 15-55 m) as 0-group, age-1 and age-2 fish were represented at all depths when the year-classes were abundant enough to give adequate records. It was noticeable during the surveys, however, that movement of the vessel into depths greater than about 30 fath resulted in a rapid diminution of juvenile fish in the catches and an increase in catches of larger haddock as well as other species, particularly skates.

In the case of cod, there was evidence of preference for intermediate depths in 1-group fish, but it was not exclusive and age-1+ fish were found at all the depths surveyed.

Geographic distribution patterns were not clear nor consistent from year to year. For haddock, the southern sectors were favored over the northern to some extent, but it appears that the analysis by sector is on too large a scale to reveal preferences or differences in distribution between year-classes. Actual plots of catches (Scott 1982, 1984) show that there is age segregation but it is on a patchy basis (Fig. 10) and was not related to depth or sector. Similarly, except for the absence of 0-group fish, there was no evidence for geographic preference or geographical segregation of year-classes of cod.

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Table 1. Total catches (numbers), mean catch per tow and percent frequency of occurrence of fishes caught in Sable Island surveys, 1981-85.

	1981			1982			1983			1984			1985		
	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq
Haddock *Melanogrammus aeglefinus*	76663	1321.8	97	23844	264.9	94	6518	80.5	84	199	5.4	41	452	13.3	56
Silver hake *Merluccius bilinearis*	5981	103.1	74	9842	109.4	71	6842	84.5	73	549	14.8	65	2019	59.4	91
Atlantic cod *Gadus morhua*	3534	60.9	88	5056	56.6	82	2635	32.5	16	241	6.5	62	852	25.1	82
Yellowtail flounder *Limanda ferruginea*	710	12.2	66	2554	28.4	81	1089	13.4	74	612	16.5	73	758	22.3	100
Herring *Clupea harengus*	650	11.2	9	87	0.9	9	794	9.8	16	1	-	3	-	-	-
Dollarfish *Poronotus triacanthus*	225	3.9	14	43	0.5	16	2385	29.4	16	5	0.1	11	2	0.1	3
Mackerel *Scomber scombrus*	161	2.8	34	266	2.9	52	714	8.8	53	25	0.7	5	104	3.1	41
Winter skate *Raja ocellata*	66	1.1	36	185	2.1	34	40	0.5	9	20	0.5	27	67	2.0	38
Sandlance *Ammodytes dubius*	53	0.9	16	298	3.3	13	685	8.5	18	19	0.5	14	6	0.2	9
Brill *Scophthalmus aquosus*	47	0.8	21	127	1.4	43	18	0.2	10	15	0.4	22	76	2.2	47
Longhorn sculpin *Myoxocephalus octodecemspinosus*	31	0.5	22	221	2.5	51	67	0.8	20	434	11.7	49	72	2.1	65
Squid *Illex illecebrosus*	27	0.5	43	468	5.2	35	17	0.2	37	10	0.3	8	3	0.1	6
Winter flounder *Pseudopluronectes americanus*	22	0.4	17	177	2.0	51	358	4.4	56	74	2.0	59	364	10.7	100
Pollock *Pollachius virens*	20	0.3	2	4	-	5	20	0.2	12	60	1.6	11	1	-	3

Table 1. (cont'd.)

	1981			1982			1983			1984			1985		
	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq	No. caught	Catch/ tow	% freq
Plaice *Hippoglossoides platessoides*	11	0.2	10	47	1.6	21	51	0.6	26	10	0.4	14	1	–	3
Sea raven *Hemitripterus americanus*	11	0.2	14	15	0.2	16	22	0.3	19	15	0.4	16	21	0.6	32
Witch flounder *Glyptocephalus cynoglossus*	2	–	2	1	–	–	2	–	5	2	0.1	5	–	–	–
Thorny skate *Raja radiata*	2	–	3	2	–	–	11	0.1	15	–	–	–	–	–	–
Little skate *Raja erinacea*	1	–	2	61	0.7	23	20	0.2	25	71	1.9	27	334	9.8	62
File fish *Monacanthus hispidus*	1	–	2	–	–	–	2	–	1	–	–	–	1	–	3
Red hake *Urophycis chuss*				13	0.1	9	27	0.3	–	28	0.8	19	14	0.4	15
White hake *Urophycis tenuis*				4	–	3	–	–	24	28	0.8	32	1	–	3
Angler *Lophius americanus*				19	0.2	19	35	0.4	20	6	0.2	11	7	0.2	15
Atlantic halibut *Hippoglossus hippoglossus*				5	0.1	3	4	–	12	1	–	3	5	0.1	15
Spiny dogfish *Squalus acanthias*				1	–	1	–	–	–	–	–	–			
Round scad *Decaptenus punctatus*							38	0.4	5	2	–	3			
Electric ray *Torpedo nobiliana*										1	–	3			
Cunner *Tautogolabrus adspersus*										3	0.1	5	42	1.2	12
Moonfish *Selene vomer*										1	–	3			
Ocean pout *Macrozoarces americanus*													1	–	3

Table 2. Vessel details, fishing gears, survey dates and effort in Sable Island surveys 1981-85.

	1981	1982	1983	1984	1985
Vessel name	KEVIN O.A.	KEVIN O.A.	OCEAN SWELL	J.L. HART	J.L. HART
Vessel length O.A. (ft)	65	65	65	65	65
Vessel type	Stern trawler	Stern trawler	Stern trawler	Research vessel	Research vessel
Vessel gear[1]	Western IIA	Western IIA	Western IIA	Concord	Concord
Date start[2]	10.08.81	10.08.82	03.08.83	24.08.84	03.08.85
Date end[2]	20.08.81	19.08.82	19.08.83	28.08.84	07.08.85
No. fishing days	7	6	7	5	4.5
No. of tows	58	114[3]	81	37	34

[1]All trawls were fitted with a 1/2-in. mesh codend liner.
[2]Not including steaming time to and from survey area but including mid-cruise breaks.
[3]Includes 56 replicates.

Table 3. Mean catch per tow (numbers) for different age groups of haddock in different depth ranges in Sable Island surveys 1981-85.

Depth	1981			1982			1983			1984			1985		
(fath)/Age group	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
5-9	15.3	147.7	2.9	4.0	149.0	131.7	-	172.0	137.0	-	-	-	-	-	-
10-14	790.6	409.3	-	166.3	80.0	85.2	-	88.2	38.8	-	-	0.2	0.4	0.9	4.6
15-19	1048.3	1856.5	-	183.1	172.9	165.3	-	500.8	20.3	-	-	0.8	6.9	0.8	2.6
20-24	150.0	577.4	3.2	136.4	37.7	34.6	-	140.0	76.4	-	0.3	10.2	1.7	2.0	34.7
25-29	126.2	245.0	8.7	35.5	36.2	12.3	-	320.3	23.0	-	1.5	8.0	-	-	-
30+	12.6	0.2	-	10.8	0.4	-	-	79.0	-	0.5	-	-	-	-	-

Table 4. Mean catch per tow (numbers) for different age groups of haddock in different geographic sectors in Sable Island surveys 1981-85. NW - northwest; NC - north-central; NE - northeast; SE - southeast; SC - south-central; SW - southwest.

Area/Age group	1981			1982			1983			1984			1985		
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
NW	33.7	984.1	5.0	13.8	256.6	-	-	930.0	-	-	-	-	-	-	9.7
NC	710.1	18.5	-	20.2	71.3	-	-	244.9	-	0.1	-	-	9.4	-	9.4
NE	-	1012.0	-	14.5	694.5	-	-	246.0	87.5	-	-	-	-	-	-
SE	43.5	405.5	-	49.0	101.5	-	-	52.5	-	-	-	-	0.5	-	-
SC	833.9	1523.1	1.2	328.1	60.8	0.7	-	89.4	2.6	-	0.1	2.1	1.1	-	0.4
SW	486.4	228.9	-	54.1	126.5	128.1	0.1	360.8	31.1	-	-	6.3	0.6	4.0	35.9

Table 5. Mean catch per tow (numbers) for different age groups of cod in different depth ranges in Sable Island surveys 1981-85.

Depth (fath)/Age group	1981			1982			1983			1984			1985		
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
5-9	-	-	61.3	-	28.0	11.7	-	84.0	73.5	-	6.0	-	-	120.0	-
10-14	2.4	4.5	11.3	-	16.9	6.2	0.1	5.1	1.9	-	1.1	0.1	-	13.2	3.2
15-19	2.5	34.4	3.6	0.1	19.1	0.5	0.7	3.7	0.7	-	0.5	1.7	-	6.9	6.5
20-24	4.7	104.4	15.5	-	58.3	19.8	0.5	97.8	0.2	-	8.2	8.3	-	37.1	7.3
25-29	-	8.7	40.0	-	12.3	147.7	-	2.5	2.5	-	0.5	1.5	-	0.5	-
30+	-	26.6	34.0	-	0.4	-	-	12.6	3.4	-	0.5	0.5	-	-	-

Table 6. Mean catch per tow (numbers) for different age groups of cod in different geographic sectors in Sable Island surveys 1981-85. NW - northwest; NC - north-central; NE - northeast; SE - southeast; SC - south-central; SW - southwest.

Area/Age group	1981			1982			1983			1984			1985		
	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
NW	-	-	52.6	-	-	26.8	-	1.5	5.5	-	-	-	-	-	9.7
NC	0.9	25.2	28.3	-	3.8	-	0.1	10.5	3.1	-	0.1	2.4	-	0.1	6.1
NE	-	-	-	-	44.5	18.0	-	70.0	147.0	-	12.0	-	-	83.0	4.0
SE	-	18.0	2.0	-	16.0	-	-	-	-	-	-	-	-	135.5	1.5
SC	3.6	6.2	0.1	0.1	43.1	4.3	0.7	42.5	3.3	-	2.8	5.1	-	22.1	-
SW	0.1	2.5	4.8	-	23.4	12.6	-	6.4	5.0	-	6.5	1.0	0.3	4.8	0.4

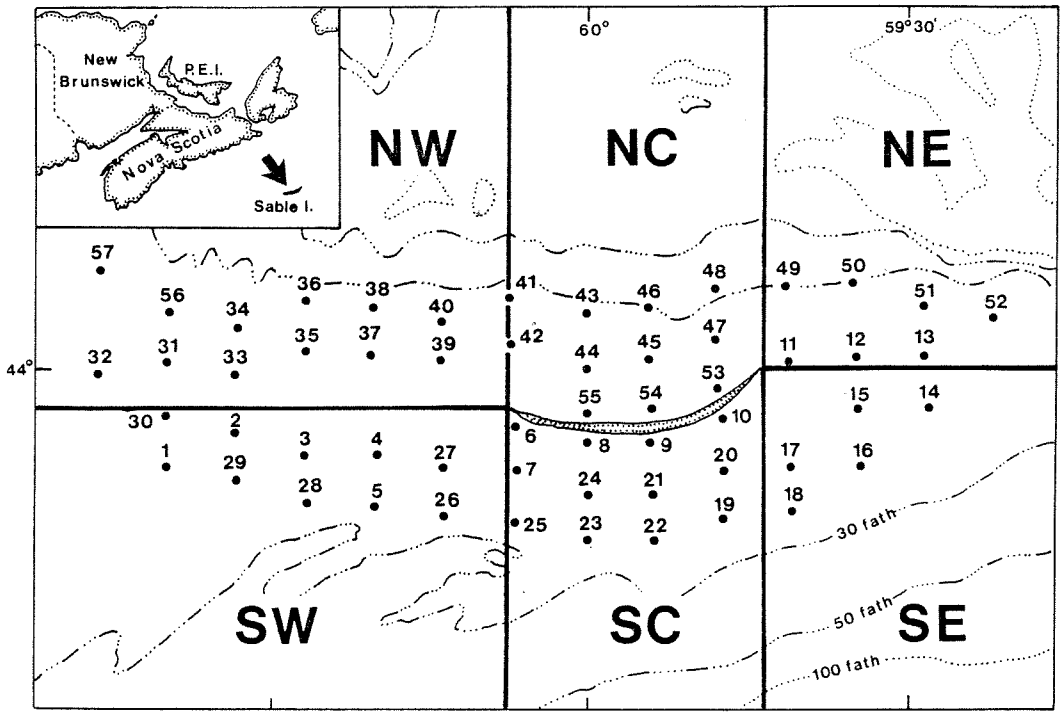

Fig. 1. Distribution of standard fishery stations, and sector divisions for Sable Island survey cruises 1981-85.

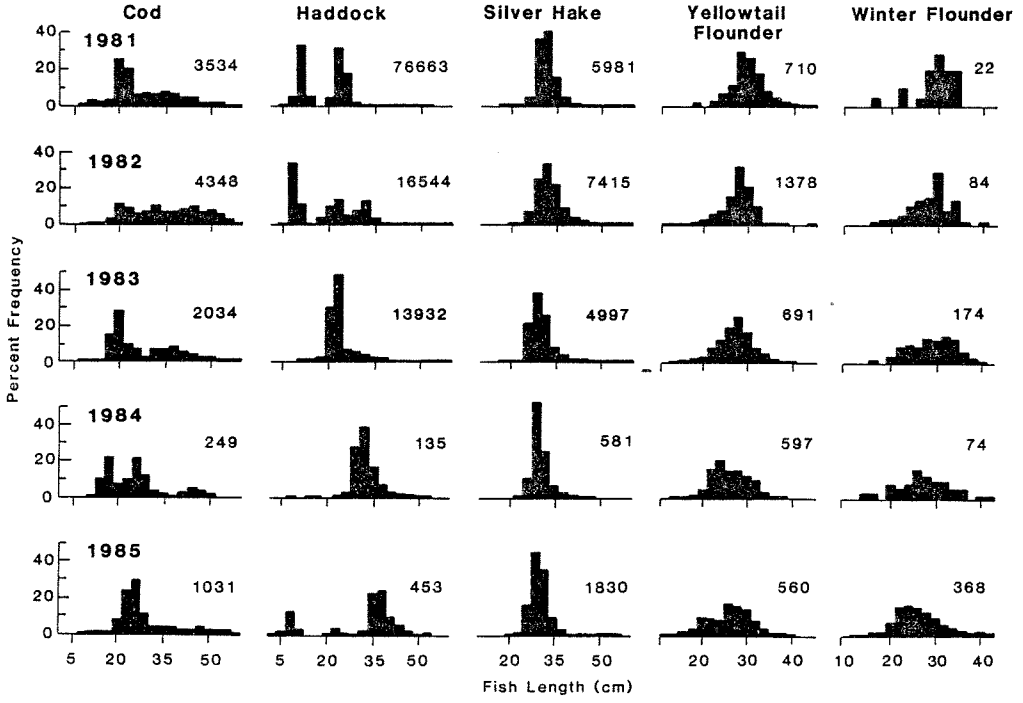

Fig. 2. Annual length-frequency distributions of principal fish species from Sable Island survey cruises 1981-85.

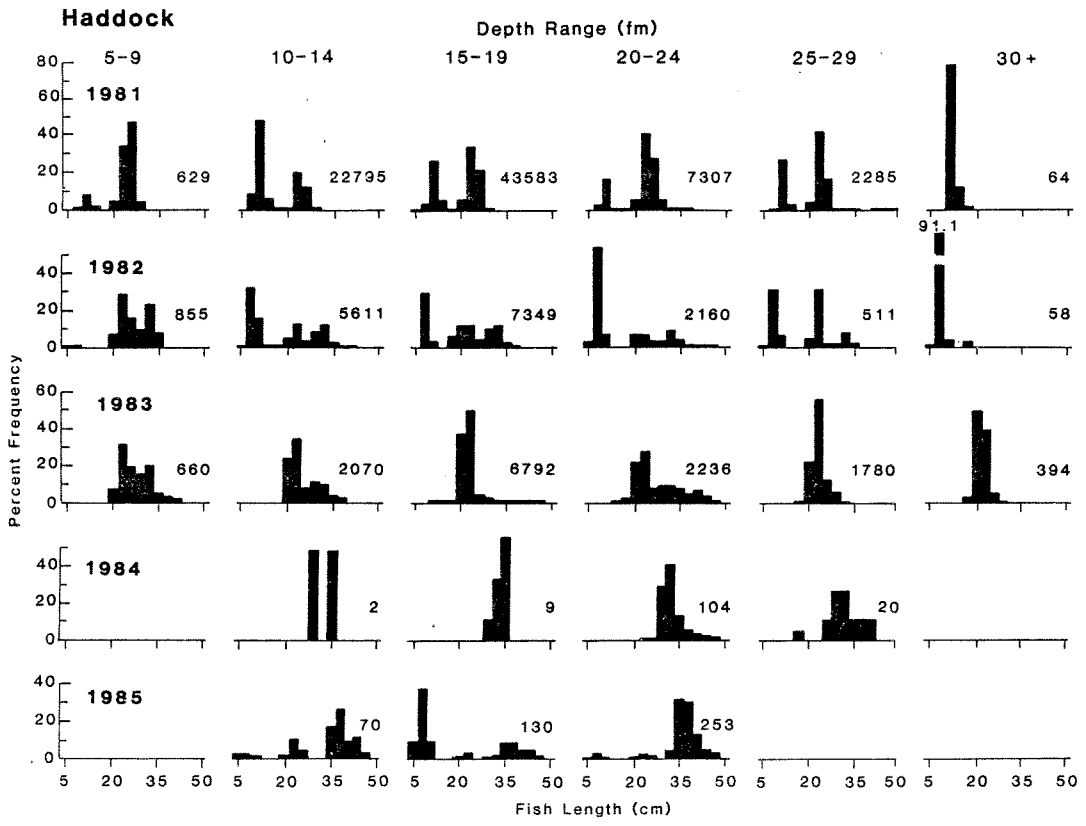

Fig. 3. Annual length-frequency distributions of haddock from Sable Island survey cruises 1981-85 by depth zone (fathoms).

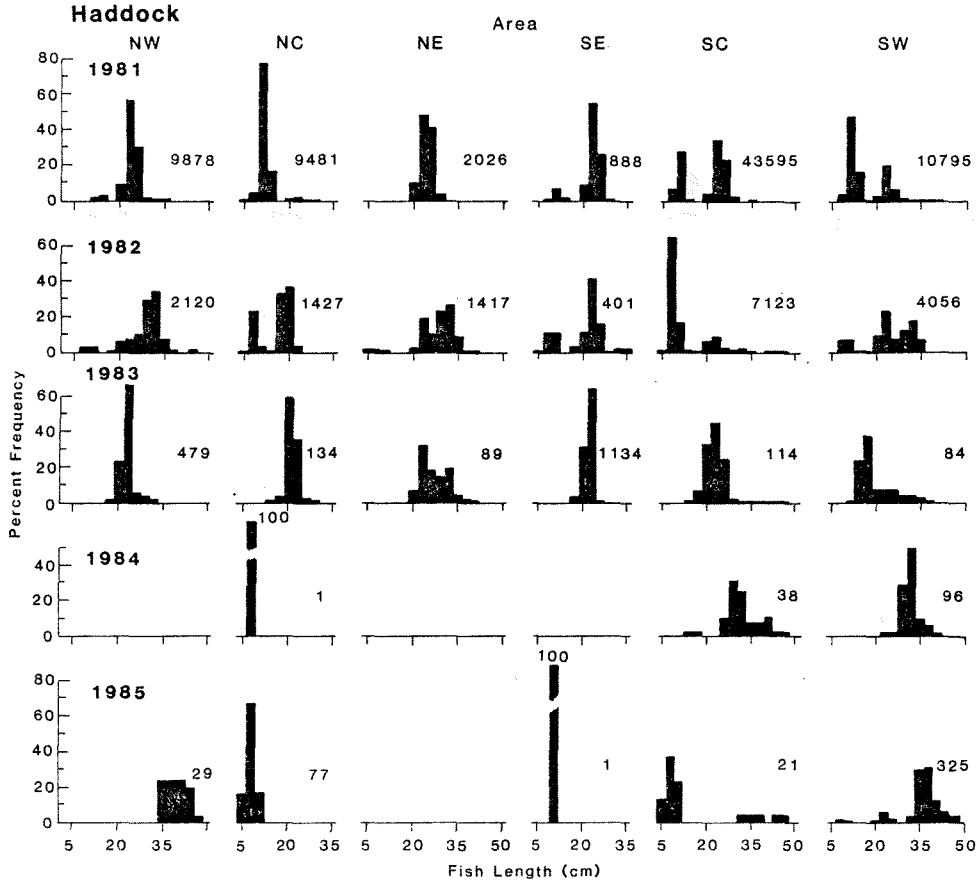

Fig. 4. Annual length-frequency distributions of haddock from Sable Island survey cruises 1981-85 by geographic sector. NW - northwest, NC - north-central, NE - northeast, SE - southeast, SC - south-central, SW - southwest.

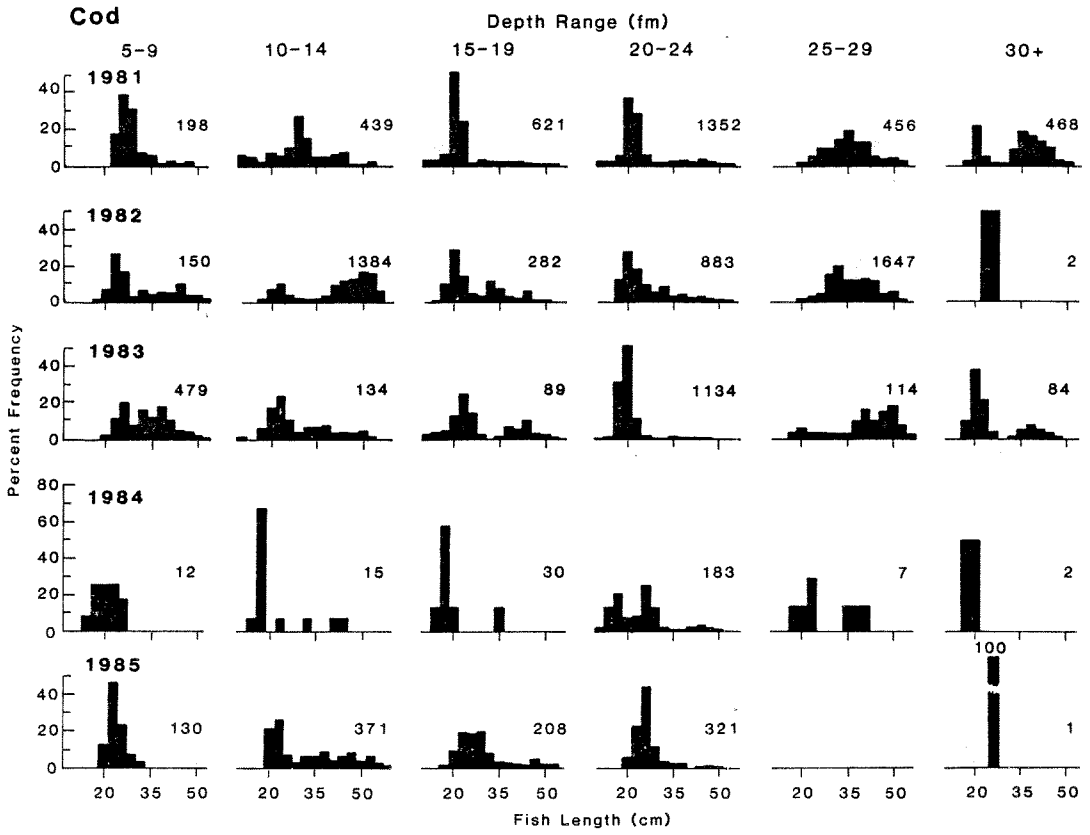

Fig. 5. Annual length-frequency distributions of cod from Sable Island survey cruises 1981-85 by depth zone (fathoms).

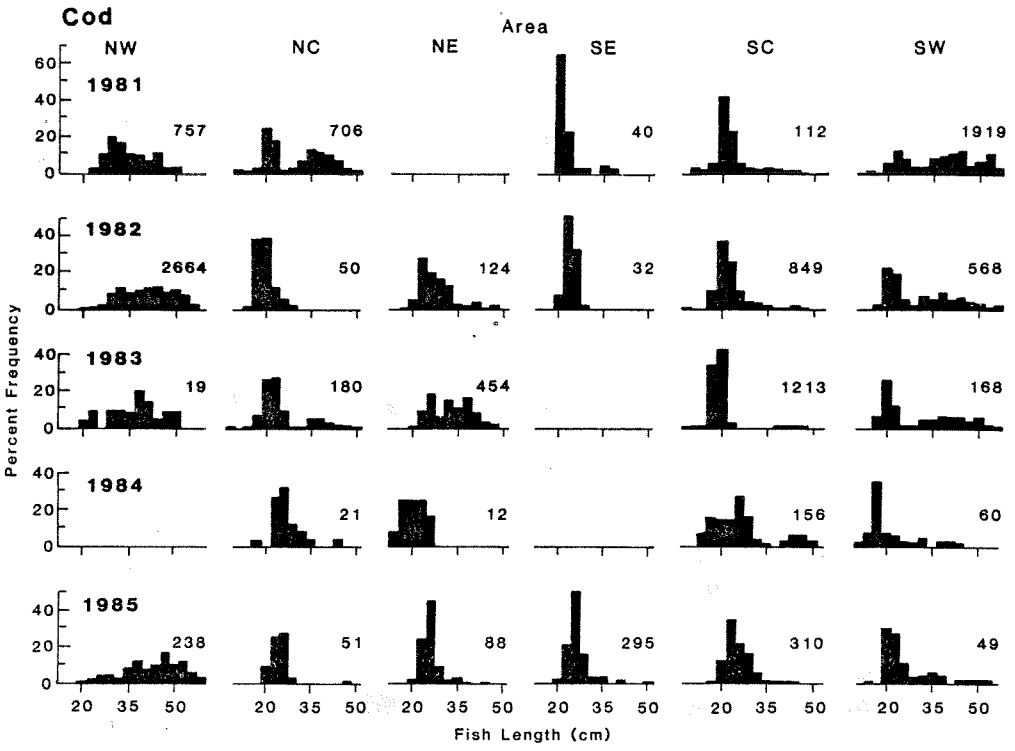

Fig. 6. Annual length-frequency distributions of cod from Sable Island survey cruises 1981-85 by geographic sector. NW - northwest, NC - north-central, NE - northeast, SE - southeast, SC - south-central, SW - southwest.

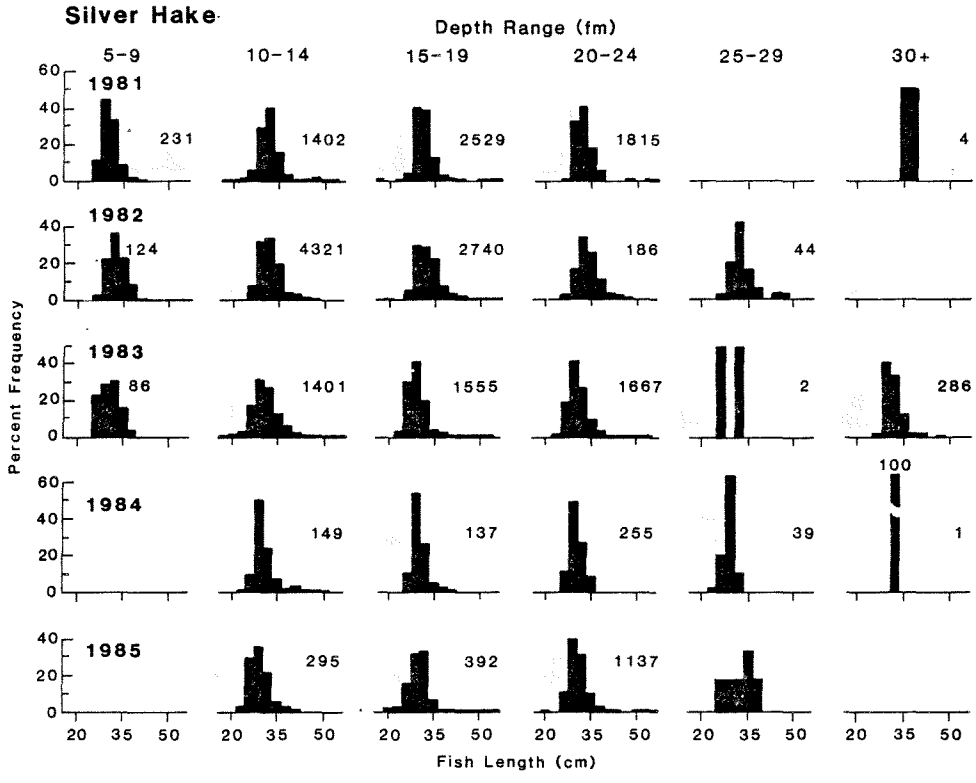

Fig. 7. Annual length-frequency distributions of silver hake from Sable Island survey cruises 1981-85 by depth zone (fathoms).

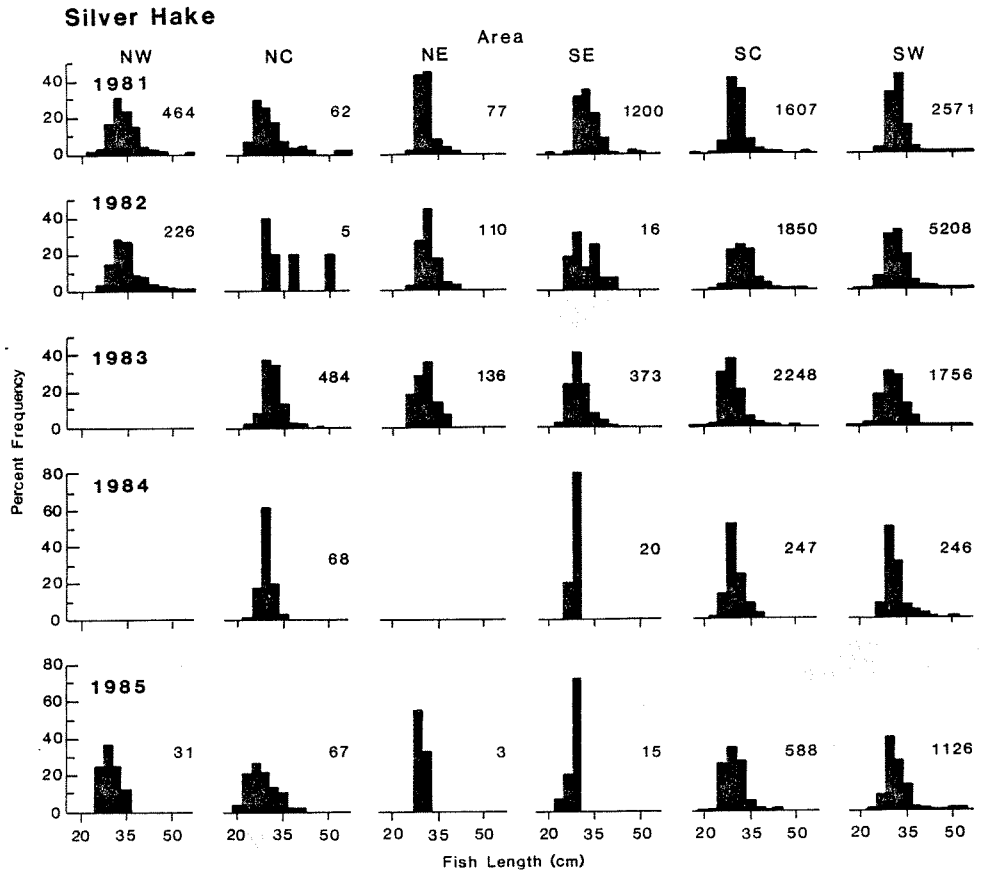

Fig. 8. Annual length-frequency distributions of silver hake from Sable Island survey cruises 1981-85 by geographic sector. NW - northwest, NC - north-central, NE - northeast, SE - southeast, SC - south-central, SW - southwest.

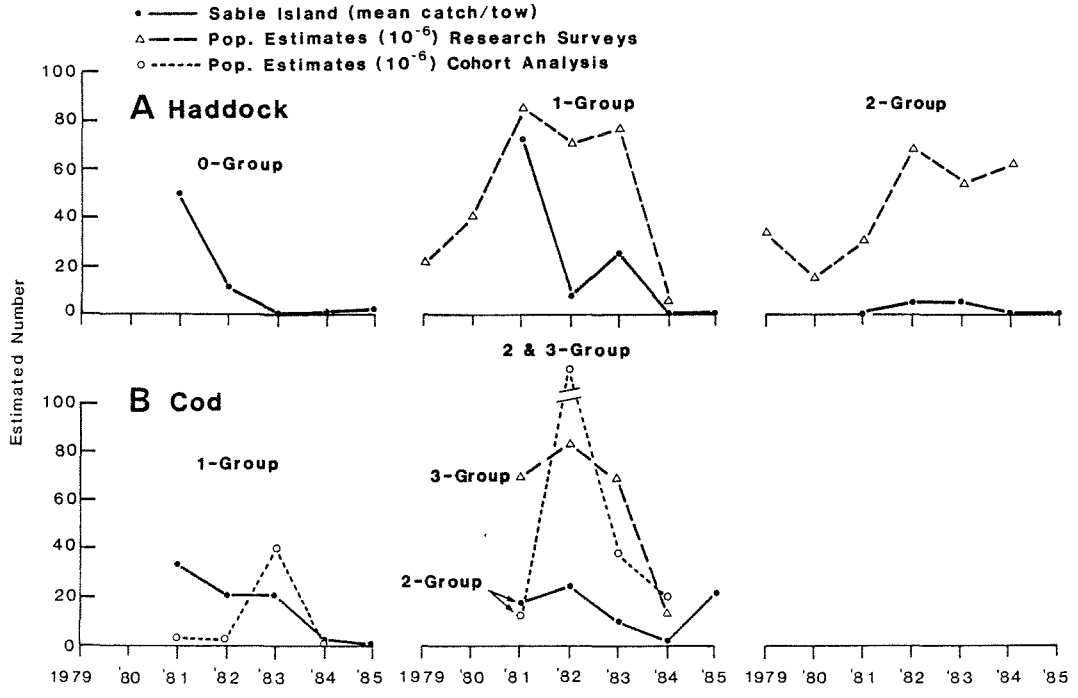

Fig. 9. Estimated population numbers and mean catch-per-tow data from Sable Island surveys for the years 1981-85 for juvenile (A) haddock and (B) cod.

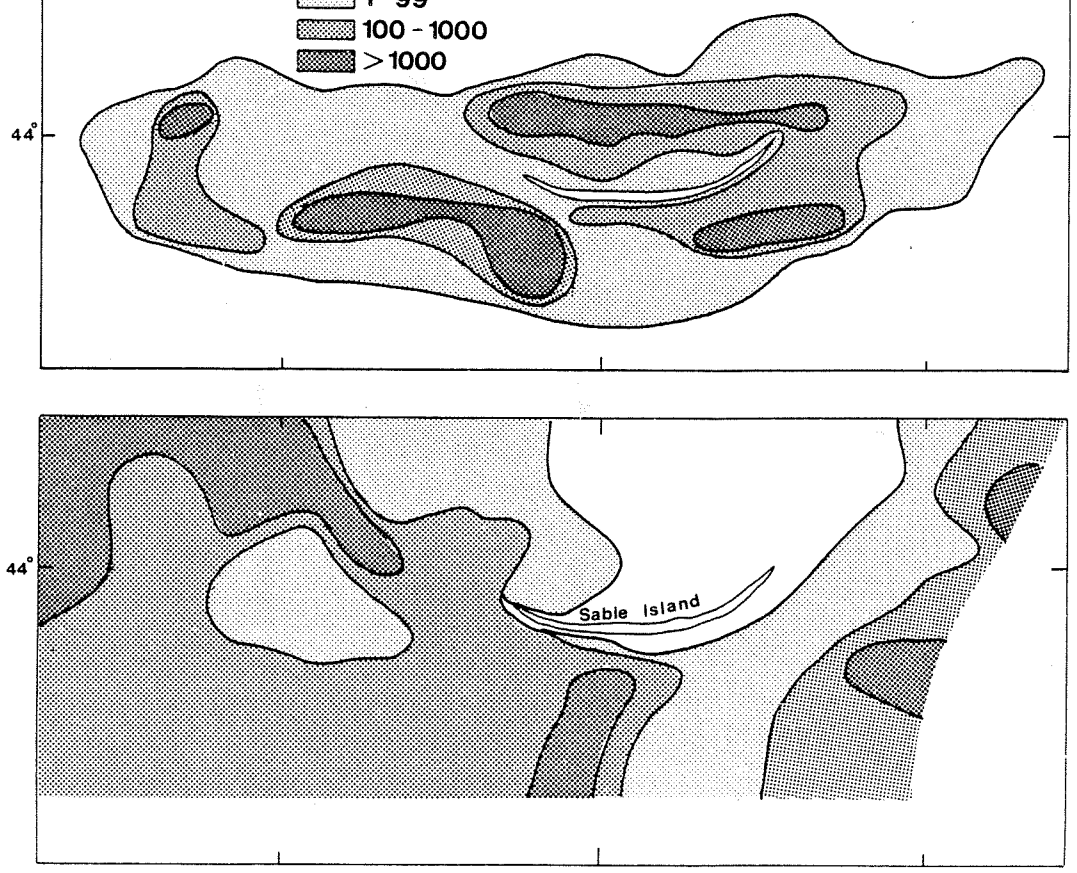

Fig. 10. Geographic distribution of catch rates of 0-group (upper) and 1-group (lower) haddock around Sable Island, August, 1981. (From Scott 1982).