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Icelandic Groundfish Survey, 1985

by

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Abstract

The main objective of the Icelandic ground fish survey is to improve the accuracy of stock assessments of demersal fish in Icelandic waters, with particular emphasis on the cod stock. Increased cooperation with fishermen and other sections of the fisheries community through fisheries research, is a further major objective of the project.

Stations were distributed in the survey area in a semi-randomly stratified process, with respect to the estimated abundance of cod within rectangles of 30x30 nautical miles . The exact position of half the number of stations within each rectangle was set randomly, and the other half by fishermen. A standardized bottom trawl was designed for the sampling.

Sampling was carried out during 8-25 of March on 5 commercial trawlers covering 595 stations in the continental shelf area within the 500 meters depth contour.The data sampled include length measurements of 27 species, otolith samples of 12 species and sex determination of 11 species ,as well as the registration of environmental and fishing gear parameters. All data were recorded on a personal computer on board the trawlers.

The results presented cover length distribution, geographical distribution and biomass indices of cod, haddock,saithe, redfish, catfish and long rough dab. Age distribution ,weight at age and maturity at age of cod, haddock, saithe and catfish, as well as the diurnal variation of cod and redfish. Furthermore, results on environmental and fishing gear parameters are presented.

The accuracy in abundance estimation of the fish stocks has been increased significantly through this survey ,and the project was carried out in a successful cooperation with fishermen. Thus, it is concluded that the main objectives of project have been achieved satisfactorily.

1. Introduction

Ground fish species have been investigated in Icelandic waters since the turn of the century, the time when the pioneer fisheries biologist Bjarni Sæmundsson began his research in marine biology. In the absence of any Icelandic research vessels in these early days of marine research, Sæmundsson mainly collected his material on board commercial trawlers.In 1930 Arni Friðriksson began his fisheries research in Icelandic waters, and since then ground fish investigations have been continuous.

In the mid nineteen fifties a regular, standardized sampling of the demersal fish stocks in Icelandic waters started.During each summer a survey of approximately 20 standard stations was carried out, covering mainly the inshore areas of the continental shelf. These surveys were continued into the late nineteen sixties.

An extensive survey of biology and abundance of juvenile cod was initiated in 1976 (Palsson 1984).This was carried out during different seasons and covered the continental shelf north and east of Iceland. During each survey a grid of approximately 80 standard stations was worked.

In 1981 a more extensive, random-stratified survey was initiated to investigate biology and abundance of cod and other demersal species in the continental shelf waters around Iceland (Schopka et al. 1983). This survey ,which was carried out in late winter and autumn, included approximately 200 stations.

This brief review indicates substantial improvements in the planning, methods and effort of ground fish surveys in Icelandic waters, particularily during the last decade. However, the need for still further improvements in the accuracy of stock size estimates, as a basis of modern fisheries management, has become even more urgent.

Under these circumstances the present ground fish project was initiated. The main objective is to estimate with increased accuracy,by a fisheries independent method, the size of the demersal fish stocks, particularily the cod . Thus, improving the quality of the scientific advise needed for management purposes.A further objective is to increase cooperation and communication with fishermen and other sections of the fisheries community through joint engagement in a research project.

To reach these objectives it was considered necessary to work approximately 600 stations during a period of 2 weeks.Compared with previous fish surveys this is an increase of 400 stations , and a reduction in survey time of 2 weeks. However,as the Marine Research Institute does not have the research vessels required for such an effort, 5 commercial trawlers were hired for the sampling.

2. Methods

2.1. General

During the planning stage considerable attention was paid to he timing of the survey. From the experience of earlier surveys the month of March was eventually chosen,as diurnal migrations are then less pronounced than in the autumn.Also the spawning stock gathers on the south western grounds during this time ,and is therefore more available for surveying than during other seasons .Furtermore, for interpretation of the results, it was considered essential to sample in the same season as previously. These arguments prevailed despite the fact that the geographical distribution of the cod seems to be more patchy in late winter than in autumn. It was anticipated that stationary gears (gill nets and long lines) might hinder the sampling during the spawning season. However, that did not turn out to be the case.

On the basis of following arguments the area of investigation was confined to the 500 m depth contour. Below 600 m hardly any commercial species of demersal fish can be found except redfish and greenland halibut. Below 400 m the slopes of the continental shelf are relatively steep making the 400-600 m depth zone rather small compared with the shelf area. Earlier ground fish surveys were initially limited to 400 m depth.During one survey the area was extended down to 600 m depth. This extention was again abandoned as hardly any cod were caught in the 400-600 m depth interval. However, as cod are sometimes caught in the commercial fishery abundantly below 400 m, the 500 m depth-line was chosen for the present survey.

As mentioned in the introduction the utilization of commercial fishing vessels was necessary in order to work the 600 stations within a reasonable time limit. As standardization was important 5 stern-trawlers, identical

in size (462 BWT), engine power and overall design, were leased. The standard crew of 15 was decreased to 13 making extra berth available for the research crew of 5.

One of the objectives of this project is to improve the cooperation and communication with fishermen and other sections of the fisheries community .

Fishermen, mainly the captains of the research trawlers, were involved in the planning of the project from the beginning. They participated in meetings and discussions with project team members on all relevant aspects of the project, such as gear standardization and stratification of the survey area with respect to fish abundance.

The most important contribution of the fishermen regards the positioning of the stations. Stations within each rectangle were divided equally between fishermen and project members. Fishermen were asked to locate their share of stations in each rectangle in accordance with their knowledge and experience of fishing, fish behaviour and fishing grounds. Project members ,however, selected a random position for their stations, from which fishermen decided on the direction of the tow. Apart from the captains of the research trawlers ,several fishermen from all parts of the country participated in this work, which was organized in cooperation with the union of fisheries officers. Through this work the extensive knowlegde and experience of generations of fishermen on the fish behavior , migrations and the topography of the fishing grounds, has been integrated in the project.

2.2. Stratification and survey design

Based on biological and hydrographical considerations, the survey area within the 500 m depth contour was divided into two areas, northern and southern area (Fig.1).

A total of 600 stations were divided between the two areas, roughly in proportion to their areal , and considering that 25-30% of the total cod stock would,at the survey time, be located in the southern area . Thus in the northern area 425 stations were planned and 175 in the southern one. Each area was divided into statistical rectangles bounded by half a degree latitude and one degree longitude.Based on the estimated density of cod, 10 strata were constructed from the statistical rectangles, 4 in the southern area and 6 in the northern one (Fig. 1).

Statistical rectangles in each strata are not necessarily adjacent, which allows more possibilities in constructing homogeneous strata with regard to density. Secondly this stratification scheme allows flexible construction of different strata for different analyses without modifying the basic system. The main idea of this approach is of a similar kind as that developed for a ground fish survey in East Greenland waters (Cornus pers. communication).

Different sources of information on cod abundance were used when deciding which statistical rectangles should be in each stratum. These were gathered from the captains of the research trawlers and their advisors, from commercial fisheries data and relative density distributions of former surveys. The fishermen graded each rectangle ,with regard to cod abundance, from 1 to 6 in the northern area and 1 to 4 in the southern area . The grades 6 and 4 indicate the highest abundance in north and south area, respectively (Fig. 1).

The stations were then divided between strata in direct proportion to the areal of each strata and its estimated cod density, as shown in the following text table.

Northern area

Stratum no.	density	area (nm^2)	no. of stations
1	6	5125	103
2	5	6724	112
3	4	6441	86
4	3	7549	76
5	2	6282	42
6	1	1916	6

Southern area

Stratum no	density	area (nm^2)	no. of stations
7	4	3550	34
8	3	14432	105
9	2	5280	26
10	1	4189	10

Finally the number of hauls in each rectangle, within a stratum, was in direct proportion to the areal of the rectangle.

Stations within each rectangle were divided equally between the fishermen and the project members.The fishermen positioned their stations freely in each rectangle, i.e. by subjective decision based on experience. The project members generated a random position for the other stations, from which the fishermen eventually decided the direction of the tow.

Instead of 30 minute hauls as in previous surveys it was decided to take 4 nm hauls (about 1 hour) as the captains of the trawlers considered 30 minute hauls as insufficient for adequate sampling.

This sampling method can be classified as "semi-random stratified" in the sense that only half of the stations are randomly selected. In addition stations were allocated to each rectangle prior to the random selection, which clearly results in a more even distribution than in an overall random scheme. The direction of the tows was not decided randomly.

In future surveys it is intended to repeat the hauls in the same way. This should minimize the so called "captains-factor" and, in our opinion, give more accurate results than by selecting new stations randomly for each new survey.

2.3. Standardization of fishing gear and method

The selectivity of fishing gears is known to depend on several environmental, biological and technical factors. In order to understand better how representative the catches from the standardized bottom trawl (Fig. 2) are with respect to the actual fish stocks it should be worthwhile to review the general selectivity of bottom trawls.

The selectivity can be divided into four different stages: The selectivity of the bridles, the trawl frame, the front part of the net cone and the selectivity of the codend (Thorsteinsson 1983).

In general the bridles herd better the faster swimming fish, which usually are the larger ones within each species. The herding efficiency will be reduced by high towing speed, long bridles and a high angle of attack between the bridles and the towing direction (size of otter boards).

Environmental conditions such as the contour and the composition of the bottom (sand clouds),and hydrographic and weather factors (temperature, bottom currents, light intensity) will influence the behaviour of the fish. Similarily biological factors (spawning, feeding activity and schooling behaviour) are of importance.

The selectivity of the bridles is not uniform for the fish situated between the otter boards. The fish located in front of the trawl opening will not be affected by the bridles selectivity as it only takes place on both sides and will be more effective the closer the fish are to one of the otter boards.

The second stage of selectivity in bottom trawling is the one caused by the net frame. Main (1982) has shown that cod have the tendency to escape under the footrope or between the footrope and fishing line whereas haddock try to escape above the headline. The shape of the trawl opening therefore has a species selective effect.

The selectivity of the net frame does not affect the fish which are too far off the bottom. If the size distribution of a species is not uniform in vertical direction the size distribution of the catch is not definitively identical with that of the stock.

Usually fish have a negative thigmotaxis (touch instinct) against netting. This means that they avoid touching the net until the panic reaction overcomes the negative thigmotaxis which happens in the codend. According to this the codend selectivity should in principle follow that of the trawl frame.

In practice however a selectivity occurs in the front and belly parts of the net cone. Small and exhausted fish do escape through these parts (Ellis, 1963). This is the third stage of selection in bottom trawls.

Finally the selectivity in the codend is probably so well known that it should not be necessary to review in this paper.

A standardization of the bottom trawl is essential in groundfish surveys but also problematic since it actually means to restrain from technical development. The standardization of the trawl shown in Fig. 2 was done in cooperation between the scientists of the MRI and the captains of the research trawlers. This trawl type is, apart from the smaller mesh size in the aft belly and the cod end, very similar to commercial bottom trawls used in Iceland.

Looking at this trawl design as a sampling tool it becomes obvious that slow and/or small fish might to some extent get overrun by the bridles since big and effective otter boards are used in connection with rather long bridles.

The horizontal distance between the wing end (or the otter boards) could not be measured. Based on measurements on similar trawl designs and on data from the flume tank in Hirtshals, Danmark, the average distance between the wing ends is estimated 17 m. This figure is,however, believed to depend very much on the depth, i.e. decreasing with increasing depth. In order to keep the catchability of the trawl as constant as possible on all fishing depths the length of the bridles was extended from 35 to 45 fathoms when fishing on water deeper than 100 fathoms.

The main feature of the net frame is a heavy groundrope weighting approximately 4.200 kg in air (Danleno - danleno) and some 1.900 kg in sea water. The purpose of this heavy groundrope is to prevent as far as possible the escapement of cod and some other species under the fishing line. The measured average height of the middle of the headline was 3.07 m indicating that this trawl is not very effective to sample fish staying far off the bottom.

The mesh sizes of the trawl are rather small (135 mm in the front part of the net), where commercial trawlers frequently use 200 or 180 mm. In the belly the mesh size is reduced to 80 mm and the extension piece and the codend are covered inside with 40 mm netting. Some escapement of small and exhausted fish is likely to occur through the wings and square but hardly significantly in the aft belly and codend (Pálsson and Thorsteinsson 1985) .

Not only the sampling gear but also the fishing method was standardized as far as possible. The standard towing speed was 3.8 knots over the bottom and the towing

distance was 4.0 nautical miles. In case of running fast a haul was considered as valid if the towing distance was at least 2 miles.

The warp lengths could not be fixed as different fishing conditions may call for different warp lengths. As a general rule however the used warp length was approximately 3 times the fishing depth.

As regards weather it was decided to stop fishing when the wind force exceeded 8 on Beaufort scale with corresponding sea state.

2.4. Data sampling

The data sampling can be divided into three categories, i.e. biological, environmental and trawling data.

For biological sampling the catch was sorted into species and the numbers caught of each species counted. For large catches a subsample was counted. Total length measurements were made for the 27 major species (Table 1). When the catch of particular species was very large a portion representing at least five times the observed length range in centimeters was measured.

For species with different growth rate by sexes , the sex of the measured fish was also recorded. No weighing of fish were made at sea and the biomass calculations presented in this paper are based on length-weight relationships from earlier data.

As the growth rate of fish varies greatly in Icelandic waters it was necessary to divide the research area into subareas for biological samples on ageing (Fig. 3). For the length stratified age-length keys the same number of fish were collected in each subarea for each species. The numbers sampled per length group depended on the length and age range of the species and also whether the sexes were sampled separately.

Otoliths for age readings were collected for 11 species (Table 1). Of the fish sampled for ageing a record was also made on length, sex and maturity stage . The stage of maturity was divided into four categories, i.e. immature fish, maturing fish (prespawners), spawning fish and spent fish.

In the environmental category the following meteorological and hydrographic data were recorded on each trawling station: Wind force (Beaufort scale) and direction, air temperature, weather conditions ,cloud coverage, sea state, ice conditions and barometric pressure. Sea surface temperature was recorded at each station, and on four of the trawlers the near-bottom temperature was also registered during the tow by means of a Sonde mounted on the headline. If possible the captains also estimated the surface current speed and direction during a tow.

The trawling data include the starting and the end positions of each tow, by means of Loran C, as well as the direction of the tow and the trawling speed. Further, a Loran plot was made of each haul. Other parameters which were registered, were maximum and minimum depth, local timing and duration of the tow , warp length , vertical opening of the trawl and the length of bridles.

2.5. Statistical calculations

Catches of fish are usually characterized by a negative binomial distribution rather than normal distribution (Pennington and Grosslein, 1978). This is demonstrated in Fig. 4 by the cod data of the present survey. In spite of this, untransformed stratified mean catch in number and weight per haul are used as basic indices, since no better approximation appears to be available.

The formulas used to compute the stratified mean and its standard error are (Cochran, 1953):

$$\bar{Y}_{st} = \frac{1}{A} \sum_{i=1}^{k} \bar{Y}_i \cdot A_i$$

$$V(\bar{Y}_{st}) = \frac{1}{A^2} \sum_{i=1}^{k} \frac{A_i^2 \cdot s_i^2}{n_i}$$

$$S_{\bar{Y}_{st}} = \sqrt{V(\bar{Y}_{st})}$$

Where:

$\bar{Y}_{st}$ = stratified mean catch per haul.

$V(\bar{Y}_{st})$ = sample variance of the i-th stratum.

$S_{\bar{Y}_{st}}$ = standard error of the stratified mean.

A = total surveyed area.

A_i = area of the i-th stratum.

$\bar{Y}_i$ = mean catch per tow in the i-th stratum.

s_i^2 = variance of catches in the i-th stratum.

n_i = number of tows in the i-th stratum.

k = number of strata.

The applied formula for the biomass indices is:

$$B = \bar{Y}_{st} \frac{A}{\bar{a}}$$

Where:

B = biomass index.

A = sum of strata areas.

$\bar{a}$ = area swept per tow.

and its standard error:

$$S(B) = \frac{A}{\bar{a}} \cdot S(\bar{Y}_{st})$$

The area swept in a standard tow ($\bar{a}$) is the product of the estimated distance beween the wing ends (17 m) and the standard tow length (4 nautical miles), i.e. 2/54 nm^2. No attempt has been made to estimate the catchability coefficient of the trawl.

With large number of hauls the stratified mean becomes nearly normally distributed and the t-distribution can be used as an approximation. Thus, for the computation of confidence intervals for the average number or weight per haul the usual t-interval should be a reasonable approximation.

3. Material presented

The sampling was carried out during 8-25 March and covered 595 valid stations (Fig. 1). The huge material sampled (Table 1 and 2) is too extensive to present in any detail in this paper. However, the results will be presented here for cod (Gadus morhua morhua (L.)), haddock (Melanogrammus aeglefinus (L.)), saithe (Pollachius virens (L.)), redfish (Sebastes marinus (L.)), catfish (Anarhichas lupus lupus L.) and long rough dab (Hippoglossoides platessoides limandoides (Bloch)). Except for the long rough dab these are the major exploited demersal fish stocks in Icelandic waters.

The data on length measurements are given in Tables 3-20. Age data for 4 species are given in Table 2.

4. Results

Detailed results, for the different species, are given in Tables 3-20 on following aspects : The length distribution of a stock by numbers (number * 10-3) and percentages (length dist.(%)). Also given are the number measured in each length group and the corresponding percentages . The age distribution of a stock by numbers(number * 10-3) and weight (biomass index (t)) as well as the corresponding percentages. The average length (mean length (cm)) and weight (mean weight(gr)) of the fish by age , as well as the relative number of mature fish (mature(%)).Furthermore, abundance indices are given in Tables 21-24. The main results are shown in Fig. 5-28 , and summarized in the following text.

4.1. Environmental features

Near-bottom temperature and surface temperatures were measured on 435 stations and 505 stations respectively. The accuracy of the temperature measurements is expected to be rather low (0.1 degr. C) but the results might be useful for comparison purposes in the future.

Both near-bottom and surface temperatures were high (Fig. 5), in fact the highest recorded in this season since observations stared in March 1970 (Malmberg pers. comm.)

The estimates of wind force and sea state demonstrate the unususally good wheather conditions which prevailed during the survey. Comparable conditions are very unlikely to occur again in the near future. Thus, parameters of this kind are considered potential correction factors in case of wheather related catchability.

4.2. Fishing gear parameters

At 483 stations it was possible to keep the standard towing distance of 4.0 nautical miles. In 42 cases the towing distance was slightly longer and on 70 occations it was shorter.

Figure 6 shows some paramters related to the fishing gear , i.e. the relation between warp length and trawling depth ,towing speed and the vertical opening of the trawl.

For depths down to approximately 200 m the relation between warp length and depth was approximately 3:1. In deeper water relatively shorter warp lengths have been used. The solid line in Fig. 6 indicates the 3:1 relation (slope 0.33) , whereas the broken line is a calculated linear regression with slope 0.36.

The towing speed was on average 3.8 knots. Its frequency distribution as shown in Fig. 6 .

The vertical trawl opening, as measured on 319 stations, had a mean value of 3.07 m. The frequency

distribution(Fig. 6) shows that figures of 3.0 and 3.5 m are most common.

4.3. Length distribution

4.3.1. Cod

Fig. 7 shows the length distribution of cod for the whole investigation area ,and separatly in the southern and the northern areas . The bulk of the older cod are distributed on the 40-70 cm length groups ,whereas the small fish are mainly confined to the 20-29 cm length groups. In previous ground fish surveys, however, the share of this small fish has generally been very low. The length distributions in the two areas reflect the well known distribution pattern of the Icelandic cod, the small fish being much more numerous in the northern area where the main nursery grounds are located. The large and mature fish, on the other hand, are more abundant on the spawning grounds in the southern area.

4.3.2. Haddock

As for cod the length distribution of haddock was found to be bi-modal, i.e. the bulk of the larger haddock was of 45-60 cm length and still higher peaks of fish smaller than 30 cm (Fig. 8). These small fish are again distinctively divided into two peaks. Small haddock were found to be almost as abundant in the south area as in the north one. The larger haddock , however, were very scarce in the northern area. This is a common distribution pattern of haddock which, contrary to cod, seems not to be entierly characterized by the spawning season.

4.3.3. Saithe

The total length distribution of saithe was characterized by medium sized fish in the 50-70 cm length groups(Fig. 9). The length distribution for the southern area was very similar to that of the total area while the distribution in the northern area varies greatly from these two. In the northern area juvenile saithe , 25-30 cm in length, were most numerous in the catches along with large fish in the 75-85 cm length groups.

4.3.4. Redfish

The length distribution of redfish in the total survey area (Fig. 10) was characterized by one peak in the 30-34 cm length group. Small fish were poorly represented. From the separate length distributions it is obvious that larger fish were much more abundant in the southern area.In fact the total catches in the northern area were almost negligible with fish smaller than 25 cm only occurring to some extent.

4.3.5. Catfish

Both small and large catfish were similarily represented in the catches (Fig. 11) However, the number of fish smaller than 35 cm was always less than that of the larger ones and gradually deminishing. The total length distribution further indicates a relatively small fluctutions of year class strength. Separate distributions for the two areas are not strikingly different except that small catfish were better represented in the northern area.

4.3.6. Long rough dab

Individuals of long rough dab larger than 20 cm were evenly represented in the samples (Fig. 12).The length distributions for the two areas demonstrate that the fish

in the northern part tend to be larger. Specimens smaller than 15 cm were almost negligible in the catches, and therefore the survey gives little indication of the whereabouts of the youngest fish.

4.3.7. Comparative remarks

Considering the 3 gadoid species, it is interesting to note the relatively large share of juvenile cod, haddock and saithe in the survey catches. These small fish have generally been very scarce in previous ground fish surveys. As new gear is used in this present survey the inevitable question arises whether we are observing exceptionally large new year classes of all these 3 species or if the factors of catchability and/or vunerability have been increased . In view of the information available from previous surveys, the latter explanation seems more probable. This trend of higher catches of juvenile fish was not observed for the non-gadoid species.

4.4. Age distribution

4.4.1. Cod

The age distribution of cod by numbers and weight is shown in Fig. 13 for the investigations area as a whole and for the southern and northern areas separately.

It has been shown that cod in Icelandic waters recruit gradually with age to the continental shelf area and are more or less fully recruited at age 3 or 4 (Palsson 1984). Thus, the age distribution of 4 years old and older cod represents that of the recruited, catchable stock. The age distribution of younger cod, however, is only to a limited degree comparable between age groups because of the varying stage of recruitment.

As shown in Fig. 13 age group 5 (year class 1980) dominated in the catchable component of the stock, both in numbers (21.7%) and especially in weight (30.9%). Age groups 4,6 and 7 are comparable in weight (18.7%, 16.0%, 11.6%) as well as age groups 8, 9 and 10 (5.4%, 4.5%, 2.8%). Older age groups yield less than 1% in weight to the catchable stock, and not more than 0.1% by number.

The large proportion of immature fish in the dominating age groups was evident. The bulk of the spawning stock consisted of age groups 5,6 and 7, which are only to a limited proportion mature. Furthermore, the larger part of the spawning stock was recorded in the northern area, i.e. the main grounds of the younger and immature stock component. The older and mature fish, however, are scarce and therefore contribute less to the spawning stock than normally would be expected. The state of the stock with respect to age distributions of the two stock components is ,therefore,characterized by somewhat unbalanced proportions.

The northern area of the continental shelf includes the main nursery grounds of cod in Icelandic waters (Pálsson 1980). The results from this area are therefore used to estimate recruitment.

Year class 1982 (age group 3 in Fig. 13) has been estimated as exceptionally poor (Anon. 1985) which seems to be consistent with its low abundance in March 1985. By comparision year class 1983 would be estimated to be of average strength. Year class 1984 was in August of that year recorded in large numbers as 0-group (Vilhjálmsson and Magnussson 1984). Its low abundance, however, as 1 year old fish in March 1985 seems at this stage to make uncertain any assumption of its actual size.

4.4.2. Haddock

The age distribution of haddock is shown in Fig. 14.The age group 5 (year class 1980) dominated in the catchable part of the stock (3+), both in numbers (16.2%)

and in weight (26.3%). Three age groups , 4, 7, and 9, were similar in weight, yielding 15.3%, 16.6% and 15.2% of the total stock respectively. Year class 1979 (age group 6) appears to be exceptionally weak, which is in agreement with estimates of that year class from other sources (Anon. 1985).

The spawning stock consisted mainly of 5, 7,and 9 year old fish, i.e. the 1980, 1978 and 1976 year classes. Other year classes were of less importance in the mature part of the stock.

As seen in Fig. 14 all age groups of the catchable stock ,except age group 3, were found mainly in the warmer, southern area of the continental shelf. The juvenile components (age groups 1 and 2), on the other hand , were more frequent in the northern area. Age group 3 was recorded in comparable quantities in the two areas.

The recruitment pattern of juvenile haddock has not been analysed in the same way as that of cod . The actual size of the youngest year classes is therefore subject to considerable uncertainty.Nevertheless, the relatively large numbers of age groups 1 and 2 suggest that these year classes might be approximately of an average order.

4.4.3. Saithe

The total stock of saithe was dominated by age group 5 (year class 1980) both in numbers (33.5%) and in weight (26.6%)(Fig. 15). The stock was mainly composed of the age groups 4-9.

The composition of the spawning stock was characterized by a wide range of age groups of similar biomass. Age group 9 (year class 1976) ,however, contributed more to this part of the stock than the remaining age groups.

Saithe younger than 4 years were recorded in limited numbers in both areas. However, age group 2 was more numerous in the northern area than in the southern one.

4.4.4. Catfish

The stock of catfish was based on a relatively large number of age groups (Fig. 16). Age groups 8-16 contributed mainly to the stock by weight. Catfish enter the fishery at age 8 and the commercial catch is mainly limited to age groups 10-15 (Gunnar Jónsson pers. communication). Therefore it seems adequate to consider catfish at age 8 and older as the catchable component of the stock. Most age groups of this part of the stock were recorded in the northern area. With increasing age, however, a larger part of the age groups was recorded in the southern area. Thus, age groups 15-17 were more numerous in the southern area than the northern one (Tables 15-17).

The bulk of the spawning stock consisted of 10-16 year old fish . Older age groups do not contribute significantly to the spawning biomass. The younger age groups ,on the other hand, are still largely immature.

The age groups belonging to the juvenile part of the stock (age group 1-7) were found to be more abundant in the northern area than in the southern one. In both areas a gradual increase in numbers was observed with increasing age. This suggests a gradual recruitment of the fish to the continental shelf area.

4.4.5. Comparative remarks

The results presented reveal considerable differences in the age distributions of the various species. The age distribution of cod is rather narrow, especially when compared to the state of the stock in earlier decades . Furthermore, most year classes are apparently relatively weak, both the mature ones,and the juvenile year classes. The stocks of haddock and saithe seem to be more balanced in this respect. The age distribution of catfish on the other hand, is especially

wide and relatively even ,and gives the impression of a stable stock under relatively low pressure of fishing.

4.5. Weight at age

The average weight at age for cod, haddock, saithe and catfish in March 1985 is shown in Fig. 17.

The gadoid species enter the fisheries in significant numbers at age 4 (Anon. 1985). At that age their average weight was 1.3 kg, 1.5 kg and 1.8 kg for cod, haddock and saithe respectively. The weight of catfish, however, at this age was 0.09 kg.

Cod and saithe are 50% mature around age 7, and their weight at that age was 3.6 kg and 4.2 kg respectively. The weight of haddock at that age was 3.4 kg, and that of catfish 0.4 kg.At the age of approximate 50% maturity of haddock and catfish ,age 5 and 9 respectively, their weight was 2.2 kg and 0.8 kg respectively.

At age 9, the oldest age group of the gadoids sufficiently sampled (Table 2), the weight was 6.0kg, 4.2 kg and 4.5 kg for cod , haddock and saithe respectively. The weight of saithe at this age seems to be abnormally low. This is in agreement with previous findings (Anon. 1985). The weight of catfish at this age was 0.7 kg.

In general the growth of haddock is apparently slower than that of cod and saithe.During the juvenile phase the growth of saithe is more rapid than that of cod. Around age 10 ,however, the average weight of cod and saithe is similar. The growth of catfish is much slower than observed for the other species.

Differences in growth of cod and haddock with respect to geographical distribution are well known in Icelandic waters (Sæmundsson 1923, 1925), and are demonstrated in the present data (Fig. 18).At age 9 this difference was distinctly greater for cod than for haddock, or almost 4 kg for cod and less than 0.5 kg for haddock .

4.6. Maturity at age

The average percentage of sexual maturity is shown in Fig. 19 for cod , haddock, saithe and catfish.

The age of first maturity is quite similar for the different species, i.e. 2 years for haddock, 3 years for saithe and catfish and 4 years for cod. The subsequent development of maturity, however, follows somewhat different patterns. The haddock are 50% mature approximately at age 5, saithe between age 6 and 7, and the cod reach this stage of maturity approximately at age 7 . The catfish ,on the other hand, are 50% mature at age 9. The age of 100% maturity seems to be approximately twice that of 50% maturity , i.e. 11 years for haddock, 12 years for saithe, 14 years for cod and 18 years for catfish.

4.7. Biomass indices

For each species the calculated biomass indices and stratified mean catch per standard tow are shown in Tables 21-24 .

4.7.1. Cod

The total biomass index estimated for cod was 556 thousand tons. The bulk (83%) of the biomass was distributed on the nursery grounds in the northern area along the north and east coasts, but only 17% on the spawning grounds in the southern area (Table 21). Of this biomass index 61 thousand tons (66%) were mature in the southern and 111 thousand tons (24%) in the northern area. The total spawning biomass index was estimated 157 thousand tons or 28% of total stock index (Table 22).

This proportion of total biomass versus spawning stock biomass is in fairly good accordance with VPA results (Anon 1985). On the other hand the total biomass index for cod is about 50% of the present estimated VPA stock biomass.

It is interesting to note that for age groups 6 and older the stock indices in numbers from the survey, and the absolute stock in numbers at the beginning of 1985 as estimated by VPA, are almost identical. For the age groups 5 and younger,however, the survey indices are lower than the corresponding VPA values indicating that these age groups are not fully recruited to the survey.

Stratified mean catch in numbers per standard tow was 15 times higher in the northern area compared with the southern area (Table 23). The difference in mean catch in weight between the areas was much less pronounced since the older and hence heavier cod are more numerous in the southern area (Table 24) . The estimated standard error of the mean catch per standard tow was 18-19% by numbers and 16-22% by weight (Tables 23-24).

4.7.2. Haddock

The total biomass index of haddock was estimated 244 thousand tons. Opposite to cod the bulk of the biomass (78%) was distributed on the grounds off the southern and south western coasts but only 23% in the colder waters off the north and east coasts. The spawning biomass index was estimated 139 thousand tons, or 57% of the total biomass index. In the northern area 38% of the fish were mature but 62% in the southern area.

The estimated total biomass index for haddock was of the same order as the present VPA stock biomass (Anon 1985).

As for cod there was a good agreement between the stock indices in numbers for 5 years and older haddock and the absolute stock values in numbers from the VPA for the same ages. Due to limited knowledge on the strength of the younger haddock year classes in VPA , direct comparison with the survey results is not feasible .

The stratified mean catch in numbers per standard tow was 65% higher in the southern area compared to the northern one. In weight this difference was much more pronounced, since the mean catch per standard tow was 257 kg in southern region compared with only 59 kg in the northern region. The estimated standard error of the mean catch per tow was 14-20% by numbers but 10-30% by weight.

4.7.3. Saithe

The estimated total biomass index for saithe was 44 thousand tons and 42% of this biomass was mature fish. This is only 13% of the estimated VPA biomass (Anon 1985). Mean catch in numbers was low i.e. 16 fish/tow in the southern area and only 4 fish/tow in northern area. Thus,it appears that the present survey method does not cover the stock of saithe adequately. Young immature saithe are often pelagic in behaviour and therefore only occasionally available to the gear. This is also demonstrated by the high standard error of the mean indices for saithe, ranging between 15-44% by numbers and 21-34% by weight .

4.7.4. Redfish

Of the total biomass index of 429 thousand tons for redfish 325 thousand tons (76%) were recorded in the southern area and 104 thousand tons (24%) in the northern one. This species was the one most numerous during the survey. The stratified mean catch in numbers per tow was 560 and 253 fish in the southern and northern areas respectively. The stratified mean catch in weight was 114 kg/tow in the northern area , which is almost 4 timer lower than the catch of 439 kg/tow in the southern area .

The redfish in Icelandic waters is regarded to be a part of the redfish stock in the East Greenland-Iceland-Faroe area. The estimated VPA biomass from a joint assessment in this area is approximately 1100 thousand tons (Anon 1984). The present estimated biomass index for redfish is therefore about 40% of this VPA biomass estimate.

4.7.5. Catfish

The total estimated biomass index for catfish was 43 thousand tons. Of this biomass 32 thousand tons (76%) were mature fish. About 25 thousand ton (60%) of the catfish was distributed in the northern area; of this 25 thousand tons 71% were mature. In the southern area 82% of population were mature. At present there is no VPA available on this stock, and, therefore, no comparison possible.

Stratified mean catch in numbers per tow was relatively low i.e. 17 fish in the southern area and twice that value in the northern area . On the other hand the difference in catch in weight per tow was small i.e. 24 kg in the southern and 27 kg in the northern area. The estimated standard error of the mean catch per tow was 11-24% by numbers and 15-29% by weight.

4.6.6. Long rough dab

This species has so far not been commercially exploited. However, compared to the results of more the important species above the estimated total biomass index for long rough dab of 49 thousand tons is relatively high. The greatest part of this stock (76% of the total biomass) was located in the colder waters along the north and east coasts . Stratified mean catch in numbers per tow was 79 fish in the southern and 137 fish in the northern area. The stratified mean catch by weight was, on the other hand, relatively low, i.e. 17 and 40 kg/tow in the southern and the northern area. Standard error of the mean catch per tow was 6-14% by weight and 6-13% by numbers.

4.7.7. Comparison of biomass indices

Due to different behaviour of the species, their availability and/or catchability is different, and, therefore, a direct comparison of the biomass indices is difficult.On the other hand, the standard error of the mean is a measure of accuracy of the results and can be used for comparison.

The present ground fish survey was mainly designed to reduce as much as possible the variance in the abundance estimation of cod. However, it is interesting to note that for some other species relatively lower standard errors were observed in the abundance indices . This may indicate greater patchiness of cod compared to the other species. On the average the standard error for cod was 16% of the biomass index, for haddock 23%, saithe 27%, redfish 13%, catfish 14% and only 6% for long rough dab (Table 21).

The relatively low standard error values for both redfish and catfish suggests the biomass indices may be of great importance in coming years in estimating their abundance. It has already been pointed out that the biomass index for saithe appears to be somewhat doubtful. For haddock the total biomass index fits well to the VPA biomass stock abundance estimation,although the standard error of the stratified mean by weight is relatively high. For cod, however, the total biomass index was about 50% of the present VPA biomass.

As mentioned above (chapter 2.3.) it is not possible to compare the present biomass indices to the surveys of former years. However, the calculated standard errors of the mean biomass indices can be compared. In the 1982 and 1983 late winter surveys the standard error

of the mean for the whole survey area were as follows (the present estimates are given in brackets): 20-28% for cod (16%), 27-31% for haddock (23%), 19-25% for redfish (13%), 25-45% for catfish ((14%) and 12-21% for long rough dab (6%) (Schopka et al. 1983). This comparison demonstrates that the present survey has markedly improved the accuracy in estimation of the biomass indices .

4.8. Geographical distribution

The geographical distribution of the fish was calculated as the average number of fish per standard tow in each rectangle .The distribution range of each species was divided into 6 arbitrary categories (Fig. 20-25).

4.8.1. Cod

The largest densities of cod were recorded off the north coast, both in the fjords as well as in off shore waters (Fig. 20). Average densities were recorded off the north western coast, the north eastern and eastern coasts. In other areas considerably lower densities were recorded , especially in the deeper parts of the survey area.

4.8.2. Haddock

The largest concentrations of haddock were mainly recorded in the relatively warm waters of the southern area, but also in fjords and shallow waters off the northern coast (Fig. 21). Particularily in northern coastal waters the distribution of haddock was characterized by decreasing density with increasing depth. Off the eastern coast the haddock had limited distribution.

4.8.3. Saithe

The largest concentrations of saithe were recorded off the western and south western coasts (Fig. 22). Average densities were found off the south easte and off the north coasts. In general, however, the distribution of saithe was characterized by low density and patchiness.

4.8.4. Redfish

The largest densities of redfish were recorded off the western and the south western coasts, particularily in the deeper areas (Fig. 23). Average densities were most frequently found off the north and the south coasts. The lowest densities, on the other hand , were recorded off the east coast and in the Iceland-Faroe-Ridge area.

4.8.5. Catfish

The catfish were recorded in largest densities in relatively shallow waters off the north west coast (Fig. 24). In addition catfish were found in considerable densities off the east coast. The catfish were rarely found off the south west and the north coasts.

4.8.6. Long rough dab

The greatest concentrations of long rough dab were recorded in inshore waters, mainly off the north west ,north and north east coasts (Fig. 25). The largest areas of relatively high density were found off the north east coast and off the south coast. Intermediate densities were recorded off the northern and the eastern coasts. Long rough dab were relativley scarce off the western coast, particularily in the deeper waters.

4.9.Diurnal variation

The analysis of the diurnal variation in the average number of fish per standard tow for cod and redfish indicates that intervals shorter than 4 hours were inadequate due to high variance. Further the randomly distributed tows have higer variance than those appointed by the fishermen.

The diurnal variation of cod and redfish is shown in Figs 26-28,based on the fishermens' tows only. In gerneral, the two species show a similar diurnal variation with the highest occurrence at the bottom around noon, and considerably lower around midnight.

The findings for the cod are in rather good accordance with earlier observations on immature cod (Pálsson 1984). The data for redfish are in general agreement with observations in the commercial trawling fisheries.

The coefficient of variation (standard deviation/average number of fish per tow) were within the following limits:

cod all sizes: 0.86-2.23
redfish all sizes: 1.12-2.05
cod by length groups: 0.86-2.98
redfish by length groups: 1.26-3.23

As mentioned in chapter 2.1. March was chosen as survey time partly because of minimal diurnal variation. The maximum variation observed for all sizes of cod and redfish was 1:2.4 (Fig. 25), which is approximately 1/3 of the maximum observed for immature cod in summer and autumn (Pálsson 1984).

Conclusions

The analysis of the length distributions of the 6 species confirms results from previous surveys. However, a relatively large number of small fish were recorded for the 3 gadoid species. This is explained with an increased catchability of the new standard trawl.

The age distributions of 4 species reveal considerable differences between areas , as well as in age spectrum between species. The age distribution of cod is found to be rather limited, whereas that of catfish gives the impression of a stable stock. In general, the findings are in agreement with results already available.

In the estimation of abundance indices relatively low values of standard error were achieved, not only for cod (16% of the biomass index) the main target species , but also for redfish (16%), catfish (14%) and long rough dab (6%). For haddock and saithe the standard error was higher or 23% and 27% respectively. In view of the limited material sampled for saithe ,which probably is due to its pelagic behavior, this species is considered inadequately covered in the survey.

Compared with earlier surveys the estimation of the abundance of 5 of the species reveals significant improvements in accuracy .The reduction in the standard error of the mean biomass indices is highest for the non-gadoid species , but relatively limited for haddock. For cod, however, the standard error was reduced from approximately 24% to 16% .

It can be concluded that the main objectives of this project have been achieved ,i.e. the accuracy in abundance estimation has been increased significantly and the project was carried out in a successful cooperation with fishermen.

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Table 1 Species and numbers sampled for various observations

Species	Length measurements	Aging	Sex determination
Cod (Gadus morhua morhua)	104 467	2 690	2 690
Haddock (Melanogrammus aeglefinus)	44 612	1 996	1 996
Saithe (Pollachius virens)	3 216	1 253	1 253
Whiting (Merlangius merlangus merlangus)	1 418	5	5
Redfish (Sebastes marinus)	67 136	0	2 216
Ling (Molva molva)	352	231	352
Blue ling (Molva dypterygia dypterygia)	235	157	235
Tusk (Brosme brosme)	1 760	918	1 760
Catfish (Anarhichas lupus lupus)	18 946	1 867	1 867
Starry ray (Raja radiata)	8 825	0	8 825
Silver smelt (Argentina silus)	3 077	353	353
Halibut (Hippoglossus hippoglossus)	2 190	471	471
Greenland halibut (Reinhardtius hippoglossoides)	1 786	630	1 786
Plaice (Pleuronectes platessa)	5 768	602	5 422
Lemon sole (Microstomus kitt)	2 045	0	0
Witch (Glyptocephalus cynoglossus)	1 234	0	0
Megrim (Lepidorhombus whiffiagonis)	505	0	0
Dab (Limanda limanda)	2 011	0	0
Long rough dab (Hippoglossus platessoides limandoides)	37 822	0	0
Norway pout (Trisopterus esmarki)	3 348	0	0
Lumpsucker (Cyclopterus lumpus)	1 945	0	1 945
Redfish (Sebastes viviparus)	8 100	0	9
Redfish (Sebastes mentella)	2 612	0	297
Grenadier (Macrourus berglax)	53	0	53

Table 2. Number of otolith samples analysed by age for cod, haddock, saithe and catfish.

Age (years)	Cod	Haddock	Saithe	Catfish
1	150	247	8	11
2	214	270	49	37
3	198	204	59	58
4	249	255	132	79
5	390	334	254	84
6	332	62	166	94
7	368	230	173	90
8	272	117	97	156
9	254	232	237	119
10	152	21	32	184
11	37	8	16	110
12	37	5	10	188
13	9		6	139
14	9		7	97
15	9		5	130
16	2			94
17				43
18				39
19				17
20				2
?	8	11	2	96
Total	2690	1996	1253	1867

Table 3. Cod in total area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 61478 n. sq. miles
Number of tows = 595 Fish measured = 104467

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	909	0.2	327	0.3
10- 14	17053	4.2	6541	6.3
15- 19	3748	0.9	1420	1.4
20- 24	41456	10.2	12751	12.2
25- 29	68603	16.9	21174	20.3
30- 34	19838	4.9	6176	5.9
35- 39	13775	3.4	3466	3.3
40- 44	23132	5.7	5115	4.9
45- 49	38139	9.4	7272	7.0
50- 54	46021	11.3	9487	9.1
55- 59	42150	10.4	9480	9.1
60- 64	37406	9.2	7923	7.6
65- 69	22340	5.5	5295	5.1
70- 74	10954	2.7	2943	2.8
75- 79	8220	2.0	1951	1.9
80- 84	4321	1.1	1158	1.1
85- 89	2530	0.6	729	0.7
90- 94	1902	0.5	488	0.5
95- 99	1116	0.3	307	0.3
100-104	752	0.2	172	0.2
105-109	495	0.1	123	0.1
110-114	225	0.1	54	0.1
115-119	201	0.0	53	0.1
120-124	93	0.0	27	0.0
125-129	74	0.0	21	0.0
130-134	32	0.0	9	0.0
135-139	13	0.0	4	0.0
140-144	1	0.0	1	0.0
145-149	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	19676	4.9	463	0.1	12.2	24	0.0
2	110021	27.1	18692	3.4	25.3	170	0.5
3	46987	11.6	24204	4.4	35.9	515	0.0
4	78934	19.5	104245	18.7	50.1	1321	3.4
5	87884	21.7	172081	30.9	57.2	1958	18.3
6	30891	7.6	89160	16.0	65.1	2886	38.7
7	17951	4.4	64782	11.6	69.8	3609	46.7
8	6037	1.5	30168	5.4	77.6	4998	66.9
9	4131	1.0	24971	4.5	82.5	6045	54.4
10	2197	0.5	15405	2.8	85.3	7011	73.0
11	333	0.1	4170	0.7	107.0	12533	100.0
12	346	0.1	4694	0.8	109.9	13546	88.4
13	66	0.0	1062	0.2	116.3	16048	86.5
14	66	0.0	1131	0.2	118.6	17158	100.0
15	57	0.0	1280	0.2	130.4	22278	100.0

Table 4. Cod in southern area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 27441 n. sq. miles
Number of tows = 174 Fish measured = 4673

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	0	0.0	0	0.0
10- 14	215	1.0	53	1.1
15- 19	114	0.5	27	0.6
20- 24	78	0.4	19	0.4
25- 29	435	2.1	90	1.9
30- 34	494	2.4	114	2.4
35- 39	364	1.7	75	1.6
40- 44	485	2.3	84	1.8
45- 49	741	3.5	132	2.8
50- 54	940	4.5	193	4.1
55- 59	1604	7.6	329	7.0
60- 64	2057	9.8	436	9.3
65- 69	2599	12.4	576	12.3
70- 74	2117	10.1	507	10.8
75- 79	2125	10.1	497	10.6
80- 84	1624	7.7	406	8.7
85- 89	1318	6.3	306	6.5
90- 94	1225	5.8	261	5.6
95- 99	895	4.3	202	4.3
100-104	542	2.6	122	2.6
105-109	437	2.1	98	2.1
110-114	213	1.0	50	1.1
115-119	191	0.9	48	1.0
120-124	83	0.4	22	0.5
125-129	65	0.3	17	0.4
130-134	26	0.1	6	0.1
135-139	11	0.1	3	0.1
140-144	0	0.0	0	0.0
145-149	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	298	1.4	8	0.0	13.4	26	0.0
2	598	2.8	124	0.1	27.0	208	0.0
3	1218	5.8	773	0.8	38.6	634	0.0
4	3201	15.2	5847	6.3	55.5	1826	8.4
5	4271	20.3	12161	13.2	64.8	2847	27.0
6	4459	21.2	18094	19.6	73.1	4058	47.1
7	2203	10.5	12568	13.6	82.1	5705	71.9
8	2042	9.7	13943	15.1	87.3	6827	82.2
9	1070	5.1	9161	9.9	94.3	8559	95.1
10	904	4.3	9102	9.8	99.6	10069	94.9
11	328	1.6	4190	4.5	107.6	12788	100.0
12	240	1.1	3265	3.5	110.3	13591	100.0
13	48	0.2	872	0.9	122.2	18294	100.0
14	67	0.3	1245	1.3	122.4	18458	100.0
15	49	0.2	1094	1.2	130.6	22366	100.0

Table 5. Cod in northern area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 34037 n. sq. miles
Number of tows = 421 Fish measured = 99794

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	909	0.2	327	0.3
10- 14	16838	4.4	6488	6.5
15- 19	3633	0.9	1393	1.4
20- 24	41379	10.8	12732	12.8
25- 29	68168	17.7	21084	21.1
30- 34	19344	5.0	6062	6.1
35- 39	13412	3.5	3391	3.4
40- 44	22647	5.9	5031	5.0
45- 49	37398	9.7	7140	7.2
50- 54	45080	11.7	9294	9.3
55- 59	40546	10.5	9151	9.2
60- 64	35349	9.2	7487	7.5
65- 69	19741	5.1	4719	4.7
70- 74	8837	2.3	2436	2.4
75- 79	6095	1.6	1454	1.5
80- 84	2697	0.7	752	0.8
85- 89	1212	0.3	423	0.4
90- 94	677	0.2	227	0.2
95- 99	221	0.1	105	0.1
100-104	210	0.1	50	0.1
105-109	58	0.0	25	0.0
110-114	12	0.0	4	0.0
115-119	10	0.0	5	0.0
120-124	10	0.0	5	0.0
125-129	9	0.0	4	0.0
130-134	6	0.0	3	0.0
135-139	1	0.0	1	0.0
140-144	1	0.0	1	0.0
145-149	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	19201	5.0	365	0.1	12.1	19	0.0
2	111174	28.9	19077	4.1	25.4	172	0.7
3	41954	10.9	20394	4.4	35.4	486	0.0
4	67665	17.6	81543	17.6	48.8	1205	1.9
5	89293	23.2	168824	36.4	56.6	1891	17.8
6	25826	6.7	68546	14.8	63.4	2654	39.6
7	19673	5.1	62975	13.6	67.3	3201	44.3
8	4740	1.2	18573	4.0	71.5	3919	65.2
9	3276	0.9	15285	3.3	75.8	4665	43.2
10	1508	0.4	6520	1.4	72.4	4322	59.6
11	42	0.0	460	0.1	102.4	10891	100.0
12	66	0.0	796	0.2	105.2	12046	71.6
13	9	0.0	117	0.0	109.6	13581	69.3
14	6	0.0	72	0.0	101.3	11175	100.0
15	9	0.0	212	0.0	131.1	22726	85.3

Table 6. Haddock in total area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 61478 n. sq. miles
Number of tows = 595 Fish measured = 44612

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	3	0.0	2	0.0
10- 14	5928	3.2	1668	3.7
15- 19	33216	18.0	5830	13.1
20- 24	3811	2.1	623	1.4
25- 29	18780	10.2	4602	10.3
30- 34	23965	13.0	8120	18.2
35- 39	5834	3.2	1891	4.2
40- 44	10186	5.5	2848	6.4
45- 49	15681	8.5	4328	9.7
50- 54	16738	9.1	4493	10.1
55- 59	18165	9.8	4169	9.3
60- 64	11522	6.2	2263	5.1
65- 69	9315	5.0	1663	3.7
70- 74	6961	3.8	1298	2.9
75- 79	3526	1.9	640	1.4
80- 84	787	0.4	160	0.4
85- 89	60	0.0	11	0.0
90- 94	10	0.0	3	0.0
95- 99	0	0.0	0	0.0
100-104	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	40683	22.1	2494	1.0	16.5	61	0.0
2	40522	22.0	13571	5.6	29.4	335	1.5
3	20215	11.0	15395	6.3	38.6	762	13.6
4	24047	13.0	37127	15.3	49.7	1544	46.8
5	29750	16.1	64003	26.3	55.6	2151	46.4
6	3581	1.9	11318	4.7	63.4	3161	71.4
7	11752	6.4	40375	16.6	65.1	3436	68.4
8	4282	2.3	17956	7.4	69.8	4193	92.4
9	8847	4.8	36920	15.2	69.8	4173	88.8
10	545	0.3	2677	1.1	73.7	4911	89.7
11	175	0.1	874	0.4	73.8	5004	100.0
12	101	0.1	504	0.2	74.4	4993	100.0

Table 7. Haddock in southern area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 27441 n. sq. miles
Number of tows = 174 Fish measured = 20125

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	0	0.0	0	0.0
10- 14	3200	3.1	815	4.0
15- 19	10953	10.5	2556	12.7
20- 24	921	0.9	231	1.1
25- 29	7822	7.5	1942	9.6
30- 34	9855	9.4	2407	12.0
35- 39	2566	2.5	594	3.0
40- 44	5154	4.9	1045	5.2
45- 49	9715	9.3	1787	8.9
50- 54	11334	10.8	2017	10.0
55- 59	14079	13.4	2134	10.6
60- 64	9959	9.5	1483	7.4
65- 69	8469	8.1	1295	6.4
70- 74	6445	6.2	1079	5.4
75- 79	3382	3.2	578	2.9
80- 84	761	0.7	148	0.7
85- 89	60	0.1	11	0.1
90- 94	10	0.0	3	0.0
95- 99	0	0.0	0	0.0
100-104	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	14825	14.2	859	0.5	16.1	58	0.0
2	16043	15.3	5609	3.0	29.9	350	2.9
3	8599	8.2	6448	3.4	38.3	750	23.4
4	17096	16.3	26290	13.9	49.6	1538	64.3
5	22694	21.7	51986	27.5	56.8	2291	63.4
6	4114	3.9	12824	6.8	63.0	3117	69.1
7	10627	10.2	38731	20.5	66.5	3645	79.4
8	5152	4.9	21280	11.2	69.4	4130	92.8
9	4868	4.6	21689	11.5	71.5	4456	93.5
10	520	0.5	2607	1.4	74.2	5018	100.0
11	78	0.1	469	0.2	79.6	6049	100.0
12	85	0.1	436	0.2	75.1	5146	100.0

Table 8. Haddock in northern area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 34037 n. sq. miles
Number of tows = 421 Fish measured = 24487

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	3	0.0	2	0.0
10- 14	2728	3.4	853	3.5
15- 19	22263	27.9	3274	13.4
20- 24	2890	3.6	392	1.6
25- 29	10958	13.7	2660	10.9
30- 34	14110	17.7	5713	23.3
35- 39	3268	4.1	1297	5.3
40- 44	5032	6.3	1803	7.4
45- 49	5966	7.5	2541	10.4
50- 54	5404	6.8	2476	10.1
55- 59	4086	5.1	2035	8.3
60- 64	1563	2.0	780	3.2
65- 69	846	1.1	368	1.5
70- 74	516	0.6	219	0.9
75- 79	145	0.2	62	0.3
80- 84	26	0.0	12	0.0
85- 89	0	0.0	0	0.0
90- 94	0	0.0	0	0.0
95- 99	0	0.0	0	0.0
100-104	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	27104	34.0	1761	3.3	16.9	65	0.0
2	22931	28.7	7894	14.6	29.8	344	2.8
3	9606	12.0	6307	11.7	36.7	657	23.4
4	9627	12.1	13394	24.8	48.0	1391	68.5
5	7304	9.2	14520	26.9	54.1	1988	69.7
6	786	1.0	1956	3.6	58.0	2490	73.4
7	1474	1.8	4457	8.3	62.2	3024	86.1
8	546	0.7	1899	3.5	65.4	3481	92.9
9	393	0.5	1602	3.0	69.3	4074	92.2
10	37	0.0	156	0.3	69.9	4238	100.0
11	3	0.0	18	0.0	79.3	5990	100.0
12	6	0.0	27	0.0	73.7	4834	100.0

Table 9. Saithe in total area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 61478 n. sq. miles
Number of tows = 595 Fish measured = 3216

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
10- 14	6	0.0	3	0.1
15- 19	36	0.2	14	0.4
20- 24	8	0.1	4	0.1
25- 29	262	1.7	64	2.0
30- 34	588	3.9	200	6.2
35- 39	108	0.7	54	1.7
40- 44	88	0.6	42	1.3
45- 49	480	3.2	209	6.5
50- 54	978	6.5	234	7.3
55- 59	3030	20.1	315	9.8
60- 64	2329	15.4	271	8.4
65- 69	2044	13.5	322	10.0
70- 74	1341	8.9	315	9.8
75- 79	1380	9.1	400	12.4
80- 84	1012	6.7	327	10.2
85- 89	506	3.4	170	5.3
90- 94	313	2.1	96	3.0
95- 99	146	1.0	41	1.3
100-104	100	0.7	31	1.0
105-109	108	0.7	33	1.0
110-114	124	0.8	37	1.2
115-119	67	0.4	19	0.6
120-124	56	0.4	14	0.4
125-129	4	0.0	1	0.0
130-134	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	42	0.3	2	0.0	16.3	56	0.0
2	913	6.0	300	0.7	30.9	329	0.0
3	473	3.1	480	1.1	46.4	1015	1.9
4	3053	20.2	5402	12.4	57.2	1769	4.3
5	5064	33.5	11585	26.6	62.5	2288	13.1
6	1814	12.0	5937	13.6	71.2	3273	40.8
7	1162	7.7	4858	11.1	77.8	4179	59.1
8	550	3.6	2818	6.5	83.6	5122	74.5
9	1510	10.0	6886	15.8	80.4	4560	62.3
10	166	1.1	1302	3.0	97.7	7827	91.7
11	84	0.6	784	1.8	104.9	9363	94.8
12	81	0.5	888	2.0	111.0	10943	100.0
13	61	0.4	701	1.6	113.1	11497	100.0
14	99	0.7	1272	2.9	117.5	12791	100.0
15	36	0.2	393	0.9	111.3	10959	100.0

Table 10. Saithe in southern area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 27441 n. sq. miles
Number of tows = 174 Fish measured = 1700

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
10- 14	0	0.0	0	0.0
15- 19	0	0.0	0	0.0
20- 24	0	0.0	0	0.0
25- 29	4	0.0	1	0.1
30- 34	31	0.3	8	0.5
35- 39	15	0.1	3	0.2
40- 44	29	0.2	8	0.5
45- 49	241	2.0	69	4.1
50- 54	802	6.8	155	9.1
55- 59	2856	24.2	223	13.1
60- 64	2228	18.9	211	12.4
65- 69	1908	16.2	242	14.2
70- 74	1109	9.4	182	10.7
75- 79	957	8.1	204	12.0
80- 84	495	4.2	114	6.7
85- 89	364	3.1	89	5.2
90- 94	255	2.2	62	3.6
95- 99	133	1.1	35	2.1
100-104	82	0.7	22	1.3
105-109	69	0.6	16	0.9
110-114	105	0.9	26	1.5
115-119	63	0.5	16	0.9
120-124	54	0.5	13	0.8
125-129	4	0.0	1	0.1
130-134	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	0	0.0	0	0.0	0.0	0	0.0
2	45	0.4	17	0.0	32.9	387	0.0
3	242	2.1	280	0.8	48.9	1157	1.9
4	2753	23.3	4955	14.2	57.6	1800	4.3
5	4581	38.8	10428	29.8	62.4	2276	12.9
6	1466	12.4	4579	13.1	70.0	3123	37.5
7	841	7.1	3402	9.7	76.7	4043	56.0
8	422	3.6	2173	6.2	83.7	5151	73.2
9	1027	8.7	4668	13.4	80.2	4544	60.7
10	124	1.0	983	2.8	98.4	7950	92.9
11	66	0.6	617	1.8	104.8	9361	94.6
12	68	0.6	757	2.2	111.5	11084	100.0
13	51	0.4	593	1.7	113.9	11699	100.0
14	91	0.8	1176	3.4	118.0	12952	100.0
15	29	0.2	322	0.9	111.5	10998	100.0

Table 11. Saithe in northern area. Information with respect to length and age. See text for explainations (chapter 4).

Areal of the worked area = 34037 n. sq. miles
Number of tows = 421 Fish measured = 1516

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
10- 14	6	0.2	3	0.2
15- 19	36	1.1	14	0.9
20- 24	8	0.2	4	0.3
25- 29	258	7.8	63	4.2
30- 34	557	16.9	192	12.7
35- 39	93	2.8	51	3.4
40- 44	59	1.8	34	2.2
45- 49	239	7.2	140	9.2
50- 54	176	5.3	79	5.2
55- 59	174	5.3	92	6.1
60- 64	101	3.0	60	4.0
65- 69	135	4.1	80	5.3
70- 74	232	7.0	133	8.8
75- 79	423	12.8	196	12.9
80- 84	517	15.6	213	14.1
85- 89	142	4.3	81	5.3
90- 94	57	1.7	34	2.2
95- 99	13	0.4	6	0.4
100-104	18	0.5	9	0.6
105-109	39	1.2	17	1.1
110-114	19	0.6	11	0.7
115-119	4	0.1	3	0.2
120-124	1	0.0	1	0.1
125-129	0	0.0	0	0.0
130-134	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	42	1.3	2	0.0	16.3	56	0.0
2	868	26.3	282	3.3	30.8	326	0.0
3	231	7.0	200	2.3	43.7	867	2.0
4	300	9.1	447	5.2	53.5	1490	4.7
5	483	14.6	1157	13.4	62.9	2398	15.3
6	348	10.5	1358	15.7	76.2	3904	54.9
7	321	9.7	1456	16.8	80.5	4538	67.0
8	128	3.9	546	7.5	83.4	5028	78.8
9	483	14.6	2218	25.6	80.9	4595	65.6
10	43	1.3	319	3.7	95.8	7474	88.1
11	18	0.5	167	1.9	104.9	9371	95.6
12	13	0.4	130	1.5	108.3	10195	100.0
13	10	0.3	108	1.2	109.5	10504	100.0
14	9	0.3	96	1.1	111.6	11102	100.0
15	7	0.2	71	0.8	110.7	10785	100.0

Table 12. Redfish in total area. Information with respect to length.
See text for explainations (chapter 4).

Areal of the worked area = 61478 n. sq. miles
Number of tows = 595 Fish measured = 67136

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	512	0.1	158	0.2
10- 14	17046	2.6	4956	7.4
15- 19	25401	3.9	7319	10.9
20- 24	22424	3.4	5262	7.8
25- 29	82112	12.6	12418	18.5
30- 34	135645	20.8	14681	21.9
35- 39	230406	35.3	13467	20.1
40- 44	112499	17.2	6698	10.0
45- 49	23072	3.5	1769	2.6
50- 54	3625	0.6	313	0.5
55- 59	522	0.1	71	0.1
60- 64	97	0.0	23	0.0
65- 69	2	0.0	1	0.0
70- 74	0	0.0	0	0.0

Table 13. Redfish in southern area. Information with respect to length.
See text for explainations (chapter 4).

Areal of the worked area = 27441 n. sq. miles
Number of tows = 174 Fish measured = 19035

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	100	0.0	13	0.1
10- 14	1648	0.4	174	0.9
15- 19	2353	0.6	386	2.0
20- 24	5468	1.3	455	2.4
25- 29	33889	8.1	1172	6.2
30- 34	66621	15.8	2944	15.5
35- 39	188120	44.7	7467	39.2
40- 44	99247	23.6	5021	26.4
45- 49	19800	4.7	1216	6.4
50- 54	2951	0.7	162	0.9
55- 59	310	0.1	25	0.1
60- 64	0	0.0	0	0.0
65- 69	0	0.0	0	0.0
70- 74	0	0.0	0	0.0

Table 14. Redfish in northern area. Information with respect to length.
See text for explainations (chapter 4).

Areal of the worked area = 34037 n. sq. miles
Number of tows = 421 Fish measured = 48101

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	412	0.2	145	0.3
10- 14	15398	6.6	4782	9.9
15- 19	23048	9.9	6933	14.4
20- 24	16956	7.3	4807	10.0
25- 29	48223	20.7	11246	23.4
30- 34	69024	29.6	11737	24.4
35- 39	42286	18.2	6000	12.5
40- 44	13252	5.7	1677	3.5
45- 49	3272	1.4	553	1.1
50- 54	674	0.3	151	0.3
55- 59	212	0.1	46	0.1
60- 64	97	0.0	23	0.0
65- 69	2	0.0	1	0.0
70- 74	0	0.0	0	0.0

Table 15. Catfish in total area. Information with respect to length a
See text for explainations (chapter 4).

Areal of the worked area = 61478 n. sq. miles
Number of tows = 595 Fish measured = 18946

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	335	0.7	140	0.7
10- 14	1868	4.2	824	4.3
15- 19	2604	5.8	1132	6.0
20- 24	2655	5.9	1172	6.2
25- 29	3172	7.1	1435	7.6
30- 34	3847	8.6	1769	9.3
35- 39	4512	10.1	2090	11.0
40- 44	3881	8.7	1736	9.2
45- 49	3883	8.7	1641	8.7
50- 54	3965	8.9	1650	8.7
55- 59	4563	10.2	1765	9.3
60- 64	3865	8.6	1517	8.0
65- 69	2607	5.8	957	5.1
70- 74	1220	2.7	465	2.5
75- 79	834	1.9	283	1.5
80- 84	495	1.1	172	0.9
85- 89	287	0.6	107	0.6
90- 94	123	0.3	56	0.3
95- 99	49	0.1	26	0.1
100-104	17	0.0	7	0.0
105-109	4	0.0	2	0.0
110-114	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	335	0.7	1	0.0	7.0	3	0.0
2	1681	3.8	26	0.1	12.4	16	0.0
3	2274	5.1	98	0.2	17.2	43	13.2
4	2530	5.6	231	0.5	22.1	91	4.0
5	2797	6.2	454	1.1	26.5	162	3.2
6	3233	7.2	838	2.0	31.2	259	17.8
7	3134	7.0	1158	2.7	35.8	369	31.0
8	4808	10.7	2841	6.7	41.4	591	41.5
9	3340	7.5	2461	5.8	44.9	737	48.8
10	5016	11.2	4969	11.6	49.6	991	66.3
11	2969	6.6	3759	8.8	54.5	1266	76.3
12	4657	10.4	6983	16.4	57.6	1499	81.8
13	3181	7.1	5541	13.0	60.4	1742	86.8
14	1544	3.4	3241	7.6	64.5	2099	90.9
15	1606	3.6	4171	9.8	69.5	2596	97.7
16	956	2.1	2831	6.6	71.9	2961	94.4
17	338	0.8	1353	3.2	80.3	4005	97.9
18	293	0.7	1187	2.8	80.3	4052	100.0
19	105	0.2	556	1.3	88.5	5301	100.0

Table 16. Catfish in southern area. Information with respect to length and age

Areal of the worked area = 27441 n. sq. miles
Number of tows = 174 Fish measured = 2823

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	0	0.0	0	0.0
10- 14	123	1.0	30	1.1
15- 19	353	2.8	87	3.1
20- 24	453	3.6	114	4.0
25- 29	592	4.8	136	4.8
30- 34	622	5.0	151	5.3
35- 39	730	5.9	174	6.2
40- 44	795	6.4	183	6.5
45- 49	1101	8.9	249	8.8
50- 54	1249	10.0	284	10.1
55- 59	1772	14.2	377	13.4
60- 64	1644	13.2	358	12.7
65- 69	1332	10.7	297	10.5
70- 74	616	5.0	142	5.0
75- 79	518	4.2	115	4.1
80- 84	314	2.5	69	2.4
85- 89	151	1.2	37	1.3
90- 94	53	0.4	14	0.5
95- 99	11	0.1	3	0.1
100-104	11	0.1	3	0.1
105-109	0	0.0	0	0.0
110-114	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	0	0.0	0	0.0	0.0	0	0.0
2	119	1.0	2	0.0	12.7	17	0.0
3	299	2.4	14	0.1	17.8	47	14.2
4	419	3.4	40	0.2	22.5	95	4.3
5	476	3.8	77	0.4	26.6	162	3.2
6	568	4.6	158	0.9	31.5	277	17.4
7	551	4.4	212	1.2	36.2	385	31.5
8	1064	8.6	733	4.2	43.6	689	41.9
9	847	6.8	705	4.0	46.9	833	47.8
10	1505	12.1	1694	9.7	52.0	1125	68.6
11	1049	8.4	1426	8.2	56.0	1359	76.7
12	1806	14.5	2904	16.6	59.2	1608	82.9
13	1343	10.8	2533	14.5	62.5	1886	89.1
14	706	5.7	1586	9.1	66.3	2246	90.8
15	826	6.6	2270	13.0	71.1	2750	97.8
16	496	4.0	1584	9.1	74.2	3195	95.5
17	185	1.5	762	4.4	81.3	4129	97.5
18	143	1.1	574	3.3	80.3	4016	100.0
19	39	0.3	183	1.0	85.1	4727	100.0

Table 17. Catfish in northern area. Information with respect to length and age

Areal of the worked area = 34037 n. sq. miles
Number of tows = 421 Fish measured = 16123

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	335	1.0	140	0.9
10- 14	1745	5.4	794	4.9
15- 19	2251	7.0	1045	6.5
20- 24	2202	6.8	1058	6.6
25- 29	2581	8.0	1299	8.1
30- 34	3225	10.0	1618	10.0
35- 39	3782	11.7	1916	11.9
40- 44	3086	9.5	1553	9.6
45- 49	2782	8.6	1392	8.6
50- 54	2717	8.4	1366	8.5
55- 59	2791	8.6	1388	8.6
60- 64	2221	6.9	1159	7.2
65- 69	1275	3.9	660	4.1
70- 74	604	1.9	323	2.0
75- 79	316	1.0	168	1.0
80- 84	181	0.6	103	0.6
85- 89	137	0.4	70	0.4
90- 94	70	0.2	42	0.3
95- 99	37	0.1	23	0.1
100-104	6	0.0	4	0.0
105-109	4	0.0	2	0.0
110-114	0	0.0	0	0.0

age (year)	number * 10-3	age dist.(%)	biomass index(t)	age dist.(%)	mean lenght(cm)	mean weight(gr)	mature (%)
1	335	1.0	1	0.0	7.0	3	0.0
2	1561	4.8	24	0.1	12.3	16	0.0
3	1975	6.1	84	0.3	17.1	43	13.1
4	2111	6.5	191	0.8	22.0	91	3.9
5	2321	7.2	377	1.5	26.5	162	3.2
6	2665	8.2	680	2.7	31.2	255	17.8
7	2583	8.0	946	3.7	35.7	366	30.9
8	3745	11.6	2107	8.3	40.7	563	41.3
9	2493	7.7	1756	7.0	44.2	704	49.1
10	3511	10.9	3275	13.0	48.6	933	65.3
11	1920	5.9	2332	9.2	53.7	1215	76.0
12	2852	8.8	4079	16.2	56.6	1430	81.1
13	1838	5.7	3008	11.9	58.9	1637	85.1
14	838	2.6	1655	6.6	63.0	1976	91.0
15	781	2.4	1900	7.5	67.9	2434	97.5
16	460	1.4	1248	4.9	69.4	2710	93.2
17	153	0.5	591	2.3	79.0	3856	98.3
18	150	0.5	613	2.4	80.4	4086	100.0
19	66	0.2	373	1.5	90.5	5636	100.0

Table 18. Long rough dab in total area. Information with respect to length. See text for explainations (chapter 4).

Areal of the worked area = 61478 n. sq. miles
Number of tows = 595 Fish measured = 38122

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	648	0.4	153	0.4
10- 14	7834	4.2	1257	3.3
15- 19	27491	14.9	4452	11.7
20- 24	42270	22.9	7250	19.0
25- 29	39535	21.4	8292	21.8
30- 34	37157	20.1	8910	23.4
35- 39	25630	13.9	6776	17.8
40- 44	3948	2.1	989	2.6
45- 49	170	0.1	40	0.1
50- 54	2	0.0	1	0.0
55- 59	2	0.0	1	0.0
60- 64	2	0.0	1	0.0
65- 69	0	0.0	0	0.0
70- 74	0	0.0	0	0.0

Table 19. Long rough dab in southern area. Information with respect to length. See text for explainations (chapter 4).

Areal of the worked area = 27441 n. sq. miles
Number of tows = 174 Fish measured = 6205

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	34	0.1	8	0.1
10- 14	2787	4.7	259	4.2
15- 19	11787	20.0	1072	17.3
20- 24	18900	32.1	1708	27.5
25- 29	12176	20.7	1294	20.9
30- 34	7228	12.3	1002	16.1
35- 39	4707	8.0	702	11.3
40- 44	1216	2.1	149	2.4
45- 49	100	0.2	11	0.2
50- 54	0	0.0	0	0.0
55- 59	0	0.0	0	0.0
60- 64	0	0.0	0	0.0
65- 69	0	0.0	0	0.0
70- 74	0	0.0	0	0.0

Table 20. Long rough dab in northern area. Information with respect to length. See text for explainations (chapter 4).

Areal of the worked area = 34037 n. sq. miles
Number of tows = 421 Fish measured = 31917

length group(cm)	number * 10-3	length dist.(%)	number measured	length dist.(%)
5- 9	614	0.5	145	0.5
10- 14	5047	4.0	998	3.1
15- 19	15704	12.5	3380	10.6
20- 24	23370	18.6	5542	17.4
25- 29	27359	21.8	6998	21.9
30- 34	29928	23.8	7908	24.8
35- 39	20923	16.6	6074	19.0
40- 44	2731	2.2	840	2.6
45- 49	70	0.1	29	0.1
50- 54	2	0.0	1	0.0
55- 59	2	0.0	1	0.0
60- 64	2	0.0	1	0.0
65- 69	0	0.0	0	0.0
70- 74	0	0.0	0	0.0

Table 21 Total biomass indices (B) ($x10^{-3}$ tons) and their standard errors (S_B) in tons ($x10^{-3}$) and %

Area	Cod			Haddock			Saithe			Redfish			Catfish			Long rough dab		
	B	S_B	%	B	S_B	%	B	S_B	%	B	S_B	%	B	S_B	%	B	S_B	%
South	92	20	22	190	57	30	35	12	34	325	53	16	17	5	29	13	2	14
North	464	87	19	54	6	11	1	2	20	104	15	14	25	3	12	37	3	8
Total	556	89	16	244	57	23	44	12	27	429	55	13	43	6	14	49	3	6

Table 22 Spawning stock biomass indices (SSB) in tons ($x10^{-3}$) and in % of B

Area	Cod		Haddock		Saithe		Catfish	
	SSB	%	SSB	%	SSB	%	SSB	%
South	61	66	117	62	14	40	14	82
North	111	24	22	40	5	54	18	71
Total	157	28	139	57	19	42	32	76

Table 23 Stratified mean catch per standard tow (4 nautical miles) in number ($\bar{Y}$) and standard error of the mean ($S_{\bar{Y}}$) (in numbers and percentage)

Area	Cod			Haddock			Saithe			Redfish			Catfish			Long rough dab		
	$\bar{Y}$	$S_{\bar{Y}}$	%	$\bar{Y}$	$S_{\bar{Y}}$	%	$\bar{Y}$	$S_{\bar{Y}}$	%	$\bar{Y}$	$S_{\bar{Y}}$	%	$\bar{Y}$	$S_{\bar{Y}}$	%	$\bar{Y}$	$S_{\bar{Y}}$	%
South	28	5	18	142	29	20	16	7	44	560	95	17	17	4	24	79	10	13
North	418	78	19	86	13	15	4	0.6	15	253	27	11	35	4	11	137	10	7
Total	244	44	18	111	15	14	9	3	33	390	45	12	27	3	11	111	7	6

Table 24 Stratified mean catch per standard tow in weight ($\bar{Y}_W$) and standard error of the mean $S_{\bar{Y}}$ (in weight and percentage)

Area	Cod			Haddock			Saithe			Redfish			Catfish			Long rough dab.		
	$\bar{Y}_W$	$S_{\bar{Y}}$	%	$\bar{Y}_W$	$S_{\bar{Y}}$	%	$\bar{Y}_W$	$S_{\bar{Y}}$	%	$\bar{Y}_W$	$S_{\bar{Y}}$	%	$\bar{Y}_W$	$S_{\bar{Y}}$	%	$\bar{Y}_W$	$S_{\bar{Y}}$	%
South	125	27	22	257	76	30	47	16	34	439	71	16	24	7	29	17	2	14
North	505	95	19	59	6	10	9	2	21	114	16	14	27	3	12	40	3	8
Total	335	54	16	147	34	23	26	7	27	259	33	13	26	4	15	30	2	6

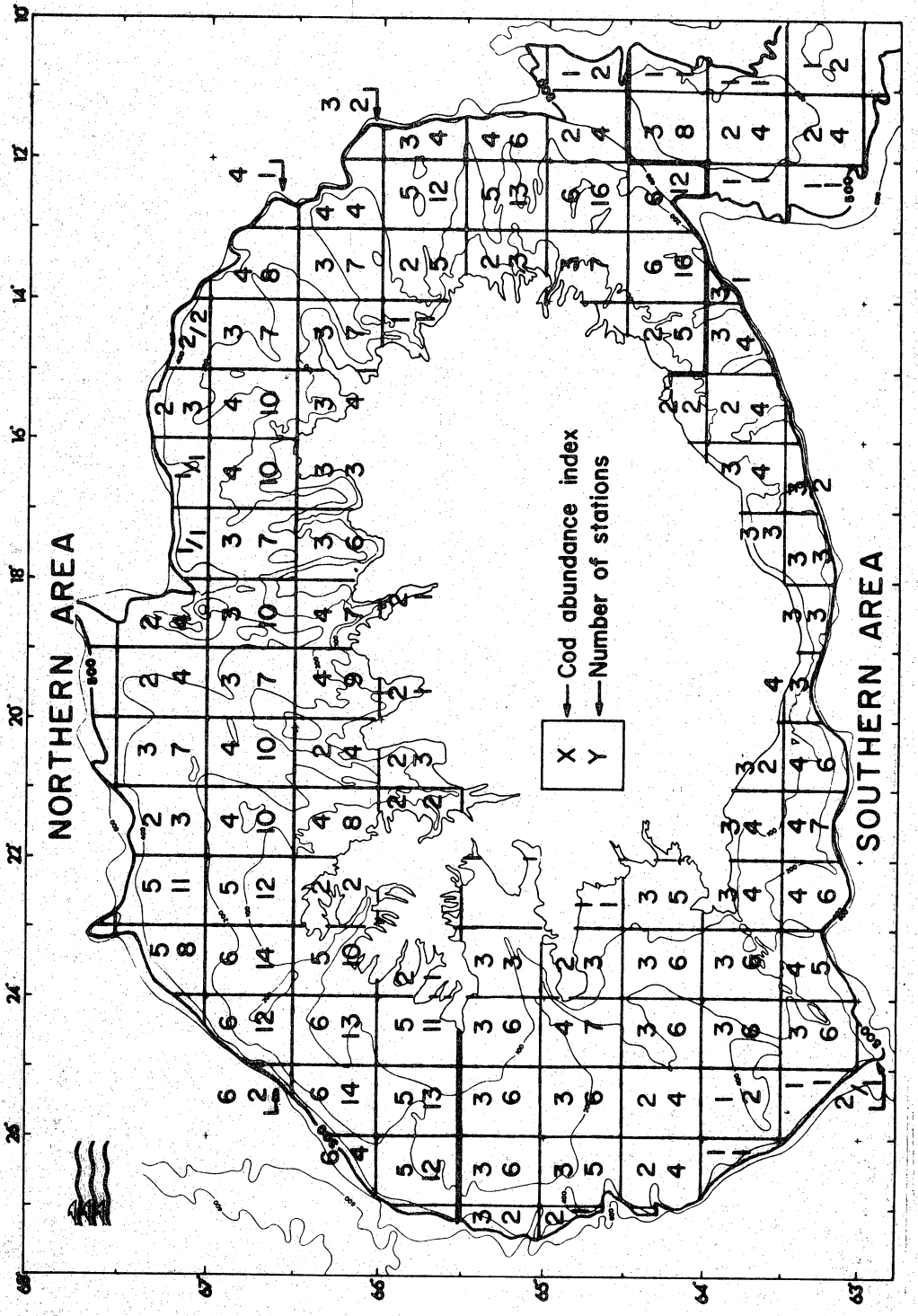


Fig. 1. The survey area within the 500 m depth contour, and the division in northern and southern areas. Cod abundance index and number of stations within each rectangle are shown.

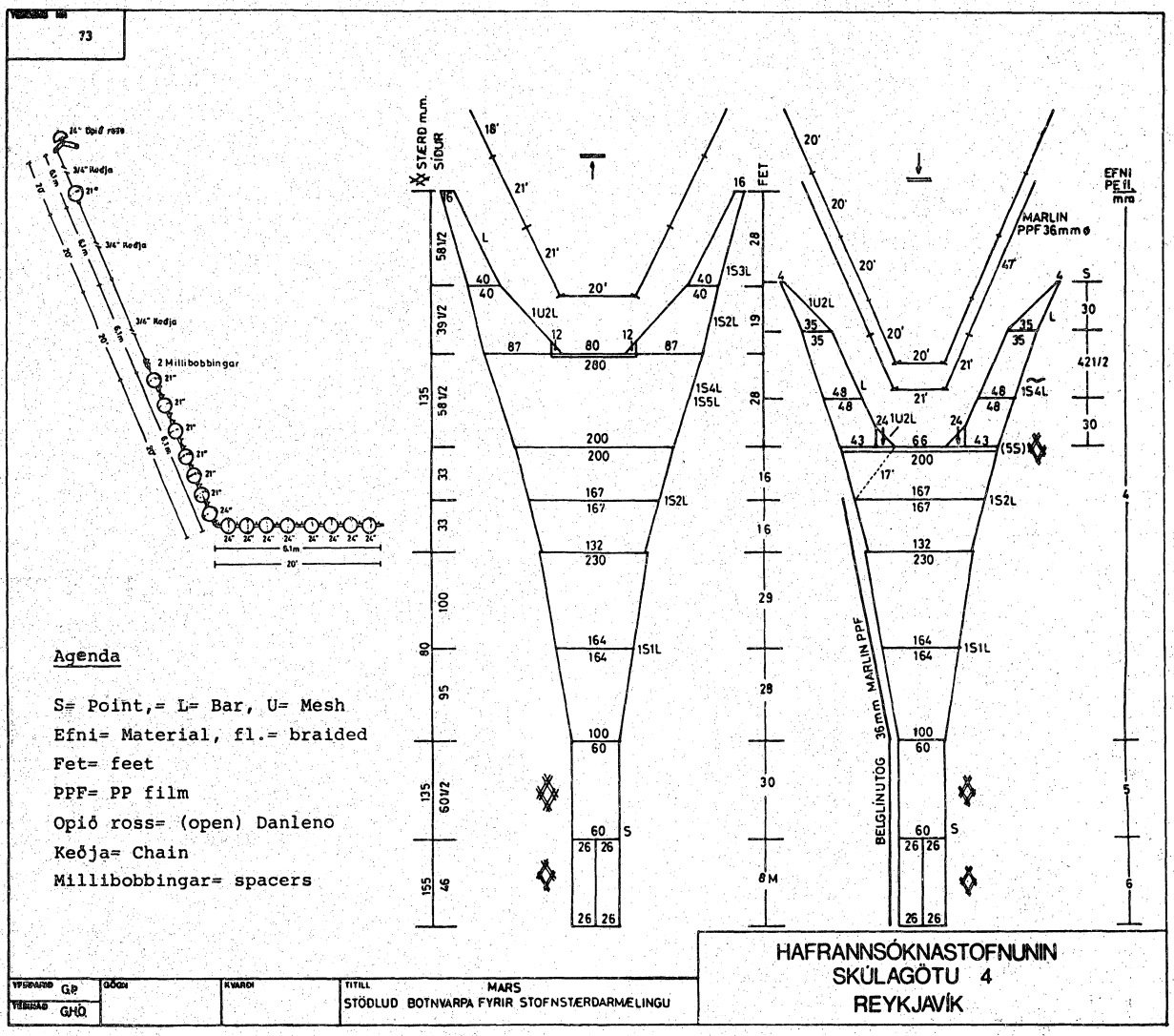


Figure 2. Standardized bottom trawl for the Icelandic ground fish survey.

Headline = 18 mm SW 105'.
Floats (4 1): 82 (15, 15, 22, 15, 15) + 12 on codend.
Fishing line: 3x21'13 mm (1/2") chain.
Wing line: 14 (16) mm comb. wire 47'.
Headline legs: 16 mm SW 18'.
Bobbins footrope: 20 mm (3/4") chain 3x20'.
Spacers: 30 pieces (Approx. 7.5 kg each).
Bridles: 36 mm (3 1/2") SW 35 fathoms and
+ 10 fathoms chain beyond 100 fm depth.
Otter boards: Poly-Ice No 7 (1750 kg).
Back strops: 20'(double) + 10'(single).
Codend cover (+ extension piece) 40 mm.

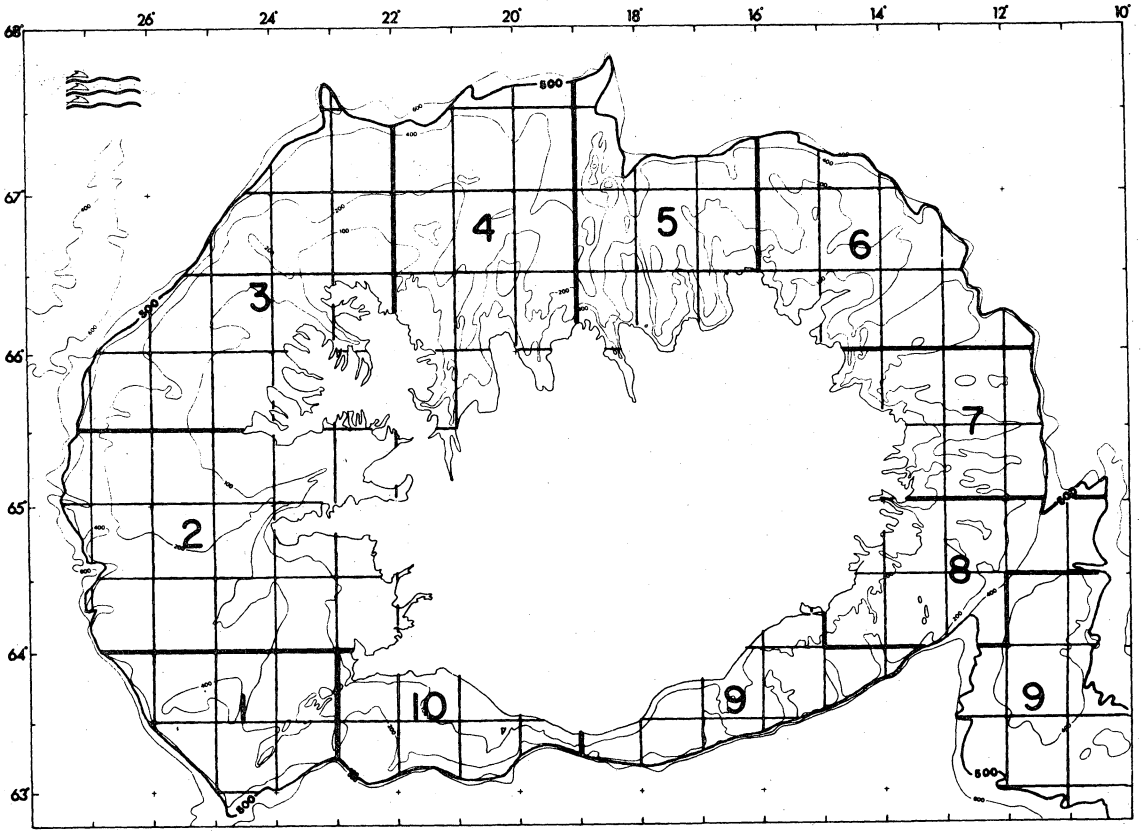


Fig. 3. Subareas for length stratified sampling of otoliths.

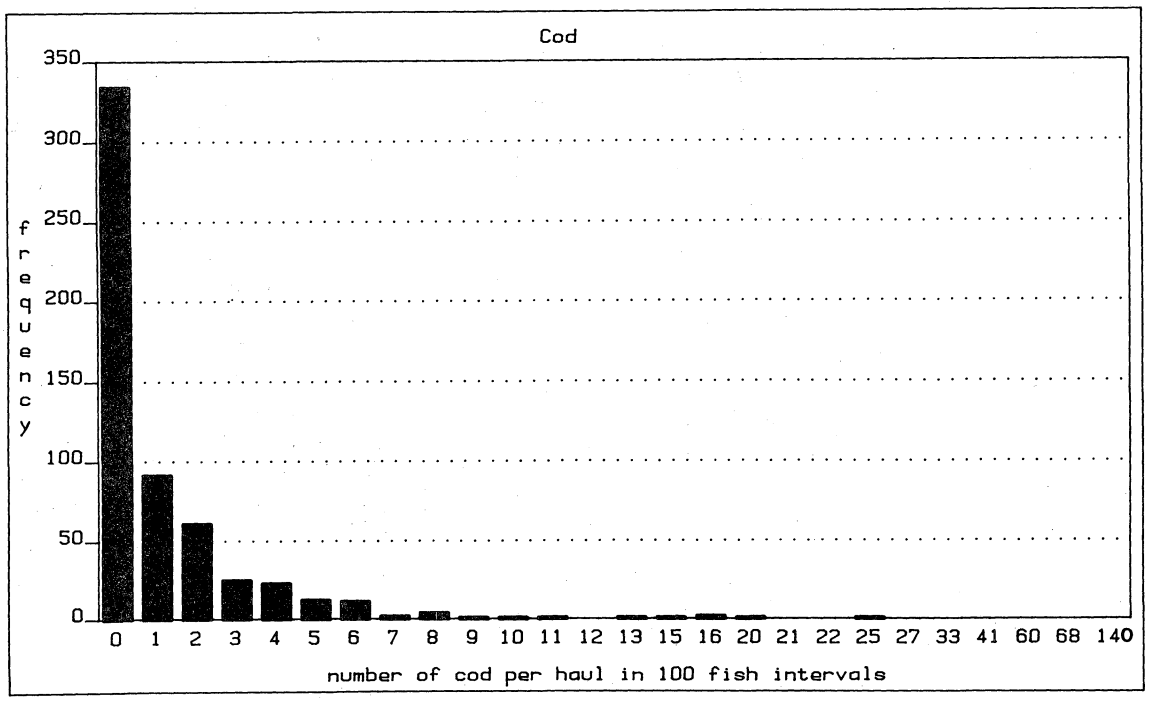
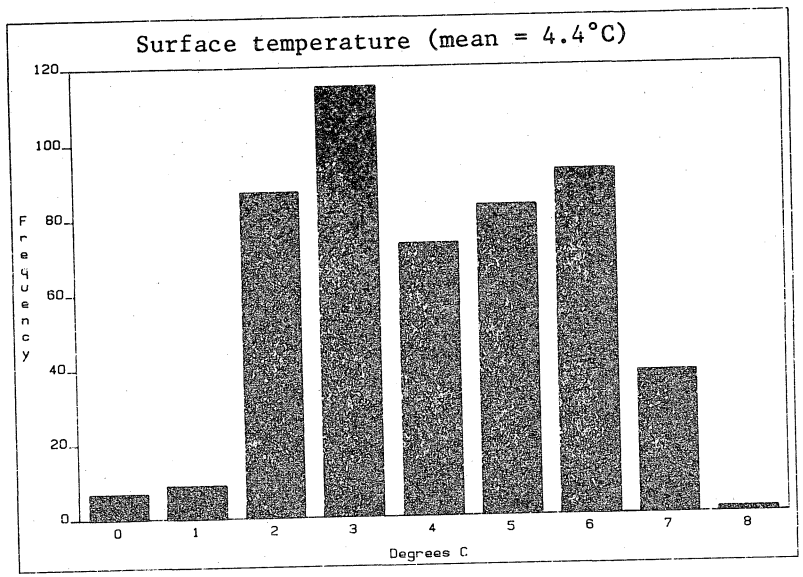
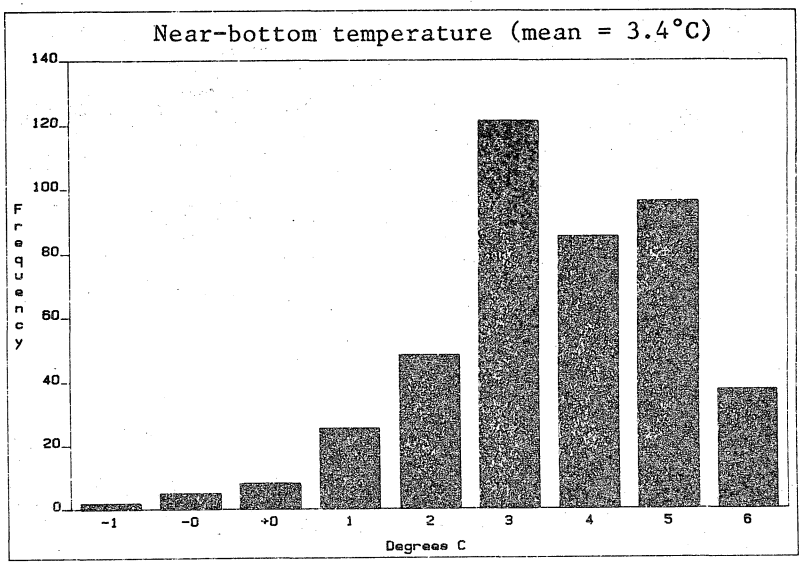
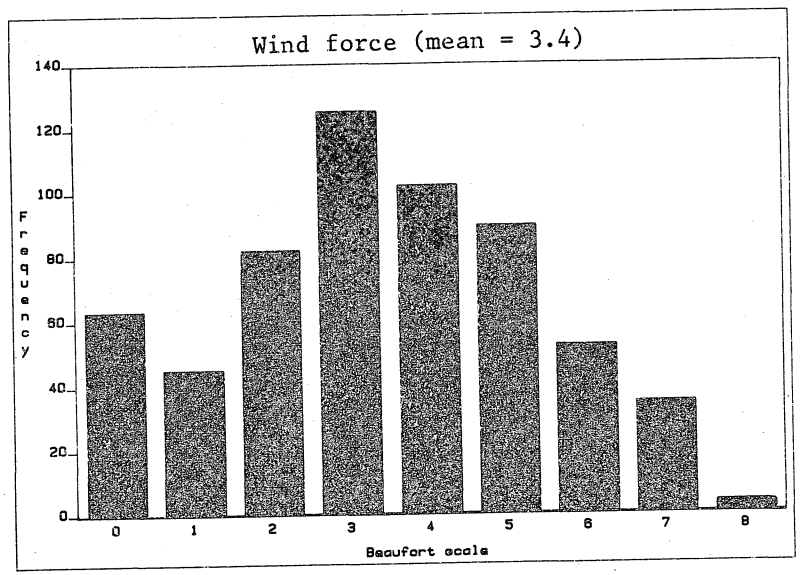


Fig. 4. Frequency distribution of catches of cod in March 1985 (number of fish in standard tow).







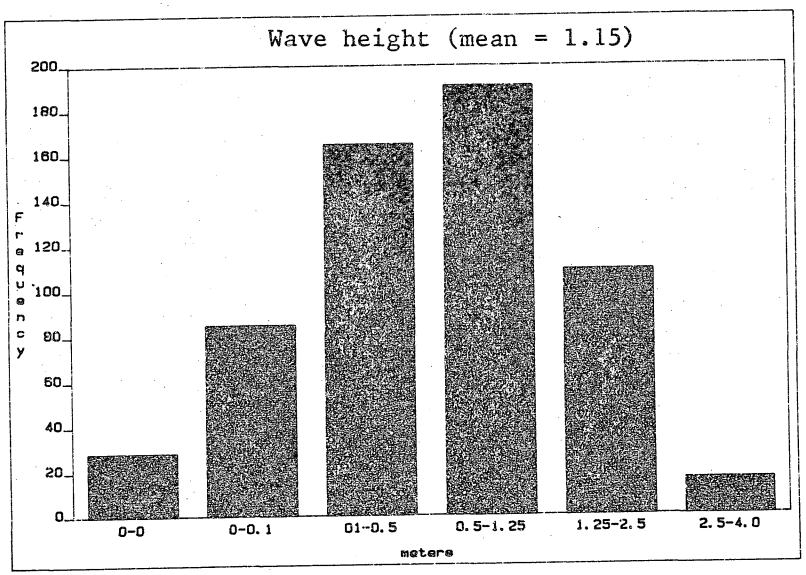
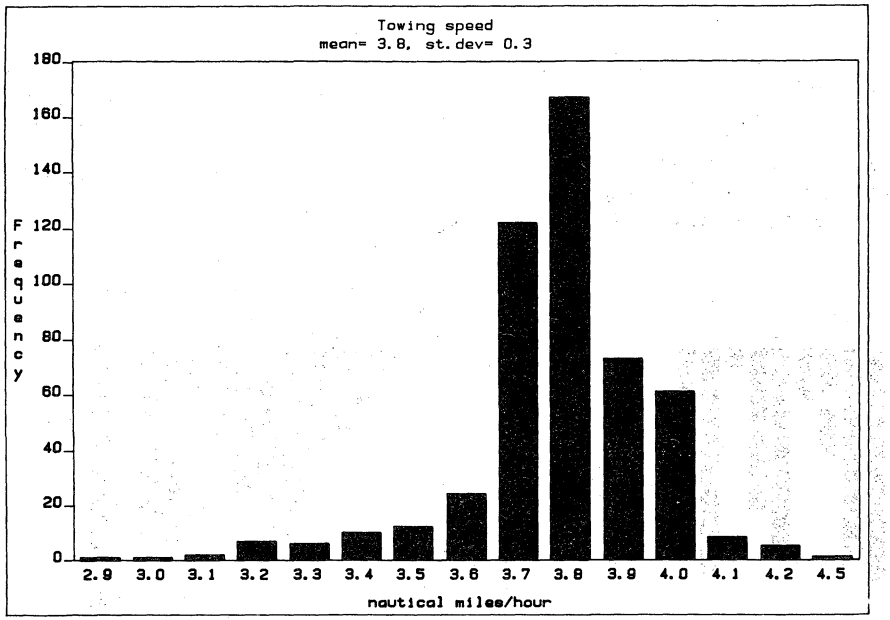
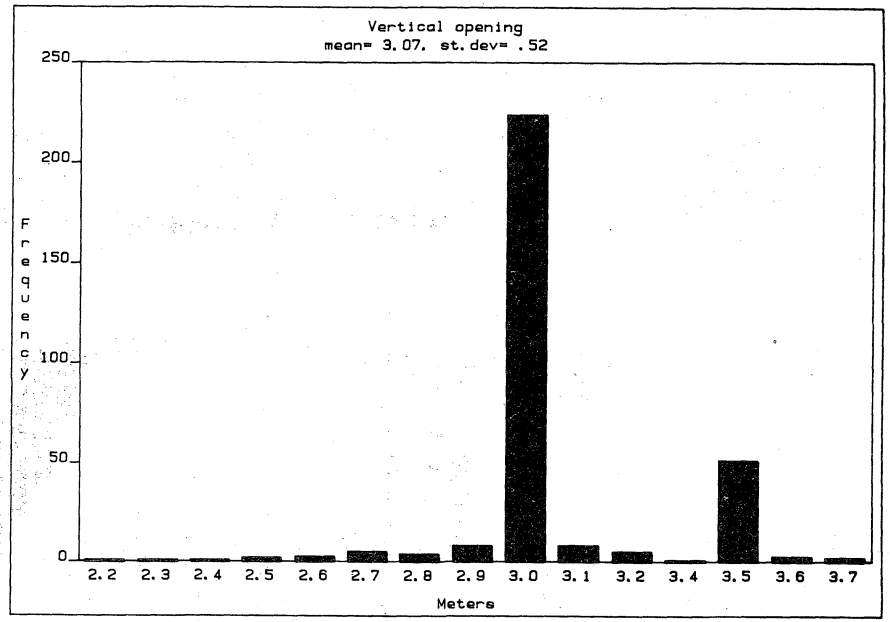


Fig. 5. Environmental features during the sampling 8-25 March.





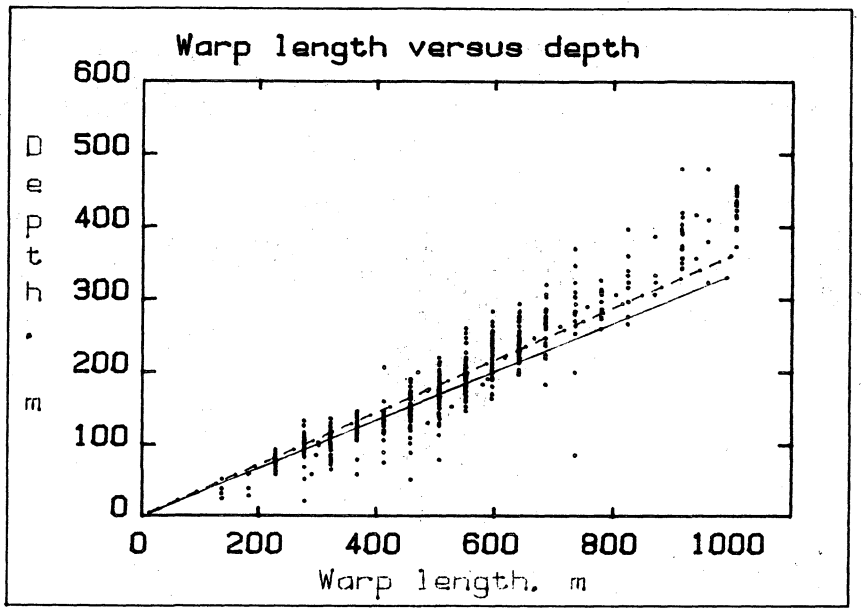


Fig. 6. Fishing gear parameters during the sampling 8-25 March.

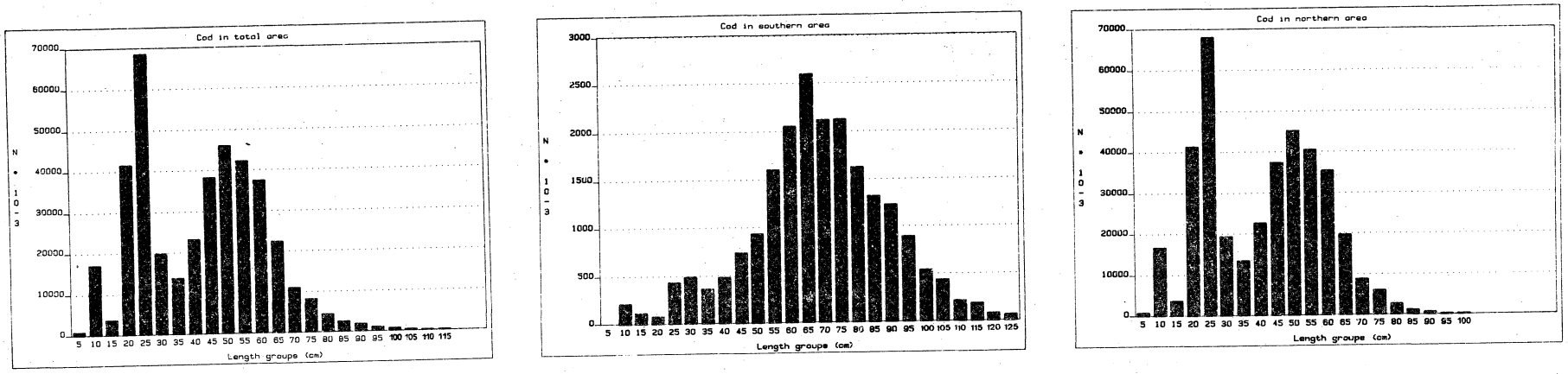


Fig. 7. The length distributions of cod in numbers.
Notice the different scales.
See Tables 3-5 for details.

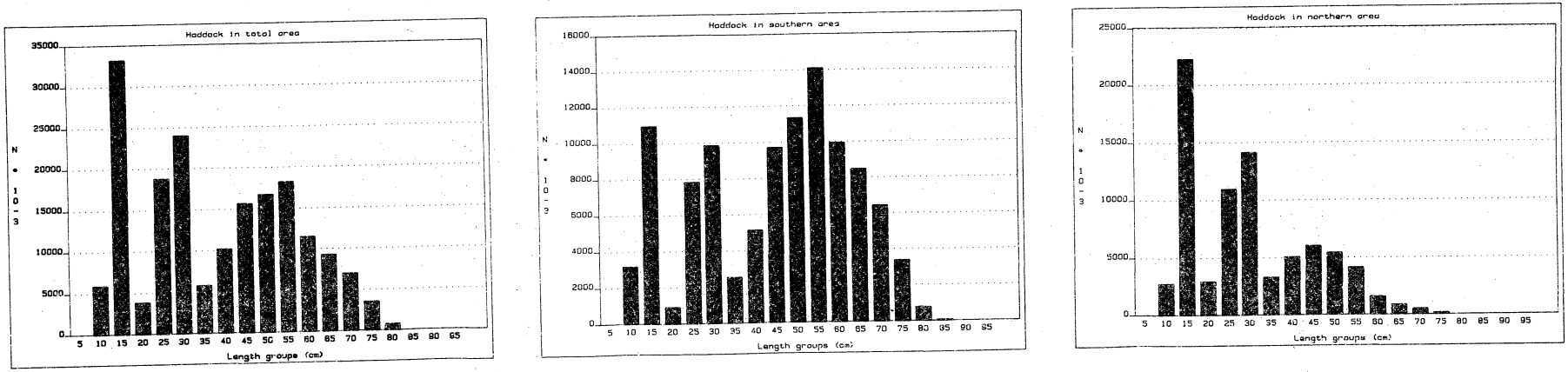


Fig. 8. The length distributions of haddock in numbers.
Notice the different scales.
See Tables 6-8 for details.

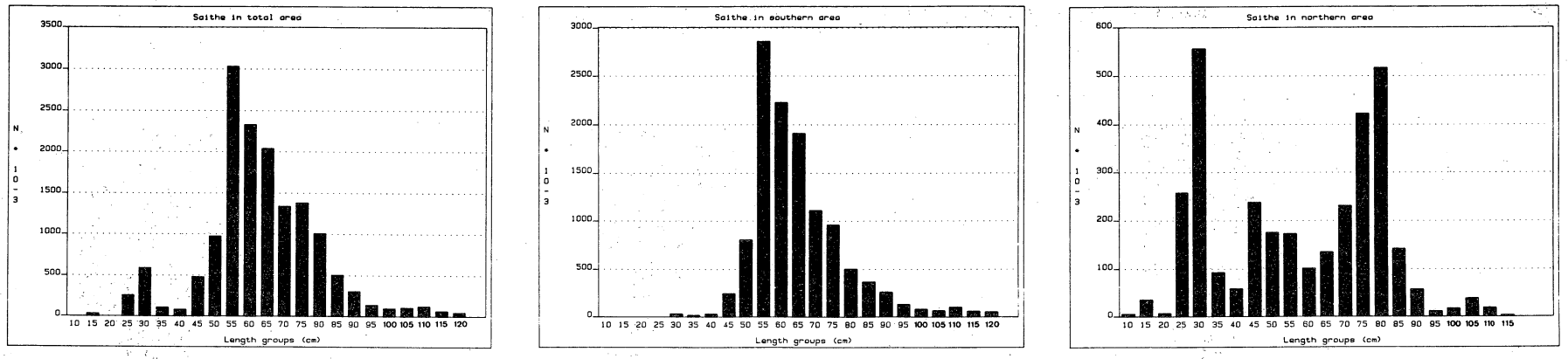


Fig. 9. The length distributions of saithe in numbers.
Notice the different scales.
See Tables 9-11 for details.

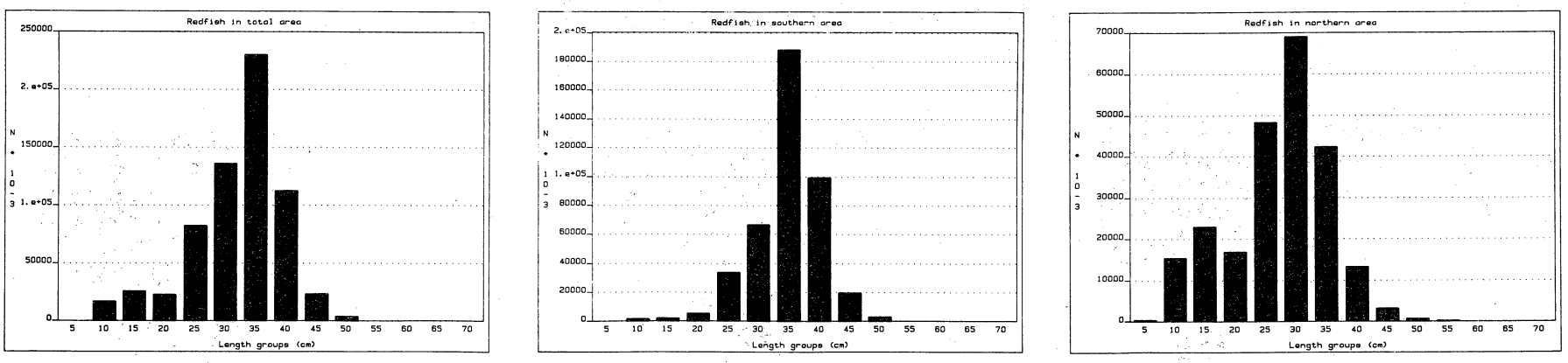
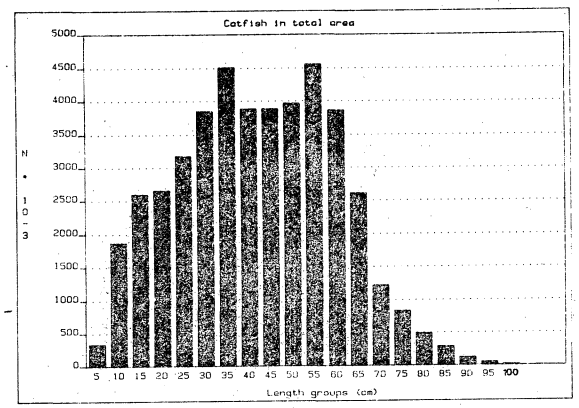
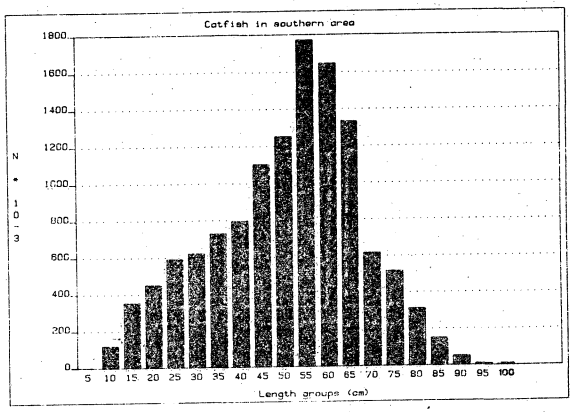


Fig. 10. The length distributions of redfish in numbers.
Notice the different scales.
See Tables 12-14 for details.





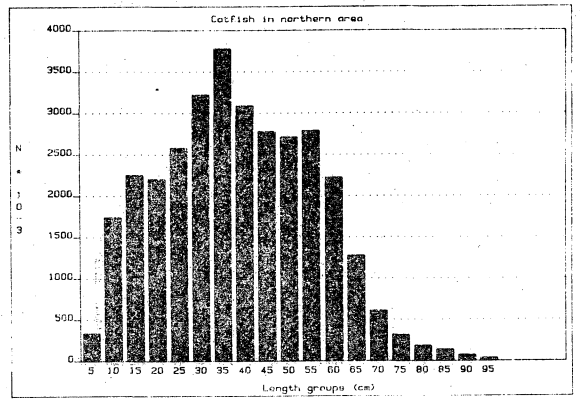
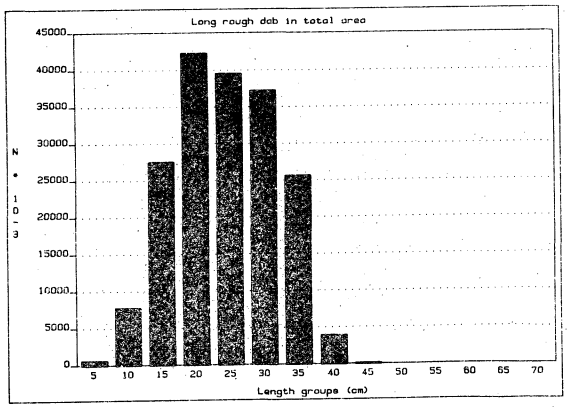
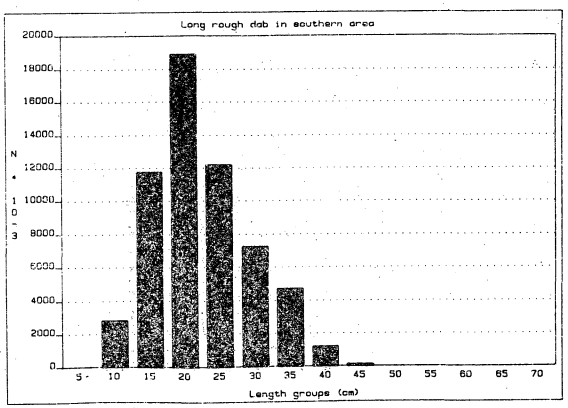


Fig. 11. The length distributions of catfish in numbers.
Notice the different scales.
See Tables 15-17 for details.





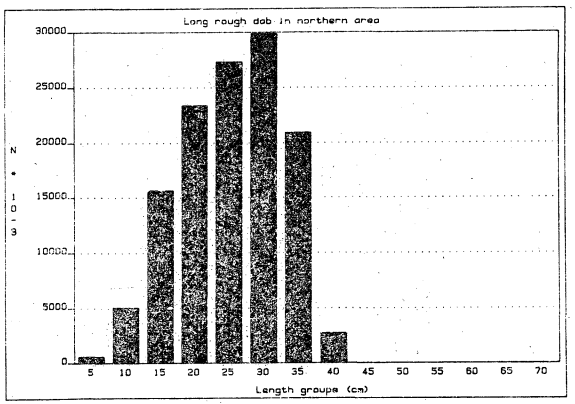


Fig. 12. The length distributions of long rough dab in numbers.
Notice the different scales.
See Tables 18-20 for details.

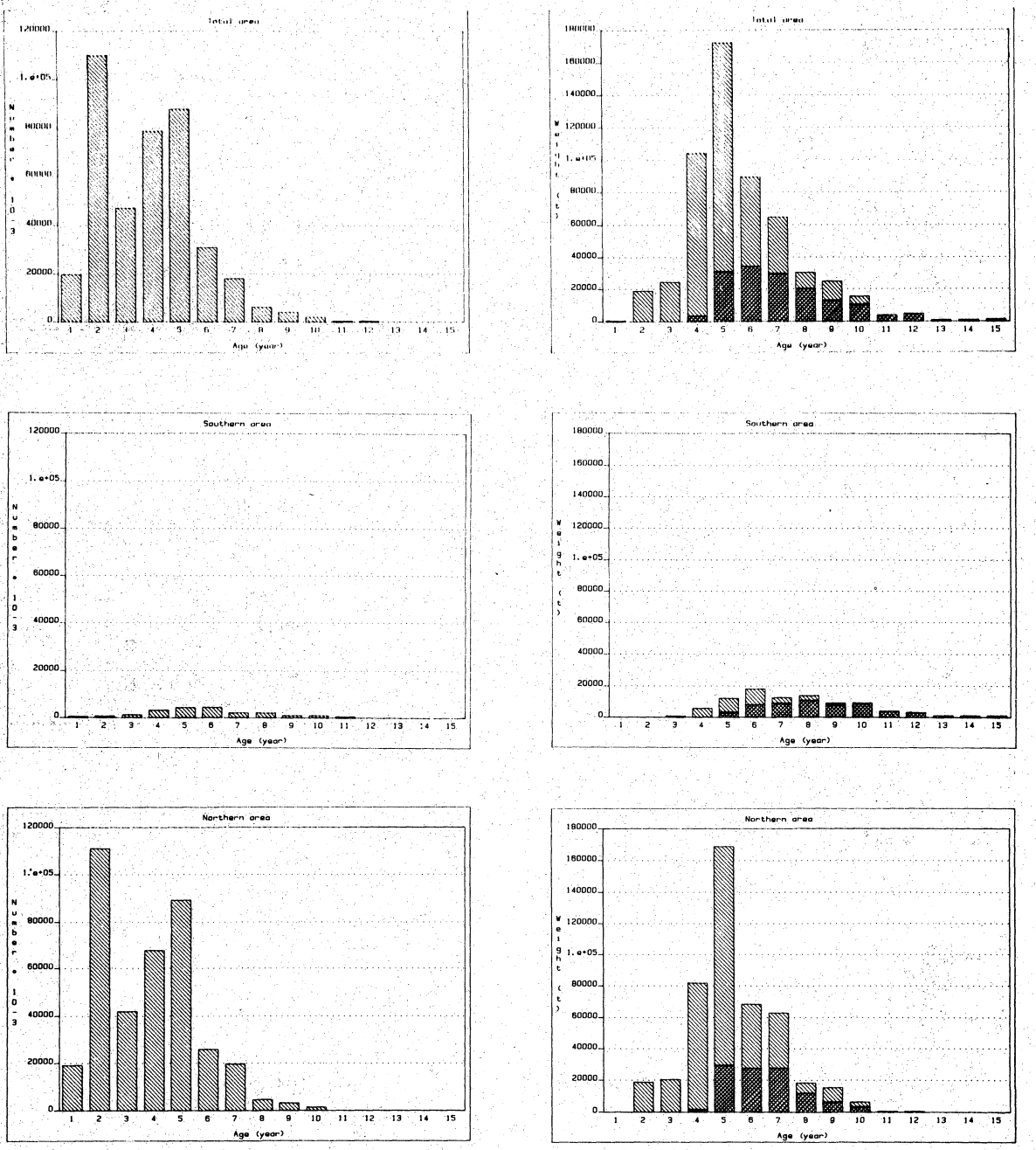
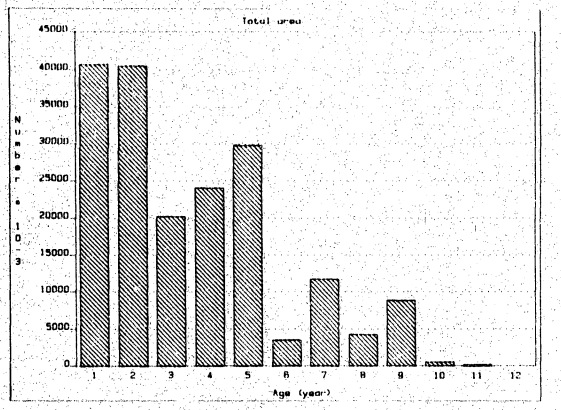
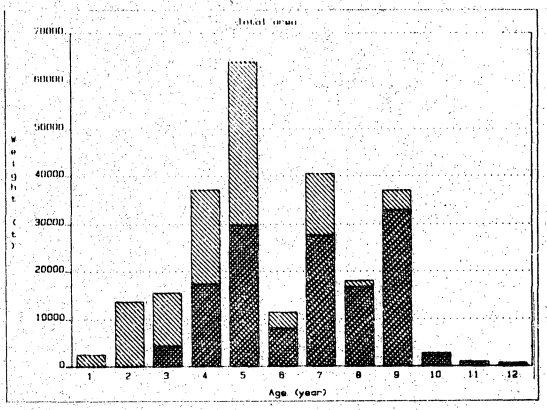
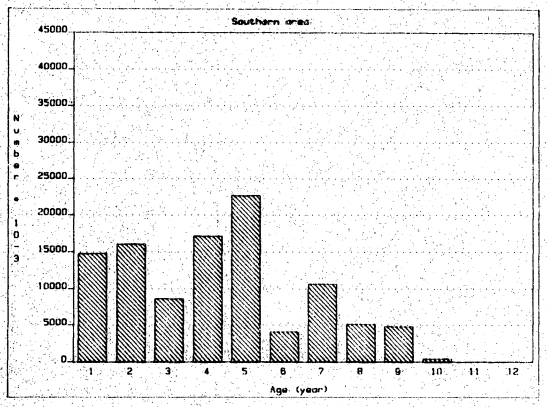
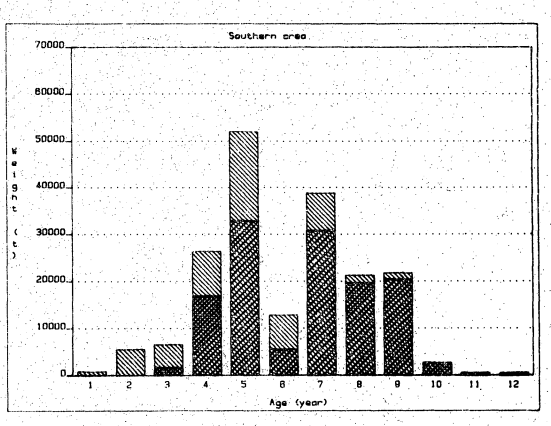


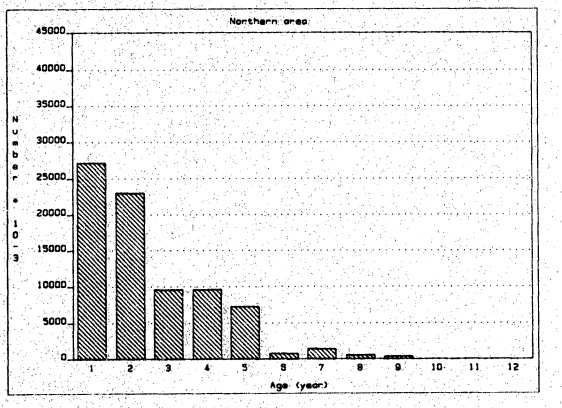
Fig. 13. The age distributions of cod in numbers and weight. The mature part of each age group (by weight) is indicated by the cross hatched part. See Tables 3-5 for details.











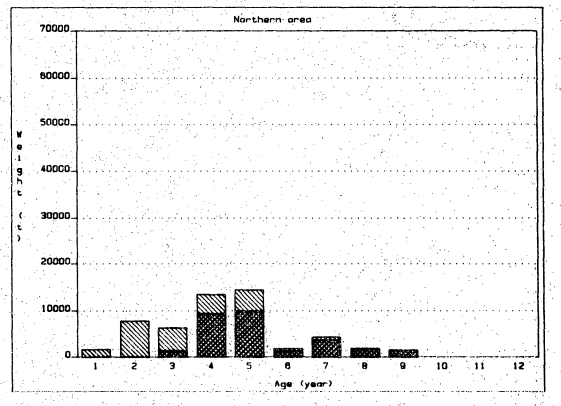


Fig. 14. The age distributions of haddock in numbers and weight. The mature part of each age group (by weight) is indicated by the cross hatched part. See Tables 6-8 for details.

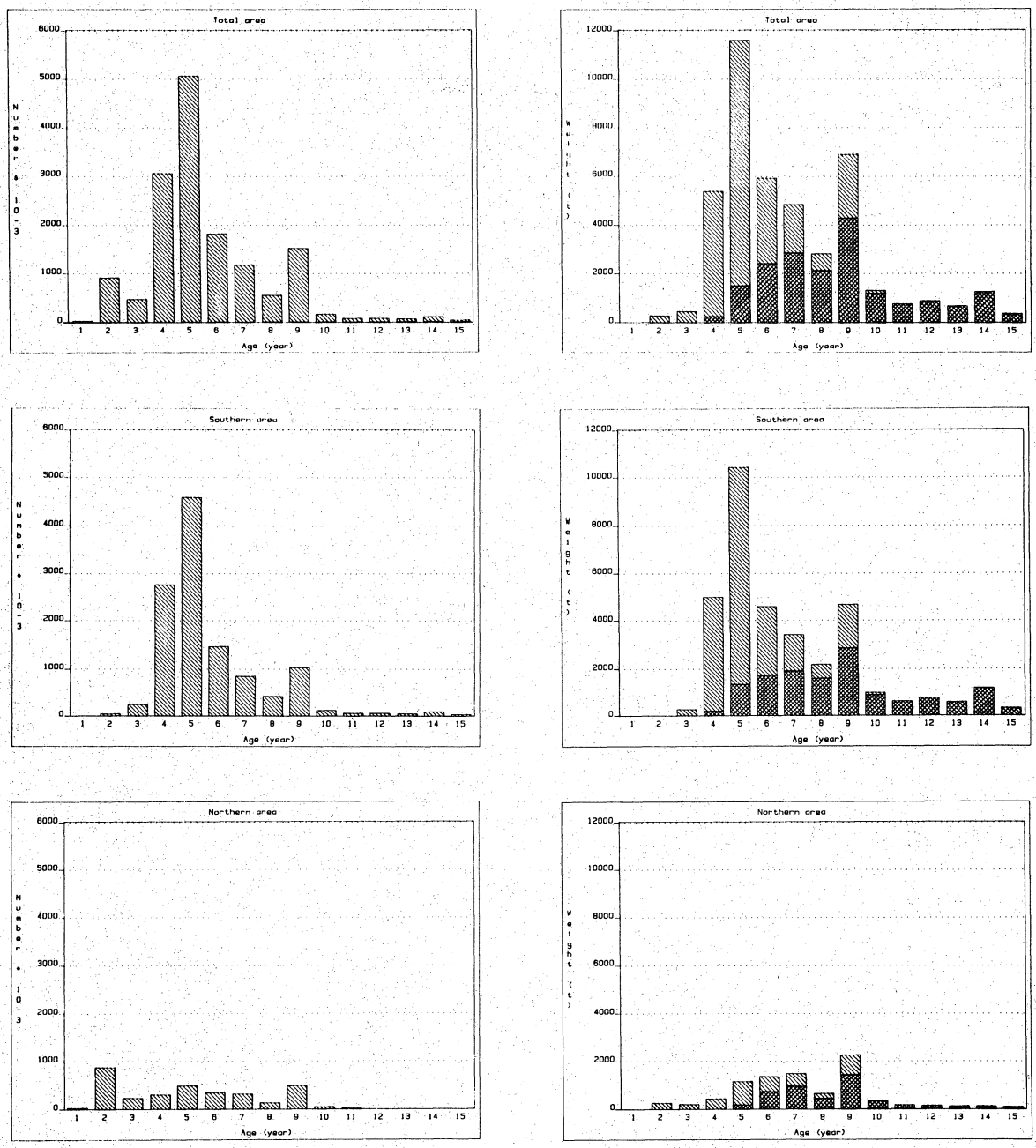


Fig. 15. The age distributions of saithe in numbers and weight. The mature part of each age group (by weight) is indicated by the cross hatched part. See Tables 9-11 for details.

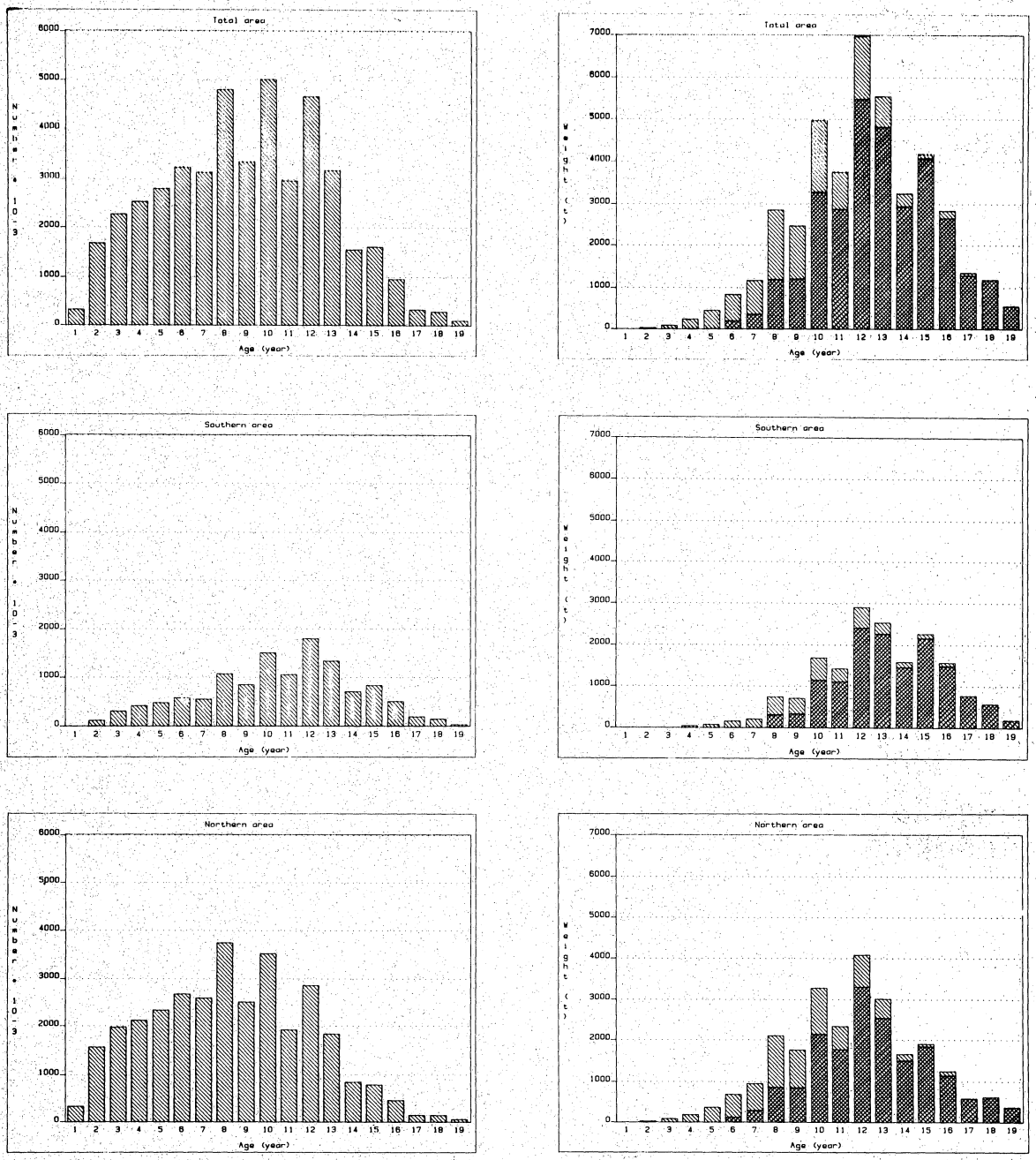


Fig. 16. The age distributions of catfish in numbers and weight. The mature part of each age group (by weight) is indicated by the cross hatched part. See Tables 15-17 for details.

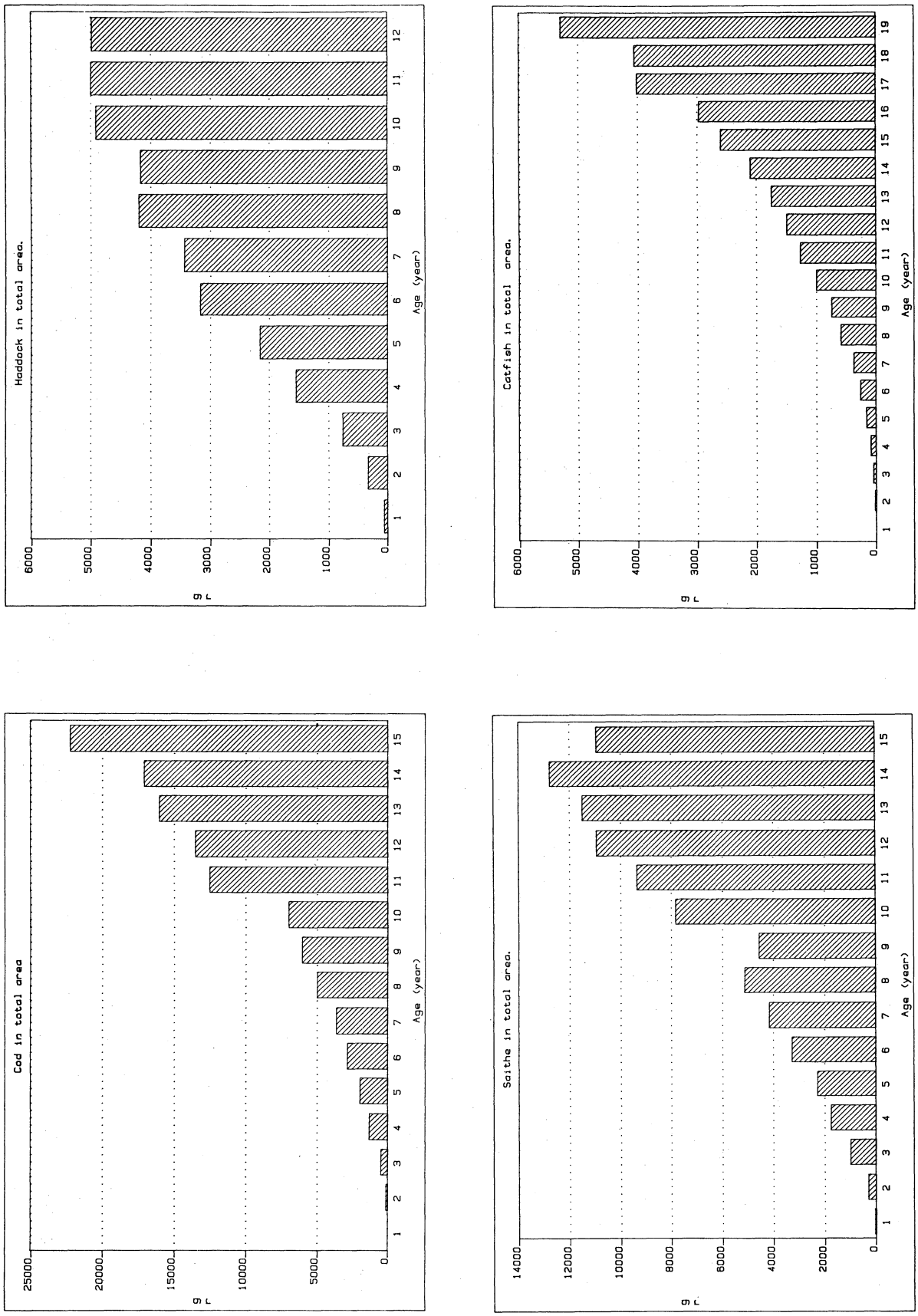
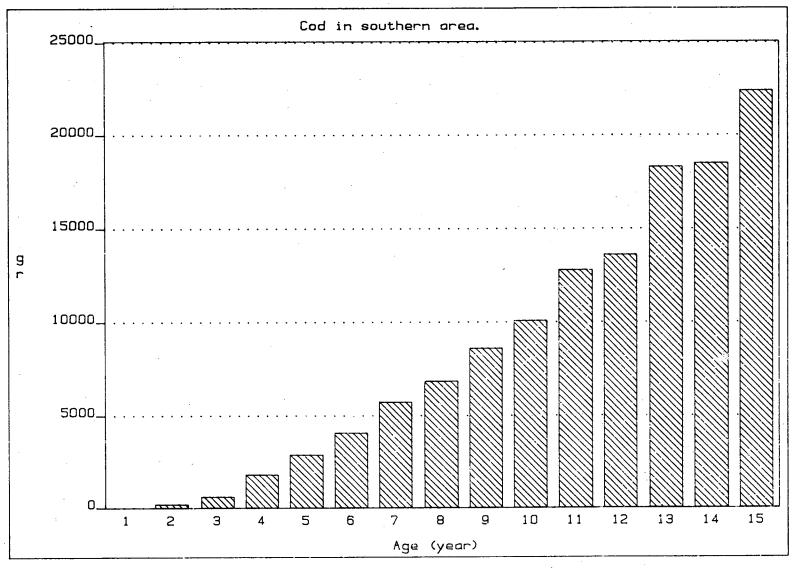
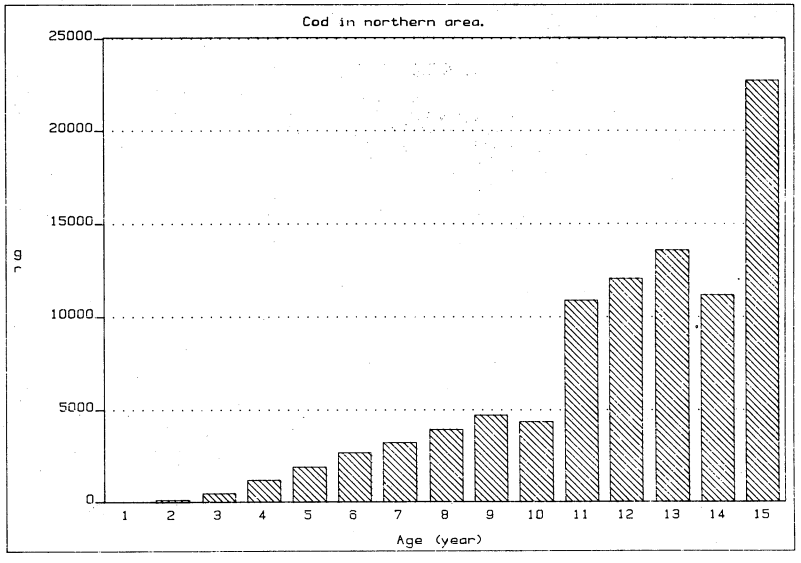
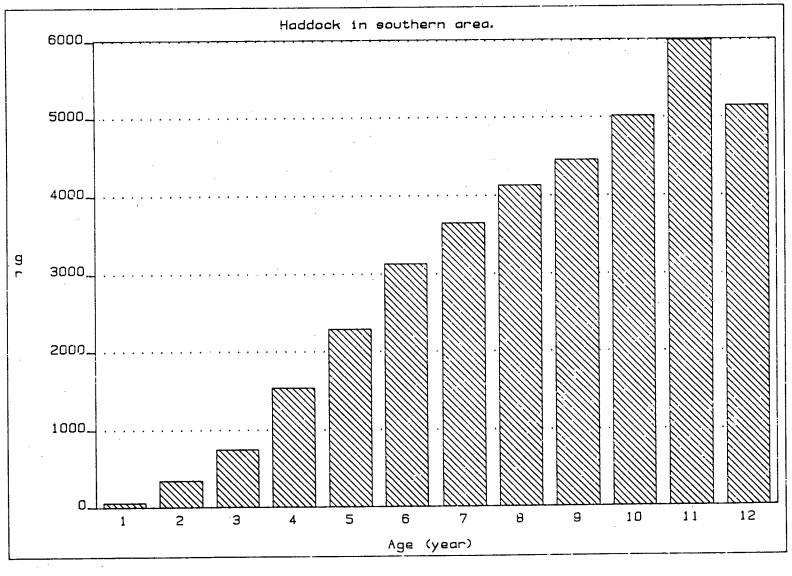


Fig. 17. The average weight at age (grams) of cod, haddock, saithe and catfish based on all data.







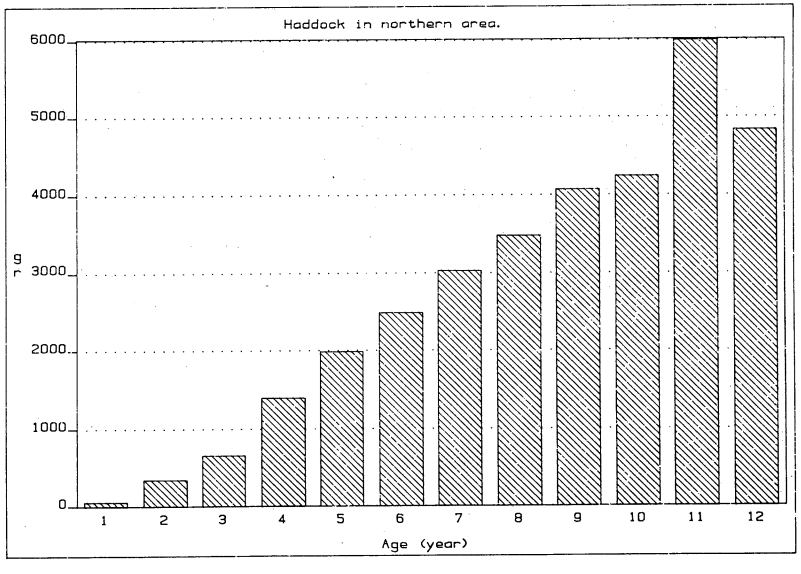
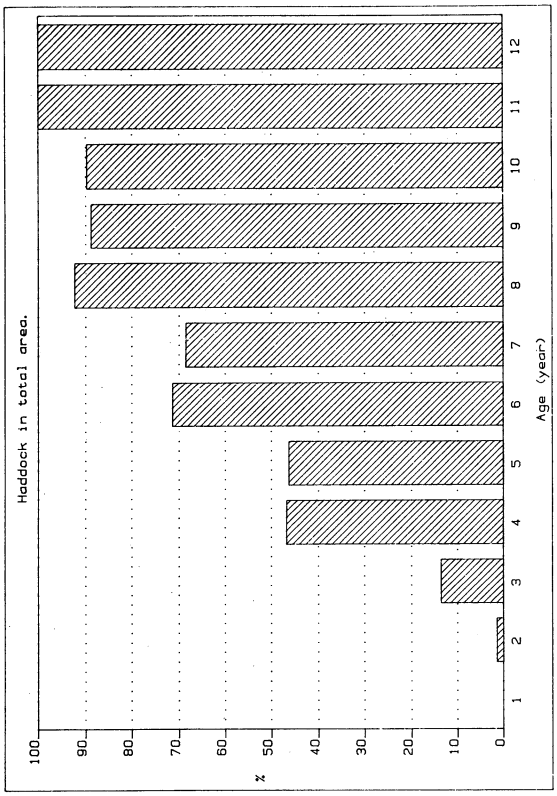
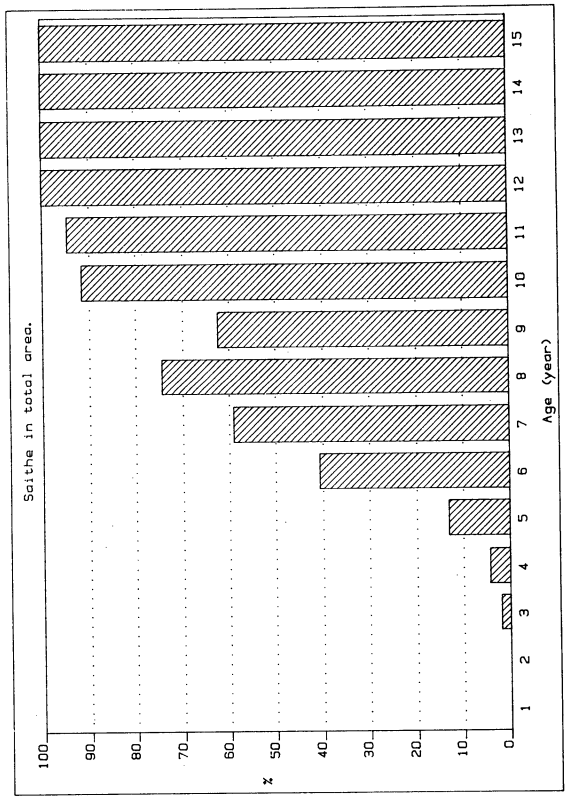
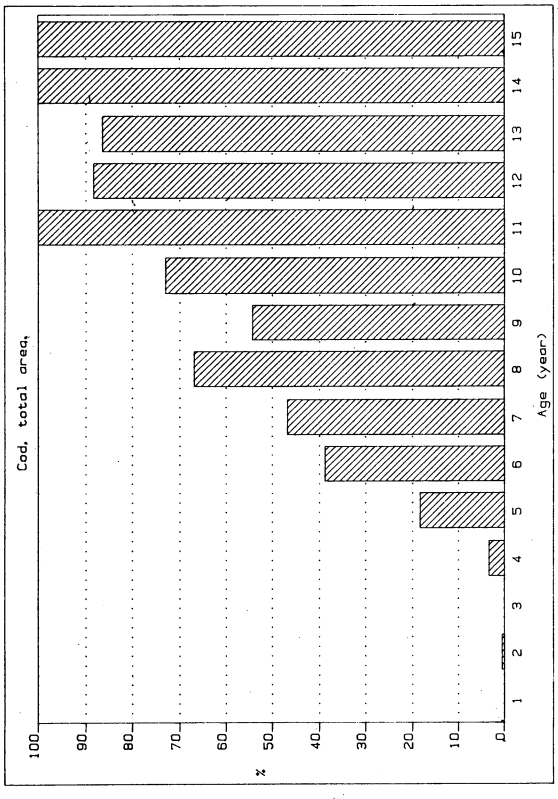


Fig. 18. The average weight (grams) of cod and haddock in the northern and the southern areas.







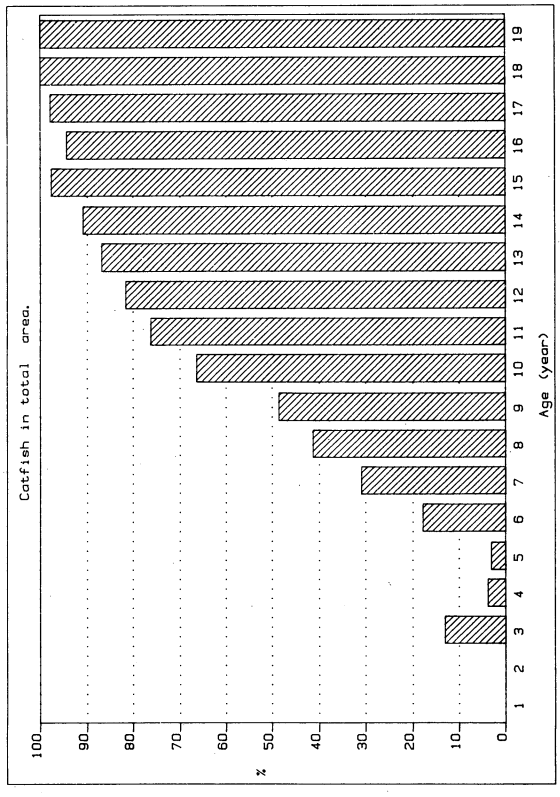


Fig. 19. Maturity at age (%) of cod, haddock, saithe and catfish based on all data.

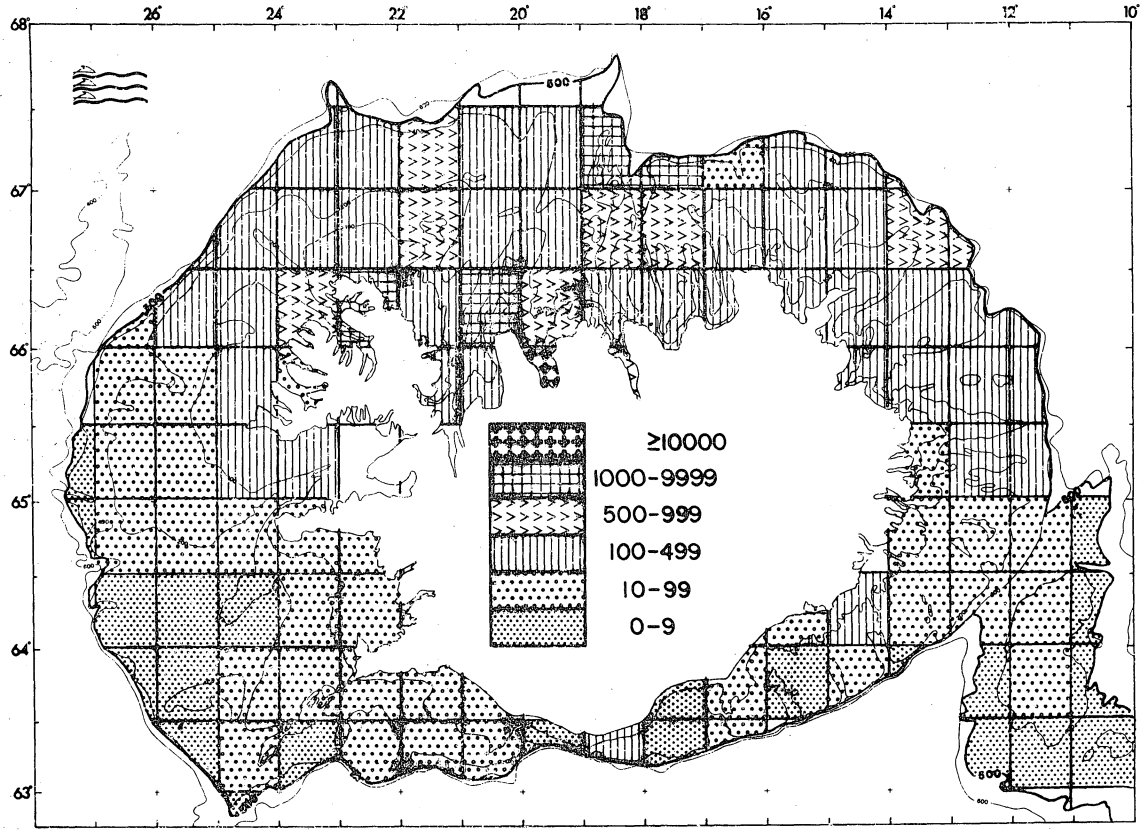


Fig. 20. The geographical distribution of cod based on the average number of fish per standard tow in a rectangle.

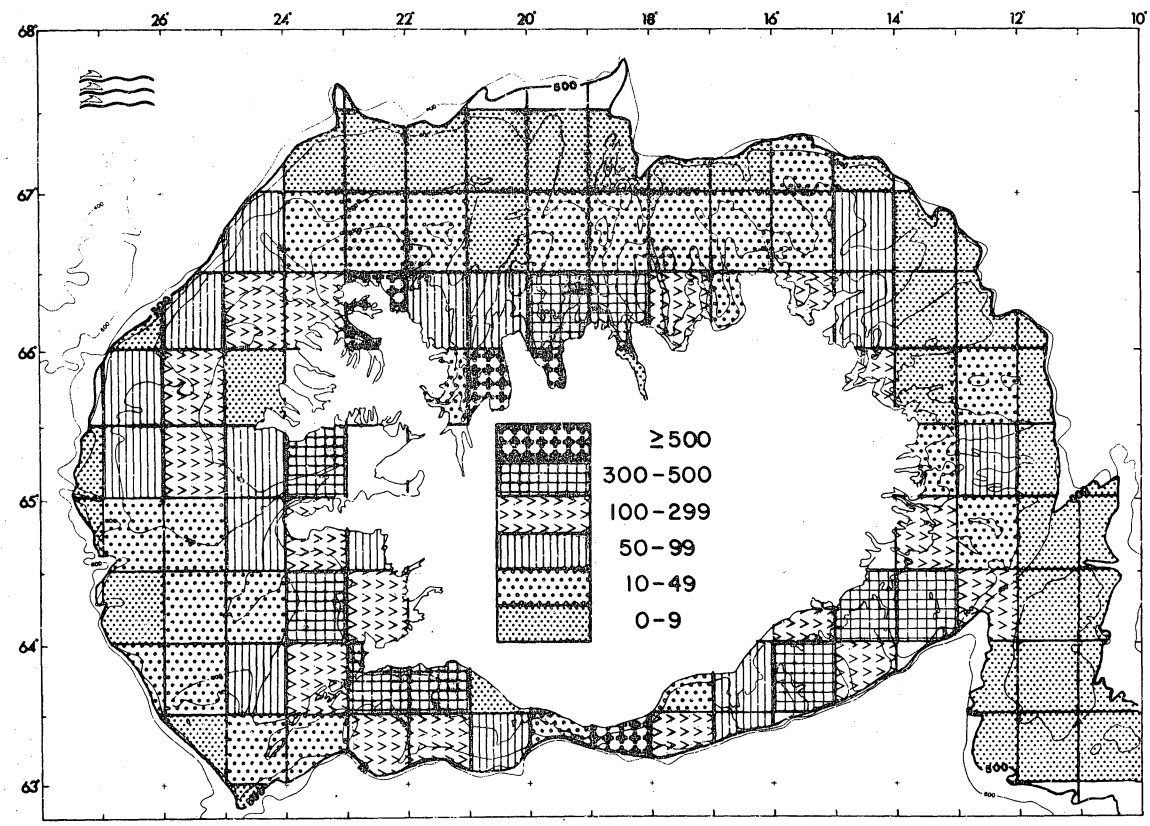


Fig. 21. The geographical distribution of haddock based on the average number of fish per standard tow in each rectangle.

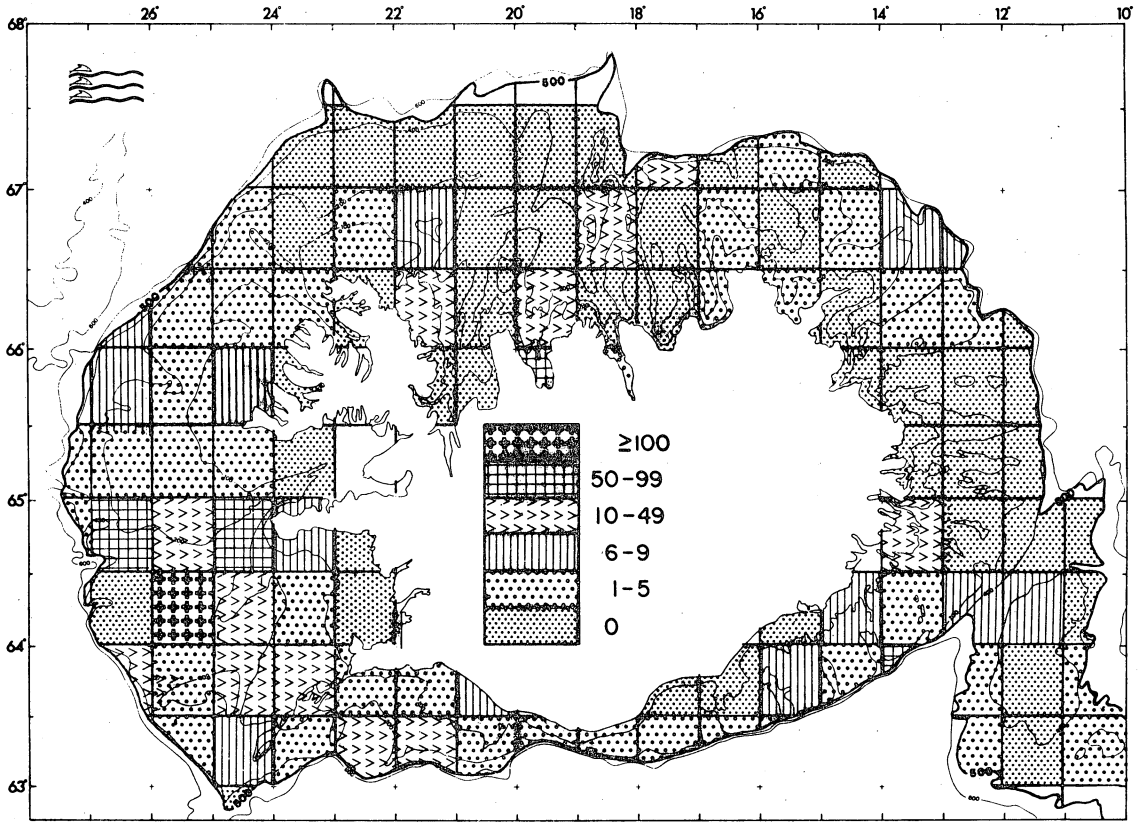


Fig. 22. The geographical distribution of saithe based on the average number of fish per standard tow in each rectangle.

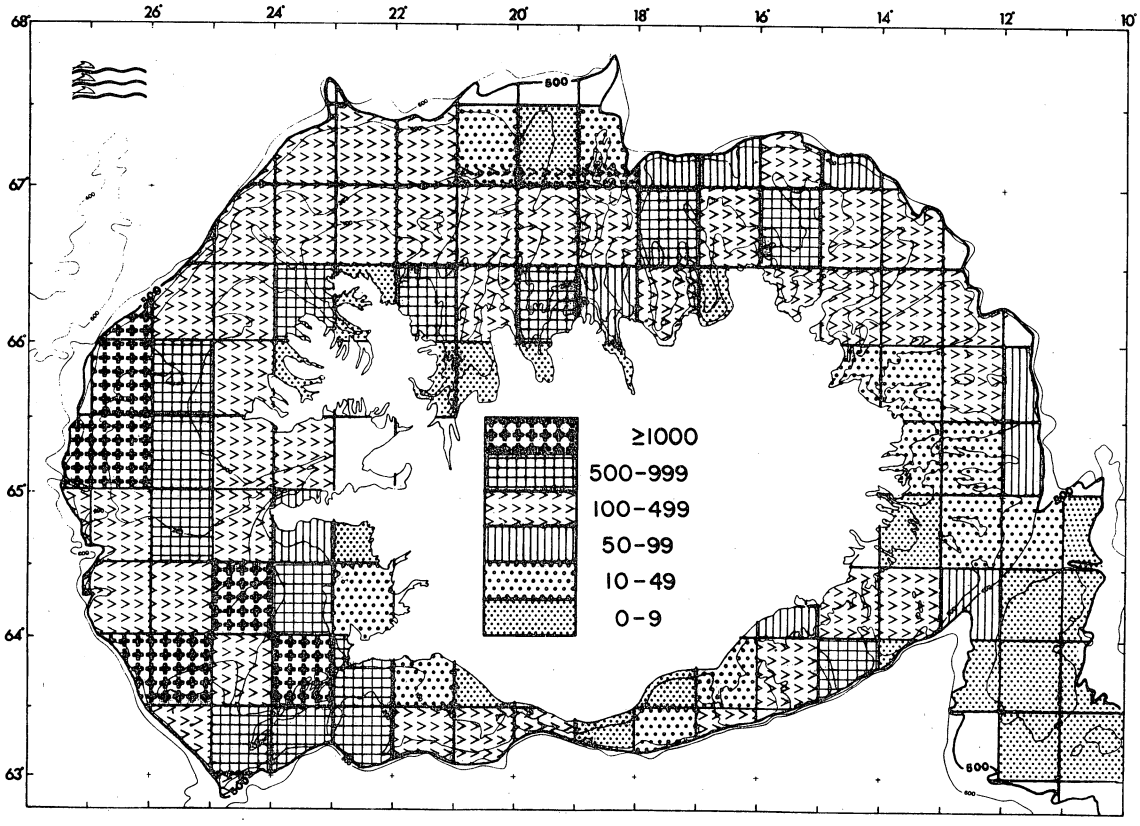


Fig. 23. The geographical distribution of redfish based on the average number of fish per standard tow in each rectangle.

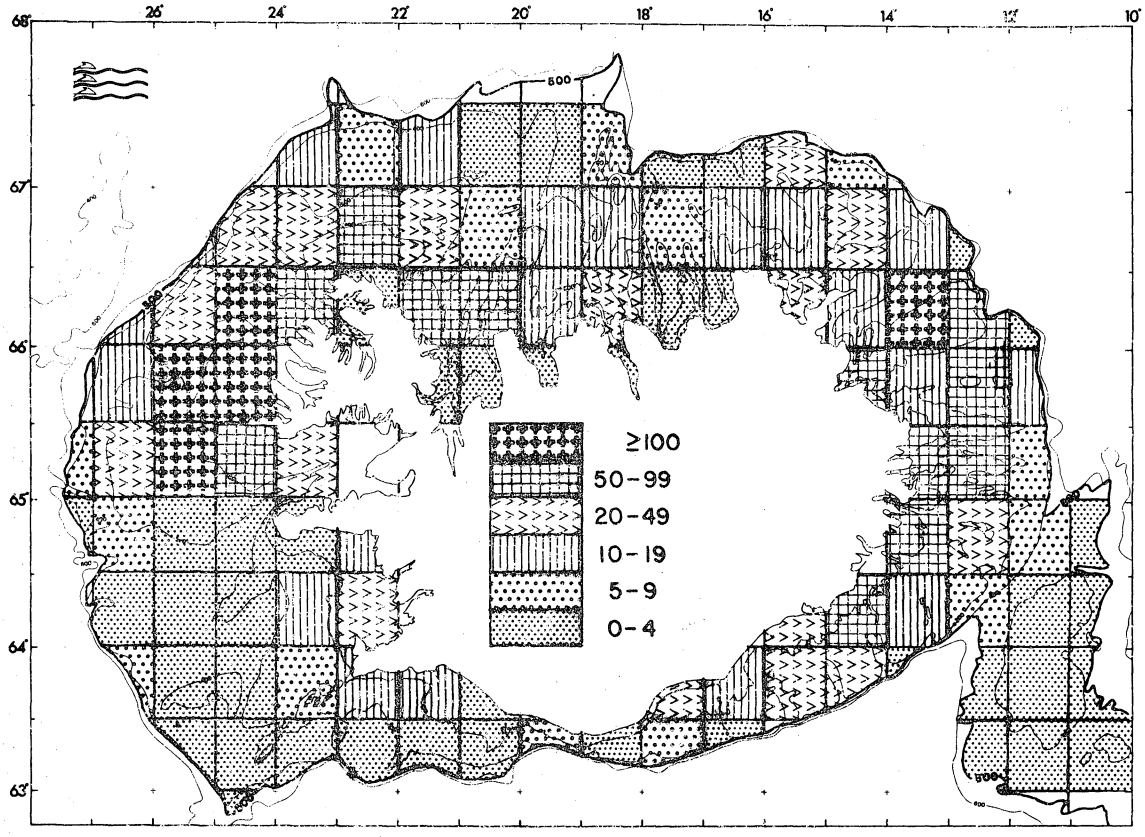


Fig. 24. The geographical distribution of catfish based on the average number of fish per standard tow in each rectangle.

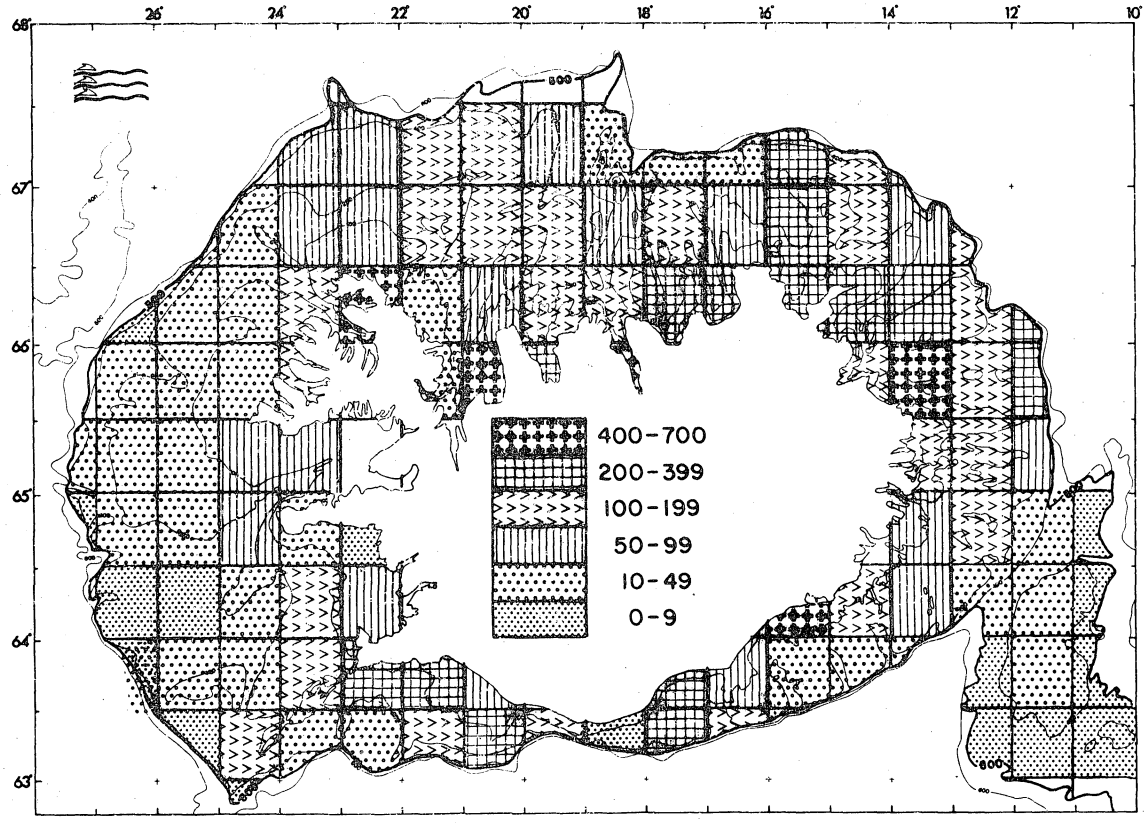
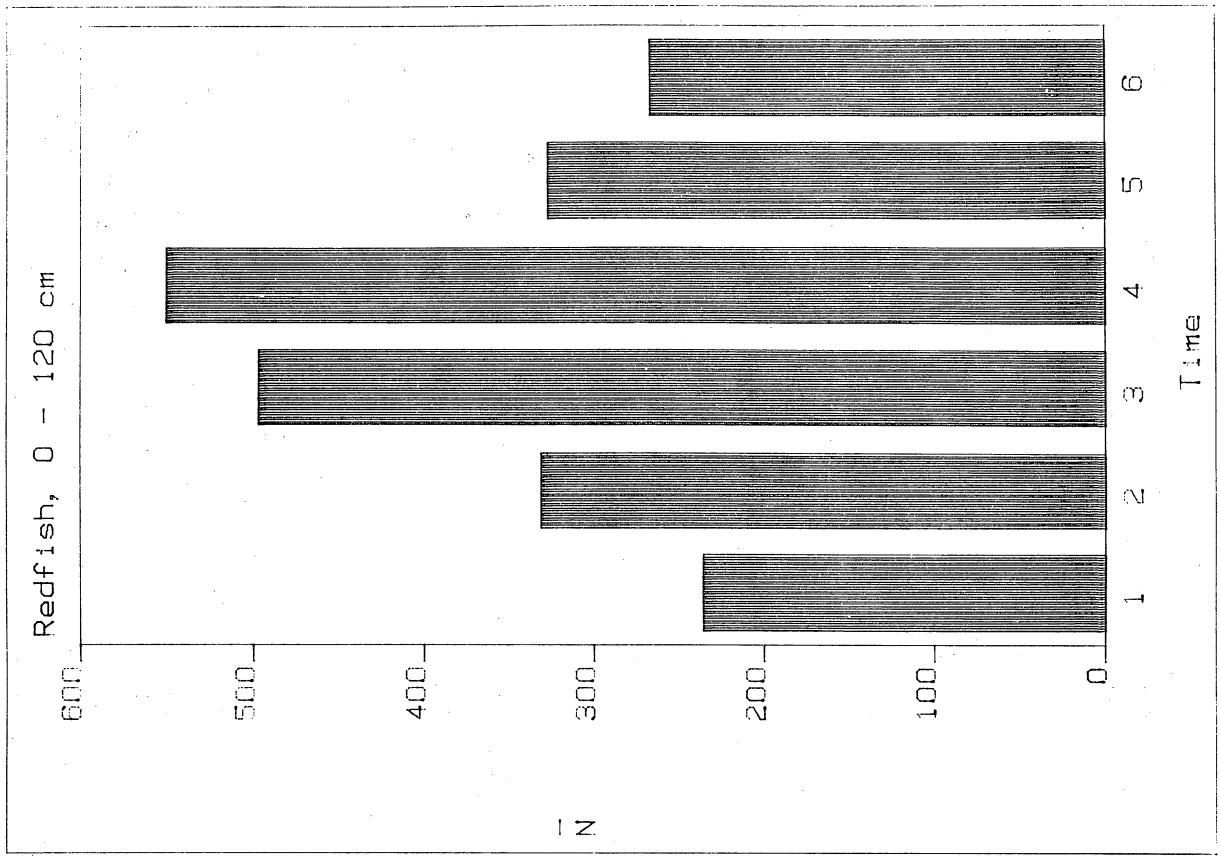


Fig. 25. The geographical distribution of long rough dab based on the average number of fish per standard tow in each rectangle.



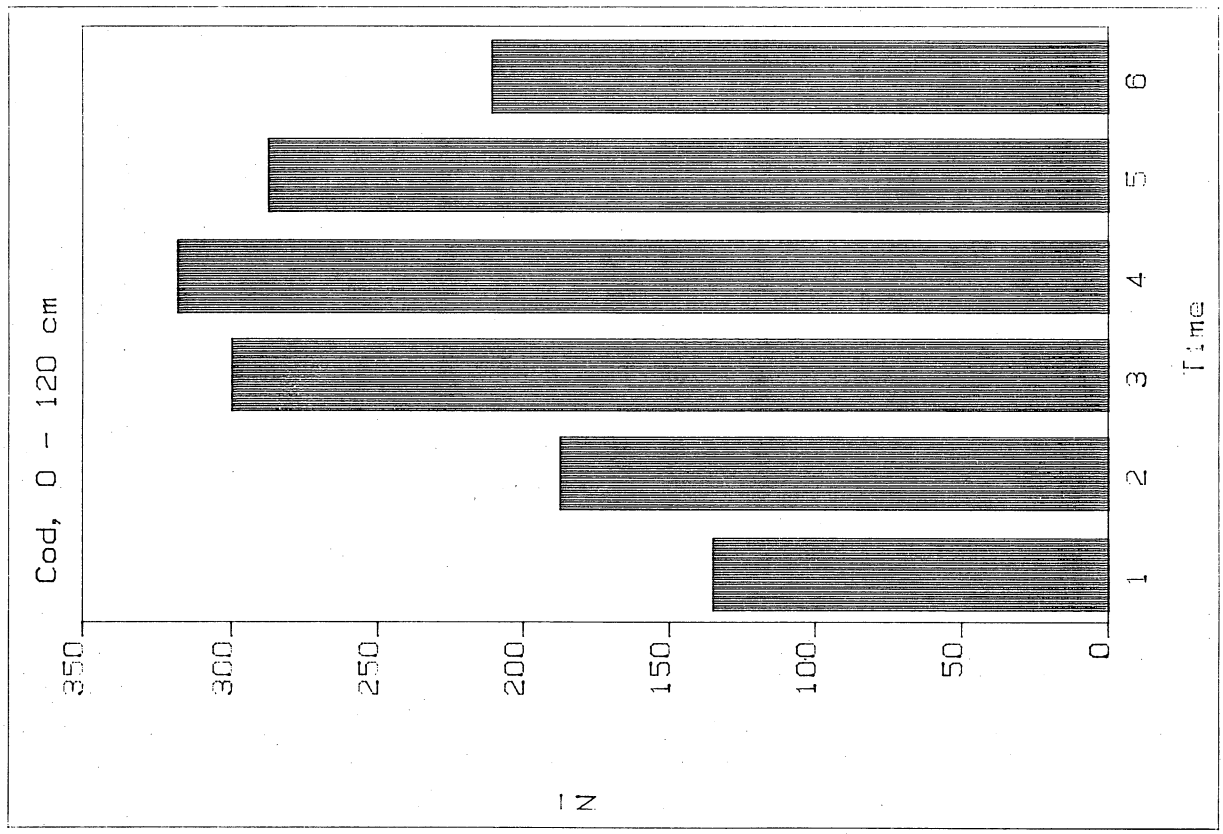


Fig. 26. The diurnal variation of cod and redfish. Average number of fish per standard tow in the fishermens' hauls. (1=00-04 hours ; 2=04-08 hours ; etc.)

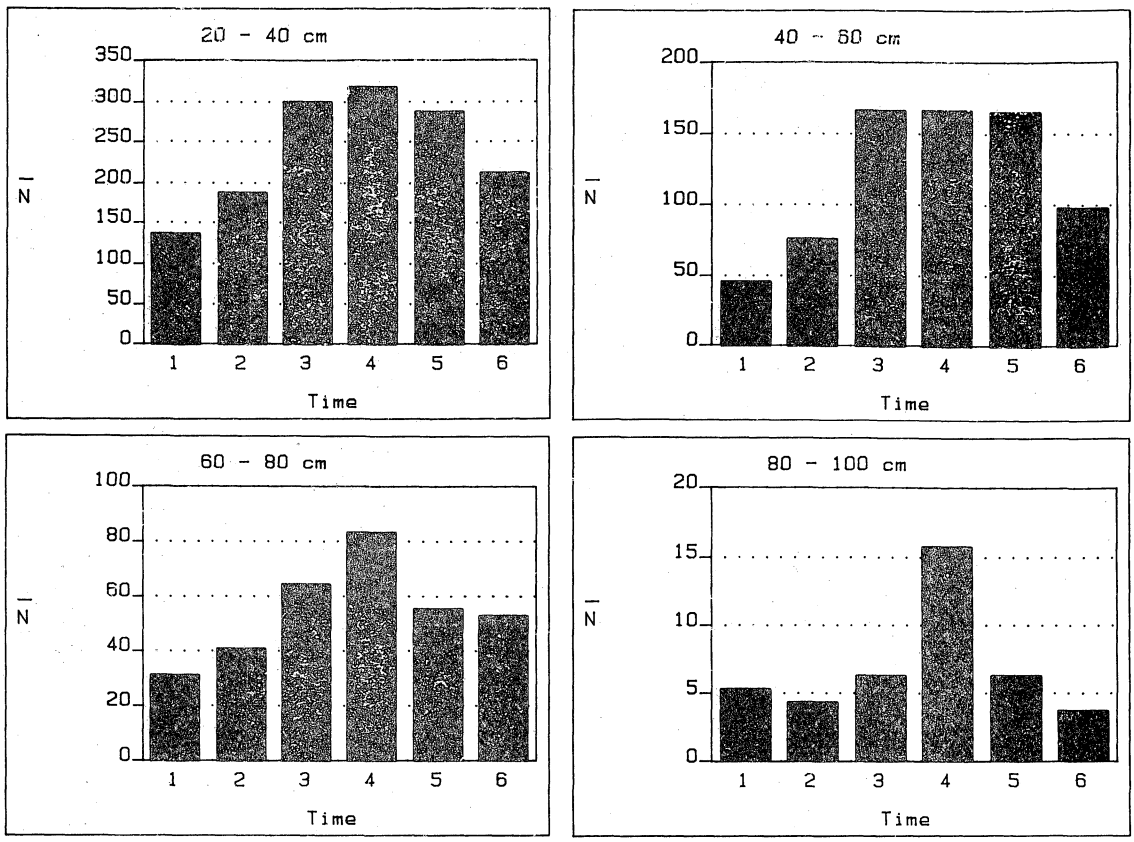


Fig. 27. The diurnal variation of cod by length groups. Average number of fish per standard tow in the fishermens' hauls.

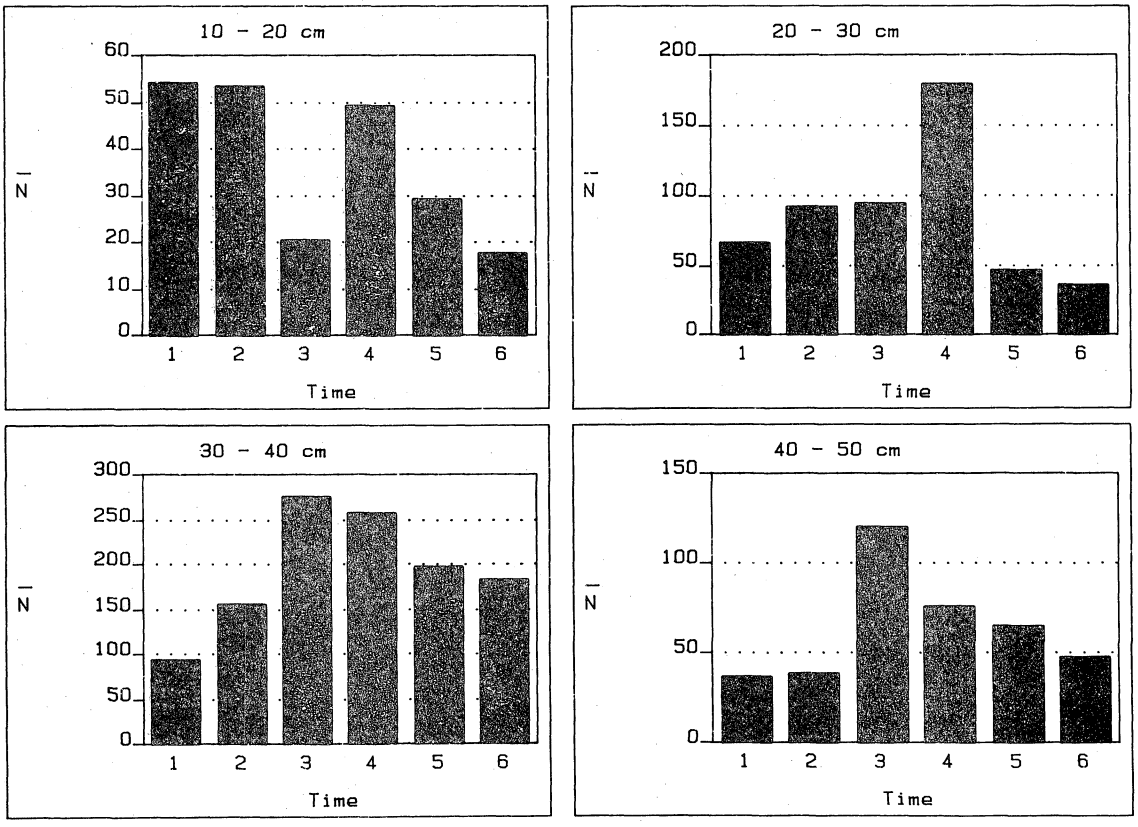


Fig. 28. The diurnal variation of redfish by length groups. Average number of fish per standard tow in the fishermens' hauls.