

Report on the International Whiting Surveys of the  
North Sea in 1960 and 1961

by

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Introduction

The International Council for the Exploration of the Sea promoted an international trawling survey of the North Sea in the spring and autumn of 1960 and 1961, primarily to study the young herring stocks. A great amount of whiting data was also collected during the course of these surveys, and I.C.E.S. therefore encouraged the formation of a working group to process this. The working group<sup>1)</sup> met a number of times, and prepared preliminary reports on the basic data available and the results derived from them. These reports were presented at meetings of the Near Northern Seas Committee of I.C.E.S. in 1961 and 1962 (Gamble, Roessingh and Sahrhage, 1961; Gambell and Sahrhage, 1962). The preliminary reports also outlined the scope of the material available, and the way in which the data from different vessels which took part in the surveys were combined using appropriate conversion factors for fishing power. The present report deals with the more general observations and conclusions which have been drawn from all four survey cruises.

Distribution of age groups

The main concentrations of the whiting of different year classes in spring and autumn are illustrated in Figs. 1 to 5. These charts were obtained by combining the data from the two cruises made in each season. The older age groups of fish, of two years and more, had similar distributions to one another in each cruise and so have been grouped together.

1) The working group for the 1961 data consisted of the authors, of whom D.J. Garrod and K. Kuiter replaced D.W.R. Rout and M. Roessingh respectively of the group concerned with the 1960 data. Dr.D. Sahrhage was convener throughout the two years.

The O-group whiting were concentrated mainly to the north of the Tail End and in the Skagerrak in the autumn. Smaller concentrations also occurred south of the Dogger Bank and in the Shields area.

The I-group in spring showed a more widespread distribution, with an extension of the concentrations around the Dogger to the west and south. There were also large numbers between the Great Fisher and Ling Banks, and off the Scottish east coast. In the autumn this age group had its greatest concentrations in a zone to the north, east and south of the Dogger, and off the north-east of Scotland. The apparent absence of O-group concentrations from the Scottish east coast which would correspond with the I-group centres of density in this area is probably due to inadequate sampling. Ellis and Jones (1956) have shown that the O-group whiting are present on the inshore grounds, especially the Firth of Forth, but these grounds were scarcely sampled in these four survey cruises.

In the spring the two years of age and older whiting (II+ groups) were centred in an area from the Fladen Ground to Shetland in the north, while the concentration to the north of the Dogger was more to the west, and that to the south a little further south. The autumn distribution of these older fish was very like that of the I-group in the autumn, around the three sides of the Dogger and off north-east Scotland.

#### Age composition

To illustrate the age structure of the whiting population of the North Sea, the mean percentage age composition in six selected areas (A-F) in the spring and autumn are shown in Figs. 6 and 7. Due to the variations in the strengths of the year classes concerned, differences occur in the numbers of whiting of the same age group in successive years, while some year classes also make greater contributions to the stock in certain areas than in other. By combining the data for 1960 and 1961 the effects of such fluctuations and differences tend to be smoothed out, and so make general conclusions drawn from the mean figures more reliable. These figures show, as indicated already in the section on the distribution of the age groups, that the youngest whiting (O-group in autumn and I-group in spring) occurred most commonly in the three eastern areas of the North Sea (D, E and F). The oldest fish (III and IV+ group) were most abundant in the extreme northern area (A). The three eastern areas had very similar age compositions to one another in both seasons;

the two western areas B and C were also similar to each other, and differed from the three eastern areas in the small proportion of the youngest age group present.

#### Seasonal density changes

When the numbers of each year class of whiting per statistical rectangle are compared from one cruise to the next, differences appear between various regions of the North Sea. These are indicated in Figs. 8 and 9, which show the overall changes in abundance for all year classes except the 0-group, from spring to autumn (1960 and 1961 combined) and from autumn to spring (1960-61). The 0-group figures are not included, as these fish were not fully sampled in the autumn, when they were just taking up the demersal phase of their life history. All the other year classes showed similar patterns of change, while the changes between the two spring to autumn surveys were also similar, allowing a single chart to be drawn for each period.

A general reduction in the number of fish of each year class would be expected between successive sampling periods, due to mortality. But, between spring and autumn there is an increase in the number of whiting of each year class in the southern North Sea, and a decrease only in the north. From autumn to spring this change in abundance is reversed, numbers increasing in the north and decreasing in the south.

#### Availability changes

The average densities of the different year classes of whiting over the whole North Sea in spring and autumn of 1960 and 1961 are given in Table I. It is known from research vessel data from a number of countries that there tended to be an increase in year class strength from 1956 to 1960, with the 1956 year class a very poor one (Jones and Gamble, 1960; Gamble, 1961). From the figures in Table I it appears that in both seasons of the surveys the 1959 year class was more abundant than the 1960 year class as one year olds; that the 1958 year class was more abundant than the 1959 year class as two year olds; and that the 1957 year class was more abundant than the 1958 year class as three year olds. Since very few fish older than four years were present in the catches, it can also be concluded that the 1956 year class was more numerous than the 1957 year class as four year olds, and therefore, by implication, the largest of all the year classes considered.

Table I. Mean number of whiting per statistical rectangle per 1 hour's trawling (standard 'Scotia' units)

Spring cruises						
Year class	Age group	I	II	III	IV+	
	1960		19.44			
1959		61.45	23.48			
1958			39.56	12.20		
1957				16.41	3.05	
1956+					5.58	
Autumn cruises						
Year class	Age group	0	I	II	III	IV+
	1961		197.10			
1960		207.54	55.89			
1959			216.36	57.66		
1958				95.38	16.56	
1957					26.77	1.89
1956+						5.61

This is in conflict with the known facts from other sources, and so the argument developed from the data in Table I is incorrect. In fact there must have been a decrease in the availability of whiting of all ages in 1961 compared with 1960, in both spring and autumn, to account for the changes in numbers observed.

The data in Table I also indicate that there was an increased availability of whiting in the autumn compared with the spring. Adding together the density figures for all year classes except the 0-group to obtain a measure of the total abundance of whiting gives the result shown in Fig. 10. It can be seen that the autumn figure for the mean total catch is greater in both years. If there was no

change in availability, the total numbers obtained from the same year classes in this way would be smaller in the autumn than in the spring because of mortality. Thus the change in availability must be underestimated, and is even bigger than shown by the figure.

The total figures for the two years are not exactly comparable, since the 1960 total is based on the 1959 year class and earlier, while the 1961 total also includes the 1960 year class. The difference in size between the 1959 and 1960 year classes is not thought to be very great, so that Fig. 10 also reflects the decreased availability of whiting in the second sampling year.

#### Mortality estimates

The mortality estimates derived from the catches are not reliable. There are large differences between the estimates for the same areas when calculated from spring to spring and autumn to autumn, probably because they were based on the limited data of only two years' surveys. For example, area A of the six special areas (Figs. 6 and 7) gave an overall estimate of Z for all year classes of 1.16 in spring and 2.52 in autumn. The comparable values of Z for the other areas are: B 1.88 and 1.07; C 1.82 and 1.00; D 1.13 and -0.6; E 2.51 and 0.34 and F 3.90 and 2.84. These values must also be overestimated, because of the decreased availability of whiting in the second year of the surveys.

#### Mean lengths

To demonstrate the differences in the mean size of whiting of the same age group over the whole North Sea, a comparison of the mean lengths of whiting in the two spring cruises and the two autumn cruises for each of the six special areas indicated in Figs. 6 and 7 has been made. The results are plotted in Figs. 11 and 12,

These figures show that the two north-western areas (A and B) always had relatively high mean lengths, with the values for A usually being higher than for B. The central and south-eastern areas (E and F) always showed low mean length values, while area C usually had intermediate values. The mean lengths in the entrance to the Skagerrak (area D) showed interesting changes between spring and autumn. In the spring the mean lengths were high, while in the autumn they were low.

It must be borne in mind that these special areas were selected to demonstrate the characteristics of the whiting in the different

parts of the North Sea. They have no particular significance of themselves, but it can be concluded from Figs. 11 and 12 that most areas have relatively consistent length characteristics. Area D is an exception, as in this part of the North Sea there appears to be a seasonal change in the whiting population.

The trend of increasing mean lengths from the south-east to the north-west of the North Sea is shown further by the mean length curves for three different year classes, Fig. 13. The values for area D have been omitted from these diagrams, because the seasonal variations found in the area produce a different pattern of increasing mean size.

### Discussion

One of the main problems concerning the North Sea whiting population is its possible separation into distinct unit stocks. The sub-division into northern and southern stocks has been suggested on evidence from parasite studies (Kabata, in press) and vertebral numbers (Gamble, 1959). The data obtained from the four international survey cruises show that the whiting populations in the northern and southern North Sea have different characteristics of age composition and year class mean lengths, but these appear to show a gradation from north to south. The distribution of the age groups, on the other hand suggests two main centres of whiting, one in the south-eastern and the other in the north-western North Sea. The shift from the south and east as the main centre of 0 and I-groups to north and west for the older fish can be due to two possible factors (a) differential mortality, with a much greater mortality being experienced in the south-eastern area, or (b) migration with age from south-east to north-west. Unfortunately, the mortality estimates derived from the available survey data give no clear indication whether or not mortality is the responsible factor.

Migration is also a factor to be considered when the distinct differences in the seasonal density patterns in the northern and southern areas are examined. The most obvious way to account for the changes observed is to suggest a migration of whiting from north to south between spring and autumn, and the reverse movement from autumn to spring. The consistency of the order of increasing mean lengths for all year classes (Fig. 13) from area E to area A suggests, however, that there is no major migration of unit stocks in the North Sea, although the smaller differences found for the older fish may indicate a certain intermingling of stocks. Messtorff (1959) also

concludes from various studies that there is little indication of active whiting migration from one area to another.

It is possible that the seasonal fluctuations are due to local random dispersal movements from the areas of high density from autumn to spring, rather than large scale directional migrations, followed by a reconcentration in the original areas in the autumn. This idea suggests a "pulsating" effect from the centres of high concentration.

No definite mechanism for the consistent seasonal variations in density can be given at the moment, and further work, especially a co-ordinated international tagging programme, is needed to solve both this problem and also the larger one of stock separation.

#### Effect of different minimum landing sizes

The immediate effects on the number and weight of whiting which could be landed if different minimum landing sizes were imposed have been calculated on data from the autumn 1961 cruises. Curves for the percentage reduction in landings are shown in Fig. 14 for each of the six special areas of the North Sea. From these it appears that the effect of an increase from the present minimum size of 20 cm to say 25 cm becomes progressively greater the further south-east you go.

It must be stressed that these estimates are based on research vessel data and not commercial catches, and are probably over-estimates of the losses. The commercial boats will generally tend to fish the larger and most productive grounds, and so sustain rather smaller losses with an increased minimum landing size than these derived from research vessel data, based on random fishing positions.

#### Summary and conclusions

The whiting data available from the four international survey cruises of the North Sea in 1960 and 1961 have been processed. The distribution of the age groups suggests two main concentrations of whiting, one centred in the north-western and the other in the south-eastern North Sea. The populations in the northern and southern North Sea have different characteristics of age composition and year class mean lengths, and these appear to show a gradation from north to south. There are differences in the seasonal density patterns in the two areas, and annual availability changes are also apparent over the whole North Sea. These findings are discussed, and the effect of an increased minimum landing size for whiting is considered.

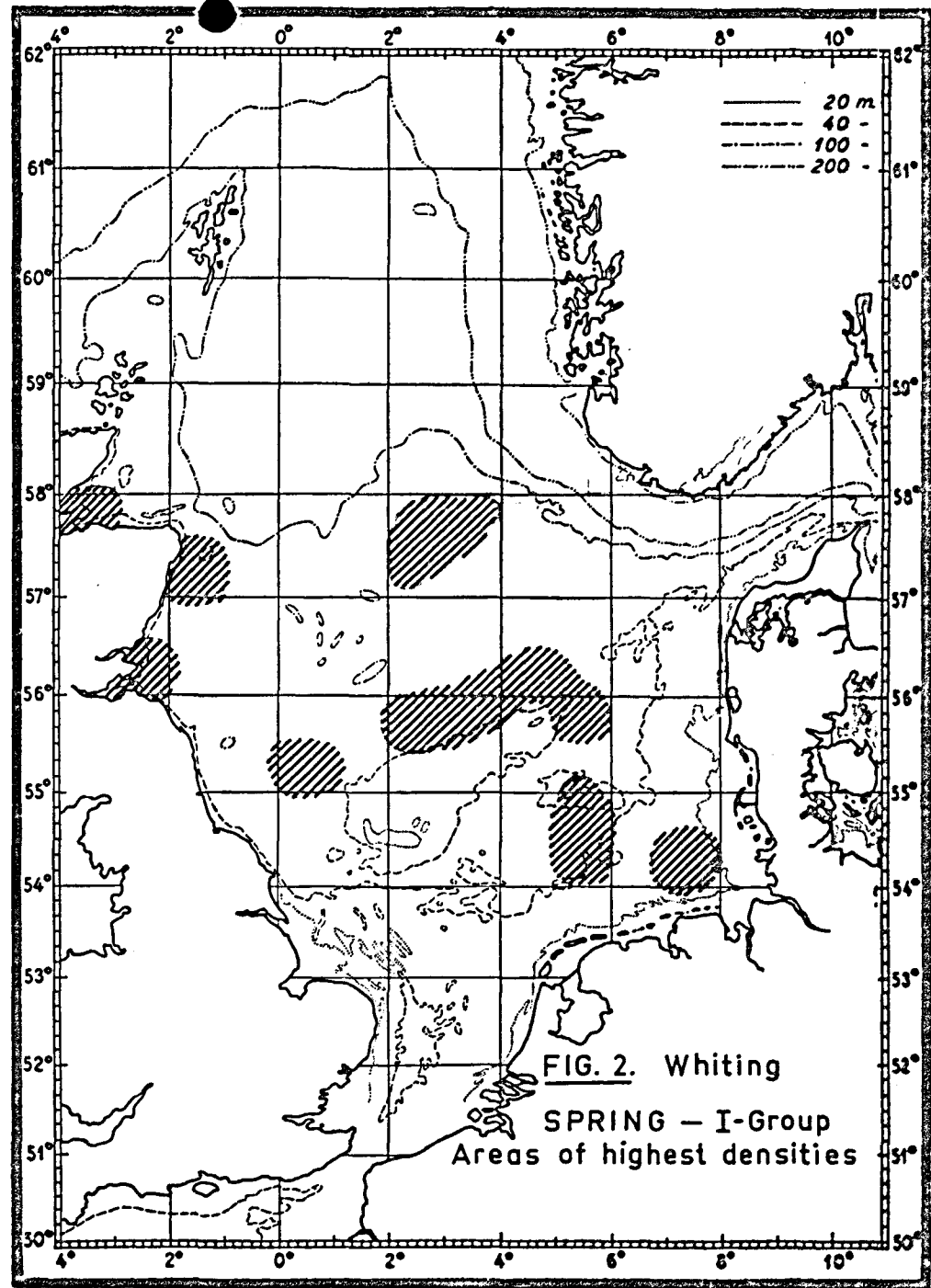
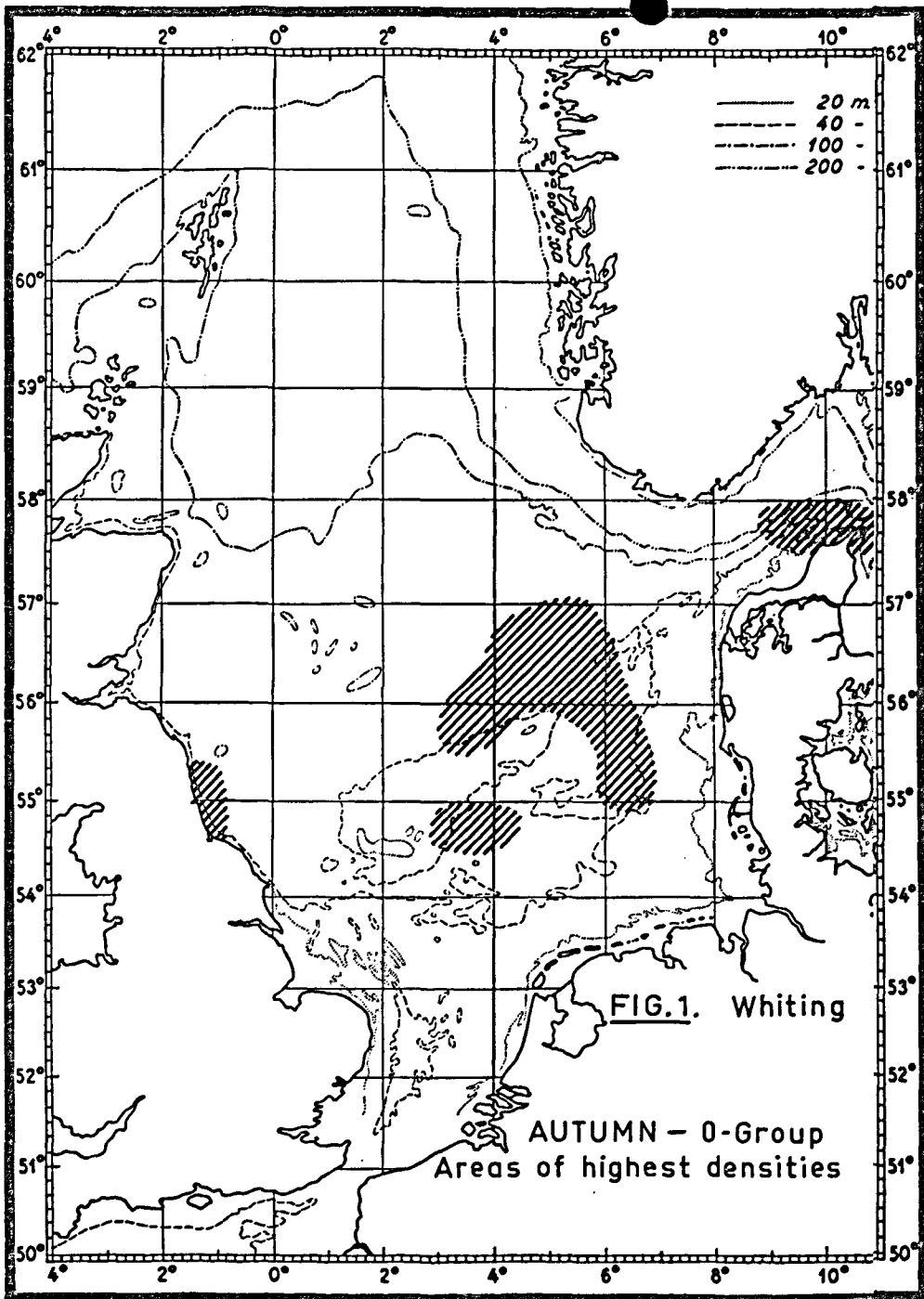
It is suggested that an important step in solving the problems of the North Sea whiting, especially in connection with the major consideration of stock separation, would be made through a co-ordinated international tagging programme.

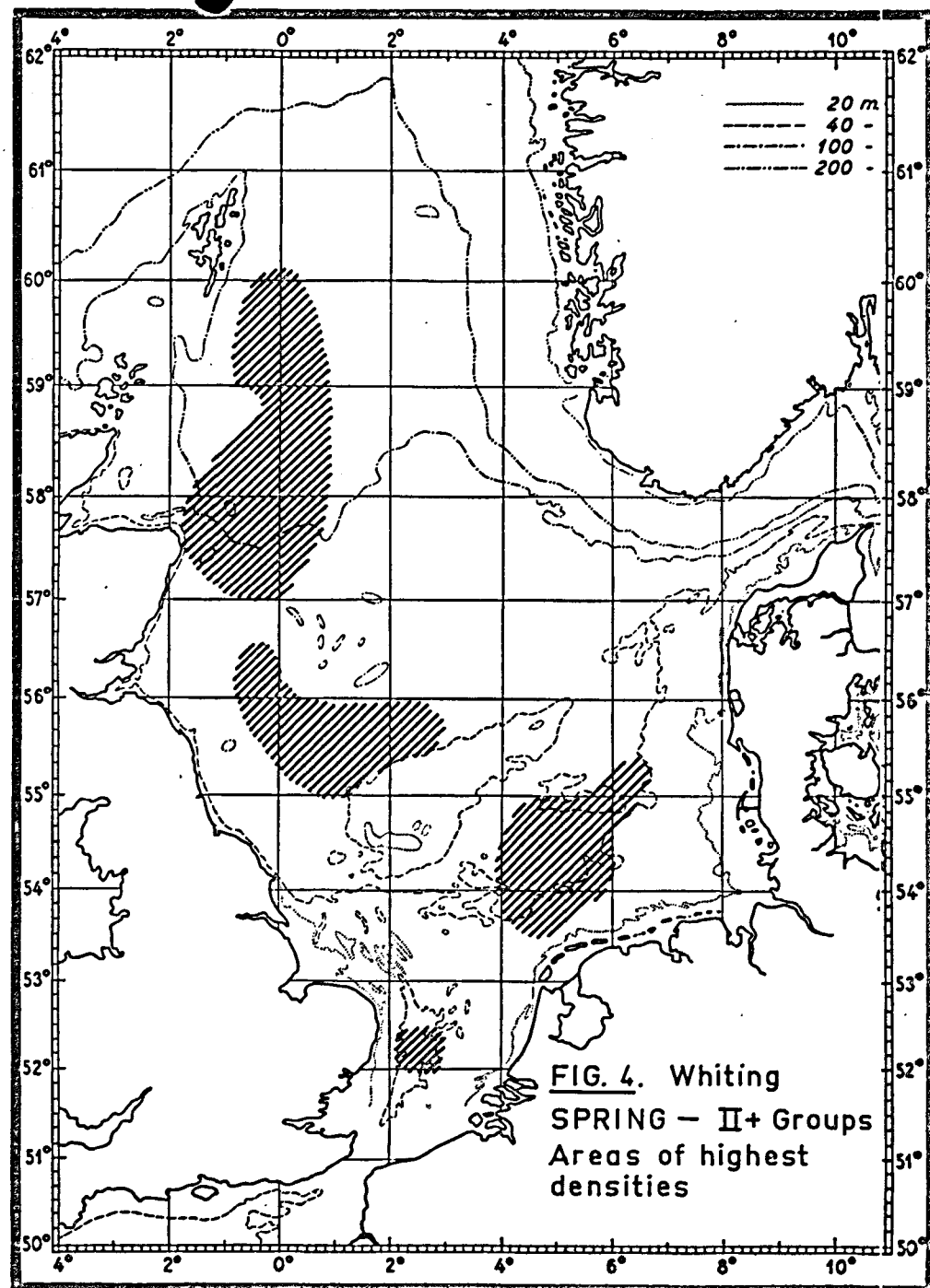
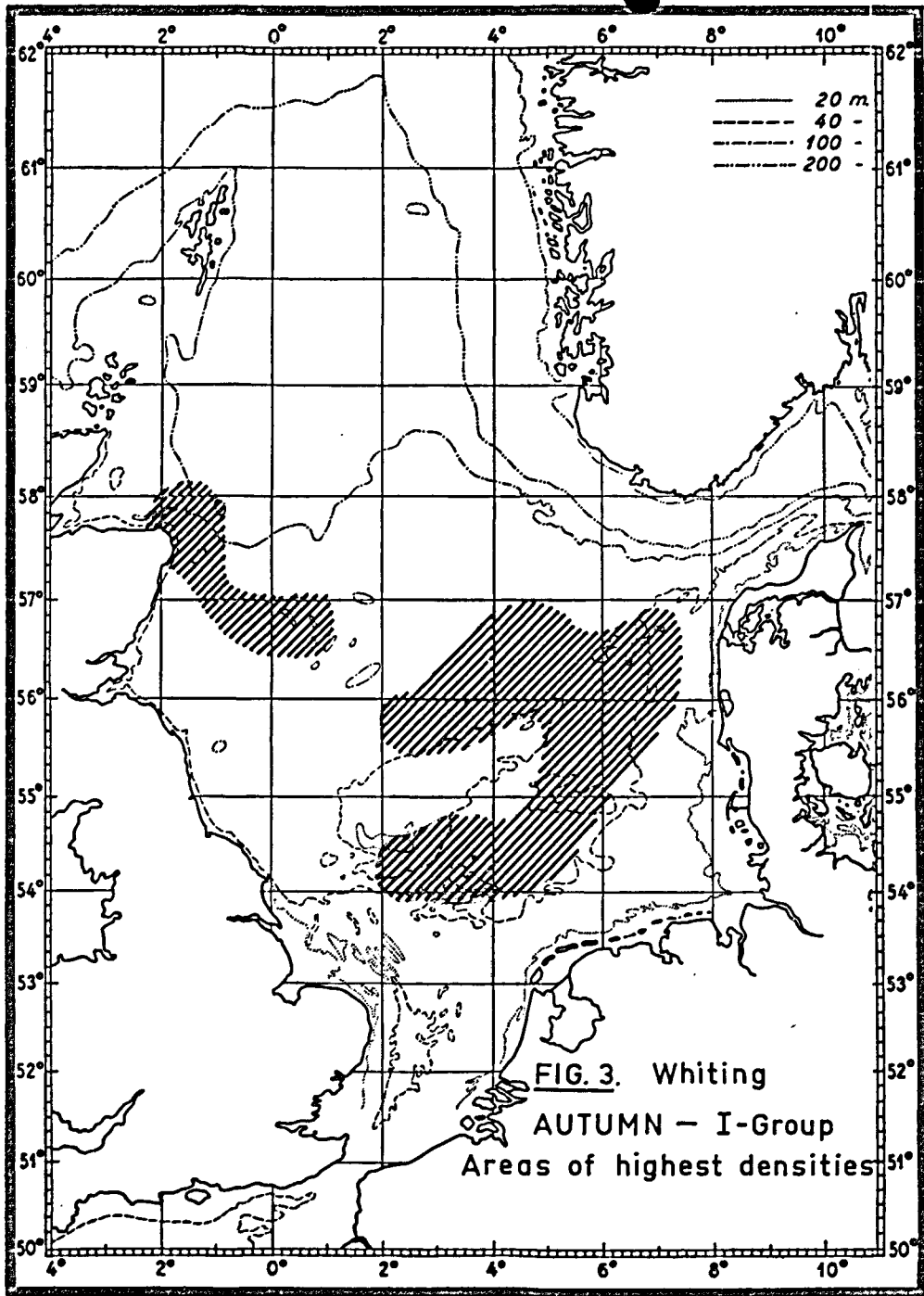
As a result of the meetings of the working group it was found that there is a great deal of material available on the North Sea whiting in many countries, some already published but much unpublished. It is suggested that this material could usefully be brought together, and with this report, made into a complete survey of the present state of knowledge of the North Sea whiting.

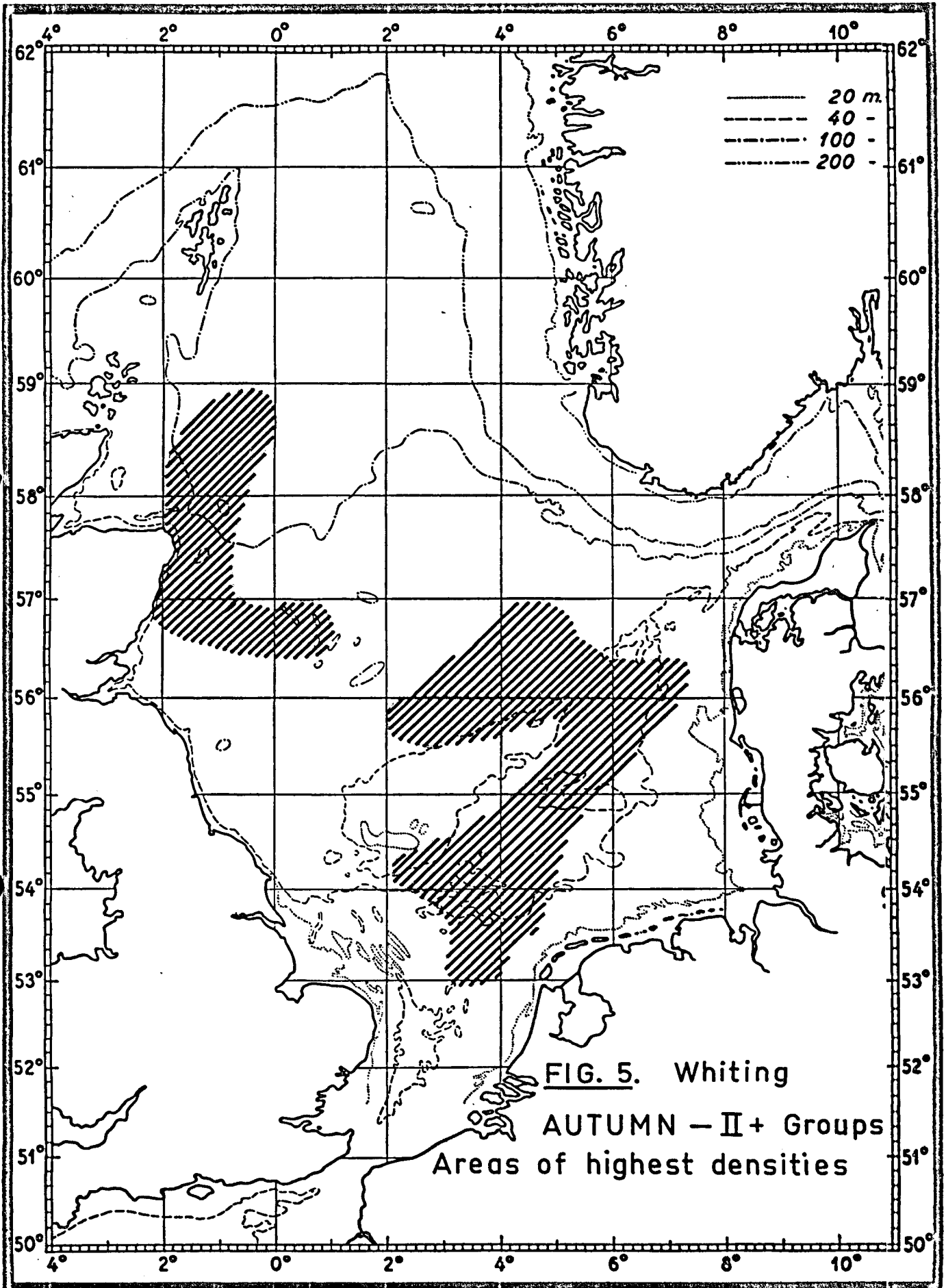
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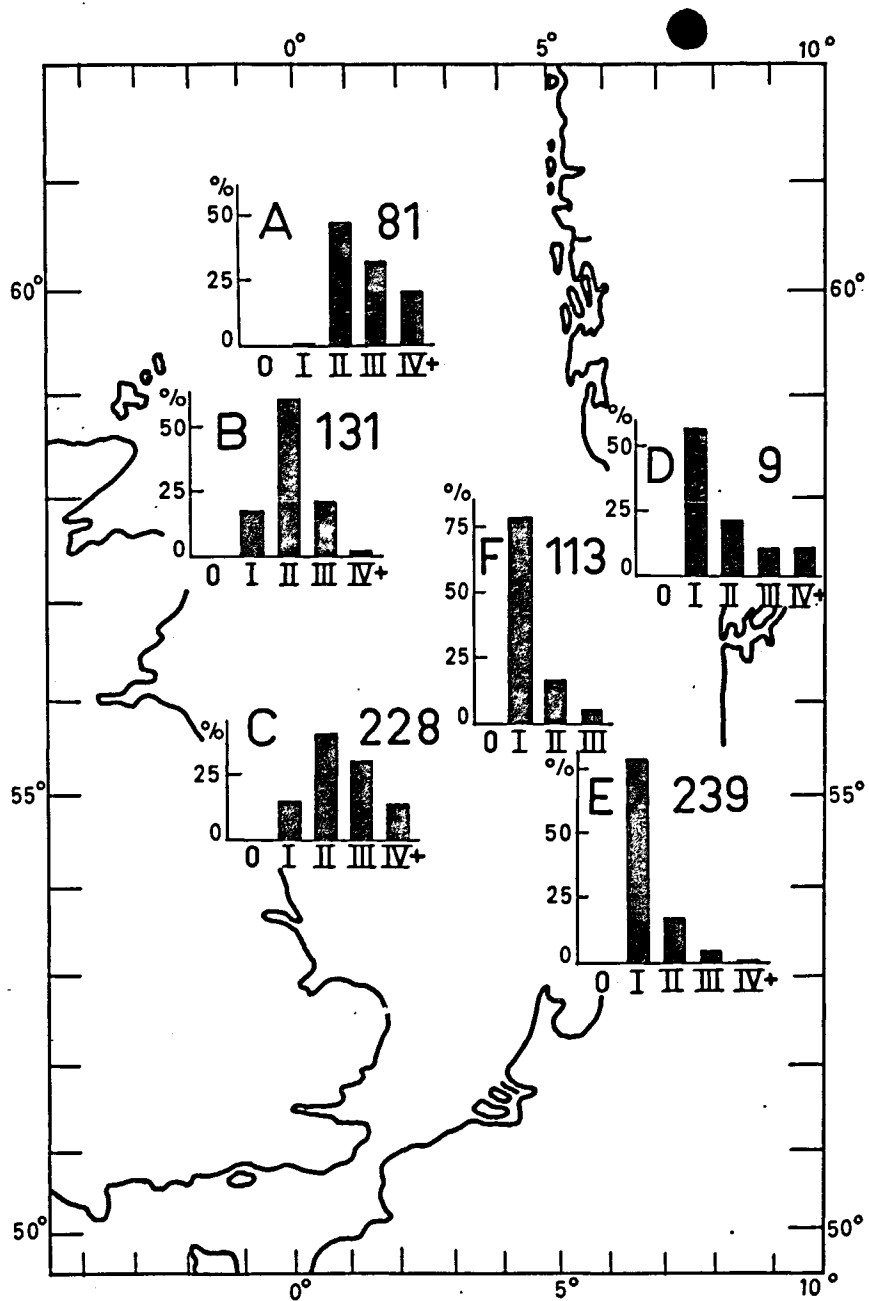
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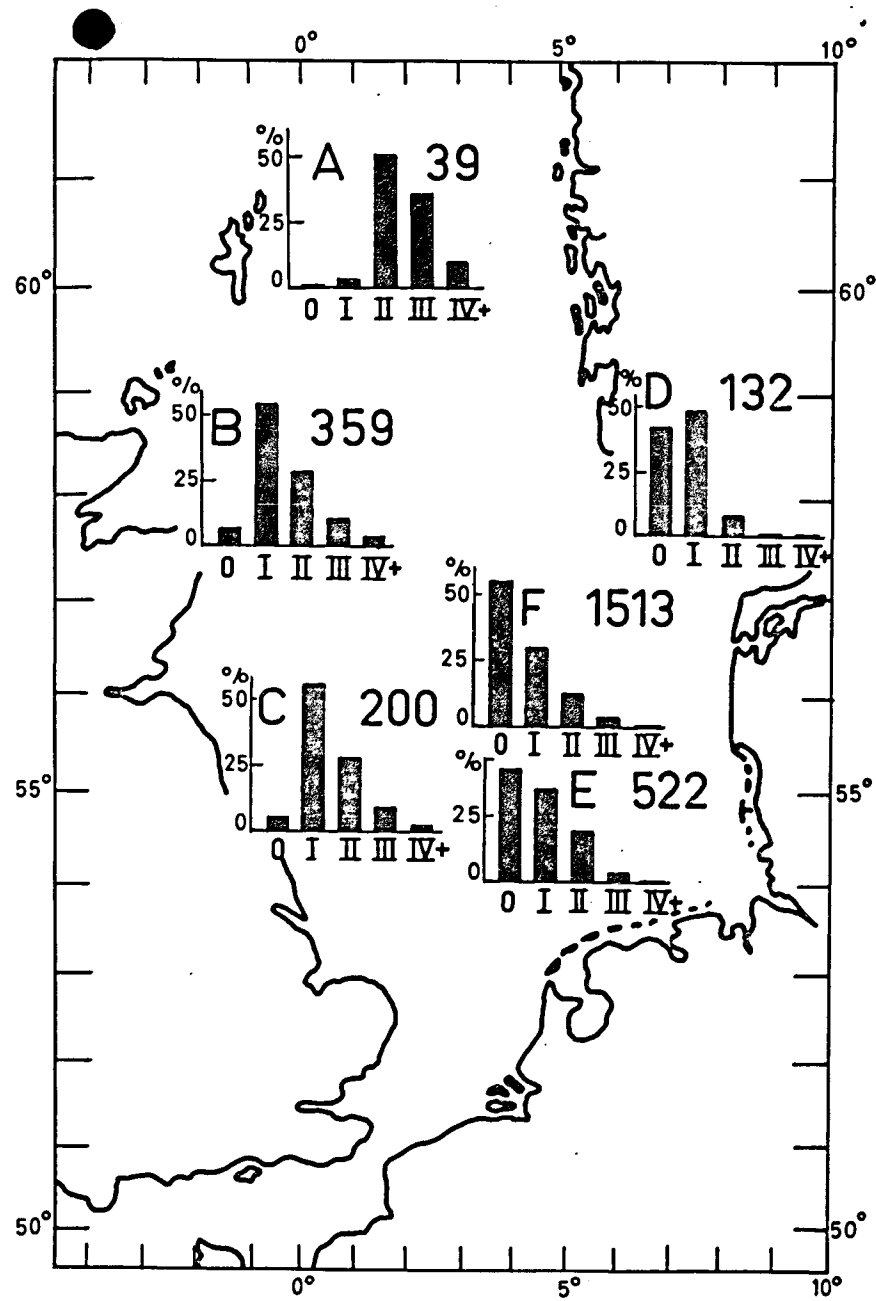




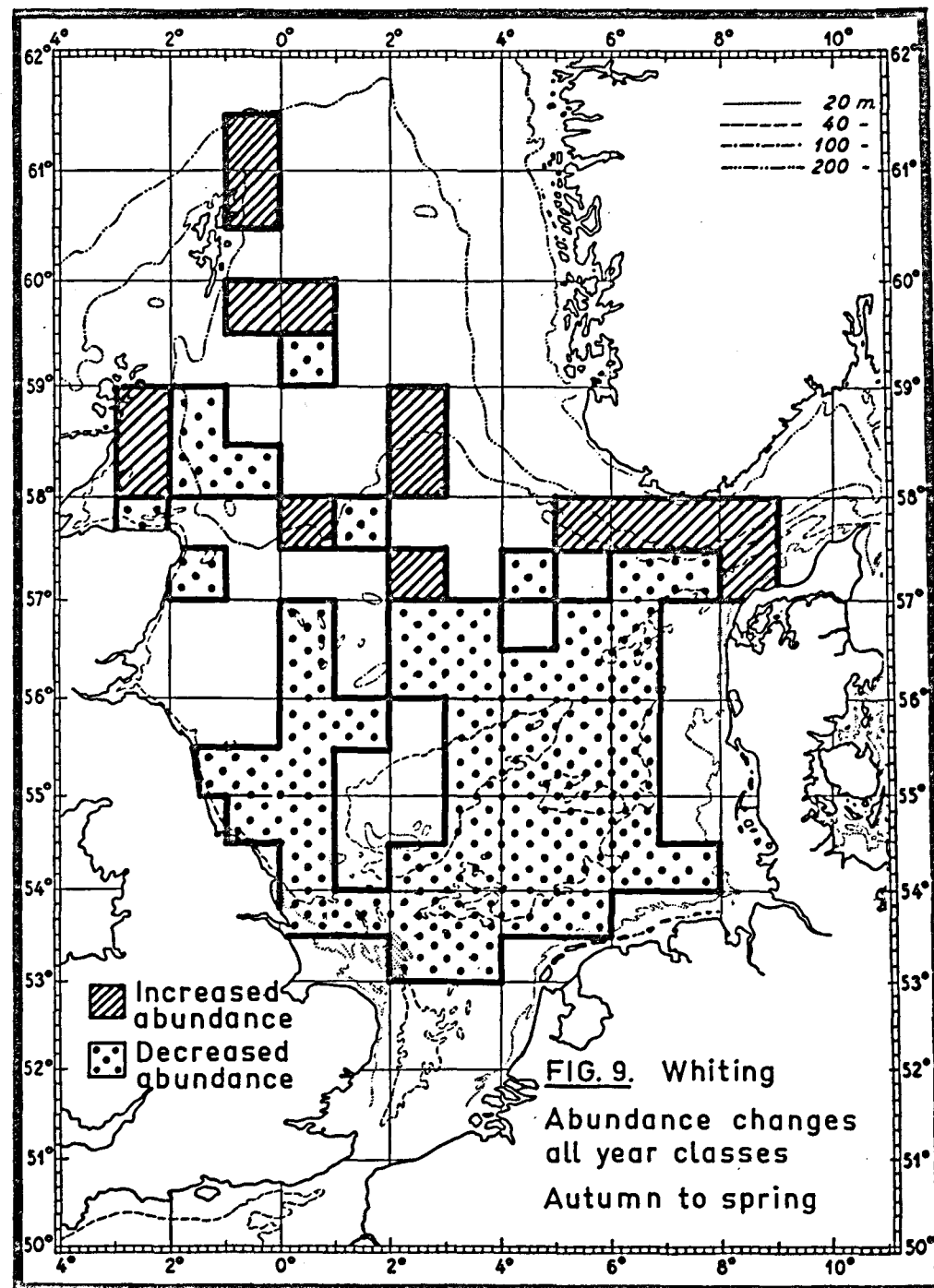
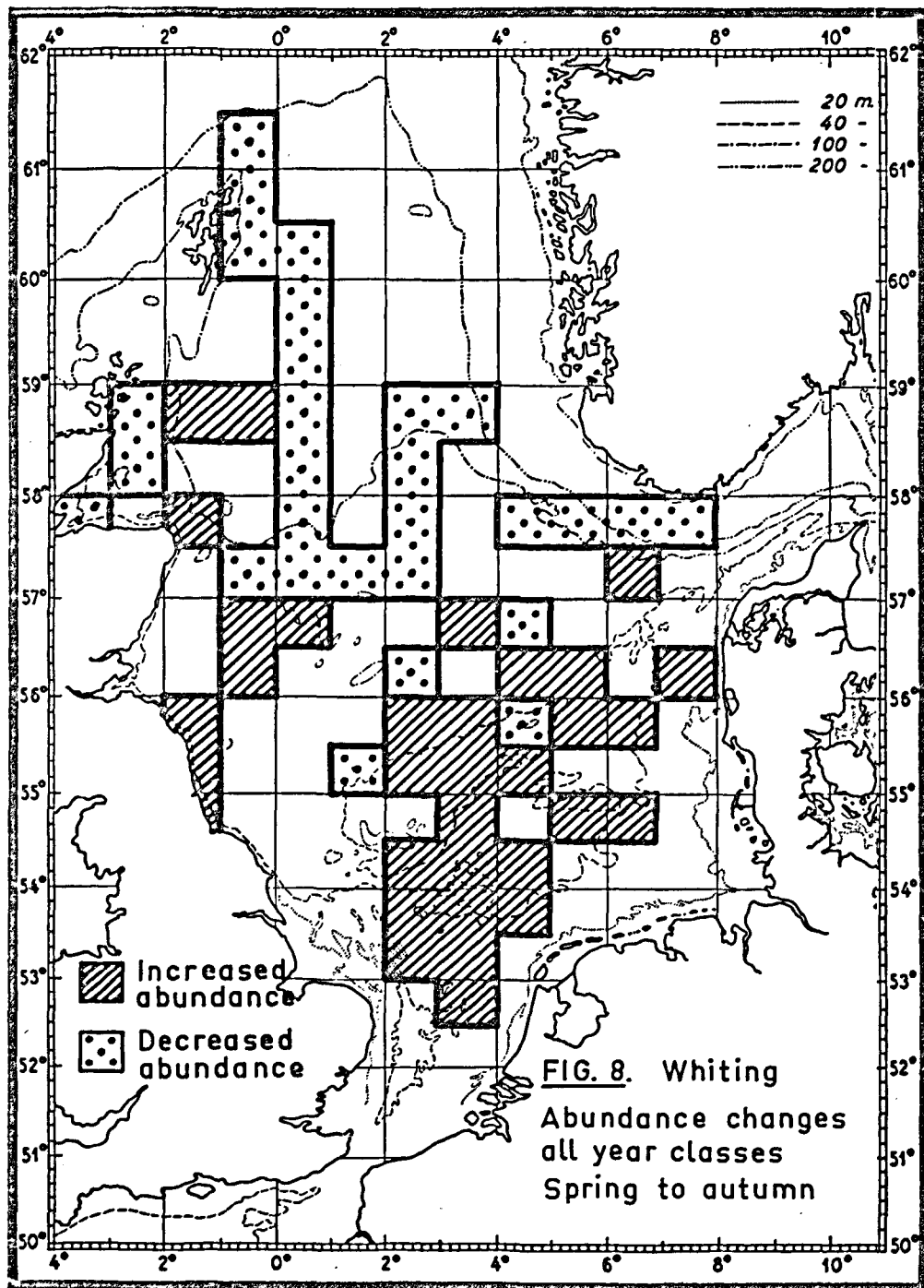


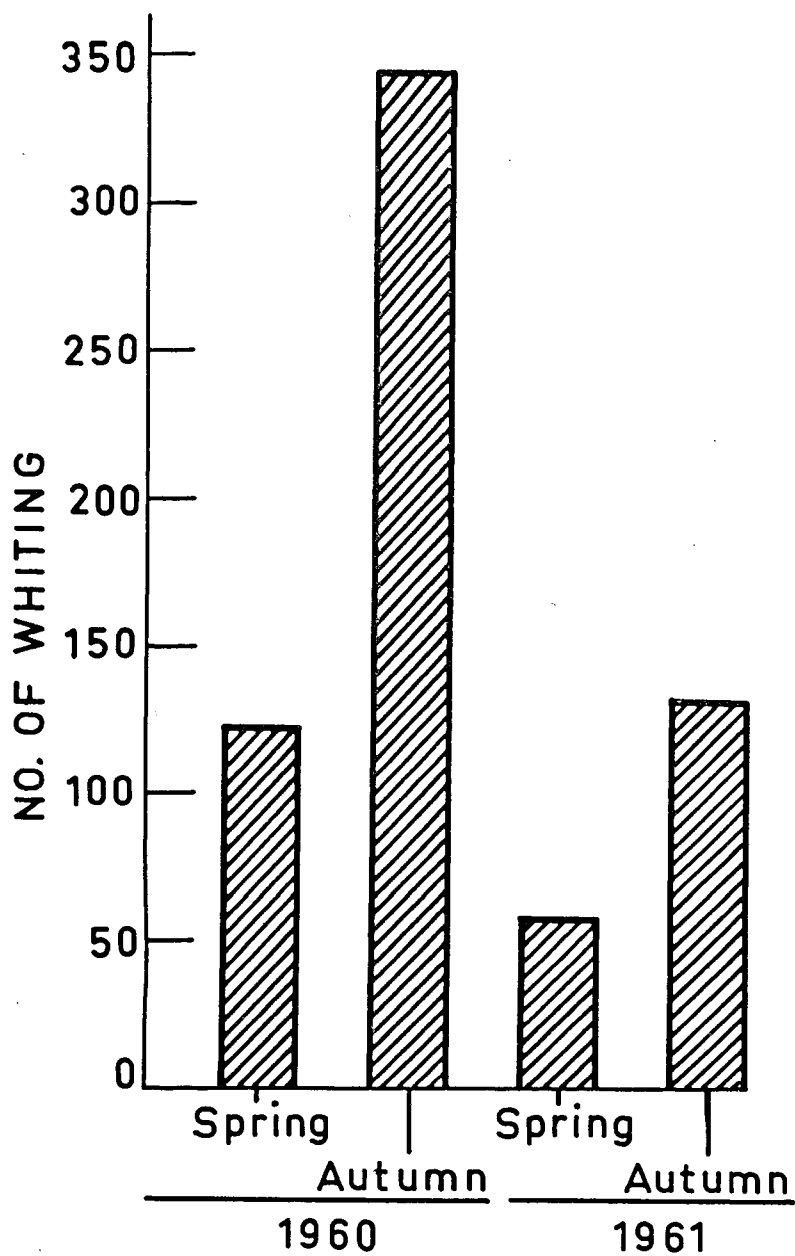


**FIG. 6** WHITING - Spring 1960 and 1961  
 Mean age composition (%)  
 (numbers: total mean catch per 1 hour)

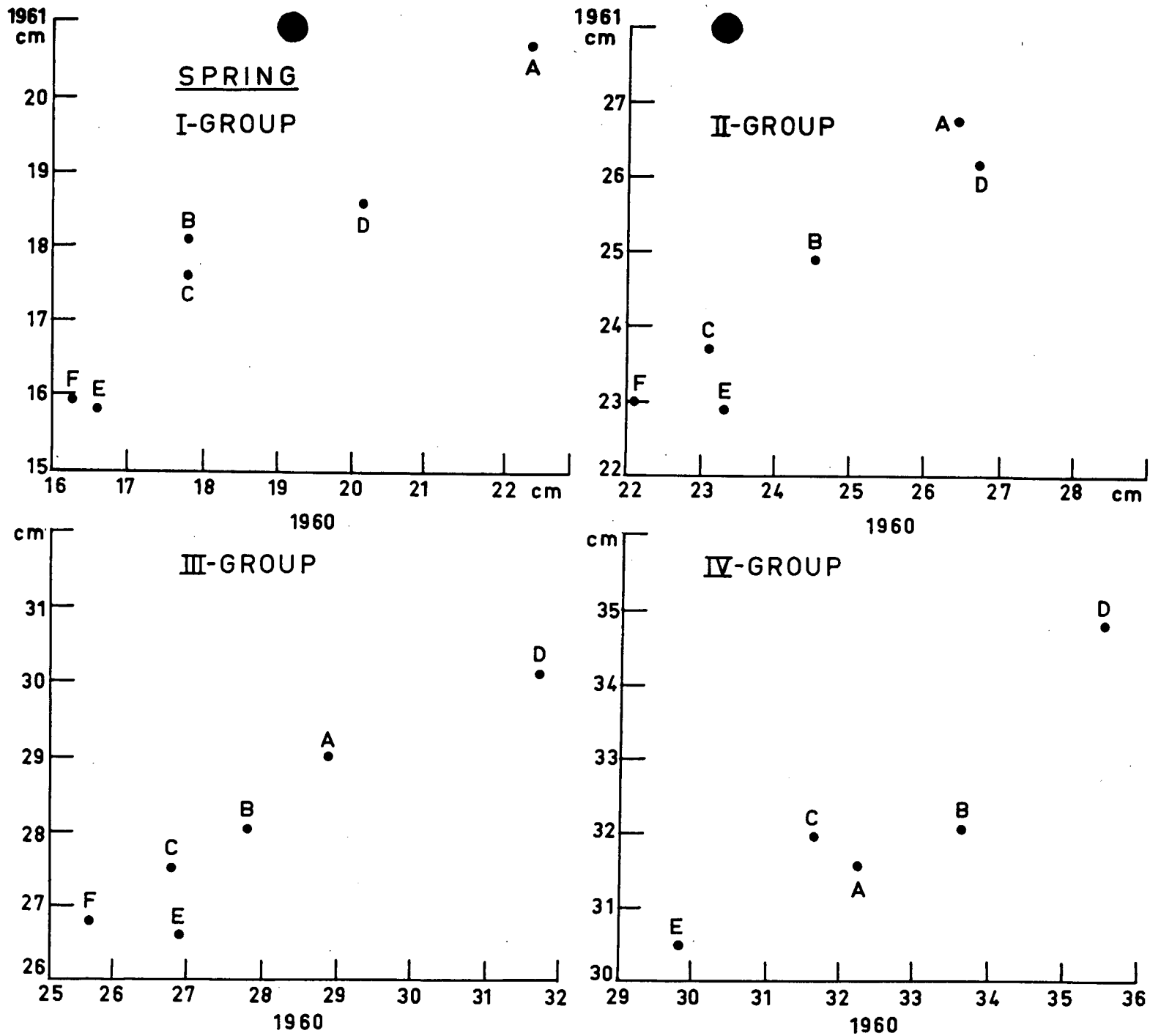


**FIG. 7** WHITING - Autumn 1960 and 1961  
 Mean age composition (%)  
 (numbers: total mean catch per 1 hour)





**FIG. 10** Total mean density of whiting (I+groups) per statistical rectangle per 1 hr's trawling.



**FIG. 11** Correlations between the mean lengths of whiting in 6 selected areas during the spring cruises of 1960 and 1961.

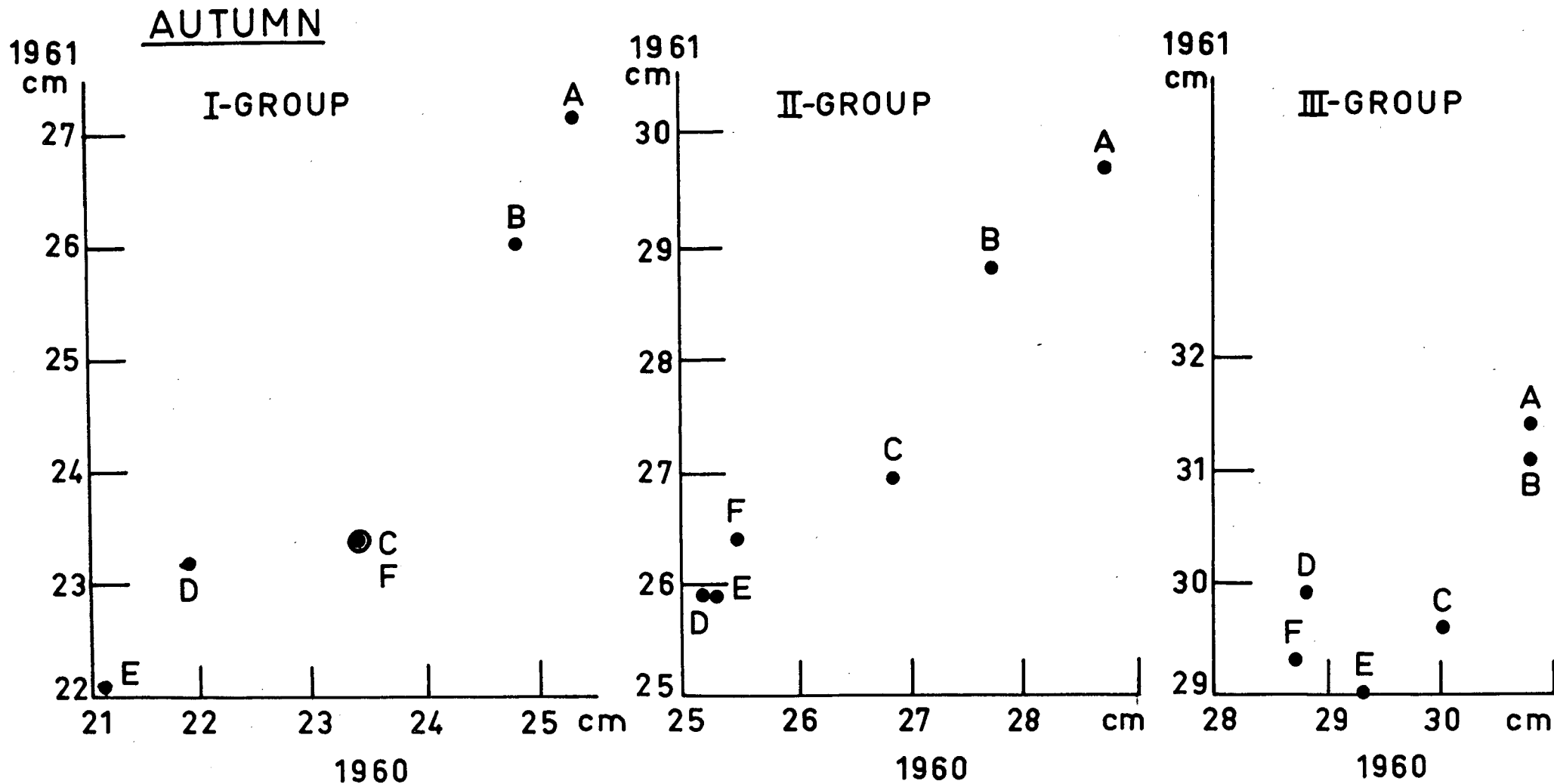
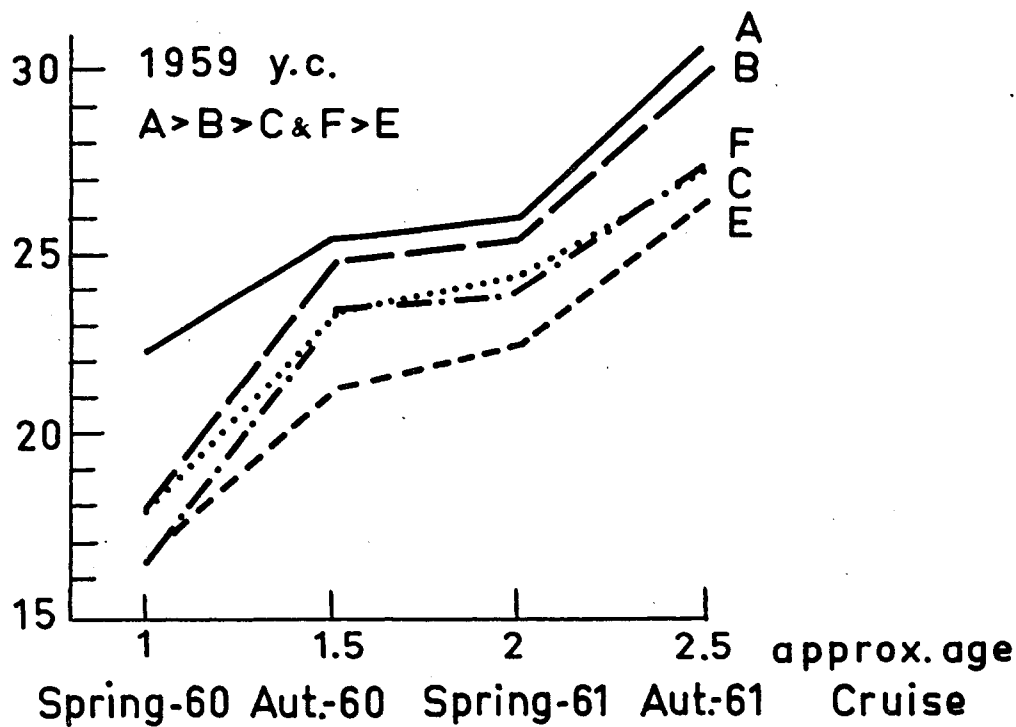
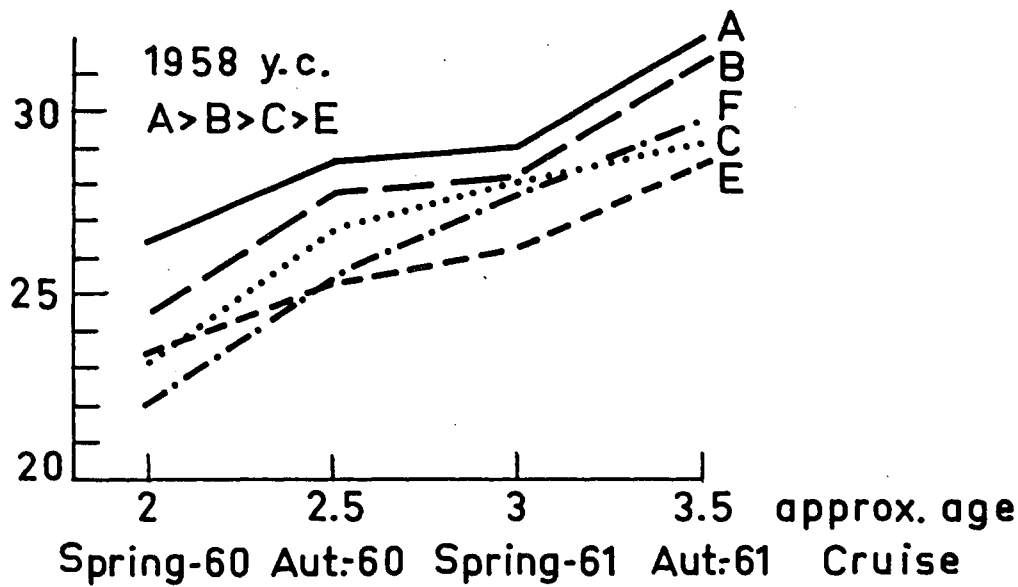
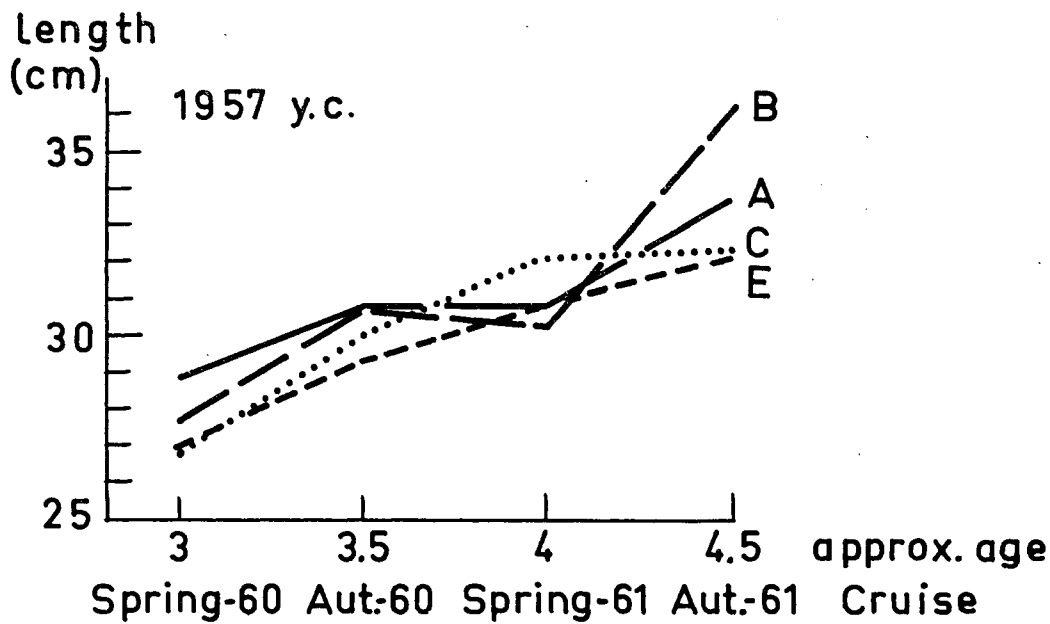
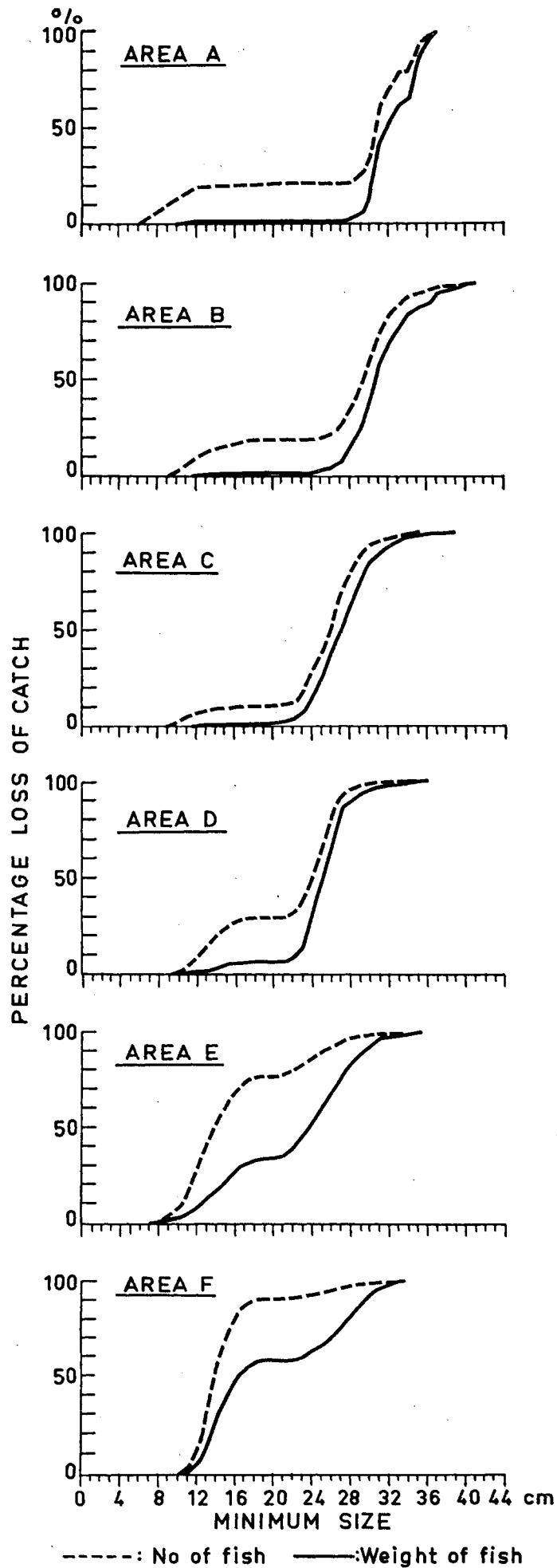


FIG. 12 Correlations between the mean lengths of whiting in 6 selected areas during the autumn cruises of 1960 and 1961.





**FIG. 13** Mean lengths of three year classes from the different special areas at four cruises.



**FIG.14** Percentage reduction in whiting landings from the North Sea for different minimum landing sizes.