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REPORT OF THE *AD HOC* STUDY GROUP ON MANAGEMENT MEASURES FOR THE SMALL-MESHED FISHERY IN DIVISION IIIA

Charlottenlund, 22-25 October 1985

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1. Introduction.

1.1. Participants.

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1.2. Terms of Reference.

The three parties to the consultations on fishery regulations in the Skagerrak and Kattegat (EEC, Norway and Sweden) in January 1985 requested ICES to provide an early opinion on technical regulatory measures for the sprat fishery in that area.

Lack of detailed information prevented ACFM in dealing with this request at its meeting in May 1985, and it was decided to call a meeting of an *ad hoc* Study Group to consider this problem. The terms of reference of this group were given in a letter of 10.7.85 from the General Secretary of ICES to the ICES delegates:

1. to describe the small-meshed fishery
   - define the target species for sectors of the fleet;
   - assess fleet size by sector;
   - compile historic catches broken down by species, and in as short time-periods and small sub-divisions as possible;

2. to review the biological basis of previously agreed management measures for the fishery in this area;

3. to assess the biological implications of different management measures.

The Study Group should meet at the Danish Institute for Fisheries and Marine Research, Charlottenlund, Copenhagen on 22-25 October 1985, and report to the November meeting of ACFM.

1.3. Background.

The present problem concerning the catches of juvenile herring in Div. IIIa partly arises from recent changes in the ratio between the sprat and herring stocks in that area (and also in the North Sea). In the late 1970's, the bulk of the clupeoid catch taken by the small-meshed trawl fisheries consisted of sprat, and a 10% by-catch regulation in principle seemed a practicable method of limiting the catch of juvenile herring.

The situation changed in the early 1980's with the decline of the sprat stock, and the enormous increase in herring recruitment. Juvenile herring, of mixed origin (North Sea, Div. IIIa), gradually started making up the bulk of the catch taken by the small-meshed fishery. Strict enforcement of the 10 % by-catch regulation would in practice stop the entire small-meshed fishery, which from a socio-economical point of view was unacceptable. Consequently, enforcement of the 10 % by-catch regulation was relaxed, and catches of juvenile herring, particularly 0-group, reached very high levels in the early 1980's.

This increase in 0-group herring catch was noticed by ACFM, and concern was expressed about its possible consequences. Despite the succesful recovery of herring stocks in the North Sea and Div. IIIa, it was considered necessary to retain the restrictions on the catch of juvenile herring, because these catches were expected to considerably reduce the recruitment to adult stocks both in the North Sea and in Div. IIIa itself.

Because of the lack of enforcement of existing regulations, ACFM in 1984 recommended a ban on fishing for herring and sprat with mesh sizes less than 32 mm in the whole of Div. IIIa from 1 July to 30 September (the main clupeoid season) for all vessel categories.

The ACFM advice, however, was not followed by the three parties responsible for management of the fisheries in Div. IIIa, (Norway, Sweden and EEC). During their meeting in December 1984, they agreed on a sprat TAC of 58000 tons for Div.IIIa, although it was not clear how this catch could be taken without violating the existing by-catch regulations. However, the sprat TAC for 1985 was somewhat lower than the one agreed in former years, and this reduction in sprat TAC could be regarded as a new effort to reduce the catch of juvenile herring.

Shortly after the three parties meeting in December 1984, EEC proposed a removal of the by-catch limitation for other species in the sprat fishery. By-catches of other species (in practice mainly juvenile herring) would form an integral part of the sprat quota, which then in fact became a mixed quota. However, no agreement was reached on this proposal, nor on any other revision of the regulatory measures previously agreed for this fishery. The parties agreed that consultations should be resumed later in the year, and that in the meantime ICES should be asked to provide advice on the merits and consequences of different regulations in the sprat fishery.

2. Description of the small-meshed fishery.

2.1 The Danish small-meshed fishery in Division IIIa.

The small-meshed fishery is defined as the trawl fishery using a mesh size below 32mm.

The disposal of the catch in the small-meshed fishery is mainly for reduction to fish meal and -oil, and for mink-food. The catch is taken by a large number of relatively small vessels based in several ports. Reduction plants are situated in three ports along the Danish Skagerrak-Kattegat coast: Hirtshals, Skagen and Strandby. The latter is supplied with catches predominantly taken in Division IIIa, while the plants in Hirtshals and Skagen also processes catches from the North Sea.

In a number of smaller ports along the east coast of Jutland part of the landings are carried by truck directly to mink farms and to plants producing mink and trout food, while the major part of the landings goes to fish meal plants in ports along the west and north coast of Jutland.

Three different types of fishery can be identified within the small-meshed fishery in Division IIIa: The fishery for sandeel, the fishery for clupeoids (sprat and herring), and the fishery for gadoids (Norway pout and blue-whiting). In general, the definition of the type of fishery does not imply that a certain sector of the fleet only participate in one fishery. However it is possible to characterize the vessels fishing for each of the three target species and in the following sections each fishery and the fleet are described in broad terms.

2.1.1. The sandeel fishery

The fleet fishing for sandeel uses trawls with a cod-end mesh size of 6-9mm. The use of a mesh size below 16mm is only allowed in the period 1st of March to 31st of July in the Kattegat and from 1st of March to 31st of October in the Skagerrak. Thus the fishing season is more extended in the Skagerrak, that area also being by far the most important. The sandeels are fished at water depth about 20-60 meter and the major part of the smaller vessels participate in the fishery in the 2 nd quarter. In years of high sandeel abundance larger vessels also join the fishery and the fishery continues in the 3 quarter. The by-catch of other species is very low and the fishery is governed by a 5% by-catch rule.

2.1.2. The fishery for clupeoids (Sprat and herring)

The small-meshed fishery uses a mesh size of 16mm. The peak season is the 3rd quarter and fishing areas cover the shallower parts of the Skagerrak and Kattegat. Figure 1 illustrates the waters less than 40 m in Div.IIIa. Existing catch records are based on ICES squares and they do not allow a breakdown of catches into smaller geographical areas. A large part of the catch is taken in a pair-trawl fishery and the catch is a mixture of sprat and herring. The proportion of sprat and herring varies with the recruitment to the stocks and in the most recent years herring has been the major component in the catches. Vessels of different size categories participate in this fishery.

2.1.3. The fishery for Norway pout and blue whiting.

The Norway pout and blue whiting catches are taken with a 16mm mesh in the deeper areas of the Division IIIa (Skagerrak). Only relatively large vessels are able to fish at these depths. The Norway pout are caught with bottom trawls in water depths between 100-150 m by vessels above 30-40 GRT. The blue whiting are fished in water depths of about 150 meters or more by vessels above 40-50 GRT.

The by-catch in this fishery is regulated by a 10% by-catch rule.

2.1.4. Structure of the small-mesh trawler fleet in Division IIIa.

The catch statistics for the industrial fisheries are not directly related to the individual vesseltype, the landings are randomly sampled irrespective of vessel characteristics. It is therefore difficult to give precise information on catches by vessels category and time period.

Attempts have been made to distribute total industrial catches on catch by vessel category and quarter using log-book information. The results are given in Table 2.1. Using the overall proportion of clupeoid catches (sprat and herring) to total catches the catches are scaled to show the clupeoid catch by vessel size and quarter, see Table 2.2. The calculation is based on the assumption that the clupeoid fishery is equally important to all vessel categories, an assumption which is not fulfilled. However, the Study Group had no other alternative if an approximate table was to be constructed during the meeting.

Gross Register Tonnage (GRT) has been used for the definition of vessel groups. Figure 2.2 shows the approximate relation between GRT and length of the vessel.

2.2. Description of the Norwegian small-meshed fishery in Division IIIa.

Two types of fisheries by small-meshed nets are conducted by Norwegian vessels in the Skagerrak.

1. The sprat fishery (purse seine)
2. The industrial trawl fishery

2.2.1. The sprat fishery.

A fishery of sprat for canning purposes takes place in the fiords along the Norwegian coast in Div. IIIa . The eastern part particularly the Oslofjord, is most important for this fishery.

The sprat fishery usually takes place in January and July-December. The main period in the Oslofjord is August-October. These are also the months giving the highest bycatch of herring.

All catches are taken by purse seines with a mesh size of about 17 mm, mostly by the use of artificial light.

In the later years 20-25 vessels, mainly 50-70 ft and a few 40-50 or 70-90 ft, have been engaged in the fishery.

2.2.2. The industrial trawl fishery.

A small-scale Norwegian trawl fishery for Norway pout, blue whiting and lesser silver smelt takes place in selected areas in the Skagerrak, mainly in the second half of the year. The main area is in the entrance of the Skagerrak as a part of the Egersund Bank fishery. In the deeper part of the Norwegian trench some small catches of argentines are taken.

Rather few vessels participate in the trawl fishery, and in the latest years they have altogether only made about five trips per year.

The mesh size is 20-22 mm (mainly 22 mm). There is no bycatch of herring in this fishery.

2.3. Description of the Swedish small-meshed fishery in Div. IIIa.

2.3.1. The purse seine fishery for sprat.

The purse seine fishery for sprat is mainly carried out in the archipelago of the Swedish west coast during September to March. The fleet consists of vessels less than 90 feet. The number of boats participating has decreased steadily since the 1960's and is now about 10. The demand for sprat to the canning industry has for several years been around 3000 tonnes. This quantity is allocated on a catch per boat per week basis.

By-catches of herring in the purse seine fishery are normally limited and are included in the by-catch figures for all consumption fisheries for herring. (see Sect. 4).

2.3.2. The Swedish trawl fishery in Div. IIIa with 16 mm mesh has sprat as its target species. It is conducted with boats in the range of 50-100 feet. Its importance can be demonstrated by the numbers of days fished, which in 1982-1984 varied between 260-460 days per year. The catches are dominated by clupeoids of which a part is sorted out for human consumption and the rest is used for reduction purposes. The total yearly catches (all species) in 1982-1984 were 1400-2400 tonnes (Table 3.8).

3. Catch Statistics.

3.1. General.

Total annual catches of the species landed mainly for non-human consumption outlets from Division IIIa fisheries are presented in Table 3.1. This covers the years 1974-84 and also provides a catch breakdown by countries where available.

It is clear that Denmark has accounted for the major part of these landings for all species.

Catches of Norway pout, sandeel and blue whiting show considerable year to year fluctuations, without any clearly defined trends, whereas sprat and herring show an inverse relationship over this period. Sprat predominated in the period 1974-81, followed by a rapid change to herring predominance in the years 1982-84. This reflected parallel changes in the North Sea stocks of the two species over the same period.

The change in balance between herring and sprat, and the relative importance of the different species contributions to the total industrial catch are more clearly shown in Table 3.2. Average catches by species are compared for the periods 1974-81 and 1982-84 and the inverse shift between sprat and herring catches is clearly evident. The catch of Norway pout shows an increase between the two periods, whilst that of sandeels was much the same, but as noted above these fisheries have registered considerable annual fluctuations. Insufficient information is available to compare blue whiting catches.

This table also emphasises the fact that herring have become the most important component of industrial landings in recent years.

3.2. Catch statistics by Country.

Some more detailed statistics by time and area were made available to the meeting and these are presented by countries below.

3.2.1. DENMARK.

The long term importance of herring to the Danish industrial fishery in both the Skagerrak and the Kattegat is shown by Figure 3.1. This presents a time series of catches covering the years 1965-1984. It clearly shows that parallel changes have taken place in both areas, and that catches in the most recent years are now back to a level comparable with that in the years prior to 1974. The very high catches recorded in 1968 were boosted by a fishery for adult herring in the open Skagerrak area that year.

Table 3.3 covering the years 1974-1984, provides a quarterly breakdown of total industrial landings for the Kattegat and the Skagerrak, together with the herring component of these catches. The available data did not allow a more disagregated analysis of catch by area.

The increased importance of herring to the total industrial catch in the most recent years is shown for both areas. The quarterly breakdown indicates that on average the peak herring catch has been taken during the third quarter although in a number of years there have been exceptions to this, particularly in the Kattegat fishery.

Age composition of the Danish industrial herring catch.

Table 3.4 provides a breakdown by age groups and quarters of the contributions by number and weight of herring to the Danish catch in the years 1982-84.

It can be seen that the exploitation pattern is very similar in each area. The fishery exploits mainly 0-group fish in the last half of each year, commencing in the third quarter, and follows these through to 1-group in the first quarter of the following year.

On an annual basis the contribution of 0-group fish by number to the catch is around 70-75 %, but in terms of weight they contribute about the same as 1-groups, namely 40-45%. The representation of older age groups is relatively low, around 10 % by weight.

3.2.2. NORWAY.

Catch statistics covering landings in the Norwegian Skagerrak coast fishery undertaken by small-meshed purse seines are presented in Table 3.5. These are broken down by quarters for the years 1981-84, together with the herring by-catches. It is an entirely human consumption fishery for the canning industry and quality requirements govern the times of fishing and amount of herring by-catch allowed. The main fishery usually takes place in July-December with a small amount in January. In the main fishing area,the Oslofjord, August-October are the most important months, and these also give the highest by-catches of juvenile herring. The annual percentages ranged between 15-20 %, and although relatively high, in absolute terms the amount of juvenile herring involved is only a few hundred tonnes per year.

An approximate breakdown of the herring age composition by weight is provided in Table 3.6. These were indirectly estimated from data provided by sales slip categories (number per kg.), a general weight/length relationship, and a length-age key. It is evident that 0-group constitute the major part of the herring by-catch, amounting to 89 % by weight when averaged over the 4-year period.

Norwegian industrial trawl fishery in the Skagerrak.

Catch statistics are presented in Table 3.7. This is a very small-scale fishery exploiting mainly blue whiting and Norway pout in deeper water. There is no herring by-catch involved.

3.2.3. SWEDEN.

Catch statistics from logbooks covering the small-mesh trawl fishery for clupeoids are shown in Table 3.8. Quarterly and annual catches are presented for the years 1982-84 in the Kattegat and Skagerrak. The catches involve a mixture of sprat and herring but insufficient data is available to estimate the herring component. The catches are used for both human consumption and industrial outlets. This fishery is distinct from the main sprat fishery undertaken in the coastal fjords using small mesh purse-seines, and here the catches are taken mainly for human consumption.

4. Racial Composition of the Herring in Division IIIa.

4.1. Introductory Remarks.

Herring caught in the Skagerrak and the Kattegat consist of components of different origin which may be divided into three main groups:

Autumn spawners from the North Sea
Spring spawners from Div. IIIa itself
Spring spawners from the western Baltic.

In very general terms it may be stated that II-group and older herring belong to the spring spawning components while the immature herring is a mixture of autumn and spring spawners. In any attempt of assessing the effects of fishing for immature herring the proportion of the catch belonging to either component is a necessary information. The North Sea autumn spawned progeny drifting into Div. IIIa is a fraction of the total potential recruitment to the North Sea stocks. In case of the local spring spawners it is reasonable to assume that all immatures are confined within Division IIIa while offspring from the western Baltic gradually moves into Div. IIIa with increasing age and/or length.

In late January 1983 an ICES Workshop on Stock Components in Div. IIIa looked into the possibilities of making a split between the main components in samples from the commercial landings and in research vessel hauls. It concluded that an analysis of length components present in a given length distribution was a feasible method in dividing autumn spawners from spring spawners using vertebral counts as check. The basic assumption for this method is - of course - that the autumn spawned components being several months older than the spring spawned components of the same age group reach a proportionally larger size. Unfortunately there is, at present, no method by which the two spring-spawning groups (i.e. Div.IIIa and Western Baltic) can be separated. It is a well known feature that especially young herring segregate according to length and depth, i.e. that the bigger specimens of a component move into deeper water earlier than the smaller specimens. As the different fisheries exploit herring at different depths it is necessary to apply any method of racial identification to rather well-defined fisheries. In the present context this was done by 1) Danish industrial by-catches of juvenile herring mainly in shallow areas, 2) Swedish landings of herring for human consumptions caught in medium to deep water and 3) Research vessel surveys. The latter (Young Fish Surveys in February and acoustic surveys in August/September) are important both to assessments and in making prognoses. They have their limitations, however, as to giving a fully representative picture of the stock composition because the more shallow areas are less efficiently covered, i.e. the surveys tend to underestimate the smaller components of the I-group and the entire 0-group.

4.2. Herring bycatch in the Danish industrial fisheries.

From the material collected in 1979-82 and presented at the above-mentioned Work Shop, it appeared that autumn and spring spawned components could readily be separated on length criteria. Even while the said Work Shop was in session, new samples from the northern Kattegat negated the conclusions reached at the Work Shop meeting. A new component of length less than the local springspawners had vertebral counts (VS) that could either be interpreted as being pure North Sea autumn spawners (Medium VS) or a mixture between Skagerrak fiord spring spawners (high VS) and local Kattegat spring spawners (low VS).

For this reason all Danish monthly length compositions from samples of industrial landings in Div. IIIa 1982 from to medio 1985 were re-analysed by Mr. K.P. Andersen by the following method described in annex I.

The results are shown graphically in Figures 4.1-4.3 for year-classes commencing as 0-groups in 1982-1984. For each month the two or three length components found by the analysis are shown by squares the size of which indicates the percentage in numbers. To components where vertebral counts are available and may be indicative of the origin, a small arrow pointing upwards shows a VS>56.2, an arrow pointing sideways indicates a VS between 56.0 and 56.2 and downwards pointing arrows indicate VS<56, i.e. pure local spring spawners.

The figures indicate three main features:

(i) The autumn-spawned component play an insignicant role as I-group in the second half year.

(ii) 2-group herring consist almost exclusively of spring spawners.

(iii) Fish with medium VS-values appear to be of increasing importance as 0 and I-group in winter.

This does not necessarily mean that the autumn-spawned component has left Div. IIIa as I-group in autumn. As indicated by the Swedish results shown below, it is more probably the effect of an emigration with increased length into deeper water and thereby out of reach of the industrial fishery. An estimate of the actual composition of components expressed in numbers caught could, unfortunately, not be undertaken during the short meeting of the Study Group.

4.3 Separation of Swedish catches of 1-group and 2-group herring in Div.IIIa.

The separated catches include all catches of 1-group and 2-group herring in the trawl fisheries with 32mm and 16mm as well as catches in the purse seine fishery for sprat and herring. The vast majority of the 1-group herring is caught in the pelagic trawlfishery with 32mm mesh size (see section 2.3). The 0-group herring catches are limited and not further analysed.

The catches have been separated by the same method as used in the IYFS estimate of spring and autumn spawned components (ICES C.M.1983/Assess:5). The separation of the 1-group herring gave two groups of components: one with low mean length and VS counts below 56.20 and one with higher mean length and VS of 56.30 or more. It has been possible to follow the components throughout the year and also in 2-groups in the first quarter.

The result of the separation of 1-group and 2-group herring for the period 1980-1984 is given in Table 4. Incomplete sampling of the Skagerrak catches in 1980 prevented an analysis in that area.

4.4 Separation of juvenile herring caught during research vessel surveys into stock components.

The indices of 1-group herring from the Young Fish Surveys in Div.IIIa have been separated in spring and autumn spawned components respectively for the years 1980-1985. The results of the separation are reported in ICES Doc. C.M.1985/Assess:12. and the following text table is taken from that report.

Year	Index Total	Index Spring Spawned	Index Autumn Spawned
1985	7.994	3947*	4047*
1984	6.035	2793	3242
1983	5.419	1522	3897
1982	2.560	1408	1152
1981	3.246	996	2280
1980	2.311	1607	704

* Preliminary index.

The proportion of the autumn spawned component has varied between 0.3 in 1980 and 0.72 in 1983 and proportion has for the most recent years been about 0.5.

In the 1985 report of the Herring Assessment Working Group, the appearance of a third component was discussed This component showed a low mean length 10-12 cm in the first quarter and high numbers of vertebrae, 56.2-56.6 and it appeared both in the 1985 IYFS and in the Danish catches in the northwestern part of the Kattegat from 1983 onwards.

During the acoustic survey in Div.IIIa carried out in August-September 1985, the same age group taken during the February IYFS was sampled again. At present only samples from the Kattegat and the Skagerrak east of Hirtshals have been analysed. The result of the split is given in the text table below.

Split of 1-group herring August-September

	Mean length cm	Mean VS	Proportion
Skagerrak	16.96	55.85	.31
	22.51	56.40	.69
Kattegat	20.80	56.28	1.0

In the Skagerrak the split gave two components that could be identified as being spring and autumn spawned respectively. In the Kattegat it was not possible to identify more than one component with an intermediate mean length 20.8 cm and a vertebrae count of 56.28. This component has similar characteristics as the third component in 1984 and in the first quarter of 1985. The origin of this component is still not known.

The 2-group and older herring in August-September have vertebral counts below 56.00 and are thus classified as spring spawners.

5. The biological consequences of catching juvenile herring.

The basis for biological advice concerning the exploitation of juvenile herring is based on two separate issues:

1. Rebuilding Spawning Stocks.

2. Yield per recruit considerations.

5.1 Rebuilding spawning stock.

Concommitant with the decline in the North Sea herring stocks in the 1970's, a reduced recruitment was observed and an empiric stock-recruitment relationship was identified. During the 1970's when the biomass of North Sea herring was low, the objective of the management advice was to rebuild the spawning stock as quickly as possible. Reduction in the juvenile fishery was advised in order to maximize the recruitment to the spawning stock. The management measures taken involve a 10% by-catch rule in the small-meshed trawl fishery.

Since 1980, the recruitment to North Sea stocks and also to stocks in Division IIIa has been very high. In 1985, the 1-group index of herring in both the North Sea and Division IIIa are the highest on record. The high recruitment since 1980 in years of moderate spawning stock sizes has reduced the urgency of rebuilding spawning stock size in the North Sea.

5.2 Yield per recruit considerations.

Calculations of yield per recruit for various exploitation patterns, especially different exploitation levels on the juvenile herring, form the basis for a recommendation allowing only limited fishing on juvenile herring.

ACFM stated in the May 1985 report (p.11) that "...the yield per recruit studies showed that the potential yield and spawning stock size from a year class are highest if the 0- and 1-ringed herring are not fished". Attempts have been made to quantify the gain in yield obtained by closing the fishery on juvenile herring. The gain is heavily dependent on the M on juveniles and estimates must be based on a series of assumptions. The Herring Assessment Working Group (C.M. 1984/Assess:12) carried out a preliminary analysis of the stomach sampling data from the North Sea and gave preliminary estimates of natural mortality. On this basis the working group calculated that for each ton of 0-group herring caught, the catch of adult (2-group and older) herring would be 4 tonnes lower compared with a zero catch of 0-group.

In order to evaluate the yield from a fish stock exploited by several types of fleets, say a 16mm fishery on juveniles and a 32mm on adult herring, the exploitation pattern of each of the fleets should be estimated and the yield from the stock calculated for various levels of fishing mortality for each of the fishing fleets.

The 16mm fleet exploits mainly 0 and 1-groups whereas the 32mm fleet exploits the 1-group and older. The exploitation pattern by fleet is not available at present and a full analysis of the effect on total yield is not possible at present.

The calculations presented in the 1984 Herring Working Group Report (C.M.1984/Assess:12) and in the ACFM report (May 1985) both consider exploitation of age groups, i.e. 0-group versus adult herring) and must therefore be considered as an approximation to the effects of fishing juvenile herring using small-meshed trawls.

As stated above, the applied estimate of natural mortality has strong impact of the estimated yield from the stock when catching juvenile herring. In the most recent years, new estimates from multispecies approaches have become available.

In Annex II, the effect of using alternative estimates of M is considered. Comparing the estimate used by the Herring Working Group 1984 and ACFM 1985 respectively with estimates derived from improvement of the multispecies model, the effect of catching juvenile herring is drastically changed.

The Study Group was not able to evaluate the basis for the new estimate of natural mortality and concluded that no precise estimate of the effect of catching juvenile herring could be given.

The Study Group agreed in view of the uncertainty that possible changes in both the biological basis for management policy as well as the policy itself have to be made gradually.

Based on the values of natural mortality presently considered likely, the fishery on juvenile herring leads to a disproportionate loss in the adult herring fishery, but quantitative effects are difficult to give at present.

Further studies have to be carried out in respect to multispecies models and predation mortality. Further, it is important to investigate whether predation estimates from the North Sea can be applied in the Division IIIa.

6. Review of previously agreed Management Measures

6.1 Background

The Danish industrial fisheries in Division IIIa have a long standing story. Up to the seventies, young herring with varying bycatch of sprat was the main target of the small-meshed fisheries (14mm meshes). The decline of the North Sea herring stocks in the early seventies was concomitant with an increase in the sprat population, and sprat took the place of the declining immature herring from the North Sea as the target species of the small-meshed fisheries.

In order to protect and hopefully initiate a recovery of recruitment to the North Sea herring stocks, strict regulations were imposed upon the herring fisheries not only in the North Sea but also in Division IIIa. The present problems derive from the fact that since 1980 a substantial increase in recruitment to the North Sea autumn spawned herring has occurred at the same time as a decline in the sprat stock in Division IIIa. The consequent increase in the influx of North Sea 0-group herring into Division IIIa has thus reversed the situation to that prior to the seventies and made the measures introduced during that decade prohibitive to small-meshed fisheries on clupeoids. In the sections below, the four main restrictive measures recommended and agreed upon, are briefly commented on, especially with reference to the present situation in Division IIIa.

6.2 By-catch limits

That by-catch of herring when fishing for sprat with a minimum mesh size of 16mm must not exceed 10% of the individual landing, was one of the first measures to be introduced. With the present ratio between sprat and herring, the 10% by-catch limit is meaningless unless the aim is to bring the industrial fishery to a complete stop. To increase the limit is not a feasible way either. If it is set too high, it will give no protection for young herring. If set too low, it will stop the fishery altogether and probably not be enforcable. To set a maximum percentage at a reasonable level will demand prognoses of future sprat-herring ratios which cannot be made. For these reasons, a by-catch limit is not a usable tool for a gradual reduction of juvenile herring catches. Last - but not least - by-catch limits are far more difficult to control in an area as Division IIIa where the fishery is carried out by many small vessels landing in many small ports as compared to the North Sea.

6.3 Ban on directed herring fishery for industrial purposes.

There is no strict biological ground for a ban on fishing herring for industrial purposes. This measure was introduced to reduce the total catch of herring at a time when TAC's were not effective.

This measure is economically not very logical at a time when human consumption markets apparently are saturated and prices are low. The most likely result of such a ban is that only the large herring are landed and the non-marketable size categories are discarded. Apart from being an economic waste, discards at sea introduce a serious uncertainty about the actual catches. It should be noted that such a ban is not adopted by one of the three parties engaged in Div.IIIa fisheries. It should also be noted that the suspension of the ban will not benefit the small-meshed fisheries directly as long as other measures like minimum mesh size, minimum landing size and by-catch limits are in force.

6.4 Minimum legal landing size.

The introduction of 18 cm as minimum legal landing size in Division IIIa has not proved very successful. Rigorous enforcement is very difficult and could lead - if practicable - to discarding of unrecorded quantities, especially when abundance of juvenile herring is high. To the small-meshed clupeoid fisheries, the enforcement of a minimum legal landing size equals a total ban at present.

6.5 Minimum legal mesh size.

The presently agreed 32mm minimum mesh size to be used in directed herring fisheries with trawls, appears from Swedish trials to be the largest mesh size that can be applied generally. In pelagic trawls, larger mesh sizes seem to create serious meshing problems, while larger meshes are actually in use in bottomtrawling for herring in the southern Kattegat.

The 32mm mesh cannot be used in fishing for sprat and it appears to reduce the by-catch (catch) of 0-group herring so effectively that in major parts of the Division IIIa it almost equals a ban on fisheries with these targets.

Mesh-size regulations have an advantage on the other measures mentioned, in that it is the most easily enforced, apart from total bans. It can be controlled at sea as well as on shore and especially so, if a vessel were only allowed to carry gear in accordance with one particular mesh regulation on a particular voyage.

7. Alternative Management Measures.

7.1. As mentioned in previous sections, the problem for the small-meshed industrial fisheries is the spectacular increase in the recruitment to some herring stocks particular in the North Sea. Thus the ratio between young herring (0- and I-groups) and sprat has been reversed over a few years and regulations introduced when sprat was the dominant species would effectively put a stop to these fisheries if strictly enforced.

ACFM (May 1985) advised a policy of gradually reducing catches of juvenile herring in the small-meshed trawl fishery. Regulatory measures should be introduced which would enable such a gradual reduction of juvenile herring catches. As discussed in section 6, the regulatory measures presently in force are not adequate to achieve this policy of gradual reduction. In the following paragraphs, three new measures will be considered which hitherto have not been applied or agreed in Div. IIIa.

7.2. Closed areas.

In this paragraph, the possibility of closing certain areas within Div. IIIa for a certain part of the year is considered.

Introduction of closed areas as boxes has been applied in several cases in order to protect juvenile fish. Examples are the Norway pout box in the northeastern North Sea, the sprat box along the west coast of Denmark and the mackerel box around Lands End. In case of Division IIIa, however, it is not possible on the basis of the available catch statistics to define smaller areas or periods that contain a relative high proportion of juvenile herring, and a low proportion of sprat. It has to be assumed that the distributions of sprat and juvenile herring nearly completely overlap in time and space, and that it is not possible to direct the trawl fishery for small clupeoids specifically towards sprat.

A closed area would have to virtually include the whole of Div. IIIa and extend at least during the 3rd quarter, and preferably also the 4th. Some sectors of the industry would be severely disrupted, as they have no possibilities to fish outside Div.IIIa.

Because of the difficulties in defining smaller areas as potential boxes and especially of evaluating their effect, the Study Group did not find basis for further consideration of this possibility.

7.3. TAC on Immature Herring.

The existence of a 10 % by-catch regulation and a 32 mm minimum mesh size <u>de facto</u> turns Div. IIIa into a closed area for small-meshed trawl fisheries on clupoids. A derogation necessitated by e.g. socio-economic reasons could be in the form of a special TAC for immature herring. A serious difficulty in this connection is the control of landings and the necessity of an elaborate sampling scheme considering the large number of boats and small landing places along the coasts of Div. IIIa.

Another problem in setting a TAC specifically for juvenile herring is that no prediction can be made of the biological effect of such a TAC. The strength of the incoming herring year-class is unknown, and it is not possible to state the fishing mortality which will be generated by a certain catch of juvenile herring.

7.4. Combined TAC for clupeoids taken by the small-meshed trawl fishery.

A more feasible approach - which indeed has been tried by EEC in 1985 - is the combination of a licensing system and a combined TAC for clupeoids caught with small-meshed trawls.When a licensed vessel lands her catch, the total landing is counted against the quota irrespective of the species composition. This makes a sampling system for enforcement purposes superfluous and the quotacontrol can be moved from the many boats to the few buyers of industrial fish.

If the licensed vessel changes to other fisheries, e.g. blue whiting and Norway pout, it must report the landings in advance to the fishing control officers in order to avoid that they are counted against the clupeoid quota.

Small-meshed fisheries directed at other species do not require a special licence, and their catches are regulated by the existing by-catch rule. The experience in Denmark in 1985 has shown that it is feasible in practise to record catches taken by these fisheries separately, and to stop these fisheries from engaging in the fishery for clupeoids.

The blue whiting/Norway pout fishery is difficult to define by the gear used as is the case in most trawl fisheries. It is, however, controlled by by-catch percentages both for Annex V species and for herring.

In case of the sandeel fishery, there should be no special problems. The fishery is well defined by the use of very small meshes and subject to a 5 % maximum by-catch rule. The small mesh size also makes the gear less suitable for capture of other species.

Fig. 7.1 shows the 1985 regulation in Division IIIa.

In fixing a combined TAC for small-meshed clupoid fisheries, it should be kept in mind that the extreme consequences to the herring fisheries is the - perhaps less likely - situation where the landings consist of 100% herring. As to the biological consequences of any level of fishing young herring, reference is made to section 5, while the possible magnitudes of derogations may be deducted from Tables 2.1 and 2.2.

8. Conclusions.

Catches of juvenile herring in Div. IIIa probably result in a reduction of adult catches in the North Sea and Div. IIIa. If the management objective is to maximise the total catch of herring in these various areas, the catches of juvenile herring should be restricted as far as possible, ideally to zero.

From a management point of view, there may be some reasons for allowing a certain amount of juvenile herring to be taken by the small-meshed fishery and accepting the subsequent reduction in the catch of adult herring. One reason is that without taking some juvenile herring, it is impossible to exploit the sprat resource in the area. Another reason is that a sudden ban on catches of juvenile herring would create socio-economic problems for certain sectors of the fleet.

Under present circumstances, the first reason is not valid. Because juvenile herring make up about 80 % of the small-mesh clupeoid catch, the reduction in catch of adult herring is likely to be greater than the combined catch of sprat and juvenile herring. The maximum catch of clupeoids would therefore be obtained after a complete closure of the small-meshed fishery for these species. This leaves the socio-economic argument as the only justification for taking a certain amount of juvenile herring.

It should be stressed that from a biological point of view, it is impossible to advise on the quantity of juvenile herring that has to be set aside for this purpose. Until now, the policy advised by ACFM has been to maximise the total catch of herring, and consequently to minimise the catch of juvenile herring. The regulatory measures currently in force (32 mm minimum mesh size, 18 cm minimum landing size, ban on fishing herring for reduction purposes, and 10 % by-catch limitation) are all based on the policy to protect juvenile herring.

If for socio-economic reasons, it is necessary to allow some quantity of juvenile herring to be taken by a certain sector of the industry, the decision on this amount will be a purely political one. The consequences of taking a certain amount of juvenile herring have been discussed in this report, and it is up to the management authorities to decide what loss in the adult herring fisheries they are willing to accept in order to solve socio-economic problems in certain sectors of the small-meshed trawl fishery.
If the existing management policy is maintained, that is to aim for a maximum catch of adult herring, steps should be taken to gradually reduce the amount of juvenile herring that is taken by the small-meshed fisheries.

The assessment of the negative effects of catches of 0-group herring is critically dependent upon estimates of natural mortality, both in juvenile and adult herring. The estimates presently available were derived from the international stomach sampling programme in the North Sea, and it has been assumed that these estimates also apply to Div. IIIa. For a more precise estimate of natural mortality in Div. IIIa, however, it will be necessary to collect specific information on consumption of herring by various predators in this area.

In Div. IIIa, a maximum by-catch rule is not the best method to reduce catches of juvenile herring. The fishermen cannot direct their fishing activities specifically towards sprat, and the by-catch percentage will be governed entirely by the ratio between herring and sprat in the area. If the by-catch percentage is set too high, there is little restriction on the catch of juvenile herring. If it is set too low, the fishery has to be stopped completely. A maximum by-catch percentage therefore cannot be used to gradually reduce the catch of juvenile herring.

Other methods were considered by the Study Group, including a closed area for small-meshed fisheries, and a mixed clupeoid quota for the small-meshed fisheries.

If a closed area regulation is to be effective, it would have to encompass all the shallow waters of Div. IIIa. There are no biological data available to delimit smaller areas for closures; besides, enforcement of restricted closed areas would be extremely difficult and costly. The closure would have to apply at least to the 3rd quarter of the year, the season which is also the main fishing period for sprat. Adoption of this method would therefore create considerable disruption of the industry, particularly among the smaller boats that cannot fish outside Div. IIIa.

The last method involves setting a mixed clupeoid quota for the small-meshed trawl fishery. This method has the potential advantage of allocating the quota specifically to that sector of the industry that has no alternative employment. It also sets a ceiling on the maximum amount of juvenile herring that can be taken, and it offers the possibility of a gradual reduction of this catch, for instance by a certain percentage each year. A disadvantage of the method is that all attempts to direct the fishery towards sprat are abandoned. Under present circumstances, the catch taken under a mixed quota will consist of about 80 % of juvenile herring. The size of the mixed quota will therefore be determined mainly by the need to preserve juvenile herring, and not by the availability of sprat.

The first trials with a mixed clupeoid quota in Denmark in 1985 have shown that methods can be designed to exclude catches of other species, taken by small-meshed trawl, from the mixed clupeoid quota.

If directed sprat fisheries, such as the purse seine fishery, are also included in this mixed quota, the problem arises that these fisheries will be unnecessarily restricted by the gradual reduction of the mixed quota. It would be advisable, therefore, to maintain, in addition to the mixed clupeoid quota, a quota for directed sprat catches, governed by an appropriate by-catch percentage. The size of this sprat quota would depend on the abundance of sprat in this area.

ANNEX I.

As the length distributions are supposed to be the result of a mixing of two or three normal distributions, the length frequencies fr(l) can be expressed approximately in this way:

```
fr(l)=
(N1*exp(-(l-m1)**2/2/s1**2)/sqrt(2*pi)/s1 +
N2*exp(-(l-m2)**2/2s2**2)/sqrt(2*pi)/s2+                (1)
N3*exp(-(l-m3)**2/2/s3**2)/sqrt(2*pi)/s3))*delta-l
+epsilon(l)
```

where Ni is the number, mi the mean length, and si the standard deviation of the i´s distribution, respectively. Delta-l is the length of the grouping interval and the epsilons are random components. If the samples are random samples from a distribution composed of two (three) normal distributions, the epsilons are approximately independently normally distributed with mean zero and variances equal to fr(l).

The N´s, m´s, and s´s can therefore be taken as regression coefficients in the non-linear regression (1), and estimated by least squares. The standard methods for solving non-linear regressions also give an appoximate covariance matrix for the regression coefficients and the residual variance. As the least square method only demands relative variances of the observations fr(l), and the residual variance is an estimate of the proportionality factor, it can be used for a rough test of the validity of the model.

ANNEX II

In order to evaluate the importance of a reliable estimate of natural mortality, the effect of catching juvenile herring has been calculated for three different levels of natural mortality.

Method

Three different arrays of natural mortality were used:

age	0	1	2	3	4	5	6	7	8	9+
A	1.0	0.45	0.30	0.25	0.1	0.1	0.1	0.1	0.1	0.1
B	1.0	0.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C	1.4	1.0	0.6	0.2	0.2	0.2	0.2	0.2	0.2	0.2

where A is from the Multispecies WG (C.M.1984/Assess:20), B is that used by the Herring WG in 1984, and C is (for age group 0, 1 and 2) the array from a revised version of the MSVPA computer programme, which will be presented at the MSVPA WG meeting in November 1985. The most important improvement from the former programme is the incorporation of prey weight at age as actually found in the stomachs of the predators instead of the mean weight in the sea. For age group 3 and older, M=0.2 were chosen.

Within the range of estimates which presently seems likely, option C represents the high values.

In order to assess the biological effect of fishing juvenile herring, yield per recruit simulations were done using the following assumptions:

1. Weight at age: 9g, 50g, 126g, 176g, 211g, 243g, 251g, 267g, 271g, and 271 g for the age groups 0 to 9+ which is equal to that used by the Herring WG in 1984.

2. Fishing mortality on 0 and 1-groups set at half the value of F in the older age groups.

3. F0.1 was used as fishing mortality level and steady state situations were assumed.

Results

Using natural mortalities from option A, a catch of 0-group of 1 tonne would reduce the catch of 1-group and older with 4.7 tonnes. Using natural mortalities from option B, a catch of 0-group of 1 tonne would reduce the catch of 1-group and older with 3.9 tonnes. With the C array, a catch of 0-group of 1 tonne would give a loss of 1.1 tonnes of 1-group and older.

With respect to the fishery of 1-group herring, a catch of 1 tonne 1-group under assumption A would reduce the catch of 2-group and older with 0.7 tonnes. Under assumption B with 1.8 tonnes and under assumption C with 0.4 tonnes.

Table 2.1 Total Danish industrial catch from Div. IIIA 1984 (Tonnes).

GRT	Quarter 1	2	3	4	TOTAL
5-19.99	7894	9210	24027	7554	48685
20-29.99	819	1454	2887	1376	6536
30-39.99	5835	5311	22313	6520	39979
40-	11535	24043	65135	39323	140036
total	26083	40018	114362	54773	235236

Table 2.2 Total Danish industrial catch of Herring and Sprat 1984 from Div. IIIA (Tonnes).

Tentative breakdown by vessel group and quarter.

GRT	Quarter 1	2	3	4	Total
5-19.99	4572	5335	13917	4376	28200
20-29.99	474	842	1672	797	3785
30-39.99	3380	3076	12924	3777	23157
40-	6681	13927	37728	22777	81113
total	15107	23180	66241	31727	136255

Table 3.1. (Part 1).

Division IIIa Annual Landings (Tonnes x 10^{-3}). For Reduction Purposes.

	Norway Pout				Sandeel			Blue Whiting		
	Denmark	Norway	Sweden	Total	Denmark	Sweden	Total	Denmark	Norway	Total
1974	10.7	0.1	2)(2.1)	12.9	7.9	2)(0.2)	8.1	N/A	N/A	-
75	15.7	0.9	2)(2.3)	18.9	16.4	0.1	16.5	N/A	N/A	-
76	40.1	Ø	2.3	42.4	21.4	0.1	21.5	N/A	N/A	-
77	20.6	0.1	0.3	21.0	6.1	0.4	6.5	N/A	N/A	-
78	23.9	0.4	0.6	24.9	21.7	2)(1.1)	22.8	N/A	N/A	-
79	24.0	1.2	Ø	25.2	33.3	Ø	33.3	6.0	N/A	6.0
1980	26.2	0.1	Ø	26.3	39.4	Ø	39.4	13.7	N/A	13.7
81	29.3	0.8	0.1	30.2	59.4	Ø	59.4	N/A	Ø	-
82	43.0	1.3	0.1	44.4	18.0	Ø	18.0	4.5	0.5	5.0
83	1)29.1	1.0	Ø	30.1	1)28.1	Ø	28.1	1)16.1	0.1	16.2
1)84	45.5	0.1	Ø	45.6	1)18.8	-	18.8	1)15.3	0.1	15.4
Period Means	28.0	0.5	0.7	29.2	24.6	0.2	24.8	-	-	-

1) Provisional
2) Also includes some N.Sea catch
Ø <0.1
N/A No Data available.

Table 3.1 (Part 2).

Division IIIa Annual Landings (Tonnes x 10^{-3}).. For Reduction Purposes.

	Sprat				Herring
	[1] Denmark	[2] Sweden	[2] Norway	Total	[3] Denmark
1974	48.9	20.6	1.2	70.7	76.1
75	75.7	23.0	1.9	100.6	57.4
76	40.7	16.1	2.0	58.8	37.5
77	54.3	12.0	1.2	67.5	32.0
78	63.6	11.6	2.7	77.9	16.2
79	79.3	14.5	1.8	95.6	12.7
1980	67.4	20.1	3.4	90.9	24.7
81	49.4	29.2	4.6	83.2	62.6
82	31.9	11.5	1.8	45.2	54.1
83	12.5[4]	19.9	1.5	33.9	89.1[4]
84	24.0[4]	10.6	1.7	36.3	112.2[4]
Period Means	49.8	17.2	2.2	69.2	52.2

1) Danish Data supplied to this W.G.
2) Data from ICES Doc. C.M. 1985/Assess:8
3) Includes catches from 32mm mesh Fishery

[A major part of the Swedish and Norwegian sprat catch is landed for human consumption]

4) Provisional

Table 3.2.

Division IIIa Period Mean Annual Landings by Species. For Reduction Purposes.

Species	(Tonnes x 10^{-3}) 1974-81	1982-84	Percentage composition Four important species 1974-81	1982-84
Sprat	80.7	38.5	47.0	20.8
Herring	39.9	85.1	23.2	46.0
Norway Pout	25.2	40.0	14.7	21.6
Sandeel	25.9	21.6	15.1	11.7
Blue whiting	N/A	12.2	-	-
Total	171.7	185.2	100.0	100.0

1) Exclusive Blue whiting

Table 3.3. Total Industrial Fish and Herring Catch Component (Tonnes). DENMARK.

By Quarters and Year, 1974-1984.

KATTEGAT

Year		1	2	3	4	Total	Herring %
1974	a	24,022	22,844	32,962	19,542	99,370	47.2
	b	9,547	11,753	12,356	13,282	46,938	
1975	a	18,428	17,413	70,528	23,966	130,335	31.0
	b	10.223	6,630	15,884	7,619	40,356	
1976	a	20,064	15,242	29,072	26,014	90,392	39.4
	b	10.462	10.393	9,303	5,429	35,584	
1977	a	21,290	19,454	38,125	31,341	110,210	26.9
	b	8,493	1,928	6,530	12,734	29,685	
1978	a	21.501	10,585	35,162	24,728	91,976	15.2
	b	5.632	1,851	4,059	2,464	14,006	
1979	a	17,367	10,466	29,326	17,497	74,656	11.2
	b	1,481	1,444	4,125	1,350	8,400	
1980	a	17,038	17,625	30,802	16,779	82,244	5.7
	b	1,477	898	1,212	1,119	4,708	
1981	a	22,648	9,726	24,691	25,960	83,025	40.4
	b	5,069	1,433	11,188	15,837	33,527	
1982	a	23,737	11,370	28,691	25,972	89,770	32.6
	b	7,892	2,793	6,724	11,833	29,240	
1983	a	20,724	10,455	29,309	21,164	81,652	62.5
	b	13,929	5,463	21,028	10,584	51,007	
1984	a	21,837	11,140	35,869	16,690	85,536	71.4
	b	16,058	7,566	29,170	8,310	61,104	
Period means	a	20,787	14,211	34,982	22,696	92,676	34.8
	b	8,206	4,741	11,052	8,233	32,232	

a - Total Catch landed for Industrial Purposes (include all Species and Mesh Sizes

b - Herring only

Table 3.3. (continued).
DENMARK.

By quarters and year, 1974-1984.

SKAGERRAK

Year		1	2	3	4	Total	Herring %
1974	a	8,284	19,788	50,715	15,590	94,377	30.9
	b	1,387	2,577	18,541	6,669	29,174	
1975	a	11,914	24,474	45,401	16,028	97,817	17.4
	b	3,987	6,953	4,937	1,156	17,033	
1976	a	7,050	12,544	72,498	28,146	120,238	1.6
	b	165	140	527	1,116	1,948	
1977	a	6,530	14,856	21,691	12,984	56,061	4,2
	b	1,098	93	362	789	2,342	
1978	a	5,375	18,955	50,527	18,814	93,671	2.3
	b	304	95	1,245	537	2,181	
1979	a	3,601	10,772	52,738	35,395	102,506	4.2
	b	194	274	1,480	2,375	4,323	
1980	a	8,630	29,588	62,735	23,910	124,863	16.0
	b	463	731	16,177	2,655	20,026	
1981	a	14,690	27,137	86,575	24,015	152,417	19.1
	b	2,207	835	21.886	4,162	29,090	
1982	a	7,857	17,807	68,199	35,072	128,935	19.3
	b	1,390	1,600	16,713	5,203	24,906	
1983	a	12,125	25,837	74,266	27,015	139,243	27.3
	b	4,985	2,735	18,266	12,075	38,061	
1984	a	10,927	29,105	83,751	25,914	149,697	34.2
	b	7,658	2,965	32,358	8,145	51,126	
Period means	a	8,817	20,988	60,827	23,898	114,530	17.5
	b	2,167	1,727	12,045	4,080	20,019	

a - Total Catch Landed for Industrial Purposes (Includes all Species and Mesh Sizes)
b - Herring only

Table 3.4. Denmark. No ($x10^{-6}$) of herring taken in the industrial Fishery by age groups and quarters.

(i) Kattegat

Year	Quarter	(Age Groups) 0	1	2	3>
1982	I	-	270.3	3.5	3.5
	II	-	82.9	1.6	1.6
	III	342.1	47.8	0.4	-
	IV	560.8	10.3	0.6	-
1983	I	-	990.0	30.9	1.9
	II	172.0	193.6	23.9	1.5
	III	1740.8	128.1	4.1	-
	IV	738.8	72.2	4.9	0.2
1984	I	-	1233.3	61.1	4.2
	II	8.1	197.6	63.3	9.3
	III	4144.9	221.1	4.2	-
	IV	270.2	51.6	10.1	-

(ii) Skagerrak

Year	Quarter	0	1	2	3>
1982	I	-	48.2	2.0	0.2
	II	-	30.4	3.6	2.1
	III	2224.8	26.8	2.5	0.2
	IV	232.2	2.4	0.2	-
1983	I	-	114.9	20.0	7.5
	II	-	79.0	2.4	0.6
	III	1313.7	66.9	14.5	4.1
	IV	590.5	21.5	2.6	0.3
1984	I	-	404.6	11.8	2.2
	II	-	111.0	13.7	1.7
	III	29.2	397.5	95.5	4.8
	IV	594.2	12.2	1.7	-

1982-84 Means (Annual Catch)

	0	1	2	3>
Katt.	2659.2	1166.3	69.5	7.4
%	68.1	29.9	1.8	0.2
Skag.	1661.5	438.5	56.8	7.9
%	76.8	20.3	2.6	0.3

Table 3.4. (cont.) Denmark. Tonnes of Herring taken in the industrial Fishery by Age Groups and Quarters.

(i) Kattegat

Year	Quarter	0	1	2	3≥	Total
1982	I	-	6627	248	238	7113
	II	-	2542	94	153	2789
	III	5118	2120	26		7264
	IV	11491	609	66		12166
1983	I	-	12514	1285	131	13930
	II	843	3952	1187	146	6128
	III	11002	3140	236		14378
	IV	8127	3222	350	30	11729
1984	I	-	13332	2383	399	16114
	II	40	4182	3287	756	8265
	III	24911	7249	232		32392
	IV	5319	2255	797		8371

(ii) Skagerrak

Year	Quarter	0	1	2	3≥	Total
1982	I	-	1268	108	13	1389
	II	-	1153	260	216	1629
	III	16819	1091	306	33	18249
	IV	5101	107	12		5220
1983	I	-	3048	1316	636	5000
	II	-	2273	152	71	2496
	III	12493	3882	1392	503	18270
	IV	10504	1249	222	29	12004
1984	I	-	6830	707	167	7704
	II	-	2100	791	159	3050
	III	267	23713	7629	489	32098
	IV	7623	835	156		8614

1982-84 Means (Annual Catch)

	0	1	2	3≥	Total
Katt.	22284	20581	3397	618	46880
%	47.5	43.9	7.3	1.3	
Skag.	17602	15850	4350	772	38574
%	45.6	41.1	11.3	2.0	

Table 3.5. Quarterly and Annual Catch (Tonnes) - Purse Seine.
NORWAY.
Skagerrak Coast. Sprat Fishery (including Oslo Fjord).

Year		Quarters I	II	III	IV	Total Annual	% Herring
1981	a	72	-	2926	2469	5467	15.6
	b	15	-	178	660	853	
1982	a	180	-	1449	689	2318	20.2
	b	20	-	174	274	468	
1983	a	267	-	1658	465	2390	19.4
	b	10	-	336	118	464	
1984	a	38	-	1975	188	2201	18.5
	b	2	-	365	40	407	

a Total Sprat + Herring

b Herring only

Table 3.6. Estimated Age compositions of the Norwegian Herring By-Catch (Tonnes)

Year	Age Group 0	1	2	3
1981	772.4	76.9	3.4	0.3
1982	396.8	70.0	2.2	
1983	405.9	56.8	1.4	
1984	378.8	27.7	0.5	

Table 3.7. Quarterly and Annual Catch (Tonnes) in the Skagerrak Industrial Trawl Fishery.
NORWAY.

Year	Quarters I	II	III	IV	Total
1980	-	-	4	44	48
1981	-	39	3	50	92
1982	-	22	65	544	631
1983	-	-	191	28	219
1984	-	159	-	19	178

The Fishery exploits mainly Blue whiting and Norway Pout

Table 3.8. Small Mesh Clupeoid Fishery (Trawl)
SWEDEN
Quarterly and Annual Catch (Tonnes)

(i) Kattegat

Year	I	II	III	IV	Total Annual
1982	433	276	372	324	1405
1983	46	164	104	183	497
1984	76	135	112	126	449

(ii) Skagerrak

1982	41	444	312	216	1013
1983	20	503	296	67	886
1984	99	601	951	442	2093

Table 4. Separation of the Swedish catches of 1-group and 2-group herring in a spring (S) and autumn (A) spawned component in the years 1980–1984

SK=Skagerrak; K=Kattegat.

Nos. $10^{\cdot 6}$

Year	Quarter	1-group 1 S	1-group 1 A	1-group 2 S	1-group 2 A	1-group 3 S	1-group 3 A	1-group 4 S	1-group 4 A	Total S	Total A	2-group 1 S	2-group 1 A
1980	K	6.04	18.12	–	1.20	28.72	24.47	54.25	40.92	89.01	84.71	No data	
	SK	–	–	no data		–	–	–	–	–	–		
	Σ												
1981	K	–	2.38	2.45	3.00	2.70	5.01	1.68	3.92	6.83	14.31	6.72	2.36
	SK	–	–	–	–	1.20	.83	–	–	1.20	.83		
	Σ		2.38	2.45	3.00	3.90	5.84	1.68	3.92	8.03	15.14	No data	
1982	K	50.49	98.01	8.46	10.77	33.50	11.77	112.93	19.93	205.38	140.48	65.94	20.83
	SK	–	18.52	–	–	–	15.86	–	–	–	34.38	.48	5.52
	Σ	50.49	116.53	8.46	10.77	33.50	27.63	112.93	19.93	205.38	174.86	66.42	26.35
1983	K	38.83	122.96	11.33	35.89	81.35	13.24	66.10	74.54	197.61	246.63	98.79	10.98
	SK	5.61	22.48	15.73	62.93	184.19	3.76	22.90	13.45	228.43	102.57	6.23	6.75
	Σ	44.44	145.39	27.06	98.82	265.54	17.00	89.00	87.99	426.04	349.20	105.02	17.73
1984	K	16.20	108.39	1.77	9.32	15.53	5.18	108.14	53.26	141.64	176.15	28.18	42.27
	SK	–	1.88	–	14.79	–	166.50	3.91	39.51	3.91	222.68	132.86	33.22
	Σ	16.20	110.27	1.77	24.11	15.53	171.68	112.05	92.77	145.55	398.83	161.04	75.49

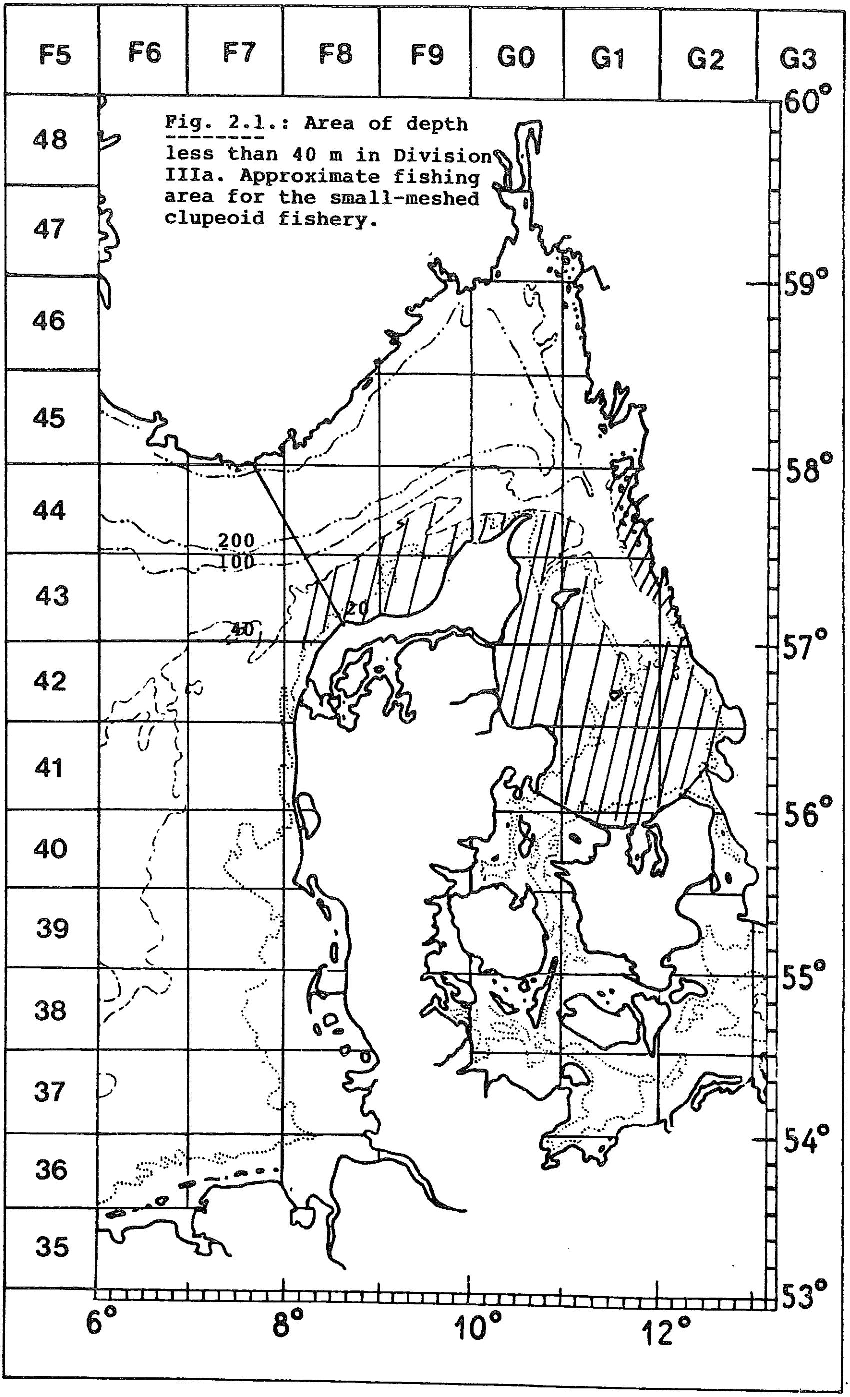


Fig. 2.1.: Area of depth less than 40 m in Division IIIa. Approximate fishing area for the small-meshed clupeoid fishery.

FIG. 2.2

Approximate relation between GRT and length(m) of danish vessels

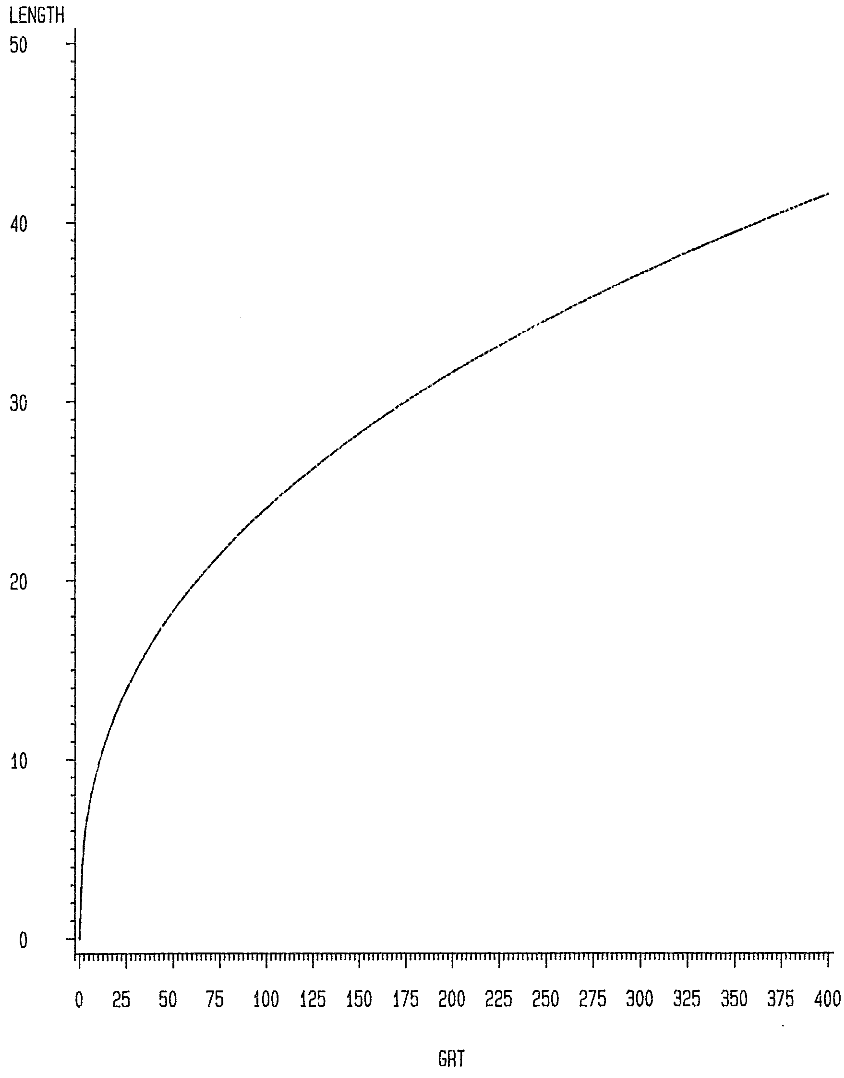


FIGURE 3.1
TOTAL DANISH CATCHES OF INDUSTRIAL HERRING
SKAGERRAK, KATTEGAT 1965–1984

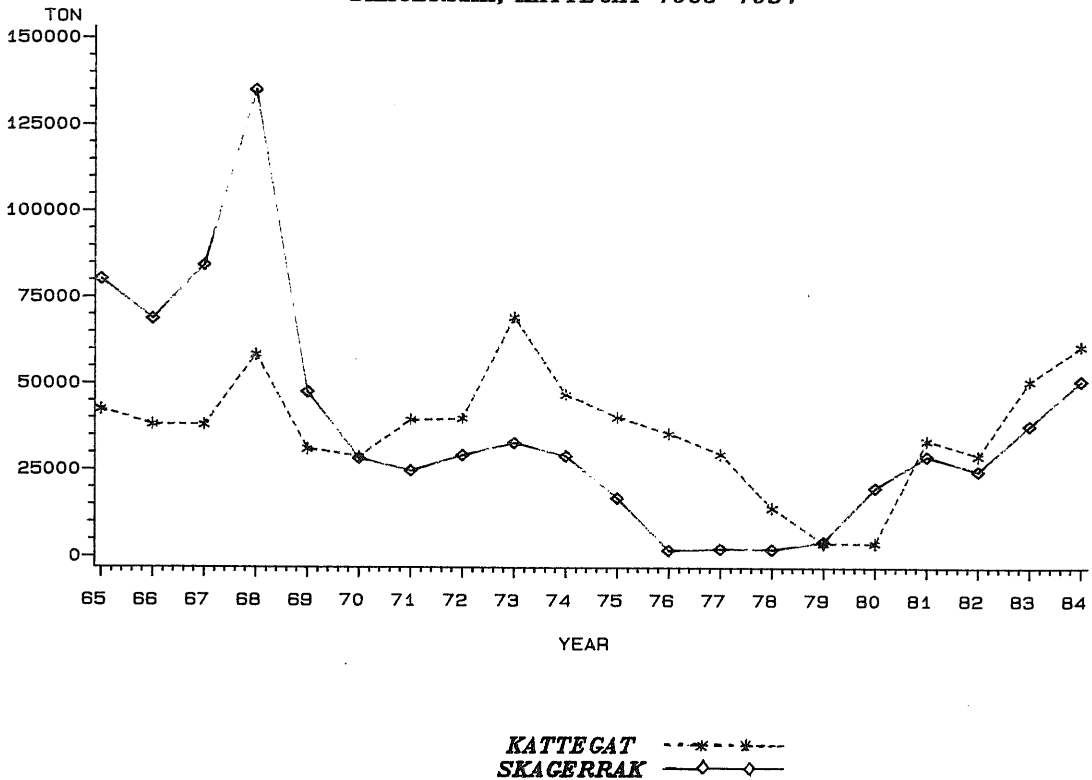


Fig. 4.1.

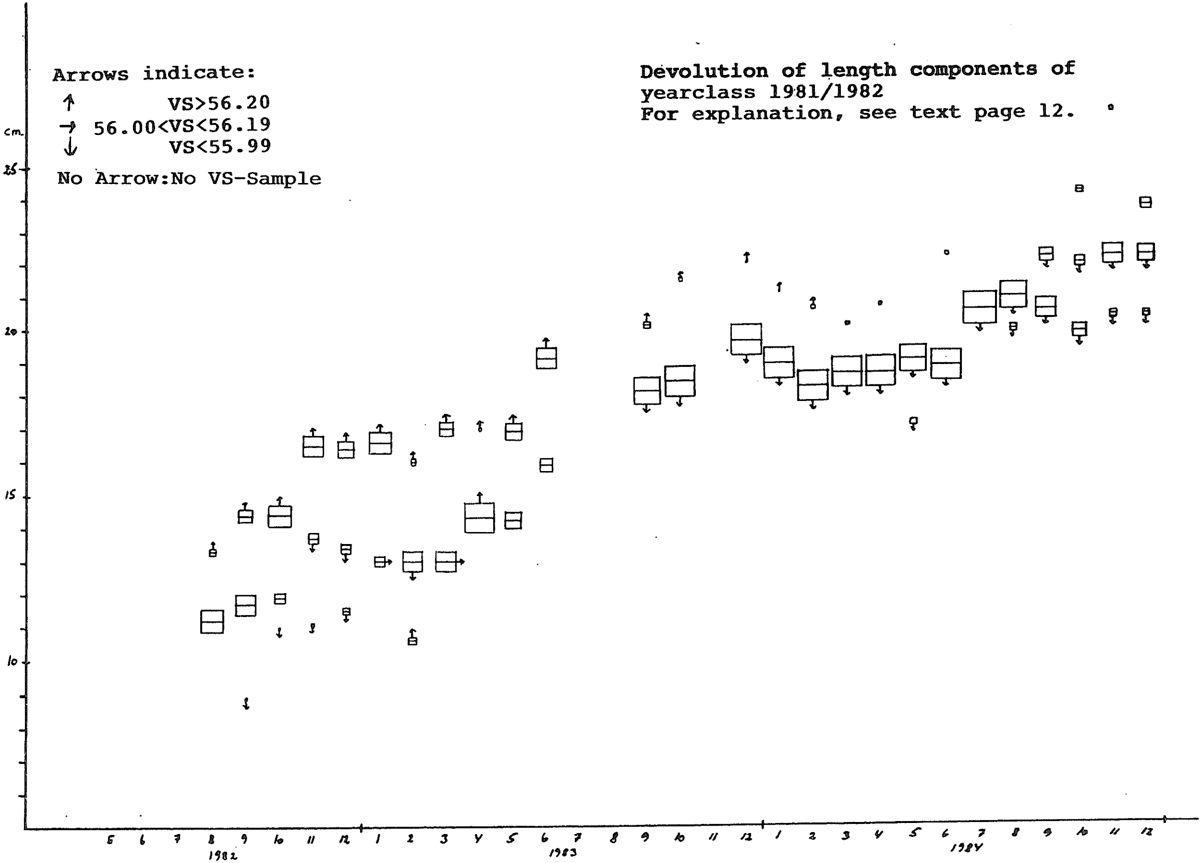
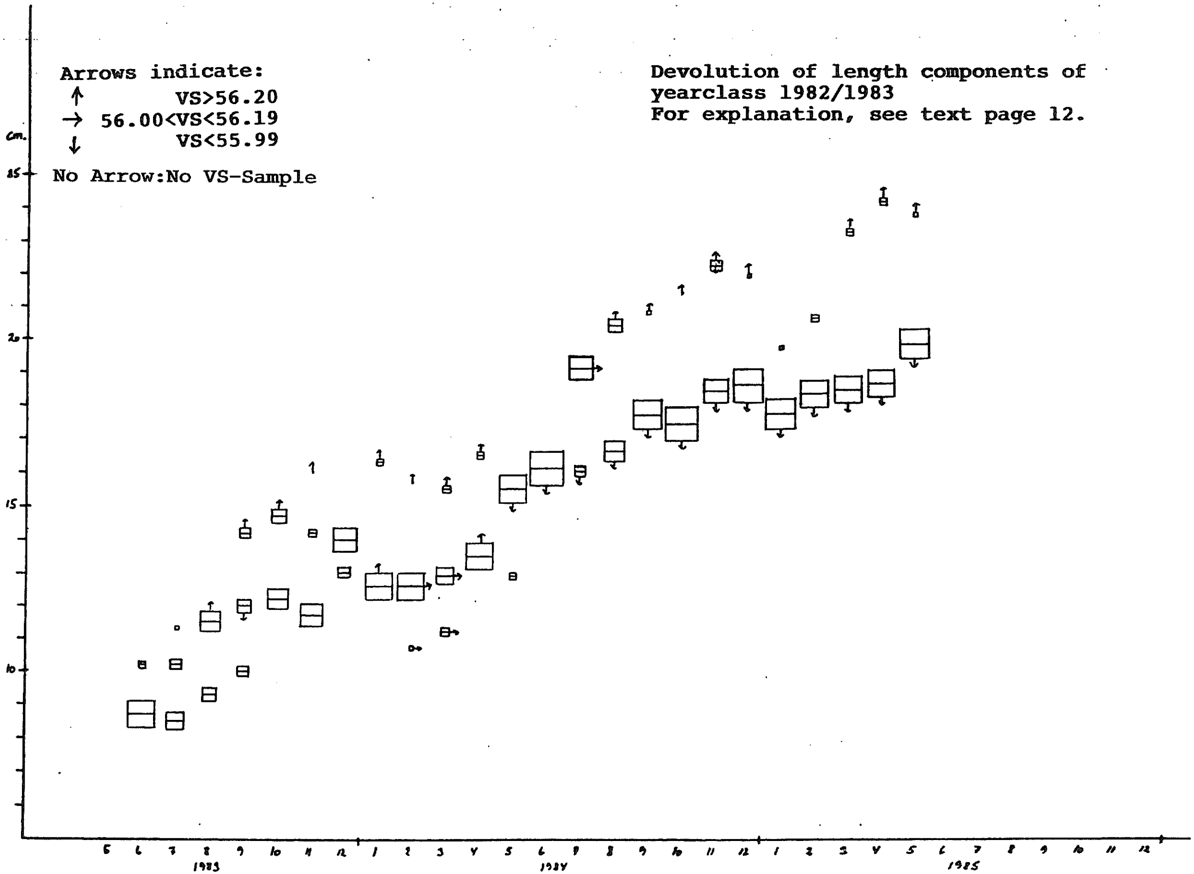

Arrows indicate:
↑ VS>56.20
→ 56.00<VS<56.19
↓ VS<55.99
No Arrow:No VS-Sample
Devolution of length components of
yearclass 1981/1982
For explanation, see text page 12.
cm.
25
20
15
10
5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1982
1983
1984

Fig. 4.2.



Devolution of length components of yearclass 1982/1983
For explanation, see text page 12.

Fig. 4.3.

Devolution of length components of
yearclass 1983-1984
For explanation, see text page 12.

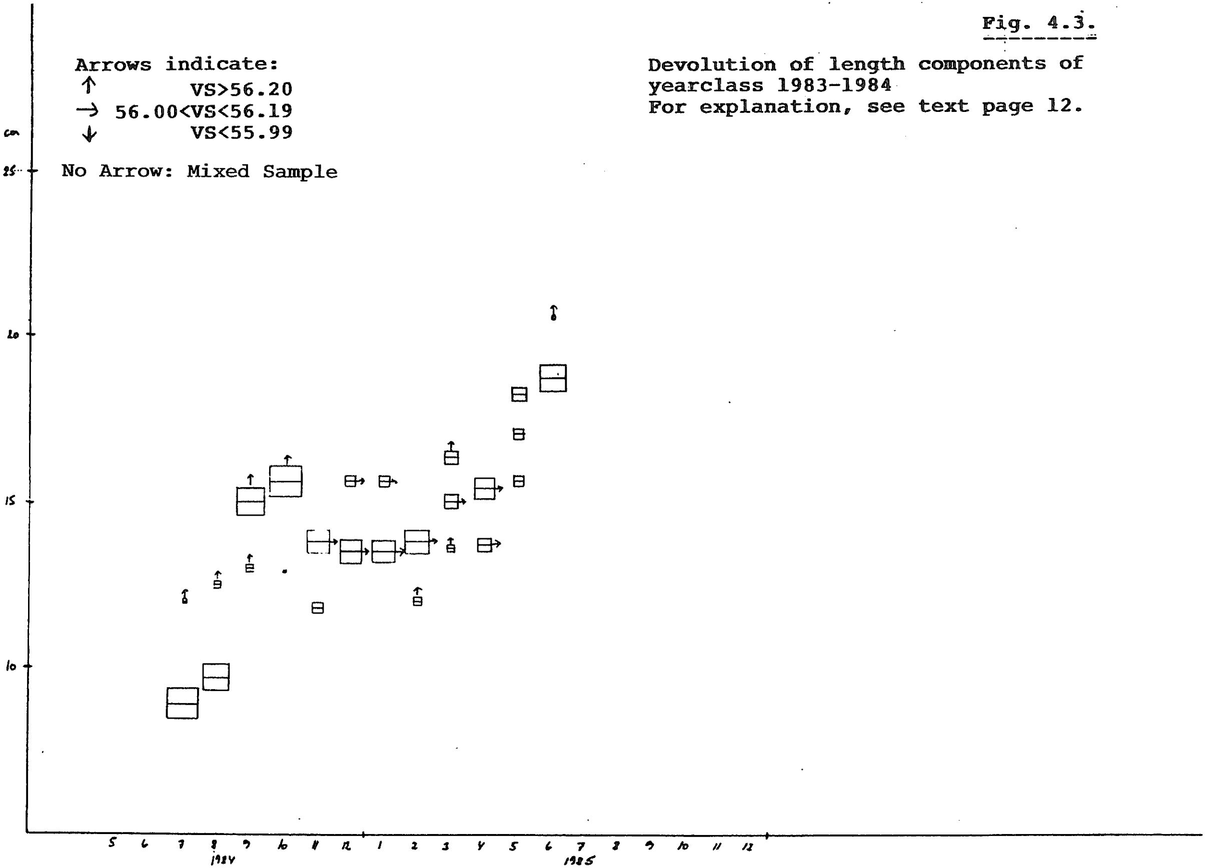


Fig. 7.1. 1985 Regulation of the fishery in Division IIIa.

<table>
<tr><td colspan="6">TRAWLERS</td></tr>
<tr><td colspan="4">INDUSTRIAL</td><td colspan="2" rowspan="2">NON INDUSTRIAL,
≥ 32 mm MESH
(Shrimp≥ 30 mm)</td></tr>
<tr><td>< 16 mm MESH</td><td colspan="3">> 16 mm MESH</td></tr>
<tr><td rowspan="3">SANDEEL

KATTEGAT
1 Mar-31 jul.

SKAGERRAK
1 Mar-31 Oct.

< 5 %
bycatch of
Annex V
species

< 5 %
bycatch of
herring</td><td colspan="2">LICENCED FOR CLUPEOIDS
15.Jul-15.Sept</td><td>⊛
NO
LICENCE</td><td>HERRING</td><td>OTHER</td></tr>
<tr><td>HERR.
SPRAT</td><td>GADOIDS</td><td rowspan="2">GADOIDS</td><td rowspan="2">Week end prohibition

Min. landing size 18 cm

Ban on directed Fishing for reduction
< 10% undersized herring</td><td rowspan="2"></td></tr>
<tr><td>Counted against quota

< 10 %
Annex V</td><td>Report prior to landing

< 5% bycatch of herring + sprat and 10% of Annex V species

No mackerel</td></tr>
</table>

⊛ EEC ONLY