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REPORT OF THE WORKING GROUP ON DIVISION IIIa STOCKS

Copenhagen, 18.-24. March 1981

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CONTENT

1. INTRODUCTION

1.1. Venue and Terms of Reference

The Working Group on Division IIIa stocks met at ICES Headquarters in the period 18-24 March 1981 with the following terms of reference (C.Res. 1980/2:6,3):-

(i) evaluate any new data available on stock components in Division IIIa herring,

(ii) assess TACs for 1982 for cod, whiting, haddock, plaice and sprat in Division IIIa,

(iii) examine any new data available which might cast more light on the interrelations between cod and herring in Division IIIa and in the Baltic,

(iv) estimate the species composition of by-catches in the Pandalus borealis fisheries and advise on an appropriate by-catch limit.

The Working Group did not make an assessment of the herring stocks in Div. IIIa. It did, however, do some of the preparatory work necessary for an assessment which is referred to the Herring Assessment Working Group for the Area South of 62°N.

1.2. Participation

D.S. Danielssen	Norway
O. Hagström	Sweden
S.A. Iversen	Norway
F. Lamp	Federal Republic of Germany
P. Lewy	Denmark
K. Popp Madsen	Denmark (Chairman)
E. Nielsen	Denmark
R. Rosenberg	Sweden
B. Sjöstrand	Sweden
R.J. Wood	United Kingdom

2. HERRING

2.1. The Fisheries

The landings of herring during the last decade are given in Table 2.1. The preliminary total landings based on official figures in 1980 for Div. IIIa amounted to approx. 64 000 tonnes, i.e., about the same as in the previous year. However, estimates made by the WG indicated that at least 20 000 tonnes should be added as unallocated landings.

These include misreported and illegal landings, by-catches in the sprat fisheries and landing of undersized herring (minimum landing size is 18 cm). The total landing in 1980 was then calculated to about 84 000 tonnes and exceeded the landings from the previous year by approx. 10 000 tonnes. The recommended TAC in 1980 of 50 000 tonnes was thus exceeded by almost 70 percent.

The figure of the total landings should be regarded as an underestimate of the catches as the discards at sea of small herring are not included. As no information were available, the WG suggested last year that the discards were between 4 and 10 percent of the landings. The WG agreed that an addition of 7 percent, giving a total catch of approx. 90 000 tonnes, could still be an underestimate but closer to the actual catch.

2.2. Stock Components

2.2.1. Separation by Otolith and Fish Length Criteria.

Studies regarding herring stock separation in Div. IIIa have been continued at the Institute of Marine Research, Sweden, and the results summarized below are taken from a manuscript by Rosenberg and Palmén (in prep.). Samples of herring in spawning condition (mainly maturity stages VI and VII) from Div. IIIa, the North Sea and adjacent waters were characterized by their mean values of VS, K_2 and O_1 (Fig. 2.1), where O_1 is the distance between the outher margins of the first winter ring along the

length axis of the otolith (rostrum - post rostrum). From the figure it is clear that autumn spawners have higher mean values of O_1 (>65) than spring spawners (generally <61), as allready found by the herring otolith workshop held in Lysekil, Sept. 1979. Today, no autumn spawning herring of any importance to the fisheries are spawning in Div. IIIa. Four types of indigenous spring spawners were distinguished: The Skagerrak Spring Spawners, the Kattegat Spring Spawners, the Kattegat Coastal Spring Spawners and the Skagerrak Fjordic Spring Spawners. The latter stock occurs only locally and in low numbers.

Based on length measurements and with reference to meristic characters of spawning fish it was possible also to separate young herring into spring and autumn spawned fish (Fig. 2.2) and thereby estimate the proportion of indigenous young herring in Div. IIIa. The 1-group herring were separated by fish length measurements and 2-group and older herring by O_1 measurements. Samples from the seventies and 1980 clearly indicated that the vast majority of 2-group and older herring originated from that area. However, a proportion of the 1-group herring were autumn spawned. In the hauls taken in February 1980 during the International Young Fish Survey (IYFS) in Div. IIIa 60 percent were indigenous herring and 40 percent autumn spawned probably mainly deriving from the North Sea and its adjacent waters. In a trawl survey in the same area in September 1980 the percentage of indigenous spring spawners was 80 percent. This indicates that part of the 1-group autumn spawned herring population could by then have already migrated out of the area.

The Working Group concluded that the abundance indices of 1-group herring derived from the IYFS in Div. IIIa could be of much greater value if they were separated into both spring and autumn spawned components. It is clear that for herring up to the age when the first winter ring is laid down this can be achieved directly from the total length measurements of the fish. With older herring, however, the otolith mea-

surement (O_1) must be used. In many cases K_2 and VS provided a valuable check on the validity of the separations achieved.

2.2.2. Additional Data on Stock Composition in 1980 from Norwegian Samples

Skagerrak.

Samples of purse-seine-caught herring in spawning condition were obtained from the Norwegian coast in March and April. In the 6 March samples, age 3 predominated and 2 and 3-ring fish combined made up 82 % of the total age composition. Mean VS varied between 57.0 and 57.6. A sample in April had a predominance of 2-ring fish, with 2 and 3 ringers combined making up 78 % of the sample. The mean VS of 56.5 was much lower than in March. Purse seine samples from the Norwegian coast in August and September included appreciable numbers of 1-ring immatures and had a very wide range of mean VS from 56.3 to 57.2.

Kattegat.

Some research vessel samples taken in the Kattegat during March by pelagic trawl had a mean VS 56.0. The fish were almost entirely 1 and 2-ring immatures. Samples for all age groups combined in November showed mean VS values of 56.4 in the northern part, and values of 56.0 - 55.8 in the rest of the Kattegat.

2.2.3. Separation by Muscle Fibre Counts

Greer - Walker et alia (1972) showed that the number of fibres in skeletal muscles could be used to separate components amongst the autumn spawning herring in the North Sea.

In Division IIIa immigrants from the Baltic (e.g., the Rügen spring spawner) may be abundant outside the actual spawning period. They are, however, very close to the local Kattegat spring spawners in growth rate and meristic characters. In order to try other means of separation the Danish Research Institute have initiated a pilot experiment using the counts of muscle fibres as described by Greer-Waker et alia. So far,

the best results have been obtained by tissue fixed in Bouins solution and stained with Haematoxylen-eosin. Sections are cut out to a thickness of 10. Fibre numbers counted on dorsal tissue do not appear to differ from counts made on ventral tissue from the same fish. It appears, however, that the dorsal fibres are somewhat easier to count and will hence be used in future routines.

While the counting procedure apparently can be much reduced by use of electronic scanners the preparation of the tissue is a rather tidious and time-consuming task. The pilot work will therefore be centered on developing a routine that permits a large number of sections to be prepared.

3. SPRAT

3.1. The Fishery

Table 3.1 shows the landings of sprat in Divisions IIIa and IVa East (Norwegian fiords). The landings in the latter areas were somewhat lower than in the previous years while in Division IIIa there was a considerable increase, amounting to some 20 000 tonnes. As in the last three years, the Danish landings made up about 75 % of the total. The 1980 fishery was supposed to be restricted by a TAC of 75 000 tonnes while the actual landings amounted to 102 000 tonnes.

The quarterly landings in the Kattegat and the Skagerrak are shown in Table 3.2. As in 1979, the highest catches were taken in the third quarter of the year. The low figures in October-December were, however, due entirely to the closure of the Danish fishery following the exhaustion of the national quotum.

3.2. Stock Assessment

3.2.1. Age Composition

The landings in numbers at age were calculated for each quarter for the Danish landings in the period 1975-80 (Table 3.3). No data were available from the Swedish and Norwegian landings, which are assumed to contain a higher percentage of older age groups due to sorting. Consequently, the observed Danish age compositions are not applied to these.

3.2.2. Recruitment

From the Young Herring Surveys the following indices of year class strength have been derived for sprat in Division IIIa (Calculated as the geometric mean of the aritmetic means within squares):

Year class	Index
1971	1 004
1972	1 322
1973	1 324
1974	5 074
1975	464
1976	1 403
1977	4 223
1978	886
1979	4 253
1980	2 423

The abundance of the 1980 year class seems to be only about half that of the strong 1979 year class. The latter year class dominated the Danish landings in 1980. Because of the closed period for the Danish fleet in the last quarter of the year, the total number landed is not quite comparable to earlier years.

3.2.3. Estimates of Stock Biomass from Acoustic Surveys

Two estimates of sprat stock biomass in the open sea were available to the Working Group from surveys carried out in September and November 1980. Both estimates were based on a length dependent conversion factor.

The September survey was carried out by RV ARGOS using a 120 KHz scientific echo sounder and a QM MK II integrator. Biomass estimates were based on TS_{kg} = - 38.3dB for herring and sprat, and a target strength four times lower was assumed for species lacking swim bladders. The value -38.3dB had been established from a cage experiment on 23.7 cm herring (Aglen et al in prep.). Integrated echo intensities were converted to biomass using a length dependent conversion factor (C_1) calculated as:

$$10 \log_{10} C_1 = -TS_{kg} - 48.8 - A \text{ dB}$$

where 48.8dB was established by calibration and the amplification Factor A was 20dB. The conversion factor for herring with a mean length of 23.7 cm was found to be 3 tonnes/MM.NM^2. This value corresponds to

C = 0.13 x fish length (in cm) for herring and sprat and
C = 0.52 x fish length (in cm) for fish without swim bladders.

Each biomass (B) was calculated from

$$B = \frac{K_i M}{\sum \frac{K_i}{C_i}} \cdot Y$$

where K is the proportion by weight of species 'i' in the catch and M is the mean deflection in MM in area Y.

I November, the area was surveyed again, this time by RV JOHAN HJORT. The equipment used was a Simrad 38 KHz echo sounder working through a ceramic transducer (30cm x 30cm) with an effective half-power beam angle of 7^{o}. The TVG unit operated on a 20log R basis and the signals were integrated and processed by a "MARIUS" computer.

The observed fish echo intensities were divided into different species and age groups. The proportions, P_i, of the different categories (species and length) were calculated from trawl catch composition and fish length measurements using

$$P_i = \frac{N_i \cdot L_i^2}{\sum^{n} N_i \cdot L_i^2}$$

where L_i is the mean length and N_i the number of each category in the catches.

Biomass estimates made using a length dependent target strength were based on measurements made by Nakken and Olsen (1977).

$$TS_{kg} = -10 \log L - 25.4$$

where L is the fish length in cm

or $\frac{39 \times L \text{ tonnes/square nautical mile}}{\text{MM deflection/nautical mile}}$ (Aglen per.com.)

The applied target strength formula fits very well with measurements made last year by Aglen and Hagström (in prep.). They found a target strength per kilo as -38.3dB for herring of 23.7 cm in caged experiments. The applied formula for the November survey gives a target strength for this length as - 39.15 dB per kg.

From the acoustic survey carried out in September 1980, the sprat stock biomass in Division IIIa was estimated to be about 74 000 tonnes, corresponding to 6 317 x 10^6 individual fish in an area of approximately 11 000 nm^2, which is about 75 % of the total Division IIIa area. This may be compared with the results of the survey conducted in September 1979 when an area of 6 170 nm^2, or about 40 %, was covered. If sprat are distributed mainly in the southeastern part of the Skagerrak and in the Kattegat then the estimates in the two years may be considered comparable as these localities had equal coverage in both years. The biomass estimates and calculated age compositions are given in the text-table below:

		1979	1980
Biomass (tonnes c 10^{-3}):		130.5	73.7
Year class	Age group	Numbers (x10^{-6})	
1980	0	2 500	249
1979	1	9 350	5 428
1978	2	130	542
1977	3	40	57
1976	4	-	39
1975	5	50	5
1974	6		1

The age composition in 1979 is considered to be less reliable than that for 1980, owing to the low level of sprat sampling during the 1979 acoustic survey.

From the results of the acoustic survey in November 1980, the sprat biomass in the open sea of Division IIIa was estimated to be 65 000 tonnes, of which 13 000 tonnes consisted of 0-group sprat and 52 000 tonnes of older sprat mainly 1-group.

Alternative estimates of biomass were made using a length independent target strength of -29 dB for sprat and -31 dB for herring, as proposed for the North Sea by the ICES Planning Group for Acoustic Surveys at its meeting in Aberdeen (February 1981).

Using length independent target strength reduces the biomass estimates for sprat in Division IIIa to 17 000 tonnes in

September and 16 000 tonnes in November. Catches of sprat amounted to 54 000 tonnes in the third quarter and 16 000 tonnes in the fourth quarter of 1980, but, due to the closure of the Danish fishery at the end of August, these figures do not reflect the true abundance of sprat in Division IIIa. The total sprat biomass must have been much higher than indicated by those catch statistics, moreover, there were no indications of a decline in sprat abundance from the Swedish fishery which continued until the end of the year. The acoustic biomass estimates therefore appear to be unrealistically low for sprat in Division IIIa when based on the length independent target strength. The Working Group decided to accept the values based on a length-dependent target strength as being better estimates of sprat biomass in Division IIIa in 1980.

3.2.3. Management Advice

The landings from the fisheries in 1980 consisted predominantly of 1-group sprat.

An estimate of the stock size of this age group for 1981 could not be made during the two acoustic surveys in the autumn of 1980 because only a minority appeared in the surveyed area as 0-group sprat at that time.The Young Fish Survey in February 1981 indicated that the 1-group sprat could be of about average strength compared with the indices of the last decade. Based on this abundance index and the catch statistics, the Working Group could not find any strong reason to change the earlier proposed recommendation of a TAC of 70 000 tonnes for 1981. However, for 1982 no recommendation for a TAC can be given as the yearclass 1981 is not yet born. Thus, the Working Group recommends that the strength of the 1981 year class should be assessed in early 1982 and that a precautionary TAC for 1982 be adjusted in accordance with the results.

4. COD

4.1. The Fisheries

Danish, Swedish and Norwegian landings from Division IIIa are reported for the Kattegat and the Skagerrak respectively. In the case of the Federal Republic of Germany, landings from Div. IIIa were split by assuming a Kattegat portion of 30 percent. (In accordance with the 1979 landings from cutters larger than 35 GRT.). For the first time since 1976, the United Kingdom has reported landings from Division IIIa, presumably from the Skagerrak (2900 tonnes included in "others", Table 4.3).

Landings from the Kattegat decreased from about 14 800 tonnes in 1979 to about 13 000 tonnes in 1980 or about 1 800 tonnes. (Table 4.1).

In the Skagerrak the landings increased from about 17 200 tonnes in 1979 to about 27 700 tonnes in 1980 (Table 4.4).

Danish cod landings by quarters from the Kattegat and the Skagerrak are shown in Table 4.2.

4.2. Stock Assessment (the Kattegat)

4.2.1. Age Distribution

Only the Danish age distribution for 1980 was available. The Danish landings at age figures are therefore raised to the total international landings for the Kattegat and the Skagerrak respectively. The 1979 figures for landings at age are revised. The age distributions are shown for the Skagerrak in Table 4.5 and for the Kattegat as input figures for the VPA (Table 4.7).

4.2.2. Weights at Age

The average weights at age figures for 1978-1980 are given in Table 4.6. The table shows that the weight at age for the Kattegat are rather different in the three years. As it is not known whether the variation is due to biological changes or statistical errors in the weight estimation, the average for the three years available have been used in calculating the spawning stock biomass for the period 1971-1978. For 1979 and 1980 the actual average

weights at age are used.

4.2.3. Fishing Mortality

The natural mortality is assumed to be o.2 for all age groups as there is no additional information which would make it possible to estimate the exchange rate between the Baltic and Div. IIIa.

The fishing mortalities for 1980 used as input values in the VPA are for each age group older than 2, assumed to be equal to the averages of the reference period 1975-77. This assumption has been made because no effort information is available.

The assumption of an unchanged level of fishing mortality should furthermore lead to a conservative estimate of the biomass.

The fishing mortality of the 2-year-old cod (yearclass 1978) is chosen so that it corresponds to 22 million 1-year-old recruits, being the average recruitment for the years 1972-77 obtained from the VPA.

The 1980 landings of 13 000 tonnes probably do not indicate any major decrease in effort even though the recommended TAC of 16 400 tonnes was not taken, as this could be caused by the weak appearance of the 1978 year class in the 1980 landings.

The reason for maintaining the assumption of year class 1978 as being of average strength despite its weak appearance in the landings is the increase in the legal minimum landing size from 33 cm to 38 cm which Denmark introduced in her fisheries in 1979.

The mean lengths calculated from the Bertalanffy parameters: L_∞=116.07 cm, t_o= -0.02 yrs and K=0.15 (Bagge, pers. communication) are shown below:

2	years	old	30.3	cm	average	length
2.5	"	"	36.5	"	"	"
3	"	"	42.3	"	"	"
3.5	"	"	47.6	"	"	"

Evidently the effect of the increase in minimum landing

size will be the removal from the landings of a major part of fish less than 3 years of age.

As Sweden did not increase the minimum landing size and as the Danish age composition was applied also to the Swedish landings, the calculated number of 2-year-old fish caught is likely to be an underestimate.

The fishing mortality of the 2-group could also be underestimated possibly even more so as the increase in legal size could lead to an increase in discards. The Working Group had, however, no means by which to assess such effects.

4.2.4. Results of the VPA

The results are shown in Tables 4.7, 4.8 and 4.9.

The spawning stock biomass calculated from the VPA is for the period 1971-78 based on mean weights at age averaged for the years 1978-80.

This is a revision compared with last year's biomass calculations, where weights at age data for 1979 only were used.

The development of the spawning stock biomass is shown in the Table below:

Year	Spawning stock biomass (age≥3)	Year	Spawning stock biomass (age≥3)
1971	31 521	1976	32 121
1972	37 807	1977	33 416
1973	38 355	1978	(19 751)
1974	36 697	1979	(24 452)
1975	24 642	1980	(22 918)

4.3. Prognosis for Cod in the Kattegat.

4.3.1. Recruitment

The abundance index for 1-group cod from IYFS 1981 is estimated at 18.4 very close to the average (14.9) of the previous years, excluding the very high 1980 figure. As the correlation between the VPA and the abundance index is very poor (Table 4.10) the recruitment in 1981 is assumed to be the VPA mean of the year classes 1971-76, i.e., 22 million 1-year-

old fish.

The 1979 yearclass will be of major importance to the fishery in 1982. In last year report it was assumed at 50 million 1-groups because of the very high abundance index obtained from the International Young Fish Survey in 1980. There were other indications that this yearclass is good, i.e. above average, but it has not been possible to quantify its absolute strength.

As this appears to be the most decisive component of the prognosis and because of the poor correlation between abundance indices and VPA figures the Working Group agreed to run two options: One assuming yearclass 1979 at average strength (22 mill. 1-year olds) and another using last years assumption of yearclass 1979 being about twice as strong.

4.3.2. Weight at age

Danish gutted mean weights at age for 1980, raised by a factor 1.18, were used in the prognosis (Table 4.6).

4.3.3. Fishing Pattern

The exploitation pattern used as input in the VPA are used in the prognoses. It is assumed, that to take the TAC of 16 400 tonnes in 1981, will not lead to significant changes in the fishing mortality relative to 1980.

4.3.4. Results

The input data for the prognosis are given in Table 4.11 while the calculated landings in 1982 and spawning stock biomass in 1983 for an array of values of F_{82}/F_{80} are shown in Table 4.12 and in Figures 4.1 and 4.2.

The difference between the results of the two options illustrates very clearly, that a reasonable forecast of the catch possibilities are not feasible without reliable estimates of the strength of recruiting yearclasses.

4.4. Cod in the Skagerrak.

4.4.1. The Fishery (Table 4.4)

The 1980 landings increased from last year's figure of 17 200 tonnes to about 27 700 tonnes, the highest total in the period 1971-80. The increase is due both to higher Danish landings and landings of 3 000 tonnes from the United Kingdom, which had not reported any from Division IIIa during the previous 5 years.

The Norwegian landings consist mainly of local coastal stocks, while about 500 tonnes come from the open sea fishery, but could not be separated into North Sea and Skagerrak landings.

4.4.2. Age Distribution

Age distributions are only available for 1978-80 and are entirely based on Danish data given in Table 4.5.

Because of the short period in which catch data are established and because no other vital parameters of the fisheries can be estimated, the Working Group felt that no factual management advice could be given.

5. HADDOCK

5.1. Landings

Table 5.1 shows the landings for the period 1971-80. Even though the landings of some countries could not be divided between Sub-area IV and Division IIIa in the first half of the seventies and consequently are not included in the total landings for IIIa, it is reasonable to assume that they increased gradually until 1976-77 when the total landings amounted to 9 - 10 000 tonnes. The landings dropped again in 1978, and in 1979 they were about half of the 1976-77 level. The TAC for 1979 was set to 9 000 tonnes, the decrease must therefore be explained by a reduction in the availability. In 1980, however, the landings were about 1 000 tonnes above the TAC (6 600 tonnes).

5.2. Prognosis

There were no data available from the Danish landings in 1980. Due to the lack of a data base the Working Group felt that it would not be appropriate to suggest a TAC for 1982.

6. WHITING

6.1. Landings

The landings are shown in Table 6.1. Prior to 1975, it was not possible to split the Swedish landings into Divisions IVa and IIIa. Since 1975, however, the Danish landings contributed more than 90%, and therefore the Danish landings can be assumed to give a fairly precise picture of the development during the whole period.

From a peak of about 29 000 tonnes in 1974, the landings decreased to a level of 19 000 tonnes in 1975-76. A sharp increase to 48 000 tonnes took place in 1978, followed by a decline in 1979 to 18 000 tonnes. This was mainly due to a closure of the fishery in the period 17-31 March immediately followed by a ban on directed fishing for whiting for industrial purposes. In 1980, the landings increased to more than 22 000 tonnes as a dispensation from the ban was given in part of that year.

6.2. Stock Assessment

As in the previous years there were no data available to the WG which could permit a proper assessment to be made. The Swedish participation in the IYFS, rendered an index of recruitment strength which are shown below together with those of earlier cruises (calculated as the arithmetic mean of the arithmetic means within squares);

Year class	Whiting <20 cm
1976	134
1977	497
1978	592
1979	945
1980	669

The 1980 year class appears to be a good one, though not as strong as that of 1979. The distribution pattern of the 1-group was more or less the same as for the 1979 year class.

The WG felt that in want of any relevant biological data it was not able to indicate a TAC for 1982.

7. Plaice.

7.1. The Fisheries

7.1.1. Landings from the Kattegat.

Only Denmark and Sweden provided catch data for the Kattegat and the Skagerrak respectively. The very small landings by the Federal Republic of Germany (below 50 tonnes) have been omitted from Table 7.1, which only shows the Danish and Swedish landings in the Kattegat.

The Danish landings declined sharply in 1980 and have not been at such a low level since 1966.

The pronounced decline in the catch is not only caused by the closed fishery during weekends. The fishermen have reported that it was very difficult to catch plaice in 1980 especially in the southern part of the Kattegat.

Table 7.3 shows the Danish landings by quarters, where the decrease in the 1980 catch can also be seen. The decline is apparent in all four quarters.

7.1.2. The Skagerrak.

In the last two years, Danish landings have shown a declining tendency. In 1980, they only reached about 70% of the peak landings in 1978. Other reasons than potential effort restrictions caused by the closed weekends are not known.

The total landings from Division IIIa, showing Danish, Swedish and other countries' landing are included in Table 7.2. In 1980, the figure for "others", contributed by Federal Republic of Germany, United Kingdom and Norway is rather low. Belgium and the Netherlands provided no information.

7.2. VPA in the Kattegat

7.2.1. Age Distribution

The age compositions as numbers landed per age group are given in table 7.5 (input to VPA). The data are based only on Danish sampling. The Danish landings were raised to the total landings in the Kattegat.

Comparing the last 3 years (1978-80) with the previous time period, it appears that a change in age composition has taken place. The importance of 2 and 3 years old fish in the recent landings have been reduced, while that of 5 and 6 years old plaice have increased both in relative and absolute terms. This could be the result of a change in the exploitation pattern but there is no information in support of that. Another reason could be, that a sequence of relatively good yearclasses is followed by 3 decidedly weak ones, i.e. yearclasses 1976, 1977 and 1978. The apparant change after 1977 is concommitant with a change in the Danish sampling system. At present, however, it is not possible to explain, how an intensified and more efficient sampling could result in a change in the age composition as radical as the one observed.

The Working Group therefore concluded that recruitment in recent years have been below average.

There are no estimate of yearclass strength in plaice based on surveys. A series of such were unfortunately stopped in 1973 and only resumed in 1980. A correlation between the early data and the strength of 1-group calculated by VPA as shown below gives a correlation koeffi-cient of 0.89.

	1-group (VPA) x 10^{-6}	Abundance indices
1968	68.3	74
1969	49.1	33
1970	44.8	53
1971	17.7	18
1972	56.8	62
1973	27.9	3
.		
.		
1980	-	7

The intercept of the regression line (VPA on abundance) is, however, so large as to render the regression almost useless for predicting the strength of the 1979 yearclass.

The abundance index shows, however, that the yearclass must be anticipated as being well below average.

From the catch data available the Working Group thought it unrealistic to assume the average strength of 50 million I-group plaice in case of the recent yearclasses. The Working Group agreed instead upon the following assumptions:

Yearclass	1977	12.5	millions
"	1978	25	"
"	1979	25	"
"	1980	25	"

7.2.2. Weight at Age Data

Danish mean weights at age data were available for 1978, 1979 and 1980 (Table 7.4).

The Working Group decided to use the means of 1978-1980 as input weights for the period 1968-77 and to use the actual weight data for 1978, 1979 and 1980 respectively.

7.2.3. Fishing Mortalities

No effort data are available for the Kattegat area by which an estimate of the level af F in 1980 could be obtained. Average F at age based on 1972-76 values by a trial VPA run were used as input figures for fish older than 3-years while fishing mortalities for the younger age groups were fitted to produce the yearclass strength shown above (Table 7.6). Natural mortality was assumed at M = 0.1.

7.3. Prognosis

7.3.1. The Kattegat

The landings in 1982 and the spawning stock as at 1. January 1983 were calculated for several values of F in 1982 and on the following assumptions:

(i) The exploitation pattern in 1981-82 will be the same as assumed for 1980.

(ii) The fishing mortalities in 1981 will be the same as in 1980. This means that the TAC in 1981 will not be taken. To do so would require an unrealistic increase in the fishing effort.

(iii) Recruitment of recent yearclasses will only be half the average strength (see 7.2.2). This is perhaps the most critical of the assumptions made and the Working Group wants to stress the uncertainty of the entire assessment caused by the lack of knowledge concerning the recruitment. For this reason it also thought it pointless to give other options based on various assumptions about the strength of recent yearclasses.

(iv) Mean weights at age for 1980 were applied in the prognosis, the results of which are shown in Figure 7.1 and in the texttable below:

F_{82}/F_{80}	Calculated landings in 1982	Spawning biomass 1983
.2	1241	25463
.4	2357	24314
.6	3362	23280
.8	4270	22348
1.0	5092	21505
1.2	5838	20741
1.4	6518	20047
1.8	7706	18838

7.3.2. The Skagerrak

Since 1978, Denmark has provided data on landings in numbers from the Skagerrak.

Although the age groups 4 and 5 still form the major components of the landings in 1980 the proportion of fish older than 6 years was substantially higher than in the previous years.

The Working Group felt that without any adequate data base available it could not give any management advice on the plaice in the Skagerrak.

8. COMPOSITION OF THE BY-CATCHES IN THE PANDALUS FISHERIES

Data on species composition in the Danish and Swedish Pandalus fisheries were presented to the Working Group.

The Danish data comprise the species composition of landings sampled in the harbours of Skagen, Hirtshals and Hanstholm during the period 1973-77 (Table 8.1). The proportions of cod, haddock, whiting and Nephrops landed for human consumption are specified. The amounts of these species included in landings for industrial purposes are not given.

Catch composition in the Swedish Pandalus fishery were obtained from a number of selected vessels (about 10 % of the fleet) delivering daily catch reports during 1976-80. The figures given refer to catches irrespective of their use. Discards are included (Table 8.2).

The "unspecified" portion in both data sets is dominated by species such as Norway pout, blue whiting, grenadier, Argentina sp., rays, skates and sharks.

The data show that the catches of protected fish species are small in the Pandalus fisheries.

No single species exceeds 10 % by weight on a yearly basis. Most species make up less than 5 % each of the total catch.

The data presented to the Working Group were not sufficiently specific to allow an analysis of the seasonal and area variations in the catch composition of the Pandalus fisheries. Advice on an appropriate by-catch percentage for single landings must consequently await a more detailed analysis of the basic data which were not presented to the Working Group.

Table 2.1 HERRING in Division IIIa. Landings in tonnes 1971-80.
(Data mainly provided by Working Group members)

	Country/Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980[x)]
SKAGERRAK	Denmark	26 985	34 900	42 098	35 732	29 997	7 326	19 889	6 425	5 153	5 180
	Faroe Islands	5 636	4 115	5 265	7 132	8 053	1 553	10 064	1 041	817	526
	Germany,Fed.Rep.	-	-	-	36	108	6	32	28	181	-
	Iceland	3 066	7 317	15 938	231	1 209	123	-	-	-	-
	Norway(Open Sea)	6 120	1 045	836	698	196	-	-	1 860	2 460	1 350
	Norway (Fjords)	3 166	4 222	1 680	1 720	1 459	2 304	1 837	2 271	2 259	2 795
	Sweden	19 763	19 644	20 429	11 683	12 348	6 505	8 109	11 551	8 104	10 701
	Total	64 736	71 243	86 246	57 232	53 370	17 817	39 931	23 176	18 974	20 552
KATTEGAT	Denmark	50 177	52 755	78 125	54 540	48 974	41 749	38 205	29 241	21 337	25 380
	Sweden	49 760	39 972	40 418	39 779	23 769	30 263	37 160	35 193	25 272	18 260
	Total	99 937	92 727	118 543	94 319	72 743	72 012	75 365	64 434	46 609	43 640
Division IIIa Total		164 673	163 970	204 789	151 551	126 113	89 829	115 296	87 610	65 583	64 192
Unallocated										8 117	20 053
GRAND TOTAL										73 700	84 245

x) Preliminary

Table 3.1. Landings of SPRAT in Division IIIa and in Norwegian fjords in Division IVa (10^{-3} tonnes). (Data provided by Working Group members)

Year	SKAGERRAK				KATTEGAT			IIIa total	Norwegian fjords south of 62°N	Grand total
	Denmark	Sweden	Norway	Total	Denmark	Sweden	Total			
1969	0.8	1.9	1.7	4.4	0.8	1.6	2.4	6.8	11.8	18.6
1970	1.1	2.4	2.4	5.9	3.1	6.0	9.1	15.0	6.4	21.4
1971	0.7	2.4	2.9	6.0	1.5	9.6	11.1	17.1	4.4	21.5
1972	0.8	3.3	2.4	6.5	1.4	17.9	19.3	25.8	6.9	32.7
1973	19.4	2.5	3.2	25.1	19.3	16.2	35.5	60.6	8.8	69.4
1974	17.3	2.0	1.2	20.5	31.6	18.6	50.2	70.7	3.3	74.0
1975	14.9	2.1	1.9	18.9	69.7	20.9	90.6	109.5	2.9	112.4
1976	12.8	2.6	2.0	17.4	30.4	13.5	43.9	61.3	0.6	61.9
1977	7.2	2.2	1.2	10.6	53.3	9.8	63.1	73.7	5.4	79.1
1978	23.1	2.2	2.7	28.0	36.1	9.4	45.5	73.5	5.2	78.7
1979	17.3	8.1	1.8	27.2	45.8	6.4	52.2	79.4	5.0	84.4
1980	43.1	-	3.4	46.5	35.8	-	35.8	102.4 x)	2.9	105.3

x) Sweden: 20 124 tonnes in Div. IIIa. No allocation on the Skagerrak and the Kattegat possible.

Table 3.2. Landings of sprat in Division IIIa by quarters (tons) (Norwegian fiords in Div. IV not included).

Year	Months	Kattegat	Skagerrak	Total
1975	Jan-Mar	6 569	2 316	8 885
	Apr-Jun	11 610	450	12 060
	Jul-Sep	53 347	7 976	61 323
	Oct-Dec	19 541	8 248	27 789
	Total	91 067	18 990	110 057
1976	Jan-Mar	9 462	913	10 375
	Apr-Jun	4 867	997	5 864
	Jul-Sep	18 070	5 493	23 563
	Oct-Dec	10 253	10 001	20 254
	Total	42 652	17 404	60 056
1977	Jan-Mar	9 340	1 507	10 847
	Apr-Jun	10 499	189	10 688
	Jul-Sep	24 217	2 808	27 025
	Oct-Dec	18 938	6 067	25 005
	Total	62 994	10 571	73 565
1978	Jan-Mar	13 139	2 899	16 038
	Apr-Jun	7 949	6 313	14 262
	Jul-Sep	18 511	15 175	33 686
	Oct-Dec	6 757	4 398	11 155
	Total	46 356	28 785	75 141
1979	Jan-Mar	8 848	2 817	11 665
	Apr-Jun	5 549	1 042	6 591
	Jul-Sep	25 898	8 053	33 951
	Oct-Dec	11 922	15 218	27 140
	Total	52 217	27 130	79 347
1980 x)	Jan-Mar	10 312	2 345	16 992
	Apr-Jun	8 078	7 012	15 385
	Jul-Sep	15 010	31 421	54 072
	Oct-Dec	2 351	5 775	15 979
	Total	35 751	46 553	102 428

x) Swedish landings 1980 only included in total.

Table 3. 3. Danish landings of sprat in Division IIIa in numbers at age (x 10^{-6}).

Year	Months	0	1	2	3	4	5
1975	Jan-Mar		435.86	200.44	56.28	2.46	
	Apr-Jun		230.75	398.91	146.51	0.16	
	Jul-Sep	32.81	5 979.74	527.61	50.92	0.34	
	Oct-Dec	139.22	985.73	54.32	0.68		
	Total	172.03	7 632.08	1 181.28	254.39	2.96	
1976	Jan-Mar		336.00	164.95	9.11	1.23	0.65
	Apr-Jun		556.41	57.07	27.38	0.91	
	Jul-Sep	509.96	2 334.72	171.39	16.80	2.21	
	Oct-Dec	918.64	1 084.09	23.24	0.55		0.11
	Total	1 428.60	4 311.22	416.65	53.84	4.35	0.76
1977	Jan-Mar		2 515.11	408.99	11.29		
	Apr-Jun		2 177.51	483.23	20.70	3.37	
	Jul-Sep	725.13	2 185.47	208.70	30.26	7.42	1.21
	Oct-Dec	1 948.34	813.86	142.90	0.79		
	Total	2 673.47	7 691.95	1 243.82	63.04	10.79	1.21
1978	Jan-Mar		4 376.51	203.89	12.52		
	Apr-Jun		5 004.51	33.18	3.57		
	Jul-Sep	23.99	3 987.97	61.57	14.70	0.70	
	Oct-Dec	261.12	262.21	16.70	0.84		
	Total	285.11	13 631.20	315.34	31.63	0.70	
1979	Jan-Mar		1 098.75	426.69	60.68	1.92	1.94
	Apr-Jun		763.41	239.49	2.39	-	-
	Jul-Sep	690.32	3 674.64	7.37	1.59	-	1.99
	Okt-Dec	260.04	1 360.87	22.45	2.51	-	3.13
	Total	950.36	6 897.67	696.00	67.37	1.92	7.06
1980	Jan-Mar		1 161.54	748.60	25.02	0.73	
	Apr-Jun		5 155.16	421.79	3.66		
	Jul-Sep	407.17	6 306.95	68.40	14.86		
	Oct-Dec	413.46	671.10	5.65			
	Total	820.63	13 294.75	1 244.44	43.54	0.73	

Table 4.1. COD landings from the Kattegat 1971-80 (tonnes).

Year	Denmark	Sweden	Germany, Fed. Rep. of[1]	Total
1971	11 748	3 962	22	15 732
1972	13 451	3 957	34	17 442
1973	14 913	3 850	74	18 837
1974	17 043	4 717	120	21 880
1975	11 749	3 642	94	15 485
1976	12 986	3 242	47	16 275
1977	16 668	3 400	51	20 119
1978	10 293	2 893	204	13 390
1979	11 045	3 763	22	14 830
1980	9 219	3 780	38	13 037

1) Landing statistics incompletely split on the Kattegat and the Skagerrak. The figures are estimated by the Working Group.

Table 4.2. Danish landings of COD by quarters (tonnes).

Kattegat 1973-80								
	1973	1974	1975	1976	1977	1978	1979	1980
Jan-Mar	8 229	10 038	5 824	7 010	10 899	5 949	6 839	6 303
Apr-Jun	2 391	2 331	2 650	2 093	1 960	1 822	1 996	1 030
Jul-Sep	1 619	1 706	1 426	1 433	1 629	886	636	707
Oct-Dec	2 663	2 967	1 848	2 450	2 180	1 636	1 574	1 179
Total	14 902	17 042	11 748	12 986	16 668	10 293	11 045	9 219
Skagerrak 1973-80								
Jan-Mar	1 837	1 829	3 752	4 452	4 941	3 848	3 963	5 407
Apr-Jun	1 970	1 598	3 932	4 124	4 071	5 671	5 143	5 242
Jul-Sep	1 487	1 246	3 335	4 856	4 472	5 873	2 244	5 252
Oct-Dec	1 382	2 021	3 151	5 415	5 134	8 222	2 657	5 430
Total	6 676	6 694	14 170	18 847	18 618	23 614	14 007	21 331

Table 4.3. COD landings from Division IIIa - Kattegat and Skagerrak.

(Danish and Swedish landings from national sources, other countries from Bulletin Statistique)

Year	Denmark	Norway x)	Sweden	Others	Total
1971	17 662	1 355	6 002	35	25 054
1972	20 410	1 201	5 882	56	27 549
1973	21 586	1 253	5 540	101	28 480
1974	23 737	1 197	6 097	212	31 243
1975	25 920	1 190	4 559	146	31 815
1976	31 833	1 241	4 115	513	37 702
1977	35 286	979	3 960	726	40 951
1978	33 907	1 442	3 485	464	39 298
1979	25 052	1 745	5 042	235	32 074
1980	30 550	1 820	5 319	3 032	40 721

x) Mainly landings from Norwegian fiords

Table 4.4 COD landings from the Skagerrak 1971-80.

Year	Denmark	Sweden	Norway x)	Others	Total
1971	5 914	2 040	1 355	13	9 322
1972	6 959	1 925	1 201	22	10 107
1973	6 673	1 690	1 253	27	9 643
1974	6 694	1 380	1 197	92	9 363
1975	14 171	917	1 190	52	16 330
1976	18 847	873	1 241	466	21 427
1977	18 618	560	979	675	20 832
1978	23 614	592	1 442	260	25 908
1979	14 007	1 279	1 745	213	17 244
1980	21 331	1 539	1 820	2 994	27 684

x) Mainly landings from Norwegian fiords

Table 4.5 COD in the Skagerrak. Total international landings in numbers in 1978-80 (x 10^{-3}). (Including Norwegian fiord cod)

Age	1978	1979	1980
1	4 593	481	1 129
2	11 833	4 812	6 956
3	3 059	3 289	5 428
4	821	534	2 009
5	193	225	401
6	176	38	108
7	47	37	99
8+	55	31	13
Total	20 777	9 447	16 143
Catch in tonnes	25 908	17 244	27 684

Table 4.6 Average weights at age. COD in the Kattegat and the Skagerrak 1978-1980. (grammes)

AGE	KATTEGAT				SKAGERRAK	
	1978	1979	1980	avg. 78-80	1979	1980
0						
1	716[1)]	708	723	716	599	743
2	830[1)]	868	791	830	860	1 146
3	1 170	1 086	937	1 064	1 894	1 542
4	1 690	1 890	1 431	1 670	3 498	3 308
5	2 860	2 215	2 436	2 504	5 510	4 825
6	4 120	3 382	3 154	3 552	7 093	8 855
7	5 180	7 314	3 533	5 342	7 304	8 287
8+	6 900	6 101	6 835	6 612	9 888	11 343

[1)] average of 1979 and 1980

Tabel 4.7. Cod in the Kattegat. Catch in number

UNIT: THOUSANDS

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	15049	38	5	591	188	166	1	88	213
2	7937	3811	623	4250	3610	4431	2218	6015	3161
3	6936	6422	2167	6943	2906	6983	7078	2551	6116
4	1918	2427	3954	4543	3251	1835	4942	2100	991
5	887	809	2280	1538	661	1039	492	913	1039
6	207	433	780	349	429	287	376	83	230
7	30	94	212	68	47	189	137	99	11
8+	30	38	160	31	19	52	102	71	47
TOTAL	32994	14072	10181	18313	11111	14982	15346	11920	11808

	1980
1	144
2	1124
3	5204
4	3154
5	345
6	369
7	117
8+	34
TOTAL	10491

Table 4.8. Cod in the Kattegat. Fishing Mortality.

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	0.579	0.002	0.000	0.022	0.008	0.017	0.000	0.005	0.010
2	0.360	0.279	0.037	0.456	0.179	0.258	0.337	0.349	0.225
3	0.679	0.556	0.254	0.720	0.655	0.615	0.843	0.817	0.725
4	0.602	0.538	0.815	1.299	0.919	1.230	1.297	0.656	0.912
5	0.670	0.554	1.629	0.909	0.651	0.888	1.555	0.925	0.819
6	0.690	0.838	1.925	1.462	0.706	0.666	0.996	1.474	0.636
7	0.600	0.800	1.500	1.000	0.800	0.800	0.800	0.800	0.800
8+	0.600	0.800	1.500	1.000	0.800	0.800	0.800	0.800	0.800
mean F(3- 8),W	0.662	0.563	0.726	0.914	0.762	0.721	1.015	0.773	0.753

	1980
1	0.007
2	0.070
3	0.700
4	1.100
5	1.000
6	0.800
7	0.800
8+	0.800
mean F(3- 8),W	0.829

Table 4.9. Cod in the Kattegat. Stock in numbers

	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	37411	22887	15532	30269	26321	10580	27344	21161	22614
2	28806	17164	18704	12712	24249	21380	8512	22386	17246
3	15359	16457	10626	14751	6597	16602	13519	4977	12926
4	4634	6379	7726	6751	5879	2805	7348	4762	1801
5	1982	2079	3050	2801	1508	1920	671	1644	2022
6	453	830	978	490	924	644	647	116	534
7	73	186	294	117	93	374	271	196	22
8+	73	75	222	53	38	103	202	140	93
TOTAL	88790	66057	57131	67944	65609	54407	58514	55383	57257
SPAWN. ST.(≥3)	22573	26006	22895	24962	15040	22448	22658	11835	17398

	1980
1	22774
2	18322
3	11275
4	5124
5	592
6	730
7	231
8+	67
TOTAL	59116
SPAWN. ST.(≥3)	18019

Table 4.10. COD in the Kattegat. Recruitment.

Year class	R_1 from VPA (1 000 fish)	Abundance indices for 1-group cod from IYHS
1971	22 887	8
1972	15 532	18
1973	30 269	29
1974	26 321	5
1975	10 580	3
1976	27 344	8
1977	(21 161)	35
1978	-	13
1979	-	71
1980	-	18

Table 4.11 COD in the Kattegat.
Input data for the prognosis.

Age	Stock in Number 1980 Option 1	Stock in Number 1980 Option 2	Mean Weight	Exploitation Pattern	Natural Mortality
1	22 774	50 000	0.723	0.006	0.2
2	18 322		0.791	0.064	0.2
3	11 275		0.937	0.636	0.2
4	5 124		1.431	1	0.2
5	592		2.436	0.909	0.2
6	730		3.154	0.727	0.2
7	231		3.533	0.727	0.2
8^+	67		6.835	0.727	0.2

Table 4.12. Cod in the Kattegat. Prognoses for catches in 1982 and spawning stock biomasses in 1983.

	R_{79}=22 mill. 1-group		R_{80} = 50 mill. 1-group	
F_{82}/F_{80}	Landings 1982	SSB 1983	Landings 1982	SSB 1983
0.2	4071	41683	5918	58263
0.4	7526	37041	10987	51463
0.6	10467	33132	15339	45678
0.8	12979	29833	19085	40747
1.0	15132	27041	22317	36535
1.2	16983	24671	25114	32930
1.4	18583	22654	27541	29838
1.6	19969	20930	29652	27180
1.8	21177	19453	31495	24890
2.0	22232	18182	33109	22912

Table 5.1. Nominal landings of HADDOCK from the Skagerrak and the Kattegat.

Country	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980 x)
Belgium	-	-	-	-	-	181	118	25	50	-f)
Denmark	2 101	2 816	2 832	4 417	5 015	7 488	6 907	4 978	4 120	7 072
German Dem.Rep.	..a)	..a)	1	-	-	1	-	-	-	-g)
Germany, Fed.Rep.of	9	20	+	+	12	1	16	11	1	6h)
Netherlands	-	-	-	-	5	59	81	20	5	
Norway	139	153	242	175	122	191	156	168	248	236
Sweden	..b)	..b)	..b)	..b)	921	1 075	2 485	1 435c)	361	302
U.K. (England and Wales)	-	-	16	26	40	59	-	-	-	
U.K. (Scotland)	-	-	-	+	-	-	-	-	-	-
Total	2 249	2 989	3 091	4 618	6 115	9 055	9 763	6 637	4 784	7 617

a) Division IIIa included in Sub-area IV
b) Division IIIa included in Division IVa
c) Division IIIa includes Division IVa,b

x) preliminary

f) Jan-Nov. from Data Form 5
g) Data Form 5
h) Jul-Dec. catch estimates based on information from fishing vessels

Table 6.1 WHITING landings from Division IIIa (from Bulletin Statistique).

Year	Denmark	Norway	Sweden	Others	Total
1971	13 971	17	IIIa incl. in IVa	1	13 989
1972	14 538	24	↓	-	14 562
1973	22 479	67		1	22 547
1974	28 749	89		4	28 842
1975	19 018	57	611	4	19 690
1976	17 870	48	1 002	57	18 977
1977	18 116	55	973	41	19 185
1978	48 102	58	899[a]	32	49 091
1979	16 971	63	1 033	16	18 083
1980[x]	21 106	57	1 478[b]	-	22 641

x) Preliminary

a) Swedish fishery statistics

b) Based on fishery logbook reports

Table 7.1 PLAICE landings from the Skagerrak (tonnes).

Year	Denmark	Sweden	Total
1971	3 741	64	3 805
1972	5 095	70	5 165
1973	3 871	80	3 951
1974	3 429	70	3 499
1975	4 888	77	4 965
1976	9 251	81	9 332
1977	12 855	142	12 997
1978	13 383	94	13 477
1979	11 045	105	11 150
1980	9 514	92	9 606

PLAICE landings from the Kattegat (tonnes)

Year	Denmark	Sweden	Total
1971	15 819	331	16 150
1972	15 504	348	15 852
1973	10 021	231	10 252
1974	11 401	255	11 656
1975	10 158	369	10 527
1976	9 487	271	9 758
1977	11 611	300	11 911
1978	12 685	368	13 053
1979	9 721	281	10 002
1980	5 582	289	5 871

Table 7.2. Plaice landings in Div. IIIa. The Kattegat and the Skagerrak combined. Data produced by Working Group members.

Year	Denmark	Sweden	Other Countries	Total
1971	19 560	395	19	19 974
1972	20 599	418	80	21 097
1973	13 892	311	55	14 258
1974	14 830	325	58	15 213
1975	15 046	446	199	15 691
1976	18 738	352	756	19 846
1977	24 466	442	884	25 792
1978	26 068	462	480	27 010
1979	20 766	386	810	21 962
1980[x)]	15 096	381	56	15 533

x) Preliminary. No information from Belgium and the Netherlands.

Table 7.3 Danish landings of PLAICE by quarters in the Kattegat and Skagerrak (in tonnes).

Kattegat 1973-80

	1973	1974	1975	1976	1977	1978	1979	1980
Jan-Mar	2 330	2 950	2 127	2 637	2 526	2 410	2 002	1 825
Apr-Jun	1 302	2 738	2 372	2 096	2 497	2 487	2 786	1 168
Jul-Sep	2 265	2 861	2 781	2 183	2 924	3 815	2 525	1 396
Oct-Dec	4 124	2 852	2 878	2 571	3 663	3 973	2 422	1 193
Total	10 021	11 401	10 158	9 487	11 610	12 685	9 721	5 582

Skagerrak 1973-80

	1973	1974	1975	1976	1977	1978	1979	1980
Jan-Mar	1 046	840	668	1 732	2 119	1 289	967	1 042
Apr-Jun	902	971	949	2 234	3 617	3 522	5 097	3 325
Jul-Sep	1 028	1 098	1 514	2 944	4 614	4 302	2 963	3 381
Oct-Dec	895	520	1 757	2 341	2 505	4 270	2 018	1 766
Total	3 871	3 429	4 888	9 251	12 855	13 383	11 045	9 514

Table 7.4 PLAICE in the Kattegat.
Mean weights at age (smoothed).

Age	1978	1979	1980	Average 1978-80
1	.200	.120	.120	.147
2	.230	.220	.263	.238
3	.240	.258	.277	.258
4	.260	.275	.300	.278
5	.300	.303	.310	.304
6	.460	.344	.356	.387
7	.720	.450	.500	.557
8	.780	.650	.600	.676
9	.800	.920	.690	.803
10	.820	1.005	.810	.878
11	.830	1.030	.890	.917
12	.830	1.061	.950	.947

Table 7.5. Plaice in the Kattegat.

Input data

CATCH XXXXXXXX in numbers (x 10^{-3})

age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	1	1	1	1	1	1470	50	140	10	10	1
2	3790	1180	3660	680	1120	8590	3100	7880	8657	3330	147
3	20320	14070	11830	8190	21790	5830	21630	7330	11026	20150	9686
4	10570	10510	9760	23570	17720	6260	3470	8140	2100	9230	27862
5	2280	2840	3140	14170	7910	3130	2620	1040	3060	2680	8685
6	790	760	710	1870	1110	1770	1020	730	431	900	1144
7	500	300	650	350	200	510	740	420	280	230	227
8	260	300	370	190	120	180	330	350	207	270	49
9	180	270	370	330	80	20	120	150	87	210	48
10	70	240	240	260	80	10	80	110	74	130	33
11	0	50	80	80	30	30	50	50	10	100	17
12	50	100	140	40	60	30	140	10	13	190	40

age	1979	1980
1	37	1
2	859	299
3	6464	2833
4	17331	7123
5	7984	5318
6	1715	2292
7	576	497
8	105	156
9	73	120
10	49	53
11	38	35
12	16	17

NATURAL MORTALITY AT AGE:

age	1	2	3	4	5	6	7	8	9	10	11	12
mort.	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Mean fishery mortality calculated for ages 3 to 12.

Table 7.6. Plaice in the Kattegat.

FISHING MORTALITIES

age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	0.000	0.000	0.000	0.000	0.000	0.060	0.001	0.001	0.000	0.000	0.000
2	0.071	0.020	0.091	0.017	0.071	0.186	0.157	0.169	0.108	0.071	0.006
3	0.663	0.361	0.257	0.269	0.958	0.544	0.838	0.583	0.335	0.346	0.271
4	0.850	0.769	0.404	1.023	1.316	0.716	0.645	0.788	0.289	0.458	0.992
5	0.595	0.510	0.483	1.573	1.081	0.765	0.662	0.358	0.691	0.637	0.922
6	0.177	0.357	0.203	0.526	0.406	0.660	0.535	0.342	0.220	0.392	0.546
7	0.258	0.085	0.518	0.131	0.086	0.294	0.566	0.390	0.190	0.157	0.144
8	0.147	0.217	0.129	0.248	0.055	0.093	0.280	0.507	0.301	0.253	0.041
9	0.177	0.201	0.401	0.145	0.141	0.010	0.075	0.178	0.201	0.498	0.058
10	0.053	0.335	0.246	0.482	0.043	0.021	0.047	0.082	0.112	0.456	0.119
11	0.000	0.044	0.159	0.109	0.083	0.018	0.125	0.034	0.009	0.195	0.088
12	0.010	0.030	0.150	0.100	0.100	0.100	0.100	0.030	0.010	0.200	0.100
Mean	0.567	0.429	0.315	0.772	0.969	0.546	0.702	0.566	0.339	0.384	0.655

age	1979	1980
1	0.002	0.000
2	0.078	0.014
3	0.371	0.350
4	0.946	0.788
5	0.773	0.765
6	0.403	0.463
7	0.518	0.173
8	0.082	0.231
9	0.071	0.121
10	0.070	0.061
11	0.176	0.054
12	0.100	0.100
Mean	0.662	0.551

Table 7.7. Plaice in the Kattegat.

STOCK IN NUMBERS

age	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1	68201	48685	45764	19038	58507	26342	58788	98291	56148	26862	13272
2	57799	61785	44089	41442	17231	52993	22438	53147	88806	50800	24297
3	43835	48697	54783	36416	36852	14527	39795	17359	40608	72131	42801
4	19257	20448	30725	38346	25180	12788	7626	15583	8771	26289	46162
5	5318	7444	8572	18552	12472	6113	5654	3619	6410	5945	15044
6	5111	2655	4047	4783	3481	3830	2574	2638	2289	2907	2844
7	2305	3874	1681	2988	2557	2098	1792	1364	1695	1662	1778
8	1994	1612	3221	906	2371	2124	1415	921	836	1268	1285
9	1165	1558	1174	2563	640	2031	1751	967	502	560	891
10	1420	883	1153	711	2006	503	1819	1470	733	371	308
11	3673	1218	572	816	397	1739	445	1570	1226	593	213
12	5280	3555	1055	441	662	331	1545	355	1373	1100	441

age	1979	1980
1	24158	26271
2	12011	21824
3	21845	10052
4	29539	13639
5	15491	10377
6	5417	6474
7	1491	3276
8	1393	803
9	1116	1161
10	761	941
11	247	642
12	177	188

SPAWNING BIOMASS (TONS)

1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
33440	31296	33439	33671	27939	17228	21931	16157	20729	32994	31887

1979	1980
24126	16830

Table 8.1. Species composition in Danish Pandalus fishery in Divison IIIa.

	Percentage				
Species/Year	1973	1974	1975	1976	1977
Pandalus	13.02	16.09	21.41	47.93	33.27
Fish landed for consumption:					
Cod	3.12	2.63	1.03	1.98	2.79
Haddock	0.27	0.06	0.06	0.14	0.36
Whiting	0.16	0.01	0.03	1.24	0.78
Plaice	0.28	0.09	1.68	0.06	0.05
Nephrops	1.92	1.60	2.09	6.29	2.72
Other by-catch	81.23	79.52	73.70	42.36	60.03
Reported landings (tonnes)	2 032	1 100	1 655	153	180
Reported effort (hours)	28 634	14 047	22 072	2 937	2 898

Table 8.2. Species composition in the Swedish Pandalus fishery in Division IIIa.

	Percentage				
Species \ Year	1976	1977	1978	1979	1980
Pandalus	56.29	51.06	49.58	53.04	59.68
By-catch:					
Nephrops	0.60	0.33	0.25	0.10	0.55
Cod	5.71	4.89	5.29	6.75	6.47
Haddock	0.26	0.22	0.75	0.44	0.63
Whiting	0.37	0.50	0.80	0.36	0.78
Hake	0.82	0.52	0.90	0.56	0.51
Pollack	0.79	1.27	1.21	0.82	0.45
Ling	0.85	1.00	1.06	0.79	0.55
Saithe	0.01	0.01	0.02	-	0.002
Plaice	0.23	0.24	0.23	0.15	0.21
Witch	2.39	2.39	2.35	2.00	1.24
Brill	0.004	0.01	0.01	0.01	0.002
Turbot	0.01	0.002	0.01	-	0.01
Lemon sole	0.004	0.01	0.02	0.01	0.01
Halibut	0.09	0.03	0.04	0.07	0.03
Dab	0.001				
Herring	0.01	0.43	0.06	0.02	0.16
Other species	31.58	37.09	37.40	34.88	28.71
Reported catch (tonnes)	405	368	304	350	366
Reported effort (hours)	8 808	8 139	7 395	6 712	6 693

Figure 2.1. Herring in spawning condition. Combinations of means of O_1-VS and O_1-K_2 of different stocks. Generalized separation between spring and autumn spawned herring indicated in the figure.

Spring-Winter Spawners

- ▽ Skagerrak Spring Spawners
- □ Kattegat Spring Spawners
- ▼ Kattegat Coastal Spawners
- ⊛ Fjordic Spring Spawners
- △ N.W. Scotland Spring Spawners
- ϕ English Channel Winter Spawners

Autumn Spawners

- ○ Autumn Spawners from the North Sea, N.W. Scotland, Orkney-Shetland
- ● Kattegat Autumn Spawners
- ϕ S.W. Baltic Autumn Spawners
- ⍋ Moray Firth Autumn Spawners

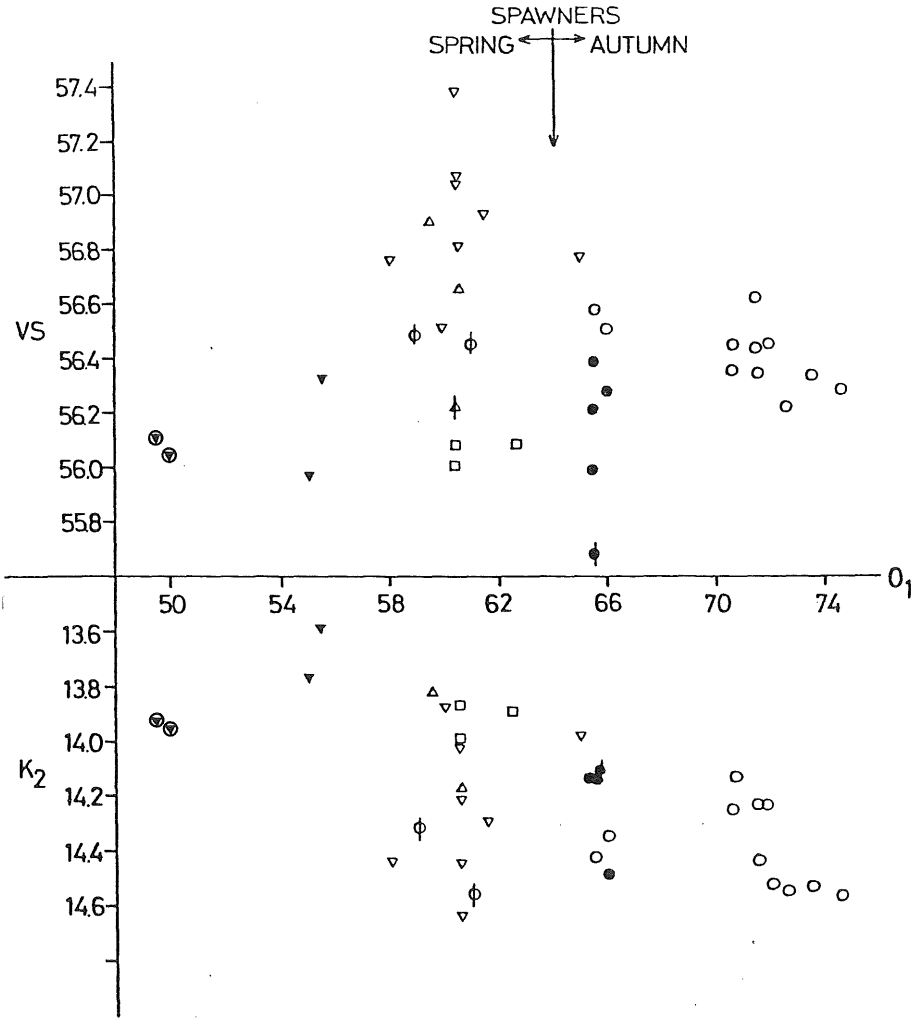

Fig. 2.2. One-group herring from the IYFS in February 1980. Combinations of means of O_1-VS and O_1-K_2 of spring spawned (○) and autumn spawned (●) herring after separation by lengths. O_1 is measured in eye piece units (epu), where 25 epu:s equals 1 mm.

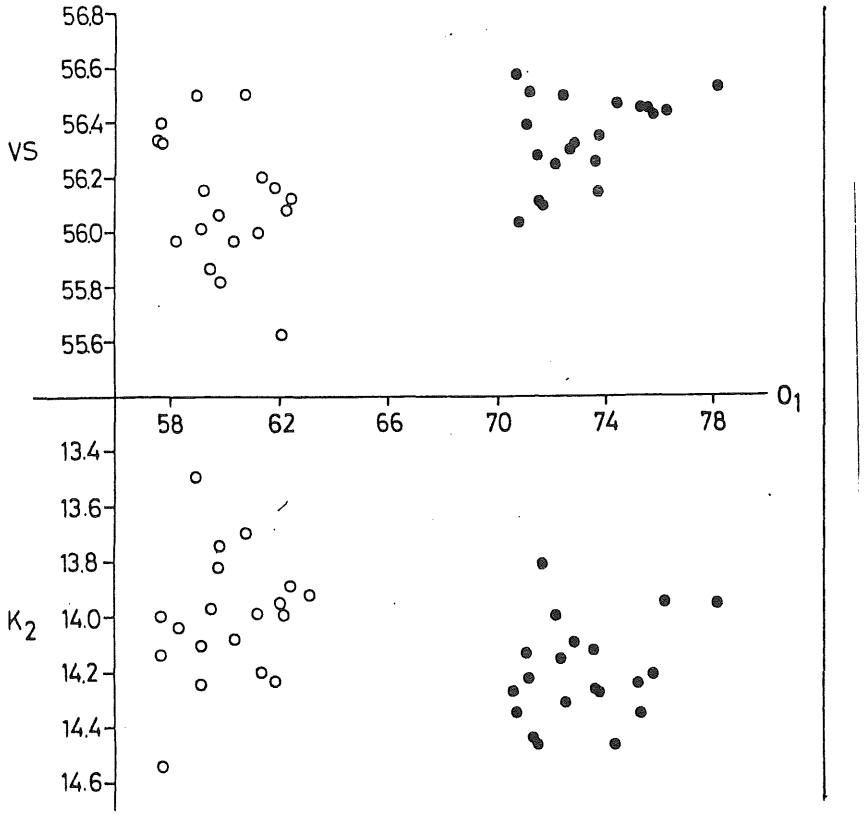

FIGURE 4.1. COD IN THE KATTEGAT. R_{79}= 22 mill.1-GROUPS

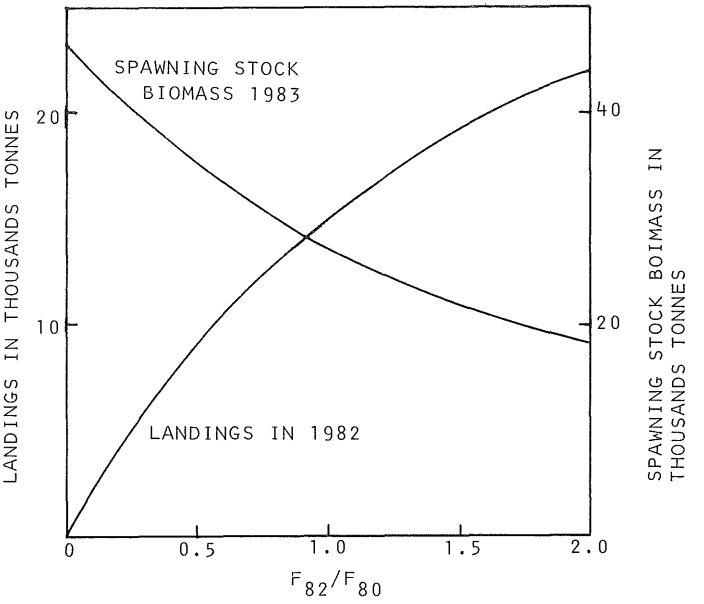

FIGURE 4.2. COD IN THE KATTEGAT. R_{79}= 50 mill.1-GROUPS

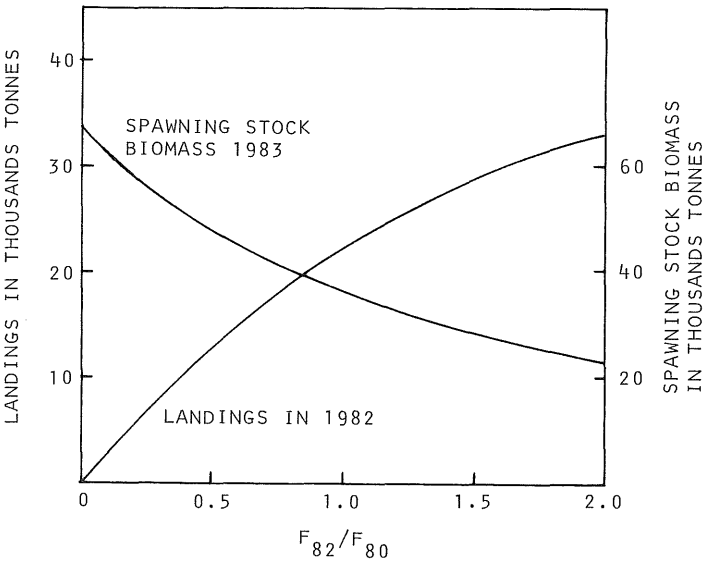

FIGURE 7.1. PLAICE IN KATTEGAT.