4 Sandeel in IV (WGNSSK Sep. 2007)

For assessment purposes, the European continental shelf has since 1995 been divided into four regions: Division IIIa (Skagerrak), Division IV (the North Sea excl Shetland Islands), Division Vb2 (Shetland Islands), and Division VIa (west of Scotland). Only the stock in Division IV is assessed in this report. This assessment is classified as an update assessment.

4.1 General

4.1.1 Ecosystem aspects

Sandeels in the North Sea can be divided into a number of reproductively isolated sub-populations (see the Stock Quality Handbook no. Q4). A decline in the sandeel population in recent years, with SSB being below Blim from 2001 to 2006 concurrent with a markedly change in distribution increased the concern about local depletion, of which there have been some evidence (ICES WGNSSK 2006b). This may be of consequence for marine predators that are dependent on sandeels as a food source. This year's assessment shows an improvement in the overall stock situation from 2006 to 2008 as well as a repopulation of sandeels in several areas in which local stock size has been low in recent years, indicating that the risk of local depletion have decreased. It is however presently not possible to make an assessment that takes account of the sub-population structure of sandeels, although a framework for carrying out such analyses have been outlined (ICES AGSAN 2007a).

The stock annex contains a broader description of ecosystem aspects. However there is new material relevant to this section and this is described below.

In general, fishing on sandeel aggregations at a distance less than 100 km from seabird colonies has been found to affect some surface feeding bird species, especially black-legged kittiwake and sandwich tern. Recent research of effects on seabird predators due to changes in sandeel availability showed that breeding success of black-legged kittiwake Rissa tridactyla in the Firth of Forth area off the Scottish east coast was related to abundance of both 1+ group, the age class targeted by the fishery, and 0 group sandeels. The same relationship was not found for six other sandeel dependent seabird species. Controlling for environmental variation (sea surface temperature, abundance of larval sandeels and size of adult sandeels), Frederiksen et al. (submitted) found that breeding productivity in the seabird colony on the Isle of May was significantly depressed by the fishery during periods of unregulated fishery for one surface-feeding seabird species (black-legged kittiwake), but not for four diving species. The mechanism by which the fishery affects the seabird however remains unclear as the fishery is not always in direct competition with the birds. The strong impact on this surface-feeding species, while no effects are documented found for e.g. diving species, could result from its inherently high sensitivity to reduced prey availability, from changes in the vertical distribution of sandeels at lower densities, or from sandeels showing avoidance behaviour to fishery vessels.

4.1.2 Fisheries

General information about the sandeel fishery can be found in the Stock Quality Handbook (no. Q4).

There has been a substantial decrease in the Danish fishing fleet due to decommissioning in recent years. The Norwegian fleet has also seen a drastic decline in the number of vessels fishing sandeels in recent years (ICES WGNSSK 2006b and section 4.2.5).

The sandeel fishery in 2007 was first opened 1st of April, both in the EU zone and in the Norwegian EEZ. The fishery in 2007 differed markedly from that of recent years fisheries, with much higher catch rates from the start of the fishing season, sandeels that were available to the fishery at least one week earlier than in the two previous years, and a higher mean weight of 1-group sandeels than in the two previous years (see ICES AGSAN 2007b). Further, in addition to the fishery in the Dogger Bank area, a large part of the fishery took place in the Northern part of the North Sea (in the Norwegian EEZ, in Skagerrak, and at the grounds off the Danish west coast) in areas where fishing have been on a low level in recent years because of low local abundance of sandeels. The change in the distribution of the fishery partly explains the increase in mean weight at age seen in 2007 (section 4.2.3).

Regulation of the fishery is no explanation to the small fishery observed from 2003 to 2006 (section 4.2.1). The TAC in force has until 2007 never been restrictive in the sandeel fishery. In 2005 (the only year, except for 2007, when additional regulation was introduced in the EU EEZ) the fishery was first regulated in July after the main fishing season. In the Norwegian EEZ the fishery in 2005 was closed from June 23 onwards. Following an experimental fishery (6 vessels in 3 weeks) that indicated a poor state of the stock in 2006 in the Norwegian EEZ, Norway chose not to open the fishery.

4.1.3 ICES Advice

Based on the 2006 assessment ICES (ICES-ACFM 2006) classified the stock as having reduced reproductive capacity. SSB was estimated at below Blim since 2001. A drastic change in the stock situation of sandeels in IV occurred from 2003 and onwards. The change in 2003 came from a historic low recruitment in 2002. An apparent increase in the stock size from 2005 to 2006 is due to the recruitment in 2005. However, this increase only applies to the southern part of the North Sea, whereas the stock in the Northern part of the North Sea is still at a much lower level. The fishing mortality in 2005 was close to the time-series mean, but below that of the last 4 years. Fishing mortality from the completed 2006 fishery was lower than the time-series mean.

Several traditional sandeel aggregations seem depleted, particularly in the northern area of the North Sea. ICES advised that management of fisheries should try to prevent further local depletion of sandeel aggregations, particularly in areas where predators congregate, and that efforts should be made to keep adequate levels of sandeel biomass available as prey.

In response to a special request from The European Community and Norway for “advice on management measures for the sandeel and Norway pout fisheries in the North Sea and Skagerrak in 2007”, ICES noted that an F based strategy that aims for maximum yield is not consistent with the precautionary approach. A spawner escapement strategy that aims at a surviving annual amount of spawners equal to Bpa (or having a high probability of being above Blim) could be considered as an appropriate alternative to the fixed-F strategy.

ICES advise that the fishery in 2007 should remain closed until information is available which assures that the stock can be rebuilt to Bpa by 2008. ICES suggests a management procedure for 2007 as outlined in a response to a special request (ICES 2006):

1) The aim of management in 2007 should be to rebuild SSB in 2008 above Blim with a high (95%) probability.

2) The total kilowatt-days for fisheries for sandeel in 2007 may initially be set at no more than 30% of the total kilowatt-days applied in 2005. This effort may be used for exploratory fishing in April and early May 2007.

3) A TAC for 2007 and the maximum number of kilowatt-days shall be determined, as early as possible based on advice from ICES on the size of the 2006 year class of North Sea sandeel in accordance with the following rules

a) TAC 2007= −597 + 4.073 × N1 (N1 is the real-time estimate of age group 1 in billions, derived from an exploratory fishery in April and early May 2007; the TAC is expressed in 1000 t)

b) If the TAC calculated in point 3a) exceeds 400 000 t the TAC shall be set at 400 000 t

c) The number of kilowatt-days for 2007 shall not exceed the effort in 2005

4) .The fishery shall be closed 1 August 2007.

The relationship between the TAC and the real-time recruitment estimate is conditional on the October 2006 assessment of age group 2 and older at the start of 2007.

The real-time monitoring estimate should be based on a regression between CPUE observations and “bias-corrected” stock numbers at age 1. ICES has applied a bias correction to the assessment output by calculating a bias factor from the terminal estimates of a series of retrospective runs divided by the “true value” as estimated in the most recent assessment. The application of the bias factor gave a 50% lower estimate of SSB in 2007. ICES consider that the bias correction reduces the concern about assessment bias for management of the sandeel fishery in 2007.

Because ICES cannot fully evaluate whether the harvest control rule is consistent with the precautionary approach in the longer term, ICES presents the HCR as a suggestion only.

Closing the fishery on 1 August will enhance the possibilities for the 0-group to contribute to the local aggregations and to repopulate earlier depleted grounds.

Real time management (RTM) of the sandeel fishery in 2007

An ICES Ad Hoc group on North Sea sandeel (ICES AGSAN 2007a) met at ICES 27-28 February 2007, to establish a real time monitoring (RTM) system for the North Sea sandeel stock to be implemented in 2007. The AGSAN build upon the work carried out by previous STECF expert group on the RTM methodology (STECF 2004, 2005a and 2005b), by the WGNSSK in 2006 (WGNSSK 2007) and in a response from ICES to a special request (ICES 2006). The TOR for the AGSAN meeting was to:

1) Compile all pertinent information of relevance for the implementation of a real-time monitoring system for the stock of North Sea sandeel. In compiling this information consider the arrangements between the Community and Norway on the 20 000 tonnes allocated to the "experimental fishing" both in Community and Norwegians waters;

2) Suggest methods, on the basis the information compiled under point 1, for a further improvement of the real time monitoring system for the stock of North Sea sandeel that by early May 2007 can provide an unbiased estimate of the size of the 2006 year class of sandeel;

3) Outline feasible options for future management arrangements, taking into account the biological characteristics of the stock as well as future availability of relevant data.

The AGSAN was scheduled to work by correspondence to provide an estimate of the size of the 2006 year class of North Sea sandeel at age 1 as early as possible in May and no later than 15 May 2007.

The HCR investigated by the group was the same as suggested (not advised) by ACFM 2006.

The AGSAN produced the final report 10th of May. The 2006 year class was estimated to 419·109 individuals at age 0 in 2006 and to 188·109 individuals at age 1 in 2007. Using the HCR the TAC for 2007 was estimated to 170 000 t.

ICES advised 15th of May on a TAC for 2007, based on the final AGSAN report (ICES AGSAN 2007b). ICES concluded that "The data obtained from the experimental fishery are considered adequate to provide an estimate of the size of 1-group sandeel in 2007, according to the agreed methodology (ICES AGSAN 2007a)."

4.1.4 Management

The suggestion from ICES on a management strategy for 2007 (section 4.1.3) was later used in the regulation of the 2007 fishing opportunities in Community waters (Council Regulation (EC) No 41/2006 of 21 December 2006 - OJ L15 of 20 January 2007 p 1) and in the Norwegian EEZ

TAC

In the fishery consultations between EU and Norway for 2007, the agreed record allowed the parties to fish 20 000 tonnes of sandeel in each others zones. These quotas were primarily for an experimental fishery, but fishing against these quotas could continue if the commercial fishery was opened.

Both EU and Norway accepted the TAC of 170 000 t as suggested by ICES (22nd of May, EU DG III – Fisheries: NOTE TO DELEGATIONS 225/07). Because there is no agreement between EU and Norway on how to share the sandeel stock, the TAC was overfished by 36 000 t. EU landed 155 000 t and Norway 51 000 t, which correspond to 91% and 30%, respectively, of the TAC of 170 000 t.

Denmark closed the sandeel fishery for Danish vessels in the EU zone from 16th May. From 8th of June Danish vessels were allowed to fish 10 500 t of sandeels, 2 100 t in Norwegian EEZ and 8 400 t in EU waters and Skagerrak/Kattegat. Of the 8 400 t, 4 600 t were a rest of the 2006 TAC that was transferred to 2007, and 3 800 t a rest of the 2007 TAC. The 10 500 t was fully utilized. EU closed the sandeel fishery in the Norwegian EEZ for EU vessels from 4th May. Norway closed the sandeel fishery for Norwegian vessels from 6th of May and reopened the fishery May 16 following the ICES advice. The fishery was closed again in mid-June when the quota of 51 000 t had been taken.

Closed periods

Since 2005 Danish vessels have not been allowed to fish sandeels before 31st of March. In 2007 sandeel fishery in the EU zone was first opened 1st of April and closed again from 1st of August.

Since 2004 the fishery in the Norwegian EEZ has been opened April 1. In 2005 the fishery was closed June 23, and in 2006 the fishery in the Norwegian EEZ was closed except for a limited experimental fishery. In 2007 the sandeel fishery in the Norwegian EEZ was opened April 1t and closed again May 6 pending advice from ICES. The quota of 51 000 t set by Norway for Norwegian vessels was taken within mid-June.

Closed areas

All commercial fishing in the Firth of Forth area has been prohibited since 2000, except for a maximum of 10 boat days in each of May and June for stock monitoring purposes. The closure was maintained for three years (see e.g. Wright et al. 2002) and has been extended until 2007, with an increase in the effort of the monitoring fishery to 40 boat days. There is presently no decision on weather a full commercial sandeel fishery will be reopened in the Firth of Forth area.

In the Norwegian EEZ all fishing grounds were open during the monitoring fishery in 2007. . When the fishery was reopened May 16, a number of fishing grounds were closed (Fig. 4.1.4.1). The rational for closing these areas was the poor state of several local stocks in the northern North Sea over the last 6-12 years (Fig. 4.2.1.4).

4.2 Data available

4.2.1 Catch

Landing and trends in landings

Landings statistics of sandeels is given in Tables 4.2.1.1 to 4.2.1.5. For 2006 official landings were only available as total landings for Area IV. Figure 4.1.2.1 shows the areas for which catches are tabulated in Tables 4.2.1.1 to 4.2.1.5. The catch history is shown in Figure 4.2.1.1.

The sandeel fishery developed during the 1970's, and landings peaked in 1998 at more than 1 million tons. Since then there have been a rapid decrease in landings, with a steep drop from 2002 to 2003, after which total landings have been low and historic low in 2005 (Figure 4.2.1.1 and Table 4.2.1.2). Average total landings were 270 000 t in the period 2003-2007 whereas they were 801 000 t in the previous 20 year period.. In spite of a substantial decrease in the fleet size (section 4.2.5) landings were on a much higher level in 2007 compared to the previous 3 years up to when the fishery in the EU zone was closed in mid May.

There are large differences in regional patterns in landings. This is shown in Figure 4.2.1.2 in which landings are given for the three regions: i) north-western North Sea, ii) north-eastern North Sea and iii) the southern North Sea. The landings from the southern North Sea were on a much higher level then those in the north-eastern North Sea until 1985 when a steep increase was seen in landings from the north-eastern North Sea. From 1985 to 1998 landings in the two areas were approximately at the same level. However, from 1999 landings in the north-eastern North Sea decreased dramatically until 2006, when only a limited experimental fishery in the Norwegian EEZ was allowed. The same decline in landings was observed in the southern North Sea, but the decline in this area first occurred from 2003, i.e. 4 years after that in the north-eastern part of the North Sea. Landings in the north-western part of the North Sea have generally been on a much smaller level than those in the other two regions, the exception being 1994 and 1995. The peak in landings in 1995 was due to a large fishery at the Viking Bank. From 2006 to 2007, a large increase was seen in landings in the north-eastern North Sea.

The distribution of landings

The spatial distribution of sandeel landings is considered as a good representation of stock distribution, except for areas where severe restrictions on fishing effort is applied (i.e. the Firth of Forth, Shetland areas, Norwegian EEZ in 2006 and in the North Sea in 2007). Figure 4.2.1.3 shows the distribution of catches for 2006 (no fishery in first quarter) and 2007 (only fishery in second quarter) by quarter and ICES statistical rectangle. Yearly landings for the period 1995-2007 distributed by ICES rectangle are shown in Figure 4.2.1.4.

Large variations in the fishing pattern occurred concurrent with the decline in landings and CPUE (section 4.2.5). The distribution of landings in the southern North Sea in 2003 to 2005 (i.e. from the first year when landings were on a low level in both the northern and southern North Sea) seemed more dispersed than the typical long-term pattern in the same area. Hence, grounds usually less exploited became more important for the total fishery during this period. In 2006 there was another large change in the fishing pattern, when the fishery showed a strong concentration at the fishing grounds in the Dogger Bank area. In 2007 yet another change in the distribution of landings was observed, when landings in the north-eastern part of

the North Sea were on about the same level as those in the southern North Sea. Although this overall large variation in fishing pattern there is a general high importance for most years of the Dogger Bank area.

As for last year's assessment Danish landing of 13739 t of sandeels in second half year of 2005 was added to first half year landings data on 141057 t (see ICES 2006b).

4.2.2 Age compositions

Catch numbers at age by half-year is given in Table 4.2.2.1.

4.2.3 Weight at age

The compilation of age-length-weight keys was carried out using the method described in the Stock Quality Handbook no. Q4. The mean weights-at-age in the catch for the northern and southern North Sea in the time period 2001 to 2007 are given by country in Tables 4.2.3.1 and 4.2.3.2. The mean weight at age in the catch used in the assessment is the mean weights at age in the catch for the Southern and Northern North Sea weighted by catch numbers. Mean weight in the catch from 1983 to 2007, used in the assessment is given in Table 13.2.3.3 by half year.

The mean weight at age in the stock is mean weight in the catch first half-year, and an arbitrary chosen weight at 1 gram was used for the 0-group. Mean weight in the stock from 1983 to 2007 is given in Table 4.2.3.4 by half year. There was no biological sampling of the small fishery in second half year of 2006 (representing 21 000 tonnes or 9% of the landings in first half year). As more than 95% of the 21 000 tonnes were taken in July mean weight in the stock from June 2006 was also used for second half year of 2006.

The time series of mean weight in the catch and in the stock is shown in Figure 4.2.3.1 and 4.2.3.2. Mean weight at age show large fluctuations over time. Most remarkable are the large changes in mean weight from 1994 to 1996, which partly may be explained by a change in the methodology used for age determination (ICES 1995) that was applied from 1995 and 1996. An increase in mean weight is observed from 2004 to 2006 in first half year in both the northern and southern North Sea. Also from 2006 to 2007 an increase in mean weight was observed. Due to the early stop of the fishery in 2007 (section 4.1.4) and a lack of samples from the small fishery in June mean weight in 2007 used in the assessment may be slightly underestimated.

The large fluctuations of mean weight-at-age have an impact on the quality of the assessment. This year we made a more detailed examination of the variability in the observed mean weight-at-age in the catch, with a view to possible forecasting of this quantity. This is relevant because mean weight at age for 2008 and 2009 is an important input in the short term forecast (section 4.6). Data from the Danish sandeel catch-sampling programme from 1995-2007, corresponding to the period after the introduction of the new age determination procedure, was used as the basis for this analysis. The raw data consisted of a length-class frequency distribution for a given year, month, age of individual fish, and location of the catch (binned into "Northern North Sea" and "Southern North Sea"), using the definitions shown in Figure 4.1.2.1. Each length-class had a total number and weight of fish associated with it, from which the mean weight of an individual in that class could be determined. The overall mean weight-at-age for a given month, year, age and area was then determined using an arithmetic mean weighted by the number of observations for the given length class. The uncertainty in the mean was estimated from the standard deviation, calculated in an analogous manner. Data from the Danish sandeel dredge survey (see ICES 2006b and 2007a) was analysed in a similar fashion.

Inter-annual variation in the mean weight-at-age appears to be a significant factor (Figures 4.2.3.3 and 4.2.3.4). Due to the nature of the dataset used here, it was not possible to test such a hypothesis statistically (e.g. using an ANOVA). However, visual inspection of the plots suggests that the variation between years is significantly greater than the uncertainty in the estimated mean weight-at-age. The most likely explanation arises from the fact that this analysis is based on catch data, rather than survey or population data: the mean weight-at-age is not spatially uniform across the North Sea stock unit and the spatial exploitation pattern of the fishery is known to vary greatly between years. Changes in the distribution of fishing sites between years will also change the mean weight-at-age of fish going into the catch and can thereby create the observed between-year variations.

Further evidence of strong inter-annual effects is provided by normalising the mean weight-at-age in a given month and year by the value averaged over all years (Figures 4.2.3.5 and 4.2.3.6): this transformation allows us to view the mean weight-at-age in terms of an anomaly from the mean value, and thereby easily observe common trends. There appears to be a common pattern between the normalised weights-at-age, especially in the older age-groups (i.e. age 1+), again suggesting that the between-year variability is more important than within year variability.

The month and fishing area from which the catch data are sampled appear to have a strong influence on the observed mean weight-at-age (Figure 4.2.3.7). Generally, the mean weight-at-age is larger in the northern North Sea than in the southern North Sea. The mean weight-at-age increases monotonically throughout the first half of the year, before peaking in early summer (June-July) and decreasing slowly into autumn. There is insufficient data to fully understand these trends, due to the lack of fishing during the winter half of the year, and there does not appear to be an obvious biological explanation. However, it must be remembered that these data only reflect the nature of the fishery, not of the entire population, and are thus likely to be confounded by effects such as temporal changes in both the fishing pattern and catchability (e.g effects such as larger sandeels burrowing into the sand before smaller ones, see e.g. Bergstad et al. 2002, Reeves 1994, or Rindorf et al. 2000). More data, from both catches and dredge surveys, is required in the data-poor autumn and winter months to fully understand these trends.

There does not appear to be a strong cohort effect (Figure 4.2.3.8). While one might expect that some cohorts grow faster or slower than others (e.g. due to competition effects), such an effect does not appear to be strong. Again, due to the nature of the data, it has not been possible to test this hypothesis easily using statistical methods, and thus we are forced to rely on visual examination of the data. If the cohort effect were significant, we would expect that some cohorts are generally above an average weight, and some are generally below it. This does not appear to be the case, and cohorts move above and below the average in a seemingly random manner, suggesting the effect is not significant. However, such an analysis method is inherently weak, and firm conclusions cannot be drawn without the use of proper statistical tests.

Finally, the potential use of observed weights-at-age to predict future weights-at-age was examined. Correlation coefficients were calculated between the mean weight-at-age of a cohort at age t, and that of the cohort again at some point in the future, $t+\delta t$. Generally, it was found that the predictive power of such an approach was extremely poor: the r2 coefficient was almost always below 0.30 for any useful value of δt (e.g. forecasting one year ahead). This result formalises the more qualitative observation made above that there is no cohort effect: if there were, we would expect to see much higher correlation coefficients.

The results of the correlation analysis in relation to the December sandeel dredge survey are worth noting (Table 4.2.3.5). While the r2 values are only based on three data points, they are also appreciably higher than the other values. This is a promising result and may offer a possi-

ble route via which mean weight-at-age predictions for the coming spring could be made. The addition of further data points will quickly clarify whether such a method is practicable.

In conclusion, it does not appear to be feasible, with the currently available data, to forecast the mean weight-at-age. The mean weight-at-age appears to exhibit significant area, month and inter-annual effects, but there does not appear to be a strong cohort effect, limiting the ability to make forecasts. As a substantial proportion of inter-annual variability in mean weight at age is likely to be a result of spatial variability in the growth of sandeels, and because the industrial fishery target different part of the sandeel populations during the year and between years. A proposed forecast method would thus need to include information about the expected spatial exploitation pattern in future years, a highly uncertain parameter. Division of the primary North Sea stock unit into smaller units, each assessed individually, may resolve many of these problems.

Because it is not possible to forecast mean weight at age, an average of the time period 1996 to 2007 is used for 2008 and 2009 in the short term forecast (section 4.6).

Additional information about the variation in catch weight at age can be found in the Stock Quality Handbook (Q4).

4.2.4 Maturity and natural mortality

Maturity and natural mortality, used also in this year's assessment, are assumed at fixed values and are described in the Stock Quality Handbook no. Q4. The proportion mature is assumed constant over the whole period with 100% mature from age 2 and 0% of age 0 and 1.

Values for natural mortality by age and half year used in the assessments.

Age	First half year	Second half year
0	0.0	0.8
1	1.0	0.2
2	0.4	0.2
3	0.4	0.2
4+	0.4	0.2

4.2.5 Catch, effort and research vessel data

Catch data

Catch data used in the assessment is given in Table 4.2.2.1. No catch data was available for second half year of 2007 because no fishery has been recorded.

Recent changes in the fleet composition

The size distribution of the Danish fleet has changed through time, with a clear tendency towards fewer and larger vessels (ICES WGNSSK 2006b). This change is especially apparent in 2005, when only 98 Danish vessels participated in the North Sea sandeel fishery, compared to 200 vessels in 2004 (Table 4.2.5.1). This change was retained in 2006 and 2007 with a small increase to 124 vessels in 2006 and 116 in 2007 (when the fishery was closed in May). The remaining Danish industrial vessels were in 2007 given individual tradable quotas (ITQ) on sandeels. The introduction of ITQ will accelerate the change towards fewer and larger vessels. From the experience with ITQ on herring a halving of number of vessels in the Danish industrial fleet could occur.

The same tendency was seen for the Norwegian vessels fishing sandeels until 2005 (Table 4.2.5.1). In 2006 only 6 Norwegian vessels were allowed to participate in an experimental sandeels fishery in the Norwegian EEZ. In 2007 41 Norwegian vessels with individual quotas participated in the sandeel fishery

From 2002 to 2007 the average GRT per trip in the Norwegian fleet increased from 269 to 460 t. Of the 41 Norwegian vessels that fished sandeel in 2007, 9 participated for the first time. Since 1998 25 of the 41 vessels entered the fishery during this 10 yr period, 9 vessels were rebuilt (either extended or had larger engines installed) whereas only 7 vessels remained unaltered. In addition, there is likely to be a continuous increase in efficiency due to improvement in fishing gear, instruments etc.

Such rapid changes in the structure of the fleet may introduce more uncertainty in the assessment, as the fishing pattern and efficiency of the "new" fleet may differ from the previous fleet.

Trends in overall effort and CPUE

Tables 4.2.5.2 and 4.2.5.3 and Figure 4.2.5.1 show the trends in the international effort over years. Total international standardized effort peaked in 1989, and was at a relative stable level from 1989 to 2001. Total international effort has been decreasing since 2001, with a particular large decrease from 2001 to 2002 and another large decrease from 2004 to 2005. The effort in 2007 is the lowest recorded in the time period used in the assessment. The decrease in effort is likely due to a combination of decreasing catch opportunities and increasing fuel prices. In 2007 the regulation of the fishery was a strong limitation of the effort used.

Figure 4.2.5.1 shows the trends in CPUE over years. CPUE fluctuated without a clear trend throughout the period 1983 to 2001. A large increase in CPUE was observed from 2001 to 2002, followed by a steep decrease from 2002 to 2003. CPUE has been increasing since 2004. A discussion about the possible problems of using commercial CPUE as an index of sandeel population size was included in last years WG report.

The tuning series used in the assessments

As in previous assessments effort data from the commercial fishery in the northern and southern North Sea are treated as two independent tuning fleets separated into first and second half year. Because of the trends in the residuals for 1-group sandeels in the first half year, the two tuning fleets in the first half year have since the 2005 assessment (ICES 2006a) been split into two time periods, i.e. before and after 1999, when a change in gear types has been observed (ICES 2006b). This change in the tuning series removed the trends in the residuals of log stock numbers, and the tendency to underestimate F and overestimate SSB was reduced markedly. The definition of tuning fleets used in 2005 was also used in this year's assessment. The following tuning series were used (Table 4.2.5.4):

Fleet 1: Northern North Sea 1983-1998 first half year
Fleet 2: Northern North Sea 1999-2007 first half year
Fleet 3: Southern North Sea 1983-1998 first half year
Fleet 4: Southern North Sea 1999-2007 first half year
Fleet 5: Northern North Sea 1983-2006 second half year
Fleet 6: Southern North Sea 1983-2006 second half year

The effort data for the southern North Sea prior to 1999 are only available for Danish vessels, but since 1999 Norwegian vessels have also provided effort data. These data for the first half year has since 2003 been included in tuning series. The tuning fleet used for the northern North Sea is a mixture of Danish and Norwegian vessels.

No effort data was available for second half year of 2007 because no fishery has been recorded.

Standardisation of effort data

Due to the change in size distribution of the vessels fishing sandeels in the North Sea (see e.g. ICES WGNSSK 2006b or STECF 2004 and 2005a) and the relationship between vessel size and fishing power effort standardisation is required when establishing the commercial tuning series used in the sandeel assessment. The standardisation was carried out using the same procedure as during last years WG meeting. The standardisation procedure is described in the Stock Quality Handbook no. Q4.

The combined Norwegian and Danish effort is shown in Tables 4.2.5.2 and 4.2.5.3. The tuning fleets used in the assessments area given in Table 4.2.5.4. The CPUE for these fleets are summarised in Figures 4.2.5.2 and 4.2.5.3.

Trends in CPUE tuning series

Similar trends were observed in CPUE in the northern and southern North Sea in first and second half year (Figure 4.2.5.2). The exception is 2002 when there was a markedly increase in CPUE in the first half year and a large decrease in the second half year. The CPUE was at a historic low level in 2003, after when CPUE increased. This increase is due to an increase in CPUE only for age-1 sandeels, whereas CPUE for age 2+ sandeels has not increased (Figure 4.2.5.3). The exception is in 2007 when CPUE of age-2 sandeels increased in southern North Sea first half-year.

Fisheries independent tuning

There is no survey time-series available for this stock.

4.3 Data analyses

Seasonal XSA (SXSA) is used as the assessment model for sandeels in IV because it allows the use data from first half year of the assessment year, and it therefore provides a more up to date evaluation of the stock status than the XSA. Comparison between the SXSA and XSA has been carried out during several WG meetings and in all cases the models show about the same trends in stock development.

4.3.1 Reviews of last year's assessment

See the WGNSSK report from April 2007 (ICES WGNSSK 2007).

4.3.2 Exploratory catch-at-age-based analyses

Settings used in the assessment models

The Seasonal XSA developed by Skagen (1993) was used to estimate fishing mortalities and stock numbers at age by half year, using data from 1983 to 2006 and first half year of 2007. The settings used in the SXSA are listed in Table 4.3.2.1.

Settings used this year in the assessment models compared to 2006

The settings used for this year's SXSA assessment are the same as those used for the final 2006 SXSA assessment.

Results of the SXSA analysis

Output from the SXSA analysis is presented in Tables 4.3.2.2 (fishing mortality at age by half year), 4.3.2.3 (fishing mortality at age by year), 4.3.2.4 (stock numbers at age), 4.3.2.5 (catchabilities for the tuning fleets). The stock summary is presented in Table 4.3.2.6.

The residuals of log stock number for the SXSA analysis are given in Figure 4.3.2.1. From 2002 the residuals have in first half year been positive for age-1 sandeels and negative for age-2 sandeels in the Northern North Sea. In this time period both the fishery and the stock in the northern North Sea have been on a low level, except for in 2007 with a drastic change was observed. Also in the southern North Sea the residuals were negative in first half year for age-2 sandeels from 1993 to 1998. There is no clear explanation to these observed trends in the residuals, although some problems with aging the 1998 and 1999 year class (due to the formation of the "winter" ring in the autumn) have been identified at the Norwegian laboratory. There are no clear trends in the residuals of log stock numbers for any of the other age-groups and fleets.

The retrospective analysis (Figure 4.3.2.2) shows that the SXSA has a tendency to underestimating F and overestimating stock size although the retrospective bias seems to have decreased in 2006 compared to 2004 and 2005. This bias in the assessment is also seen in the plot of the historical performance of the assessments (Figure 4.3.2.4). Due to the tendency of the assessment to underestimate F and overestimate N the short term forecast in 2006 was based on a bias-corrected assessment. The bias-correction factors used in 2006 for F and N were estimated for each year and age between 2000-2005 and are variable (Figure 4.6.1 and 4.6.2, WGNSSK 2006). The average value from the last 3 years used and the performance of these adjustments is as follows:

N Age 1, 1st Jan 2006.
bias used in forecast -42%
"actual" bias from final 2007 assessment -15%

N Age 2, 1st Jan 2006.
bias used in forecast -21%
"actual" bias present from 2007 assessment -23%

F Age 1, 1st half year
bias used in forecast +72%
"actual" bias from final 2007 assessment +40%

F Age 2, 1st half year
bias used in forecast +15%
"actual" bias from final 2007 assessment +54%

The bias-correction used in 2006 was thus excessive on the 1-group and not enough on the 2-group.

4.3.3 Exploratory survey-based analyses

No survey based analyses were carried out.

4.3.4 Conclusions drawn from exploratory analyses

The SXSA estimates the 2006 year-class to 401·109 individuals at age 0, which is below average. F1-2 declines from 2004 to 2007 with 2007 being historic low and only about 30% of the

long term average. SSB have been below Blim from 2001 to 2006, and is estimated to above Blim but below Bpa in 2007. The increase in SSB to above Blim in 2007 is, in combination with a more uniform spatial distribution pattern, an improvement of the stock situation.

4.3.5 Final assessment

The SXSA update assessment was chosen as the final assessment.

4.4 Historic Stock Trends

The stock summary is given in Figure 4.3.2.3. The final assessment estimate SSB to below Blim from 2001 to 2006 and to above Blim but under Bpa in 2007. Although the 2005 and 2006 year classes are estimated to below average SSB increase to above Blim in 2007 due to a fish-ing mortality well below average since 2006.

The decrease in the sandeel stock concurrent with a decrease in fishing effort, has led to a large decrease in sandeel landings since 2003. Danish landings declined 56% from 2002 to 2003 and Norwegian landings declined by more than 80%. The decrease in landings seen since 2003 has been particularly large in the northern part of the North Sea, with a reduction on 83% in 2003 and 96% in 2006 (only experimental fishery in the Norwegian EEZ) compared to average landings in 1994-2002 in the same area (Figures 4.2.1.2 and 4.2.1.4 and Table 4.2.1.4). A large change in the fishing pattern was observed in 2007, when the fishing season was comparable to those before the considerable change in the stock occurred in 2003. Weekly landings and effort were on a higher level in 2007 compared to the previous 4 years, up to when the fishery was closed (section 4.1.4). Further, landings in the northern North Sea in 2007 were at the same level as in the southern North Sea.

Owing to the large change in the North Sea sandeel stock a harvest control rule has been implemented since 2004, to adjust the fishing effort to the reduced size of the sandeel population in order to prevent recruitment overfishing (see e.g. STECF, 2004, 2005a, 2006, ICES 2006a, 2006b and 2007).

4.5 Recruitment estimates

As no recruitment estimates from surveys are available, recruitment estimated in the assessments are based exclusively on commercial catch-at-age data. The tuning diagnostics indicate that the 0-group CPUE is a rather poor predictor of recruitment.

ICES Study Group on Recruitment Variability in North Sea Planktivorous Fish (ICES-SGRECVAP 2007) analysed the stock-recruitment relationship of sandeels in IV. The residuals in the stock-recruitment relationship are evenly and randomly distributed around the mean value, and do not appear to reflect any obvious trends in the stock dynamics. The productivity (recruits per spawner) is highly variable throughout the time series modelled (1984 to 2005) with the highest productivity in 1997 and 2002, for both years followed by a sharp decrease in the following year. In the most recent years there is again an increasing trend in productivity.

Fisheries independent information on sandeel abundance

In the latest WG reports the need for fishery independent information on sandeel distribution and abundance has been highlighted (ICES 2005, 2006a and 2006b). Catches of sandeels in the international coordinated ICES surveys are not considered representative enough to be used in the assessment. Dedicated sandeel surveys have only been established in recent years to provide large scale abundance estimates of sandeels. The demand for such surveys has increased due to the recent years decline in the North Sea sandeel stock concurrent with large changes in distribution and in the composition and fishing pattern of the fleet.

A detailed description of the methodologies that are presently used for measuring sandeel abundance on scientific surveys is given in the last WG report together with preliminary results from some of the methods (ICES WGNSSK 2007). The methods described are:

- Sampling of sandeel larvae from April to May at sandeel fishing grounds, using a plankton net (a MIK with a diameter of 1 m).
- Sampling of juvenile and adult sandeels in the seabed using dredges, sledges, and seabed samplers such as grabs and box corers.
- Sampling of juvenile and adult sandeels in the water column using a full commercial sandeel trawl equipped with a multiple cod end system.
- Acoustic techniques for measuring the biomass of juvenile and adult sandeels in the water column.

The WG concluded, that all the surveys have the potential to establish a time series of indices that can be used for tuning the historic assessment, and to estimate the size of the incoming year-class all ready in January, before the decisions about how the fishery will be managed have to be made. However, the time series are limited to a few years and therefore still insufficient to be used in the assessment. Further, an analysis of the ability of the indices to measure stock trends, i.e. contrasting the information in the many sources of survey and commercial fishing data, still need to be carried out to achieve a proper evaluation of the methods applied. The WG recommended such an evaluation to be carried out. Further, the WG stated that an international coordinated effort is required to establish a time series of survey information for North Sea sandeels that can be used for stock assessment.

Provisional information about the 2007 year class

Due to no fishing in second half year of 2007 (see section 4.2.1) there are no fishing data from 2007 that can be used to estimate the size of the 2007 year-class.

The Danish Institute for Fisheries Research (DIFRES) has measured sandeel larvae abundance in the North Sea in April 2007. This material is presently being analysed. Further, DIFRES will carry out a survey in December 2007 that may provide information about the size of the 2007 year class. Further the Institute of Marine research (IMR) plan to conduct surveys in 2008 to measure the abundance 1-group and older sandeels in April/May

Recruitment estimates used for short term forecasting

For the short term forecast (section 4.6) the 25th percentile, on 324 109 age-0 sandeels, of the long-term recruitment estimated in the final SXSA assessment was used as the recruitment in 2007 and 2008. This was used because recruitment has been below average since 2002.

4.6 Short-term forecasts

The high natural mortality of sandeel and the few year classes in the fishery make the stock size and catch opportunities largely dependent on the size of the incoming year classes.

Although recruits (age 0) usually have appeared in the second half years fishery at the time of the WG, the biological samples from this fishery are normally not available. Further, in 2007 there was no fishery after June (see section 4.2.1). There is therefore no information in the 2007 catch data that can be used for the estimation of the 2007 year-class.

0-group CPUE is a poor predictor of recruitment (ICES WGNSSK 2004) Traditional deterministic forecasts are therefore not considered appropriate. However, because of the low sandeel stock the working group has since 2004 provided an indicative short term prognosis, using a

range of scenarios for the recruitment and exploitation pattern. The same approach as used for the standard prognosis in 2006 was taken during this WG meeting to carry out a short term prognosis for 2008 and 2009.

Prognosis for 2008 and 2009

The prediction was made using half year time steps. Stock numbers at 1st of January 2007 were taken from the final SXSA assessment. Values for natural mortalities and proportion mature are the same as those used in the assessment.

In the absence of information about the recruitment a low recruitment was assumed for 2007 and 2008. This was used because recruitment has been below average since 2002. Recruitment in 2007 and 2008 was assumed to be 324 109, which is the 25th percentile of the long-term recruitment (section 4.5).

No fishery was recorded for second half year of 2007. Further, no fishery was assumed for second half year of 2008, due to no or very limited fishery in second half year of 2005, 2006 and 2007. F-at-age for the first half year of 2007 was also used for the first half year of the forecast year. The argument for this is that the exploitation pattern seems to depend on the abundance of the age-classes relative to each other (see e.g. ICES AGSAN 2007a), and it can be assumed that this relative contribution of age-groups to the stock in 2008 will be much like in 2007. Since 2002 recruitment has been below average with the 2005 and 2006 year-classes at about the same level. Therefore, unless the 2007 year class is high exploitation pattern in 2008 is likely to be like that in 2007. Alternative exploitation patterns were also analysed (mean exploitation pattern 2005-2007 scaled to 2007 and mean exploitation pattern 2004-2006 scaled to 2006). However, the results of using these alternative exploitation patterns in the forecast were largely the same as for the forecast that used the 2007 exploitation pattern.

Stock and catch weights for the first half year of 2007 was those used in the assessment. Because of the inability to predict future stock and catch weight (section 4.2.3) average weights of the time period 1995 to 2007 were used for first half year of 2008 and 2009. Stock and catch weight previous to 1995 were not used, due to a change in the procedure used for age determination from 1995 (section 4.2.3 and ICES 1995). Stock and catch weight of second half year of 2007 and 2008 are irrelevant, because SSB is estimated in the start of first half year and no fishery is assumed in second half year.

Data used in the forecast is given in Table 4.6.1.

The forecast predict SSB in 2008 to 681 000 t and above Bpa. In case of low recruitment landings in 2008 on 400 000 t will lead SSB in 2009 to be above Bpa. Landings on 400 000 will lead to F in 2008 being 2.3 times higher than F in 2007.

It was noted that short term forecasts from 2004 and 2005 overestimated the SSB in 2005 and 2006 by a factor 2-3 when compared to the SSB estimated by the SXSA in 2006 (ICES 2006b). However, the standard forecast from 2006 estimated SSB in 2007 to 498 000 t. SSB is in this years assessment estimated to 455 000 tonnes, e.g. at about the same level as the standard forecast in 2006.

SSB(2008) = 681 000 t; landings (2007) = 204 000 t. Input data in Table 4.6.1.

Shaded scenarios are not considered consistent with the precautionary approach.

The settings applied in the forecast were used to estimate the relationship between recruitment in 2007 and the catch in 2008 that will lead to SSB being 600 000 t in 2009, i.e. the maximum catch in 2008 that will meet the objective of SSB to be above Bpa in 2009. The result of this analysis (Figure 4.6.3) is the relationship:

TAC2008=-138+R0,2007*1.69 (1)

where R0,2007 is recruitment at age-0 in 2007 and TAC2008 is the catch in 2008 that will result in SSB=Bpa in 2009.

The relationship (1) can be translated into a relationship between the stock size of 1-group sandeels in 2008 and the TAC in 2008, that will lead to SSB being 600 000 t in 2009, by projecting age-0 sandeels in second half year of 2007 to age-1 sandeels 1st of January 2008 apply-ing natural mortality of age-0 sandeels for second half year of 2007. This result is the relation-ship (Figure 4.6.3):

TAC2008=-138+R1,2008*3.77 (2)

where R1,2008 is the stock size of age-1 sandeels in 2008.

The TAC for 2007, based on 2007 RTM, was set at a lower level than the stock size in 2007 allowed, because mean weights used for 2007 in the estimation procedure were much lower than the mean weights measured during the 2007 fishery. When estimating the TAC for 2008 it is therefore suggested to adjust the mean weight for age-1 sandeels used in (2) using observed mean weights from the 2008 RTM. This gives the relationship:

(3)

where Wobs is mean weight of age-1 sandeels observed during 2008 RTM and Wm is the mean weight of age-1 sandeels in 2008 used in the short term prediction (Table 4.6.1).

Using this correction of mean weight of age-1 sandeels will reduce the risk of over and underestimating the TAC for 2008 leading to under exploitation or overexploitation of the stock. Relationship (3) is suggested as a harvest control rule for the fishery in 2008.

The forecast assumption is based on the relationship between effort and F. However this relationship is poor. The relationship between the effort and landings in the table above are therefore doubtful.

4.7 Medium-term forecasts

Medium term prognoses can not be made for sandeels.

4.8 Biological reference points

Blim is set at 430,000 t, the lowest observed SSB. The Bpa is estimated to 600,000 t. Further information about biological reference points for sandeels in IV can be found in the Stock Quality Handbook no. Q4.

4.9 Quality of the assessment

The tendency in the assessment of underestimating F and overestimation stock size has been important in recent years with a low sandeel stock. When the stock is projected forward in short term prediction these tendencies is even more pronounced (Figure 4.3.2.4). In recent years this bias in the assessment seems to be related to changes in the stock size and distribution pattern of sandeels (section 4.6 and ICES 2006b). The changes in the sandeel stock have subsequently led to a large change in the fishing pattern (section 4.2.1) and fleet structure (section 4.2.5). As a consequence the assumptions about catchabilities of the commercial fleets seem to be violated.

In lack of fisheries independent data for tuning of the assessment the start population and fishing mortalities used in the short term forecast were in last year's assessment adjusted according to the bias estimated from the retrospective analysis. A detailed description of the uncertainties in the assessment and forecast was given in last years WG report, and the method used for bias correction was evaluated by the WG during the 2007 meeting in May (ICES WGNSSK 2007).

In this year's assessment the tendency of underestimating F and overestimating stock size seem to have reduced (Figure 4.3.2.2), although the tendency is still present. This apparent improvement of the quality of this year's assessment concurred with an improvement of the stock situation, with both increasing stock size and a more widespread distribution (section 4.2.1, 4.2.5 and 4.4). This seems to confirm the conclusions in last years WG report that changes in sandeel population size and distribution, and changes in the fishing pattern have introduced bias in the assessment.

In the plot of the historical performance of the assessments (Figure 4.3.2.4) it appears, that last year's adjustment of N's and F's for the short term forecast led to an underestimate of SSB in 2007, although the increase in mean weights observed in 2007 makes up a large portion of the discrepancy between the bias-corrected forecast SSB and the estimate of this years final assessment (20.8%). Further, the harvest rule used in 2007 probably led to an under exploitation of the sandeels stock in 2007.

Suggestions for modifications of the assessment

The assessment should take account of the stock structure of sandeels. It is accordingly important to define the population units to be assessed. A framework for implementing area based population analysed is presented in ICES (ICES AGSAN 2007a).

The large change in the fleet composition that have all ready taken place, and the likely change that will occur during the next years is expected to increase the uncertainty in the sandeel assessment. It will be most important to develop an approach to include the data from such a changed fleet into the assessment process.

It is a prerequisite for the improvement of the assessment that fisheries independent time series of sandeel abundance is established that can be used in the assessment. This is dependent on the effort used for establishing such time series and coordination of both methodology and effort between European institutes.

4.10 Status of the Stock

Recruitment has been below average since 2002. SSB is estimated to below Bpa from 2001 to 2006. The stock size has increased in the last two years, due to a low fishing mortality. SSB is estimated to above Bpa in 2008. Concurrent with the increase in the stock size some areas with recent low abundance have been repopulated, especially in the northern North Sea. There is an increasing trend in productivity (recruits per spawner) in most recent years.

The probability of SSB being above Bpa in 2009 is not as highly dependent on the size of the incoming year-class (2007 year-class) as was the case in the previous two years. This is mainly due to an increase in the population size of age-2+ sandeel during the last two years.

4.11 Management Considerations

No fishing mortality (F) reference points are given for sandeels in the North Sea because there is only a weak correlation between the size of the spawning stock biomass and the recruitment. The recruitment of sandeels seems more linked to environmental factors than to the size of the spawning stock biomass (see the Stock Quality Handbook no. Q4).

The present knowledge on defining subpopulations is too limited to recommend specific management measures for 2008, which can fully take the population structure into account, but work is proceeding on defining local sub-populations so that the scale of "local depletion" can be quantified and be made operational for a North Sea-wide implementation.

Suggestion for management of the sandeel fishery in 2008

1) The aim of management in 2008 should be SSB in 2009 being at least Blim with a high (95%) probability.

2) The total kilowatt-days for the exploratory fishing for sandeel in April and early May 2008 should be set at no more than the total kilowatt-days applied in 2007. This effort may be used for exploratory fishing in April and early May 2008 (the RTM monitoring period). An effort ceiling in the RTM monitoring period corresponding to the effort used in 2007 will give less than 5% probability of SSB in 2009 getting below Blim (WG document no. ** by DIFRES).

3) A TAC for 2008 shall be determined, as early as possible based on advice from ICES and STECF on the size of the 2007 year class of North Sea sandeel in accordance with the follow-ing rules:

   a) where R1,2008 is recruitment at age-1 in 2008, TAC2008 is the catch in 2008 that will result in SSB=Bpa in 2009, Wobs is mean weight of age-1 sandeels observed during 2008 RTM and Wm is the mean weight of age-1 sandeels in 2008 used in the ICES forecast.

   b) If the TAC calculated in point 3a) exceeds 500 000 t the TAC shall be set at 500 000 t

4) The fishery shall be closed 1 August 2007.

The relationship between the TAC and the real-time recruitment estimate is conditional on the assessment of age group 2 and older at the start of 2008 from the final assessment (section 4.4).

The estimate of age group 1 sandeels at the start of 2008 (R1,2008 in 3a above) is to be derived from real-time monitoring in 2008 using a regression between historical CPUE observations and stock numbers at age 1. The regression used in RTM in 2007 have been updated, using

- the methodology described in ICES AGSAN (2007a),
- stock numbers of age-1 sandeels from the final assessment presented here (section 4.4)
- Danish and Norwegian log book data up to and including 2007.

The regression was done on log-transformed data, ($\log(N1) = a+b\cdot\log(CPUE1)$) which gave a more uniform distribution of the residuals. As used in ICES AGSAN (2007a):

- large year classes (1989, 1992, 1995, 1997, 2002) are left out from the analysis, to reduce the tendency of overestimating small year classes,
- years with very high SSB are excluded (1987, 1988, 1993, 1995, 1996, 1998), because the fishery in these years may have been directed more at older fish than at age 1, and
- 1990 is excluded due to poor sampling that year.

The years used in the regression are 1991, 1994, 1999, 2000, 2001, 2003, 2004, 2005 and 2006.

Figure 4.11.1 and Table 4.11.1 show the regression week by week with the year-classes used. The results are close to those of ICES AGSAN (2007a), i.e. using the new assessment results and 2007 logbook data only changed the regression parameters slightly and led to a small improvement of the fit (R-square for week 18 changed from 0.90 to 0.92).

The TAC that is derived according to 3a above is sensitive to decisions on the selection of years included in the regression between CPUE and N1. This selection have been made very carefully in a long process, that probably represents the best possible use of the catch and CPUE data, and are largely on the conservative side.

A proposed time table of when data and model estimates from 2008 RTM will be made available is given in Table 4.11.2. An Ad Hoc Group could work by correspondence, as in 2007, in order to provide an estimate of the 2008 year-class numbers to ICES ACFM by the 8th May 2008 allowing ICES to report by the 15th May.

The final report from the Ad Hoc Group on Sandeel will be submitted to the ICES Share Point on May 8th (at the end of the day).

Risk of local depletion

The increase in stock size and a repopulation of areas with previous low sandeel abundance have reduced the risk of local depletion.

Changes in the fleet composition

There was a 50% decline in the number of Danish vessels (from 200 to 98 vessels) fishing sandeels from 2004 to 2005. In 2006 and 2007 the Danish fleet increased to 124 and 116 vessels participating in the sandeel fishery. Danish industrial vessels were in 2007 given individual tradable quotas (ITQ) on sandeels. The introduction of ITQ will accelerate the change towards fewer and larger vessels. Also for the Norwegian fleet a drastic decline in number of vessels fishing sandeels has been observed in recent years, with a marked increase again in 2007 when the vessels were given individual quotas.

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Sandeel in IV (WGNSSK Sep. 2007)

Table 4.2.1.1. SANDEEL in IV.

Official landings reported to ICES

SANDEELS IVa

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	23,138	3,388	4,742	1,058	111	399	147	-	N/A
Faroe Islands	11,000	6,582	-	-	-	-	15	-	N/A
Norway	172,887	44,620	11,522	4,121	185	280	64	-	N/A
Sweden	55	495	55	-	-	73	-	-	N/A
UK (E/W/NI)	-	-	-	-	-	-	-	-	N/A
UK (Scotland)	5,742	4,195	4,781	970	543	186	-	-	N/A
Total	212,822	59,280	21,100	6,149	839	938	226	0	

*Preliminary.

SANDEELS IVb

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	603,491	503,572	533,905	638,657	627,097	245,096	273492	129776	N/A
Faroe Islands	-	-			16,167	5,168	3461	-	N/A
Germany	-	-	-	-	-	534	2658	-	N/A
Ireland	-	389	-	-	-	-	-	-	N/A
Norway	170,737	142,969	107,493	183,329	175,799	29,336	48464	17341	N/A
Sweden	8,465	21,920	27,867	47,080	36,842	21,444	34477	8327	N/A
UK (E/W/NI)	-	-	-	-	-	-	-	-	N/A
UK (Scotland)	18,008	7,280	5,978	-	2,442	115	29	-	N/A
Total	800,701	676,130	675,243	869,066	858,347	301,693	362,552	155,444	N/A

*Preliminary.

SANDEELS IVc

Country	1998	1999	2000	2001	2002	2003	2004	2005	2006
Denmark	9,674	10,356	11,993	7,177	4,996	28,646	14,104	22,985	N/A
France	-	-	1	-	-	-	+	-	N/A
Netherlands	+	+	-	-	+	-	-	-	N/A
Norway	-	-	-	-	-	-	139	-	N/A
Sweden	-	-	-	-	-	160	-	-	N/A
UK (E/W/NI)	-	-	+	-	-	+	-	-	N/A
Total	9,674	10,356	11,994	7,177	4,996	28,806	14,243	22,985	N/A

*Preliminary.

Summary table official landings

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total IV tonnes	1,023,197	745,766	708,337	882,392	864,182	331,437	377,021	178,429	N/A
TAC	1,000,000	1,000,000	1,020,000	1,020,000	1,020,000	918,000	826,200	660,960	300,000

By-catch and other landings

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Area IV tonnes: official-WG	18,797	10,628	9,188	20,781	53,482	5,817	15,521	6,329	N/A

Summary table - landing data provided by Working Group members

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total IV - tonnes	1,004,400	735,138	699,149	861,611	810,700	325,620	361,500	172,100	287,900

Table 4.2.1.2. SANDEEL in IV.

Landings (‘000 t), 1952-2006 (Data provided by Working Group members)

Year	Denmark	Germany	Faroes	Ireland	Netherlands	Norway	Sweden	UK	Total
1952	1.6	-	-	-	-	-	-	-	1.6
1953	4.5	+	-	-	-	-	-	-	4.5
1954	10.8	+	-	-	-	-	-	-	10.8
1955	37.6	+	-	-	-	-	-	-	37.6
1956	81.9	5.3	-	-	+	1.5	-	-	88.7
1957	73.3	25.5	-	-	3.7	3.2	-	-	105.7
1958	74.4	20.2	-	-	1.5	4.8	-	-	100.9
1959	77.1	17.4	-	-	5.1	8.0	-	-	107.6
1960	100.8	7.7	-	-	+	12.1	-	-	120.6
1961	73.6	4.5	-	-	+	5.1	-	-	83.2
1962	97.4	1.4	-	-	-	10.5	-	-	109.3
1963	134.4	16.4	-	-	-	11.5	-	-	162.3
1964	104.7	12.9	-	-	-	10.4	-	-	128.0
1965	123.6	2.1	-	-	-	4.9	-	-	130.6
1966	138.5	4.4	-	-	-	0.2	-	-	143.1
1967	187.4	0.3	-	-	-	1.0	-	-	188.7
1968	193.6	+	-	-	-	0.1	-	-	193.7
1969	112.8	+	-	-	-	-	-	0.5	113.3
1970	187.8	+	-	-	-	+	-	3.6	191.4
1971	371.6	0.1	-	-	-	2.1	-	8.3	382.1
1972	329.0	+	-	-	-	18.6	8.8	2.1	358.5
1973	273.0	-	1.4	-	-	17.2	1.1	4.2	296.9
1974	424.1	-	6.4	-	-	78.6	0.2	15.5	524.8
1975	355.6	-	4.9	-	-	54.0	0.1	13.6	428.2
1976	424.7	-	-	-	-	44.2	-	18.7	487.6
1977	664.3	-	11.4	-	-	78.7	5.7	25.5	785.6
1978	647.5	-	12.1	-	-	93.5	1.2	32.5	786.8
1979	449.8	-	13.2	-	-	101.4	-	13.4	577.8
1980	542.2	-	7.2	-	-	144.8	-	34.3	728.5
1981	464.4	-	4.9	-	-	52.6	-	46.7	568.6
1982	506.9	-	4.9	-	-	46.5	0.4	52.2	610.9
1983	485.1	-	2.0	-	-	12.2	0.2	37.0	536.5
1984	596.3	-	11.3	-	-	28.3	-	32.6	668.5
1985	587.6	-	3.9	-	-	13.1	-	17.2	621.8
1986	752.5	-	1.2	-	-	82.1	-	12.0	847.8
1987	605.4	-	18.6	-	-	193.4	-	7.2	824.6
1988	686.4	-	15.5	-	-	185.1	-	5.8	892.8
1989	824.4	-	16.6	-	-	186.8	-	11.5	1039.1
1990	496.0	-	2.2	-	0.3	88.9	-	3.9	591.3
1991	701.4	-	11.2	-	-	128.8	-	1.2	842.6
1992	751.1	-	9.1	-	-	89.3	0.5	4.9	854.9
1993	482.2	-	-	-	-	95.5	-	1.5	579.2
1994	603.5	-	10.3	-	-	165.8	-	5.9	785.5
1995	647.8	-	-	-	-	263.4	-	6.7	917.9
1996	601.6	-	5.0	-	-	160.7	-	9.7	776.9
1997	751.9	-	11.2	-	-	350.1	-	24.6	1137.8
1998	617.8	-	11.0	-	+	343.3	8.5	23.8	1004.4
1999	500.1	-	13.2	0.4	+	187.6	22.4	11.5	735.1
2000	541.0	-	-	-	+	119.0	28.4	10.8	699.1
2001	630.8	-	-	-	-	183.0	46.5	1.3	861.6
2002	629.7	-	-	-	-	176.0	0.1	4.9	810.7
2003	274.0	-	-	-	-	29.6	21.5	0.5	325.6
2004	277.1	2.7	-	-	-	48.5	33.2	+	361.5
2005	154.8	-	-	-	-	17.3	-	-	172.1
2006	250.6	3.2	-	-	-	5.6	27.8	-	287.9
2007	144.6	1.0	2.0	-	-	51.1	6.6	1.0	206.3

2007 only include first half year.
+ = less than half unit.
- = no information or no catch.

Table 4.2.1.3. SANDEEL in IV.

Monthly landings (ton) by Denmark, Norway and Scotland from each area defined in Fig 4.1.2.1. Data provided by Working Group members.

	1A	1B	1C	2A	2B	2C	3	4	5	6 Shetland		Total
2000												
Mar	800	42	0	3257	5618	0	739	0	0	393	687	11536
Apr	30931	19012	0	15259	71384	281	33583	479	0	595	1436	172959
May	110128	6843	0	24941	42647	0	53911	6685	3089	662	1651	250558
Jun	73632	3262	26	18564	16440	0	17287	11240	2503	29205	0	172160
Jul	10610	33	4	25193	3286	11	5996	2024	2692	12201	0	62049
Aug	0	0	0	3	113	0	117	0	1	127	560	921
Sept	0	0	0	21	393	0	18	0	0	145	0	577
Oct	0	0	0	0	0	0	2	0	0	1	0	3
Total	226102	29192	30	87238	139882	292	111652	20428	8285	43329	4334	670763
2001												
Mar	3205	0	0	5235	2078	0	915	218	334	180	144	12309
Apr	60040	10891	0	19956	16609	0	1968	916	0	265	295	110940
May	96489	2014	0	71446	20668	0	15266	4829	510	3767	589	215578
Jun	72384	0	1556	15160	8103	120	8265	4790	4291	22748	0	137417
Jul	6703	90	0	67814	24065	0	8769	1664	2204	13747	0	125056
Aug	473	0	0	51965	61169	0	8679	0	0	2927	236	125449
Sep	578	0	0	24926	31178	0	4802	0	0	4840	0	66324
Oct	0	0	0	6464	14027	0	972	0	0	500	0	21963
Total	239872	13026	1556	262966	177898	120	49635	12417	7339	48974	1264	815067
2002												
Mar	3077	0	0	3911	2715	0	928	322	0	0	0	10953
Apr	104033	1745	0	66992	51007	0	15466	904	59	475	109	240790
May	176437	3341	0	78497	37385	0	37058	915	151	3272	12	337068
Jun	118879	125	0	27386	19380	10	10561	8673	2531	12498	0	200043
Jul	1128	0	0	90	48	0	193	2744	204	9869	0	14276
Aug	0	0	0	109	261	0	397	0	0	5146	422	6335
Sept	0	0	0	0	74	0	290	0	0	0	0	364
Oct	0	0	0	1	0	0	0	0	0	2	0	3
Dec	0	0	0	0	0	0	0	0	2	0	0	2
Total	403554	5211	0	176986	110870	10	64893	13558	2947	31262	543	809834
2003												
Mar	1947	52	0	97	380	7	225	325	0	0		3033
Apr	28806	5026	0	8341	6072	0	1900	81	0	662	49	50937
May	59890	1812	24	8884	9357	0	4532	10995	1020	9991	16	106521
Jun	11737	49	0	11906	398	10	2140	20891	13318	21639		82088
Jul	3604	0	0	9857	2013	0	3272	2738	1697	5790		28971
Aug	960	6	0	4381	4687	0	11293	16	175	687	121	22326
Sept	0	255	73	35	1551	0	2955	0	0	1094		5963
Oct	0	0	0	114	0	0	1589	0	0	127		1830
Nov	0	0	0	0	0	0	2070	0	0	0		2070
Dec	0	0	0	0	0	0	45	0	0	0		45
Total	106944	7200	97	43615	24458	17	30021	35046	16210	39990	186	303784
2004												
Feb	0	0	0	0	0	0	0	0	0	7		7
Mar	326	0	0	1001		0	37		260	2		1626
Apr	15893	627	0	15824	4847	0	10732	471	322	834		49550
May	46631	1044	0	21607	5495	0	22629	20484	233	8578		126701
Jun	21841	146	0	5077	1800	0	13821	13680	4789	35909		97063
Jul	1146	116		813	2272		6019	7430	1184	12923		31903
Aug	325			3963	5449		2589			3357		15683
Sept					3006		116			2		3124
Oct												
Total	86162	1933	0	48285	22869	0	55943	42065	6788	61612	0	325657
2005												
Apr	4017			71	1476		462	144		88		6258
May	34506	57		9536	7512		6507	13333	32	2410		73893
Jun	19216	21		8952	2545		8107	8224	19370	21959		88394
Jul				1668			987	922				3577
Aug				3			2					5
Sep												0
Okt										1		1
Total	57739	78	0	20230	11533	0	16065	22623	19402	24457	0	172128
2006												
Apr	10141			8733	1387		188	111		82		20642
May	96349			25020	3096		3830	201		6455		134951
Jun	59827	34		3184	47		4815	12035	5236	9506		94684
Jul	1122			94			3309	2600	1171	11745		20041
Aug				2			94			283		379
Sep				5			2			2		9
Oct					5		257					262
Nov		30										30
Total	167439	64	0	37038	4530	0	12495	14947	6407	28073	0	270998
%	62%	0%	0%	14%	2%	0%	5%	6%	2%	10%	0%	100%
Average 2000-2006												
	38%	2%	0%	20%	15%	0%	10%	5%	2%	8%	0%	100%
2007												
Apr	23545			6378	19966		7098	646		406		58039
May	65238	308	4	4990	31062		22979	3024	244	1470		129319
Jun	501	69		50	4512		4032	25	559	2966		12714
Total	89284	377	4	11418	55540	0	34109	3695	803	4842	0	200072
%	45%	0%	0%	6%	28%	0%	17%	2%	0%	2%	0%	100%

Table 4.2.1.4. SANDEEL in IV.

Annual landings (‘000 t) by area of the North Sea. Data provided by Working Group members (Denmark, Norway and Scotland).

	Area										Sampling area		
Year	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Northern	Southern
1972	98.8	28.1	3.9	24.5	85.1	0.0	13.5	58.3	6.7	28.0	0	130.6	216.3
1973	59.3	37.1	1.2	16.4	60.6	0.0	8.7	37.4	9.6	59.7	0	107.6	182.4
1974	50.4	178.0	1.7	2.2	177.9	0.0	29.0	27.4	11.7	25.4	7.4	386.6	117.1
1975	70.0	38.2	17.8	12.2	154.7	4.8	38.2	42.8	12.3	19.2	12.9	253.7	156.5
1976	154.0	3.5	39.7	71.8	38.5	3.1	50.2	59.2	8.9	36.7	20.2	135.0	330.6
1977	171.9	34.0	62.0	154.1	179.7	1.3	71.4	28.0	13.0	25.3	21.5	348.4	392.3
1978	159.7	--50.2--		346.5	--70.3--		42.5	37.4	6.4	27.2	28.1	163.0	577.2
1979	194.5	0.9	61.0	32.3	27.0	72.3	34.1	79.4	5.4	44.3	13.4	195.3	355.9
1980	215.1	3.3	119.3	89.5	52.4	27.0	90.0	30.8	8.7	57.1	25.4	292	401.2
1981	105.2	0.1	42.8	151.9	11.7	23.9	59.6	63.4	13.3	45.1	46.7	138.1	378.9
1982	189.8	5.4	4.4	132.1	24.9	2.3	37.4	75.7	6.9	74.7	52.0	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37.0	78.2	419.0
1984	337.8	4.1	5.9	74.9	30.4	0.1	51.3	56.0	3.9	60.2	32.6	91.8	532.8
1985	281.4	46.9	2.8	82.3	7.1	0.1	29.9	46.6	18.7	84.5	17.2	79.7	513.5
1986	295.2	35.7	8.5	55.3	244.1	2.0	84.8	22.5	4.0	80.3	14.0	375.1	457.4
1987	275.1	63.6	1.1	53.5	325.2	0.4	5.6	21.4	7.7	45.1	7.2	395.9	402.8
1988	291.1	58.4	2.0	47.0	256.5	0.3	37.6	35.3	12.0	102.2	4.7	384.8	487.6
1989	228.3	31.0	0.5	167.9	334.1	1.5	125.3	30.5	4.5	95.1	3.5	492.4	526.3
1990	141.4	1.4	0.1	80.4	156.4	0.6	61.0	45.5	13.8	85.5	2.3	219.5	366.7
1991	228.2	7.1	0.7	114.0	252.8	1.8	110.5	22.6	1.0	93.1	+	372.9	458.9
1992	422.4	3.9	4.2	168.9	67.1	0.3	101.2	20.1	2.8	54.4	0	176.7	668.6
1993	196.5	21.9	0.1	26.2	164.9	0.3	88.0	26.6	3.9	48.7	0	276.0	301.9
1994	157.0	108.6	-	61.7	203.4	2.7	175.0	16.0	2.8	42.0	0	489.7	279.5
1995	322.4	43.9	147.4	86.7	169.5	1.0	59.4	26.6	5.3	55.8	1.3	421.2	496.8
1996	310.5	18.6	31.2	40.8	153.0	4.5	134.1	12.7	3.0	52.5	1	341.2	419.5
1997	352.0	53.3	8.9	92.8	390.5	1.2	112.9	18.1	4.7	88.6	2.4	566.8	535.8
1998	282.2	58.3	2.0	90.3	395.3	1.0	40.6	34.5	4.2	63.4	5.2	497.2	480.7
1999	266.7	32.6	0.1	132.8	167.9	0.0	48.0	16.9	2.7	27.2	4.2	248.7	446.4
2000	226.1	29.2	0.0	87.2	139.9	0.3	111.7	20.4	8.3	43.3	4.3	281.0	385.4
2001	239.9	13.0	1.6	263.0	177.9	0.1	49.6	12.4	7.3	49.0	1.3	242.2	571.6
2002	403.6	5.2	0.0	177.0	110.9	0.0	64.9	13.6	3.0	31.3	0.5	181.0	628.4
2003	106.9	7.2	0.1	43.6	24.5	0.0	30.0	35.0	16.2	40.0	0.5	61.8	241.7
2004	86.2	1.9		48.3	22.9		55.9	42.1	6.8	61.6		80.7	245.0
2005	57.7	0.1		20.2	11.5		16.1	22.6	19.4	24.5		27.7	144.4
2006	184.4	0.1		37.0	4.5		12.5	14.9	6.4	28.1		17.1	270.8

Sampling areas: Northern - Areas 1B, 1C, 2B, 2C, 3.
Southern - Areas 1A, 2A, 4, 5, 6.

Table 4.2.1.5. SANDEEL in IV.

Monthly landings (t) by Denmark, Norway and Scotland (data provided by Working Group Members).

Year	Month	Denmark	Norway	Scotland	Total
2001	Mar	10,684	1,481	144	12,310
	Apr	95,723	14,922	295	110,940
	May	183,757	31,231	589	215,577
	Jun	127,292	10,124	0	137,416
	Jul	106,654	18,403	0	125,057
	Aug	65,021	60,192	236	125,449
	Sep	33,741	32,583	0	66,324
	Oct	7,910	14,054	0	21,963
	Nov	30	0	0	30
	Total	630,811	182,991	1,264	815,066
2002	Mar	10,236	717	0	10,953
	Apr	177,597	63,083	109	240,789
	May	247,494	86,942	2,898	337,334
	Jun	174,467	24,568	1,448	200,483
	Jul	14,228	48	0	14,276
	Aug	5,652	261	422	6,335
	Sep	0	364	0	364
	Oct	3	0	0	3
	Dec	2	0	0	2
	Total	629,679	175,983	4,877	810,539
2003	Mar	2,802	231		3,033
	Apr	42,885	8,003	366	51,254
	May	96,105	10,401		106,506
	Jun	80,271	1,817		82,088
	Jul	27,784	1,186		28,970
	Aug	15,782	6,422	121	22,325
	Sep	4,407	1,555		5,962
	Oct	1,831	0		1,831
	Nov	2,070	0		2,070
	Dec	45	0		45
	Total	273,982	29,615	487	304,084
2004	Feb	7	0		7
	Mar	1,444	183		1,627
	Apr	42,664	6,886		49,550
	May	100,715	25,986	29	126,730
	Jun	89,369	7,695		97,064
	Aug	30,485	1,419		31,904
	Sep	12,191	3,492		15,683
	Oct	254	2,869		3,123
	Total	277,129	48,530	29	325,688
2005	Apr	4,350	1,876		6,226
	May	60,473	12,556		73,029
	Jun	76,234	2,900		79,134
	Jul	13,719			13,719
	Oct	18			18
	Sep	2			2
	Total	154,796	17,332	0	172,128
2006	Apr	19,258	1,385		20,643
	May	115,949	4,200		120,149
	Jun	94,683			94,683
	Jul	20,042			20,042
	Aug	379			379
	Sep	9			9
	Oct	266			266
	Nov	30			30
	Total	250,616	5,585	678	256,879
2007	Apr	46,817	11,222		58,039
	May	89,057	35,976		125,033
	Jun	8,775	3,938		12,713
	Total	144,649	51,136	1,000	196,785

Table 4.2.2.1. SANDEEL in IV.

Catch numbers at age (numbers · 10^{-5}) by half year.

Fishery in the northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	7911.	*	0.	*	349.	*	7105.	*	455.	*	13196.
1	5684.	303.	11692.	1207.	2688.	109.	23934.	7077.	26236.	5768.	9855.	1283.
2	1215.	316.	1647.	121.	3292.	239.	2600.	473.	10855.	198.	25922.	340.
3	89.	19.	153.	43.	1002.	89.	200.	0.	350.	0.	1319.	119.
4+	12.	0.	5.	0.	480.	11.	0.	0.	155.	0.	26.	17.
SOP	50871.	37464.	91792.	20871.	106279.	12946.	174378.	128325.	305979.	83202.	430970.	71479.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	3380.	*	12107.	*	13616.	*	6797.	*	26960.	*	457.
1	56661.	4038.	13101.	1670.	41855.	866.	9871.	48.	15768.	1004.	28490.	829.
2	2219.	274.	3907.	342.	2342.	28.	4056.	3.	2635.	112.	7225.	1211.
3	3385.	0.	578.	51.	908.	8.	486.	0.	1023.	34.	5954.	396.
4+	0.	0.	175.	15.	318.	3.	305.	0.	646.	22.	2155.	25.
SOP	437540.	57222.	148411.	70806.	374465.	55536.	115957.	38189.	188264.	86785.	413536.	83222.

Year	1995		1996		1997		1998		1999		2000	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	4046.	*	31817.	*	2431.	*	35220.	*	33653.	*	0.
1	36140.	3374.	11524.	1706.	67038.	11346.	6667.	10005.	2118.	694.	22887.	467.
2	3360.	338.	5385.	1772.	3640.	633.	33216.	1837.	3491.	551.	8810.	84.
3	1091.	26.	761.	136.	5254.	25.	2039.	79.	5086.	58.	1420.	24.
4+	145.	2.	301.	55.	1206.	2.	410.	1.	1023.	0.	1470.	46.
SOP	348280.	71351.	201546.	141902.	451606.	103226.	360999.	148508.	135432.	115849.	270507.	9974.

Year	2001		2002		2003		2004		2005		2006	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	46385.	*	0.	*	7510.	*	2961.	*	0.	*	0.
1	6434.	771.	21719.	157.	2315.	118.	6819.	656.	2550.	0.	1408.	230.
2	2408.	73.	2649.	6.	1305.	164.	542.	9.	412.	0.	122.	37.
3	472.	134.	402.	0.	456.	0.	375.	11.	97.	0.	17.	9.
4+	1035.	0.	219.	0.	635.	0.	213.	0.	49.	0.	2.	2.
SOP	88280.	153698.	179581.	1263.	51447.	29772.	59588.	19555.	27623.	0.	13400.	3703.

Year	2007
Season	1
AGE	
0	*
1	8494.
2	778.
3	134.
4+	40.
SOP	91249.

Fishery in the southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	9298.	*	0.	*	11940.	*	112.	*	298.	*	0.
1	2232.	240.	62517.	9423.	7790.	1896.	43629.	5350.	4351.	3095.	2349.	0.
2	35029.	2806.	2257.	92.	39301.	3229.	7333.	293.	22771.	6664.	10074.	234.
3	934.	513.	13272.	577.	2490.	2234.	1604.	241.	1158.	196.	17914.	2084.
4+	387.	2.	442.	44.	265.	298.	30.	18.	165.	51.	2769.	68.
SOP	380561.	61745.	556796.	80581.	472949.	114931.	335960.	47286.	296758.	105111.	464851.	40003.

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	1.	*	597.	*	12115.	*	134.	*	838.	*	0.
1	44444.	1619.	20179.	1438.	20058.	11411.	60337.	3903.	3581.	1037.	24697.	4093.
2	4525.	165.	16670.	477.	9224.	344.	10021.	382.	14659.	953.	2594.	322.
3	957.	35.	2467.	71.	1320.	111.	1002.	157.	3707.	266.	2654.	198.
4+	3368.	123.	745.	21.	454.	0.	621.	34.	1012.	87.	715.	137.
SOP	309830.	22244.	341693.	24002.	345866.	123092.	618474.	47520.	267430.	34453.	226318.	47670.

Year	1995		1996		1997		1998		1999		2000	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.	*	2088.	*	198.	*	1142.	*	1322.	*	6659.
1	39683.	3166.	10194.	2031.	52359.	15238.	9546.	738.	31951.	203.	35613.	3601.
2	6607.	2789.	16015.	4080.	3648.	536.	39553.	2673.	6499.	58.	5973.	496.
3	1555.	307.	6403.	536.	2405.	406.	3188.	209.	13150.	1392.	1825.	339.
4+	1226.	157.	1169.	1023.	683.	136.	2260.	65.	947.	166.	3528.	330.
SOP	427820.	67591.	293882.	138796.	420729.	138483.	448116.	42753.	431487.	35899.	358998.	53020.

Year	2001		2002		2003		2004		2005		2006	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	73443.	*	0.	*	5320.	*	2383.	*	0.	*	0.
1	64084.	819.	84858.	1370.	4982.	922.	33909.	1637.	15842.	0.	33256.	1827.
2	13531.	15.	8667.	472.	15588.	452.	1113.	473.	5204.	0.	2801.	38.
3	1158.	0.	1060.	0.	3593.	163.	4302.	405.	312.	0.	1035.	20.
4+	2389.	0.	250.	0.	1204.	28.	270.	68.	439.	0.	240.	0.
SOP	432330.	184311.	608649.	17428.	197210.	31295.	249398.	30821.	144167.	0.	252624.	17024.

Year	2007
Season	1
AGE	
0	*
1	9301.
2	4871.
3	365.
4+	129.
SOP	114122.

Table 4.2.3.1. SANDEEL in IV.

Northern North Sea. Mean weight (g) in the catch by country and combined. Age group 4++ is the 4-plus group used in assessment

		Denmark		Norway		Combined	
		Half-year		Half-year		Half-year	
Year	Age	1	2	1	2	1	2
2001	0	1.89	2.48	1.62	3.28	1.68	3.10
	1	5.48	9.73	7.21	9.07	6.29	9.61
	2	10.10	17.00	15.63	17.61	11.78	17.50
	3	11.55	-	19.81	9.07	15.82	9.07
	4	13.09	-	25.45	-	-	-
	5	16.93	-	-	-	-	-
	5+			8.03			
	6	21.04	-	-	-	-	-
	4++	15.20	-	9.18	-	11.58	-
2002	0	-	-	1.77	-	1.77	-
	1	4.89	7.33	7.65	-	6.17	7.33
	2	9.05	17.52	12.17	-	11.77	17.52
	3	23.36	-	18.27	-	18.40	-
	4	25.29	-	-	-	-	-
	5	-	-		-	-	-
	5+						
	6	26.42	-	-	-		
	4++	26.08	-	32.12	-	31.98	-
2003	0	2.26	3.56		2.82	2.26	3.37
	1	5.34	15.74	5.23	12.13	5.30	13.00
	2	13.03	17.90	15.72		14.70	17.90
	3	11.86		20.57		17.81	
	4	14.47				14.47	
	5	17.24				17.24	
	5+						
	6						
	4++	14.82		29.93		18.69	
2004	0		3.76	1.73	3.46	1.73	3.56
	1	6.07	13.13	7.36		6.27	13.13
	2	11.10		10.07	21.42	10.64	21.42
	3	11.23	18.50	15.78		13.40	18.50
	4	25.01				25.01	
	5	33.17				33.17	
	5+						
	6						
	4++	30.69		27.53		28.39	
2005	0	1.00				1.00	
	1	7.36		7.56		7.43	
	2	15.44		14.28		14.42	
	3	17.16		15.99		16.06	
	4	22.56				22.56	
	5	33.00				33.00	
	5+						
	6						
	4++	23.41		23.94		23.90	
2006	0						
	1	8.35	11.99	6.99		7.92	11.99
	2	13.79	17.62	15.28		14.42	17.62
	3	26.02	27.45	24.23		25.47	27.45
	4	16.30	16.30			16.30	16.30
	5	31.00	31.00			31.00	
	5+						
	6						
	4++	30.95	30.94	23.00		30.61	30.94
2007	0	1.00		1.74		1.74	
	1	7.50		10.72		8.60	
	2	15.97		16.81		16.68	
	3	21.10		26.95		26.48	
	4	30.93				30.93	
	5						
	5+						
	6						
	4++	30.93		41.93			41.62

Table 4.2.3.2. SANDEEL in IV.

Southern North Sea. Mean weight (g) in the catch by (Denmark). Age group 4++ is the 4-plus group used in assessment

		Half-year	
Year	Age	1	2
2002	0	1.07	-
	1	6.14	8.40
	2	8.10	12.53
	3	12.49	-
	4	15.58	-
	5	18.25	-
	6	17.79	-
	7	15.93	-
	8+	-	-
	4++	16.73	-
2003	0	2.13	2.65
	1	5.25	7.47
	2	7.86	15.72
	3	9.33	17.30
	4	11.65	13.80
	5	15.27	-
	6	24.43	-
	7	15.05	-
	8+	15.90	-
	4++	12.47	13.80
2004	0		2.60
	1	5.49	7.35
	2	10.49	13.31
	3	11.34	13.37
	4	10.27	12.97
	5		
	6		
	7		
	8+		
	4++	10.27	12.97
2005	0	2.46	-
	1	5.54	-
	2	9.17	-
	3	10.73	-
	4	11.93	-
	5	13.63	-
	6	14.35	-
	7	12.67	-
	8+		-
	4++	12.18	-
2006	0	1.81	-
	1	6.19	8.97
	2	10.66	9.69
	3	12.83	13.30
	4	14.09	16.30
	5	15.35	-
	6	16.06	-
	7		-
	8+		-
	4++	15.15	16.30
2007	0	1.40	-
	1	5.91	-
	2	10.60	-
	3	14.90	-
	4	16.08	-
	5	16.73	-
	6	16.37	-
	7		-
	8+		-
	4++	16.18	-

Table 4.2.3.3. SANDEEL in IV.

Mean weight (g) in the catch by half year.

Northern North Sea, first half-year

year	age-1	age-2	age-3	age-4+
1983	5.64	13.05	27.30	43.97
1984	5.64	13.05	27.30	42.20
1985	5.64	13.05	27.30	43.34
1986	5.64	13.05	27.30	
1987	5.64	13.05	27.30	43.84
1988	5.64	13.05	27.30	42.20
1989	6.20	14.00	16.30	
1990	5.64	13.05	27.30	44.32
1991	7.43	14.23	22.40	30.87
1992	5.45	10.86	18.49	29.92
1993	5.97	20.62	24.92	22.14
1994	6.43	13.70	15.08	19.29
1995	6.95	19.75	24.90	24.70
1996	7.80	14.98	25.93	37.49
1997	4.94	7.95	11.76	24.64
1998	4.24	8.73	14.21	33.61
1999	6.53	8.08	13.20	25.68
2000	6.78	7.90	11.86	19.66
2001	6.29	11.78	15.82	11.58
2002	6.17	11.77	18.40	31.98
2003	5.30	14.70	17.81	18.69
2004	6.27	10.64	13.40	28.39
2005	7.43	14.42	16.06	23.90
2006	7.92	14.44	25.47	30.61
2007	8.60	16.68	26.48	41.62

Northern North Sea, second half-year

year	age-0	age-1	age-2	age-3	age-4+
1983	3.03	13.23	27.84	36.20	
1984	3.03	13.23	27.84	36.20	
1985	3.03	13.23	27.84	36.20	51.91
1986	3.03	13.23	27.84	36.20	
1987	3.03	13.23	27.84	36.20	
1988	3.03	13.23	27.84	36.20	44.00
1989	5.00	8.90	16.00		
1990	3.03	13.23	27.84	36.20	44.00
1991	3.42	9.57	14.99	16.20	44.00
1992	5.48	18.03	25.40	21.56	
1993	2.71	10.37	19.22	20.28	21.37
1994	6.58	22.75	30.20	58.07	72.15
1995	5.08	13.46	14.20	21.00	19.00
1996	2.94	10.85	14.92	15.59	23.58
1997	1.71	8.11	10.15	23.96	17.19
1998	2.48	3.91	11.13	20.15	13.39
1999	3.07	7.78	10.43	24.15	
2000		14.92	17.95	19.18	22.67
2001	3.10	9.61	17.50	9.07	
2002		7.33	17.52		
2003	3.37	13.00	17.90		
2004	3.56	13.13	21.42	18.50	
2005					
2006		11.99	17.62	27.45	30.94

Southern North Sea, first half-year

year	age-1	age-2	age-3	age-4+
1983	5.51	9.96	13.74	16.90
1984	5.51	9.96	13.74	16.95
1985	5.51	9.96	13.74	16.51
1986	5.51	9.96	13.74	16.30
1987	5.80	11.00	15.60	18.04
1988	4.00	12.50	15.50	18.73
1989	4.00	12.50	15.50	18.01
1990	4.00	12.50	15.50	19.28
1991	8.20	16.40	16.90	17.20
1992	7.43	13.83	17.51	22.60
1993	6.08	11.54	15.09	20.31
1994	6.07	11.01	13.46	16.94
1995	7.30	13.20	16.60	20.48
1996	5.57	8.31	13.16	16.89
1997	6.52	10.92	11.81	16.27
1998	5.54	8.38	10.64	13.21
1999	5.52	9.27	13.50	18.33
2000	6.16	9.56	14.42	15.93
2001	4.22	7.93	12.57	16.76
2002	6.14	8.10	12.49	16.73
2003	5.25	7.86	9.33	12.47
2004	5.49	10.49	11.34	10.27
2005	5.54	9.17	10.73	12.18
2006	6.19	10.66	12.83	15.15
2007	5.91	10.60	14.90	16.18

Southern North Sea, second half-year

year	age-0	age-1	age-2	age-3	age-4+
1983	2.42	7.50	10.75	14.12	17.71
1984	2.42	7.50	10.75	14.12	17.71
1985	2.42	7.50	10.75	14.12	18.66
1986	2.42	7.50	10.75	14.12	18.76
1987	1.30	8.90	10.80	21.40	19.85
1988	1.00	10.50	14.00	17.00	19.11
1989	1.00	10.50	14.00	17.00	19.01
1990	1.00	10.50	14.00	17.00	20.05
1991	2.60	7.50	13.60	12.00	
1992	3.40	9.43	16.61	20.04	22.58
1993	3.08	10.13	15.66	17.04	21.96
1994		8.56	17.16	19.50	23.74
1995		6.60	13.60	17.70	21.22
1996	2.34	9.90	16.66	21.77	33.39
1997	4.72	7.99	13.54	14.73	18.88
1998	2.79	3.01	12.65	11.57	17.14
1999	5.42	10.02	11.05	16.85	15.68
2000	1.66	6.61	13.68	15.74	18.34
2001	2.40	9.51	17.00		
2002		8.40	12.53		
2003	2.65	7.47	15.72	17.30	13.80
2004	2.60	7.35	13.31	13.37	12.97
2005					
2006		8.97	9.69	13.30	16.30

Table 4.2.3.4. SANDEEL in IV.

Mean weight (g) in the stock by half year.

First half-year

Year	age-1	age-2	age-3	age-4+
1983	5.03	12.89	16.92	24.76
1984	4.10	13.81	16.28	21.01
1985	4.19	12.79	18.75	22.08
1986	4.18	13.10	16.32	27.79
1987	4.70	12.82	16.00	21.23
1988	4.40	14.84	15.81	19.17
1989	4.40	13.49	19.58	18.28
1990	4.26	13.31	17.59	19.26
1991	4.29	13.22	16.95	20.65
1992	4.08	13.07	17.18	21.15
1993	4.50	12.70	16.38	21.34
1994	6.26	12.99	14.58	18.71
1995	7.13	15.41	20.02	20.93
1996	6.75	9.99	14.52	21.10
1997	5.63	9.44	11.77	21.61
1998	5.01	8.54	12.03	16.34
1999	5.59	8.85	13.42	22.15
2000	6.40	8.57	13.30	17.03
2001	4.41	8.51	13.51	15.19
2002	6.14	8.96	14.11	23.85
2003	5.26	8.39	10.29	14.62
2004	5.62	10.54	11.51	18.25
2005	5.81	9.55	12.00	13.37
2006	6.26	10.82	13.03	15.30
2007	7.19	11.44	18.01	22.25

Second half-year

Year	age-0	age-1	age-2	age-3	age-4+
1983	1.11	11.83	14.73	19.14	24.35
1984	1.19	10.58	16.58	19.54	21.90
1985	1.19	10.69	14.65	22.49	24.95
1986	1.72	10.64	14.75	17.96	30.44
1987	1.43	11.18	14.29	17.26	20.91
1988	1.44	10.81	18.07	17.19	20.61
1989	1.28	10.76	15.80	17.05	19.39
1990	1.36	10.72	15.51	19.37	19.95
1991	1.10	10.67	15.49	18.02	19.39
1992	1.54	10.57	14.85	18.67	20.44
1993	1.44	10.91	14.25	17.61	20.49
1994	6.58	10.95	27.46	45.24	31.15
1995	5.08	10.14	13.66	17.96	21.19
1996	2.90	10.33	16.13	20.52	32.88
1997	1.94	8.04	11.70	15.27	18.86
1998	2.49	3.84	12.03	13.92	17.11
1999	3.15	8.29	10.49	17.14	15.68
2000	1.66	7.56	14.29	15.96	18.87
2001	2.67	9.56	17.42	9.07	17.22
2002	2.49	8.29	12.60	14.06	17.22
2003	3.07	8.10	16.30	17.30	13.80
2004	3.13	9.00	13.46	13.51	12.97
2005	3.13	9.00	13.46	13.51	12.97
2006	3.11	9.31	13.61	17.59	28.91

Table 4.2.3.5. SANDEEL in IV.

Correlation coefficient between mean weight-at-age observed for each age in the December dredge survey and that observed in the catch in the following spring.

Age in December	r^2 in following spring		
	April	May	June
0	0.496	0.747	0.673
1	0.456	0.294	0.204
2	0.585	0.342	0.826

Table 4.2.5.1. SANDEEL in IV.

Effort of Danish vessels (kilo watt days · 10^3) and number of Danish and Norwegian vessels participating in the sandeel fishery by year. In 2006 only experimental fishing was allowed for 6 Norwegian vessels. In 2007 the fishery was stopped in May due to RTM.

	Denmark		Norway
Year	Kilo watt days (thousands)	Number of vessels	Number of vessels
2002	7,867	207	53
2003	7,306	171	35
2004	7,334	200	40
2005	3,390	98	22
2006	3,946	124	6
2007	2,316	116	41

Table 4.2.5.2. SANDEEL in IV.

Fishing effort in the Northern North Sea (days fishing times scaling factors for each vessel category to represent days fishing for a vessel of 200 GT), based on Danish and Norwegian data.

	Norwegian			Danish				
Year	Standardized Fishing days	Catch sampled for fishing effort ('000t)	CPUE (t/day)	Catch sampled for fishing effort ('000 t)	CPUE (t/day)	Mean CPUE (t/day)	Total internat. catch ('000t)	Derived internat. effort ('000 days)
				First half-year				
1976	593	11.1	18.7	-	-	18.7	110.3	5.90
1977	2061	50.4	24.4	-	-	24.5	276.0	11.27
1978	1761	44.9	25.5	-	-	25.5	109.7	4.30
1979	1451	29.6	20.4	-	-	20.4	47.7	2.34
1980	2733	112.8	41.3	-	-	41.3	220.9	5.35
1981	1804	42.8	23.7	-	-	23.7	93.3	3.94
1982	1231	26.9	21.9	13.5	34.9	26.2	62.3	2.38
1983	338	8.7	25.7	17.4	28.9	27.8	54.5	1.96
1984	139	3.5	25.2	54.1	41.2	40.2	74.1	1.84
1985	382	8.7	22.8	47.4	46.7	43.0	69.9	1.63
1986	1565	60.4	38.6	154.1	54.7	50.2	221.3	4.41
1987	2219	122.9	55.4	214.4	51.8	53.1	360.9	6.80
1988	3600	143.8	39.9	158.6	39.0	39.5	332.0	8.41
1989	4211	146.9	34.9	247.0	35.1	35.0	435.2	12.43
1990	2299	58.6	25.5	89.7	24.7	25.0	148.7	5.94
1991	1748	67.7	38.7	198.4	39.0	39.0	282.2	7.24
1992	1214	53.7	44.2	106.7	33.6	37.1	151.2	4.07
1993	1565	70.7	45.2	138.2	33.6	37.5	189.0	5.04
1994	2707	130.1	48.1	289.0	56.4	53.8	413.4	7.68
1995	3429	208.6	60.8	146.4	44.7	54.2	348.5	6.43
1996	2036	100.9	49.6	101.8	30.8	40.1	203.1	5.06
1997	3489	254.9	73.1	190.0	50.9	63.6	456.5	7.18
1998	2622	220.8	84.2	125.8	37.1	67.1	364.8	5.44
1999	2217	77.4	34.9	47.5	32.9	34.2	137.2	4.02
2000	2328	104.5	44.9	154.7	40.6	42.3	271.1	6.40
2001	672	44.6	66.4	45.9	34.3	50.1	88.5	1.77
2002	1003	119.5	119.2	58.5	44.8	94.8	179.7	1.90
2003	914	17.1	18.7	15.3	16.0	17.41	53.8	3.09
2004	692	19.3	27.9	41.6	24.5	25.59	61.2	2.39
2005	469	13.8	29.4	13.9	28.2	28.78	27.7	0.96
2006	112	5.6	50.0	8.5	27.8	36.68	13.4	0.37
2007	704	49.0	69.6	39.7	49.2	60.47	92.0	1.52
				Second half-year				
1976	108	2.0	18.5	-	-	18.5	44.9	2.43
1977	445	11.8	26.5	-	-	26.5	110.0	4.15
1978	811	22.5	27.6	-	-	27.8	53.3	1.92
1979	1688	52.2	30.9	-	-	30.9	147.7	4.78
1980	1117	33.1	29.6	-	-	29.5	71.1	2.41
1981	398	7.9	19.6	-	-	19.9	44.9	2.26
1982	-	-	-	1.8	32.3	33.0	12.0	0.36
1983	65	2.4	36.9	12.3	36.6	37.3	23.7	0.64
1984	-	-	-	10.7	29.6	30.2	17.7	0.59
1985	-	-	-	16.4	38.0	38.8	16.8	0.43
1986	555	21.8	39.3	96.1	60.2	57.4	153.8	2.68
1987	1586	68.1	42.9	3.1	24.7	42.1	76.9	1.83
1988	922	26.9	29.2	64.3	29.4	29.3	71.4	2.43
1989	590	11.5	19.5	44.9	25.6	24.4	57.2	2.35
1990	721	22.8	31.6	61.0	31.1	31.3	70.8	2.26
1991	943	30.3	32.1	72.0	38.7	36.8	90.7	2.47
1992	24	1.5	63.8	43.0	34.8	35.8	25.5	0.71
1993	972	30.7	31.6	59.1	28.4	29.5	87.0	2.95
1994	777	35.7	45.9	82.8	43.6	44.3	76.4	1.73
1995	1009	53.3	52.8	59.4	44.8	48.6	72.6	1.49
1996	749	42.9	57.3	93.9	36.5	43.0	140.7	3.27
1997	1542	95.7	62.1	22.9	27.5	55.4	121.5	2.19
1998	2257	114.4	50.7	35.5	24.6	44.5	148.5	3.34
1999	1665	77.8	46.7	37.8	29.3	41.0	125.2	3.05
2000	0	0.0	0.0	7.6	33.3	33.3	10.0	0.30
2001	1508	122.2	81.0	28.0	36.9	72.8	153.8	2.11
2002	0	0.7	0.0	0.5	10.6	4.5	1.3	0.29
2003	295	7.5	25.4	19.5	21.0	22.23	29.8	1.34
2004	419	7.8	18.6	9.6	19.0	18.76	19.6	1.04
2005	0	0	-	0.0	-	-	*	-
2006	0	0	-	2.3	30.2	30.2	3.7	0.12

- No data * Added to first half year

Table 4.2.5.3. SANDEEL in IV.

Fishing effort in the southern North Sea (days fishing times scaling factors for each vessel category to represent days fishing for a vessel of 200 GT), based on Danish and Norwegian data.

	First half year			Second half year		
Year	CPUE (t/day)	Total Int'l catch ('000 t)	Total int'l effort ('000 days)	CPUE (t/day)	Total Int'l catch ('000 t)	Total int'l effort ('000 days)
1982	48.2	427	8.85	35.7	53	1.47
1983	42.8	360	8.41	33.9	59	1.75
1984	50.5	461	9.13	32.9	71	2.16
1985	41.9	417	9.95	33.6	111	3.29
1986	53.7	386	7.20	44.1	76	1.71
1987	57.4	298	5.19	37.1	105	2.83
1988	46.7	462	9.89	30.2	33	1.11
1989	43.8	506	11.54	29.5	19	0.63
1990	31.0	342	11.03	35.6	24	0.67
1991	47.0	327	6.95	46.6	132	2.84
1992	54.9	621	11.31	36.2	73	2.02
1993	38.6	268	6.94	32.0	34	1.07
1994	53.4	226	4.24	48.9	48	0.97
1995	56.8	429	7.56	52.0	68	1.30
1996	41.6	294	7.05	50.1	139	2.77
1997	64.2	421	6.55	41.1	138	3.36
1998	46.6	448	9.61	26.2	43	1.64
1999	40.9	432	10.56	31.9	36	1.13
2000	43.1	360	8.36	33.4	53	1.59
2001	38.7	433	11.20	46.4	185	3.98
2002	62.2	609	9.79	22.4	19	0.86
2003	22.6	211	9.33	20.5	31	1.53
2004	25.2	250	9.91	23.5	31	1.32
2005	27.9	145	5.18	*	*	*
2006	39.0	254	6.50	30.3	17	0.56
2007	45.6	114	2.51			

* Added to first half year

Table 4.2.5.4. SANDEEL in IV.

Tuning fleets used in the SXSA assessment. Total international standardised effort and catch at age in numbers (millions)

Year	Season	Fleet	Effort	a-0	a-1	a-2	a-3	a-4+
1976	1	1	5.9	237	5697.2	1130	445	155.1
1977	1	1	11.3	3686.2	24306.5	2350.5	516.3	144
1978	1	1	4.3	0	6126.9	2337.8	572.5	143.5
1979	1	1	2.3	0	2335.2	1327.6	242.2	11.8
1980	1	1	5.4	17.3	13394.1	8865	1049.6	827.3
1981	1	1	3.9	17	5505	4109	904	174
1982	1	1	2.4	2	3518	2132	556	85
1983	1	1	2	0	5684	1215	89	12
1984	1	1	1.8	0	11692.2	1646.7	152.7	4.5
1985	1	1	1.6	1	2688	3292	1002	480
1986	1	1	4.4	7	23934	2600	200	0
1987	1	1	6.8	0	26236	10855	350	155
1988	1	1	8.43	2453	9855	25922	1319	26
1989	1	1	12.43	6124	56661	2219	3385	0
1990	1	1	5.95	0	13101	3907	578	175
1991	1	1	7.26	0	41855	2342	908	318
1992	1	1	4.07	137	9871	4056	486	305
1993	1	1	5.04	1112	15768	2635	1023	646
1994	1	1	7.69	397.9	28490.2	7225.3	5953.5	2155.5
1995	1	1	6.43	0	36140	3360	1091	145
1996	1	1	5.06	0	11523.6	5384.6	760.8	300.7
1997	1	1	7.18	2433.8	67037.8	3640.3	5254.3	1205.7
1998	1	1	5.44	2277.7	6667.1	33215.8	2038.9	410.1
1999	1	2	4.02	264.8	2117.7	3490.8	5086	1022.7
2000	1	2	6.4	0	22887.2	8809.9	1419.8	1469.7
2001	1	2	1.77	87.4	6433.8	2407.8	472	1034.6
2002	1	2	1.9	11.5	21718.8	2649	401.5	219.2
2003	1	2	3.09	598.7	2315.3	1304.6	456.1	635.4
2004	1	2	2.39	178.6	6819.1	541.5	375.3	212.8
2005	1	2	0.96	5.2	2550.1	411.6	97.3	49.3
2006	1	2	0.37	0	1407.7	121.7	16.5	2.4
2007	1	2	1.52	469.7	8494.4	778	133.8	40.3
1982	1	3	8.9	242	56545	6224	3277	1939
1983	1	3	8.4	955	2232	35029	934	387
1984	1	3	9.1	20.4	62517	2257.1	13271.7	442.1
1985	1	3	10	6573	7790	39301	2490	265
1986	1	3	7.2	0	43629	7333	1604	30
1987	1	3	5.19	0	4351	22771	1158	165
1988	1	3	9.89	1420	2349	10074	17914	2769
1989	1	3	11.54	29	44444	4525	957	3368
1990	1	3	11.03	0	20179	16670	2467	745
1991	1	3	6.95	0	20058	9224	1320	454
1992	1	3	11.31	2	60337	10021	1002	621
1993	1	3	6.96	0	3581	14659	3707	1012
1994	1	3	4.25	0	24697.1	2594.2	2654.4	715.3
1995	1	3	7.56	0	39060	6503	1531	1226
1996	1	3	7.05	0	10193.9	16015.3	6403.4	1169.1
1997	1	3	6.56	0	52358.7	3647.9	2404.6	683.3
1998	1	3	9.62	56.6	9545.8	39552.9	3188	2260.3

Table 4.2.5.4. Continued.

Year	Season	Fleet	Effort	a-0	a-1	a-2	a-3	a-4+
1999	1	4	10.57	0	31950.9	6498.7	13149.8	946.7
2000	1	4	8.36	1126.2	35612.8	5972.9	1825.3	3528
2001	1	4	11.2	579.2	64084	13530.7	1158	2389.1
2002	1	4	9.79	420.1	84858	8666.7	1059.9	250
2003	1	4	9.33	6148.4	4981.9	15588.3	3592.7	1203.8
2004	1	4	9.91	0	33909.4	1112.5	4302.4	270.3
2005	1	4	5.18	73.5	15841.8	5203.8	311.6	438.5
2006	1	4	6.5	868.7	33255.5	2801.4	1034.9	239.7
2007	1	4	2.51	144.8	9300.6	4871	364.9	128.9
1976	2	5	2.4	6125.6	648	83.5	367.8	36.6
1977	2	5	4.2	3067.2	2855.7	913.3	141.9	141.1
1978	2	5	1.9	7820.2	1001	307.3	38.9	1.9
1979	2	5	4.8	44202.9	1310.1	433.1	66.2	9.5
1980	2	5	2.4	8348.8	1172.7	213.9	19.4	7.5
1981	2	5	2.3	9128	346	94	14	6
1982	2	5	0.4	6530	65	0	0	0
1983	2	5	0.6	7911	303	316	19	0
1984	2	5	0.6	0	1207.2	120.6	42.6	0
1985	2	5	0.4	349	109	239	89	11
1986	2	5	2.7	7105	7077	473	0	0
1987	2	5	1.83	455	5768	198	0	0
1988	2	5	2.43	13196	1283	340	119	17
1989	2	5	2.35	3380	4038	274	0	0
1990	2	5	2.26	12107	1670	342	51	15
1991	2	5	2.47	13616	866	28	8	3
1992	2	5	0.71	6797	48	3	0	0
1993	2	5	2.95	26960	1004	112	34	22
1994	2	5	1.73	457	828.6	1211	396.3	24.7
1995	2	5	1.49	4046	3374	338	26	2
1996	2	5	3.27	31817.4	1705.7	1771.5	135.8	55.3
1997	2	5	2.19	2431	11345.6	633.2	24.9	1.9
1998	2	5	3.34	35220	10005.3	1837	78.8	0.6
1999	2	5	3.05	33652.8	693.5	550.7	57.8	0
2000	2	5	0.3	0	467.2	83.9	23.6	46.1
2001	2	5	2.11	46385.4	771.2	72.8	134.3	0
2002	2	5	0.29	0	157	6.4	0	0
2003	2	5	1.34	7509.8	118	163.7	0	0
2004	2	5	1.04	2960.9	656.1	8.8	11.4	0
2005	2	5	0	0	0	0	0	0
2006	2	5	0.12	0	229.6	36.9	8.8	1.9
1982	2	6	1.5	5039	4718	490	344	40
1983	2	6	1.8	9298	240	2806	513	2
1984	2	6	2.2	0	9422.5	91.6	577.3	43.8
1985	2	6	3.3	11940	1896	3229	2234	298
1986	2	6	1.7	112	5350	293	241	18
1987	2	6	2.83	298	3095	6664	196	51
1988	2	6	1.11	0	0	234	2084	68
1989	2	6	0.63	1	1619	165	35	123
1990	2	6	0.67	597	1438	477	71	21
1991	2	6	2.84	12115	11411	344	111	0
1992	2	6	2.02	134	3903	382	157	34
1993	2	6	1.07	838	1037	953	266	87
1994	2	6	0.97	0	4092.9	322.3	197.6	136.9
1995	2	6	1.3	0	3166	2789	307	157
1996	2	6	2.77	2088.1	2030.5	4080.4	536.1	1023
1997	2	6	3.36	198	15238.3	535.5	406.2	135.6
1998	2	6	1.64	1141.8	737.5	2672.5	209.4	65.2
1999	2	6	1.13	1322.1	202.5	58.2	1391.8	166.4
2000	2	6	1.59	6659	3600.6	495.9	339.2	329.5
2001	2	6	3.98	73442.6	819.3	15.1	0	0
2002	2	6	0.86	0	1370.4	472.2	0	0
2003	2	6	1.53	5319.6	921.8	452	163.2	27.8
2004	2	6	1.32	2382.7	1637.4	472.9	405	68
2005	2	6	0	0	0	0	0	0
2006	2	6	0.56	0	1826.5	37.7	20.3	0.3

Table 4.3.2.1. SANDEEL in IV.

```
Options for seasonal survivor analysis (SXSA)
Dankert Skagens SXSA program
   last updated 5/9 - 1995
 ============================
 Name of the stock:
 Sandeel in the North Sea

Data were input from the following files:
  1: Catch in numbers:       CANUM4.hyr
  2: Weight in catch:        WECA4.hyr
  3: Weight in stock:        WEST4.hyr
  4: Natural mortalities:    natmor.hyr
  5: Maturity ogive:         matprop.hyr
  6: Tuning data (CPUE):     Tuning4.hyr
  7: *Weighting for rhats:   tweq.new
  8: *Weighting for shats:   twred.xsa
  9: *Catches to be fitted:

The following fleets were used:
Fleet:  1: Northern First Half 76-98
Fleet:  2: Northern First Half 99-07
Fleet:  3: Southern First Half 82-98
Fleet:  4: Southern First Half 99-07
Fleet:  5: Northern Secon Half 76-06
Fleet:  6: Southern Secon Half 82-06

The following values was used:
 1: First VPA year                  1983
 2: Last VPA year                   2007
 3: Youngest age                       0
 4: Oldest true age                    3
 5: Number of seasons                  2
 6: Recruiting season                  2
 7: Last season in last year           1
 8: Spawning season                    1
 9: Number of fleets                   6

The following options were used:
 1: Inv. catchability: (1: Linear; 2: Log; 3: Cos. filter)                  2
 2: Indiv. shats: (1: Direct; 2: Using z)                                   2
 3: Comb. shats: (1: Linear; 2: Log.)                                       2
 4: *Fit catches: (0: No fit; 1: No SOP corr; 2: SOP corr.)                 0
 5: *Est. unknown catches: (0: No; 1: No SOP corr; 2: SOP corr.; 3: Sep. F) 0
 6: *Weighting of r: (0: Manual; (1: not available at present).)            0
 7: *Weighting of shats: (0: Manual; 1: Linear; 2: Log.)                    0
 8: Handling of the plus group: (1: Dynamic; 2: Extra age group)            1

 You need a factor for weighting the inverse catchabilities at the oldest age vs. the
second oldest age
 It must be between 0.0 and 1.0.
 Factor 1.0 means that the catchabilities for the oldest are used as they are
 Present value 0.0000000E+00

 You have to specify a minimum value for the survivor number.
 This is used instead of the estimate if the estimate becomes very low
 Present value: 1.000000

 The iteration will carry on until convergence.

Weighting factors for computing catchability for both fleets (Weighting for rhats)

Year 1983-2005           Year 2006
Season  1    2           Season  1   2
Age                       Age
0       1    1           0    0.5         0.1
1       1    1           1    0.5         0.1
2       1    1           2    0.5         0.1
3       1    1           3    0.5         0.1

Weighting factors for computing survivors in all years (Weighting for shats)

Season  1    2
AGE
0       *  0.02
1       1  0.1
2       1  0.1
3       1  0.1
```

Table 4.3.2.2 SANDEEL in IV.

SXSA fishing mortality at age.

Partial fishing mortality
Northern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.013	*	0.000	*	0.000	*	0.017	*	0.003	*	0.027
1	0.089	0.010	0.055	0.015	0.044	0.004	0.077	0.052	0.162	0.081	0.191	0.057
2	0.021	0.012	0.079	0.009	0.087	0.027	0.173	0.071	0.135	0.005	0.786	0.036
3	0.034	0.015	0.012	0.012	0.118	0.024	0.046	0.000	0.088	0.000	0.066	0.020
4+	0.051	0.000	0.008	0.000	0.222	0.010	0.000	0.000	0.053	0.000	0.014	0.118
F (1- 2)	0.055	0.011	0.067	0.012	0.066	0.016	0.125	0.062	0.148	0.043	0.488	0.047

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.015	*	0.028	*	0.025	*	0.031	*	0.065	*	0.001
1	0.357	0.087	0.168	0.059	0.277	0.016	0.052	0.001	0.197	0.029	0.198	0.015
2	0.169	0.041	0.169	0.042	0.161	0.005	0.145	0.000	0.057	0.004	0.352	0.116
3	0.710	0.000	0.167	0.041	0.190	0.003	0.137	0.000	0.118	0.008	0.388	0.053
4+	0.000	0.000	0.199	0.059	0.450	0.015	0.192	0.000	0.545	0.151	1.162	0.208
F (1- 2)	0.263	0.064	0.169	0.050	0.219	0.011	0.098	0.000	0.127	0.017	0.275	0.066

Year	1995		1996		1997		1998		1999		2000	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.016	*	0.024	*	0.011	*	0.139	*	0.103	*	0.000
1	0.166	0.039	0.126	0.044	0.137	0.056	0.078	0.289	0.026	0.022	0.222	0.014
2	0.096	0.017	0.104	0.067	0.149	0.044	0.306	0.038	0.205	0.067	0.546	0.015
3	0.183	0.008	0.072	0.030	0.376	0.004	0.258	0.022	0.197	0.005	0.324	0.014
4+	0.030	0.001	0.083	0.035	0.403	0.001	0.086	0.000	0.299	0.000	0.227	0.018
F (1- 2)	0.131	0.028	0.115	0.055	0.143	0.050	0.192	0.164	0.115	0.045	0.384	0.015

Year	2001		2002		2003		2004		2005		2006	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.085	*	0.000	*	0.040	*	0.029	*	0.000	*	0.000
1	0.059	0.023	0.143	0.004	0.121	0.017	0.117	0.042	0.075	0.000	0.016	0.007
2	0.157	0.015	0.140	0.001	0.055	0.016	0.132	0.004	0.050	0.000	0.017	0.009
3	0.148	0.083	0.142	0.000	0.096	0.000	0.072	0.007	0.081	0.000	0.007	0.007
4+	4.496	*	0.232	0.000	*	*	0.208	0.000	0.038	0.000	0.002	0.003
F (1- 2)	0.108	0.019	0.142	0.002	0.088	0.016	0.124	0.023	0.062	0.000	0.016	0.008

Year	2007
Season	1
AGE	
0	*
1	0.079
2	0.034
3	0.047
4+	0.030
F (1- 2)	0.057

Partial fishing mortality
Southern North Sea

Year	1983		1984		1985		1986		1987		1988	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.016	*	0.000	*	0.014	*	0.000	*	0.002	*	0.000
1	0.035	0.008	0.293	0.115	0.129	0.069	0.140	0.040	0.027	0.044	0.046	0.000
2	0.600	0.105	0.109	0.007	1.040	0.366	0.487	0.044	0.283	0.158	0.305	0.025
3	0.355	0.404	1.053	0.164	0.294	0.601	0.365	0.101	0.290	0.088	0.893	0.354
4+	1.654	0.471	0.824	0.228	0.123	0.261	0.012	0.010	0.056	0.025	1.541	0.472
F (1- 2)	0.318	0.056	0.201	0.061	0.584	0.218	0.313	0.042	0.155	0.101	0.175	0.013

Year	1989		1990		1991		1992		1993		1994	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.000	*	0.001	*	0.022	*	0.001	*	0.002	*	0.000
1	0.280	0.035	0.259	0.051	0.133	0.217	0.317	0.052	0.045	0.030	0.171	0.074
2	0.344	0.025	0.723	0.058	0.633	0.059	0.358	0.026	0.318	0.036	0.126	0.031
3	0.201	0.020	0.714	0.057	0.276	0.043	0.283	0.082	0.428	0.062	0.173	0.026
4+	1.625	1.296	0.848	0.082	0.642	0.000	0.390	0.044	0.853	0.596	0.386	1.151
F (1- 2)	0.312	0.030	0.491	0.054	0.383	0.138	0.338	0.039	0.181	0.033	0.149	0.052

Year	1995		1996		1997		1998		1999		2000	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.000	*	0.002	*	0.001	*	0.005	*	0.004	*	0.020
1	0.182	0.037	0.111	0.052	0.107	0.075	0.111	0.021	0.390	0.007	0.346	0.111
2	0.189	0.138	0.310	0.154	0.150	0.037	0.364	0.055	0.382	0.007	0.370	0.089
3	0.261	0.097	0.607	0.118	0.172	0.058	0.403	0.059	0.508	0.127	0.416	0.195
4+	0.257	0.055	0.322	0.655	0.228	0.099	0.472	0.027	0.277	0.102	0.546	0.129
F (1- 2)	0.186	0.088	0.211	0.103	0.128	0.056	0.238	0.038	0.386	0.007	0.358	0.100

Year	2001		2002		2003		2004		2005		2006	
Season	1	2	1	2	1	2	1	2	1	2	1	2
AGE												
0	*	0.135	*	0.000	*	0.028	*	0.023	*	0.000	*	0.000
1	0.583	0.025	0.560	0.032	0.261	0.131	0.581	0.104	0.465	0.000	0.368	0.052
2	0.884	0.003	0.459	0.052	0.661	0.044	0.271	0.223	0.629	0.000	0.380	0.009
3	0.363	0.000	0.374	0.000	0.760	0.093	0.822	0.232	0.259	0.000	0.439	0.016
4+	10.383	*	0.265	0.000	*	*	0.264	0.129	0.342	0.000	0.244	0.000
F (1- 2)	0.733	0.014	0.510	0.042	0.461	0.087	0.426	0.164	0.547	0.000	0.374	0.031

Year	2007
Season	1
AGE	
0	*
1	0.087
2	0.216
3	0.127
4+	0.096
F (1- 2)	0.151

Table 4.3.2.3. SANDEEL in IV.

SXSA annual fishing mortality at age.

Year	age-0	age-1	age-2	age-3	age-4+	F1-2
1983	0.029	0.146	0.787	0.772	4.169	0.466
1984	0.000	0.455	0.219	1.356	1.167	0.337
1985	0.015	0.231	1.602	0.968	0.604	0.917
1986	0.017	0.290	0.829	0.536	0.021	0.559
1987	0.005	0.278	0.595	0.487	0.140	0.436
1988	0.027	0.291	1.296	1.387	2.956	0.794
1989	0.015	0.775	0.622	1.046	4.083	0.699
1990	0.029	0.533	1.089	1.073	1.406	0.811
1991	0.047	0.586	0.943	0.553	1.370	0.764
1992	0.032	0.435	0.579	0.532	0.694	0.507
1993	0.067	0.298	0.447	0.664	2.629	0.372
1994	0.001	0.456	0.649	0.688	3.853	0.552
1995	0.017	0.425	0.441	0.578	0.363	0.433
1996	0.026	0.314	0.638	0.880	1.039	0.476
1997	0.012	0.342	0.395	0.658	0.801	0.369
1998	0.144	0.384	0.824	0.803	0.652	0.604
1999	0.107	0.472	0.713	0.896	0.736	0.593
2000	0.020	0.699	1.120	0.999	1.021	0.910
2001	0.222	0.737	1.201	0.633	0.000	0.969
2002	0.000	0.800	0.710	0.571	0.557	0.755
2003	0.068	0.505	0.851	1.040	0.000	0.678
2004	0.052	0.859	0.631	1.202	0.634	0.745
2005	0.000	0.594	0.758	0.374	0.422	0.676
2006	0.000	0.455	0.453	0.511	0.274	0.454
2007	0.000	0.167	0.252	0.174	0.127	0.210

Table 4.3.2.4. SANDEEL in IV.

SXSA stock numbers at age (millions)

```
 Stock numbers (at start of season)
 **********************************

Year          1983              1984              1985              1986              1987              1988
Season           1        2        1        2        1        2        1        2        1        2        1        2
AGE
     0           *   880841.       *   227326.       *  1206501.       *   624178.       *   199718.       *   718807.
     1      105529.    34021.   384252.    96348.   102144.    31221.   533878.   155424.   275624.    82844.    89235.    25425.
     2       90721.    31138.    27362.    15145.    69265.    11558.    23748.     7786.   116006.    50230.    59808.    10619.
     3        3754.     1679.    22669.     4205.    12208.     5324.     6325.     2763.     5682.     2574.    34916.     7658.
     4+        498.        6.      896.      235.     3034.     1424.     3143.     2082.     3732.     2240.     3718.      204.

SSN          94974.            50927.            84507.            33216.           125420.            98441.
SSB        1245261.           765753.          1181794.           501663.          1657336.          1510835.
TSN         200503.   947685.  435179.   343259.  186651. 1256028.  567094.   792233.  401043.   337607.  187676.   762714.
TSB        1776070. 1871141. 2341186. 1628297. 1609778. 2094080. 2733274. 2955145. 2952767. 2020848. 1903466. 1637664.


Year          1989              1990              1991              1992              1993              1994
Season           1        2        1        2        1        2        1        2        1        2        1        2
AGE
     0           *   325614.       *   636356.       *   805763.       *   319095.       *   622823.       *   872257.
     1      314135.    54241.   144041.    32805.   277418.    64504.   344805.    84263.   138732.    39301.   261219.    63837.
     2       19656.     7654.    39290.     9490.    24046.     6649.    41703.    16429.    65414.    29689.    30330.    12291.
     3        8175.     1925.     5869.     1441.     7028.     2887.     5107.     2205.    13103.     4910.    23344.     8600.
     4+       4366.      169.     1571.      300.     1283.      228.     2440.      877.     2351.      218.     3829.      216.

SSN          32197.            46731.            32357.            49250.            80867.            57503.
SSB         505034.           656457.           463509.           684399.          1095543.           805977.
TSN         346332.   389603.  190772.   680392.  309775.  880031.  394055.   422869.  219600.   696942.  318722.   957202.
TSB        1887230. 1157451. 1270074. 1398202. 1653630. 1734036. 2091203. 1685142. 1719839. 1839654. 2441207. 7171801.


Year          1995              1996              1997              1998              1999              2000
Season           1        2        1        2        1        2        1        2        1        2        1        2
AGE
     0           *   358741.       * 1935600.       *   328464.       *   389939.       *   496073.       *   494502.
     1      391624.    98081.   158481.    45129.   846994.   239174.   145826.    43813.   150837.    34826.   199456.    37894.
     2       47812.    23889.    74385.    32341.    33568.    16534.   171765.    55559.    26150.     9350.    27702.     6466.
     3        8676.     3649.    16730.     5349.    21183.     7929.    12480.     4086.    41408.    12826.     7105.     2105.
     4+       6534.     3258.     5210.     2289.     4669.     1583.     7273.     2689.     5226.     1891.    10587.     3005.

SSN          63023.            96324.            59421.           191518.            72785.            45394.
SSB        1047247.          1095939.           667111.          1735847.           902891.           512194.
TSN         454647.   487619.  254805. 2020708.  906414.  593684.  337344.   496086.  223622.   554967.  244850.   543972.
TSB        3839527. 3277852. 2165684. 6786092. 5435685. 2904566. 2466436. 1910455. 1746069. 2198920. 1788711. 1290058.


Year          2001              2002              2003              2004              2005              2006
Season           1        2        1        2        1        2        1        2        1        2        1        2
AGE
     0           *   860079.       *    77203.       *   280902.       *   153366.       *   366148.       *   401011.
     1      217730.    37327.   306135.    47979.    34689.    8336.   117617.    18566.    65330.    12878.   164521.    39500.
     2       27344.     5280.    29122.    10256.    37900.   11574.     5884.     2590.    13125.     4201.    10544.     4675.
     3        4770.     1863.     4243.     1648.     7964.    2024.     8919.     2149.     1684.      794.     3439.     1445.
     4+       3516.        0.     1403.      557.     1805.       0.     1509.      616.     1825.      824.     1325.      690.

SSN          35629.            34769.            47669.            16312.            16635.            15308.
SSB         350539.           354277.           426317.           192214.           169965.           179172.
TSN         253360.   904549.  340904.   137643.  82358.  302835.  133929.   177287.  81965.   384846.  179829.   447320.
TSB        1310730. 2762130. 2233948.  751965.  608783. 1153556.  853225.  719010.  549532. 1339911. 1209074. 1723866.


Year          2007
Season           1
AGE
     0           *
     1      180186.
     2       30479.
     3        3760.
     4+       1719.

SSN          35958.
SSB         454648.
TSN         216144.
TSB        1750185.
```

Table 4.3.2.5. SANDEEL in IV.

SXSA catchability.

Fleet 1: Northern North Sea 83-98

	Log inverse q		q	
Season	1	2	1	2
Age				
0	*	*	*	*
1	3.685	*	0.0251	*
2	3.596	*	0.0274	*
3	3.596	*	0.0274	*

Fleet 2: Northern North Sea 99-07

	Log inverse q		q	
Season	1	2	1	2
Age				
0	*	*	*	*
1	3.283	*	0.0375	*
2	2.974	*	0.0511	*
3	2.974	*	0.0511	*

Fleet 3: Southern North Sea 83-98

	Log inverse q		q	
Season	1	2	1	2
Age				
0	*	*	*	*
1	4.224	*	0.0146	*
2	3.186	*	0.0413	*
3	3.186	*	0.0413	*

Fleet 4: Southern North Sea 99-07

	Log inverse q		q	
Season	1	2	1	2
Age				
0	*	*	*	*
1	3.030	*	0.0483	*
2	2.880	*	0.0561	*
3	2.880	*	0.0561	*

Fleet 5: Northern North Sea 83-06

	Log inverse q		q	
Season	1	2	1	2
Age				
0	*	4.572	*	0.0103
1	*	4.138	*	0.0160
2	*	4.648	*	0.0096
3	*	4.648	*	0.0096

Fleet 6: Southern North Sea 83-06

	Log inverse q		q	
Season	1	2	1	2
Age				
0	*	6.261	*	0.0019
1	*	3.562	*	0.0284
2	*	3.555	*	0.0286
3	*	3.555	*	0.0286

Table 4.3.2.6. SANDEEL in IV.

Assessment summary for SXSA.

Year	Recruitment Age 0 thousands	TSB tonnes	SSB tonnes	Landings tonnes	Yield/SSB	Mean F Ages 1-2
1983	880841	1776070	1245261	530640	0.426	0.466
1984	227326	2341186	765753	750040	0.979	0.337
1985	1206501	1609778	1181794	707105	0.598	0.917
1986	624178	2733274	501663	685950	1.367	0.559
1987	199718	2952767	1657336	791050	0.477	0.436
1988	718807	1903466	1510835	1007304	0.667	0.794
1989	325614	1887230	505034	826835	1.637	0.699
1990	636356	1270074	656457	584912	0.891	0.811
1991	805763	1653630	463509	898959	1.939	0.764
1992	319095	2091203	684399	820140	1.198	0.507
1993	622823	1719839	1095543	576932	0.527	0.372
1994	872257	2441207	805977	770747	0.956	0.552
1995	358741	3839527	1047247	915043	0.874	0.433
1996	1935600	2165684	1095939	776126	0.708	0.476
1997	328464	5435685	667111	1114044	1.670	0.369
1998	389939	2466436	1735847	1000375	0.576	0.604
1999	496073	1746069	902891	718668	0.796	0.593
2000	494502	1788711	512194	692498	1.352	0.910
2001	860079	1310730	350539	858619	2.449	0.969
2002	77203	2233948	354277	806921	2.278	0.755
2003	280902	608783	426317	309725	0.727	0.678
2004	153366	853225	192214	359361	1.870	0.745
2005	366148	549532	169965	171790	1.011	0.676
2006	401011	1209074	179172	266751	1.489	0.454
2007		1750185	454648	205371	0.452	0.210
2008			681000*			
Average	565888		763189	685836	1.117	0.603
Units	(Millions)		(Tonnes)	(Tonnes)		

*Forecast

Table 4.6.1. SANDEEL in IV.

Data used for short term forecast.

Input in the assesment year

Year	Season	Age	N	F	WEST	WECA	M	PROPMAT
2007	1	0	0	0.0000	0.0000	0.0000	0.0	0
2007	1	1	180186	0.1660	0.0072	0.0072	1.0	0
2007	1	2	30479	0.2500	0.0114	0.0114	0.4	1
2007	1	3	3760	0.1740	0.0180	0.0180	0.4	1
2007	1	4	1719	0.1260	0.0223	0.0223	0.4	1
2007	2	0	323984	0.0000	0.0031	0.0031	0.8	0
2007	2	1	0	0.0000	0.0091	0.0091	0.2	0
2007	2	2	0	0.0000	0.0135	0.0135	0.2	1
2007	2	3	0	0.0000	0.0149	0.0149	0.2	1
2007	2	4	0	0.0000	0.0183	0.0183	0.2	1

Input for forecast Year and forward

Year	Season	Age	N	F	WEST	WECA	M	PROPMAT
2008	1	0	0	0.0000	0.0000	0.0000	0.0	0
2008	1	1	0	0.1660	0.0059	0.0059	1.0	0
2008	1	2	0	0.2500	0.0099	0.0099	0.4	1
2008	1	3	0	0.1740	0.0137	0.0137	0.4	1
2008	1	4	0	0.1260	0.0186	0.0186	0.4	1
2008	2	0	323984	0.0000	0.0031	0.0031	0.8	0
2008	2	1	0	0.0000	0.0091	0.0091	0.2	0
2008	2	2	0	0.0000	0.0135	0.0135	0.2	1
2008	2	3	0	0.0000	0.0149	0.0149	0.2	1
2008	2	4	0	0.0000	0.0183	0.0183	0.2	1

Table 4.11.1. SANDEEL in IV.

Result of the VPA 1-group vs CPUE 1-group regression. VPA estimates in billions, CPUE estimates in millions.

Week no.	Intercept	Slope	Adj Rsq
12	4.65	0.41	0.95
13	3.80	0.79	0.85
14	4.23	0.63	0.88
15	4.33	0.59	0.93
16	4.25	0.59	0.90
17	4.12	0.60	0.89
18	4.05	0.68	0.92
19	3.91	0.76	0.95
20	3.92	0.72	0.93
21	3.90	0.72	0.88
22	3.89	0.72	0.88
23	3.93	0.72	0.88
24	3.99	0.70	0.86
25	4.07	0.65	0.83
26	4.09	0.65	0.81

Table 4.11.2. SANDEEL in IV.

Time table for the real time monitoring of the sandeel fishery 2008.

Month	Week	Day		Collection of samples	Data deadline	Report deadline	Comment
April	14	1	Tuesday				**Start of monitoring fishery**
		2	Wednsday				
		3	Thursday				
		4	Friday				
		5	Saturday				
		6	Sunday				
	15	7	Monday				
		8	Tuesday	From landing week 14			
		9	Wednsday				
		10	Thursday				
		11	Friday				
		12	Saturday				
		13	Sunday				
	16	14	Monday				
		15	Tuesday	From landing week 15	Up to and incl. week 14 (bio) and week 15 (log book)		
		16	Wednsday				
		17	Thursday			1st Report	
		18	Friday				
		19	Saturday				
		20	Sunday				
	17	21	Monday				
		22	Tuesday	From landing week 16	Up to and incl. week 15 (bio) and week 16 (log book)		
		23	Wednsday			2nd Report	
		24	Thursday				
		25	Friday				
		26	Saturday				
		27	Sunday				
	18	28	Monday				
		29	Tuesday	From landing week 17	Up to and incl. week 16 (bio) and week 17 (log book)		
		30	Wednsday			3rd Report	
May		1	Thursday				*Ascension Day*
		2	Friday				
		3	Saturday				
		4	Sunday				**End of monitoring period**
	19	5	Monday				
		6	Tuesday	From landing week 18	Up to and incl. week 17 (bio) and week 18 (log book)		
		7	Wednsday				
		8	Thursday			Final Report	
		9	Friday				
		10	Saturday				
		11	Sunday				*Whitsunday*
	20	12	Monday				*Whit Monday*
		13	Tuesday	From landing week 19			
		14	Wednsday				
		15	Thursday				ACFM/STECF advice
		16	Friday				

Danish sandeel sampling areas.

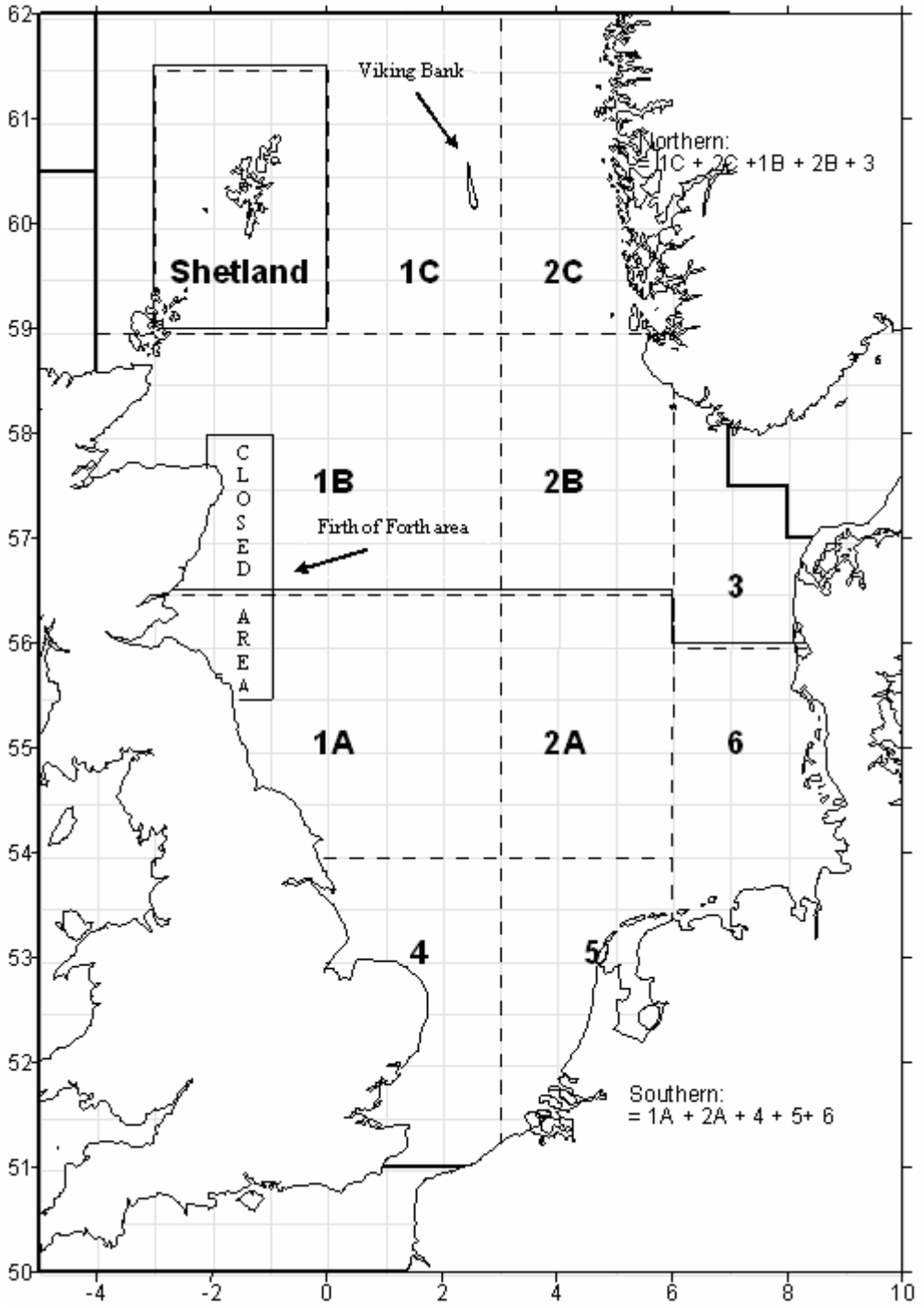


Figure 4.1.2.1. SANDEEL in IV.

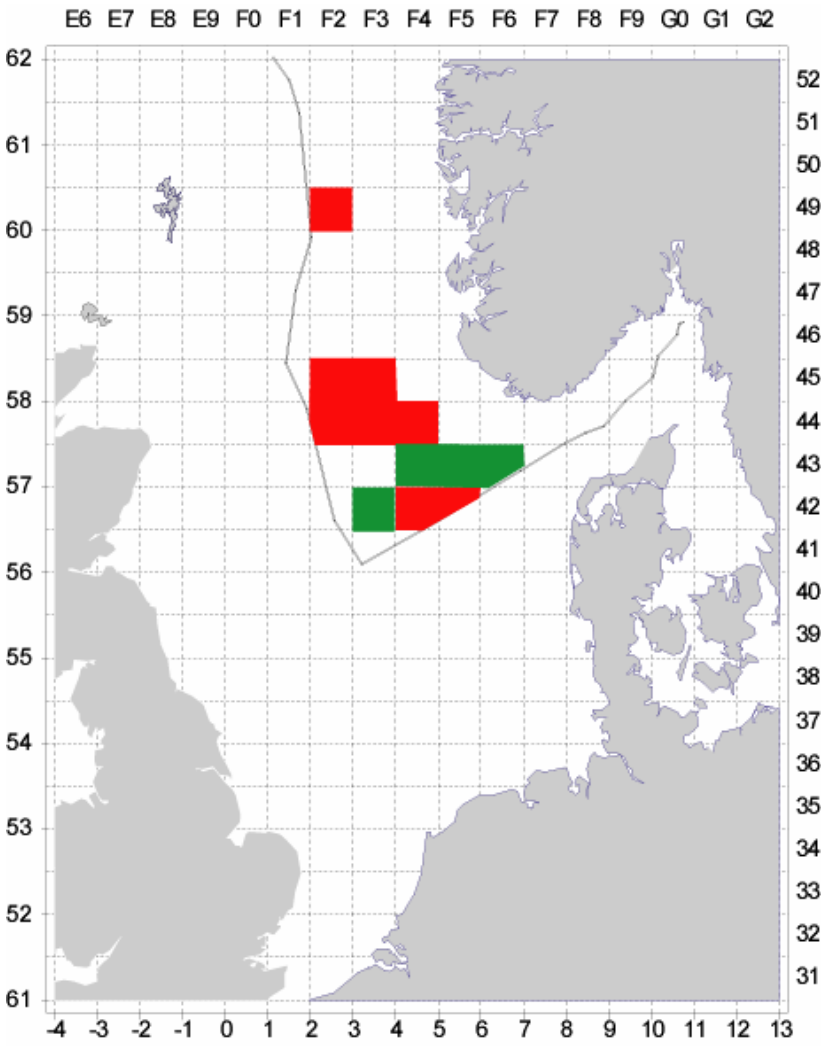


Figure 4.1.4.1. SANDEEL in IV.

Closed (red) and open (green) areas in the Norwegian EEZ during the post-monitoring fishery between mid-May and mid-June 2007. White areas do not have significant sandeel fishing grounds..

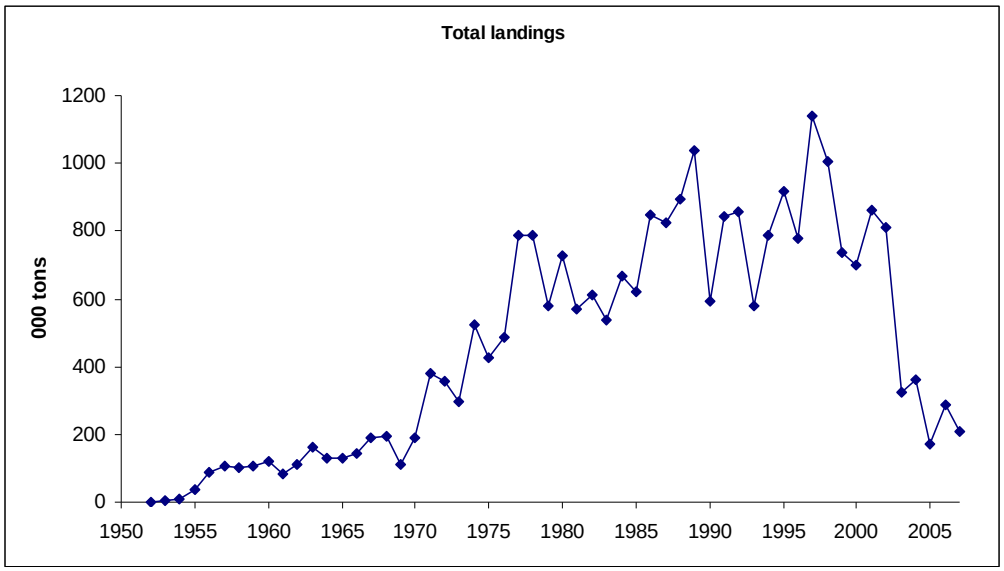


Figure 4.2.1.1. SANDEEL in IV.

Total international landings..

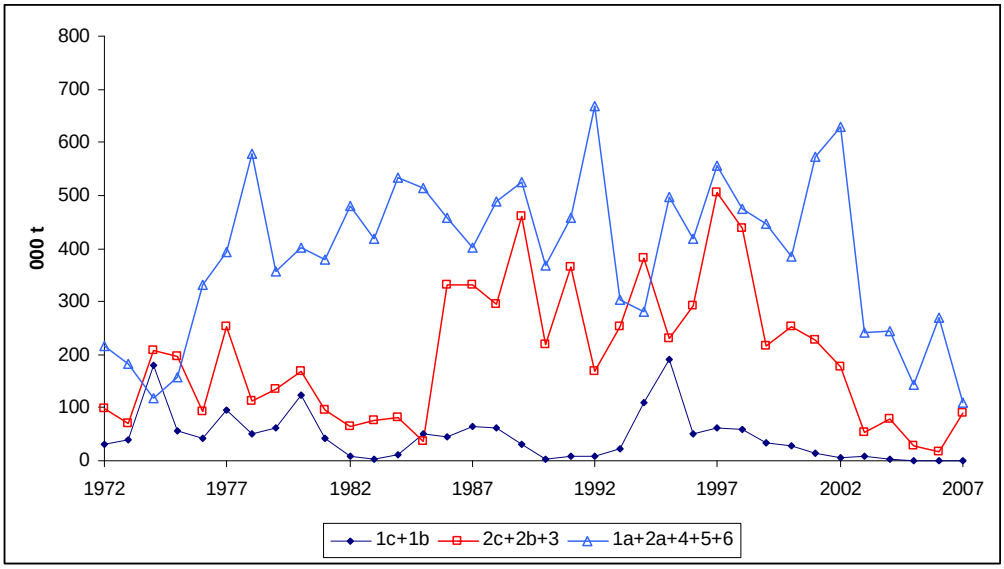


Figure 4.2.1.2. SANDEEL in IV.

Total international landings by three areas (see Figure 4.1.2.1): 1B+1C (north-western North Sea), 2B+2C+3 (north-eastern North Sea) and 1A+2A+4+5+6 (Southern North Sea).

Quarterly catches of sandeels by Denmark and Norway in 2006 and 2007 by ICES rectangle (‘000 tonnes).

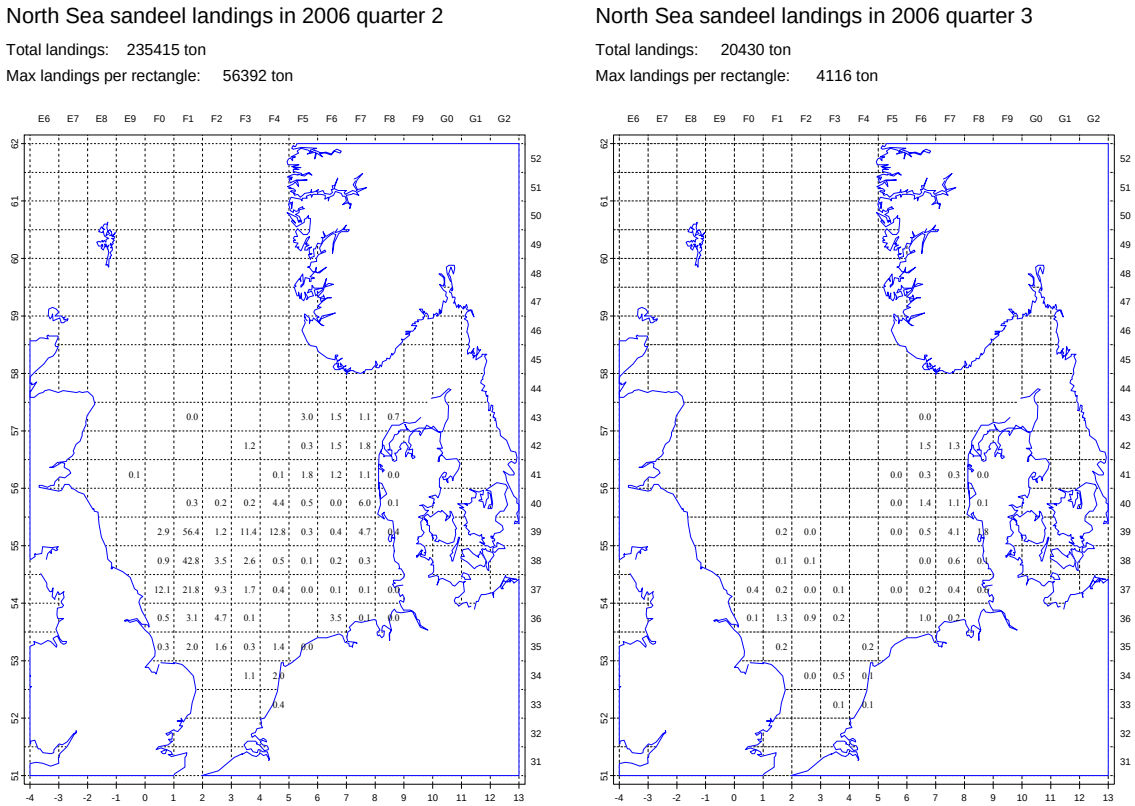
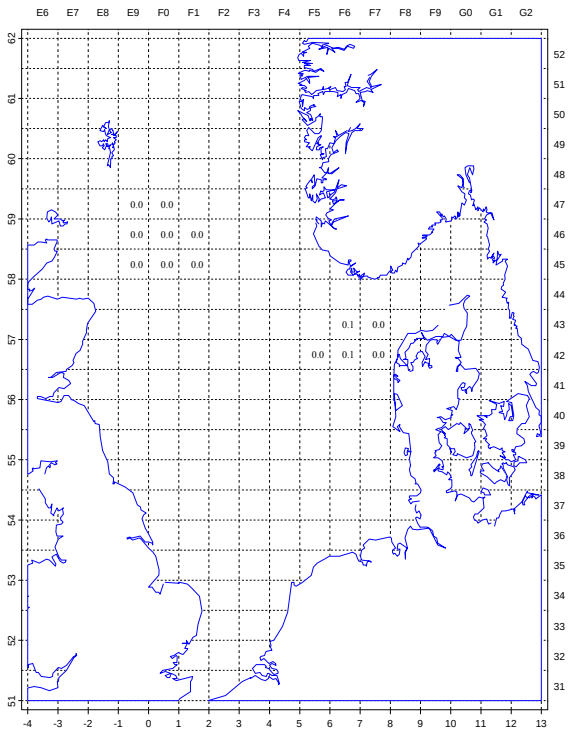


Figure 4.2.1.3. SANDEEL in IV.

North Sea sandeel landings in 2006 quarter 4

Total landings: 296 ton

Max landings per rectangle: 144 ton



North Sea sandeel landings in 2007 quarter 2

Total landings: 195782 ton

Max landings per rectangle: 33518 ton

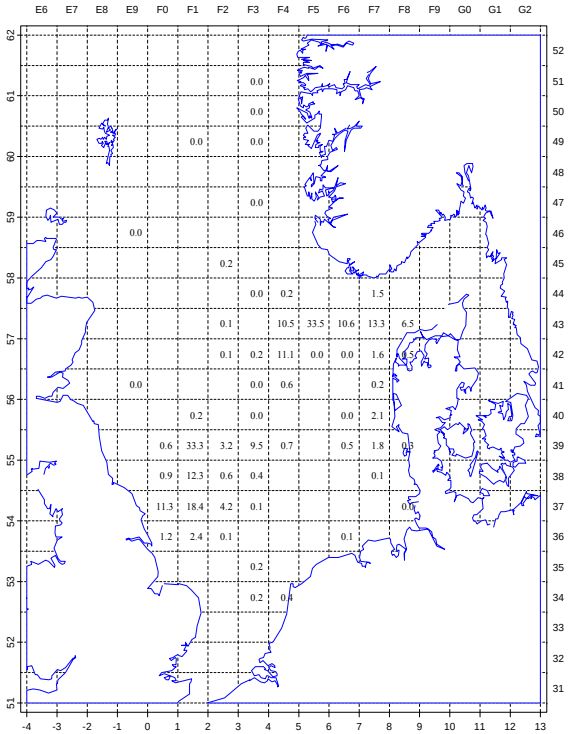


Figure 4.2.1.3. SANDEEL in IV. Continued.

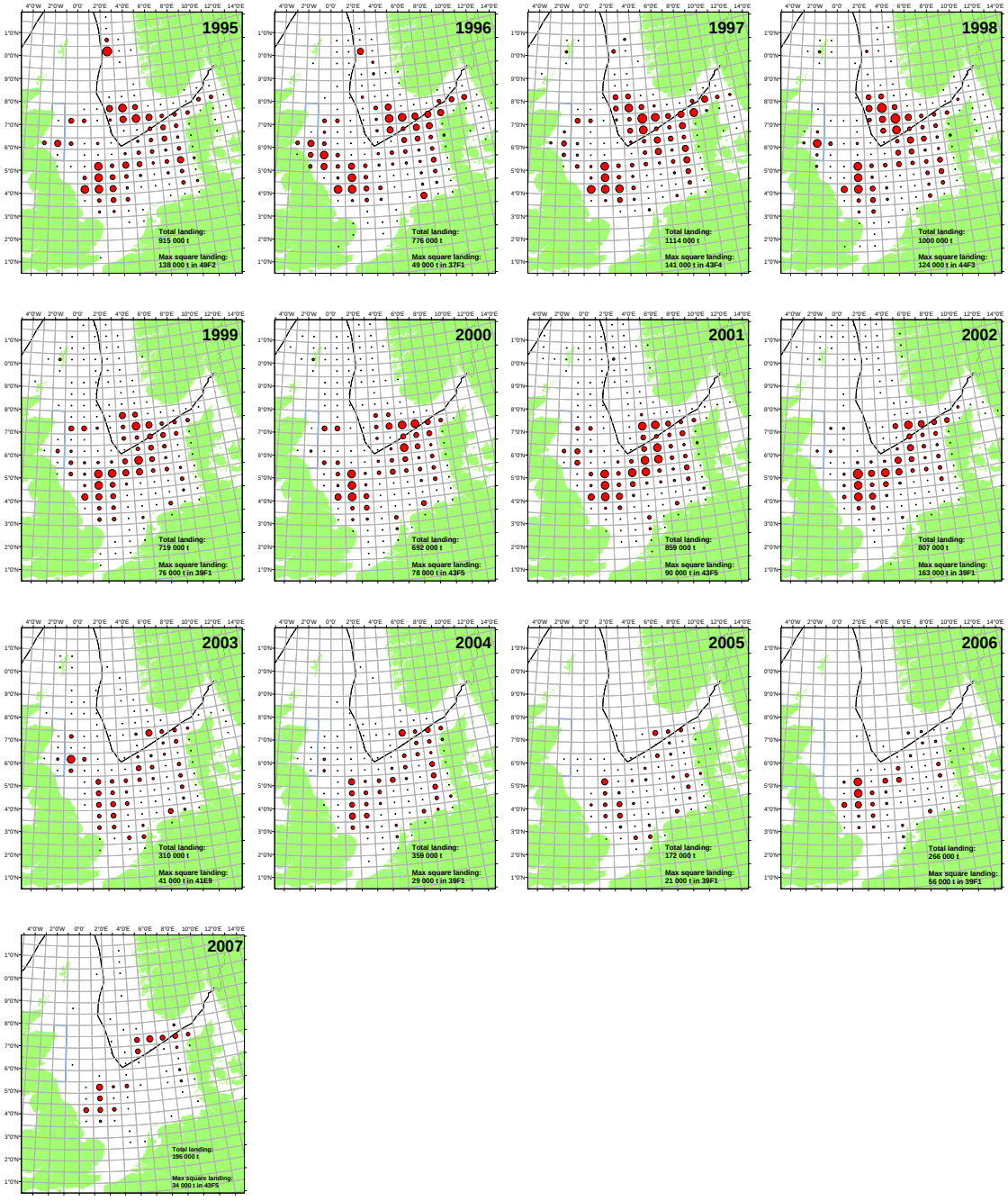
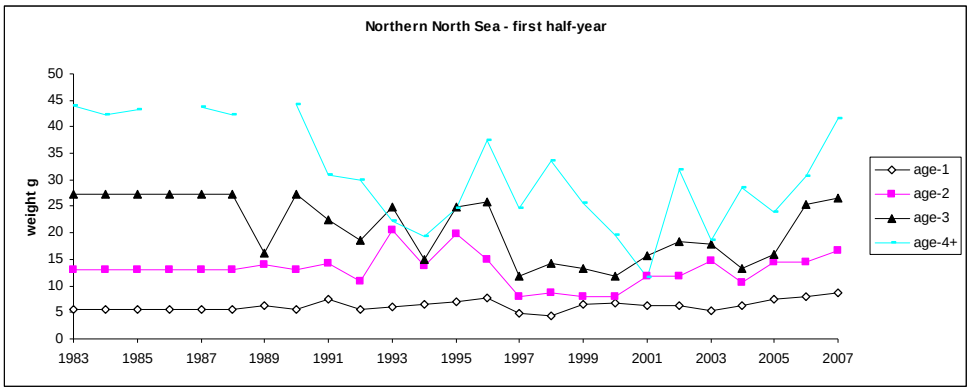
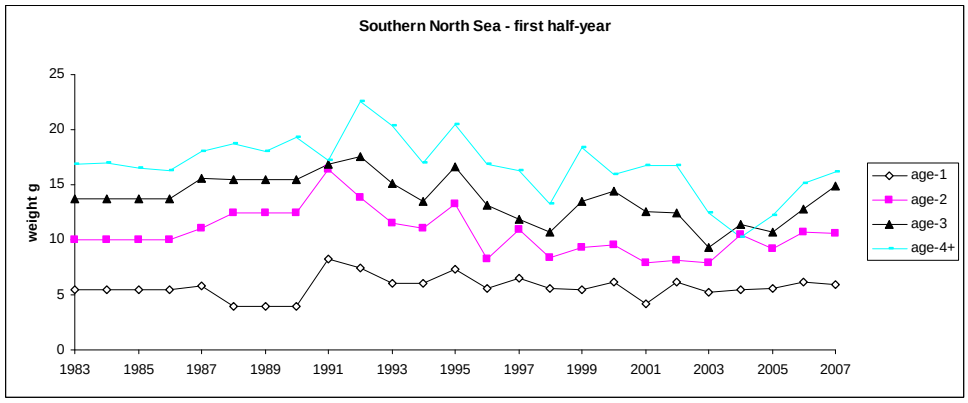
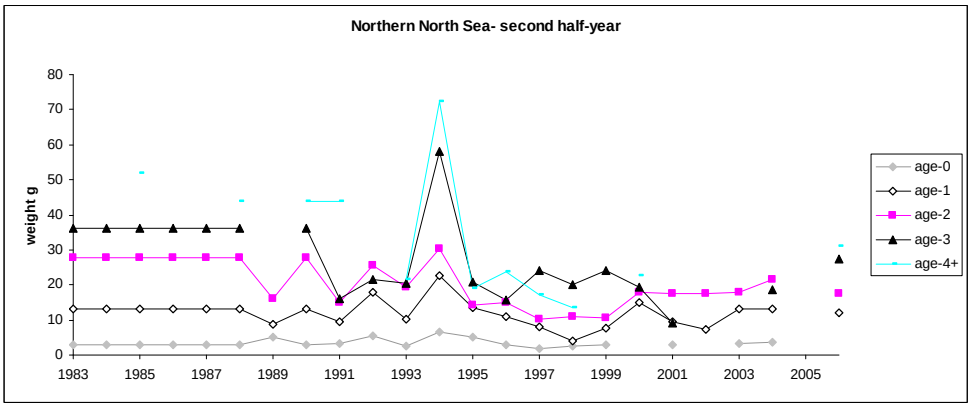


Figure 4.2.1.4. SANDEEL in IV.

Landings of Sandeel by year and ICES rectangles for the period 1995-2007. Landings include Danish and Norwegian landing for the whole period. Scottish landings are included from 1997 and onwards; Swedish landings are included from 1998. Landing from other countries are negligible. The area of the circles corresponds to landings by rectangle. All rectangle landings are scaled to the largest rectangle landings shown at the 1995 map. The area that was closed to sandeel fishery in 2000 and the boundary between the EU and the Norwegian EEZ are shown on the map







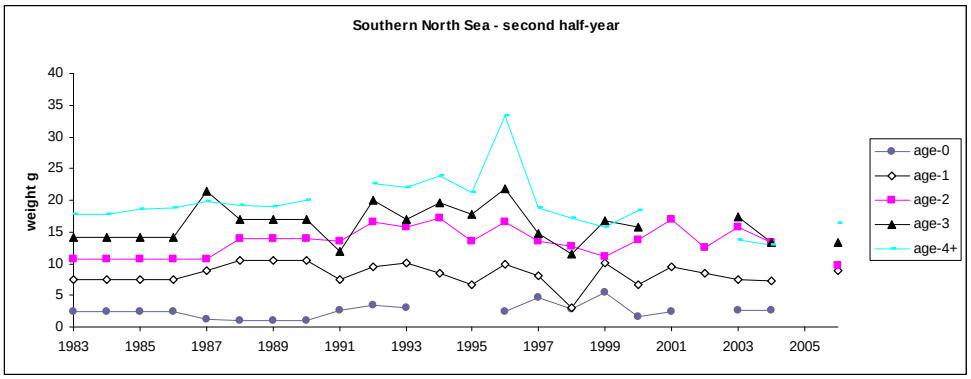
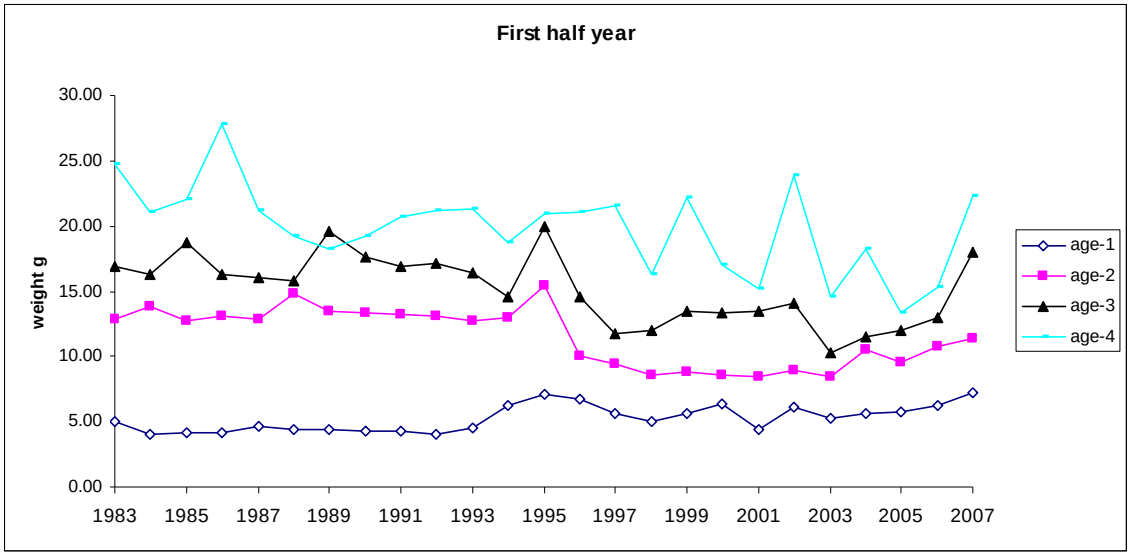


Figure 4.2.3.1 SANDEEL in IV.

Mean weight at age in the catch by area and half year.



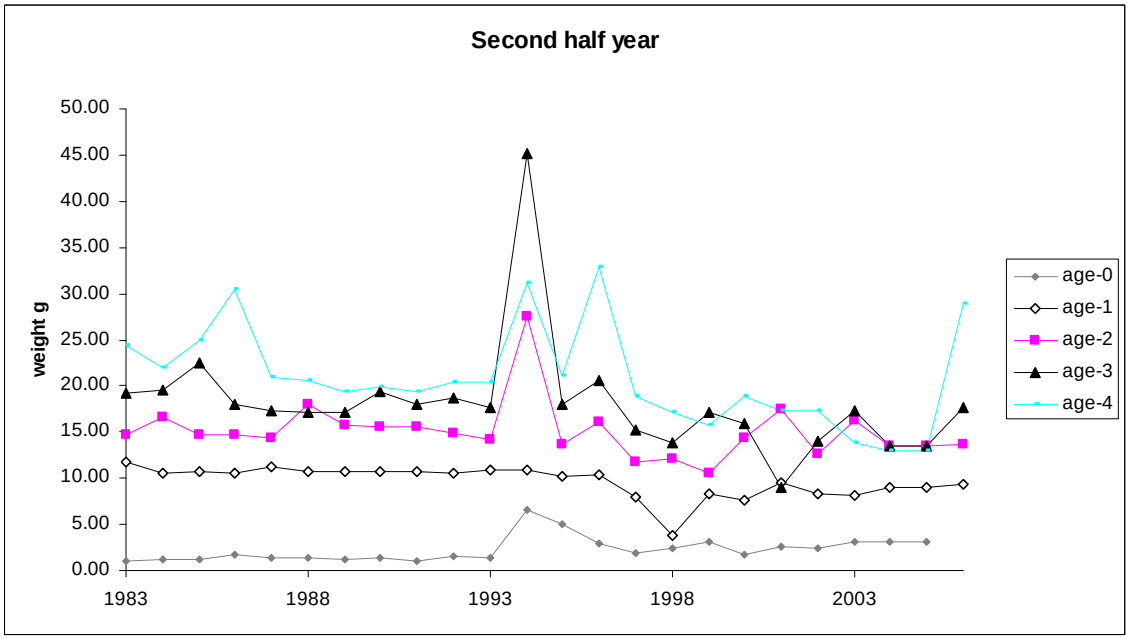


Figure 4.2.3.2 SANDEEL in IV.

Mean weight at age in the stock by half year.

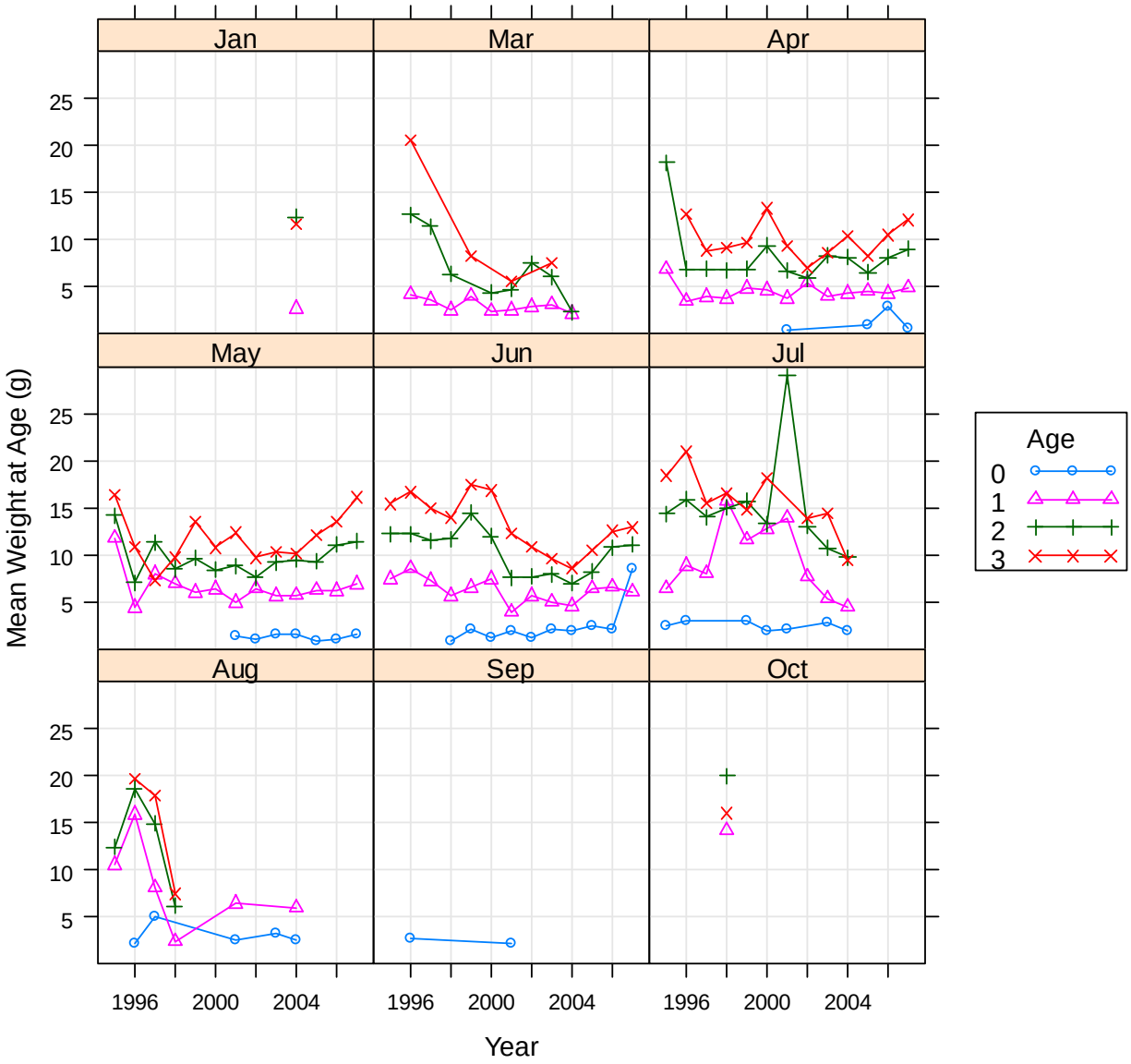


Figure 4.2.3.3 SANDEEL in IV.

Mean weight-at-age in a given month for the period 1995-2007 for sandeel in the southern North Sea. Uncertainties in the mean weight at age are generally of a similar scale to the points used to the plot the data, and have not been plotted for reasons of clarity.

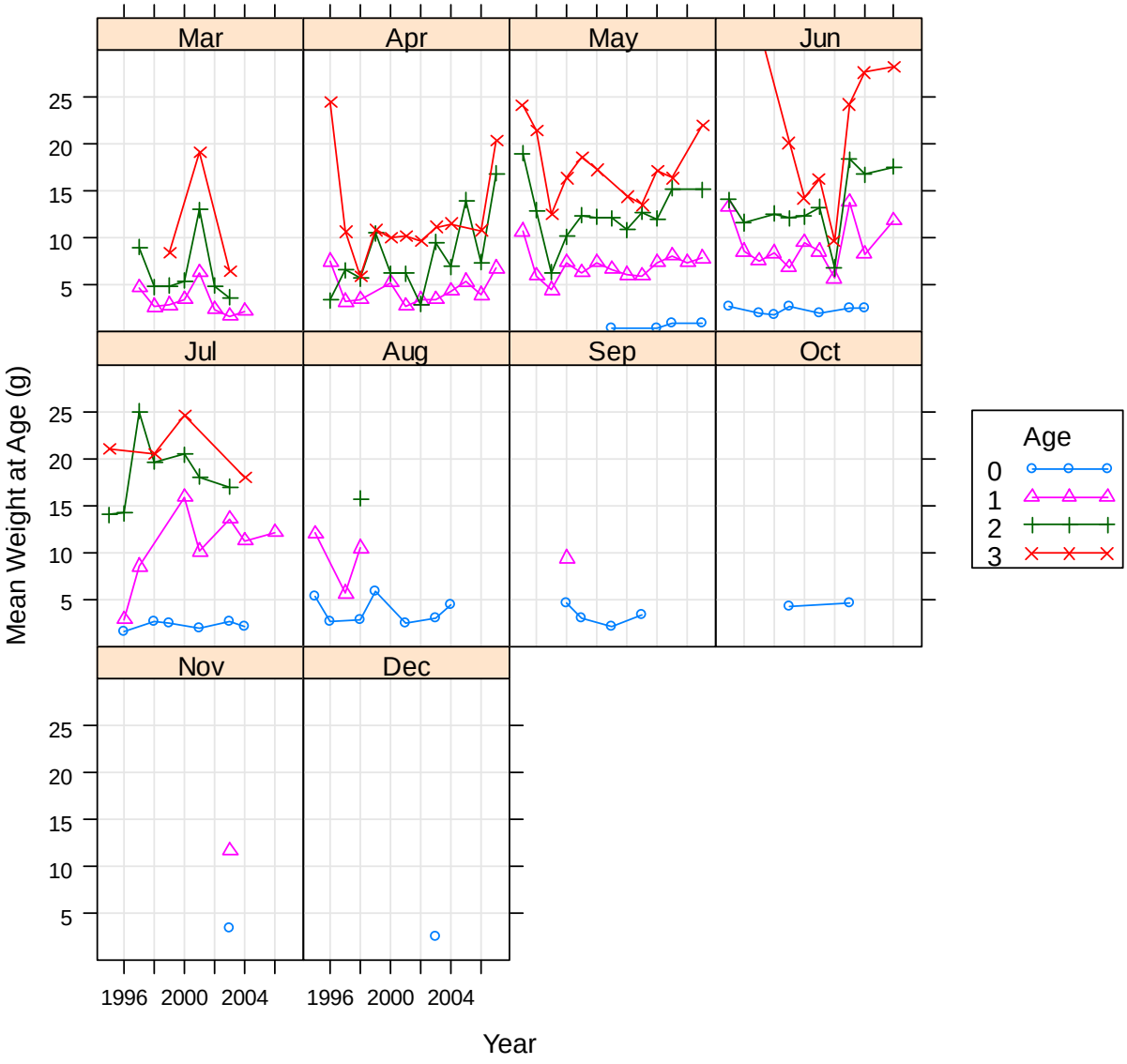


Figure 4.2.3.4 SANDEEL in IV.

Mean weight-at-age in a given month for the period 1995-2007 for sandeel in the northern North Sea. Uncertainties in the mean weight at age are generally small, and of a similar scale to the points used to the plot the data.

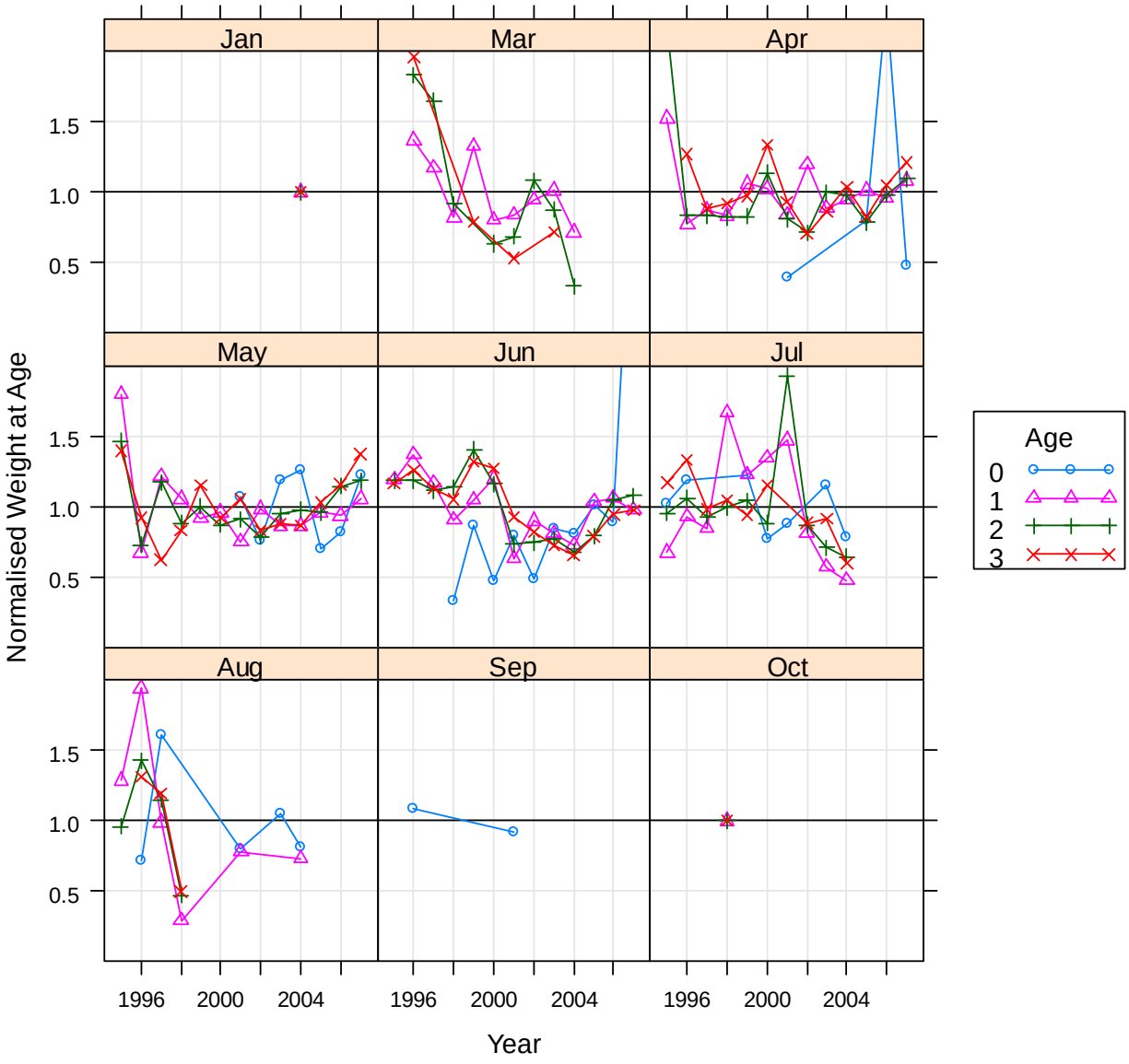


Figure 4.2.3.5 SANDEEL in IV.

Mean weight-at-age for sandeels in the southern North Sea in a given month normalised by the overall mean weight-at-age for that month.

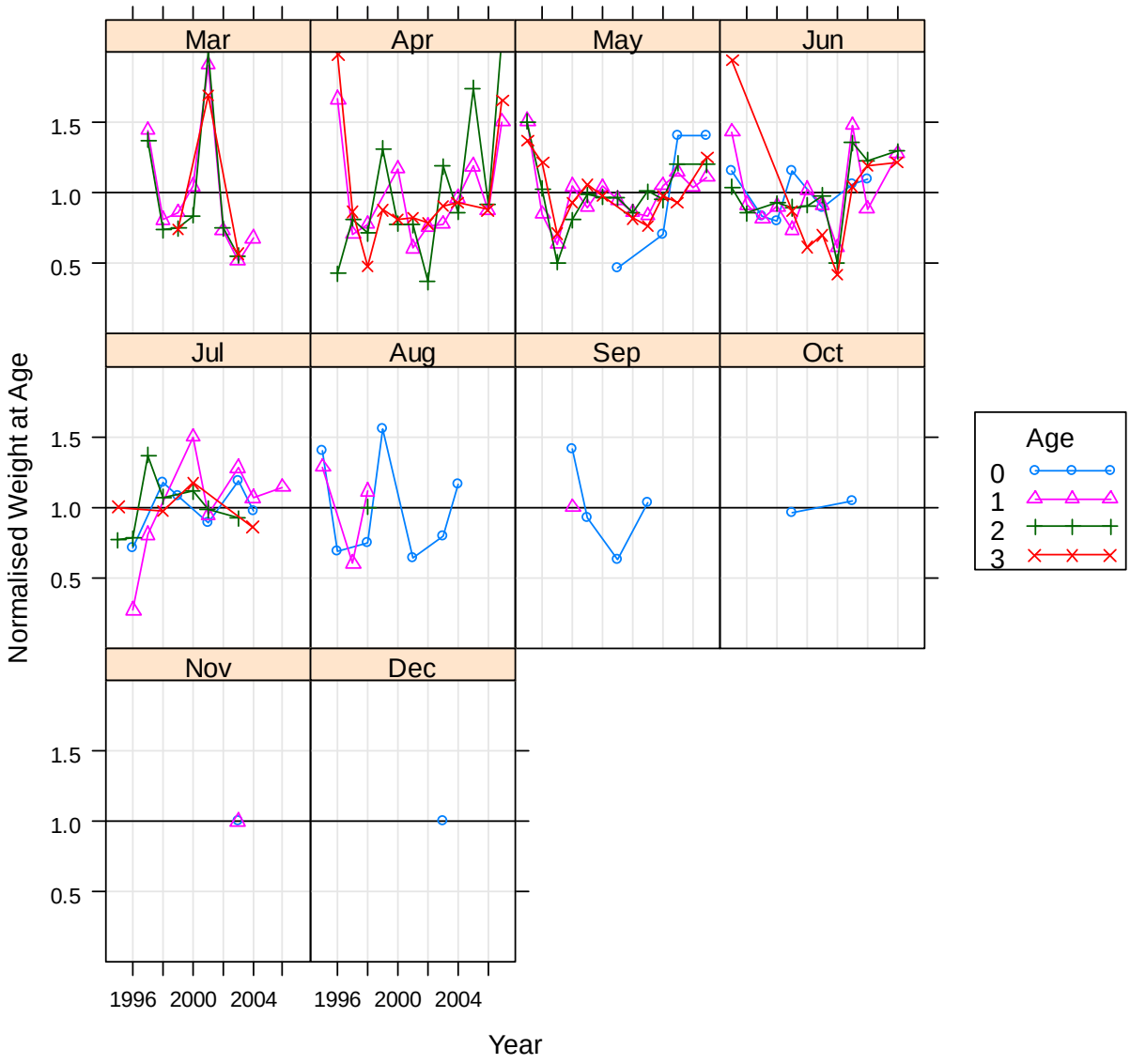


Figure 4.2.3.6 SANDEEL in IV.

Mean weight-at-age of sandeels in the northern North Sea in a given month normalised by the overall mean weight-at-age for that month.

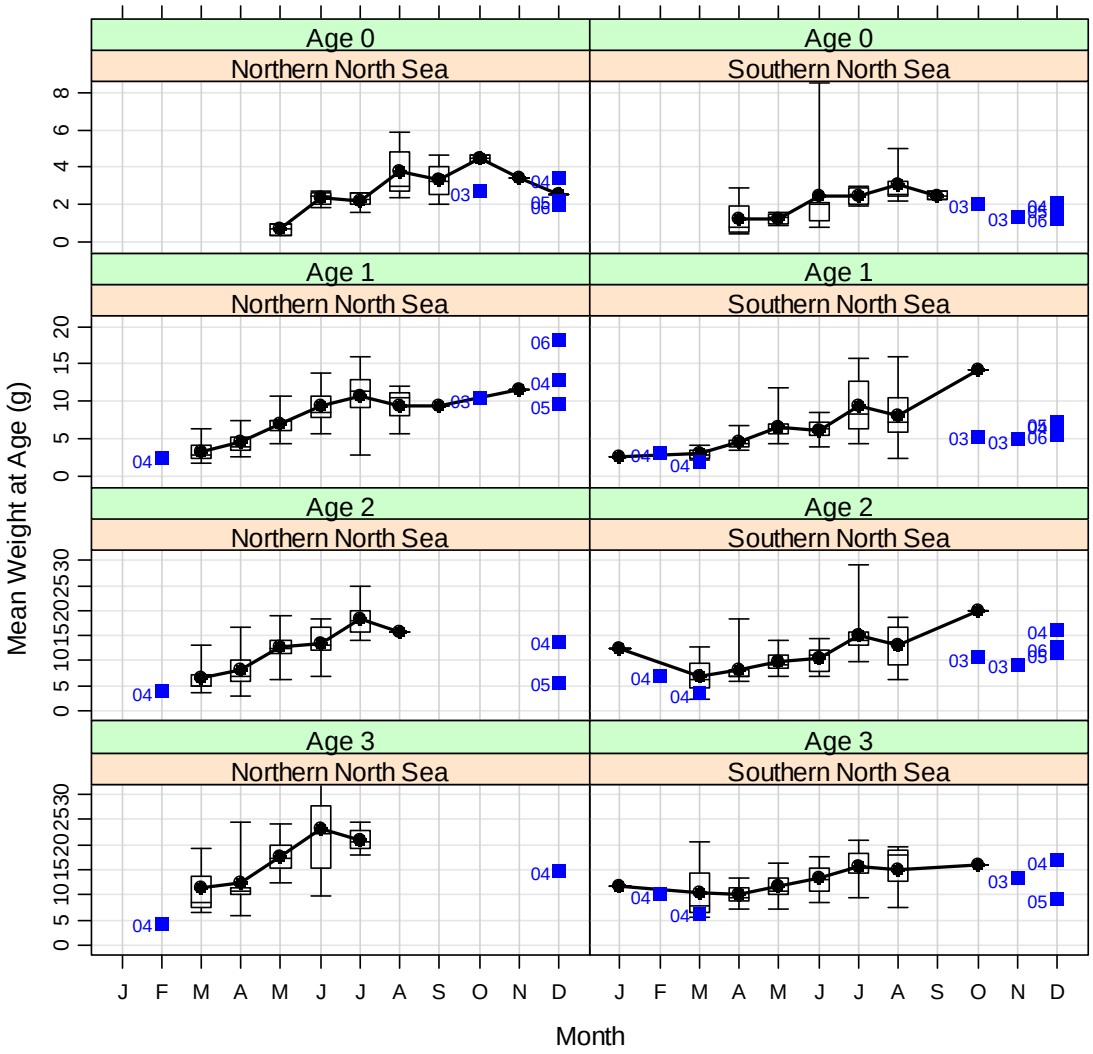


Figure 4.2.3.7 SANDEEL in IV.

Mean weight-at-age in the catch by age and fishing area. Box and whisker plots show the distribution of mean weight-at-age observed in a given month for the period 1995-2007: the box encapsulates the upper and lower quartiles, the horizontal line in the box represents the median, and the whiskers show the full range of observed values. The black line (circles) plots the mean weight-at-age in a given month, averaged over all years. Data from the Danish dredge survey are also shown (blue squares) and are labelled with the corresponding years.

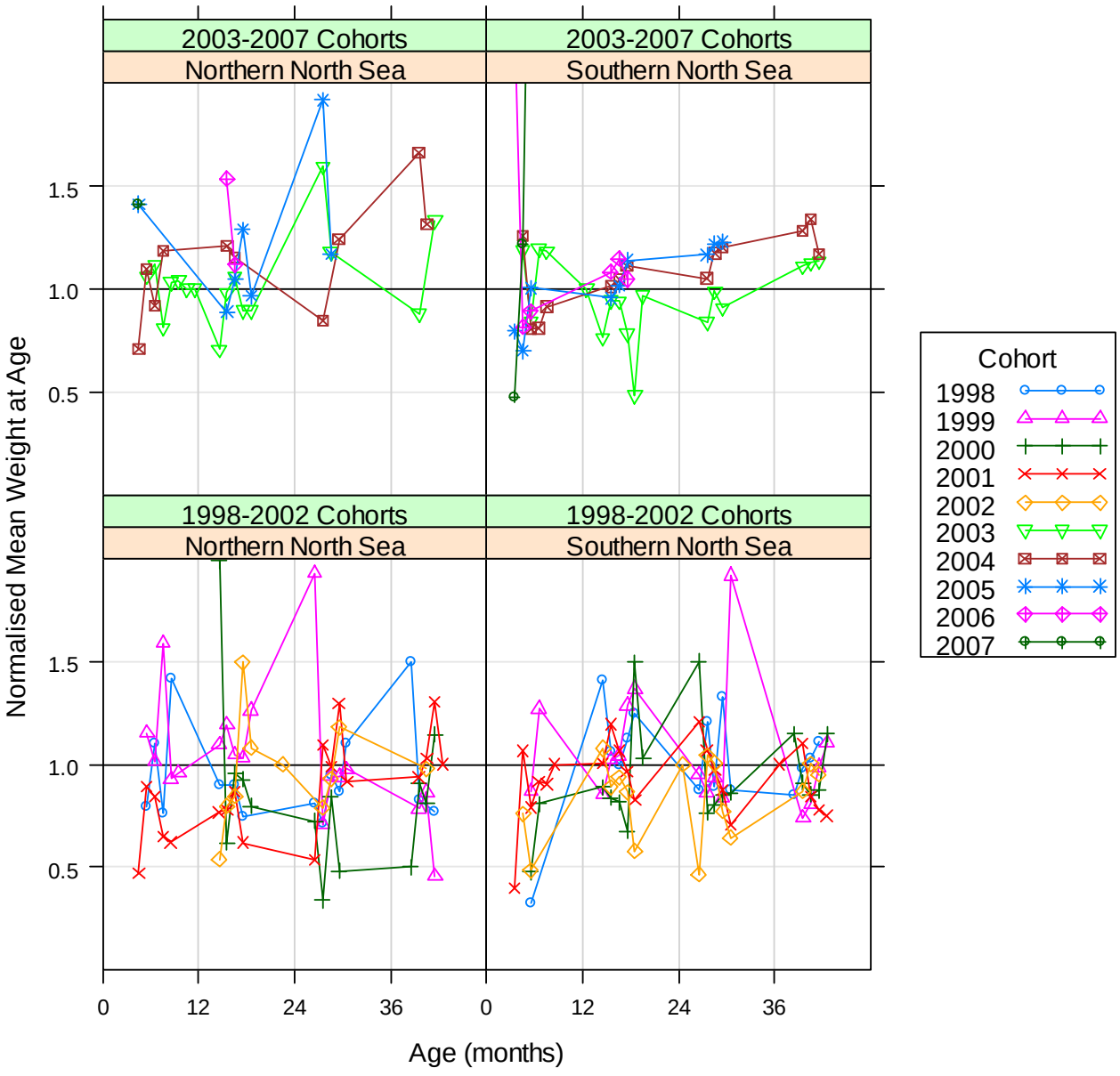


Figure 4.2.3.8 SANDEEL in IV.

Mean weight-at-age normalised by the overall average mean weight-at-age, plotted by cohort and area.

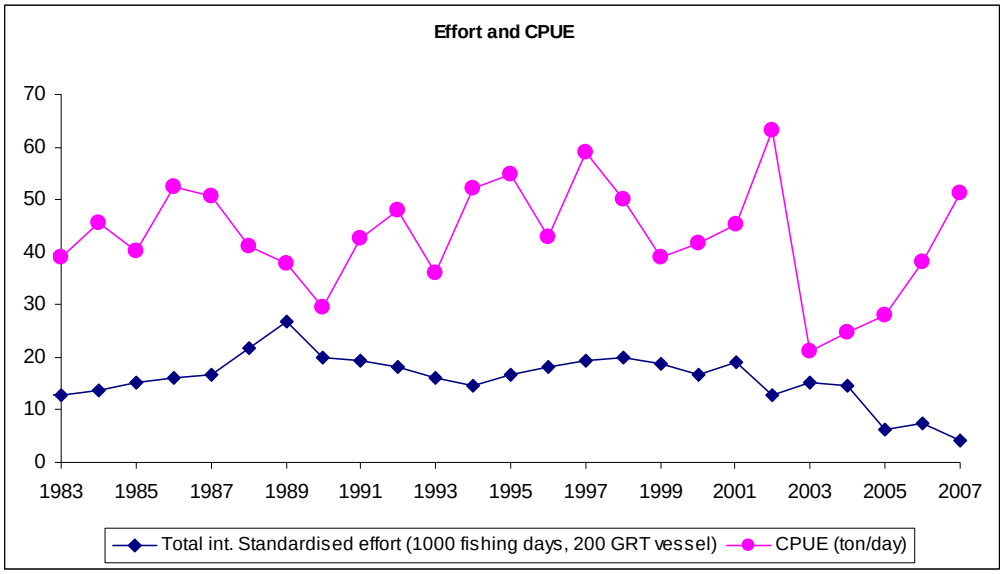
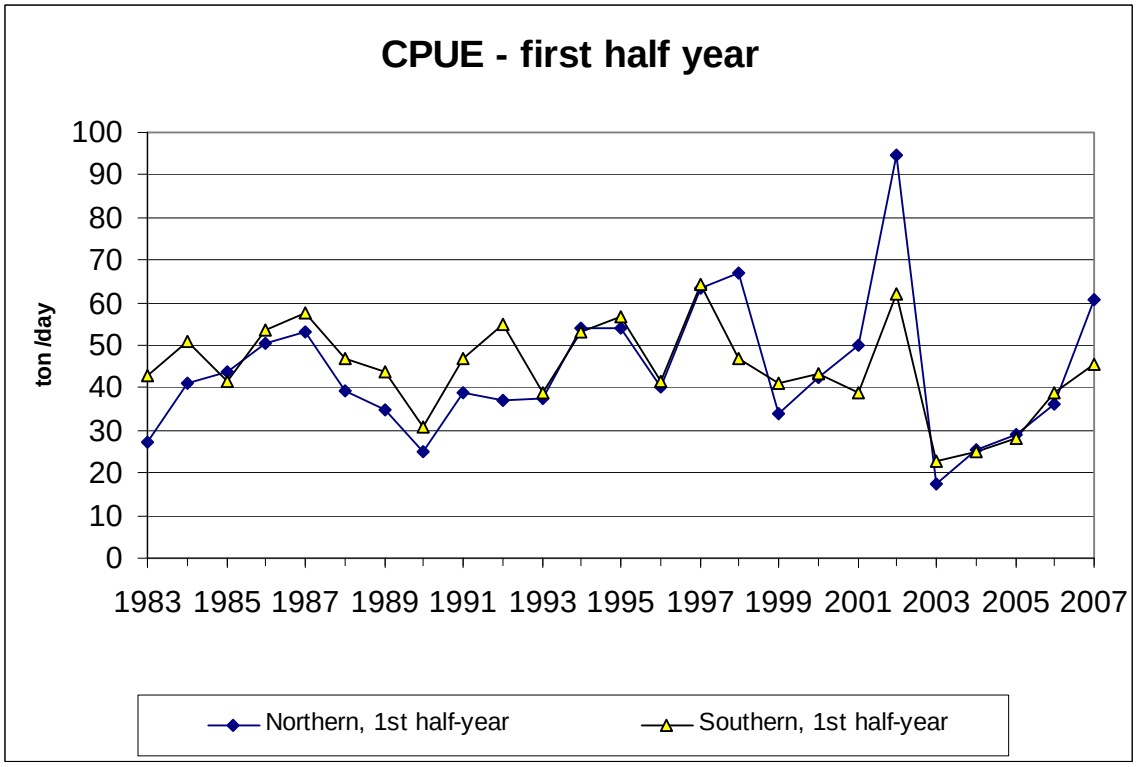


Figure 4.2.5.1. SANDEEL in IV.

Total international effort and CPUE.2007 only represent first half year (see the text for further details about landings in second half year of 2007).



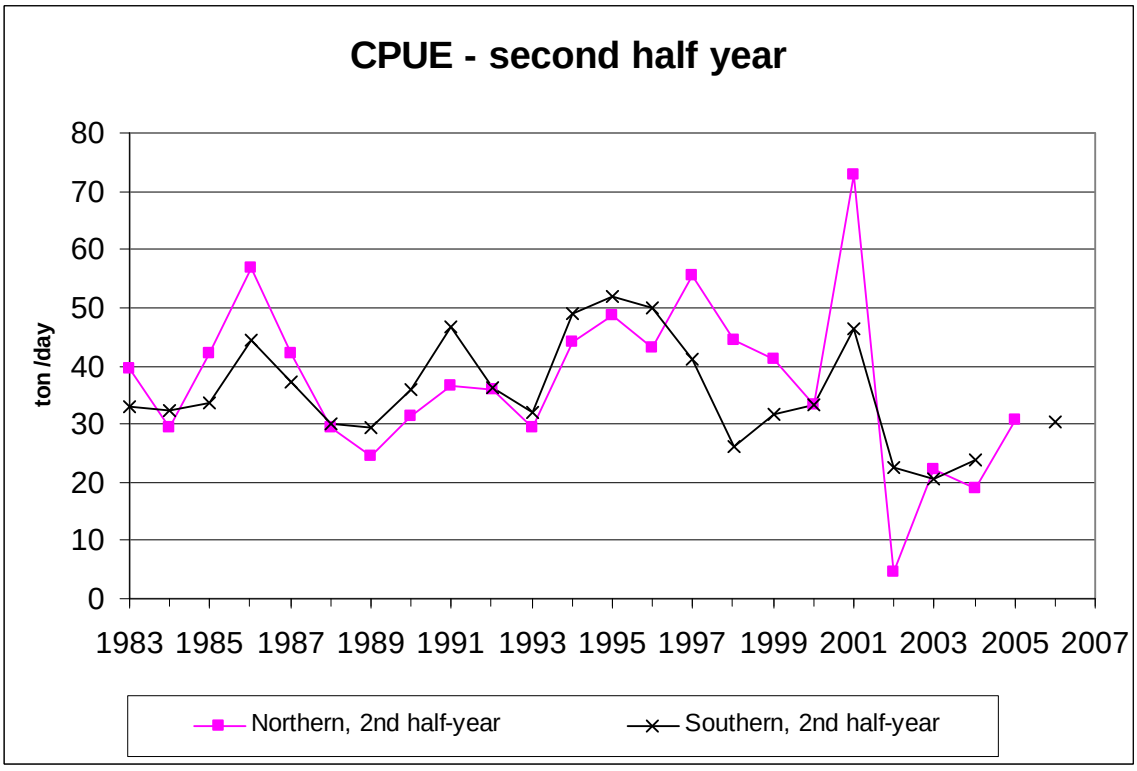


Figure 4.2.5.2. SANDEEL in IV.

CPUE (ton/day) by area, half year and year.

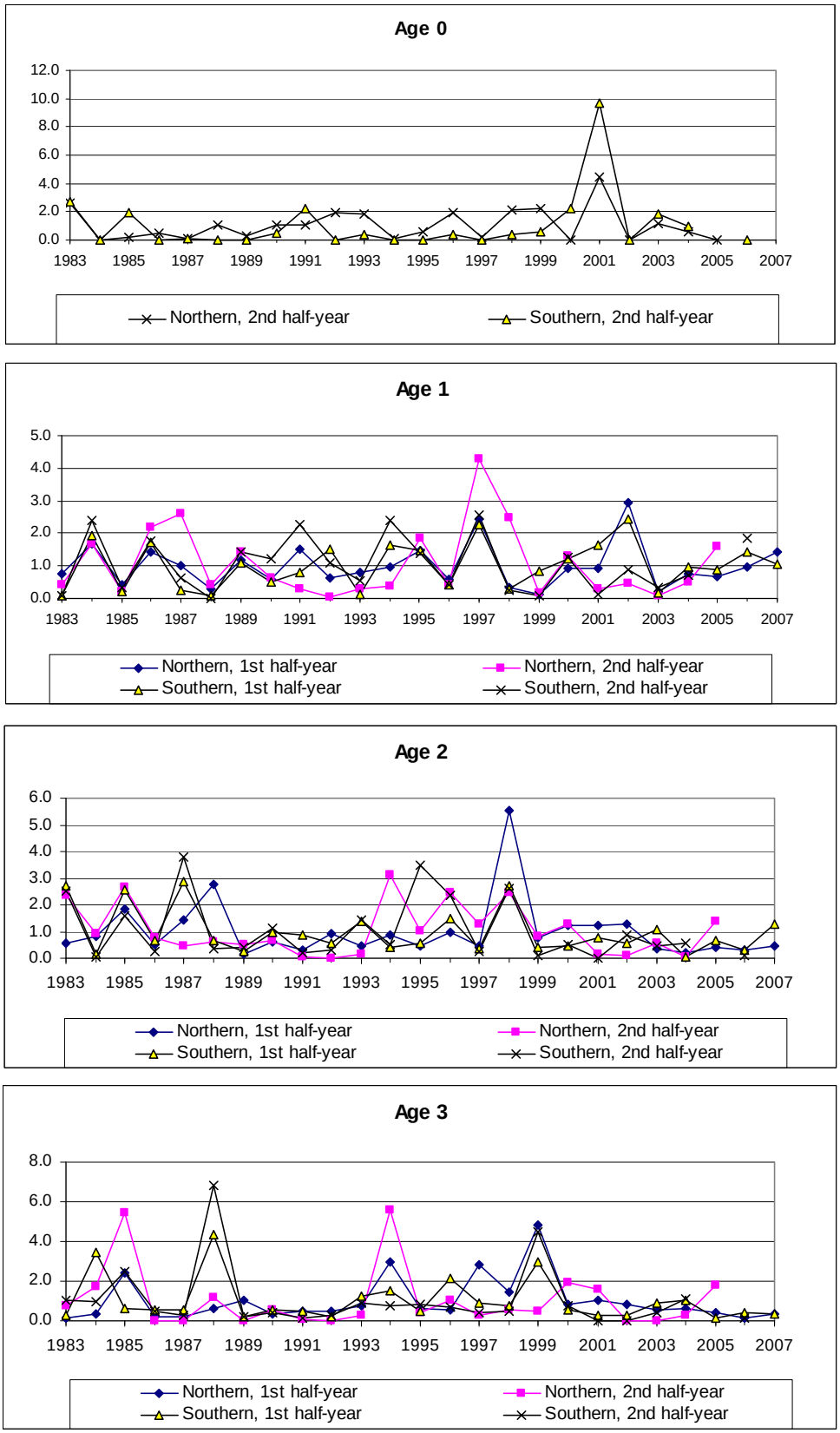


Figure 4.2.5.3 SANDEEL in IV.

CPUE (ton/day) by area age group and year.

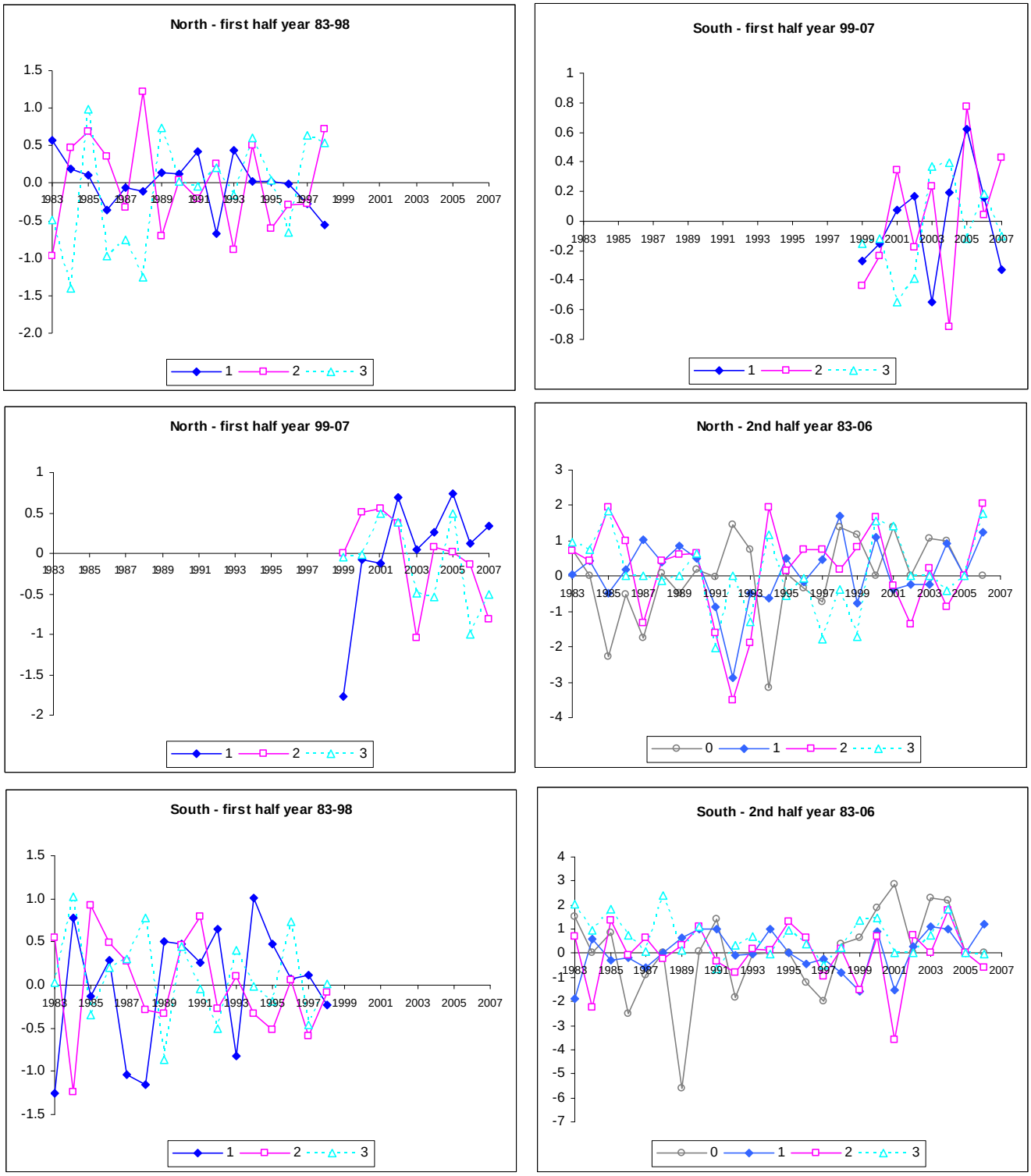
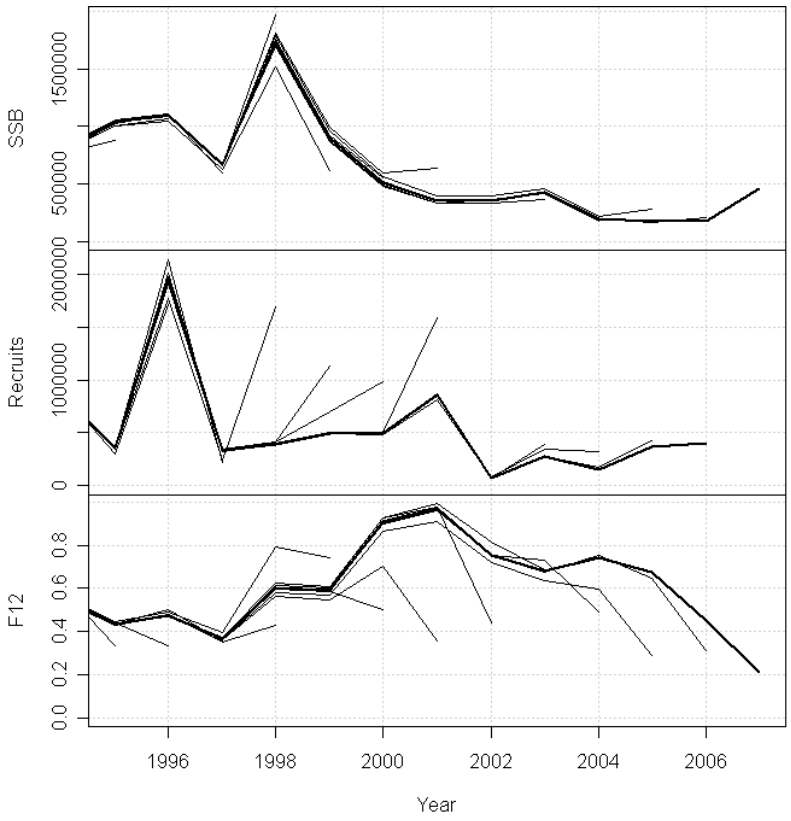


Figure 4.3.2.1 SANDEEL in IV.

Log residual stocknr. (nhat/n) by fleet. SXSA.

a) Retrospective analysis of SSB, recruitment, and F_{bar} 1995-2007 for the SXSA analysis.



b) Retrospective analysis of SSB, recruitment, and F_{bar} 2002-2007 for the SXSA analysis.

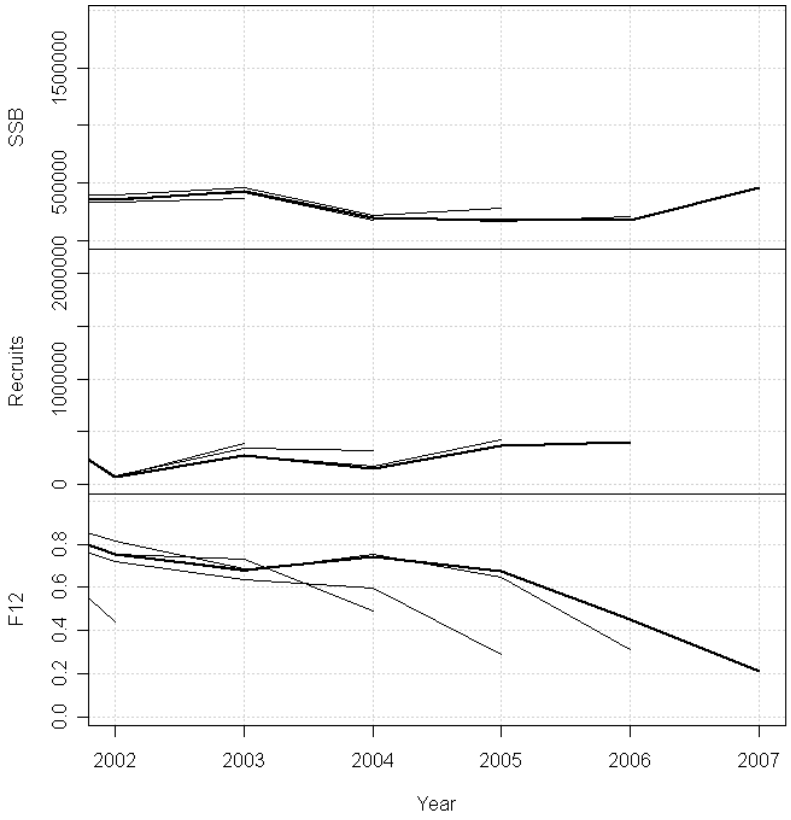


Figure 4.3.2.2. SANDEEL in IV.

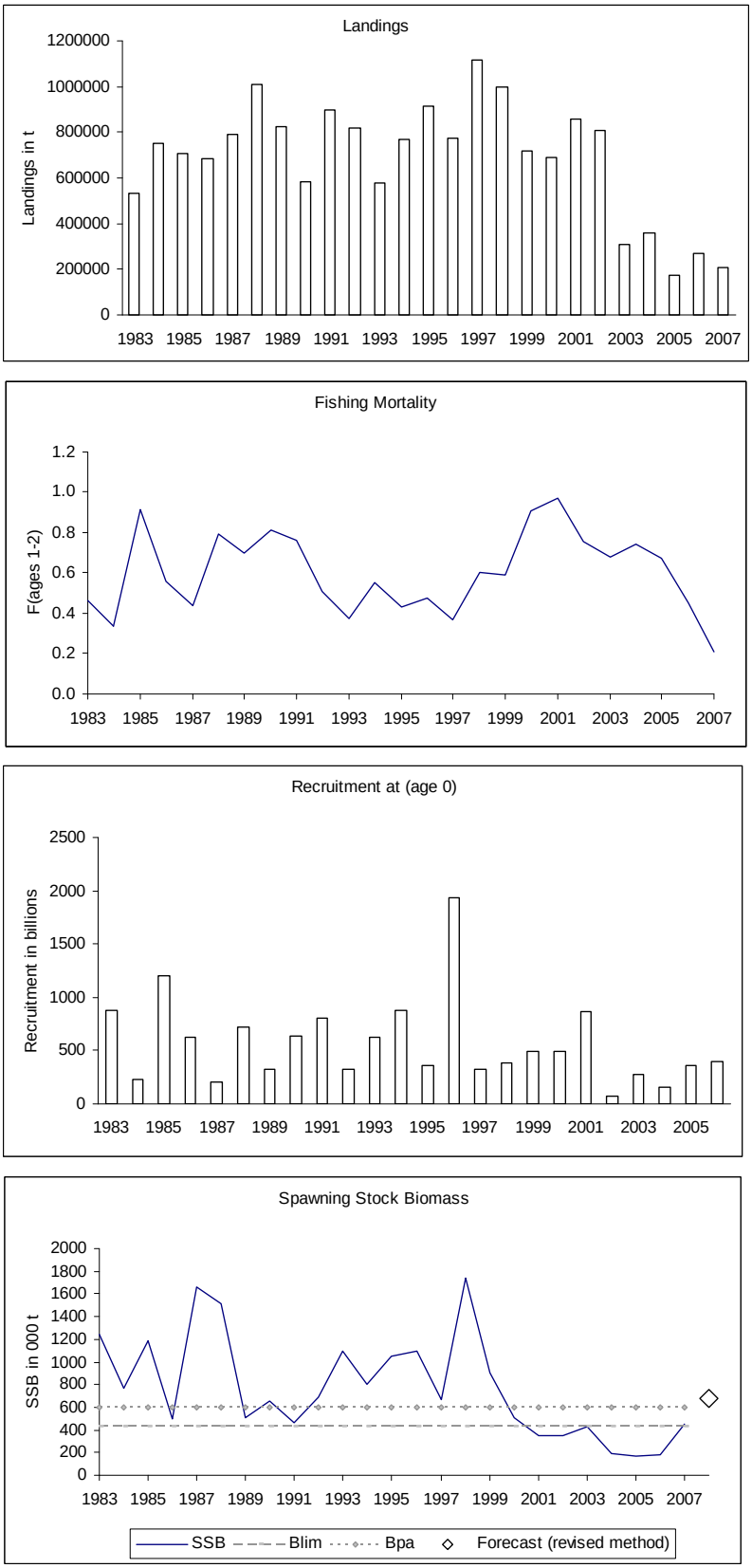
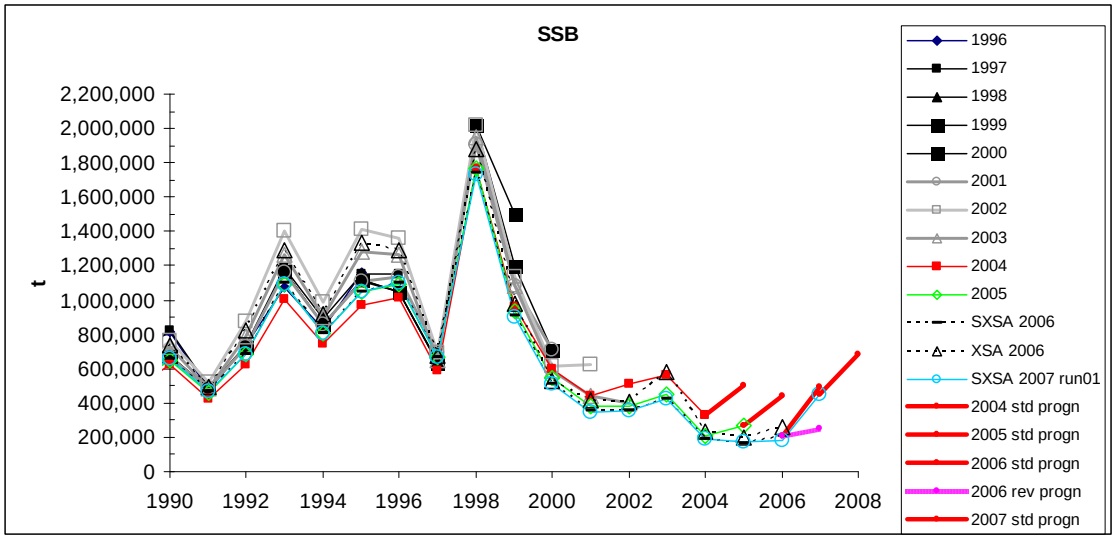
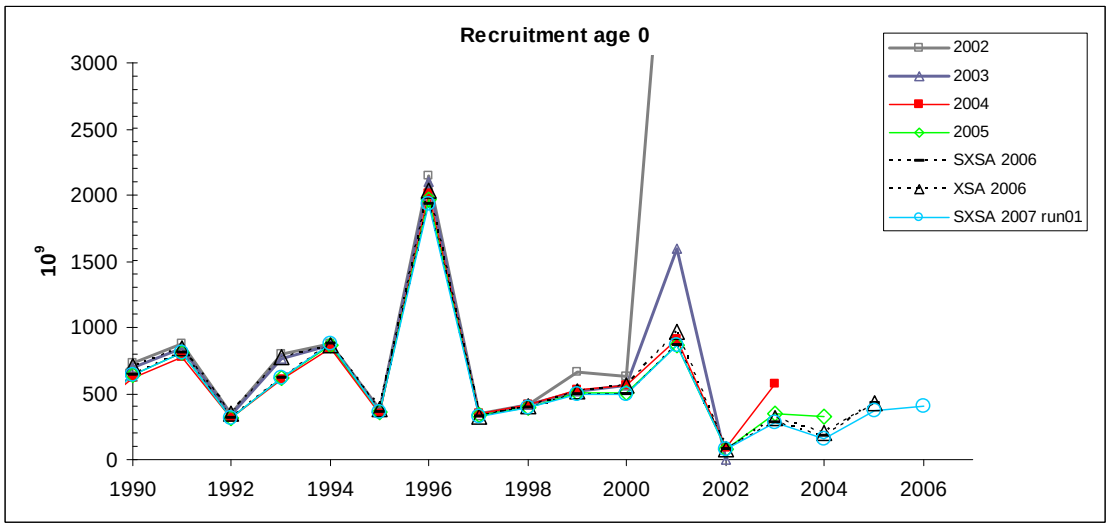


Figure 4.3.2.3. SANDEEL in IV.

SXSA Stock Summary.





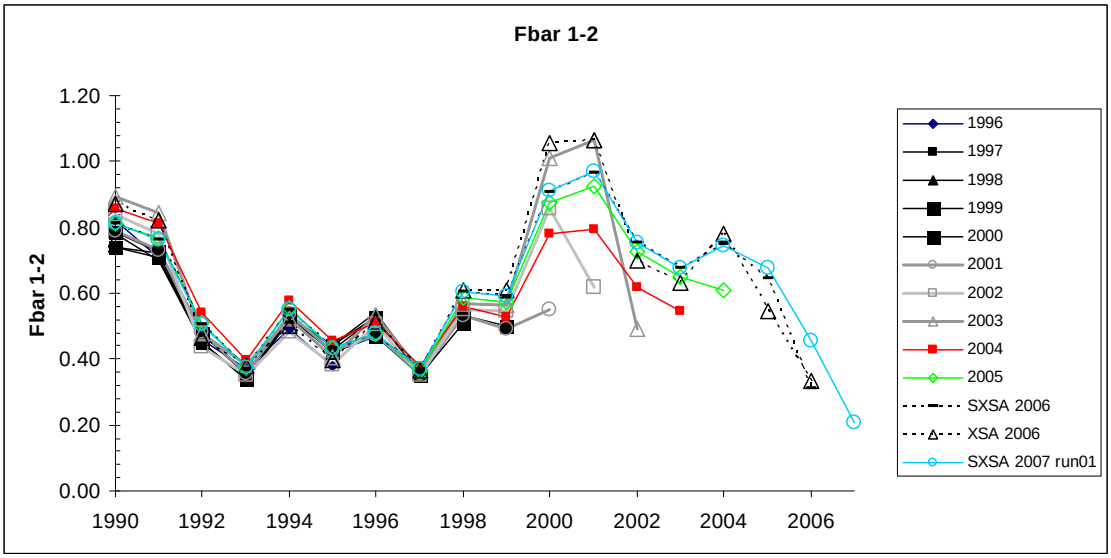


Figure 4.3.2.4. SANDEEL in IV.

Comparison of historical performance of assessments in 2007. F_{bar1-2} in 2007 based on data for only first half year of 2007.

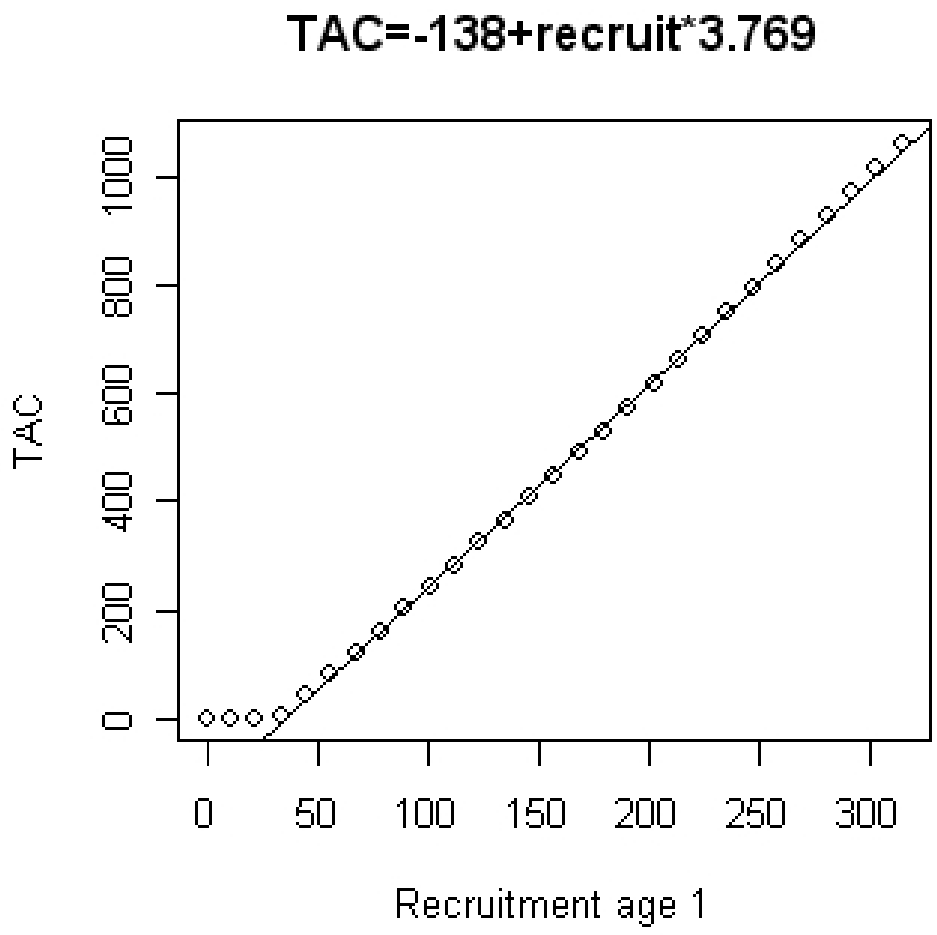


Figure 4.6.3. SANDEEL in IV.

Regression of recruitment in 2007 against TAC in 2008, where TAC in 2008 will lead to SSB in 2009 being B_{pa}.

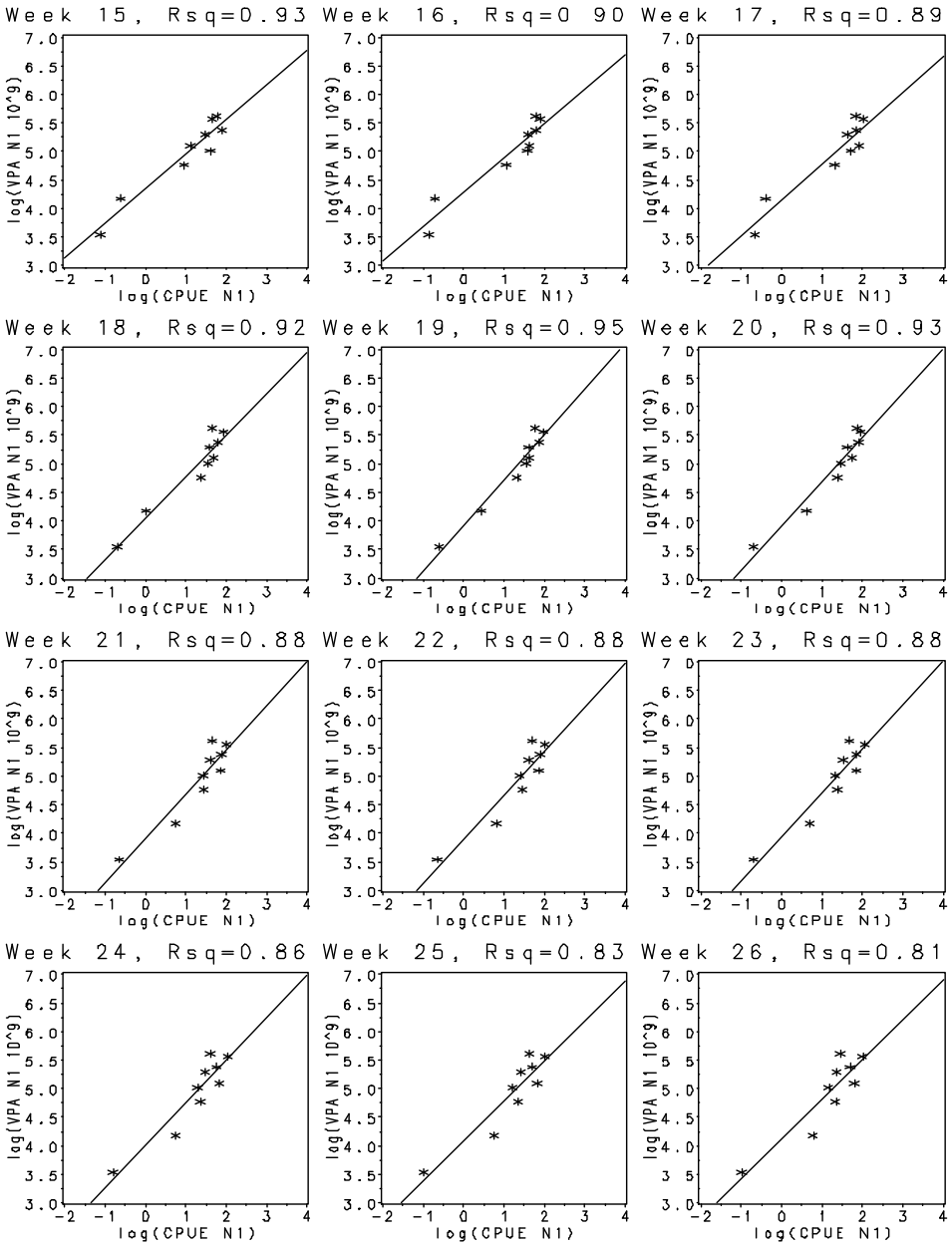


Figure 4.11.1. SANDEEL in IV.

Weekly regression analysis of log(VPA-1-group, billions) on cumulative log(CPUE 1-group, millions)