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International Council for the Exploration of the Sea

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1 North Sea

1.1 Ecosystem overview

1.1.1 Ecosystem components

Sea bed topography and substrates

The topography of the North Sea can broadly be described as a gradual slope from shallow (<50 m) in the south to deeper (100–150 m) in the north. The other main feature is the Norwegian Trench in the northeastern North Sea along the Norwegian coast into the Skagerrak with depths greater than 200 m. The shallow area is found south of a line drawn from 53°N on the UK coast to 57°N on the Danish coast. The 100-m contour runs approximately east to west at around 58°N. The remainder, up to 62°N, is between 100 and 200 m deep in the west and up to 500 m deep in the Norwegian Trench area in the east. Further to the southeast, the Kattegat east of Denmark is also a marked shallow watershed. The substrates are dominated by fine muds and sands in the main part of the North Sea, and the general trend is towards coarse sands and gravels in patches to the east and west. The area around and to the west of the Orkney/Shetland archipelago is dominated by coarse sand and gravel. The deep areas of the Norwegian trench are mostly fine mud; however, some of the slopes have rocky bottoms and several underwater canyons extend further towards the coasts of Norway and Sweden. A number of sand banks across the North Sea qualify for protection under the EU habitats directive, mainly along the UK coast, the eastern Channel, and the approaches to the Skagerrak. Extensive biogenic reefs of *Lophelia* have recently been mapped in the Norwegian part of the eastern Skagerrak.

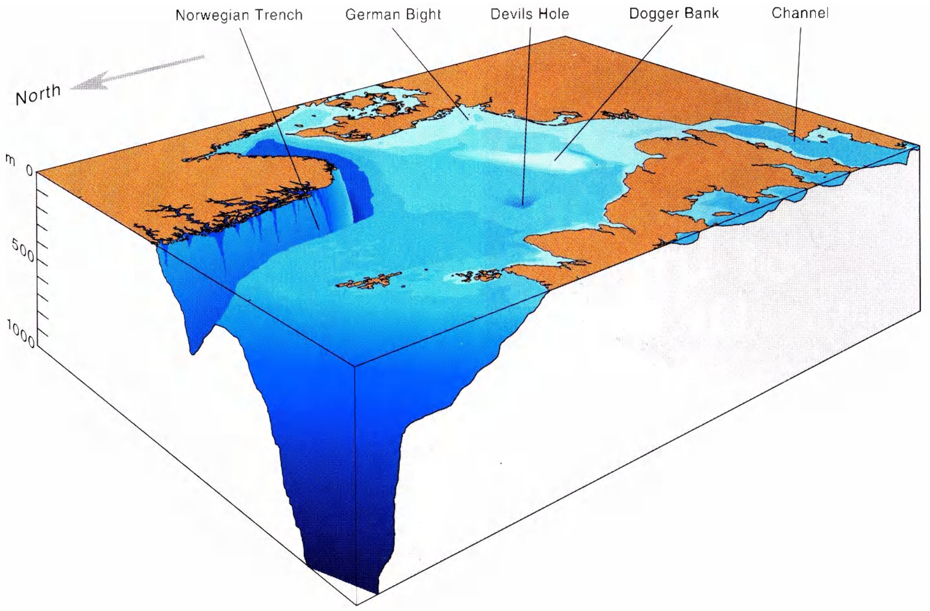

Figure 1.1.1 Bathymetry of the North Sea.

Circulation patterns

Circulation in the North Sea is classically presented as an anticlockwise gyre driven mainly by wind forcing. However, modelling and some empirical observations suggest that this may be reversed some of the time as a result of wind forcing, and may also split into two gyres in the north and south. Circulation may even cease for limited times (Kauker and von Storch, 2000). Empirically, it seems likely that these changes and their timings may be important for fish stocks, e.g. the transport of larval herring to nursery areas in the southeastern North Sea. However, no precise data on these changes have been found. The main inflows are of warm and more saline North Atlantic water along the shelf break into the Norwegian Trench, and also around the Shetland Islands. The strength of these inflows has been linked to zooplankton and fish distributions. Atlantic water also enters into the southern North Sea, via the Channel (Hughes and Lavin, 2004). The eastern Skagerrak and the Kattegat are strongly influenced by the brackish surface water entering from the Baltic, following the Swedish coast and turning west along southern Norway. However, the bottom water layer, which runs below the brackish water layer in the opposite direction, is of oceanic origin, giving rise to similar bottom fauna components as commonly found in the North Sea proper. There are a number of known frontal systems in the North Sea (e.g. Fair Isle, Flamborough, and Skagerrak). Changes in these frontal systems would be expected to be important for several fish species and would merit monitoring.

Physical and chemical oceanography

North Sea oceanographic conditions are determined mainly by the inflow of saline Atlantic water through the northern entrances, and to a lesser degree through the Channel. This mixes with river runoff and lower-salinity Baltic outflow along the Norwegian coast. The temperature of the North Sea is largely controlled by local solar heating and atmospheric heat exchange. The salinity and the temperature of the North Sea generally reflect the influence of the North Atlantic Oscillation (NAO) on the movement of Atlantic water into the North Sea and the ocean-atmosphere heat exchange. Numerical model simulations show strong differences in the North Sea circulation, depending on the state of the NAO. A balance of tidal mixing and local heating forces the development of a seasonal stratification from April/May to September in most parts of the North Sea. This stratification is absent in the southern part of the North Sea (up to 100 km from the Dutch/German coast) throughout the summer. The extent and duration of this mixed area is probably an important environmental factor for fish in this area. Recently, the NAO index (Hurrell winter index) was weak after having been strongly negative in 2001. The ICES Annual Ocean Climate Status Summary (IAOCSS) for 2003/04 suggests that it may have been negative in the winter of 2003/04. A negative NAO would suggest colder and drier weather conditions in the North Sea (Hughes and Lavin, 2004).

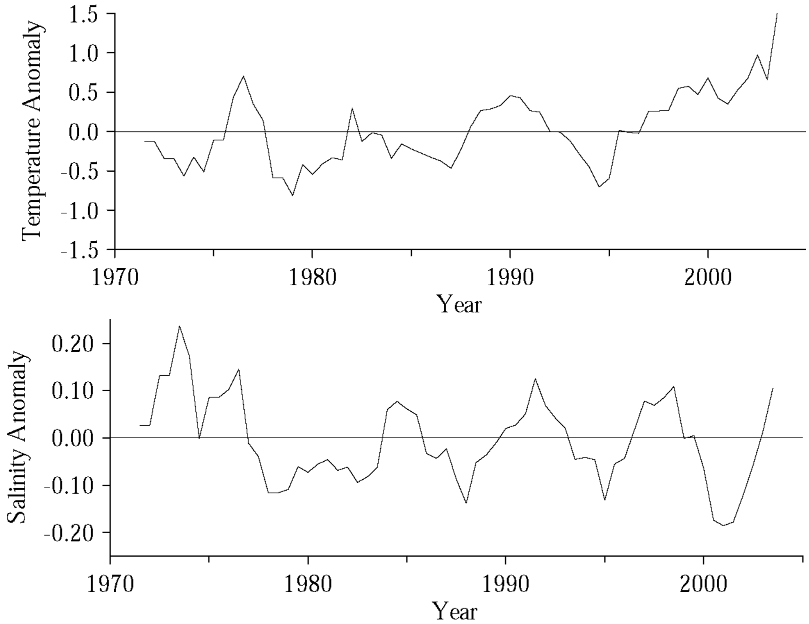

Figure 1.1.2 Temperature and salinity anomalies in the Fair Isle Current (FIC) entering the North Sea from the North Atlantic.

Both 2003 and 2004 were unusually warm years, particularly in August and September. The inflowing Atlantic water was also warmer than the long-term mean. The temperature anomalies can be overstated, however. While August in 2003 was the warmest on record since 1968, the pattern was closer to average from December 2002 to May 2003. The increased temperature was evident in deeper waters as well as at the surface. Surface salinity levels have also risen in the recent years, but from a recent low value to close to the long-term average. Initial indications from a coastal monitoring site in the north western North Sea suggest that summer temperatures in 2004 did not quite reach the extremes of 2003; however, Norwegian stations suggest similar or higher summer temperatures, at least in the Atlantic inflow (www.marlab.ac.uk/FRS.web/Delivery/display_standalone.aspx?contentid=1166).

There is perceived to be considerable eutrophication in some areas of the North Sea, particularly in the Wadden Sea area, the southern part of the Kattegat and coastal part of the Skagerrak, and shallow waters and estuaries along the UK and the European mainland coast. Below the halocline decomposition of organic matter may occasionally cause oxygen deficiency during late summer/autumn. This phenomenon may be linked to enhanced primary productivity but can be a natural process, especially in enclosed inshore areas such as the Kattegat, fjords, and estuaries. The problem is accelerated by large-scale eutrophication of the coastal waters (Karlsson *et al.*, 2002).

Major climatic and oceanographic features

See the general text on this topic in the separate section on the Northeast Atlantic (see Volume 1 section 2.1)

Phytoplankton

Primary productivity in the North Sea is dominated by diatoms and dinoflagellates. Up to the 1970s this was classically seen as following a spring/autumn bloom pattern. This is borne out by Continuous Plankton Recorder (CPR) "greenness" values. Since the 1970s this separation has become increasingly blurred and primary production has been continuous over much of the year. This longer and less bipolar productivity has led to a much greater primary production in all recent years. At the same time this production has involved a reduction in diatom production and an increase in dinoflagellates. Both trends appear to be continuing in the most recent years in the North Sea. Theoretically this should provide more food at the base of the food web (SAHFOS, 2003). After the recent changes the primary productivity in the North Sea can be considered as stronger and lasting longer than in adjacent Atlantic waters.

Zooplankton

Zooplankton production in the North Sea is dominated by copepods and euphausids, both important food items for many key commercial fish stocks. Zooplankton change in the North Sea has been linked to Atlantic inflow patterns across the twentieth century (Reid *et al.*, 2003). CPR and other data sources show that the abundance of copepods (particularly *Calanus finmarchicus*) has declined dramatically in the last 10 years (Heath *et al.*, 1999, and www.marlab.ac.uk/ FRS.web/Uploads/Documents/Zooplankton.pdf). This decline shows a strong link to the NAO and can be linked to spring wind patterns and the volume of cold bottom water in the Faroe-Shetland Channel rather than to conditions in the North Sea *per se*. At the same time the relative proportions of *C. finmarchicus* to *C. helgolandicus* have changed markedly. Up to the 1970s *C. finmarchicus* was dominant, representing around 70% of the zooplankton biomass. In recent years (since 1995) the copepod abundance has been dominated by *C. helgolandicus*. Additionally, *C. helgolandicus* is generally a smaller and less valuable prey than *C. finmarchicus*. *C. finmarchicus* is seen as a coldwater species, while *C. helgolandicus* is generally considered a more warmwater species. The CPR data also show a reduction in euphausid availability. This trend appears to be continuing, and links have been made with cod and flatfish recruitment (Beaugrand *et al.*, 2003; Beaugrand, 2004) as well as with herring growth and migration patterns. It seems likely that if both cod and herring life histories are linked to zooplankton availability, there may also be implications for other demersal and pelagic species.

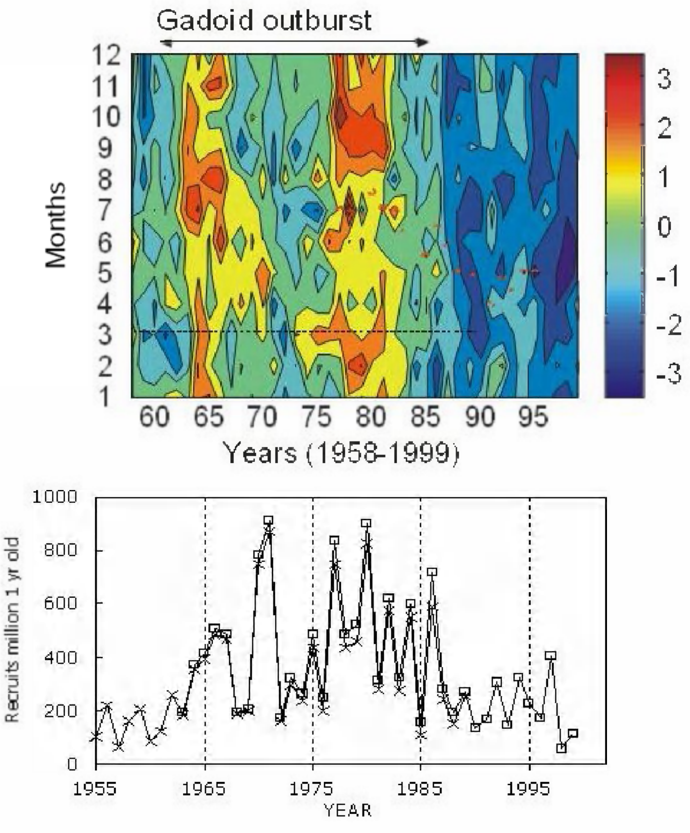

Figure 1.1.3 Top plot: long-term monthly changes (1958–1999) in the Beaugrand *et al.* (2003) plankton index. A negative anomaly in the index indicates a low value for *Calanus finmarchicus*, euphausiids, and mean size of calanoid copepods, with the exception of *C. helgolandicus* (opposite pattern) and *Pseudocalanus* spp. (no relationship). A positive anomaly indicates a high abundance of prey (and prey of suitable size). The lower plot shows cod recruitment in the North Sea. The period of the

Gadoid Outburst is also indicated. Source: SAHFOS (2003) – modified, from Beaugrand *et al.* (2003).

Benthos and larger invertebrates

The 50-m, 100-m, and 200-m depth contours broadly define the boundaries between the main benthic communities in the North Sea, with local community structure further modified by sediment type (Künitzer *et al.*, 1992; Callaway *et al.*, 2002). Descriptions of the spatial distribution of infaunal and epifaunal invertebrates show that the diversity of infauna and epifauna is lower in the southern North Sea than in the central and northern North Sea. However, large spatial scale gradients in biomass are not so pronounced. Bottom temperature, sediment type, and beam trawling intensity have been identified as the main environmental variables affecting community structure, but the relationships are not necessarily causal. Epifaunal communities are dominated by free-living species in the south and sessile species in the North.

In areas with periodical oxygen deficiency e.g. in the Kattegat, benthic fauna are affected by mortality and reduced growth (Diaz and Rosenberg, 1995). This may in turn cause shortage of food for demersal fish.

Directed fisheries exist for *Nephrops norvegicus, Pandalus borealis,* and brown shrimp *Crangon crangon.*

Fish community

Dominant species

The pelagic component of the North Sea fish community is throughout the year dominated by herring and to some extent sprat. Mackerel and horse mackerel are mainly present in the summer half year when they enter the North Sea from the south and from the northwest. Dominating gadoid species are cod, haddock, whiting, and saithe, whereas the main flatfish species are dab, long rough dab, plaice, sole, and lemon sole. The major forage fish species in the North Sea are sandeels, herring, sprat, and Norway pout. The total biomass of North Sea fish is in the order of 10 million tonnes.

The late 1960s and early 1970s were characterised by a sudden and yet unexplained increase in the abundance of a number of gadoid species, the 'gadoid outburst'. In this period the gadoids: cod, haddock, whiting, and saithe, all produced a series of strong year classes. Since the early 1980s, however, the stocks of these species have been decreasing and especially cod is at the lowest level observed over the last century. North Sea herring was heavily overfished in the 1960s and 1970s. After a closure of the fishery in the late 1970s the stock has increased again and is now above precautionary levels.

Over the last decade a number of so-called 'southern' species have increased in abundance, which is probably a response to the raise in water temperatures (Beare *et al.*, 2004).

Size spectrum

On the basis of three trawl surveys Daan *et al.* (2005) have shown that abundance of small fish (all species) as well as abundance of species with a low maximum length (demersal species only) have steadily and significantly increased in absolute numbers over large parts of the North Sea during the last 30 years (for comparison along the Swedish Skagerrak coast see Svedäng, 2003). At the same time the abundance of the larger fish species decreased.

Biomass/abundance of crucial species in the food chain

Landings of Norway pout in recent years were the lowest of the past two decades. Spawning biomass of sandeel was at the lowest level ever observed in 2004. Sandeel are an essential component of the diet of most piscivorous fish species as well as birds and marine mammals and their low abundance is therefore expected to have severe implications for the whole North Sea ecosystem.

Status of vulnerable species

Certain species that have been fairly common in the North Sea have disappeared completely (e.g. tuna) or have become very rare (e.g. halibut). Recently, species like hake and pollack in the Skagerrak and Kattegat are decreasing.

The stocks of most elasmobranchs are at low levels. The spurdog (*Squalus acanthias*) was once the most common shark species but is now considered to be depleted to approximately 5% of its virgin biomass in the whole Northeast Atlantic (Hammond and Ellis, 2005). Species such as porbeagle and tope have become rare. Most ray species are at low levels and have disappeared from large parts of the North Sea (Walker and Heessen, 1996).

Fish population structure

There is generally an apparent lack of information about the population structure of many important fish species such as cod in the North Sea, Skagerrak, and Kattegat, both in a genetic sense and with regards to spatial distribution of spawning aggregations. For instance, due to the disappearance of local spawning subpopulations in the last 20 years, the North Sea spawning stock has become increasingly more important for the recruitment of cod in the Kattegat-Skagerrak area (Svedäng, 2003; Cardinale and Svedäng, 2004).

Notwithstanding uncertainties concerning the cod meta-population structure in the North Sea region, historic spawning aggregations are well known from various parts of the area, and it may be argued that such aggregations are important aspects of the cod meta-population structure. Remaining cod spawning aggregations may thus not necessarily give a reassurance of a readily recovery of the stock biomass in the Kattegat or in the North Sea, even if the fishing intensity is substantially reduced.

Birds

About 2.5 million pairs of seabirds breed around the coasts of the North Sea. The seasonal distributions, current and historical, of these populations are quite well known. Some progress was made in tabulating the current status (i.e., size) and trends of seabird populations in some parts of the North Sea. The seabird fauna is dominated by seagulls (black-headed gull, mew gull, lesser black-backed gull, herring gull) kittiwakes, fulmars, terns, common guillemots, and puffins. There is an observed increase in the number of cormorants in coastal areas in the southern North Sea and in the Kattegat. Certain fisheries activities disturb various species such as marine birds and mammals. Recent restrictions to the North Sea sandeel fishery in order to safeguard food for birds and mammals and the driftnet ban to protect sea mammals are examples where environmental problems were the origin of fisheries management actions. Seal population trends have by ICES been recommended as useful EcoQ elements. Similarly, trends in individual colonies of kittiwakes might serve as an index of seabird community health.

Mammals

Seven marine mammal species occur regularly and frequently in the North Sea, others occur in low numbers or in small parts of the area (e.g., orca whale, Risso's dolphin, sperm whale). The cetacean species that occur regularly are: harbour porpoise (*Phocoena phocoena*), white-beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus*), and minke whale (*Balaenoptera acutorostrata*). The seal species are the harbour seal (*Phoca vitulina*) and the grey seal (*Halichoerus grypus*). The only abundance estimate in the North Sea for harbour porpoises is 262,540 individuals. This estimate was made in 1994 (Hammond *et al.*, 2002) and included the whole North Sea and the Channel. The Kattegat and part of the Skagerrak had an additional estimate of 36,046 harbour porpoises.

1.1.2 Major environmental influences on ecosystem dynamics

No specific environmental signals were identified specifically to be considered in assessment or management in this area in 2005.

1.1.3 Fishery effects on benthos and fish communities

Large-scale discarding is known to occur in the mixed demersal trawl fisheries in the North Sea. In the roundfish fishery (cod, haddock) discards will mainly consist of small-sized specimens of the target species, or of unwanted bycatch of landable size. In the flatfish (plaice, sole) and the *Nephrops norvegicus* fishery there is also discarding of a variety of macrobenthos species.

Bottom trawling modifies the biomass, production, size structure, and diversity of benthic communities, with the intensity and patchiness of bottom trawling disturbance determining the aggregate impacts (ICES, 1999). One recent estimate suggests that beam trawling in the southern and central North Sea beam trawl fleets reduces total benthic biomass by 39% and benthic production by 15% relative to the unfished state (Hiddink *et al.*, in press), but similar estimates are not available for most other fleets. Historically, trawling effort has been greatly concentrated in preferred fishing grounds. Cumulative trawling impacts would increase if trawling effort were spread more homogeneously or relocated, particularly to more vulnerable habitats, because the first impacts of trawling on a previously untrawled community are greater than subsequent effects (Duplisea *et al.*, 2002). For example, the cod box closure of 2001 led to the beam trawl vessels fishing in previously unimpacted areas (Rijnsdorp *et al.*, 2001), and led to a greater reduction in the total productivity of benthic communities (Dinmore *et al.*, 2003).

Many management actions could result in effort redistribution that could increase fishery impacts on benthic communities and habitats. Fisheries management should consider this factor, and seek to implement measures which do not provide incentives for the industry to relocate effort to new areas.

The principal effects of fishing on the size and species composition of the North Sea fish community has been that as fishing mortality rose, the mean size of individuals in the community fell, and species with larger body sizes formed a smaller proportion of community biomass (Gislason and Sinclair, 2000). This is reflected in the steeper slopes of size spectra (Rice and Gislason, 1996), reductions in the abundance of large species, such as many elasmobranchs, with low intrinsic rates of increase (Walker and Heessen, 1996; Walker and Hislop, 1998), increases in abundance of many smaller species (Greenstreet and Hall, 1996; Heessen and Daan, 1996; Greenstreet *et al.,* 1998; Daan *et al.*, 2003; 2005). The changes in size composition of the community redistribute predation mortality among species and sizes of fish, and these changes are taken into account in the natural mortality values used in assessments. Changes in size composition of species and communities due to overfishing can also affect population fecundity both directly (reduction of larger, more fecund spawners), and indirectly (earlier maturation at smaller sizes). These changes are considered when setting reference points as well as when providing management advice to protect the productivity of the exploited resources.

The long-term effects of an eroded population structure must be considered. The differences between the various subpopulations may be behavioural or genetic, but go unobserved by both the fishers and by regulators who believe there is a gradual decline in one big stock while in fact they are witnessing the successive disappearance of a series of sub-populations. Fishing also has differential effects on species with contrasting life histories (Jennings *et al.,* 1999), with many large and vulnerable species subject to unsustainable mortality rates when taken as bycatch in mixed fisheries. Management should take account of the status of these species, and ensure that fishing mortality on bycatch species does not exceed estimates of sustainable mortality for vulnerable species (e.g. Pope *et al.*, 2000).

1.1.4 Important topics for further research

Many of the issues which arise in the North Sea, and for which additional research is necessary for improved scientific advice, are also issues in the other ecological areas. However, because of the greater availability of data and information for the North Sea, and the focused scientific effort historically and currently through for example REGNS, it may be appropriate to highlight the research needs for this area. Progress in this area should be viewed with regard to implications for other areas, however, and opportunities for collaborative and integrative work should be sought:

- Community ecology: what are the ecological effects of a diminishing size spectrum and a dominance of prey species like herring? Can these changes be readily reversed through management?
- Temperature preferences, i.e. what are the effects of climate change on reproduction, egg mortality, growth, and the implications for changes in stock population dynamics and distributions?
- What are the consequences of the loss of meta-population structure and erosion of spawning aggregations in depleted populations?
- There should be better estimations of population fecundity, i.e. better understanding of reproduction biology, including better estimates of maturity ogives, variation in maturation rates, and the linkage between maturation, growth, and temperature, for a more realistic view of stock productivity.

Using this information, it is important to investigate and test management strategies which would be sustainable in the face of these dynamic ecological conditions: how to preserve the productivity of the seas and have some revenues from fishing at the same time.

1.1.5 Synthesis

The presently observed low abundance of species that play an important role in the North Sea food web (*Calanus*, sandeels, and Norway pout) is expected to have considerable impact on growth, maturation, and possibly recruitment of a range of fish species and on the breeding success of seabirds.

Many North Sea fish stocks are presently seriously depleted (e.g. cod). Recruitment of commercially important gadoids is at a low level and the ecosystem may be changing in an irreversible direction. Another phenomenon worth mentioning is the apparent increase in the presence of a number of southern species. In the case of red mullet *Mullus surmuletus* the increase is so significant that a new fishery is developing.

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1.2 The human use of the ecosystem

1.2.1 Overall impacts

1.2.2 Fisheries

The fisheries in the North Sea can be grouped into demersal and pelagic human consumption fisheries and into industrial fisheries, which land their catch for industrial purposes. Demersal human consumption fisheries usually target a mixture of roundfish species (cod, haddock, whiting), or a mixture of flatfish species (plaice and sole) with a bycatch of roundfish or *Nephrops* generally taken in a multi-species fishery. A fishery directed at saithe exists along the shelf edge. The catch of these fisheries is landed for human consumption. The pelagic fisheries mainly target herring, mackerel, and horse mackerel. Although most of the landings of these species may be landed for human consumption purposes, part of the landings is used for fishmeal and fish oil. The catch of the industrial fisheries mainly consists of sandeel, Norway pout, and sprat. The industrial catches also contain bycatches of other species, including herring, haddock, and whiting. In addition to the finfish fisheries, smaller fleets exist which fish for crustaceans, including *Nephrops*, *Pandalus,* and brown shrimp (*Crangon crangon*), both of which are associated with medium to high by-catch and/or discard rates of commercially important species (Madsen and Hansen, 2001; Graham, 2003; Anon, 2004).

Each fishery uses a variety of gears. Demersal fisheries: otter trawls, pair trawls, twin trawls, seines, gillnets, and beam trawls. Pelagic fisheries: pelagic trawls and purse seines. Industrial fisheries: small-meshed otter trawls, pelagic trawls, and purse seines.

Some major technological developments changed the fisheries in the North Sea during and after the 1960s such as the development of the beam trawl fishery for flatfish, purse seines in the pelagic fishery, and large pelagic trawls to replace driftnets. In recent years multiple twin trawls have been introduced in the fishery for flatfish, roundfish, and the mixed fish/*Nephrops* fishery. The introduction of power blocks in the 1960s has enormously increased the possibilities for the purse seiners. Right up to the present time further development of electronic equipment such as satellite navigation, fish finders, and sonar as well as advances in vessel design has increased the fishing efficiency of the fleets.

The trends in landings or catch of the most important species targeted by these fleets since 1970, together with the total international landings or catch, are shown in Table 1.2.2.2 and in Figure 1.2.2.1. The demersal landings have steadily declined over the period. The pelagic catches, dominated by herring, decreased to a minimum in the late 1970s, when the fishery for herring was closed, but increased again up to over 1 million t in the period 1987–1995. In 1996 they were reduced by about half and have again slightly increased since 2002. The landings in the industrial fisheries increased to approximately 1.5 million t in the mid-1970s, and have fluctuated around 1 million t from 1980 onwards. These landings show the largest annual variations, due to the short life span of the species. The industrial landings have suddenly dropped to below 400 thousand tonnes in 2003. Total landings from the North Sea reached 3 million t in the.

Landings by fleet segment in the North Sea and Skagerrak demersal fisheries in 2003 and 2004 are shown in Table 1.2.2.3 and figure 1.2.2.2. The table and figure allow comparisons between different fleet segments. Some discard estimates are included in the table, but in many cases the estimates of discards are based on extrapolations from very limited sampling and should only be considered as indicative of the potential amount of discards.

Most commercial species are managed by TAC/quota regulations that apply to Subarea IV, or to a combination of Subarea IV with an adjacent area. The national management measures with regard to the implementation of the quota in the fisheries differ between species and countries. The industrial fisheries are subject to regulations for the bycatches of protected species.

Fishing effort by demersal fleet segment between 2000 and 2004 are shown in Table 1.2.2.4 and figure 1.2.2.3. A longer time series of effort from selected countries (for which data was available) is shown in figures 1.2.2.5 and 1.2.2.6. Effort by demersal fishing fleets in the North Sea and Skagerrak has decreased in recent years. The strongest decrease was observed after 2000 in the demersal trawl fishery with mesh size over 100 mm. Some of the effort that was removed from that fishery has been used to increase the fishing effort in the demersal trawl fishery with 70-99 mm (Nephrops fishery, twintrawl fishery). Fishing effort in the beamtrawl fleets has decreased over a longer period but the decline after 2000 is less pronounced.

Stock status

In the past 10 years the state of the stock for most roundfish and flatfish species in the North has further deteriorated. Some of these stocks have reached a historical low within this period. One of the major causes of this deterioration is the continuous very high level of exploitation. This exploitation has lead to a reduction in the number of age groups in the stocks and fishing opportunities have consequently become more dependent on the success of recruitment. Recruitment for most stocks is very variable. For a number of species (cod, plaice) recruitment in the recent decade has been lower than in previous decades. At the same time it is observed that a number of species (cod, haddock, whiting, sole, and plaice) simultaneously show a reduction of growth. Southern species like sea bass and red mullet have increased in the North Sea and have sometimes attracted a new fishery. There is considerable speculation on the reasons for the observed changes. The reduction in recruitment can be explained by a reduction in the production of eggs by the reduced spawning stocks, but it cannot be excluded that changes in the environment play a role. In the last 10 years the climate has changed not only on land but also in the sea, and mean temperatures in the sea have increased. Changes in the sea currents have also been observed. The changes in environmental conditions may also be responsible for changes in the distribution and abundance of the different species.

All roundfish and flatfish stocks in the North Sea have been exposed to high levels of exploitation. The present assessments indicate that the fishing mortality in recent years has been reduced for haddock, saithe, sole, and plaice (human consumption fishing mortality only). This coincides with an overall decrease in fishing effort (see above). The total catches (landings and discards) of cod, haddock, saithe, whiting, sole, and plaice peaked in the late 1960s and early 1970s around 1.5 million t per year (Figure 1.2.2.1). Since then the catches have gradually decreased to less than 0.4 million t in 2004. The aggregate fishing mortality has been above the aggregate $\mathbf{F}_{pa}$ since 1974, but has decreased to below in the most recent three years.

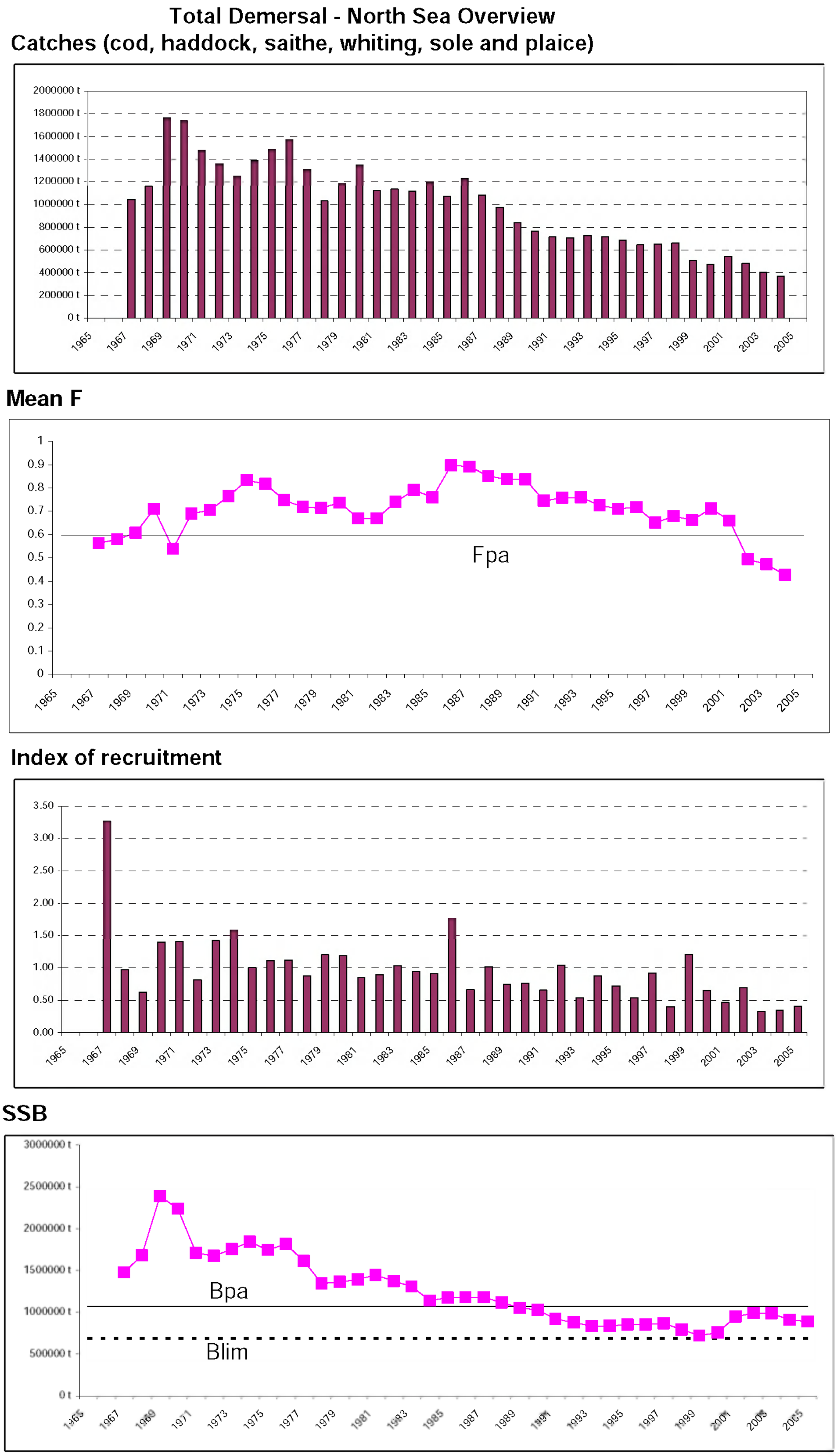

Figure 1.2.2.1 Aggregate historical stock development for North Sea cod, haddock, saithe, whiting, sole, and plaice.

Multispecies assessments have shown that there are indications of changes in natural mortality for a number of North Sea stocks. For haddock and cod these changes entail a reduction in natural mortality on the youngest ages due to a reduction in fish-predator abundances, and an increase in natural mortality on older ages due to increased abundance of grey seals. The single-species assessments models are only moderately affected by incorporating time-varying estimates in natural mortality and the assessments put forward by ICES do not include time-varying natural mortality.

Several technical measures have been implemented in the mixed demersal fisheries in the North Sea in 2001 and onwards. If implemented effectively, these measures are likely to impact the exploitation patterns for roundfish, and to a lesser extent flatfish. The effects of the new technical measures have so far been observed to a limited extent in changes in selection patterns or in weights-at-age in the landings. However, this may be confounded by shifts towards smaller mesh mixed *Nephrops* fisheries due to higher effort allocations in comparison to the 120-mm fleet segment.

The **herring** stock in the North Sea collapsed in the mid-1970s due to heavy exploitation, but has recovered after a closure of the fisheries between 1977 and 1981. In the mid-1990s it declined again. In 1996, effective management measures have been implemented to reduce the catches in both human consumption and industrial fisheries. These measures resulted in a considerable reduction in the fishing mortality in 1996–2001. Additionally, the North Sea autumn-spawning herring showed a very high recruitment over a number of years. The stock has been below $\mathbf{B}_{pa}$ until 2002, but has now recovered and is expected to remain at this level in the short term. Recruitment of the 2001 and 2002 year classes is well above average. However, the year classes from 2003 to 2005 appear to be low, and catch opportunities will be reduced in the medium term. Catches in the human consumption and industrial fisheries in the North Sea have increased from 450 000 t in 2003 to 550 000 t in 2004 (IV and VIId), following an increase of the TAC in recent years. The herring stock is exploited in the North Sea and the Channel (Downs herring) by human consumption fisheries. Bycatches of juvenile North Sea herring are taken in the industrial fishery for sprat in the North Sea and Division IIIa (Skagerrak/Kattegat).

The **sprat** stock fluctuates considerably between years. The actual state of the sprat stock is not precisely known, but the biomass is thought to be high at present. Landings in 2004 increased to 194 000 t.

The North Sea component of the Northeast Atlantic **mackerel** stock collapsed in the early 1970s. The 2002 and 2005 egg surveys in the North Sea with limited spatial and temporal coverage both indicate a higher egg production in the North Sea area than in 1999. However, this component is still considered to be severely depleted. Most of the mackerel catches taken in the northern North Sea in recent years originate from the western component. The total catch recorded from the North Sea in 2004 was about 297 000 t, which is 34 000 t less than the catches in 2003. There had been a trend of increasing catches in this area since 1996, but this trend has reversed in the last two years with a decline in catches since 2002. Misreporting of catches taken in this area into VIa has decreased by more than 50% of levels from previous years to 18 000 t. This component of the catch is highly variable and depends on the availability of mackerel to the fleet.

The present state of the North Sea **horse mackerel** stock is not known. In 2004 the catch was 35 154 tonnes, which is almost 3000 tonnes more than in 2003. Roughly one third of the catch is used for industrial purposes. Both the industrial and the human consumption fishery increasingly exploit younger fish in the southern North Sea and the Eastern Channel in the 1^{st} and 4^{th} quarter.

The estimated yield (landings and discards) for **cod in Subarea IV and Divisions IIIa and VIId** was the lowest in the historical time-series (34 500 t). Estimates of mortality in 2004 were extremely sensitive to sparse data from research-vessel surveys. Although the current level of fishing mortality is not precisely estimated, all data sources consistently indicate that SSB and recruitment were very low in 2004. Preliminary indications from the Scottish Q3 survey are that in the northern North Sea the abundance of the 0-group cod is higher than in recent years, but this perception is very uncertain and will need to be confirmed by subsequent surveys.

The strong 1999 year class again dominated the catches of **haddock in Subarea IV and Division IIIa** in 2004 (66 500 t). However, the contribution of this year class to the fishery appears to be drawing to a close, and this estimated yield was the lowest in the historical time-series. Recruitment following the 1999 year class has been low, and SSB will decline further in the short term. All sources of information agree that fishing mortality has declined rapidly in this fishery to at or near an historical minimum. Indications from the third-quarter Scottish groundfish survey are that the 2005 year class may be stronger than those in recent years. Haddock is known to produce strong recruitment only every 7–8 years.

Catches of **whiting in Subarea IV and Division VIId** have continued to decline, and are now at their lowest observed level (29 000 t). Recent information from both commercial fleets and research-vessel surveys indicate similar trends in mortality, biomass, and recruitment for the last 10 years, with all three being at their lowest observed levels.

The estimated SSB for **saithe in Subareas IV and VI and Division IIIa** is above $\mathbf{B}_{pa}$ and is apparently increasing. Fishing mortality is at or near the historic low, and recruitment remains just below the long-term mean. Considerable annual revisions of the saithe assessment are a direct consequence of the lack of survey or fishery information for younger age-groups. Reported landings for 2004 (104 000 t) were around the recent mean.

Landings of **sole in Subarea IV** in 2004 (17 000 t) were at a similar level as in recent years. SSB has fluctuated around a moderate level for several years and for 2004 was estimated to be above $\mathbf{B_{pa}}$. Fishing mortality appears to have declined rapidly in 2004 and, although uncertain, is now estimated to be below $\mathbf{F_{pa}}$. After the strong 2001 year class, recruitment has fallen back down to near the mean of the full time-series.

The yield of **sole in Division VIId** in 2004 was at or near the historic maximum. Fishing mortality is estimated to be around $\mathbf{F_{pa}}$. SSB is above $\mathbf{B_{pa}}$ (8000 t) following improved recruitment in recent years, particularly of the year classes 1998 to 2000 and 2003.

As last year, the assessment for **plaice in Subarea IV** included discards (based on sampling after 1999, growth modelling before 1999). Although reported landings for 2004 are at the lowest observed level (61 500 t), estimated total catches (120 000 t) are around the recent average. SSB is estimated to be stable, but low and fluctuating between $\mathbf{B_{pa}}$ and $\mathbf{B_{lim}}$. Fishing mortality is fluctuating around the proposed Fpa. Recent recruitment appears to be below average.

Plaice landings **in Division IIIa** have remained stable since 1997 with landings of 9000 tonnes in 2004. Historically, the TAC has not been restrictive for this stock. About 82% of the landings were taken in Skagerrak. The stock status is uncertain.

Landings of **plaice in Division VIId** were below the recent mean, and near the historical minimum. Discrepancies between catch-at-age based analyses and survey-based analyses has prevented ICES from assessing the state of this stock.

Landings in 2004 for **sandeel in Subarea IV** (359 000 t) remained at or near the same low level as in 2003. Landings in 2005 have continued this trend. Following the implementation of a real-time management plan, the fishery was closed in July 2005. Estimated SSB is at its lowest observed level. Fishing mortality has declined in recent years but is still high in comparison with the historical estimates, while recruitment remains low.

Landings for **Norway pout in Subarea IV** in 2004 (13 500 t) were the lowest observed. The directed Norway pout fishery remained closed during 2005, and only very limited bycatch was observed in other fisheries. Estimated SSB for this stock in 2004 was very near to $\mathbf{B_{lim}}$, fishing mortality was the lowest in the historical time-series, and recruitment was at or near the historical minimum.

The yields for stocks of ***Nephrops*** are fairly stable from year to year. Reported landings for Functional Unit 3 (Skagerrak, 2200 t), FU 4 (Kattegat, 1600 t), FU 5 (Botney Gut, 1100 t), FU 6 (Farne Deeps, 2200 t), FU 8 (Firth of Forth, 1100 t), FU 9 (Moray Firth, 1300 t), FU 10 (Noup, 230 t), and FU 32 (Norwegian Deeps, 900 t) are all at or near the respective recent averages. Both FU 7 (Fladen, 8700 t) and FU 33 (Off Horn Reef) are at their highest observed levels. Indications from TV surveys for FUs 6, 7, 8, and 9 are that stock densities are fluctuating about a long-term mean and are currently at high levels in FUs 6, 8 and 9.

The stock of ***Pandalus borealis*** in Division IVa (Norwegian Deep) and Division IIIa appears to be stable to sustain current fishing pressure. The state of the stocks in Division IVa (Fladen Ground) and Division IVb (Farn Deep) is not known, as data for assessments were insufficient. The fishery in the latter two areas is opportunistic, strongly influenced by stock abundance and market prices. Landings in 2004 were about 15 200 t.

The state of individual stocks is presented in more detail in the stock sections.

1.3 Assessments and advice

1.3.1 Assessments and advice regarding fisheries

Effects of fishing on the ecosystem

Sandeel and Norway pout

The ecosystem effects of industrial fisheries are discussed in the Report of the ICES Advisory Committee on Ecosystems, June 2003, Section 11 (ICES CRR 262). The direct effects of industrial fishing that have been identified on other species fished for human consumption, e.g. haddock and whiting, are relatively small in comparison to the effects of directed fisheries for human consumption species. Sandeel are important prey species for many marine predators. However, there is still relatively scant information on the effects of fisheries targeting these stocks (sandeel, Norway pout, sprat), and further analysis of the ecological impacts of these fisheries is required. The effects of variation in the sizes of most industrial stocks on their predators are also poorly known. The importance of these species in the food-web and the potential indirect effects of fishing are discussed in Section 1.1.

North Sea skates and rays

Elasmobranchs have been shown to generally have life history traits which result in them being able to sustain only low and some species of skates and rays are widely thought to have relatively high catchabilities in fishing gears. Taken together the vulnerability to capture and low rates of sustainable mortality have been proposed as major factors in the severe decline in the common skate from the Irish Sea and trends in a variety of other skates and rays. In 1998 ICES (WGECO) reported life history-based estimates of the maximum total mortality rate that were sustainable for 5 species of rays (common skate *Dipturus batis* – 0.38, thornback ray *Raja clavata* – 0.5, spotted ray *Raja montagui* – 0.54, cuckoo ray *Raja naevus* – 0.58, and starry ray *Raja radiata* – 0.87). In that report, ICES also reported that recent estimates of total mortality from survey catch data were greater than the theoretical sustainable mortality rates for three of the five species, and could not be estimated for a fourth, because this species was reduced to such a low abundance that current mortality rates could not be estimated. ICES (1997) advised some specified areas of the North Sea be closed to gears with a high by-catch of these species.

Recently ICES has developed and implemented analytical methods for estimating at least relative catchability of different fish species to different fishing gears (WGFE 2004). ICES is also in the process of changing the form of advice to advise on fleet-based effort levels consistent with the single-species catch boundaries of the suite of species taken by the fishery. When the methods of estimating catchability have been applied to skates and rays, the combination of fleet-based effort advice and gear-specific catchabilities will allow estimates of the maximum fleet-specific effort levels that can be exerted without exceeding the sustainable mortality rates for skates and rays. Then it will be possible to integrate the fishery- and fleet-based catch advice with the need to ensure that impacts on non-target species are also sustainable.

Mixed fisheries and fisheries interactions

Demersal fisheries in the area are mixed fisheries, with many stocks exploited together in various combinations in different fisheries. In these cases management advice must consider both the state of individual stocks and their simultaneous exploitation in demersal fisheries. Stocks in the poorest condition, particularly those outside safe biological limits, become the overriding concern for the management of mixed fisheries, where these stocks are exploited either as a targeted species or as a by-catch.

The exploitation of sole and plaice are closely connected as they are caught together in fisheries mainly targeting sole, which are more valuable. This means that the minimum mesh size is decided on the basis of the more valuable species, resulting in substantive discards of undersized plaice. The mixed fisheries for flatfish is dominated by a mixed beam trawl fishery using 80-mm mesh in the southern North Sea where up to 80% in number of all plaice caught are being discarded. Measures to reduce discarding in the mixed beam trawl fishery would greatly benefit the plaice stock and future yields. In order to improve the selection pattern, mesh size increases or configuration changes (i.e. square mesh), would help reduce the discards. However, this would result in a short term loss of marketable sole. Readjustment of minimum landing sizes corresponding to an improved selection pattern could be considered.

Roundfish are caught in otter trawl and seine fisheries, with a 120-mm minimum mesh size. This is a mixed demersal fisheries with more specific targeting of individual species in some areas and/or seasons. Cod, haddock, and whiting form the predominant roundfish catch in the mixed fisheries, although there can be important bycatches of other species, notably saithe and anglerfish in the northern and eastern North Sea and of *Nephrops* in the more offshore *Nephrops* grounds. Cod and whiting also comprise a bycatch in the beam trawl fisheries. Static gear fisheries with mesh sizes generally in excess of 140 mm are also used to target cod. Saithe in the North Sea are mainly taken in a directed trawl fishery in deeper water near the northern shelf edge and the Norwegian Deeps. There is little bycatch of other demersal species associated with the directed fishery.

For mixed demersal fisheries improvements to gear selectivity, such as increased mesh size or the inclusion of square mesh panels, would contribute to a reduction in discards and better exploitation patterns. Commission regulation (EC) No. 2056/2001 and several UK unilateral measures were evaluated by an EU expert meeting in April 2003 (Anon., 2003). The actual uptake of these measures is still unknown. However, in the case of full uptake it was shown that discards are substantially reduced over both the short and the medium term. While there for cod and haddock would be medium-term gains in yield, for whiting the effects of the gear regulations alone result in immediate and short term (ca. 2–3 years) losses in consumption landings that do not revert to gains in the medium term (ca. 10 years). A phased, stepped increase in mesh size over a period of years is likely to reduce discards significantly, and be more acceptable to industry due to the reduction of short term losses.

Nephrops fisheries take place in discrete areas that comprise an appropriate muddy sea bed sediment. Targeted *Nephrops* fisheries on these grounds are taken predominantly in trawls with mesh sizes of between 70 mm and 100 mm using single or multiple-rig trawls. UK legislation prohibits the use of meshes less than 100 mm in most of its twin trawl *Nephrops* fishery, particularly in the offshore areas. *Nephrops* fishing grounds vary from small, localised inshore grounds to more offshore large areas such as the Fladen Ground in the northern North Sea, and while there is bycatch and discarding of other demersal species associated with *Nephrops*, the general nature of these fisheries and their bycatch can vary widely. Prior to the increase in minimum mesh size (MMS) in 2003/2003, a significant proportion of the vessels reporting *Nephrops* also recorded significant catches of other whitefish species. These vessels used 100-mm mesh in order to avoid catch composition regulations. However, following the mesh size increases almost all these vessels switched to 80-mm mesh to avoid losses of *Nephrops*. This is likely to have resulted in increased discards because of lower selection and high grading due to catch composition regulations associated with the mesh size. There is a desperate need to obtain selection patterns similar to a 120-mm mesh codend while still retaining *Nephrops* (Graham and Ferro, 2004). Solutions could, e.g., include modifications to the square mesh panel construction and location.

Small-mesh industrial fisheries for sandeel and Norway pout occur separately in the North Sea. Sandeel fisheries take place throughout the North Sea in areas defined by the appropriate sandy sea bed sediment. These fisheries have a low bycatch rate of important demersal species. Fishing for Norway pout takes place in the northern and northeastern North Sea and has higher bycatch rates of other species such as haddock and whiting.

The available national log-book data suggest that landed bycatch of fish for human consumption from the *Pandalus* fisheries in Skagerrak and the Norwegian deep amounts to 10-15% of landed shrimp. In the Fladen Ground fishery for *Pandalus* (Danish log-book records) this bycatch varies from 8% to 20 % relative to shrimp landings.

Single-stock exploitation boundaries and critical stocks

The state and the limits to exploitation of the individual stocks are presented in the stock sections. The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2006 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**in relation to high long-term yield**	**in relation to precautionary limits**	
Cod in the North Sea, Eastern Channel and Skagerrak	Reduced reproductive capacity	Uncertain	Overexploited	Due to the lack of a short term forecast the exploitation boundaries in relation to existing management plans cannot be calculated.		Given the low stock size, recent poor recruitment, it is not possible to identify any non-zero catch which will be compatible to the precautionary approach	**Zero TAC**
Cod in Kattegat	**Reduced reproductive capacity**	**Harvested unsustainably**	Overexploited	Even with no landings in 2006 the SSB in 2007 is likely to be below $\mathbf{B_{lim}}$. In this case, the management plan would set a TAC consistent with F below 0.6 and a more than 30% increase in SSB; however, there is no estimate of the stock size on which to calculate this.	Yield-per-recruit analysis suggests that F=0.2–0.3 is a reasonable exploitation boundary.	**Taking into account the current state of the stock, fishing at any level will involve a risk for further depletion of the stock. There should therefore be no fishing on this stock in 2006**	**Zero TAC**
Haddock in the North Sea and Division IIIa	**Full reproductive capacity**	**Harvested sustainably**	Close to target	Following the agreed management plan (F=0.3) would imply human consumption landings of 39 400 t in 2006 which is expected to lead to an SSB of 225 800 t in 2007.			**TAC 39 400 t**
Whiting in the North Sea and Eastern Channel	unknown	unknown	unknown	Unknown	Unknown	The stock status cannot be assessed with reference to precautionary reference points. However, in the light of the low estimate of stock size in combination with the low recent landings with indication of current low exploitation rates, ICES recommends that the human consumption landings in 2006 should not be allowed to increase above the recent (2002–2004) average of 17 300t for Subarea IV and Division VIId.	**TAC <17 300 t**
Saithe in the North Sea, Division IIIa and Subarea VI	Full reproductive capacity	Harvested sustainably	Appropriate	At the present SSB level, F should be below 0.3 to be in accordance with the management plan. This corresponds to catches of less than 108.7 kt in 2006. Unless paragraph 6 is invoked the management plan limits the annual deviation of the TAC to 15% which would correspond to catches of 136 kt.			**TAC <136 000 t.**

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2006 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**in relation to high long-term yield**	**in relation to precautionary limits**	
Anglerfish in Division IIIa, Subareas IV and VI	unknown	unknown	unknown	No management plan.	Unknown	The effort in this fishery should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and bycaught fish.	**No effort increase**
Plaice in the North Sea	At risk of reduced reproductive capacity	Harvested sustainably	Overexploited	The management agreement has not been renewed for 2005. Therefore, advice is only presented in the context of precautionary boundaries.	The current fishing mortality is estimated as 0.58, which is above rates which are expected to lead to high long-term yields ($\mathbf{F_{max}}$ on human consumption=0.17).	The exploitation boundaries in relation to precautionary limits imply human consumption landings of less than 48 000 t in 2006, which is expected to rebuild SSB to the proposed Bpa (=230 000 t) in 2007.	**TAC < 48 000 t.**
Plaice in the Eastern Channel	Unknown	Unknown	Unknown	No management plan.	No long-term reference points are available	No short-term forecasts can be provided. There is conflicting information; some information suggests that the stock is stable and some information suggests that the stock is declining and as a minimum measure there should be no increase in effort.	**No effort increase**
Plaice in Division IIIa	Unknown	Unknown	Unknown	No management plan	Unknown	There is no basis for an analytical forecast. Given the possible increase in stock size in recent years in combination with an unknown exploitation rate, fishing mortality in 2006 should not be allowed to increase. This may be achieved by allowing landings of less than 9 600 t in 2006, which is the average of landings of the last four years.	**TAC < 9 600 t.**
Sole in Division IIIa	Full reproductive capacity	Likely sustainably exploited	Unknown			Given the uncertainties in the assessment regarding non-reporting and discarding in recent years, ICES advises a TAC for 2006 not higher than the TAC for 2005, even though SSB is estimated much higher than B_{pa}. The estimate of present (status quo) fishing mortality is uncertain but *status quo* fishing mortality is probably at or below $\mathbf{F_{pa}}$. It is thus not considered precautionary to increase the fishing mortality above status quo irrespective of the actual estimate.	**TAC< 900 t**

Stock	**State of the stock**			**ICES considerations in relation to single-stock exploitation boundaries**			**Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2006 and % reduction in F.**
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**in relation to high long-term yield**	**in relation to precautionary limits**	
Sole in the North Sea	Full reproductive capacity	Harvested sustainably	Overexploited	No management plan	The current fishing mortality (**F_{sq}**) is estimated as 0.35, which is above the rate that would lead to high long-term yields. **F_{max}** is not well defined and **$F_{0.1}$** is 0.13. Fishing at **$F_{0.1}$** is expected to lead to landings in 2006 of 5 600 t and SSB in 2007 of around 41 300 t.	The exploitation boundaries in relation to precautionary limits imply human consumption landings of less than 11 900 t in 2006, which is expected to lead to an SSB equal to **B_{pa}** (=35 000 t) in 2007.	**TAC<11 900 t.**
Sole Eastern Channel	Full reproductive capacity	At risk of being harvest unsustainably	Overexploited	No management plan	Target reference points have not been agreed for this stock. The current fishing mortality (**F_{sq}**) is estimated as 0.42, which is above the rate that would lead to high long-term yields (F0.1=0.13). **F_{max}** is not well defined. Fishing at **$F_{0.1}$** is expected to lead to landings in 2006 of 2 100 t and SSB in 2007 of around 15 500 t.	The exploitation within the precautionary limits would imply landings of less then 5 720 t in 2006 which is expected to lead to a 12% decrease in SSB in 2007.	**TAC < 5 720 t.**
Sandeel North Sea	Reduced reproductive capacity	F reference points are not defined	Unknown	No management plan	Management of fisheries should try to prevent local depletion of sandeel aggregations, particularly in areas where predators congregate.	The fishery should remain closed until information is available which assures that the stock can be rebuilt to **B_{pa}** by 2007. The information on which this could be based includes a survey in December 2005 and exploratory fishing in April 2006.	**In-year considerations**
Norway pout North Sea	Reduced reproductive capacity	F reference points are not defined	F reference points are not defined	No management plan.	Unknown	ICES recommends that the fishery should remain closed. Re-opening the fishery should only be considered if the IBTS survey in January-February 2006 demonstrates a strong 2005 year class and only if it can be assured that the SSB in 2007 will be above **B_{pa}**.	**In-year considerations**
Nephrops in Division IIIa (Management Area E)	Unknown	Unknown	Unknown	No management plan	Unknown	Given the apparent stability of the stocks, current levels of exploitation appear to be sustainable. Due to uncertainty in the available data ICES is not able to reliably forecast catch. Therefore ICES recommends that fishing effort for fleets targeting *Nephrops* should not be allowed to increase.	**No increase in effort**
Nephrops in Division IVa, East of 2° E + rectangles 43 F5-F7 (Management Area S)	Unknown	Unknown	Unknown	No management plan	Unknown	Given the apparent stability of the stocks, current levels of exploitation appear to be sustainable. Therefore, ICES recommends that fishing effort for fleets targeting *Nephrops* should not be allowed to increase.	**No increase in effort**

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2006 and % reduction in F.
	Spawning biomass in relation to precautionary limits	**Fishing mortality in relation to precautionary limits**	**Fishing mortality in relation to high long-term yield**	**In relation to agreed management plan**	**in relation to high long-term yield**	**in relation to precautionary limits**	
Nephrops in Divisions IVa, rectangles 44-48 E6-E7+44 E8 (Management Area F)	Unknown	Unknown	Unknown	No management plan	Unknown	Due to uncertainty in the available data ICES is not able to reliably forecast catch. Therefore ICES recommends that fishing effort for fleets targeting *Nephrops* should not be allowed to increase	**TAC < 2000 t. No increase in effort**
Nephrops in Division IVa, West of 2° E, excluding Management Area F (Management Area G)	Unknown	Unknown	Unknown	No management plan	Unknown	Information on these stocks are considered inadequate to provide advice based on precautionary limits. Therefore ICES recommends that the level of exploitation, i.e. effort on these stocks should not be increased.	**TAC <12 800 t. No increase in effort**
Pandalus stocks	Unknown	Unknown				Based on the assessment it is recommended that the total landings from IIIa and IVa East in the 2006 are not increased above the recent average (2002-2004) of 13,500 t. However, it is likely that the stock may even sustain a higher exploitation.	**TAC<13,500 t.**
Autumn spawning herring inNorth Sea, VIId and IIIa	Full reproductive capacity	Harvested sustainably		F(adult) = 0.25, F(juv)=0.12, See scenarios			F(adult) = 0.25, F(juv)=0.12, See scenarios See scenarios
Spring spawning herring in Subdivisions 22-24 and IIIa	Reference points not defined	Reference points not defined	Unknown			Current fishing mortality has led to stable or increased SSB and the fishing mortality should not be allowed to increase. This corresponds to landings of less than 95 000 t in 2006.	**TAC < 95 000 t**
Sprat in the North Sea	unknown	unknown	unknown			There are no precautionary limits for this stock. Maintaining the exploitation rate of recent years, the catch in 2005 is predicted to be 244 000 t, based on IBTS survey results. The 2005 TAC is set at 257 000 t.	**Only in-year advice**
Mackerel in the North Sea	Unknown	Unknown	Unknown			**ICES advises that the existing measures to protect the North Sea spawning component remain in place. These are: - There should be no fishing for mackerel in Divisions IIIa and IVb,c at any time of the year. - There should be no fishing for mackerel in Division IVa during the period 15 February 31 July. - The 30 cm minimum landing size at present in force in Subarea IV should be maintained.**	**No fishing for mackerel in IIIa and IVb,c**

Stock	State of the stock			ICES considerations in relation to single-stock exploitation boundaries			Upper limit corresponding to single-stock exploitation boundary for agreed management plan or in relation to precautionary limits. Tonnes or effort in 2006 and % reduction in F.
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to high long-term yield	In relation to agreed management plan	in relation to high long-term yield	in relation to precautionary limits	
Horse Mackerel in the North Sea	Unknown	Unknown	Unknown			**ICES reiterates the recommendation made in 2004 to limit the catches to be below the 1982–1997 average of 18 000 t, in order to constrain the fishery until there is more information about the structure of horse mackerel stocks, and sufficient information to show that higher exploitation rates are sustainable.**	**TAC < 18 000 t**
Rays and skates in the North Sea	Unknown	Unknown	Unknown			**The stocks of common skate and thornback rays are depleted. Target fisheries should not be permitted, and by-catch in mixed fisheries should be reduced to the lowest possible level. If the fisheries for rays continue to be managed with a common TAC for all ray species, this TAC should be set at zero for 2006.**	**Minimal bycatch. Zero TAC.**
Spurdog	Unknown	Unknown	Unknown			**Target fisheries should not be permitted to continue, and by-catch in mixed fisheries should be reduced to the lowest possible level. A TAC should cover all areas where spurdog are caught in the northeast Atlantic. This TAC should be set at zero for 2006.**	**Low bycatch. Zero TAC.**

Identification of critical stocks

The above table identifies the stocks where spawning stock biomass is at reduced reproductive capacity (cod in the North Sea, Eastern Channel and Skagerrak, cod in Kattegat, sandeel in the North Sea) and/or where fishing mortality indicates unsustainable harvesting of the stock (cod in the North Sea, Eastern Channel and Skagerrak, cod in Kattegat). Norway pout is also being considered as a critical stock because the spawning stock is around $\mathbf{B}_{\mathrm{lim}}$ and recent recruitments of this short-living species have been very low. These stocks are the overriding concerns in the management of all demersal fisheries:

- For cod in the North Sea, Eastern Channel and Skagerrak, for cod in Division IIIa, North Sea and Eastern Channel and for cod in Kattegat, it is not possible to identify any non-zero catch which will be compatible to the precautionary approach. ICES therefore recommends a zero catch;
- for sandeel and Norway pout in the North Sea ICES recommends that the fishery should remain closed until information is available which assures that the stock can be rebuilt to $\mathbf{B}_{\mathrm{pa}}$ by 2007. For sandeel the information on which this could be based includes a survey in December 2005 and exploratory fishing in April 2006. For Norway pout the IBTS survey in February 2006 will provide the information.

There are also concern about the stocks of spurdog, porbeagle, and some rays species taken as bycatch in fisheries directed towards other species.

Advice for fisheries management

Fisheries in Division IIIa (Skagerrak-Kattegat), in Subarea IV (North Sea) and in Division VIId (Eastern Channel) should in 2006 be managed according to the following rules, which should be applied simultaneously:

Demersal fisheries

- **with minimal bycatch or discards of cod;**
- **Implement TACs or other restrictions that will curtail fishing mortality for those stocks mentioned above for which reduction in fishing pressure is advised;**
- **within the precautionary exploitation limits for all other stocks (see text table above);**
- **Where stocks extent beyond this area, e.g. into Division VI (saithe and anglerfish) or are widely migratory (Northern hake), taking into account the exploitation of the stocks in these areas so that the overall exploitation remains within precautionary limits.**
- **With minimum by-catch of spurdog (see Volume 9, section 1.4.6), porbeagle and thornback ray and skate.**

Pelagic fisheries exploiting herring (western Baltic spring-spawning and North Sea autumn-spawning stocks) mackerel and horse mackerel

- **with minimal bycatch or discards of cod;**
- **with minimal catch of North Sea mackerel, respecting the closed season;**
- **within the precautionary exploitation limits for the herring stocks taking into account the exploitation of herring in the western Baltic (Subdivisions 22-24);**
- **Where stocks extend beyond this area, e.g. widely migratory species (NEA mackerel and blue whiting), taking into account the exploitation of the stocks in these areas so that the overall exploitation remains within precautionary limits.**

Fisheries with small meshed gears for industrial purposes

- **with minimal bycatch of cod and other fish used for human consumption;**
- **without fishing for Norway pout or sandeel except if the fisheries are reopened on basis of information that they will rebuild to $\mathbf{B}_{\mathrm{pa}}$;**
- **within the single-stock exploitation limits for all other stocks (see text table above).**

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching species that are identified as critical stocks. Industry-initiated programmes to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of critical stocks are fully and credibly reported. Such programmes could be considered in the management of these fisheries.

Reductions in fishing mortalities have been advised for several demersal stocks in the North Sea. Fishing mortality is generally high but for some stocks there are now indications that fishing mortality is decreasing in recent years. This is consistent with the observed decrease in fishing effort due to days at sea regulations and decommissioning in the major fleets. ICES reiterates that required reductions in fishing mortality can only be achieved if significant reductions in effort are included in management, and effective deterrents to discarding are implemented. Extensive discarding occurs in most fisheries on roundfish, flatfish, and *Nephrops* in the North Sea. These discards are largely small and juvenile fish. They always result in foregone potential yield, and for depleted stocks they are a serious impediment to rebuilding.

Short-term implications
The catch options that would apply if single stocks could be exploited independently of others are summarized in the table above. However, many stocks are exploited in mixed fisheries. Mixed fisheries management options should be based on the expected catch in specific combinations of effort in the various fisheries taking into consideration the advice given above. The distributions of effort across fisheries should be responsive to objectives set by managers, which is also the basis for the scientific advice presented above.

The information on the mix of demersal species in 2003 has been compiled by ICES (Tables 3.4.1.3–5). However, ICES is not yet in a position to present scenarios of the effects of various combinations of fleet effort, because the methodology to calculate these scenarios has not been agreed.

The extent to which the stocks are taken in the same fisheries has not been quantified on basis of available data. The existing information suggest that the stocks are caught together to a high (H), medium (M), low (L) extent, or not at all (0), as indicated in the table below. The information in the table relates to catches and the linkage is thus indicated as high, also in cases where the catches of most of one stock taken in a fishery with another stock is discarded.

Main gears	Interactions															
	Cod 347d	Cod katt.	Had 34	Whg 47d	Sai 346	Ang 346	Ple 4	Ple 7d	Ple 3a	Sol 3a	Sol 4	Sol 7d	San 4	Nop 4	Nep stocks	Pan stocks
Cod 347d		0L	H	H	M	??	M	M	M	M	M	M	L0	L	HM	M
Cod kattegat	BT, OT		L	0	0	??	0	0	M	M	0	0	00	0	M	0
Had 34	OT			H	M	??	L	0	L	L	L	0	L0	L	M	M
Whg 47d	OT				M	??	M	M	0	0	M	M	0L	L	M	??M
Sai 346	OT					??	L	0	L	L	L	0	L0	L	L	??M
Ang 346																M
Ple 4	BT		OT	BT	OT	??		0	0	0	H	0	L	L	L	0
Ple 7d	BT			BT, OT		??			0	0	0	H	0L	L	L	0
Ple 3a	BT, OT	BT, OT	OT			??				H	0	0	0	0	L	0
Sol 3a	BT,OT,GN	BT,OT,GN	OT	BT, OT					BT		0	0	0	0	L	0
Sol 4	BT		OT	BT	OT		BT					0	0	0	L	0
Sol 7d	BT			BT				BT					0	0	L	0
San 4	Ind		Ind	Ind	Ind									M	0	0
Nop 4	Ind		Ind	Ind	Ind								Ind		0	0L
Nep. stocks																M
Pan. stocks																

H; the stocks are taken together in most fisheries where they are taken and their fisheries linkage is therefore high; M: the stocks are taken together in some but not all important fisheries and their fisheries linkage is therefore medium; L: the stocks are taken together in some fisheries but are mainly caught independently of each other and their fisheries linkage is therefore low; 0: the stocks are never or only rarely caught together and they are thus not linked in the fisheries; na: information not available.

Gears: BT = beam trawl, OT = Otter trawl, GN = gill net

Regulations in force and their effects

An emergency measure (Council Regulation (EC) 259/2001) involving the closure of a large area of the North Sea was implemented from 14 February to 30 April 2001 to all fishing vessels using gears likely to catch cod. Analysis of the effectiveness of the emergency measures indicated that the closure had an insignificant effect upon the spawning potential for cod in 2001. The redistribution of the fishery, especially along the edges of the box coupled to the increases in proportional landings from January and February appeared to have been able to negate the potential benefits of the box. The conclusion from the study was that the box would have to be extended in both space and time to be more effective (see: ICES 2004). The emergency measure has not been adopted after 2001.

EU technical regulations in force in 2003 and 2004 are contained in Council Regulation (EC) 850/98 and its amendments. The regulation prescribes the minimum target species' composition for different mesh size ranges. In 2001, haddock in the whole of NEAFC region 2 were a legitimate target species for towed gears with a minimum codend mesh size of 100 mm. As part of the cod recovery measures, the EU and Norway introduced additional technical measures from 1 January 2002 (EC 2056/2001). The basic minimum mesh size for towed gears for cod from 2002 was 120 mm, although in a transitional arrangement until 31 December 2002, vessels were allowed to exploit cod with 110-mm codends provided that the trawl was fitted with a 90-mm square mesh panel and the catch composition of cod retained on board is not greater than 30% by weight of the total catch. From 1 January 2003, the basic minimum mesh size for towed gears for cod was 120 mm. The minimum mesh size for vessels targeting haddock in Norwegian waters is also 120 mm. There is some indication of the effect of mesh size regulations in the sudden increase in weight-at-age in the human consumption component for age 2 haddock. However, a shift in exploitation pattern at the early ages has not been observed. This may be confounded by the shift to smaller mesh fisheries (80-mm mixed *Nephrops*) by some fleet segments that previously fished for a mix of fish and *Nephrops* using 100 mm. This shift was also encouraged by the differences in effort allocation between the 80- and 120-mm fleets, where the smaller mesh fishery was awarded a higher proportion of days per month. It is likely that this may have increased discarding due to the lower selectivity and high grading to comply with catch composition regulations.

Minimum landings sizes are in effect for several North Sea species. The minimum landing size for cod in Subarea IV and Divisions IIIa and VIId is 35 cm; in Denmark it is 40 cm. In addition, size restrictions occur in flatfish fisheries. The minimum landing size of North Sea plaice is 27 cm. This minimum landing size results in high discard rates in the mixed flatfish fishery with beam trawls using 80-mm mesh size. The minimum landing size of North Sea sole is 24 cm.

Effort restrictions in the EC were introduced in 2003 (EC 2341/2002, Annex XVII, amended in EC 671/2003). Effort restriction measures were revised for 2004 (EC 2287/2003, Annex V). Preliminary analysis of fishing effort trends in the major fleets exploiting demersal stocks indicates that fishing effort in those fleets has been decreasing since the mid-1990s due to a combination of decommissioning and days-at-sea regulations. The decrease in effort is most pronounced in the years 2002 and beyond. However, effort restrictions combined with higher fuel costs has resulted in effort being shifted towards coastal fisheries. It is likely that this will increase discard rates because of the presence of small plaice in these areas.

A cod protection area has been implemented for 2004 only (EC 2287/2003, amended in EC 867/2004) which defined the conditions under which certain stocks, including haddock, could be caught in Community waters. A maximum of 35% of the haddock TAC in 2004 could be taken from within the cod protection area. For UK a special permit was introduced that was needed to fish for haddock in the cod protection area. Although this management scheme was proposed to permit additional haddock to be caught in 2004, the uptake of the special permit has been relatively low.

In 2004 agreement was reached within the EU on a formal cod recovery plan that will be operational during the TAC and management decision processes of 2004, effectively rendering the plan operational in 2005. Details of it are given in Council Regulation (EC) 423/2004. Technical measures applicable to the flatfish fishery in the North Sea included mesh size regulations, minimum landing size, gear restrictions, and a closed area (the plaice box). Mesh size regulations for towed gears require that vessels fishing North of 55°N (or 56°N east of 5°E, since January 2000) should have a minimum mesh size of 100 mm, while to the south of this limit, where the majority of the plaice fishery takes place, an 80-mm mesh is allowed. In the fishery with fixed gears a minimum mesh size of 100 mm is required. Mesh enlargement would reduce the catch of undersized plaice and cod, but would also result in loss of marketable sole. An increase in the minimum landing size of sole could provide an incentive to fish with larger mesh sizes and therefore a reduction in the discarding of plaice and juvenile cod.

In addition to this, since 2002 a small part of the North Sea plaice fishery is affected by the additional cod recovery plan (EU regulation 2056/2001) that prohibits trawl fisheries with a mesh size <120 mm in the area to the north of 56°N. The aggregated beam length of beam trawls is limited to 24 m. In the 12 nautical mile zone the maximum aggregated beam-length is 9 m in the plaice box. The plaice box has been enforced since 1989, and the area was closed in all quarters since 1995. The closed area applies to vessels using towed gears, but vessels smaller than 300 HP, including the small mesh fishery for *Crangon,* are exempted from the regulation. The effectiveness of the plaice box has been evaluated by an expert group in 2004, but the report of that group was not yet available to ICES.

Previous MAGP programmes have induced changes in fleet compositions in the flatfish fishery. The Dutch beam trawl fleet has reduced in number of vessels and shifted towards two categories of vessels: 2000 HP (the maximum engine power allowed) and 300 HP (the maximum engine power for vessels that are allowed to fish within the 12-mile coastal zone and the plaice box). A substantial part of the decommissioned vessels have been replaced by vessels in other countries (England, Scotland, Germany, Belgium). Overall capacity and effort of North Sea beam trawl vessels appears to have decreased since 1995. A management plan has been implemented in 1999 for the North Sea herring fishery. The management plan consists of restraining fishing mortality and keeping the stock above threshold levels. Simulations indicate that the current management strategy maintains this stock within precautionary limits. The likelihood of exceeding precautionary limits depends on the accuracy of the assessment and the compliance of the fishery with the regulations. Thus, overfishing the TAC by 20%, combined with an overestimation of the stock in assessment by 10% on average, would lead to a near 50% risk that SSB drops below $\mathbf{B}_{pa}$ and a 4% risk that it falls below $\mathbf{B}_{lim}$.

Information from the fishing industry

ICES held consultations with North Sea Commission Fisheries Partnership in Copenhagen, **October 3–4 2005**, during which meeting the participants and two invited experts reviewed four stocks: cod, whiting, plaice, and sole. Plaice and cod were also reviewed in 2002, 2003, and 2004 and various recommendations were made as a part of that review and have been implemented by the relevant assessment working group.

Quality of assessments and uncertainties

The level of biological sampling of the commercial landings of roundfish, flatfish, herring, and mackerel is relatively good and has been maintained. However, a major drawback in the available data is that they mostly refer to the landed component of the catch for most species. Discard data have traditionally only been used directly in assessments for haddock and whiting, with the majority of whiting discards based on a historical series only for one country. Several countries now collect discard data on a recurrent basis. This year, discards data have been included in the assessments of North Sea cod and plaice. It is noted that the inclusion of discards appears to reduce potential biases but may increase the uncertainties in the assessment (noise), because discards sampling is often rather scanty. In order to be able to include discards into an assessment, when discards have only been sampled in recent years, assumptions have to be made about the historical part of the time-series. These assumptions could compromise the reliability of the assessment that is based on them.

Data on catch and effort are available for many fisheries, but it is uncertain how reliably these data reflect trends in effective effort, i.e. nominal effort after corrections for technological improvements or changes in efficiency. Restrictive management measures (TACs) have also resulted in changes in the fishing practice of some fleets and redirected their effort to other species. In a number of cases this has lead to abandoning the use of time-series of commercial CPUE data in the assessments (cod, haddock, whiting, plaice), although the time-series of CPUE are still presented in the working group reports. In some recent years there was misreporting of roundfish landings associated with restrictive quotas. Substantial underreporting of cod landings is estimated to have occurred in between 1993 and 2003. Additionally, misreporting where fish are caught may have created problems for species groups such as those in the Eastern Channel. The consequence of the reporting problems in landings may have led to retrospective problems in analytical assessments. These retrospective problems lead to further uncertainty in short-term forecasts.

Several series of research vessel survey indices are available for most species. Quarterly data were available from the International Bottom Trawl Survey for a period of 6 years (1991–1996) and these were used in the assessment of some stocks. This survey has covered quarters 1 and 3 since then. For herring and mackerel the spawning stock sizes are estimated by annual larvae and acoustic surveys (herring) or intermittent egg surveys (mackerel). Lack of any fisheries-independent surveys for sandeels has resulted in analytical problems with potential auto-correlation between catch and fisheries-dependent indices in the model. Changes in English and Scottish surveys in the time-series has resulted in the use of a split time-series for several species (e.g. haddock), which has improved the residual patterns in the assessment.

Multispecies considerations are incorporated in the assessments and the forecasts for the North Sea stocks of cod, haddock, whiting, herring, sprat, sandeel, and Norway pout. In those cases average natural mortalities estimated by multispecies assessments were incorporated in the assessments. Incorporation of time variable natural mortalities from a multispecies assessment model into the single-species assessments has been carried out as a sensitivity analysis of the assessments.

Sources of information

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Table 1.2.2.1 Species composition in the Danish and Norwegian small-meshed fisheries in the North Sea of the catches landed for reduction (1000 tonnes). Data provided by WG members. The category "other" is subdivided by species in Table 1.2.2.2.

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1836
1976	488	622	12	435	36	48	150	67		1858
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1674
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1039	63	146	162	28	2	36	1	59	1536
1990	591	71	115	140	22	3	50	8	40	1040
1991	843	110	131	155	28	5	38	1	38	1349
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
1996	761	81	39	122	93	5	5	0	13	1119
1997	1091	99	15	126	46	7	7	3	21	1416
1998	956	131	16	72	72	5	3	3	24	1283
1999	678	166	23	97	89	4	5	2	40	1103
2000	655	191	24	176	98	8	8	6	21	1187
2001	810	156	21	59	76	6	7	3	14	1152
2002	804	142	26	73	107	4	8	8	15	1186
2003	303	175	16	18	139	1	3	8	18	681
2004	324	193	19	12	107	1	2	7	29	692
Avg 74-04	705	199	60	231	65	12	36	8	33	1337

Year quarter	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1998 q1	37	7	7	13	11	1	0	0	5	80
1998 q2	754	1	2	8	12	2	1	0	4	784
1998 q3	153	60	4	29	38	2	1	2	9	298
1998 q4	12	63	4	23	12	0	0	0	6	121
1999 q1	14	14	4	8	23	1	1	1	8	74
1999 q2	507	2	4	22	30	1	2	1	8	577
1999 q3	139	129	10	41	18	1	2	0	7	347
1999 q4	17	21	6	25	17	1	1	0	18	106
2000 q1	10	42	1	9	13	1	0	0	5	82
2000 q2	581	2	4	17	32	3	2	0	4	646
2000 q3	63	133	10	30	39	2	3	6	5	291
2000 q4	0	15	8	119	14	2	3	0	8	169
2001 q1	12	40	2	20	15	1	1	0	3	94
2001 q2	462	1	2	10	32	3	1	2	4	517
2001 q3	314	44	4	4	12	1	2	0	5	386
2001 q4	22	72	13	24	16	1	2	0	2	152
2002 q1	11	5	6	8	18	0	0	0	2	50
2002q2	772	0	3	5	19	1	2	0	4	806
2002q3	21	71	8	31	46	1	3	5	4	189
2002q4	0	66	10	28	24	1	2	3	6	141
2003 q1	3	18	1	2	14	0	0	1	5	45
2003 q2	239	1	2	4	42	0	1	1	3	292
2003 q3	57	56	4	5	56	0	1	4	4	188
2003 q4	4	100	9	7	28	0	1	2	6	157
2004 q1	2	1	4	1	19	0	0	1	12	41
2004 q2	273	0	2	1	33	0	1	1	5	315
2004 q3	50	55	5	4	37	0	0	2	7	160
2004 q4	0	136	9	6	18	0	0	2	5	177

0 denotes < 500 tonnes

Table 1.2.2.2 Sum of Danish and Norwegian North Sea by-catch (tonnes) landed for industrial reduction in the small-meshed fisheries by year and species (excluding saithe, haddock and whiting accounted for in Table 1.2.2.1.

Species	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**
Gadus morhu	544	710	1092	1404	2988	2948	570	1044	1052	876
Scomber scor	4	534	2663	6414	8013	5212	7466	4631	4386	3576
Trachurus tra	22789	16658	7391	18104	22723	14918	5704	6651	6169	4886
Trigla sp.	0	888[2]	45342[2]	5394[2]	9391[2]	2598[2]	5622[2]	4209	1593	1139
Limanda lima	187	3209	4632	3781	7743	4706	5578	3986	4871	528
Argentina spp	8714	5210	3033	1918	778	2801	3434	2024	2874	2209
Hippoglossoic	59	718	1173	946	2160	1673	1024	1694	1428	529
Pleuronectes	34	119	109	372	582	566	1305	218	128	143
Merluccius me	349	165	261	242	290	429	28	359	109	10
Trisopterus m	0	68[3]	0	5[2]	48[2]	121[2]	79[2]	111	36	0
Molva molva[3]	51	1	40	39	37	13	65	10	28	0
Glyptocephalu	236[3]	132	341	44	255[3]	251[3]	1439[3]	195[3]	246	40
Gadiculus arg	1210	729	3043	2494	741	476	801	0	0	0
Others	31715[1]	3853	3604	3670	3528	3154	4444	4553	4106	5141
Total	65892	32994	72724	44827	59277	39866	37559	29685	27026	19077

Species	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**[2]	**2003**	**2004**
Gadus morhu	955	366	1688	1281	532	383	192	29	49	44
Scomber scor	2331	2019	3153	1934	2728	2443	1749	1260	2549	6515
Trachurus tra	2746	2369	3332	2576	5116	5312	1159	2338	5791	10272
Trigla sp.	2091	897	2618	1015	2566	1343	2293	1071	847	1101
Limanda lima	1028	1065	2662	6620	4317	441	1441	321	596	386
Argentina spp	292	3101	2604	5205	3580	333	397		1376	786
Hippoglossoic	617	339	1411	2229	1272	493	431	112	208	174
Pleuronectes	33	90	73	91	88	64	56	51	28	1
Merluccius me	0	3625	2364	33	211	231	167	6	301	423
Trisopterus m	9	30	181	261	922	518	0	196	5	91
Molva molva[3]	0	0	31	31	125	19	49	0	42	169
Glyptocephalu	0	97	394	860	437	154	246	58	437	286
Gadiculus arg	0	7	248	248	387	532	942	459	993	1550
Others	5158	50	749	5405	17931	8927	301	2226	4888	6953
Total	15260	14055	21508	27787	40211	21192	12523	8127	20115	28750

[1]DK cod and mackerel included. [2]Only DK catches. [3]N catches. DK catches in "Others". [4]Until 1995 N catches only. DK catches in "Others".

Table 1.2.2.2 Landings of demersal, pelagic, and industrial species from the North Sea. For some species Divisions IIIa and/or VIId have been included.

Species	Cod	Cod	Haddock	Haddock	Whiting	Whiting	Saithe	Saithe	Sole	Plaice	Norway pout	Sandeel	Sprat	Herring autumn spawners	Mackerel	Horse mackerel NS stock	Demersal	Pelagic	Industrial	Total
Type	dem	ib	dem	ib	dem	ib	dem	ib	dem	dem	i	i	i	p	p	p				
landings/catch	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	lndgs	catch	catch	catch				
Area	3a,4,7d	3a,4,7d	4	4	4,7d	4,7d	3a,4	3a,4	4	4	3a,4	4	4	3a,4,7d	3a,4	3a4bc7d				
1970	226	n/a	525	180	83	115	163	59	20	130	238	191	51	563	322	12	1147	897	834	2878
1971	328	n/a	235	32	61	72	218	35	24	114	305	382	95	520	244	32	980	796	921	2697
1972	354	n/a	193	30	64	61	248	28	21	123	445	359	92	498	189	8	1003	695	1015	2713
1973	239	n/a	179	11	71	90	229	31	19	130	346	297	228	484	327	42	867	853	1003	2723
1974	214	n/a	150	48	81	130	267	42	18	113	736	524	314	275	298	31	843	604	1794	3241
1975	205	n/a	147	41	84	86	271	38	21	108	560	428	641	313	263	10	836	586	1794	3216
1976	234	n/a	166	48	83	150	295	67	17	114	437	488	622	175	306	9	909	490	1812	3211
1977	209	n/a	137	35	78	106	217	6	18	119	390	786	304	46	260	1	778	307	1627	2712
1978	297	n/a	86	11	97	55	163	3	20	114	270	787	398	11	149	5	777	165	1524	2466
1979	270	n/a	83	16	107	59	134	2	23	145	329	578	380	25	153	1	762	179	1364	2305
1980	294	n/a	99	22	101	46	142		16	140	483	729	323	71	88	2	792	161	1603	2556
1981	335	n/a	130	17	90	67	145	1	15	140	239	569	209	175	67	7	855	249	1102	2206
1982	303	n/a	166	19	81	33	185	5	22	155	395	611	153	275	35	4	912	314	1216	2442
1983	259	n/a	159	13	88	24	197	1	25	144	451	537	88	387	41	8	872	436	1114	2422
1984	228	n/a	128	10	86	19	214	6	27	156	393	669	77	429	44	29	839	502	1174	2515
1985	215	n/a	159	6	62	15	222	8	24	160	205	622	50	614	50	27	842	691	906	2439
1986	204	n/a	166	3	64	18	202	1	18	165	178	848	16	671	244	25	819	940	1064	2823
1987	216	n/a	108	4	68	16	177	4	17	154	149	825	32	792	302	12	740	1106	1030	2876
1988	184	n/a	105	4	56	49	140	1	22	154	110	893	87	888	338	24	661	1250	1144	3055
1989	140	n/a	76	2	45	36	117	1	22	170	168	1039	63	787	282	33	570	1102	1309	2981
1990	125	n/a	51	3	47	50	100	8	35	156	152	591	73	646	305	19	514	970	877	2361
1991	102	n/a	45	5	53	38	115	1	34	148	193	843	112	657	366	12	497	1035	1192	2724
1992	114	n/a	70	11	52	27	104		29	125	300	855	124	716	367	15	494	1098	1317	2909
1993	122	0.66	80	11	53	20	118	1	31	117	184	579	200	671	391	14	521	1076	996	2592
1994	111	0.78	80	5	49	10	115		33	110	182	786	320	571	472	6	498	1049	1304	2851
1995	136	0.96	75	8	47	27	124	1	30	98	241	918	357	579	322	17	510	918	1553	2981
1996	126	0.34	76	5	41	5	120	0	23	82	166	777	137	275	213	19	468	507	1090	2065
1997	124	0.79	79	7	36	7	110	3	15	83	170	1137	103	264	229	20	447	513	1428	2388
1998	146	0.4	77	5	29	3	107	3	21	71	80	1004	164	392	270	31	451	693	1259	2403
1999	96	0.1	66	4	30	5	114	3	25	81	92	735	188	363	301	37	412	701	1027	2140
2000	71	0.06	47	9	28	8	88	6	23	81	184	699	196	388	273	48	338	709	1102	2149
2001	50	0.1	41	8	25	7	95	3	20	82	66	862	170	363	315	46	313	724	1116	2153
2002	55	0.03	59	4	22	7	117	8	16	70	77	811	144	372	372	23	339	767	1051	2156
2003	32 *	0.05	45	1	16	3	102	8	18	66	25	326	177	480	332	32	279	844	540	1663
2004	27 *	0.04	49	1	8	1	100	7	19	61	14	362	194	567	297	35	264	899	579	1742

hc = for human consumption, ib = industrial by catch, i = for industrial purposes, p = pelagic, dem = demersal.
* nominal landings only, WG estimate of catch not available

Table 1.2.2.3.a North Sea landings and discards by species and country **in 2004** as estimated by the working group.

	COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
country	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**		
BEL	1501	72	368	166	4519	2044	44	3	1603	139	305	137	8340	2560
DEN	7962	382	5252	2364	13731	6211	10511	643	609	53	76	34	38141	9687
ENG	2214	106	1561	703	7224	3268			483	42	659	296	12141	4415
FRA	1971	95	1105	497	258	117	21550	1318	724	63	8813	3957	34421	6046
GER	2106	101	1679	756	3802	1720	9015	551	752	65	332	149	17686	3342
NED	2303	110	141	64	28224	12767			13462	1166	1492	670	45622	14777
NOR	4987	239	2304	1037	1967	890	61690	3772	125	11	38	17	71111	5966
SCO	7692	369	31105	14004	6768	3061	4711	288	250	22	5630	2528	56155	20271
SWE	510	24	147	66									657	91
Grand Total	31246	1498	43661	19657	66492	30077	107520	6575	18008	1560	17345	7788	284273	67155

Table 1.2.2.3.b North Sea landings and discards by species and country, gear and mesh size range **in 2004** as estimated by the working group.

			COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
Country	**Gear**	**Mesh size range**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**		
BEL	-1	-1	129	6	0	0	36	16			43	4	92	41	301	68
	LARGE_BEAM	-1	1130	54	347	156	3602	1629	23	1	1081	94	76	34	6260	1969
		80-99	34	2									40	18	74	20
	OTTER	-1	98	5	15	7	323	146	18	1	55	5	21	10	531	173
	SMALL_BEAM	-1	95	5	5	2	558	253	2	0	424	37	51	23	1135	319
		80-99	15	1									24	11	39	12
DEN	-1	-1	1478	71	1045	470	1421	643	3401	208	168	15	7	3	7520	1410
	BEAM	>=120	56	3	41	18			9	1					106	22
		100-119	4	0	0	0									5	0
	DEM_SEINE	>=120	456	22	837	377	1261	571	219	13	1	0	2	1	2777	984
		-1	6	0	2	1	28	13	0	0	0	0			36	14
		100-119	42	2	44	20	228	103	12	1	0	0			327	126
		80-99	226	11	243	109	191	86	63	4	0	0	8	4	731	214
	GILL	>=220	15	1	0	0	11	5	0	0	1	0			26	6
		-1	10	0	0	0	0	0	0	0	2	0			12	1
		100-119	42	2	14	6	63	28	4	0	216	19			339	56
		120-219	2622	126	187	84	4261	1927	134	8	122	11			7326	2156
		90-99	3	0	0	0	6	3	0	0	88	8			97	11
	LARGE_BEAM	>=120	42	2	23	10	1440	651	1	0	0	0			1507	664
		-1	4	0	0	0	163	74	0	0	0	0			167	74
	OTTER	<16	12	1	25	11	0	0	120	7					158	19
		>=120	1402	67	1712	771	2061	932	3774	231	2	0	42	19	8993	2020
		-1	4	0	5	2	22	10	4	0	0	0			35	13
		100-119	113	5	74	33	775	351	85	5	1	0	2	1	1049	395
		16-31	5	0	27	12			53	3					86	16
		32-54	174	8	128	58	1	0	378	23	1	0	3	1	685	91
		70-79	69	3	18	8			34	2					121	14
		80-99	1176	56	825	371	1791	810	2219	136	7	1	13	6	6031	1380
	SMALL_BEAM	>=120	0	0			5	2			0	0			5	2
		-1	0	0	0	0	3	1			0	0			3	1
ENG	DEM_SEINE	>=120	11	1	31	14	341	154			0	0	3	1	385	170
	DREDGE	-1	1	0			0	0			0	0			2	0
	GILL	>=220	0	0							3	0			3	0

			COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
Country	Gear	Mesh size range	Land	Disc	Land	Disc	Land	Disc	Land	Disc	Land	Disc	Land	Disc		
		100-119	24	1			9	4			53	5	3	1	90	11
		120-219	482	23	26	12	16	7			26	2	13	6	562	50
		90-99	14	1			0	0			28	2	1	0	43	4
	LARGE_BEAM	100-119	7	0	1	1	148	67			28	2	5	2	189	72
		80-99	127	6	48	22	5893	2666			216	19	12	6	6297	2718
	LONGLINE	-1	300	14	0	0	0	0			2	0	2	1	304	16
	OTTER	>=120	1081	52	1180	531	746	338			113	10	414	186	3535	1116
		70-79	138	7	273	123	70	32			4	0	206	93	692	254
	POTS	-1	29	1	1	1	0	0			10	1	0	0	40	3
FRA	DREDGE	-1	0	0									0	0	0	0
		80-99	0	0									1	0	1	0
	GILL	-1	94	5			12	6			115	10	7	3	228	23
		100-119	25	1							0	0	1	0	26	2
		10-30									1	0			1	0
		120-219	278	13	0	0	5	2	15	1	6	0	9	4	314	21
		50-70	10	0									0	0	10	1
		90-99	253	12			62	28			537	47	16	7	868	94
	LONGLINE	-1	8	0									0	0	8	0
	OTTER	<16	1	0									0	0	1	0
		>=120	11	1	30	14	0	0	432	26			2	1	475	41
		-1	34	2	1	0	0	0	89	5	0	0	65	29	190	37
		100-119	86	4	1055	475	0	0	20993	1284			318	143	22452	1906
		16-31	0	0									2	1	2	1
		32-54	6	0									23	10	29	11
		55-69	0	0									0	0	0	0
		70-79	0	0									2	1	3	1
		80-99	1132	54	18	8	92	42	0	0	14	1	8276	3716	9533	3821
	PEL_TRAWL	100-119											0	0	0	0
		32-54	2	0									8	4	11	4
		80-99	7	0									32	15	39	15
	POTS	-1	0	0									0	0	0	0
	ZZZ	-1	23	1			86	39	19	1	51	4	50	23	230	68
GER	DEM_SEINE	>=120	616	30	480	216	6	3	257	16			1	0	1360	265
	GILL	100-119	3	0			8	4			54	5			65	8

			COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
Country	**Gear**	**Mesh size range**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**		
		120-219	124	6	2	1	13	6			4	0			143	13
		90-99	1	0			1	0			17	1			19	2
	LARGE_BEAM	>=120	3	0	1	0	31	14			10	1	1	0	46	16
		100-119	1	0			14	6							15	6
		16-31					17	8			10	1	1	0	28	9
		80-99	57	3	2	1	1121	507			493	43	71	32	1744	585
	OTTER	>=120	1067	51	1015	457	41	19	6525	399			45	20	8693	946
		100-119	59	3	82	37	580	262	2185	134	2	0	8	4	2916	439
		32-54			2	1			7	0					9	1
		55-69											2	1	2	1
		80-99	168	8	95	43	1777	804	6	0	69	6	202	91	2317	952
	PEL_TRAWL	32-54							35	2					35	2
	SMALL_BEAM	>=120					4	2							4	2
		100-119					6	3							6	3
		16-31									3	0			3	0
		80-99	7	0			183	83			90	8	1	0	281	91
NED	LARGE_BEAM	100-119	2303	110	141	64							1492	670	3936	844
		80-99					28224	12767			13462	1166			41686	13933
NOR	DEM_SEINE	>=120	208	10	206	93	37	17	47	3			2	1	500	123
		80-99	10	0	10	5			3	0					23	5
	GILL	120-219	1910	92	368	165	51	23	7160	438	10	1	3	1	9501	720
	LARGE_BEAM	100-119	42	2	29	13	1115	504	1	0	99	9	1	1	1288	529
	LONGLINE	-1	1272	61	458	206	0	0	558	34			1	0	2289	302
	OTTER	>=120	1138	55	1045	470	754	341	49831	3047	15	1	20	9	52803	3923
		32-54	309	15	161	73	1	0	223	14			11	5	704	106
		70-79	48	2	18	8	3	1	66	4			0	0	135	16
	PEL_SEINE	32-54	3	0	7	3			3749	229					3759	232
	PEL_TRAWL	32-54			0	0			39	2					40	3
	POTS	-1	47	2	1	1	6	3	14	1	0	0			69	6
SCO	DEM_SEINE	>=120	995	48	6441	2900	195	88	373	23	0	0	888	399	8892	3457
		100-119	6	0	423	191	5	2	2	0	0	0	41	18	477	211
		32-54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		55-69	0	0	69	31	0	0	4	0	0	0	5	2	77	33
		70-79	1	0	11	5	0	0	1	0	0	0	3	1	16	6

			COD_NS		HAD_NS		PLE_NS		POK_NS		SOL_NS		WHG_NS		Total Land	Total Disc
Country	**Gear**	**Mesh size range**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**	**Land**	**Disc**		
		80-99	5	0	49	22	1	0	1	0	0	0	12	5	69	28
	GILL	>=220	1	0	0	0	0	0	0	0	0	0	0	0	1	0
		-1	4	0	0	0	0	0	0	0	0	0	0	0	4	0
		120-219	27	1	0	0	0	0	0	0	0	0	0	0	28	1
	LARGE_BEAM	>=120	36	2	23	11	871	394	2	0	11	1	10	4	953	412
		100-119	22	1	8	4	2191	991	0	0	30	3	1	0	2253	999
		32-54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		80-99	142	7	19	9	2194	992	0	0	206	18	40	18	2601	1044
	LONGLINE	-1	19	1	14	6	0	0	18	1	0	0	0	0	52	9
	OTHER	32-54	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		<16	0	0	9	4	0	0	0	0	0	0	0	0	10	4
	OTTER	>=120	5300	254	19064	8583	481	218	3633	222	0	0	3041	1365	31519	10642
		-1	0	0	2	1	0	0	2	0	0	0	0	0	3	1
		100-119	177	8	976	439	374	169	99	6	1	0	214	96	1841	719
		16-31	0	0	6	3	0	0	0	0	0	0	0	0	7	3
		32-54	3	0	193	87	3	1	1	0	0	0	9	4	208	92
		55-69	0	0	1	0	0	0	0	0	0	0	0	0	1	0
		70-79	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		80-99	949	45	3796	1709	365	165	575	35	1	0	1366	613	7053	2569
		>=120	0	0	0	0	37	17	0	0	0	0	0	0	37	17
	SMALL_BEAM	80-99	1	0	0	0	50	23	0	0	1	0	0	0	51	23
		120-219	34	2	0	0									34	2
SWE	GILL	>120	35	2	46	21									81	22
	OTTER	100-119	21	1	5	2									26	3
		32-54	36	2	21	9									57	11
		70-79	24	1	1	0									25	2
		80-99	360	17	74	33									434	51
		31246	1498	43661	19657	66492	30077	107520	6575	18008	1560	17345	7788	284273	67155	
Grand Total																

Table 1.2.2.4.a Skagerrak and Kattegat landings and discards by species in **2004** and country as estimated by the working group.

	PLE_KS	
country	Land	Disc
BEL	38	2
DEN	5455	307
GER	7	0
NED	1539	87
NOR	74	4
SWE	392	22
Grand Total	7506	423

Table 1.2.2.4.b Skagerrak and Kattegat landings and discards by species and country, gear and mesh size **in 2004** range as estimated by the working group.

			PLE_KS	
country	Gear	Mesh_size_range	Land	Disc
BEL	LARGE_BEAM	-1	38	2
DEN	-1	-1	444	25
	BEAM	>=120	1378	78
		100-119	52	3
	DEM_SEINE	>=120	83	5
		-1	6	0
		100-119	171	10
		80-99	1623	91
	GILL	-1	13	1
		100-119	3	0
		120-219	537	30
		90-99	13	1
	OTTER	<16	1	0
		>=120	114	6
		-1	0	0
		100-119	132	7
		16-31	3	0
		32-54	3	0
		70-79	32	2
		80-99	849	48
GER	DEM_SEINE	>=120	1	0
	OTTER	>=120	1	0
		80-99	5	0
NED	LARGE_BEAM	80-99	1539	87
NOR	DEM_SEINE	80-99	1	0
	GILL	120-219	55	3
	OTTER	>=120	5	0
		32-54	10	1
		70-79	3	0
SWE	GILL	120-219	69	4
	OTTER	>120	2	0
		100-119	8	0
		32-54	0	0
		70-79	8	0
		80-99	305	17
Grand Total			7506	423

Table 1.2.2.5.a Eastern Channel landings and discards by species and country **in 2004** as estimated by the working group.

	PLE_EC	
country	Land	Disc
BEL	985	
FRA	2401	
Grand Total	3386	

Table 1.2.2.5.b Eastern Channel landings and discards by species and country, gear and mesh size range **in 2004** as estimated by the working group.

			PLE_EC	
country	Gear	Mesh_size_range	Land	Disc
BEL	-1	-1	1	
	LARGE_BEAM	80-99	653	
	OTTER	-1	4	
	SMALL_BEAM	80-99	327	
FRA	DREDGE	>=120	0	
		-1	30	
		100-119	0	
		32-54	0	
		70-79	0	
		80-99	24	
	GILL	>=220	0	
		-1	106	
		100-119	37	
		120-219	104	
		50-70	14	
		90-99	197	
	LONGLINE	-1	0	
	OTTER	<16	1	
		>=120	0	
		-1	126	
		100-119	6	
		16-31	1	
		32-54	29	
		55-69	0	
		70-79	2	
		80-99	1083	
	POTS	-1	1	
	ZZZ	-1	639	
Grand Total			3386	

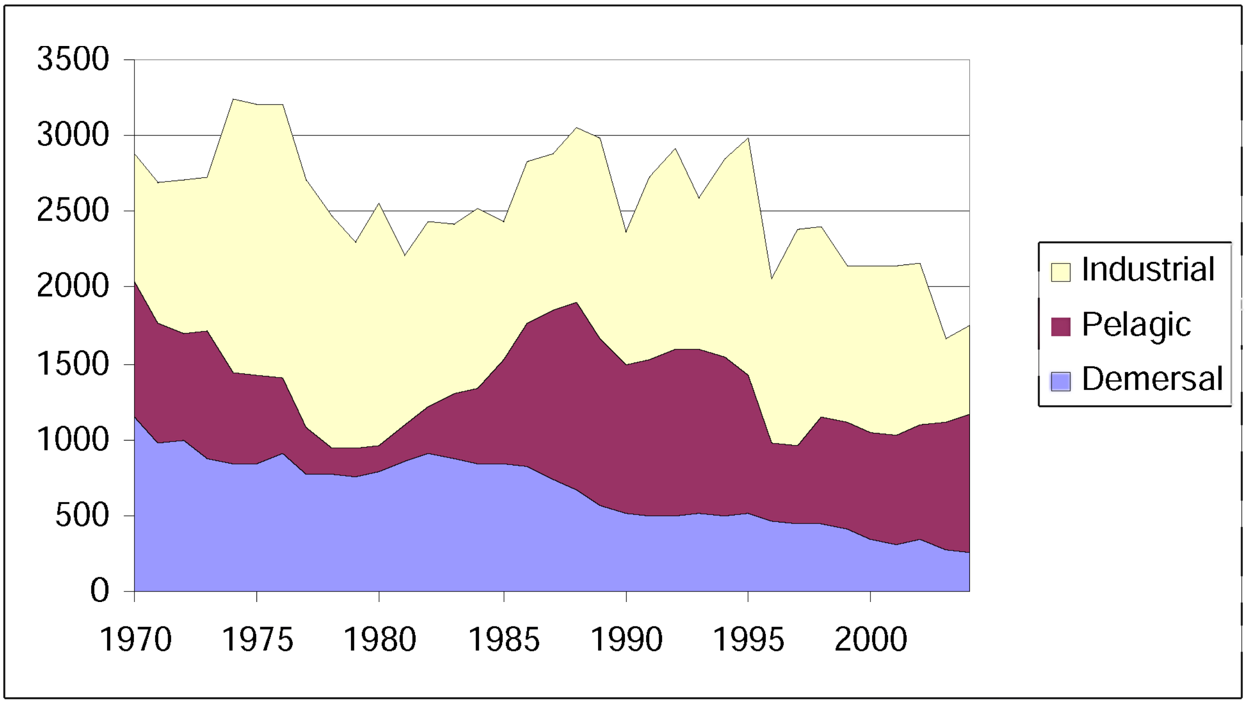


Figure 1.2.2.2 Estimated landings in the North Sea (1970-2004).

1.3.2 Special requests

1.3.2.1 Long-term Management Advice (DG Fish with Norway)

ICES has received a request from the European Community and Norway:

'Background

The Community and Norway have developed work on long-term management modelling of shared stocks through work reported in "Multi-Annual management plans for stocks shared by EU and Norway, Brussels, 14 to 18 June 2004" and "Evaluation of Harvest Control Rules for North Sea Cod. Report of a two-day Meeting of Scientists from Norway and the Community.Brussels, 18th. and 19th. March 2002 ". These two documents are forwarded to ICES under separate cover.

The Community and Norway wish three additional issues to be addressed in the context of ICES long-term management advice:

a). Appropriate long-term management of the North Sea cod stock in any eventual post-recovery situation;

b). An updating of the simulation studies for North Sea plaice to take account of new data and perceptions of discarding.

c). Management strategies for western horse mackerel, sandeel, Norway pout and anglerfish.

The detailed request *is as follows:*

1) *ICES is requested to evaluate a range of harvest rules for the North Sea cod (from a starting point of SSB=Bpa) and North Sea plaice (from a starting point based on the ICES assessment made in 2004) with respect to medium and long term yields, stability of yield and effort; stock status with respect to safe biological limits. Evaluations shall at a first instance be made on a single species basis, but the experts shall, to the extent possible, quantify mutual compatibility of the rules for cod with those for other stocks that are exploited in mixed fisheries.*

   - *The types of harvest rules to be considered should include*
   - *Harvest rules where TACs and/or fishing effort are derived according to a target fishing mortality, supplemented with a rule for reducing the mortality if the spawning stock biomass is below a trigger level, to ensure avoiding a limit value for the spawning biomass.*
   - *Harvest rules as above, but with an additional constraint on the year to year variation of the TAC including a +/- 15% limit on TAC variation.*
   - *Evaluate alternative approaches to limit year-to-year changes in TAC. The current simulated harvest control rule uses a fixed target F (F_{LT}) above a trigger biomass (B_{trig}). Increased stability can be achieved by replacing F_{LT} with a F rule that implies reducing F with increasing stock size. One candidate is the rule corresponding to a fixed TAC for stock sizes above B_{trig}.*
   - *Alternative rules if feasible.*

2) *The rules shall be evaluated through simulations taking into account inter alia:*

   - *Alternative scenarios for future recruitments, weights and maturities at age, assessment error, discarding and other unaccounted mortality.*
   - *Changes in fishing practice (i.e. selection at age).*
   - *Feedback between stock assessment and fisheries management.*

3) *The performance of the rules shall be evaluated both with respect to the perceived state of the stock and to the state of the underlying operating model population. The performance criteria shall include:*

   - *Compatibility with the precautionary approach and relevant international standards and agreements.*
   - *Probability distributions of TACs, yield, spawning stock biomass and fishing mortality.*
   - *Year to year variation in TACs, yield and fishing mortality.*
   - *The risk of entering rebuilding situations ($B<B_{trig}$) in simulations without the year-to-year limitations in TAC change.*

4) *Evaluations shall show:*

   - *The robustness of the harvest rules in assuring stock recovery and maintaining stocks within safe biological limits, considering a plausible range of scenarios as outlined in 3 and a range of alternative parameters as outlined in 2.*

Request concerning western horse mackerel, anglerfish, sandeels and Norway pout:

1. *Advise on appropriate management systems including management strategies, objectives and ecosystem considerations for western horse mackerel, anglerfish, sandeels and Norway pout.'*

ICES comments:

The present response deals specifically with the request concerning North Sea cod and plaice, and anglerfish. For sandeel, Norway pout, and western horse mackerel work has been initiated within the ICES community that will enable a response to be delivered by October 2005.

The Ad hoc Group on Long-Term Advice [AGLTA] met at ICES Headquarters, Copenhagen from 12–13 April 2005 to discuss and agree the technical basis for the ICES advisory response to this joint request from EC and Norway. The results of their evaluations and simulations are summarised in this response, but their report should be consulted for full technical details (ICES CM 2005/ACFM:25).

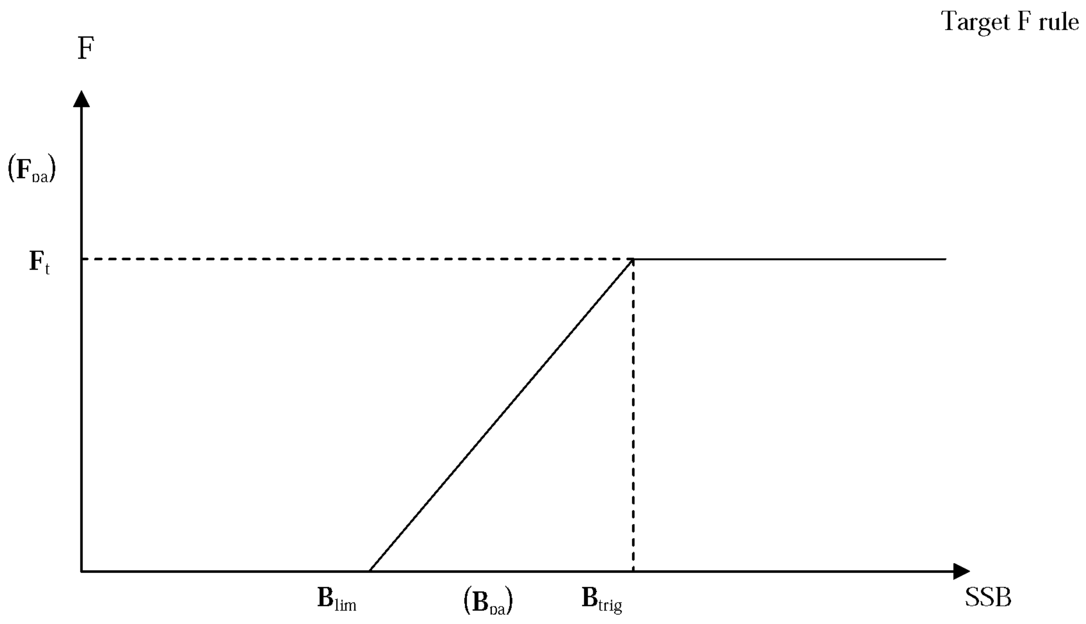
Evaluation framework

Based on the request, the objectives of the management strategies to be evaluated are in all cases assumed to be high medium- and long-term yields and good stock status with respect to safe biological limits (reflected by a low risk of SSB falling below a conservation limit). The hierarchy is assumed to be that high long-term yield will be conditioned by simultaneous low risk to SSB, which has overall priority. Important performance criteria are taken to be stability of yield and robustness to both assumptions concerning stock productivity (reflected in assumptions about a stock-recruitment relationship) and the precision and bias of stock assessments.

Note that for brevity, the phrase *low risk to reproduction* is used within the text of this response to replace *low risk of SSB falling below a conservation limit.*

The evaluations for North Sea cod and plaice are based on simulations of stochastic medium-term projections over a 10-year period, taking into account uncertainty in initial stock numbers-at-age, future recruitments, and individual weights and maturities. The robustness of the simulated outcomes to uncertainty and bias in future assessments, assumptions about the recruitment regime and implementation error have been evaluated though sensitivity tests (ICES CM 2005/ACFM:25). Implementation error in this document is understood as including both failure to make decisions according to the management plan and failure to enforce management decisions. The evaluations of management strategies have been undertaken within the common framework presented next.

The management strategies evaluated included a harvest control rule (HCR) with three parameters – a target F ($\mathbf{F}_t$), a limit spawning stock biomass ($\mathbf{B}_{lim}$), and a trigger spawning stock biomass ($\mathbf{B}_{trig}$). Pictorially, depicted by:

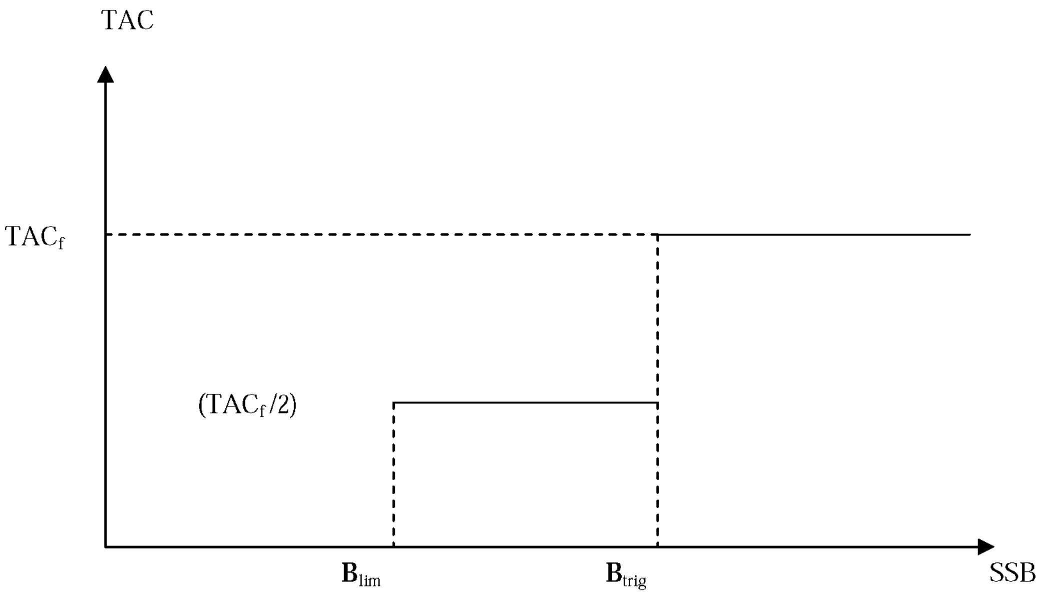


The figure represents the decision rule and not the realised fishing mortality. The actual fishing mortality will be different due to assessment and implementation error. In the simulations, which have been part of the evaluation, such errors have been included. A small fishing mortality below $\mathbf{B}_{\text{lim}}$ has also been included to simulate a small unavoidable mortality which must be assumed to exist even if management decisions for closure of targeting and important mixed fisheries catching the species in question have been made.

In this framework values of $\mathbf{F}_t$ and $\mathbf{B}_{\text{trig}}$ are estimated which achieve objectives regarding low risk to SSB and high future yields whilst satisfying relevant performance criteria.

$\mathbf{F}_t$ and $\mathbf{B}_{\text{trig}}$ are conceptually different from the reference points $\mathbf{F}_{\text{pa}}$ and $\mathbf{B}_{\text{pa}}$ used in an earlier framework. $\mathbf{F}_{\text{pa}}$ and $\mathbf{B}_{\text{pa}}$ are signposts regarding the state of the stock and the fisheries within the Precautionary Approach where the concern is the need to maintain low risk that the actual spawning stock falls below the biomass level below which there is increased risk of impaired recruitment, $\mathbf{B}_{\text{lim}}$. Even though $\mathbf{F}_{\text{pa}}$ and $\mathbf{B}_{\text{pa}}$ are parameters of the state of the stock they have in practice been used as parameters in a decision rule which implicitly has had avoidance of risk to SSB as its sole objective. The new framework distinguishes between state of the stock parameters ($\mathbf{B}_{\text{pa}}$ and $\mathbf{F}_{\text{pa}}$) and management plan decision rule parameters ($\mathbf{F}_t$ and $\mathbf{B}_{\text{trig}}$). The management decision rule parameters should be selected such that all objectives and performance criteria are satisfied or balanced simultaneously. As low risk to SSB is a prioritised objective the normal assumption will be that $\mathbf{F}_t$ will be lower than $\mathbf{F}_{\text{pa}}$ and that $\mathbf{B}_{\text{trig}}$ will be higher than $\mathbf{B}_{\text{pa}}$.

An alternative set of strategies was evaluated, based on a fixed TAC (TAC_f) and the biomass parameters $\mathbf{B}_{\text{lim}}$ and $\mathbf{B}_{\text{trig}}$. Pictorially, Fixed TAC rule



Other variants, such as a TAC slope below B_{trig} or more than one intermediate TAC level below $\mathbf{B}_{trig}$, are conceivable, but due to practical limitations of the simulation software a harvest control rule with one plateau of $TAC_f/2$ was used between $\mathbf{B}_{lim}$ and $\mathbf{B}_{trig}$.

The assumed benefits of a fixed TAC approach relative to a target F approach are stability in fishing opportunities and that management becomes less dependent on the precision of annual stock assessments as long as the stock is well above $\mathbf{B}_{trig}$. The possible losses in terms of yield, risk to reproduction and performance are evaluated below.

While $\mathbf{B}_{lim}$ is supposed to be an estimate of a property of nature (namely, the spawning stock biomass below which reproduction is at risk of being impaired) both $\mathbf{B}_{trig}$ and $\mathbf{F}_t$ (or in the fixed TAC rule TAC_f) are only parameters of the decision rule. These parameters can be decided entirely on the basis of the desired objectives and performance of the management strategy.

In some cases with fishing mortalities far below what has been observed in several decades, the simulated long-term spawning stock levels of both cod and plaice grow well beyond what has been observed historically. It is emphasised that simulations which do not take biological interactions and density-dependent growth/maturity into account will not produce results which are reliable in an absolute quantitative sense. The results should therefore only be taken as indicative of the direction of change when simulations are well beyond the historical range of fishing mortalities. For that reason alone, this response does not include the quantitative graphical outputs of the simulations undertaken by ICES and reported in ICES CM 2005/ACFM:25.

For the present, this response deals only with the request concerning North Sea cod and plaice, and anglerfish.

- For sandeel and Norway pout the management strategy will be based on in-year information from either an initial fishery (sandeel) or surveys (Norway pout). The currently available software does not enable simulation for these stocks, but a process has been proposed by which simulations and advice will be produced during 2005 (ICES CM 2005/ACFM:25). The response to this part of the request will thus be available in October 2005.

- For western horse mackerel, the spasmodic nature of spawning indicates that a dual management regime is needed with different management rules for the cases where a large year class either is, or is not, present. The conditions for such a regime have been discussed within ICES and a process devised through which proposals for a management strategy will be produced (ICES CM 2005/ACFM:25). The response to this part of the request will be available in October 2005.

- For anglerfish there is insufficient catch data, no survey information and important aspects of the biology are unknown. This response therefore includes a proposal for a two-step adaptive approach that will enable better information to be produced, after which management measures could be adapted.

Overall conclusions

Some overall conclusions regarding management strategies may be drawn across the stocks studied. These conclusions are based on the stocks for which simulations were made:

- At low target Fs (considerably lower than the present F), low risk to reproduction and high long-term yields are achieved simultaneously. The general pattern is that there is no conflict between the two objectives. A low $\mathbf{F}_t$ will lead to high yield simultaneously with a low risk to reproduction that is lower than the 5-10% risk which has generally been considered acceptable by managers.
- Once stocks have recovered and fishing mortality is around a low F target, the outcomes are insensitive to $\mathbf{B}_{trig}$. Criteria for the selection of $\mathbf{B}_{trig}$ in this situation are discussed below.
- Fixed TAC regimes are feasible, but result in lower long-term yield for the same risk to reproduction.
- At low target Fs there is low sensitivity to recruitment assumptions (recruitment model used in simulations).
- Implementation errors above 10–20% disrupt achievement of low risk to reproduction and high long-term yield.

The selection of $\mathbf{F}_t$ and $\mathbf{B}_{trig}$ is evaluated by simulated outcomes of management strategies in terms of the achievement of objectives and performance criteria. While the simulations provide clear indications of the relevant ranges of $\mathbf{F}_t$, the outcomes may be insensitive to choices of $\mathbf{B}_{trig}$ once low Fs have been achieved. Some general supplementary considerations in the choice of $\mathbf{B}_{trig}$ are:

- As low risk to SSB is a prioritised objective the normal assumption will be that $\mathbf{F}_t$ will be lower than $\mathbf{F}_{pa}$ and that $\mathbf{B}_{trig}$ will be higher than $\mathbf{B}_{pa}$.
- The main role of having a $\mathbf{B}_{trig}$ is to have an early response to a declining SSB. A high $\mathbf{B}_{trig}$ is more robust to implementation and assessment error and poor recruitment.
- As a rule-of-thumb, $\mathbf{B}_{trig}$ should be chosen to be well above $\mathbf{B}_{lim}$ and take into account the uncertainty in the annual SSB estimate.
- A low $\mathbf{B}_{trig}$ is expected to result in large interannual variations in the Fs prescribed by the decision rule. This will result when the variance in the biomass estimates results in estimates of SSB changing from one year to the next from being above $\mathbf{B}_{trig}$ to being below or close to $\mathbf{B}_{lim}$, and vice versa.
- A high $\mathbf{B}_{trig}$ will result in faster response and thus more proactive action in worst case situations of consecutive years with low recruitment.

North Sea cod summary

The evaluation of the probability of recovery to $\boldsymbol{B}_{pa}$ was not part of the request. However, in order to derive a starting population for a recovered North Sea cod stock at $\boldsymbol{B}_{pa}$, ICES has evaluated several scenarios by which the recovery might be achieved and has concluded that:

- recovery is unlikely unless F can be substantially reduced from current levels;
- implementation bias over 10% seriously reduces the likelihood of the cod recovery; and
- recovery time and probability are dependent on the continued influx of at least moderate recruitment.

The last point is critical and cannot be predicted as the stock presently is in a state where future reproduction is unknown. For this reason, ICES in 2003 concluded that a precautionary recovery plan must include an adaptive element implying that the fisheries for cod remains closed until an initial recovery of the cod SSB has been proven.

In relation to the joint request, the evaluations of harvest control rules for North Sea cod have demonstrated the following:

- target fishing mortalities (covering all catches) below 0.4 (ages 2–4) result in a low risk of SSB falling below the conservation limit $\mathbf{B}_{lim}$ and high long-term yields. With fishing mortalities below 0.4 the following conclusions can be drawn:
    - a low risk to reproduction when a constraint on year-to-year variation in TAC (down to ± 5%) is used;
    - a constraint to year-to-year variation in TAC of less than ± 20% results in reductions in long-term yields;
    - implementation error above 10% results in significant increases in risk to $\mathbf{B}_{lim}$.

However, a word of caution is necessary. In the simulations with low fishing mortalities, the absolute stock sizes projected are very high and well outside of the historically observed ranges. It is unknown whether such high stock sizes can actually be achieved given the constraints within the natural system and what effects this would have on the dynamics of the stock. However, the numerical results of the simulations in terms of risk to reproduction and expected yield are conditional on these large stock sizes. The conclusions regarding the general direction required are not sensitive to density-dependent effects – i.e. significant reductions in fishing mortality to achieve simultaneously a low risk to reproduction and high long-term yield. It is therefore suggested that an implementation of long-term management plans is based on an adaptive approach whereby the development of the stock is monitored as the effects of the reduced fishing mortality are developing, and the specific numerical values within the management plan may then be modified on the basis of the outcome of the fishing mortality reductions.

North Sea plaice summary

The starting population for the simulations on North Sea plaice was taken from the last ICES assessment made in 2004 (ICES CM 2005/ACFM:07) which included simulated discards (1957–1998) and estimated discards (1999–2003). The exploitation pattern used is thus based on assessments including landings and discards.

In relation to the joint request, the evaluations of harvest control rules for plaice have demonstrated, under the assumption of the current exploitation pattern, that target fishing mortalities (covering all catches) in the range 0.3–0.4 (ages 2–6) result in a low risk to reproduction and high long-term yields. The performance of a long-term management plan with target Fs below 0.4 is not sensitive to choices of $\mathbf{B}_{trig}$. A major improvement to the stock development and to the landings is expected if an additional (i.e. more than proportional) reduction of juvenile mortality could be achieved, in which case the target mortality could be reconsidered. A constraint on annual TAC variations is expected to improve the performance both in terms of minimising short-term landings variation and in terms of making the system less sensitive to the noise in annual assessments. For $\mathbf{F}_t$ in the range of 0.3 to 0.4, the likelihood of meeting objectives and performance criteria is relatively insensitive to assumptions regarding stock productivity and assessment error and bias.

A fixed TAC regime with TAC below 80 000 t is expected to produce the same results in terms of low risk to reproduction, but will result in considerably lower average landings in the longer term.

The simulations investigated have neither taken biological interactions nor density dependent growth/maturity into account and are thus merely indicative of the direction of outcomes from the management strategies prescribed in the joint request. However, the conclusions regarding the general direction required are not sensitive to density-dependent effects – i.e. significant reductions in fishing mortality to achieve simultaneously a low risk to reproduction and high long-term yield. It is therefore suggested that an implementation of long-term management plans is based on an adaptive approach whereby the development of the stock is monitored as the effects of the reduced fishing mortality are developing, and the specific numerical values within the management plan may then be modified on the basis of the outcome of the fishing mortality reductions.

Anglerfish approach

There are major uncertainties about catch and effort data for anglerfish, as well as limited knowledge about population dynamics and distribution. In addition, existing surveys have not proven useful in describing the population. For these reasons, simulations of management plans would have to be so generic that they would tell little about the expected outcomes.

In this situation the most productive way forward would be a two-stage approach. The first stage would be to substantially improve the quality and quantity of data collected on the fishery while maintaining exploitation at its current level. This was the basis of ICES recommendation (ACFM 2004) to allow the fishery to continue with the current effort (inasmuch as this can be determined). This was to be accompanied by a detailed and stringent monitoring programme, including the mandatory reporting of both catch and effort data in logbooks, as well as the use of VMS data. The programme would also include the development of a targeted, industry collaboration trawl survey to start in 2005.

A key point in this recommendation was that the restrictive TAC in 2004 and previous years had led to extensive mis-reporting. Management aimed at maintaining effort at or below that of 2004, but without a specific TAC, would have allowed the accurate reporting of catch and effort. In the event, a TAC-based regime was retained, although at an increased level. To date it is not clear if this has improved the quality of the landings data, however, the TAC is still perceived as restrictive by the industry. The existing tally book scheme is to be continued and extended, and observers will be placed on as many vessels as is feasible. The targeted survey is planned to go ahead in the autumn of 2005 and analysis of VMS data at approximately the same time. More robust management measures to control the targeted fishery have been proposed in the UK.

This first stage of data collection would be expected to take at least five years to establish useable time-series of fisheries-dependent and -independent data. The second stage could then be launched to use these data to examine alternative management approaches and harvest control rules appropriate to this fishery in a fashion similar to that used elsewhere within this response; e.g. North Sea cod and plaice. Should evidence appear of a decline in the stock size during this period of data collection, the management of this stock should be revisited and appropriate management measures initiated.

Sources of information

ACFM(2004).
Report of the Ad hoc Group on Long-Term Advice, 12–13 April 2005 (ICES CM 2005/ACFM:25).
Report on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 7–16 September 2004 (ICES CM 2005/ACFM:07).

1.3.2.2 Sole in Division IIIa (DG FISH)

The EC DG FISH has by 21 January 2005, requested non-recurrent advice from ICES on sole in Division IIIa. The EC asked ICES:

- when "…significant new information would be collected to allow a meaningful reassessment of this stock";
- if ICES could "…assess this new information and provide a review of its advice for 2005".

ICES has now done this and the outcome is presented below as an ICES Advice (including Management considerations), taking into account the mixed fishery aspect of the Division IIIa sole fishery, and as a single-stock summary text.

ICES Advice

Fisheries of sole in Division IIIa (Skagerrak–Kattegat) should in 2005 be managed according to the following rules, which should be applied simultaneously:

- **with minimal bycatch or discards of cod;**
- **within the precautionary exploitation limits for sole (see attached single-stock summary text).**

Management considerations

ICES notes that this advice presents a strong incentive to fisheries to avoid catching cod that are identified as critical stocks. Industry-initiated programmes to pursue such incentives should be encouraged, but must include a high rate of independent observer coverage, or other fully transparent methods for ensuring that their catches of critical stocks are fully and credibly reported. Such programmes could be considered in the management of these fisheries.

Single-Stock Summary

Sole in Division IIIa (Skagerrak and Kattegat).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield		Comment
Full reproductive capacity	Likely sustainably exploited	unknown		

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity. The assessment is uncertain due to substantial discarding and non-reporting in the most recent years. While the SSB estimate is relatively robust against this, the fishing mortality estimate in the most recent year is more uncertain, but available information indicates sustainable exploitation.

Management objectives

There are no management objectives for this stock. However, for any management criteria to meet the proposed precautionary criteria F should be less than the proposed $\mathbf{F}_{pa}$ and the SSB should be maintained above the proposed $\mathbf{B}_{pa.}$

Reference points

	ICES considers that:	**ICES proposed that:**
Limit reference points	$\mathbf{B}_{lim}$ is 770 t.	$\mathbf{B}_{pa}$ be set at 1060 t.
	$\mathbf{F}_{lim}$ is 0.47.	$\mathbf{F}_{pa}$ be set at 0.30.
Target reference points		N/A

The assessment has revised the level of SSB considerably for the last 5 years. Because of this, previously defined biomass-related reference points need to be re-evaluated.

Technical basis:

$\mathbf{B}_{lim}$: $\mathbf{B}_{pa}$*exp(-1.645*0.2).	$\mathbf{B}_{pa}$: MBAL.
$\mathbf{F}_{lim}$: $\mathbf{F}_{med}$ 98 excluding the abnormal years around 1990.	$\mathbf{F}_{pa}$: consistent with $\mathbf{F}_{lim}$.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Given the uncertainties regarding non-reporting and discarding in recent years, ICES advises a fishing mortality not higher than the *status quo* fishing mortality to be applied in setting the final TAC for 2005. ICES will on the basis of the decision by the EU commission on the fishing in 2005 advise on the fishing options for 2006 in October 2005. The predicted catches in 2005 at various fishing mortalities are very sensitive to assumptions regarding non-reporting and discarding in recent years, which cannot be estimated precisely. The catch option table for 2005 is therefore provided in relative terms and gives the change of catch relative to the total catch in 2004, i.e. reported landings and unreported/discarded catches in the order of 100% as well as corresponding changes in SSB in 2006 relative to 2005.

Short-term implications

Outlook for 2006

Basis: F(2004) = $\mathbf{F}_{sq}$; SSB(2005) = 4621 t, catch (2004) = 784[1] t.

Rationale	Basis	% Catch change[2) 3)]	% SSB change[4)]
Zero catch	F=0		14.2
Status quo	$\mathbf{F}_{sq}$	2.6	-3.3
	$\mathbf{F}_{sq}$ * 0.5	-46.0	5.0
	$\mathbf{F}_{sq}$ * 0.6	-36.0	3.3
	$\mathbf{F}_{sq}$ * 0.7	-26.0	1.6
	$\mathbf{F}_{sq}$ * 0.8	-16.3	0
	$\mathbf{F}_{sq}$ * 0.9	-6.8	-1.7
	$\mathbf{F}_{sq}$ * 1.1	11.1	-4.8
	$\mathbf{F}_{sq}$ * 1.2	20.8	-6.4
	$\mathbf{F}_{sq}$ * 1.3	29.6	-7.9
	$\mathbf{F}_{sq}$ * 1.4	38.1	-9.4

Weights in tonnes.
Shaded scenarios are not considered consistent with the precautionary approach. The estimate of present (*status quo*) fishing mortality is uncertain, but *status quo* fishing mortality is probably at or below $\mathbf{F}_{pa}$. It is thus not considered precautionary to increase the fishing mortality above *status quo* irrespective of the actual estimate.

1) Catch includes reported landings plus an overall estimate of non-reporting and discarding of legal sized sole of 100% in 2004. This estimate is uncertain and the forecast is therefore provided on a relative basis.
2) Catch includes reported landings plus non-reporting and discarding due to quota restrictions.
3) Catch 2005 relative to catch 2004.
4) SSB 2006 relative to SSB 2005.

Management considerations

Due to considerable non-reporting, discarding of fish above minimum landing size caused by restrictive quotas since 2002 and to a lesser extent misreporting to other species in recent years, the assessment is considered uncertain in relation to the estimate of F in the final year. The forecast presented is based on the best available information from the industry and inspection regarding non-reporting and discards in 2002, 2003, and 2004, but this information is by its nature uncertain. The sensitivity of the assessment and the forecasts to assumptions regarding non-reporting and discarding has been evaluated for a range of likely scenarios. SSB estimates are more stable against such assumptions, but estimates of recent F and thus the projected catches in future years are not. The short-term forecast has therefore been provided as changes relative to the assumed catches in 2004.

The estimate of present F may be an underestimate, but the present F is likely to be at or below $\mathbf{F}_{pa}$. In order to avoid fishing at a fishing mortality above $\mathbf{F}_{pa}$ ICES therefore advises that single-stock boundaries for fishing mortality should be below *status quo* fishing mortality in 2005.

The change in total catch provided in the forecast refers to the sum of reported and non-reported landings and discards of legal-sized sole.

Cod is taken as a bycatch in the sole fishery, thus the TAC for sole in 2005 should be set taking into account the status of the Kattegat cod stock, i.e. advice of no fishery in 2005.

Management plan evaluations

There is no management plan in place.

Regulations and their effects

The Danish fishery is regulated by half-monthly rations that depend on vessel length and vary over the year. The rations have been reduced since 2002, reflecting the decline in the agreed TAC and the Danish sole fishery was entirely closed late in the years 2002 to 2004.

For the period 1991–1993 the official catch statistics are disputable with a significant amount of sole assumed landed without being properly recorded. For Kattegat where most of the sole catches in 1994–2000 were taken under an effort regime, the official statistics are assumed fairly accurate. Considerable misreporting by areas in 2000 and 2001 was corrected, i.e. North Sea sole reported as caught in Division IIIa.

Analyses of private logbooks, survey data, and observer data indicate that there was considerable economic incentive to non-report landings in 2002–2004 as the entire two-week ration in many cases could be taken in just a few hauls. However, it is not known to what extent these catches are discarded or landed as black landings (i.e. excluding both catch and effort data from the official statistics), or distributed to and landed by vessels not having caught their rations. Thus, this information could not be used to quantify discarding and/or non-reporting.

Based on information from the industry non-reporting and discarding is believed to be in the order of magnitude of 50–100% in 2002 and 100–200% in 2003 and 2004. Although the advice on the stock status is robust to the assumptions, unreported catches in this order of magnitude have a severe impact on the quality of the stock assessment through the estimate of *status quo* F and needs to be quantified properly.

There is a mis-match between the assessment area that is Division IIIa and the management area that includes Division IIIa plus the Western Baltic (Subdivisions 22–24). Danish vessel rations cover the management area and there are therefore no incentives for misreporting IIIa sole into the Western Baltic. However, the low TAC creates incentives for non-reporting for this stock.

Ecosystem considerations

Sole is taken in a directed trawl fishery with bycatch of *Nephrops* and cod. Sole itself is taken as bycatch in the *Nephrops* trawl fishery. Gillnet catches are mainly taken in directed fisheries.

Factors affecting the fisheries and the stock

Changes in fishing technology and fishing pattern

Sole are caught with both gillnet and trawl. The peak season for trawl is from October to January. On average more than 75% of the annual sole catches with trawl are caught in this 4-month season. However, September and February are important months for the sole fishery also, but the percentage of sole in the catches is significantly less, indicating that there might be other target species also in these periods. The season for sole gillnet fishery is from April to September.

The environment

The stock is probably influenced by both temperature and salinity because it is located near the species' physiological limits for both of these factors. Large variations in either factor will therefore influence stock productivity.

The large increase in landings in the early 1990s compared to long-term historical levels (1950s–1980s) may represent both changes in environmental conditions and fishery developments (e. g., increased effort), but the relative importance of the two factors is not known.

The Kattegat has also been eutrophicated over the past 50 years, but the specific effects of eutrophication on sole have not been investigated.

Scientific basis

Data and methods

The assessment includes CPUE data from seven new commercial CPUE series and one CPUE series from a scientific trawl survey with Havfisken in quarter 4. Four of the commercial series were based on data from private logbooks (6 trawlers and 3 gillnetters and 2 area combinations) and three of the series on official logbooks from fisheries outside the main sole fishing seasons when rations were not restrictive (small and large trawlers as well as gillnetters). Assessment results were robust to various combinations of CPUE fleets. As in previous years, the 1st quarter IBTS Argos and Havfisken surveys were not used in the assessment, due to their low signal-to-noise ratio. This is consistent with the practice in the assessment of the North Sea sole, where IBTS indices are similarly not used in the assessment.

The available data from discard sampling is insufficient to be used directly in the assessment. Overall estimates of non-reporting and discarding have been used in the assessment based on information from the industry and the inspection, see section on management considerations above and information from the industry below.

Uncertainties in assessment and forecast

The assessment is considered highly uncertain in relation to the estimates of F in the final year, while SSB estimates are more stable to assumed levels of unreported catches.

Due to a closure in the fisheries in the 4th quarter of 2002 to 2004, the commercial data matrix is biased in not reflecting the strength of the incoming recruitment at the end of the year.

Information from the fishing industry

Collaboration between the Danish Fishermen's Organisation and DIFRES was initiated in 2004 to establish a database with data from private logbooks. Data from 6 trawlers and 3 gillnetters covering the time period 1987 to 2004 were available for the assessment.

The industry provided information on the likely order of magnitude of discarding and non-reporting in 2002–2004.

Comparison with previous assessment and advice

New data (CPUE series based on private and official logbooks and estimates of non-reporting and discards of legal-sized sole in recent years) have been compiled to supplement the data formerly available for the assessment. Utilising the new CPUE series from private and official logbooks and catch data including an estimate of discard and non-reporting revises the perception of the stock in the most recent years. This new perspective indicates an increasing trend in SSB and decreasing F since the late 1990s. Previous advice was based on a perception of the stock, which was close to $\mathbf{B}_{pa}$ and fished around $\mathbf{F}_{pa}$.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19 Ref.H.

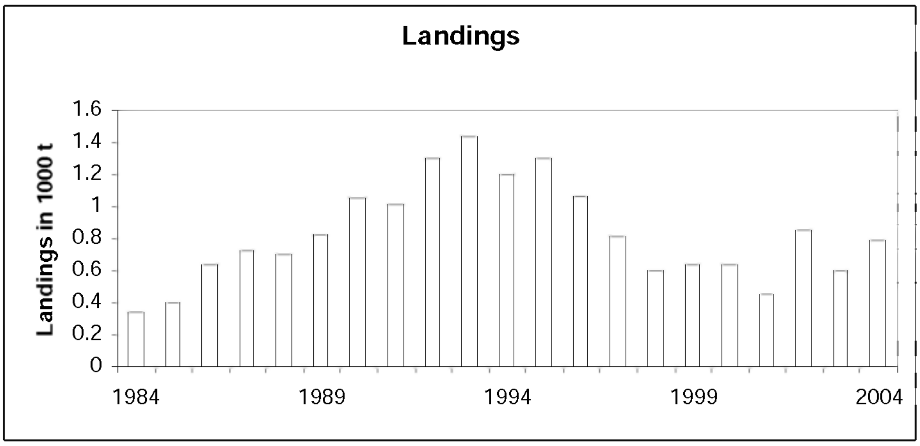
Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	ACFM Catch
1987	-		-		0.85	0.72
1988	-		-		0.95	0.71
1989	TAC		<0.8		0.80	0.82
1990	Precautionary TAC		0.6		0.50	1.05
1991	TAC		1.0		1.00	-[1]
1992	TAC		1.0		1.40	-[1]
1993	TAC at recent catch levels		1.0		1.60	-[1]
1994	No advice due to uncertain catches		-		2.10	1.20
1995	No advice		-		2.25	1.30
1996	No advice		-		2.25	1.10
1997	No advice		-		2.25	0.81
1998	No advice		-		1.80	0.61
1999	No increase in F		0.8		1.35	0.64
2000	No increase in F		0.65		0.95	0.63
2001	No increase in F		0.7		0.70	0.46
2002	F below $\mathbf{F}_{pa}$		0.5		0.50	0.84[2]
2003	F below $\mathbf{F}_{pa}$		0.3		0.35	0.60[3]
2004	F below $\mathbf{F}_{pa}$		0.5		0.52	0.78[3]
2005	No increase in F		-			
2006	Will be available in Oct. 2005		Will be available in Oct. 2005			

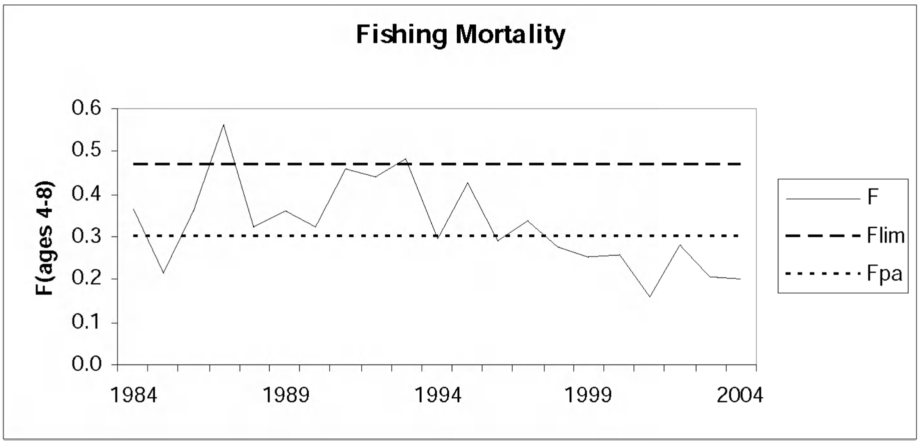
Weights in '000 t.

[1] Uncertain.

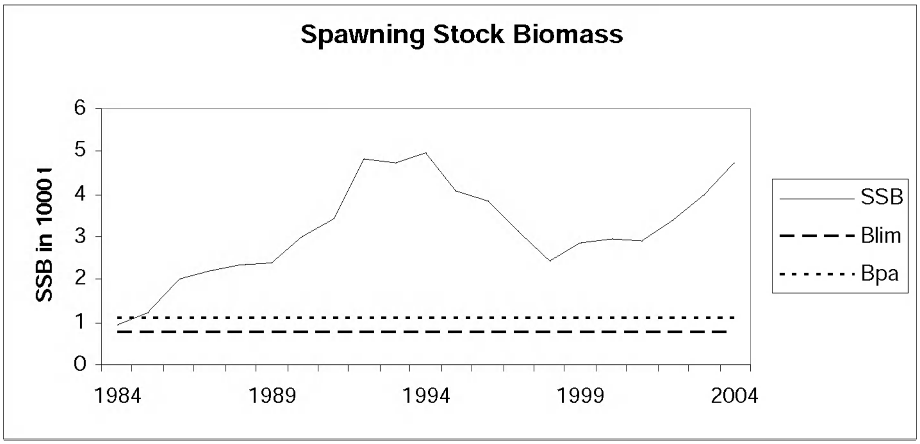
[2] 50% non-reporting/discarding assumed.

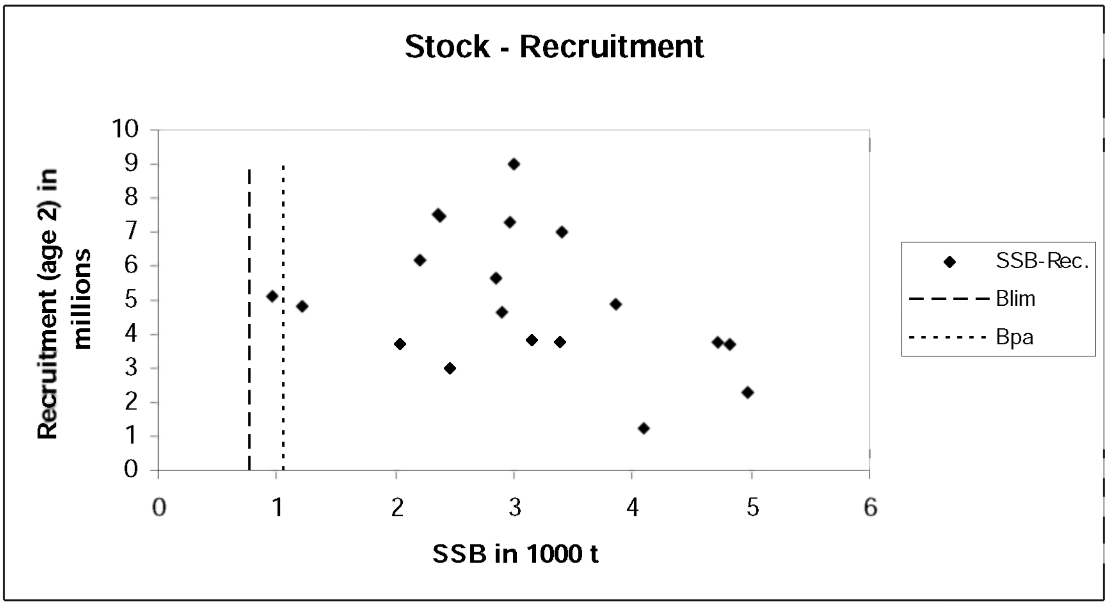
[3] 100% non-reporting/discarding assumed.


Landings
Landings in 1000 t
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1984
1989
1994
1999
2004


Fishing Mortality
F(ages 4-8)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1984
1989
1994
1999
2004
F
Flim
Fpa


Recruitment (age 2)
Recruitment in millions
10
8
6
4
2
0
1984
1989
1994
1999
2004


Spawning Stock Biomass
SSB in 1000 t
6
5
4
3
2
1
0
1984
1989
1994
1999
2004
SSB
Blim
Bpa



Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4
5
6

Table 1.3.3.2.1 Sole in Division IIIa. Catches (tonnes) in the Kattegat and Skagerrak 1952–2004. Official statistics and Working Group corrections. Danish catches are given for Kattegat and Skagerrak combined 1952–1969. For Sweden there is no information 1962–1974.

Year	Denmark		Sweden	Germany	Belgium	Netherlands	Working Group	Total
	Kattegat	Skagerrak	Skag+Kat	Kat+Skag	Skagerrak	Skagerrak	Corrections	
1952	156		51	59				266
1953	159		48	42				249
1954	177		43	34				254
1955	152		36	35				223
1956	168		30	57				255
1957	265		29	53				347
1958	226		35	56				317
1959	222		30	44				296
1960	294		24	83				401
1961	339		30	61				430
1962	356			58				414
1963	338			27				365
1964	376			45				421
1965	324			50				374
1966	312			20				332
1967	429			26				455
1968	290			16				306
1969	261			7				268
1970	158	25						183
1971	242	32		9				283
1972	327	31		12				370
1973	260	52		13				325
1974	388	39		9				436
1975	381	55	16	16		9	-9	468
1976	367	34	11	21	2	155	-155	435
1977	400	91	13	8	1	276	-276	513
1978	336	141	9	9		141	-141	495
1979	301	57	8	6	1	84	-84	373
1980	228	73	9	12	2	5	-5	324
1981	199	59	7	16	1			282
1982	147	52	4	8	1	1	-1	212
1983	180	70	11	15		31	-31	276
1984	235	76	13	13		54	-54	337
1985	275	102	19	1	+	132	-132	397
1986	456	158	26	1	2	109	-109	643
1987	564	137	19		2	70	-70	722
1988	540	138	24		4			706
1989	578	217	21	7	1			824
1990	464	128	29	-	2		+427	1050
1991	746	216	38	+			+11	1011[1]
1992	856	372	54				+12	1294[1]
1993	1016	355	68	9			-9	1439[1]
1994	890	296	12	4			-4	1198
1995	850	382	65	6			-6	1297
1996	784	203	57	612			-597	1059
1997	560	200	52	2				814
1998	367	145	90	3				605
1999	431	158	45	3				637
2000	399	320	34	11			-132[2]	633[2]
2001[1]	249	286	25				-103[2]	455[2]
2002	360	177	15	11			+281[3]	844[3]
2003	195	77	11	17			+301[4]	602[4]
2004	249	109	16	18			+392[4]	784[4]

[1]Considerable non-reporting assumed for the period 1991–1993. [2]Catches from Skagerrak were reduced by these amounts because of misreporting from the North Sea. The subtracted amount has been added to the North Sea sole catches. Total landings for these years in IIIA has been reduced by the amount of misreporting. [3]50%non-reporting/discarding assumed, [4]100% non-reporting/discarding assumed.

Table 1.3.3.2.2 **Sole in Division IIIa.** Summary output files from run based on assumptions regarding discarding and non- reporting as indicated in Table 1.4.9.2.

Summary (without SOP correction)
Terminal Fs derived using XSA (With F shrinkage to 1.5)

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
	Age 2					
1984	3070	1520	958	337	0.3516	0.3655
1985	6018	2263	1216	397	0.3266	0.2153
1986	5092	2880	2039	643	0.3153	0.359
1987	4808	2978	2209	722	0.3269	0.5621
1988	3692	2939	2352	706	0.3001	0.322
1989	6177	3470	2383	824	0.3458	0.359
1990	7550	4356	2997	1050	0.3503	0.3242
1991	7460	4701	3403	1011	0.2971	0.4615
1992	9005	6730	4812	1294	0.2689	0.4404
1993	7018	5976	4726	1439	0.3045	0.4838
1994	3690	5618	4976	1198	0.2407	0.296
1995	3743	4798	4098	1297	0.3165	0.4254
1996	2291	4261	3858	1059	0.2745	0.29
1997	1264	3409	3159	814	0.2577	0.3386
1998	4873	3241	2456	605	0.2463	0.2766
1999	3800	3467	2851	638	0.2238	0.2523
2000	2979	3463	2959	633	0.2139	0.256
2001	5663	3935	2893	455	0.1573	0.1573
2002	7322	4658	3391	845	0.2492	0.2812
2003	4619	4791	3982	600	0.1507	0.2082
2004	3745	5481	4714	784	0.1659	0.2016
Arith. Mean	4947	4045	3164	826	0.2706	0.3274
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

1.4 NORTH SEA

1.4.1 Cod in the Kattegat

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Reduced reproductive capacity	Harvested unsustainably	Overexploited	Unsustainable	The stock is depleted with low SSB and very low recruitment in the last 5 years. The recent stock size is not precisely known, but is indicated to be well below $\mathbf{B}_{lim}$.

Based on the all available evidence on SSB and fishing mortality ICES classifies the stock as having reduced reproductive capacity. Given the low stock size, the present fishing mortality is high and the stock is harvested unsustainably. The estimated SSB in 2004 is considerably below $\mathbf{B}_{lim}$.

The spawning stock declined steadily from about 35 000 t in the early 1970s to about 10 000 t in the 1990s, with a concurrent drop in recruitment from 20–30 millions in the 1970s, to around 10 millions in the 1990s and less than 1 million in the recent years. The fishing mortality exceeded 1.0 during most of the 1980s and 1990s, and has continued to do so in the last decade. In the present state the stock is highly dependent on the strength of incoming year classes only.

The present assessment indicates that recruitment has been well below average since the late 1990s. Available information indicates that recruitment in the last five years is very low.

Management objectives

In 2004 agreement was reached within the EU on a formal recovery plan that will be operational during the TAC and management decision processes of 2004, effectively rendering the plan operational in 2005. Details of it are given in Council Regulation (EC) 423/2004:

Article 1
This Regulation establishes a recovery plan for the following cod stocks (hereinafter referred to as 'depleted cod stocks'):
(a) cod in the Kattegat;
(b) cod in the North Sea, in the Skagerrak and the eastern Channel;
(c) cod to the west of Scotland;
(d) cod in the Irish Sea.

Article 3 - Purpose of the recovery plan
The recovery plan referred to in Article 1 shall aim to increase the quantities of mature fish to values equal to or greater than the target levels specified in the following table: (Stock Target levels in tones)
Cod in the Kattegat 10 500
Cod in the North Sea, Skagerrak and eastern Channel 150 000
Cod to the west of Scotland 22 000
Cod in the Irish Sea 10 000

Article 4 - Reaching of target levels
Where the Commission finds, on the basis of advice from ICES and following agreement on that advice by the Scientific Technical and Economic Committee for Fisheries (STECF), that for two consecutive years the target level for any cod stock concerned has been reached, the Council shall decide by qualified majority on a proposal from the Commission to remove that stock from the scope of this Regulation and to establish a management plan for that stock in accordance with Article 6 of Regulation (EC) No 2371/2002.

Article 5 - Setting of TACs
A TAC shall be set in accordance with Article 6 where the quantities of mature cod have been estimated by the STECF, in the light of the most recent report of ICES, to be equal to or above the minimum levels specified in the following table (Stock Minimum levels in tones)
Cod in the Kattegat 6 400
Cod in the North Sea, Skagerrak and eastern Channel 70 000
Cod to the west of Scotland 14 000
Cod in the Irish Sea 6 000

Article 6 - Procedure for setting TACs

1. Each year, the Council shall decide by qualified majority, on the basis of a proposal from the commission, on a TAC for the following year for each of the depleted cod stocks.

2. The TACs shall not exceed a level of catches which a scientific evaluation, carried out by the STECF in the light of the most recent report of the ICES, has indicated will result in an increase of 30 % in the quantities of mature fish in the sea at the end of the year of their application, compared to the quantities estimated to have been in the sea at the start of that year.

3. The Council shall not adopt a TAC whose capture is predicted by the STECF, in the light of the most recent report of the ICES, to generate in its year of application a fishing mortality rate greater than the following values: Concerned fish stock Fishing mortality rate

Cod in the Kattegat 0,60
Cod in the North Sea, Skagerrak and eastern Channel 0,65
Cod to the west of Scotland 0,60
Cod in the Irish Sea 0,72

4. Where it is expected that application of paragraph 2 will result in a quantity of mature fish at the end of the year of application of the TAC in excess of the quantity indicated in Article 3, the Commission shall carry out a review of the recovery plan and propose any adjustments necessary on the basis of the latest scientific evaluations. Such a review shall in any event be carried out by 16 March 2007.

5. Except for the first year of application of this Article:

(a) where the rules provided for in paragraphs 2 or 4 would lead to a TAC which exceeds the TAC of the preceding year by more than 15 %, the Council shall adopt a TAC which shall not be more than 15 % greater than the TAC of that year; or
(b) where the rules provided for in paragraphs 2 or 4 would lead to a TAC which is more than 15 % less than the TAC of the preceding year, the Council shall adopt a TAC which is not more than 15 % less than the TAC of that year.

6. Paragraphs 4 or 5 shall not apply when their application would entail an exceeding of the values laid down in paragraph 3.

Article 7 - Setting TACs in exceptional circumstances

Where the quantities of mature fish of any of the cod stocks concerned have been estimated by the STECF, in the light of the most recent report of the ICES, to be less than the quantities set out in Article 5, the following rules shall apply:

(a) Article 6 shall apply where its application is expected to result in an increase in the quantities of mature fish at the end of the year of application of the TAC to a quantity equal to or greater than the quantity indicated in Article 5;
(b) where the application of Article 6 is not expected to result in an increase in the quantities of mature fish at the end of the year of application of the TAC to a quantity equal to or greater than the quantity indicated in Article 5, the Council shall decide by a qualified majority, on a proposal from the Commission, on a TAC for the following year that is lower than the TAC resulting from the application of the method described in Article 6.

Article 8 - Fishing effort limitations and associated conditions

1. The TACs referred to in Chapter III shall be complemented by a system of fishing effort limitation based on the geographical areas and groupings of fishing gear, and the associated conditions for the use of these fishing opportunities specified in Annex V to Council Regulation (EC) No 2287/ 2003 of 19 December 2003 fixing for 2004 the fishing

opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and, for Community vessels, in waters where catch limitations are required (1).

2. Each year, the Council shall decide by a qualified majority, on the basis of a proposal from the Commission, on adjustments to the number of fishing days for vessels deploying gear of mesh size equal to or greater than 100 mm in direct proportion to the annual adjustments in fishing mortality that are estimated by ICES and STECF as being consistent with the application of the TACs established according to the method described in Article 6.

3. The Council may decide by a qualified majority, on a proposal from the Commission, on alternative arrangements for fishing effort limitations to be applied under the recovery plan in order to manage fishing effort consistently with the TACs established according to the method described in Article 6.

This management plan has not been evaluated by ICES, and because article 7 clause (b) opens for unspecified actions ICES cannot evaluate it precisely. In such an evaluation it would have to be assumed that decisions made in accordance with article 7 clause (b) would imply reductions in the TAC as needed to ensure the required increase in the SSB.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 6400 t	$\mathbf{B}_{pa}$ be set at 10 500 t
	$\mathbf{F}_{lim}$ is 1.0	$\mathbf{F}_{pa}$ be set at 0.6
Target reference points		$\mathbf{F}_y$ be set at 0.2-0.3

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-5	Yield/R	SSB/R
Average last 3 years	1.082	0.772	0.921
$\mathbf{F}_{max}$	0.242	1.152	5.804
$\mathbf{F}_{0.1}$	0.150	1.084	8.623
$\mathbf{F}_{med}$	0.962	0.803	1.074

Technical basis:

$\mathbf{B}_{lim}$: lowest observed SSB	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim}$*exp(1.645*0.3)
$\mathbf{F}_{lim}$: The spawning stock has declined steadily since the early 1970s at fishing mortality rates averaging F = 1.0. $\mathbf{F}_{lim}$ is tentatively set equal to F = 1.0.	$\mathbf{F}_{pa}$: $\mathbf{F}_{lim}$*exp(-1.645*0.3)

Single stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Even with no landings in 2006 the SSB in 2007 is likely to be below $\mathbf{B}_{lim}$. In this case, the management plan would set a TAC consistent with F below 0.6 and a more than 30% increase in SSB; however, there is no estimate of the stock size on which to calculate this.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Yield-per-recruit analysis suggests that F=0.2–0.3 is a reasonable exploitation boundary.

Exploitation boundaries in relation to precautionary limits

Taking into account the current state of the stock, fishing at any level will involve a risk for further depletion of the stock. There should therefore be no fishing on this stock in 2006.

Short-term implications

Outlook for 2006

Even with no fishing in 2006 it is likely that the stock will remain below $\mathbf{B}_{\mathrm{lim}}$.

Environment conditions

The productivity of the fish community in the area during the last 20 years seems to depend mainly on fishing mortality, with a decrease of most of the commercial stocks and an increase of several other species, including scavenger and other small-sized fish as an effect of predation release.

Management considerations

The stock is at such a low level that any fishing at any level will involve a risk for further depletion of the stock. Therefore, there should be no fishing on this stock in 2006. However, no fishing on cod implies a closure of all demersal fisheries in the Kattegat. If this is not possible then the reductions should be concentrated to the period where cod is most available to capture, i.e. the first and fourth quarters. Implementation of proven technical measures to avoid catching cod could also be considered.

There is evidence of misreporting from the Kattegat to the western Baltic, indicating that the effort and TAC restriction are not sufficient to limit the catches at the intended level.

Management plan evaluations

ICES considers the management plan to be not consistent with the precautionary approach when the stock is below $\mathbf{B}_{\mathrm{lim}}$.

Ecosystem considerations

SSB of cod in Kattegat has declined steadily from around 35 000 tonnes in the 1970s to around 5000–6000 tonnes in the 1990s. This decline seems associated with the disappearance of separate spawning aggregations/subpopulations in the Kattegat area.

Factors affecting the fisheries and the stock

Regulations and their effects

The TAC is implemented by period rations for individual vessels. Ration sizes have been low in recent years and may have created incentives to discard in order to high-grade the landing. At the same time, because ration sizes were higher in the Western Baltic there might also have been misreporting of Kattegat catches into the Western Baltic. The recovery plan, agreed in 2004, stipulate strict rules for carrying and landing cod in Kattegat.

Changes in fishing technology and fishing patterns

An effort regulation system is now in place for the mixed fisheries. A separator grid has been introduced in the *Nephrops* trawl fishery.

The environment

Recent analysis of the possible effect of environment and climate on this stock has shown that fishing mortality has been the major driver on the long-term dynamics of the stock. A possible influence of wind-temperature conditions on recruitment together with inflow of larvae from the adjacent North Sea stock has been demonstrated.

Information from the fishing industry

The fishing industry reported that there were relatively high catch rates of cod in the northern Kattegat since 2004. ACFM considers that such catches are possibly a spill-over effect from Skagerrak.

Scientific basis

Data and methods

This assessment does not include discard data. There is discarding, but this has not yet been quantified. The assessment is age-based (XSA) with research survey tuning indices. This assessment is indicative of trends although estimates of F and SSB in the most recent year are uncertain due to the noise in the survey indices and uncertain catch data. The commercial effort data indicate a significant reduction for most fleets; however, it has not been possible to evaluate the effect of this reduction in terms of fishing mortality.

Uncertainties in assessment and forecast

Restrictive TACs may have resulted in misreporting, e.g. reporting catches taken in the Kattegat to the western Baltic (Subdivisions 22–24). However, misreporting has not been quantified yet and thus catch data are uncertain. Recruitment estimates as derived from XSA are unreliable since there is a mix between age 1 individuals from the North Sea stock and Kattegat cod in the area, and the proportion of the Kattegat component is unknown.

Comparison with previous assessment and advice

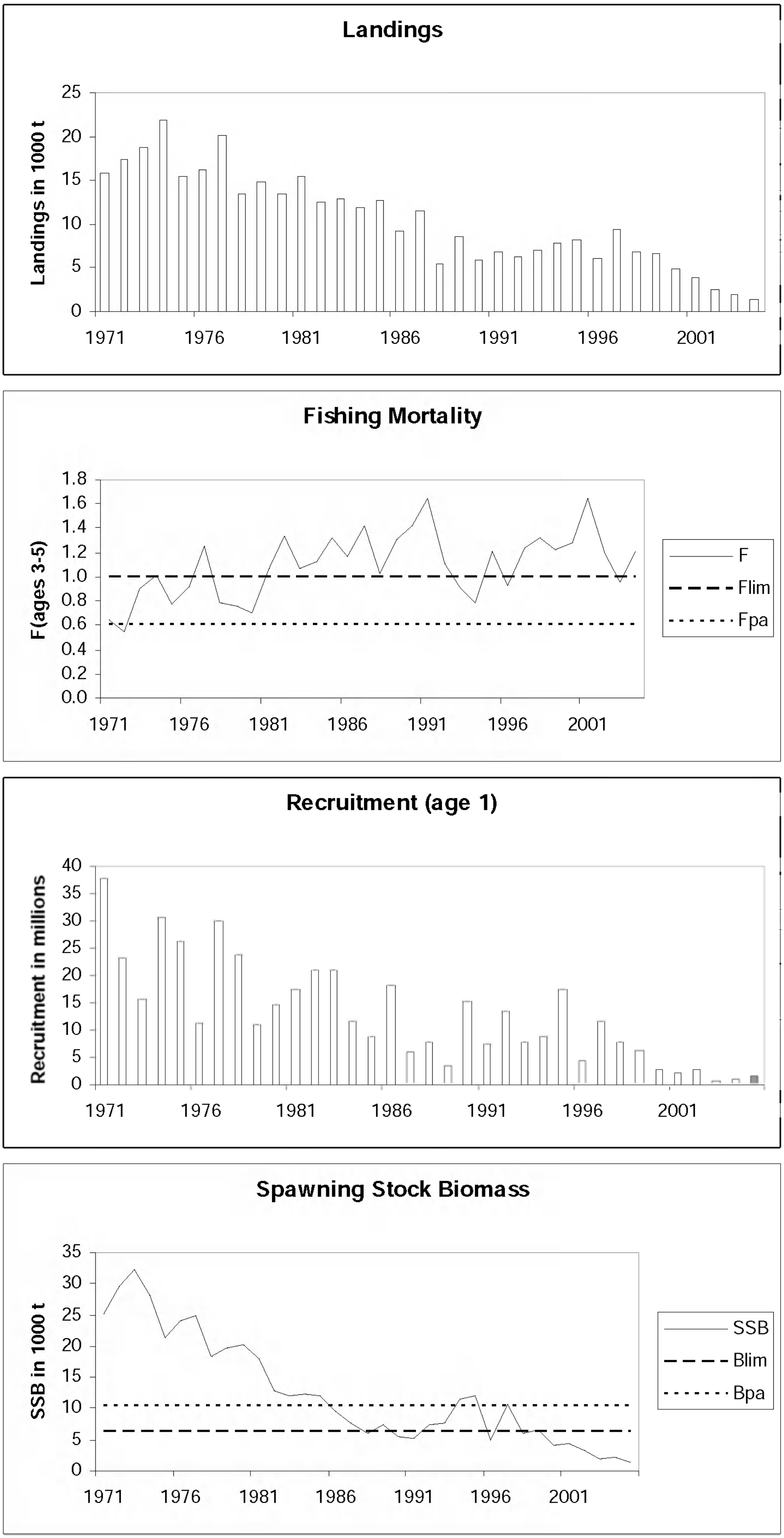
The perception of the state of the stock and the exploitation and therefore the advice, are similar to last year. Tagging information supports the estimated high F in 2004. The perception of the overall state of the stock and the fishing mortality is robust to the level of assumed misreporting.

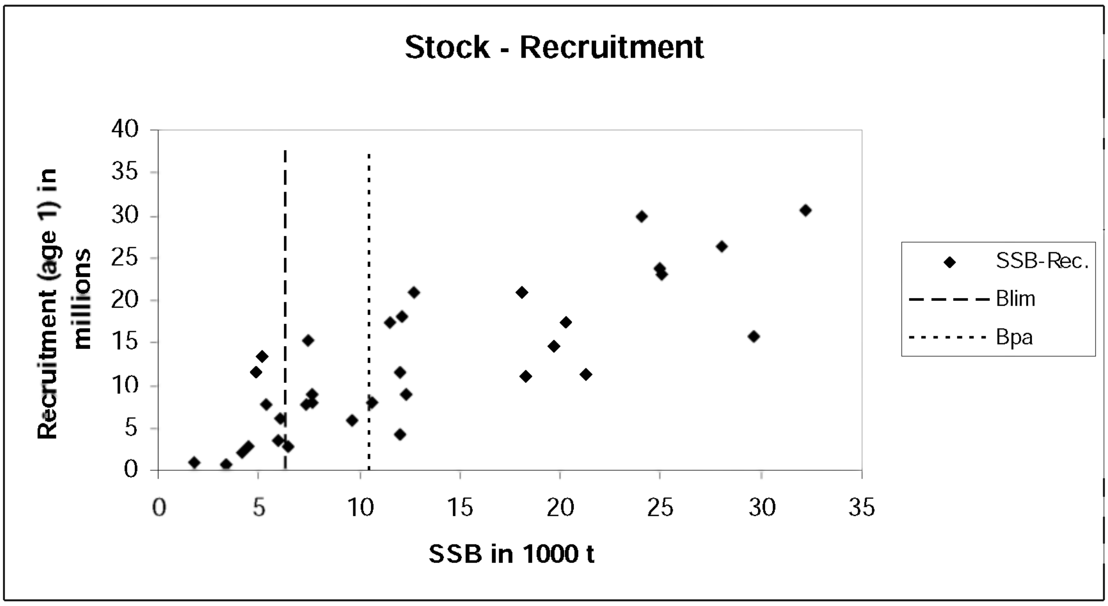
Source of information

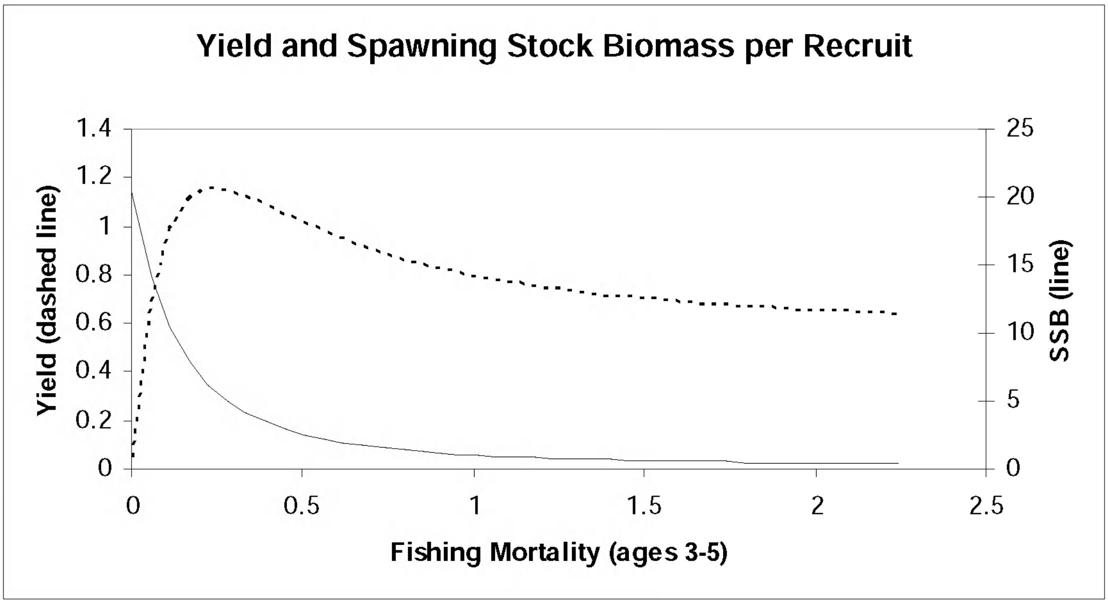
Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	ACFM Catch
1987	Reduction in F		< 13.0		15.5	11.5
1988	Reduction in F		< 15.0		15.0	5.5
1989	TAC		10.0		12.5	8.6
1990	TAC		7.0		8.5	5.9
1991	TAC		6.3		6.65	6.8
1992	30% reduction in fishing effort		-		6.65	6.3
1993	Limit fishing effort to 70% of 1991 effort		-		6.8	7.2
1994	Reduction in catch from 1991–1992		< 6.3–6.8		6.7	7.8
1995	Precautionary TAC based on recent catches		6–7		6.7	8.2
1996	30% Reduction in fishing effort from 1994 level		-		7.7	6.1
1997	Fishing effort should not exceed 70% of the 1994 level		-		8.5	9.5
1998	Fishing effort should not exceed 70% of the 1994 level		-		7.5	6.8
1999	F = 0.6		4.5		6.3	6.6
2000	At least 40% reduction in F		6.4		7.0	4.9
2001	$F = \mathbf{F}_{pa} = 0.6$		4.7		6.2	3.9
2002	No fishery		0		2.8	2.3
2003	No fishery		0		2.3	2.0
2004	No fishery		0		1.363	1.4
2005	No fishery	No fishery	0	0	1.0	
2006	No fishery	No fishery	0	0		

Weights in ‘000 t.


Landings
Landings in 1000 t
25
20
15
10
5
0
1971
1976
1981
1986
1991
1996
2001
Fishing Mortality
F (ages 3-5)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
F
Flim
Fpa
Recruitment (age 1)
Recruitment in millions
40
35
30
25
20
15
10
5
0
Spawning Stock Biomass
SSB in 1000 t
35
30
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-5)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
25
20
15
10
5
0
0
0.5
1
1.5
2
2.5

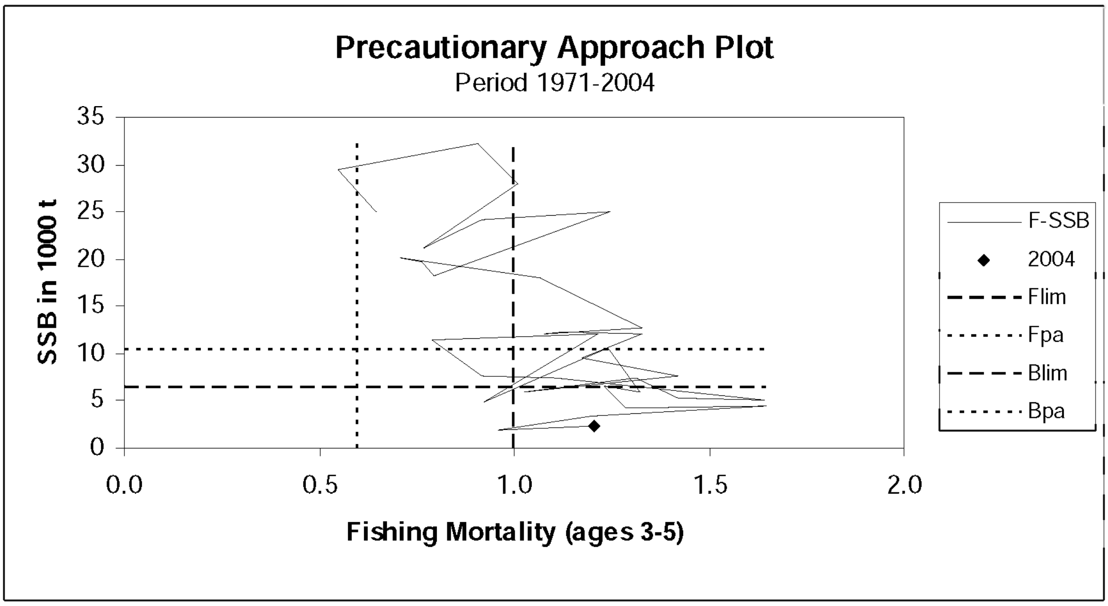

Precautionary Approach Plot
Period 1971-2004
SSB in 1000 t
Fishing Mortality (ages 3-5)
F-SSB
2004
Flim
Fpa
Blim
Bpa
35
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0

Table 1.4.1.1 Cod in Kattegat. Cod landings (in tonnes). 1971–2004.

Year	Kattegat			Total
	Denmark	Sweden	Gemany[2]	
1971	11,748	3,962	22	15,732
1972	13,451	3,957	34	17,442
1973	14,913	3,850	74	18,837
1974	17,043	4,717	120	21,880
1975	11,749	3,642	94	15,485
1976	12,986	3,242	47	16,725
1977	16,668	3,400	51	20,119
1978	10,293	2,893	204	13,390
1979	11,045	3,763	22	14,830
1980	9,265	4,206	38	13,509
1981	10,693	4,380	284	15,337
1982	9,320	3,087	58	12,465
1983	9,149	3,625	54	12,828
1984	7,590	4,091	205	11,886
1985	9,052	3,640	14	12,706
1986	6,930	2,054	112	9,096
1987	9,396	2,006	89	11,491
1988	4,054	1,359	114	5,527
1989	7,056	1,483	51	8,590
1990	4,715	1,186	35	5,936
1991	4,664	2,006	104	6,834
1992	3,406	2,771	94	6,271
1993	4,464	2,549	157	7,170
1994	3,968	2,836	98	7,802[3]
1995	3,789	2,704	71	8,164[4]
1996	4,028	2,334	64	6,126[5]
1997	6,099	3,303	58	9,460[6]
1998	4,207	2,509	38	6,835
1999	4,029	2,540	39	6,608
2000	3,285	1,568	45	4,897
2001	2,752	1,191	16	3,960
2002	1,726	744 [1]	3	2,470
2003	1,441	603	1	2,045
2004	827	575	0	1,402

[1]The Swedish landings for 2002 were revised at the very end of the WG-meeting and the assessment results
are calculated using an initial value of 610 tonnes.
[2]Landings statistics incompletely split on the Kattegat and Skagerrak.
[3]Including 900 t reported in Skagerrak.
[4]Including 1,600 t misreported by area.
[5]Excluding 300 t taken in Sub-divisions 22–24.
[6]Including 1,700t reported in Sub-division 23.

Table 1.4.1.2 Cod in the Kattegat (Southern part of Division IIIa).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-5
1971	37666	25025	15732	0.6485
1972	23121	29590	17442	0.5482
1973	15763	32181	18837	0.9064
1974	30669	28031	21880	1.0102
1975	26298	21245	15485	0.7677
1976	11215	24107	16275	0.9201
1977	29942	24966	20119	1.2447
1978	23823	18322	13390	0.7932
1979	11042	19688	14830	0.7632
1980	14654	20250	13509	0.7080
1981	17416	18127	15337	1.0660
1982	20915	12757	12465	1.3304
1983	20948	12020	12828	1.0748
1984	11523	12291	11886	1.1303
1985	8906	12149	12706	1.3273
1986	18217	9641	9096	1.1728
1987	5785	7663	11491	1.4182
1988	7912	5943	5527	1.0258
1989	3413	7473	8590	1.3126
1990	15384	5404	5936	1.4204
1991	7649	5194	6834	1.6403
1992	13489	7395	6271	1.1081
1993	7727	7697	7013	0.9193
1994	8855	11489	7802	0.7895
1995	17410	12077	8165	1.2158
1996	4280	4897	6126	0.9215
1997	11563	10613	9461	1.2396
1998	7957	6038	6835	1.3223
1999	6126	6496	6608	1.2291
2000	2935	4194	4897	1.2865
2001	2233	4445	3960	1.6445
2002	2800	3398	2470	1.1994
2003	670	1813	2045	0.9568
2004	993	2271	1402	1.2076
2005	1649[1]	1492		
Average	12884	12468	10390	1.0962

[1]Recruitment is the geometric mean of the last five years

1.4.2 Cod in Subarea IV (North Sea), Division VIId (Eastern Channel), and Division IIIa (Skagerrak)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Reduced reproductive capacity	Uncertain	Overexploited	

The assessment is indicative of trends in SSB and recruitment and is based on survey results. Recent trends in fishing mortality are uncertain. Based on this assessment of SSB ICES classifies the stock as suffering reduced reproductive capacity. SSB is well below the $\mathbf{B}_{\text{lim}}$ of 70 000 t. The 2001–2004 year classes are all estimated to be well below average.

Management objectives

In 1999 the EU and Norway have "*agreed to implement a long-term management plan for the cod stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of SSB greater than 70 000 t ($\boldsymbol{B}_{lim}$).*
2. *For 2000 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of 0.65 for appropriate age groups as defined by ICES.*
3. *Should the SSB fall below a reference point of 150 000 t ($\boldsymbol{B}_{pa}$), the fishing mortality referred to under paragraph 2 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 150 000 t.*
4. *In order to reduce discarding and to enhance the spawning biomass of cod, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from, inter alia, ICES.*
5. *The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES.*"

ICES considers that the reference points in the management plan are consistent with the precautionary approach, provided they are used as upper bounds on F and lower bounds on SSB, and not as targets.

The recovery plan adopted by the EU Council in 2004, is still to be fully implemented. Details of it are given in Council Regulation (EC) 423/2004:

Article 3. Purpose of the recovery plan: The recovery plan (..) shall aim to increase the quantities of mature fish to values equal to or greater than 150 000 t (Cod in the North Sea, Skagerrak and eastern Channel)

Article 4: Reaching of target levels. Where the Commission finds, on the basis of advice (..), that for two consecutive years the target level for any cod stock concerned has been reached, the Council shall decide by (..) to remove that stock from the scope of this Regulation (...)

Article 5: Setting of TACs. A TAC shall be set in accordance with Article 6 where the quantities of mature cod have been estimated by the STECF, in the light of the most recent report of ICES, to be equal to or above the minimum level of 70 000 t (Cod in the North Sea, Skagerrak and eastern Channel).

Article 6: Procedure for setting TACs. (1.) Each year, the Council shall decide (..) on a TAC for the following year for each of the depleted cod stocks. (2.) The TACs shall not exceed a level of catches which a scientific evaluation (..) has indicated will result in an increase of 30 % in the quantities of mature fish in the sea at the end of the year of their application, compared to the quantities estimated to have been in the sea at the start of that year. (3.) The Council shall not adopt a TAC whose capture is predicted (..) to generate in its year of application a fishing mortality rate greater than 0.65 (Cod in the North Sea, Skagerrak and eastern Channel). (4.) (...) (5.) Except for the first year of application of this Article: (a) where the rules provided for in paragraphs 2 or 4 would lead to a TAC which exceeds the TAC of the preceding year by more than 15 %, the Council shall adopt a TAC which shall not be more than 15 % greater than the TAC of that year; or (b) where the rules provided for in paragraphs 2 or 4 would lead to a TAC which is more than 15 % less than the TAC of the preceding year, the Council shall adopt a TAC which is not more than 15 % less than the TAC of that year.

Article 7: Setting TACs in exceptional circumstances. Where the quantities of mature fish of any of the cod stocks concerned have been estimated by the STECF, in the light of the most recent report of the ICES, to be less than the quantities set out in Article 5, the following rules shall apply: (a) Article 6 shall apply where its application is expected to result in an increase in the quantities of mature fish at the end of the year of application of the TAC to a quantity equal to or greater than the quantity indicated in Article 5; (b) where the application of Article 6 is not expected to result in an increase in the quantities of mature fish at the end of the year of application of the TAC to a quantity equal to or greater than the quantity indicated in Article 5, the Council shall decide (..) on a TAC for the following year that is lower than the TAC resulting from the application of the method described in Article 6.

Article 8. Fishing effort limitations and associated conditions. (1.) The TACs referred to in Chapter III shall be complemented by a system of fishing effort limitation based on the geographical areas and groupings of fishing gear, and the associated conditions for the use of these fishing opportunities specified in Annex V to Council Regulation (EC) No 2287/2003 of 19 December 2003 fixing for 2004 the fishing opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and, for Community vessels, in waters where catch limitations are required. (2.) Each year, the Council shall decide by a qualified majority, on the basis of a proposal from the Commission, on adjustments to the number of fishing days for vessels deploying gear of mesh size equal to or greater than 100 mm in direct proportion to the annual adjustments in fishing mortality that are estimated by ICES and STECF as being consistent with the application of the TACs established according to the method described in Article 6.

ICES has not evaluated the current cod recovery plan. In response to a request from the European Community and Norway ICES has evaluated a range of harvest rules for the North Sea cod (from a starting point of a stock recovered to $\mathbf{B}_{pa}$) with respect to medium- and long-term yields, stability of yield and effort and stock status with respect to safe biological limits (see section on evaluation of management plans).

Reference points

	ICES considers that:	**ICES proposed that:**
Limit reference points	$\mathbf{B}_{lim}$ is 70 000 t	$\mathbf{B}_{pa}$ be set at 150 000 t
	$\mathbf{F}_{lim}$ is 0.86	$\mathbf{F}_{pa}$ be set at 0.65
Target reference points		Not Defined

Yield and spawning biomass per Recruit (from ACFM 2004).
F-reference points

	Fish Mort Ages 2-4	Yield/R	SSB/R
$\mathbf{F}_{max}$	0.201	0.628	2.767
$\mathbf{F}_{0.1}$	0.132	0.595	4.095
$\mathbf{F}_{med}$	0.791	0.355	0.292

Candidates for reference points which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $\mathbf{F}_{0.1}$-$\mathbf{F}_{max}$.

Technical basis

$\mathbf{B}_{lim}$ = $\mathbf{B}_{loss}$ **(~1995)** =70 000 t.	$\mathbf{B}_{pa}$ = Previous MBAL and signs of impaired recruitment below 150 000 t.
$\mathbf{F}_{lim}$ =$\mathbf{F}_{loss}$ = 0.86	$\mathbf{F}_{pa}$ = Approx. 5^{th} percentile of $\mathbf{F}_{loss}$ and implies an equilibrium biomass > $\mathbf{B}_{pa}$.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Due to the lack of a short-term forecast the exploitation boundaries in relation to existing management plans cannot be calculated.

Exploitation boundaries in relation to precautionary limits

Given the low stock size and recent poor recruitment, it is not possible to identify any non-zero catch which will be compatible with the Precautionary Approach. Rebuilding can only be achieved if fishing mortality is significantly reduced on a longer term.

Short-term implications

Outlook for 2006

With zero catch in 2006 in all fisheries, SSB in 2007 could be around $\mathbf{B}_{\text{lim}}$.

Management considerations

There is a continued substantial removal from this stock. The officially reported landings in 2004 were 27 200 t and the estimated discards from these landings in 2004 were 6 400 t, giving a total of 33 600 t. However, the surveys indicate that the year classes are depleted faster than one would expect from these estimated catches. The source of this apparent additional mortality cannot be determined precisely.

Cod are taken by towed gears in mixed demersal fisheries, which include haddock, whiting, *Nephrops*, plaice, and sole. They are also taken in directed fisheries using fixed gears. Mixed fishery advice is further elaborated in Section 1.3.

Although the current SSB and fishing mortality are uncertain, it is clear that the stock has been reduced to a level at which productivity is impaired and the biological dynamics of the stock are difficult to predict. All assessments indicate that the stock is below $\mathbf{B}_{\text{lim}}$._During 2002 to 2004, 90%, 80%, and 75% of the international landings in number were accounted for by juvenile cod aged 1–3.

Assessment estimates and reports from some fisheries indicate that quota restrictions have not been effective in controlling the catch of cod. Since 1992, TACs were set by managers to substantially reduce F, and were accompanied by an increasing number of technical measures and effort limitation (since 2003) imposed on the fisheries targeting cod. These measures were intended to reduce F and discarding. However, effort restrictions in the smaller mesh size fisheries, which have significant discards, have been less stringent. Missing catch components (discards and unrecorded landings) between 35% and 50% of official landings were estimated by the assessment model. Management of cod fisheries must deal with the combined effects of unreliable catch data and the inability of management to control catch. As long as these two interrelated conditions persist for fisheries which catch North Sea cod, rebuilding cannot be achieved.

Cod catch in Division VIId is managed by a TAC for Divisions VIIb-k,VIII, IX, X and CECAF 34.1.1, (i.e. the TAC covers a small proportion of the North Sea cod stock together with cod in Divisions VIIe-k). Cod taken in Division VIId should be included with the North Sea cod TAC.

Management plan evaluations

In response to a request from the European Community and Norway, ICES has evaluated *a range of harvest rules for the North Sea cod* (see Section 1.3.3.1 and the ICES AGLTA report Section 3.6). The starting population for the simulations on North Sea cod was taken as the $\mathbf{B}_{\text{pa}}$ value. Results indicated that target fishing mortalities (covering all catches and ages 2–4) below 0.4 were expected to result in a low risk to reproduction and high long-term yields unless the constraint on year-to-year variation in TAC is less than ± 20%. The performance of a long-term management plan with target Fs below 0.4 was not sensitive to choices of $\mathbf{B}_{\text{trig}}$ (the biomass where management measures were triggered). A constraint on annual TAC variations was expected to improve the performance both in terms of minimizing short-term landings variation and in terms of making the system less sensitive to the noise in annual assessments. It should be noted that the simulations have not taken biological interactions or density-dependent growth and maturity into account, therefore the numerical results of these simulations are only indicative of trends.

Factors affecting the fisheries and the stock

See Section 1.4 on mixed fisheries.

The effects of regulations

An emergency measure (Council Regulation (EC) 259/2001) involving the closure of a large area of the North Sea was implemented from 14 February to 30 April 2001 to all fishing vessels using gears likely to catch cod. Analysis of the effectiveness of the emergency measures indicated that the closure had an insignificant effect upon the spawning potential for cod in 2001. The redistribution of the fishery, especially along the edges of the box coupled to the increases in proportional landings from January and February appeared to have been able to negate the potential benefits of the box. The box would have to be extended in both space and time to be more effective (see: ICES 2004). This emergency measure has not been adopted after 2001.

EU technical regulations in force in 2003 and 2004 are contained in Council Regulation (EC) 850/98 and its amendments. The regulation prescribes the minimum target species composition for different mesh size ranges. In 2001, cod in the whole of NEAFC region 2 was a legitimate target species for towed gears with a minimum codend mesh size of 100 mm. As part of the cod recovery measures, the EU and Norway introduced additional technical measures from 1 January 2002 (EC 2056/2001). The basic minimum mesh size for towed gears for cod from 2002 was 120 mm, although in a transitional arrangement until 31 December 2002, vessels were allowed to exploit cod with 110 mm codends provided that the trawl was fitted with a 90 mm square mesh panel and the catch composition of cod retained on board was not greater than 30% by weight of the total catch. From 1 January 2003, the basic minimum mesh size for towed gears for cod was 120 mm. The minimum mesh size for vessels targeting cod in Norwegian waters is also 120 mm.

Effort restrictions in the EC were introduced in 2003 (EC 2341/2002, Annex XVII, amended in EC 671/2003). Effort restriction measures were revised for 2004 (EC 2287/2003, Annex V). Preliminary analysis of fishing effort trends in the major fleets exploiting North Sea cod indicates that fishing effort in those fleets has been decreasing since the mid-1990s due to a combination of decommissioning and days-at-sea regulations. The decrease in effort is most pronounced in the years 2002 and beyond.

A cod protection area has been implemented in 2004 (EC 2287/2003, amended in EC 867/2004) which defined the conditions under which certain stocks, including haddock, could be caught in Community waters (see Figure 4.4.1.a.1). A maximum of 35% of the haddock TAC in 2004 could be taken from within the cod protection area. For UK a special permit was introduced that was needed to fish for haddock in the cod protection area. Although this management scheme was proposed to permit additional haddock to be caught in 2004, the uptake of the special permit has been relatively low. This cod protection area was only in force in 2004.

In 2004 agreement was reached within the EU on a formal recovery plan that will operate during the TAC and management decision processes of 2004, effectively rendering the plan operational in 2005 (EC 423/2004). Details of the recovery plan are presented above.

The minimum landing size for cod in Subarea IV and Divisions IIIa and VIId is 35 cm; in Denmark it is 40 cm.

Changes in fishing technology and fishing patterns

The expected benefits from the increase in mesh size to 120 mm are not apparent from the available data. The effect of this is confounded by the transfer of effort from the fleets fishing with meshes (>120 mm) to fleets fishing with (70–99 mm). Fishing with the smaller mesh allowed more days at sea than fishing with larger meshes.

Information presented to ICES indicated that the UK large mesh, demersal trawl fleet category (>100 mm, 4A) has been reduced by decommissioning and days-at-sea regulations to 40% of the levels recorded in the EU reference year of 2001. There was a movement into the 70–90 mm sector to increase days at sea in 2002 and 2003, but the level of effort stabilised in 2004.

Scientific basis

Data and methods

The assessment model (ADAPT) used reported landings and estimated discards, calibrated with three survey indices. Two implementations were used: the first used all surveys and data up to 2005 and estimated missing catch components, assuming that they have the same age composition as reported landings and estimated discards; the second using the same inputs except the Scottish survey data in 2005. Discards were included in the assessment for the North Sea only.

Discards were estimated from the Scottish discards sampling program, raised to the total international fleet.

A commercial CPUE series was available for the Scottish fleet, but was not a reliable index of abundance because of problems in estimating effort.

Information from the fishing industry

The fishermen's survey was evaluated. Signals from the survey suggest little change in fishable biomass in most areas, confirming the perception from the assessment model.

Uncertainties in assessment and forecast

Estimating and projecting missing catch components is difficult and imposes considerable uncertainty in the assessment and forecasts. However, the different data sets and models all indicate that SSB and recruitment are very low.

Different datasets and model formulations give considerably different perceptions of fishing mortality levels and trends since 2003, with more certainty for SSB and recruitment. The catch data indicate a continued decline in F to an historic low, while the combined survey data also indicate a decline although to a lesser extent. When considered separately, the English and Scottish Q3 surveys indicate a substantial increase in F in 2004, which is not apparent from the IBTS Q1 series and is not in agreement with effort trends in the fishery since 2003.

Comparison with previous assessment and advice

No full analytical assessment is presented this year, due to the uncertainties in the status of the landings data and the discrepancies between the surveys. The assessment is now only presented as indicative of trends in SSB and recruitment. Last year the assessment was presented as an absolute indication of stock size and of unaccounted removals.

The advice is consistent with last year.

Sources of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 7–16 September 2004 (ICES CM 2005/ACFM: 07).
Report of the Subgroup on Resource Status (SGRST) of the Scientific, Technical and Economic Committee for Fisheries (STECF): Evaluation of recovery plans (Brussels, 20–22 March 2002, SEC(2002) 764).
Report of a two-day meeting of scientists from Norway and the Community on the evaluation of Harvest Control Rules for North Sea cod (Brussels, 18–19 March 2002).
ICES (2003). Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. Copenhagen, 11–20 June 2002. ICES C.M. 2003 / ACFM: 02.
ICES (2004). Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. Copenhagen, 9–18 September 2003. ICES C.M. 2004 / ACFM: 07.

Landings for each of the three parts of this combined assessment area and for the combined area are given in Tables 1.4.2.1.

North Sea (Subarea IV)

Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	Official landings	ACFM landings
1987	SSB recovery; TAC		100–125		175	167	182
1988	70% of F(86); TAC		148		160	142	157
1989	Halt SSB decline; protect juveniles; TAC		124		124	110	116
1990	80% of F (88); TAC		113		105	99	105
1991	70% of effort (89)				100	87	89
1992	70% of effort (89)				100	98	97
1993	70% of effort (89)				101	94	105
1994	Significant effort reduction				102	87	95
1995	Significant effort reduction				120	112	120
1996	80% of F(94) = 0.7		141		130	104	107
1997	80% of F(95) = 0.65		135		115	100	102
1998	F(98) should not exceed F(96)		153		140	114	122
1999	F = 0.60 to rebuild SSB		125		132	80	78
2000	F less than 0.55		<79		81	62	59
2001	lowest possible catch		0		48.6	42.3	41
2002	lowest possible catch		0		49.3	44.2	44.3
2003	Closure		0		27.3	27.4	NA
2004	Zero catch	Zero catch	0	0	27.3	23.4	NA
2005	Zero catch	Zero catch	0	0	27.3		
2006	Zero catch	Zero catch	0	0			

Skagerrak (Division IIIa)

Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings[1]
1987	F = $\mathbf{F}_{max}$		<21		22.5	20.9
1988	Reduce F				21.5	16.9
1989	F at $\mathbf{F}_{med}$		<23		20.5	19.6
1990	F at $\mathbf{F}_{med}$; TAC$^{:\ TAC}$		21.0		21.0	18.6
1991	TAC		15.0		15.0	12.4
1992	70% of F(90)				15.0	14.8
1993	Precautionary TAC				15.0	15.3
1994	No long-term gain in increased F + precautionary TAC				15.5	13.9
1995	If required precautionary TAC; link to North Sea				20.0	12.1
1996	If required precautionary TAC; link to North Sea				23.0	16.4
1997	If required precautionary TAC; link to North Sea				16.1	14.9
1998	If required precautionary TAC; link to North Sea		21.9		20.0	15.3
1999	F = 0.60 to rebuild SSB		17.9		19.0	11.0
2000	F less than 0.55		<11.3		11.6	9.3
2001	lowest possible catch		0		7.0	7.1
2002	lowest possible catch		0		7.1	7.5
2003	Closure		0		3.9	NA
2004	Zero catch	Zero catch	0	0	3.9	NA
2005	Zero catch	Zero catch	0	0	3.9	
2006	Zero catch	Zero catch	0	0		

[1] Norwegian fjords not included. Weight in '000 t.

Eastern Channel (Division VIId)

Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to Single-Stock Exploitation Boundaries	Agreed TAC[1]	Official landings	ACFM landings
1987	Not assessed		-		-	9.4	14.2
1988	Precautionary TAC		-		-	10.1	10.7
1989	No increase in F; TAC		10.0[2]		-	n/a	5.5
1990	No increase in F; TAC		9.0[2]		-	n/a	2.8
1991	Precautionary TAC		3.0[2]		-	n/a	1.9
1992	If required, precautionary TAC		5.5[2]		-	2.7	2.7
1993	If TAC required, consider SSB decline		-		-	2.5	2.4
1994	Reduce F+ precautionary TAC				-	2.9	2.9
1995	Significant effort reduction; link to North Sea				-	4.0	4.0
1996	Reference made to North Sea advice				-	3.5	3.5
1997	No advice				-	7.2	7.0
1998	Link to North Sea		4.9		-	8.7	8.6
1999	F = 0.60 to rebuild SSB		4.0		-	n/a	6.9
2000	F less than 0.55		<2.5		-	3.6	2.3
2001	lowest possible catch		0		-	2.0	1.6
2002	lowest possible catch		0		-	1.6	3.1
2003	Closure		0		-	1.3	NA
2004	Zero catch	Zero catch	0	0	-	0.2	NA
2005	Zero catch	Zero catch	0	0	-		
2006	Zero catch	Zero catch	0	0			

[1] Included in TAC for Subarea VII (except Division VIIa). [2] Including VIIe. Weight in '000 t.

Table 1.4.2.1 Nominal landings (in tonnes) of COD in IIIa (Skagerrak), IV and VIId, 1985–2004 as officially reported to ICES and as used by the Working Group.

Sub-area IV										
Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	4,815	6,604	6,693	5,508	3,398	2,934	2,331	3,356	3,374	2,648
Denmark	42,547	32,892	36,948	34,905	25,782	21,601	18,998	18,479	19,547	19,243
Faroe Islands	71	45	57	46	35	96	23	109	46	80
France	4,834	8,402	8,199	8,323	2,578	1,641	975	2,146	1,868	1,868
Greenland										
Germany	7,675	7,667	8,230	7,707	11,430	11,725	7,278	8,446	6,800	5,974
Netherlands	30,844	25,082	21,347	16,968	12,028	8,445	6,831	11,133	10,220	6,512
Norway	5,766	4,864	5,000	3,585	4,813	5,168	6,022	10,476	8,742	7,707
Poland	-	10	13	19	24	53	15	-	-	-
Sweden	748	839	688	367	501	620	784	823	646	630
UK (E/W/NI)	29,692	25,361	29,960	23,496	18,375	15,622	14,249	14,462	14,940	13,941
UK (Scotland)	60,931	45,748	49,671	41,382	31,480	31,120	29,060	28,677	28,197	28,854
United Kingdom										
Total Nominal Catch	187,923	157,514	166,806	142,306	110,444	99,025	86,566	98,107	94,380	87,457
Unallocated landings	6,773	11,292	15,288	14,253	5,256	5,726	1,967	-758	10,200	7,066
WG estimate of total landings	**194,696**	**168,806**	**182,094**	**156,559**	**115,700**	**104,751**	**88,533**	**97,349**	**104,580**	**94,523**
Agreed TAC	**250,000**	**170,000**	**175,000**	**160,000**	**124,000**	**105,000**	**100,000**	**100,000**	**101,000**	**102,000**
	0.78	0.99	1.04	0.98	0.93	1.00	0.89	0.97	1.04	0.93

Division VIId										
Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	501	650	815	486	173	237	182	187	157	228
Denmark	-	4	-	+	+	-	-	1	1	9
France	2,589	9,938	7,541	8,795	n/a	n/a	n/a	2,079	1,771	2,338
Netherlands	-	-	-	1	1	-	-	2	-	-
UK (E/W/NI)	326	830	1,044	867	562	420	341	443	530	312
UK (Scotland)	-	-	-	-	-	7	2	22	2	+
United Kingdom										
Total Nominal Catch	3,416	11,422	9,400	10,149	n/a	n/a	n/a	2,734	2,461	2,887
Unallocated landings	-111	3,722	4,819	580	-	-	-	-65	-29	-37
WG estimate of total landings	**3,305**	**15,144**	**14,219**	**10,729**	**5,538**	**2,763**	**1,886**	**2,669**	**2,432**	**2,850**

Division IIIa (Skagerrak)										
Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Denmark	14,521	18,424	17,824	14,806	16,634	15,788	10,396	11,194	11,997	11,953
Sweden	1,914	1,505	1,924	1,648	1,902	1,694	1,579	2,436	2,574	1,821
Norway	193	174	152	392	256	143	72	270	75	60
Germany	-	-	-	-	12	110	12	-	-	301
Others	-	-	-	106	34	65	12	102	91	25
Norwegian coast *	990	917	838	769	888	846	854	923	909	760
Danish industrial by-catch *	1,751	997	491	1,103	428	687	953	1,360	511	666
Total Nominal Catch	16,628	20,103	19,900	16,952	18,838	17,800	12,071	14,002	14,737	14160
Unallocated landings	0	0	0	0	-141	0	-12	0	0	-899
WG estimate of total landings	**16,628**	**20,103**	**19,900**	**16,952**	**18,697**	**17,800**	**12,059**	**14,002**	**14,737**	**13,261**
Agreed TAC	**29,000**	**29,000**	**22,500**	**21,500**	**20,500**	**21,000**	**15,000**	**15,000**	**15,000**	**15,500**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined										
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total Nominal Catch	207,967	189,039	196,106	169,407	n/a	n/a	n/a	114,843	111,578	104,504
Unallocated landings	6,662	15,014	20,106	14,833	-	-	-	-823	10,171	6,130
WG estimate of total landings	**214,629**	**204,053**	**216,212**	**184,240**	**139,936**	**125,314**	**102,478**	**114,020**	**121,749**	**110,634**

* The Danish industrial by-catch and the Norwegian coast catches are not included in the (WG estimate of) total landings of Division IIIa
n/a not available ** provisional

Table 1.4.2.1 (Cont'd) Nominal landings (in tonnes) of COD in IIIa (Skagerrak), IV and VIId, 1985–2004 as fficially reported to ICES and as used by the Working Group.

Sub-area IV

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium	4,827	3,458	4,642	5,799	3,882	3,304	2,470	2,616	1,482	1,615
Denmark	24,067	23,573	21,870	23,002	19,697	14,000	8,358	9,022	4,676	5,889
Faroe Islands	219	44	40	102	96		9	34	36	
France	3,040	1,934	3,451	2,934	1,750	1,222	717	1,777	617	
Germany	9,457	8,344	5,179	8,045	3,386	1,740	1,810	2,018	2,048	2,212
Greenland									1,352	
Netherlands	11,199	9,271	11,807	14,676	9,068	5,995	3,574	4,707	2,305	1,728
Norway	7,111	5,869	5,814	5,823	7,432	6,410	4,383	4,994	4,518	3,205
Poland	-	18	31	25	19	18	18	39	35	
Sweden	709	617	832	540	625	640	661	463	252	226
UK (E/W/NI)	14,991	15,930	13,413	17,745	10,344	6,543	4,087	3,112	2,213	1,889
UK (Scotland)	35,848	35,349	32,344	35,633	23,017	21,009	15,640	15,416	7,852	6,644
United Kingdom										
Total Nominal Catch	111,468	104,407	99,423	114,324	79,316	60,881	41,727	44,198	27,386	23,408
Unallocated landings	8,555	2,161	2,746	7,779	-924	-1,114	-754	102	NA	NA
WG estimate of total landings	**120,023**	**106,568**	**102,169**	**122,103**	**78,392**	**59,767**	**40,973**	**44,300**	**NA**	**NA**
Agreed TAC	**120,000**	**130,000**	**115,000**	**140,000**	**132,400**	**81,000**	**48,600**	**49,300**	**27,300**	**27,300**

Division VIId

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium	377	321	310	239	172	110	93	51	54	47
Denmark	-	-	-	-	-	-	-	-		
France	3,261	2,808	6,387	7,788		3,084	1,677	1,361	1,127	
Netherlands	-	+	-	19	3	4	17	6	36	14
UK (E/W/NI)	336	414	478	618	454	385	249	145	121	100
UK (Scotland)	+	4	3	1	-	-	-	-		
United Kingdom										
Total Nominal Catch	3,974	3,547	7,178	8,665	629	3,583	2,036	1,563	1,338	161
Unallocated landings	-10	-44	-135	-85	6,229	-1,258	-463	1,534	NA	NA
WG estimate of total landings	**3,964**	**3,503**	**7,043**	**8,580**	**6,858**	**2,325**	**1,573**	**3,097**	**NA**	**NA**

Division IIIa (Skagerrak)

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	8,948	13,573	12,164	12,340	8,734	7,683	5,901	5,526	3,071	3,039
Sweden	2,658	2,208	2,303	1608	1,909	1,350	1,035	1,716	509	495
Norway	169	265	348	303	345	301	134	146	193	133
Germany	200	203	81	16	54	9	32	83	-	
Others	134	-	-	-	-	-	-	-	-	
Norwegian coast *	846	748	911	976	788	624	846	n/a	n/a	720
Danish industrial by-catch *	749	676	205	97	62	99	687	n/a	n/a	10
Total Nominal Catch	12109	16249	14896	14267	11042	9343	7102	7471	3773	3667
Unallocated landings	0	0	50	1,064	-68	-66	-16	-3	NA	NA
WG estimate of total landings	**12,109**	**16,249**	**14,946**	**15,331**	**10,974**	**9,277**	**7,086**	**7,468**	**NA**	**NA**
Agreed TAC	**20,000**	**23,000**	**16,100**	**20,000**	**19,000**	**11,600**	**7,000**	**7,100**	**3,900**	**3,900**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined

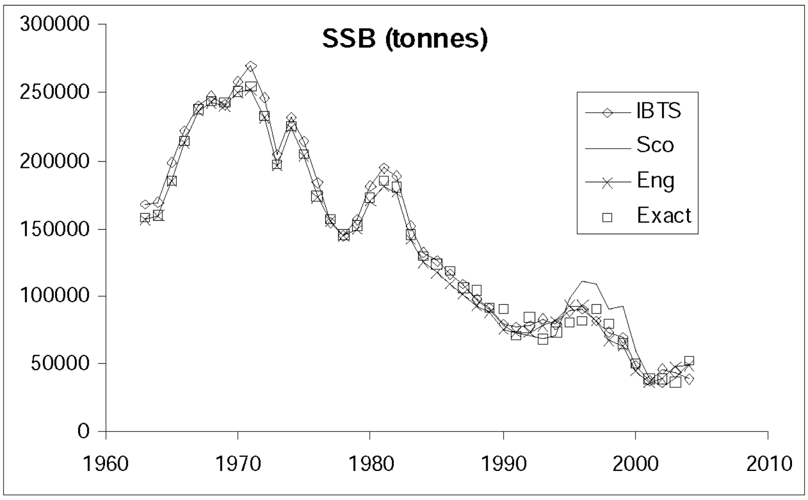
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Nominal Catch	127,551	124,203	121,497	137,256	90,987	73,807	50,865	53,232	32,497	27,236
Unallocated landings	8,545	2,117	2,661	8,758	5,238	-2,438	-1,233	1,633	NA	NA
WG estimate of total landings	**136,096**	**126,320**	**124,158**	**146,014**	**96,225**	**71,369**	**49,632**	**54,865**	**NA**	**NA**

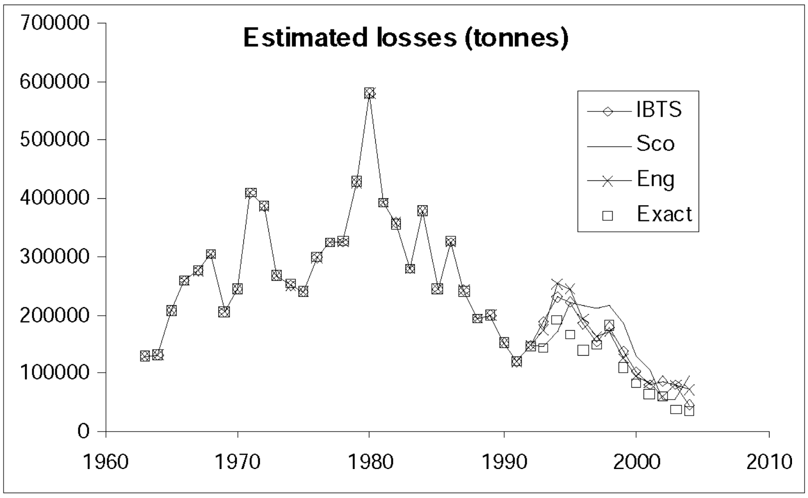
* The Danish industrial by-catch and the Norwegian coast catches are not included in the (WG estimate of) total landings of Division IIIa

n/a not available ** provisional

Division IIIa (Skagerrak) landings not included in the assessment

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Norwegian coast *	846	748	911	976	788	624	846	n/a	n/a	720
Danish industrial by-catch	749	676	205	97	62	99	687	n/a	n/a	10
Total	**1,595**	**1,424**	**1,116**	**1,073**	**850**	**723**	**1,533**	**0**	**0**	**730**





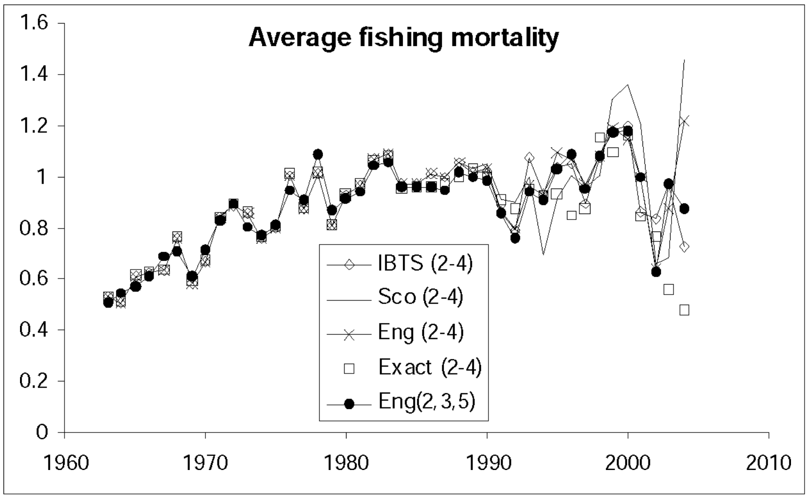


Figure 1.4.2.1 Cod in Subarea IV and Divisions IIIa (Skagerrak) and VIId. ADAPT estimates of average fishing mortality, estimated removals and spawning stock biomass from model fits to individual survey series (IBTS, EGFS (Eng), SGFS (Sco)) and without misreporting (called "Exact" in the figures). Removals means reported plus unreported catches under the assumption that natural mortality are correctly reflected in the models.

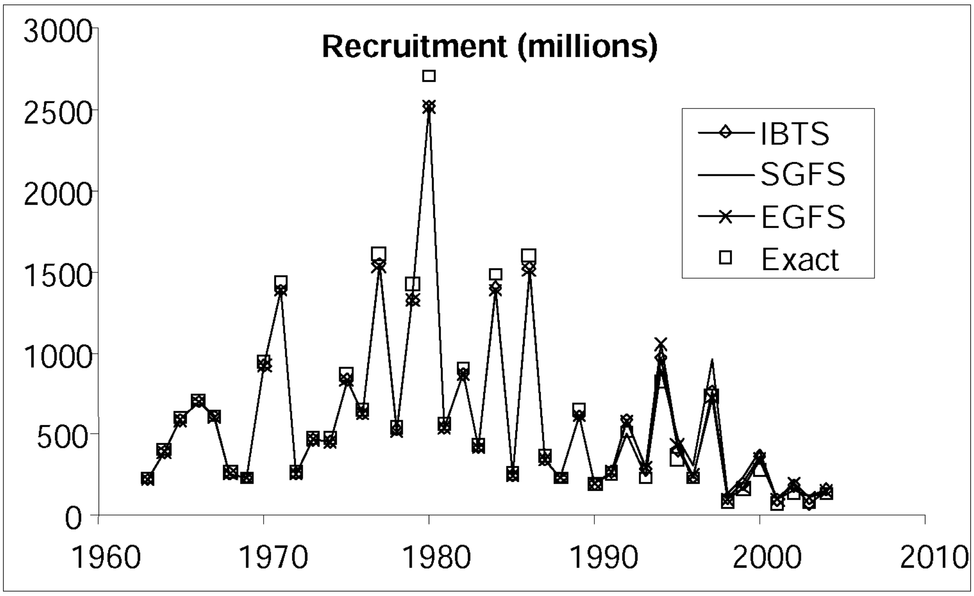


Figure 1.4.2.2 Cod in Subarea IV and Divisions IIIa (Skagerrak) and VIId. ADAPT estimates of recruitment from model fits to individual survey series (IBTS, EGFS, SGFS) and without misreporting (called "Exact" in the figures).

1.4.3 Haddock in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to management target	Comment
Full reproductive capacity	Harvested sustainably	Close to target	

Based on the most recent estimate of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainably. SSB in 2004 is estimated at 289 000 t and is estimated to have decreased to around 266 000 t in 2005. SSB is well above the $\mathbf{B}_{pa}$ of 140 000 t. The 2001–2004 year classes are all estimated to be well below average. Indications from surveys and industry are that the 2005 year class will be above the long-term geometric mean. Fishing mortality in 2004 is estimated at 0.31, which is well below $\mathbf{F}_{pa}$ = 0.7.

Management objectives

In 1999 the EU and Norway have *"agreed to implement a long-term management plan for the haddock stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield."*. The agreement was updated in November 2004:

"The plan shall consist of the following elements:

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 100,000 tonnes (Blim).*
2. *For 2005 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups.*
3. *Should the SSB fall below a reference point of 140,000 tonnes (Bpa), the fishing mortality rate referred to under paragraph 2, shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 140,000 tonnes.*
4. *In order to reduce discarding and to enhance the spawning biomass of haddock, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from inter alia ICES.*
5. *A review of this arrangement shall take place no later than 31 December 2006.*
6. *This arrangement enters into force on 1 January 2005.*

ICES considers that the agreed Precautionary Approach reference points in the management plan are consistent with the precautionary approach, provided they are used as lower boundaries on SSB, and not as targets.

Reference points

	ICES considers that:	ICES proposed that:
Limit reference points	$\mathbf{B}_{lim}$ is 100 000 t	$\mathbf{B}_{pa}$ be set at 140 000 t
	$\mathbf{F}_{lim}$ is 1.0	$\mathbf{F}_{pa}$ be set at 0.7
Target reference points	Target F according to the management plan is 0.3	

Yield and spawning biomass per Recruit (from the 2004 assessment)
F-reference points

	Fish Mort Ages 2-4	Yield/R	SSB/R
$\mathbf{F}_{max}$	0.321	0.004	0.016
$\mathbf{F}_{0.1}$	0.202	0.004	0.024
$\mathbf{F}_{med}$	0.498	0.004	0.010

Candidates for reference points which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $\mathbf{F}_{0.1}$-$\mathbf{F}_{max}$.

Technical basis

$\mathbf{B}_{lim}$: Smoothed $\mathbf{B}_{loss.}$	$\mathbf{B}_{pa}$: 1.4*$\mathbf{B}_{lim.}$
$\mathbf{F}_{lim}$: 1.4* $\mathbf{F}_{pa}$	$\mathbf{F}_{pa}$: implies a long-term biomass > $\mathbf{B}_{pa}$ and a less than 10% probability that SSB_{MT} < $\mathbf{B}_{pa}$.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Following the agreed management plan (F=0.3) would imply human consumption landings of 39 400 t in 2006, which is expected to lead to an SSB of 225 800 t in 2007.

Short-term implications

Outlook for 2006:
Basis: F(2005) =scaled mean F (2002-2004). F (ages 2-5) = 0.32, SSB(2006)=232, HC landings (2005) =51, Discards (2005) =13, Industrial bycatch (2005) =5.

Rationale	HumanCons 2006	Basis	F 2006	Fmult (2006)	Catches 2006	Disc 2006	Industrial bycatch 2006	SSB 2007
Zero catch	0	F=0	0.00	0.00	0	0	7.8	294.7
Status quo	41.6	$\mathbf{F}_{sq}$	0.32	1.00	63.3	21.7	7.6	238.4
High long-term yield	27.3	F(long-term yield)	0.20	0.63	41.4	14.0	7.7	257.7
Agreed management plan	39.4	F(management plan)	0.30	0.95	60.0	20.6	7.6	240.0
Precautionary limits	10.0	F(prec limits) * 0.1	0.07	0.22	15.1	5.0	7.8	281.2
	24.8	F(prec limits) * 0.25	0.18	0.55	37.4	12.7	7.7	261.2
	45.4	F(prec limits) * 0.5	0.35	1.09	69.3	23.9	7.6	233.1
	64.6	F(prec limits) * 0.75	0.53	1.64	99.5	35.0	7.5	207.3
	73.9	F(prec limits) * 0.90	0.63	1.97	114.7	40.8	7.4	194.7
	80.0	F(prec limits)	0.70	2.19	124.7	44.7	7.4	186.6
	85.6	F(prec limits) * 1.1	0.77	2.41	134.1	48.5	7.3	179.1
	93.6	F(prec limits) * 1.25	0.88	2.73	147.8	54.3	7.2	168.5

Weights in '000 t.
Shaded scenarios are considered inconsistent with the Precautionary Approach.

Management considerations

The stock and fishery is dominated by the 1999 year class with a sequence of poor recruitments following it. The sustainable catch from this stock is expected to decline in the future unless new strong year classes emerge.

Information on fishing effort indicates significant reductions in the fleet sectors which take the largest proportion of haddock.

Management plan evaluations

In June 2004 an EU-Norway expert group met in Brussels to evaluate harvest control rules (HCRs) for different stocks, among which was North Sea haddock. The report of this meeting is available, but has not been evaluated by ICES so far.

Factors affecting the fisheries and the stock

Haddock are generally caught in mixed fisheries along with cod and whiting.
The effects of regulations

EU technical regulations in force are contained in Council Regulation (EC) 850/98 and its amendments. The regulation prescribes the minimum target species composition for different mesh size ranges. In 2001, haddock in the whole of NEAFC region 2 were a legitimate target species for towed gears with a minimum codend mesh size of 100 mm. As part of the cod recovery measures, the EU and Norway introduced additional technical measures from 1 January 2002 (EC 2056/2001). The basic minimum mesh size for towed gears for cod from 2002 was 120 mm, although in a transitional arrangement running until 31 December 2002 vessels were allowed to exploit cod with 110-mm codends provided that the trawl was fitted with a 90-mm square mesh panel and the catch composition of cod retained on board was not greater than 30% by weight of the total catch. From 1 January 2003, the basic minimum mesh size for towed gears for cod was 120 mm. The minimum mesh size for vessels targeting haddock in Norwegian waters is also 120 mm.

Effort restrictions in the EC were introduced in 2003 (EC 2341/2002, Annex XVII, amended in EC 671/2003). Effort restriction measures were revised for 2005 (EC 27/2005, Annex IV). Preliminary analysis of fishing effort trends in the major fleets exploiting North Sea cod indicates that fishing effort in those fleets has been decreasing since the mid-1990s due to a combination of decommissioning and days-at-sea regulations. The decrease in effort is most pronounced in the years 2002 and beyond.

Changes in fishing technology and fishing patterns

The change in mesh size might be expected to shift exploitation patterns to older ages and increase the weight-at-age for retained fish from younger age classes. Improvements in the exploitation pattern have not been observed. It was not possible to examine if this is due to confounding effects from other fleet segments. Information presented to ICES noted that the UK large mesh, demersal trawl fleet category (>100 mm, 4A) has been reduced by decommissioning and days-at-sea regulations to 40% of the levels recorded in the EU reference year of 2001. There was a movement into the 70-90 mm sector to increase days at sea in 2002 and 2003, but the level of effort stabilised in 2004. The effort of the combined trawl gears has shown a continued decrease of 36% overall, from the EU reference year of 2001.

Scientific basis

Data and methods

The assessment model is XSA calibrated with five survey indices. Alternative methods were evaluated, and all confirmed the indications from the final assessment of F in 2004 around the lowest estimated level since 1963. Discards and industrial bycatch were included in the assessment for the North Sea only. Discards were estimated from the Scottish discards sampling program, raised to the total international fleet. The strong 1999 year class is slow-growing and is forecast to have a relatively low mean weight in the future.

Information from the fishing industry

The fishermen's survey was evaluated and shows a stabilisation or decline of fishable biomass in most areas, confirming the perception from the assessment.

Uncertainties in assessment and forecast

Stock dynamics estimated using several different sources of information were consistent. Retrospective bias could not be evaluated. The very different F pattern of the 1999 year class compared to other year classes may indicate that this year class is overestimated. The assessment and forecast are largely influenced by the strong 1999 year class. The weight and exploitation pattern of the 1999 year class were taken into account in projections. Estimated recruitment of the 2005 year class was derived from the Q3 Scottish groundfish survey (1998–2005).

Comparison with previous assessment and advice

In this assessment the 1999 year class is estimated to be less strong, and accordingly the estimate of SSB in 2003 was also revised significantly downwards.

Since the management plan has been revised in 2004 the single-stock exploitation boundary is now given on that basis.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

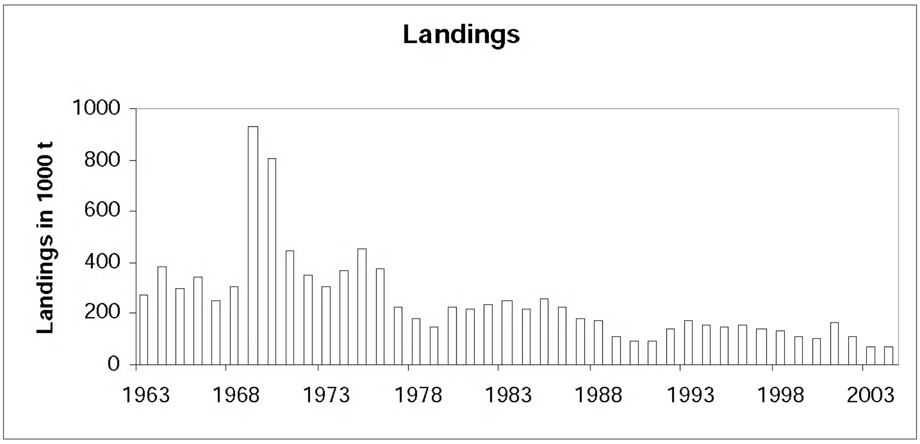
Subarea IV

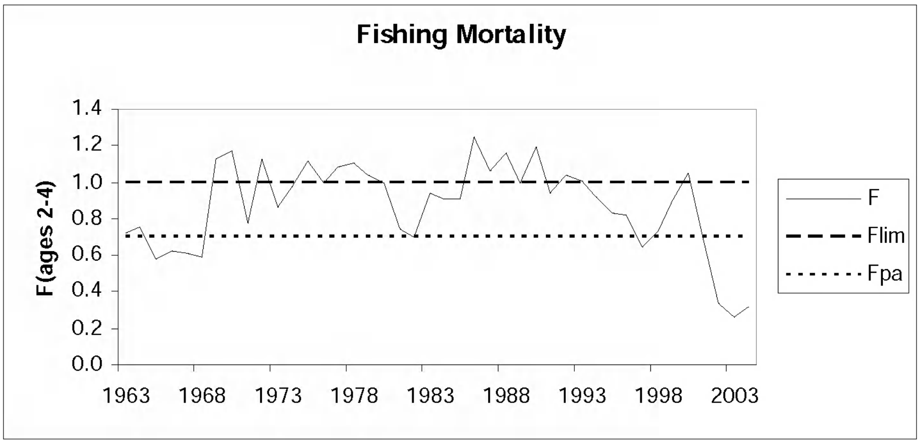
Year	ICES Advice	Single-stock Exploitation Boundaries	Predicted lndgs corresp. to advice[1]	Predicted lndgs corresp. To Single-stock Exploitation Boundaries[2]	Agreed TAC	Off. lndgs.	ACFM catches Hum. Cons.	Disc Slip.	Indust. bycatch	Total
1987	80% of F(85)		105		140	109	108	59	4	172
1988	77% of F(86); TAC		185		185	105	105	62	4	171
1989	Reduce decline in SSB; TAC; protect juveniles		68		68	64	76	26	2	104
1990	80% of F(88); TAC		50		50	43	51	33	3	87
1991	70% of effort (89)				50	45	45	40	5	90
1992	70% of effort (89)				60	51	70	48	11	129
1993	70% of effort (89)				133	80	80	80	11	170
1994	Significant reduction in effort; mixed fishery				160	87	81	65	4	150
1995	Significant reduction in effort; mixed fishery				120	75	75	57	8	140
1996	Mixed fishery to be taken into account				120	75	76	73	5	154
1997	Mixed fishery to be taken into account				114	73	79	52	7	138
1998	No increase in F		100.3		115	72	77	45	5	128
1999	Reduction of 10% F(95–97)		72		88.6	64	64	43	4	111
2000	F less than $\mathbf{F}_{pa}$		<51.7		73.0	47	45	47	8	100
2001	F less than $\mathbf{F}_{pa}$		<58.0		61	40	39	118	8	165
2002	F less than $\mathbf{F}_{pa}$		<94.0		104.0	54	53	45	4	101
2003	No cod catches		-		52	42	42	23	1	76
2004	Mixed fisheries consideration	F should be below $\mathbf{F}_{pa}$	*	No forecast	85	47	47	17	1	65
2005	Mixed fisheries consideration	F should be below $\mathbf{F}_{pa}$	*	92	66					
2006	Mixed fisheries consideration	F should be below 0.3	*	39						

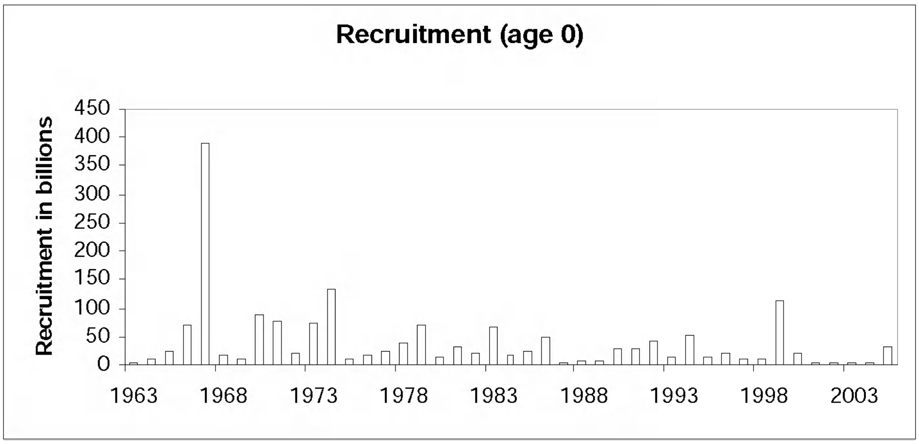
[1]Only pertaining to the North Sea. [2] For the whole stock (IIIa and IV). * Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits. Weights in '000 t.

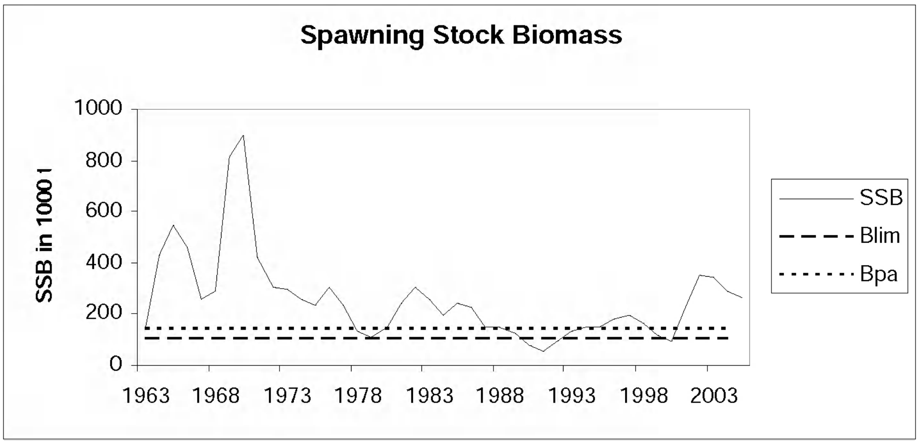
Division IIIa:

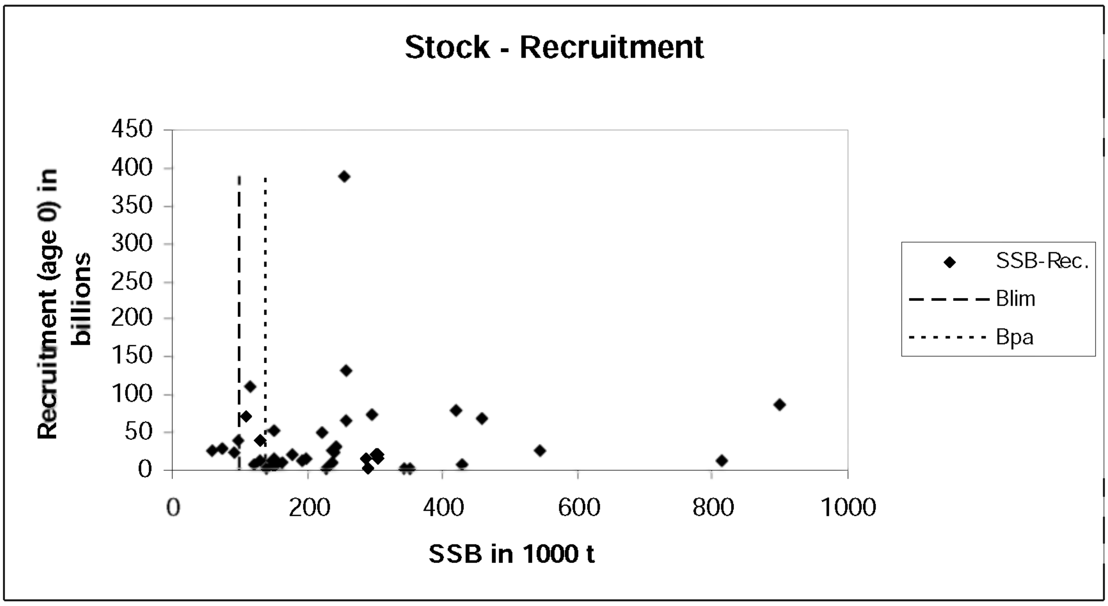
Year	ICES Advice	Single-stock Exploitation Boundaries	Predicted lndgs corresp. to advice	Predicted lndgs corresp tol single-stock exploitation boundaries	Agreed TAC	ACFM landings Hum. Cons.	Indust. bycatch	Total
1987	Precautionary TAC		-		11.5	3.8	1.4	5.3
1988	Precautionary TAC		-		10.0	2.9	1.5	4.3
1989	Precautionary TAC		-		10.0	4.1	0.4	4.5
1990	Precautionary TAC		-		10.0	4.1	2.0	6.1
1991	Precautionary TAC		4.6		4.6	4.1	2.6	6.7
1992	TAC		4.6		4.6	4.4	4.6	9.0
1993	Precautionary TAC		-		4.6	2.0	2.4	4.4
1994	Precautionary TAC		-		10.0	1.8	2.2	4.0
1995	If required, precautionary TAC; link to North Sea		-		10.0	2.2	2.2	4.4
1996	If required, precautionary TAC; link to North Sea		-		10.0	3.1	2.9	6.1
1997	Combined advice with North Sea		-		7.0	3.4	0.6	4.0
1998	Combined advice with North Sea		4.7		7.0	3.8	0.3	4.0
1999	Combined advice with North Sea		3.4		5.4	1.4	0.3	1.7
2000	Combined advice with North Sea		<1.8		4.5	1.5	0.6	2.1
2001	Combined advice with North Sea		<2.0		4.0	1.9	0.2	2.1
2002	Combined advice with North Sea		<3.0		6.3	4.1	0.06	4.1
2003	Combined advice with North Sea		-		3.2	1.8	Na	1.8
2004	Combined advice with North Sea	F should be below $\mathbf{F}_{pa}$		No forecast	4.9	1.4	na	1.4
2005	Combined advice with North Sea	F should be below $\mathbf{F}_{pa}$		-	4.0			
2006	Combined advice with North Sea	F should be below 0.3		-				


Landings
Landings in 1000 t
1000
800
600
400
200
0
1963
1968
1973
1978
1983
1988
1993
1998
2003


Fishing Mortality
F(ages 2-4)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1963
1968
1973
1978
1983
1988
1993
1998
2003
F
Flim
Fpa


Recruitment (age 0)
Recruitment in billions
450
400
350
300
250
200
150
100
50
0
1963
1968
1973
1978
1983
1988
1993
1998
2003


Spawning Stock Biomass
SSB in 1000 t
1000
800
600
400
200
0
1963
1968
1973
1978
1983
1988
1993
1998
2003
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
450
400
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
SSB in 1000 t
SSB-Rec.
Blim
Bpa

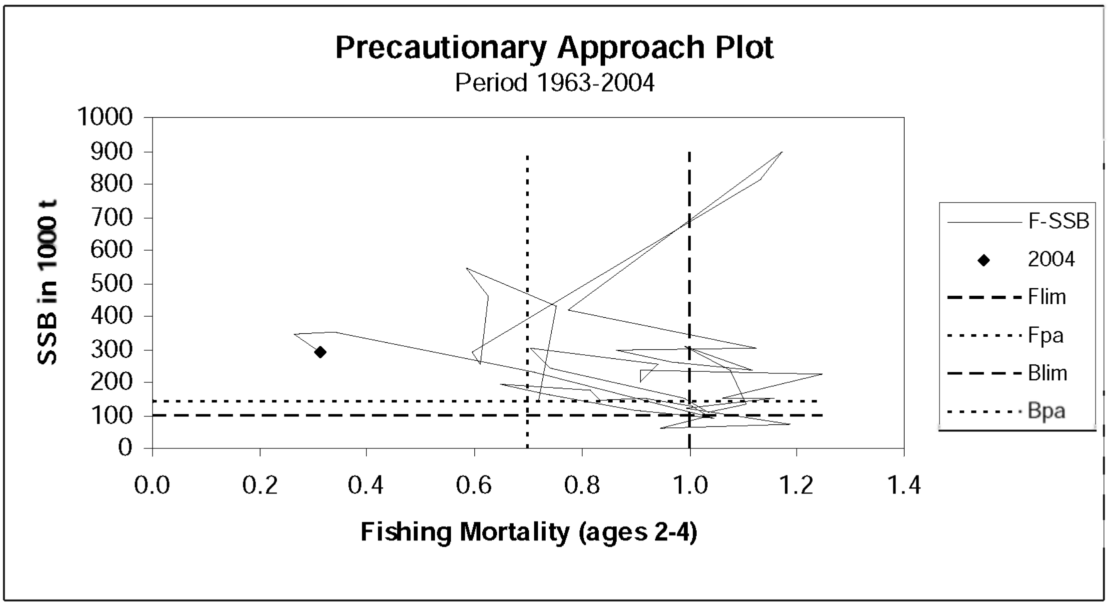

Precautionary Approach Plot
Period 1963-2004
SSB in 1000 t
1000
900
800
700
600
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Fishing Mortality (ages 2-4)
F-SSB
2004
Flim
Fpa
Blim
Bpa

Table 1.4.3.1 Nominal catch (t) of haddock from Division IIIa and the North Sea 1998–2004, as officially reported to ICES and estimated by ACFM.

Division IIIa

Country	1999	2000	2001	2002	2003	2004	2005
Belgium	0	0	0	0	0	0	
Denmark	1,012	1,033	1,590	3,791	1,741	1,116	
Germany	3	1	128	239	113	69	
Netherlands	0	0	0	0	6	1	
Norway	168	126	149	149	184	154	
Sweden	206	367	283	393	165	158	
UK - England & Wales	0	0	0	0	0	0	
UK – Scotland	0	0	7	0	0	0	
Total reported	1,389	1,527	2,157	4,572	2,209	1,498	
Unallocated	-29	-42	-254	-435	-401	-55	
WG estimate of H.cons. landings	1,360	1,485	1,903	4,137	1,808	1,443	
WG estimate of industrial by-catch	334	617	218	0	0	0	
WG estimate of total catch	**1,694**	**2,102**	**2,121**	**4,137**	**1,808**	**1,443**	
TAC	*5,400*	*4,450*	*4,000*	*6,300*	*3,150*	*4,940*	*4,018* *

* Includes areas III bcd (EC waters)

Sub-area IV

Country	1999	2000	2001	2002	2003	2004	2005
Belgium	462	399	606	559	374	373	
Denmark	2,104	1,670	2,407	5,123	3,035	2,074	
Faeroe Islands	55	0	1	25	12	0	
France	0	724	485	914	1,100	0	
Germany	565	342	681	852	1,562	1,240	
Greenland	0	0	0	0	149	0	
Ireland	0	0	0	0	1	0	
Netherlands	110	119	274	359	187	104	
Norway	3,830	3,150	1,902	2,404	2,213	2,206	
Poland	17	13	12	17	16	0	
Spain	0	0	0	0	0	0	
Sweden	686	596	804	572	477	187	
UK - Eng+Wales+N.Irl.	2,398	1,876	3,334	3,647	1,561	1,158	
UK - England & Wales	0	0	0	0	0	0	
UK – Scotland	53,628	37,772	29,263	39,624	31,526	39,337	
Un. Sov. Soc. Rep.	0	0	0	0	0	0	
Total reported	63,855	46,661	39,769	54,096	42,213	46,679	
Unallocated	354	-577	-811	75	66	575	
WG estimate of H.cons. landings	64,209	46,084	38,958	54,171	42,279	47,253	
WG estimate of discards	42,562	48,841	118,320	45,892	23,499	17,226	
WG estimate of industrial by-catch	3,834	8,134	7,879	3,717	1,149	554	
WG estimate of total catch	**110,605**	**103,059**	**165,157**	**103,780**	**66,927**	**65,033**	
TAC	*88,550*	*73,000*	*61,000*	*104,000*	*51,735*	*77,000*	*66,000* *

* Includes area II a (EC waters)

Division IIIa and Sub-area IV

	1999	2000	2001	2002	2003	2004	2005
WG estimate of total catch	112,299	105,161	167,278	107,917	68,735	66,476	
TAC	*93,950*	*77,450*	*65,000*	*110,300*	*54,885*	*81,940*	*70,018* *

* Includes areas II a and III bcd (EC waters)

Table 1.4.3.2 Haddock in Subarea IV (North Sea) and Division IIIa.

	Recruitment Age 0	Total Biomass	SSB	Total Catch	HC	Disc	IBC	Yield/SSB	F (2-4)	F HC (2-4)	F Disc (2-4)	F IBC (2-4)
1963	2.406	3473	140	272	69	189	14	1.94	0.72	0.49	0.2	0.03
1964	9.201	1314	430	380	131	160	89	0.88	0.75	0.47	0.12	0.16
1965	26.316	1101	544	299	162	62	75	0.55	0.59	0.34	0.1	0.14
1966	68.833	1497	458	347	226	74	47	0.76	0.63	0.36	0.17	0.1
1967	388.514	5514	254	247	148	78	21	0.97	0.61	0.35	0.23	0.03
1968	17.097	6901	288	302	106	162	34	1.05	0.59	0.38	0.15	0.07
1969	12.153	2476	813	931	331	260	339	1.15	1.13	0.69	0.15	0.29
1970	87.711	2545	899	807	525	101	180	0.90	1.17	0.7	0.2	0.27
1971	78.186	2532	419	447	237	177	32	1.07	0.78	0.54	0.18	0.06
1972	21.501	2192	301	354	195	128	30	1.17	1.12	0.84	0.24	0.04
1973	73.092	4116	296	308	182	115	11	1.04	0.86	0.65	0.21	0
1974	133.188	4767	259	369	153	167	49	1.43	0.97	0.6	0.23	0.13
1975	11.514	2388	237	455	151	260	43	1.92	1.12	0.68	0.34	0.1
1976	16.513	1096	306	377	173	154	50	1.23	0.99	0.62	0.25	0.11
1977	26.009	1060	237	226	145	44	37	0.96	1.08	0.68	0.21	0.18
1978	39.580	1103	131	180	92	77	12	1.38	1.11	0.79	0.28	0.04
1979	72.067	1324	110	146	87	42	17	1.33	1.04	0.85	0.14	0.04
1980	15.796	1438	152	224	105	95	24	1.47	0.99	0.75	0.13	0.11
1981	32.439	967	243	217	139	60	18	0.89	0.74	0.57	0.14	0.03
1982	20.453	1070	304	238	177	41	21	0.78	0.71	0.54	0.11	0.05
1983	66.632	2226	257	254	167	66	20	0.99	0.94	0.69	0.21	0.04
1984	17.118	1657	199	223	135	75	13	1.12	0.91	0.72	0.15	0.03
1985	23.938	1164	239	258	166	85	7	1.08	0.91	0.76	0.13	0.02
1986	49.658	1955	223	226	169	52	4	1.01	1.25	0.94	0.3	0.01
1987	4.160	1090	151	177	112	59	6	1.17	1.06	0.81	0.24	0.01
1988	8.417	620	152	176	108	62	5	1.16	1.16	0.86	0.25	0.05
1989	8.576	619	122	109	80	26	3	0.89	0.99	0.74	0.22	0.03
1990	28.072	1568	75	93	56	33	5	1.23	1.19	0.78	0.36	0.04
1991	27.393	1527	59	97	49	40	8	1.66	0.94	0.81	0.11	0.03
1992	40.824	1331	96	138	75	48	15	1.43	1.03	0.85	0.17	0.02
1993	12.685	979	130	174	82	80	13	1.34	1.01	0.74	0.24	0.03
1994	53.369	1407	151	154	83	65	6	1.02	0.91	0.63	0.27	0.01
1995	13.317	1101	147	145	78	57	10	0.98	0.83	0.58	0.24	0.01
1996	20.883	994	178	160	79	73	8	0.90	0.82	0.53	0.26	0.02
1997	11.995	890	192	142	82	52	7	0.74	0.65	0.42	0.2	0.03
1998	9.377	710	162	132	81	45	5	0.81	0.73	0.47	0.22	0.04
1999	112.466	2965	116	112	66	43	4	0.97	0.9	0.52	0.35	0.03
2000	22.635	2923	91	105	48	49	9	1.15	1.05	0.7	0.26	0.09
2001	2.365	982	228	167	41	118	8	0.73	0.71	0.39	0.2	0.11
2002	3.967	649	351	108	58	46	4	0.31	0.34	0.22	0.1	0.02
2003	3.216	562	344	69	44	23	1	0.20	0.26	0.07	0.17	0.02
2004	3.282	575	289	66	49	17	1	0.23	0.31	0.15	0.16	0
mean	40.403	1842	256	248	130	87	31	1.05	0.87	0.6	0.2	0.06
units	1000 million	1000 tonnes	1000 tonnes	1000 tonnes	1000 tonnes	1000 tonnes	1000 tonnes					

Table 1.4.3.3 Haddock in Subarea IV (North Sea) and Division IIIa.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-4
1963	2406440	140251	271531	0.7190
1964	9201402	429790	380158	0.7504
1965	26316326	544405	299464	0.5850
1966	68832616	457782	346726	0.6266
1967	388513792	253987	246589	0.6101
1968	17096554	288304	302043	0.5942
1969	12152716	812539	930538	1.1313
1970	87710552	898941	806674	1.1717
1971	78186328	418672	446634	0.7750
1972	21500850	301057	353606	1.1243
1973	73091968	295689	307688	0.8628
1974	133187760	258613	368797	0.9690
1975	11513633	236679	454536	1.1156
1976	16513344	306064	377118	0.9905
1977	26009306	236778	226411	1.0775
1978	39580416	130896	180144	1.1077
1979	72067064	109817	146001	1.0359
1980	15796213	151691	223610	0.9910
1981	32438630	242868	217151	0.7392
1982	20453130	304255	237842	0.7053
1983	66632180	256784	253594	0.9414
1984	17118460	198529	222563	0.9081
1985	23938372	238637	258117	0.9091
1986	49657860	223328	225697	1.2460
1987	4159788	151227	176880	1.0600
1988	8416760	151591	175516	1.1569
1989	8576424	121998	108772	0.9926
1990	28072398	75227	92720	1.1879
1991	27393074	58519	97021	0.9439
1992	40823684	96445	138001	1.0342
1993	12685144	129805	174296	1.0051
1994	53369028	151147	153864	0.9143
1995	13316662	147119	144773	0.8332
1996	20883384	178365	159671	0.8169
1997	11994814	191719	141900	0.6465
1998	9376685	162495	131621	0.7346
1999	112466128	115673	112299	0.8961
2000	22634786	91118	105161	1.0463
2001	2365188	228248	167278	0.7095
2002	3966718	351241	107917	0.3396
2003	3215785	344372	68735	0.2638
2004	3281846	288592	66476	0.3141
2005	30000000	265600		
Average	39532889	256459	247765	0.8710

Geometric mean (1963-2004) =21159107.

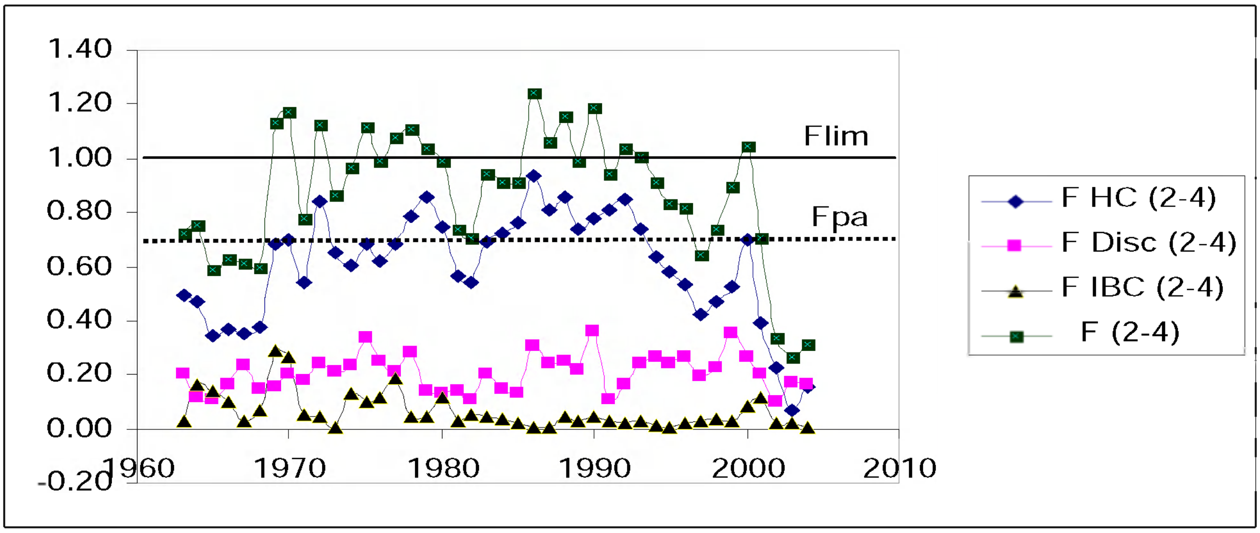


Figure 1.4.3.1 Fishing mortality split into components: Human Consumption, Discards, and Industrial by-catches.

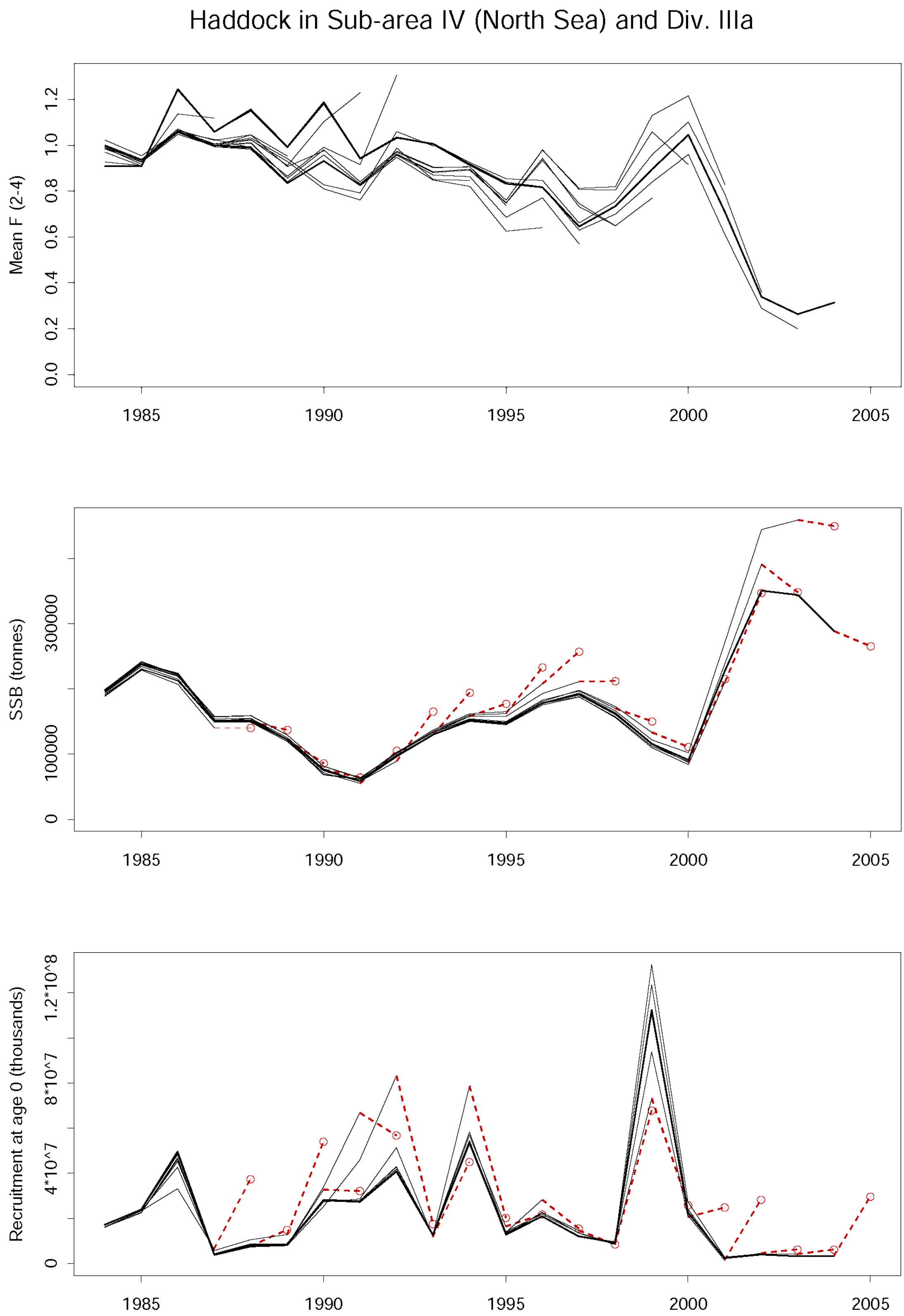


Figure 1.4.3.2 **Haddock in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat).** Results of the most recent assessment in comparison with results of previous assessments. Circles indicate forecasts at *status quo F*.

Note: fishing mortality before the 2003 assessment were based on a different age range (2-6)

1.4.4 Whiting in IIIa (Skagerrak – Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	
Unknown	Unknown	Unknown	

The available information is inadequate to evaluate spawning stock or fishing mortality. It is likely that this stock is linked to the North Sea stock.

Management objectives

There are no explicit management objectives for this stock.

Reference points

There are no reference points defined for the stock.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

The landings in 2005 should be less than 1 500 t as a precautionary value to restrict the potential for re-expansion of the fishery and misreporting from other regions.

Management considerations

The major part of the catch is taken as a bycatch in small-mesh fisheries. The landings value advised for 2006 is consistent with ICES advice provided in 2005, and is based on the average of the catch during 1996–1998.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM: 09).

Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to Single-Stock Exploitation Boundaries	Agreed TAC	ACFM Catch[1]
1987	Precautionary TAC		-		17.0	16.7
1988	Precautionary TAC		-		17.0	11.8
1989	Precautionary TAC		-		17.0	13.3
1990	Precautionary TAC		-		17.0	19.4
1991	TAC		-		17.0	14.0
1992	No advice		-		17.0	12.3
1993	Precautionary TAC		-		17.0	4.6
1994	If required, precautionary TAC		-		17.0	6.0
1995	If required, precautionary TAC		-		15.2	9.6
1996	If required, precautionary TAC		-		15.2	2.9
1997	If required, TAC equal to recent catches		-		15.2	0.7
1998	No advice				15.2	1.0
1999	TAC, average period 1993–1996		6.0		8.0	1.3
2000	TAC, average period 1996–1998		1.5		4.0	0.6
2001	TAC, average period 1996–1998		1.5		2.5	0.2
2002	TAC, average period 1996–1998		1.5		2.0	0.3
2003	TAC, average period 1996–1998		1.5		1.5	0.2
2004	TAC, average period 1996–1998		1.5		1.5	0.2
2005	[2)]	TAC, average period 1996–1998	1.5			
2006	[2)]	TAC, average period 1996–1998	1.5			

[1]Includes bycatch in small-mesh industrial fishery except for 2001–2003. [2)] Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits. Weights in '000 t.

Table 1.4.4.1 Nominal landings (t) of Whiting from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (ICES 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	917	11,662	12,579	29	675	-	13,283
1990	1,016	17,829	18,845	49	456	73	19,423
1991	871	12,463	13,334	56	527	97	14,041
1992	555	10,675	11,230	66	959	1	12,256
1993	261	3,581	3,842	42	756	1	4,641
1994	174	5,391	5,565	21	440	1	6,027
1995	85	9,029	9,114	24	431	1	9,570
1996	55	2,668	2,723	21	182	-	2,926
1997	38	568	606	18	94	-	718
1998	35	847	882	16	81	-	979
1999	37	1,199	1,236	15	111	-	1,362
2000	59	386	445	17*	138	1	622
2001	61	n/a	n/a	27*	126	+	214
2002	101	n/a	n/a	23*	127	1	252
2003	93	n/a	n/a	20	71	2	186
2004	93	n/a	n/a	17*	74	1	185

*Preliminary.

1.4.5 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	

The available information is inadequate to evaluate the spawning stock in relation to precautionary approach reference points. The assessment is indicative of trends only. The stock is estimated at or near the lowest observed level (see Figure 1.4.5.1). Landings are at an historical low, and fishing mortality as well.

Management objectives

There are no explicit management objectives for this stock.

Reference points

The assessment is only regarded as indicative of trends for the most recent 10–15 years. Without a reliable assessment for the whole time period, no revised reference points can be proposed. The present indicative assessment cannot be compared to the previous defined reference points.

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 225 000 t, the lowest observed biomass.	$\mathbf{B}_{pa}$ be set at 315 000 t. This affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of assessments. Below this value the probability of below-average recruitment increases.
$\mathbf{F}_{lim}$ is 0.90, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F}_{pa}$ be set at 0.65. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F}_{lim}$, taking into account the uncertainty of the assessment.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 2-6	Yield/R	SSB/R
$\mathbf{F}_{max}$	N/A		
$\mathbf{F}_{0.1}$	0.268	0.022	0.158
$\mathbf{F}_{med}$	0.373	0.023	0.132

Technical basis:

$\mathbf{B}_{lim}$=$\mathbf{B}_{loss}$=225 000 t.	$\mathbf{B}_{pa}$ =1.4*$\mathbf{B}_{lim}$, apparent impaired recruitment below this value: 315 000 t.
$\mathbf{F}_{lim}$=$\mathbf{F}_{loss}$=0.9.	$\mathbf{F}_{pa}$ ~ 0.7 $\mathbf{F}_{lim}$=0.65.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary considerations

The stock status cannot be assessed with reference to precautionary reference points. However, in the light of the low estimate of stock size in combination with the low recent landings with indication of current low exploitation rates, ICES recommends that the human consumption landings in 2006 should not be allowed to increase above the recent (2002–2004) average of 17 300 t for Subarea IV and Division VIId.

Management considerations

The minimum mesh size increased to 120 mm in the northern area in 2002 and this may have contributed to the substantial decrease in reported landings. However, research vessel and fisher surveys both indicate a decline in the northern component. Landings in the southern area (which uses a smaller mesh) have remained stable, and now represent the principal fishery for whiting. Fisher surveys indicate that the southern component is either stable or increasing. Therefore management actions appropriate for one area may not be suitable for the other.

Whiting is taken in mixed fisheries together with other roundfish and *Nephrops*.

Factors affecting the fisheries and the stock

The effects of regulations

The EU technical regulations in force in 2004 and 2005 are contained in Council Regulation (EC) 850/98 and its amendments. The minimum mesh size for vessels fishing for cod in the mixed demersal fishery in EC Zones 1 and 2 (West of Scotland and North Sea, excluding Skagerrak) was changed from 100 mm to 120 mm from the start of 2002 under EU regulations regarding the cod recovery plan (Commission Regulation EC 2056/2001), with a one-year derogation of 110 mm for vessels targeting other species such as whiting. This derogation was not extended beyond the end of 2002. The UK implemented a national regulation in mid-2000, requiring the mandatory fitting of a 90-mm square mesh panel (SSI 227/2000), predominantly to reduce discarding of the large 1999 year class of haddock. Further unilateral legislation in 2001 (SSI 250/2001) banned the use of lifting bags in the Scottish fleet. The minimum landing size for whiting in the North Sea is 27 cm.

Restrictions on fishing effort were introduced in 2003 and details of its implementation in 2004 can be found in Annex V of Council Regulation (EC) no. 2287/2003, and for 2005 in Annex IVa of Council Regulation (EC) no. 27/2005.

Vessel decommissioning in several fleets has been underway since 2002. Effort reductions for much of the international fleet to 15 days at sea per month have been imposed since February 2003 (EU 2003/0090).

Given the uncertainties in the fishing mortality estimates it is not possible to determine regulatory effects on the stock.

Scientific basis

Data and methods

Commercial catch-at-age data were disaggregated into human consumption, discards, and industrial bycatch components. This could not be done on an area basis. Discards were estimated based on the Scottish discards sampling program and raised to the total international fleet.

Three survey CPUE series are available: English groundfish survey (EngGFS), Scottish groundfish survey (ScoGFS), and IBTS Q1. Due to non-mandatory reporting of effort (in terms of hours fished), commercial CPUE series were not considered reliable and were not included in the exploratory analyses.

Several assessment approaches (XSA, TSA, ICA, CSA, SURBA) were explored.

Information from the fishing industry

Spatial information on landings (based on 70% of the total in 2002) suggests three distinct areas of major catch: a northern zone, an area off the eastern English coast, and a southern area extending into the Channel (with the largest catches, and prosecuted predominantly by French vessels). The southern whiting fishery uses 80-mm nets, whereas the other fisheries are prosecuted by vessels using larger mesh nets. Northern catches have declined whilst southern landings have been maintained. In the northern zone the reduction in landings may have taken place because of changes in mesh (increases, square mesh panels, etc.).

The fishers' North Sea Stock Survey indicated different stock trends in different roundfish areas of the North Sea. These stock trend perceptions were in broad agreement with IBTS Q1 survey indices aggregated by roundfish area. The fishers' survey suggests a decreasing stock in the north, but increasing further south.

Uncertainties in assessment and forecast

There are considerable discrepancies in the historical stock trends between the survey time-series and the assessment based on commercial catch data. The main discrepancies occur prior to 1990 (see Figure 1.4.5.1). This could be related to indications from research vessel surveys of different stock trends in different areas (Figure 1.4.5.2). This is confirmed by fisher surveys.

Discard estimates are based on the Scottish sampling program, which is mainly in the northern area. Extrapolation of this to the entire area is a source of uncertainty because the fishery in the southern area is mostly carried out with different gears and smaller mesh sizes.

Comparison with previous assessment and advice

No analytical assessment of whiting has been provided in the recent years due to the discrepancies between survey information and the catch data. The assessment that is the basis for the current advice covers a short time-series of catch data and survey information where this discrepancy does not occur. The assessment is only considered indicative of trends and does not form the basis for a short-term forecast.

Compared to the situation last year, both the assessment based on the commercial catch and the research vessel data indicate a low stock size this year. Therefore, the catch advice this time is lower than last year.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM: 09).

North Sea (Subarea IV)

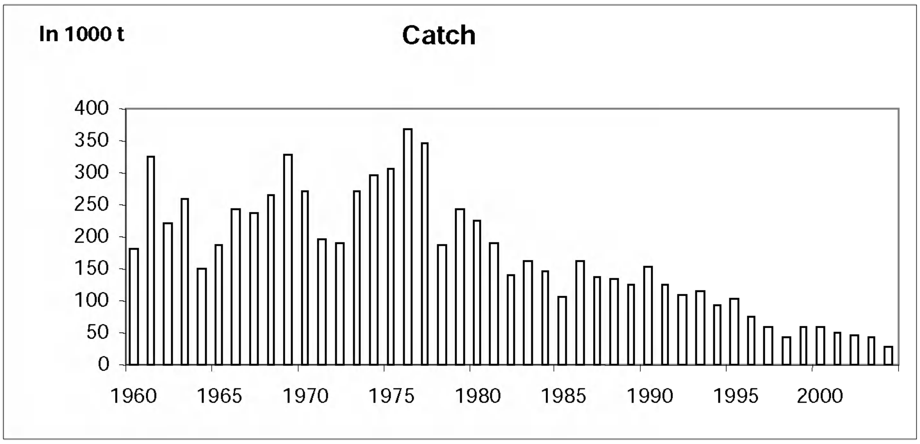
Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted Landings Corresp. To advice	Predicted Landings Corresp. To single-stock exploitation boundaries	Agreed TAC	Off. Lndgs.	ACFM figures			
							Hum. Cons.	Indust. by-catch	Disc. slip.	Total catch
1988	No increase in F; TAC		134		120	66	52	49	28	129
1989	Protect juveniles		-		115	40	41	43	36	120
1990	80% of F(88); TAC		130		125	41	43	51	56	150
1991	70% of effort (89)		-		141	47	47	38	34	119
1992	70% of effort (89)		-		135	47	46	27	31	104
1993	70% of effort (89)		-		120	47	48	20	43	111
1994	Significant reduction in effort; mixed fishery		-		100	42	43	10	33	86
1995	Significant reduction in effort; mixed fishery		-		81	41	41	27	30	98
1996	Mixed fishery; take into account cod advice		-		67	35	36	5	28	69
1997	Mixed fishery; take into account cod advice		-		74	32	31	6	17	54
1998	No increase from 1996 level		54		60	24	24	3	13	40
1999	at least 20% reduction of F(95–97)		40.4		44	25	26	5	24	55
2000	lowest possible catch		0		30	24	24	9	22	55
2001	60% reduction of F(97–99)		19.4		30	19	19	7	16	43
2002	F not larger than 0.37		≤33		32	16	16	7	17	40
2003	No cod catches		-		16	11	11	3	24	38
2004	No cod catches*)	Fishing mortality in 2004 should be less than	*)	catch should not increase in 2004 compared to recent years.	16	13	9	1	14	25
2005	No cod catches*)	Less than recent average	*)	52**)	28.5					
2006	No cod catches*)	Less than recent average	*)	< 17.3**)						

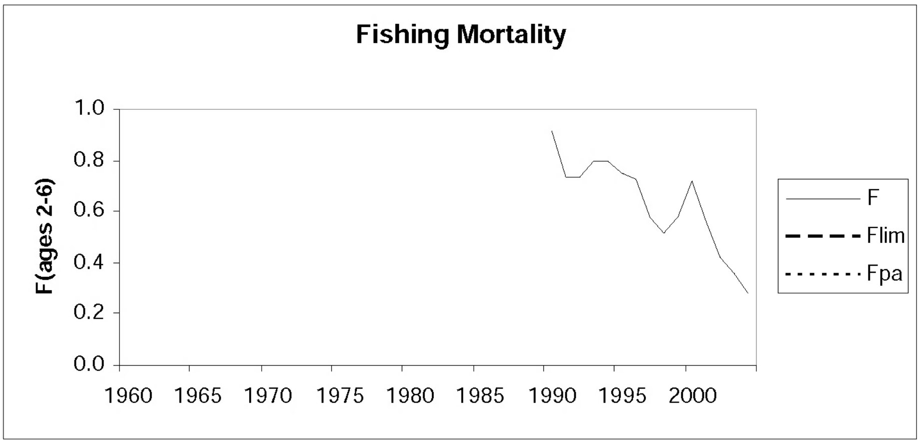
*) Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits. **) including VIId.
Weights in '000 t.

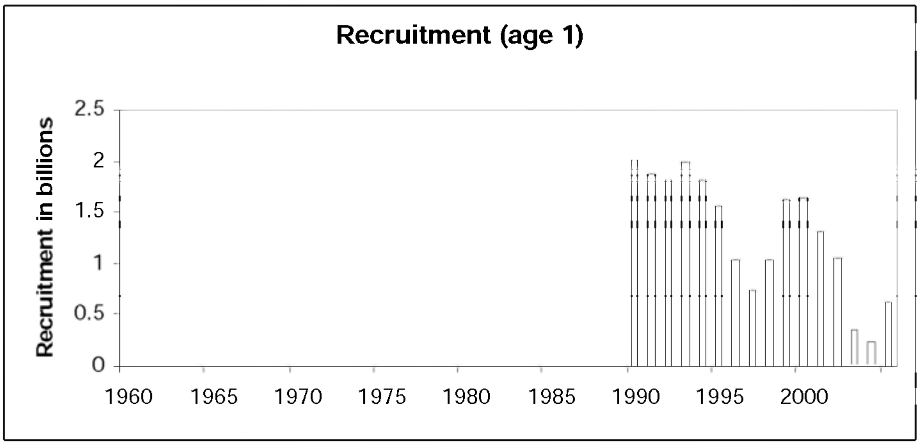
Eastern Channel (Division VIId)

Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted Landings Corresp. To single-stock exploitation boundaries	Agreed TAC[1]	Official landings	ACFM Catch
1988	Precautionary TAC		-		-	7.8	4.4
1989	Precautionary TAC		-		-	n/a	4.2
1990	No increase in F; TAC		8.0[2]		-	n/a	3.5
1991	$\mathbf{F}_{sq}$; TAC		5.1		-	n/a	5.7
1992	If required, precautionary TAC		6.0[2]		-	5.9	5.7
1993	No basis for advice		-		-	5.4	5.2
1994	No long-term gains in increasing F		-		-	7.1	6.6
1995	Significant reduction in effort; link to North Sea		-		-	5.6	5.4
1996	Reference made to North Sea advice		-		-	5.1	5.0
1997	Reference made to North Sea advice		-		-	4.8	4.6
1998	Reference made to North Sea advice		5.8		-	4.8	4.6
1999	Reference made to North Sea advice		3.9		-	n/a	4.4
2000	Lowest possible catch		0		-	6.1	4.3
2001	60% reduction of $\mathbf{F}_{sq}$		2.5		-	6.6	5.8
2002	F not larger than 0.37		<=4		-	5.4	5.8
2003	No cod catches		-		-	6.8	5.7
2004	No cod catches *)	Fishing mortality in 2004 should be less than $\mathbf{F}_{pa}$		Catch should not increase in 2004 compared to recent years.	-	0.3	4.4
2005	No cod catches *)	-		-			
2006	No cod catches *)	Less than recent average	< 17.3**)				

[1] Included in TAC for Subarea VII (except Division VIIa). [2] Including VIIe. Weights in '000 t. n/a=Not available.
*) Single stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits.
**) Includes both areas (IV and VIId).


In 1000 t
Catch
400
350
300
250
200
150
100
50
0
1960
1965
1970
1975
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 2-6)
1.0
0.8
0.6
0.4
0.2
0.0
1960
1965
1970
1975
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in billions
2.5
2
1.5
1
0.5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000

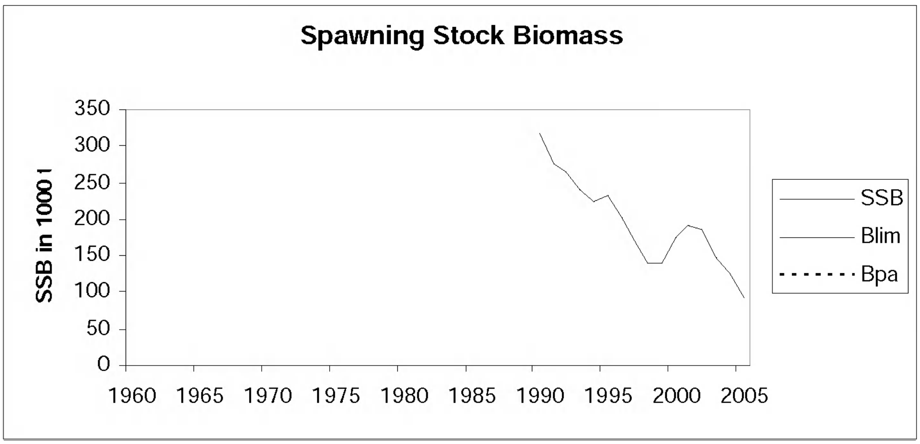

Spawning Stock Biomass
SSB in 1000 t
350
300
250
200
150
100
50
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
SSB
Blim
Bpa

Table 1.4.5.1 Nominal landings (in tonnes) of Whiting in Subarea IV and Division VIId, as officially reported to ICES.

Sub-area IV

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium	944	1,042	880	843	391	268	529	536	454	270	248	140.2
Denmark	1,418	549	368	189	103	46	58	105	105	96	89	62
Faroe Islands	7	2	21	-	6	1	1	-	-	17	5	0
France	5,502	4,735	5,963	4,704	3,526	1,908*	4,292*[1]	2,527	3,455	3,314	2,414	-
Germany	441	239	124	187	196	103	176	424	402	354	334	296.4
Netherlands	4,799	3,864	3,640	3,388	2,539	1,941	1,795	1,884	2,478[2]	2,425	1,442	978
Norway	130	79	115	66	75	65	68	33	44	47	39	23
Poland	-	-	-	-	-	1	-	-	-	-	-	-
Sweden	18	10	1	1	1	+	9	4	6	7	10	1.8
UK (E.&W)[3]	2,774	2,722	2,477	2,329	2,638	2,909	2,268	1,782	1,301	1,322	680	1,207.2
UK (Scotland)	31,268	28,974	27,811	23,409	22,098	16,696	17,206	17,158	10,589	7,756	5,734	5,059.6
United Kingdom												
Total	47,301	42,216	41,400	35,116	31,573	23,938	26,402	24,453	18,834	15,608	10,996	7,768.3
Unallocated landings	680	401	-348	1,006	-276	-72	-421	-412	592	308	-337	
WG estimate of H.Cons. landings	47,981	42,617	41,052	36,122	31,297	23,866	25,981	24,041	19,412	15,916	10,659	*
WG estimate of discards	42,871	33,010	30,264	28,181	17,217	12,708	23,584	23,214	16,488	17,509	24,093	*
WG estimate of Ind. By-catch	20,099	10,354	26,561	4,702	5,965	3,141	5,183	8,886	7,357	7,327	2,743	*
WG estimate of total catch	110,951	85,981	97,877	69,005	54,479	39,715	54,748	56,609	43,258	40,752	37,496	*

*Preliminary.

[1]Includes Division IIa (EC).

[2]Not included here are 68 t reported into an unknown area.

[3]1989-1994 revised. N. Ireland included with England and Wales.

Division VIId

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Belgium	74	61	68	84	98	53	48	65	75	58	66	44.9
France	5,032	6,734	5,202	4,771	4,532	4,495*	-	5,875	6,338	5,172	6,478	-
Netherlands	-	-	-	1	1	32	6	14	67	19	175	132
UK (E.&W)	321	293	280	199	147	185	135	118	134	112	109	79.5
UK (Scotland)	2	-	1	1	1	+	-	-	-	-	-	-
United Kingdom												
Total	5,429	7,088	5,551	5,056	4,779	4,765	189	6,072	6,614	5,361	6,828	274.4
Unallocated	-214	-463	-161	-104	-156	-167	4,242	-1,775	-810	439	-1,117	*
W.G. estimate	5,215	6,625	5,390	4,952	4,623	4,598	4,431	4,297	5,804	5,800	5,712	*

*Preliminary.

Sub-area IV and Division VIId

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
W.G. estimate	116,166	92,606	103,267	73,957	59,102	44,313	59,179	59,587	49,062	46,552	43,208	*

Annual TAC for Subarea IV and Division IIa

	2000	2001	2002	2003	2004
TAC	29,700	32,358	16,000	16,000	28,500

* Not available.

Table 1.4.5.2 Whiting Subarea IV (North Sea) & Division VIId (Eastern Channel).

Year	Recruitment Age 1 thousands	SSB tonnes	Catch tonnes	Mean F Ages 2-6
1960	4010000	312900	182400	1.562
1961	3253000	374300	326100	1.427
1962	5823000	282900	222400	1.260
1963	6508000	462900	260800	0.934
1964	1430000	517000	150000	0.631
1965	2772000	461100	186800	0.596
1966	2482000	392600	242200	1.118
1967	4647000	321900	237000	0.816
1968	9131000	452300	265300	0.935
1969	1081000	626300	327600	0.702
1970	1821000	378500	271600	0.845
1971	3041000	238300	195400	0.528
1972	5427000	290700	191300	0.767
1973	7423000	409300	270500	0.974
1974	3683000	477000	296200	1.043
1975	7602000	489500	305000	1.183
1976	4833000	630300	368200	1.078
1977	4661000	600300	347100	0.802
1978	4653000	453100	188200	0.742
1979	4774000	515400	243800	0.722
1980	4423000	522400	223500	0.882
1981	1720000	489000	192000	0.890
1982	1946000	378600	140200	0.689
1983	1743000	337400	161200	0.747
1984	2599000	271600	145700	0.917
1985	1889000	271100	106400	0.821
1986	3923000	288800	161700	0.905
1987	3274000	299300	138800	1.124
1988	2298000	295700	133500	0.878
1989	4406000	279900	123800	0.990
1990	2014000	317900	153500	0.916
1991	1875000	277500	125000	0.733
1992	1811000	265800	109700	0.735
1993	1985000	239700	116200	0.797
1994	1812000	223800	92600	0.796
1995	1562000	232900	103300	0.752
1996	1044000	202500	74000	0.725
1997	743000	173300	59100	0.575
1998	1027000	139900	44300	0.513
1999	1622000	140700	59200	0.581
2000	1641000	174300	60900	0.721
2001	1318000	192400	49100	0.559
2002	1063000	184800	46600	0.425
2003	360000	148900	43200	0.357
2004	244000	124500	29100	0.279
Average	3000326	331593	169557	0.810

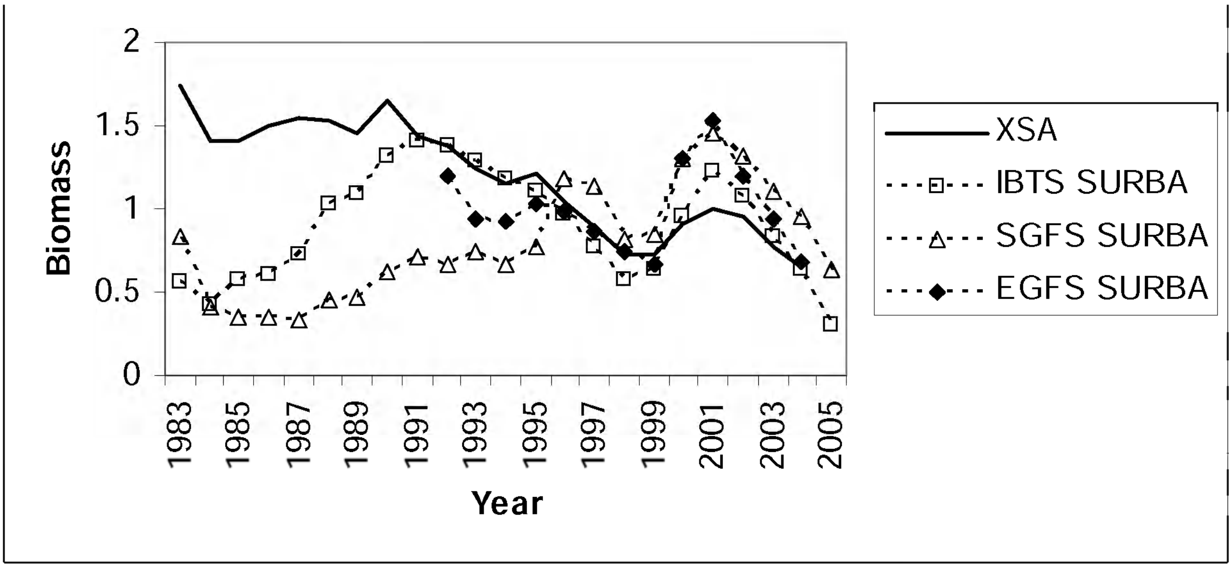


Figure 1.4.5.1 Comparison of SSB time-series estimated from XSA and SURBA runs, mean standardized over 1992–2004.

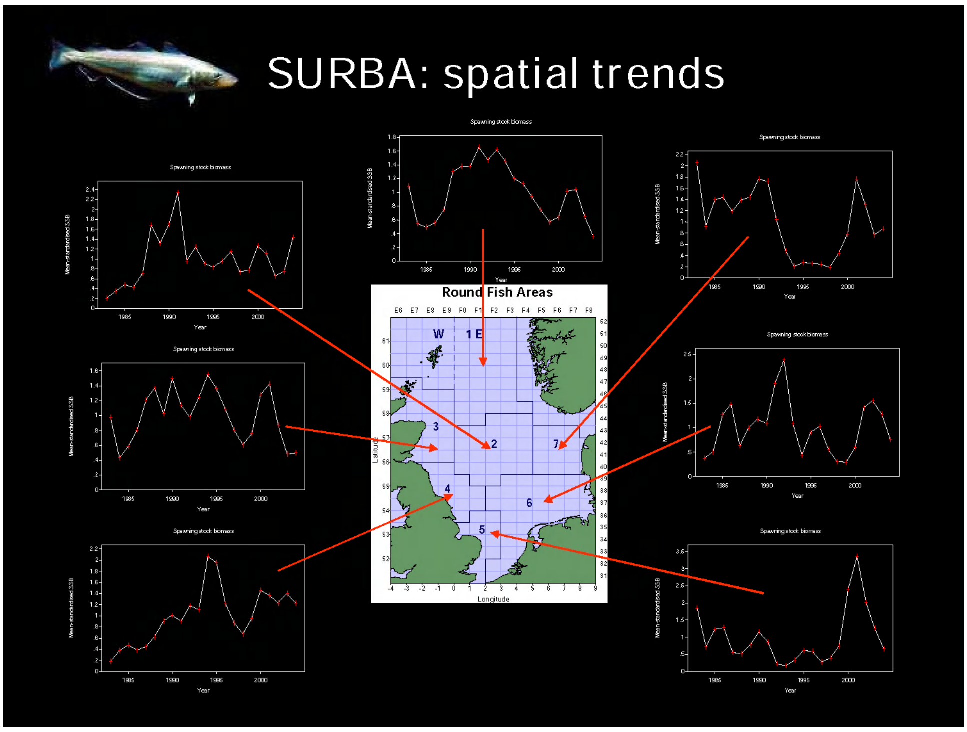


Figure 1.4.5.2. Relative SSB trends estimated using SURBA with spatially disaggregated IBTS Q1 indices (1982–2005).

1.4.6 Plaice in Division IIIa (Skagerrak – Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	

The assessment is indicative of trends only. In the absence of a reliable assessment, the state of the stock cannot be evaluated in relation to the Precautionary Approach. Indices from both surveys and the commercial fishery suggest a substantial increase in biomass in recent years. Survey indices indicate that recruitment of the year classes 1999 and onwards have been high, and these year classes might have contributed to an increase in SSB in recent years.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ cannot be accurately defined.	$\mathbf{B}_{pa}$ = 24 000 t.
	$\mathbf{F}_{lim}$ cannot be accurately defined.	$\mathbf{F}_{pa}$ = 0.73.
Target reference points		$\mathbf{F}_{y}$ undefined

Technical basis

	$\mathbf{B}_{pa}$ = smoothed $\mathbf{B}_{loss}$ (no sign of impairment).
	$\mathbf{F}_{pa}$ = $\mathbf{F}_{med}$.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

There is no basis for an analytical forecast. Given the possible increase in stock size in recent years in combination with an unknown exploitation rate, fishing mortality in 2006 should not be allowed to increase. This may be achieved by allowing landings of less than 9 600 t in 2006, which is the average of landings of the last four years.

Short-term implications

The assessment is very uncertain and is characterized by large annual revisions in population estimates, hence no short-term forecasts were performed (see Uncertainties in assessment and forecast).

Management considerations

Plaice is taken both in a directed fishery and as an important bycatch in a mixed cod-plaice fishery. The stock area for North Sea cod includes the Skagerrak (Division IIIaN). Both North Sea cod and Kattegat (Division IIIa South) cod are well below $\mathbf{B}_{lim}$. Thus, monitoring of bycatches and discards of cod should be continued.

Ecosystem considerations

The large-scale circulation pattern in the northern Kattegat depends mainly on the interaction between Baltic runoffs and local variations due to wind stress. Nielsen *et al.* (1998) demonstrated that the abundance of settled 0-group plaice along the Danish coast of the Kattegat depends on transport from the Skagerrak. The 0-group abundance measured in July–August was significantly higher in years when wind conditions during the larval development period (March–April) were moderate to strong. This might imply that larval plaice are food-limited in years when calm conditions prevail during the larval drift period (Nielsen *et al.*, 1998).

It was recognized long ago that the stock boundaries are arbitrary and drawn more to suit management purposes than for biological stock separation. Electrophoresis and meristic character indicated that the plaice in IIIa is a mixed population of the Kattegat and the Skagerrak component, which is dominating, and a Belt Sea component. Some additional work has been started in 2004 about the biological links between the Kattegat and the Western Baltic (ICES Area 22) and the potential extension of the stock beyond its current assessment area. Preliminary results concluded that there is good evidence for mixing sub-populations in both areas. There may also be linkages with the North Sea plaice stock. Migrations of plaice outside and/or inside the assessment area are one of the factors that could explain the large and likely unrealistic fluctuations in the estimated fishing mortality.

Factors affecting the fisheries and the stock

The effects of regulations

The use of beam trawl is prohibited in the Kattegat, but allowed in the Skagerrak. Minimum mesh size is 90 mm for towed gears, and 100 mm for fixed gears. The minimum landing size is 27 cm. Danish fleets are prohibited to land female plaice from Division IIIa from January 15th to April 30th.

Scientific basis

The quality of input data or model assumptions used in the exploratory assessments is generally poor. There are indications that misreporting from the North Sea to the Skagerrak and from the Belt Sea (ICES area 22) could have occurred repeatedly in the rectangles being shared between those areas.

Data and methods

The exploratory assessments are based on catch data calibrated with three commercial and four survey indices (XSA, SMS) and also based on survey data (SURBA) only.

Information from the fishing industry

The fishing industry has provided information which has been included in considerations of assessments. Such information has contributed to the understanding of the fisheries, also in cases where information has not been in a form which enables direct inclusion in quantitative assessments.

Uncertainties in assessment and forecast

The assessment is very uncertain, and is characterized by large annual revisions in population estimates. Fishing mortality displays excessive fluctuations between years, and point estimates are very uncertain. Principal inconsistencies between catch and survey data lead to different perceptions of the stock status. This inconsistency could partly be due to increasing migration patterns to outside the assessment area, or to discard and misreporting practices. Current commercial tuning series are considered questionable when used as measures for stock abundance. More accurate tuning fleet definitions should be considered. Under these conditions the assessment is only considered to be indicative of trends.

Comparison with previous assessment and advice

Poor performances of the analytical assessment lead to rejection of the final assessment. Several exploratory analyses were attempted, but principal inconsistencies between survey and catch data impedes any firm conclusions. Catch data suggest a strong 2001 year class while surveys suggest several strong year classes since 1999.

Sources of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Nielsen, E., Bagge, O., and MacKenzie, B. R. 1998. Wind-induced transport of plaice (*Pleuronectes platessa*) early life-history stages in the Skagerrak-Kattegat. J Sea Res 39, 11-28.

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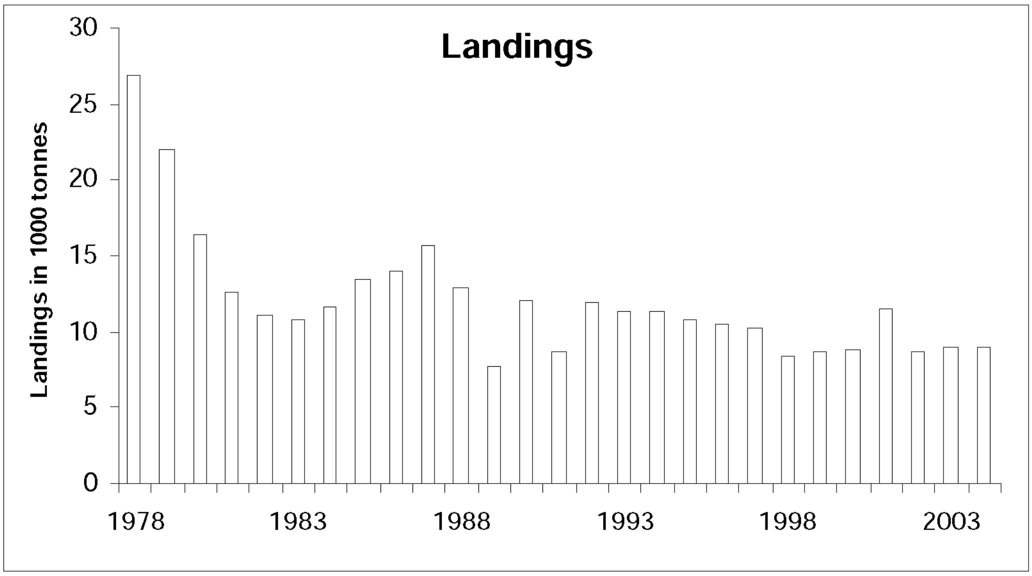
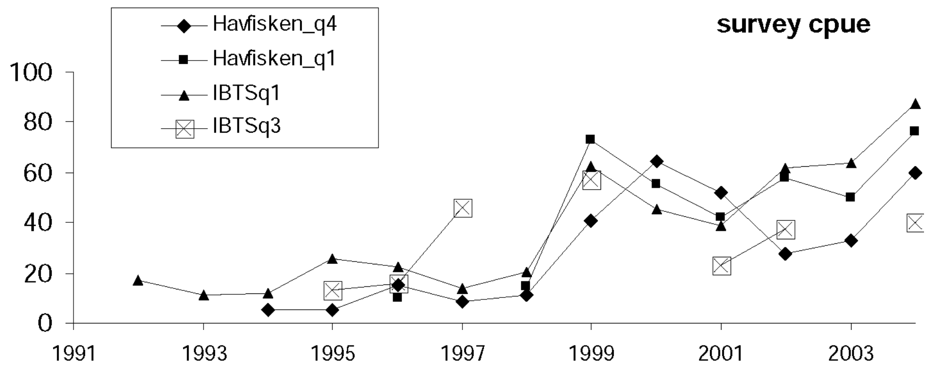
Year	ICES Advice	Single-stock Exploitation Boundaries	Predicted catch corresp. to advice		Predicted catch corresp. to Single-stock Exploitation Boundaries		Agreed TAC:		ACFM Landings
			Kattegat	Skagerrak	Kattegat	Skagerrak	Kattegat	Skagerrak	
1992	TAC		14.0				2.8	11.2	11.9
1993	Precautionary TAC		-				2.8	11.2	11.3
1994	If required, precautionary TAC		-				2.8	11.2	11.3
1995	If required, precautionary TAC		-				2.8	11.2	10.8
1996	If required, precautionary TAC		-				2.8	11.2	10.5
1997	No advice		-				2.8	11.2	10.1
1998	No increase in F from the present level		11.9				2.8	11.2	8.4
1999	No increase in F from the present level		11.0				2.8	11.2	8.5
2000	$F < \mathbf{F}_{pa}$		11.8				2.8	11.2	8.8
2001	$F < \mathbf{F}_{pa}$		9.4				2.35	9.4	11.7
2002	$F < \mathbf{F}_{pa}$		8.5[1]				1.6[2]	6.4[2]	8.7
2003	$F < \mathbf{F}_{pa}$		18.4				3.0	10.4	8.9
2004	[3]	$F < \mathbf{F}_{pa}$	[3]		n.a.		1,8	9.5	9.1
2005		$F < \mathbf{F}_{pa}$	< 9.5				1.9	7.6	
2006			< 9.6						

1) In March 2002 ACFM revised its advice to 11.6 for both areas combined. 2) The TAC for the two areas combined was adjusted to 11 200 tonnes in mid-2002. 3) Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries. Weights in '000 t.

Plaice in Division IIIa (Skagerrak - Kattegat).



Plaice in IIIa. CPUE indices from surveys.



Plaice in IIIa. Stock summary by comparison of XSA using surveys only and SURBA. Relative values.

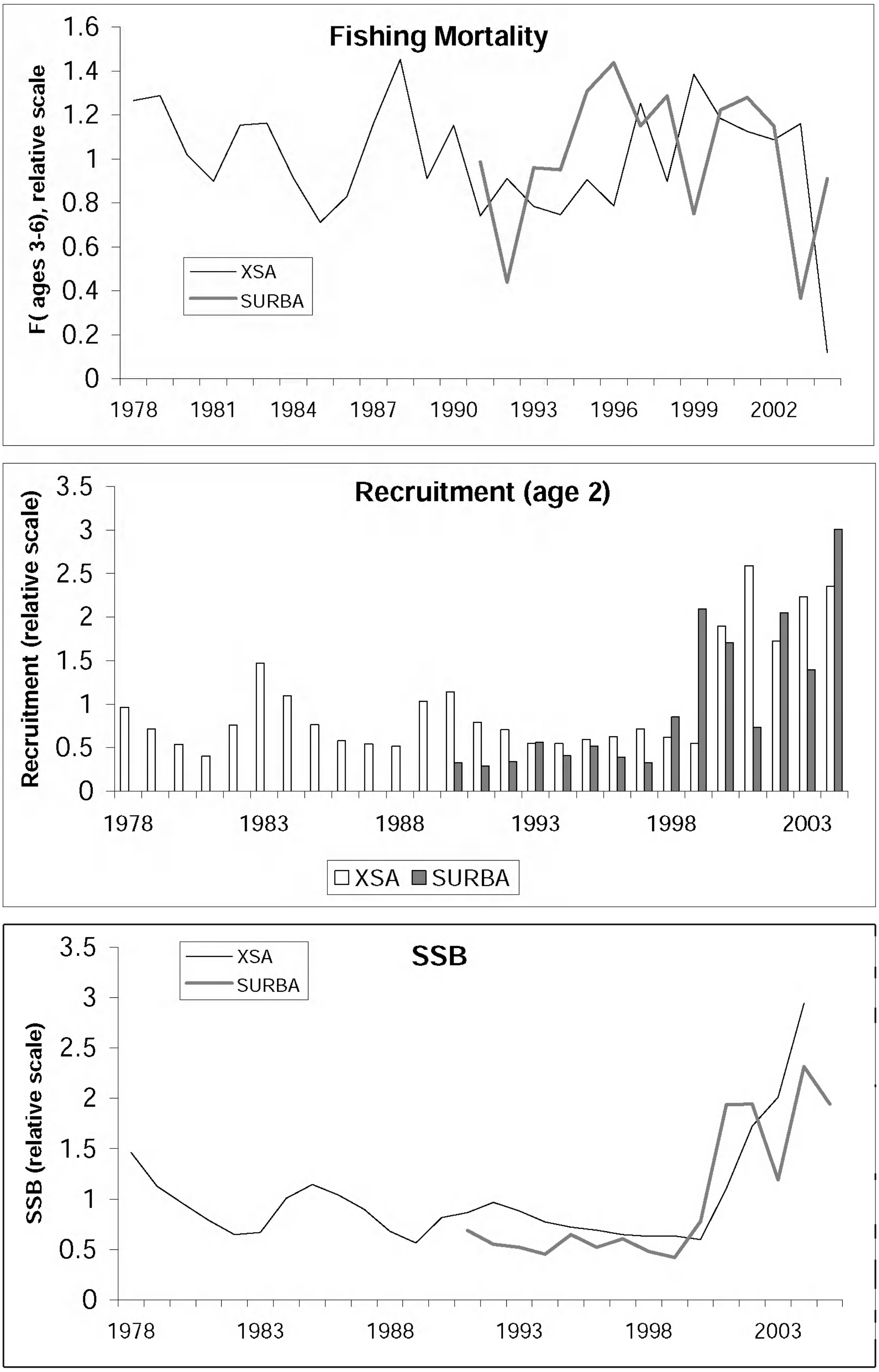


Table 1.4.6.1 Plaice in IIIa. Official landings in tonnes as reported to ICES and WG estimates, 1972-2004

Year	Denmark		Sweden		Germany		Belgium		Norway		Netherlands		Total			
	Official	WG est.	Official	WG est.	Official	WG est.	Official	WG est.	Official	WG est.	Official	WG est.	Official	Unalloc.	WG est.	TAC
1972		20,599		418		77				3					21,097	
1973		13,892		311		48				6					14,257	
1974		14,830		325		52				5					15,212	
1975		15,046		373		39				6					15,464	
1976		18,738		228		32		717		6					19,721	
1977		24,466		442		32		846		6					25,792	
1978		26,068		405		100		371		9					26,953	
1979		20,766		400		38		763		9					21,976	
1980		15,096		384		40		914		11					16,445	
1981		11,918		366		42		263		13					12,602	
1982		10,506		384		19		127		11					11,047	
1983		10,108		489		36		133		14					10,780	
1984		10,812		699		31		27		22					11,591	
1985		12,625		699		4		136		18					13,482	
1986		13,115		404		2		505		26					14,052	
1987		14,173		548		3		907		27					15,658	19,250
1988		11,602		491		0		716		41					12,850	19,750
1989		7,023		455		0		230		33					7,741	19,000
1990		10,559		981		2		471		69					12,082	13,000
1991		7,546		737		34		315		68					8,700	11,300
1992		10,582		589		117		537		106					11,931	14,000
1993		10,419		462		37		326		79					11,323	14,000
1994		10,330		542		37		325		91					11,325	14,000
1995	9,722	9,722	470	470	48	48	302	302	224	224			10,766	0	10,766	14,000
1996	9,593	9,641	465	465	31	11			428	428			10,517	28	10,545	14,000
1997	9,505	9,504	499	499	39	39			249	249			10,292	-1	10,291	14,000
1998	7,918	7,918	393	393	22	21			98	98			8,431	-1	8,430	14,000
1999	7,983	7,983	373	394	27	27			336	336			8,719	21	8,740	14,000
2000	8,324	8,324	401	414	15	15			67	67			8,807	13	8,820	14,000
2001	11,112	11,114	385	385	1	0			61	61			11,559	1	11,560	11,750
2002	8,275	8,276	322	338	29	29			58	58			8,684	17	8,701	12,800
2003	6,884	6884	377	396	14	14			74	74	1494	1584	8,843	109	8,952	16,600
2004	7,133	7,112	317	316	77	77			80	80	1455	1511	9,062		9,096	11,173
2005																9,500

Table 1.4.6.2 Plaice in Division IIIa (Skagerrak – Kattegat).

Year	Landings tonnes
1978	26953
1979	21976
1980	16445
1981	12602
1982	11047
1983	10780
1984	11591
1985	13482
1986	14052
1987	15658
1988	12850
1989	7741
1990	12082
1991	8700
1992	11931
1993	11323
1994	11325
1995	10766
1996	10545
1997	10291
1998	8430
1999	8740
2000	8820
2001	11560
2002	8701
2003	8952
2004	9096

1.4.7 Plaice in Subarea IV (North Sea)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
At risk of reduced reproductive capacity	Harvested sustainably	Overexploited	Above	

Based on the most recent estimate of SSB and fishing mortality, ICES classifies the stock as being at risk of reduced reproductive capacity and as being harvested sustainably. SSB in 2004 was estimated at around 170 000 t and is expected to have increased to just above 200 000 t in 2005. SSB is below the $\mathbf{B}_{pa}$ of 230 000 t. Fishing mortality in 2004 is estimated to be at or near $\mathbf{F}_{pa}$. Fishing mortality has been disaggregated into human consumption ($\mathbf{F}_{hc}$) and discards ($\mathbf{F}_{disc}$) components, and the former appears to be decreasing while the latter is increasing. Recent recruitment has been below average.

Management objectives

In 1999, the EU and Norway have "*agreed to implement a long-term management plan for the plaice stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of SSB greater than 210 000 t ($\mathbf{B}_{lim}$).*
2. *For 2000 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality of 0.3 for appropriate age groups as defined by ICES.*
3. *Should the SSB fall below a reference point of 300 000 t ($\mathbf{B}_{pa}$), the fishing mortality referred to under paragraph 2 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 300 000 t.*
4. *In order to reduce discarding and to enhance the spawning biomass of plaice, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from, inter alia, ICES.*
5. *The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES.*"

The management agreement was not renewed for 2005. A new management plan for North Sea plaice is under development. The current plan does not refer to the reference points changed in 2004. In response to a request from the European Community and Norway, ICES has evaluated a range of harvest rules for the North Sea plaice (from a starting point based on the ICES assessment made in 2004) with respect to medium- and long-term yields, stability of yield and effort, and stock status with respect to safe biological limits (see section on evaluation of management plans).

Reference points (as changed in 2004)

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 160 000 t.	$\mathbf{B}_{pa}$ be set at 230 000 t
	$\mathbf{F}_{lim}$ is 0.74	$\mathbf{F}_{pa}$ be set at 0.60.
Target reference points	Target F according to the management plan is 0.3	

Yield and spawning biomass per Recruit (from ACFM 2004)
F-reference points

	Fish Mort Ages 2-6	Yield/R	SSB/R
$\mathbf{F}_{max}$	0.167	0.142	1.503
$\mathbf{F}_{0.1}$	0.117	0.136	2.107
$\mathbf{F}_{med}$	0.473	0.093	0.340

Candidates for reference points which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $\mathbf{F_{0.1}}$-$\mathbf{F_{max}}$.

Technical basis

$\mathbf{B_{lim}}$=$\mathbf{B_{loss}}$=160 000 t, the lowest observed biomass in 1997 as assessed in 2004	$\mathbf{B_{pa}}$ = Approximately 1.4 $\mathbf{B_{lim}}$.
$\mathbf{F_{lim}}$=$\mathbf{F_{loss}}$=0.74 (ages 2-6).	$\mathbf{F_{pa}}$ =5th percentile of $\mathbf{F}_{loss}$ (0.6) and implies that $\mathbf{B}_{eq}$>$\mathbf{B}_{pa}$[1)] and a 50% probability that $\mathbf{SSB}_{MT}$ ~ $\mathbf{B}_{pa}$.[2)]

1) see Figure 4.4.4.b.2 in ICES 2004. 2) see Figure 4.4.4.b.3 in ICES 2004.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The management agreement has not been renewed for 2005. Therefore, advice is only presented in the context of precautionary boundaries.

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality is estimated at 0.58, which is above the rate expected to lead to high long-term yields ($\mathbf{F}_{max}$ on human consumption=0.17).

Exploitation boundaries in relation to precautionary limits

The exploitation boundaries in relation to precautionary limits imply human consumption landings of less than 48 000 t in 2006, which is expected to rebuild SSB to the proposed Bpa (=230 000 t) in 2007.

Management considerations

Because the assessment now incorporates discards, ICES has proposed to change the value of Fpa so that it refers to the overall fishing mortality (landings and discards). Managers should reconsider the value of F=0.3 as it was stated in the management agreement between the EC and Norway.

Due to a range of factors such as TAC constraints on plaice, effort limitations and increases in fuel prices, the fishing effort of the major fleets has concentrated in the southern part of the North Sea. This is the area where a large part of the juvenile fish of e.g. plaice in the North Sea are found. In addition, juvenile plaice has shown a more off-shore distribution in recent years. The combination of a change in fishing pattern and the spatial distribution of juvenile plaice has lead to an apparent increase in discarding of plaice.

Technical measures applicable to the mixed flatfish fishery will affect both sole and plaice. The minimum mesh size of 80 mm in the beam trawl fishery selects sole at the minimum landing size. However, this mesh size generates catches of plaice from 17 cm, while the minimum landing size is 27 cm, leading to a high discard rate. Mesh enlargement would reduce the catch of undersized plaice, but would also result in short-term loss of marketable sole. An increase in the minimum landing size of sole could provide an incentive to fish with larger mesh sizes and therefore mean a reduction in the discarding of plaice.

Management plan evaluations

In response to a request from the European Community and Norway ICES has evaluated *a range of harvest rules for the North Sea plaice* (see Section 1.3.3.1 and the ICES AGLTA report Section 4.7). The starting population for the simulations on North Sea plaice was taken from the 2004 ICES assessment (ICES CM 2005/ACFM:07) which included landings and discards. Results indicated that target fishing mortalities (covering all catches and ages 2-6) in the range of

0.3–0.4 were expected to have a low risk to reproduction and high long-term yields. The performance of a long-term management plan with target Fs below 0.4 was not sensitive to choices of $\mathbf{B}_{trig}$ (the biomass where management measures were triggered). A constraint on annual TAC variations was expected to improve the performance both in terms of minimizing short-term landings variation and in terms of making the system less sensitive to the noise in annual assessments. A fixed TAC regime with a TAC below 80 000 t was expected to produce the same results in terms of low risk to reproduction, but would result in considerably lower average landings in the longer term. It should be noted that the simulations have not taken biological interactions or density-dependent growth and maturity into account; the numerical results of these simulations are therefore only indicative of trends.

Factors affecting the fisheries and the stock

The effects of regulations

The TACs for plaice are likely to have been respected.

Previous MAGP programs have induced changes in fleet compositions. The Dutch beam trawl fleet has reduced the number of vessels and shifted towards two categories of vessels: 2000 HP (the maximum engine power allowed) and 300 HP (the maximum engine power for vessels that are allowed to fish within the 12-nautical mile coastal zone and in the plaice box). A substantial part of the decommissioned vessels have been replaced by vessels in other countries (England, Scotland, Germany, Belgium). Overall capacity and effort of North Sea beam trawl vessels appears to have decreased since 1995.

The minimum landing size of North Sea plaice is 27 cm. This minimum landing size results in high discarding levels in the mixed flatfish fishery with beam trawls using 80-mm mesh size.

The plaice box is a closed area along the continental coast that has been introduced in 1989. The area was closed in all quarters since 1995. The closed area applies to vessels using towed gears, but vessels smaller than 300 HP are exempted from the regulation. The closed area applies to vessels using towed gears, but vessels smaller than 300 HP are exempted from the regulation. An evaluation of the plaice box (Grift et al, 2004) has indicated that: "From trends observed it was inferred that the Plaice Box has likely had a positive effect on the recruitment of plaice but that its overall effect has decreased since it was established. There are two reasons to assume that the Plaice Box has a positive effect on the recruitment of plaice: 1) at present, the Plaice Box still protects the majority of undersized Plaice. Approximately 70 % of the undersized Plaice are found in the Plaice Box and Wadden Sea, and despite the changed distribution, densities of juvenile Plaice inside the Box are still higher than outside; 2) In the 80 mm fishery, discard percentages in the Box are higher than outside. Because more than 90 % of the Plaice caught in the 80 mm fishery in the Box are discarded, any reduction in this fishery would reduce discard mortality. There is, however, no proof of a direct relationship between total discard mortality and recruitment."

Changes in fishing technology and fishing patterns

The Dutch beam trawl fleet, one of the major operators in the mixed flatfish fishery in the North Sea, has shifted towards more inshore fishing grounds and a reduction in fishing effort in the more northern areas. This shift may be caused by a number of factors, such as the implementation of fishing effort restrictions, the recent increase in fuel prices, and different changes in the TACs for the two main target species plaice and sole. However, the contribution of each of these factors is yet unknown.

The environment

Adult North Sea plaice have an annual migration cycle between spawning and feeding grounds. The spawning grounds are located in the central and Southern North Sea, overlapping with the distribution area of sole. The feeding grounds are located more northerly than the sole distribution areas.

Juvenile stages are concentrated in shallow inshore waters and move gradually offshore as they become larger. The nursery areas on the eastern side of the North Sea contribute most of the total recruitment. Sub-populations have strong homing behavior to specified spawning grounds and rather low mixing rate with other sub-populations during the feeding season. Genetically, North Sea and Irish Sea plaice are weakly distinguishable from Norway, Baltic, and Bay of Biscay stocks using mitochondrial DNA.

Juvenile plaice have been distributed more offshore in recent years. Surveys in the Wadden Sea have shown that 1-group plaice is almost absent from the area where it was very abundant in earlier years. This could be linked to environmental changes in the productivity or changes in the temperature of the southern North Sea, but these links have not been shown conclusively.

Scientific basis

Data and methods

The stock assessment is based on an XSA of landings and estimated discards, calibrated with three survey indices. Commercial CPUE series are not included in the assessment model but they are used as general indicators of stock development.

Discards were included in a dual approach. For the years 1999–2004, sampled Dutch and UK discard numbers were raised by effort ratio. The weighted average of these numbers was calculated, and then raised to the total international landings. This approach was used as it incorporates all available discard data from observer sampling programmes. For the years prior to 1999, discards were reconstructed based on a model-based analysis of growth, selectivity of the 80-mm beam trawl gear, and the availability of undersized plaice on the fishing grounds.

Information from the fishing industry

The fishers' survey report was available and has been evaluated. Signals from the fishers' survey indicate that in the southern and southeastern North Sea, plaice is becoming more available. The assessment indicates that the plaice stock has more or less remained at a low level since the mid-1990s. Although the exact magnitude of the increase is difficult to derive from the fishers' survey, there does seem to be a difference in perception between the fishermen and the assessment.

Uncertainties in assessment and forecast

The assessment is considered to be uncertain. Estimates of discards are based on a few observations of two dominant fleets since 1999, and by using a reconstruction model for the years prior to 1999. The inclusion of discard estimates appears to contribute to a reduction in the retrospective bias that was previously observed in this assessment. However, the apparent reduction in bias has probably been accompanied by decreased precision.

Different trends are observed in different areas of the North Sea. Commercial CPUE series and a survey in the central part of the North Sea appear to indicate an increase in the plaice stock, whereas surveys in the southern North Sea indicate that the stock has remained at a low level.

Available tagging information suggests that Nursery grounds in the North Sea contribute around 40% to the recruits in VIId. Movements of adult plaice are also reported. Some similarities between trends in F, SSB and R between VIId and North Sea Plaice stocks suggest that the mixing between Eastern Channel and North Sea may be important for this species.

Comparison with previous assessment and advice

This year's assessment is consistent with the assessment carried out in 2004. The assessment cannot be directly compared to assessments prior to 2004 because the inclusion of discards has a large influence on both the estimates of recruitment and the mean fishing mortality.

In 2003, ICES recommended a recovery plan for plaice because the stock was perceived to be well below $\mathbf{B_{lim}}$. Recent assessments including discards have changed the perception of the stock dynamics and in 2004 ICES therefore proposed a change in the biological reference points to accommodate this perception.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Grift, R,E., Tulp, I., Clarke, L., Damm, U., McLay, A., Reeves, S., Vigneau, J., Weber, W. 2004. Assessment of the ecological effects of the Plaice Box. Report of the European Commission Expert Working Group to evaluate the Shetland and Plaice boxes. Brussels. 121 p.

Short term implications

Outlook for 2006:

Basis: Fsq =mean F(02-04) scaled=0.58: R04-05 = GM 1987-2001=914 millions: landings (2005) = 66.5: SSB(2006) = 193.2
The maximum fishing mortality which would be in accordance with precautionary limits (F (precautionary limits)) is 0.6
The fishing mortality which is consistent with taking high long-term yield and achieving low risk of depleting the productive potential of the stock (F(long term yield)) is 0.17

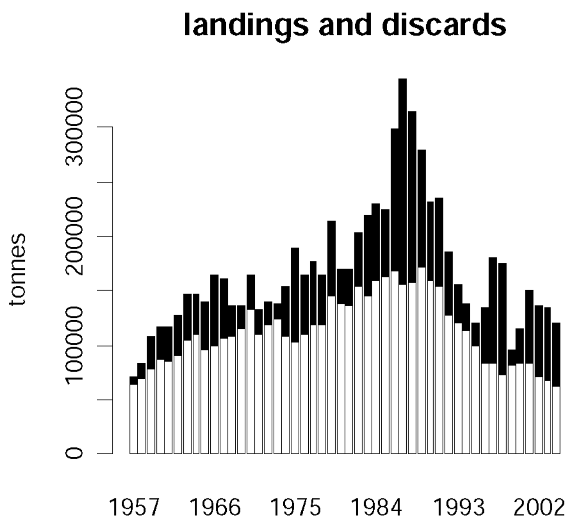
Rationale	Landings (2006)	Basis	F total (2006)	F HCons (2006)	F disc (2006)	Disc (2006)	Catch (2006)	SSB (2007)	%SSB change 1)	%TAC change 2)
Zero catch	0.0	F=0	0.00	0.00	0.00	0.0	0.0	323	67%	-100%
High long term yield	23.0	F(long term yield)	0.17	0.10	0.14	16.7	39.7	278	44%	-61%
Status quo	8.2	Fsq *0.10	0.06	0.04	0.05	6.0	14.1	307	59%	-86%
	33.5	Fsq *0.45	0.26	0.16	0.21	24.4	57.9	258	33%	-43%
	36.8	Fsq *0.50	0.29	0.18	0.23	26.9	63.6	251	30%	-38%
	48.0	Fsq *0.68	0.39	0.24	0.31	35.0	82.9	230	19%	-19%
	59.0	TACsq = Fsq *0.88	0.51	0.31	0.40	43.1	102.0	209	8%	0%
	65.0	**Fsq *1.00**	**0.58**	**0.35**	**0.46**	**47.5**	**112.4**	**197**	**2%**	**10%**
	69.8	Fsq *1.10	0.63	0.39	0.50	51.0	120.8	188	-3%	18%
	76.5	Fsq *1.25	0.72	0.44	0.57	56.0	132.4	175	-10%	30%
Precautionary limits	8.5	F(prec limits) *0.10	0.06	0.04	0.05	6.2	14.7	306	59%	-86%
	20.4	F(prec limits) *0.25	0.15	0.09	0.12	14.9	35.2	283	47%	-65%
	38.2	F(prec limits) *0.50	0.30	0.18	0.24	27.8	66.0	249	29%	-35%
	48.0	F(prec limits) *0.65	0.39	0.24	0.31	35.0	82.9	230	19%	-19%
	62.0	F(prec limits) *0.90	0.54	0.33	0.43	45.2	107.1	203	5%	5%
	67.1	**Fpa = Fsq *1.04**	**0.60**	**0.37**	**0.48**	**49.0**	**116.0**	**193**	**0%**	**14%**
	72.0	F(prec limits) *1.10	0.66	0.40	0.53	52.6	124.5	183	-5%	22%
	78.9	F(prec limits) *1.25	0.75	0.46	0.60	57.7	136.4	170	-12%	34%
	89.1	F(prec limits) *1.50	0.90	0.55	0.72	65.3	154.2	151	-22%	51%
	98.0	F(prec limits) *1.75	1.05	0.64	0.84	72.0	169.8	134	-31%	66%
	107.8	F(prec limits) *2.00	1.20	0.73	0.96	79.3	186.9	115	-41%	83%
	121.3	F(prec limits) *2.25	1.35	0.82	1.08	89.2	210.3	89	-54%	106%

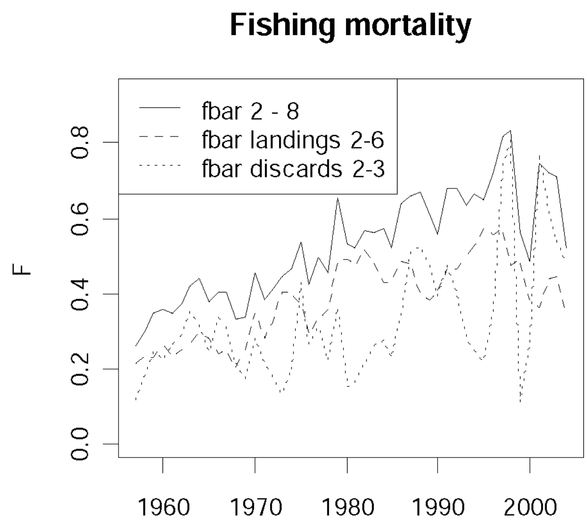
All weight in '000 tonnes
shaded scenario's not consistent with precautionary approach
1) SSB 2007 relative to SSB 2006
2) Landings 2006 relative to TAC 2005 = 59

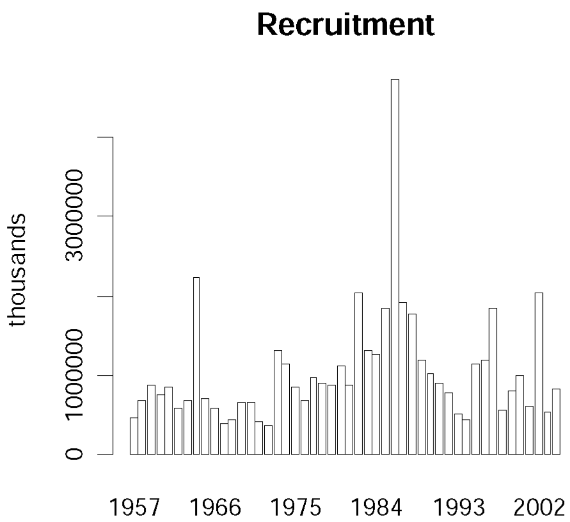
Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresponding to advice	Predicted catch corresponding to single-stock boundaries	Agreed TAC	Official landings	ACFM landings
1987	F<F(84); TAC		120		150	131	154
1988	70% of F(85); TAC		150		175	138	154
1989	Reduce F; Buffer SSB		<175		185	152	170
1990	*status quo* F; TAC		171		180	156	156
1991	No increase in F; TAC		169		175	144	148
1992	No long-term gains in increasing F		-[1]		175	123	125
1993	No long-term gains in increasing F		170[1]		175	115	117
1994	No long-term gains in increasing F		-[1]		165	110	110
1995	Significant reduction in F		87[2]		115	96	98
1996	Reduction in F of 40%		61		81	80	82
1997	Reduction in F of 20%		80		91[3]	82	83
1998	Fish at F=0.3		82		87	70	72
1999	Fish at F=0.3		106		102	79	81
2000	Fish at F=0.3		95		97	84	81
2001	Fish at F=0.26		78		78	80	82
2002	F<$\mathbf{F_{pa}}$		<77		77	70	70
2003	Fish at F=0.23		60		73	66	67
2004		Recovery plan		-	61	61	61
2005	Rebuild the SSB above $\mathbf{B}_{pa}$ in 2006		35	35	59		
2006	Rebuild the SSB above $\mathbf{B}_{pa}$ in 2007		48				

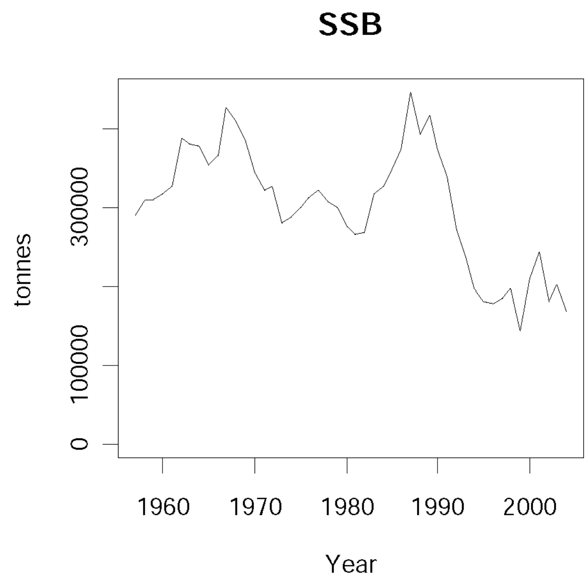
Weights in '000t.

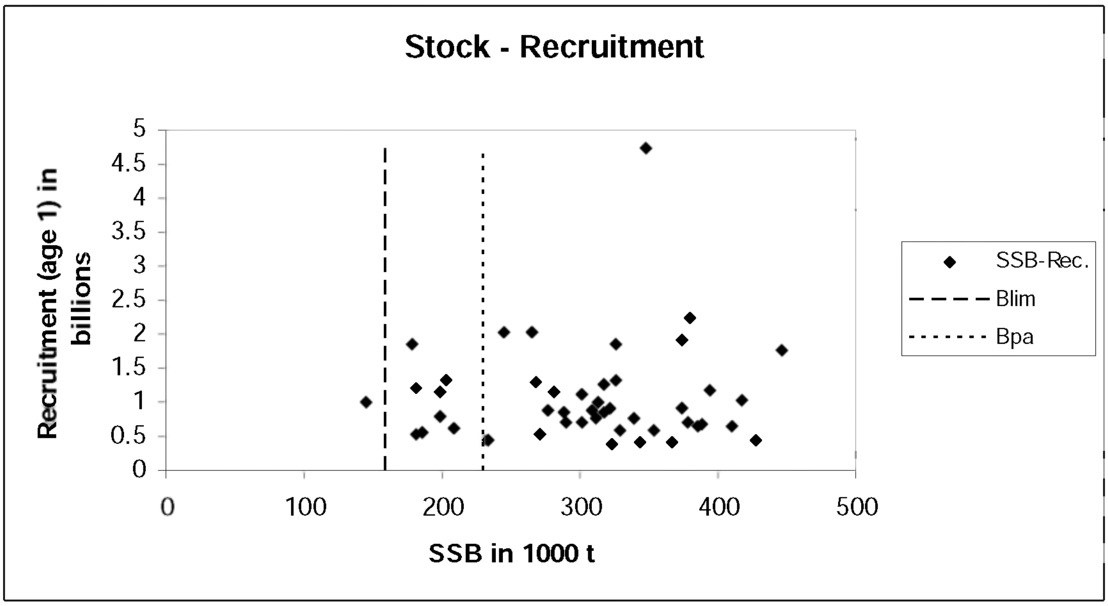
1) Catch at *status quo* F. 2) Catch at 20% reduction in F. 3) After revision from 77 000 t.


landings and discards
tonnes
0
100000
200000
300000
1957
1966
1975
1984
1993
2002


Fishing mortality
fbar 2 - 8
fbar landings 2-6
fbar discards 2-3
F
0.0
0.2
0.4
0.6
0.8
1960
1970
1980
1990
2000


Recruitment
thousands
0
1000000
3000000
1957
1966
1975
1984
1993
2002


SSB
tonnes
0
100000
300000
1960
1970
1980
1990
2000
Year


Stock - Recruitment
Recruitment (age 1) in billions
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
100
200
300
400
500
SSB in 1000 t
SSB-Rec.
Blim
Bpa

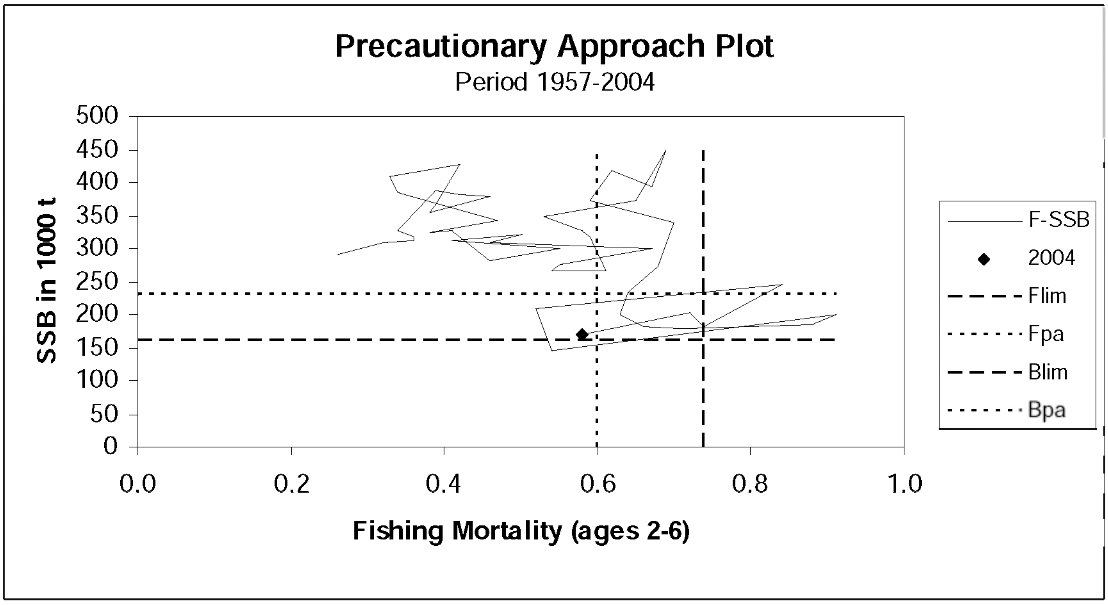

Precautionary Approach Plot
Period 1957-2004
SSB in 1000 t
500
450
400
350
300
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0
Fishing Mortality (ages 2-6)
F-SSB
2004
Flim
Fpa
Blim
Bpa

Table 1.4.7.1 North Sea plaice. Nominal landings (tonnes) in Subarea IV as officially reported to ICES and the WG estimates, 1997–2004.

YEAR	Belgium	Denmark	France	Germany	Nether-lands	Norway	Sweden	UK E/W/NI	UK Scotland	Others	Total	Unallocated	WG estimate	TAC
1980	7005	27057	711	4319	39782	15	7	18687	4345		101928	38023	139951	
1981	6346	22026	586	3449	40049	18	3	17129	4390		93996	45700	139697	105000
1982	6755	24532	1046	3626	41208	17	6	16385	4355		97930	56616	154546	140000
1983	9716	18749	1185	2397	51328	15	22	13241	4159		100812	43218	144030	164000
1984	11393	22154	604	2485	61478	16	13	12681	4172		114996	41153	156149	182000
1985	9965	28236	1010	2197	90950	23	18	11335	4577		148311	11527	159838	200000
1986	7232	26332	751	1809	74447	21	16	12428	4866		127902	37445	165347	180000
1987	8554	21597	1580	1794	76612	12	7	14891	5747		130794	22876	153670	150000
1988	11527	20259	1773	2566	77724	21	2	17613	6884	43	138412	16063	154475	175000
1989	10939	23481	2037	5341	84173	321	12	20413	5691		152408	17410	169818	185000
1990	13940	26474	1339	8747	78204	1756	169	18810	6822		156261	-21	156240	180000
1991	14328	24356	508	7926	67945	560	103	18267	9572		143565	4438	148003	175000
1992	12006	20891	537	6818	51064	836	53	21049	10228		123482	1708	125190	175000
1993	10814	16452	603	6895	48552	827	7	20586	10542		115278	1835	117113	175000
1994	7951	17056	407	5697	50289	524	6	17806	9943		109679	713	110392	165000
1995	7093	13358	442	6329	44263	527	3	15801	8594		96410	1946	98356	115000
1996	5765	11776	379	4780	35419	917	5	13541	7451		80033	1640	81673	81000
1997	5223	13940	254	4159	34143	1620	10	13789	8345		81483	1565	83048	91000
1998	5592	10087	489	2773	30541	965	2	11473	8442	1	70365	1169	71534	87000
1999	6160	13468	624	3144	37513	643	4	9743	7318		78617	2045	80662	102000
2000	7260	13408	547	4310	35030	883	3	13131	7579		82151	-1001	81150	97000
2001	6369	13797	429	4739	33290	1926	3	11025	8122		79700	2147	81847	78000
2002	4859	12552	548	3927	29081	1996	2	8504	8236		69705	512	70217	77000
2003	4570	13742	343	3800	27353	1967	2	7135	6757		65669	820	66489	73250
2004	4314	12123	231*	3649	23662	1744	1	7542	7742		61008	428	61436	61000

Table 1.4.7.2 Plaice Sub-area IV (North Sea)

	Recruit age 1	TSB	SSB	landings	discards	catch	fhc2-6	fdisc2-3	F2-6	Y/ssb	%disc_N	%disc_W
1957	460650	347310	289595	70563	7900	78463	0.21	0.12	0.26	0.24	32	10
1958	698409	374303	309305	73354	14900	88254	0.23	0.19	0.32	0.24	48	17
1959	870209	405403	310943	79300	29961	109261	0.23	0.24	0.36	0.26	63	27
1960	758653	420242	318039	87541	29642	117183	0.26	0.23	0.36	0.28	58	25
1961	864419	433918	328458	85984	32431	118415	0.23	0.27	0.34	0.26	62	27
1962	591497	481391	388941	87472	37736	125208	0.25	0.29	0.39	0.22	62	30
1963	689152	476922	380355	107118	41273	148391	0.26	0.35	0.42	0.28	61	28
1964	2237755	495310	378357	110540	36871	147411	0.3	0.32	0.46	0.29	55	25
1965	699828	474713	353602	97143	42728	139871	0.28	0.25	0.38	0.27	70	31
1966	591142	503784	367138	101834	65485	167319	0.24	0.33	0.39	0.28	71	39
1967	403510	499373	427491	108819	54159	162978	0.25	0.32	0.42	0.25	61	33
1968	433664	478991	409729	111534	27990	139524	0.21	0.22	0.33	0.27	48	20
1969	650729	465439	386051	121651	21194	142845	0.24	0.17	0.34	0.32	41	15
1970	651801	430382	343555	130342	30520	160862	0.35	0.28	0.47	0.38	50	19
1971	411090	409218	323138	113944	23030	136974	0.28	0.22	0.38	0.35	48	17
1972	367677	406557	326691	122843	19671	142514	0.32	0.18	0.41	0.38	40	14
1973	1314405	370854	280551	130429	13408	143837	0.41	0.13	0.46	0.46	41	9
1974	1135886	419914	288974	112540	45267	157807	0.4	0.2	0.49	0.39	70	29
1975	867139	478496	300976	108536	86809	195345	0.37	0.43	0.55	0.36	77	44
1976	692949	470614	312539	113670	53332	167002	0.29	0.26	0.41	0.36	61	32
1977	987569	474988	322362	119188	57573	176761	0.33	0.31	0.5	0.37	63	33
1978	911346	459519	308364	113984	45816	159800	0.36	0.22	0.46	0.37	60	29
1979	891156	462836	301424	145347	68075	213422	0.48	0.36	0.67	0.48	62	32
1980	1128414	419792	276339	139951	31183	171134	0.49	0.16	0.55	0.51	50	18
1981	870249	394861	265234	139747	32734	172481	0.47	0.16	0.54	0.53	48	19
1982	2032996	469630	267914	154547	49945	204492	0.52	0.22	0.61	0.58	61	24
1983	1306992	513888	317007	144038	73948	217986	0.48	0.26	0.59	0.45	65	34
1984	1259596	536190	326374	156147	70522	226669	0.43	0.28	0.58	0.48	60	31
1985	1850266	559097	347348	159838	60892	220730	0.43	0.23	0.53	0.46	59	28
1986	4736957	727924	373808	165347	131038	296385	0.48	0.34	0.65	0.44	79	44
1987	1922902	749205	447054	153670	189493	343163	0.48	0.51	0.69	0.34	82	55
1988	1772259	664546	394289	154475	157360	311835	0.4	0.53	0.67	0.39	77	50
1989	1185701	596075	417500	169818	107648	277466	0.38	0.47	0.62	0.41	67	39
1990	1035258	528835	373942	156240	72355	228595	0.4	0.39	0.59	0.42	58	32
1991	911293	485110	339040	148004	81556	229560	0.46	0.47	0.7	0.44	61	36
1992	773844	388856	271499	125190	58180	183370	0.46	0.4	0.68	0.46	58	32
1993	524073	330603	233602	117113	35120	152233	0.5	0.28	0.64	0.5	48	23
1994	436686	284881	199125	110392	24000	134392	0.52	0.25	0.63	0.55	38	18
1995	1155106	292041	180977	98356	22094	120450	0.57	0.22	0.66	0.54	44	18
1996	1206464	307591	178152	81673	52123	133796	0.56	0.35	0.71	0.46	68	39
1997	1842940	348689	185503	83048	96909	179957	0.57	0.74	0.88	0.45	79	54
1998	569882	321073	198799	71534	103414	174948	0.47	0.81	0.91	0.36	84	59
1999	799079	257948	145232	80662	14385	95047	0.49	0.11	0.54	0.56	35	15
2000	997139	324719	209194	81148	31624	112772	0.38	0.26	0.52	0.39	61	28
2001	609982	376799	244631	81963	67467	149430	0.36	0.77	0.84	0.34	75	45
2002	2038954	346502	180806	70217	64499	134716	0.44	0.61	0.74	0.39	79	48
2003	530432	343198	202391	66502	67336	133838	0.45	0.54	0.72	0.33	82	50
2004	822000	317747	169225	61436	58689	120125	0.35	0.48	0.58	0.36	75	49
2005	914000		205000									

1) 2004 recruitment: RCT3

2) 2005 recruitment: GM 1957-2002

1.4.8 Plaice in Division VIId (Eastern Channel)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	Divergent perception between catch-at-age based and survey-based analyses

The state of the stock cannot be assessed due to discrepancies in the available data. The most recent estimates have shown a divergent perception of the historical trends between the catch-at-age based analyses and the survey-based analyses. This divergence seriously affects the trends of the last 5 years, leading to an uncertain assessment of the state of the stock. Possible stock identification problems may contribute to divergence between catch and survey data.

Management objectives

There are no explicit management objectives for this stock.

Reference points

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ = 5 600 t	$\mathbf{B_{pa}}$ = 8 000 t.
$\mathbf{F_{lim}}$ = 0.54	$\mathbf{F_{pa}}$ = 0.45.

Technical basis

$\mathbf{B_{lim}} \sim \mathbf{B_{loss}}$ (= 5 584 t)	$\mathbf{B_{pa}}$= 1.4 $\mathbf{B_{lim}}$.
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$	$\mathbf{F_{pa}}$= 5th percentile of $\mathbf{F_{loss}}$; long-term SSB >$\mathbf{B_{pa}}$ and P(SSB_{MT}<$\mathbf{B_{pa}}$) < 10 %

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

No short-term forecasts can be provided. There is conflicting information; some information suggests that the stock is stable and some information suggests that the stock is declining; as a minimum measure there should be no increase in effort.

Management considerations

The plaice stock in VIId is mostly harvested in a mixed fishery with sole. Even if there exists a directed fishery on plaice that occurs in a limited period at the beginning of the year on the spawning grounds, plaice is mainly taken as bycatch by the demersal fisheries, especially targeting sole.

Due to the minimum mesh size (80 mm) in the mixed beam trawl fishery, a large number of undersized plaice are discarded. The 80-mm mesh size is not matched to the minimum landing size of plaice (27 cm). Measures taken specifically to sole fisheries will impact the plaice fisheries.

Factors affecting the fisheries and the stock

The effects of regulations

The minimum landing size for plaice is 27 cm. Demersal gears permitted to catch plaice are 80 mm for beam trawling and otter trawling. Fixed nets are required to use 100-mm mesh since 2002 although an exemption to permit 90 mm has been in force since that time.

An EU regulation that was enforced in 2004 is a limit of 22 days at sea per month for trawlers with mesh size less than 99 mm, 14 days at sea for beam trawlers, and gillnetters have a derogation of 20 days at sea in the Eastern Channel provided that their mesh size is less than 110 mm.

Scientific basis

Data and methods

The assessment is based on reported landings data, three commercial CPUE indices, and three survey indices. Time-series of discard data are not available, but French observations from 2003 indicate that discards are high.

Information from the fishing industry

The fishing industry has provided information which has been included in considerations of assessments. Such information has contributed to the understanding of the fisheries, also in cases where information has not been in a form which enables direct inclusion in quantitative assessments.

Uncertainties in assessment and forecast

The updated formulation as used in the 2004 assessment exhibited patterns in the residuals, trends in the index-specific catchabilities, and a retrospective problem. These may be associated with a lack of discarding information, use of commercial catch rate indices, and stock identification problems.

There is some uncertainty about the stock structure in VIId Plaice. Historical tagging information show that around 40% of the juvenile plaice in VIId come from nursery grounds in the North Sea, while the Eastern Channel supplies very few recruits to the North Sea. Similarly, around 20% of the recruits in VIIe come from VIId, while VIId does not receive significant numbers of juvenile from VIIe. There is also an adult migration between the North Sea and the Channel with 20-30% of the plaice caught in the winter in VIId were from migratory North Sea fish. The available information also suggests that plaice may migrate from the VIIe into the VIId and the North Sea after spawning.

Comparison with previous assessment and advice

The assessment was considered unreliable due to the conflicting signals of data.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES Advice	Single-stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock	Agreed TAC[1]	Official landings	ACFM landings
1987	Precautionary TAC[1]		6.8[1]		8.3	7.9	8.4
1988	Precautionary TAC[1]		6.9[1]		9.96	9.1	10.4
1989	No increase in effort[1]		11.7[1]		11.7	6.7[2]	8.8
1990	No increase in F; TAC		10.7[1]		10.7	7.8[2]	9.0
1991	TAC		8.8[1]		10.7	7.4[2]	7.8
1992	*Status quo* F gives mean SSB		7.6[3]		9.6	6.2	6.3
1993	Within safe biological limits		6.4[3]		8.5	4.8	5.3
1994	No long-term gains in increased F		-		9.1	5.6	6.1
1995	No increase in F		5.6		8.0	4.6	5.1
1996	No long-term gains in increasing F		6.5		7.53	4.6	5.4
1997	No advice		-		7.09	5.3	6.3
1998	Reduce F in 98 by 30% from 96 value		4.3		5.7	4.8	5.8
1999	Fishing at $\mathbf{F}_{pa}$		6.3		7.4	5.4	6.3
2000	Fishing at $\mathbf{F}_{pa}$		4.9		6.5	5.2	6.0
2001	Fishing at $<\mathbf{F}_{pa}$		<4.4		6.0	5.0	5.3
2002	Fishing at $<\mathbf{F}_{pa}$		<5.8		6.7	5.5	5.8
2003	Fishing at $<\mathbf{F}_{pa}$		<5.3		6.0	4.5	
2004	*)	Fishing at $<\mathbf{F}_{pa}$	*)	<5.4	6.06	4.0	
2005		Fishing at $<\mathbf{F}_{\mathbf{pa}}$		<4.4	5.15		
2006		No effort increase					

[1]TACs for Divisions VIId,e. [2]For France Division VIId landings are estimated by ICES from combined VIId,e landings.
[3]Catch at *status quo* F. Weights in '000 t.
*) Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.

Plaice in Division VIId (Eastern Channel).

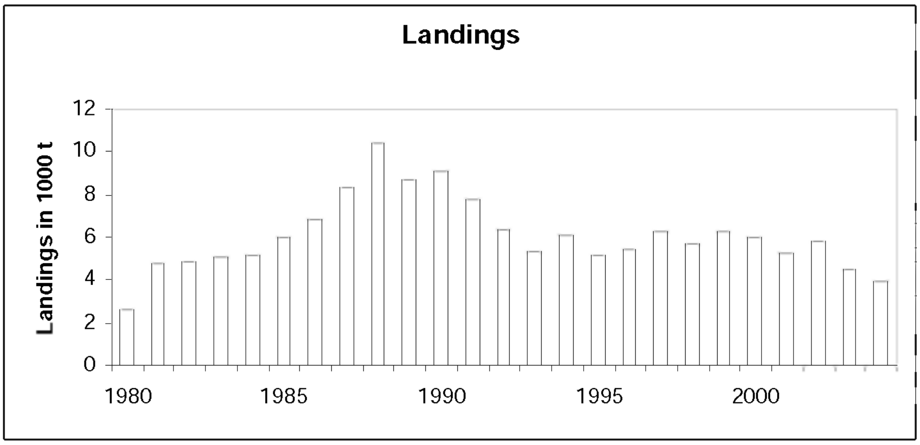


Table 1.4.8.1 Plaice in Division VIId. Nominal landings (tonnes) as officially reported to ICES, 1976–2003.

Year	Belgium	Denmark	France	UK(E+W)	Others	Total reported	Un-allocated	Total as used by WG
1976	147	1(1)	1439	376	-	1963	-	1963
1977	149	81(2)	1714	302	-	2246	-	2246
1978	161	156(2)	1810	349	-	2476	-	2476
1979	217	28(2)	2094	278	-	2617	-	2617
1980	435	112(2)	2905	304	-	3756	-1106	2650
1981	815	-	3431	489	-	4735	34	4769
1982	738	-	3504	541	22	4805	60	4865
1983	1013	-	3119	548	-	4680	363	5043
1984	947	-	2844	640	-	4431	730	5161
1985	1148	-	3943	866	-	5957	65	6022
1986	1158	-	3288	828	488 (2)	5762	1072	6834
1987	1807	-	4768	1292	-	7867	499	8366
1988	2165	-	5688 (2)	1250	-	9103	1317	10420
1989	2019	+	3265 (1)	1383	-	6667	2091	8758
1990	2149	-	4170 (1)	1479	-	7798	1249	9047
1991	2265	-	3606 (1)	1566	-	7437	376	7813
1992	1560	1	3099	1553	19	6232	105	6337
1993	877	+(2)	2792	1075	27	4771	560	5331
1994	1418	+	3199	993	23	5633	488	6121
1995	1157	-	2598 (2)	796	18	4569	561	5130
1996	1112	-	2630 (2)	856	+	4598	795	5393
1997	1161	-	3077	1078	+	5316	991	6307
1998	854	-	3276 (23)	700	+	4830	932	5762
1999	1306	-	3259 (23)	743	+	5437	889	6326
2000	1298	-	3183	752	+	5233	781	6014
2001	1346	-	2962	655	+	4963	303	5266
2002	1204	-	3454	841		5499	278	5777
2003	995	-	2783 (3)	756		4536	-	4536
2004	987	-	2439(4)	580	-	4007	-	4007

1 Estimated by the Working Group from combined Division VIId+e
2 Includes Division VIIe
3 Preliminary
4 Data provided to the WG but not officially provided to ICES

Table 1.4.8.2 Plaice in Division VIId (Eastern Channel).

Year	Landings tonnes
1980	2650
1981	4769
1982	4865
1983	5043
1984	5161
1985	6022
1986	6834
1987	8366
1988	10420
1989	8758
1990	9047
1991	7813
1992	6337
1993	5331
1994	6121
1995	5130
1996	5393
1997	6307
1998	5762
1999	6326
2000	6015
2001	5266
2002	5777
2003	4536
2004	3947
Average	6080

1.4.9 Sole in Division IIIa (Skagerrak and Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield		Comment
Full reproductive capacity	Likely sustainably exploited	Unknown		

Based on the most recent estimates of SSB, ICES classifies the stock as having full reproductive capacity. The assessment is uncertain due to substantial discarding and non-reporting in the most recent years. While the SSB estimate is relatively robust against this, the fishing mortality estimate in the most recent year is uncertain, but available information indicates sustainable exploitation.

Management objectives

There are no management objectives for this stock. However, for any management criteria to meet the proposed precautionary criteria F should be less than the proposed $\mathbf{F}_{pa}$ and the SSB should be maintained above the proposed $\mathbf{B}_{pa}$.

Reference points

	ICES considers that:	ICES proposed that:
Limit reference points	$\mathbf{B}_{lim}$ is 770 t	$\mathbf{B}_{pa}$ be set at 1060 t
	$\mathbf{F}_{lim}$ is 0.47	$\mathbf{F}_{pa}$ be set at 0.30
Target reference points		**N/A**

The assessment has revised the level of SSB considerably for the last 5 years. Because of this, previously defined biomass related reference points need to be re-evaluated.

Technical basis:

$\mathbf{B}_{lim}$: $\mathbf{B}_{pa}$*exp(-1.645*0.2)	$\mathbf{B}_{pa}$: MBAL
$\mathbf{F}_{lim}$: $\mathbf{F}_{med}$ 98 excluding the abnormal years around 1990	$\mathbf{F}_{pa}$: consistent with $\mathbf{F}_{lim}$

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Given the uncertainties in the assessment regarding non-reporting and discarding in recent years, ICES advises a TAC for 2006 not higher than the TAC for 2005, even though SSB is estimated much higher than $\mathbf{B}_{pa}$. The estimate of the present (*status quo*) fishing mortality is uncertain, but *status quo* fishing mortality is probably at or below $\mathbf{F}_{pa}$. It is thus not considered precautionary to increase the fishing mortality above *status quo* irrespective of the actual estimate.

Short-term implications

Outlook for 2006

On the basis of ICES advice in May 2005 the European Community has set a TAC at 900 t for 2005. This TAC includes both area IIIa and Divisions IIIbcd. Given the uncertainties in catches it is not possible to quantify exactly the historical contributions from Divisions IIIbcd, but official statistics, from 2002 to 2004 indicate that 5–18% of the TAC was taken outside IIIa.

A short-term forecast using F *status quo* for 2005 predicts a catch of 805 t in 2005. This catch is for area IIIa only, but seems consistent with a TAC of 900 t for the whole of Subarea III.

Basis: F(2005) = $\mathbf{F}_{sq}$(2004) catch (2005) = 805 t[1)] ; SSB(2005) = 4621 t.

2006					2007	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
5163	4488	0	0.000	0	5732	5057
.	4393	0.1	0.020	91	5643	4968
.	4393	0.2	0.040	179	5557	4882
.	4393	0.3	0.060	266	5472	4797
.	4393	0.4	0.081	351	5389	4714
.	4393	0.5	0.101	434	5308	4633
.	4393	0.6	0.121	515	5228	4553
.	4393	0.7	0.141	594	5150	4475
.	4393	0.8	0.161	672	5074	4399
.	4393	0.9	0.181	748	4999	4324
.	4393	1	0.202	823	4926	4251
.	4393	1.1	0.222	896	4854	4180
.	4393	1.2	0.242	967	4784	4109
.	4393	1.3	0.262	1037	4716	4041
.	4393	1.4	0.282	1105	4648	3973
.	4393	1.5	0.302	1172	4582	3907
.	4393	1.6	0.323	1238	4518	3843
.	4393	1.7	0.343	1302	4454	3780
.	4393	1.8	0.363	1365	4392	3718
.	4393	1.9	0.383	1427	4332	3657
.	4393	2	0.403	1487	4272	3597

Shaded scenarios are not considered consistent with the Precautionary Approach.
[1)] Catch includes reported landings plus an overall estimate of non-reporting and discarding of legal-sized sole of 100% in 2004. The TAC was set mid-2005 by the EU-Commission.

Status quo fishing mortality gives a catch of 823 t for Division IIIa. This value is consistent with a TAC of 900 t for the areas IIIa and IIIbcd combined.

Management considerations

Due to considerable non-reporting, discarding of fish above minimum landing size caused by restrictive quotas since 2002 and, to a lesser extent misreporting to other species in recent years, the assessment is considered uncertain in relation to the estimate of F in the final year. The forecast presented is based on the best available information from the industry and inspection regarding non-reporting and discards in 2002, 2003, and 2004, but this information is by its nature uncertain. The sensitivity of the assessment and the forecasts to assumptions regarding non-reporting and discarding has been evaluated for a range of likely scenarios. SSB estimates are more stable against such assumptions, but estimates of recent fishing mortalities and thus the projected catches in future years are not.

The estimate of fishing mortality at present is uncertain and the fishing mortality is likely to be at or below $\mathbf{F}_{pa}$. In order to avoid fishing at a fishing mortality above $\mathbf{F}_{pa}$ ICES therefore advises that single-stock boundaries for fishing mortality should be below *status quo* fishing mortality in 2004.

The North Sea RAC has proposed that the entire fishery in Kattegat should be managed by an effort regulation in 2006. The format for an effort regulation in Kattegat is to be discussed during the autumn 2005.

Sole is taken in a directed trawl fishery with bycatch of *Nephrops* and cod. Also, sole is taken as bycatch in the *Nephrops* trawl fishery. There is a directed gillnet fishery for sole catches. TAC for sole in 2006 should be set taking into account the status of the Kattegat cod stock, for which ICES advises no fishery in 2006.

Management plan evaluations

There is no management plan in place.

The effects of regulations

The Danish fishery is regulated by half-month rations that depend on vessel length and vary over the year. The rations have been reduced since 2002 reflecting the decline in the agreed TAC, and the Danish sole fishery was entirely closed late in the years 2002, 2003, and 2004.

For the period 1991–1993 the precision of the official catch statistics is disputable. It is assumed that there are significant amounts of sole landed without being properly recorded. For Kattegat where most of the sole catches in 1994–2000 were taken under an effort regime, the official statistics are assumed to be fairly accurate. Considerable misreporting by areas in 2000 and 2001 was corrected by ICES for assessment purposes, i.e. North Sea sole reported as caught in Div. IIIa.

Analyses of private logbooks, survey data, and observer data indicate that in 2002–2004 there was considerable economic incentive to land sole without reporting it, as the entire two-week ration in many cases could be taken in just a few hauls. However, it is not known to what extent these catches were discarded or landed as black landings (i.e. without providing both catch and effort data to the official statistics), or distributed to and landed by vessels not having caught their rations. Thus, this information could not be used to quantify discarding and/or non-reporting.

Based on information from the industry non-reporting and discarding is believed to be in the order of magnitude of 50% in 2002 and 100% in 2003 and 2004. Although the advice on the stock status is robust to the assumptions, unreported catches in this order of magnitude have a severe impact on the quality of the stock assessment through the estimate of *status quo* F and need to be quantified properly.

There is a mis-match between the assessment area that is Div. IIIa and the management area that includes Div. IIIa plus the Western Baltic (SD 22–24). Danish vessel rations cover the management area and there are therefore no incentives for misreporting IIIa sole into the Western Baltic.

Factors affecting the fisheries and the stock

Changes in fishing technology and fishing pattern

Sole are caught with both gillnet and trawl. The peak season for trawl is from October to January. On average more than 75% of the annual sole catches with trawl are caught in this 4-month season. However, September and February are important months for the sole fishery also, but the percentage of sole in the catches is significantly less, indicating that there might be other target species in these periods. The season for sole gillnet fishery is from April to September.

The environment

The stock is probably influenced by both temperature and salinity because it is located near the physiological limits of the species for both of these factors. Large variations in either factor will therefore influence stock productivity.

The large increase in landings in the early 1990s compared to long-term historical levels (1950s–1980s) may represent both changes in environmental conditions and fishery developments (e. g., increased effort), but the relative importance of the two factors is not known.

The Kattegat has also been eutrophicated over the past 50 years, but the specific effects of eutrophication on sole have not been investigated.

Scientific basis

Data and methods

The assessment includes CPUE data from seven commercial CPUE series (not previously included in the assessment) and one CPUE series from a Danish scientific trawl survey in quarter 4. Four of the commercial series were based on data from private logbooks (6 trawlers and 3 gillnetters and 2 area combinations) and three of the series based on official logbooks from fisheries outside the main sole fishing seasons when rations were not restrictive (small and large trawlers as well as gillnetters). Assessment results were robust to various combinations of CPUE fleets. As in previous years, the quarter 1 IBTS survey was not used in the assessment, due to their low signal to noise ratio. This is consistent with the practice in the assessment of the North Sea sole, where similarly IBTS indices are not used in the assessment.

The available data from discard sampling is insufficient to be used directly in the assessment. Overall estimates of non-reporting and discarding have been used in the assessment based on information from the industry and from control and enforcement; see the sections on management considerations above and information from the industry below.

Uncertainties in assessment and forecast

The assessment is considered highly uncertain in relation to the estimates of F in the final year, while SSB estimates are more stable to assumed levels of unreported catches.

Due to a closure in the fisheries in the 4th quarter of 2002 to 2004, the commercial data matrix is biased and does not well reflect the strength of the incoming recruitment at the end of the year.

Information from the fishing industry

Collaboration between the Danish Fishermen's Organisation and DIFRES was initiated in 2004 to establish a database with data from private logbooks. Data from 6 trawlers and 3 gillnetters covering the time period 1987 to 2004 were available for the assessment.

The industry provided information on the likely order of magnitude of discarding and non-reporting in 2002-2004.

Comparison with previous assessment and advice

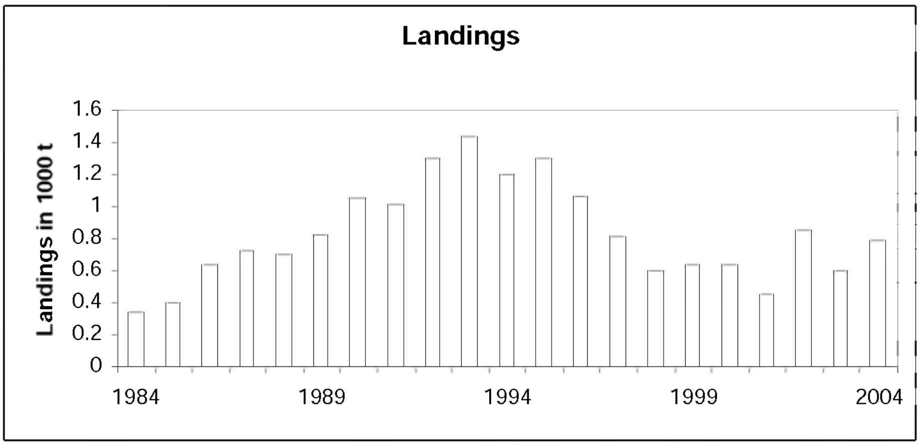
New data (CPUE series based on private and official logbooks and estimates of non-reporting and discards of legal-sized sole in recent years) have been compiled to supplement the data formerly available for the assessment. The assessment includes new CPUE series from private and official logbooks and catch data including an estimate of discard and non-reporting. This assessment revises the perception of the stock in the most recent years and indicates an increasing trend in SSB and decreasing F since the late 1990s. Previous advice was based on a perception of the stock, which was close to $\mathbf{B}_{pa}$ and fished around $\mathbf{F}_{pa}$.

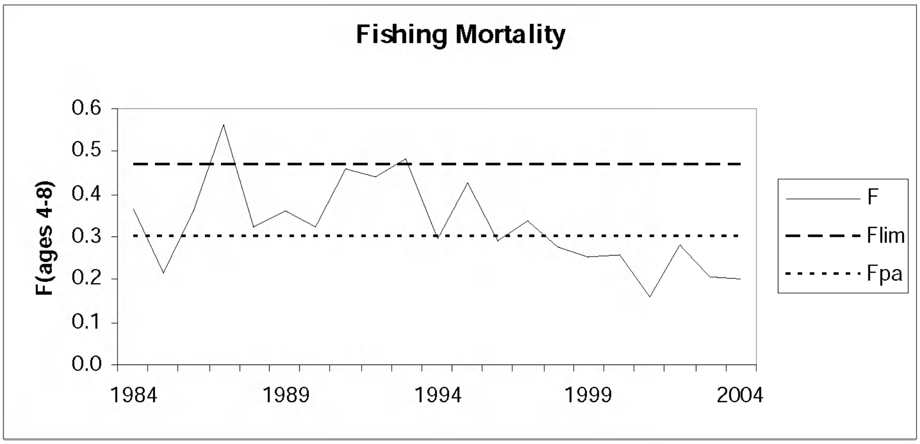
Source of information

Report of the Baltic Fisheries Assessment Working Group. Hamburg, 12 – 21 April 2005. ICES CM 2005/ACFM:19.

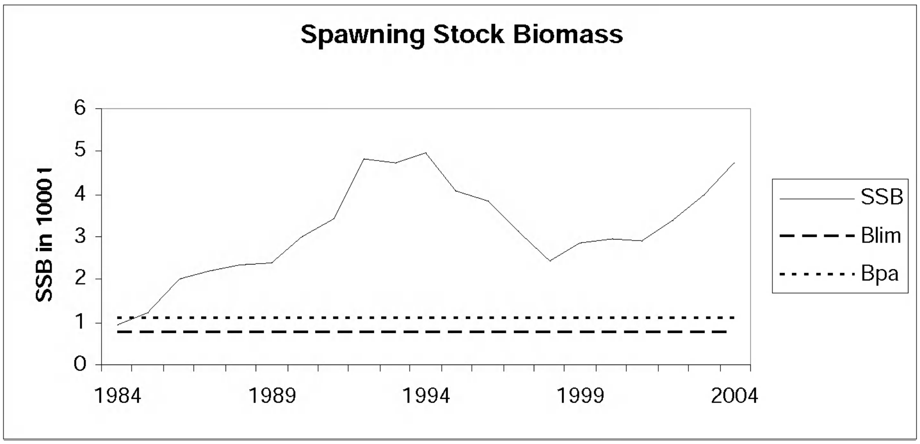
Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC	ACFM Catch
1987	-		-		0.85	0.72
1988	-		-		0.95	0.71
1989	TAC		<0.8		0.80	0.82
1990	Precautionary TAC		0.6		0.50	1.05
1991	TAC		1.0		1.00	-[1]
1992	TAC		1.0		1.40	-[1]
1993	TAC at recent catch levels		1.0		1.60	-[1]
1994	No advice due to uncertain catches		-		2.10	1.20
1995	No advice		-		2.25	1.30
1996	No advice		-		2.25	1.10
1997	No advice		-		2.25	0.81
1998	No advice		-		1.80	0.61
1999	No increase in F		0.8		1.35	0.64
2000	No increase in F		0.65		0.95	0.63
2001	No increase in F		0.7		0.70	0.46
2002	F below $\mathbf{F}_{pa}$		0.5		0.50	0.84[2]
2003	F below $\mathbf{F}_{pa}$		0.3		0.35	0.60[3]
2004	F below $\mathbf{F}_{pa}$		0.5		0.52	0.78[3]
2005	No increase in F		-		0.90	
2006	No increase in F	TAC at 900 t	0.9			

Weights in '000 t.
[1] Uncertain. [2] 50% non-reporting/discarding assumed. [3] 100% non-reporting/discarding assumed.


Landings
Landings in 1000 t
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1984
1989
1994
1999
2004


Fishing Mortality
F(ages 4-8)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1984
1989
1994
1999
2004
F
Flim
Fpa


Recruitment (age 2)
Recruitment in millions
10
8
6
4
2
0
1984
1989
1994
1999
2004


Spawning Stock Biomass
SSB in 1000 t
6
5
4
3
2
1
0
1984
1989
1994
1999
2004
SSB
Blim
Bpa

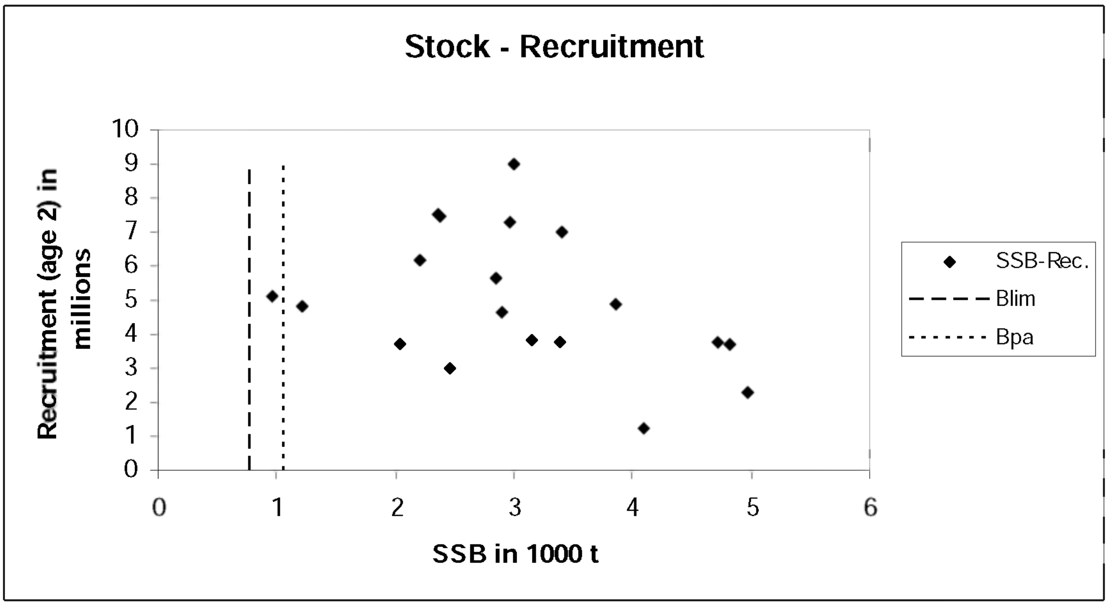

Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4
5
6

Table 1.4.9.1 **Sole in Division IIIa**. Catches (tonnes) in the Kattegat and Skagerrak 1952–2004. Official statistics and Working Group corrections. Danish catches are given for Kattegat and Skagerrak combined 1952–1969. For Sweden there is no information 1962–1974.

Year	Denmark		Sweden	Germany	Belgium	Netherlands	Working Group	Total
	Kattegat	Skagerrak	Skag+Kat	Kat+Skag	Skagerrak	Skagerrak	Corrections	
1952	156		51	59				266
1953	159		48	42				249
1954	177		43	34				254
1955	152		36	35				223
1956	168		30	57				255
1957	265		29	53				347
1958	226		35	56				317
1959	222		30	44				296
1960	294		24	83				401
1961	339		30	61				430
1962	356			58				414
1963	338			27				365
1964	376			45				421
1965	324			50				374
1966	312			20				332
1967	429			26				455
1968	290			16				306
1969	261			7				268
1970	158	25						183
1971	242	32		9				283
1972	327	31		12				370
1973	260	52		13				325
1974	388	39		9				436
1975	381	55	16	16		9	-9	468
1976	367	34	11	21	2	155	-155	435
1977	400	91	13	8	1	276	-276	513
1978	336	141	9	9		141	-141	495
1979	301	57	8	6	1	84	-84	373
1980	228	73	9	12	2	5	-5	324
1981	199	59	7	16	1			282
1982	147	52	4	8	1	1	-1	212
1983	180	70	11	15		31	-31	276
1984	235	76	13	13		54	-54	337
1985	275	102	19	1	+	132	-132	397
1986	456	158	26	1	2	109	-109	643
1987	564	137	19		2	70	-70	722
1988	540	138	24		4			706
1989	578	217	21	7	1			824
1990	464	128	29	-	2		+427	1050
1991	746	216	38	+			+11	1011[1]
1992	856	372	54				+12	1294[1]
1993	1016	355	68	9			-9	1439[1]
1994	890	296	12	4			-4	1198
1995	850	382	65	6			-6	1297
1996	784	203	57	612			-597	1059
1997	560	200	52	2				814
1998	367	145	90	3				605
1999	431	158	45	3				637
2000	399	320	34	11			-132[2]	633[2]
2001[1]	249	286	25				-103[2]	455[2]
2002	360	177	15	11			+281[3]	844[3]
2003	195	77	11	17			+301[4]	602[4]
2004	249	109	16	18			+392[4]	784[4]

[1]Considerable non-reporting assumed for the period 1991–1993. [2]Catches from Skagerrak were reduced by these amounts because of misreporting from the North Sea. The subtracted amount has been added to the North Sea sole catches. Total landings for these years in IIIA have been reduced by the amount of misreporting. [3] 50% non-reporting/discarding assumed. [4] 100% non-reporting/discarding assumed.

Table 1.4.9.2 **Sole in Division IIIa**. Summary output files from run based on assumptions regarding discarding and non-reporting as indicated in Table 1.4.4.9.1.

Summary (without SOP correction)
Terminal Fs derived using XSA (With F shrinkage to 1.5)

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 4- 8
	Age 2					
1984	3070	1520	958	337	0.3516	0.366
1985	6018	2263	1216	397	0.3266	0.215
1986	5092	2880	2039	643	0.3153	0.359
1987	4808	2978	2209	722	0.3269	0.562
1988	3692	2939	2352	706	0.3001	0.322
1989	6177	3470	2383	824	0.3458	0.359
1990	7550	4356	2997	1050	0.3503	0.324
1991	7460	4701	3403	1011	0.2971	0.462
1992	9005	6730	4812	1294	0.2689	0.440
1993	7018	5976	4726	1439	0.3045	0.484
1994	3690	5618	4976	1198	0.2407	0.296
1995	3743	4798	4098	1297	0.3165	0.425
1996	2291	4261	3858	1059	0.2745	0.290
1997	1264	3409	3159	814	0.2577	0.339
1998	4873	3241	2456	605	0.2463	0.277
1999	3800	3467	2851	638	0.2238	0.252
2000	2979	3463	2959	633	0.2139	0.256
2001	5663	3935	2893	455	0.1573	0.157
2002	7322	4658	3391	845	0.2492	0.281
2003	4619	4791	3982	600	0.1507	0.208
2004	3745	5481	4714	784	0.1659	0.202
Arith. Mean	4947	4045	3164	826	0.2706	0.327
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

1.4.10 Sole in Subarea IV (North Sea)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	Harvested sustainably	Overexploited	

Based on the most recent estimate of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity, and as being harvested sustainably. SSB in 2005 was estimated at 41 000 t which is above $\mathbf{B}_{pa}$ (35 000 t), while F in 2004 (0.35) is at or near $\mathbf{F}_{pa}$. The 2001 year class is estimated to be strong, but the 2002 and subsequent year classes are relatively weak.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{B}_{lim}$ = 25 000 t	$\mathbf{B}_{pa}$ = 35 000 t
	$\mathbf{F}_{lim}$ is undefined	$\mathbf{F}_{pa}$ = 0.4.
Target reference points		$\mathbf{F}_{y}$ = undefined

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 2-6	Yield/R	SSB/R
Average last 3 years	0.479	0.171	0.336
$\mathbf{F}_{0.1}$	0.133	0.153	1.151
$\mathbf{F}_{med}$	0.380	0.172	0.427

Candidates for reference points which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $\mathbf{F}_{0.1}$-$\mathbf{F}_{max}$.

Technical basis

$\mathbf{B}_{lim}$=$\mathbf{B}_{loss}$=25 000 t.	$\mathbf{B}_{pa}$ = 1.4 *$\mathbf{B}_{lim}$.
$\mathbf{F}_{lim}$: undefined	$\mathbf{F}_{pa}$ = 0.4 implies $\mathbf{B}_{eq} > \mathbf{B}_{pa}$ and P($\mathbf{SSB}_{MT} < \mathbf{B}_{pa}$) < 10%.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The current fishing mortality ($\mathbf{F}_{sq}$) is estimated at 0.35, which is above the rate that would lead to high long-term yields. $\mathbf{F}_{max}$ is not well defined and $\mathbf{F}_{0.1}$ is 0.13. Fishing at $\mathbf{F}_{0.1}$ is expected to lead to landings in 2006 of 5 600 t and SSB in 2007 of around 41 300 t.

Exploitation boundaries in relation to precautionary limits

The exploitation boundaries in relation to precautionary limits imply landings of less than 11 900 t in 2006, which is expected to lead to an SSB equal to $\mathbf{B}_{pa}$ (=35 000 t) in 2007.

Short-term implications

Outlook for 2006

Basis: $\mathbf{F}_{sq}$ =mean F(02-04) scaled=0.35; landings (2005) = 14.9; SSB(2006) = 37.

Rationale	Landings (2006)	Basis	F total (2006)	SSB (2007)	%SSB change 1)	%TAC change 2)
Zero catch	0.0	F=0	0.00	46.8	27%	-100%
High long term yield	5.6	F(long term yield)	0.13	41.3	12%	-70%
Status quo	1.6	Fsq *0.1	0.04	45.2	22%	-91%
	6.7	Fsq *0.45	0.16	40.1	9%	-64%
	7.4	Fsq *0.5	0.18	39.5	7%	-60%
	10.6	Fsq *0.75	0.26	36.3	-2%	-43%
	11.9	F(sq) * 0.86	0.30	35.0	-5%	-36%
	12.4	Fsq *0.9	0.32	34.5	-7%	-33%
	13.6	**Fsq *1**	**0.35**	**33.4**	**-10%**	**-27%**
	14.7	Fsq *1.1	0.39	32.3	-13%	-21%
	16.3	Fsq *1.25	0.44	30.7	-17%	-13%
Precautionary limits	1.8	F(prec limits) *0.1	0.04	45.0	22%	-90%
	4.4	F(prec limits) *0.25	0.10	42.5	15%	-76%
	8.3	F(prec limits) *0.5	0.20	38.6	4%	-55%
	11.9	F(prec limits) *0.75	0.30	35.0	-5%	-36%
	13.9	F(prec limits) *0.9	0.36	33.1	-11%	-26%
	15.1	**Fpa = Fsq *1.14**	**0.40**	**31.9**	**-14%**	**-19%**
	16.3	F(prec limits) *1.1	0.44	30.7	-17%	-12%
	18.0	F(prec limits) *1.25	0.50	29.0	-22%	-3%
	20.6	F(prec limits) *1.5	0.60	26.4	-29%	11%
	23.0	F(prec limits) *1.75	0.70	24.1	-35%	24%
	26.3	F(prec limits) *2	0.80	20.9	-44%	41%
	29.6	F(prec limits) *2.25	0.90	17.7	-52%	59%

Basis: $\mathbf{F}_{sq}$ =mean F(02-04) scaled=0.35; landings (2005) = 14.9; SSB(2006) = 37.

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	11.9	F(sq) * 0.86	0.30	35.0	-5%	-36%
	12.4	Fsq *0.9	0.32	34.5	-7%	-33%
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	29.6	F(prec limits) *2.25	0.90	17.7	-52%	59%

Weights in '000 t.

[1)] SSB 2007 relative to SSB 2006.

[2)] Landings 2006 relative to TAC 2005 = 18.6.

Shaded scenarios are considered inconsistent with the Precautionary Approach.

Management considerations

Sole are mainly caught in a mixed beam trawl fishery with plaice and other flatfish using 80-mm mesh in the southern North Sea. The minimum mesh size in the mixed beam trawl fishery in the southern North Sea means that large numbers of undersized plaice and cod are discarded. Measures to reduce discarding in the mixed beam trawl fishery would greatly benefit these stocks. An increase in the minimum landing size of sole could provide an incentive to fish with larger mesh sizes and therefore mean a reduction in the discarding of plaice.

The peaks in SSB of North Sea sole are heavily dependent on the occasional occurrence of strong year classes. The SSB and landings in recent years have been dominated by the 1996 and 2001 year classes. The low advice is the result of the weak 2004 year class and the need to maintain SSB above Bpa which requires a reduction in fishing mortality

TACs in recent years have been above the levels associated with $\mathbf{F}_{pa}$.

Due to a range of factors such as TAC constraints on plaice, effort limitations, and increases in fuel prices, the fishing effort of the major fleets targeting sole has concentrated in the southern part of the North Sea. This is the area where a large part of the juvenile fish of e.g. plaice in the North Sea is found. In addition, juvenile plaice has shown a more off-shore distribution in recent years. The combination of a change in fishing pattern and the spatial distribution of juvenile plaice has lead to an apparent increase in discarding of plaice.

The present advice framework implies large inter-annual changes in TAC advice when stocks are just above or just below Bpa. Such variations could be avoided with the development of a long-term management plan.

Factors affecting the fisheries and the stock

The effects of regulations

The TACs are assumed to be restricting the fishery. The TAC in 2004 was agreed at 17 000 t and for 2005 the TAC was set at 18 600 t. Estimated landings are higher than the TAC. This is predominantly due to a discrepancy in the conversion factor between dead weight and live weight. The inspection authorities use a lower conversion factor than the research institutes.

Technical measures applicable to the sole fishery in the North Sea included mesh size regulations, minimum landing size, gear restrictions, and a closed area (the plaice box). Mesh size regulations for towed gears require that vessels fishing north of 55°N (or 56°N east of 5°E, since January 2000) should have a minimum mesh size of 100 mm, while south of this limit, where the majority of the plaice fishery takes place, an 80-mm mesh is allowed. In the fishery with fixed gears a minimum mesh size of 100 mm is required.

The aggregated beam length of beam trawlers is limited to 24 m. In the 12-nautical mile zone and in the plaice box the maximum aggregated beam-length is 9 m.

The minimum landing size of North Sea sole is 24 cm. Mesh enlargement would reduce the catch of undersized plaice and cod, but would also result in short-term loss of marketable sole.

The plaice box has been been established in 1989, and the area was closed in all quarters since 1995. The closed area applies to vessels using towed gears, but vessels smaller than 300 HP are exempted from the regulation. The effectiveness of the plaice box has been evaluated by an expert group (Grift *et al*, 2004. See section 1.4.7 on North Sea plaice) . The proportion of undersized sole inside the plaice box did not change after closure and remained stable at 60-70%.

Changes in fishing technology and fishing patterns

The fishing effort of the major fleets exploiting North Sea sole has decreased since the mid-1990s. Recently the combination of days-at-sea regulations, high oil prices, and decreasing TAC for plaice and relatively stable TAC for sole, appear to have induced a more coastal fishing pattern in the southern North Sea. This concentration of fishing effort could result in increased discarding of juvenile plaice that are mainly distributed in those areas.

There are indications that technical efficiency has increased in the sole fishery, which could have counteracted the overall decrease in effort.

Data and methods

The stock assessment is based on an XSA assessment, calibrated with two survey indices and one commercial CPUE index. Survey data for 2005 has been used in recruitment estimation.

Information from the fishing industry

The North Sea Stock Survey was available and has been evaluated (Figure 4.4.5.b.1). Signals from the fisher's survey indicate that sole are becoming more abundant. This is in agreement with the research-vessel survey indices and is likely to be caused by the strong 2001 year class recruiting to the fishery. However, the low uptake of quota until September 2005 indicates that it is unlikely that the TAC will be taken by the end of the year. It is not clear if these two signals are consistent with each other.

Uncertainties in assessment and forecast

There are indications of considerable retrospective underestimation of fishing mortality and some overestimation of abundance. The status quo fishing mortality which was used to forecast the landings in 2005 may therefore be an underestimate.

Comparison with previous assessment and advice

The assessment is generally consistent with previous assessments, although there is a tendency to underestimate fishing mortality. The low advice is a result of the weak 2004 year class and the need to maintain SSB above $\mathbf{B}_{pa}$, which requires a reduction in fishing mortality.

Source of information

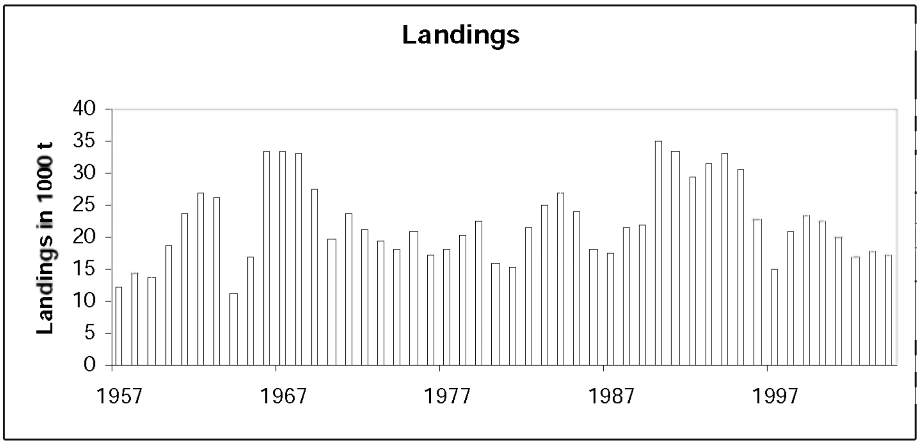
Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

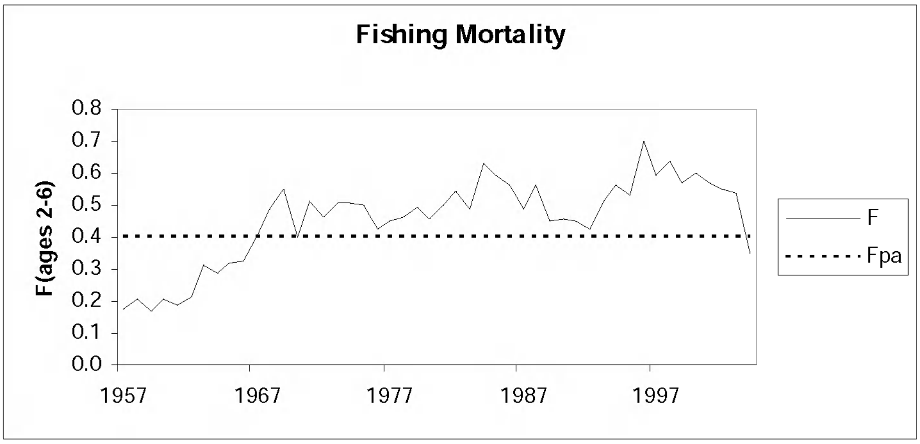
Grift, R,E., Tulp, I., Clarke, L., Damm, U., McLay, A., Reeves, S., Vigneau, J., Weber, W. 2004. Assessment of the ecological effects of the Plaice Box. Report of the European Commission Expert Working Group to evaluate the Shetland and Plaice boxes. Brussels. 121 p.

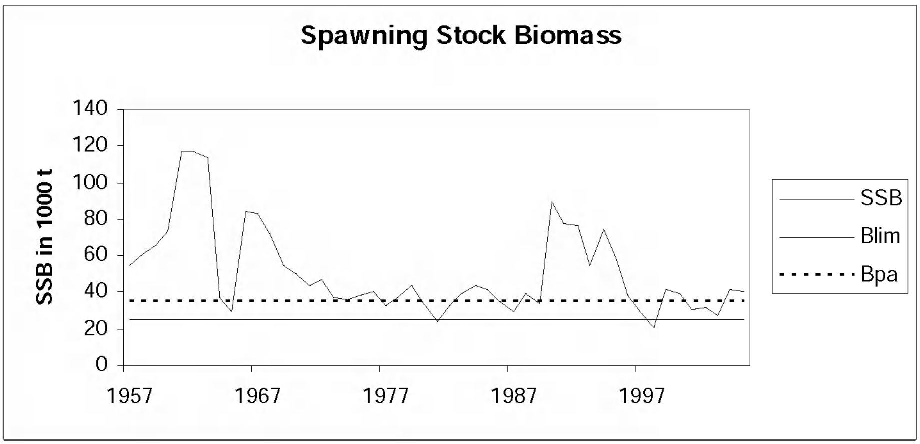
Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresponding to advice	Predicted catch corresponding to single-stock	Agreed TAC	Official landings	ACFM landings
1987	Rebuild SSB to 40 000 t; TAC		11.0		14.0	13.8	17.4
1988	Increase SSB towards 50 000 t; TAC		11.0		14.0	13.4	21.6
1989	Increase SSB towards 50 000 t; TAC		14.0		14.0	14.5	21.8
1990	80% of F(88); TAC		25.0		25.0	26.5	35.1
1991	SSB>50 000 t; TAC		27.0		27.0	27.6	33.5
1992	TAC		21.0		25.0	26	29.3
1993	no long-term gains in increased F		29.0[1]		32.0	29.8	31.5
1994	no long-term gains in increased F		31.0[1]		32.0	31.3	33
1995	no long-term gains in increased F		28.0[1]		28.0	28.8	30.5
1996	Mixed fishery, link plaice advice		23.0[1]		23.0	20.4	22.7
1997	<80% of F(95)		14.6		18.0	13.7	15
1998	75% of F(96)		18.1		19.1	19.7	20.9
1999	F<$\mathbf{F}_{pa}$ (80% of F(97))		20.3		22.0	22	23.5
2000	F< $\mathbf{F}_{pa}$		<19.8		22.0	20.7	22.5
2001	F< $\mathbf{F}_{pa}$		<17.7		19.0	16.4	19.8
2002	F<0.37		<14.3		16.0	16	16.9
2003	F< $\mathbf{F}_{pa}$		<14.6		15.85	16.7	17.9
2004	[2]	F< $\mathbf{F}_{pa}$	[2]	<17.9	17.0	17.1	18.8
2005		F< $\mathbf{F}_{pa}$		<17.3	18.6		
2006	Keep SSB above Bpa			<11.9			

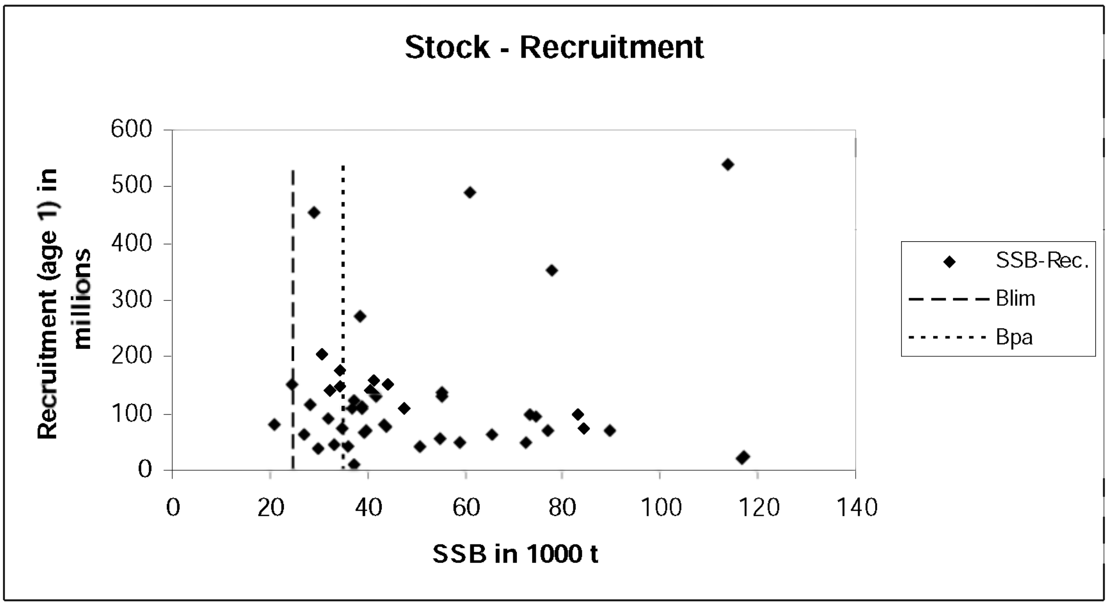
[1] Catch *status quo* F. [2] Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits. Weights in '000 t.

Sole in Subarea IV (North Sea).

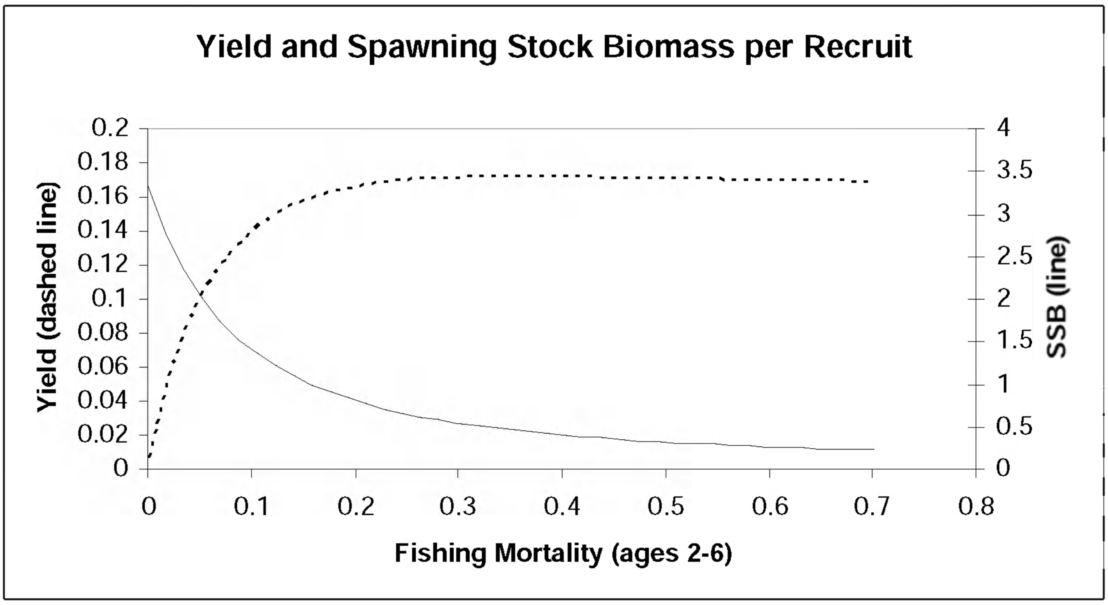




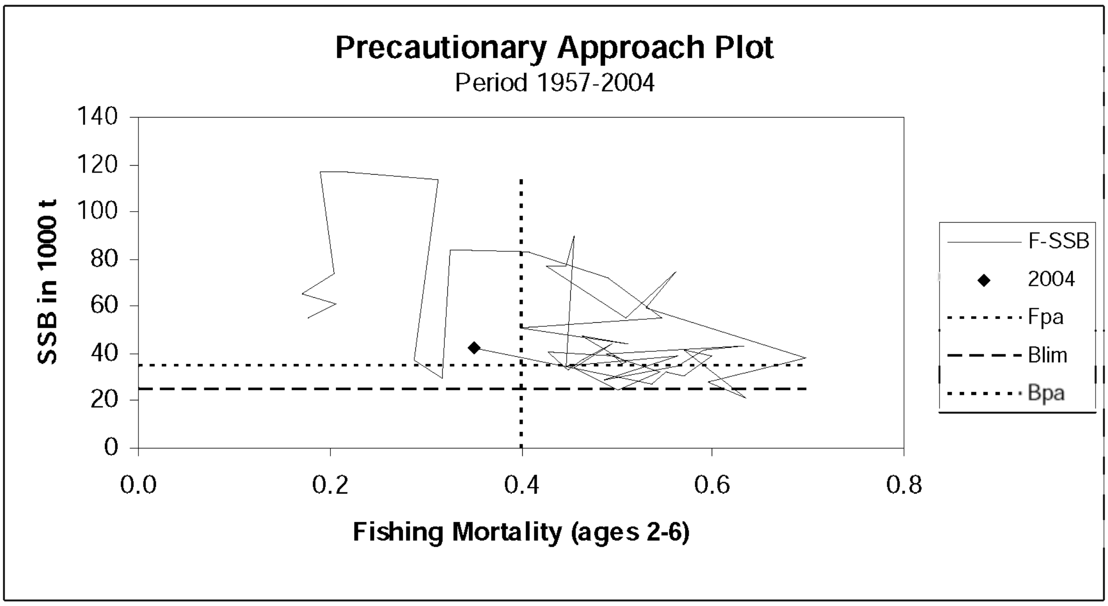




Stock - Recruitment
Recruitment (age 1) in millions
600
500
400
300
200
100
0
0
20
40
60
80
100
120
140
SSB in 1000 t
SSB-Rec.
Blim
Bpa



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
4
3.5
3
2.5
2
1.5
1
0.5
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 2-6)



Precautionary Approach Plot
Period 1957-2004
SSB in 1000 t
140
120
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
Fishing Mortality (ages 2-6)
F-SSB
2004
Fpa
Blim
Bpa

Table 1.4.10.1 Nominal catch (tonnes) of Sole in Subarea IV and landings as estimated by the Working Group.

Year	Belgium	Denmark	France	Germany	Netherlands	UK (E/W/NI)	Other countries	Total reported	Unallocated landings	WG Total	TAC
1982	1927	522	686	290	17749	403		21174	405	21579	21000
1983	1740	730	332	619	16101	435		19522	5405	24927	20000
1984	1771	818	400	1034	14330	586	1	18354	8485	26839	20000
1985	2390	692	875	303	14897	774	3	19160	5088	24248	22000
1986	1833	443	296	155	9558	647	2	12287	5914	18201	20000
1987	1644	342	318	210	10635	676	4	13153	4215	17368	14000
1988	1199	616	487	452	9841	740	28	12623	8967	21590	14000
1989	1596	1020	312	864	9620	1033	50	14495	7311	21806	14000
1990	2389	1428	352	2296	18202	1614	263	26544	8576	35120	25000
1991	2977	1307	465	2107	18758	1723	271	27608	5905	33513	27000
1992	2058	1359	548	1880	18601	1281	277	26004	3335	29339	25000
1993	2783	1661	490	1379	22015	1149	298	29775	1716	31491	32000
1994	2935	1804	499	1744	22874	1137	298	31291	1711	33002	32000
1995	2624	1673	640	1564	20927	1040	312	28780	1687	30467	28000
1996	2555	1018	535	670	15344	848	229	21199	1452	22651	23000
1997	1519	689	99	510	10241	479	204	13741	1160	14901	18000
1998	1844	520	510	782	15198	549	339	19742	1126	20868	19100
1999	1919	828	357	1458	16283	645	501	21991	1484	23475	22000
2000	1806	1069	362	1280	15273	600	346	20736	1796	22532	22000
2001	1874	772	411	958	13345	597	395	18352	1592	19944	19000
2002	1437	644	266	759	12120	451	292	15969	976	16945	16000
2003	1605	703	264	749	12469	520	364	16674	1246	17920	15850
2004	1451	805	NA*	949	12869	534	541	17149	1609	18758	17000

Table 1.4.10.2 Sole in Subarea IV (North Sea).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1957	129000	55100	12100	0.178
1958	129000	60900	14300	0.207
1959	489000	65600	13800	0.171
1960	62000	73400	18600	0.204
1961	99000	117100	23600	0.190
1962	23000	116800	26900	0.213
1963	20000	113600	26200	0.313
1964	539000	37100	11300	0.289
1965	122000	30000	17000	0.317
1966	40000	84200	33300	0.325
1967	75000	82900	33400	0.407
1968	100000	72300	33200	0.490
1969	50000	55200	27600	0.547
1970	138000	50700	19700	0.399
1971	42000	43700	23700	0.512
1972	77000	47400	21100	0.463
1973	108000	36700	19300	0.509
1974	110000	36000	18000	0.506
1975	41000	38700	20800	0.497
1976	113000	40400	17300	0.428
1977	140000	33200	18000	0.449
1978	47000	37300	20300	0.464
1979	11000	44100	22600	0.496
1980	152000	34300	15800	0.456
1981	150000	24400	15400	0.502
1982	153000	32500	21600	0.546
1983	142000	39900	24900	0.489
1984	71000	43400	26800	0.633
1985	81000	41200	24200	0.592
1986	160000	34900	18200	0.565
1987	73000	29200	17400	0.487
1988	455000	38900	21600	0.565
1989	108000	34400	21800	0.447
1990	178000	89800	35100	0.455
1991	71000	77600	33500	0.448
1992	354000	76900	29300	0.426
1993	69000	54900	31500	0.510
1994	57000	74400	33000	0.561
1995	96000	59100	30500	0.531
1996	49000	38500	22700	0.697
1997	271000	28100	14900	0.595
1998	115000	20900	20900	0.635
1999	81000	41900	23500	0.571
2000	129000	39400	22600	0.599
2001	67000	30700	19900	0.570
2002	203000	32100	16900	0.551
2003	90000	27200	17900	0.536
2004	61000 [1)]	42100	17100	0.351
2005	56500 [1)]	41000		
Average	127367	51022	22273	0.456

[1)] RCT3 estimate

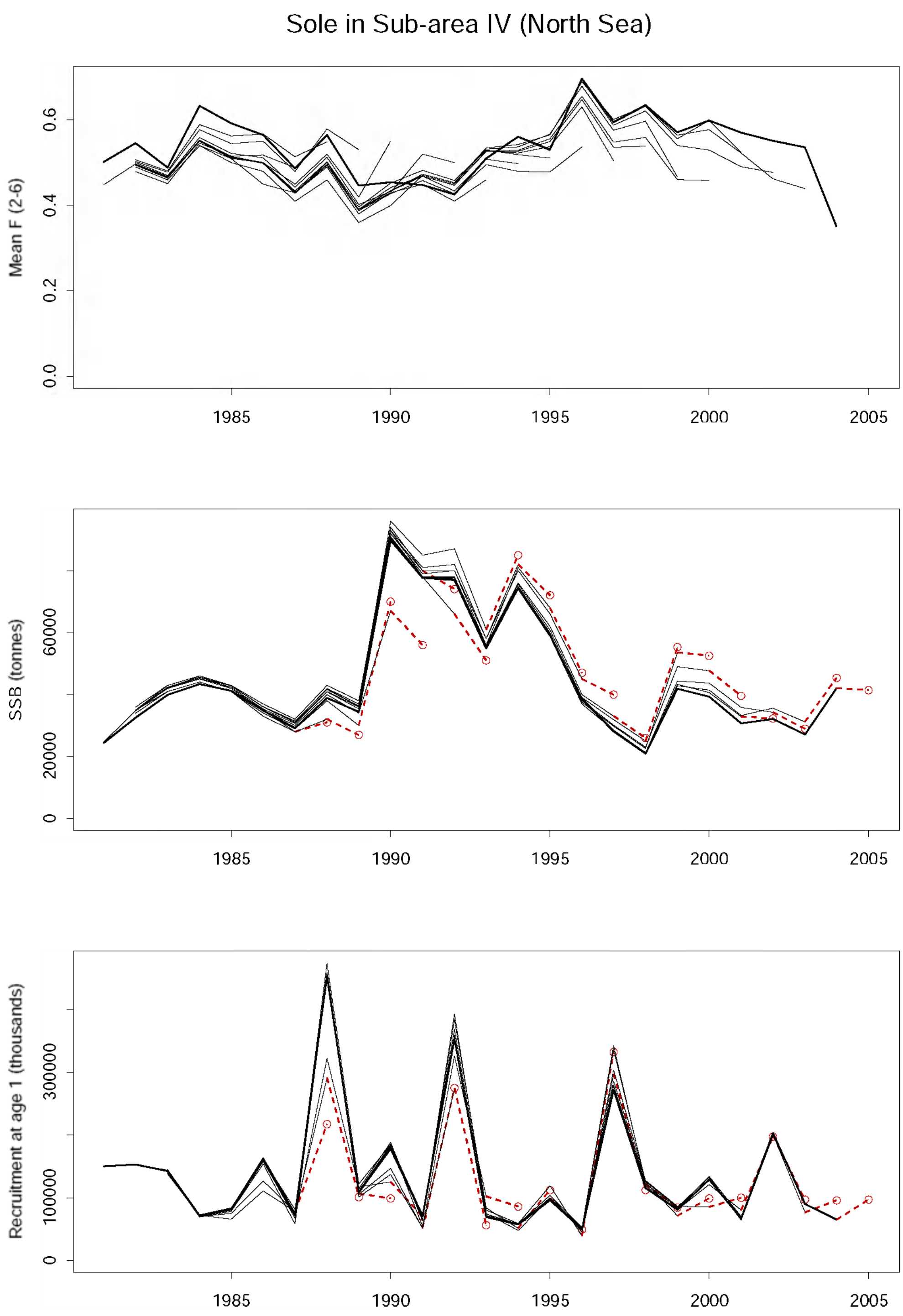


Figure 1.4.10.1 Sole in Subarea IV (North Sea)

Results of the most recent assessment in comparison with results of previous assessments. Circles indicate forecast values. Note: fishing mortalities before the 2003 assessment were based on a different age range (2–8).

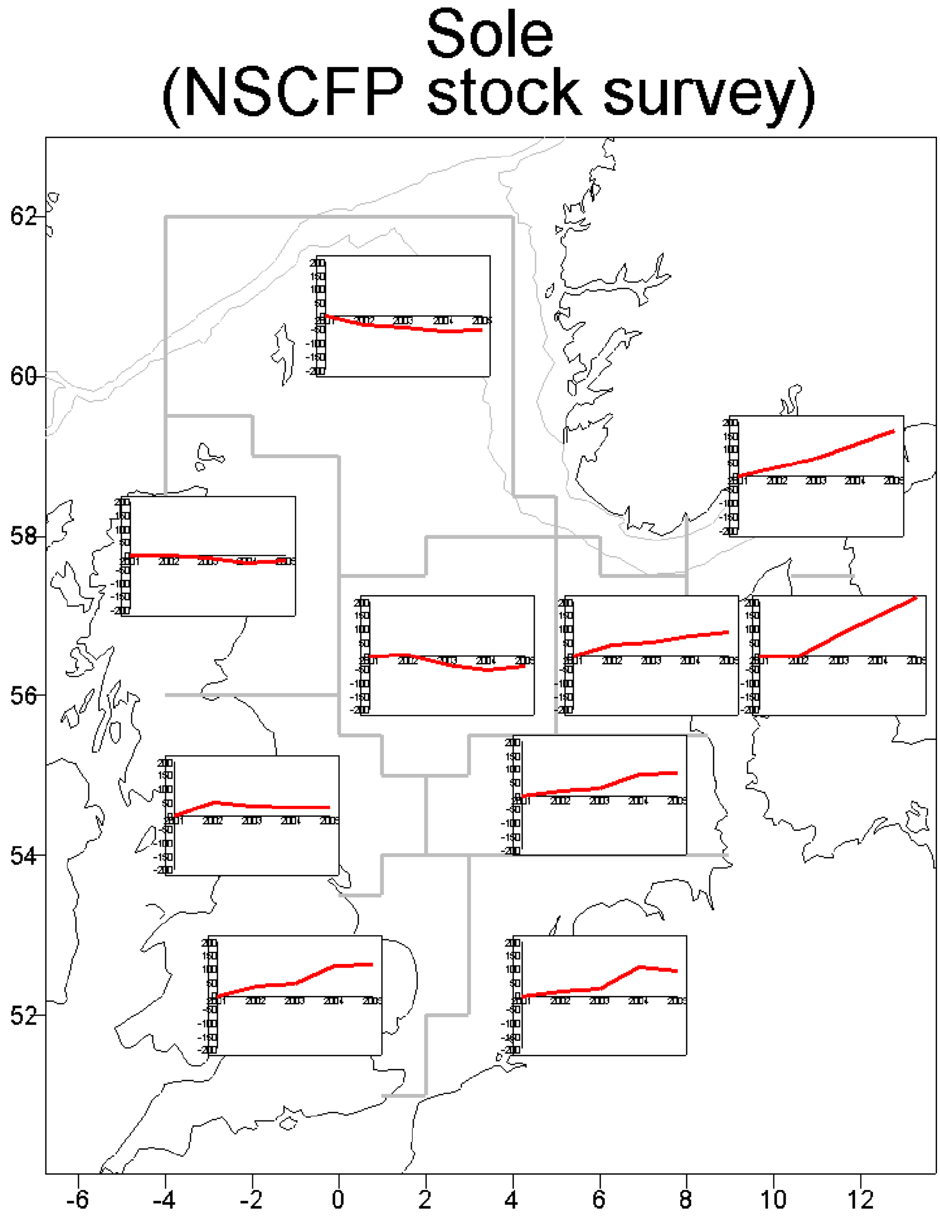


Figure 1.4.10.2 North Sea sole: results of the fishers' survey.

1.4.11 Sole in Division VIId (Eastern Channel)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Full reproductive capacity	At risk of being harvest unsustainably	Overexploited	

Based on the most recent estimate of SSB (12 000 t), ICES classifies the stock as having full reproductive capacity. The spawning stock biomass has been fluctuating around a mean of about 10 000 t since 1982, and is presently above $\mathbf{B}_{pa}$.

Based on the most recent estimates of fishing mortality (0.42), ICES classifies the stock at risk of being harvested unsustainably. The fishing mortality has decreased since 1999 and has been around $\mathbf{F}_{pa}$ since 2001.

Recent recruitment has been strong, with the 2001 and 2003 year classes being the highest and second-highest, respectively, of the time-series (1982–2004).

Management objectives

No explicit management objectives are set for this stock.

Reference points

(unchanged since 1999)

ICES considers that:	ICES proposes that:
There is currently no biological basis for defining $\mathbf{B}_{lim}$.	$\mathbf{B}_{pa}$ be set at 8 000 t. This is the lowest observed biomass at which there is no indication of impaired recruitment.
$\mathbf{F}_{lim}$ is 0.55. This is a fishing mortality at or above which the stock has shown continued decline.	$\mathbf{F}_{pa}$ be set at 0.4. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F}_{lim}$.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-8	Yield/R	SSB/R
Average last 3 years	0.405	0.168	0.365
$\mathbf{F}_{max}$	0.308	0.169	0.501
$\mathbf{F}_{0.1}$	0.132	0.152	1.119
$\mathbf{F}_{med}$	0.396	0.168	0.375

Technical basis:

$\mathbf{B}_{lim}$: Poor biological basis for definition.	$\mathbf{B}_{pa}$: Smoothed $\mathbf{B}_{loss}$ (no sign of impairment): 8 000 t.
$\mathbf{F}_{lim}$ is set equal to $\mathbf{F}_{loss}$, but poorly defined; analogy to North Sea and setting of 1.4 $\mathbf{F}_{pa}$ = 0.55.	$\mathbf{F}_{pa}$: Between $\mathbf{F}_{med}$ and 5th percentile of $\mathbf{F}_{loss}$; SSB>$\mathbf{B}_{pa}$ and probability ($\mathbf{SSB}_{mt}$<$\mathbf{B}_{pa}$), 10%: 0.4.

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Target reference points have not been agreed for this stock. The current fishing mortality ($\mathbf{F}_{sq}$) is estimated at 0.42, which is above the rate that would lead to high long-term yields ($\mathbf{F}_{0.1}$=0.13). $\mathbf{F}_{max}$ is not well defined. Fishing at $\mathbf{F}_{0.1}$ is expected to lead to landings in 2006 of 2 100 t and SSB in 2007 of around 15 500 t.

Exploitation boundaries in relation to precautionary limits

The exploitation within the precautionary limits would imply landings of less than 5 720 t in 2006, which is expected to lead to a 12% decrease in SSB in 2007.

Short-term implications

Outlook for 2006:

Basis: F(2005) = $\mathbf{F}_{sq}$ = mean F(02-04) = 0.41; SSB(2005) = 11.76; SSB(2006) = 13.57; landings (2005) = 5.99.

Rationale	TAC(2006) (1)	Basis	F(2006)	SSB(2007)	%SSB change	%TAC change
Zero catch	0.00	F=0	0.00	17.65	30%	-100%
Status quo	5.78	$\mathbf{F}_{sq}$	0.41	11.89	-12%	1%
High long-term yield	2.09	F(long-term yield)	0.13	15.56	14%	-66%-
Status quo	2.59	$\mathbf{F}_{sq}$ *0.4	0.16	15.06	11%	-55%
	3.17	$\mathbf{F}_{sq}$ *0.5	0.21	14.48	7%	-44%
	3.74	$\mathbf{F}_{sq}$ *0.6	0.25	13.92	3%	-34%
	4.28	$\mathbf{F}_{sq}$ *0.7	0.29	13.38	-1%	-25%
	4.80	$\mathbf{F}_{sq}$ *0.8	0.33	12.86	-5%	-16%
	5.30	$\mathbf{F}_{sq}$ *0.9	0.37	12.36	-9%	-7%
	5.78	$\mathbf{F}_{sq}$ *1	0.41	11.89	-12%	1%
	6.24	$\mathbf{F}_{sq}$ *1.1	0.45	11.43	-16%	10%
Precautionary limits	0.68	TAC($\mathbf{F}_{pa}$) *0.1	0.04	16.98	25%	-88%
	1.64	TAC($\mathbf{F}_{pa}$) *0.25	0.10	16.01	18%	-71%
	3.14	TAC($\mathbf{F}_{pa}$) *0.5	0.20	14.52	7%	-45%
	4.49	TAC($\mathbf{F}_{pa}$) *0.75	0.30	13.17	-3%	-21%
	5.24	TAC($\mathbf{F}_{pa}$) *0.9	0.36	12.42	-8%	-8%
	5.72	$\mathbf{F}_{pa}$ = $\mathbf{F}_{sq}$ *0.98	0.40	11.95	-12%	0%
	6.18	TAC($\mathbf{F}_{pa}$) *1.1	0.44	11.49	-15%	8%
	6.84	TAC($\mathbf{F}_{pa}$) *1.25	0.50	10.84	-20%	20%
	7.85	TAC($\mathbf{F}_{pa}$) *1.5	0.60	9.84	-28%	38%
	8.77	TAC($\mathbf{F}_{pa}$) *1.75	0.70	8.93	-34%	54%
	9.61	TAC($\mathbf{F}_{pa}$) *2	0.80	8.11	-40%	69%
	10.77	TAC($\mathbf{F}_{pa}$) *2.25	0.90	6.96	-49%	89%

(1) It is assumed that the TAC will be implemented and that the landings in 2006 therefore correspond to the TAC.
All weights in thousand tones.
Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

Due to recent large recruitments, SSB is expected to remain well above $\mathbf{B}_{pa}$ in the short term, provided the fishing mortality does not exceed $\mathbf{F}_{pa}$.

Sole is taken in a mixed fishery with plaice, with bycatches of cod and whiting.

Due to the minimum mesh size (80 mm) in the mixed beam trawl fishery, a large number of (undersized) plaice are discarded. The 80-mm mesh size is not matched to the minimum landing size of plaice. Measures to reduce discarding in the sole fishery would greatly benefit the plaice stock and future yields. Mesh enlargement would reduce the catch of undersized plaice, but would also result in short-term loss of marketable sole. An increase in the minimum landing size of sole could provide an incentive to fish with larger mesh sizes and therefore mean a reduction in the discarding of plaice.

Factors affecting the fisheries and the stock

There are 5 main commercial fleets fishing for sole in Division VIId. Belgian and English offshore beam trawlers (> 300 HP) fish mainly for sole, but can switch to scallops or move to adjacent areas. French offshore trawlers target roundfish and take sole as bycatch. Numerous inshore (under 10-m vessels) on the English and French coasts using mainly fixed nets target sole in the spring and autumn. The inshore vessels take half the reported landings and sole forms their main source of income. Effort from the beam trawl fleet can change considerably depending on whether the fleet moves to other areas or directs effort at other species such as scallops and cuttlefish.

The minimum landing size for sole is 24 cm. Demersal gears permitted to catch sole are 80 mm for beam trawling and 80 mm for otter trawlers. Fixed nets are required to use 100-mm mesh since 2002, although an exemption to permit 90 mm has been in force since that time.

The effects of regulations

The EU regulation enforced since 2004 is a limitation of 22 days at sea per month for trawlers with mesh size less than 99 mm, 14 days at sea for beam trawlers, and gillnetters have a derogation of 20 days at sea in the Eastern Channel provided that their mesh size is less than 110 mm. However, these effort limitations from the cod recovery plan are not likely to decrease the effort on sole in Division VIId.

Changes in fishing technology and fishing patterns

No major changes of fishing technology and fishing pattern have taken place in the assessment period (1982–2004).

Scientific basis

Data and methods

The assessment is based on landings data, two commercial CPUE indices and two research-vessel survey indices.

Uncertainties in assessment and forecast

The past performance of this assessment for estimating this stock has been poor. Discarding of sole is thought to be minor and it is assumed that the lack of discard will not notably affect the assessment results. However, under-reporting from the inshore fleets and misreporting by beam trawlers fishing in adjacent management areas is thought to be significant. The historical landings have been adjusted for misallocated landings between the Eastern and Western Channel over the period 1986–2004. XSA diagnostics and the retrospective analysis indicate a tendency to underestimate fishing mortality and overestimate SSB.

Comparison with previous assessment

The current assessment has revised the value of SSB in 2003 downwards by 5%. Past recruitment estimates were subject to considerable annual revision.

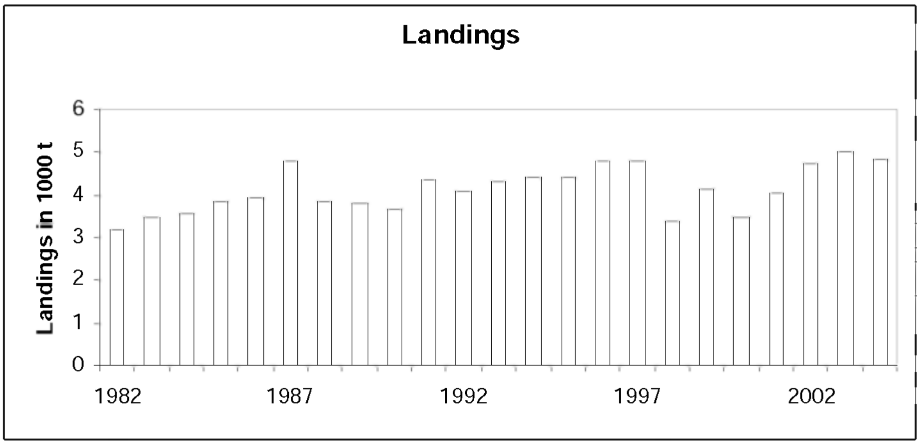
Source of information:

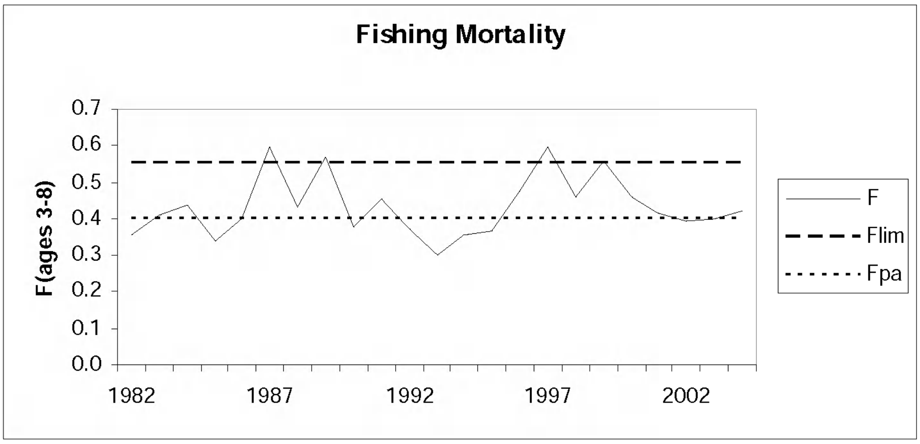
Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

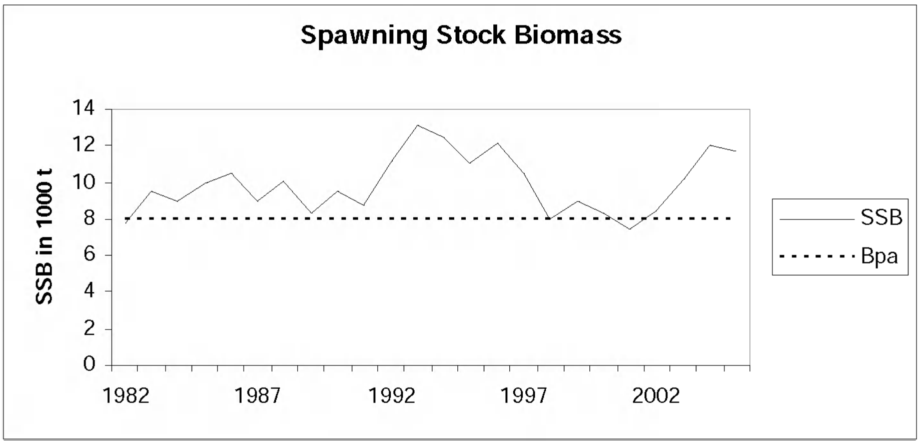
Year	ICES advice	Single-Stock Exploitation Boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to Single-Stock Exploitation Boundaries	Agreed TAC	Official landings	ACFM landings
1987	Precautionary TAC		3.1		3.85	3.8	4.8
1988	*Status quo* (Shot) TAC		3.4		3.85	3.3	3.9
1989	*Status quo* (Shot) TAC		3.8		3.85	2.9	3.8
1990	No effort increase; TAC		3.7		3.85	3.0	3.6
1991	*Status quo* F; TAC		3.4		3.85	3.8	4.4
1992	TAC		≤2.7		3.5	3.8	4.1
1993	70% of F(91)~2 800 t		2.8		3.2	3.4	4.3
1994	Reduce F		<3.8		3.8	3.7	4.4
1995	No increase in F		3.8		3.8	3.7	4.4
1996	No long-term gain in increasing F		4.7		3.5	4.1	4.8
1997	No advice		-		5.23	3.9	4.8
1998	No increase in effort		4.5		5.23	3.0	3.4
1999	Reduce F to $\mathbf{F}_{pa}$		3.8		4.7	3.9	4.1
2000	F < $\mathbf{F}_{pa}$		<3.9		4.1	3.8	3.5
2001	F < $\mathbf{F}_{pa}$		<4.7		4.6	4.6	4.0
2002	F < $\mathbf{F}_{pa}$		<5.2		5.2	5.4	4.7
2003	F < $\mathbf{F}_{pa}$		<5.4		5.4	5.6	5.0
2004	[1)]	F < $\mathbf{F}_{pa}$	[1)]	<5.9	5.9	5.3	4.8
2005	[1)]	F < $\mathbf{F}_{pa}$	[1)]	<5.7	5.7		
2006	[1)]	F < $\mathbf{F}_{pa}$	[1)]	<5.7			

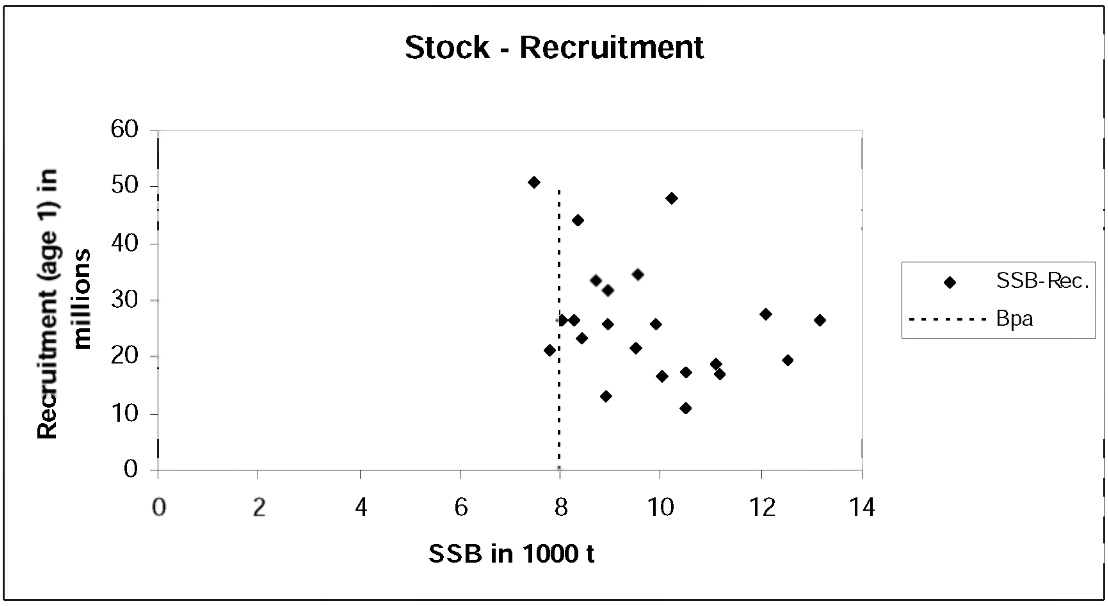
1) Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits. Weights in '000 t.

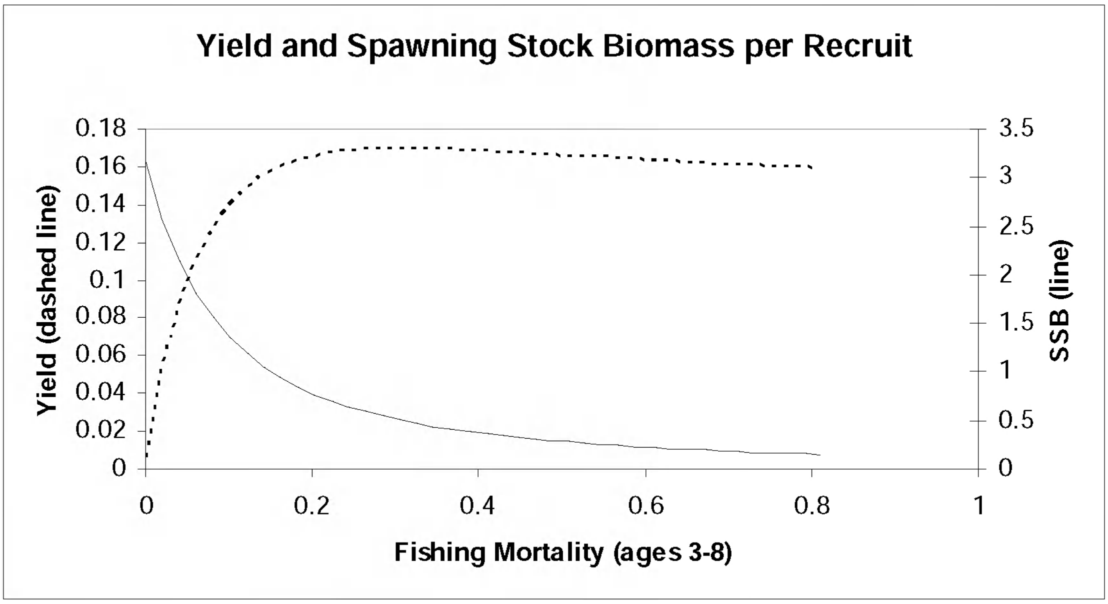
Sole in Division VIId (Eastern Channel).








Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Bpa
0
10
20
30
40
50
60
0
2
4
6
8
10
12
14


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-8)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0
0.5
1
1.5
2
2.5
3
3.5
0
0.2
0.4
0.6
0.8
1

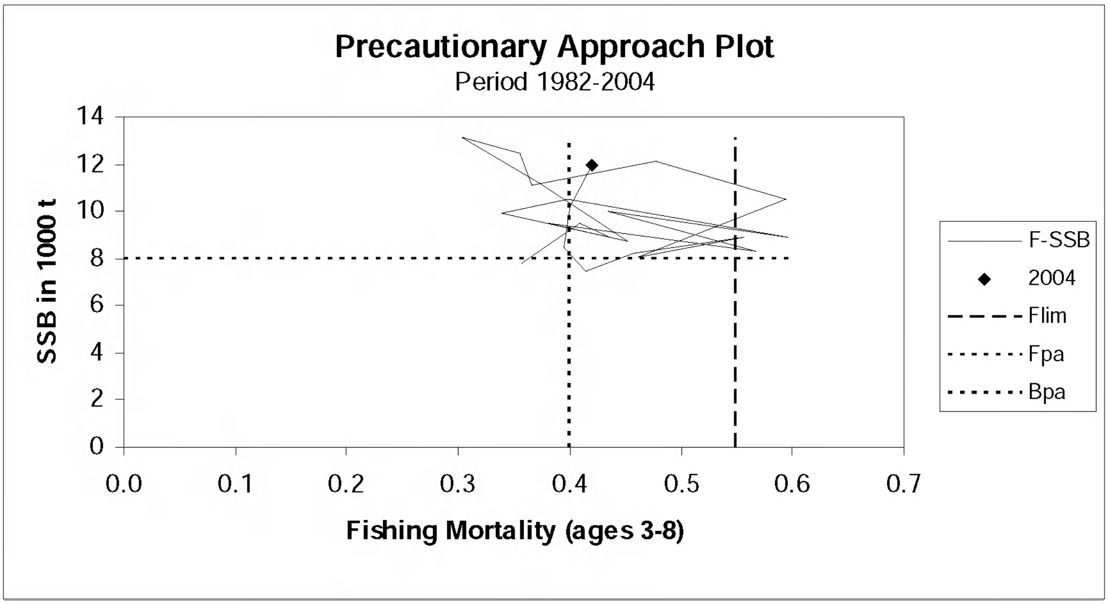

Precautionary Approach Plot
Period 1982-2004
SSB in 1000 t
Fishing Mortality (ages 3-8)
F-SSB
2004
Flim
Fpa
Bpa
0
2
4
6
8
10
12
14
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

Table 1.4.11.1 Sole VIId. Nominal landings (tonnes) as officially reported to ICES and used by the working group.

Year	Belgium	France		UK(E+W)	others	reported	Unallocated*	Total used by WG	TAC
1974	159	469		309	3	940	-56	884	
1975	132	464		244	1	841	41	882	
1976	203	599		404	.	1206	99	1305	
1977	225	737		315	.	1277	58	1335	
1978	241	782		366	.	1389	200	1589	
1979	311	1129		402	.	1842	373	2215	
1980	302	1075		159	.	1536	387	1923	
1981	464	1513		160	.	2137	340	2477	
1982	525	1828		317	4	2674	516	3190	
1983	502	1120		419	.	2041	1417	3458	
1984	592	1309		505	.	2406	1169	3575	
1985	568	2545		520	.	3633	204	3837	
1986	858	1528		551	.	2937	995	3932	
1987	1100	2086		655	.	3841	950	4791	3850
1988	667	2057		578	.	3302	551	3853	3850
1989	646	1610		689	.	2945	860	3805	3850
1990	996	1255		742	.	2993	654	3647	3850
1991	904	2054		825	.	3783	568	4351	3850
1992	891	2187		706	10	3794	278	4072	3500
1993	917	1907		610	13	3447	852	4299	3200
1994	940	2001		701	15	3657	726	4383	3800
1995	817	2248		669	9	3743	677	4420	3800
1996	899	2322		877	.	4098	699	4797	3500
1997	1306	1702		933	.	3941	823	4764	5230
1998	541	1703	**	803	.	3047	316	3363	5230
1999	880	2239	**	769	.	3888	247	4135	4700
2000	1021	2190		621	.	3832	-356	3476	4100
2001	1313	2482		822		4617	-592	4025	4600
2002	1643	2780		976		5399	-666	4733	5200
2003	1659	2898		1114	1	5672	-634	5038	5400
2004	1465	2734	***	1102		5300	-474	4826	5900

* Unallocated mainly due misreporting
** Preliminary
*** Data provided to the WG but not officially provided to ICES

Table 1.4.11.2 Sole in Division VIId (Eastern Channel).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-8
1982	12691	7780	3190	0.357
1983	21332	9525	3458	0.410
1984	21555	8921	3575	0.437
1985	12891	9913	3837	0.340
1986	25720	10514	3932	0.398
1987	10962	8951	4791	0.596
1988	25804	10035	3853	0.434
1989	16753	8357	3805	0.568
1990	44261	9534	3647	0.380
1991	34737	8722	4351	0.453
1992	33672	11188	4072	0.373
1993	16765	13150	4299	0.303
1994	26494	12514	4383	0.356
1995	19390	11078	4420	0.367
1996	18673	12105	4797	0.477
1997	27515	10512	4764	0.594
1998	17447	8030	3363	0.461
1999	26308	8946	4135	0.556
2000	31921	8258	3476	0.458
2001	26341	7476	4025	0.415
2002	50986	8443	4733	0.395
2003	23130	10208	5038	0.400
2004	48063	11992	4826	0.420
2005	23050	11756		
Average	25686	9913	4120	0.433

1.4.12 Saithe in Subarea IV (North Sea), Division IIIa (Skagerrak), and Subarea VI (West of Scotland and Rockall)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	Harvested sustainably	Appropriate	

Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainably. Fishing mortality declined since 1986, and appears to be below $\mathbf{F}_{pa}$ since 1997. SSB was below $\mathbf{B}_{pa}$ from 1984 to 1997 (and was below $\mathbf{B}_{lim}$ from 1990–1993), but increased in the late 1990s and is estimated to have been at or near $\mathbf{B}_{pa}$ since 1997.

Management objectives

In 2004 EU and Norway *agreed to implement a long-term plan for the saithe stock in the Skagerrak, the North Sea and west of Scotland, which is consistent with a precautionary approach and designed to provide for sustainable fisheries and high yields. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of Spawning biomass (SSB) greater than 106 000 tonnes (B_{lim}).*
2. *Where the SSB is estimated to be above 200 000 tonnes the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups.*
3. *Where the SSB is estimated to be below 200 000 tonnes but above 106 000 tonnes the TAC shall not exceed a level which, on the basis of a scientific evaluation by ICES, will result in a fishing mortality rate equal to 0.30-0.20*(200 000-SSB)/94 000.*
4. *Where the SSB is estimated by the ICES to be below the minimum level of SSB of 106 000 tonnes the TAC shall be set at a level corresponding to a fishing mortality rate of no more than 0.1.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15% from the TAC the preceding year the Parties shall fix aTAC that is no more than 15% greater or 15% less than the TAC of the preceding year.*
6. *Notwithstanding paragraph 5 the Parties may where considered appropriate reduce the TAC by more than 15% compared to the TAC of the preceding year.*
7. *A review of this arrangement shall take place no later than 31 December 2007.*
8. *This arrangement enters into force on 1 January 2005.*

The saithe management plan has not been evaluated by ICES.

Reference points

	ICES considers that:	**ICES proposed that:**
Limit reference points	$\mathbf{B}_{lim}$ is 106 000 t	$\mathbf{B}_{pa}$ be set at 200 000 t
	$\mathbf{F}_{lim}$ is 0.6	$\mathbf{F}_{pa}$ be set at 0.4
Target reference points	Target F according to the management plan is 0.3	

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average last 3 years	0.268	0.824	1.903
$\mathbf{F}_{max}$	0.216	0.829	2.399
$\mathbf{F}_{0.1}$	0.105	0.756	4.479
$\mathbf{F}_{med}$	0.349	0.807	1.392

Technical basis

$\mathbf{B}_{lim}$=$\mathbf{B}_{loss}$=106 000 t (estimated in 1998)	$\mathbf{B}_{pa}$ = 200 000 t affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$.
$\mathbf{F}_{lim}$=$\mathbf{F}_{loss}$=0.6, the fishing mortality estimated to lead to stock falling below $\mathbf{B}_{lim}$ in the long term.	$\mathbf{F}_{pa}$ = 0.4 implies that $\mathbf{B}_{eq} > \mathbf{B}_{pa}$ and $P(SSB_{MT} < \mathbf{B}_{pa}) < 10\%$.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

At the present SSB level, F should be below 0.3 to be in accordance with the management plan. This corresponds to catches of less than 108.7 kt in 2006. Unless paragraph 6 is invoked the management plan limits the annual deviation of the TAC to 15% which would correspond to catches of 136 kt.

Short-term implications

The short-term prognosis is made using the $\mathbf{F}_{sq}$ assumption for the intermediate year. An $\mathbf{F}_{sq}$ landings for 2005 corresponds to 99 000 t, which is far below the agreed TACs (145 000 t for the North Sea plus IIIa, and 15 000 t for Division VIa).

Outlook for 2006:

Basis: F(2005) =0.27;SSB(2006) = 235; catch (2005) = 99.1.

Rationale	**TAC (2006)**[1]	**TAC IIIa & IV (2006)**[3]	**TAC VI (2006)**[3]	**Basis**	**F 2006**	**SSB 2007**	**%SSB change** [1)]	**% TAC change** [2)]
Zero catch	0			F=0	0	332	41	
Target reference point				Ftarget or Btarget				
Status quo	99.6	90.6	9	$\mathbf{F}_{sq}$	0.27	234	0	-38
High long-term yield	42.9	39	3.9	F(long-term yield)	0.1	289	23	-73
Agreed management plan	10.9	9.9	1.0	TAC(man. plan) * 0.1	0.02	320	36	-93
	27.2	24.8	2.4	TAC(man. plan) * 0.25	0.06	304	30	-83
	54.4	49.5	4.9	TAC(man. plan) * 0.50	0.13	278	18	-66
	81.5	74.2	7.3	TAC(man. plan) * 0.75	0.21	252	7	-49
	97.8	89.0	8.8	TAC(man. plan) * 0.90	0.26	236	1	-39
	108.7	98.9	9.8	TAC(man. plan)	0.3	225	-4	-32
	119.6	108.8	10.8	TAC(man. plan) * 1.1	0.34	215	-8	-25
	135.9	123.3	12.2	TAC(man. plan) * 1.25	0.40	200	-15	-15
Precautionary limits	13.7	12.5	1.2	TAC($\mathbf{F}_{pa}$)* 0.1	0.03	318	35	-91
	34.3	31.2	3.1	TAC($\mathbf{F}_{pa}$)* 0.25	0.08	298	27	-79
	68.5	62.3	6.2	TAC($\mathbf{F}_{pa}$)* 0.5	0.17	265	13	-57
	102.8	93.5	9.3	TAC($\mathbf{F}_{pa}$)* 0.75	0.28	232	-1	-36
	123.3	112.2	11.1	TAC($\mathbf{F}_{pa}$)* 0.90	0.35	212	-10	-23
	135.9	123.3	12.2	$\mathbf{F}_{pa}$ (= $\mathbf{F}_{sq}$ *1.48)	0.40	200	-15	-15
	150.7	137.1	13.6	TAC($\mathbf{F}_{pa}$)* 1.1	0.46	185	-21	-6
	171.3	155.9	15.4	TAC($\mathbf{F}_{pa}$)* 1.25	0.54	165	-30	7

Weights in '000 t.

1) SSB 2007 relative to SSB 2006.
2) TAC 2006 relative to TAC 2005.
3)Landings split according to the average in 1993–1998, i.e., 91% in IIIa&IV and 9% in VI.

Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

Before 1999, saithe in Subarea VI and saithe in Subarea IV and Division IIIa were assessed as two separate stocks. The ICES advice now applies to the combined areas IIIa, IV, and VI.

The reported landings have been much lower than the TAC the last four years. Information from fishers indicates that very low prices on saithe combined with high fuel prices are causing these reductions in landings. These factors may also have led to increased discarding, although information was not available to quantify this.

The saithe management plan has not been evaluated by ICES. A requirement for consistency with the Precautionary Approachis that the SSB decision parameters are used as lower bounds on SSB, and not as targets and that par 6 will be invoked whenever there is high risk that the SSB may fall below B_{lim} in the short term.

Ecosystem considerations

Because of its life-history, saithe in the North Sea is partly geographically protected from heavy exploitation as juveniles and as large adults.

The geographical distribution of juvenile (< age 3) and adult saithe differs. Typical for all saithe stocks are the inshore nursery grounds. Juvenile saithe in the North Sea are therefore mainly distributed along the west and south coast of Norway, the coast of Shetland, and the coast of Scotland. Around age 3 the individuals gradually migrate from the coastal areas to the northern part of the North Sea (57°N–62°N). The age at maturity is between 4 and 6 years, and spawning takes place in January–March at about 200-m depth along the Northern Shelf edge and the western edge of the Norwegian deeps.

Tagging experiments by various countries have shown that exchange takes place between all saithe stock components in the northeast Atlantic.

Factors affecting the fisheries and the stock

The effects of regulations

Management of saithe is by TAC and technical measures. In January 2002 the minimum mesh size (in bottom trawls for human consumption) was changed from 100 to 110 mm in EU-waters and from 100 to 120 mm in Norwegian waters (the minimum mesh size for Norwegian vessels was set to 120 mm both in Norwegian and EU waters). This regulation was not strictly enforced in the first half of 2002 to allow a transition period, i.e. the implementation of larger mesh sizes probably happened gradually during 2002. Minimum landing size is 35 cm in the EU zone, 32 cm in the Norwegian zone.

Changes in fishing technology and fishing patterns

Variations in EU and Norwegian mesh size regulations in the saithe fishery in 2001–2003 might have contributed to changes in the exploitation pattern (spatial and temporal changes in size-specific fishing mortality between years).

Scientific basis

Data and methods

There are no discard estimates for the majority of the fishery, and they were thus not included in the assessment.

The stock assessment is based on an XSA model, calibrated by three commercial CPUE series and two survey indices.

Information from the fishing industry

The reported catch in 2004 was much lower than the TAC and the reported effort was also considerably lower than in 2003. Information from fishers indicates that very low prices on saithe are causing these reductions.

The fishers' survey corresponds with the outcome of the assessment.

Uncertainties in assessment and forecast

The assessment is considered to be uncertain because of incomplete catch information, residual patterns in catchability, retrospective bias in F and SSB estimates, uncertain recruitment estimates, the age range used to compute mean F uses ages not fully recruited, and there is no logical explanation for the steady decline in F since the mid-1980s given a rather constant level of landings and an increase in SSB.

The most serious problem with stock forecasts for saithe is the lack of reliable information about year-class strength before age 3. An annual 0-group survey has been conducted by the Institute of Marine Research (IMR, Norway) since 1999 in the northern North Sea, but this will not be continued due to lack of relationship between the 0-group index and later XSA population estimates for the year classes 1999–2001 (the 0-group index for the 2000 year class is extremely high, while this year class is estimated to be around average for age 4 in this year's assessment). IMR considers starting a new survey along the west coast of Norway to measure the relative abundance of saithe between 1 and 3 years old (when the saithe is distributed along the coast).

Comparison with previous assessment and advice

The estimate of 2004 SSB is about 10% less than the previous estimate, while the 2003 F was estimated to be similar.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, September 2005 (ICES CM 2006/ACFM:09).

Saithe in IIIa and IV

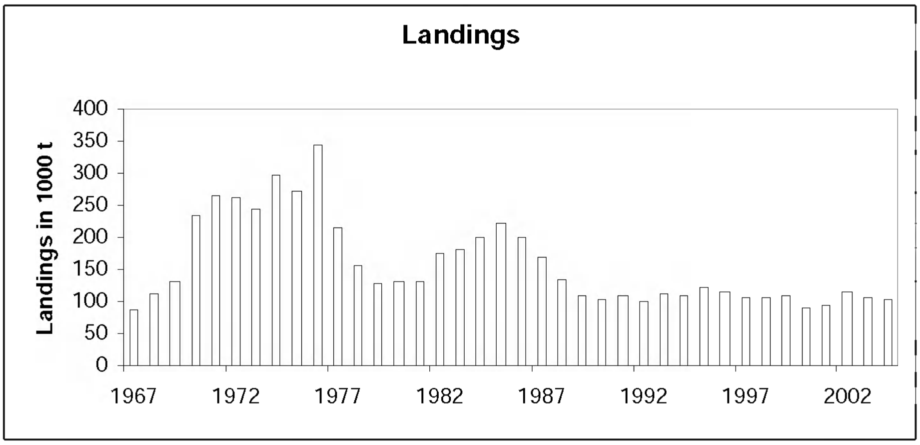
Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted landings corresp. to advice	Predicted landings correp. to single-stock exploitation boundaries	Agreed TAC	Official landings	ACFM landings
1987	Reduce F		<198		173	154	149
1988	60% of F(86); TAC		156		165	113	107
1989	No increase in F; TAC		170		170	92	92
1990	No increase in F; TAC		120		120	85	88
1991	No increase in F; TAC		125		125	93	99
1992	No increase in F; TAC		102		110	92	92
1993	70% of F(91) ~ 93 000 t		93		93	99	105
1994	Reduce F by 30%		72		97	90	102
1995	No increase in F		107		107	97	113
1996	No increase in F		111		111	96	110
1997	No increase in F		113		115	86	103
1998	Reduce F by 20%		97		97	88	100
1999	Reduce F to $\mathbf{F}_{pa}$		104		110	108	107
2000	Reduce F by 30 %		75		85	85	87
2001	Reduce F by 20 %		87		87	88	90
2002	$F < \mathbf{F}_{pa}$		<135		135	113	117
2003	$F < \mathbf{F}_{pa}$		<176		165	105	102
2004	*	$F < \mathbf{F}_{pa}$	*	<211	190	87	100
2005	*	F according to man. plan	*	<137	145		
2006	*	F according to man. plan ($< \mathbf{F}_{pa}$)	*	<123			

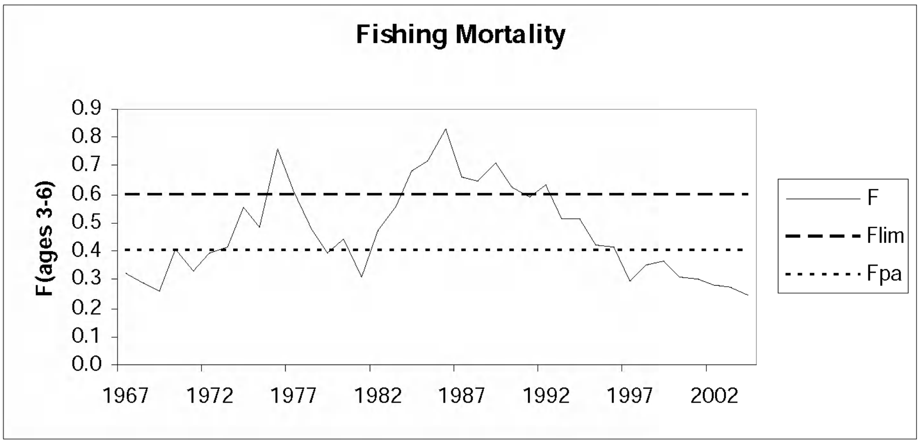
Weights in '000 t. * Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.

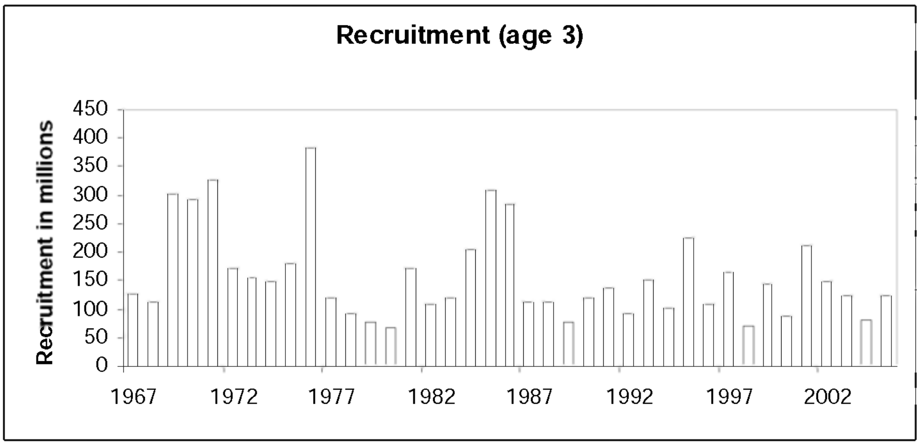
Saithe in VI

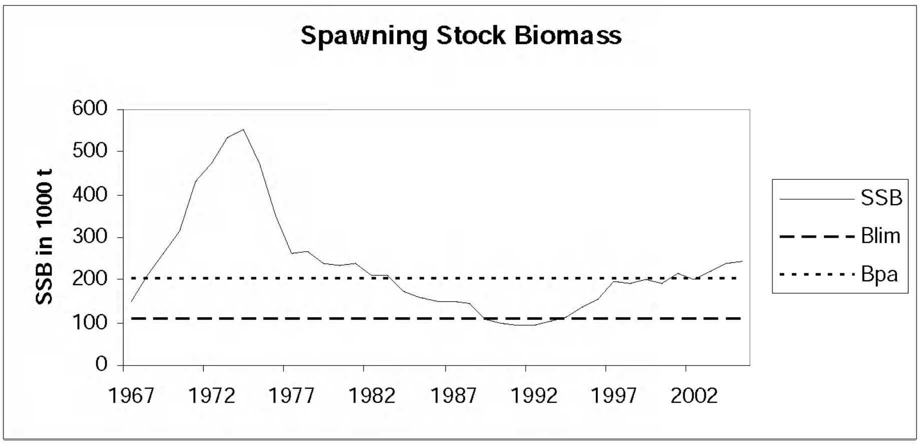
Year	ICES Advice	Single-stock exploitation boundaries	Predicted landings corresp. to advice	Predicted catch corresp to single-stock exploitation boundaries	Agreed TAC	Official landings	ACFM landings
1987	F reduced towards $\mathbf{F}_{max}$		19		27.8	32.5	31.4
1988	80% of F(86); TAC		35		35	32.8	34.2
1989	F < 0.3; TAC		20		30	22.4	25.6
1990	80% of F(88); TAC		24		29	18.0	19.9
1991	Stop SSB decline; TAC		21		22	17.9	17.0
1992	Avoid further reduction in SSB		<19		17	10.8	11.8
1993	F = 0.21		6.3		14	14.5	13.9
1994	Lowest possible F				14	13.0[2]	12.8
1995	Significant reduction in effort		-		16	10.6[2]	11.8
1996	No increase in F		10.2[1]		13	9.4[2]	9.4
1997	Significant reduction in F				12	8.6[2]	9.4
1998	60% Reduction in F		4.8		10.9	7.4[2]	8.4
1999	60% reduction in F		4.8		7.5	6.8	7.3
2000	Reduce F by 30 %		6.0		7	6.4	5.9
2001	Reduce F by 20 %		9.0		9	8.7	8.4
2002	F < $\mathbf{F}_{pa}$		<13		14	5.6	5.2
2003	F < $\mathbf{F}_{pa}$		<17		17.1	5.0	5.3
2004	F < $\mathbf{F}_{pa}$	F < $\mathbf{F}_{pa}$	<21	<21	20	1.6	4.4
2005	F < $\mathbf{F}_{pa}$	F according to man. plan	<14	<14	15		
2006	*	F according to man. plan (< $\mathbf{F}_{pa}$)	*	<12			

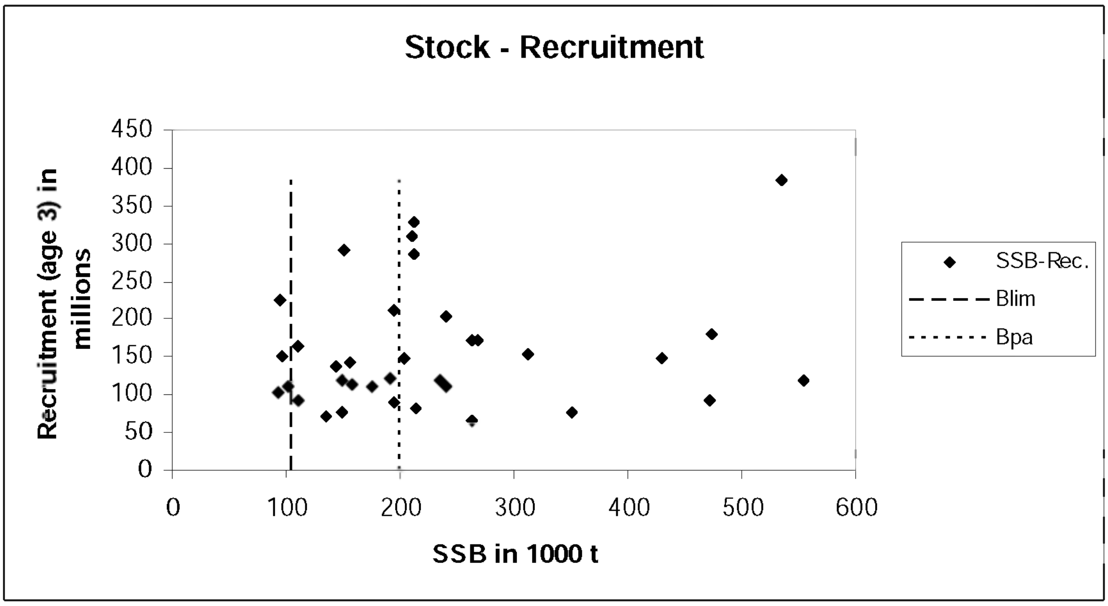
Weights in '000 t.
[1] *Status quo* catch. [2] Incomplete data. * Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.

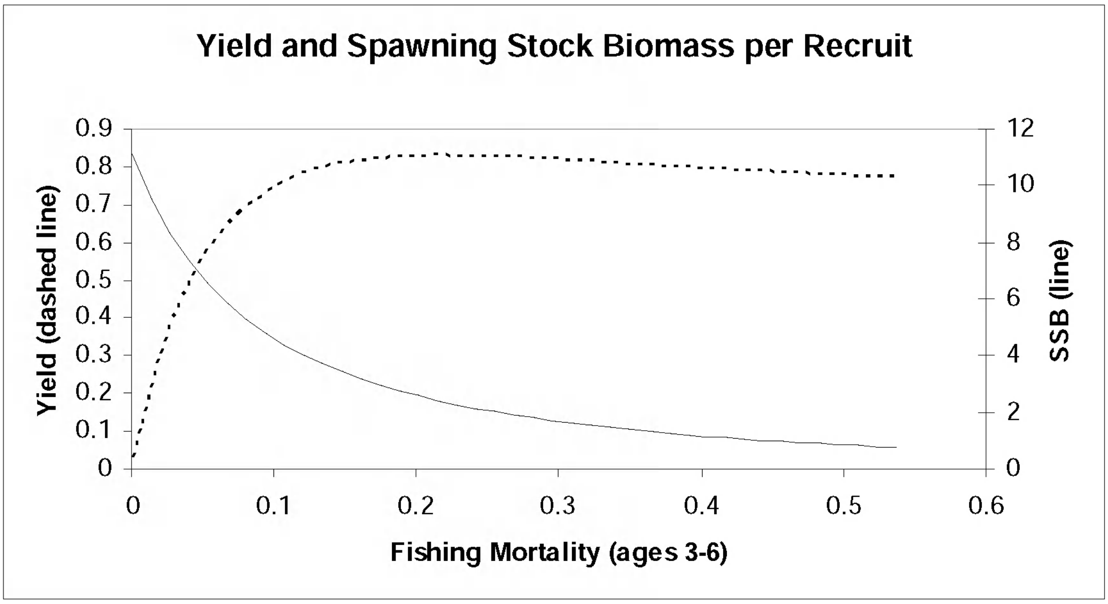

Landings
Landings in 1000 t
400
350
300
250
200
150
100
50
0
1967
1972
1977
1982
1987
1992
1997
2002


Fishing Mortality
F(ages 3-6)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1967
1972
1977
1982
1987
1992
1997
2002
F
Flim
Fpa


Recruitment (age 3)
Recruitment in millions
450
400
350
300
250
200
150
100
50
0
1967
1972
1977
1982
1987
1992
1997
2002


Spawning Stock Biomass
SSB in 1000 t
600
500
400
300
200
100
0
1967
1972
1977
1982
1987
1992
1997
2002
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 3) in millions
450
400
350
300
250
200
150
100
50
0
0
100
200
300
400
500
600
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
10
8
6
4
2
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
Fishing Mortality (ages 3-6)

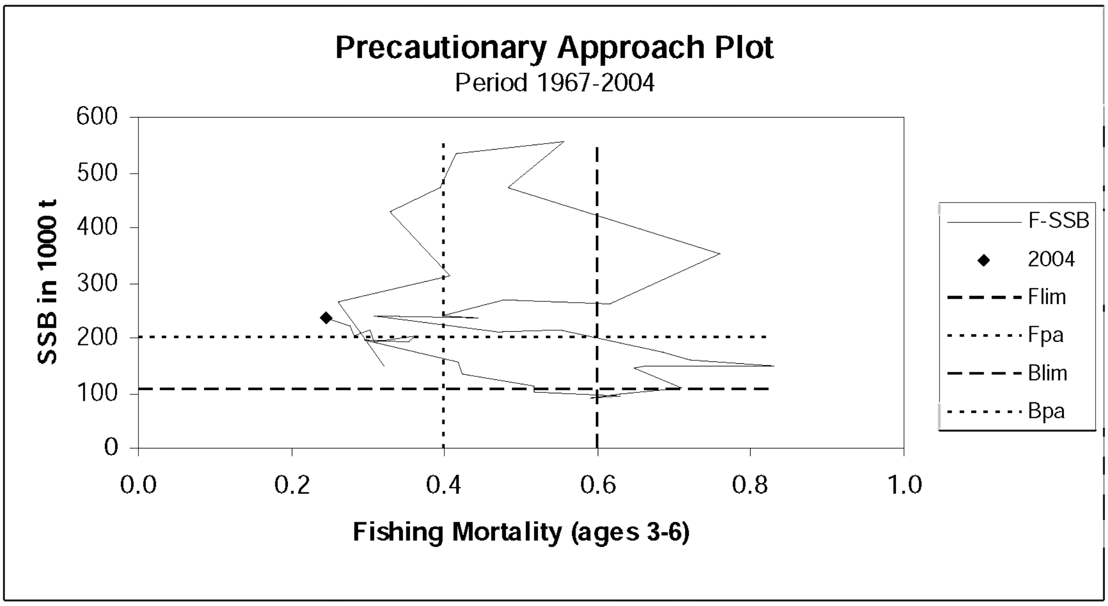

Precautionary Approach Plot
Period 1967-2004
SSB in 1000 t
600
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
Fishing Mortality (ages 3-6)
F-SSB
2004
Flim
Fpa
Blim
Bpa

Table 1.4.12.1 Nominal catch (in tonnes) of Saithe in Subarea IV and Division IIIa and Subarea VI, 1998 2004, as officially reported to ICES.

SAITHE IV and IIIa

Country	1998	1999	2000	2001	2002	2003	2004[*]
Belgium	249	200	122	24	107	44[*]	21
Denmark	3967	4494	3529	3575	5668	6954	7983
Faroe Islands	1298	1101					
France	11786[*]	24305[1*]	19200	20472	25441	18001	
Germany	10117	10481	9273	9479	10999	8956	9589
Greenland	-	-	601[2*]	1526[2*]	-[*]		
Ireland	-	-	1	-	-		
Netherlands	7	7	11	20	6	11[*]	3
Norway	50254	56150	43665	43725[*]	58983[*]	61690[*]	61128
Poland	813	862	747	727	752	734[*]	
Russia	-	-	67	-	-	-	
Sweden	1857	1929	1468	1627	1863	1876	2245
UK (E/W/NI)	2293	2874	1227	1186	2521	1215	456
UK (Scotland)	5353	5420	5484	5219	6596	5829	5920
Total reported	87994	107823	85395	87580	112936	105310	87346
Unallocated	12269	-510	2281	2093	3852	-3771	12406
W. G. Estimate	100263	107314	87676	89673	116788	101539	99752[3]
TAC	97000	110000	85000	87000	135000	165000	190000

[*]Preliminary. [1]Reported by TAC area, IIa(EC),IIIa-d(EC) and IV. [2]Preliminary data reported in Division IVa.
[3]Age 3+

SAITHE VI

Country	1998	1999	2000	2001	2002	2003	2004[*]
Belgium	-	-	-	-	-	-[*]	
Denmark	-	-	-	-	-	-	
Faroe Islands		2					
France	3635[*]	3467[1*]	3310	5157	3062	3499	
Germany	506	250	305	466	467	54	4
Ireland	216	320	410	399	91		
Norway	41	126	58	92[*]	136[*]	22[*]	16
Portugal	-	-	-	-	-	-	
Russia	-	3	25	1	1	6	
Spain	54	23	3	15	4		
UK (E/W/NI)	526	503	276	273	307	263	29
UK (Scotland)	2402	2084	2463	2246	1567	1189	1555
Total reported	7380	6778	6850	8649	5635	5033	1610
Unallocated	1056	564	-960	-1831	-449	217	2876
W. G. Estimate	8436	7342	5890	6818	5186	5250	4486[3]
TAC	10900	7500	7000	9000	14000	17119	20000

[*]Preliminary. [1]Reported by TAC area, Vb(EC),VI, XII and XIV.
[3]Age 3+

SAITHE IV, IIIa and VI

	1998	1999	2000	2001	2002	2003	2004
WG estimate	108699	114655	93566	96491	121974	106789	104237

Table 1.4.12.2 Saithe in Subarea IV, Division IIIa (Skagerrak) & Subarea VI.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1967	127000	150800	88300	0.322
1968	114000	211700	113800	0.291
1969	301000	264000	130600	0.262
1970	292000	312000	235000	0.408
1971	328000	429600	265400	0.329
1972	171000	474100	261900	0.395
1973	153000	534500	242500	0.416
1974	149000	554900	298400	0.556
1975	181000	472000	271600	0.482
1976	384000	351500	344000	0.760
1977	118000	263100	216400	0.615
1978	92000	268000	155100	0.477
1979	78000	240900	128400	0.396
1980	67000	234900	131900	0.443
1981	172000	240800	132300	0.307
1982	110000	209800	174400	0.471
1983	118000	213100	180000	0.552
1984	205000	175000	200800	0.683
1985	311000	158500	220900	0.720
1986	286000	148900	198600	0.831
1987	112000	149100	167500	0.663
1988	114000	143800	135200	0.648
1989	77000	109900	108900	0.711
1990	120000	96500	103800	0.628
1991	138000	92400	108000	0.591
1992	93000	94700	99700	0.630
1993	152000	102300	111500	0.516
1994	103000	111300	109600	0.516
1995	224000	134400	121800	0.422
1996	110000	155300	115000	0.417
1997	164000	195300	107300	0.294
1998	72000	193900	106100	0.353
1999	143000	203700	110700	0.364
2000	89000	192000	91300	0.308
2001	211000	214600	95100	0.304
2002	148000	202500	116000	0.283
2003	122000	221100	105600	0.277
2004	81000	237700	104200	0.245
2005	124000	244000		
Average	157795	230836	158095	0.471

1.4.13 *Nephrops* in Division IIIa (Management Area E)

There are two Functional Units in this Management Area: Skagerrak (FU 3) and Kattegat (FU 4).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment *[used if qualifiers to present state are necessary]*
Unknown	Unknown	Unknown		

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk, so the state of the stock is unknown. Indices from commercial fishery suggest that the stocks in this Management Area are exploited at sustainable levels. Large amounts of discards in recent years (1999–2000) may indicate strong recruitment.

Management objectives

No management objectives have been set for this fishery.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Given the apparent stability of the stocks, current levels of exploitation appear to be sustainable.

Due to uncertainty in the available data ICES is not able to reliably forecast catch. Therefore ICES recommends that fishing effort for fleets targeting *Nephrops* should not be allowed to increase.

Management considerations

Discards are known to be very high and any improvement of the fishing pattern of the catches would benefit the stock and medium-term yield.

Since most of the trawl fisheries for *Nephrops* in Division IIIa are mixed fisheries, the effort in these fisheries may affect by-catch levels of other commercial species caught unless the species and size selectivity properties of the *Nephrops* trawls is improved (e.g. grids and square meshes).

In view of the catch restrictions for cod and other demersal fish species in the North Sea and IIIa it should also be noted that if *Nephrops* fishing effort is allowed to increase, this may have implications for those stocks in mixed fisheries where *Nephrops* is targeted, unless species and size selectivity of the gears is improved (see above). Cod and sole are significant bycatch species in these fisheries in IIIa, and even if data on catch including discards of the bycatch gradually become available, they have not yet been used in the management.

Ecosystem considerations

Individual stocks inhabit distinct areas of suitable muddy sediment. No information is available on the extent to which larval mixing occurs between *Nephrops* stocks.

Cod have been identified as a predator of *Nephrops* in some areas, and the generally low level of the cod stock is likely to have resulted in reduced predation.

Factors affecting the fisheries and the stock

The majority of landings are taken by Denmark and Sweden, with Norway contributing only small landings from the Skagerrak. During the last 10 years, total landings from the Skagerrak have varied between 1 900 and 3 250 t, while landings from the Kattegat have varied between 900 and 1 800 t (with the lowest landings recorded in 1992–1995).

The effects of regulations

The minimum landing size for *Nephrops* in Area IIIa is 40 mm carapace length.

Days-at-sea limits restrict *Nephrops* trawlers to 19 days per month when using 90-mm mesh with no square mesh panel, and 22 days with a square mesh panel. New gear regulations imply that it is mandatory to use a 35-mm species-selective grid and 8 metres of 70-mm full square mesh codend and extension piece when trawling for *Nephrops* in Swedish national waters. As Sweden has bilateral agreements with Denmark and Norway to fish inside the 12 nm limit, the regulations cover only waters exclusively fished by Swedish vessels (inside 3 nm in Kattegat and 4 nm in Skagerrak).

Traditionally, *Nephrops* have mainly been caught in trawls using 70–89 mm mesh sizes. In the last five years an increasing proportion of the total landings of *Nephrops* have been caught by vessels using gears with mesh sizes >89 mm (which historically have been used in the fishery for cod, plaice, and other demersal fish species). In Skagerrak and Kattegat mesh sizes between 70–89 mm have been prohibited since 2005, unless the codend and the extension piece is constructed of square meshed netting with a sorting grid (Council Regulation 27/2005). Those changes in fishing patterns may be seen in the light of the declines in most important demersal fish stocks in the North Sea, Skagerrak, and Kattegat.

Changes in fishing technology and fishing patterns

Recent reports from industry and gear technologists suggest a more widespread use of “flip-up” gear in twin rig *Nephrops* trawls (see Graham, WD). This development will allow fleets to expand onto rougher ground, potentially exploiting new *Nephrops* areas.

Scientific basis

Data and methods

LPUE and mean size data are available for both FUs. Length compositions are available from 1991 onwards.

Uncertainties in assessment and forecast

The assessment of the state of the *Nephrops* stocks in the Skagerrak and Kattegat area is based on the patterns in fluctuations of total combined LPUE by Denmark and Sweden during the period 1990–2004 and the patterns in fluctuations of discards in the fisheries as estimated from the catch samples for the same period.

However, the quality of LPUE could be affected by changes in catchability (due to sudden changes in the environmental conditions), or changes in selectivity and/or in gear efficiency. Discards are also dependent on selectivity of the gear and on discarding practices.

Comparison with previous assessment and advice:

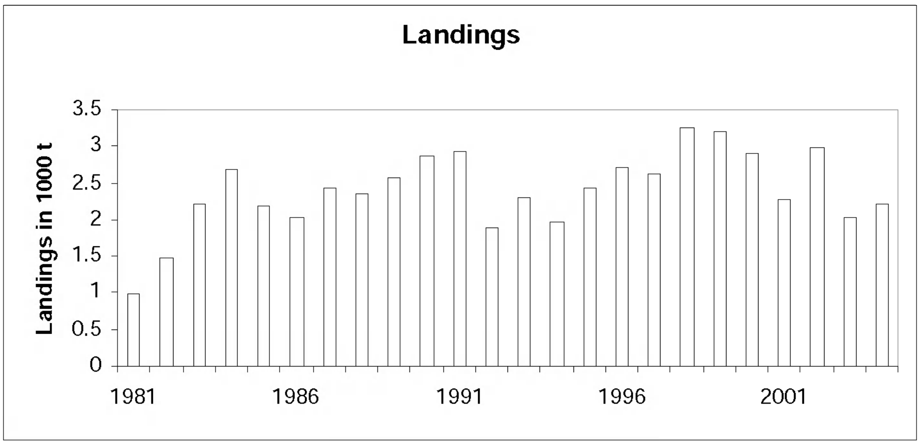
Due to the ageing problems for *Nephrops* in general, ICES decided not to conduct age-based assessments of these stocks and no analytical assessments on these FUs were performed in 2005. However, the perception of the state of these stocks based on stock indicators as LPUEs is the same as in 2003.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM landings [1]
1987				4.0
1988				3.7
1989				3.9
1990				4.3
1991				4.2
1992		~4.0	3.5	2.9
1993		~4.3	3.5	3.2
1994		2.9	3.5	2.9
1995		2.9	4.8	3.4
1996	*Status quo* TAC	2.9	4.8	4.0
1997	*Status quo* TAC	2.9	4.8	4.2
1998		4.0	4.8	5.0
1999		4.0	4.8	4.9
2000		3.8	5.0	4.7
2001		3.8	4.5	4.1
2002	*Catches to be maintained at the 2000 level*	4.7	4.5	4.4
2003	*Catches to be maintained at the 2000 level*	4.7	4.5	3.6
2004	*Catches to be maintained at the 2000 level*	4.7	4.7	4.0
2005	*Catches to be maintained at the 2000 level*	4.7	4.7	
2006	*No increase in effort*			
2007	*No increase in effort*			

(Weights in '000 t) [1)] Does not include discards.

Nephrops in Division IIIa (Management Area E) Skagerrak FU 3



Nephrops in Division IIIa (Management Area E) Kattegat FU 4

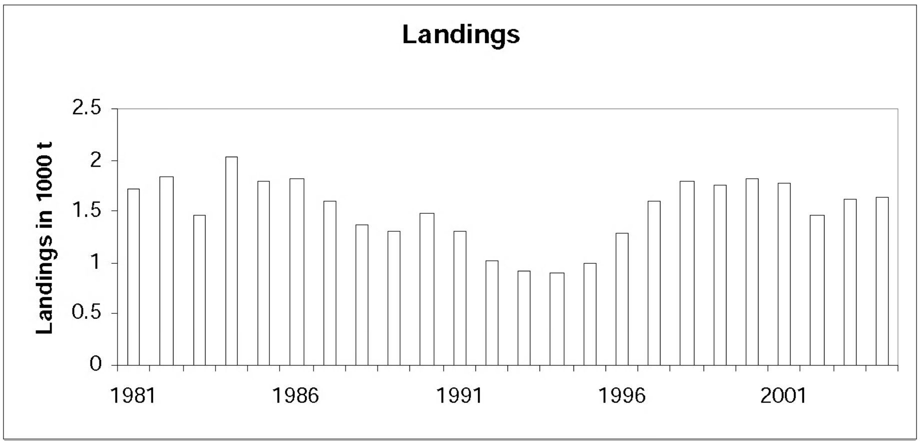


Table 1.4.13.1 Management Area E (IIIa): Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1991–2004.

Year	FU 3	FU 4	Other	Total
1991	2934	1304	0	***4238***
1992	1900	1012	0	***2912***
1993	2285	924	0	***3209***
1994	1981	893	0	***2874***
1995	2429	998	0	***3427***
1996	2694	1285	0	***3979***
1997	2612	1594	0	***4206***
1998	3248	1796	0	***5044***
1999	3194	1749	0	***4943***
2000	2894	1809	0	***4703***
2001	2282	1773	0	***4055***
2002	2977	1464	0	***4441***
2003	2126	1628	0	***3754***
2004	2312	1641	0	***3953***

Table 1.4.13.2 Management Area E (IIIa): Total *Nephrops* landings (tonnes) by country, 1991–2004.

Year	Denmark	Norway	Sweden	Total
1991	2824	195	1219	***4238***
1992	2052	111	749	***2912***
1993	2250	100	859	***3209***
1994	2049	62	763	***2874***
1995	2419	90	918	***3427***
1996	2844	101	1034	***3979***
1997	2959	117	1130	***4206***
1998	3541	184	1319	***5044***
1999	3486	214	1243	***4943***
2000	3325	181	1197	***4703***
2001	2880	138	1037	***4055***
2002	3293	116	1032	***4441***
2003	2757	99	898	***3754***
2004	2955	95	903	***3953***

Table 1.4.13.3 *Nephrops* Division IIIa (Management Area E) Skagerrak FU 3

Year	Landings tonnes
1981	992
1982	1470
1983	2205
1984	2675
1985	2191
1986	2018
1987	2441
1988	2363
1989	2564
1990	2866
1991	2934
1992	1900
1993	2285
1994	1981
1995	2429
1996	2694
1997	2612
1998	3248
1999	3194
2000	2894
2001	2282
2002	2977
2003	2027
2004	2217
Average	2394

Table 1.4.13.4 *Nephrops* Division IIIa (Management Area E) Kattegat FU 4

Year	Landings tonnes
1981	1728
1982	1828
1983	1472
1984	2036
1985	1798
1986	1807
1987	1605
1988	1364
1989	1313
1990	1475
1991	1304
1992	1012
1993	924
1994	893
1995	998
1996	1285
1997	1594
1998	1796
1999	1749
2000	1809
2001	1773
2002	1464
2003	1628
2004	1641
Average	1512

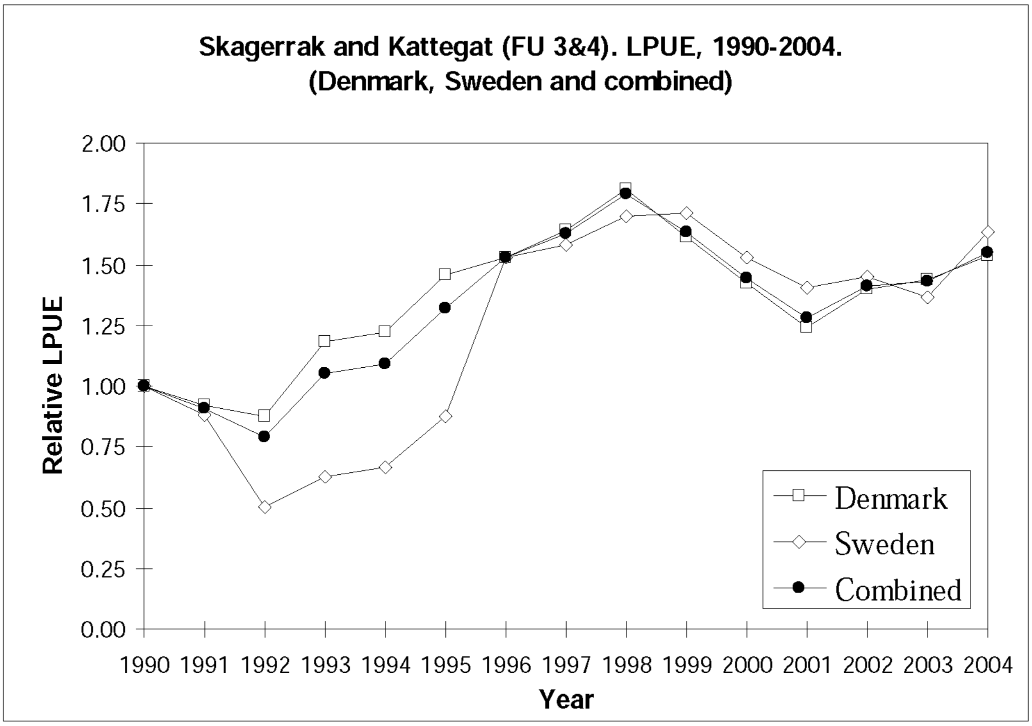


Figure 1.4.13.1 *Nephrops* in Division IIIa

1.4.14 Shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deeps)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Unknown	Unknown			The stock appears to be stable at the same level in 2005 and 2006 as in recent years.

The current state of the stock appears to be stable and at a rather high level. This assessment is based on 1) evaluation of LPUE from the fishery 1984–2005 and the 2004–2005 survey indices of biomass and 2) production model-based estimates using the 1985–2002 survey and catch data (1984–2005).

Management objectives

There are no explicit management objectives for this stock.

Reference points

There are no precautionary reference points.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary considerations

Based on the assessment it is recommended that the total landings from IIIa and IVa East in the 2006 are not increased above the recent average (2002–2004) of 13 500 t. However, it is likely that the stock may sustain an even higher exploitation.

Short-term implications

Outlook for 2006

There are no signs indicating that the development in 2005 and 2006 will change dramatically compared to 2004.

Management considerations

The exploitable biomass comprises only few age groups (1–3) of which age group 2 and older constitute around 70% in weight of the total catch.

Sorting grids or other means of facilitating the escape of fish should be implemented in this fishery.

Factors affecting the fisheries and the stock

Regulations and their effects

The main regulation tool is a TAC which is not fully fished by all countries.

Changes in fishing technology and fishing patterns

Within the last 5–10 years almost all Danish trawlers had started fishing with twin trawls. This change allowed the individual vessels to increase the swept area (wing end to wing end) by approximately 50% without increased demands to the vessels' engine capacity or a noticeable increase in fuel consumption.

The environment

Strong fluctuations in the *Pandalus* stocks are frequently observed. Predator pressure as well as the few age groups in the stock contributes significantly to such fluctuations. The natural mortality for *Pandalus* is likely to be substantially higher than the fishing mortality and fluctuates considerably according to the abundance of predators.

Scientific basis

Data and methods

The perception of the state of the stock in 2004 is based on the result of the stock production model as well as trends in commercial LPUEs combined with a comparison of the 2004 biomass index from a Norwegian survey in May 2004 and 2005. The assessments in previous years (2001–2003) took predation into account and indicated that predators annually remove a much larger fraction of the stock than the fishery. This year's model does not take predation specifically into account.

Comparison with previous assessment and advice

The production model assessment presented this year confirms last year's LPUE based assessment of the state of stock.

Source of information

Report of the *Pandalus* Assessment Working Group, Halifax, 26 October–4 November 2005 (ICES CM 2006/ACFM:06).

Year	ICES Advice	Single-Stock Exploitation Boundaries	Predicted lndgs corresp. to advice[1]	Predicted lndgs corresp. to Single-Stock Exploitation Boundaries [1]	Agreed TAC IIIa	Agreed TAC IIIa + IV	ACFM catches Discards.	Landings	Total
1987	Not assessed						0.7	14.2	14.9
1988	Catches significantly below 1985–1986[3]						0.8	12.2	12.9
1989	No advice				3.1[1]		1.1	11.0	12.1
1990	F as F(pre-85)[3]; TAC[3]; No increase in F[4]; TAC[4]		10.0		2.75[1]		1.2	10.2	11.4
1991	No increase in F; TAC		12.0		8.55		0.5	11.6	12.1
1992	Within safe biological limits		15[2]		10.50	15.0	0.5	13.0	13.6
1993	Within safe biological limits		13[2]		10.50	15.0	0.9	12.6	13.5
1994	Within safe biological limits		19[2]		12.60	18.0	0.2	11.5	11.7
1995	Within safe biological limits		13[2]		11.20	16.0	0.3	14.2	14.5
1996	No advice		11[2]		10.50	15.0	0.3	14.2	14.5
1997	No advice		13[2]		10.50	15.0	1.0	15.1	16.1
1998	No increase in F; TAC		19[2]		13.16	18.8	0.4	15.4	15.8
1999	Maintain F		19[2]		13.16	18.8	0.6	11.2	11.9
2000	Maintain F		<11.5[2]		9.10	13.0	0.7	10.8	11.5
2001	Maintain F		13.4		10.15	14.5	0.7	11.0	11.7
2002	Long-term average landings		12.6		10.15	14.5	0.2	12.1	12.3
2003	Maintain F		14.7		10.15	14.5	1.3	13.3	14.6
2004	[5]	No increase in F		15.3[5]	10.71	15.69	1.3	15.2	16.5
2005		No increase in catch above recent level		~13[5]	10.71	15.60			
2006		No increase in catch above recent level		~13.5[5]					

[1]EU zone only. [2] Catch at *status quo* F. [3] IIIa. [4]Norwegian Deep. [5] Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits. Weights in '000 t.

Tabel 1.4.14.1 *Pandalus borealis* landings (tonnes) from Divisions IIIa (Skagerrak) and IVa (eastern part) as estimated by ICES.

Year	Denmark	Norway	Sweden	Total	Estimated discards*)	TAC	Catch
1970	1102	1729	2742	5573			
1971	1190	2486	2906	6582			
1972	1017	2477	2524	6018			
1973	755	2333	2130	5218			
1974	530	1809	2003	4342			
1975	817	2339	2003	5159			
1976	1204	3348	2529	7081			
1977	1120	3004	2019	6143			
1978	1459	2440	1609	5508			
1979	1062	3040	1787	5889			
1980	1678	4562	2159	8399			
1981	2593	5183	2241	10017			
1982	3766	5042	1450	10258			
1983	1567	5361	1136	8064			
1984	1800	4783	1022	7605	200		7805
1985	4498	6646	1571	12715	558		13273
1986	4866	6490	1463	12819	414		13233
1987	4488	8343	1322	14153	723		14876
1988	3240	7661	1278	12179	750		12929
1989	3242	6411	1433	11086	1107		12193
1990	2479	6108	1608	10195	1226		11421
1991	3583	6119	1908	11610	497		12107
1992	3725	7136	2154	13015	541	15000	13556
1993	2915	7371	2300	12586	889	15000	13475
1994	2134	6813	2601	11548	214	18000	11761
1995	2460	8095	2882	13437	275	16000	13713
1996	3868	7878	2371	14117	318	15000	14436
1997	3909	8565	2597	15071	1039	15000	16110
1998	3330	9606	2469	15406	348	18800	15753
1999	2072	6739	2445	11256	639	18800	11895
2000	2371	6118	2225	10714	687	13000	11401
2001	1953	6895	2108	10956	701	14500	11657
2002	2466	7321	2301	12088	254	14500	12342
2003	3244	7715	2389	13348	1253	15690	14601
2004	3905	8998	2464	15203	1248	15690	16451

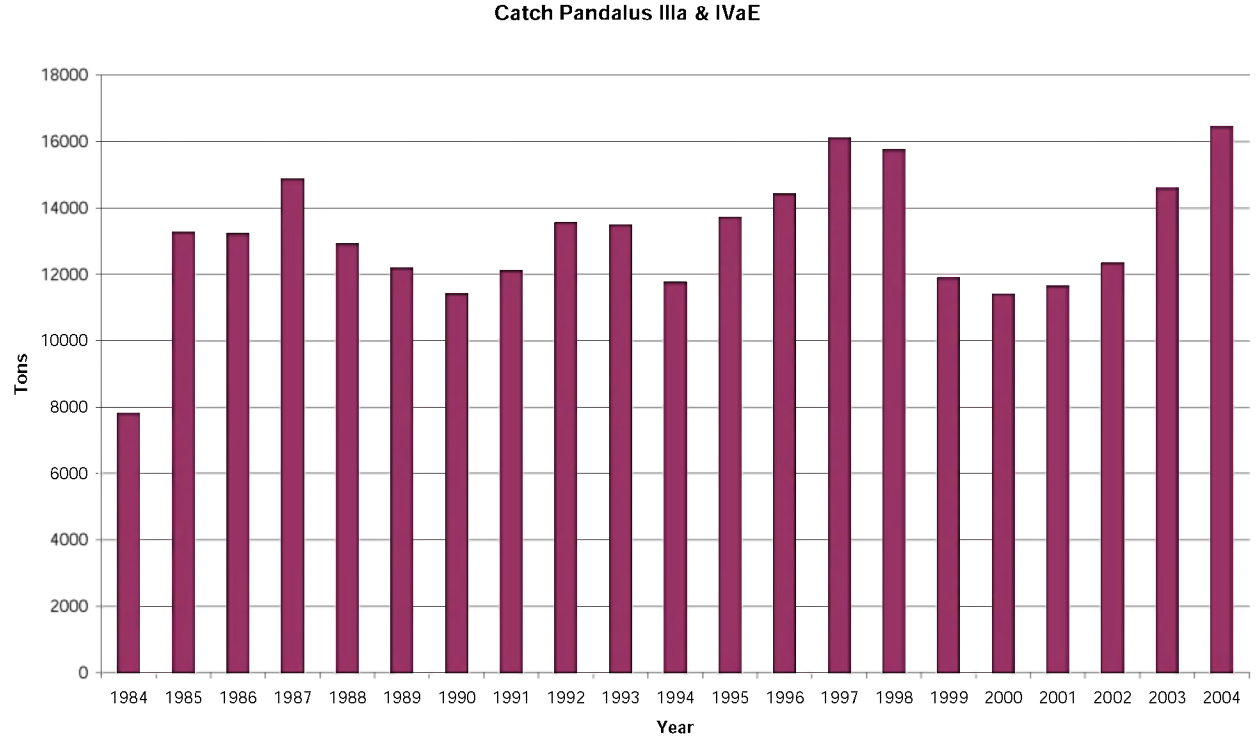


Figure 1.4.14.1 Total landings of *Pandalus* from the Skagerrak and eastern part of the North Sea.

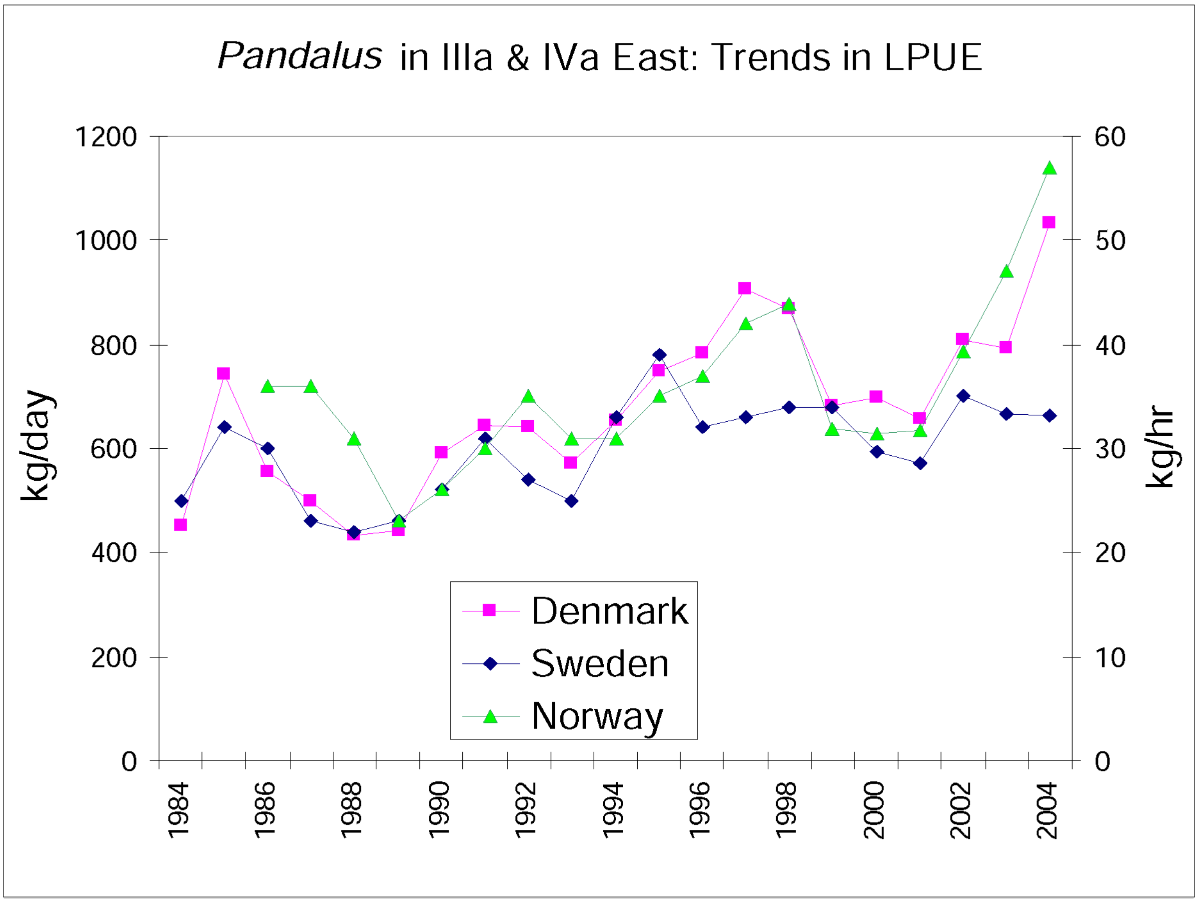


Figure 1.4.14.2 Landings per unit effort (LPUE) in kg per fishing day and total effort in '000 hours trawled.

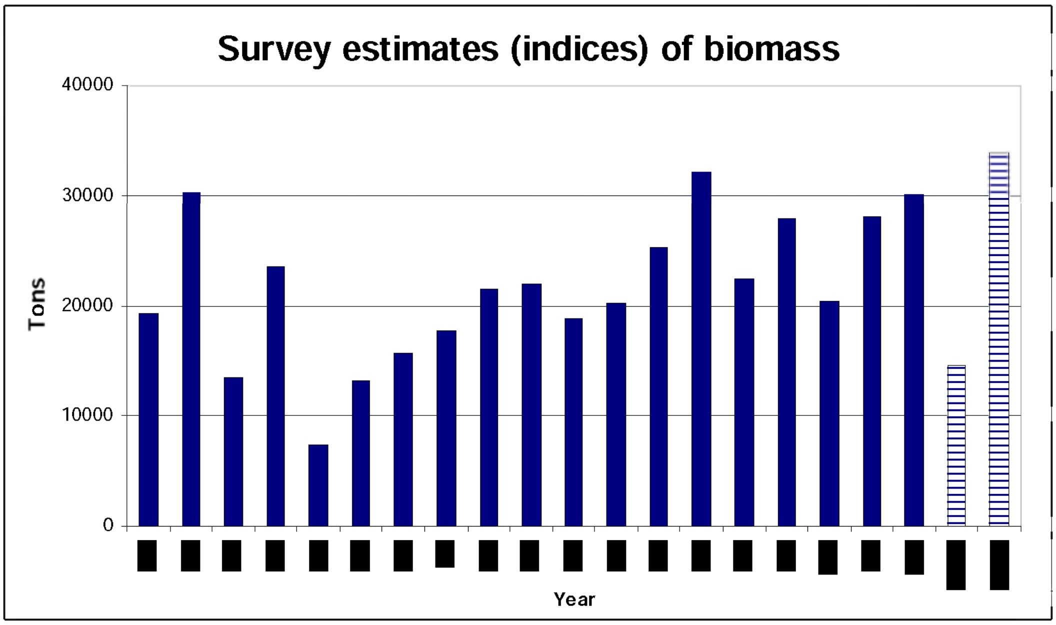


Figure 1.4.14.3 **Survey results: Trends in biomass, 1984–2004.** The estimates for 2003 and 2004 are not comparable to the previous estimates. In 2003 a trawl with large mesh size was used in the survey.

1.4.15 *Pandalus* on Fladen Ground (Division IVa)

State of the stock

The shrimp stock on Fladen Ground has not been assessed since 1992, due to insufficient data. There is a total lack of separate, fishery-independent data. The most recent analytical assessment of this stock was presented in the 1992 ACFM Report (ICES, 1992). Landings have declined gradually from 1999 to 2003, but in 2004 nearly no catches were recorded (23 t). Part of the explanation for this development is the low price for shrimp combined with the rather high fuel costs. No monitoring of this stock has taken place, but it cannot be ruled out that the dramatic drop in 2004 also reflects a serious decline in the stock.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No reference points have been defined.

Short-term considerations

ICES recommends that catches are not increased above average recent (2001–2003) landings of about 1300 t.

Management considerations

The development in the 2004 fishery, as described above, could indicate a low stock level. For the Fladen Ground stock such events have occurred previously, notably in 1987–1988. However, a recovery of the stock after that decline was observed already in 1989–1990 without any management actions.

Catches from Fladen Ground consist mainly of two age groups. During the first two quarters of the year age groups 2 and 3 normally dominate the catches. During the fourth quarter, age group 3 usually disappears from the catches, while age group 1 enter the catches.

Scientific basis

Some data for use in an analytical assessment for later years have been compiled. However, due to the frequent large seasonal fluctuations in the Fladen Ground fishery, samples for length composition of the catches do not always cover the entire year. There is no survey information available and stock predictions for the Fladen Ground shrimp are not possible.

ICES has, so far, maintained the view that shrimp caught on the Fladen Ground constitute a stock separated from the *Pandalus* in the Norwegian Deeps and Skagerrak. This assumption is under review; there are indications that the Fladen Ground shrimp and the shrimp in the Norwegian Deep are correlated.

Source of information

Report of the *Pandalus* Assessment Working Group, Halifax, 26 October–4 November 2005 (ICES CM 2006/ACFM:06).

Table 1.4.15.1 Landings in tonnes of *Pandalus borealis* from the Fladen Ground (Division IVa) as estimated by ICES.

Year	Denmark	Norway	Sweden	UK (Scotland)	Total
1972	2204			187	2391
1973	157			163	320
1974	282			434	716
1975	1308			525	1833
1976	1552			1937	3489
1977	425	112		1692	2229
1978	890	81		2027	2998
1979	565	44		268	877
1980	1122	76		377	1575
1981	685	1		347	1033
1982	283			352	635
1983	5729	8		1827	7564
1984	4553	13		25	4591
1985	4188			1341	5529
1986	3416			301	3717
1987	8620			686	9306
1988	1662	2		84	1748
1989	2495	25		547	3067
1990	1681	3	4	365	2053
1991	422	31		53	506
1992	1448			116	1564
1993	1521	38		509	2068
1994	1229	0		35	1264
1995	4659	15		1298	5972
1996	3858	32		1893	5783
1997	3022	9		365	3396
1998	2900	3		1365	4268
1999	1005	9		456	1470
2000	1482			378	1860
2001	1263	18		397	1678
2002	1147	9		70	1226
2003	999	8	1	0	1008
2004	23			0	23

Note: 2004 figures are preliminary.

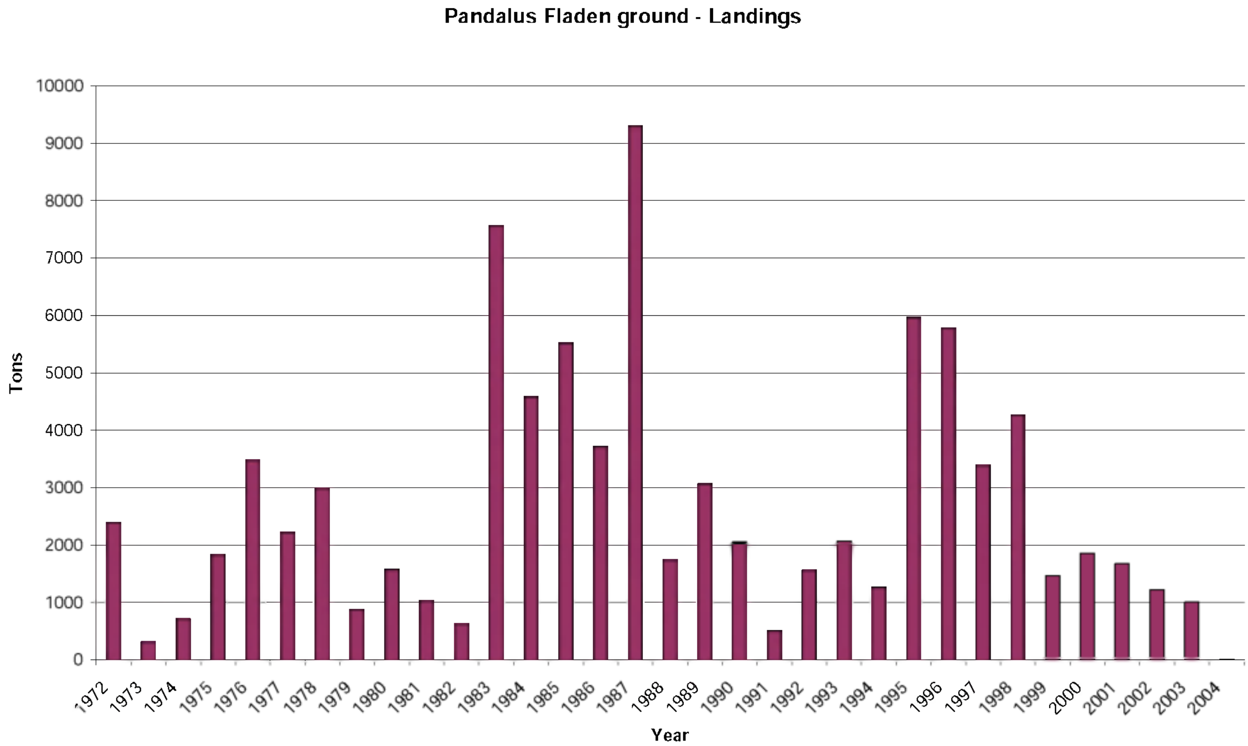


Figure 1.4.15.1 Total landings of *Pandalus* on Fladen Ground.

1.4.16 *Pandalus* in Farn Deeps (Division IVb)

State of Stock

Since 1991, only UK vessels have fished *Pandalus* in the Farn Deeps. Total landings fell from 500 t in 1988 to none in 1993. In 1995 and 1996 again about 100 ton were reported. Since 1997 the *Pandalus* fishery in Farn Deeps has been negligible. No assessments of these shrimps are available.

Source of information

Report of the *Pandalus* Assessment Working Group, Halifax, 26 October – 4 November 2005 (ICES CM 2006/ACFM:06).

1.4.17 Herring in Subdivisions 22–24 and Division IIIa (spring spawners)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Reference points not defined	Reference points not defined	unknown	unknown	

In the absence of defined reference points, the state of the stock cannot be evaluated with regard to these. An analytical assessment demonstrates that SSB has been slightly increasing over a number of years. The fishing mortality estimates for 2004 are 0.36 for adults and 0.11 for the juveniles (0- and 1-ringers). The age structure in the catch over the last three years consistently reflects that the large 1999 year class is now part of the spawning stock. The 2003 year class seems to be above average.

Management objectives

There are no explicit management objectives for this stock.

Reference points

There are no reference points for this stock.

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average last 3 years	0.413	0.025	0.051
$\mathbf{F}_{0.1}$	0.212	0.023	0.099
$\mathbf{F}_{med}$	0.529	0.025	0.037

If target reference points are to be established, $\mathbf{F}_{0.1}$ would be associated with high long-term yields and low risk of reduced reproductive capacity.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Current fishing mortality has led to stable or increased SSB and the fishing mortality should not be allowed to increase. This corresponds to landings of less than 95 000 t in 2006.

Short-term implications

Outlook for 2006

Basis: F(2005) = $\mathbf{F}_{sq}$ = 0.358; SSB(2005) =194; catch (2005) =92.
Landings are for Division IIIa (spring-spawning herring and western Baltic (Subdivisions 22–24) combined), see further in Section 1.4.18.

Rationale	Catches (2006)	Basis	F(2006)	SSB(2007)
Zero catch	0	**F**=0	0	325
Proportion F	78	$\mathbf{F}_{sq}$ *0.8	0.286	249
Proportion F	87	$\mathbf{F}_{sq}$ *0.9	0.322	240
Status quo	95	$\mathbf{F}_{sq}$	0.358	233
Proportion F	104	$\mathbf{F}_{sq}$ *1.1	0.393	225
Proportion F	111	$\mathbf{F}_{sq}$ *1.2	0.429	218
Proportion F	119	$\mathbf{F}_{sq}$ *1.3	0.465	211
$\mathbf{F}_{0.1}$	60	$\mathbf{F}_{0.1}$	0.212	266

Weights in '000 t.

Management considerations

North Sea Autumn-Spawning and the Western Baltic Spring-Spawning herring stocks are exploited and managed simultaneously in Division IIIa. Hence, the management of the herring fisheries in Division IIIa influences both stocks. The advisory emphasis on one or the other stock will vary between periods and depends on their relative status.

In the second half of the 1990s and the beginning of the 2000s the North Sea Autumn-Spawning stock was depleted and advice on management of herring fisheries in Division IIIa focused on rebuilding the North Sea herring. The herring fishery in Division IIIa was then managed in a manner consistent with the management of the North Sea Autumn-Spawning herring. With the rebuilding of the North Sea stock, concerns for the North Sea Autumn-Spawning herring are less and advice on management of the herring fisheries in Division IIIa is now more focused on the Western Baltic stock.

Catch options for the whole stock of Western Baltic Spring-Spawning herring can be partitioned into catches by area. Likewise, the catches of WBSS in Division IIIa also imply catches of North Sea Autumn-Spawning herring which constitute part of the total catch in that area. The basis for the split of the Western Baltic Spring-Spawning herring catch by area and of the catch in Division IIIa by stock was the ratios between the catches in 2004. The current relevant fleet definitions are:

Division IIIa
Fleet C: Directed herring fisheries with purse seiners and trawlers
Fleet D: Bycatches of herring caught in the small-mesh fisheries

Subdivision 22-24
The WBSS are exploited by other fleets as well, in Subdivisions 22–24.

The text table below shows the 2004 share of the total catch in tonnes of Western Baltic Spring-Spawning herring by fleet:

WBSS	Fleet C (IIIa)	Fleet D (IIIa)	SD 22-24 + Fleet A (IV)	Total
2004	16 825 (22%)	11 175 (15%)	48 815 (64%)	76 815

The text table below shows the proportion of Western Baltic Spring-Spawning herring in the catches by fleet in Division IIIa, as well as for the fleets in SD 2224.

WBSS	Fleet C	Fleet D	SD22-24 + *Fleet A (IV)**
2004	0.56	0.51	1

* Only WBSS caught in Subarea IV are accounted for in the calculations

The text table below shows the expected catches for each stock and in each area corresponding to a range of total catch options for the Western Baltic Spring-Spawning herring stock:

Management considerations for Division IIIa based on short-term predictions (2006)						
Western Baltic Spring-Spawners			North Sea Autumn-Spawners		Both Stocks together	
All fleets total catches	Fleet C (22% of TAC)	Fleet D (15% of TAC)	Fleet C (WBSS/56%)	Fleet D (WBSS/51%)	Fleet C	Fleet D
60,000	13,100	8,700	10,500	8,400	23,600	17,100
65,000	14,200	9,500	11,400	9,100	25,600	18,600
70,000	15,300	10,200	12,200	9,800	27,500	20,000
75,000	16,400	10,900	13,100	10,500	29,500	21,400
80,000	17,500	11,600	14,000	11,200	31,500	22,800
85,000	18,600	12,400	14,900	11,900	33,500	24,300
90,000	19,700	13,100	15,700	12,600	35,400	25,700
95,000	20,800	13,800	16,600	13,300	37,400	27,100
100,000	21,900	14,500	17,500	14,000	39,400	28,500

A TAC of up to 37 400 t for the C-fleet is in accordance with the largest advised total catch of 95 000 t Western Baltic Spring-Spawning herring, under assumptions of retained catch share among areas and retained proportions among stocks. The corresponding number for the D fleet is 27 100 t.

Low recruitment of the three most recent NSAS year classes together with an increase in the WBSS stock is expected to lead to changes in stock composition as well as area distribution and thereby affect near future catch options. Especially consequences for the D-fleet catch options should be closely followed.

Factors affecting the fisheries and the stock

Regulations and their effects

ICES considered the effects on the WBSS of the present EU-Norway agreement in 2005 on quota transfer in Division IIIa. The agreement sets 12 800 tonnes for Norway of which 50% can be taken in the North Sea. A bycatch TAC for Division IIIa herring in the small-meshed fishery (fleet-D) is set at 24 150 tonnes, none of which is taken by Norway and thus no transfer in this fleet category is possible.

The effect of a transfer of 50% of Norwegian catches amount to 6400 t and will at the most equal a reduction in outtake of 3600 t in the exploitation of WBSS, since part of the catches will anyway be taken in the transfer area where WBSS are taken. The changes in F and SSB for WBSS will thus be marginal.

Changes in fishing technology and fishing patterns

Since 2001 the fishery behavior has changed in the German fleet. In former years the dominant part of herring was caught in the passive gears, bottom-set gillnets and trapnets. The proportion of herring, which was caught by trawlers in the area off the Rügen Island coast up to the Arcona Sea (Subdivision 24), increased from 26% in 2001 to 52% in 2004. This change was caused by new requirements from a new fish factory on the Rügen Island.

The environment

Herring in Division IIIa and Subdivisions 22–24 make age- and stage-specific migrations. There are feeding migrations from the Western Baltic into more saline waters of Division IIIa and the eastern parts of Division IVa.

Scientific basis

Data and methods

The otolith microstructure method to calculate the proportion of spring and autumn spawners caught in these areas has been used for all catch and IBTS data for the period 1991–2004. Analytical assessment is based on catch data and acoustic and trawl survey results.

In order to continue to improve the assessment, an acoustic survey covering the whole stock is needed. Development of stock identification methods using combinations of genetics and otolith analyses continues. Results from such methods allow exploration of the importance of stock migrations and local stock components in the area.

Uncertainties in assessment and forecast

There is a tendency to overestimate the fishing mortality in the five-year retrospective analysis.

The historical bias in the assessment is small, except in the recruitment. Apparently, the strength of a year class is not firmly estimated before the year class has been followed for 2–3 years.

Comparison with previous assessment and advice

The current procedure for assessing the stock has given consistent results with respect to fishing mortality and spawning biomass for several years. Compared to last year's assessment, the change in the estimate is +1% for the fishing mortality in 2003 and -2% for the SSB in 2003.

The assessment carried out in 2004 is in line with the 2003 assessment.

Information from the fishing industry

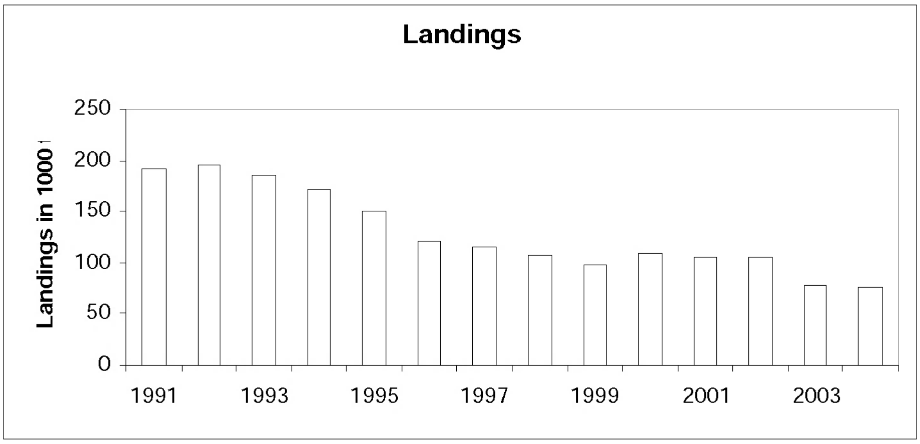
The fishing industry suggests that substantial area misreporting occurs from the North Sea to Kattegat.

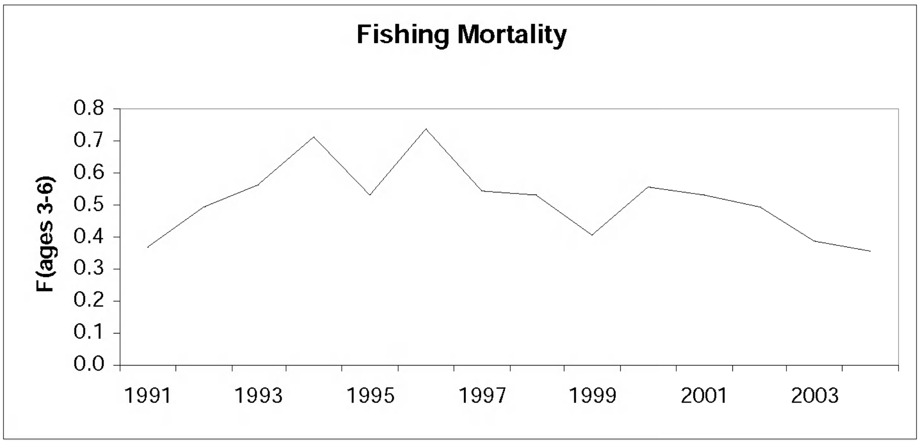
Source of information

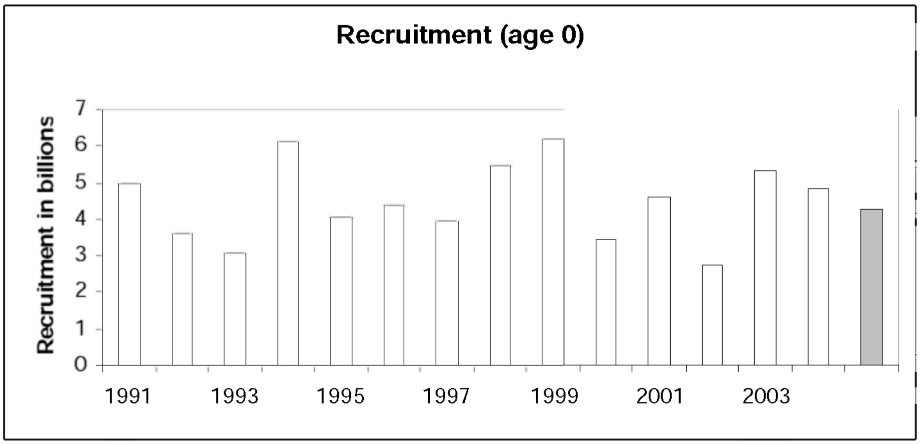
Report of the Baltic Fisheries Assessment Working Group Hamburg, 12–21 April 2005, ICES CM 2005/ACFM:19.
Report of the Herring Assessment Working Group for the Area South of 62°N, 8–17 March 2005 (ICES CM 2005/ACFM:16).

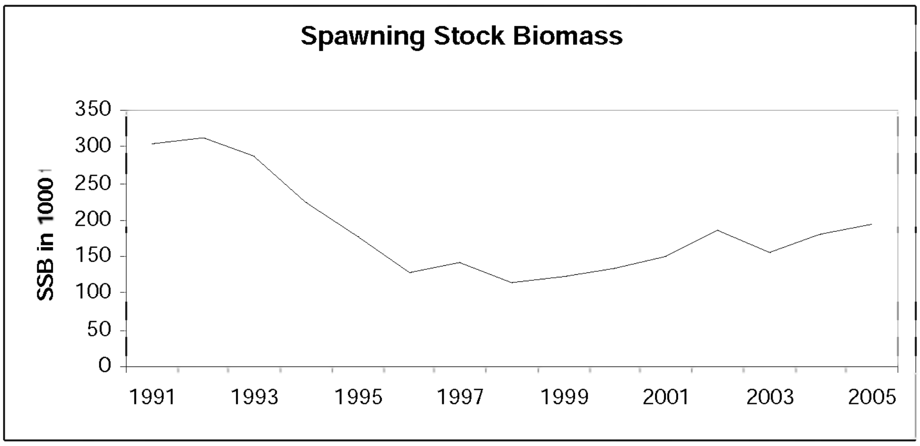
Year	ICES Advice	Pred. Catch Corresp. to advice	Agreed TAC IIIa[2]	ACFM catch of Stock			
				22–24	IIIa	IV	Total
1987	Reduction in F	224	218	102	59	14	175
1988	No increase in F	196	218	99	129	23	251
1989	TAC	174	218	95	71	20	186
1990	TAC	131	185	78	118	8	204
1991	TAC	180	155	70	112	10	192
1992	TAC	180	174	85	101	9	195
1993	Increased yield from reduction in F; reduction in juvenile catches	188	210	81	95	10	186
1994	TAC	130–180	191	66	92	14	172
1995	If required, TAC not exceeding recent catches	168–192	183	74	80	10	164
1996	If required, TAC not exceeding recent catches	164–171	163	58	71	1	130
1997	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	66–85[1]	100	68	55	1	124
1998	Should be managed in accordance with North Sea autumn spawners	-	97	51	53	8	112
1999	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-	99	50	43	5	98
2000	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60 for Sub-divs. 22–24	101	54	57	7	118
2001	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Sub-divs. 22–24	101	64	42	6	112
2002	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Sub-divs. 22–24	101	53	47	7	107
2003	Reduce F	<80	101	40	36	2	78
2004	Separate management regime for this stock Reduce F	<92	91	42	24	7	77
2005	Separate management regime for this stock *Status quo* F	95	120				
2006	Separate management regime for this stock *Status quo* F	95					

Weights in '000 t.
[1]Catch in Subdivisions 22–24. [2]Including mixed clupeoid TAC and bycatch ceiling in small-mesh fishery.

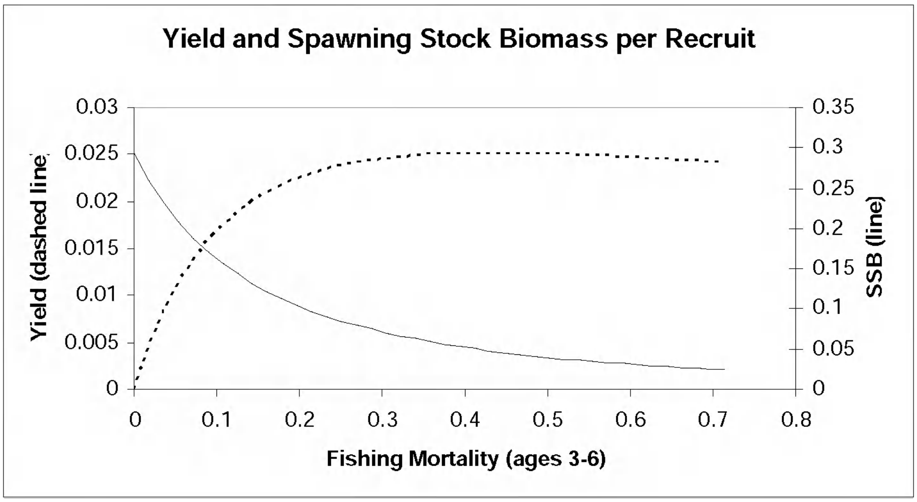

Landings
Landings in 1000 t
250
200
150
100
50
0
1991
1993
1995
1997
1999
2001
2003


Fishing Mortality
F(ages 3-6)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1991
1993
1995
1997
1999
2001
2003


Recruitment (age 0)
Recruitment in billions
7
6
5
4
3
2
1
0
1991
1993
1995
1997
1999
2001
2003


Spawning Stock Biomass
SSB in 1000 t
350
300
250
200
150
100
50
0
1991
1993
1995
1997
1999
2001
2003
2005


Stock - Recruitment
Recruitment (age 0) in billion
SSB in 1000 t
0
1
2
3
4
5
6
7
0
50
100
150
200
250
300
350


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-6)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

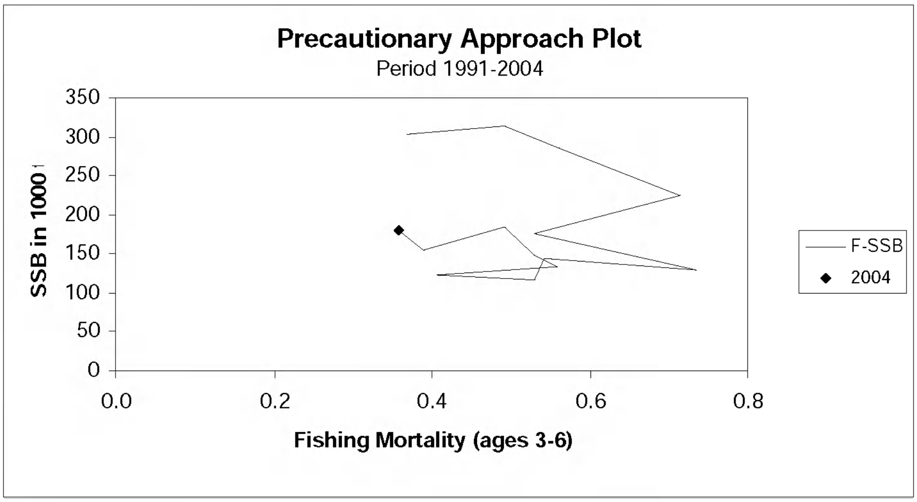

Precautionary Approach Plot
Period 1991-2004
SSB in 1000 t
Fishing Mortality (ages 3-6)
0
50
100
150
200
250
300
350
0.0
0.2
0.4
0.6
0.8
F-SSB
2004

Table 1.4.17.1 HERRING in Division IIIa and Subdivisions 22-24, 1985-2004.
Landings in thousands of tonnes.

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Skagerrak										
Denmark	88.2	94.0	105.0	144.4	47.4	62.3	58.7	64.7	87.8	44.9
Faroe Islands	0.5	0.5								
Norway	4.5	1.6	1.2	5.7	1.6	5.6	8.1	13.9	24.2	17.7
Sweden	40.3	43.0	51.2	57.2	47.9	56.5	54.7	88.0	56.4	66.4
Total	133.5	139.1	157.4	207.3	96.9	124.4	121.5	166.6	168.4	129.0
Kattegat										
Denmark	69.2	37.4	46.6	76.2	57.1	32.2	29.7	33.5	28.7	23.6
Sweden	39.8	35.9	29.8	49.7	37.9	45.2	36.7	26.4	16.7	15.4
Total	109.0	73.3	76.4	125.9	95.0	77.4	66.4	59.9	45.4	39.0
Sub. Div. 22+24										
Denmark	15.9	14.0	32.5	33.1	21.7	13.6	25.2	26.9	38.0	39.5
Germany	54.6	60.0	53.1	54.7	56.4	45.5	15.8	15.6	11.1	11.4
Poland	16.7	12.3	8.0	6.6	8.5	9.7	5.6	15.5	11.8	6.3
Sweden	11.4	5.9	7.8	4.6	6.3	8.1	19.3	22.3	16.2	7.4
Total	98.6	92.2	101.4	99.0	92.9	76.9	65.9	80.3	77.1	64.6
Sub. Div. 23										
Denmark	6.8	1.5	0.8	0.1	1.5	1.1	1.7	2.9	3.3	1.5
Sweden	1.1	1.4	0.2	0.1	0.1	0.1	2.3	1.7	0.7	0.3
Total	7.9	2.9	1.0	0.2	1.6	1.2	4.0	4.6	4.0	1.8
Grand Total	349.0	307.5	336.2	432.4	286.4	279.9	257.8	311.4	294.9	234.4

Year	1995	1996	1997	1998 [2]	1999 [2]	2000	2001 [3]	2002	2003	2004 [1]
Skagerrak										
Denmark	43.7	28.7	14.3	10.3	10.1	16.0	16.2	26.0	15.5	8.0
Faroe Islands										
Germany									0.7	0.5
Norway										1.4
Sweden	48.5	32.7	32.9	46.9	36.4	45.8	30.8	26.4	25.8	21.8
Misreporting										
Total	95.2	64.4	50.2	60.2	46.5	61.8	47.0	43.4	43.9	31.7
Kattegat										
Denmark	16.9	17.2	8.8	23.7	17.9	18.9	18.8	22.5	14.0	10.9
Sweden	30.8	27.0	18.0	29.9	14.6	17.3	16.2	7.2	10.2	9.6
Total	47.7	44.2	26.8	53.6	32.5	36.2	35.0	29.7	24.2	20.5
Sub. Div. 22+24										
Denmark	36.8	34.4	30.5	30.1	32.5	32.6	28.3	11.0	6.1	7.1
Germany	13.4	7.3	12.8	9.0	9.8	9.3	11.4	22.4	18.8	18.0
Poland	7.3	6.0	6.9	6.5	5.3	6.6	9.3	7.0	4.4	5.5
Sweden	15.8	9.0	14.5	4.3	2.6	4.8	13.9	10.7	9.6	9.9
Total	73.3	56.7	64.7	49.9	50.2	53.3	62.9	51.1	38.9	40.5
Sub. Div. 23										
Denmark	0.9	0.7	2.2	0.4	0.5	0.9	0.6	0.4	2.3	1.2
Sweden	0.2	0.3	0.1	0.3	0.1	0.1	0.2	1.0	0.2	0.3
Total	1.1	1.0	2.3	0.7	0.6	1.0	0.8	1.4	2.6	1.5
Grand Total	217.3	166.3	144.0	164.4	129.8	152.3	145.7	125.6	109.6	94.2

[1] Preliminary data.
[2] Data for 1998 and 1999 revised in 2003
[3] German data revised in 2004

Table 1.4.17.2 Herring in Subdivisions 22-24 and Division IIIa (spring spawners).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1991	4979060	302863	191573	0.3689
1992	3631200	313084	194411	0.4924
1993	3057310	287160	185010	0.5602
1994	6141020	224788	172438	0.7135
1995	4036680	177088	150831	0.5307
1996	4380020	129220	121266	0.7344
1997	3964840	143328	115588	0.5417
1998	5479590	115933	107032	0.5301
1999	6192940	121986	97240	0.4058
2000	3460880	133636	109914	0.5592
2001	4607080	149508	105803	0.5299
2002	2736450	185430	106191	0.4928
2003	5311160	154966	78309	0.3894
2004	4808130	180386	76815	0.3575
2005	*4255743	193981		
Average	4469474	187557	129459	0.5148

* Geometric mean for the years 1993–2002.

1.4.18 Herring in Subarea IV, Division VIId and Division IIIa (autumn spawners)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Full reproductive capacity	Harvested sustainably			

Based on the most recent estimates of SSB and fishing mortality ICES classifies the stock as having full reproduction capacity and as being harvested sustainably. SSB in 2004 was estimated at 1.9 million t, but is expected to decrease to 1.8 million t in 2005, which is above the $\mathbf{B}_{pa}$ of 1.3 million t. Both the 1998 and the 2000 year classes are strong. However the incoming 2004 year class is estimated to be among the weakest in the time-series, as were the 2002 and 2003 year classes.

Due to the current unusual circumstances of a clearly identified sequence of three poor recruiting year classes of North Sea herring it is particularly important that the imminent decline of this stock is addressed with sufficient determination to ensure the safety of the spawning stock in the next few years.

Management objectives

***According to the EU-Norway agreement (November 2004):** -*

1. *Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the 800,000 tonnes (Blim).*
2. *Where the SSB is estimated to be above 1.3 million tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries , reflecting a fishing mortality rate of no more than 0.25 for 2 ringers and older and no more than 0.12 for 0-1 ringers.*
3. *Where the SSB is estimated to be below 1.3 million tonnes but above 800,000 tonnes, the Parties agree to set quotas for the direct fishery and for by-catches in other fisheries, reflecting a fishing mortality rate equal to:*

   0.25 – (0.15(1,300,000-SSB)/500,000) for 2 ringers and older, and*

   0.12 – (0.08(1,300,000-SSB)/500,000) for 0-1 ringers.*
4. *Where the SSB is estimated to be below 800,000 tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries, reflecting a fishing mortality rate of less than 0.1 for 2 ringers and older and less than 0.04 for 0-1 ringers.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15% from the TAC of the preceding year the Parties shall fix a TAC that is no more than 15% greater or 15% less than the TAC of the preceding year.*
6. *Not withstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15% compared to the TAC of the preceding year.*
7. *By-catches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted.*
8. *The allocation of TAC for the directed fishery for herring shall be 29% to Norway and 71% to the Community. The by-catch quota for herring shall be allocated to the Community.*
9. *A review of this arrangement shall take place no later than 31 December 2007 .*

ICES has examined the performance of this revised harvest control rule and considers the agreement in terms of target F to be consistent with the Precautionary Approach. However, ICES also considers that the strict application of the TAC change limit of 15% (rule number 5) is not consistent with the Precautionary Approach in a situation like the present when three consecutive weak year-classes have recruited to the population. The harvest control rule is in accordance with the precautionary approach if paragraph 6 is consistently invoked sufficiently early to prevent or minimise the risk of SSB falling below B_{pa} even in the case of several consecutive weak year-classes. Assuming that paragraph 6 would be invoked when TAC constraints would lead to SSB falling below B_{pa} it is considered that the revised HCR is in accordance with the Precautionary Approach.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 800 000 t	$\mathbf{B}_{pa}$ be set at 1.3 million t
	$\mathbf{F}_{lim}$ is not defined	$\mathbf{E}_{pa}$ be set at: $\mathbf{F}_{ages\ 0\text{-}1} = 0.12$ $\mathbf{F}_{ages\ 2\text{-}6} = 0.25$

Yield and spawning biomass per Recruit
F-reference points:

	Mean $\mathbf{F}_{2\text{-}6}$	Yield/R	SSB/R
Average last 3 years	0.250	0.020	0.073
$\mathbf{F}_{max}$	0.412	0.013	0.041
$\mathbf{F}_{0.1}$	0.126	0.011	0.100

Candidates for reference points which are consistent with taking high long-term yields and achieving a low risk of depleting the productive potential of the stock may be identified in the range of $\mathbf{F}_{0.1}$-$\mathbf{F}_{pa}$.

Technical basis

$\mathbf{B}_{lim}$: below this value poor recruitment has been experienced	$\mathbf{B}_{pa}$: part of a harvest control rule based on simulations
$\mathbf{F}_{lim}$: Not defined	$\mathbf{F}_{pa}$: part of a harvest control rule based on simulations

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The revised management plan implies TACs and corresponding allocations among fleets as indicated in the catch options tables below.

Management of the autumn-spawning herring must be considered together with the western Baltic Herring.

The management plan is not specific as to when paragraph 6 should be invoked and how much the TAC would be reduced beyond the 15% limitation. Due to the current unusual circumstances of a clearly identified sequence of three poor recruiting year-classes of North Sea herring it is particularly important that management action should address the imminent decline of the stock with sufficient determination to ensure the safety of the spawning stock in the next few years. ICES has commented that the management plan can only be considered as in accordance with the precautionary approach if paragraph 6 is invoked when TAC constraints would lead to SSB falling below B_{pa}, With the three consecutive weak year-classes there is a high risk that SSB in 2008 would fall below B_{pa} if the TAC constraint of 15% is used in both 2006 and 2007, see figure 1.4.18.1. The choice within the management plan is thus either to use the TAC constraint for the TAC for 2006 with a high risk that severe reductions will be necessary for the TAC for 2007 or to invoke paragraph 6 already from the TAC for 2006 and thereby stabilising the stock and reducing the reductions required in 2007.

Short-term implications

Catch forecasts are presented below for different options of sharing the catch amongst fleets, producing the total fishing mortality given in the table headings. The forecasts are based on an assumption of the fisheries in 2005 taking the TAC. There is firm evidence for significant non-reporting and thus overshoot of the TAC for the A-fleet in 2004. Whether there will be any overshooting in 2005 in not known and is thus not included in the intermediate year (2005) in the forecasts. The forecasts for 2006 thus represent what could be taken in 2006 if there was no non-reporting or other overshoot of the TAC in 2005. If a TAC overshoot in 2005 is included, the forecasted landings in 2006 would be smaller if the F constraint of the harvest control rule is applied (invoking paragraph 6 of the rule). If the maximum TAC change of 15% was applied the resulting SSB in 2007 would be smaller.

The options presented below conform to the harvest control rule given above and include two main options. The first is with the catches in 2006 to comply with the F constraint in the harvest control rule (assuming that paragraph 6 of the management plan is invoked in view of the decline of the stock). The second shows catch options to comply with a maximum 15% reduction in TAC. The first table (one line of numerical entries) presents the assumed catch by fleet in 2005 assuming a fishing mortality based on a TAC constraint for the A-fleet.

Since the management plan only stipulates overall fishing mortalities for juveniles and adults, making fleet-wise predictions for 4 fleets, that are more or less independent, provides an extensive range of options for 2006. The following tables include examples of the short-term forecast. In addition, an extensive range of catch options for fleets were investigated and are available from the ICES Secretariat.

The predicted catches in 2006 of North Sea herring corresponding to the advice for herring in 22–24 and IIIa is about 30 000 t (approximately 17 000 t in fleet C and 13 000 t in fleet D).

Outlooks, assuming a TAC constraint for fleet A in 2005

The TAC constraint for 2005 may be optimistic as the starting point for the 2006 fishery because there have been overshoots of the TAC in recent years, and this would lead to lower stock at the start of 2006.

For 2005 with $F_{0\text{-}1}$=0.101 and $F_{2\text{-}6}$=0.302

$F_{2\text{-}6}$ A-fleet	$F_{0\text{-}1}$ B-fleet	$F_{0\text{-}1}$ C-fleet	$F_{0\text{-}1}$ D-fleet	Catch A-Fleet	Catch B-fleet	Catch C-fleet	Catch D-fleet	Catch Total	SSB 2005
0.274	0.075	0.006	0.019	**535**	**25**	**20**	**15**	595.2	1820

Selected management scenarios (invoking para 6 in the Management plan)

For 2006 with $F_{0\text{-}1}$ = 0.05 and $F_{2\text{-}6}$ = 0.25

$F_{2\text{-}6}$ A-fleet	$F_{0\text{-}1}$ B-fleet	$F_{0\text{-}1}$ C-fleet	$F_{0\text{-}1}$ D-fleet	Catch A-fleet	Catch B-fleet	Catch C-fleet	Catch D-fleet	Catch Total	SSB 2006	SSB 2007
0.238	0.040	0.002	0.008	430	21.2	8.3	6.7	465.9	1639	1522
0.237	0.036	0.002	0.012	427	19.1	8.3	10.0	464.6	1640	1523
0.235	0.032	0.002	0.015	425	17.1	8.3	13.3	463.4	1641	1524
0.235	0.038	0.004	0.008	424	20.5	12.5	6.7	463.9	1641	1524
0.234	0.034	0.004	0.012	422	18.5	12.4	10.0	462.6	1642	1525
0.232	0.031	0.004	0.015	419	16.4	12.5	13.3	461.3	1643	1526
0.232	0.037	0.005	0.008	419	19.9	16.6	6.7	462.0	1642	1526
0.230	0.033	0.005	0.012	416	17.8	16.6	10.0	460.6	1643	1527
0.229	0.029	0.005	0.015	414	15.8	16.6	13.3	459.3	1645	1529

For 2006 with $F_{0\text{-}1}$ = 0.12 and $F_{2\text{-}6}$ = 0.25

$F_{2\text{-}6}$ A-fleet	$F_{0\text{-}1}$ B-fleet	$F_{0\text{-}1}$ C-fleet	$F_{0\text{-}1}$ D-fleet	Catch A-fleet	Catch B-fleet	Catch C-fleet	Catch D-fleet	Catch Total	SSB 2006	SSB 2007
0.236	0.109	0.002	0.008	425	57.2	8.3	6.7	497.2	1640	1507
0.234	0.105	0.002	0.012	423	55.2	8.3	10.0	496.0	1641	1509
0.232	0.102	0.002	0.016	420	53.2	8.3	13.3	494.7	1642	1510
0.232	0.108	0.004	0.008	420	56.6	12.4	6.7	495.2	1642	1510
0.231	0.104	0.004	0.012	417	54.6	12.5	10.0	494.1	1643	1511
0.229	0.100	0.004	0.016	414	52.5	12.5	13.3	492.6	1644	1512
0.229	0.107	0.005	0.008	414	55.9	16.6	6.7	493.2	1643	1512
0.227	0.103	0.005	0.012	411	53.9	16.6	10.0	491.9	1644	1513
0.226	0.099	0.005	0.016	409	51.9	16.6	13.3	490.5	1645	1515

Selected management scenarios TAC for the A fleet determined by the 15% limit on TAC change

For 2006 with TAC A-fleet 455, F0-1 approx. 0.05

$F_{2\text{-}6}$ A-fleet	$F_{0\text{-}1}$ B-fleet	$F_{0\text{-}1}$ C-fleet	$F_{0\text{-}1}$ D-fleet	Catch A-fleet	Catch B-fleet	Catch C-fleet	Catch D-fleet	Catch Total	SSB 2006	SSB 2007
0.255	0.039	0.002	0.008	455	20.9	8.3	6.7	490.8	1619	1481
0.255	0.036	0.002	0.012	455	19.3	8.3	10.0	492.7	1618	1477
0.255	0.032	0.002	0.015	455	17.2	8.3	13.3	493.7	1617	1475
0.255	0.038	0.004	0.008	455	20.4	12.5	6.7	494.7	1616	1474
0.255	0.034	0.004	0.012	455	18.2	12.4	10.0	495.4	1616	1471
0.255	0.030	0.004	0.015	455	16.1	12.5	13.3	496.8	1615	1468
0.255	0.037	0.005	0.008	455	19.8	16.6	6.7	498.1	1614	1467
0.255	0.033	0.005	0.012	455	17.7	16.6	10.0	499.3	1613	1464
0.255	0.030	0.005	0.015	455	16.1	16.6	13.3	501.0	1612	1461

For 2006 with TAC A-fleet 455, $F_{0\text{-}1}$ approx. 0.12

$F_{2\text{-}6}$ A-fleet	$F_{0\text{-}1}$ B-fleet	$F_{0\text{-}1}$ C-fleet	$F_{0\text{-}1}$ D-fleet	Catch A-fleet	Catch B-fleet	Catch C-fleet	Catch D-fleet	Catch Total	SSB 2006	SSB 2007
0.255	0.109	0.002	0.008	455	57.0	8.3	6.7	526.9	1616	1459
0.255	0.105	0.002	0.012	455	54.9	8.3	10.0	528.1	1615	1456
0.255	0.101	0.002	0.016	455	52.8	8.3	13.3	529.4	1614	1453
0.255	0.108	0.004	0.008	455	56.5	12.5	6.7	530.7	1613	1452
0.255	0.104	0.004	0.012	455	54.4	12.5	10.0	532.1	1612	1449
0.255	0.100	0.004	0.016	455	52.3	12.4	13.3	532.9	1612	1447
0.256	0.106	0.005	0.008	455	55.4	16.6	6.7	533.8	1611	1445
0.256	0.102	0.005	0.012	455	53.4	16.6	10.0	535.0	1610	1443
0.256	0.100	0.005	0.016	455	52.3	16.6	13.3	537.3	1609	1439

The fleet definition

Fleet A: Directed herring fisheries with purse seiners and trawlers (with 32-mm minimum mesh size) in the North Sea. Bycatches in industrial fisheries by Norway are included.

Fleet B: Herring taken as bycatch in the small-mesh fisheries in the North Sea (with mesh size less than 32 mm).

Fleet C: Directed herring fisheries in Skagerrak and Kattegat with purse seiners and trawlers (with 32-mm minimum mesh size).

Fleet D: Bycatches of herring caught in the small-mesh fisheries (with mesh size less than 32 mm) in Skagerrak and Kattegat.

Management considerations

There are now three recruiting year classes (2002, 2003, and 2004) that are all well below average. This is unusual and managers should take this into account when implementing the HCR as there is an increased risk that the stock may fall below the 1.3 mill. tonnes in the medium-term if the rule of 15% constraint on TAC variation is applied.

Medium term simulations indicate that using a constraint on the year-to-year variation in TAC for the TAC in 2006 and onwards will lead to a considerable risk that SSB will fall below B_{pa} in the period where these year classes will dominate the spawning stock, i.e. around 2008 - 2010. This risk is exacerbated and a considerable risk of the SSB falling below B_{lim} is added if the TAC is overfished and/or the stock is overestimated in the assessment as has been seen in recent years. The risk can be reduced by maintaining the low fishing mortality on juveniles that has been practiced in recent years, and it can be eliminated by removing the constraint on TAC variation, see figure 1.4.18.1. The figure demonstrates that the probability for the stock to be below B_{pa} in 2008 is about 0.74 given that the 15% rule in the agreed management plan is followed. The probability for the stock to be below B_{lim} in 2008 is 0.2. If however paragraph 6 of the management plan is invoked, the probability for the stock to be below B_{lim} is reduced to 0 while there is still a 0.12 probability to being below B_{pa}. This assumes full implementation and enforcement. If the enforcement bias as has been experienced in recent years leading to overshoots of the TAC in the order of 10% continues the risk of being below B_{pa} and B_{lim} increases considerably, especially if the TAC constraint is applied.

Misreporting of landings taken in the North Sea, but reported from other areas such as Divisions IIa and IIIa, and VIaN have significantly increased in 2004. The estimates of the total amount of misreported and unallocated catches in 2004 was about 49 000 t (roughly 9% of the total catch in the North Sea). The agreed area flexibility of catches from the Skagerrak that occurred in 2004, may have had a similar effect as this implies flexibility of exploitation among the different herring stocks.

Management of the autumn-spawning herring must be considered together with the western Baltic herring. The options for TACs for the C and D fleets have been selected to be compatible with the exploitation of Western Baltic Spring Spawners (see Section 1.4.17).

The Divisions IVc and VIId Sub-TAC was established for the conservation of the spawning aggregation of Downs herring. The Downs herring has returned to its pre-collapsed state and is now again a major component of the stock, but is currently dominated by one year class. Hence, the management of the fishery on the spawning aggregations of Downs herring should be more cautious than for the North Sea herring as a whole. More knowledge about the dynamics and catches of Downs herring is required.

The advice for a quota on catches in Divisions IVc and VIId for 2003 was that this should not exceed the 2002 quota, and for 2004 and 2005 that the quota should not increase faster than the TAC for the North Sea as a whole. ICES proposes that a share of 11% on the total North Sea TAC (average share 1989-2002) would be appropriate for distributing the harvesting among Downs Herring and other stock components.

Management plan evaluations

The HCR has been tested but the present situation with 3 poor year-classes in succession is exceptional. The performance of the present harvest rule is not very good in this situation, since it may easily break down if assessment and/or implementation, enforcement and compliance are sufficiently biased. It is considered by ACFM that the present assessment may possibly be an overestimate, and that the TACs in the consumption fishery have been regularly overshot. For this situation a HCR is required that is robust to errors in the assessment and implementation; the current HCR is not thought to be sufficiently robust to errors in the assessment and implementation. As the stock is set to decrease more rapidly than expected due to the coincidence of three poor year classes, managers should be particularly cautious and ensure that reductions in TACs are sufficient to maintain F at the agreed level of F=0.25. In this context it would be advisable for managers to explicitly include implementation failure, such as area misreporting, into the TAC if they cannot ensure compliance.

Allowance for efficient reduction of the TACs increases the robustness of the regime. In particular, if reduction of the TAC is too heavily constrained when the stock is declining this may lead into a vicious circle, which is clearly demonstrated in some of the examples in the HAWG report. The simulations also show the beneficial effect of reducing the fishing mortality on juveniles. The effect of a lower fishing mortality on adults was not explored in this study, but earlier simulations indicate that the effect is slightly less than for similar reductions in TACs on juveniles.

Ecosystem considerations

Herring is considered to have a major impact as prey and predator to most other fish stocks and is prey to sea birds and sea mammals in that area. Herring spawning and nursery areas, being near the coasts, are particularly sensitive and vulnerable to anthropogenic influences. The most serious of these is the ever increasing pressure for marine sand and gravel extraction. This has the potential to seriously damage and destroy the spawning habitat and disturb spawning shoals and to destroy spawn if carried out during the spawning season. Similarly, trawling at or close to the bottom in known spawning areas can have the same detrimental effects. It is possible that the disappearance of spawning on the western edge of the Dogger Bank could well be attributable to such anthropogenic influences.

Despite the fact that the stock is considered to have full reproductive capacity, it has recently produced three poor year classes in a row. Larvae surveys, which are considered to be a reliable indicator of the stock size, are carried out annually and show large abundance of larvae in recent years. However, survival of these larvae seems to be very poor. The reasons for this are not known. It is noted that also other stocks, such as sandeel and Norway pout, have shown recruitment failure in recent years, which cannot be related to the state of the stock or the fisheries upon it. It is possible that changes in the environmental conditions in the North Sea are responsible or have contributed to the observed recruitment failures. Volume 1 Section 1.1 (Ecosystem Overview) identify poor feeding conditions (particularly with respect to *Calanus*) for herring in the North Sea as a cause for concern. Both 2003 and 2004 were unusually warm years, particularly in August and September. The inflowing Atlantic water was also warmer than the long-term mean and the last three years these waters have been the warmest since 1970. The pattern of Atlantic inflow is believed to be important for zooplankton and hence fish populations in the North Sea (ICES CM 2005/ACE:01).

Factors affecting the fisheries and the stock

Regulations and their effects

Based on ICES estimates of total catch, TACs for the human consumption fishery in Subarea IV and Division VIId have been exceeded in all recent years. The relative amount of unallocated and misreported catch is estimated around 10% from 2001 onwards. Prior to 2001, unallocated catches were substantially higher. The largest absolute amounts of unallocated catches occur in Subdivision IVa west (14,000-28,000 tonnes in 2002-2004). The largest relative unallocated catches occur in Divisions IVc and VIId (12-17% in 2002-2004).

Scientific basis

Data and methods

The age-based assessment is based on landings from Subarea IV and Division VIId and on surveys (Acoustic 1–9+wr, IBTS 1–5+wr, MIK 0wr and MLAI larvae SSB indices). Some national catch estimates were corrected for unallocated and misreported catch.

In 2004 the total weight of herring discarded in the North Sea was estimated at about 17 000 t, based on the raised figure for two sampled fleets. The estimates in 2002 and 2003 were 17 000 t and 4000 t respectively, based on the same two fleets. More complete information on discarding that could be raised by fleet to total catch would be desirable. Information on discards is included in the assessment, when available.

Denmark and Norway provided information on bycatches of herring in the industrial fishery. These are the only countries conducting these fisheries.

Uncertainties in assessment and forecast

Catch and survey indices show different signals in the residual patterns, which were detected in 2003 and 2004, but show greater magnitude in this year's assessment. Positive residuals in the catch of 2wr+ fish against negative residuals in the acoustic survey and IBTS suggests a slightly higher fishing mortality from the surveys than given by the catch information. It is considered by ICES that the present assessment may possibly be an overestimate of SSB and an underestimate of F.

Comparison with previous assessment and advice

The current assessment agrees very closely with the 2004 assessment. In 2005 the SSB for 2003 was estimated at 1.73 mill. tonnes, while in 2004 it was estimated at 1.75 mill. tonnes. Fishing mortality in 2003 was estimated in last year's assessment at 0.25 and is still estimated at 0.25.

Source of information

Report of the Herring Assessment Working Group for the Area South of 62°N, 8–17 March 2005 (ICES CM 2005/ACFM:16).

Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC[1]	Bycatch ceiling Fleet B	ACFM Lndgs.[4] IV, VIId	ACFM Catch[5] IV, VIId	ACFMCatch Autumn spawners IIIa, IV, VIId
1987	TAC	610	600		625	625	792
1988	TAC	515	530		710	710	888
1989	TAC	514	514		669	717	787
1990	TAC	403	415		523	578	646
1991	TAC	423	420		537	588	657
1992	TAC	406	430		518	572	716
1993	No increase in yield at F > 0.3	340[1]	430		495	540	671
1994	No increase in yield at F > 0.3	346[1]	440		463	498	571
1995	Long-term gains expected at lower F	429[1]	440		510	516	579
1996	50% reduction of agreed TAC[2]	156[1]	156[3]	44	207	233	275
1997	F = 0.2	159[1]	159	24	175	238	264
1998	F(adult) = 0.2, F(juv)< 0.1	254[1]	254	22	268	338	392
1999	F(adult) = 0.2, F(juv)< 0.1	265[1]	265	30	290	333	363
2000	F(adult) = 0.2, F(juv)< 0.1	265[1]	265	36	284	346	388
2001	F(adult) = 0.2, F(juv)< 0.1	See scenarios	265	36	296	323	363
2002	F(adult) = 0.2, F(juv)< 0.1	See scenarios	265	36	304	353	372
2003	F(adult) = 0.25, F(juv)=0.12	See scenarios	400	52	414	450	480
2004	F(adult) = 0.25, F(juv)=0.1	See scenarios	460	38	484	550	567
2005	F(adult) = 0.25, F(juv)=0.1	See scenarios	535	50			
2006	F(adult) = 0.25, F(juv)=0.12	See scenarios					

Weights in '000 t.
[1]Catch in directed fishery in IV and VIId. [2]Revision of advice given in 1995. [3]Revised in June 1996, down from 263.
[4] Landings are provided by the working group and do not in all cases correspond to official statistics. [5]ACFM catch includes unallocated and misreported landings, discards and slipping.

Herring in Subarea IV, Divisions VIId & IIIa (autumn spawners)

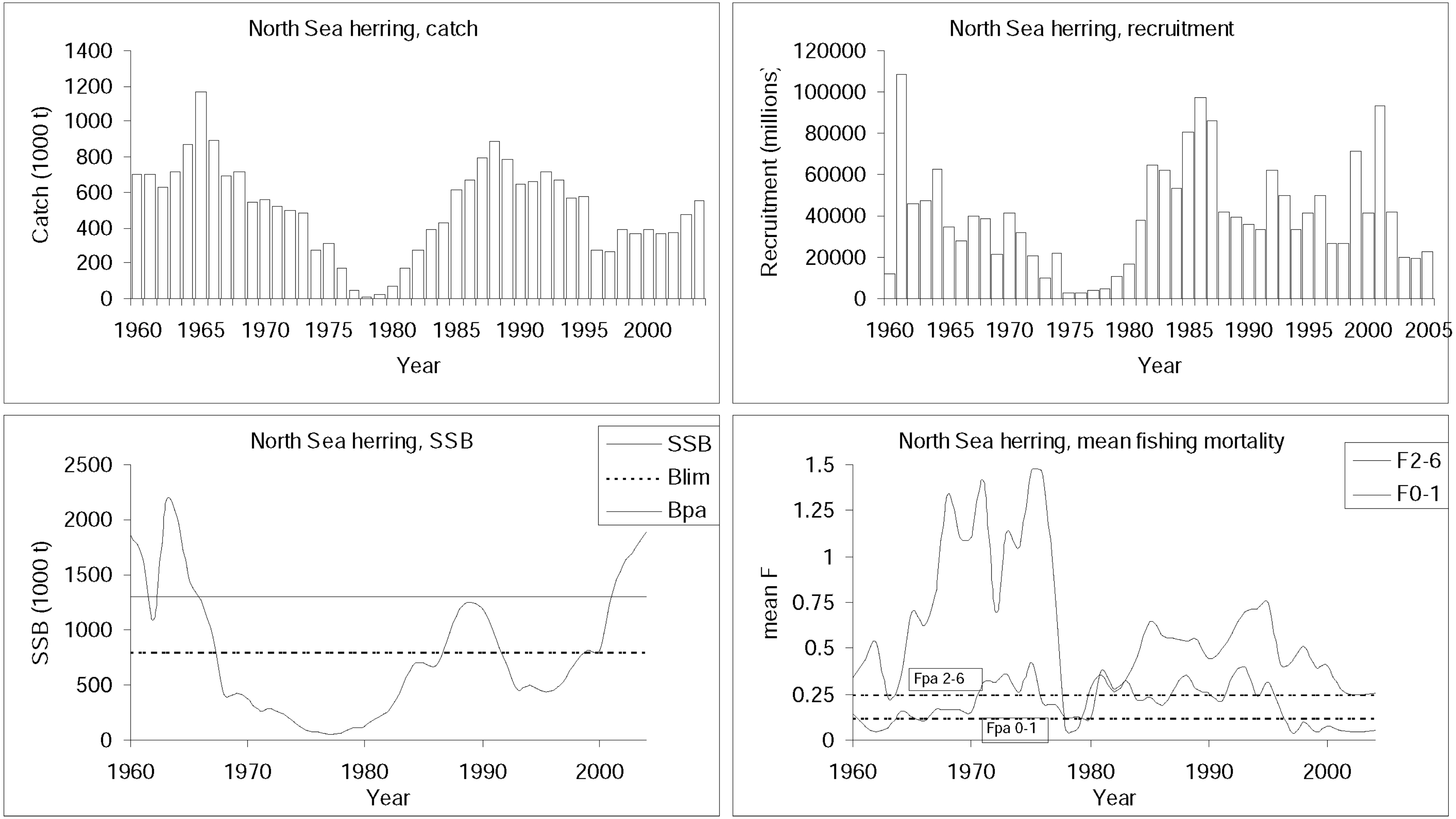


Table 1.4.18.1 Herring, catch in tonnes in the North Sea (Subarea IV and Division VIId). Catch in tonnes by country, 1995–2004. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	1995 [9]	1996 [9]	1997 [9]	1998 [9]	1999 [9]
Belgium	-	-	1	-	2
Denmark	153361	66733	38324	58924	61268
Faroe Islands	2018	815	1156	1246	1977
France	29503	12500	14525	20784	26962
Germany, Fed.Rep	43299	14215	13380	22259	26764
Netherlands	82286	42792	35985	49933	54467
Norway [4]	131026	43739	41606	70981	74071
Sweden	5147	2458	2253	3221	3241
USSR/Russia	-	-	1619	452	-
UK (England)	14899	6880	3470	7635	11434
UK (Scotland)	47944	17212	22582	31313	29911
UK (N.Ireland)	-	-	-	1015	-
Unallocated landings	6599 [12]	26069 [12]	63403 [,12]	70329 [12]	43327 [12]
Misreporting from VIaN		-	-		
Total landings	516082	233413	238304	338092	333424
Discards	-	-	-		
Total catch	**516082**	**233413**	**238304**	**338092**	**333424**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	10315	855	979	7833	4732
Thames estuary [5]	203	168	202	88	88
Norw. Spring Spawners [1]	9501	30274	54728	29220	32106

Country	2000 [9]	2001 [9]	2002	2003	2004 [1]
Belgium	-	-	23	5	8
Denmark [7]	64123	67096	70825	78606	99037
Faroe Islands	915	1082	1413	627	402
France	20952	24880 [14]	25422	31544	34521
Germany	26687	29779	27213	43953	41858
Netherlands	54341	51293	55257	81108	96162
Norway [4]	72072	75886 [1]	74974 [1]	112481 [1]	137638
Sweden	3046	3695	3418	4781	5692
Russia	-	-	-	-	-
UK (England)	11179	14582	13757	18639	20855
UK (Scotland)	30033	26719	30926	40292	45331
UK (N.Ireland)	996	1018	944	2010	2656
Unallocated landings	61673 [12]	27362 [12]	31552 [12]	31875 [12]	48898 [12]
Misreporting from VIaN					
Total landings	346017	323392 [14]	335724	445921	533058
Discards			17093	4125	17059
Total catch	**346017**	**323392** [14]	**352817**	**450046**	**550117**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	6649	6449	6652	2821	7079
Thames estuary [5]	76	107	60	84	62
Others [11]	378	1097	0	308	0
Norw. Spring Spawners [1]	25678	7108	4069	979	452

1 Preliminary.
4 Catches of Norwegian spring spawners removed (taken under a separate TAC).
5 Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
7 Including any bycatches in the industrial fishery
9 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)
10 Figure altered in 2001
11 Caught in the whole North Sea, partly included in the catch figure for The Netherlands
12 may include misreported catch from VIaN and discards
13 These catches (including some local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.
14 Figure altered in 2004

Table 1.4.18.2 Herring, catch in tonnes in Division IVa West. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	1995 [11]	1996 [11]	1997 [11]	1998 [11]	1999 [11]
Denmark	17748	3183	2657	4634	15359
Faroe Islands	2018	815	1156	1246	1977
France	10427	3177	362	4758	6369
Germany	17095	2167	4576	7753	11206
Netherlands	27205	7714	6072	10917	21552
Norway	56124	22187	16869	27290	31395
Sweden	1007	769	1617	315	859
Russia	-	-	1619	452	-
UK (England)	3315	2391	49	4306	7999
UK (Scotland)	43204	12763	17121	29462	28537
UK (N. Ireland)	-	-	-	1015	-
Unallocated landings	-2556 [8]	12681 [8]	40662 [6,8]	56058 [8]	25469 [8]
Misreporting from VIa North					
Total Landings	175587	67847	92760	148206	150722
Discards					
Total catch	**175587**	**67847**	**92760**	**148206**	**150722**

Country	2000 [11]	2001 [11]	2002	2003	2004 [1]
Denmark [7]	25530	17770	26422	48358	48128
Faroe Islands	205	192	-	95	-
France	3210	8164	10522	11237	10941
Germany	5811	17753	15189	25796	17559
Netherlands	15117	17503 [10]	18289	25045	43876
Norway	33164	11653 [1]	10836 [1]	34443	36119
Sweden	1479	1418	2397	2647	2178
Russia	-	-	-	-	-
UK (England)	8859	12283	10142	12030	13480
UK (Scotland)	29055	25105	30014	39970	43490
UK (N. Ireland)	996	1018	944	2010	2656
Unallocated landings	44334 [8]	24725 [8]	14201 [8]	14115 [8]	28631 [8]
Misreporting from VIa North					
Total Landings	167760	137584	138956	215746	247058
Discards			17093	4125	15794
Total catch	**167760**	**137584**	**156049**	**219871**	**262852**

1 Preliminary.
4 Including IVa East.
5 Negative unallocated catches due to misreporting from other areas.
6 Altered in 2000 on the basis of a Bayesian assessment on misreporting into VIa (North)
7 Including any bycatches in the industrial fishery
8 May include misreported catch from VIaN and discards
9 Figure altered in 2001
10 Including 1057 t of local spring spawners
11 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)

Table1.4.18.3 Herring, catch in tonnes in Division IVa East. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	1995 [7]	1996 [7]	1997 [7]	1998 [7]	1999 [7]
Denmark [5]	45257	19166	22862	25750	18259
Faroe Islands	-	-	-	-	-
France	4	-	3	-	115
Germany	-	-	-	-	-
Netherlands	167	-	756	301	-
Norway [2]	62224	18256	20975	43646	39977
Sweden	2211	1119	422	1189	772
Unallocated landings	-132 [4]	-	-756 [4]	-292 [4]	-
Total landings	109731	38541	44262	70594	59123
Discards	-	-	-	-	-
Total catch	**109731**	**38541**	**44262**	**70594**	**59123**
Norw. Spring Spawners [6]	9501	30274	54728	29220	32106

Country	2000 [7]	2001 [7]	2002	2003 [1]	2004 [1]
Denmark [5]	11300	18466	17846	7401	16278
Faroe Islands	710	890	1365	359	-
France	-	-	-	-	-
Germany	29	-	81	54	888
Netherlands	38	-	-	-	-
Norway [2]	38655	56904 [1]	63482 [1]	62306	100443
Sweden	1177	517	568	1529	1720
Unallocated landings	338	o	5961	11991	0
Total landings	52247	76777	89303	83640	119329
Discards	-	-	-	-	-
Total catch	**52247**	**76777**	**89303**	**83640**	**119329**
Norw. Spring Spawners [6]	25678	7108	4069	979	452

1 Preliminary
2 Catches of Norwegian spring spawners herring removed (taken under a separate TAC).
3 Included in IVa West.
4 Negative unallocated catches due to misreporting into other areas.
5 Including any bycatches in the industrial fishery
6 These catches (including some local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.
7 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)

Table 1.4.18.4 Herring, catch in tonnes in Division IVb. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	1995 [6]		1996 [6]		1997 [6]		1998 [6]		1999 [6]	
Belgium	-		-		-		-		1	
Denmark [4]	87917		43749		11558		26667		26211	
Faroe Islands	-		-		-		-		-	
France	7639		2373		6069		8945		7634	
Germany	21209		11051		7455		13590		13529	
Netherlands	31025		21053		14976		27468		22343	
Norway	12678		3296		3762		45		2699	
Sweden	1929		570		214		1717		1610	
UK (England)	9688		2757		2033		1767		1641	
UK (Scotland)	4700		4449		5461		1851		1374	
Unallocated landings	-12552	3	-17313	5	-3744	5	-12138	5	-3794	5
Total landings	164233		71985		47784		69912		73248	
Discards [2]	-									
Total catch	**164233**		**71985**		**47784**		**69912**		**73248**	

Country	2000 [6]		2001 [6]		2002		2003 [1]		2004 [1]	
Belgium	-		-		-		-		-	
Denmark [4]	26825		30277		26387		22574		33857	
Faroe Islands	-		-		48		173		402	
France	10863		7796	14	4214		7918		10592	
Germany	18818		8340		7577		12116		13823	
Netherlands	26839		24160		13154		19115		23649	
Norway	253		7329	1	656	1	15732		1076	
Sweden	390		1760		453		605		1794	
UK (England)	669		814		317		2632		2864	
UK (Scotland)	978		1614		289		322		1841	
Unallocated landings	-9820	5	-22885	5	4052		-2401		8300	
Total landings	75815		59205		57147		78786		98198	
Discards [2]									1265	
Total catch	**75815**		**59205**	14	**57147**		**78786**		**99463**	

1 Preliminary
2 Discards partly included in unallocated
3 Negative unallocated catches due to misreporting from other areas.
4 Including any bycatches in the industrial fishery
5 May include discards. Negative unallocated due to misreporting into other areas.
6 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)
14 Figure altered in 2004

Table 1.4.18.5 Herring, catch in tonnes in Division IVc and VIId. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	1995 [9]	1996 [9]	1997 [9]	1998 [9]	1999 [9]
Belgium	-	-	1	-	1
Denmark	2439	635	1247	1873	1439
France	11433	6950	8091	7081	12844
Germany	4996	997	1349	916	2029
Netherlands	23889	14024	14181	11247	10572
UK (England)	1895	1733	1388	1562	1794
UK (Scotland)	40	-	-	-	-
Unallocated landings	21840 [4]	30702 [4]	27241 [4]	26701 [4]	21652 [4]
Total landings	66532	55041	53498	49380	50331
Discards [3]					
Total catch	**66532**	**55041**	**53498**	**49380**	**50331**
Coastal spring spawners included above [2]	203	168	143	88	88

Country	2000 [9]	2001 [9]	2002	2003 [1]	2004 [1]
Belgium	1	-	23	5	8
Denmark	468	583	170	273	774
France	6879	8750	10686	12389	12988
Germany	2029	3686	4366	5987	9588
Netherlands	12348	9630	23814	36948	28637
UK (England)	1651	1485	3298	3977	4511
UK (Scotland)	-	-	623	-	-
Unallocated landings	26822 [4]	25522 [4]	7338	8170	11967
Total landings	50198	49656	50318	67749	68473
Discards 3			-	-	-
Total catch	**50198**	**49656**	**50318**	**67749**	**68473**
Coastal spring spawners included above [2]	76	147 [11]	60	84	62

1 Preliminary
2 Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
3 Discards partly included in unallocated
4 May include misreported catch and discards.
9 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)
10 Figure altered in 2002 (was 7851 t higher before)
11 Thames/Blackwater herring landings: 107 t, others included in the catch figure for The Netherlands
14 Figure altered in 2004

Table 1.4.18.6 ("The Wonderful Table"): HERRING in Subarea IV, Division VIId ,and Division IIIa. Figures in thousand tonnes.

Year	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995** [18]	**1996** [18]	**1997** [18]	**1998** [18]	**1999** [18]	**2000** [18]	**2001** [18]	**2002**	**2003**	**2004**	**2005**
Sub-Area IV and Division VIId: TAC (IV and VIId)																	
Recommended Divisions IVa, b [1]	484	373, 332	363 [6]	352	290 [7]	296 [7]	389 [11]	156	159	254	265	265	- [22]	- [22]	- [22]	- [22]	[22]
Recommended Divisions IVc, VIId	30	30	50-60 [6]	54	50	50	50	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	[14]
Expected catch of spring spawners				10	8												
Agreed Divisions IVa,b [2]	484	385	370 [6]	380	380	390	390	263;131 [13]	134	229	240	240	240	223	340.5	393.9	460.7
Agreed Div. IVc, VIId	30	30	50 [6]	50	50	50	50	50; 25 [13]	25	25	25	25	25	42.7	59.5	66.1	74.3
Bycatch ceiling in the small mesh fishery									24	22	30	36	36	36	52.0	38.0	50.0
CATCH (IV and VIId)																	
National landings Divisions IVa,b [3]	639	499	495	481	463	421	465	183	149	245	261	261	272	261	354.5	427.7	
Unallocated landings Divisions IVa,b	-2	14	30	14	-1	6	-15	-5	36	44	22	35	2	24	23.7	36.9	
Discard/slipping Divisions IVa,b [4]	3	4	2	3	1	1	-	-	-	-	-	-	-	17	4.1	17.1	
Total catch Divisions IVa,b [5]	638	516	527	498	463	428	450	178	185	289	283	296	273	303	382.3	481.6	
National landings Divisions IVc, VIId [3]	30	24	42	37	32 [21]	42	45	24	26	23	29	23	24	43	59.5	56.5	
Unallocated landings Divisions IVc,VIId	48	32	16	35	43	30	22	31	27	27	22	27	26	7	8.2	12.0	
Discard/slipping Divisions IVc, VIId [4]	1	5	3	2	2	2	-	-	-	-	-	-	-	0	-	-	
Total catch Divisions IVc, VIId	79	61	61	74	77 [21]	74	67	55	53	49	50	50	50	50	67.7	68.5	
Total catch IV and VIId as used by ACFM [5]	**717**	**578**	**588**	**572**	**540** [21]	**498**	**516**	**233**	**238**	**338**	**333**	**346**	**323**	**353**	**450.0**	**550.1**	
CATCH BY FLEET/STOCK (IV and VIId) [10]																	
North Sea autumn spawners directed fisheries (Fleet A	N.a.	N.a.	446	441	438	447	439	195	225	316	313	322	296	323	434.9	529.5	
North Sea autumn spawners industrial (Fleet B)	N.a.	N.a.	134	124	101	38	67	38	13	14	15	18	20	22	12.3	13.6	
North Sea autumn spawners in IV and VIId total	**696**	**569**	**580**	**564**	**539**	**485**	**506**	**233**	**237**	**330**	**329**	**339**	**317**	**346**	**447.2**	**543.0**	
Baltic-IIIa-type spring spawners in IV	20	8	8	8	9	13	10	1	1	8	5	7	6	7	2.8	7.1	
Coastal-type spring spawners	2.3	1.1	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	1.2	0.1	0.1	0.1	
Norw. Spring Spawners caught under a separate quota	N.a.	4	5	5	9	6	10	30	55	29	32	26	7	4	1.0	0.5	
Division IIIa: TAC (IIIa)																	
Predicted catch of autumn spawners			96	153	102	77	98	48	35	58	43	53	- [22]	- [22]	- [22]	- [22]	- [22]
Recommended spring spawners	84	67	91	90	93 113	- [9]	- [12]	- [12]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [22]	- [22]
Recommended mixed clupeoids	80	60	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Agreed herring TAC	138	120	104.5	124	165	148	140	120	80	80	80	80	80	80	80.0	70.0	96.0
Agreed mixed clupeoid TAC	80	65	50	50	45	43	43	43									
Bycatch ceiling in the small mesh fishery									20	17	19	21	21	21	21.0	21.0	24.2
CATCH (IIIa)																	
National landings	192	202	188	227	214	168	157	115	83	120	86	108	90	79	76.0	61.1	
Catch as used by ACFM	162	195	191	227	214	168	140	105	74	108	79	99	82	73	68.1	52.7	
CATCH BY FLEET/STOCK (IIIa) [10]																	
Autumn spawners human consumption (Fleet C)	N.a.	N.a.	26	47	44	42	38	24	21	59	28 [17]	36	34	17	24.1	13.4	
Autumn spawners mixed clupeoid (Fleet D) [19]	N.a.	N.a.	13	23	25	12	6	9	4	6	8 [17]	13	12	9	8.4	10.8	
Autumn spawners other industrial landings (Fleet E)	N.a.	N.a.	38	82	63	32	29	8	2								
Autumn spawners in IIIa total	**91**	**77** [8]	**77**	**152**	**132**	**86**	**73**	**43**	**27**	**61**	**34** [17]	**49**	**46**	**26**	**32.5**	**24.2**	
Spring spawners human consumption (Fleet C)	N.a.	N.a.	68	53	68	59	44	58	43	40	40 [17]	45	33	38	31.6	16.8	
Spring spawners mixed clupeoid (Fleet D) [19]	N.a.	N.a.	5	2	1	1	2	4	3	3	3 [17]	5	3	9	4.0	11.2	
Spring spawners other industrial landings (Fleet E)	N.a.	N.a.	40	20	12	24	21	2	1								
Spring spawners in IIIa total	**71**	**118**	**113**	**75**	**81**	**84**	**67**	**64**	**47**	**43**	**43** [17]	**50**	**36**	**47**	**35.6**	**28.0**	
North Sea autumn spawners Total as used by ACFM	**787**	**646**	**657**	**716**	**671**	**571**	**579**	**275**	**264**	**392**	**363**	**388**	**363**	**372**	**479.7**	**567.2**	

1 Includes catches in directed fishery and catches of 1-ringers in small mesh fishery up to 1992. 2 IVa,b and EC zone of IIa. 3 Provided by Working Group members. 4 Incomplete, only some countries providing discard information. Discards might also be included in un. 5 Includes spring spawners not included in assessment. 6 Revised during 1991. 7 Based on F=0.3 in directed fishery only; TAC advised for IVc, VIId subtracted. 8 Estimated. 9 130-180 for spring spawners in all areas. 10 Based on sum-of-products (number x mean weight at age). 11 Status quo F catch for fleet A. 12 The catch should not exceed recent catch levels. 13 During the middle of 1996 revised to 50% of its original agreed TAC. 14 Included in IVa,b. 15 Managed in accordance with autumn spawners. 17 Figure altered in 2001 and again in 2004. 18 Data for 1995-2001 were verified and amended where necessary by SG REDNOSE in 2003. 19 Fleet D and E are merged from 1999 onwards. 20 These catches (including local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area. 21 figure altered in 2003 to account for earlier summarizing errors. 22 See catch option tables for different fleets.Shaded cells for the catch by fleet in Division IIIa indicate persisting inconsistencies which have to be resolved intersessionally.

Table 1.4.18.7 Herring in Subarea IV, Divisions IIIa and VIId (autumn spawners).

Year	Recruitment Age 1 (0 w.r.) thousands	SSB tonnes	Catch tonnes	Mean F Ages 1-2	Mean F Ages 2-6
1960	12085810	1857636	696200	0.1409	0.3393
1961	108849690	1638004	696700	0.0740	0.4359
1962	46274910	1098707	627800	0.0473	0.5355
1963	47657580	2170065	716000	0.0695	0.2277
1964	62785190	2016341	871200	0.1605	0.3444
1965	34894780	1435223	1168800	0.1266	0.6948
1966	27857860	1272584	895500	0.1034	0.6197
1967	40255750	921114	695500	0.1619	0.7981
1968	38698280	411855	717800	0.1676	1.3361
1969	21581660	423845	546700	0.1687	1.1054
1970	41073920	374645	563100	0.1516	1.1058
1971	32308480	266003	520100	0.3181	1.4082
1972	20858500	288287	497500	0.3183	0.6969
1973	10103560	233375	484000	0.3601	1.1354
1974	21692510	161982	275100	0.2634	1.0524
1975	2817930	81631	312800	0.4232	1.471
1976	2719920	77825	174800	0.1990	1.4446
1977	4327240	47382	46000	0.1981	0.8105
1978	4594140	64639	11000	0.1231	0.0538
1979	10601180	106834	25100	0.1254	0.0644
1980	16722120	130653	70764	0.1196	0.2843
1981	37863520	195260	174879	0.3839	0.3526
1982	64750020	278173	275079	0.2799	0.2642
1983	61792670	432253	387202	0.3258	0.3382
1984	53437890	678858	428631	0.2159	0.4555
1985	80888510	698919	613780	0.2342	0.6438
1986	97558410	678666	671488	0.1890	0.5724
1987	86152360	899455	792058	0.2671	0.553
1988	42252210	1192507	887686	0.3527	0.5382
1989	39120340	1246773	787899	0.2809	0.5477
1990	35835440	1181607	645229	0.2563	0.4437
1991	33595240	976042	658008	0.2133	0.4918
1992	62085590	699494	716799	0.3424	0.5854
1993	50115230	468745	671397	0.4000	0.6958
1994	33522870	506049	568234	0.2404	0.7143
1995	41215390	455908	579371	0.3156	0.7498
1996	49838780	448794	275098	0.1668	0.4118
1997	26792470	536286	264313	0.0356	0.4355
1998	26976620	707455	391628	0.0941	0.5078
1999	71136210	814895	363163	0.0428	0.3971
2000	41527050	809971	388157	0.0786	0.4067
2001	93576800	1275881	363343	0.0551	0.2855
2002	41756580	1583035	370941	0.0475	0.2459
2003	20331850	1730894	472587	0.0480	0.2483
2004	19622580	1891500	567252	0.0491	0.2543
2005	22350000**	1820000*			
Average	40062079	810566	509140	0.1941	0.6023

*projected (at spawning time in autumn). ** determined by survey.

Constraint on TAC variation F0-1 = 0.12

Constraint on TAC variation F0-1 = 0.05

No constraint on TAC variation F0-1 = 0.12

No bias

10% bias on implementation and/or enforcement and/or assessment

Figure 1.4.18.1 Probabilities in the medium term of SSB > 1 300 000 tonnes, 800 000 < SSB < 1300 000 tonnes and SSB < 800 000 tonnes for some alternative implementations of the harvest rule, with and without assessment/implementation/enforcement bias as seen in the recent past.

1.4.19 Sprat in Division IIIa

State of the stock

The state of the stock is unknown. Sprat in this area is short-lived with large annual natural fluctuations in stock biomass. Landings of sprat in Division IIIa averaged about 70 000 t in the 1970s, but since 1982 have typically been around 20 000 t, except in 1994–1995.

Management objectives:

There are no explicit management objectives for this stock.

Reference points

Reference points for this stock have not been defined.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

As sprat is mainly fished together with juvenile herring the exploitation of sprat will be limited by the restrictions imposed on fisheries for juvenile herring.

Short-term implications

Catch forecast for 2006

The available survey results are not reliable indicators of sprat abundance in Division IIIa. Therefore, fishing possibilities in 2005 or 2006 cannot be projected.

Factors affecting the fisheries and the stock

Sprat cannot be fished without bycatches of herring except in years with high sprat abundance or low herring recruitment. The most recent period when this occurred was 1994–1995. Management of this stock should consider management advice given for herring in Subarea IV, Division VIId, and Division IIIa.

The directed sprat fishery serves a very small market. Most sprat catches are taken in an industrial fishery where catches are limited by herring bycatch restrictions. This combination of factors has prevented full utilisation of the occasional strong year class. Such year classes emerge and disappear very quickly.

Regulations and their effects

With the current management regime, where there are bycatch ceilings of herring as well as bycatch percentage limits, the sprat fishery is controlled by these factors.

The environment

Changes in environmental conditions, e.g., long-term changes in the temperature may affect the ecology of this stock. The influence of inflow events is currently unknown.

Scientific basis

Data and methods

Insufficient data are available to carry out an assessment.

Information from the fishing industry

Sprat catches in the beginning of 2005 have been reported by the industry as good.

Source of information
Report of the Herring Assessment Working Group for the Area South of 62°N, 8–17 March 2005 (ICES CM 2005/ACFM:16).

Year	ICES Advice	Pred. cat. corr. to adv.	Agreed TAC[1]	Official lndgs.[2]	ACFM catch
1987	-	-	80	68	14
1988	TAC for "mixed clupeoid" fishery	80[1]	80	63	9
1989	Sprat catch lowest possible level; TAC for "mixed clupeoid" fishery	80[1]	80	62	10
1990	Sprat catch lowest possible level; TAC for "mixed clupeoid" fishery	60[1]	65	43	10
1991	Sprat catch lowest possible level; Zero TAC for "mixed clupeoid" fishery	-	50	44	14
1992	No advice for sprat; Zero TAC for "mixed clupeoid" fishery	-	50	40	11
1993	No advice for sprat	-	45	36	9
1994	Separate sprat TAC based on recent catches	10-14	43	67	96
1995	Separate sprat TAC based on recent catches	9-14	43	45	56
1996	No advice	-	43	28	18
1997	Reduce bycatch of herring	-	40	19	16
1998	Limited by restriction on juvenile herring catches	-	40	26	18
1999	Limited by restriction on juvenile herring catches	-	50	35	27
2000	Limited by restriction on juvenile herring catches	-	50	28	20
2001	Limited by restriction on juvenile herring catches	-	50	34	29
2002	Limited by restriction on juvenile herring catches	-	50	31	18
2003	Limited by restriction on juvenile herring catches	-	50		17
2004	Limited by restriction on juvenile herring catches	-	50		20
2005	Limited by restriction on juvenile herring catches	-	50		
2006	Limited by restriction on juvenile herring catches	-			

Weights in '000 t.
[1]TAC applies to all species in "mixed clupeoid" catch. [2]Includes other species in "mixed clupeoid" catches.

Table 1.4.19.1 Landings in ('000 t) 1974 – 2004. (Data provided by Working Group members). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes. In the period from 1982 to 1992 Sweden only reported total catches from Division IIIa.

	Skagerrak				Kattegat			Div. IIIa	**Div. IIIa**
Year	Denmark	Sweden	Norway	**Total**	Denmark	Sweden	**Total**	Sweden	**total**
1974	17.9	2	1.2	21.1	31.6	18.6	50.2		71.3
1975	15	2.1	1.9	19	60.7	20.9	81.6		100.6
1976	12.8	2.6	2	17.4	27.9	13.5	41.4		58.8
1977	7.1	2.2	1.2	10.5	47.1	9.8	56.9		67.4
1978	26.6	2.2	2.7	31.5	37	9.4	46.4		77.9
1979	33.5	8.1	1.8	43.4	45.8	6.4	52.2		95.6
1980	31.7	4	3.4	39.1	35.8	9	44.8		83.9
1981	26.4	6.3	4.6	37.3	23	16	39		76.3
1982	10.5		1.9	12.4	21.4		21.4	5.9	39.7
1983	3.4		1.9	5.3	9.1		9.1	13.0	27.4
1984	13.2		1.8	15	10.9		10.9	10.2	36.1
1985	1.3		2.5	3.8	4.6		4.6	11.3	19.7
1986	0.4		1.1	1.5	0.9		0.9	8.4	10.8
1987	1.4		0.4	1.8	1.4		1.4	11.2	14.4
1988	1.7		0.3	2	1.3		1.3	5.4	8.7
1989	0.9		1.1	2	3.0		3	4.8	9.8
1990	1.3		1.3	2.6	1.1		1.1	6.0	9.7
1991	4.2		1.0	5.2	2.2		2.2	6.6	14.0
1992	1.1		0.6	1.7	2.2		2.2	6.6	10.5
1993	0.6	4.7	1.3	6.6	0.8	1.7	2.5		9.1
1994	47.7	32.2	1.8	81.7	11.7	2.6	14.3		96.0
1995	29.1	9.7	0.5	39.3	11.7	4.6	16.3		55.6
1996	7.0	3.5	1.0	11.5	3.4	3.1	6.5		18.0
1997	7.0	3.1	0.4	10.5	4.6	0.7	5.3		15.8
1998	3.9	5.2	1.0	10.1	7.3	1.0	8.3		18.4
1999	6.8	6.4	0.2	13.4	10.4	2.9	13.3		26.7
2000	5.1	4.3	0.9	10.3	7.7	2.1	9.8		20.1
2001	5.2	4.5	1.4	11.2	14.9	3.0	18.0		29.1
2002	3.5	2.8	0.0	6.3	9.9	1.4	11.4		17.7
2003	2.3	2.4	0.8	5.6	7.9	3.1	10.9		16.5
2004	6.2	4.5	1.1	11.8	8.2	2.0	10.2		22.0

Table 1.4.19.2 Sprat in Division IIIa.

Year	Landings tonnes
1974	71300
1975	100600
1976	58800
1977	67400
1978	77900
1979	95600
1980	83900
1981	76300
1982	39700
1983	27400
1984	36100
1985	19700
1986	10800
1987	14400
1988	8700
1989	9800
1990	9700
1991	14000
1992	10500
1993	9100
1994	96000
1995	55600
1996	18000
1997	15800
1998	18400
1999	26700
2000	20100
2001	29107
2002	17716
2003	16479
2004	21996
Average	37987

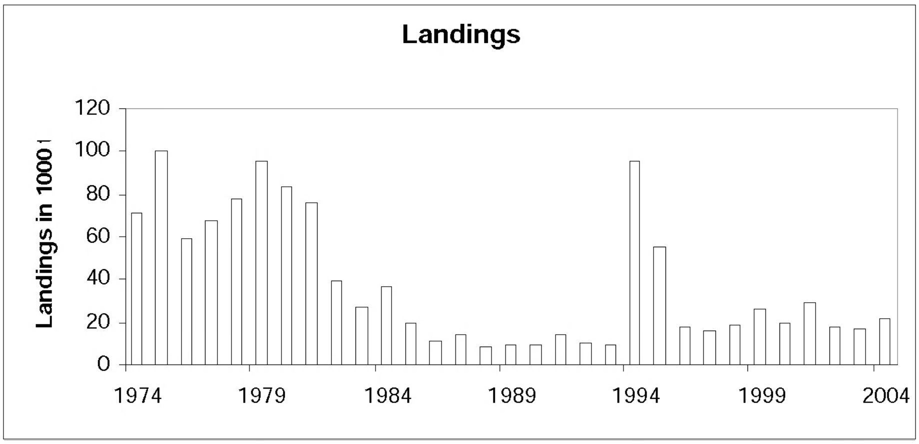


Figure 1.4.19.1 Sprat landings ('000 t) from Division IIIa in the period from 1974 to 2004.

1.4.20 Sprat in the North Sea (Subarea IV)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
unknown	unknown	unknown		

The available information is inadequate to evaluate the state of the stock and the absolute stock size is unknown. The biomass seems to have increased in recent years. The IBTS (February) 2005 survey results indicated a good 2004 year class recruiting to the 2005 fishery (the age-1 index in 2005 was the highest observed). This suggests that the stock is in good condition.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No reference points have been defined for this stock.

Single-stock exploitation boundaries

There are no precautionary limits for this stock. Maintaining the exploitation rate of recent years, the catch in 2005 is predicted to be 244 000 t, based on IBTS survey results. The 2005 TAC is set at 257 000 t.

Management considerations

For this stock only in-year catch forecasts are available. Based on the historic relationship between survey and catch, i.e. maintaining the recent exploitation rate, the 2005 survey value indicates an expected catch of 244 000 t in 2005. The present assessment and TAC-setting regime requires a two-year forecast. This means that the estimated TAC for 2006 has to be calculated in 2005 based on commercial catch data collected in 2004. This may not be a realistic approach for a stock consisting of only a few year classes, with a predominance of 1-year-old fish in the catches. If a TAC regime was necessary and the required data was available, a management approach including a mid-year revision of the TAC and taking into account an estimate of incoming recruitment would have to be considered for sprat. Despite the short-comings of the exploratory assessment described below, there are indications that the stock is lightly exploited.

The proportion of herring bycatch in the sprat fishery has been around 8% for the last four years. In 2005, a low bycatch of 1-ringer herring is expected to occur during the third and the fourth quarter as the incoming year classes of herring are estimated to be low. However, change in the regulation of bycatches in 2005 (up to 40% of herring is allowed, compare to 20% previously) may affect this bycatch level.

Ecosystem considerations

Multispecies investigations have demonstrated that sprat is one of the important prey species in the North Sea ecosystem. Many of the plankton feeding fish have recruited poorly in recent years. The implications for sprat are at present unknown. There are some indications that there may be interactions between herring and sprat biomass. The current situation is unclear and is further complicated by the increasing presence of sardine and anchovy in the central and southern North Sea (ICES CM 2005/G:06).

The plankton community in the North Sea has changed dramatically in recent years.

Factors affecting the fisheries and the stock

Regulations and their effects

Prior to 1993, sprat was caught with a relatively high percentage of herring bycatch. In 1993, 1994, and 1995 the sprat fishery could be conducted with rather low herring bycatch percentages. In some periods in 1997, 2001, and 2002 the sprat fishery was stopped due to high bycatch of herring. Generally, the sprat fishery is not limited by the TAC with the exception of 1998. Bycatch regulation has been changed in 2005.

Scientific basis

Data and methods

Assessment of a short-lived species like sprat requires reliable survey data. A Catch-Survey Analysis (CSA) was implemented as an exploratory assessment during the Working Group in 2003 (ICES CM 2003/ACFM:17).The method is based on the "modified DeLury" two-stage model (Conser, 1995) and on an implementation tested on simulated data presented to the Methods Working Group in 2003 (Mesnil, 2003). The model assumes that the population consists of two stages: the recruits (preferably a single year class which corresponds to the group of 1-year-olds) and the fully recruited ages (the 2+ group). ICES regards this assessment as exploratory.

Source of information

Report of the Herring Assessment Working Group for the Area South of 62°N, 8–17 March 2005 (ICES CM 2005/ACFM:16).

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings	ACFM Catch
1987	Catch at lowest practical level	0	57	78	32
1988	TAC < recent catches, preferably zero	0	57	93	87
1989	No advice	-	59	50	63
1990	No advice	-	59	49	73
1991	No advice	-	55	92	112
1992	No advice	-	55	72	124
1993	No advice	-	114	127	200
1994	No advice for sprat; maintain bycatch regulations	-	114	184	320
1995	No advice	-	175	190	357
1996	No advice	-	200	141	136
1997	Enforce bycatch regulations	-	150	123	103
1998	Limited by restrictions on juvenile herring	-	150	175	163
1999	Limited by restrictions on juvenile herring	-	225	167	188
2000	Limited by restrictions on juvenile herring	-	225	208	196
2001	Catch prediction	225	225	180	170
2002	Catch prediction	160	232	167	144
2003	Catch prediction	175	257		177
2004	Catch prediction	171	257		194
2005	Catch prediction	244	257		
2006	-	-			

Weights in '000 t.
[1]EU zone.

Table 1.4.20.1 Sprat in the North Sea. Catches (' 000 t) 1987-2004. Catch in fjords of western Norway excluded. (Data provided by Working Group members except where indicated). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Division IVa West (North Sea) stock																		
Denmark	0.2	0.1				0.3	0.6						0.7		0.1	1.1		0.0
Netherlands																		
Norway					0.1													
Sweden															0.1			
UK(Scotland)								0.1										
Total	0.2	0.1			0.1	0.3	0.6	0.1					0.7		0.2	1.1		0.0
Division IVa East (North Sea) stock																		
Denmark										0.3								
Norway						0.5	2.5		0.1									
Sweden					2.5													
Total					2.5	0.5	2.5		0.1	0.3								
Division IVb West																		
Denmark	3.4	1.4	2.0	10.0	9.4	19.9	13.0	19.0	26.0	1.8	82.2	21.1	13.2	18.8	11.1	16.3	22.0	53.8
Norway		3.5	0.1	1.2	4.4	18.4	16.8	12.6	21.0	1.9	2.3				0.9	0.0		
UK(Engl.&Wales)						0.5	0.5											
UK(Scotland)	0.1						0.5						0.8					
Total	3.5	4.9	2.1	11.2	13.8	38.8	30.8	31.6	47.0	3.7	84.5	21.1	14.0	18.8	12.0	16.3	22.0	53.8
Division IVb East																		
Denmark	28.0	80.7	59.2	59.2	67.0	66.6	136.2	251.7	283.2	74.7	10.9	98.2	147.1	144.1	132.9	109.8	130.9	122.2
Germany																		
Norway		0.6		0.6	25.1	9.5	24.1	19.1	14.7	50.9	0.8	15.3	13.1	0.9	5.0			0.1
Sweden				+	+				0.2	0.5		1.7	2.1		1.4			
UK(Scotland)													0.6					
Total	28.0	81.3	59.2	59.8	92.1	76.1	160.3	270.8	298.1	126.1	11.7	115.2	162.9	145.0	139.3	109.8	131.0	122.2
Division IVc																		
Denmark		0.1	0.5	1.5	1.7	2.5	3.5	10.1	11.4	3.9	5.7	11.8	3.3	28.2	13.1	14.8	22.3	16.8
France									+									
Netherlands		0.4	0.4										0.2					
Norway							0.4	4.6	0.4		0.1	16.0	5.7	1.8	3.6			
UK(Engl.&Wales)	0.7	0.6	0.9	0.2	1.8	6.1	2.0	2.9	0.2	2.6	1.4	0.2	1.6	2.0	2.0	1.6	1.3	1.5
Total	0.7	1.1	1.8	1.7	3.5	8.6	5.9	17.6	12.0	6.5	7.2	28.0	10.8	32.0	18.7	16.4	23.6	18.3
Total North Sea																		
Denmark	31.6	82.3	61.7	70.7	78.1	89.2	153.3	280.8	320.6	80.7	98.8	131.1	164.3	191.1	157.2	142.0	175.2	192.7
France									+									
Germany																		
Netherlands		0.4	0.4										0.2					
Norway		4.1	0.1	1.8	29.6	28.4	43.8	36.3	36.2	52.8	3.2	31.3	18.8	2.7	9.5	0.0		0.1
Sweden					2.5								2.7		1.4			
UK(Engl.&Wales)	0.7	0.6	0.9	0.2	1.8	6.6	2.5	2.9	0.2	2.6	1.4	0.2	1.6	2.0	2.0	1.6	1.3	1.5
UK(Scotland)	0.1						0.5	0.1					0.8					
Total	32.4	87.4	63.1	72.7	112.0	124.3	200.1	320.1	357.0	136.1	103.4	162.6	188.4	195.9	170.1	143.6	176.5	194.3

Table 1.4.20.2 Sprat in the North Sea.

Year	Landings tonnes
1987	32400
1988	87400
1989	63100
1990	72700
1991	112000
1992	124270
1993	200100
1994	320100
1995	357000
1996	136100
1997	103400
1998	162600
1999	188400
2000	195877
2001	170097
2002	143641
2003	176489
2004	194274
Average	157775

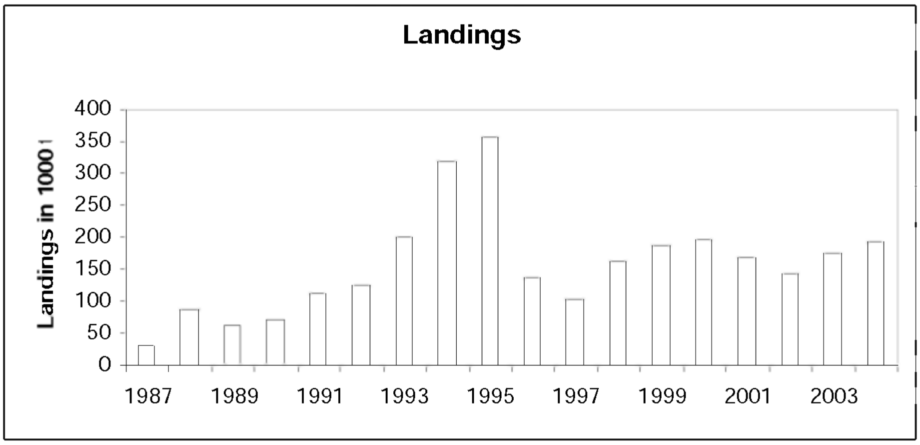


Figure 1.4.20.1 Sprat landings ('000 t) from the North Sea in the period from 1987 to 2004.

1.4.21 North Sea horse mackerel (*Trachurus trachurus*) (Division IIIa (Eastern part), Divisions IVb,c VIId)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	No assessment available, due to limited data.

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk, so the state of the stock is unknown. Catches increased rapidly in the late 1990s and have remained high since then.

Management objectives

No explicit management objectives have been established for this stock.

Reference points

Not available.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary considerations

ICES reiterates the recommendation made in 2004 to limit the catches to below the 1982–1997 average of 18 000 t, in order to constrain the fishery until there is more information about the structure of horse mackerel stocks, and sufficient information to show that higher exploitation rates are sustainable.

Short-term implications

No forecast can be made for this stock.

Management considerations

ICES advised in 1999 to constrain an expansion of the fishery until there was a scientific basis for advice, because high catch rates can be maintained in pelagic fisheries even when the stock is in decline.

North Sea horse mackerel migrate to areas where they mix with the western horse mackerel stock. The present agreed TAC is for the North Sea and Division IIa, and these areas do not correspond to the distribution area of the stock. The TAC should apply only to those areas where the North Sea horse mackerel are fished, i.e. Divisions IIIa, IVb,c, and VIId.

The allocation of catches to the different horse mackerel stocks is based on the temporal and spatial distribution of the fishery. It is therefore important that catches be reported by ICES rectangle and by quarter.

The points listed below should be taken into account when considering management options for the North Sea horse mackerel:

1) The stock units are incompatible with the management units.
2) Catches have increased during the last decade. The major part of the increased catches is taken in Division VIId in quarters 1 and 4, which is adjacent to the boundary of the western stock. It is also adjacent to an area where juveniles of the western horse mackerel stock are found.
3) Recent catches are above the advised TACs of 18 000 t. The average annual catch in the period 1995–2004 was 31 000 t.
4) There is a bycatch of mackerel in the horse mackerel fishery.

Factors affecting the fisheries and the stock

Changes in fishing technology and fishing patterns

In earlier years, the majority of the catch was taken as bycatch in the small-mesh industrial fishery. In recent years, most of the catch has come from a directed fishery for human consumption, mainly in Division VIId. This has led to a change in the age composition of the landings with a higher proportion of younger age groups.

Scientific basis

Data and methods

The stock cannot be assessed because sampling is insufficient and fishery-independent indices of abundance are lacking.

Eggs surveys for horse mackerel were carried out during the period 1988–1991. New information indicates that horse mackerel is probably an indeterminate spawner. Therefore, it is not possible currently to provide a realistic estimate of the spawning biomass. The mackerel egg surveys in the North Sea do not cover the spawning area of horse mackerel.

Comparison with previous assessment and advice

There is no assessment on which to base the status of this stock. The current advice reiterates last year's advice based on average catches observed between 1982 and 1997.

Source of information

Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2005 (ICES CM 2006/ACFM:08).

Year	ICES Advice	Predicted catch corresp. To advice	Agreed TAC[1]	ACFM landings[2]
1987	Not assessed	-	30	12
1988	No advice	-	50	24
1989	No advice	-	45	33
1990	No advice	-	40	19
1991	No advice	-	45	12
1992	No advice	-	55	15
1993	No advice	-	60	14
1994	No advice	-	60	6
1995	No advice	-	60	17
1996	No advice	-	60	19
1997	No advice	-	60	20
1998	Develop and implement management plan	-	60	31
1999	Develop and implement management plan	-	60	37
2000	Develop and implement management plan	-	51	48
2001	No increase in catch	-	51	46
2002	No increase in catch from 1982–1997 average	<18	58	23
2003	No increase in catch from 1982–1997 average	<18	50	32
2004	No increase in catch from 1982–1997	<18	42	35
2005	No increase in catch from 1982–1997	<18	43	
2006	No increase in catch from 1982–1997	<18		

Weights in '000 t.
[1]Division IIa and Subarea IV (EU waters only).
[2]Catch of North Sea stock (Divisions IIIaE, IVb,c & VIId).

Table 1.4.21.1 Landings and discards of HORSE MACKEREL (t) by year and Division, for the North Sea, Western, and Southern horse mackerel. (Data submitted by Working Group members.)

Year	IIIa	IVa	IVb,c	Discards	VIId	**North Sea Stock**	IIa	IIIa	IVa	VIa,b	VIIa-c,e-k	VIIIa,b, d,e	VIIIc	Disc	**Western Stock**	**Southern Stock** (IXa)	All stocks
1982	2,788[1]		-		1,247	4,035	-		-	6,283	32,231	3,073	19,610	-	61,197	39,726	104,958
1983	4,420[1]		-		3,600	8,020	412		-	24,881	36,926	2,643	25,580	-	90,442	48,733	147,195
1984	25,893[1]		-		3,585	29,478	23		94	31,716	38,782	2,510	23,119	500	96,744	23,178	149,400
1985	-		22,897		2,715	26,750	79		203	33,025	35,296	4,448	23,292	7,500	103,843	20,237	150,830
1986	-		19,496		4,756	24,648	214		776	20,343	72,761	3,071	40,334	8,500	145,999	31,159	201,806
1987	1,138		9,477		1,721	11,634	3,311		11,185	35,197	99,942	7,605	30,098	-	187,338	24,540	223,512
1988	396		18,290		3,120	23,671	6,818		42,174	45,842	81,978	7,548	26,629	3,740	214,729	29,763	268,163
1989	436		25,830		6,522	33,265	4,809		85,304[2]	34,870	131,218	11,516	27,170	1,150	296,037	29,231	358,533
1990	2,261		17,437		1,325	18,762	11,414	14,878	112,753[2]	20,794	182,580	21,120	25,182	9,930	398,645	24,023	441,430
1991	913		11,400		600	12,000	4,487	2,725	63,869[2]	34,415	196,926	25,693	23,733	5,440	357,288	21,778	391,066
1992			13,955	400	688	15,043	13,457	2,374	101,752	40,881	180,937	29,329	24,243	1,820	394,793	26,713	436,548
1993			3,895	930	8,792	13,617	3,168	850	134,908	53,782	204,318	27,519	25,483	8,600	458,628	31,945	504,190
1994			2,496	630	2,503	5,689	759	2,492	106,911	69,546	194,188	11,044	24,147	3,935	413,022	28,442	447,153
1995	112		7,948	30	8,666	16,756	13,133	128	90,527	83,486	320,102	1,175	27,534	2,046	538,131	25,147	580,034
1996	1,657		7,558	212	9,416	18,843	3,366		18,356	81,259	252,823	23,978	24,290	16,870	420,942	20,400	460,185
1997			14,078	10	5,452	19,540	2,617	2,037	65,073[3]	40,145	318,101	11,677	29,129	2,921	471,700	27,642	518,882
1998	3,693		10,530	83	16,194	30,500	2,540[4]		17,011	35,043	232,451	15,662	22,906	830	326,443	41,574	398,523
1999			9,335		27,889	37,224	2,557[5]	2,095	47,316	40,381	158,715	22,824	24,188		298,076	27,733	363,033
2000			25,954		22,471	48,425	1,169[6]	1,105	4,524	20,657	115,245	32,227	21,984		196,911	27,160	272,496
2001	85	69	8,157		38,114	46,356	60	72	11,456	24,636	100,676	54,293	20,828		212,090	24,911	283,357
2002			12,636	20	10,723	23,379	1,324	179	36,855	14,190	86,878	32,450	22,110	305	194,292	23,665	241,336
2003	48	623	10,309		21,098	32,078	24	1,974	21,272	23,254	101,948	21,732	19,979		190,183	19,570	241,831
2004	351		18,348		16,455	35,154	47		11,841	21,929	98,984	8,353	15,772	701	157,627	23,581	216,361

[1]Divisions IIIa and IVb,c combined.
[2]Norwegian catches in IVb included in Western horse mackerel.
[3] Includes Norwegian catches in IVb (1,426 t).
[4]Includes 1,937 t from Vb.
[5]Includes 132 t from Vb.
[6]Includes 250 t from Vb.

Table 1.4.21.2 Landings (t) of HORSE MACKEREL in Subarea IV and Division IIIa by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	8	34	7	55	20	13	13	9	10
Denmark	199	3,576	1,612	1,590	23,730	22,495	18,652	7,290	20,323
Faroe Islands	260	-	-	-	-	-	-	-	-
France	292	421	567	366	827	298	231[2]	189[2]	784[2]
Germany, Fed.Rep.	+	139	30	52	+	+	-	3	153
Ireland	1,161	412	-	-	-	-	-	-	-
Netherlands	101	355	559	2,029[3]	824	160[3]	600[3]	850[4]	1,060[3]
Norway[2]	119	2,292	7	322	[3]	203	776	11,728[4]	34,425[4]
Poland	-	-	-	2	94	-	-	-	-
Sweden	-	-	-	-	-	-	2	-	-
UK (Engl. + Wales)	11	15	6	4	-	71	3	339	373
UK (Scotland)	-	-	-	-	3	998	531	487	5,749
USSR	-	-	-	-	489	-	-	-	-
Total	2,151	7,253	2,788	4,420	25,987	24,238	20,808	20,895	62,877

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	10	13	-	+	74	57	51	28	-
Denmark	23,329	20,605	6,982	7,755	6,120	3,921	2,432	1,433	648
Estonia	-	-	-	293	-		17	-	-
Faroe Islands	-	942	340	-	360	275	-	-	296
France	248	220	174	162	302		-	-	-
Germany, Fed.Rep.	506	2,469[5]	5,995	2,801	1,570	1,014	1,600	7	7,603
Ireland	-	687	2,657	2,600	4,086	415	220	1,100	8,152
Netherlands	14,172	1,970	3,852	3,000	2,470	1,329	5,285	6,205	37,778
Norway	84,161	117,903	50,000	96,000	126,800	94,000	84,747	14,639	45,314
Poland	-	-	-	-	-	-	-	-	-
Sweden	-	102	953	800	697	2,087	-	95	232
UK (Engl. + Wales)	10	10	132	4	115	389	478	40	242
UK (N. Ireland)	-	-	350	-	-		-	-	-
UK (Scotland)	2,093	458	7,309	996	1,059	7,582	3,650	2,442	10,511
USSR / Russia (1992 -)	-	-	-						
Unallocated + discards	12,482[4]	-317[4]	-750[4]	-278[6]	-3,270	1,511	-28	136	-31,615
Total	112,047	145,062	77,904	114,133	140,383	112,580	98,452	26,125	79,161

Country	1998	1999	2000	2001	2002	2003[1]	2004
Belgium	19	21	19	19	1,004	5	4
Denmark	2,048	8,006	4,409	2,288	1,393	3,774	8738
Estonia	22	-	-				
Faroe Islands	28	908	24	-	699	809	
France	379	60	49	48	-	392	2532
Germany	4,620	4,071	3,115	230	2,671	3,048	4912
Ireland	-	404	103	375	72	93	1
Netherlands	3,811	3,610	3,382	4,685	6,612	17,354	26301
Norway	13,129	44,344	1,246	7,948	35,368	20,493	
Russia	-	-	2	-	-		
Sweden	3,411	1,957	1,141	119	575	1,074	97
UK (Engl. + Wales)	2	11	15	317	1,191	1,192	5634
UK (Scotland)	3,041	1,658	3,465	3,161	255	1	2
Unallocated + discards	737	-325	14613	649	-149	-14,009	-13068
Total	31,247	64,725	31583	19,839	49,691	34,226	35154

[1] Preliminary. [2] Includes Division IIa. [3] Estimated from biological sampling. [4] Assumed to be misreported. [5] Includes 13 t from the German Democratic Republic. [6] Includes a negative unallocated catch of -4,000 t.

1.4.22 Norway pout in ICES Subarea IV (North Sea) and Division IIIa (Skagerrak – Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Reduced reproductive capacity	Reference points not defined	Reference points not defined	Biomass-based limit reference points have been formulated on the basis of the lowest biomass ever observed from which the stock has been shown to recover, as well as a biomass point which will lead to below-average recruitment.

Based on the most recent estimates of SSB, ICES classifies the stock as suffering from reduced reproductive capacity (Stock biomass is below $\mathbf{B}_{\mathrm{lim}}$ in 2005). Estimated fishing mortality has decreased in recent years and was in 2004 at the lowest level in the time-series, and because of the fishery closure in 2005, fishing mortality is likely to be close to zero in 2005. Recruitment has been below average in the period 2000-2004, with a record low in 2003-2004. Estimates of the 2005 year class from a single survey indicates a recruitment slightly below average.

Management objectives

There are no explicit and specific management objectives for this stock.

Reference points (unchanged since 1997)

	ICES considers that:	**ICES proposed that:**
Limit reference points	$\mathbf{B}_{\mathrm{lim}}$ is 90 000 t	$\mathbf{B}_{\mathrm{pa}}$ be set at 150 000 t
Target reference points		$\mathbf{F}_{\mathrm{y}}$ not defined

Technical basis

$\mathbf{B}_{\mathrm{lim}}$: lowest observed biomass	$\mathbf{B}_{\mathrm{pa}}$: Below-average recruitment when SSB is less than 150 000 t

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007. The information on which this could be based includes the IBTS surveys in January-February and August-September 2006.

Short-term implications

Outlook for 2006

In the case of a zero catch in 2005 and an estimated recruitment of age 0 fish of 112 billions in second quarter of 2005, based on the SGF in 3 quarter 2005, the SSB is forecasted to be 78 000 t in 2006 compared to 57 000 in 2005. With no catch in 2006 the 2005 year class alone will result in a SSB estimate at 150 000 t in 2007, such that the total SSB including an unknown 2006 year class is above the Bpa. Because the estimate of recruitment in 2006 is only based on one survey, the estimate is likely to be uncertain, and the estimate has to be confirmed by surveys in 2006.

Management considerations

The stock was in the first part of 2005 considered by ICES to be below $\mathbf{B}_{lim}$. The stock is expected to still be below $\mathbf{B}_{lim}$ in 2006. EU and Norway agreed to close the fishery in 2005 based on the advice from ICES.

In managing this fishery, bycatches of haddock, whiting, herring, and blue whiting should be taken into account and existing measures to protect these bycatch species should be maintained.

The 3rd and 1st quarter IBTS survey and the 4th quarter commercial fishery (when it exists) indices provide relatively good indicators of the year-class strengths and the size of the stock. This information could be used as real-time monitoring of this stock.

Ecosystem considerations

The population dynamics of Norway pout in the North Sea and Skagerrak are very dependent on changes caused by recruitment variation and variation in predation mortality (or other natural mortality causes). Recruitment is highly variable and influences SSB and TSB rapidly, due to the short life span of the species. With present fishing mortality levels the status of the stock is more determined by natural processes and less by the fishery. However, there is a need to ensure that the stock remains high enough to provide food for a variety of predator species (e.g. saithe, haddock, and mackerel).

Factors affecting the fisheries and the stock

Historically, the fishery includes bycatches especially of blue whiting, haddock, whiting, and herring.

Norway pout are currently taken as bycatch in the blue whiting fishery.

Scientific basis

Data and methods

The assessment (SXSA) is considered appropriate to indicate trends in the stock. It provides stock status of all year classes up to the second quarter of the assessment year 2005. Also, it gives an indication of the likely recruitment by January 1 of the following year.

Comparative runs with the SXSA, SMS, and SURBA assessment models gave consistent estimates of stock status and dynamics. Consequently, the accepted assessment using small artificial landings in the first and second quarter of the year 2005 does not change the perception of the stock status.

Uncertainties in assessment and forecast

Studies indicate that natural mortality used in the assessment may be inappropriate.

Comparison with previous assessment and advice

The estimates of the SSB, recruitment, and the average fishing mortality of ages 1 and 2, are consistent with the estimates of previous years assessment.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

North Sea (Subarea IV)

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings	ACFM landings
1987	No advice	-	200	215	147
1988	No advice	-	200	187	102
1989	No advice	-	200	276	167
1990	No advice	-	200	212	140
1991	No advice	-	200	223	155
1992	No advice	-	200	335	255
1993	No advice	-	220	241	176
1994	No advice	-	220	214	176
1995	Can sustain current F	-	180	289	181
1996	Can sustain current F; take bycatches into consid.	-	220	197	122
1997	Can sustain current F; take bycatches into consid.	-	220	155	133
1998	Can sustain current F; take bycatches into consid.	-	220	72	62
1999	Can sustain current F; take bycatches into consid.	-	220	93	85
2000	Can sustain current F; take bycatches into consid.	-	220	182	175
2001	Can sustain current F; take bycatches into consid.	-	211	63	57
2002	Can sustain current F; take bycatches into consid.	-	198	93	74
2003	Can sustain current F; take bycatches into consid.		198	24	21
2004	The stock is in risk of decreasing below $\mathbf{B}_{lim}$.		198	16	14
2005	Fishery should be closed		0		
2006	The fishery should remain closed until information is available which assures that the stock can be rebuilt to Bpa by 2007		0		

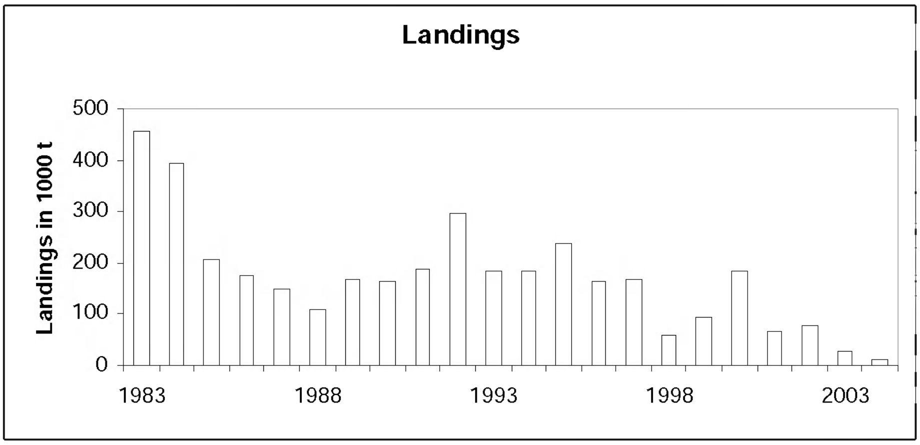
[1] IIa(EU), IIIa, IV(EU). Weights in '000' t.

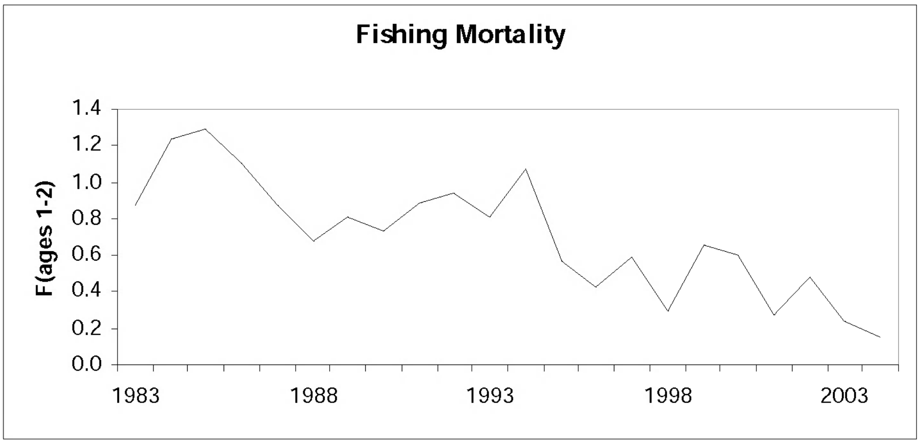
Skagerrak (Division IIIa)

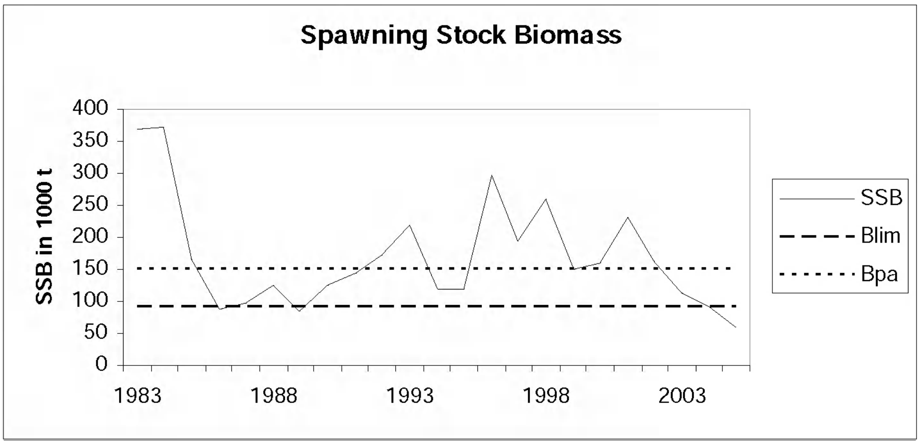
Year	ICES Advice	Official landings	ACFM Catch
1987	No advice		2
1988	No advice		8
1989	No advice	17	5
1990	No advice	41	12
1991	No advice	49	38
1992	No advice	84	45
1993	No advice	37	8
1994	No advice	24	7
1995	No advice	68	50
1996	No advice	58	36
1997	See advice for North Sea	35	29
1998	See advice for North Sea	11	13
1999	See advice for North Sea	7	8
2000	See advice for North Sea	15	10
2001	See advice for North Sea	14	7
2002	See advice for North Sea	4	3
2003	See advice for North Sea	4	3
2004	See advice for North Sea	0.2	0.3
2005	See advice for North Sea	0	
2006	See advice for North Sea	0	

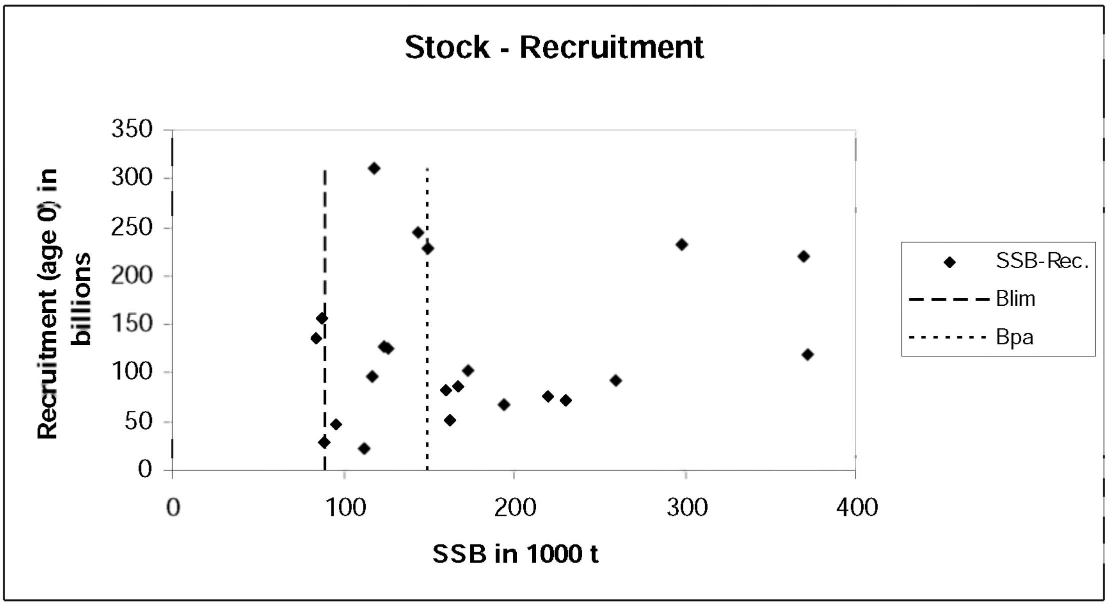
Weights in '000' t.

Norway pout in Subarea IV and Division IIIa.








Stock - Recruitment
Recruitment (age 0) in billions
SSB in 1000 t
0
50
100
150
200
250
300
350
0
100
200
300
400
SSB-Rec.
Blim
Bpa

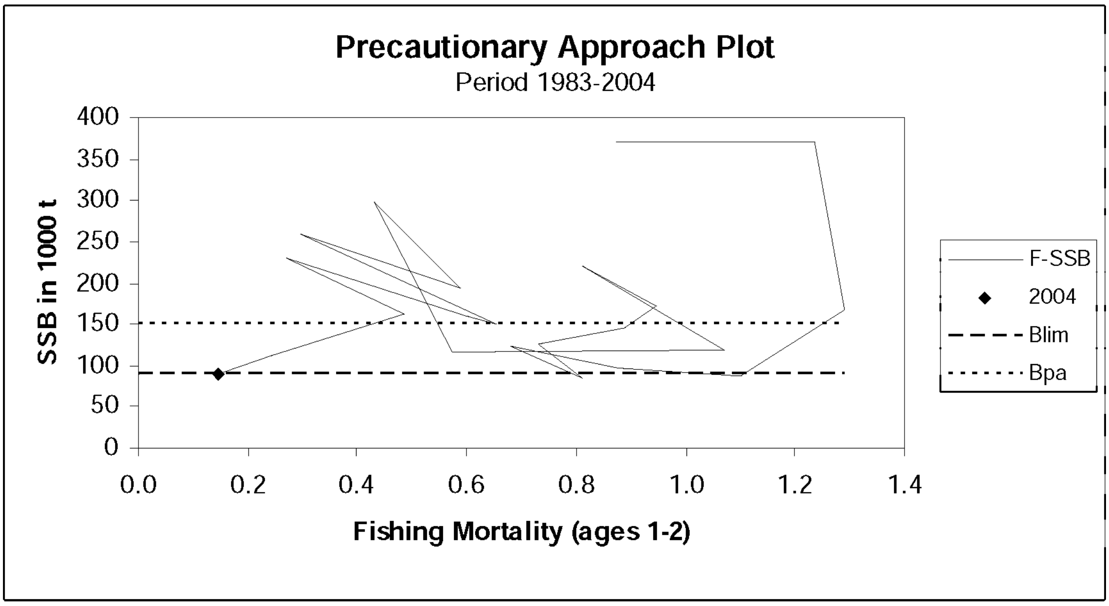

Precautionary Approach Plot
Period 1983-2004
SSB in 1000 t
Fishing Mortality (ages 1-2)
0
50
100
150
200
250
300
350
400
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
F-SSB
2004
Blim
Bpa

Table 1.4.22.1 **NORWAY POUT nominal landings (tonnes) from the North Sea and Skagerrak / Kattegat, ICES areas IV and IIIa in the period 1997-2004, as officially reported to ICES and EU.**

Norway pout ICES area IIIa

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	34 746	11 080	7 194	14 545	13 619	3 780	4 235	110
Faroe Islands	-	-	-	-	-	-	50	-
Norway	-	-	-	-	-	96	30	41
Sweden	2	-	-	133	780	-	-	-
Germany	-	-	-	-	-	-	-	54
Total	34 748	11 080	7 194	14 678	14 399	3 876	4 315	205

*Preliminary.

Norway pout ICES area IVa

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	106 958	42 154	39 319	133 149	44 818	68 858	12 223	10 762
Faroe Islands	7 033	4 707	2 534		49	3 367	2 199	-
Netherlands	35	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	27
Norway	39 006	22 213	44 841	48 061	17 158	23 657	11 357	4 958
Sweden	+	-	-	-	-	-	-	-
Total	153 032	69 074	86 694	181 210	62 025	95 882	25 779	15 747

*Preliminary.

Norway pout ICES area IVb

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	1 794	3 258	5 299	158	632	556	191	473
Germany	-	-	-	2	-	-	-	26
Netherlands	50	2	-	3	-	-	-	-
Norway	-	57	-	34	-	-	-	-
Sweden	-	-	-	-	-	-	-	2
UK (E/W/NI)	-	-	-	+	-	+	-	-
UK (Scotland)	+	-	-	-	-	-	-	-
Total	1 844	3 317	5 299	197	632	556	191	501

*Preliminary.

Norway pout ICES area IVc

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	-	-	514	182	304	-	-	-
Netherlands	-	-	+	-	-	-	-	-
UK (E/W/NI)	-	-	-	-	+	-	-	-
Total	0	0	0	0	0	0	0	0

*Preliminary.

Norway pout Sub-area IV and IIIa (Skagerrak) combined

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	143 498	56 492	51 812	147 852	59 069	73 194	16 649	11 345
Faroe Islands	7 033	4 707	2 534	0	49	3 367	2 249	0
Norway	39 006	22 270	44 841	48 095	17 158	23 753	11 387	4 999
Sweden	2	0	0	133	780	0	0	2
Netherlands	85	2	0	3	0	0	0	0
Germany	0	0	0	2	0	0	0	107
UK	0	0	0	0	0	0	0	0
Total nominal landings	189 624	83 471	99 187	196 085	77 056	100 314	30 285	16 453
By-catch of other species and other	-19 924	-3 671	-7 187	-11 685	-11 456	-23 614	-5 385	-2 953
WG estimate of total landings (IV+IIIaN)	169700	79800	92000	184400	65600	76700	24900	13500
Agreed TAC	220000	220000	220000	220000	220000	220000	220000	220000

* provisional
** provisional
+ Landings less than 1
n/a not available

Table 1.4.22.2 Norway pout in Subarea IV and Division IIIa.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1-2
1983	221117000	369863	457600	0.872
1984	119149000	371937	393000	1.236
1985	85616000	167121	205100	1.289
1986	156495000	87773	174300	1.101
1987	46362000	96134	149300	0.876
1988	128131000	124275	109300	0.680
1989	135390000	84774	166400	0.810
1990	126079000	125777	163300	0.731
1991	244107000	144290	186600	0.887
1992	102886000	172743	296800	0.945
1993	75548000	219481	183100	0.810
1994	310089000	118268	182000	1.072
1995	97673000	117400	236800	0.574
1996	233318000	298157	163800	0.430
1997	67308000	194419	169700	0.589
1998	92452000	259557	57700	0.295
1999	228064000	149954	94500	0.656
2000	82369000	160397	184400	0.598
2001	72172000	230748	65600	0.271
2002	51190000	162451	80000	0.485
2003	23559000	112444	27100	0.241
2004	28164000	89375	13500	0.148
2005	112093000	58692		
Average	123449174	170262	170905	0.709

1.4.23 Sandeel in Division IIIa (Skagerrak – Kattegat)

State of the stock

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk, so the state of the stock is unknown.

Management objectives

There are no explicit management objectives for this stock.

Management considerations

The fishery is an extension of the North Sea fishery into Division IIIa, but with smaller vessels working closer inshore, mostly along the coast of Jutland.

The available information suggests that Subarea IV and Division IIIa can be combined to one stock unit. No assessments of sandeel in Division IIIa have been carried out so far. Biological data for this area are sparse and would have to be evaluated before a decision is made about treating sandeels in Subarea IV and Division IIIa as one stock.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6 – 15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES Advice	ACFM Catch
1987	No advice	5
1988	No advice	23
1989	No advice	18
1990	No advice	16
1991	No advice	23
1992	No advice	39
1993	No advice	45
1994	No advice	55
1995	No advice	12
1996	No advice	53
1997	No advice	81
1998	No advice	11
1999	No advice	13
2000	No advice	17
2001	No advice	25
2002	No advice	49
2003	No advice	9
2004	No advice	11
2005	No advice	
2006	No advice	

Weights in '000 t.

1.4.24 Sandeel in Subarea IV

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Reduced reproductive capacity	F reference points are not defined	Unknown	

Based on the most recent estimates of SSB, ICES classifies the stock as having reduced reproductive capacity. SSB in 2004 and 2005 were below $\mathbf{B}_{\text{lim}}$. In the absence of a defined F reference point, the state of the stock cannot be evaluated with regard to sustainable harvest. The fishing mortality in 2004 (0.61) was equivalent to the time-series mean and below that of the last 4 years.

Management objectives

There are no explicit management objectives for this stock.

Reference points

Reference points have been unchanged since 1999.

	ICES considers that:	ICES proposed that:
Precautionary Approach reference points	$\mathbf{B}_{\text{lim}}$ is 430 000 t	$\mathbf{B}_{\text{pa}}$ be set at 600 000 t
	$\mathbf{F}_{\text{lim}}$ is undefined	$\mathbf{F}_{\text{pa}}$ is undefined
Target reference points		$\mathbf{F}_{\text{y}}$ is undefined

Technical basis:

$\mathbf{B}_{\text{lim}}$: The lowest observed biomass that gave recruitment about the average level	$\mathbf{B}_{\text{pa}}$: set to 1.4 * $\mathbf{B}_{\text{lim}}$
$\mathbf{F}_{\text{lim}}$: None proposed	$\mathbf{F}_{\text{pa}}$: None proposed
	$\mathbf{F}_{\text{y}}$: None proposed

Single-stock exploitation boundaries

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

Management of fisheries should try to prevent local depletion of sandeel aggregations, particularly in areas where predators congregate.

Exploitation boundaries in relation to precautionary limits

The fishery should remain closed until information is available which assures that the stock can be rebuilt to $\mathbf{B}_{\text{pa}}$ by 2007. The information on which this could be based includes a survey in December 2005 and exploratory fishing in April 2006.

Short-term implications

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. In 2005 there was a very low fishery in the second half year, because of the stop of the fishery from July 2005 and onwards. This makes it impossible to get any indications of the 2005 year class from the fishery. Furthermore, age-0 CPUE is only giving indications of year class sizes and its predictive power is poor, which means that deterministic forecasts are not generally considered appropriate. However, the critical state of the sandeel stock indicated by the current assessment requires a provisional forecast which illustrates the likely consequences in case recruitment continues to be low. The forecast is thus not a prediction of the most likely outcome but an illustration of the development in the case that recruitment is not improved.

The prediction was made using half-year time steps. In the absence of information about the recruitment a low recruitment was assumed for 2005 and 2006. This was chosen because recruitments in the last 3 years have been low. Recruitment in 2005 and 2006 was assumed to be 327 10^9, which is the 25th percentile of the long-term average recruitment. Stock and catch weights for the second half year of 2005 and for 2006 were taken as averages of half-year values in 2003–2004. Stock numbers at 1st of January 2005 were taken from the final SXSA assessment. Fs-at-age for the forecasts were taken as the average exploitation pattern for 2003–2004, scaled to $\mathbf{F}_{1\text{-}2}$ in 2004. 2004 first half year $\mathbf{F}_{sq}$=0.454 and 2004 second half year $\mathbf{F}_{sq}$ =0.148.

Low recruitment (25th percentile of time-series recruitment) was used for 2005 and 2006.

Basis: F(2006) =F(2004) scaled over 2003 and 2004; SSB(2006) = 446 000 t; landings (2005) = 167 000 t.

Rationale	Relative effort F(2006)/F(2004)	Basis	F(2006)	Landings(2006) `000 t	SSB(2007) `000 t
Zero catch	0	F=0	0.000	0	718
Status quo	0.1	$\mathbf{F}_{sq}$ *0.1	0.060	56	673
	0.2	$\mathbf{F}_{sq}$ *0.2	0.120	109	632
	0.25	$\mathbf{F}_{sq}$ *0.25	0.150	135	612
	0.3	$\mathbf{F}_{sq}$ *0.3	0.180	160	593
	1.0	$\mathbf{F}_{sq}$ *1	0.602	442	384

Weights in '000t.
Shaded scenarios are not considered consistent with the Precautionary Approach.

Management considerations

Stock abundance in the prediction year is highly dependent on the incoming year class for which no reliable estimate exists. If the survey to be carried out in late 2005 indicates that the 2005 year class is at least about average, then real-time monitoring of a fishery in 2006 could be implemented. The monitoring would provide a more accurate estimate of the size of the 2005 year class and enable more effective management of the fishery. It is, however, paramount that the harvest control rules are enforced expediently. In 2005 the fishery was closed when the main sandeel season was over, despite the recommendation from STECF to close the fishery in the middle of May.

The Council of the EU agreed during the December 2004 meeting that the Commission should implement a fishing effort regulation for vessels fishing for sandeel in the North Sea and the Skagerrak. Effort for the 2005 fishery was not allowed to exceed 40% of the 2004 level. This maximum effort level was to be revised as early as possible based on the strength of the 2004 year class.

The regulation was implemented through a real-time monitoring of the sandeel fishery on the basis of a methodology developed by an STECF *ad hoc* working group in 2004. The method was improved in 2005 by STECF in order to improve the identification of small year classes. The method for estimating the 2004 year class used data from the Danish fishery in April of 2005, where approximately 10% of the annual catches are taken. DIFRES was responsible for all data gathering and model runs. Quality assurance was achieved by data and model output exchange between DIFRES, CEFAS, and FRS on a weekly basis. The STECF working group produced a short summary of the final model output to STECF by the 9 May, and STECF advised shortly thereafter, that the fishery should be closed. The fishery in the EU zone was closed 2nd of July, when the 40% effort level was reached. The final regulation from the Commission was submitted in July and the closure of the fishery was enforced by 19th of July when the sandeel season was nearly over.

$\mathbf{B}_{lim}$ was derived as the lowest observed SSB that gave recruitment about the average level. Until 2003 the sandeel stock has been considered to be within safe biological limits, and the stock has been able to sustain the fishing mortality. However, the 2005 final assessment estimates SSB in 2004 to be historic low and under $\mathbf{B}_{lim}$, and to be below $\mathbf{B}_{pa}$ from 2000 and for the rest of the time-series.

The low stock size increases the risk of local depletion. There is therefore a need to monitor the stock situation and hence the fishery on a finer spatial scale. Access to VMS data is a prerequisite for this.

There has been a 50% decline in the number of vessels fishing sandeels from 2004 to 2005.

The Danish fishing industry has proposed effort limitations and closed seasons for the 2006 sandeel fishery.

Management plan evaluations

There are no management objectives set for this stock. There is a need to develop management objectives that ensure that the stock remains high enough to provide food for a variety of predator species.

Ecosystem considerations

Mortality appears to be determined mostly by natural causes rather than by fishing. The recruitment of sandeels seems more linked to environmental factors than to the size of the spawning stock biomass.

In the light of studies linking low sandeel availability to poor breeding success of kittiwake, 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 and has been extended until 2006, with an increase in the effort of the monitoring fishery to 20 days, after which the effect of the closure will be evaluated.

The ecosystem effects of industrial fisheries are discussed in the Report of the ICES Advisory Committee on Ecosystems, June 2003, Section 11 (ICES CRR 262). The direct effects of industrial fishing that have been identified on other species fished for human consumption, e.g. haddock and whiting, are relatively small in comparison to the effects of directed fisheries for human consumption species. Sandeel is an important prey species for many marine predators. However, there is still relatively scant information on the effects of fisheries targeting these stocks (sandeel, Norway pout, sprat), and further analysis of the ecological impacts of these fisheries is required. The effects of variation in the sizes of most industrial stocks on their predators are also poorly known.

Factors affecting the fisheries and the stock

The effects of regulations

The Council of the EU agreed in December 2004 that the Commission should implement a fishing effort regulation in 2005 for vessels fishing for sandeel in the North Sea and the Skagerrak. The Council of the EU adopted a harvest control rule based on the size of the 2004 year class. The Commission based this regulation on advice from STECF.

From the estimate of the 2004 year class, STECF recommended in May that the agreed HCR for sandeel given in Annex V of Council Regulation (EC) 27/2005 should be implemented with immediate effect, which meant a closure of the fishery for North Sea sandeel for the remainder of 2005. Furthermore, STECF stressed the importance of rapid action to close the fishery as the HCR depends on swift action to function correctly. However, the sandeel fishery in the EU zone was first closed 2nd July and the closure enforced by 19th July, when the main sandeel fishing season was over.

The environment

The decline in the density of sandeel in the entire North Sea is not limited to the fished areas. If this change in the stock situation is caused by changes in the environment this may suggest that the reference points used for sandeels need to be revised. However, presently there is not data to quantify a link between changes in the environment and sandeel population dynamics.

Other factors

Sandeel is taken by trawlers using small mesh gear. The fishery is seasonal, taking place mostly in the spring and summer. There is a targeted 0-group fishery carried out in autumn (3rd quarter). Most of the catch consists of *Ammodytes marinus*, but other sandeel species are caught as well. There is a low percentage bycatch of other species, including species for which a TAC has been set.

Sandeels are largely stationary after settlement and the North Sea sandeel must be considered as a complex of local populations. Recruitment to local areas may not only be related to the local stock, as interchange between areas seems to take place during the early phases of life before settlement. The Shetland sandeel stock is assessed as a separate unit.

Scientific basis

Data and methods

The assessment of sandeel is carried out without fisheries-independent indices of abundance. Different sampling approaches have been tried during scientific surveys, but at present no scientific survey time-series exist that can be used for the assessment.

The assessment method used is Seasonal XSA (SXSA), which allows the use of data by half-year. Catches from 1st half of 2005 are included and because the fishery was closed in July this represent almost all the catches for 2005. 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 half-years. In order to improve the model fit, the CPUE series were split into two time periods, i.e. before and after 1999.

At the 2005 WG meeting, the SMS model was used for exploratory analyses and compared to the SXSA. SXSA and SMS explorative runs gave similar results for the time trend of SSB, but the absolute levels differ between model configurations.

Uncertainties in assessment and forecast

The major source of uncertainty in this assessment is a result of the lack of a fishery-independent survey. This required use of standardized commercial CPUE at age. This may result in auto-correlation problems between the tuning series and the catch-at-age data which may mask uncertainty in the analysis.

As no recruitment estimates from surveys are available, recruitment estimates 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.

Comparison with previous assessment and advice

The changes made in the present assessment (changes in the configuration of the tuning fleets) gives a more pessimistic view on the stock situation than the 2004 assessment, by downscaling both SSB and recruitment and increasing F for the most recent years.

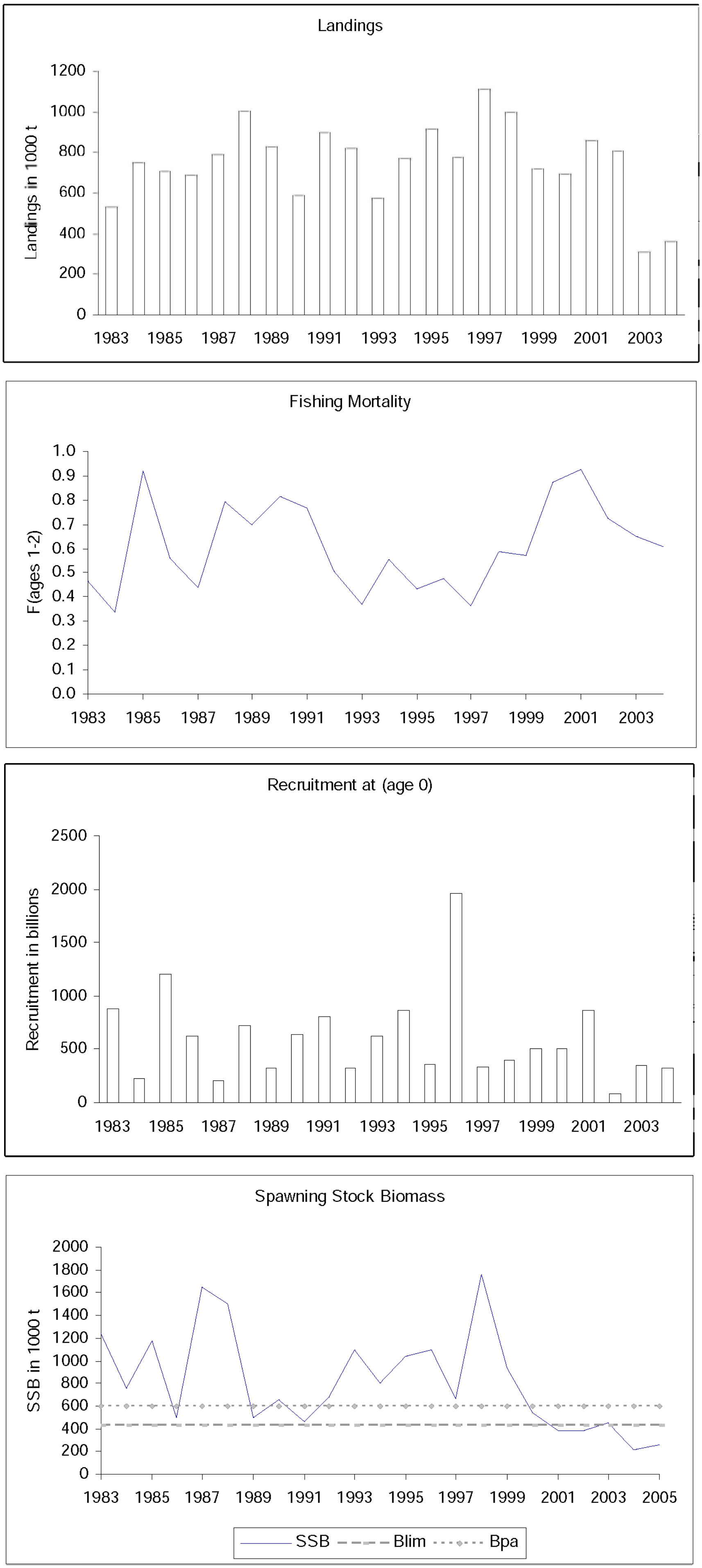
Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES Advice	Catch corresponding to advice	TAC	ACFM Catch
1987	No advice[1]; No advice[2]			825
1988	No advice[1]; No advice[2]			893
1989	No advice[1]; No advice[2]			1039
1990	No advice[1]; No advice[2]			591
1991	No advice[1]; No advice[2]			843
1992	No advice[1]; No advice[2]			855
1993	No advice[1]; No advice[2]			579
1994	No advice[1]; No advice[2]			786
1995	Can sustain current F[1]; No advice[2]			918
1996	Can sustain current F			777
1997	Can sustain current F			1138
1998	Can sustain current F		1000	1004
1999	Can sustain current F		1000	735
2000	Can sustain current F		1020	699
2001	Can sustain current F		1020	862
2002	Can sustain current F		1020	811
2003	No increase in F		918	326
2004	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2003 year class		826	362
2005	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class		661	
2006	The fishery should remain closed until information is available which assures that the stock can be rebuilt to $\mathbf{B}_{pa}$ by 2007.			

[1]Southern stock component. [2]Northern stock component. Weights in '000 t.

Sandeel in Subarea IV




Stock - Recruitment
Recruitment (age 0) in billions
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
SSB in 1000 t
SSB-Rec.
Blim
Bpa

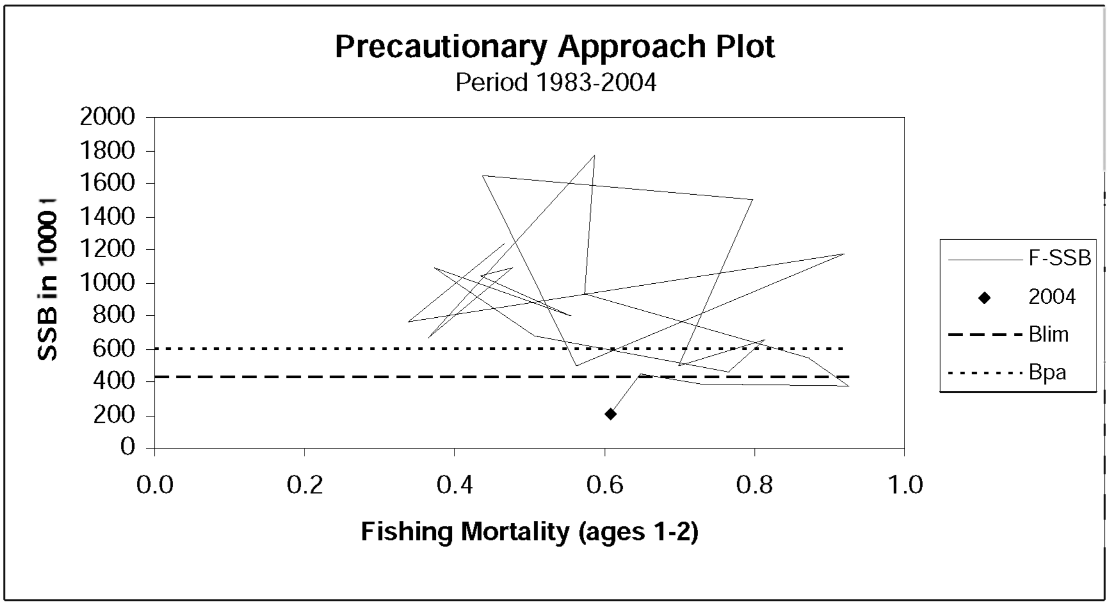

Precautionary Approach Plot
Period 1983-2004
SSB in 1000 t
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
0.2
0.4
0.6
0.8
1.0
Fishing Mortality (ages 1-2)
F-SSB
2004
Blim
Bpa

Table 1.4.24.1 Sandeel in IV. Official landings reported to ICES.

SANDEELS IVa

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	26,498	23,138	3,388	4,742	1,058	111	399	N/A
Faroe Islands	11,221	11,000	6,582					N/A
Norway	98,386	172,887	44,620	11,522*	4,121*	185*	280*	N/A
Sweden	-	55	495	55	-	-	73	N/A
UK (E/W/NI)	-	-	-	-	-	-	-	N/A
UK (Scotland)	3,463	5,742	4,195	4,781	970	543	186	N/A
Total	139,568	212,822	59,280	21,100	6,149	839	938	

*Preliminary.

SANDEELS IVb

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	731,184	603,491	503,572	533,905	638,657	627,097	245,096	N/A
Faroe Islands	-	-	-					N/A
Germany	-	-	-	-	-	-	534	N/A
Ireland	-	-	389	-	-	-		N/A
Norway	252,177	170,737	142,969	107,493*	183,329*	175,799*	29,336*	N/A
Sweden	-	8,465	21,920	27,867	47,080	36,842	21,444	N/A
UK (E/W/NI)	2,575	-	-	-	-	-	-	N/A
UK (Scotland)	20,554	18,008	7,280	5,978	-	2,442	115	N/A
Total	1,006,490	800,701	676,130	675243	869066	842180	296525	

*Preliminary.

SANDEELS IVc

Country	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	3,163	9,674	10,356	11,993	7,177	4,996	28,646	N/A
France	-	-	-	1	-	-	-*	N/A
Netherlands	-	+	+	-	-	+	-*	N/A
Sweden	-	-	-	-	-	-	160	N/A
UK (E/W/NI)	-	-	-	+	-	-	+	N/A
Total	3,163	9,674	10,356	11,994	7,177	4,996	28,806	

*Preliminary.

Summary table official landings

	1997	1998	1999	2000	2001	2002	2003	2004
Total IV tonnes	1,149,221	1,023,197	745,766	708,337	882,392	848,015	326,269	372,343
TAC		1,000,000	1,000,000	1,020,000	1,020,000	1,020,000	918,000	826,200

By-catch and other landings

	1997	1998	1999	2000	2001	2002	2003	2004
Area IV tonnes: official-WG	11,439	18,797	10,628	9,188	20,781	37,315	00,849	N/A

Summary table - landing data provided by Working Group members

	1997	1998	1999	2000	2001	2002	2003	2004
Total IV - tonnes	1,137,782	1,004,400	735,138	699,149	861,611	810,700	325,420	361,600

Table 1.4.24.2. Sandeel in IV. Landings ('000 t), 1952–2004 (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

\+ = less than half unit.

\- = no information or no catch.

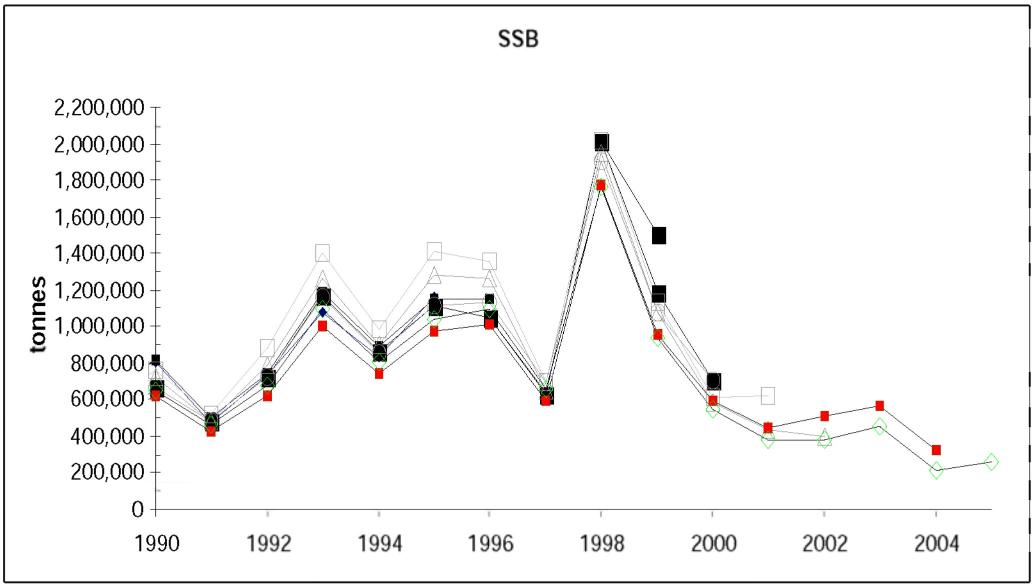
Table 1.4.24.3 Sandeel in IV. Monthly landings (tonnes) by Denmark, Norway, and Scotland from each area defined in Figure 13.1.1.1 in WG Report.

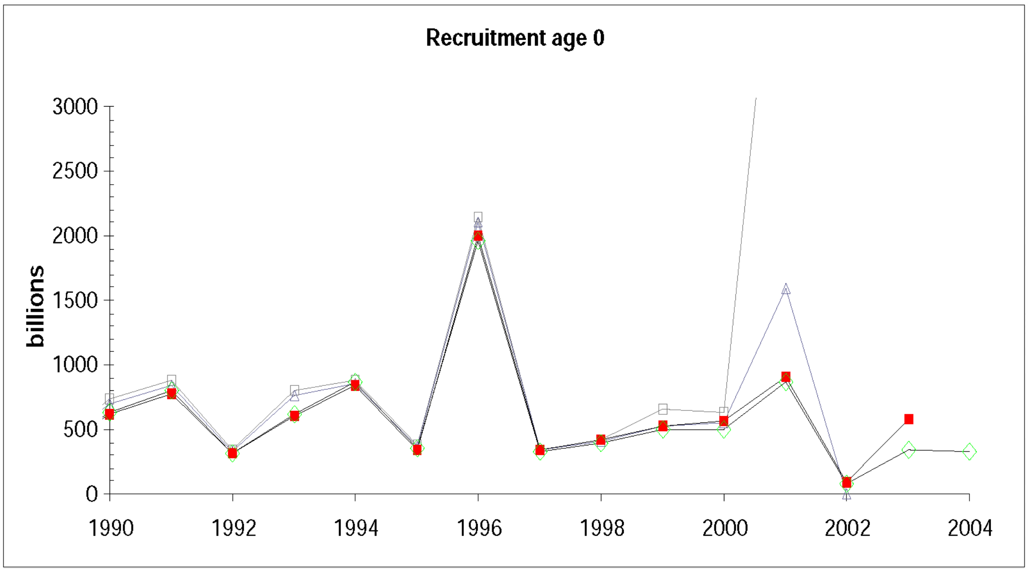
	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Total
1999												0
Mar	1448	2587	136	1047	9371	0	466	73	218	0	479	15826
Apr	52710	3030	0	64860	17779	0	644	80	55	1360	1080	141598
May	151806	15520	0	42635	45709	0	7299	1567	82	1271	461	266351
Jun	52943	9427	0	6199	8224	0	3304	12744	1097	18254	6	112198
Jul	7816	1883	0	15142	13918	0	14841	2434	1270	5274	0	62578
Aug	1	0	0	1770	29621	0	15376	0	0	99	2043	48909
Sept	1	155	0	930	26486	0	4129	0	0	883	88	32672
Oct	0	0	0	42	16440	0	1754	0	0	68	0	18305
Dec	0	0	0	181	358	0	198	0	0	0	0	737
Total	266725	32603	136	132807	167905	0	48011	16898	2722	27208	4157	699174
2000												0
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												0
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
%	26%	1%	0%	15%	7%	0%	17%	13%	2%	19%	0%	100%
Average 1994-2004												
	37%	2%	0%	21%	18%	0%	10%	4%	1%	7%	0%	100%
2005*												
Apr	4017			71	1476		462	144		57		6227
May	34506	57		9536	7512		6507	13333	30	1549		73030
Jun	19216	21		8952	2545		8107	8224	17956	14111		79132
Total	57739	78	0	18559	11533	0	15076	21701	17986	15717	0	158389
%	36%	0%	0%	12%	7%	0%	10%	14%	11%	10%	0%	100%

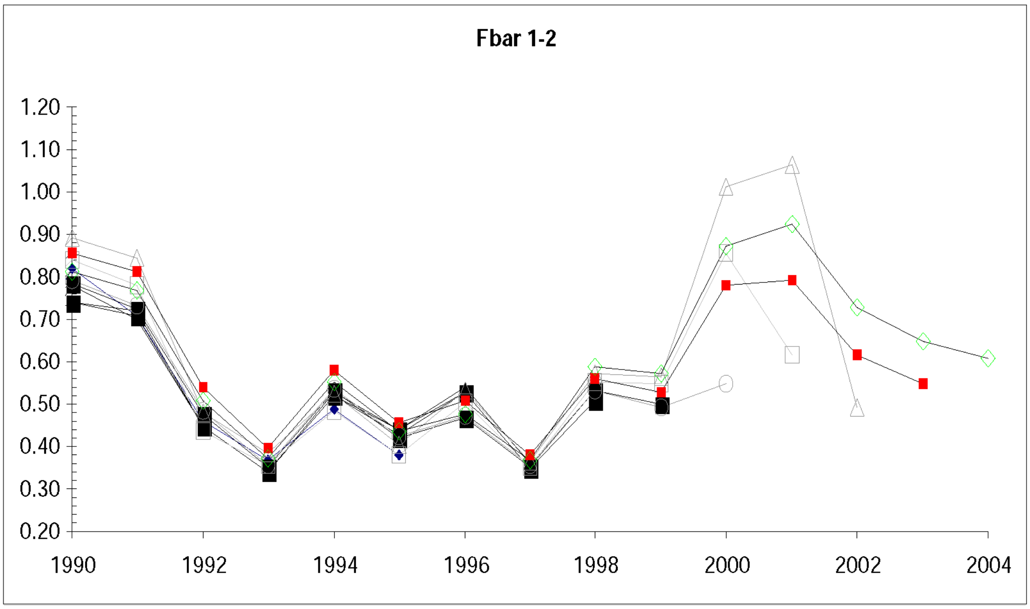
Table 1.4.24.4 Sandeel in Subarea IV.

Year	Recruits Age 0	Totalbio	SSB	Landings	Yield/SSB	Mean F Ages 1-2
1983	879980	1771700	1242258	530,641	0.4272	0.4678
1984	226732	2336391	762545	750,040	0.9836	0.3377
1985	1204901	1604817	1177952	707,105	0.6003	0.9200
1986	623273	2726443	497838	685,949	1.3779	0.5617
1987	199460	2945903	1652384	791,050	0.4787	0.4372
1988	718210	1898065	1505944	1,007,303	0.6689	0.7962
1989	325139	1882443	501428	826,836	1.6490	0.6997
1990	635693	1266515	653807	584,912	0.8946	0.8128
1991	805045	1649807	460963	898,959	1.9502	0.7666
1992	318713	2087062	681575	820,140	1.2033	0.5077
1993	621985	1716034	1092510	576,932	0.5281	0.3729
1994	870725	2436418	803545	770,746	0.9592	0.5536
1995	358049	3831088	1043716	915,042	0.8767	0.4342
1996	1964368	2159608	1091963	776,126	0.7108	0.4776
1997	334086	5504935	663586	1,114,044	1.6788	0.3664
1998	396891	2510163	1766917	1,000,376	0.5662	0.5875
1999	503692	1797153	936514	718,667	0.7674	0.5736
2000	504485	1843453	545027	692,499	1.2706	0.8731
2001	868658	1359149	379176	858,619	2.2644	0.9256
2002	80066	2286852	383513	806,921	2.1040	0.7275
2003	345286	640539	451305	309,724	0.6863	0.6492
2004	324031	1034992	211395	359,362	1.7000	0.6090
2005		1090748	264223			
Average	595885	2103490	816091	750091	1.1066	0.6117
Units	(Millions)	(Tonnes)	(Tonnes)	(Tonnes)		

Sandeel in Subarea IV Results of the most recent assessment in comparison with results of previous assessments.







1.4.25 Sandeel in the Shetland area

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Comment
Unknown	Unknown	Unknown	

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk, so the state of the stock is unknown.

It is believed that fishing mortality is well below natural mortality. This means that natural processes largely drive stock variations. Landings in 2004 were 186 t, substantially lower than in landings in preceding years, and below the TAC of 7000 t.

An assessment made in 2001 based on survey data alone suggests that the SSB in 2000 is close to its lowest observed value and that recent recruitment has been weak.

Management objectives

There is a national management plan in force taking both fisheries and wildlife conservation in consideration.

Reference points

No reference points have been defined for this stock.

Single-stock exploitation boundaries

ICES considers that no advice can be given for the stock.

Short-term implications

There is no short-term forecast given for this stock.

Management considerations

The Shetland sandeel fishery re-opened in 1995 subject to a multi-annual management regime. This was revised for the 1998 fishing season onwards. The new regime consists of an annual TAC of 7000 t and a closure during the months of June and July. The seasonal closure is to avoid any possibility of direct competition between the fishery and seabirds during the chick-rearing season. There is also a limit on vessel size to boats of 20 m or less. These arrangements were renewed in 2001 for another three years.

The landings in 2004 are only a small fraction of the agreed TAC.

Management plan evaluations

ICES suggested in October 2001 that the management plan be evaluated before the agreed end date. The evaluation has been carried out and all interest groups have agreed to the continuation of the current measures. An update of the assessment for this stock is required for 2005.

Ecosystem considerations

Fishing grounds are close inshore and often adjacent to large colonies of seabirds for which the sandeel population is an important food supply, especially during the breeding season. For some seabird species the availability of 0-group sandeel as prey is very important.

In some years, most of the recruitment comes from spawning areas away from Shetland. The availability of 0-group sandeel is, therefore, not closely linked to the local spawning population. The sandeel population is also an important food source for other predator species in the Shetland area.

Factors affecting the fisheries and the stock

Other factors

The sandeel population at Shetland is not a separate stock, but forms part of a larger complex of sub-populations. Estimates of the consumption of sandeel by seabirds and other predators greatly exceed the quantities taken by the fishery in recent years.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES Advice	Predicted Catch corresp. to advice	Agreed TAC	ACFM Catch
1987	No advice	-		7.2
1988	No advice	-		4.7
1989	No advice	-		3.5
1990	No advice	-		2.3
1991	Low fishing	-		+
1992	No fishing prudent	-		-
1993	No fishing prudent	-		-
1994	TAC	3		-
1995	TAC	3	3	1.2
1996	No advice	-	3	1.0
1997	No advice	-	3	2.1
1998	No advice	-	7	5.2
1999	No advice	-	7	4.2
2000	No catch advice	-	7	4.9
2001	No advice	-	7	1.3
2002	No advice	-	7	0.5
2003	No advice	-	7	0.2
2004	No advice	-	7	0.2
2005	No advice	-	-	
2006	No advice	-		

Weights in '000 t.

1.4.26 *Nephrops* in Divisions IVa, rectangles 44-48 E6-E7+44 E8 (Management Area F)

There are two Functional Units in this Management Area: a) Moray Firth (FU 9) and b) Noup (FU 10).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Unknown	Unknown	Unknown		

The available fishery information is inadequate to use analytical methods to evaluate spawning stock or fishing mortality relative to risk. Results from TV surveys suggest that all stocks in this Management Area are exploited at sustainable levels.

a) Moray Firth: The TV survey estimate of abundance for *Nephrops* in the Moray Firth suggests that the population increased in 2002–2003, and has remained relatively stable at this higher level since then. Abundance is estimated to be over 40% higher in recent years (2002–2004) compared to the previous period (1999–2001). Indications from the fishery support this and suggest an increase in recruitment in 1995 and 2002.
b) Noup: The TV survey estimate of abundance for *Nephrops* in the Noup suggests that the population declined between the two surveys in 1994 and 1999, but unfortunately no newer data are available. Landings have fluctuated between 200 and 400 tonnes since 1995, with no long-term trend, although effort has declined and LPUE has increased over the same timescale. There is no evidence to suggest any concerns for this stock at the present levels of exploitation.
c) Small quantities of landings are made outside the main Fladen Ground Functional Unit but within the Management Area.

Management objectives

No management objectives have been set for this fishery.

Reference points

No reference points have been determined for *Nephrops*.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Due to uncertainty in the available fishery data, ICES is not able to reliably forecast catch. The effort in this fishery should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and by-catch species.

Short-term implications

Outlook for 2006

The harvest ratio is a proxy for relative effort. Historically for this stock the harvest ratio has been around 15%. As an indication of relation between landings (tonnes) and effort the table below shows calculated landings for a range of harvest ratios applied to TV survey biomass results

HR%	Landings	95%
7.5	1054	
10	1405	+/- 453
15	2108	+/- 679
20	2811	+/- 906
25	3513	+/- 1132
30	4216	+/- 1359

Shaded options are not in accordance with the advice as this implies increased effort

Management considerations

In the North Sea TAC (which comprises eight *Nephrops* stocks), the present aggregated management approach runs the risk of unbalanced effort distribution. Adoption of management initiatives to ensure that effort can be appropriately controlled in smaller areas within the overall TAC area is recommended.

Ecosystem considerations

Throughout its distribution, *Nephrops* is limited to a muddy habitat, and requires sediment with a silt and clay content of between 30–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small scale movements (a few 100 m), but larval transfer may occur between separate mud patches in some areas. In the Moray Firth area the *Nephrops* stock inhabits a single continuous area of muddy sediment extending from north of Fraserburgh to Inverness.

Cod has been identified as a predator of *Nephrops* in some areas, and the generally low level of the cod stock is likely to have resulted in reduced predation.

Factors affecting the fisheries and the stock

Landings from this fishery are predominantly reported from Scotland, with very small contributions from England in the mid-1990s, but not recently.

About three quarters of the landings are made by single-rig trawlers, a high proportion of which use a 70-mm mesh. In 1999, twin-rig vessels predominantly used a 100-mm mesh, with 90% of the twin-rig landings made using this mesh size. Legislative changes in 2000 permitted the use of an 80-mm mesh.

Discarding rates averaged over the period 2002 to 2004 for this stock were 30% by number, or 14% by weight. This represents a small increase in discarding rate compared to the 2002 to 2004 period.

The effects of regulations

The minimum landing size for *Nephrops* in the Moray Firth is 25 mm CL.

Changes in fishing technology and fishing patterns

Recent reports from industry and gear technologists suggest a more widespread use of “flip-up” gear in twin rig *Nephrops* trawls (see Graham, WD). This development will allow fleets to expand onto rougher ground, potentially exploiting new *Nephrops* areas.

Scientific basis

Data and methods

There is considerable uncertainty about landings, discard and effort data for these stocks. Underwater TV survey estimates are available for 1993–1994 and from 1996 onwards for the Moray Firth, and only in 1994 and 1999 for the Noup stock.

LPUEs are available from 1965 for the Moray Firth stock and from 1980 for the Noup stock.

Length compositions are available from 1980 for the Moray Firth stock and from 1996 for the Noup stock.

Information from the fishing industry

The NSCFP stock survey shows a continuous increase in *Nephrops* in the Northeast of Scotland (including Fladen Grounds) since 2001.

Uncertainties in assessment and forecast

There are concerns over the accuracy of landings and effort data and because of this the final assessment adopted is independent of official statistics.

LPUE may also be affected by changes in catchability (due to sudden changes in the environmental conditions), or changes in selectivity and/or in gear efficiency.

Discards are also dependent on selectivity of the gear and on discarding practices. Thus trends in mean size of the catch are difficult to interpret.

Comparison with previous assessment and advice:

TV surveys suggest the abundance of the stock has increased compared to the recent past. Previously advice for the Moray Firth has been based largely on analytical catch-at-age assessments using XSA, and average historical landings, while advice for the Noup has been based mainly on LPUE. There is considerable doubt about the quality of fisheries data and assessments cannot be based on these data, i.e. catch and CPUE. The advice is therefore for no increase in effort as it is not possible to provide a catch prediction based on fisheries data. As reliable fisheries data are not available the TV underwater survey biomass estimates are used to indicate landings associated with various effort levels.

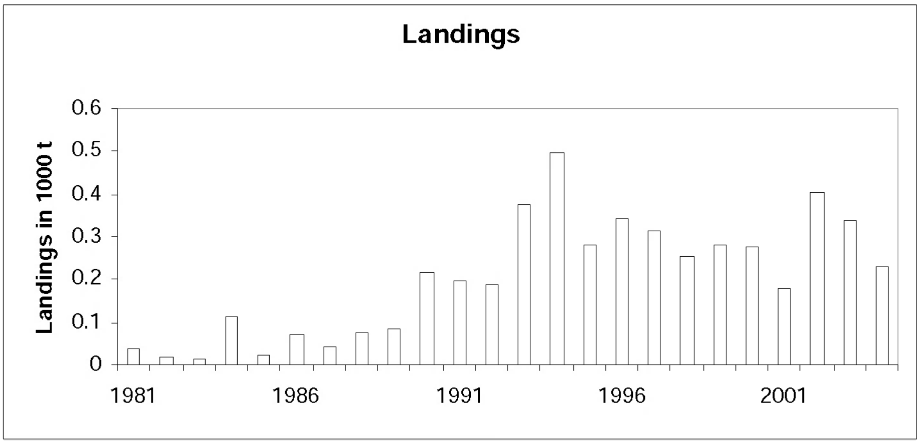
Source of information:

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM landings [2]
1987				2.1
1988				2.1
1989				2.7
1990				2.3
1991				1.8
1992		~2.4	12.0	1.8
1993		2.4	12.0	2.3
1994		2.4	13.0	2.2
1995		2.4	15.2	1.7
1996	*Status quo* TAC	2.4	15.2	1.9
1997	*Status quo* TAC	2.4	15.2	1.9
1998		2.4	15.2	1.4
1999		2.4	15.2	1.4
2000		1.85	17.2	1.9
2001		1.85	15.48	1.7
2002	*Catches to be maintained at the 2000 level*	2.0	16.623	1.6
2003	*Catches to be maintained at the 2000 level*	2.0	16.623	1.5
2004	*Catches to be maintained at the 2000 level*	2.0	21.350	1.7
2005	*Catches to be maintained at the 2000 level*	2.0	21.350	
2006	*No increase in effort*	-		

(Weights in '000 t) [1)] EU zone of IIa and IV; [2)] Does not include discards.

Nephrops in Division IVa Rectangles 44-48 E6-E7+44 E8 (Management Area F) Noup FU 10



Nephrops in Division IVa Rectangles 44-48 E6-E7+44 E8 (Management Area F) Moray Firth FU 9

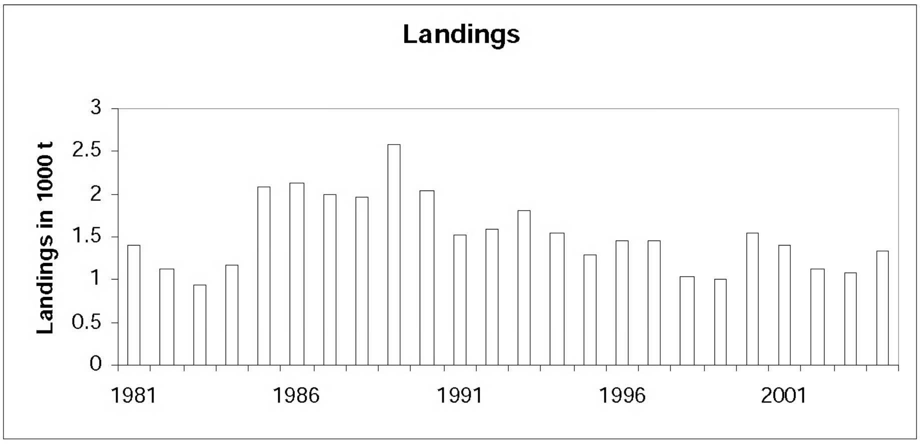


Table1.4.26.1 *Nephrops*, Management Area F: Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1981–2004.

Year	FU 9	FU 10	Other	Total
1981	1416	36	0	1452
1982	1120	19	1	1140
1983	940	15	1	956
1984	1170	111	3	1284
1985	2081	22	15	2118
1986	2143	68	44	2255
1987	1991	44	34	2069
1988	1959	76	45	2080
1989	2576	84	44	2704
1990	2038	217	68	2323
1991	1519	196	65	1780
1992	1591	188	43	1822
1993	1808	376	69	2253
1994	1538	495	138	2171
1995	1297	280	77	1654
1996	1451	344	101	1896
1997	1446	316	94	1856
1998	1032	254	74	1360
1999	1008	279	74	1361
2000	1541	275	64	1880
2001	1403	177	116	1696
2002	1118	401	69	1588
2003	1079	337	118	1534
2004	1335	228	102	1665

Table 1.4.26.2 *Nephrops* in Division IVa Rectangles 44-48 E6-E7+44 E8 (Management Area F) Noup FU 10

Year	Landings tonnes
1981	36
1982	19
1983	15
1984	111
1985	22
1986	68
1987	44
1988	76
1989	84
1990	217
1991	196
1992	188
1993	376
1994	495
1995	280
1996	344
1997	316
1998	254
1999	279
2000	275
2001	177
2002	401
2003	337
2004	228
Average	202

Table 1.4.26.3 *Nephrops* in Division IVa Rectangles 44-48 E6-E7+44 E8 (Management Area F) Moray Firth FU 9

Year	Landings tonnes
1981	1416
1982	1120
1983	940
1984	1170
1985	2081
1986	2143
1987	1991
1988	1959
1989	2576
1990	2038
1991	1519
1992	1591
1993	1808
1994	1538
1995	1297
1996	1451
1997	1446
1998	1032
1999	1008
2000	1541
2001	1403
2002	1118
2003	1079
2004	1335
Average	1525

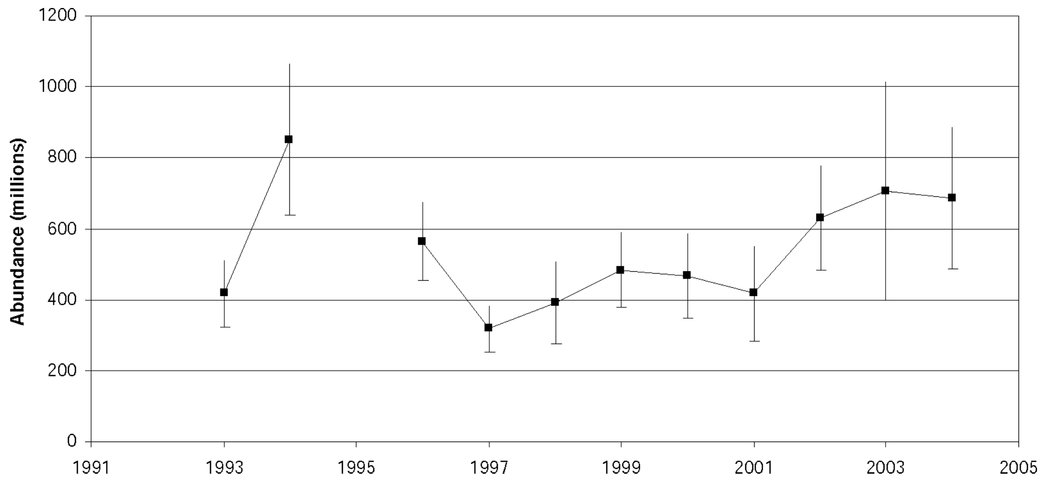


Figure 1.4.26.1 Moray Firth (FU 9). Time-series of TV survey abundance estimates, with 95% confidence intervals, 1996–2004.

1.4.27 *Nephrops* in Division IVa, West of 2°E, excluding Management Area F (Management Area G)

There is one Functional Unit in this Management Area: Fladen (FU 7).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment *[used if qualifiers to present state are necessary]*
Unknown	Unknown	Unknown		

The available fishery information is inadequate to use analytical methods to evaluate spawning stock or fishing mortality relative to risk. Results from TV surveys, however, suggest that the stock in this Management Area appear to be exploited at a sustainable level.

The TV survey estimate of abundance for *Nephrops* in the Fladen Ground suggests that the population increased between 1992 and 1994 and then declined to a stable level between 1997 and 2000 (no survey was conducted in 1996). Following this the population increased again to 2002, and has since declined to the pre-2002 stable level in the most recent years.

Small quantities of landings are made outside the main Fladen Ground Functional Unit but within the Management Area.

Management objectives

There are no management objectives set for this fishery.

Reference points

No reference points have been determined for *Nephrops*.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

There is no agreed management plan for this stock.

Exploitation boundaries in relation to precautionary limits

Information on these stocks is considered inadequate to provide an advice based on precautionary limits. The effort in this fishery should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and by-catch species.

Short-term implications

Outlook for 2006

The harvest ratio is a proxy for relative effort. Historically for this stock the harvest ratio has been around 7.5%.. As an indication of relation between landings (tonnes) and effort the table below shows calculated landings for a range of harvest ratios applied to TV survey biomass results. The range is more restricted than for other N Sea stocks owing to the more limited information on stock dynamics:

Harvest Ratio %	Landings (t)	95% confidence limits
5	8627	+/- 1402
7.5	12940	+/- 2103
10	17254	+/- 2804
15	25880	+/- 4206
20	34507	+/- 5608

Shaded options are not in accordance with the advice as this implies increased effort

Management considerations

In the North Sea TAC (which comprises eight *Nephrops* stocks), the present aggregated management approach runs the risk of unbalanced effort distribution. Adoption of management initiatives to ensure that effort can be appropriately controlled in smaller areas within the overall TAC area is recommended.

Ecosystem considerations

Throughout its distribution, *Nephrops* is limited to a muddy habitat, and requires sediment with a silt and clay content of between 30–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small scale movements (a few 100 m), but larval transfer may occur between separate mud patches in some areas. In the Fladen area the *Nephrops* stock inhabits a generally continuous area of muddy sediment extending from 57°30'N to 60°N, and from 1°W to 1°30'E, with other smaller patches to the north. The Fladen Ground is the largest known *Nephrops* ground, with around 28 200 km^2 of suitable mud substrate, and is the only major offshore ground in Scottish waters.

Cod have been identified as a predator of *Nephrops* in some areas, and the generally low level of the cod stock is likely to have resulted in reduced predation.

Factors affecting the fisheries and the stock

Although the Fladen Ground is extensive, fishing effort is primarily directed to the region that can be reached within 12 hours steaming from ports along the NE coast of Scotland. The fleet fishing the Fladen Ground for *Nephrops* comprises approximately 215 trawlers, which are predominantly Scottish (> 97%), based along the Scottish NE coast, with very few landings made in the UK by foreign vessels.

About 67% of the landings are reported as made by single-rig vessels, two thirds of which are taken with 100-mm meshes and about one third with 70- to 80-mm meshes. Twin-rig vessels account for the remaining 33% of the landings. As with the single-rig vessels, approximately two thirds of these are taken using 100-mm meshes, and the remainder with 70- to 80-mm meshes. There are concerns over the accuracy of reporting to gear type, however, and the vast majority of landings are thought to be made by twin-rig vessels.

Nearly 40% of the *Nephrops* landings are reported as bycatch, where fish are the main target species. This may, however, be an artefact of the method of reporting to the Fishery Offices, since the mesh sizes used on the Fladen Ground tend to be larger (i.e. 100 mm) than in other areas. The consequence is that vessels using a 100-mm mesh are sometimes regarded as whitefish-directed, even if they actually have been targeting *Nephrops*.

The effects of regulations

The minimum landing size for *Nephrops* in the Fladen Ground is 25 mm CL. Discarding takes place at sea, but because of the larger mesh sizes used proportionally fewer undersized animals need to be discarded than in other areas. Discarding rates averaged over the period 2002 to 2004 for this stock were 13% by number, or 7% by weight. This represents a small decrease in discarding rate compared to the 2000 to 2002 period.

Changes in fishing technology and fishing patterns

Recent reports from industry and gear technologists suggest a more widespread use of "flip-up" gear in twin-rig *Nephrops* trawls (see Graham, WD). This development will allow fleets to expand onto rougher ground, potentially exploiting new *Nephrops* areas.

Scientific basis

Data and methods

There is considerable uncertainty about landings, discard and effort data for these stocks. The underwater TV survey is presented as the best available information on the Fladen *Nephrops* stock. This survey provides a fishery-independent estimate of *Nephrops* abundance. At present it is not possible to extract any length or age structure information from the survey, and it therefore only provides information on absolute abundance over the area of the survey.

Information from the fishing industry

The NSCFP stock survey shows an increase in *Nephrops* between 2001 and 2002, a slight decrease to 2003, and a marked increase since this date. This supports the suggestion of an increase in abundance for this area, but does not indicate any change in the levels of discards or recruits.

Uncertainties in assessment and forecast

The trends in abundance observed in the TV survey data have not been reflected in LPUE data or mean size data. This may be owing to the short time-series of discard data, or to spatial changes in the fishery.

Comparison with previous assessment and advice

The results of the most recent TV surveys are consistent with those of 2003. There is considerable doubt about the quality of fisheries data and assessments cannot be based on these data, i.e. catch and LCPUE. The advice is therefore for no increase in effort as it is not possible to provide a catch prediction based on fisheries data. As reliable fisheries data are not available the TV underwater survey biomass estimates are used to indicate landings associated with various effort levels. Previously advice for the Fladen Ground has been based on a 7.5% harvest ration of fishery-independent underwater TV survey estimates of abundance.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, September 2005 (ICES CM 2006/ACFM:09).

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM Landings[2]
1989				2.3
1990				2.6
1991				4.3
1992		~2.7	12.0	3.4
1993		2.7	12.0	3.5
1994		5.0	13.0	4.7
1995		5.0	15.2	6.6
1996		5.0	15.2	5.4
1997		5.0	15.2	6.3
1998		7.0	15.2	5.2
1999		7.0	15.2	6.7
2000		9.0	17.2	5.6
2001		9.0	15.48	5.6
2002		9.0	16.623	7.4
2003		9.0	16.623	6.4
2004		12.8	21.350	8.8
2005		<12.8	21.350	
2006	No increase of effort	-		
2007				

(Weights in '000 t) [1)] EU zone iIa and IV; [2)] Does not include discards

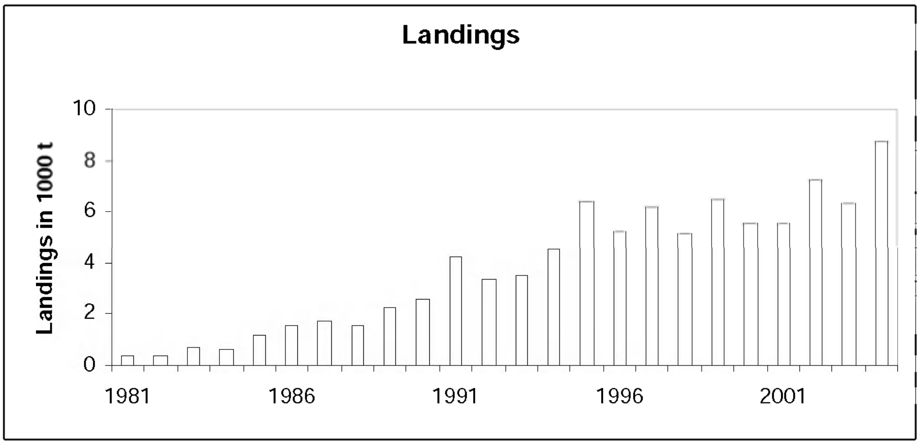

Landings
Landings in 1000 t
10
8
6
4
2
0
1981
1986
1991
1996
2001

Table.1.4.27.1 *Nephrops*, Management Area G: Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1981–2004.

Year	FU 7	Other	Total
1981	373	2	375
1982	422	0	422
1983	693	0	693
1984	646	7	653
1985	1148	18	1166
1986	1543	17	1560
1987	1696	14	1710
1988	1573	11	1584
1989	2299	31	2330
1990	2540	20	2560
1991	4221	52	4273
1992	3363	39	3402
1993	3493	39	3532
1994	4569	117	4686
1995	6440	184	6624
1996	5218	150	5368
1997	6171	95	6266
1998	5136	94	5230
1999	6521	175	6696
2000	5570	81	5650
2001	5541	103	5644
2002	7247	163	7410
2003	6294	108	6402
2004	8728	79	8807

Table 1.4.27.2 *Nephrops* in Division IVa west of 2°E, excluding Management Area F (Management Area G).

Year	Landings tonnes
1981	373
1982	422
1983	693
1984	646
1985	1148
1986	1543
1987	1696
1988	1573
1989	2299
1990	2540
1991	4221
1992	3363
1993	3493
1994	4569
1995	6440
1996	5218
1997	6171
1998	5136
1999	6521
2000	5570
2001	5541
2002	7247
2003	6294
2004	8728
Average	3810

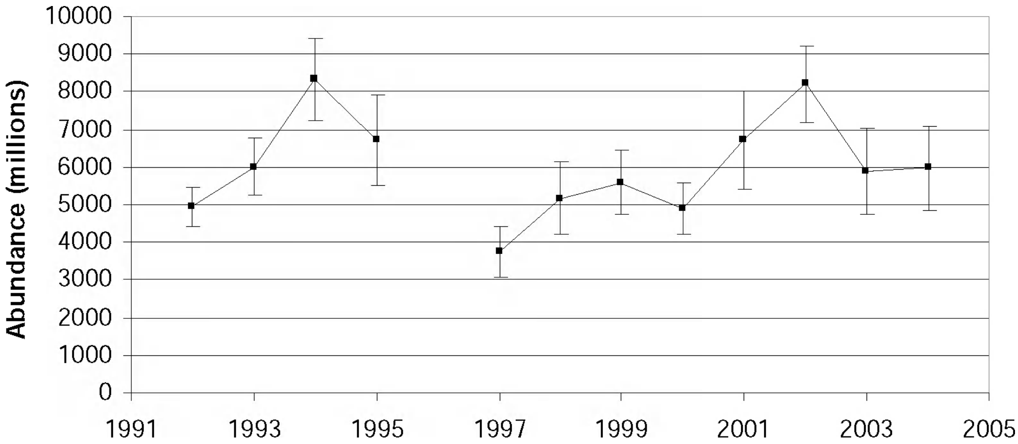


Figure 1.4.27.1 Time-series of TV survey abundance estimate.

1.4.28 *Nephrops* in Division IVa, East of 2°E + rectangles 43 F5-F7 (Management Area S)

There is only one Functional Unit in this Management Area: Norwegian Deep (FU 32).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Unknown	Unknown	Unknown		

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk.

This stock has mainly been exploited by Danish vessels. LPUEs from the Danish fishery have been rather stable over the last 10 years even though landings increased 50% in this period. A slight decrease in mean size in the catches and landings in 2004 could indicate a high exploitation pressure in recent years, and that this *Nephrops* stock is fully exploited. However, the trends in Danish LPUE figures do not indicate any decline in stock abundance.

Management objectives

There are no management objectives set for this fishery.

Reference points

No reference points have been determined for *Nephrops*.

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

There is no agreed management plan for this stock.

Exploitation boundaries in relation to precautionary limits

Information on this stock is considered inadequate to provide advice based on precautionary limits.

Management considerations

The Danish LPUE figures for this FU increased dramatically from 1992 to 1994, and then levelled off. Since then they have fluctuated around 200 kg/day. In the last 2 years an increasing trend is seen. It could be that only part of the stock is exploited at present. Sediment maps for this Management Area indicate that there are possibilities to let the fishery expand into new grounds, which have scarcely been fished to date.

Factors affecting the fisheries and the stock

The majority of the landings from this FU are made by Denmark and Norway, where Denmark accounts for around 80%. During the last five years, landings have fluctuated between 750 t and 1216 t, with the highest (provisional) figures recorded in 2002. The LPUEs of Danish vessels have increased from 50–75 kg/day in the early 1990s to more than 200 kg/day in late 2004. Mean sizes in both research vessel catches and commercial landings are high compared to neighbouring areas (Skagerrak and Kattegat).

The effects of regulations

Due to changes in the management regime (mesh size regulations in the Norwegian zone of the northern North Sea in 2002) there was a switch to increasing Danish effort targeting *Nephrops* in the Norwegian Deep.

Traditionally the Norwegian effort for *Nephrops* has been low, and the majority of the Norwegian *Nephrops* landings from FU 32 has largely been as bycatch from the *Pandalus* fishery. Because of the landings restrictions for *Pandalus*, shrimp trawlers have started fishing more specifically for *Nephrops* in the most recent years. Also, there are an increasing number of boats that target *Nephrops* year-round, making one-week trips and landing their catches in Denmark.

Scientific basis

Data and methods

The perception of the stock is based on Danish LPUE data.

Information from the fishing industry

The NSCFP stock survey shows an increase in *Nephrops* between 2001 and 2002, a slight decrease to 2003, and a marked increase since this date. This supports the suggestion of an increase in abundance for this area, but does not indicate any change in the levels of discards or recruits.

Uncertainties in assessment and forecast

Due to "technological creeping" there are concerns over effort data, because of changes in selectivity or in gear efficiency. Furthermore, LPUE may be affected by changes in catchability (due to sudden changes in the environmental conditions).

Discards could reflect the strength of the recruitment, but are also dependent on selectivity of the gear and on discarding practices. Thus trends in mean size of the catch are difficult to interpret without any information on changes in the fishing pattern and practices.

Comparison with previous assessment and advice

No assessment is presented for this stock.

Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES advice	Recommended TAC	TAC agreed	ACFM landings
1987				< 0.1
1988				< 0.1
1989				< 0.1
1990				0.2
1991				0.2
1992				0.2
1993				0.3
1994				0.8
1995				0.5
1996				1.0
1997				0.8
1998				0.8
1999				1.1
2000				1.1
2001				1.2
2002		1.2	No TAC agreed	1.2
2003		1.2	No TAC agreed	1.1
2004		1.5	1.0	0.9
2005		1.5	1.0	
2006	No increase in effort			
2007	No increase in effort			

(Weights in '000 t)

Nephrops in Division IVa, east of 2°E, + Rectangles 43 F5-F7 (Management Area S)

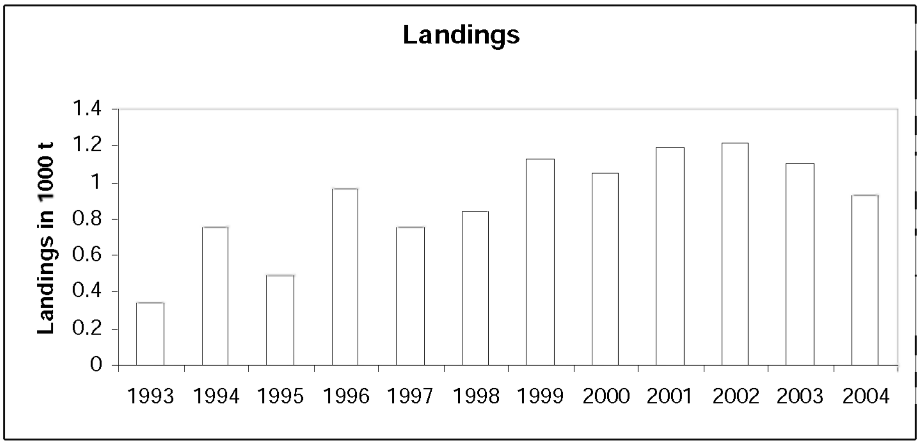


Table 1.4.28.1 *Nephrops* landings (tonnes) by country in Management Area S (IVa, East of 2°E + rectangles43 F5-F7).

Year	Denmark	Norway	UK	Total
1993	220	102	16	338
1994	584	165	10	759
1995	418	74	2	494
1996	868	82	10	960
1997	689	64	7	760
1998	743	91	4	838
1999	972	144	13	1129
2000	871	147	33	1051
2001	1026	112	53	1191
2002	1043	121	52	1216
2003	996	100	14	1110
2004*	835	93	6	934
* provisional na = not available				

Table 1.4.28.2 *Nephrops* in Division IVa, East of 2°E + rectangles 43 F5-F7 (Management Area S).

Year	Landings
	tonnes
1993	338
1994	759
1995	494
1996	960
1997	760
1998	838
1999	1129
2000	1051
2001	1191
2002	1216
2003	1110
2004	934
Average	898

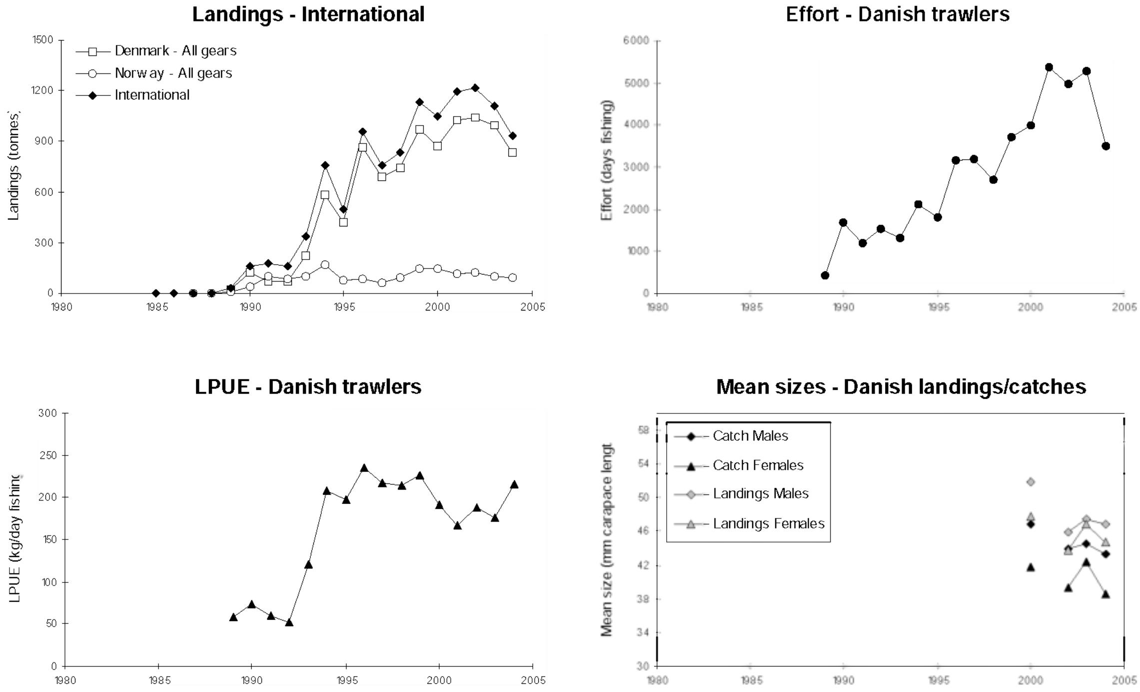


Figure 1.4.28.1 *Nephrops* Norwegian Deep (FU 32): Long-term trends in landings, effort, CPUEs and/or LPUEs, and mean sizes of *Nephrops*.

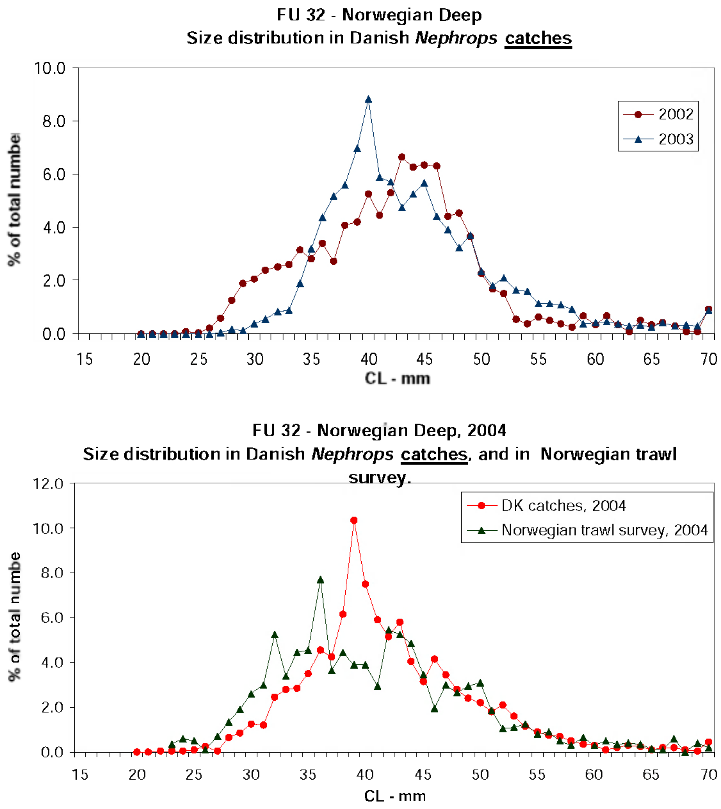


Figure 1.4.28.2 *Nephrops* Norwegian Deep (FU 32): LFDs from Norwegian survey cruises in the Skagerrak (FU 4) and the Norwegian Deep (FU 32) (using a 70-mm *Nephrops* trawl), and from Danish *Nephrops*/finfish trawlers in FU 32 (using 100-mm mesh trawls).

1.4.29 *Nephrops* in Divisions IV IVb,c, West of 1°E (Management Area I)

There are two Functional Units in this Management Area: a) Farn Deeps (FU 6) and b) Firth of Forth (FU 8).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Unknown	Unknown	Unknown		

The available information is inadequate to use analytical methods to evaluate spawning stock or fishing mortality relative to risk. Results from TV surveys, however, suggest that the stock in this Management Area appear to be exploited at a sustainable level.

Effort currently appears to be at its lowest level since 1984 and LPUE appears to be at its highest in the series. The TV surveys appear to confirm this recent increase in abundance. CPUE trends suggest that recruitment has not been strong over the last few years, but the increase in the mesh size could have masked any recruitment signals. All signs suggest that the stock is healthy although the males in this stock do suffer greater fishing pressure.

All stocks in this Management Area appear to be exploited at sustainable levels.

a) Farn Deeps: LPUEs fluctuated around a generally upward trend up to 1993, were stable for some years, and then after a dip in 2000 increased to an all time high in 2004 despite apparent declining effort. The increase in the estimate of autumn abundance from the TV surveys in the last few years corresponds to this increase in LPUE, but still remains within the range over the series. Mean size of the smaller length groups for males and females has increased in recent years, but the LPUE for these length groups has remained fairly static. CPUE trends and trends in mean size do not give any clear signals about recruitment; they suggest recruitment has been variable but fairly consistent over recent years.
b) Firth of Forth: The TV survey estimate of abundance for *Nephrops* in the Firth of Forth suggests that the population declined between 1993 and 1998 (although no surveys were conducted in 1995 or 1997), increased to a stable level between 1999 and 2001, and then increased to 2003, declining slightly in the most recent year. The recent average abundance (2002–2004) is 23% higher than the previous period (1999–2001). The increases in abundance in the late 1990s and most recent years have been reflected in CPUE and mean size data, in that they suggest an increase in recruitment in 1998 and 2003.
c) Some landings are made outside the Functional Units but inside the Management Area.

Management objectives

There are no management objectives for this fishery.

Reference points

No reference points have been proposed for *Nephrops*.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Information on these stocks is considered inadequate to provide advice based on precautionary limits. The effort in this fishery should not be allowed to increase and the fishery must be accompanied by mandatory programmes to collect catch and effort data on both target and by-catch species.

Short-term implications

Outlook for 2006

The harvest ratio is a proxy for relative effort. Historically for these stocks the harvest ratio has been around 15%.

As an indication of relation between landings (tonnes) and effort the table below shows calculated landings for the Farn Deeps Functional Unit for a range of harvest ratios applied to TV survey biomass results

Harvest ratio (%)	Landings (t)	95% confidence limits
10	1983	+/- 248
15	2975	+/- 372
20	3966	+/- 496
25	4958	+/- 620
30	5950	+/- 744

Shaded options are not in accordance with the advice as this implies increased effort

As an indication of relation between landings (tonnes) and effort the table below shows calculated landings for the Firth of Forth Functional Unit for a range of harvest ratios applied to TV survey biomass results

Harvest ratio (%)	Landings (t)	95% confidence limits
10	868	+/- 187
15	1302	+/- 281
20	1736	+/- 375
25	2170	+/- 468
30	2604	+/- 562

Shaded options are not in accordance with the advice as this implies increased effort

Management considerations

Discards are known to be very high and any improvement of the fishing pattern of the catches would benefit the stock and the medium-term yield.

In the North Sea TAC (which comprises eight *Nephrops* stocks), the present aggregated management approach runs the risk of unbalanced effort distribution. Adoption of management initiatives to ensure that effort can be appropriately controlled in smaller areas within the overall TAC area is recommended.

Between 1993 and 2002, landings from this Management Area have exceeded the TAC recommended by ICES. Up to the early 1990s, effort has increased much faster in the Farn Deeps than in the Firth of Forth. While effort has recently decreased in both FUs, there is still the potential for an imbalance in the exploitation rates. With the current large North Sea TAC area (which comprises eight *Nephrops* FUs), there is no mechanism for controlling effort locally. Management should therefore be carried out at the FU level recommended by ICES.

Effort currently appears to be at its lowest level since 1984 while LPUE appears to be at its highest in the series.

Ecosystem considerations

Throughout its distribution, *Nephrops* is limited to a muddy habitat, and requires sediment with a silt and clay content of between 30–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small-scale movements (a few 100 m), but larval transfer may occur between separate mud patches in some areas. In the Farn Deeps area the *Nephrops* stock inhabits a large continuous area of muddy sediment extending North from 54° 45’–54° 35’N and 0° 40’–1° 30’N, with smaller patches to the east and west.

Factors affecting the fisheries and the stock

Since the beginning of the time-series, the UK fleet has accounted for virtually all landings from the Farn Deeps. Landings from the Firth of Forth fishery are predominantly reported from Scotland, with very small contributions from England.

Effort currently appears to be at its lowest level since 1984 while LPUE appears to be at its highest in the series.

Estimated discarding during this period has fluctuated around 40% by weight of the catch, similar to levels recorded since the beginning of the data series in 1985.

The effects of regulations

Restrictions on other fisheries, e.g. cod recovery measures – catch composition regulations and days at sea – and technical conservation measures have already impacted the effort on these stocks.

Changes in fishing technology and fishing patterns

Changes in fleet capacity, average size of vessels, and power and fuel prices will affect the spatial dispersal of effort. Smaller vessels will not fish so far out and will be limited far more by weather.

The differences between LPUE figures for individual vessels suggest that earlier years could have included less truly directed effort. Restrictions on finfish fishing over the last five years will have restricted total effort in FU 6, thereby reducing the more casual effort on *Nephrops*.

The environment

This species is essentially sedentary and stocks are limited geographically to muddy sediment. Weather and sea temperature will effect the dispersal and settlement of larvae which to be successful depends on retention gyres and the speed in development of the zoea. Catch rates and length compositions are dependent on burrow density and are affected by weather, tides, and light intensity.

Reduction in the size and number of predators, primarily cod, may have been beneficial to these stocks.

Other factors

Catch rates are affected by emergence behaviour which in turn is affected by tides, light intensity, moult cycles, and sexual development.

Scientific basis

Data and methods

There is considerable uncertainty about landings, discard and effort data for these stocks. Underwater TV surveys of the Farn Deeps have been conducted at least once a year from 1996 onwards, and for the Firth of Forth since 1993 (missing surveys in 1995 and 1997).

Information from the fishing industry

For FU 6 the NSCFP fishermen's survey shows an increase between 2001 and 2002, a relatively stable period to 2004, and an increase in 2005. Although the sample size in the NSCFP fishermen's survey is relatively small for area 4 (n=15) the abundance trend appears to agree with the recent increase in abundance from the TV estimates for FU6.

For FU 8 the NSCFP survey shows a continuous increase in *Nephrops* since 2001. This supports the suggestion of an increase in abundance since 2001, with generally moderate or high numbers of recruits.

Uncertainties in assessment and forecast

There are concerns regarding the accuracy of landings and effort data and because of this the final assessment adopted is independent of official statistics.

LPUE may also be affected by changes in catchability (due to sudden changes in the environmental conditions), or by changes in selectivity and/or in gear efficiency.

Discards could reflect the strength of the recruitment but are also dependant on selectivity of the gear and on discarding practices. Thus trends in mean size of the catch are difficult to interpret without any information on any change in the fishing pattern and practices.

Farn Deeps: the distinct seasonality in this fishery leads to much higher exploitation in males than females. Bearing this in mind, a harvest ratio considered appropriate for stocks with more balanced exploitation may be too high for this stock.

Comparison with previous assessment and advice

Previously advice has been based largely on analytical catch-at-age assessments using XSA, and average historical landings. There is considerable doubt about the quality of fisheries data and assessments cannot be based on these data, i.e. catch and LCPUE. The present advice is therefore for no increase in effort as it is not possible to provide a catch prediction based on fisheries data. As reliable fisheries data are not available the TV underwater survey biomass estimates are used to indicate landings associated with various effort levels.

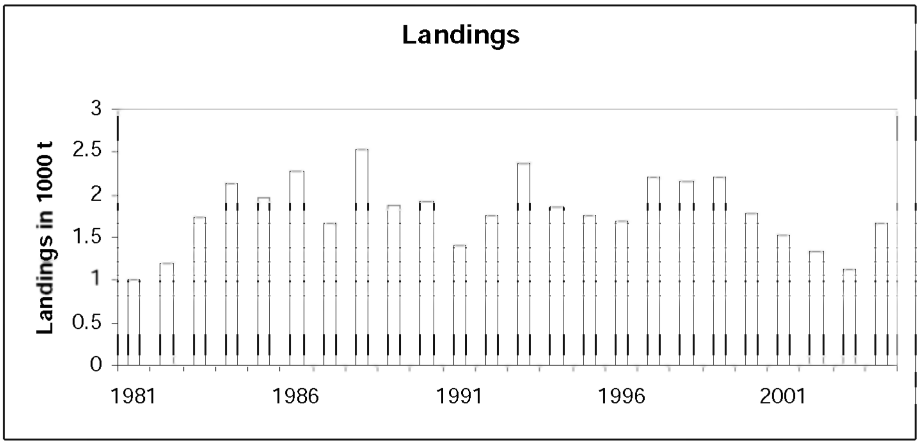
Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6–15 September 2005 (ICES CM 2006/ACFM:09).

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM Landings[2]
1987				4.0
1988				5.3
1989				5.1
1990				4.6
1991				3.8
1992		~4.6	12.0	3.5
1993		4.17	12.0	5.7
1994		4.17	13.0	5.9
1995		4.17	15.2	4.7
1996		4.17	15.2	4.6
1997		4.17	15.2	4.7
1998		4.17	15.2	4.6
1999		4.17	15.2	5.0
2000		4.17	17.2	4.4
2001		4.17	15.48	4.7
2002		4.17	16.623	3.9
2003		4.17	16.623	4.0
2004		4.17	21.350	4.4
2005		4.17	21.350	
2006	No increase in effort	-		

(Weights in '000 t) [1)] EU Zone of IIa and IV; [2)] Does not include discards.

Nephrops in Division IVb,c, west of 1°E (Management Area I) FU 8 Firth of Forth.



Nephrops in Division IVb,c, west of 1°E (Management Area I) FU 6 Farn Deeps.

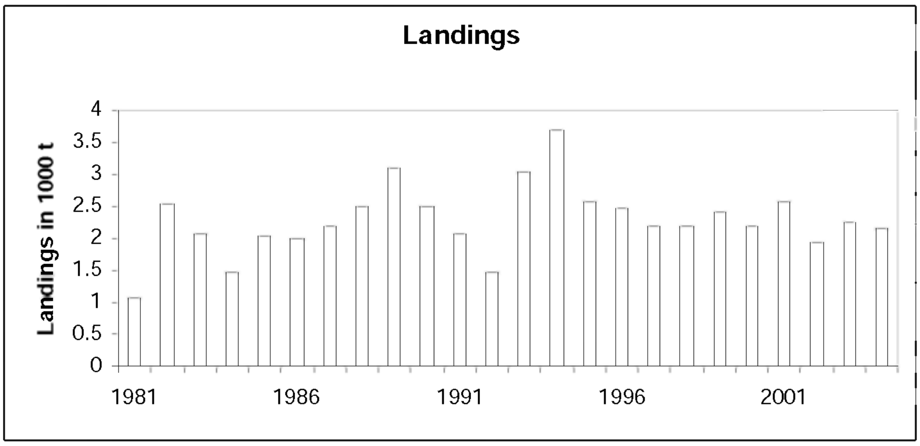


Table.1.4.29.1 *Nephrops*, Management Area I: Total *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles, 1981–2004.

Year	FU 6	FU 8	Other	Total
1981	1073	1006	74	2153
1982	2524	1195	156	3875
1983	2078	1724	100	3902
1984	1479	2134	78	3691
1985	2027	1969	106	4103
1986	2015	2263	143	4421
1987	2191	1674	147	4012
1988	2505	2528	308	5341
1989	3098	1886	158	5142
1990	2498	1930	133	4561
1991	2064	1404	355	3823
1992	1463	1757	270	3491
1993	3030	2369	261	5661
1994	3684	1850	407	5940
1995	2568	1763	373	4704
1996	2482	1688	387	4557
1997	2189	2194	339	4722
1998	2176	2145	278	4599
1999	2401	2205	401	5006
2000	2178	1785	391	4353
2001	2574	1528	633	4735
2002	1953	1340	637	3917
2003	2245	1126	653	4024
2004*	2153	1658	588	4399

Table.1.4.29.2 *Nephrops* Farn Deeps (FU 6): Landings (tonnes) by country, 1981–2004.

Year	UK England	UK Scotland	Sub total	Other countries**	Total
1981	1006	67	1073	0	1073
1982	2443	81	2524	0	2524
1983	2073	5	2078	0	2078
1984	1471	8	1479	0	1479
1985	2009	18	2027	0	2027
1986	1987	28	2015	0	2015
1987	2158	33	2191	0	2191
1988	2390	105	2495	0	2495
1989	2930	168	3098	0	3098
1990	2306	192	2498	0	2498
1991	1884	179	2063	0	2063
1992	1403	60	1463	10	1473
1993	2941	89	3030	0	3030
1994	3530	153	3683	0	3683
1995	2478	90	2568	1	2569
1996	2386	96	2482	1	2482
1997	2109	80	2189	0	2189
1998	2029	147	2176	1	2177
1999	2197	194	2391	0	2391
2000	1947	231	2178	0	2178
2001	2319	255	2574	0	2574
2002	1739	215	1953	0	1953
2003	2031	214	2245	0	2245
2004	1952	201	2153	0	2153

* provisional   na = not available
** Other countries includes Be and Dk

Table 1.4.29.3 *Nephrops*, Firth of Forth (FU 8), Nominal Landings of *Nephrops*, 1981–2004, as officially reported.

Year	UK Scotland				UK England	Total **
	Nephrops trawl	Other trawl	Creel	Sub-total		
1981	945	61	0	1006	0	1006
1982	1138	57	0	1195	0	1195
1983	1681	43	0	1724	0	1724
1984	2078	56	0	2134	0	2134
1985	1908	61	0	1969	0	1969
1986	2204	59	0	2263	0	2263
1987	1582	92	0	1674	0	1674
1988	2455	73	0	2528	0	2528
1989	1833	52	0	1885	1	1886
1990	1901	28	0	1929	1	1930
1991	1359	45	0	1404	0	1404
1992	1714	43	0	1757	0	1757
1993	2349	18	0	2367	2	2369
1994	1827	17	0	1844	6	1850
1995	1708	53	0	1761	2	1763
1996	1621	66	1	1688	0	1688
1997	2137	55	0	2192	2	2194
1998	2105	38	0	2143	2	2145
1999	2192	9	1	2202	3	2205
2000	1775	9	0	1784	1	1785
2001	1484	35	0	1519	9	1528
2002	1302	31	1	1334	6	1340
2003	1115	8	0	1123	3	1126
2004*	1651	4	0	1655	3	1658

* provisional na = not available

** There are no landings by other countries from this FU

Table 1.4.29.4 *Nephrops* in Division IVb,c, west of 1°E (Management Area I) FU 8 Firth of Forth.

Year	Landings tonnes
1981	1006
1982	1195
1983	1724
1984	2134
1985	1969
1986	2263
1987	1674
1988	2528
1989	1886
1990	1930
1991	1404
1992	1757
1993	2369
1994	1850
1995	1763
1996	1688
1997	2194
1998	2145
1999	2205
2000	1785
2001	1528
2002	1340
2003	1126
2004	1658
Average	1797

Table 1.4.29.5 *Nephrops* in Division IVb,c, west of 1°E (Management Area I) FU 6 Farn Deeps.

Year	Landings tonnes
1981	1073
1982	2524
1983	2078
1984	1479
1985	2027
1986	2015
1987	2191
1988	2495
1989	3098
1990	2498
1991	2063
1992	1473
1993	3030
1994	3683
1995	2569
1996	2482
1997	2189
1998	2177
1999	2391
2000	2178
2001	2574
2002	1953
2003	2245
2004	2153
Average	2277

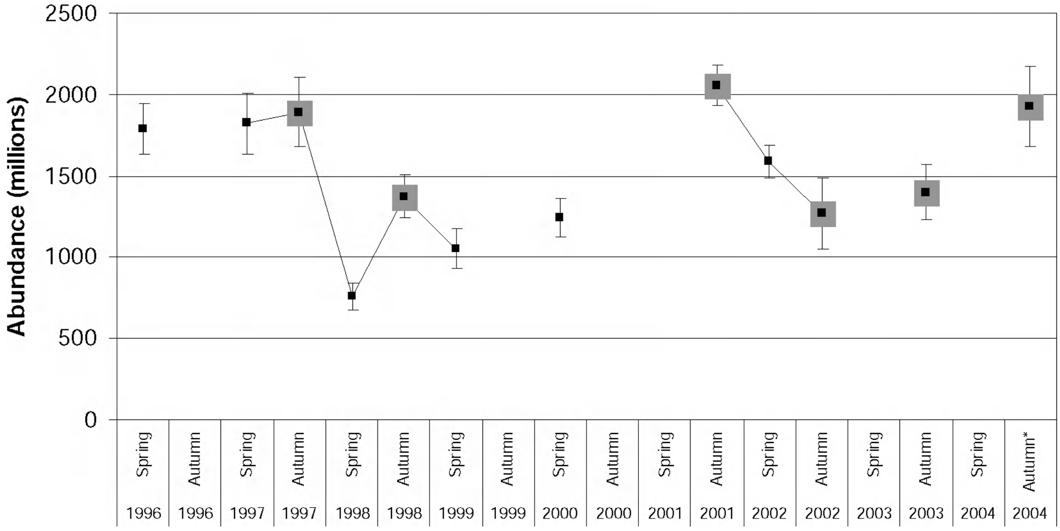


Figure 1.4.29.1 Farn Deeps (FU 6), Time-series of TV survey abundance estimates, with 95% confidence intervals, 1996–2004.

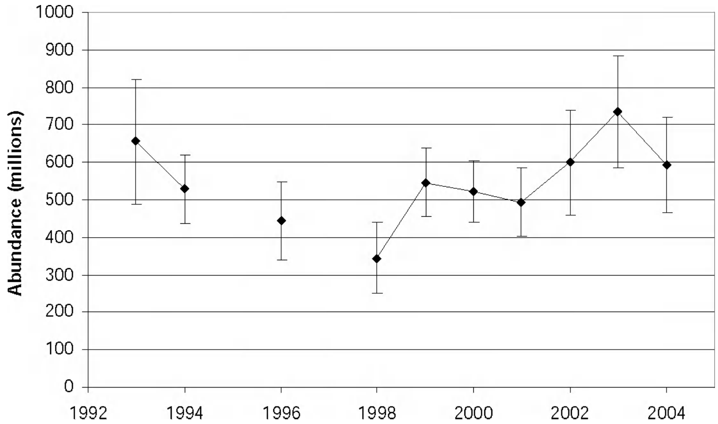


Figure 1.4.29.2 Firth of Forth (FU 8), Time-series of TV survey abundance estimates, with 95% confidence intervals, 1993–2004.

1.4.30 *Nephrops* in Divisions IVb,c, East of 1°E, excluding rectangles 43 F5-F7 (Management Area H)

There are two Functional Units in this Management Area: a) Botney Gut (FU 5) and b) Off Horn Reef (FU 33).

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment *[used if qualifiers to present state are necessary]*
Unknown	Unknown	Unknown		

The available information is inadequate to evaluate spawning stock or fishing mortality relative to risk.

a) Botney Gut: In its 2003 assessment of the *Nephrops* stock in the Botney Gut–Silver Pit area (FU 5), WGNEPH concluded that the stock was fully exploited and recommended that the TAC for FU 5 be maintained at the previously recommended level of 1100 t (ICES, 2003). The evidence of a (temporary) shift in the length composition of the landings stresses the need to closely monitor this stock, but is not of such a nature that further restrictions of the fishery need to be envisaged. Current levels of exploitation appear to be sustainable.

b) Off Horn Reef: Trends in LPUE data suggest that stock levels are remaining relatively stable. The current exploitation level seems to be sustainable.

Management objectives

There are no management objectives for this fishery.

Reference points

No reference points have been determined for *Nephrops*.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary limits

Information on these stocks is considered inadequate to provide advice based on precautionary limits. Therefore ICES recommends that the level of exploitation, i.e. effort on these stocks should not be increased.

Management considerations

In the North Sea TAC (which comprises eight *Nephrops* stocks), the present aggregated management approach runs the risk of unbalanced effort distribution. Adoption of management initiatives to ensure that effort can be appropriately controlled in smaller areas within the overall TAC area is recommended.

For FU 5 (Botney Gut) mean sizes of males in the landings show evidence of an overall downward trend, while mean sizes of females seem to have stabilised, albeit at a level that is considerably lower than in the early 1990s. For FU 33 (Horns Reef) there is no evidence of shifts in the size composition in the catches over the years 2001-2004.

Although the observed shift apparently was of a temporary nature, it stresses the need to closely monitor this stock. As a matter of fact, shifts of this type may be indicative of increased fishing pressure on the oldest age classes in the population and/or of a change in discarding practices, towards retaining more of the smaller *Nephrops*.

Factors affecting the fisheries and the stock

2003 and 2004 saw a further decline in the Belgian *Nephrops* fishery in the Botney Gut–Silver Pit area. Up to 1995, the Belgian fleet used to take over 75% of the international landings from this stock, but since then, its share has dropped to less than 25%. The Netherlands is now the most important player in FU 5, with over 60% of the total international landings being taken by Dutch trawlers, for first sale in the Netherlands or in Belgium.

Long-term effort of the Belgian *Nephrops* fleet has shown an almost continuous decrease since the all-time high in the early 1990s.

Denmark accounts for most of the *Nephrops* landings from FU 33. Landings from this area have been steadily increasing since 2000.

Scientific basis

Data and methods

The perception of the stock is based on LPUE only.

Information from the fishing industry

The NSCFP stock survey trends show an increase between 2001 and 2002, a stable period to 2004, and an increase in 2005. There were no strong indications of changes in recruitment or discarding levels.

Uncertainties in assessment and forecast

For the Botney Gut The LPUE values for 2003 and 2004 (Belgian trawlers) should be treated with caution since (a) they are based on a very small number of vessels only, (b) the *Nephrops* specialist trawlers remaining are the ones operating twin-rigs (which do have higher catch rates than the single rigs that were in use in the 1980s and 1990s), and (c) there is a tendency – also amongst the specialist trawlers – to concentrate fishing effort in the season with the highest catch rates.

The lack of discards information for all the components of the Botney Gut fishery prevent any firm conclusion on the state of the stock based on a trend in the mean size of the catch.

Comparison with previous assessment and advice

Previous assessments have considered this stock to be fully exploited. LPUE trends have been relatively stable up to the most recent years. Interpretation of recent changes are complicated by changes in the fleet providing the data. Changes in size distribution data may suggest increases in recruitment in 2001 and 2002.

This year's advice is for a non-increase in effort.

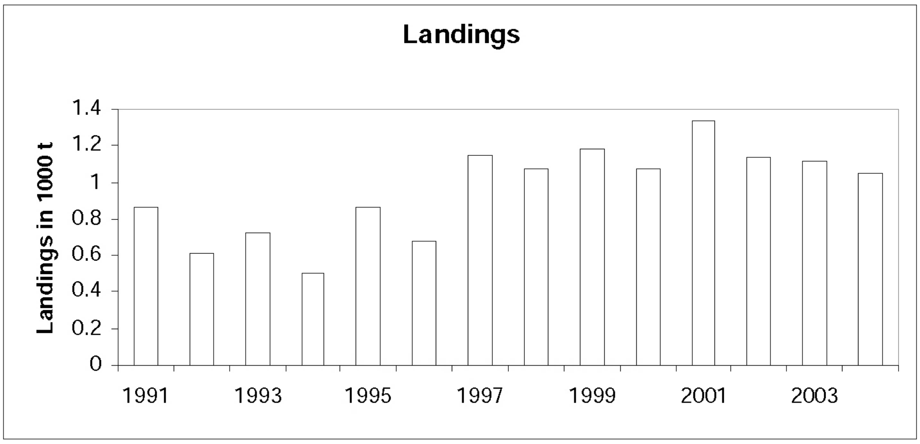
Source of information

Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, September 2005 (ICES CM 2006/ACFM:09).

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM Landings[2]
1987				0.5
1988				0.7
1989				0.8
1990				0.9
1991				1.0
1992		0.87	12.0	0.7
1993		0.87	12.0	0.9
1994		0.87	13.0	0.7
1995		0.87	15.2	1.2
1996		0.87	15.2	0.9
1997		0.87	15.2	1.6
1998		1.0	15.2	1.6
1999		1.0	15.2	2.2
2000		1.6	17.2	2.0
2001		1.6	15.48	2.4
2002		2.1	16.623	2.4
2003		2.1	16.623	2.5
2004		2.38	21.350	2.6
2005		2.38	21.350	
2006		2.38		
2007				

(Weights in '000 t) [1)] EU Zone of IIa and IV; [2)] Does not include discards.

Nephrops in Division IVb,c, east of 1°E, excluding Rectangles 43 F5-F7 (Management Area H) Botney Gut FU 5.



Nephrops in Division IVb,c, east of 1°E, excluding Rectangles 43 F5-F7 (Management Area H) Horn Reef FU 33.

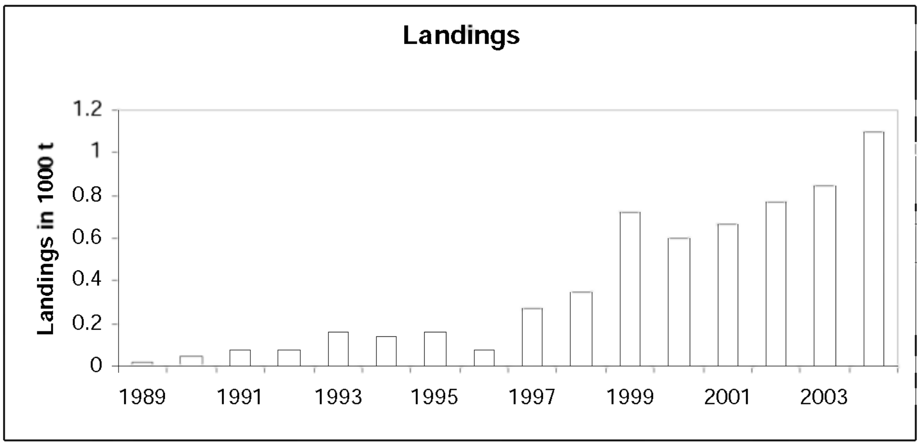


Table 1.4.30.1 *Nephrops* Botney Gut–Silver Pit (FU 5): Landings (tonnes) by country, 1991–2004.

Year	Belgium	Denmark	Netherl.	UK	Total **
1991	682	176	na	4	862
1992	571	22	na	19	611
1993	694	20	na	7	721
1994	494	0	na	9	503
1995	641	77	148	3	869
1996	266	41	317	55	679
1997	486	67	540	56	1150
1998	372	88	584	28	1071
1999	436	53	538	158	1185
2000	366	83	402	218	1070
2001	353	145	553	278	1329
2002	281	94	617	151	1142
2003	265	36	661	158	1120
2004 *	171	39	646	198	1054
* provisional na = not available					
** Totals for 1991-94 exclusive of landings by the Netherlands					

Table 1.4.30.2 *Nephrops* Botney Gut–Silver Pit (FU 5): Landings (tonnes), effort ('000 hours trawling) and LPUE (kg/hour trawling) of Belgian *Nephrops* trawlers, 1991–2004.

Year	Landings	Effort	LPUE
1991	566	74.0	7.7
1992	525	74.5	7.0
1993	672	58.3	11.5
1994	453	35.5	12.7
1995	559	32.5	17.2
1996	245	30.1	8.1
1997	399	31.8	12.5
1998	309	28.6	10.8
1999	322	31.8	10.1
2000	174	21.8	8.0
2001	195	21.5	9.1
2002	144	15.8	9.1
2003	118	6.2	19.3
2004 *	106	5.7	18.8
* provisional na = not available			

Table 1.4.30.3 *Nephrops* Off Horn Reef (FU 33): Landings (tonnes) by country, 1993–2004.

Year	Belgium	Denmark	Netherl.	UK	Total **
1993	0	159	na	1	160
1994	0	137	na	0	137
1995	3	158	0	1	164
1996	1	74	0	0	77
1997	0	274	0	0	276
1998	4	333	0	1	350
1999	22	683	0	6	724
2000	13	537	0	9	598
2001	52	667	0	+	719
2002	21	772	0	4	797
2003	15	842	0	1	858
2004*	37	1097	0	1	1135
* provisional na = not available, ** Totals for 1993-94 exclusive of landings by the N					

Table 1.4.30.4 *Nephrops* in Division IVb,c, east of 1°E, excluding Rectangles 43 F5-F7 (Management Area H). Botany Gut FU5

Year	Landings tonnes
1991	862
1992	611
1993	721
1994	503
1995	869
1996	679
1997	1150
1998	1071
1999	1185
2000	1070
2001	1329
2002	1142
2003	1120
2004	1054
Average	955

Table 1.4.30.4 *Nephrops* in Division IVb,c, east of 1°E, excluding Rectangles 43 F5-F7 (Management Area H) Horn Reef FU 33.

Year	Landings tonnes
1989	16
1990	47
1991	74
1992	76
1993	160
1994	137
1995	164
1996	77
1997	276
1998	350
1999	724
2000	597
2001	667
2002	772
2003	842
2004	1097
Average	380

1.4.31 Demersal elasmobranchs in the North Sea, Skagerrak, and eastern English Channel

State of the stocks

Landings of skates and rays in the North Sea, Skagerrak, and eastern English Channel have generally declined, and this is associated with changes in species composition and relative abundance.

Thornback ray (Raja clavata) – distribution area and abundance have strongly decreased over the past century. The area occupied has significantly decreased since 1990. Although local abundance remains high, the North Sea stock is considered depleted.

Spotted ray (Raja montagui) – area occupied and abundance has fluctuated without trend. Stock status is uncertain.

Starry ray (Amblyraja radiata) – catch rates increased from the early 1970s to the early 1990s and decreased slightly in abundance.

Cuckoo ray (Leucoraja naevus) – since 1990 the area occupied has fluctuated without trend, while abundance has decreased since the early 1990s. Stock status is uncertain.

Common skate (Dipturus batis) – is depleted. It was formerly widely distributed in the North Sea but is now only rarely found and only in the northern North Sea.

Blonde ray (Raja brachyura) – has a patchy occurrence in the North Sea. It is at the edge of its distributional range in this area and consequently ICES does not provide advice for this species.

Lesser spotted dogfish (Scyliorhinus canicula) – abundance and area occupied are increasing.

Smooth hound and starry smooth hound (Mustelus mustelus and *M. asterias)* – abundance appears to have been increasing in recent years, but the stock status is very uncertain. Identification by species is considered unreliable in the surveys.

Angel shark (Squatina squatine) is now extinct in the North Sea.

Management objectives

None have been suggested or adopted. An elasmobranch action plan has been under development since 2001.

Reference points

Not defined.

Single-stock exploitation boundaries

The stocks of common skate and thornback rays are depleted. Target fisheries should not be permitted, and bycatch in mixed fisheries should be reduced to the lowest possible level.

If the fisheries for rays continue to be managed with a common TAC for all ray species, this TAC should be set at zero for 2006.

Management considerations

North Sea demersal elasmobranchs are being landed as a bycatch in the demersal fisheries for teleosts. Only a few inshore vessels target skates and rays. They are usually landed and reported in mixed categories such as "skates and rays" and "sharks". For assessment purposes species-specific landings data are essential.

Given the relatively low value of rays, they are largely taken as bycatch. TACs only regulate the landings, and a low TAC on a low-value bycatch species could induce more discards. Because the elasmobranch species are caught as a bycatch in demersal fisheries, they would benefit from a reduction in the overall demersal fishing effort.

At least 12 species of rays have been reported from North Sea surveys, but only 4 of them are fairly common. Also 8 demersal sharks have been reported, of which only lesser spotted dogfish (*Scyliorhinus canicula)* is common.

Elasmobranchs are typically slow growing, have a high age-at-maturity and a low reproductive capacity. Measures to afford protection to the largest individuals are required.

The most vital part of the thornback ray spawning stock occurs in the southwestern North Sea. Measures to protect thornback ray in this area should be evaluated.

Landings of demersal sharks are not effectively restricted in the North Sea. Given their increased abundance and their general high discards survival, there is no immediate need to initiate regulation for these species.

Ecosystem considerations

Skates, rays, and demersal sharks are widely spread over the North Sea. They are caught as a bycatch targeting demersal teleosts. Due to their life history characteristics (slow growth, high age at maturity and low reproduction rates) they are usually very susceptible for fisheries. The larger elasmobranchs such as angel shark *Squatina squatina,* common skate *Dipturus batis*, and thornback ray *Raja clavata* tend to be the most vulnerable. The angel shark has completely disappeared from the North Sea area, *Dipturus batis* is nowadays only rarely caught in the northern North Sea, and the stock of *R. clavata* in the North Sea may be depleted, being confined mainly to the southwestern bight. Only the smaller species seem to be stable/increasing: *Amblyraja radiata*, the lesser spotted dogfish *Scyliorhinus canicula*, and possibly *Mustelus* spp.

Factors affecting the fisheries and the stock

The effects of regulations

In 1999 the EC introduced a TAC for skates and rays. The current TAC does not restrict the landings. Furthermore, the discarding of rays is thought to be high.

Scientific basis

Data and methods

Survey data are the basis for the assessments of skates, rays, and demersal sharks in the North Sea.

Uncertainties in assessment and forecast

In most countries skates and rays are landed together, most often sorted in particular size categories, rather than by species. They are usually gutted, and sometimes only wings are being landed. For assessment purposes, species-specific catch data are essential. Only some countries report (part of) the landings by species, e.g. Sweden and France. As a result of market sampling programmes the species composition of the landings can now be estimated for part of the countries landing skates and rays.

Comparison with previous assessment and advice

ICES has never produced advice for these species. However, in 1997 and 2004, ACFM gave an overview of the relative status of the main ray species in the North Sea.

Source of information

Report of the Working Group on Elasmobranch Fishes 2005 (ICES CM 2005/ACFM:03).

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresponding to advice	Predicted catch corresponding to single-stock exploitation boundaries	Agreed TAC[1]	ACFM landings	Disc. slip.	ACFM Catch
1992	No advice					6		
1993	No advice					6		
1994	No advice					6		
1995	No advice					6		
1996	No advice					6		
1997	No advice					5		
1998	No advice					5		
1999	No advice				6	3		
2000	No advice				6	4		
2001	No advice				5	4		
2002	Reduce exploitation				5	4		
2003	No advice				4	4		
2004	No advice				4	2		
2005	No advice				3			
2006	Zero catch	F=0		0				

Weights in '000 t.
[1)] EU only.

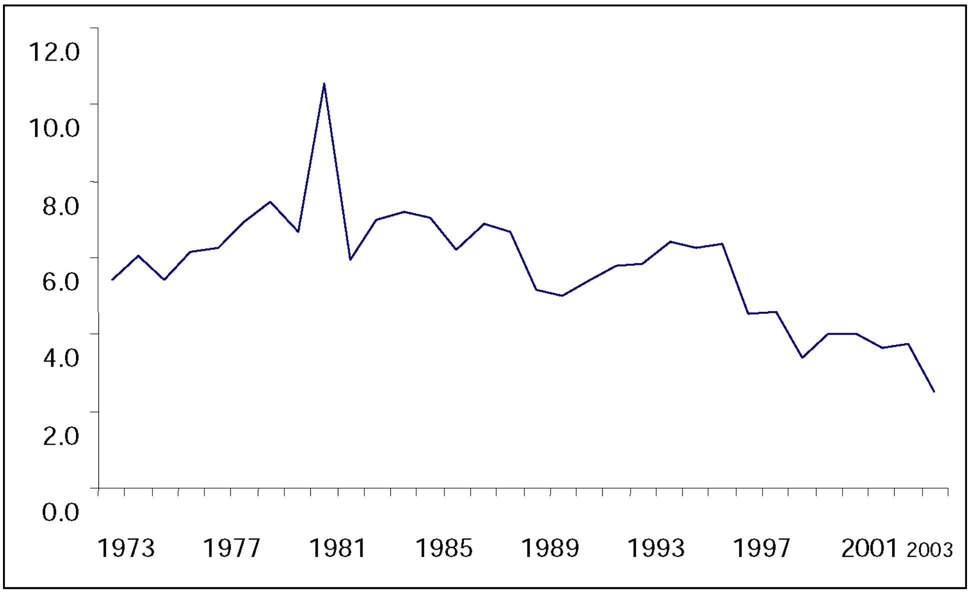


Figure 1.4.31.1 Rays and skates: landings in the North Sea, Skagerrak, and eastern English Channel. All species combined.

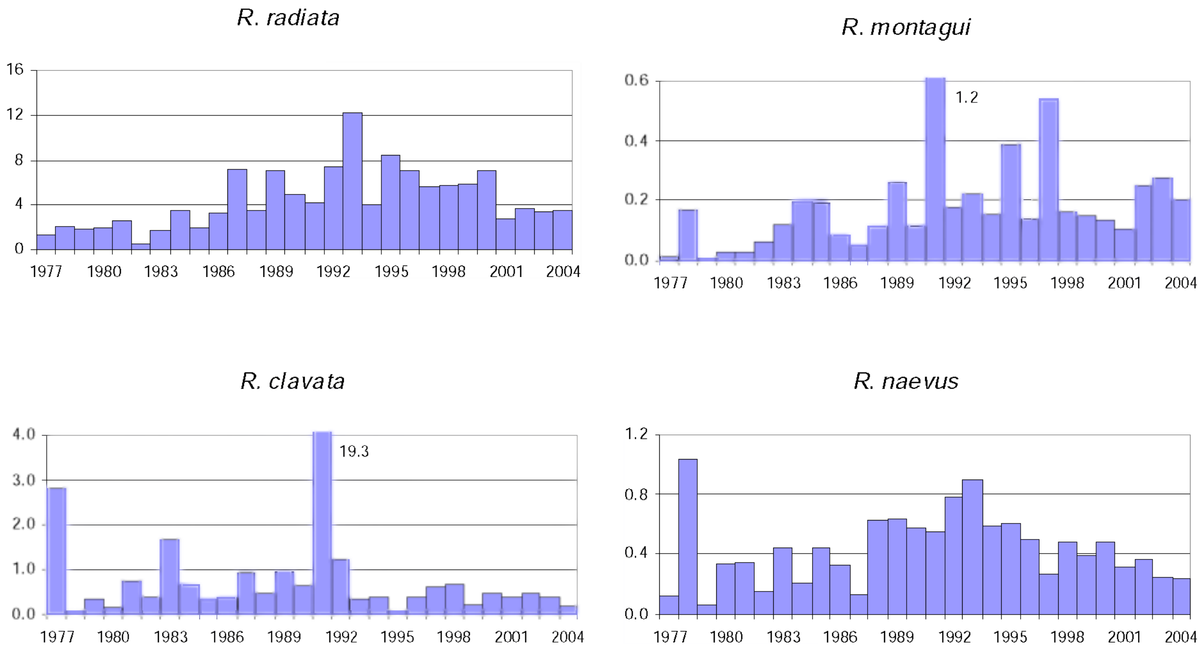


Figure 1.4.31.2 Time-series of catch rates (number per hour) for the 4 most abundant species of rays: thornback ray (*Raja clavata),* spotted ray (*Raja montagui*), starry ray (*Amblyraja radiata*), and cuckoo ray (*Leucoraja naevus*). Data from the IBTS quarter 1 survey, roundfish sampling areas 1–7.

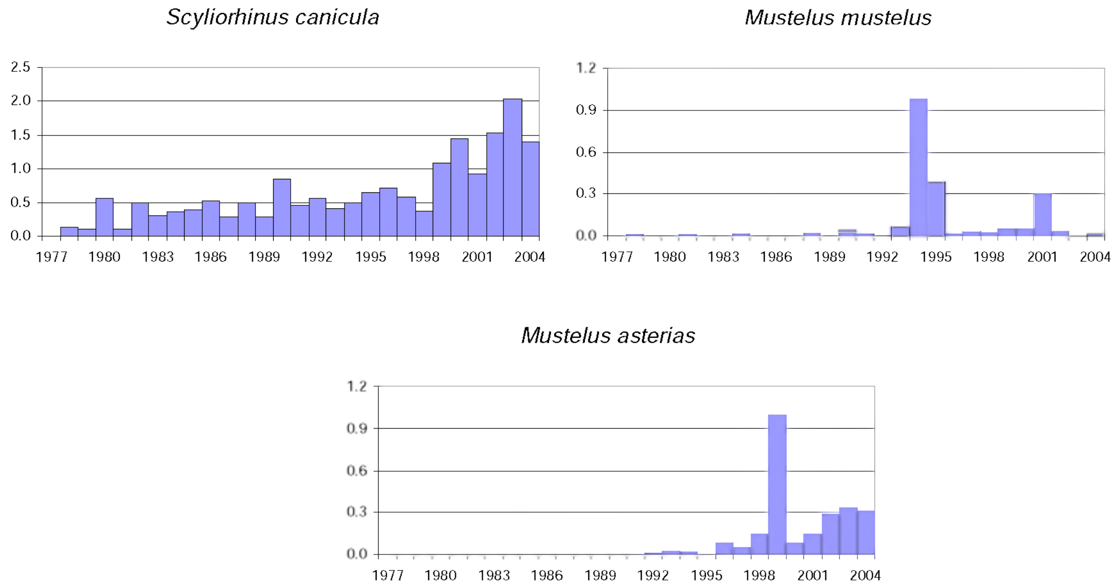


Figure 1.4.31.3 Time series of catch rates (number per hour) for the 3 most abundant shark species: lesser spotted dogfish (*Scyliorhinus canicula*), smooth hound (*Mustelus mustelus*), and starry smooth hound (*Mustelus asterias*). Data from the IBTS quarter 1 survey, roundfish sampling areas 1–7.