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International Council for the Exploration of the Sea

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VOLUME 9

Section **Page**

1 WIDELY DISTRIBUTED AND MIGRATORY STOCKS

1.1 Widely distributed marine populations

A number of marine populations are not confined to the individual areas considered in other sections of this report. They include sea mammals and fish species with stock units that are distributed over much wider areas such as hake and a number of deepwater species, and migratory species such as mackerel, horse mackerel, and blue whiting.

1.1.1 The North East Atlantic ecosystem in relation to widely distributed populations

It is difficult to characterise the whole North East Atlantic ecosystem; however, some broad descriptions are possible. Detailed information on the hydrography of this area is available from the Annual ICES Ocean Climate Status Summary (Hughes and Lavin, 2004). The most studied feature is the North Atlantic Oscillation (NAO). The NAO index is a measure of the difference in normalised sea level pressure between Iceland and the subtropical Eastern North Atlantic. When the NAO index is positive there is a strengthening of the Icelandic low and Azores high. This strengthening results in an increased north–south pressure gradient over the North Atlantic, causing colder and drier conditions over the western North Atlantic and warmer and wetter conditions in the eastern North Atlantic. During a negative NAO, a weakening of the Icelandic low and Azores high decreases the pressure gradient across the North Atlantic and tends to reverse these effects. The NAO index has been useful in the past to describe the climate of the North Atlantic region. Generally the most useful NAO index is for the winter (December through March). The winter index is called the Hurrell Index.

Following a long period of increase from an extreme and persistent negative phase in the 1960s to a most extreme and persistent positive phase during the late 1980s and early 1990s, the NAO index underwent a large and rapid decrease during the winter preceding 1996. Recent ICES Annual Ocean Climate Status Summaries (IAOCSS) describe the return of the NAO to positive conditions in the years following 1996 until a further reversal occurred over the winter preceding 2001. The NAO index is limited in that it can only describe the strength of the north–south dipole in sea level pressure (SLP) anomaly. Although this has been the predominant pattern over the last 30 years, it is not always the case. During the winter of 2002 the SLP anomaly pattern did exhibit a north–south dipole, but this was limited to the eastern region. Therefore the Hurrell NAO index was weakly positive. During 2003, the typical north-south NAO pattern was replaced by an east–west sea level pressure anomaly leading to a low value for both NAO indices in 2003. A high NAO index is believed to lead to a weakening of the warm North Atlantic current, and a stronger poleward current along the European shelf break, as well as stronger cold Labrador Sea water inflow. A low NAO index suggests a stronger North Atlantic current penetrating further into the Norwegian Sea, and a weaker slope current.

In most areas of the North Atlantic during 2003, temperature and salinity in the upper layers remained higher than the long-term average, with new records set in several regions. In Biscay, sea surface temperature in summer 2003 was the warmest in the time-series (1993–2003). Values were 1ºC above the mean from June to October and the thermocline was shallow. In the Rockall Trough the high surface temperatures and salinities continued a rise which began in 1995. Salinity values over the top 800 m were the highest on record, and corresponding temperatures were more than 0.5°C above the long-term average. Surface waters in the Faroe Shetland Channel continued the general warming trend observed over the last 20 years. Modified Atlantic Waters in the Faroe Shetland Channel were warmer and saltier in 2003 than at any period during the last 50 years. The sea surface temperature in 2003 was higher than normal over most of the Norwegian Sea. The distribution area of Atlantic water has decreased since the beginning of the 1980s, while the temperature has shown a steady increase. Since 1978 the temperature of Atlantic water has increased by about 0.6°C.

In terms of the ecosystem, probably the most important factor impacting fish stocks is the abundance of zooplankton, particularly copepods. In broad terms the long-term Continuous Plankton Recorder database provides useful data. Long-term trends in the North East Atlantic show a general decline in zooplankton abundance (Edwards *et al.*, 2004). A detailed examination of the demography of *Calanus* in the NE Atlantic is provided by Heath *et al.* (2000).

There is no fully comprehensive understanding of the links between the ecosystem and the fish stocks. However, some specific studies have illustrated particular examples:

- The distribution of mackerel prior to the pre-spawning migration and the timing of that migration appears to be related to water temperature in the northern North Sea in the winter. The temperature evolution in this area is largely modulated by the shelf edge current (Reid *et al.*, 2001a).
- The potential fecundity of mackerel appears to some extent to be modulated by feeding conditions in the Norwegian Sea in the previous autumn (Slotte and Iversen, 2004). Hence availability of zooplankton (*Calanus*) will affect the reproductive success of this species.

- The scale of the migration of western horse mackerel into the Norwegian Sea and the capture rate in the Norwegian fishery have been successfully correlated to Atlantic inflow to the North Sea and phytoplankton colour indices (Reid *et al.*, 2001b). This suggests that different patterns in the scale of inflow can influence the scale of the horse mackerel migration.
- Other changes have occurred in the spatio-temporal pattern of migration in the western mackerel over the last 30 years, which are likely to have ecosystem correlates although these have yet to be clarified. Specifically, in the 1970s the mackerel migrated from the North Sea to the spawning areas in the autumn (September/October). By the 1990s this migration occurred in January/February. This required changes in management, and in a distinct change in the timing and location of the fishery (Reid *et al.*, 2002; WD to WGMHS, 2002).
- Hake belongs to a very extended and diverse community of commercial species. The main species concerned are megrim, anglerfish, *Nephrops*, sole, seabass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, *Trachurus spp*, conger, pout, conger, cephalopods (octopus, *Loligidae*, *Ommastrephidae* and cuttlefish), rays, etc. (Lucio *et al.* (WD to WGHMM, 2003)). The relative importance of these species in the hake fishery varies largely in relation to the different gears, sea areas, and countries involved.

1.2 The populations and their exploitation

1.2.1 The fisheries and their impact

The blue whiting stock is fished in Subareas II, V, VI, and VII and by a number of countries, mainly by Norway, Russia, Iceland, Denmark, Faroe Islands, United Kingdom, and Ireland. Most of the catches are taken in the directed pelagic trawl fisheries. The main fishery has traditionally been in the spawning and post-spawning areas (Divisions Vb, VIa,b, and VIIb,c). The catches in this area have more than doubled over the last 7–8 years. In the Norwegian Sea (Subareas I and II, in Divisions Va, and XIVa,b), catches have increased dramatically over the last 8 years from 23 000 tonnes in 1996 to 964 000 tonnes in 2004. Catches are also taken in the directed and mixed fishery in Subarea IV and Division IIIa. These catches have increased by 200–300 % since the mid-1990s. The total catches in the northern areas have thus increased from 0.55 million tonnes in 1995 to 2.33 million tonnes in 2004 t. Catches in the southern areas (Subareas VIII, IX, Divisions VIId,e and g-k) have been stable in the range of 25 000–34 000 t, but increased to 85 000 tonnes in 2004. In Division IXa blue whiting is mainly taken as bycatch in mixed trawl fisheries.

The Norwegian spring-spawning herring is fished in Subareas I and II and by a number of countries, mainly by Norway, Iceland, Russia, Faroe Islands, Denmark, Netherlands, UK, Germany, and Sweden. The 2004 catches were almost 800 thousand t. Most of the catches were landed for human consumption. The spawning stock biomass was estimated at 6.5 million t in 2004.

The North Eastern Atlantic mackerel is fished in Subareas II, IV, V, VI, VII, VIII, and IX by a number of countries, mainly Norway, Russia, Ireland, UK, Ireland, Denmark, Netherlands, Germany, and the Faroe Islands. Most of the catches are taken in directed trawl fisheries in the Norwegian Sea (between 50 000 and 150 000 tonnes), in the northern part of the North Sea (between 200 000 and 400 000 tonnes), and to the west of the British Isles (200 000 to 250 000 tonnes). There are smaller-scale fisheries in Biscay and the Iberian Peninsula, where they are often taken in mixed fisheries with other pelagic species; mainly horse mackerel, sardine, and anchovy – these are dealt with in more detail in the section covering Iberian stocks. The stock is divided into three spawning components; North Sea, Western, and Southern, based on the areas in which the fish spawn. The North Sea component is no longer assessed separately, but is considered as severely depleted and around 220 000 tonnes. Before the late 1960s, the North Sea spawning biomass of mackerel was estimated at above 3 million tonnes. Due to recruitment overfishing, recruitment has failed since 1969, leading to a decline in the stock. The North Sea spawning component has increased since 1999, but it is still far below the level in the 1960s.

There are a variety of protective measures in place for this stock, including closure of the mackerel fishery in Divisions IVb,c and IIIa throughout the whole year and in Division IVa from February to July. This closure has unfortunately resulted in increased discards of mackerel in the non-directed fisheries (especially horse mackerel fisheries) in these areas as vessels at present are permitted to take only 10% of their catch as mackerel bycatch. The distribution area of the North Sea component overlaps with the western component particularly in the second half of the year, and may be implicated in the fishery at that time. The western and southern components are managed together and represent the bulk of the NEA mackerel fishery. The SSB was estimated at 2.6 million tonnes in 2005. The stock generally experiences good recruitment, although 2000 was an unusually weak year and preliminary information on the 2003 year class suggests that it may also be weak.

The western horse mackerel stock is fished in Subareas II, III IV, VI, VII, and VIII by a number of countries, mainly Norway, Ireland, UK, Ireland, Denmark, France, Netherlands, and Germany. Most of the catches are taken in directed trawl or purse seine fisheries in the Norwegian Sea (decreasing from c. 150 000 tonnes in the early 1990s to 20 000 tonnes in recent years), along the western shelf edge and in the English channel (between 120 000 and 400 000 tonnes), and in Biscay (30 000 to 75 000 tonnes). The major characteristic of this stock is the dependence of the stock abundance and the fishery on a single very strong year class (1982). Recruitment otherwise has generally been low, although 2001 may be better. The 1982 year class dominated the stock throughout the 1980s and early 1990s, and it is assumed that no major changes will occur unless another large year class appears. The SSB was not estimated in 2004 due to data inadequacy, but has been decreasing since the late 1980s, as the outstanding 1982 year class was depleted.

The northern hake landings are reported to have been at around 90 000 tonnes in the early 60s. In the recent past, landings have generally decreased from 66 500 t in 1989 to 35 000 t in 1998. Since then they have fluctuated around 40 000 t. In the early 80s, Subareas VII and VIII contributed equally to the total landings (around 30 000 t each). While landings from Subarea VII have slightly declined since then (to around 25 000 t), those from Subarea VIII have experienced a stronger decrease (to 10–15 000 t). All information available suggest that discard rates could be high (up to 95%) in some years and area, and for some fleets. The fishery employs a variety of different gears in different areas, including longlines and gillnets. The SSB was estimated at 138 000 tonnes in 2005, just below $\mathbf{B}_{pa}$.

1.2.1.1 Ecosystem impact of fisheries

Sea mammals

Bycatch in fisheries has been acknowledged to be a threat to the conservation of cetaceans in the northeast Atlantic region (CEC, 2003a; Ross and Isaacs, 2004). Cetacean bycatch in the northeast Atlantic, as elsewhere, affects mainly small cetaceans – i.e. dolphins, porpoises, and the smaller toothed whales. Species caught in the region are primarily the harbour porpoise, common dolphin, striped dolphin, Atlantic white-sided dolphin, white-beaked dolphin, bottlenose dolphin, and long-finned pilot whale (CEC, 2002a). However, other larger cetaceans, such as the minke whale, can also be affected.

An extensive review of the bycatch of cetaceans in pelagic trawls was carried out for Greenpeace in 2004 (Ross and Isaacs, 2004). This report considered published and anecdotal information. In the context of the fisheries considered here, the report identified a small number of fisheries where cetacean bycatch could be documented. These were:

- Mackerel and horse mackerel trawling SW of Ireland
- Hake trawling along the shelf edge in Biscay
- Gill netting for hake in the Celtic Sea

In all cases, the number of animals caught was low. The report identified that many countries had initiated cetacean bycatch monitoring programmes, and had generally found little or no evidence that serious bycatch had occurred.

Other interactions between cetaceans as well as other sea mammals undoubtedly occur. Many cetaceans predate on the fish covered in this overview, and may be regarded as competing with the fishery, but there is little or no data on this interaction. Anecdotal reports from observers in the mackerel fishery in the North Sea in the autumn suggest that killer whales associate with this fishery. The whales appear to target the fish discarded after the net is pumped out. The number of whales involved in this interaction is unknown, as is whether this is a subset of the population or whether it is more general.

Salmon

Post-smolt is widely distributed in the areas covered by this overview. There is a potential for bycatch of post-smolt in pelagic fisheries near the surface in the summer season. There is evidence that some post-smolt is caught, in particular in mackerel and horse mackerel fisheries, but the impact of these bycatches on the salmon stocks is still not clear.

Technical interactions between fish species

In general, mackerel and horse mackerel are caught in targeted, single-species fisheries. In the NEA mackerel fishery, particularly in the northern North Sea in quarter 4, there is some bycatch of herring. In the western area, there is relatively little interaction, except between mackerel and horse mackerel themselves. There may be interaction with blue whiting in this area as well, as the species spawn in the same area, but there is no evidence of this. The smaller scale fishery in the Iberian Peninsula has interactions between mackerel and horse mackerel, as well as other pelagic species such as sardine, anchovy, and Spanish mackerel, and possibly some demersal species. This is covered in more detail in the Iberian overview. There may be some technical interactions for mackerel in quarter 3 in the Norwegian Sea, where it may be implicated in the blue whiting fishery, but the scale of this is unclear.

The fisheries for Norwegian spring-spawning herring are largely directed fisheries with purse seine or midwater trawl, with minor interactions with other species.
As detailed by Lucio *et al.* (WD to WGHMM, 2003), the hake fishery is carried out as part of a general fishery on an extensive demersal assemblage including megrim, anglerfish, *Nephrops*, sole, seabass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, *Trachurus spp*, conger, pout, conger, cephalopods (octopus, *Loligidae*, *Ommastrephidae* and cuttlefish), rays, etc. Interaction between hake and other species are less evident for the longline and gillnet fisheries.

1.3 Assessment and Advice regarding Fisheries

The fisheries on the widely distributed stocks are, except for hake, largely taken in single-stock fisheries, and the single-stock exploitation boundaries as presented in Section 4.9 would therefore apply. They are summarised in the table below:

The state of stocks and single-stock exploitation boundaries are summarised in the table below.

Species	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 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	in relation to target reference points	
Hake – Northern stock	Increased risk	Increased risk	Overexploited	Following the agreed management, a fishing mortality of F = 0.25 is expected to lead to an SSB of 153 000 t in 2007 with estimated landings in 2006 of **44 000 t**. This implies a change in SSB of +5%.	The fishing mortality should be below $\mathbf{F}_{pa}$ and SSB should be above $\mathbf{B}_{pa}$. This is equivalent to the recovery plan. A fishing mortality of F = 0.25 is expected to lead to an SSB of around 153 000 t in 2007 with estimated landings in 2006 of 44 000 t. This implies a change in SSB of +5% and in TAC of 3%.	The current fishing mortality, estimated at 0.24, is above fishing mortalities that are expected to lead to high long-term yields and low risk of stock depletion ($\mathbf{F}_{0.1}$ = 0.10 and $\mathbf{F}_{max}$ = 0.17). This indicates that long-term yield is expected to increase at fishing mortalities well below the historic values. Fishing at such a lower mortality is expected to lead to higher SSB and therefore lower the risk of observing the stock outside precautionary limits.	44 000 t
Mackerel	Uncertain	Harvested unsustainably	Overexploited	The agreed management plan (F between 0.15 and 0.20) would, assuming catches in the range of 433 000 t in 2005, imply landings between 373 000 t and 487 000 t in 2006 with an expected increase in SSB of 5–10% in 2007 compared to 2005.	None	none	373 000 t to 487 000 t
Western Horse Mackerel	Uncertain	Uncertain	Uncertain	No agreed management plan	None	ICES recommends that catches of horse mackerel in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa-c,e-k, and VIIIa-e be limited to less than 150 000 t. Note that Division VIIIc is now part of the stock definition.	150 000 t
Blue Whiting	Full reproductive capacity	Harvested unsustainably		Fishing within the limits of the management plan (F=0.32) implies catches of less than 1.5 million t in 2006. This will also result in a high probability that the spawning stock biomass in 2006 will be above $\mathbf{B}_{pa}$. The present fishing	Exploitation boundaries in relation to precautionary limits are the same as the exploitation boundaries in relation to existing management plans.		1 500 000 t

Species	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 2005
	Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to target reference points	In relation to agreed management plan	In relation to precautionary limits	in relation to target reference points	
				level is well above levels defined by the management plan and should be reduced. The management plan point 4 calls for a reduction of the catch of juvenile blue whiting which has not taken place. ICES recommends that measures be taken to protect juveniles.			
Norwegian spring-spawning herring	Full reproductive capacity	Harvested sustainably		The management plan implies maximum catches of 732 000 t in 2006 which is expected to lead to a spawning stock of 7.7 million tonnes in 2007.	The current long-term management plan is considered to be precautionary.	The target defined in the management plan is consistent with high-term yield and have a low risk of depletion production potential.	732 000 t
Northeast Atlantic 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.
Northeast Atlantic porbeagle	Unknown	Unknown	Unknown				No fishery
Northeast Atlantic basking shark	Unknown	Unknown	Unknown				Zero TAC.

1.3.1 ICES advice for fishery management

For the blue whiting combined stock (Subareas I-IX, XII, and XIV): ICES recommends that fishing within the limits of the management plan (F=0.32) implies catches of less than 1.5 million t in 2006. This will also result in a high probability that the spawning stock biomass in 2006 will be above B_{pa}. The present fishing level is well above levels defined by the management plan and should be reduced.

For Norwegian spring-spawning herring: ICES advises that this fishery should be managed according to the agreed management plan with a fishing mortality of no more than F=0.125, implying maximum catches of 732 000 t in 2006. This is expected to lead to a spawning stock of 7.7 million tonnes in 2007.

For NEA mackerel, ICES advises following the agreed management plan (F between 0.15 and 0.20) which would imply landings between 373 000 t and 487 000 t in 2006 with an expected increase in SSB of 5-10% in 2007 compared to 2005 (assuming catches of the order of 433 000 t in 2005).

For western horse mackerel, ICES has advised that in the absence of a strong year class sustainable yield is unlikely to be higher than 130 000 t for the traditional stock areas. This corresponds to catches less than 150 000 t in the revised stock area (i.e. 130 000 t for the traditional stock area, plus 20 000 t for the inclusion of Division VIIIc in the stock definition). Accordingly, ICES recommends that catches of horse mackerel in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa-c,e-k, and VIIIa-e be limited to less than 150 000 t.

For northern hake, following the agreed recovery plan, a fishing mortality of F = 0.25 is expected to lead to an SSB of around 153 000 t in 2007, with estimated landings in 2006 of 44 000 t. This implies a change in SSB of +5%.

For spurdog: The stock is depleted and may be in danger of collapse. 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.

For Northeast Atlantic porbeagle and Northeast Atlantic basking shark, ICES advises that given the apparent depleted state of these stocks, no fishery should be permitted on these stocks.

Regulations in force and their effects

In 2002 the EU, Faroe Islands, Iceland, and Norway agreed a long-term management plan for the fisheries of the blue whiting stock aimed at constraining the harvest within safe biological limits and designed to provide for sustainable fisheries and a greater potential yield. The management plan as a whole has not been implemented, because it has not been agreed between all countries participating in the fishery. The combined total of the catches exceeds the provisions of the agreed management plans.

For the Norwegian spring-spawning herring, there was no agreement between the Coastal States (European Union, Faroe Islands, Iceland, Norway, and Russia) regarding the allocation of the quota for 2005. The Norwegians increased their quota by 14%, as did the Icelanders and the Faroese. The sum of the total revised national quotas for 2005 amounts to about 1 million tonnes.

For NEA mackerel, Division IVa is closed to mackerel fishing from the 14th of February until late summer to protect the North Sea component. Management has aimed at a fishing mortality in the range of 0.15–0.2 since 1998. The fishing mortality realised since then has been in the range of 0.25 to 0.35.

For the western horse mackerel, the distributional range of this stock increased when the exceptional 1982 year class entered the fishery. This resulted in the development of unregulated fisheries outside the TAC area in the Northern North Sea. Catches outside the area covered by a TAC have been reduced in recent years. At present, the TAC for the Western areas includes Division Vb (EU waters only), Subareas VI and VII, and Divisions VIIIa,b,d,e. A separate TAC includes EU waters in Division IIa and Subarea IV. ICES allocates horse mackerel to the Western stock which is taken in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIe–k, and VIIIa-e.

For northern hake, the minimum legal sizes for fish caught in Subareas IV, VI, VII, and VIII is set at 27 cm total length (30 cm in Division IIIa). From 14th of June 2001, an Emergency Plan was implemented by the European Commission for the recovery of the Northern hake stock (Council Regulations Nos. 1162/2001, 2602/2001, and 494/2002). In addition to a TAC reduction, 2 technical measures were implemented. A 100-mm minimum mesh size has been implemented for otter-trawlers when hake comprises more than 20% of the total amount of marine organisms retained onboard. This measure did not apply to vessels less than 12 m in length and which return to port within 24 hours of their most recent departure. Furthermore, two areas have been defined, one in Subarea VII and the other in Subarea VIII, where a 100-mm minimum mesh size is required for all otter-trawlers, whatever the amount of hake caught.

ICES has not been able to quantify the likely impact of the changes in mesh size. However, since hake is a late maturing fish, any improvement in the selection pattern that reduces the catch of younger fish is only expected to increase SSB in the medium term.

There are explicit management objectives for this stock under the EC Reg. No. 811/2004 implementing measures for the recovery of the northern hake stock. The aim is to increase the quantities of mature fish to values equal to or greater than 140 000 t. This is to be achieved by limiting fishing mortality to 0.25 and by allowing a maximum change in TAC between years of 15%. The TAC for northern hake has not appeared to be effective in controlling landings.

Council Regulation (EC) No. 1954/2003 established measures for the management of fishing effort in a 'biologically sensitive area' in areas VIIb, VIIj, VIIg, and VIIh. Effort exerted within the 'biologically sensitive area' by the vessels of each EU Member State may not exceed their average annual effort (calculated over the period 1998–2002).

Quality of assessments and uncertainties

For blue whiting, conflicting signals in the catch and survey data influence the models in ways that could not be resolved. The assessment of blue whiting has been very uncertain in recent years with upward revisions of the historic perception of the stock size with every new assessment. This trend has been driven by exceptionally good recruitment compared to the earlier period, while at the same time little fishery-independent information has been available on the recruitment. However, the quality of the assessment and recruitment estimates have been improved in this year, mostly due to a longer recruitment survey time-series, which could be used for the first time this year.

For Norwegian spring-spawning herring there has been a tendency to overestimate the spawning stock historically. The standard deviation of the spawning stock, derived from bootstrap replicates, has increased considerably from last year. The distribution is also more skewed than last year. However, there is an overall high consistency between the current assessment and that of last year.

For NEA mackerel, due to the lack of fishery-independent data and the absence of age-disaggregated information for the spawning stock index, the results of this assessment are uncertain. In recent years, there has been a tendency to overestimate the SSB and to underestimate fishing mortality. There is a broad perception that there are substantial undeclared landings in this fishery. The assessment is strongly dependent on the catch information, both recently and in the past. Managers are encouraged to obtain reliable catch information.

For western horse mackerel, no fishery-independent estimates of SSB or recruitment are currently available. Therefore, it is not possible to determine the absolute level of SSB, recruitment, and fishing mortality. Accordingly, only relative trends in these quantities have been derived.

For northern hake, several sources of uncertainties remain for this stock. This concerns mainly growth, discards estimation, and CPUE indices in the earlier years. The CPUE series and surveys do not cover the whole area. There is a lack of reliable recruitment indices for this stock, which has implications for the quality of short-term forecasts. Northern hake is a wide ranging stock where the stock definition is considered to be problematic. There are concerns about the accuracy of aging data and the calculation of historic catch-at-age data.

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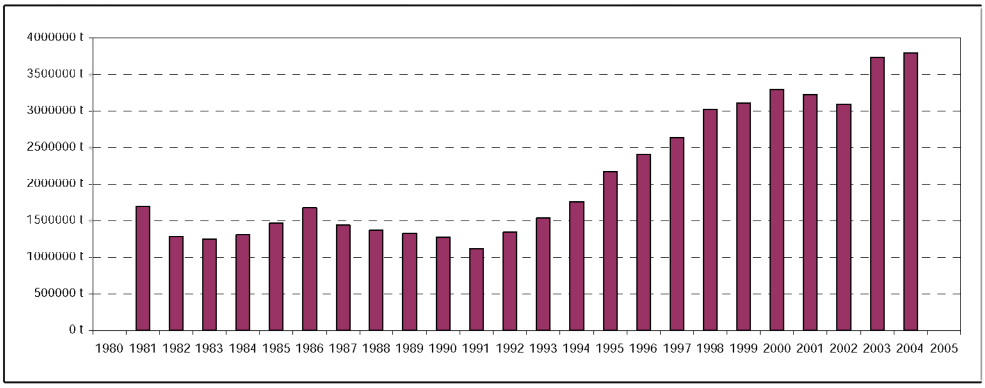
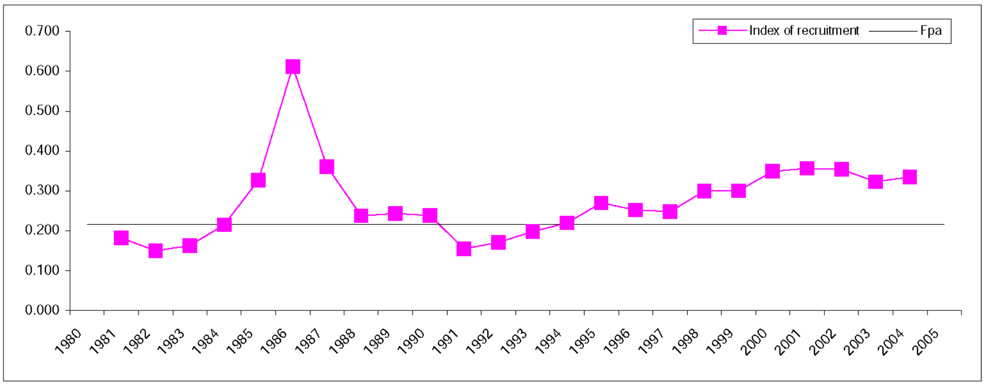
Highly Migratory Small Pelagics - Overview

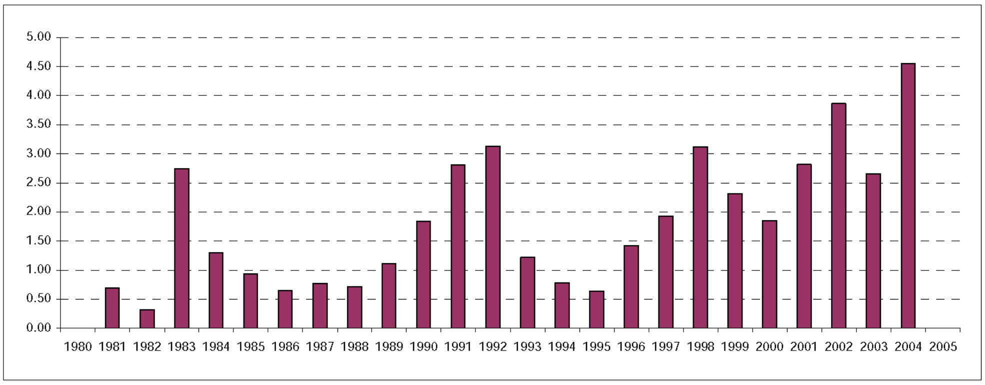
Landings (mackerel, blue whiting and Norwegian herring)



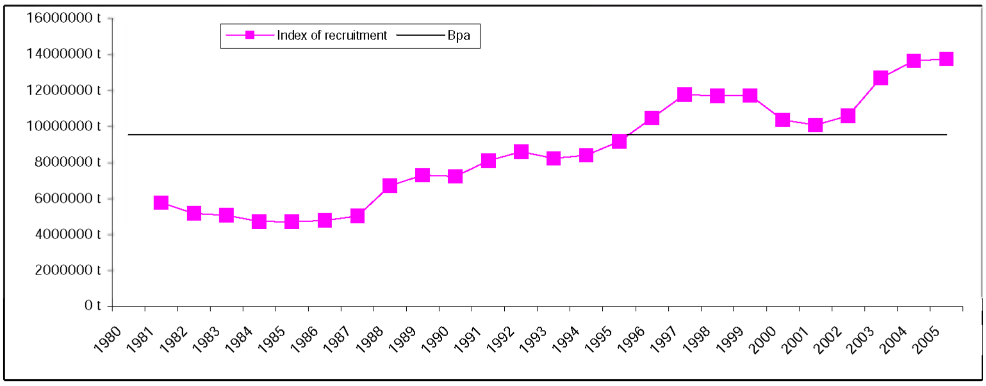
Mean F (weighted by average stock size)



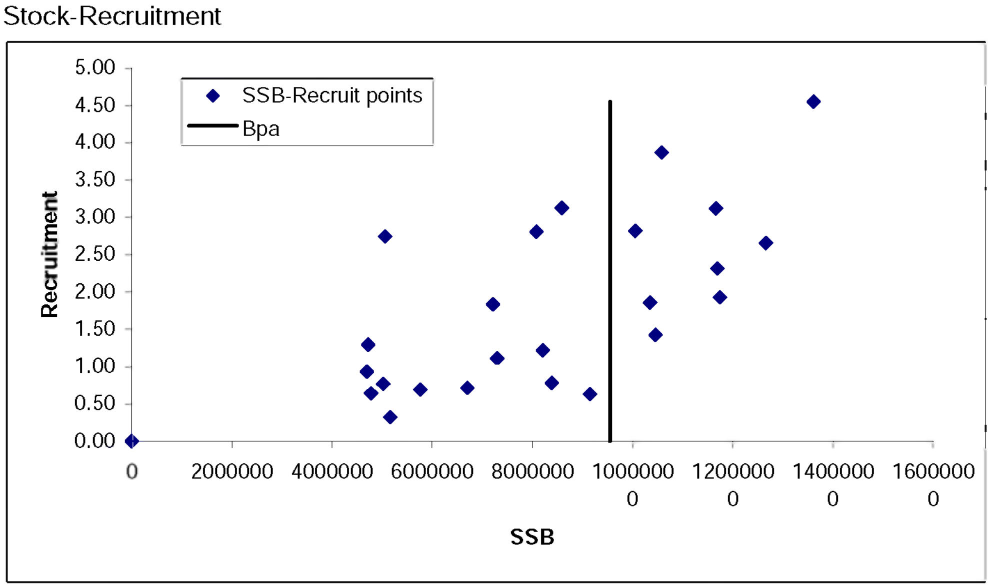
Index of recruitment

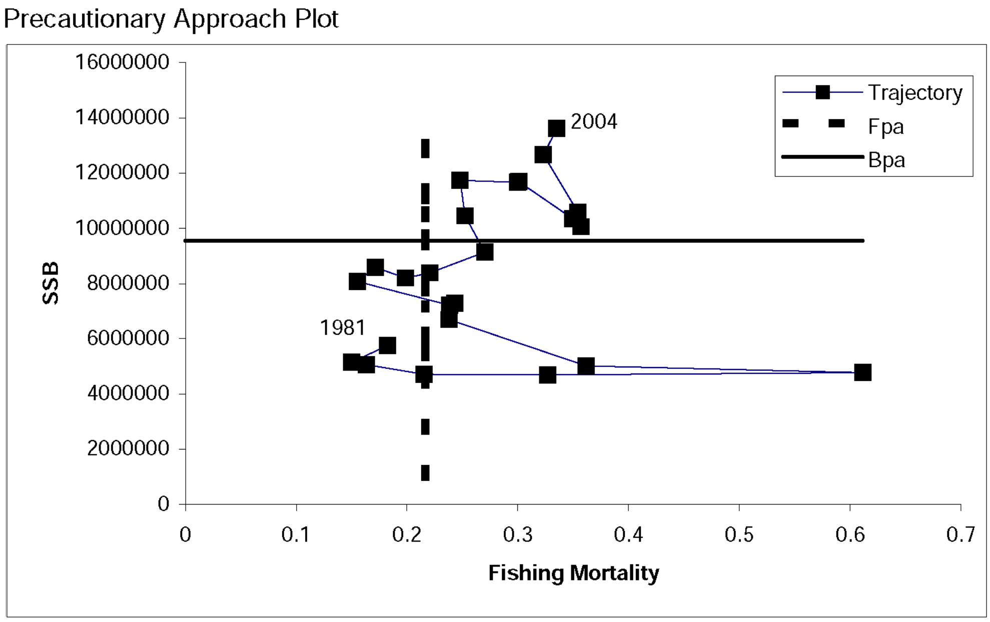


SSB



Stock-Recruitment plot for the highly migratory small pelagics (taken together) and corresponding precautionary approach plots.

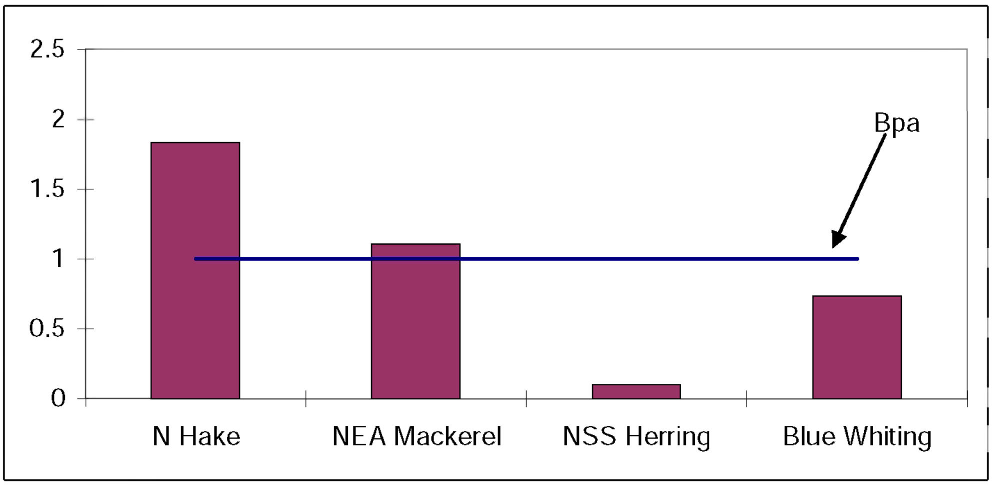




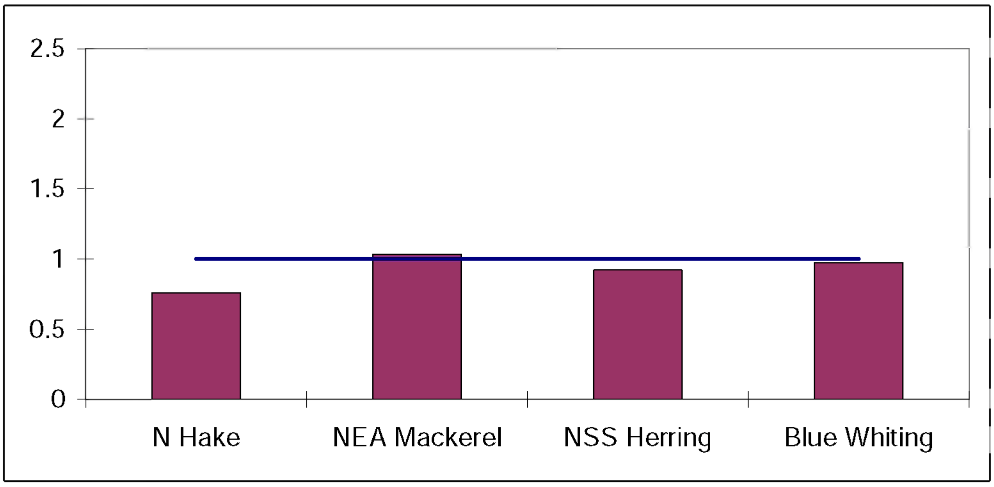
Includes NEA mackerel, Norwegian Spring Spawning herring and blue whiting.

Stock Spawning Biomass in relation to Bpa (normalized to unity) for widely distributed and migratory stocks.

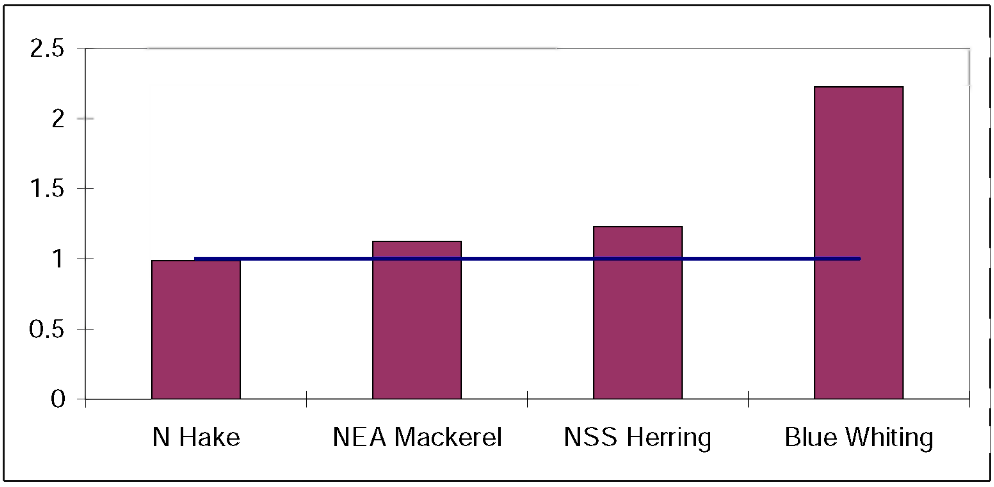
1985



1995



2005



1.3.2 Special Requests

1.3.2.1 Answer to Special request on Restocking of European Eel

The European Commission has requested ICES to:

> *Evaluate whether sufficient glass eel can be captured in areas of abundance and used for restocking in order to allow the 40% objective to be met in all European river basins.*
>
> *For the purpose of answering this question it should be assumed that it is an objective to make use of the productive potential of European river systems such that escapement of silver eel reaches 40% of the escapement that would occur in the absence of fishing, pollution and artificial river obstructions (=40% "relative escapement").*

ICES comments

The European eel stock has rapidly declined over the last 25 years. Catch data suggest that recruitment, as indicated by catch rates of glass eels has reduced by at least one order of magnitude (Figure 1). All available information indicates that the recruitment to the continental life phase has been very low since about 1980 (Figure 2), and the stock continues to decline as older fish disappear from the stock.

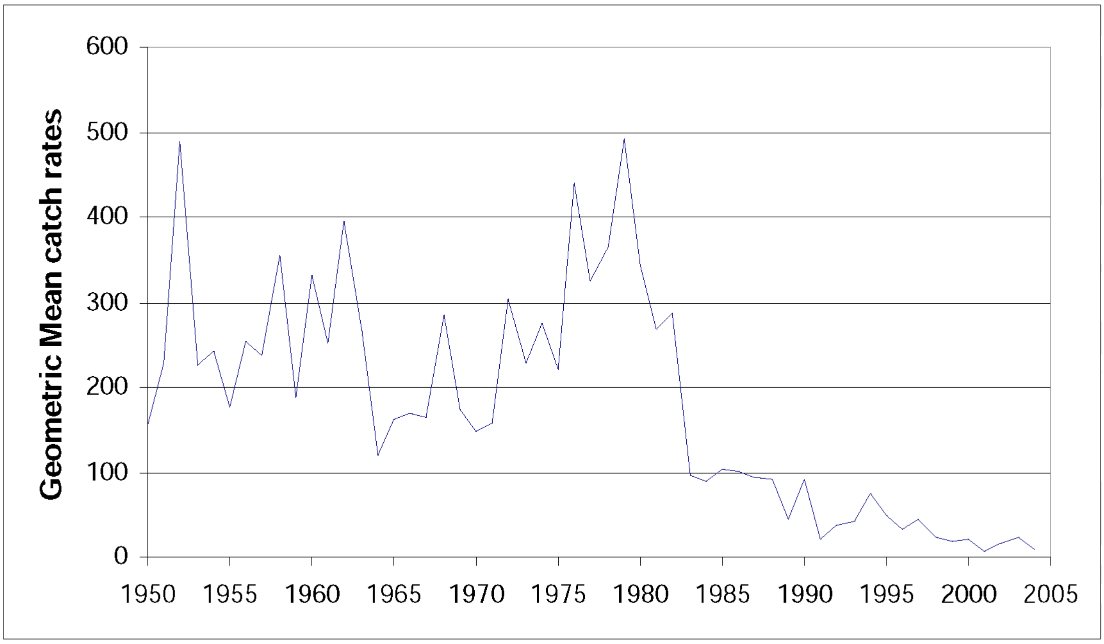


Figure 1 Time-series of glass eel monitoring in Europe. The line indicates the geometric mean of the series from Loire (F), Ems (D), and DenOever (NL), which are the longest and most consistent time-series. Each series has been scaled to the 1979–1994 average.

The eel stock is almost certainly below what would be considered as safe biological limits and the current fishery is unsustainable. The recruitment has been extremely poor for about 25 years and reached a historical minimum in 2001. The decline took place when landings from the continental stock, which are taken as being approximately proportional to the spawning stock biomass dropped below approximately 2500 tonnes around 1985 (Figure 2). It seems likely that a spawning stock above that size is needed to restore normal recruitment. It is unclear what the rebuilding target of 40% relative escapement represents in terms of measurable quantities, but is likely that this may be lower than the critical biomass of 2500 tonnes.

Actions that would lead to a recovery of the stock are urgently required. ICES (1998–2002) recommended that an international recovery plan be urgently developed, and that exploitation and other anthropogenic impacts are reduced to as close to zero as possible, until such a plan is agreed upon and implemented.

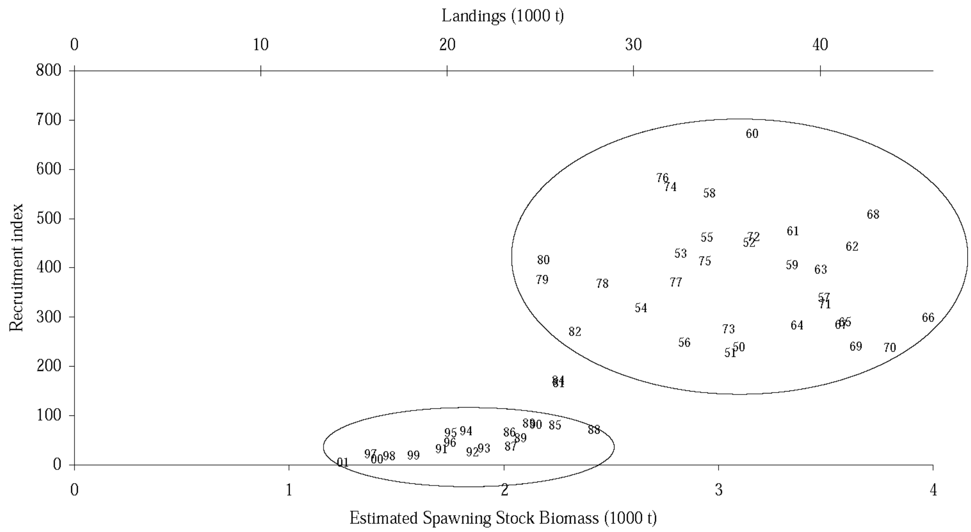


Figure 2 Stock-recruitment relationship for the European eel. Numbers indicate the year of recruitment. The spawning stock is assumed proportional to the landings from the continental stock.

The current request specifically addresses restocking as a measure to help recovery of the stock. Restocking has been practised by some countries for decades, but this has generally been to maintain fisheries rather than improve the stock or recruitment. Since artificial reproduction is currently not possible for eel, all aquaculture and restocking has to be based on capture of glass eels. There is some concern over the risk of moving fish between rivers, e.g. with respect to disease and to potential loss of genetic diversity. It is not clear how severe these risks are for eel in particular, but given the very severe recruitment failure, the risk is probably lower than the potential benefit. Furthermore, it is an essential precondition that demonstrable surplus exists in the local glass-eel stock exploited for the restocking. It should be noted that there is no actual evidence that restocking is functional in improving the SSB or recruitment. The possibility exists that subsequent mortality of restocked eels may significantly reduce any benefits, and that restocked fish may simply return to the rivers from which they originated.

It is not known to what extent this stock decline is due to the fishery and how much is due to environmental conditions. Restocking may be beneficial to rebuilding the stock, although this is unproven and may carry risks, but is not sufficient alone. Only a combination of several measures can be expected to bring the stock out of its current critical state. Such measures include cessation of fisheries, prevention of other anthropogenic mortality (e.g. pollution, mortality in turbines) and restoration of habitats.

Conventional re-stocking rates have been in the order of 100–300 glass eels per ha annually (0.03–0.1 kg/ha). The surface area of available habitats in Europe is estimated at $5–10*10^6$ ha. Accordingly, the amount of glass eel required for restocking would be in the range of 150–1000 tonnes. The current glass eel catches are believed to be about 100 tonnes. Hence, it is unlikely that sufficient glass eel can be captured in areas of abundance and used for restocking.

Even restocking in the order indicated above is highly unlikely to achieve the 40% objective in all European river basins in the medium term, i.e. at least one eel generation time (5–15 years) is required before recovery may be seen.

1.3.2.2 Assessment methods most appropriate for the assessment of Norwegian spring-spawning herring and blue whiting stocks

NEAFC proposed in a letter to ICES dated 17 November 2004 that for

> ***Blue whiting, Atlanto-Scandian herring and mackerel***
> *ICES to arrange a meeting of a special scientific group in 2005 to continue consideration of stock assessment methods most appropriate for Atlanto-Scandian herring and blue whiting stocks*

ICES commented on this proposal in a letter to NEAFC dated 2 March 2005:

> *The Chair of the Working Group on Northern Pelagic and Blue Whiting stocks (WGNPBW) does not finds it useful to hold an extra meeting this year. There is ongoing Norwegian and Russian work on this issue and instead of a special meeting; it is proposed to deal with the results of the ongoing work at the WGNPBW meeting this spring.*

For several years the Norwegian spring-spawning herring and blue whiting stocks have been assessed by different models. In the case of herring two models (SeaStar and ISVPA) were used, while four models (AMCI, ICA, ISVPA, and SMS) have been used for blue whiting. The models produced results which often differed substantially and it is not clear which model is most appropriate for assessment and management of a given stock. ICES has attempted to resolve the controversy by convening special groups to deal with the problem. A short summary of the conclusions is:

In 2003 the **Working Group on Methods in Fish Stock Assessment** compared the performance of three models (AMCI, ICA, and ISVPA) used for assessment of blue whiting and concluded that:

- Conflicting sources of information appear to present the main problem in the blue whiting assessment. The conflict in the data sources is handled differently by the methods that have been applied to this stock;
- There are indications of changes in the exploitation pattern of the most recent (strong) year classes.... it could seriously affect models that assume a fixed selection pattern over a longer period of time.

For more details see Report of the Working Group on Methods of Fish Stock Assessments in 2003 (ICES CM 2003/D:02, Section 8). See also response to a request from Faroe Islands, Greenland, Iceland, Norway, and Russia, *ICES Cooperative Research Report* No. 261, 2003, Section 3.12.5.d.

In 2004 a **Study Group on Assessment Methods Applicable to Assessment of Norwegian Spring-Spawning Herring and Blue Whiting Stocks** continued the Methods Working Group's work on assessment models for both stocks. This Group concluded that:

- noisy input data sources should be identified and not used in assessment as they may be in conflict with data sources from which consistent signals seem to be emerging;
- short time series should not be used for tuning the models;
- consistent biases in estimated F, SSB, or recruitment derived from AMCI, ISVPA, or SeaStar models were not detected, at least not to the degree of some of the differences amongst assessment outcomes;
- additional simulation testing would be necessary to isolate conflict in the data sets that is the likely source of discrepancies in model results. These simulations would entail more sophisticated and realistic tuning data series with noise and correlation. Such simulations are not trivial and would require considerable forethought.

For more details see Report of the Study Group on Assessment Methods Applicable to Assessment of Norwegian Spring-Spawning Herring and Blue Whiting Stocks in 2004 (ICES CM 2004/ ACFM:14).

Both studies concluded that the main problem for the assessments is conflicting information in the data from different sources. Because data weighting differs between the models, one model will produce results giving more weight to results from abundance surveys than would another model. Two lines of action were recommended:

1. Establishing more consistent survey data by better coordination of national surveys;
2. Development of a more consistent assessment methodology for these stocks that incorporates a flexible, transparent, and well-supported software and computational engine.

Concerning the first point: better coordination of surveys is now well under way in the ICES Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys [PGNAPES].

Concerning the second point: Norway and Russia have agreed bilaterally to develop new assessment software to ameliorate the weaknesses pointed out in the previous studies. The design of this software was outlined at a meeting between Russian and Norwegian scientists in April 2005. Writing the code will probably start early in 2006, and a preliminary version may be ready for presentation to the Northern Pelagic and Blue Whiting WG already in 2006. Even though the development of this software is planned as a joint Russian-Norwegian enterprise, ICES will overview the process (primarily through the Working Group on Northern Pelagic and Blue Whiting), and will evaluate the product in due time.

On this background, ICES concludes that there is not an urgent need for the proposed meeting, and ICES finds it more practical to return to this matter as the ongoing scientific work has progressed further.

1.3.2.3 Change in the perception of the NEA mackerel in 2004 ICES advice

NEAFC and Norway have both requested that ICES provides background information pertaining to the NEA mackerel assessment and to the change in the perception of the size of this stock that took place between the 2003 and 2004 assessment.

Assessment of the NEA mackerel stock

In this section ICES presents an analysis of the NEA mackerel assessment methodology and of the changes that were introduced in 2004.

Any assessment method is a tool to convert information from the data into stock abundances and mortalities. Most of the information contained in the data only relates to relative measures, like mortality rates, relative year-class strengths, etc. In order to obtain results in absolute numbers, information is also needed that can scale the stock abundance to absolute levels. Normally, this information comes from the absolute magnitude of the catches. The NEA mackerel assessment is based on catch data and egg surveys and in this case the egg surveys offer a possibility for scaling the stock size to the spawning stock biomass that can be estimated by these surveys. Acoustic and aerial surveys, as well as tag-recapture studies provide supplementary information. This information provide less accurate stock estimates than the egg survey and catch data and is for the time being used only to confirm estimates by the analytic assessment.

The basis for the NEA Mackerel assessment was changed between 2003 and 2004 because of a change in the interpretation of the egg survey results. The egg surveys, which are carried out every three years, are generally considered to be of high quality, and much effort has been spent making them as reliable measurements of the spawning stock biomass in absolute terms as possible. The coverage is in general considered to be good, but there are in each survey some areas and periods that are not adequately covered, for a variety of reasons.

Observed egg densities are raised to total spawning biomass through calculations which include assumptions about spawner fecundity, its relation to spawner size and egg development rates, and egg mortality. There are problems with knowing the precise value of these parameters and it has been argued that the egg survey results should not be interpreted as estimates of absolute value of spawning stock biomass (SSB) but rather used as relative indices of the SSB.

In the 2004 and 2005 assessments the egg survey results are treated as relative SSB indices. There are various reasons why this may be the better assessment strategy:

- Taking the egg survey estimates as absolute measures of the spawning stock biomass leads to a potential conflict between two sources of information about stock abundance in absolute terms. In practice, the information from the catches will dominate the abundance estimates in the past while the information from the most recent egg surveys will dominate the abundance estimate for the present. The fishing mortalities in the recent period will be biased if the two sources are in conflict;

- Taking the egg survey estimate as relative removes that conflict by relying on the catch data as the only source of information about absolute levels. Hence, the estimates of abundance, and accordingly, the predicted catches for the future, are scaled to the catches as they are reported. The fishing mortality is more correctly estimated by taking the egg survey estimates as relative.

A change from using the egg surveys as absolute SSB estimates to using them as relative estimates is equivalent to using the catch data only for providing the absolute level of the population. The NEA mackerel catch data indicate spawning stock biomasses lower than those measured by the egg surveys.

The quality of the catch data, egg survey data quality, and the interpretation of the egg surveys in particular, have been extensively considered by the ICES. The conclusions from these studies can be summarised as follows:

- There are strong indications that catches are underreported, both in the past and at present. However, the extent of this underreporting is poorly known; it is possible to calculate a theoretical non-reported removal based on the egg survey SSB estimates. This calculation suggests an unaccounted removal of about 30% of the reported catch;

- The egg survey indicates a higher SSB than do the catches. There is a clear conflict in the estimated SSB obtained from the egg surveys and from the catch data;

- The egg surveys indicate a downward trend in the stock abundance in the last 10–15 years. This trend is preserved in the assessment when using the egg survey estimates as relative, but is lost if the egg survey estimates are used as absolute. ICES considers it important that the assessment reflects this trend;

- The estimate of fishing mortality using the egg surveys as absolute SSB is biased for the most recent years, while using the egg surveys as relative indices better provides unbiased fishing mortality estimates.

In summary: Using catch data and relative survey indices was the option that ICES considered to best serve the purpose for advice because:

- it reproduces observed trends in stock abundance;
- it provides unbiased fishing mortalities;
- the problem that two conflicting sources of information determine different parts of the history of the stock development is avoided;
- This makes the assessment results compatible to the reported catches and the advice matches reported catches. Non-accounted removals are held outside the calculations.

ICES has conducted a number of studies on whether the egg survey estimate is reliable or not. Rather than indicating that the egg survey overestimates the SSB the opposite is the case. The conclusions from these studies are:

- The SSB survey estimate is likely underestimated, perhaps by as much as 60%. This is mostly because the egg production estimate is not adjusted for mortality of the eggs during the first day after spawning, and because the egg development may be faster than assumed in some areas;
- If the underestimate by the egg surveys is taken into account, the unaccounted removal would be even higher. If this removal is solely due to underreporting in the fisheries, the real catch may be more than double the reported catch;
- The discrepancy might be explained by a higher natural mortality than assumed, but such a high natural mortality is incompatible with the long life span of mackerel.

Hence, the main problem in the mackerel assessment appears to be the unknown, but probably substantial underreporting of the actual removal by the fishery, and how this underreporting varies over time.

The use of survey data as relative indices requires that a time-series is available. Typically, science standards require a minimum of 5 surveys, and therefore it would take about 15 years to build a time-series. The egg surveys only covered the entire spawning area from 1992 onwards and it was only when the 2004 estimate became available that using the data as relative would meet minimum science standards. There are earlier egg surveys covering only part of the spawning area; linking these to the present time series represents a different set of problems.

The options open to ICES were therefore, 1) to solve the problem of extrapolating former surveys to the entire spawning area, 2) to wait until a time-series would become available, or 3) to attempt an estimate of the SSB in absolute terms. If it is possible to provide an absolute estimate of SSB, the information content that one would get out of the survey is higher than if the data can only be used as relative. Extrapolating the pre-1992 surveys to the entire spawning area was attempted but could not be done accurately. Both because the data could not be used as relative as the data series was too short and because one should always get the most information out of the data – which are very costly – ICES decided in previous years to provide an absolute estimate of SSB as an interim approach.

The conflict between the survey SSB estimate and the SSB indicated from the catch data only became apparent after the third or fourth survey and the question to ICES was therefore whether the information on the conflicts was sufficient to revise the basis for the assessment. Studies were done at the time to confirm that the estimate of absolute abundance was as good as could be done with the information available. ICES discussed this internally and only in 2004 ICES decided that the use of the survey data as "indices" was to be preferred.

A change from using the egg surveys as absolute SSB estimates to using them as relative estimates is equivalent to placing all emphasis on the catch data for providing the absolute level of the population. As discussed above, the catch data are also questionable.

Answers to questions from the Mackerel Fishing Industry

Mr R. A. Banning, on behalf of The Northern Pelagic Working Group of EAPO, the Norwegian pelagic industry, and the Faroese pelagic industry raised a number of questions in a letter, dated June 20th 2005, which covers and expands the NEAFC and Norwegian requests for information. The structure of this letter is used in the response.

Mr Banning asked ICES to clarify:

i. *Why the dramatic change in assessment of NEA mackerel now [2004] when as the industry understands the ICES mackerel Working Group did not advocate such a change?*

ii. *Was the change in assessment due to the new system of peer review process adopted by ICES?*

iii. *Why did ICES choose not to use the relative estimate in 1997 using instead the absolute estimate? Using the relative estimate at that time would have yielded catches far higher than adopted.*

iv. *What is the likelihood of a different peer review group adopting a different approach?*

v. *What account if any did ICES take of the affect this huge change in the assessment would have on the viability of the pelagic industry? Even if a reduction was required (which the industry disputes) surely ICES could have recommended that it be done over a number of years?*

vi. *In light of the new perception of the stock development should the current precautionary reference points be revised?*

vii. *How does ICES take on board in its' assessment the industry's information and perceptions of the state of the NEA mackerel stock?*

NEAFC also proposed in the letter of 17th November 2004

to consider present NEA mackerel stock assessment methodology from the point of view of egg survey data quality.

The questions raise issues both concerning the ICES advisory process and on the substance of the ICES assessment of NEA mackerel.

The last question (vii) is discussed in the context of improving the research, see section below.

__ICES Comments__

Basis for ICES Advice

v. *What account if any did ICES take of the affect this huge change in the assessment would have on the viability of the pelagic industry? Even if a reduction was required (which the industry disputes) surely ICES could have recommended that it be done over a number of years?*

The basis for the ICES advice on fishery management is the status of the stocks. ICES is a biological science network that provides information and advice based on perception of the status of the fish stocks. Management decisions are the responsibility of managers, and decisions are taken based on an overall consideration of the biological advice and expected effects on the industry, its economy, and the social system. Evaluation of effects in non-biological areas is outside ICES competence; ICES is confined to evaluating the present and the future status of the fish stocks and the ecosystem. ICES takes great care of the accuracy of the assessments on which its advice is based. Therefore, ICES passes the assessments through a three-tier system: assessment, review, and advice formulation.

ICES is advocating the introduction of long-term management plans and is contributing to the development of such plans. In such plans balancing objectives should be addressed and this balancing is to be decided in a dialogue involving industry, management, and science. In ICES perspective, it is through the implementation of such plans that concerns such as those you express in your point (v) must be addressed.

It should be clear from the above that ICES without input from management cannot recommend a gradual decrease based on industry concerns. Management bodies can decide that the effects of what has been called "a seismic change in management" are too harsh on the industry and on the social system and hence prefer to implement this gradually or not at all. ICES will on request evaluate the expected effects on the fish stocks from such gradual decreases. This can be done either through a direct question or through a more generic approach such as a management plan which is within the Precautionary Approach used by ICES as its basis for advice. Where managers have asked for options regarding phased rebuilding, ICES have supplied such calculations. However, ICES cannot pre-empt managers' wishes. ICES has in the past (e.g. in the 1980s) recommended gradual decreases after dialogue with management.

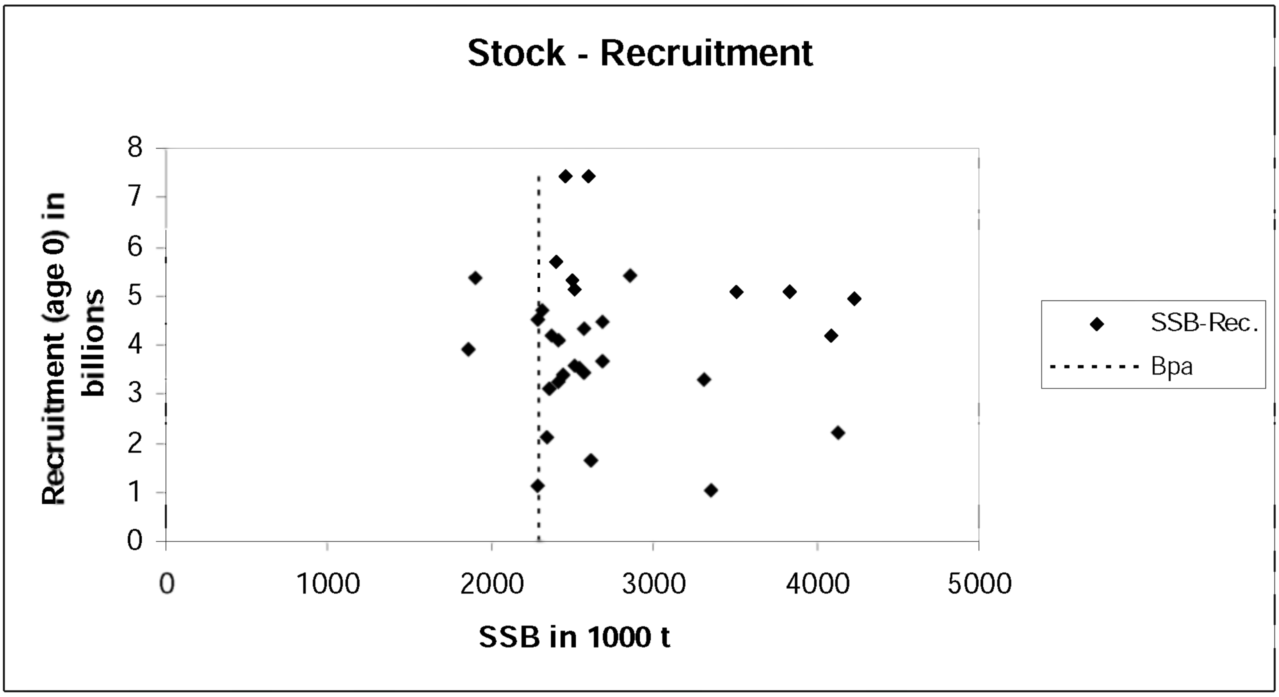
Specific questions on the assessment procedure

There were two specific questions raised concerning the assessment procedure:

iii. *Why did ICES choose not to use the relative estimate in 1997 using instead the absolute estimate? Using the relative estimate at that time would have yielded catches far higher than adopted.*

As explained above the time-series for the surveys with full area coverage was too short to allow a reliable time-series analysis. Extrapolating the earlier surveys to the entire spawning area would have provided an uncertain assessment.

vi. *In light of the new perception of the stock development should the current precautionary reference points be revised?*



Using the graph above from the 2004 ICES Advisory report it is clear that $\mathbf{B}_{lim}$ is undefined, and the Advisory report also concludes **"There is no biological basis for defining $\mathbf{B}_{lim}$." $\mathbf{B}_{pa}$** is defined through a proxy **"$\mathbf{B}_{pa}$** = **$\mathbf{B}_{loss}$** in Western stock raised by 15%: = 2.3 million t.", and on this basis the **$\mathbf{B}_{pa}$** = 2.3 mill tonnes still seems valid within the framework of the current assessment.

The Coastal States Agreement stipulates that TACs can generate a range of fishing mortalities from F 0.15 to F 0.2, while $\mathbf{F}_{pa}$ is 0.17. The historical development of the stock based on the new assessment shows that F has been above $\mathbf{F}_{pa}$ nearly every year since 1974. The $\mathbf{F}_{pa}$ is not set to lead to $\mathbf{B}_{pa}$, but rather to avoid $\mathbf{B}_{pa}$ despite fluctuations in recruitment. The egg surveys indicate a downward trend in the stock abundance in the last 10–15 years so that it at present has reached the lowest level ever observed for this stock. Hence, the fishing mortality seen historically has been above the agreed range and has not been sustainable. ICES considers that fishing mortality should be set around $\mathbf{F}_{pa}$ and there is thus no need to revise the F range defined in the Coastal States Agreement.

Nevertheless, it is good practice to review reference points as the assessment methodology matures to ensure internal consistency between reference points and current measures of SSB and exploitation (or fishing mortality). The recent trend within ICES has been, however, to consider those in the context of long-term management strategies, taking into account misreporting, survey uncertainties, etc.

ICES assessment and advisory procedure

Concerning the internal ICES procedure Mr Banning raises three questions:

- *i.* *Why the dramatic change in assessment of NEA mackerel now when as the industry understands the ICES mackerel Working Group did not advocate such a change?*
- *ii.* *Was the change in assessment due to the new system of peer review process adopted by ICES?*
- *iv.* *What is the likelihood of a different peer review group adopting a different approach?*

ICES uses a three-tier system in its advisory process: assessment, review, and advice formulation. The advisory committee (ACFM) works from input made by other groups, quality assured through a review process to provide the best possible basis for its advice. This is standard practise with quality control of scientific products. However, ACFM draws the final conclusion; the advisory committee is responsible for the advice and hence must adopt the basis on which this advice is formulated.

Concerning the mackerel process it is important to understand that the discussion on the mackerel assessment had been ongoing for quite some time and that this discussion was based on numerous analyses.

ACFM carefully considered the arguments both by the Working Group and the reviewers, and concluded that the adopted practice is preferable because it reproduces observed trends in stock abundance that are internally consistent and realistic, because the fishing mortalities are unbiased and because the assessment is scaled by only one source of information. Thus, the problem that two conflicting sources of information determine different parts of the history of the stock development is avoided.

Possible changes to the management objectives

As mentioned above ICES advocates the introduction of long-term management plans where possible. ICES considers that the development of such plans is best done in cooperation and dialogue with managers and stakeholders, and welcomes the initiative that is implicit in Mr Banning's letter.

ICES suggested in 2003 that multi-annual TACs would be appropriate for this stock. Such management strategies would both reduce the dependence of year-to-year noise in the annual assessments and hopefully make the conditions for the industry more stable and predictable. Before such regimes are established, careful consideration of the risks and benefits, taking into account both biological fluctuations in the stock productivity and the opportunities to monitor the stock, is essential. ICES contributes to the development of long-term management strategies, and evaluates proposals for such strategies.

Improving the research

Part of the answer in this section addresses the last question in Mr Banning's letter:

> *vii. How does ICES take on board in its' assessment the industry's information and perceptions of the state of the NEA mackerel stock?*

ICES welcomes a discussion with the industry on improving the science and notes that much of this discussion will be on priority settings. ICES keeps the points mentioned under close scrutiny and regularly reviews if the current approach to assessment is optimal within the existing resources. For aerial and acoustic surveys, for example, there are methodological problems that can be solved, but the present approach with an egg survey and data from the fisheries provides a more cost effective approach to assessment.

ICES considers that cooperation with the industry is of mutual benefit, not the least to identify areas where the industry possesses information that can be scientifically applicable. Information from the industry is usually fairly cheap compared to obtaining data from research vessels or aircrafts. Inputs from the industry is if only for that reason alone very welcome. However, the industry has information that is difficult or impossible to obtain otherwise, e.g. on the quality of the catch and effort data, on changes in fishing strategy (season, grounds), changes in technology, and how these changes are likely to affect the exploitation patterns. Interpretation of time-series, e.g. CPUE data is another area where input from the industry would be highly valuable.

In his letter, Mr Banning identifies topics that should be considered in improving the research and knowledge of the NEA mackerel stock. In the following paragraphs these topics are listed together with ICES comments.

- *i.* *The frequency of the egg survey should be reviewed and the possibility of carrying out the extensive egg survey every two years rather than every three years.*

Egg surveys every second or even each year would be useful. However, such surveys are very demanding both with respect to ship time and use of highly qualified personnel. Therefore, the benefit of more frequent surveys may not be in proportion to what it costs, in particular if this effort is at the expense of other important tasks. The pros and cons of changing the frequency of the egg surveys should be evaluated in terms of reduced risks to conservation and reduced risks to lost opportunities.

ii. *The scientists should evaluate whether or not the daily egg production method could be used based on one survey at peak spawning and covering a known fraction of the SSB.*

Using a Daily Egg Production Method (DEPM) approach for NEA mackerel such as the ones used for sardine and anchovy was evaluated by ICES in the 1990s. A DEPM approach would still have to cover the entire distribution of the stock around the time of peak spawning, and would require more effort for the collection of adult parameters. ICES found that because of the large spawning area, the extended spawning period, and the shift in timing of peak spawning between years, the applied Annual Egg Production Method (AEPM) is preferable. A change in methodology would require substantial initial effort and then a period of time to establish that the indices could be used successfully in the assessment. Pilot studies carried out in 1992 for horse mackerel suggest that variance in the results may also be higher.

iii. *The usefulness of acoustic and aerial surveys should be evaluated by the scientists particularly in the Norwegian Sea and the Northern North Sea.*

ICES is considering these techniques and has in particular in recent years had a mackerel aerial survey and acoustic survey study group. Most of the research effort in these fields has so far been concentrated on methodological problems that have to be solved before such surveys can provide input to assessments. Acoustic surveys are difficult because mackerel does not have a swimbladder and hence the reflected acoustic signal is weak. ICES is aware of technological improvements and is eager to adapt techniques when these become available. Considerable progress has been made, such surveys are being conducted, although only covering limited areas, and the results are used as supplementary supporting information in the assessment. Covering the whole distribution area would be a major exercise, and the benefit needs to be evaluated against the cost. At the moment the accuracy that can be obtained with these techniques are less than what can be achieved using egg surveys.

As methodological problems are overcome, such surveys may become more applicable in routine stock monitoring than they are today.

iv. *Usefulness of young fish survey should be evaluated*

Work is in progress to develop a recruitment index based on international bottom trawl surveys in the winter.

v. *Methods for incorporating the information and knowledge of the industry into the assessment should be devised*

ICES is eager to discuss with the industry how such information can be communicated in a transparent manner. The problem is not how to incorporate the information. Information from the industry to be incorporated in the assessment must stand up to the same scrutiny and transparency as other data items that are used in the assessments.

vi. *Way of improving the assessment model used should be addressed.*

Even though there is always a prospect for improving methods, the most prominent problem for mackerel is sparse and uncertain assessment data, rather than modeling problems. It is questionable whether an improved assessment model would provide more reliable assessments. ICES prefers to allocate resources to deal with the data issues.

vii. *In conjunction with the industry the scientists should address the issue of improving the reliability of the landing data and quantifying the level of discards both current and historical.*

ICES scientists are constantly working on data improvement. However, problems such as non-reporting of landings, mis-reporting of area of catch or of species do occur and the scientists are rather helpless in addressing these problems alone. Discard data, which are obtained from observer sampling onboard vessels, is an example where cooperation works well and where significant additional data have become available in recent years. ICES is eager to continue along these lines.

1.4 Widely Distributed and Migratory Stocks

1.4.1 Hake – Northern Stock (Division IIIa, Subareas IV, VI, and VII, and Divisions VIIIa,b,d)

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 (=0.25)	Comment
Increased risk	Harvested sustainably	Overexploited	F is around agreed target	

Based on the most recent estimates of SSB and fishing mortality ICES classifies the stock as being at risk of reduced reproductive capacity and being harvested sustainably.

After the mid-1980s SSB declined and was at $\mathbf{B}_{lim}$ during most of the 1990s. Thereafter SSB increased and is presently estimated to be just below $\mathbf{B}_{pa}$. Fishing mortality is estimated to have declined in recent years to just below $\mathbf{F}_{pa}$.

Management objectives

There are explicit management objectives for this stock under the EC Reg. No. 811/2004 establishing measures for the recovery of the northern hake stock.

The main Articles of interest adopted by this Regulation are:

"***Article 1. Subject matter.*** *This Regulation establishes a recovery plan for the northern hake stock which inhabits the ICES division III a, ICES subarea IV, ICES divisions V b (Community waters), VI a (Community waters), ICES subarea VII and ICES divisions VIII a, b, d, e (the northern hake stock).*

Article 2. Purpose of the recovery plan. *The recovery plan referred to in Article 1 shall aim to increase the quantities of mature fish of the northern hake stock concerned to values equal to or greater than **140 000** tonnes.*

Article 3. 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 the northern hake stock concerned has been reached, the Council shall decide by qualified majority on a proposal from the Commission to replace the recovery plan by a management plan for the stock in accordance with Article 6 of Regulation (EC) No. 2371/2002.*

Article 4. Setting of TACs. *A TAC shall be set in accordance with Article 5 where, for the northern hake stock concerned the quantities of mature northern hake have been estimated by the STECF, in the light of the most recent report of ICES, to be equal to or above **100 000** tonnes.*

Article 5. Procedure of setting TACs.
1. Each year, the Council shall decide by qualified majority on a proposal from the Commission on a TAC for the following year for the northern hake stock concerned.

*2. For 2004, the TAC shall be set at a level corresponding to a fishing mortality of **0,25**, 4 % less than status quo fishing mortality. For the subsequent years of the recovery plan, the TAC shall not exceed a level of catches which scientific evaluations carried out by the STECF, in the light of the most recent reports of ICES, indicate will correspond to a fishing mortality rate of 0,25.*

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 lead to a decrease in spawning stock biomass in its year of application.

4. Where it is expected that the setting of the TAC for a given year in accordance with paragraph 2 will result in a quantity of mature fish at the end of that year in excess of the target level indicated in Article 2, the Commission will 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 not later than three years following the adoption of this Regulation with the aim of ensuring that the objectives of the recovery plan are achieved.

5. Except for the first year of application of this Regulation, the following rules shall apply:

(a) where the rules provided for in paragraph 2 or 4 would lead to a TAC for a given year 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 rule provided for in paragraph 2 or 4 would lead to a TAC for a given year 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 6. Setting of TACs in exceptional circumstances.** Where the quantities of mature fish of the northern hake stock concerned have been estimated by the STECF, in the light of the most recent report of the ICES, to be less than 100 000 tonnes, the following rules shall apply:*

(a) Article 5 shall apply where its application is expected to result in an increase in the quantities of mature fish of the northern hake stock concerned, at the end of the year of application of the TAC to a quantity equal to or greater than 100 000 tonnes;

(b) where the application of Article 5 is not expected to result in an increase in the quantities of mature fish of the northern hake stock concerned, at the end of the year of application of the TAC, to a quantity equal to or greater than 100 000 tonnes, 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 on Article 5."

ICES has not yet evaluated the current recovery plan in relation to the precautionary approach but intends to carry out an evaluation of possible management approaches before the end of 2006.

Reference points

Precautionary reference points were updated in 2003 following a revision of the assessment model and input data in recent years. The basis for setting reference points remained unchanged.

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 100 000 t	$\mathbf{B}_{pa}$ be set at 140 000 t
	$\mathbf{F}_{lim}$ is 0.35	$\mathbf{F}_{pa}$ be set at 0.25
Target reference points		Not defined

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 2-6	Yield/R	SSB/R
Average last 3 years	0.243	0.284	0.823
$\mathbf{F}_{max}$	0.170	0.292	1.162
$\mathbf{F}_{0.1}$	0.097	0.272	1.784
$\mathbf{F}_{med}$	0.292	0.274	0.674

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:

$\mathbf{B}_{lim}$ = $\mathbf{B}_{loss}$ the lowest observed biomass in the 2003 assessment.	$\mathbf{B}_{pa}$ ~ $\mathbf{B}_{lim}$ * 1.4
$\mathbf{F}_{lim}$ = $\mathbf{F}_{loss}$	$\mathbf{F}_{pa}$ ~ $\mathbf{F}_{lim}$ * 0.72

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Following the agreed recovery plan, a fishing mortality of F = 0.25 is expected to lead to an SSB of around 153 000 t in 2007 with estimated landings in 2006 of 44 000 t. This implies a change in SSB of +5%.

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

The current fishing mortality, estimated at 0.24, is above fishing mortalities that are expected to lead to high long-term yields and low risk of stock depletion ($\mathbf{F}_{0.1}$ = 0.10 and $\mathbf{F}_{max}$ = 0.17). This indicates that long-term yield is expected to increase at fishing mortalities well below the historic values. Fishing at such a lower mortality is expected to lead to higher SSB and therefore lower the risk of observing the stock outside precautionary limits.

Exploitation boundaries in relation to precautionary limits

The fishing mortality should be below $\mathbf{F}_{pa}$ and SSB should be above $\mathbf{B}_{pa}$. This is equivalent to the recovery plan. A fishing mortality of F = 0.25 is expected to lead to an SSB of around 153 000 t in 2007 with estimated landings in 2006 of 44 000 t.

Short-term implications

Outlook for 2006

Basis: $\mathbf{F}_{sq}$ =mean F(02-04)=0.24; R04-05 = GM 1987-2002=196 millions; landings (2005) = 41.3; SSB(2006) = 146. The fishing mortality applied according to the agreed recovery plan (F(recovery plan)) is 0.25. The maximum fishing mortality which would be in accordance with precautionary limits (F (precautionary limits)) is 0.25. 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 0.18.

Rationale	Landings (2006)	Basis	F total (2006)	SSB (2007)	%SSB change [1)]	%TAC change [2)]
Zero catch	0.0	F=0	0.00	208.7	43%	-100%
High long-term yield	31.5	F(long-term yield)	0.17	168.7	16%	-26%
Status quo	5.0	$\mathbf{F}_{sq}$ *0.1	0.02	202.4	39%	-88%
	9.8	$\mathbf{F}_{sq}$ *0.2	0.05	196.2	34%	-77%
	23.3	$\mathbf{F}_{sq}$ *0.5	0.12	179.1	23%	-45%
	33.5	$\mathbf{F}_{sq}$ *0.75	0.18	166.1	14%	-21%
	39.3	$\mathbf{F}_{sq}$ *0.9	0.22	158.8	9%	-8%
	42.9	$\mathbf{F}_{sq}$ *1	0.24	154.2	6%	1%
	46.5	$\mathbf{F}_{sq}$ *1.1	0.27	149.7	3%	9%
	51.6	$\mathbf{F}_{sq}$ *1.25	0.30	143.3	-2%	21%
Agreed management plan	5.1	F(management plan) *0.1	0.03	202.2	38%	-88%
	12.4	F(management plan) *0.25	0.06	192.9	32%	-71%
	23.9	F(management plan) *0.5	0.13	178.4	22%	-44%
	34.3	F(management plan) *0.75	0.19	165.1	13%	-20%
	40.1	F(management plan) *0.9	0.23	157.7	8%	-6%
	43.9	F(management plan) *1	0.25	153.0	5%	3%
	47.5	F(management plan) *1.1	0.28	148.4	2%	11%
	52.7	F(management plan) *1.25	0.31	141.9	-3%	24%
Precautionary limits	5.1	F(prec limits) *0.1	0.03	202.2	38%	-88%
	12.4	F(prec limits) *0.25	0.06	192.9	32%	-71%
	23.9	F(prec limits) *0.5	0.13	178.4	22%	-44%
	34.3	F(prec limits) *0.75	0.19	165.1	13%	-20%
	40.1	F(prec limits) *0.9	0.23	157.7	8%	-6%
	43.9	$\mathbf{F}_{pa} = \mathbf{F}_{sq}$ *1.03	0.25	153.0	5%	3%
	47.5	F(prec limits) *1.1	0.28	148.4	2%	11%
	52.7	F(prec limits) *1.25	0.31	141.9	-3%	24%
	60.7	F(prec limits) *1.5	0.38	131.7	-10%	43%
	68.2	F(prec limits) *1.75	0.44	122.3	-16%	60%
	75.6	F(prec limits) *2	0.50	112.9	-23%	77%
	85.0	F(prec limits) *2.25	0.56	101.0	-31%	100%

All weights in '000 tonnes.
Shaded scenarios are not considered consistent with the Precautionary Approach.
[1)] SSB 2007 relative to SSB 2006.
[2)] Predicted landings 2006 relative to TAC 2005 (42.6 thousand tonnes).

Management considerations

Hake is caught in nearly all fisheries in Subareas VII and VIII and also in some fisheries of Subareas IV and VI.

The Northern hake emergency plan (EC 1162/2001, EC 2602/2001, and EC 494/2002) has been followed up by a recovery plan in 2004 (EC 811/2004). The recovery plan is aimed at achieving a SSB of 140 000 tonnes ($\mathbf{B}_{pa}$). This is to be achieved by limiting fishing mortality to F=0.25 and by allowing a maximum change in TAC between years of 15%. Targeting F well below F=0.25 is expected to increase long-term yield.

The TAC has been overshot considerably in recent years.

The major fleets exploiting Northern hake have shown in the longer term a decrease in nominal fishing effort.

Discards of juvenile hake can be substantial in some areas and fleets. Surveys suggest that juvenile hake may be much more widespread than hitherto assumed. Therefore a general increase in the minimum mesh size is expected to offer more protection of juvenile hake.

Ecosystem considerations

Hake movements have been studied from the seasonal distribution of catches. From the beginning of the year until March/April adult hake are present in the North of the Bay of Biscay. They appear on the shelf edge in the Celtic Sea in June and July. Between August and December a large hake fishery is centred to the west and southwest of Ireland, with a decline in catch rates in shallower waters.

Hake belongs to a diverse community of species including megrim, anglerfish, *Nephrops*, sole, seabass, ling, blue ling, greater forkbeard, tusk, whiting, blue whiting, *Trachurus spp*, conger, pout, cephalopods (octopus, *Loligidae*, *Ommastrephidae*, and cuttlefish), and rays. The relative importance of these species in the hake fishery varies between years depending on gears, sea areas, and biological conditions.

Hake is preyed upon by sharks and other fishes. Cannibalism on juveniles by adults is well known. Adults feed on fish (mainly on blue whiting and other gadoids, sardine, anchovy, and other small pelagic fish); juvenile hake prey mainly upon planktonic crustaceans (above all euphausids, copepods, and amphipods).

Factors affecting the fisheries and the stock

The effects of regulations

The minimum mesh size was increased from 55/65 mm to 70 mm in the Bay of Biscay in 2000.

Since June 2001 an Emergency Plan was implemented for the Northern hake stock (Council Regulations N°1162/2001, 2602/2001, and 494/2002). Firstly, a 100-mm minimum mesh size has been implemented for otter-trawlers when hake comprises more than 20% of the total amount of marine organisms retained onboard. This measure did not apply to vessels less than 12 m in length and which return to port within 24 hours of their most recent departure. Secondly, two areas have been defined, one in Subarea VII SW of Ireland and the other in Subarea VIII Bay of Biscay, where a 100-mm minimum mesh size is required for all otter-trawlers, whatever the amount of hake caught. The fishing mortality of juvenile hake (in the landings) is estimated to have decreased since around 1997. No apparent change has been observed since the introduction of the hake emergency plan in 2001.

Council Regulation (EC) No. 1954/2003 established measures for the management of fishing effort in a 'biologically sensitive area' in Subareas VIIb, VIIj, VIIg, and VIIh. Effort exerted within the 'biologically sensitive area' by the vessels of each EU Member State may not exceed their average annual effort (calculated over the period 1998–2002).

The hake recovery plan (EC Reg. No. 811/2004) came in operation in 2004 and replaced the emergency plan. It is aimed at increasing the quantities of mature fish to values equal to or greater than 140 000 t. This is to be achieved by limiting fishing mortality to 0.25 and by allowing a maximum change in TAC between years of 15%.

Changes in fishing technology and fishing patterns

Since the introduction of the high-opening trawls in the mid-1990s, no significant changes in fishing technology have been observed.

Due to quota restriction the Spanish fleet stopped fishing up to two months in 2001, 2002, and 2003, and one month in 2004. However, this temporary cessation of the fishery is not mirrored in the overall trends in fishing effort.

Other factors

The main part of the fishery (close to 80% of the total landings) was conducted in five Fishery Units, three of them from Subarea VII: FU 4 (Non-*Nephrops* trawling in medium to deep water in Subarea VII), FU 1 (Longline in medium to deep water in Sub-area VII), and FU 3 (Gillnets in Subarea VII), and two from Sub-area VIII: FU 13 (Gillnets in shallow to medium water) and FU 14 (Trawling in medium to deep water in Subarea VIII), representing respectively 20%, 18%, 14%, 12%, and 14% of the total landings in 2004.

Spain accounts for the main part of the landings with 62% of the total in 2004. France is now taking 26% of the total, UK 5%, Denmark 3%, Ireland 2% and other countries (Norway, Belgium, Netherlands, Germany, and Sweden) contributing small amounts.

Scientific basis

Data and methods

An age-based assessment (XSA) assessment using 4 commercial CPUE series and 3 surveys was performed. Discards were not included in the assessment. Some discard data were available, but it was not possible to incorporate these in a consistent way.

There are indications about a strong year class in 2004, but survey estimates are too uncertain to be used in the assessment.

Information from the fishing industry

The fishing industry and scientists have met at the national level to discuss information that can be used in the assessments. Some CPUE time-series have been provided by the fishing industry. Qualitative information has also been provided and has contributed to the assessment process.

Uncertainties in assessment and forecast

Some preliminary results on growth and accuracy of age determination from otolith reading were obtained from a tagging study conducted in 2002 in the Bay of Biscay. They show an underestimation of growth and inaccuracy in the current ageing criteria used by hake otolith readers. However, the small size of the sample analysed and its spatial and temporal coverage makes it difficult to draw reliable conclusions.

Following concerns over the accuracy of aging data and the calculation of historic catch-at-age data, an alternative assessment was explored assuming faster growth. The results indicate that the perception of trends in stock dynamics is similar but the absolute levels are heavily dependent on the ageing criteria. If growth of hake is underestimated, the stock is likely to be smaller and fishing mortality higher.

Discards were not included in those assessments. Some improvement in discard data availability (number of fleets sampled and area coverage) have been observed. However, sampling does not cover all fleets contributing to hake catches, the discard rates of several fleets are simply not known and when data are available, it is not possible to incorporate them in a consistent way.

Comparison with previous assessment and advice

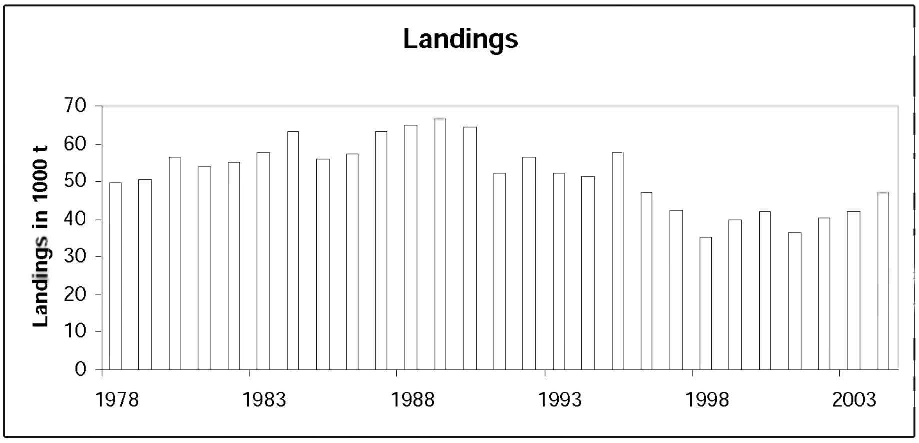
The assessment and advice are consistent with last year. The estimated low stock abundance in 2000 (90 000 t) was the basis for the ICES advice for a recovery plan for Northern hake. The recent estimate of SSB in 2000 (100 000 t) is still very low, so the basis for recovery plan advice would still be valid.

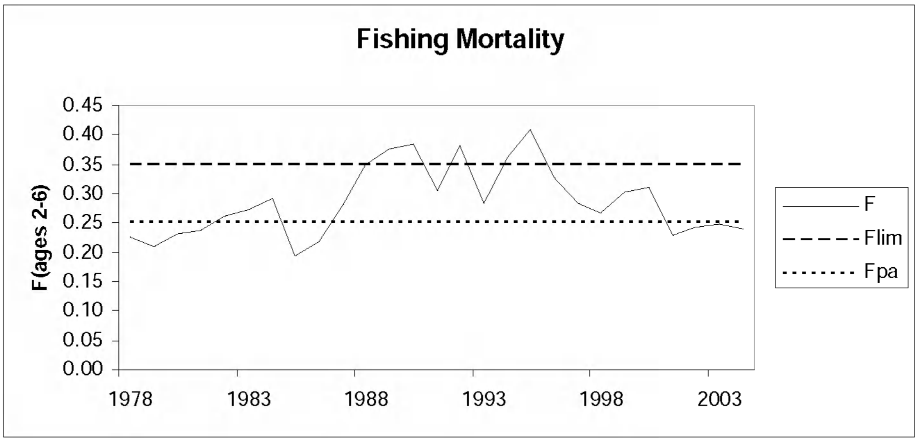
Source of information

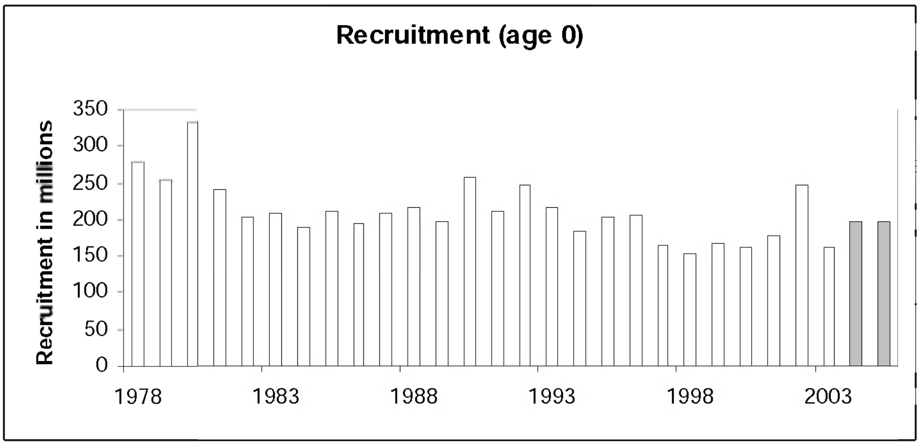
Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim, May 2005 (ICES CM 2006/ACFM:01).

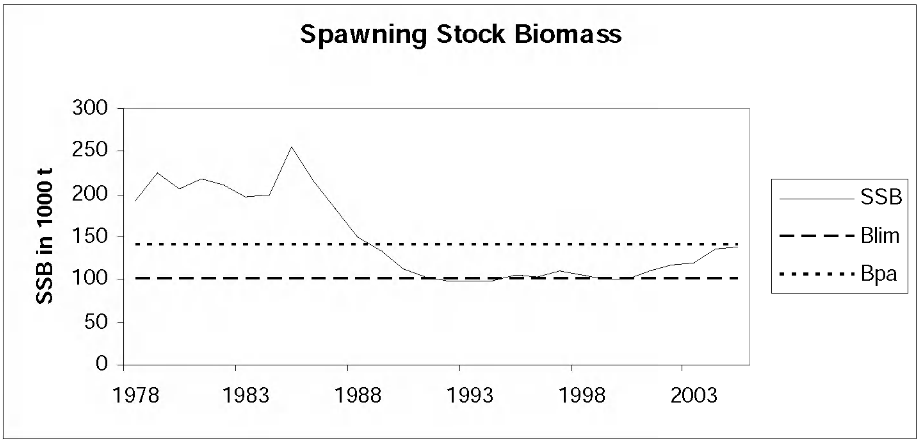
Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp to advice	Predicted catch corresp to single-stock exploitation boundaries	Agreed TAC[1]	ACFM landings	Disc. slip.	ACFM Catch***
1987	Precautionary TAC; juvenile protection		-		63.5	63.4	2.0	65.3
1988	Precautionary TAC; juvenile protection		54		66.2	64.8	2.0	66.8
1989	Precautionary TAC; juvenile protection		54		59.7	66.5	2.3	68.8
1990	Precautionary TAC; juvenile protection		59		65.1	59.9	1.5	61.4
1991	Precautionary TAC; juvenile protection		59		67.0	57.6	1.7	59.3
1992	If required, precautionary TAC		61.5		69.0	56.6	1.7	58.3
1993	Enforce juvenile protection legislation		-		71.5	52.1	1.5	53.6
1994	F significantly reduced		<46		60.0	51.3	1.9	53.1
1995	30% reduction in F		31		55.1	57.6	1.2	58.9
1996	30% reduction in F		39		51.1	47.2	1.5	48.8
1997	20% reduction in F		54		60.1	42.6	1.8	44.4
1998	20% reduction in F		45[2]		59.1	35.0	0.8	35.8
1999	Reduce F below $\mathbf{F}_{pa}$		<36[2]		55.1	39.8	0.8	40.6
2000	50% reduction in F		<20[2]		42.1	42.0	0.6	42.6
2001	Lowest possible catch, recovery plan		-		22.6	36.7	0.5	37.2
2002	Lowest possible catch / recovery plan		-		27.0	40.0	0.3	40.3
2003	Lowest possible catch / recovery plan		-		30.0	41.8	- **)	-
2004	*)70% reduction in F or recovery plan		*)	<13.8	39.1	47.1		-
2005	F=0.19			33	42.6			
2006	F=0.25			44				

Weights in '000 t.
[1]Sum of area TACs corresponding to Northern stock plus Division IIa (EC zone only). [2]Landings.
*) Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.
**) in 2003, no estimations of discards were available.
***) ACFM catch not used in the assessment. Assessment based on landings only.

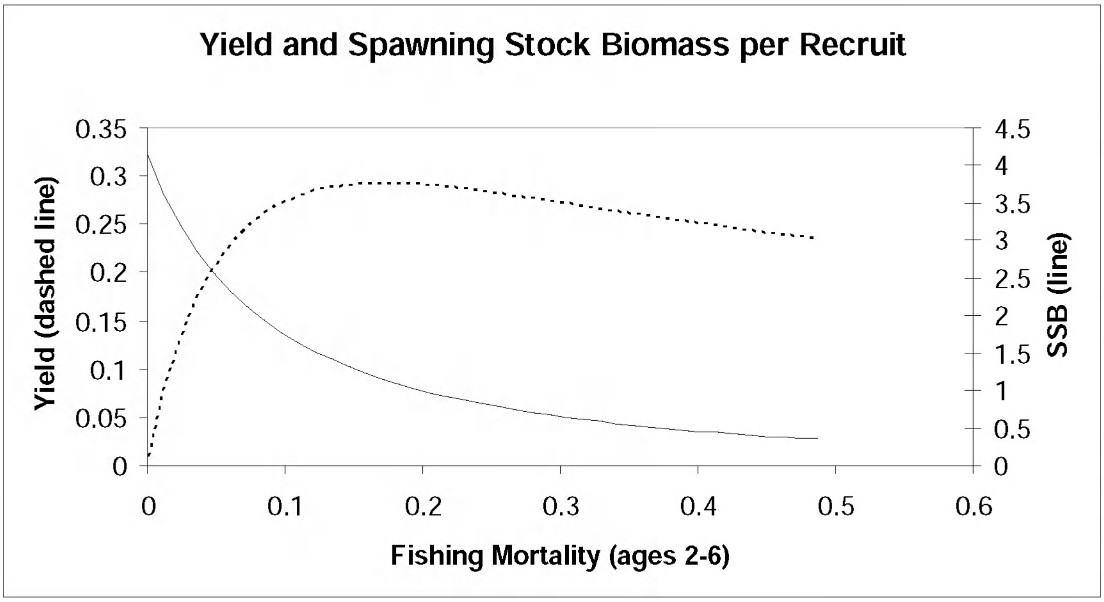

Landings
Landings in 1000 t
70
60
50
40
30
20
10
0
1978
1983
1988
1993
1998
2003


Fishing Mortality
F(ages 2-6)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1978
1983
1988
1993
1998
2003
F
Flim
Fpa

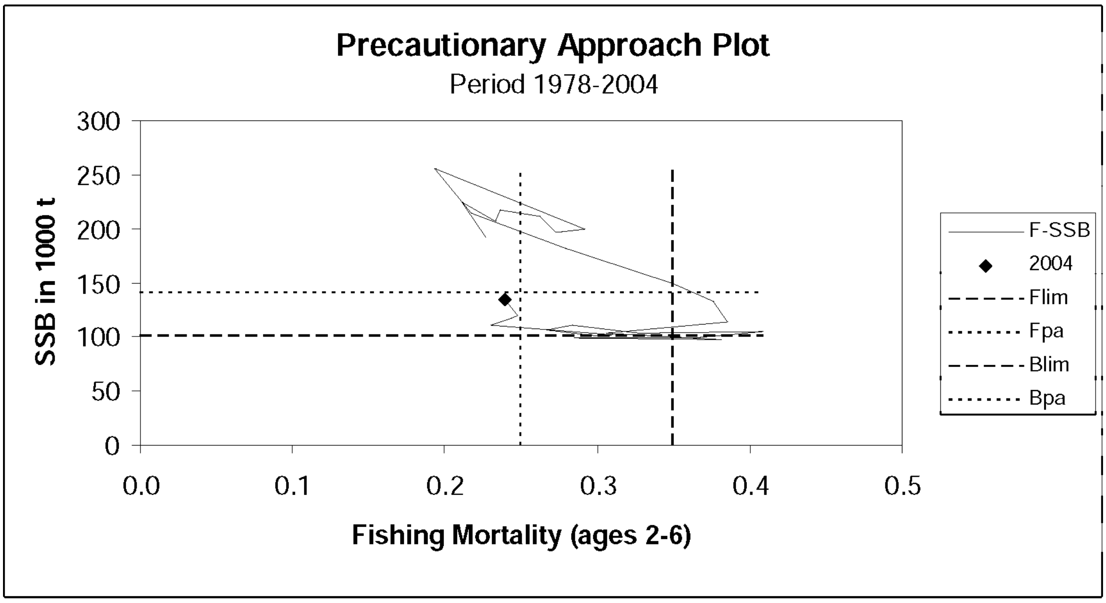

Recruitment (age 0)
Recruitment in millions
350
300
250
200
150
100
50
0
1978
1983
1988
1993
1998
2003


Spawning Stock Biomass
SSB in 1000 t
300
250
200
150
100
50
0
1978
1983
1988
1993
1998
2003
SSB
Blim
Bpa

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



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Fishing Mortality (ages 2-6)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
SSB (line)



Precautionary Approach Plot
Period 1978-2004
SSB in 1000 t
300
250
200
150
100
50
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 2-6)
F-SSB
2004
Flim
Fpa
Blim
Bpa

Table 1.4.1.1 Estimates of catches ('000 t) for Northern hake by area for 1961–2003.

	Landings (1)					Discards (2)	Catches (3)
Year	IVa+VI	VII	VIIIa,b	Unallocated	Total	VIIIa,b	Total
1961	-	-	-	95.6	95.6	-	95.6
1962	-	-	-	86.3	86.3	-	86.3
1963	-	-	-	86.2	86.2	-	86.2
1964	-	-	-	76.8	76.8	-	76.8
1965	-	-	-	64.7	64.7	-	64.7
1966	-	-	-	60.9	60.9	-	60.9
1967	-	-	-	62.1	62.1	-	62.1
1968	-	-	-	62.0	62.0	-	62.0
1969	-	-	-	54.9	54.9	-	54.9
1970	-	-	-	64.9	64.9	-	64.9
1971	8.5	19.4	23.4	0	51.3	-	51.3
1972	9.4	14.9	41.2	0	65.5	-	65.5
1973	9.5	31.2	37.6	0	78.3	-	78.3
1974	9.7	28.9	34.5	0	73.1	-	73.1
1975	11.0	29.2	32.5	0	72.7	-	72.7
1976	12.9	26.7	28.5	0	68.1	-	68.1
1977	8.5	21.0	24.7	0	54.2	-	54.2
1978	8.0	20.3	24.5	-2.2	50.6	2.4	52.9
1979	8.7	17.6	27.2	-2.4	51.1	2.7	53.8
1980	9.7	22.0	28.4	-2.8	57.3	3.2	60.5
1981	8.8	25.6	22.3	-2.8	53.9	2.3	56.3
1982	5.9	25.2	26.2	-2.3	55.0	3.1	58.1
1983	6.2	26.3	27.1	-2.1	57.5	2.6	60.1
1984	9.5	33.0	22.9	-2.1	63.3	1.9	65.1
1985	9.2	27.5	21.0	-1.6	56.1	3.8	59.9
1986	7.3	27.4	23.9	-1.5	57.1	3.0	60.1
1987	7.8	32.9	24.7	-2.0	63.4	2.0	65.3
1988	8.8	30.9	26.6	-1.5	64.8	2.0	66.8
1989	7.4	26.9	32.0	0.2	66.5	2.3	68.8
1990	6.7	23.0	34.4	-4.2	59.9	1.5	61.4
1991	8.3	21.5	31.6	-3.9	57.6	1.7	59.3
1992	8.6	22.5	23.5	2.1	56.6	1.7	58.3
1993	8.5	20.5	19.8	3.3	52.1	1.5	53.6
1994	5.4	21.1	24.7	0	51.3	1.9	53.1
1995	5.3	24.1	28.1	0	57.6	1.2	58.9
1996	4.4	24.7	18.0	0	47.2	1.5	48.8
1997	3.3	18.9	20.3	0	42.6	1.8	44.4
1998	3.2	18.7	13.1	0	35.0	0.8	35.8
1999	4.3	24.0	11.6	0	39.8	0.8	40.6
2000	4.0	26.0	12.0	0	42.0	0.6	42.6
2001	4.4	23.1	9.2	0	36.7	0.5	37.2
2002	2.9	21.1	15.9	0	40.1	0.3	40.4
2003	2.8	23.7	15.3	0	41.9	-	41.9
2004	4.4	27.2	15.5	1	47.1	-	47.1

(1) Spanish data for 1961–1972 not revised, data for Subarea VIII for 1973–1978 includes data for Divisions VIIIa,b only. Data for 1979–1981 are revised based on French surveillance data. Includes Divisions IIIa, IVb,c from 1976.
There are some unallocated landings moreover for the period 1961–1970.

(2) Discards have been estimated from 1978 and only for Divisions VIIII a,b.

(3) From 1978 total catches used for the Working Group.

Table 1.4.1.2 Hake – Northern stock (IIIa, IV, VI, VII, VIIIa,b).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1978	277660	192665	49521	0.2270
1979	254460	224837	50637	0.2110
1980	332232	207347	56473	0.2329
1981	239684	217613	53920	0.2361
1982	201512	211917	54996	0.2623
1983	206859	197230	57508	0.2731
1984	188651	200204	63288	0.2921
1985	209204	256321	56100	0.1929
1986	194203	214833	57093	0.2173
1987	206934	182306	63368	0.2797
1988	215365	148887	64824	0.3493
1989	198140	133370	66472	0.3765
1990	257601	113316	64288	0.3855
1991	209319	102910	52373	0.3052
1992	245583	97291	56618	0.3815
1993	215587	99118	52146	0.2850
1994	182469	98324	51259	0.3634
1995	202876	105559	57619	0.4081
1996	205133	103595	47213	0.3276
1997	163568	110252	42600	0.2833
1998	152210	106421	35010	0.2664
1999	165520	100635	39814	0.3028
2000	160058	101919	42022	0.3102
2001	177149	111059	36675	0.2296
2002	247375	116462	40105	0.2428
2003	161838	119884	41877	0.2477
2004	195919*	134930	47123	0.2398
2005	195919*	137521		
Average	209394	148915	51887	0.2863

* GM for 1990–2002.

1.4.2 Northeast Atlantic Mackerel (combined Southern, Western, and North Sea spawning components)

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
Uncertain	Harvested unsustainably	Overexploited	

Based on the most recent estimates of fishing mortality, ICES classifies the stock as being harvested unsustainably. Fishing mortality is estimated to be above $\mathbf{F_{lim}}$ in recent years. Because of the unknown bias in the catch information, SSB in recent years relative to $\mathbf{B_{pa}}$ cannot be accurately estimated. The 2000 year class is very poor, while both the 2001 and 2002 year classes appear to be above average. The 2002 year class is now estimated to be the highest in the time-series. Preliminary information on the 2003 year class suggests that it is low.

Management objectives

The agreed record of negotiations between Norway, Faroe Islands, and EU in 1999, states:

"For 2000 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality in the range of 0.15 - 0.20 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of the fishing mortality rate."

"Should the SSB fall below a reference point of 2 300 000 tonnes ($\mathbf{B_{pa}}$), the fishing mortality rate, referred to under paragraph 1, shall be adapted in the light of scientific estimates of the conditions prevailing. Such adaptation shall ensure a safe and rapid recovery of the SSB to a level in excess of 2 300 000 tonnes."

"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 the agreement to be consistent with the precautionary approach, if F on average is kept below 0.17. The rationale for ICES proposing $\mathbf{F_{pa}}$ = 0.17 is to have a high probability of avoiding exploiting the stock above $\mathbf{F_{lim}}$. In addition, projections indicate that F = 0.17 will optimize long-term yield and at the same time result in a low risk for the stock to decrease below $\mathbf{B_{pa}}$. However, the management plan does not specify measures that would apply under poor stock conditions that preclude further evaluation. Furthermore, the management plan assumes that catch information is unbiased so that absolute estimates of SSB can be produced. This condition has not been met for a number of years.

Reference points

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
There is no biological basis for defining $\mathbf{B_{lim}}$.	$\mathbf{B_{pa}}$ be set at 2.3 million t.
$\mathbf{F_{lim}}$ is 0.26, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.17. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty in the assessments.
Target reference points	$\mathbf{F_y}$ is not defined.

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 4-8	Yield/R	SSB/R
Average last 3 years	0.324	0.168	0.626
$\mathbf{F_{max}}$	0.681	0.176	0.370
$\mathbf{F_{0.1}}$	0.188	0.150	0.875
$\mathbf{F_{med}}$	0.266	0.163	0.712

Technical basis:

	$\mathbf{B}_{pa} = \mathbf{B}_{loss}$ in Western stock raised by 15%: = 2.3 million t.
$\mathbf{F}_{lim} = \mathbf{F}_{loss}$ = 0.26.	$\mathbf{F}_{pa} = \mathbf{F}_{lim}$ * 0.65.

The present $\mathbf{F}_{pa}$ is slightly below $\mathbf{F}_{0.1}$.

Single-stock exploitation boundaries

ICES advises that any agreed TAC should cover all areas where Northeast Atlantic mackerel are fished. 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.

Exploitation boundaries in relation to existing management plans

The agreed management plan (F between 0.15 and 0.20) would, assuming catches in the range of 433 000 t in 2005, imply landings between 373 000 t and 487 000 t in 2006 with an expected increase in SSB of 5-10% in 2007 compared to 2005.

Short/medium-term implications

Outlook for 2006

Basis: Catch(2005) = 433 (TAC plus 11 assumed discards); F(2005) =0.19; SSB(2005) = 2341.

The fishing mortality applied according to the agreed management plan [F(management plan)] is 0.15–0.20.

In 2003, ICES responded to a request from Norway to comment on the biological rationale for setting TACs by areas and to identify the implications for the TAC advice for the remaining part of the distribution area, considering a range of TAC options for the Southern area. As a consequence, in 2004 catch options were not provided by fleet. The information provided then is regarded to be still relevant. Therefore, also this year the catch predictions are not provided for the so-called "Northern" and "Southern" areas.

Rationale	Landings(2006)	F(2006 & 2007)	Basis	SSB(2006) Mid-year	SSB(2007) Mid-year
Zero catch	0	0.00	F=0	2558	3016
Status quo	689	0.29	2004	2322	2229
	129	0.05	F(management plan) *0,25	2516	2862
	254	0.10	F(management plan) *0,5	2475	2716
	373	0.15	F(management plan lower bound)	2434	2579
	419	0.17	$\mathbf{F}_{pa}$	2418	2527
	487	0.20	F(management plan upper bound)	2395	2451
	531	0.22	F(management plan) *1,1	2379	2401
	596	0.25	F(management plan) *1,25	2356	2330
	779	0.34	F(prec limits) *2	2289	2134

Weights in '000 t. Landings for 2006 exclude discards.
Shaded scenarios are not considered consistent with the management plan.

Management considerations

The exploitation boundaries in relation to the management plan given above is based on ICES interpretation that fishing mortality (F) should always be within an upper bound of 0.20. However, the management plan does not explicitly prioritise the F-based over the biomass-based decision rule, or vice versa. ICES' evaluation of the decision rule as being in accordance with the PA is based on the assumption that F should have an upper bound of 0.20.

Since 1992, there has been a downward trend in SSB, reflecting that the exploitation has not been sustainable in the sense that removals from the stock have repeatedly exceeded the annual production of the stock.

Catches have exceeded the annual TACs in most years, sometimes by a considerable amount. The degree to which estimated catches reflect the total quantity caught is unclear, but there are indications that they may be substantial underestimates. This implies that estimates of SSB, the forecast landings and probably even $\mathbf{B}_{pa}$ could be potentially biased. The advice on landings from a given SSB relative to the $\mathbf{B}_{pa}$ is only meaningful in relative terms. The estimates of SSB as well as the predicted landings are now scaled to the catches as they are reported.

The doubts about the absolute stock abundance and the large year-to-year variations in the assessments invite a reflection on long-term management strategies that are less dependent on the annual analytic assessments. Mackerel was previously considered to be a candidate for a multi-year TAC management plan because the stock appeared relatively stable. In addition, survey data are available only for a three-year cycle. Multiannual management strategies can reduce some of the problems for management and industry caused by the instability in mackerel assessments. The data and preliminary tools to evaluate such management regimes by simulations are available. Underreporting of catches, both at present and in the past causes problems that need further exploration. Further development along these lines should be done in dialogue with managers and the industry. ICES is prepared to enter such a dialogue.

The measures advised by ACFM to protect the North Sea spawning component aim at setting the conditions for making a recovery of this component possible. Before the late 1960s, the North Sea spawning biomass of mackerel was estimated at above 3 million tonnes. Due to recruitment overfishing recruitment has failed since 1969, leading to a decline in the stock. The North Sea spawning component has increased since 1999, but it is still far below the level in the 1960s.

The closure of the mackerel fishery in Divisions IVb,c and IIIa throughout the whole year is designed to protect the North Sea component in this area and also the juvenile Western mackerel which are numerous, particularly in Division IVb,c during the second half of the year. This closure has unfortunately resulted in increased discards of mackerel in the non-directed fisheries (especially horse mackerel fisheries) in these areas as vessels at present are permitted to take only 10% of their catch as mackerel bycatch. No data on the actual amount of mackerel bycaught are available, but the reported landings of mackerel in Divisions IIIa and IVb,c from 1997 onwards might seriously underestimate catches due to discarded bycatch.

The advised closure of Division IVa for fishing during the first half of the year is based on the perception that the western mackerel enter the North Sea in July/August, and stay there until December before migrating back to their spawning areas. Updated observations taken in the late 1990s suggested that this return migration actually started in mid- to late February. This was believed to result in large-scale misreporting from the Northern part of the North Sea (Division IVa) to Division VIa. It was recommended that the closure date for IVa be extended to the 15th February and not the 1st February, as stated in the advice in 2002. This was adopted for the 1999/2000 fishing season onwards. Misreporting from IVa to VIa occurred again in 2003. The reasons for the misreporting in 2003 are unclear but are not thought to be linked to a change in the timing of the migration to spawning areas.

Factors affecting the fisheries and the stock

Mackerel is mainly exploited in a directed fishery for human consumption. This fishery tends to target bigger fish and this could potentially cause discarding of smaller, marketable fish (high-grading).

Several sources of information indicate that the 2001 and 2002 year classes are above average. There are concerns that the appearance of such strong year classes in the fishery may have led to increased discarding.

Catches decreased in Spanish waters by almost half in 2003 due to the closure of the fishery in the first quarter after the "Prestige" oil spill.

The effects of regulations

Management has aimed at a fishing mortality in the range of 0.15–0.2 since 1998. The fishing mortality realised since then has been in the range of 0.28 to 0.38.

Other factors

Stock components: ICES currently uses the term "North East Atlantic Mackerel" to define the mackerel present in the area extending from ICES Division IXa in the south to Division IIa in the north, including mackerel in the North Sea and Division IIIa. The spawning areas of mackerel are widely spread, and only the area in the North Sea is sufficiently distinct to be clearly identified as a separate spawning component. Tagging experiments have demonstrated that after spawning, fish from Southern and Western areas migrate to feed in the Norwegian Sea and the North Sea during the second half of the year. In the North Sea they mix with the North Sea component. Since it is at present impossible to allocate catches to the stocks previously considered by ICES, they are at present, for practical reasons, considered as one stock: the North East Atlantic Mackerel Stock. Catches cannot be allocated specifically to spawning area components on biological grounds, but by convention the catches from the Southern and Western components are separated according to the area where they are taken.

In order to be able to keep track of the development of the spawning biomasses in the different spawning areas, the North East Atlantic mackerel stock is divided into three area components: the Western Spawning Component, the North Sea Spawning Component, and the Southern Spawning Component:

Northeast Atlantic Mackerel			
Distributed and fished in ICES Subareas and Divisions IIa, IIIa, IV, Vb, VI, VII, VIII, and IXa.			
Spawning component	**Western**	**Southern**	**North Sea**
Spawning Areas	VI, VII, VIIIa,b,d,e.	VIIIc, IXa.	IV, IIIa.

The Western Component is defined as mackerel spawning in the western area (ICES Divisions and Subareas VI, VII, VIII a,b,d,e). This component currently comprises 85% of the entire North East Atlantic Stock. Similarly, the Southern Component is defined as mackerel spawning in the southern area (ICES Divisions VIIIc and IXa). Although the North Sea component has been at an extremely low level since the early 1970s, ACFM regards the North Sea Component as still existing. This component spawns in the North Sea and Skagerrak (ICES Subarea IV and Division IIIa). Current knowledge of the state of the spawning components is summarised below:

Western Component: The catches of this component were low in the 1960s, but increased to more than 800 000 t in 1993. The main catches are taken in directed fisheries by purse seiners and mid-water trawlers. Large catches of the western component are taken in the northern North Sea and in the Norwegian Sea. The 1996 catch was reduced by about 200 000 t, compared with 1995, because of a reduction in the TAC. The catches since 1998 have been stable. The SSB of the Western Component declined in the 1970s from above 3.0 million t to 2.2 million t in 1994, but was estimated to have increased to 2.7 million t in 1999. A separate assessment for this stock component is no longer required, as a recent extension of the time-series of NEA mackerel data now allows the estimation of the mean recruitment from 1972 onwards. Estimates of the spawning stock biomass, derived from egg surveys, indicate a decrease of 14% between 1998 and 2001 and a 6% decrease from 2001 to the 2004 survey.

North Sea Component: Very large catches were taken in the 1960s in the purse seine fishery, reaching a maximum of about 1 million t in 1967. The component subsequently collapsed and catches declined to less than 100 000 t in the late 1970s. Catches during the last five years have been assumed to be about 10 000 t. The 2002 and 2005 egg survey 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.

Southern Component: Mackerel is a target species for the hand line fleet during the spawning season in Division VIIIc, during which about one-third of the total catches are taken. It is taken as a bycatch in other fleets. The highest catches (87%) from the Southern Component are taken in the first half of the year, mainly from Division VIIIc, and consist of adult fish. In the second half of the year catches consist of juveniles and are mainly taken in Division IXa. Catches from the Southern Component increased from about 20 000 t in the early 1990s to 44 000 t in 1998, and were close to 50 000 t in 2002. Estimates of the spawning stock biomass, derived from egg surveys, indicate a decrease of about 50% between 1998 and 2001. However, the SSB estimated in 2001 is similar to the survey estimates in 1995. The SSB estimated in 2004 showed a decrease of 36% over the 2001 survey.

Scientific basis

Data and methods

This assessment is based on catch numbers-at-age for the period 1972–2004 and egg survey estimates of SSB from 1992, 1995, 1998, 2001, and 2004. Exploratory assessments using different assessment models gave comparable results. The recent trend biomass is also in general agreement with measurements in acoustic surveys, and the estimate of total mortality in the past is in line with estimates from tag recapture studies. The results are sensitive to the way the surveys are used in the models. This year's assessment is an update of last year's assessment.

For mackerel, fishery-independent data of the stock size becomes available only once every 3 years from egg surveys. Inclusion of a new independent data point may result in quite large revisions of the stock size, fishing mortality, and consequently catch predictions and TAC advice.

Sampling for discards has been initiated in the EU in 2002 by legal regulations. Sampling of discards and slipping is problematic in pelagic fisheries due to high variability in discard and slipping practices, and it is uncertain whether useable information can be provided with less than 100% observer coverage.

Uncertainties in assessment and forecast

Due to the lack of fishery-independent data and the absence of age-disaggregated information for the spawning stock index, the levels of SSB are uncertain but F can be considered as indicative of the level and trend. In recent years, there has been a tendency to overestimate the SSB and to underestimate fishing mortality.

The recruitment since 2000 has been considerably more variable than that observed since the mid-1980s. This adds to the uncertainty in the forecast.

There is a broad perception that there are substantial undeclared landings in this fishery. The assessment is strongly dependent on the catch information, both recently and in the past. Managers are encouraged to obtain reliable catch information.

Comparison with previous assessment and advice

This year's assessment was an update of last year's assessment, with catch numbers-at-age for 2004 added. The result is in line with last year's assessment. Comparative assessments performed with different models gave similar results.

Last year, the use of the egg production indices in the assessment was changed by assuming that they were relative measures of the spawning stock instead of absolute. This change in the use of indices led to a change in the perception of the trajectory of the stock. This year ICES tested, by simulation, the trade-off between using the survey estimates as absolute or relative indices of the spawning biomass assuming biases in either the catches or the surveys. The results of this exercise confirmed that using the egg survey as relative indices when there is substantial misreporting of catches leads to unbiased estimates of fishing mortalities and underestimates of the spawning stock in the terminal year. Treating the indices as absolute leads, on the other hand, to an underestimation of the fishing mortality. As the management agreement is based on fishing mortality, the most appropriate model formulation to use is with the egg survey estimates as relative indices.

Furthermore, taking the egg survey estimates as absolute measures of the spawning stock biomass leads to a potential conflict between two sources of information about stock abundance in absolute terms. In practice, the information from the catches will dominate the abundance estimates in the past while the information from the most recent egg surveys will dominate the abundance estimate for the present. This leads to estimates of abundance and SSB that are inconsistent over time. Taking the egg survey estimates as relative removes that internal inconsistency by relying on the catch data as the only source of information about absolute levels. Hence, the estimates of abundance, and accordingly, the predicted catches for the future, are scaled to the reported catches. If catches have been consistently underreported, this is reflected in both the abundance estimates and the catch predictions. The advice, as derived from the present assessments, does reflect the level of reported catches.

Some information on the estimated level of discards is available and was included in the assessment, but the amount included does not appear to be sufficient to capture the scale of the problem. The forecasts have only been provided in terms of landings and not, as in the past, in terms of catches.

Source of information

Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 6–15 2005 (ICES CM 2006/ACFM:08).

Catch data for combined area

Year	ICES Advice	Predicted catch corresp. to advice	Total Agreed TAC[3]	Official landings	Disc.[1] slip	ACFM catch[2,4]
1987	Given by stock component		442	589	11	655
1988	Given by stock component		610	621	36	680
1989	Given by stock component		532	507	7	590
1990	Given by stock component		562	574	16	628
1991	Given by stock component		612	599	31	668
1992	Given by stock component		707	723	25	760
1993	Given by stock component		767	778	18	825
1994	Given by stock component		837	792	5	821
1995	Given by stock component		645	660	8	756
1996	Significant reduction in F	-	452	493	11	564
1997	Significant reduction in F	-	470	434	19	570
1998	F between 0.15 and 0.2	498	549	647	8	667
1999	F of 0.15 consistent with PA	437	562	595	n/a	616
2000	F=0.17: $\mathbf{F}_{pa}$	642	612	579	2	675
2001	F=0.17: $\mathbf{F}_{pa}$	665	670	620	1	687
2002	F=0.17: $\mathbf{F}_{pa}$	694	683	688	24	727
2003	F=0.17: $\mathbf{F}_{pa}$	542	583	580	9	617
2004	F=0.17: $\mathbf{F}_{pa}$	545	532	559	11	611
2005	F=0.15 to 0.20	[320-420]	422			
2006	F=0.15 to 0.20	[373-487]				

Weights in '000 t. [1]Data on discards and slipping from ony two fleets. [2]Landings and discards from IIa, IIIa, IV, Vb, VI, VII, VIII, and IXa. [3]All areas except some catches in international waters in II. [4] Catches updated in 2003 with revisions from SGDRAMA in 2002. n/a=not available.

Catch data for western component

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Disc. slip	ACFM catch[2,4]
1987	SSB = 1.5 mill. t; TAC	380	405	11	633
1988	F = $\mathbf{F}_{0.1}$; TAC; closed area; landing size	430	573	36	656
1989	Halt SSB decline; TAC	355	495	7	571
1990	TAC; F = $\mathbf{F}_{0.1}$	480	525	16	606
1991	TAC; F = $\mathbf{F}_{0.1}$	500	575	31	647
1992	TAC for both 1992 and 1993	670	670	25	742
1993	TAC for both 1992 and 1993	670	730	18	805
1994	No long-term gains in increased F	831[3]	800	5	796
1995	20% reduction in F	530	608	8	728
1996	No separate advice	-	422	11	529
1997	No separate advice	-	416	19	529
1998	No separate advice	-	514	8	623
1999	No separate advice	-	520	0	572
2000	No separate advice	-	573	2	639
2001	No separate advice	-	630	1	644
2002	No separate advice	-	642	24	677
2003	No separate advice	-	548	9	592
2004	No separate advice	-	500	11	577
2005	No separate advice	-	397		
2006	No separate advice	-			

Weights in '000 t. [1]TAC for mackerel taken in all areas VI, VII, VIIIa,b,d, Vb, IIa, IIIa, IVa. [2]Landings and discards of Western component; includes some catches of North Sea component. [3]Catch at *status quo* F. [4] Catches updated in 2003 with revisions from SGDRAMA in 2002.

Catch data for North Sea component

Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[2]	ACFM catch[3]
1987	Lowest practical level	LPL	55	3
1988	Closed areas and seasons; min. landing size; bycatch regulations	LPL	55	6
1989	Closed areas and seasons; min. landing size; bycatch regulations	LPL	49.2	7
1990	Closed areas and seasons; min. landing size; bycatch regulations	LPL	45.2	10
1991	Closed areas and seasons; min. landing size; bycatch regulations	LPL	65.5	-[4]
1992	Closed areas and seasons; min. landing size; bycatch regulations	LPL	76.3	-[4]
1993	Maximum protection; closed areas and seasons; min landing size	LPL	83.1	-[4]
1994	Maximum protection; closed areas and seasons; min landing size	LPL	95.7	-[4]
1995	Maximum protection; closed areas and seasons; min landing size	LPL	76.3	-[4]
1996	Maximum protection; closed areas and seasons; min landing size	LPL	52.8	-[4]
1997	Maximum protection; closed areas and seasons; min landing size	LPL	52.8	-[4]
1998	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	-[4]
1999	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	-[4]
2000	Maximum protection; closed areas and seasons; min landing size	LPL	69.7	-[4]
2001	Maximum protection; closed areas and seasons; min landing size	LPL	71.4	-[4]
2002	Maximum protection; closed areas and seasons; min landing size	LPL	72.9	-[4]
2003	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	-[4]
2004	Maximum protection; closed areas and seasons; min landing size	LPL	57.7	-[4]
2005	Maximum protection; closed areas and seasons; min landing size	LPL	44.9	-[4]
2006	Maximum protection; closed areas and seasons; min landing size			

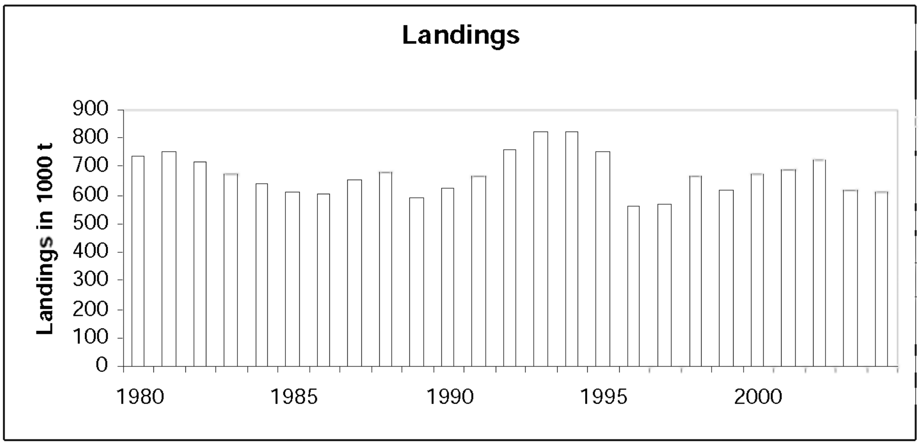
Weights in '000 t. [1]Subarea IV and Division IIIa. [2]TAC for Subarea IV, Divisions IIIa, IIIb,c,d (EU zone), and Division IIa (EU zone). [3]Estimated landings of North Sea component. [4]No information.

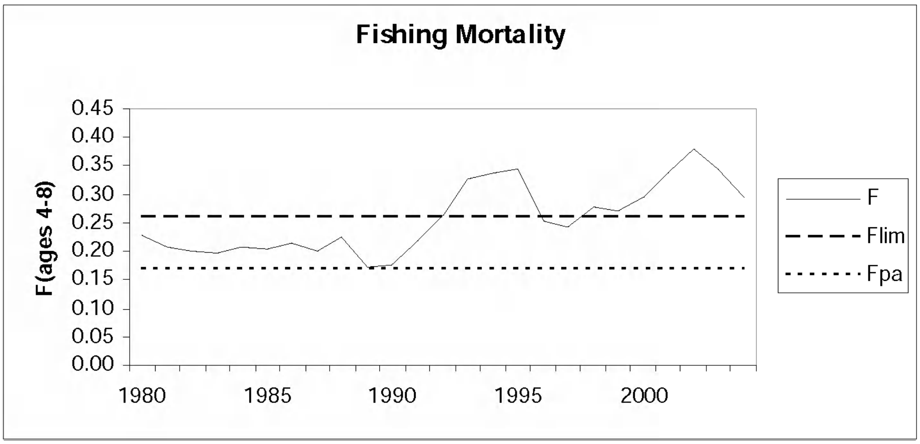
Catch data for southern component

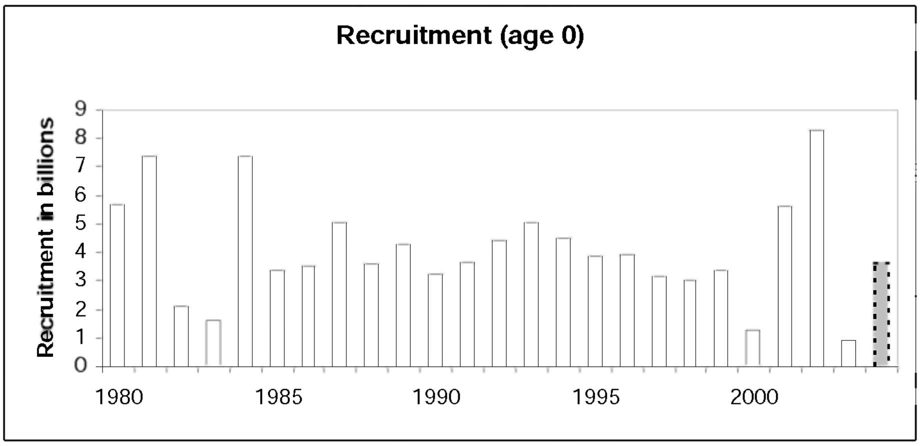
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Catch[2]
1987	Reduce juvenile exploitation	-	36.57	22
1988	Reduce juvenile exploitation	-	36.57	25
1989	No advice	-	36.57	18
1990	Reduce juvenile exploitation	-	36.57	21
1991	Reduce juvenile exploitation	-	36.57	21
1992	No advice	-	36.57	18
1993	No advice	-	36.57	20
1994	No advice	-	36.57	25
1995	No advice	-	36.57	28
1996	No separate advice	-	30.00	34
1997	No separate advice	-	30.00	41
1998	No separate advice	-	35.00	44
1999	No separate advice	-	35.00	44
2000	No separate advice	-	39.20	36
2001	No separate advice	-	40.18	43
2002	No separate advice	-	41.10	50
2003	No separate advice	-	35.00	26
2004	No separate advice	-	32.31	35
2005	No separate advice	-	24.87	
2006	No separate advice	-		

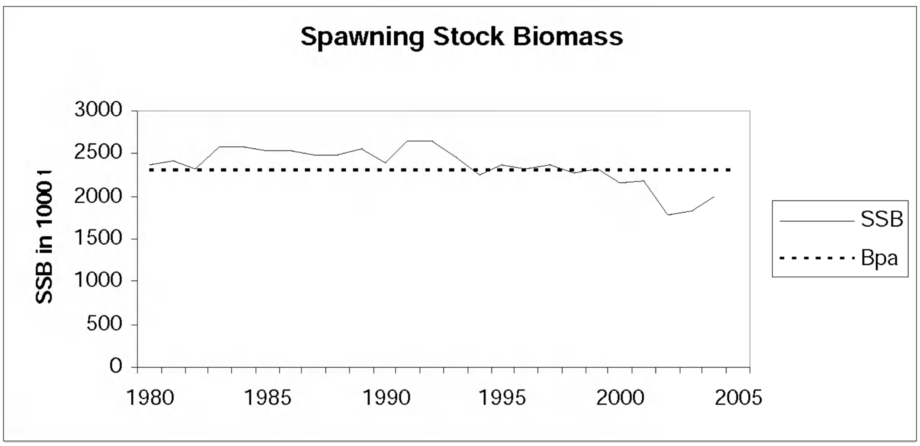
Weights in '000 t. [1]Division VIIIc, Subareas IX and X, and CECAF Division 34.1.1 (EU waters only). [2] Catches updated in 2003 with revisions from SGDRAMA in 2002.

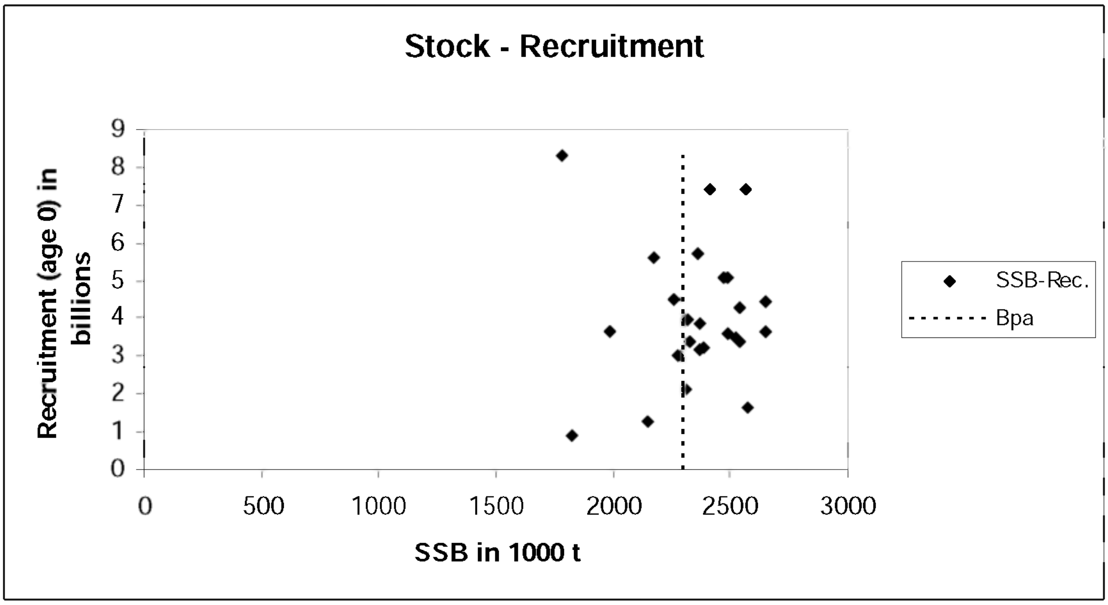
Mackerel (combined Southern, Western, and N. Sea spawning component)










Stock - Recruitment
Recruitment (age 0) in billions
9
8
7
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
SSB in 1000 t
SSB-Rec.
Bpa

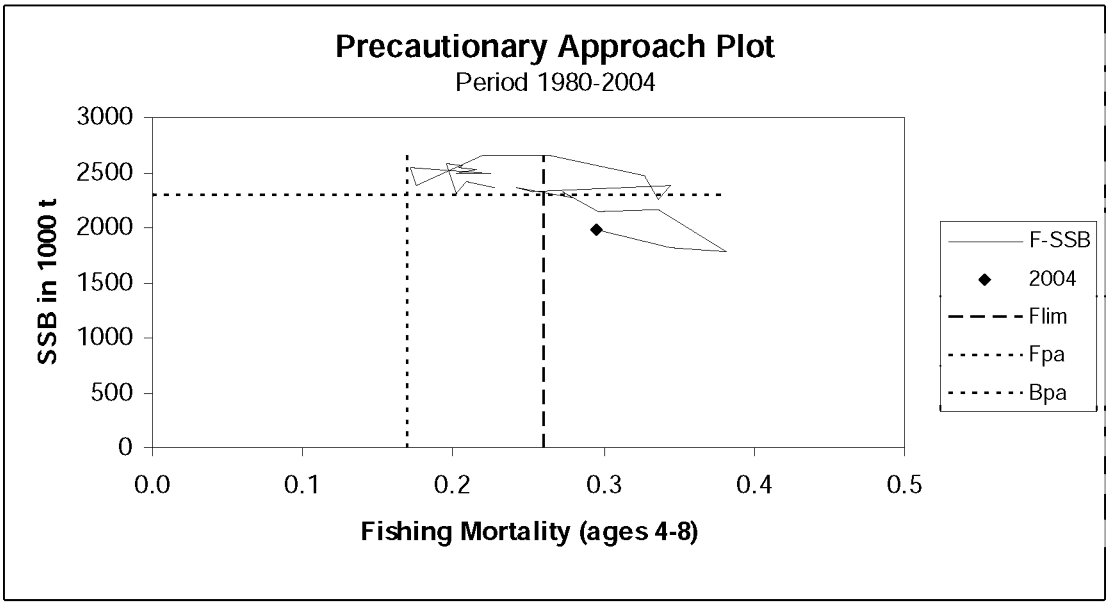

Precautionary Approach Plot
Period 1980-2004
SSB in 1000 t
3000
2500
2000
1500
1000
500
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 4-8)
F-SSB
2004
Flim
Fpa
Bpa

Table 1.4.2.1 Catches of MACKEREL by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

Year	Sub-area VI			Sub-area VII and Divisions VIIIa,b,d,e			Sub-area IV and III			Sub-area I,II & Divs.Vb[1]	Divs. VIIIc, IXa	Total		
	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Landings	Landings	Discards	Catch
1969	4,800		4,800	47,404		47,404	739,175		739,175	7	42,526	833,912	0	833,912
1970	3,900		3,900	72,822		72,822	322,451		322,451	163	70,172	469,508	0	469,508
1971	10,200		10,200	89,745		89,745	243,673		243,673	358	32,942	376,918	0	376,918
1972	13,000		13,000	130,280		130,280	188,599		188,599	88	29,262	361,229	0	361,229
1973	52,200		52,200	144,807		144,807	326,519		326,519	21,600	25,967	571,093	0	571,093
1974	64,100		64,100	207,665		207,665	298,391		298,391	6,800	30,630	607,586	0	607,586
1975	64,800		64,800	395,995		395,995	263,062		263,062	34,700	25,457	784,014	0	784,014
1976	67,800		67,800	420,920		420,920	305,709		305,709	10,500	23,306	828,235	0	828,235
1977	74,800		74,800	259,100		259,100	259,531		259,531	1,400	25,416	620,247	0	620,247
1978	151,700	15,100	166,800	355,500	35,500	391,000	148,817		148,817	4,200	25,909	686,126	50600	736,726
1979	203,300	20,300	223,600	398,000	39,800	437,800	152,323	500	152,823	7,000	21,932	782,555	60600	843,155
1980	218,700	6,000	224,700	386,100	15,600	401,700	87,931		87,931	8,300	12,280	713,311	21600	734,911
1981	335,100	2,500	337,600	274,300	39,800	314,100	64,172	3,216	67,388	18,700	16,688	708,960	45516	754,476
1982	340,400	4,100	344,500	257,800	20,800	278,600	35,033	450	35,483	37,600	21,076	691,909	25350	717,259
1983	320,500	2,300	322,800	235,000	9,000	244,000	40,889	96	40,985	49,000	14,853	660,242	11396	671,638
1984	306,100	1,600	307,700	161,400	10,500	171,900	43,696	202	43,898	98,222	20,208	629,626	12302	641,928
1985	388,140	2,735	390,875	75,043	1,800	76,843	46,790	3,656	50,446	78,000	18,111	606,084	8191	614,275
1986	104,100		104,100	128,499		128,499	236,309	7,431	243,740	101,000	24,789	594,697	7431	602,128
1987	183,700		183,700	100,300		100,300	290,829	10,789	301,618	47,000	22,187	644,016	10789	654,805
1988	115,600	3,100	118,700	75,600	2,700	78,300	308,550	29,766	338,316	120,404	24,772	644,926	35566	680,492
1989	121,300	2,600	123,900	72,900	2,300	75,200	279,410	2,190	281,600	90,488	18,321	582,419	7090	589,509
1990	114,800	5,800	120,600	56,300	5,500	61,800	300,800	4,300	305,100	118,700	21,311	611,911	15600	627,511
1991	109,500	10,700	120,200	50,500	12,800	63,300	358,700	7,200	365,900	97,800	20,683	637,183	30700	667,883
1992	141,906	9,620	151,526	72,153	12,400	84,553	364,184	2,980	367,164	139,062	18,046	735,351	25000	760,351
1993	133,497	2,670	136,167	99,828	12,790	112,618	387,838	2,720	390,558	165,973	19,720	806,856	18180	825,036
1994	134,338	1,390	135,728	113,088	2,830	115,918	471,247	1,150	472,397	72,309	25,043	816,025	5370	821,395
1995	145,626	74	145,700	117,883	6,917	124,800	321,474	730	322,204	135,496	27,600	748,079	7721	755,800
1996	129,895	255	130,150	73,351	9,773	83,124	211,451	1,387	212,838	103,376	34,123	552,196	11415	563,611
1997	65,044	2,240	67,284	114,719	13,817	128,536	226,680	2,807	229,487	103,598	40,708	550,749	18864	569,613
1998	110141	71	110,212	105,181	3,206	108,387	264,947	4,735	269,682	134,219	44,164	658,652	8012	666,664
1999[2§]	103,964		103,964	94,290		94,290	300,616		300,616	72,848	43,796	615,514	0	615,514
2000[2]	156,031	1	156,031	115,566	1,918	117,484	273,169	165	273,334	92,557	36,074	673,397	2084	675,481
2001[2]	117,997	83	117,997	142,890	1,081	143,971	314,802	24	314,826	67,097	43,198	685,984	1,188	687,172
2002[2]	113,862	12,931	126,793	102,484	2,260	104,744	363,310	8,583	371,893	73,929	49,576	703,161	23,774	726,935
2003	116,593	91	116,684	89,492		89,492	322,241	9,390	331,631	53,701	25,823	607,849	9,481	617,330
2004	114,871	240	115,111	99,922	1,862	101,784	288,370	8,870	297,240	62,486	34,840	600,488	10,972	611,461

*Preliminary.

[1]For 1976–1985 only Division IIa. Subarea I, and Division IIb included in 2000 only.

[2] Data revised for Northern Ireland.

[§] Discards reported as part of unallocated catches.

Table 1.4.2.2 Mackerel (combined Southern, Western, and N. Sea spawning component).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1980	5693010	2360014	734951	0.227
1981	7389980	2412983	754438	0.209
1982	2098100	2313701	717267	0.202
1983	1624940	2577775	671588	0.196
1984	7416130	2569129	637606	0.206
1985	3392910	2541515	614371	0.203
1986	3486560	2520085	602200	0.215
1987	5085070	2485588	654991	0.202
1988	3578850	2490994	680492	0.225
1989	4287500	2543570	589509	0.171
1990	3239450	2386333	627511	0.175
1991	3658660	2649140	667886	0.219
1992	4421530	2648794	760351	0.264
1993	5083330	2469074	825036	0.327
1994	4481570	2259500	821395	0.336
1995	3886850	2373142	755776	0.345
1996	3963120	2322321	563612	0.252
1997	3194090	2368840	569613	0.242
1998	3034550	2272310	666682	0.279
1999	3389630	2324013	615512	0.272
2000	1265970	2151289	675479	0.297
2001	5600150	2169653	687173	0.337
2002	8330800	1779544	726935	0.381
2003	921230	1821410	617330	0.344
2004	*3672928	1984940	611461	0.295
2005	*3672928			
Average	4087876	2351826	673967	0.257

*Geometric mean (1972–2001).

1.4.3 Western horse mackerel (*Trachurus trachurus*) (Divisions IIa, IVa, Vb, VIa, VIIa–c,e–k, VIIIa-e)

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
Uncertain	Uncertain	Uncertain	Uncertainty of absolute level of SSB and F; SSB has been decreasing in the last 15 years.

Based on new research information on stock identity, the Western horse mackerel stock unit has been redefined and now includes Division VIIIc.

In the absence of defined reference points and a full analytical assessment, the state of the stock is uncertain. Data exploration indicates that the SSB has been decreasing since the late 1980s, as the outstanding 1982 year class was depleted. Relative high catch rates of the 2001 year class in 2002–2004 suggest that this year class is stronger than those observed in recent years. Fishing mortality also appears to have been declining in recent years and is believed to be relatively low.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No reference points have been defined for the revised stock unit.

Single-stock exploitation boundaries

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

An $\mathbf{F}_{0.1}$ was calculated in an earlier assessment, but in view of the uncertainties in the selection profile, $\mathbf{F}_{0.1}$ cannot be updated at the present time.

Exploitation boundaries in relation to precautionary considerations

ICES has advised that in the absence of a strong year class sustainable yield is unlikely to be higher than 130 000 t for the traditional stock areas. This corresponds to catches less than 150 000 t in the revised stock area (i.e. 130 000 t for the traditional stock area, plus 20 000 t for the inclusion of Division VIIIc in the stock definition). Accordingly, ICES recommends that catches of horse mackerel in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa-c,e-k, and VIIIa-e be limited to less than 150 000 t.

Short-term implications

Given the uncertainty of the absolute levels of SSB, F, and R, and in the absence of a full analytical assessment, short-term forecasts have not been computed.

Management considerations

In the absence of outstanding year classes, sustainable yield is unlikely to be higher than about 150 000 t for the current stock area, dependent on the exploitation pattern. Exploitation at $\mathbf{F}_{0.1}$ will produce yields of this order on the basis of average recruitment, excluding the extremely large year classes. It is therefore clear that catches should not exceed such levels unless another outstanding year class is produced.

As the new definition of the stock unit now also includes Division VIIIc, the TAC advice has been adjusted, starting in 2004, by adding average catches from Division VIIIc, which were in the range of 20 000 t in the period 2000–2003.

The stock has continued to decline since the late 1980s despite progressive reductions of the catches to 157 600 t (including Division VIIIc) in 2004. Given the absence of an analytical assessment, continuing stock decline, and no clear evidence of outstanding year classes (such as that of 1982), it is clear that catches need to be effectively limited to less than 150 000 t and maintained at this level until another exceptional year class like the 1982 year class is produced and enters the fishery.

The SSB of Western horse mackerel has been dominated by an outstanding 1982 year class and reached a maximum in 1988. This year class has been gradually fished out and since then no other outstanding year classes have appeared, while the spawning biomass has slowly declined. There are indications that the 2001 year class might be a relatively strong year class. As there are no recruitment indices available, the strength of this year class can only be verified when it fully enters the spawning stock, which may take several years. Therefore, fishing should be kept at a low level in the coming years.

Major catches of juvenile horse mackerel, particularly the 2001 year class, may be a sign of the strength of this year class. As the fishery has increasingly targeted juvenile horse mackerel (see below), separating this effect from the presence of a strong year class might be difficult in the absence of fishery-independent information on the strength of incoming year classes.

More than half of the total international catch in both 2003 and 2004 consisted of one- to three-year-old fish. The juvenile fishery on the western stock has mainly taken place in Divisions VIIe,f,g,h and VIIIa,b,c, d. This may change if juveniles become targeted in other areas, or if a new large year class appears. In the ICES advice in 2003, the issue of juvenile and adult fishery was investigated (*ICES Cooperative Research Report No. 261*, 2003). An area-based management identifying juvenile and adult fisheries separately was recommended.

The TAC has only been given for parts of the distribution and fishing areas (EU waters). ICES advises that if a TAC is set for this stock, it should apply to all areas where western horse mackerel are caught, i.e. Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa–c, e–k, and VIIIa-e, and to all participants in the fishery. Note that Div. VIIIc is now included in the Western stock distribution area. If the management area limits are revised, measures should be taken to prevent misreporting of juvenile catch between VIIe,h and VIId (the latter then belonging to the North Sea stock management area). This could be done for example by imposing a separate TAC for the juvenile areas of both neighboring stocks.

Factors affecting the fisheries and the stock

The effects of regulations

The geographical range of this stock increased when the exceptional 1982 year class entered the fishery. This resulted in the development of unregulated fisheries outside the TAC area in the Northern North Sea. Catches outside the area covered by a TAC have been reduced in recent years. At present, the TAC for the Western areas includes Division Vb (EU waters only), Subareas VI and VII, and Divisions VIIIa,b,d,e. A separate TAC includes EU waters in Division IIa and Subarea IV. Horse mackerel taken in Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIe–k, and VIIIa-e are allocated by ICES to the Western stock.

Changes in fishing technology and fishing patterns

From about 1994 onwards, the fishery shifted from a fishery on adults towards a fishery on juveniles. This may be due to the lack of older fish (decline of the 1982 year class) and the development of a market for juveniles. The fishing pattern appears to have changed again in recent years, but it is not clear if this is due to a strong year class or a response to actual changes in fishing practices (targeting). The percentage of catch (in weight) in the juvenile areas increased gradually from about 40% in 1997 to about 65% in 2003 and dropped to 50% in 2004. In 2004, 53% of the catch in numbers in this area was from the 2001 year class.

Discard information has been lacking in recent years. However, given the high market value of smaller fish the discarding of small fish is unlikely to be a problem.

The environment

Research over the last decade has shown strong links between horse mackerel migration into northern areas and water mass transport patterns in the northeastern Atlantic (see Section 1.2, this volume).

Other factors

Western horse mackerel is taken in a variety of fisheries exploiting juvenile fish for the human consumption market, mid-aged fish mostly for the Japanese market, and older fish either for human consumption purposes (mostly for the African market) or for industrial purposes.

The history of this stock reflects the development of a single large year class within the period of 22 years for which data are available. The frequency of the occurrence of such large year classes cannot be evaluated on the basis of the short time-series.

Scientific basis

A wide range of assessment approaches have been explored this year, none of which are considered to provide a reliable assessment. Nevertheless, these are indicative of relative trends and suggest that SSB has been declining since the late 1980s and that the current exploitation is relatively low.

The egg production index has been extended to include Division VIIIc to reflect the new stock definition.

Data and methods

As in previous years and despite the data sampling regulation for EU countries, some countries with major catches did not carry out biological sampling programs. Though this has improved since 1998, the lack of biological data severely hampered the assessment in earlier years. It is important to note that a sufficient sampling coverage is a prerequisite for the timely detection of a strong recruiting year class, especially the verification of the possibly strong 2001 year class. Only this would allow for the implementation of management measures early enough to protect such a year class from being overexploited or discarded.

Uncertainties in assessment and forecast

As it is not possible to determine the absolute level of recruitment, abundance, and fishing mortality, only relative trends in these quantities have been derived and no catch forecasts are provided.

Comparison with previous assessment and advice

The perception of stock trends is consistent with last year's estimates.

Source of information

Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, 6–15 September 2005 (ICES CM 2006/ACFM:08).

Year	ICES Advice	Predicted catch corresp. to advice[2]	Agreed TAC[1]	ACFM Landings[2]	Disc. Slip[2]	ACFM Catch[2]
1987	Not assessed	-	155	157	-	157
1988	No increase in catches	102	169	184	4	188
1989	If sustained catches required; TAC	100	153	267	1	269
1990	TAC	~200	203	363	10	373
1991	Within safe biological limits	-	230	328	5	334
1992	Within safe biological limits	-	250	369	2	371
1993	Within safe biological limits	-	250	424	9	433
1994	Prudent not to increase F	-	300	385	4	389
1995	Reduction in catch	-	300	509	2	511
1996	Reduction in catch	-	300	379	17	397
1997	Reduction in F	173	300	440	3	443
1998	Reduction in F to 0.15	150	320	296	1	304
1999	Effectively limit catches to 200 000 t	<200	265	274	-	274
2000	Effectively limit catches to 200 000 t	<200	240	175	-	175
2001	Effectively limit catches to 224 000 t	<224	233	191	-	191
2002	Effectively limit catches to 98 000 t	<98	150	172	-	172
2003	Effectively limit catches to 113 000 t	<113	137	190[3]	-[3]	190[3]
2004	Limit catches to less than 130 000 t	<130	137	157[3]	1[3]	158[3]
2005	Limit catches to less than 150 000 t	<150[3]	137			
2006	Limit catches to less than 150 000 t	<150[3]				

Weights in '000 t.

[1]Division Vb (EU waters only), Subareas VI and VII, Divisions VIIIa,b,d,e.

[2]Divisions IIa, IVa, Vb, VIa, VIIa-c,e-k, VIII a,b,d,e ,

[3]Including VIIIc,

Table 1.4.3.1 Landings (t) of HORSE MACKEREL in Subarea II. (Data as submitted by Working Group members.)

Country	1980	1981	1982	1983	1984	1985	1986	1987
Denmark	-	-	-	-	-	-	-	39
France	-	-	-	-	1	1	-[2]	-[2]
Germany, Fed.Rep	-	+	-	-	-	-	-	-
Norway	-	-	-	412	22	78	214	3,272
USSR	-	-	-	-	-	-	-	-
Total	-	+	-	412	23	79	214	3,311

	1988	1989	1990	1991	1992	1993	1994	1995
Faroe Islands	-	-	9643	1,115	9,157[3]	1,068	-	950
Denmark	-	-	-	-	-	-	-	200
France	-2	-	-	-	-	-	55	-
Germany, Fed. Rep.	64	12	+	-	-	-	-	-
Norway	6,285	4,770	9,135	3,200	4,300	2,100	4	11,300
USSR / Russia (1992 -)	469	27	1,298	172	-	-	700	1,633
UK (England + Wales)	-	-	17		-	-	-	-
Total	6,818	4,809	11,414	4,487	13,457	3,168	759	14,083

	1996	1997	1998	1999	2000	2001	2002	2003
Faroe Islands	1,598	799[3]	188[3]	132[3]	250[3]	-		
Denmark	-	-	1,755[3]			-		
France	-	-	-			-		
Germany	-	-	-			-		
Norway	887	1,170	234	2,304	841	44	1,321	22
Russia	881	648	345	121	84[3]	16	3	2
UK (England + Wales)	-	-	-			-		
Estonia	-	-	22					
Total	3,366	2,617	2,544	2557	1175	60	1,324	24

	2004[1]
Faroe Islands	-
Denmark	-
France	-
Germany	-
Norway	42
Russia	
UK (England + Wales)	-
Estonia	-
Total	42

[1]Preliminary.
[2]Included in Subarea IV.
[3]Includes catches in Division Vb.

Table 1.4.3.2 Landings (t) of HORSE MACKEREL in North Sea Subarea IV and Skagerrak Division IIIa by country. (Data submitted by Working Group members). Catches partly concern the North Sea horse mackerel.

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	2004[1]
Belgium	19	21	19	19	1,004	5	4
Denmark	2,048	8,006	4,409	2,288	1,393	3,774	8,735
Estonia	22	-	-				
Faroe Islands	28	908	24	-	699	809	
France	379	60	49	48	-	392	174
Germany	4,620	4,071	3,115	230	2,671	3,048	4,905
Ireland	-	404	103	375	72	93	379
Netherlands	3,811	3,610	3,382	4,685	6,612	17,354	21,418
Norway	13,129	44,344	1,246	7,948	35,368	20,493	10,709
Russia	-	-	2	-	-	-	
Sweden	3,411	1,957	1,141	119	575	1,074	665
UK (Engl. + Wales)	2	11	15	317	1,191	1,192	2,552
UK (Scotland)	3,041	1,658	3,465	3,161	255	1	1
Unallocated + discards	737	-325	14613	649	-149	-14,009	-19,103
Total	31,247	64,725	31583	19,839	49,691	34,226	30,435

[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 -4000 t.

Table 1.4.3.3 Landings (t) of HORSE MACKEREL in Subarea VI by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Denmark	734	341	2,785	7	-	-	-	769	1,655
Faroe Islands	-	-	1,248	-	-	4,014	1,992	4,450[3]	4,000[3]
France	45	454	4	10	14	13	12	20	10
Germany, Fed. Rep.	5,550	10,212	2,113	4,146	130	191	354	174	615
Ireland	-	-	-	15,086	13,858	27,102	28,125	29,743	27,872
Netherlands	2,385	100	50	94	17,500	18,450	3,450	5,750	3,340
Norway	-	5	-	-	-		83	75	41
Spain	-	-	-	-	-		-[2]	-[2]	-[2]
UK (Engl. + Wales)	9	5	+	38	+	996	198	404	475
UK (N. Ireland)						-	-	-	-
UK (Scotland)	1	17	83	-	214	1,427	138	1,027	7,834
USSR	-	-	-		-	-	-	-	-
Unallocated + disc.						-19,168	-13,897	-7,255	-
Total	8,724	11,134	6,283	19,381	31,716	33,025	20,455	35,157	45,842

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	973	615	-	42	-	294	106	114	780
Faroe Islands	3,059	628	255	-	820	80	-	-	-
France	2	17	4	3	+	-	-	-	52
Germany, Fed. Rep.	1,162	2,474	2,500	6,281	10,023	1,430	1,368	943	229
Ireland	19,493	15,911	24,766	32,994	44,802	65,564	120,124	87,872	22,474
Netherlands	1,907	660	3,369	2,150	590	341	2,326	572	498
Norway	-	-	-	-	-	-	-	-	-
Spain	-2	-2	1	3	-	-	-	-	-
UK (Engl. + Wales)	44	145	1,229	577	144	109	208	612	56
UK (N.Ireland)	-	-	1,970	273	-	-	-	-	767
UK (Scotland)	1,737	267	1,640	86	4,523	1,760	789	2,669	14,452
USSR/Russia (1992-)	-	44	-	-	-	-	-	-	-
Unallocated + disc.	6,493	143	-1,278	-1,940	-6,960[4]	-51	-41,326	-11,523	837
Total	34,870	20,904	34,456	40,469	53,942	69,527	83,595	81,259	40,145

Country	1998	1999	2000	2001	2002	2003	2004[1]
Denmark	-	-	-	-	-	-	-
Faroe Islands	-	-	-	-	-	-	-
France	221	25,007	-	428	55	209	172
Germany	414	1,031	209	265	149	1,337	1,413
Ireland	21,608	31,736	15,843	20,162	12,341	20,915	15,702
Netherlands	885	1,139	687	600	450	847	3,701
Spain	-	-	-	-	-	-	-
UK (Engl. + Wales)	10	344	41	91	-	46	5
UK (N.Ireland)	1,132	-	-			453	
UK (Scotland)	10,447	4,544	1,839	3,111	1,192		377
Unallocated +disc.	98	1,507	2,038	-21	3	-553	559
Total	34,815	65,308	20,657	24,636	14,190	23,254	21,929

[1]Preliminary.
[2]Included in Subarea VII.
[3]Includes Divisions IIIa, IVa,b and VIb.
[4]Includes a negative unallocated catch of -7000 t.

Table 1.4.3.4 Landings (t) of HORSE MACKEREL in Subarea VII by country. Data submitted by the Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	-	1	1	-	-	+	+	2	-
Denmark	5,045	3,099	877	993	732	1,477[2]	30,408[2]	27,368	33,202
France	1,983	2,800	2,314	1,834	2,387	1,881	3,801	2,197	1,523
Germany, Fed.Rep.	2,289	1,079	12	1,977	228	-	5	374	4,705
Ireland	-	16	-	-	65	100	703	15	481
Netherlands	23,002	25,000	27,500[2]	34,350	38,700	33,550	40,750	69,400	43,560
Norway	394	-	-	-	-	-	-	-	-
Spain	50	234	104	142	560	275	137	148	150
UK (Engl. + Wales)	12,933	2,520	2,670	1,230	279	1,630	1,824	1,228	3,759
UK (Scotland)	1	-	-	-	1	1	+	2	2,873
USSR	-	-	-	-	-	120	-	-	-
Total	45,697	34,749	33,478	40,526	42,952	39,034	77,628	100,734	90,253

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Faroe Islands	-	28	-	-	-	-	-	-	-
Belgium	-	+	-	-	-	1	-	-	18
Denmark	34,474	30,594	28,888	18,984	16,978	41,605	28,300	43,330	60,412
France	4,576	2,538	1,230	1,198	1,001	-	-	-	27,201
Germany, Fed.Rep.	7,743	8,109	12,919	12,951	15,684	14,828	17,436	15,949	28,549
Ireland	12,645	17,887	19,074	15,568	16,363	15,281	58,011	38,455	43,624
Netherlands	43,582	111,900	104,107	109,197	157,110	92,903	116,126	114,692	81,464
Norway	-	-	-	-	-	-	-	-	-
Spain	14	16	113	106	54	29	25	33	-
UK (Engl. + Wales)	4,488	13,371	6,436	7,870	6,090	12,418	31,641	28,605	17,464
UK (N.Ireland)	-	-	2,026	1,690	587	119	-	-	1,093
UK (Scotland)	+	139	1,992	5,008	3,123	9,015	10,522	11,241	7,931
USSR / Russia (1992-)	-	-	-	-	-	-	-	-	-
Unallocated + discards	28,368	7,614	24,541	15,563	4,0103	14,057	68,644	26,795	58,718
Total	135,890	192,196	201,326	188,135	221,000	200,256	330,705	279,100	326,474

Country	1998	1999	2000	2001	2002	2003	2004[1]
Faroe Islands	-	-	550	-	-	-	-
Belgium	18	-	-	-	1	-	+
Denmark	25,492	19,223	13,946	20,574	10,094	10,867	11,529
France	24,223	-	20,401	11,049	6,466	7,199	8,083
Germany	25,414	15,247	9,692	8,320	10,812	13,873	16,352
Ireland	51,720	25,843	32,999	30,192	23,366	13,533	8,470
Netherlands	91,946	56,223	50,120	46,196	37,605	48.222	41,123
Spain	-	-	50	7	0	1	27
UK (Engl. + Wales)	12,832	8,885	2,972	8,901	5,525	4,186	7,178
UK (N.Ireland)	-	-	-	-	-		
UK (Scotland)	5,095	4,994	5,152	1,757	1,461	268	1,146
Unallocated + discards	12,706	31,239	1,884	11,046	2,576	24,897	18,485
Total	249,446	161,654	137,766	138,042	97,906	123,046	112,393

[1]Provisional.
[2]Includes Subarea VI.

Table 1.4.3.5 Landings (t) of HORSE MACKEREL in Subarea VIII by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Denmark	-	-	-	-	-	-	446	3,283	2,793
France	3,361	3,711	3.073	2,643	2,489	4,305	3,534	3,983	4,502
Netherlands	-	-	-	-	-[2]	-[2]	-[2]	-[2]	-
Spain	34,134	36,362	19,610	25,580	23,119	23,292	40,334	30,098	26,629
UK (Engl. + Wales)	-	+	1	-	1	143	392	339	253
USSR	-	-	-	-	20	-	656	-	-
Total	37,495	40,073	22,684	28,223	25,629	27,740	45,362	37,703	34,177

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	6,729	5,726	1,349	5,778	1,955	-	340	140	729
France	4,719	5,082	6,164	6,220	4,010	28	-	7	8,690
Germany, Fed. Rep.	-	-	80	62	-		-	-	-
Netherlands	-	6,000	12,437	9,339	19,000	7,272	-	14,187	2,944
Spain	27,170	25,182	23,733	27,688	27,921	25,409	28,349	29,428	31,081
UK (Engl. + Wales)	68	6	70	88	123	753	20	924	430
USSR/Russia (1992 -)	-	-	-	-	-	-	-	-	-
Unallocated + discards	-	1,500	2,563	5,011	700	2,038	-	3,583	-2,944
Total	38,686	43,496	46,396	54,186	53,709	35,500	28,709	48,269	40,930

Country	1998	1999	2000	2001	2002	2003	2004[1]
Denmark	1,728	4,818	2,584	582	-	-	
France	1,844	74	7	5,316	13,676	-	2,161
Germany	3,268	3,197	3,760	3,645	2,249	4,908	72
Ireland	-	-	6,485	1,483	704	504	1,882
Netherlands	6,604	22,479	11,768	36,106	12,538	1,314	1,047
Russia	-	-	-	-	-	6,620	
Spain	23,599	24,190	24,154	23,531	22,110	24,598	16,245
UK (Engl. + Wales)	9	29	112	1,092	157	982	516
UK (Scotland)	-	-	249	-	-	-	
Unallocated + discards	1,884	-8658	5,093	4,365	1,705	2,785	2,202
Total	38,936	46,129	54,212	76,120	54,560	41,711	24,125

[1]Preliminary.
[2]Included in Subarea VII.

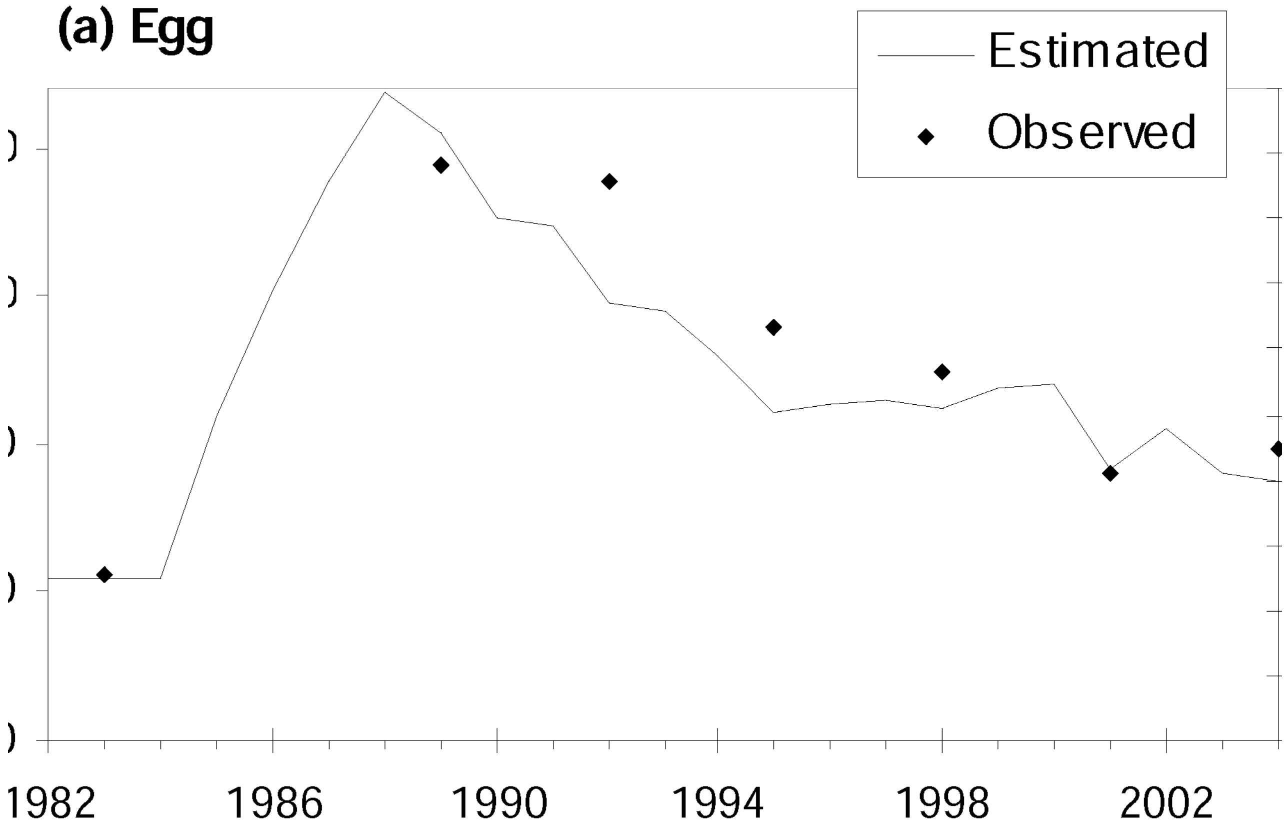


Figure 1.4.3.1 Relative index of the stock spawning biomass (Estimated line) compared to the trend observed in the egg production in the survey (Observed points).

1.4.4 Blue whiting combined stock (Subareas I–IX, XII, and XIV)

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 unsustainably		

Based on the most recent estimates of fishing mortality and SSB, ICES classifies the stock as having full reproductive capacity, but being harvested unsustainably. SSB increased to a historical high in 2003 but has decreased in 2004 and 2005. Although the estimates of SSB and fishing mortality are uncertain, the estimate of SSB appears to be well above $\mathbf{B}_{pa}$. The estimated fishing mortality is well above $\mathbf{F}_{pa}$, and is estimated to have exceeded $\mathbf{F}_{lim}$ in 2004. Recruitment in the last decade appears to be at a much higher level than earlier, and the good recruitment appears to have continued in 2004.

Management objectives

In 2002 the EU, Faroe Islands, Iceland, and Norway agreed a long-term management plan for the fisheries of the blue whiting stock aimed at constraining the harvest within safe biological limits and designed to provide for sustainable fisheries and a greater potential yield. The plan consisted of the following:

1. *Every effort shall be made to prevent the stock from falling below the minimum level of Spawning Stock Biomass (SSB) of 1 500 000 tonnes.*
2. *For 2003 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality less than 0.32 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of the fishing mortality rate.*
3. *Should the SSB fall below a reference point of 2 250 000 tonnes ($\mathbf{B}_{pa}$) the fishing mortality rate, referred to under paragraph 1, shall be adapted in the light of scientific estimates of the conditions then prevailing. Such an adaptation shall ensure a safe and rapid recovery of the SSB to a level in excess of 2 250 000 tonnes.*
4. *In order to enhance the potential yield, the Parties shall implement appropriate measures, which will reduce catches of juvenile blue whiting.*
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 plan as a whole has not been implemented, because it has not been agreed between all countries participating in the fishery. The combined total of the catches exceeds the provisions of the agreed management plans.

ICES has not evaluated the management plan in relation to the precautionary approach.

Reference points

(established in 1998)

	ICES considers that:	ICES proposed that:
Limit reference points	$\mathbf{B}_{lim}$ is 1.5 mill t	$\mathbf{B}_{pa}$ be set at 2.25 million t
	$\mathbf{F}_{lim}$ is 0.51	$\mathbf{F}_{pa}$ be set at 0.32
Target reference points		$\mathbf{F}_{y}$ is not identified

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.57	0.053	0.11
$\mathbf{F}_{max}$	undefined		
$\mathbf{F}_{0.1}$	0.28	0.050	0.18

Technical basis:

$\mathbf{B}_{lim}$: $\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim}$ exp(1.645*σ), with σ = 0.25
$\mathbf{F}_{lim}$: $\mathbf{F}_{loss}$	$\mathbf{F}_{pa}$: $\mathbf{F}_{med}$ (1998)
	$\mathbf{F}_{y}$:

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

Fishing within the limits of the management plan (F=0.32) implies catches of less than 1.5 million t in 2006. This will also result in a high probability that the spawning stock biomass in 2007 will be above $\mathbf{B}_{pa}$. The present fishing level is well above levels defined by the management plan and should be reduced. The management plan point 4 calls for a reduction of the catch of juvenile blue whiting which has not been taken place. The primarily approach to reduce catch of juveniles is to reduce overall fishing mortality. Catches of juveniles in the last 4 years are much greater than in earlier periods. If an overall reduction of fishing mortality cannot be achieved then specific measures should be taken to protect juveniles.

Exploitation boundaries in relation to precautionary limits

Exploitation boundaries in relation to precautionary limits are the same as the exploitation boundaries in relation to the existing management plan.

Short-term implications

Outlook for 2006

Basis: Catch(2005) = 2 Mt (Catch constraint, best estimate); F(2005) = 0.47; SSB(2005) = 5.0 Mt.
The fishing mortality applied according to the agreed management plan (F(management plan)) is 0.32.
The maximum fishing mortality which would be in accordance with precautionary limits (F (precautionary limits)) is 0.32.

Rationale	Catch (2006)[1]	Basis	F (2006)	SSB (2006)	SSB (2007)	%SSB change [1)]	% TAC change
Zero catch	0	F=0	0	5.5	7.1	29	
Target reference point		$\mathbf{F}_{target}$ or $\mathbf{B}_{target}$					
Status quo	2.4	$\mathbf{F}_{sq}$	0.57	4.9	4.4	-10	
Agreed management plan	0.2	F(man. plan) * 0.1	0.03	5.5	6.9	26	
	0.4	F(man. plan) * 0.25	0.08	5.4	6.6	22	
	0.8	F(man. plan) * 0.50	0.16	5.3	6.2	16	
	1.1	F(man. plan) * 0.75	0.24	5.2	5.8	10	
	1.3	F(man. plan) * 0.90	0.29	5.2	5.6	7	
	1.5	F(man. plan)	0.32	5.2	5.4	5	
	1.6	F(man. plan) * 1.1	0.35	5.1	5.3	3	
	1.8	F(man. plan) * 1.25	0.40	5.1	5.1	0	

Weights in million tonnes.
Shaded scenarios are not considered consistent with the precautionary approach.

Management considerations

Total landings in 2004 were 2.4 million t, almost the same as in 2003. Recent large landings are supported by the current high recruitments, and are much higher than in earlier years. Most of the catches are taken in the spawning and post-spawning areas along the continental edge, and in the Norwegian Sea. In the latter, the share of the total catch has increased from 5% in the mid-nineties to about 40% in 2003 and 2004. A larger proportion of the catch there consists of young fish. As a result, the age structure in the stock has changed considerably, and the stock now largely misses fish older than 6 years.

The fishing effort is much above what the stock can sustain if it returns to a lower recruitment regime. Now only a few year classes support the fishery and the spawning biomass, which makes the stock very vulnerable to overfishing. In this respect there is an urgent need for the implementation of the agreed management plan, a reduction in fishing effort and a close monitoring of the stock. Immediate management action is required if smaller recruitments occur.

Factors affecting the fisheries and the stock

In 2002 to 2004, and in the absence of agreements on TACs and their allocation, the Coastal States (EU, Faeroe Islands, Iceland, and Norway) and the Russian Federation implemented unilateral measures to limit blue whiting catches. TACs were set by EU, Norway, and Iceland. During 2003, EU increased its TAC for international waters by 250 000 t, and during 2004 by 350 000 t applicable to all areas. The fisheries by Russia and Faeroe Islands were not restricted by TACs.

Changes in fishing technology and fishing patterns

The fishing effort has increased substantially in the last 10 years, as have the catches. There has been a change in the fishing pattern with an increased proportion of juveniles in the catches and with a more northerly distribution of the fishery, where juveniles dominate.

Scientific basis

Data and methods

For blue whiting four assessment models were used to explore the data, and the results of all these approaches were similar in general. All models utilized catch-at-age data from commercial catches from 1981 onwards. Different survey time-series were available (1990–2005), but still none of the surveys cover the entire distribution area of the stock.

The exploration revealed a conflict between catch data and survey data. Models relying more on surveys estimated a larger spawning stock in recent years. This conflict in the data could not be resolved by the use of any of the models and leads to an additional source of uncertainty.

All four models make assumptions about the selection pattern, which may not be fully valid as the description of the fishery indicates substantial changes in the fishing pattern in the last 15 years. Within these assumptions the finally chosen model (AMCI model) allows for limited deviations from a constant exploitation pattern.

This year a number of recruitment indices were analyzed, and the conclusion was that reasonable estimates could be obtained for the most recent year classes (2003 and 2004 year class). However, none of the recruitment surveys cover the entire distribution area. For the final assessment, data from spawning ground surveys were used for 1990–2005, and from juvenile area surveys since 2000.

Information from the fishing industry

Information from the fishing industry suggests that catches in 2005 are about 20% lower than in 2003 and 2004. There are indications that the reduced catch is caused by a reduced availability of blue whiting (i.e. denser, but smaller schools), and/or by economic factors such as an increase in fuel prices.

Uncertainties in assessment and forecast

Conflicting signals in the catch and survey data influence the models in ways that could not be resolved. The assessment of blue whiting has been very uncertain in recent years with upward revisions of the historic perception of the stock size with every new assessment (Figure 1.4.4.1). This trend has been driven by exceptionally good recruitment compared to the earlier period, while at the same time little fishery-independent information has been available on the recruitment. However, the quality of the assessment and recruitment estimates have been improved this year, mostly due to a longer recruitment survey time-series, which could be used for the first time this year.

The uncertainty in the assessment conditional on the assessment model used this year (AMCI) is illustrated in Figure 1.4.4.2. It indicates interdependence of F and SSB and their variance estimated in bootstrap replicates.

Limited information was available on discarding. This was not included in the assessment, but it is not believed to impact the assessment.

Environmental conditions

Comparison with previous assessment and advice

The present assessment resulted – as in a few previous years – in a marked upward revision of the SSB.

Last year the advice was to limit catches to 1.1 million tonnes in order to achieve a fishing mortality of less than $\mathbf{F}_{pa}$ = 0.32. This year the advice is on a similar basis and corresponds to predicted landings of 1.5 million tonnes. The increase in predicted landings is due to the continued high recruitment in recent years.

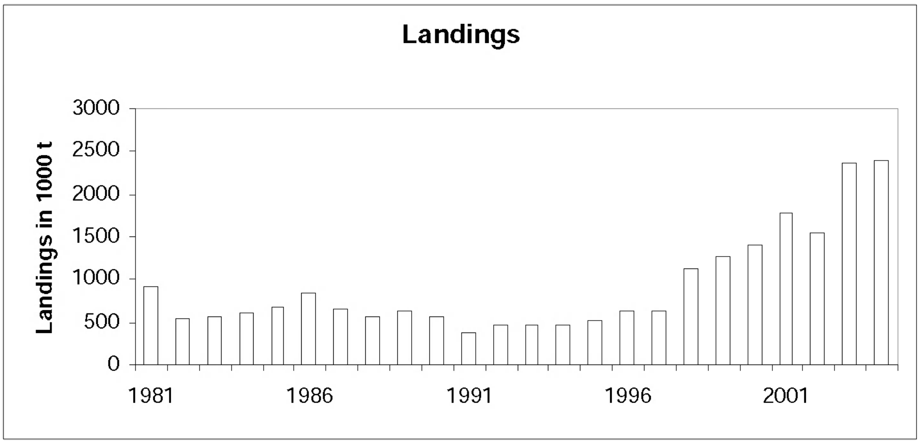
Source of information

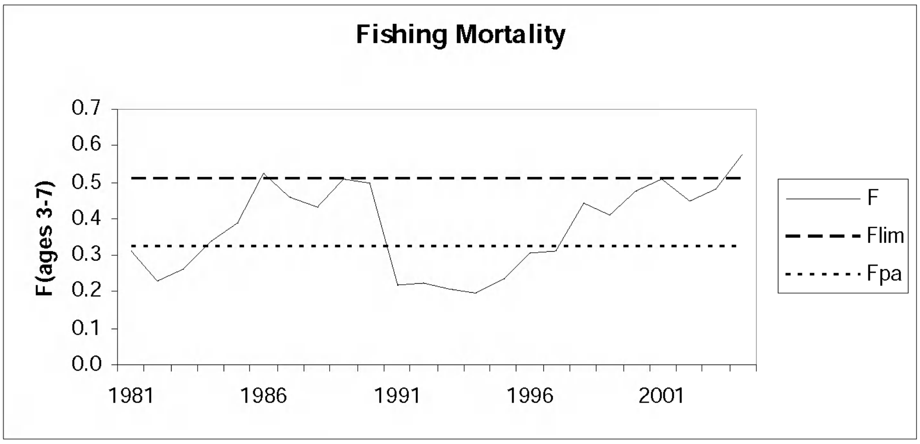
Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, 25 August–1 September 2005 (ICES CM 2006/ACFM:05).

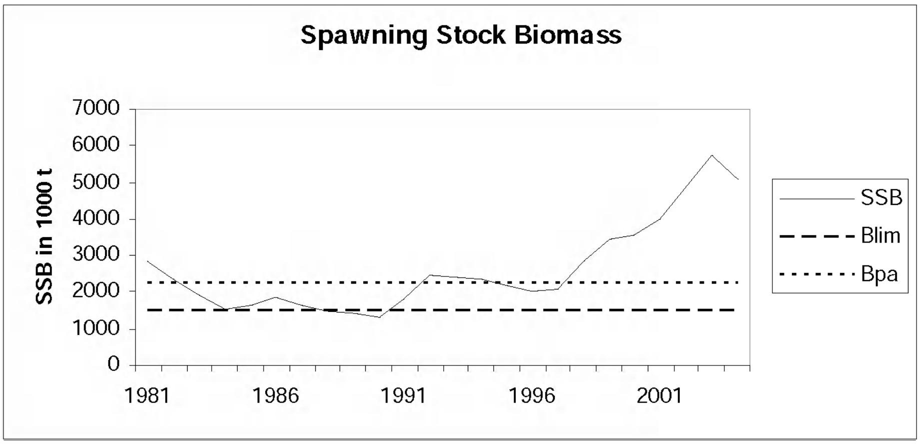
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM catch
1987	TAC for northern areas; no advice for southern areas	950	-	665
1988	TAC for northern areas; no advice for southern areas	832	-	558
1989	TAC for northern areas; no advice for southern areas	630	-	627
1990	TAC for northern areas; no advice for southern areas	600	-	562
1991	TAC for northern areas; no advice for southern areas	670	-	370
1992	No advice	-	-	475
1993	Catch at *status quo* F (northern areas); no assessment for southern areas	490	-	481
1994	Precautionary TAC (northern areas); no assessment for southern areas	485	650[1]	459
1995	Precautionary TAC for combined stock	518	650[1]	579
1996	Precautionary TAC for combined stock	500	650[1]	646
1997	Precautionary TAC for combined stock	540		672
1998	Precautionary TAC for combined stock	650		1125
1999	Catches above 650 000 t may not be sustainable in the long run	650		1256
2000	F should not exceed the proposed $\mathbf{F}_{pa}$	800		1412
2001	F should not exceed the proposed $\mathbf{F}_{pa}$	628		1780
2002	Rebuilding plan	0		1556
2003	F should be less than the proposed $\mathbf{F}_{pa}$	600		2321
2004	Achieve 50% probability that F will be less than $\mathbf{F}_{pa}$	925		2378
2005	Achieve 50% probability that F will be less than $\mathbf{F}_{pa}$	1075		
2006	F = F management plan	1500		

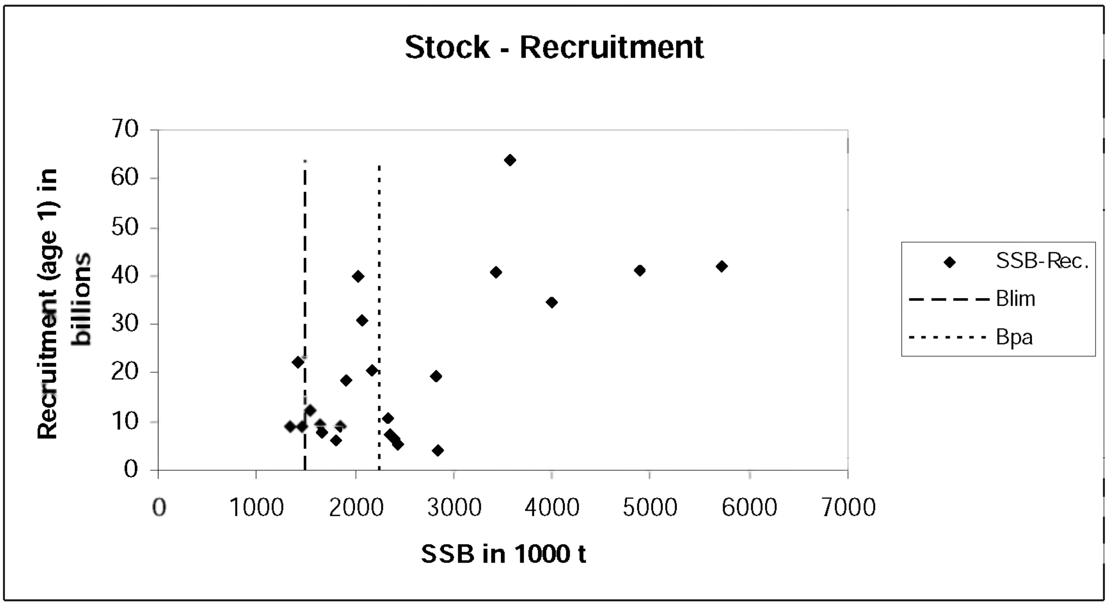
Weights in '000 t.
[1]NEAFC proposal for NEAFC regions 1 and 2.

Blue whiting combined stock (Subareas I–IX, XII, and XIV)








Stock - Recruitment
Recruitment (age 1) in billions
SSB in 1000 t
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
SSB-Rec.
Blim
Bpa

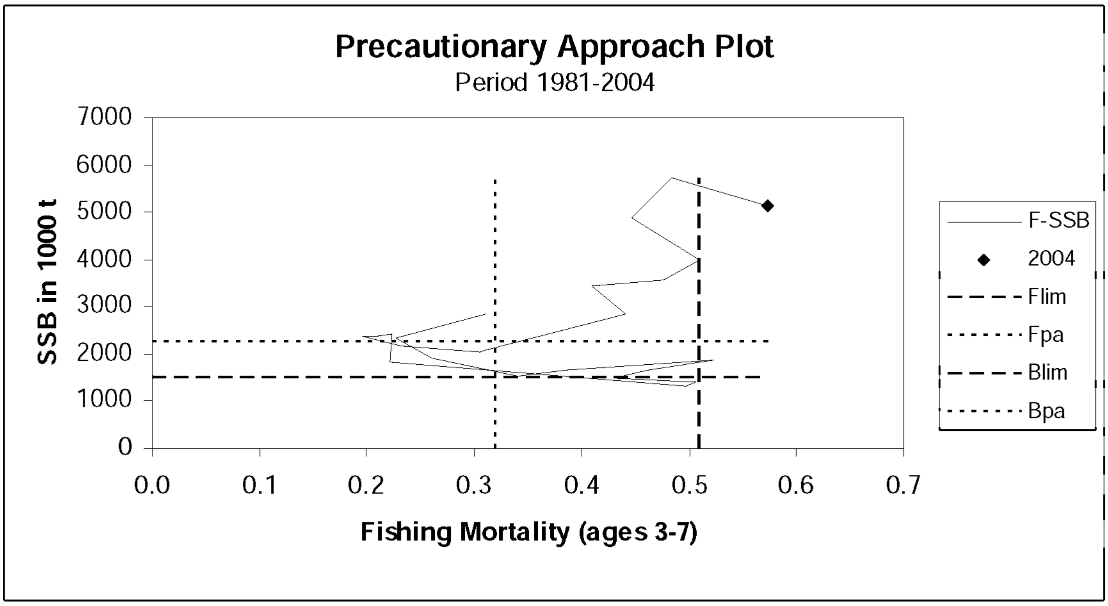

Precautionary Approach Plot
Period 1981-2004
SSB in 1000 t
Fishing Mortality (ages 3-7)
0
1000
2000
3000
4000
5000
6000
7000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
F-SSB
2004
Flim
Fpa
Blim
Bpa

Table 1.4.4.1 Landings (tonnes) of BLUE WHITING from the directed fisheries (Subareas I and II. Division Va, XIVa and XIVb 1987-2004, as estimated by the Working Group.

Country	1987	1988	1989 3)	1990	1991	1992	1993	1994 2)	1995 3)	1996	1997	1998	1999	2000	2001	2002	2003	2004
Denmark	-	-	-	-	-	-	-	-	-	-	-	-	15	7,721	5,723	13,608	38,226	23,437
Estonia	-	-	-	-	-	-	-	-	-	377	161	904	-	-	-	-	-	
Faroes	9,290	-	1,047	-	-	-	-	-	-	345	-	44,594	11,507	17,980	64,496	82,977	115,755	109,380
Germany	1,010	3	1,341	-	-	-	-	2	3	32	-	78	-	-	3117	1,072	813	488
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iceland	-	-	4,977	-	-	-	-	-	369	302	10,464	68,681 4)	96,295	155,024	245,814	195,483	312,334	322,247
Latvia	-	-	-	-	-	-	-	422	-	-	-	-	-	-	-	-		
Netherlands	-	-	-	-	-	-	-	-	72	25	-	63	435	-	5180	906	592	1,365
Norway 5)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64,581	100,922	215,075	302,166
Norway 6)	-	-	-	566	100	912	240	-	-	58	1,386	12,132	5,455	-	28,812	-	-	22167
Poland	56	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Scotland																		64
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	850	57,206	15,794
USSR/ Russia 1)	112,686	55,816	35,250	1,540	78,603	61,400	43,000	22,250	23,289	22,308	50,559	51,042	65,932	103,941	173,860	145,649	191,507	166,677
Total	123,042	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	177,494	179,639	284,666	591,583	541,467	931,508	963,785

1) From 1992 only Russia

2) Includes Vb for Russia.

3) Icelandic mixed fishery in Va.

4) include mixed in Va and directed in Vb.

5) Directed fishery

6) By-catches of blue whiting in other fisheries.

Table 1.4.4.2 Landings (tonnes) of BLUE WHITING from the directed fisheries (Subareas I and II, Division Va, XIVa and XIVb 1987-2004, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 [1)]	1999	2000	2001	2002	2003	2004
Denmark	2,655	797	25	-	-	3,167	-	770	-	269	-	5051	19,625	11,856	18,110	2,141	17,813	44,992
Estonia	-	-	-	-	-	6,156	1,033	4,342	7754	10,605	5,517	5,416	-	-	-	-	-	[4)]
Faroes	70,625	79,339	70,711	43,405	10,208	12,731	14,984	22,548	26,009	18,258	22,480	26,328	93,234	129,969	188,464	115,127	208,427	206,078
France	-	-	2,190	-	-	-	1,195	-	720	6,442	12,446	7,984	6,662	13,481	13,480	14,688	13,365	-
Germany	3,850	5,263	4,073	1,699	349	1,307	91	-	6,310	6,844	4,724	17,891	3,170	12,655	15,862	15,378	21,866	13,813
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	64,135	105,833	119,287	91,853	189,159	99,832
Ireland	3,706	4,646	2,014	-	-	781	-	3	222	1,709	25,785	45635	35,240	25,200	29,854	17,723	22,484	62,730
Japan	-	-	-	-	-	918	1,742	2,574	-	-	-	-	-	-	-	-	-	-
Latvia	-	-	-	-	-	10,742	10,626	2,160	-	-	-	-	-	-	-	-	-	-
Lithauen	-	-	-	-	-	-	2,046	-	-	-	-	-	-	-	-	-	-	-
Netherlands [2)]	5,627	800	2,078	7,280	17,359	11,034	18,436	21,076	26,703	17,644	23,676	27,884	35,408	46,128	68,415	33,365	45,239	82,520
Norway	191,012	208,416	258,386	281,036	114,866	148,733	198,916	226,235	261,272	337,434	318,531	519,622	475,004	460,274	399,932	385,495	502,320	486,843
UK (Scotland)	3,315	5,071	8,020	6,006	3,541	6,849	2,032	4,465	10,583	14,325	33,398	92,383	98,853	42,478	50,147	26,403	27,136	56,326
Sweden	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-
USSR/ Russia [3)]	165,497	121,705	127,682	124,069	72,623	115,600	96,000	94,531	83,931	64,547	68,097	79,000	112,247	141,257	141,549	144,419	163,812	179,400
Total	446,287	426,037	475,179	463,495	218,946	318,018	347,101	378,704	423,504	478,077	514,654	827,194	943,578	989,131	1,045,100	846,602	1,211,621	1,232,534

1) Including some directed fishery also in Division IVa.

2) Revised for the years 1987, 1988, 1989, 1992, 1995,1996,1997

3) From 1992 only Russia

4) Reported to the EU but not to the ICES WGNPBW. (Landings of 19,467 tonnes)

Table 1.4.4.3 Landings (tonnes) of BLUE WHITING from the directed fisheries and by-catches caught in other fisheries (Divisions IIIa, IV) 1987-2004, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993 [3]	1994	1995	1996	1997	1998 [2]	1999	2000	2001	2002	2003	2004
Denmark [4]	28,541	18,144	3,632	10,972	5,961	4,438	25,003	5,108	4,848	29,137	9,552	40,143	36,492	30,360	21,995			
Denmark [5]			22,973	16,080	9,577	26,751	16,050	14,578	7,591	22,695	16,718	16,329	8,521	7,749	7,505	35,530	26,896	21,071
Faroes [4) 6)]	7,051	492	3,325	5,281	355	705	1,522	1,794	-	6,068	6,066	-	-	-	60	7,317	5,712	6,864
Faroes [5) 6)]												296	265	42	6,741			
Germany [1]	115	280	3	-	-	25	9	-	-	-	-			-	81	-	36	19
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4		4
Netherlands	-	-	-	20	-	2	46	-	-	-	793			-	-	50	0	0
Norway [4]	24,969	24,898	42,956	29,336	22,644	31,977	12,333	3,408	78,565	57,458	27,394	28,814	48,338	73,006	21,804	85,062	117,145	107,311
Norway [5]															58,182			
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	-	-	
Scotland																		35
Sweden	2,013	1,229	3,062	1,503	1,000	2,058	2,867	3,675	13,000	4,000	4,568	9,299	12,993	3,319	2,086	17,689	8,326	3,289
UK	-	100	7	-	335	18	252	-	-	1	-	-	-	-	-	-	65	
Total	62,689	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881	106,609	114,476	118,523	145,652	158,180	138,593

[1]) Including directed fishery also in Division IVa.

[2]) Including mixed industrial fishery in the Norwegian Sea

[3]) Imprecise estimates for Sweden: reported catch of 34265 t in 1993 is replaced by the mean of 1992 and 1994, i.e. 2,867 t, and used in the assessment.

[4]) Directed fishery

[5]) By-catches of blue whiting in other fisheries.

[6]) For the periode 1987-2000 landings figures also include landings from mixed fisheries in Division Vb.

Table 1.4.4.4 Landings (tonnes) of BLUE WHITING from the Southerrn areas (Subareas VIII and IX and Division VIIg-k and VIId,e) 1987-2004, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600 [2)]	88 [2)]	973
Ireland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98 [2)]	96 [2)]	12,659
Netherlands	-	-	-	450	10	-	-	-	-	-	-	10 [1)]	-	-	-	3208 [2)]	2471,8 [2)]	11,426
Norway	4	-	-	-	-	-	-	-	-	-	-			-	-	-	-	39197
Portugal	9,148	5,979	3,557	2,864	2,813	4,928	1,236	1,350	2,285	3,561	2,439	1,900	2,625	2,032	1,746	1,659	2,651	3,937
Russia																		685
Scotland																		603
Spain	23,644	24,847	30,108	29,490	29,180	23,794	31,020	28,118	25,379	21,538	27,683	27,490	23,777	22,622	23,218	17,506	13,825	15,612
UK	23	12	29	13	-	-	-	5	-	-	-	-	-	-	-	-	181	
France	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	784	
Total	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,400	26,402	24,654	24,964	23,071	20,097	85,093

[1)] Directed fisheries in VIIIa

[2)] Landings reported as Directed fisheries and included in the Catch-at-Age calculations of that fisheries

Table 1.4.4.5 Total landings of blue whiting by country and area for 2004 in tonnes. Landing figures provided by Working Group members and these figures may not be official catch statistics and therefore cannot be used for management purposes.

Area	Denmark	Faroe Islands	France	Germany	Iceland	Ireland	Norway	Portugal	Russia	Scotland	Spain	Sweden	Netherlands	Grand Total
I							63							63
IIa	23,437	95,868		386	183,322		314,690		137,430	64		15,794	1,365	772,355
IIb				103	392		591		28,976					30,062
IIIa	4,274	53					383					2,730		7,440
IVa	16,368	6,627		19		4	106,344			35		532	0	129,929
IVb	429	184					584					27	0	1,224
IXa							0	3,937						3,937
Va		13,512			96,097		8,989							118,598
Vb	12,935	111,036		395	95,090	1,653	18,790		104,371	1,364			3,143	348,777
VIa	31,935	44,632		13,196		42,506	67,890			53,587			62,944	316,690
VIb					4,742		320,364		69,096					394,202
VIIa						0	0							0
VIIb				2		1,524	0			1,376			140	3,042
VIIc	122	47,247		220		15,538	69,616		871				16,293	149,906
VIIg						4	0							4
VIIIabd							0						131	131
VIIIc+IXa							0				15,612			15,612
VIIj				31		925	0			603			895	2,454
VIIk				942		11,730	39,197		685				10,400	62,955
XII		3,163				1,509	10,183		5,062					19,917
XIVb							0		271					271
Grand Total	89,500	322,322	1)	15,293	379,643	75,393	957,684	3,937	346,762	57,028	15,612	19,083	95,311	2,377,569

1) Reported to the EU but not to the ICES WGNPBW. (Landings of 19,467 tonnes)

Table 1.4.4.6 Blue whiting combined stock (Subareas I–IX, XII, and XIV).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1981	3634925	2840186	922980	0.3102
1982	4074635	2340060	550643	0.2275
1983	10886489	1903785	553344	0.2608
1984	18346767	1548446	615569	0.3409
1985	12241432	1651896	678214	0.3858
1986	9473497	1855547	847145	0.5231
1987	8982703	1655472	654718	0.4617
1988	7684032	1469257	552264	0.4306
1989	8938635	1412695	630316	0.5067
1990	22336699	1335867	558128	0.4962
1991	9008614	1803269	364008	0.2213
1992	6160528	2437900	474592	0.2242
1993	5525903	2385790	475198	0.2096
1994	6505223	2354832	457696	0.1960
1995	7617300	2180177	505175	0.2331
1996	20406428	2019352	621104	0.3047
1997	40137767	2062619	639680	0.3104
1998	30806559	2827013	1131954	0.4408
1999	19527741	3434783	1261033	0.4093
2000	40592635	3562036	1412449	0.4773
2001	64009279	4005004	1771805	0.5093
2002	34671620	4881275	1556954	0.4460
2003	41366871	5729501	2365319	0.4834
2004	41950091	5113236	2383503	0.5725
Average	19786932	2617083	915991	0.3742

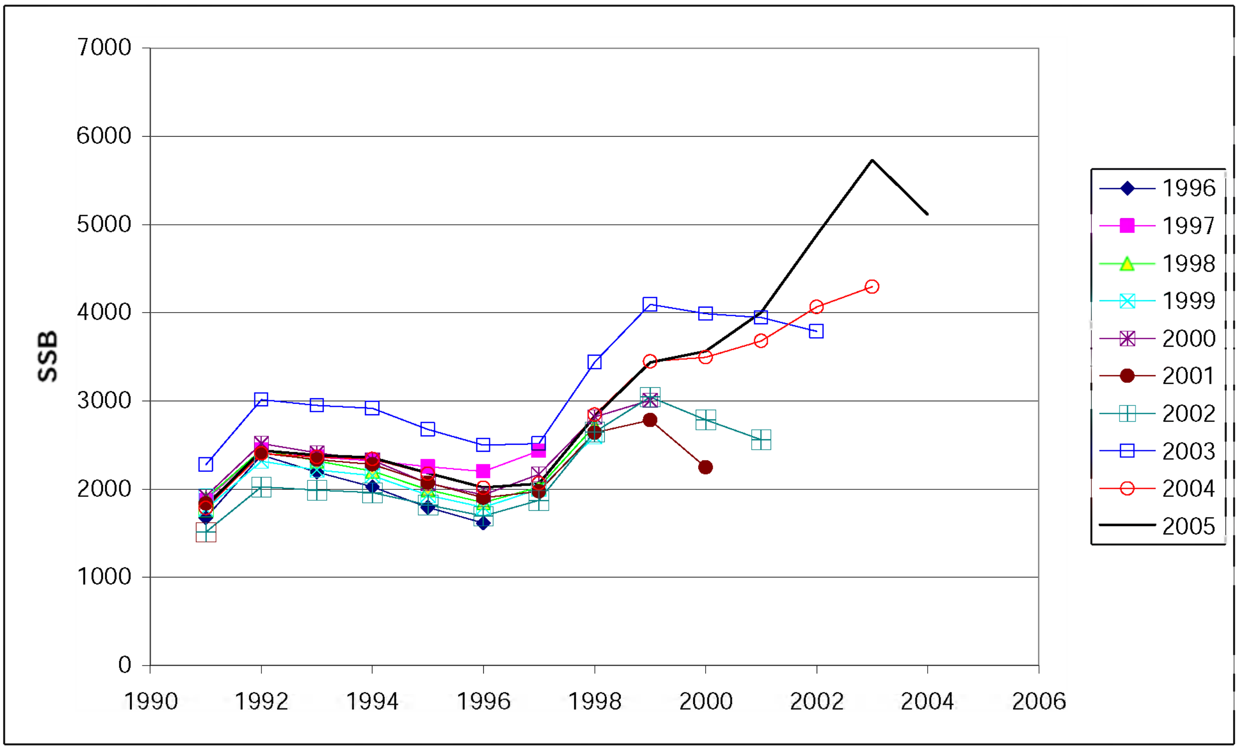


Figure 1.4.4.1 Estimates of SSB in historical assessments of the blue whiting stock (assessment year in the legend).

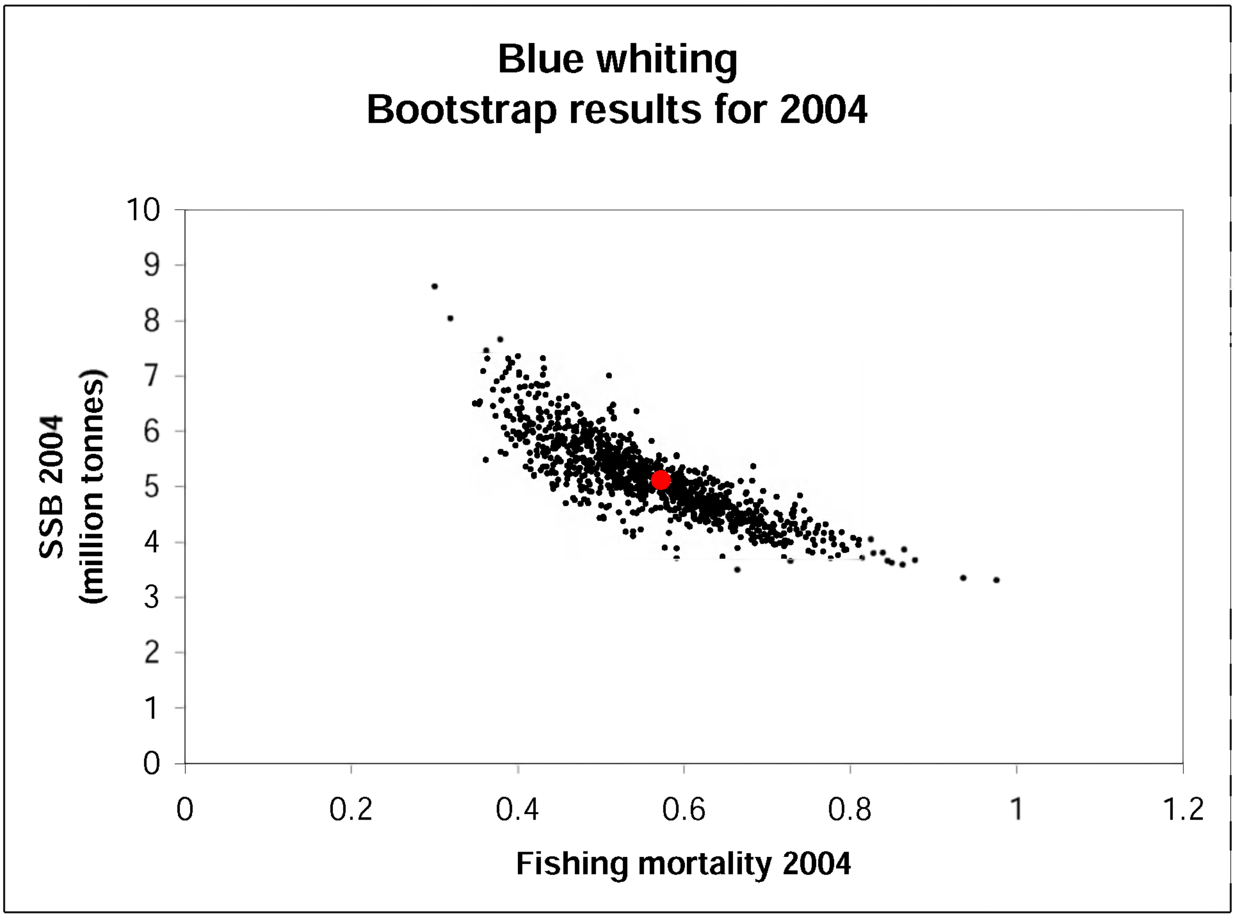


Figure 1.4.4.2 Interdependence between estimated SSB and fishing mortality in the terminal year in the AMCI bootstrap replicates.

1.4.5 Norwegian spring-spawning herring

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		

Based on the most recent estimates of SSB and fishing mortality, ICES classifies the stock as having full reproductive capacity and being harvested sustainably. The 1998 and 1999 year classes dominate the current spawning stock which is estimated at around 6.3 million t in 2005. The 2002 year class is estimated to be strong and will recruit to the fishery in 2006 and 2007. Preliminary indications show that the 2004 year class may also be strong.

Management objectives

The EU, Faroe Islands, Iceland, Norway, and Russia agreed to implement a long-term management plan. This plan consists of the following elements:

1. *Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the critical level ($\boldsymbol{B}_{lim}$) of 2 500 000 t.*
2. *For the year 2001 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of less than 0.125 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of this fishing mortality rate.*
3. *Should the SSB fall below a reference point of 5 000 000 t ($\boldsymbol{B}_{pa}$), the fishing mortality rate referred to under paragraph 2, shall be adapted in the light of scientific estimates of the conditions to ensure a safe and rapid recovery of the SSB to a level in excess of 5 000 000 t. The basis for such an adaptation should be at least a linear reduction in the fishing mortality rate from 0.125 at $\boldsymbol{B}_{pa}$ (5 000 000 t) to 0.05 at $\boldsymbol{B}_{lim}$ (2 500 000 t).*
4. *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 this agreement is consistent with the precautionary approach.

Reference points

	ICES considers that:	**ICES proposed that:**
Precautionary Approach reference points	$\mathbf{B}_{lim}$ is 2.5 million t	$\mathbf{B}_{pa}$ be set at 5.0 million t
	$\mathbf{F}_{lim}$ is not considered relevant for this stock	$\mathbf{F}_{pa}$ be set at F = 0.125

Target reference points

Management has defined a maximum fishing mortality at 0.125.

Technical basis:

$\mathbf{B}_{lim}$: MBAL	$\mathbf{B}_{pa}$: $=\mathbf{B}_{lim}$ * exp(0.4*1.645) (ICES Study Group 1998)
$\mathbf{F}_{lim}$: -	$\mathbf{F}_{pa}$: ICES Study Group 1998

Single-stock exploitation boundaries

Exploitation boundaries in relation to existing management plans

The management plan implies maximum catches of 732 000 t in 2006, which is expected to lead to a spawning stock of 7.7 million tonnes in 2007.

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

The target defined in the management plan is consistent with high long-term yield and has a low risk of depleting the production potential.

Exploitation boundaries in relation to precautionary limits

The current long-term management plan is considered to be consistent with the precautionary approach.

Short term implications

The catches calculated for 2006 are sensitive to the choice of the projected exploitation rate of the strong 2002 year class (4-year-old fish in 2006). The 2002 year class is special in that a part of it grew up in the Norwegian Sea, in contrast to all other recent strong year classes that grew up in the Barents Sea. The herring growth rate is significantly higher in the Norwegian Sea than in the Barents Sea. It is expected that this year class will mix with the older herring in the Norwegian Sea and therefore recruit early to the fishery. So for the purposes of estimating catches in 2006 the exploitation rate of this year class is assumed to be equal to that of the 2001 year class (5-year-old fish in 2006).

Outlook for 2006

Basis: Landings (2005) = 1.000[1)]; $\mathbf{F}_w(2005)$[2)] = $\mathbf{F}_{sq}$= 0.185; SSB(2005) = 6.133.
The fishing mortality applied according to the agreed management plan (F(management plan)) is 0.125.

Rationale	Landings (2006)	Basis	F(2006)	SSB(2006)	SSB(2007)
Zero catch	0	F=0	0	6489	8490
Status quo	1054	F(2005)	0.185	6384	7366
Agreed management plan	75	F(management plan)*0.1	0.013	6482	8411
	178	F(management plan)*0.25	0.031	6471	8301
	363	F(management plan)*0.50	0.063	6453	8105
	541	F(management plan)*0.75	0.094	6436	7916
	650	F(management plan)*0.90	0.113	6425	7800
	732	F(management plan)	0.125	6418	7712
	803	F(management plan)*1.1	0.138	6411	7637
	900	F(management plan)*1.25	0.156	6400	7535

Weights in '000 t.
1) There was no agreement on the allocations of the TAC in 2005. The sum of autonomous allocations from the individual Parties amounts to 1 000 664 t.
2) $\mathbf{F}_w$ = Fishing mortality weighted by population numbers.
Shaded scenarios are not considered consistent with the precautionary approach.

Management considerations

This stock has shown a large dependency on the occasional appearance of very strong year classes. In recent years the stock has tended to produce strong year classes more regularly. However, if strong year classes should become more intermittent, the stock is expected to decline.

There has been no international agreement on quota allocations in the two last years. This has led to an escalation in the F exerted on the stock (F2005>$\mathbf{F}_{pa}$), with the fisheries in 2005 probably ending close to 1 million tonnes, over 100 000 tonnes more than the TAC recommended under the long-term management plan (F=0.125).

Ecosystem considerations

Juveniles and adults of this stock form an important part of the ecosystems in the Barents Sea, the Norwegian Sea, and the Norwegian coast. The herring has an important role as transformer of the plankton production to higher trophic levels (cod, seabirds, and marine mammals). Recent changes in the herring migration have led to increased proportion feeding in Faeroese and Icelandic waters in the southwestern Norwegian Sea. The growth of these herring is faster than those feeding further east and north. A relationship between climate and herring growth is used to predict weights for the short-term forecast.

Factors affecting the fisheries and the stock

The effects of regulations

In the rebuilding phase of the stock in the 1980s and beginning of 1990s (SSB < MBAL = 2.5 million t), the objective was to keep the fishing mortality below 0.05. With the exception of a few years, this objective was followed. A minimum landing size regulation of 25 cm has been in place since 1977. This has avoided the exploitation of young herring. These regulations have contributed to a rebuilding of the stock to levels well above precautionary limits. When the fishery expanded in the mid-1990s, a long-term management plan was agreed; this plan is cited above.

For 2005 the coastal states (European Union, Faroe Islands, Iceland, Norway, and Russia) did not reach any agreement regarding the allocation of the quota. As per March 1st 2005 Norway increased its the quota by 14%. The increase was followed by Iceland and the Faroes. The sum of national quotas thus reached 1 million tonnes, which according to the current assessment leads to a fishing mortality exceeding $\mathbf{F}_{pa}$ (0.15).

Changes in fishing technology and fishing patterns

The main catches in 2004 were taken by Norway (477 000 t), Russia (116 000 t), Iceland (101 000 t), and Faroe Islands (43 000 t). Lesser catches were taken by EU fleets (55 000 t). The fishery in general follows the migration of the stock closely as it moves from the wintering and spawning grounds along the Norwegian coast to the summer feeding grounds in the Faroese, Icelandic, Jan Mayen, Svalbard, and international areas. The Norwegian fishery exploits the stock as it migrates to and remains in the wintering areas and during the spawning period. The Icelandic fishery takes place mainly in May, June, and July, and the catches were taken mainly in the international waters and in the Svalbard fishery protection zone. The main Russian catches are taken along the shelf region of the Norwegian EEZ in spring as the stock moves from the spawning grounds, and also in August and September in the eastern part of the international area and along the continental slope in the NE part of the Norwegian zone. The Faroese catches, taken in summer, are mainly from the international waters and the Svalbard fishery protection zone. Most of the EU catches are taken in the international area and the Svalbard fishery protection zone. A change in the migration pattern in 2004 with concentrations of herring in the Icelandic and Faroese zones in May was observed to be more pronounced in 2005, and the fishery for larger herring in this area increased during the 2005 season compared to 2004.

A large increase in fishing effort, new technology, and environmental changes contributed to the collapse of this stock around 1970. Recruitment failed in the second half of the 1960s when the SSB was reduced below 2.5 million t. Starting in 1989 a succession of above-average to very strong year classes were produced, promoting full recovery of the SSB and allowing an expansion of the fishery. Since 1992 the coastal fishery has increased sharply. Until 1994, the fishery was almost entirely confined to Norwegian coastal waters. During the summer of 1994 there were also catches in the offshore areas of the Norwegian Sea for the first time in 26 years. The geographical extent of this fishery increased in 1995, with nine nations participating and the total catch exceeding 900 000 t. The fishery expanded further in 1996 and the annual level of the fishery was in the order of 1.2–1.5 million t in the period 1996–2000. After 2000 the fishery has dropped to a level between 700–1000 thousand tonnes.

The environment

The Norwegian spring-spawning herring carries out extensive migrations in the NE Atlantic. Feeding has mainly taken place along the polar front from the island of Jan Mayen and northeastwards towards Bear Island. Over the last 25 years the southern and western Norwegian Sea has become colder and fresher while the eastern Norwegian Sea has warmed. In recent years the waters north and northeast of Iceland have warmed, although cold Arctic water again flowed south and eastwards during the winter 2004/2005. Average zooplankton biomass in the Norwegian Sea has decreased since 2002 and is now at a comparatively low level in the central Norwegian Sea. This is probably related to a low winter NAO index over the last years.

Scientific basis

Data and methods

The advice is based on an analytical assessment, which takes into consideration catch data, acoustic surveys of adults and juveniles, larval survey, and tagging data. This year the 2004 and 2005 summer survey estimates could be included in the assessment, due to a change in the timing of the WG meeting.

Different model formulations have been applied to assess this stock. The estimates of SSB and F are uncertain and sensitive to the choice of the model and the tuning data. After an overall evaluation, taking into account also that this assessment is an update of the one made last year, the SeaStar assessment was chosen as the final.

Uncertainties in assessment and forecast

There is a strong retrospective pattern in the assessment, leading to an overestimation of the spawning stock biomass. There are also difficulties in predicting maturity-at-age and the selection pattern of the big 2002 year class, which shows a very different spatial distribution compared to all year classes in recent decades. This uncertainty will, however, not affect the perception of the SSB in relation to precautionary limits.

An alternative model suggests a ca. 15% higher SSB in 2004, which leads to significantly higher catch opportunities for 2006. This is considered to be in the range of the uncertainty of the assessment.

There is an apparent shift in wintering areas and partly summer feeding areas for this stock. These dynamics could affect the survey results, which in return would affect the assessment.

Comparison with previous assessment and advice

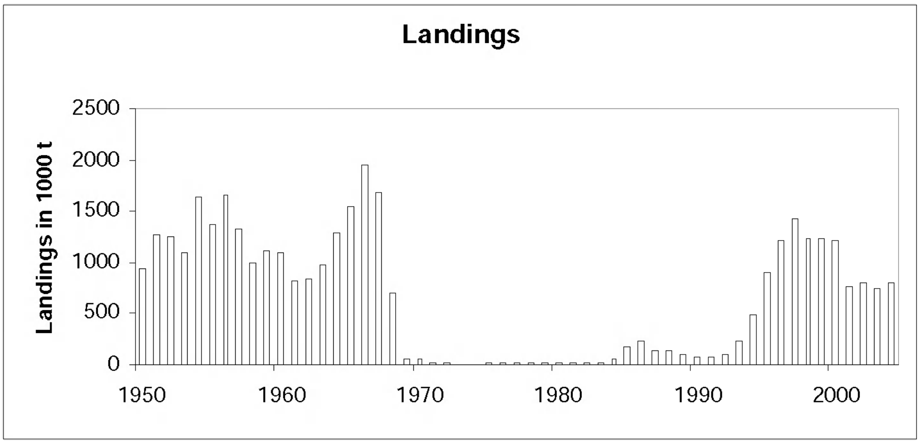
The assessment of the Norwegian spring-spawning herring was done using the same model as last year. This year's assessment gives a small downward revision of SSB (10–15% in the four most recent years) relative to last year's assessment.

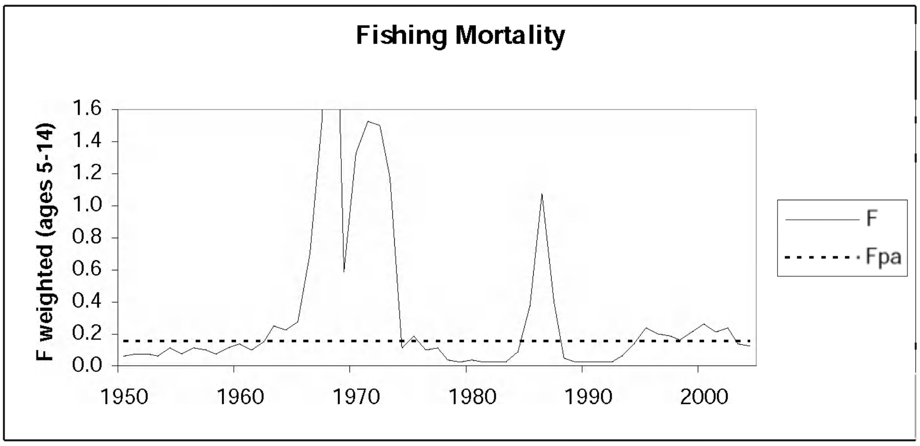
Source of information

Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, 25 August–1 September 2005 (ICES CM 2006/ACFM:05).

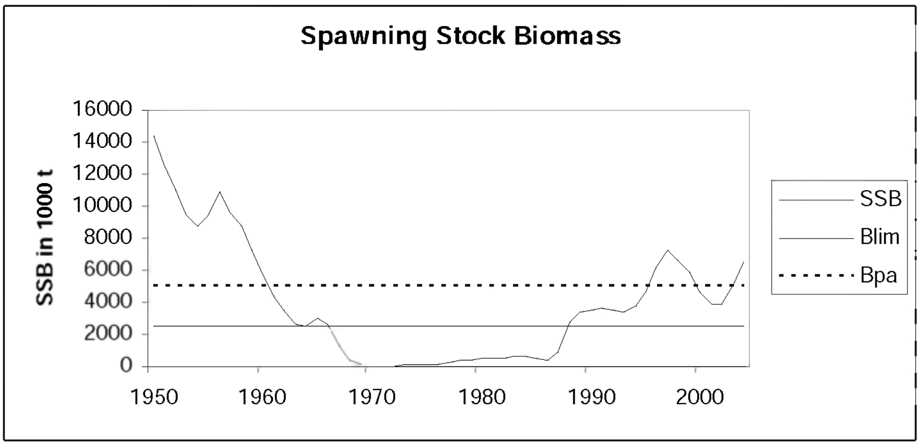
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	TAC	150	115	127
1988	TAC	120–150	120	135
1989	TAC	100	100	104
1990	TAC	80	80	86
1991	No fishing from a biological point of view	0	76	85
1992	No fishing from a biological point of view	0	98	104
1993	No increase in F	119	200	232
1994	Gradual increase in F towards $\mathbf{F}_{0.1}$; TAC suggested	334	450	479
1995	No increase in F	513	None[1]	906
1996	Keep SSB above 2.5 million t	-	None[2]	1 217
1997	Keep SSB above 2.5 million t	-	1 500	1 420
1998	Do not exceed the harvest control rule	-	1 300	1 223
1999	Do not exceed the harvest control rule	1 263	1 300	1 235
2000	Do not exceed the harvest control rule	Max 1 500	1 250	1 207
2001	Do not exceed the harvest control rule	753	850	770
2002	Do not exceed the harvest control rule	853	850	809
2003	Do not exceed the harvest control rule	710	711[3]	773
2004	Do not exceed the harvest control rule	825	825[3]	794
2005	Do not exceed the harvest control rule	890	1.000[3]	
2006	Do not exceed the harvest control rule	732		

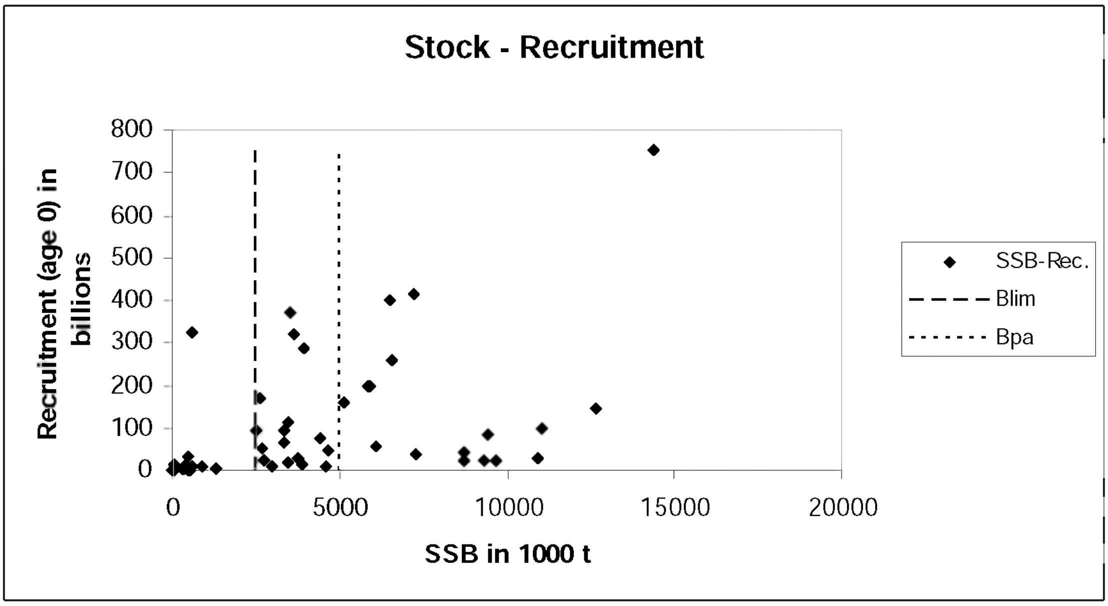
Weights in '000 t.
[1]Autonomous TACs totaling 900 000 t.
[2]Autonomous TACs totaling 1 425 000 t were set by April 1996.
[3] There was no agreement on the TAC, the number is the sum of autonomous quotas from the individual Parties.


Landings
Landings in 1000 t
2500
2000
1500
1000
500
0
1950
1960
1970
1980
1990
2000

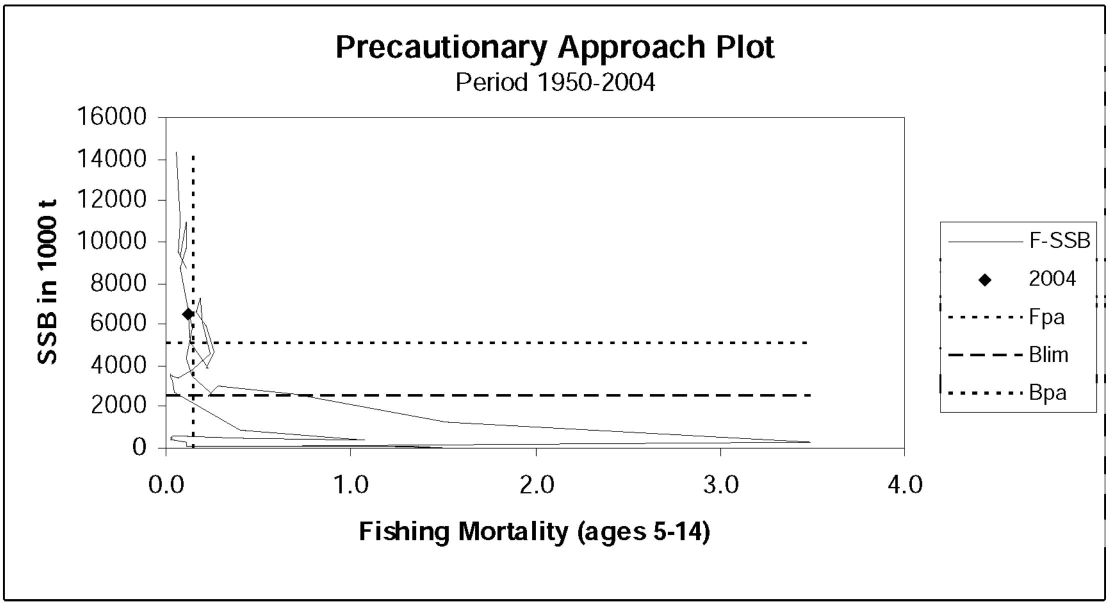

Fishing Mortality
F weighted (ages 5-14)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1950
1960
1970
1980
1990
2000
F
Fpa


Recruitment (age 0)
Recruitment in billions
800
700
600
500
400
300
200
100
0
1950
1960
1970
1980
1990
2000


Spawning Stock Biomass
SSB in 1000 t
16000
14000
12000
10000
8000
6000
4000
2000
0
1950
1960
1970
1980
1990
2000
SSB
Blim
Bpa



Stock - Recruitment
Recruitment (age 0) in billions
800
700
600
500
400
300
200
100
0
0
5000
10000
15000
20000
SSB in 1000 t
SSB-Rec.
Blim
Bpa



Precautionary Approach Plot
Period 1950-2004
SSB in 1000 t
16000
14000
12000
10000
8000
6000
4000
2000
0
0.0
1.0
2.0
3.0
4.0
Fishing Mortality (ages 5-14)
F-SSB
2004
Fpa
Blim
Bpa

Table 1.4.5.1 Total catch of Norwegian spring-spawning herring (tonnes) since 1972. Data provided by Working Group members.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireland	Nether- lands	Greenland	UK	Germany	France	Poland	Sweden	Total
1972	13,161	-	-	-	-	-	-	-	-	-	-	-	-	13,161
1973	7,017	-	-	-	-	-	-	-	-	-	-	-	-	7,017
1974	7,619	-	-	-	-	-	-	-	-	-	-	-	-	7,619
1975	13,713	-	-	-	-	-	-	-	-	-	-	-	-	13,713
1976	10,436	-	-	-	-	-	-	-	-	-	-	-	-	10,436
1977	22,706	-	-	-	-	-	-	-	-	-	-	-	-	22,706
1978	19,824	-	-	-	-	-	-	-	-	-	-	-	-	19,824
1979	12,864	-	-	-	-	-	-	-	-	-	-	-	-	12,864
1980	18,577	-	-	-	-	-	-	-	-	-	-	-	-	18,577
1981	13,736	-	-	-	-	-	-	-	-	-	-	-	-	13,736
1982	16,655	-	-	-	-	-	-	-	-	-	-	-	-	16,655
1983	23,054	-	-	-	-	-	-	-	-	-	-	-	-	23,054
1984	53,532	-	-	-	-	-	-	-	-	-	-	-	-	53,532
1985	167,272	2,600	-	-	-	-	-	-	-	-	-	-	-	169,872
1986	199,256	26,000	-	-	-	-	-	-	-	-	-	-	-	225,256
1987	108,417	18,889	-	-	-	-	-	-	-	-	-	-	-	127,306
1988	115,076	20,225	-	-	-	-	-	-	-	-	-	-	-	135,301
1989	88,707	15,123	-	-	-	-	-	-	-	-	-	-	-	103,830
1990	74,604	11,807	-	-	-	-	-	-	-	-	-	-	-	86,411
1991	73,683	11,000	-	-	-	-	-	-	-	-	-	-	-	84,683
1992	91,111	13,337	-	-	-	-	-	-	-	-	-	-	-	104,448
1993	199,771	32,645	-	-	-	-	-	-	-	-	-	-	-	232,457
1994	380,771	74,400	-	2,911	21,146	-	-	-	-	-	-	-	-	479,228
1995	529,838	101,987	30,577	57,084	174,109	-	7,969	2,500	881	556	-	-	-	905,501
1996	699,161	119,290	60,681	52,788	164,957	19,541	19,664	-	46,131	11,978	-	-	22,424	1,220,283
1997	860,963	168,900	44,292	59,987	220,154	11,179	8,694	-	25,149	6,190	1,500	-	19,499	1,426,507
1998	743,925	124,049	35,519	68,136	197,789	2,437	12,827	-	15,971	7,003	605	-	14,863	1,223,131
1999	740,640	157,328	37,010	55,527	203,381	2,412	5,871	-	19,207	-	-	-	14,057	1,235,433
2000	713,500	163,261	34,968	68,625	186,035	8,939	-	-	14,096	3,298	-	-	14,749	1,207,201
2001	495,036	109,054	24,038	34,170	77,693	6,070	6,439	-	12,230	1,588	-	-	9,818	766,136
2002	487,233	113,763	18,998	32,302	127,197	1,699	9,392	-	3,482	3,017	-	1,226	9,486	807,795
2003	438,140	122,846	14,144	27,943	117,910	1,400	8,678	-	9,214	3,371	-	-	6,431	750,077
2004[1]	477,076	115,876	23,111	42,771	102,787	11	17,369	-	1,869	4,810		-	7,986	793,666

[1] Preliminary, as provided by Working Group members.

Table 1.4.5.2 Norwegian spring-spawning herring.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	F weighted Ages 5-14
1950	750680000	14359000	933000	0.058
1951	146355000	12635000	1278000	0.070
1952	96644000	11042000	1254000	0.073
1953	86102000	9457000	1091000	0.066
1954	42086000	8703000	1645000	0.113
1955	24971000	9324000	1360000	0.078
1956	29858000	10934000	1659000	0.110
1957	25397000	9661000	1320000	0.103
1958	23094000	8731000	987000	0.079
1959	412478000	7200000	1111000	0.113
1960	197514000	5853000	1102000	0.136
1961	76103000	4403000	830000	0.104
1962	19003000	3443000	849000	0.146
1963	168931000	2641000	985000	0.253
1964	93903000	2479000	1282000	0.226
1965	8491000	2996000	1548000	0.278
1966	51409000	2658000	1955000	0.696
1967	3947000	1304000	1677000	1.519
1968	5187000	318000	712000	3.493
1969	9785000	142000	68000	0.590
1970	661000	69000	62000	1.320
1971	236000	32000	21000	1.525
1972	957000	16000	13000	1.497
1973	12884000	86000	7000	1.173
1974	8631000	91000	8000	0.114
1975	2971000	79000	14000	0.190
1976	10068000	139000	10000	0.106
1977	5095000	288000	23000	0.111
1978	6201000	360000	20000	0.043
1979	12498000	391000	13000	0.024
1980	1474000	475000	19000	0.034
1981	1100000	509000	14000	0.022
1982	2343000	507000	17000	0.020
1983	322362000	579000	23000	0.029
1984	11528000	603000	54000	0.090
1985	35051000	502000	170000	0.379
1986	6041000	401000	225000	1.074
1987	8945000	877000	127000	0.404
1988	25009000	2738000	135000	0.045
1989	67357000	3335000	104000	0.029
1990	114598000	3490000	86000	0.022
1991	318995000	3628000	85000	0.025
1992	371421000	3496000	104000	0.029
1993	92042000	3352000	232000	0.068
1994	29993000	3775000	479000	0.139
1995	9773000	4592000	906000	0.240
1996	57485000	6113000	1220000	0.197
1997	37573000	7308000	1427000	0.187
1998	258857000	6564000	1223000	0.168
1999	196635000	5930000	1235000	0.212
2000	45323000	4635000	1207000	0.262
2001	16362000	3878000	766000	0.213
2002	288899000	3918000	808000	0.232
2003	160617000	5107000	750000	0.132
2004	401287000	6513000	794000	0.119
Average	94785636	3866527	655400	0.341

1.4.6 Northeast Atlantic spurdog

State of the stock

The stock is depleted. All experimental assessments indicate that the stock is at a record low level. The frequency of the occurrence of spurdog in trawl surveys has declined and although large shoals are still caught, the frequency of these has declined. The level of exploitation is unknown, but the continuous decline in landings indicates that fishing mortality has been, and continues to be well above sustainable levels.

Management objectives

None have been suggested or adopted.

Reference points

Not defined.

Single-stock exploitation boundaries

The stock is depleted and may be in danger of collapse. Target fisheries should not be permitted to continue, and bycatch 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.

Management considerations

Spurdogs are long-lived, slow growing, have a high age-at-maturity, and are particularly vulnerable to high levels of fishing mortality. Population productivity is low, with low fecundity and a protracted gestation period.

Spurdog in the ICES area is considered to be a single stock, ranging from the Barents Sea (ICES Subarea I) to the northern Bay of Biscay (ICES Division VIIIa).

Spurdog is largely taken as bycatch. TACs only regulate the landings. A low TAC on bycatch species could induce more discards. Because spurdog is caught as a bycatch in demersal fisheries, they would benefit from a reduction in overall demersal fishing effort.

Spurdog forms size- and sex-specific schools and these have been subject to directed fisheries specifically targeting large females. Because of the low population productivity, a ban on the catching of these large females is considered a minimum requirement for population rebuilding.

Ecosystem considerations

Spurdog is an important component of the pelagic and demersal ecosystems, preying on a variety of pelagic fishes, such as herring.

Factors affecting the fisheries and the stock

The effects of regulations

There is no international agreement on a TAC that covers the distribution area of northeast Atlantic spurdog.

A TAC has been introduced for the EU waters of Subarea IV and Division IIa in 1999. This TAC has been reduced from 8870 tonnes to 1136 tonnes in 2005.

Norway has a 70-cm maximum landing size, but it is not known if this is effective at reducing the exploitation of mature females.

Changes in fishing technology and fishing patterns

Landings increased to more than 60 000 tonnes in the early 1960s, when target fisheries took place in Scotland and Norway. Landings in the Norwegian directed longline fishery decreased during the 1970s. In the 1980s, international landings increased slightly due to directed fisheries by UK (longline) and Irish (gillnet) vessels. Landings declined from the late 1980s again. Most target fisheries have ceased due to low catch rates, though they still exist in certain areas and certain times as schools appear. Spurdog is now largely taken as a bycatch in mixed demersal trawl fisheries.

The environment

Studies in the Northwest Atlantic indicate that males tend to occupy deeper, more saline water than females, and that spurdog tends to prefer waters of 7–15°C.

Scientific basis

Data and methods

Survey data and landings data are available. A number of different methods have been explored, including surplus production models, separable age-based assessments, length-structured approaches, and frequency of occurrence in survey hauls. All methods indicate similar stock trends.

Uncertainties in assessment and forecast

Particular problems identified with the data include:

- uncertainties in the historical level of catches due to landings being reported by generic 'dogfish' categories;
- limited catch composition information from countries other than UK (E&W);
- the aggregating behaviour of spurdog means that trawl survey catch rates are highly variable, with many zero catches and occasional high catches. Hence, calculated CPUE series are unlikely to provide an accurate indication of stock size.

Information from the fishing industry

Those spurdog that are landed are mostly from a mixed demersal fishery. The fishing industry provided anecdotal information that catches recorded as spurdog and others mostly consist of spurdog only. Other demersal catches do not have spurdog in the hauls. Bycatches of spurdog in other fisheries (e.g. pelagic trawl) are likely, but these will not generally be landed.

Comparison with previous assessment and advice

This is the first year that ACFM has presented advice on this stock.

Source of information

Report of the Working Group on Elasmobranch Fishes 2005 (ICES CM 2006/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[2]
1991	None					29.4
1992	None					28.8
1993	None					23.2
1994	None					21
1995	None					20.2
1996	None					16.7
1997	None					15
1998	None					14.1
1999	None				8.9	11.2
2000	None				8.9	15.5*
2001	None				8.9	16.0*
2002	None				7.1	9.1
2003	None				5.6	8.8
2004	None				4.5	5.1
2005	None				1.1	
2006	TAC	F=0	0			

Weights in '000 t.
* May include some misreported deep-sea sharks or other species.
1) Landings for total stock area: Subareas I–VIII.
2) TAC for ICES Subarea IV and Division IIa (EC).

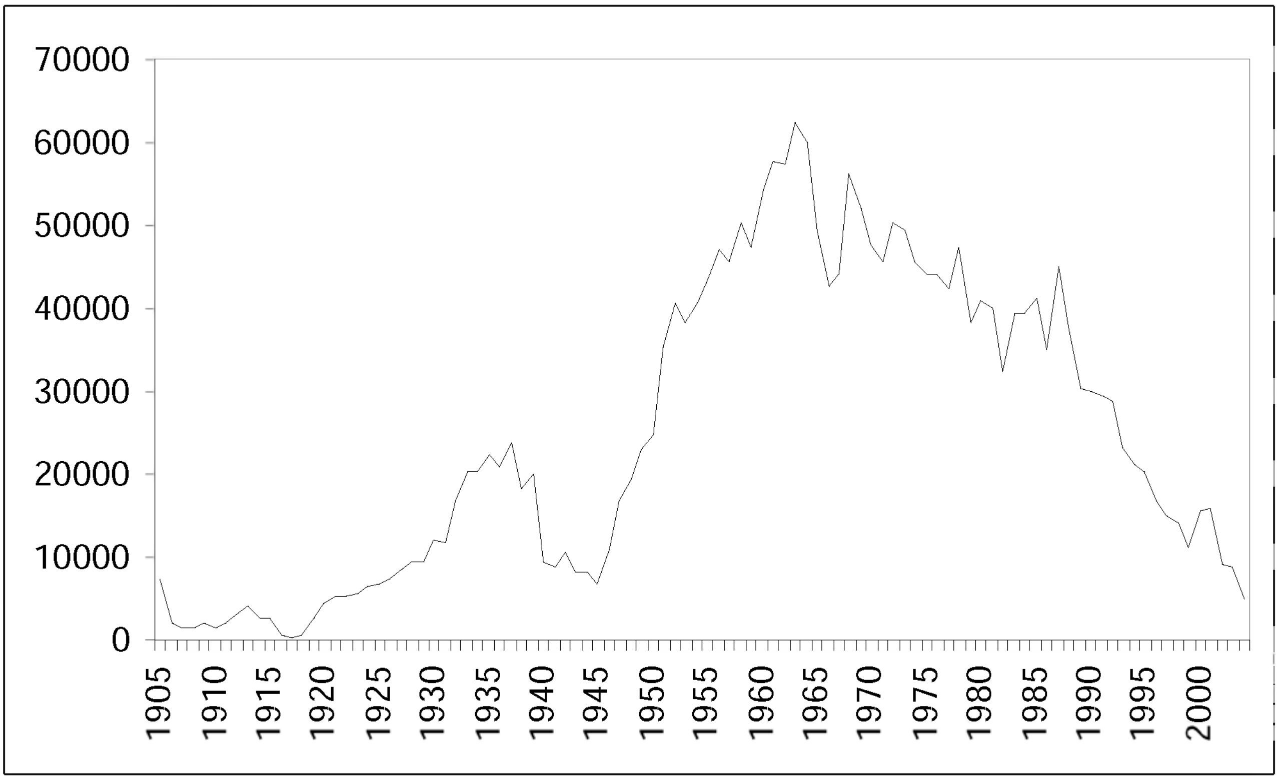


Figure 1.4.6.1 Landings of spurdog in the Northeast Atlantic (Subareas I–VIII).

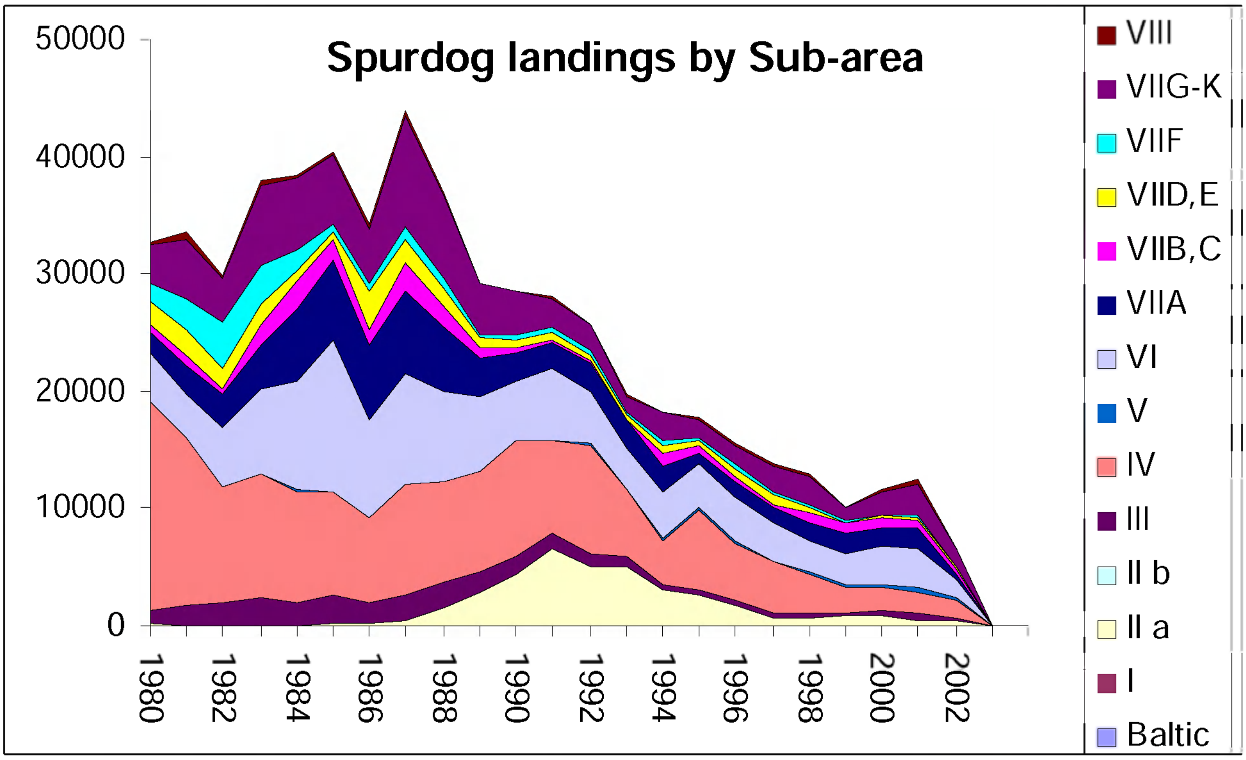


Figure 1.4.6.2 Recent landings of spurdog by area.

1.4.7 Northeast Atlantic porbeagle

State of the stock

There is no information to evaluate the stock status. The directed fishery for porbeagle stopped in the late 1970s due to very low catch rates. Sporadic small fisheries have occurred since that time. The high market value of this species means that a directed fishery would develop again if abundance increased. There are no indications of stock recovery.

Management objectives

None have been suggested or adopted.

Reference points

Not defined.

Single-stock exploitation boundaries

Given the apparent depleted state of this stock, no fishery should be permitted on this stock.

Management considerations

Porbeagle is a highly migratory and schooling species. Sporadic targeted fisheries develop on these schools and such fisheries are highly profitable.

Porbeagle catches are often only recorded as sharks without further detail of the species. If fishing on this stock is continued, a minimum requirement would be to record catches by species.

Effort has increased in recent years in pelagic longline fisheries for bluefin tuna (Japan, Republic of Korea, and Taiwan Province of China) in the North East Atlantic. These fisheries may take porbeagle as a bycatch. This fishery is likely to be efficient at catching considerable quantities of this species.

The productivity of the recently assessed NW Atlantic stock is likely to be similar to that of the NEA stock. Landings declined from over 8000 t to about 500 t by the early 1970s. Landings of around 350 t in the 1970s and 1980s appeared sustainable and the stock recovered slowly. In the 1990s, landings increased to about 2000 t annually, and the stock declined. It can be concluded that the recovery time for the NE Atlantic stock is likely to be at least as long (>25 years), even when catches are at the lowest possible level.

Factors affecting the fisheries and the stock

The effects of regulations

EC Regulation 1185/2003 prohibits the removal of shark fins of this species, and the subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters. For further details see Section 1.4.8 on basking shark.

Scientific basis

Data and methods

Landing data for porbeagle may be reported as "porbeagle", as "various sharks nei", or as "Sharks, rays, skates, etc. nei" in the official statistics. This means that the landings reported as porbeagle is likely an underestimation of the total landing of porbeagle from the NE Atlantic.

There is no fishery-independent information on this stock.

Source of information

Report of the Working Group on Elasmobranch Fishes 2005 (ICES CM 2005/ACFM:03).

Table 1.4.7.1 Available landing data for porbeagle in the ICES area. From Eurostat/ICES database. Must be considered an underestimate.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Channel Islands	15	14							1	+	2	2	2
Denmark	46	85	80	91	94	86	71	69	85	107	73	76	42
Faeroe Islands	14	7	20	76	48	44	7	9	7	10	13	8	10
France	551	300	496	633	820	565	267	315	219	318	410	368	461
Germany					22					+	17	1	3
Iceland	+	+	1	3	4	6	5	3	4	2	2	3	2
Ireland										8	1	6	3
Norway	44	32	42	24	25	27	28	17	28	33	22	17	19
Portugal	2	1									6	2	
Spain							31	124	679	1001	1184	1007	
Sweden	2	2	4	3	2	2	1	1	1	1	1	1	+
United Kingdom										6	6	10	7
Total	674	441	643	830	1015	730	410	538	1024	1486	1737	1501	549

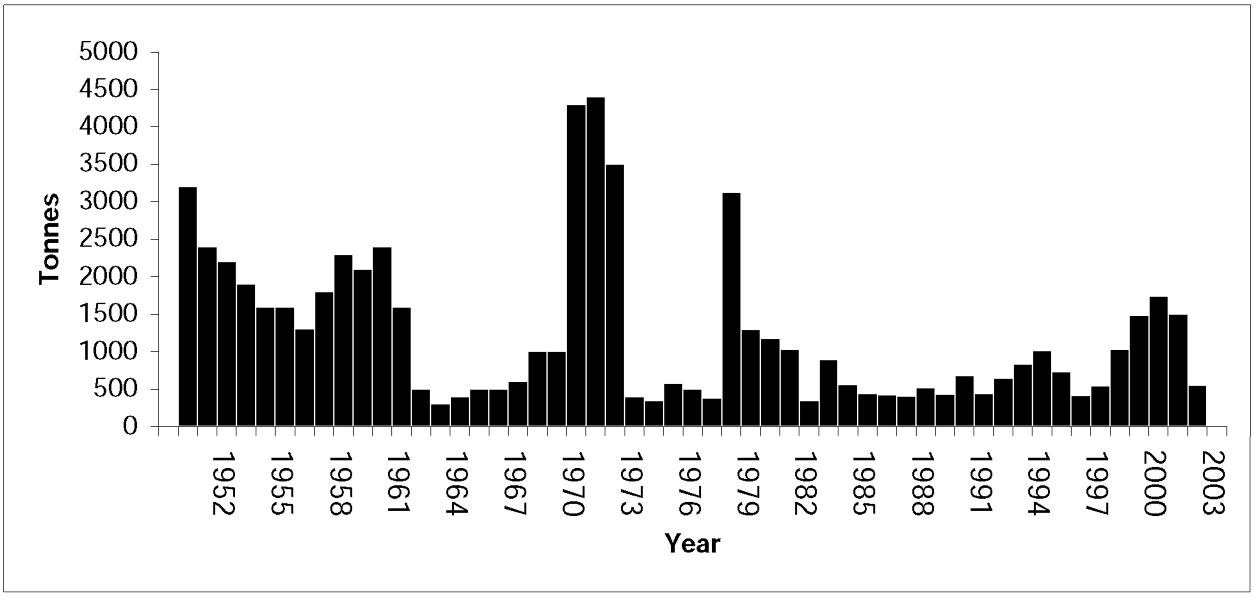


Figure 1.4.7.1 Available landings data for NEA porbeagle. It is not clear if data are complete for any year.

1.4.8 Northeast Atlantic basking shark

State of the stock

There is no information to evaluate the stock status, but landings and anecdotal information suggest that the stock is severely depleted.

Management objectives

None have been suggested or adopted.

Reference points

Not defined.

Single-stock exploitation boundaries

Given the perceived depleted stock status, ICES recommends a zero TAC for the whole distribution area of basking shark.

Management considerations

At present there are no directed fisheries for this species.

Since 2002, this species has been included in Appendix-II of the CITES convention, meaning that they may only be exported, re-exported, or introduced from the high seas if a permit has been issued by the relevant national authorities. Such a permit may only be issued when the management authorities are satisfied that such trade will not be detrimental to the survival of the species. UK legislation (Schedule 5 of the Wildlife and Countryside Act of 1981) specifies that no basking sharks can be caught within 12 miles of the coast and none landed even if caught outside territorial limits. They are also protected in UK (Isle of Man) waters. In Swedish waters the species is on the national Red List and therefore it is forbidden to fish or land the species. There is a proposal in November 2005 to include basking shark in the Convention on Migratory Species in Appendix-II.

The current high price of shark fins implies that the decline in landings is not market driven.

Factors affecting the fisheries and the stock

The effects of regulations

A zero TAC for EU member states in EU has been agreed (ICES Subareas IV, VI, and VII, Annex ID of Council Regulation 2555/2001). This regulation has been in effect since 2002.

In the past, Norway had a quota in EU waters for basking shark livers, but the EU no longer provides for this entitlement. Discarding of basking sharks in several fisheries is known to occur and the discard mortality is high.

EC Regulation 1185/2003 prohibits the removal of shark fins of basking shark, and the subsequent discarding of the body. This regulation is binding on EC vessels in all waters and non-EC vessels in Community waters. Because carcasses and fins can be landed separately in separate locations, the effectiveness of this regulation is questionable.

Changes in fishing technology and fishing patterns

The Norwegian fleet targeting basking shark with harpoons no longer exists. At present, all catches reported by Norway are taken as bycatch in gillnets.

Other factors

This species is vulnerable to mortality due to shipping.

Scientific basis

Data and methods

There is no assessment of this stock. The evaluation is based on landings data and anecdotal information.

Comparison with previous assessment and advice

ICES has never provided advice for this stock.

Source of information

Report of the Working Group on Elasmobranch Fishes 2005 (ICES CM 2005/ACFM:03).

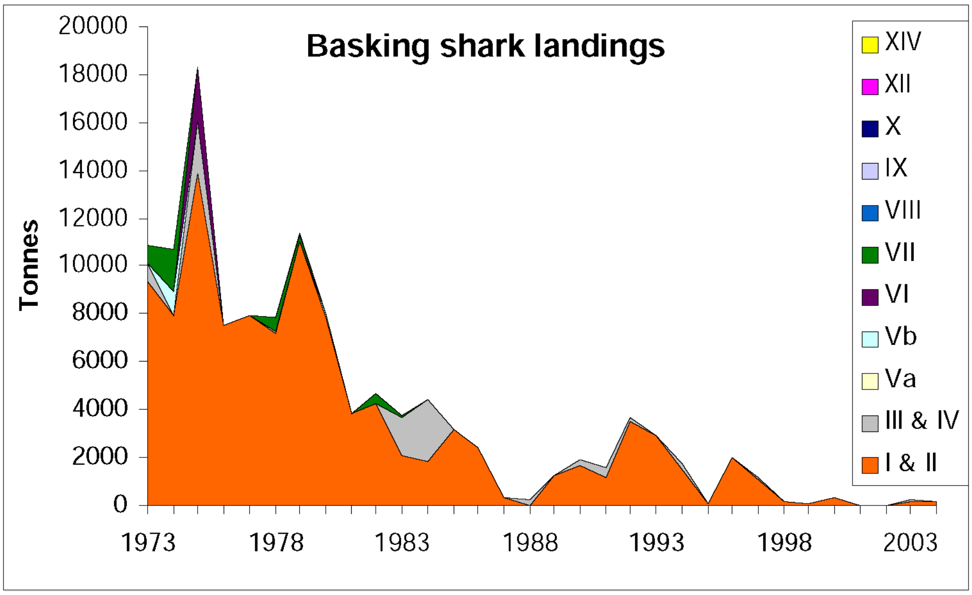


Figure 1.4.8.1 Landings of basking shark by Subarea.

1.4.9 European eel

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
SSB indicators are well below any conceivable reference point	Not established	Not available	The eel stock is almost certainly below what would be considered as safe biological limits and the current fishery is unsustainable.

All available information indicates that the current fishery is not sustainable although neither a stock-wide assessment is available, nor reference points for the state of the stock are defined. Recruitment has been declining since 1980, which is more than one eel generation time ago. Recruitment reached a historical minimum in 2001 of 1–2% of the pre-1980 level, and has not improved since then. Eels are exploited in all life stages present in continental waters. Fishing mortality is high both on juvenile (glass eel) and older eel (yellow and silver eel) in many water systems. Total yield has declined to about half that of the mid-1960s. Other anthropogenic factors (habitat loss, contamination, and transfer of diseases) have had negative effects on the stock. All information indicates that the stock is at a historical minimum and continues to decline.

Management objectives

ICES has repeatedly recommended that a recovery plan be developed for the whole stock on an urgent basis, and that exploitation and other anthropogenic impacts be reduced to as close to zero as possible until such a plan is agreed upon and implemented. The EU Commission presented an Action Plan for management of the European eel in 2003 (COM 2003, 573), based on previous ICES advice, aiming at recovery of the stock. Management measures in this plan include restrictions on fisheries, habitat restoration, and restoration of (upstream and downstream) migration routes. Work is still ongoing to develop this plan.

ICES has been requested to advise on the management of the available resource of glass eels arriving in European river systems, for the purpose of best assuring a recovery of the stock of European Eel. See answer to special request in Section 1.3.2.1 in the present report.

Reference points

Considering the many uncertainties in eel management and biology and the uniqueness of the eel stock (one single stock, spawning only once in their lifetime), a precautionary reference point for eel must be stricter than universal provisional reference targets. Exploitation, which leaves 30% of the virgin (F=0) spawning stock biomass is generally considered to be such a reasonable provisional reference target. However, for eel a preliminary value could be 50%, implying a lower exploitation than conventionally accepted.

An appropriate provisional rebuilding target would be the pre-1980s average SSB level which generated normal recruitment in the past.

Single-stock exploitation boundaries

Exploitation boundaries in relation to precautionary considerations

Actions that would lead to a recovery of the stock are urgently required. Management of eel fisheries requires coordinated action at the scale of catchment areas and at larger scales, commonly spanning multiple jurisdictions. Uncoordinated management actions in isolated areas are not likely to lead to a recovery of the stock. Because of the length of the life cycle, it will take 5–20 years before positive effects can be expected.

ICES repeats its recommendation that a recovery plan for the whole stock be developed urgently, and that exploitation and other anthropogenic impacts be reduced to as close to zero as possible, until such a plan is agreed upon and implemented.

Management considerations

Ecosystem considerations

Movement and stocking of eel may involve a risk of decreased genetic variability and may disrupt the migration behaviour. Spreading of diseases and parasites is also a risk when introducing individuals into new areas. Productivity and survival are sensitive to changes in habitats. The effects of the declined stock of eels in the ecosystems where they appear are largely unknown.

Factors affecting the fisheries and the stock

Seasonality of the fisheries

Glass eel fisheries all around Europe show a temporal distribution from October till May. In general, the yellow eel fisheries start in April with an increase in catches to a maximum in June and July and thereafter a decrease in catches until October when most fisheries end the season. The fishing pattern for the silver eel fishery is for the most part the same as for the yellow eel fishery, with the maximum catches being taken a bit later; i.e. in August, September, and October.

Regulations and their effects

Season closures have been applied locally in several areas. The effects of such closures to restrict fishing have not been evaluated. Season closure has been advised as a management measure to restrict the impact of fishing. In some countries there are license systems that control the glass eel fisheries.

The environment

The eel stock is scattered over a multitude of inland waters with divergent characteristics; anthropogenic impacts, such as barriers in migration ways, pollution, habitat loss, etc. presumably affect the eel stock to a degree comparable to the effects of fishing exploitation.

Scientific basis

Data and methods

Current monitoring is based on national programmes. Several of the long-lasting time-series may be stopped in the near future, because of the decreased turnover of the local eel fisheries and the impossibility of addressing the stock decline at the local level. However, in light of the poor state of the stock and the high anthropogenic impacts, it is of utmost importance that existing time-series of monitoring recruitment, effort, and yield continue and are preferably supplemented.

For some years there are major inconsistencies between the official statistics on eel landings and ICES estimates. ICES finds that a major revision of the databases is required and has started this work. This report therefore does not include an updated catch table, the existing data are available in the 2002 ACFM report (*ICES Cooperative Research Report* No. 255). For information, the graph below summarizes the data (up to 2002) which is currently available.

Source of information

Report from the ICES/EIFAC Working Group on Eels, ICES CM 2005/I:01, Ref. G, ACFM.
Report of the ICES Advisory Committee on Fishery Management, 2002. *ICES Cooperative Research Report* No. 255.

Table 1.4.9.1 Recruitment data series. Recruitment data series are listed, in the units in which they were reported. Part 1. Scandinavia and British Isles.

	N	S	S	S	S	DK	D	N.Irl.	Irl	Irl	UK
	Imsa	Göta Älv	Viskan	Motala	Dalälven	Vidaa	Ems	Bann	Erne	Shannon	Severn
1950		2947		305			875				
1951		1744		2713	210		719				
1952		3662		1544	324		1516				
1953		5071		2698	242		3275				
1954		1031		1030	509		5369				
1955		2732		1871	550		4795		167.00		
1956		1622		429	215		4194				
1957		1915		826	162		1829				
1958		1675		172	337		2263				
1959		1745		1837	613		4654		244.00		
1960		1605		799	289		6215	7409	1229		
1961		269		706	303		2995	4939	625		
1962		873		870	289		4430	6740	2469		
1963		1469		581	445		5746	9077	426		
1964		622		181.6	158		5054	3137	208		
1965		746		500	276		1363	3801	932		
1966		1232		1423	158		1840	6183	1394		
1967		493		283	332		1071	1899	345		
1968		849		184	266		2760	2525	1512		
1969		1595		135	34		1687	422	600		
1970		1046		2	150		683	3992	60		
1971		842	12	1	242	787	1684	4157	540		
1972		810	88	51	88	780	3894	2905			
1973		1179	177	46	160	641	289	2524			
1974		631	13	58.5	50	464	4129	5859	794		
1975	42945	1230	99	224	149	888	1031	4637	392		
1976	48615	798	500	24	44	828	4205	2920	394		
1977	28518	256	850	353	176	91	2172	6443	131	1.02	
1978	12181	873	533	266	34	335	2024	5034	320	1.37	
1979	2457	190	505	112	34	220	2774	2089	488	6.69	40.1
1980	34776	906	72	7	71	220	3195	2486	1352	4.50	32.8
1981	15477	40	513	31	7	226	962	3023	2346	2.15	32.0
1982	45750	882	380	22	1	490	674	3854	4385	3.16	30.4
1983	14500	113	308	12	56	662	92	242	728	0.60	6.2
1984	6640	325	21	48	34	123	352	1534	1121	0.50	29.0
1985	3412	77	200	15.2	70	13	260	557	394	1.09	18.6
1986	5145	143	151	26	28	123	89	1848	684	0.95	15.5
1987	3434	168	146	201	74	341	8	1683	2322	1.61	17.7
1988	17500	475	92	170	69	141	67	2647	3033	0.15	23.1
1989	10000	598	32	35.2		9	13	1568	1718	0.03	13.5
1990	32500	149	42	21		5	99	2293	2152	0.47	16.0
1991	6250	264	1	2			52	677	482	0.09	7.8
1992	4450	404	70	108	10		6	978	1371	0.03	17.7
1993	8625	64	43	89	7		20	1525	1785	0.02	20.9
1994	525	377	76	650	72		52	1249	4400	0.29	22.3
1995	1950		6	32	8		40	1403	2400	0.40	36.0
1996	1000	277	1	14	18		20	2667	1000	0.33	25.7
1997	5500	180	8	8	8		5	2533	1038	2.12	16.9
1998	1750		5	6	15		4	1283	782	0.28	20.0
1999	3750		2	85	16		3	1345	1100	0.02	18.0
2000	1625		14	270	12		4	563	900	0.04	7.6
2001	1875		2	178	8		1	250	699	0.003	5.4
2002		685	26.2	338.8	58.6		-	1000	112	0.16	5.1
2003		261	44.13	19	126.7		-	1010	580	0.378	19
2004		125	5.0	42	26.4		-	308	269	0.057	10

Table 1.4.9.2 Recruitment data series; continued. Part 2: Mainland Europe.

	NL	B	F	F	F	F	F	E	P/E	It
	DenOever	Ijzer	Vilaine	Loire	Gironde (CPUE)	Gironde (Yield)	Adour	Nalon	Minho	Tiber
1950	6.92			86						
1951	13.84			166						
1952	89.37			121						
1953	13.97			91				14,529		
1954	20.99			86				8,318		
1955	28.82			181				13,576		
1956	7.58			187				16,649		
1957	17.20			168				14,351		
1958	55.22			230				12,911		
1959	30.26			174				13,071		
1960	22.87			411				17,975		
1961	39.62			334				13,060		
1962	91.79			185				17,177		
1963	131.13			116				11,507		
1964	40.95	3.7		142				16,139		
1965	85.94	115.0	5.0	134				20,364		
1966	20.63	385.0	4.0	253				11,974		
1967	31.46	575.0	9.0	258				12,977		
1968	21.66	553.5	12.0	712				20,556		
1969	18.37	445.0	10.0	225				15,628		
1970	41.43	795.0	8.0	453				18,753		
1971	18.49	399.0	44.0	330				17,032		
1972	33.20	556.5	38.0	311				11,219		
1973	24.22	356.0	78.0	292				11,056		
1974	27.97	946.0	107.0	557				24,481	1.642	
1975	36.07	264.0	44.0	497				32,611	10.578	11.00
1976	29.33	618.0	106.0	770				55,514	20.048	6.70
1977	62.94	450.0	52.0	677				37,661	36.637	5.90
1978	41.66	388.0	106.0	526				59,918	24.334	3.60
1979	57.84	675.0	209.0	642	19.7	286.2		37,468	28.435	8.40
1980	28.92	358.0	95.0	525.5	25.9	404.8		42,110	21.32	8.20
1981	24.72	74.0	57.0	302.7	20.0	332.2		34,645	54.208	4.00
1982	15.59	138.0	98.0	274	15.0	123.3		26,295	16.437	4.00
1983	10.43	10.0	69.0	259.5	13.6	80.3		21,837	30.447	4.00
1984	14.02	6.0	36.0	182.5	19.2	82.0		22,541	31.387	1.80
1985	15.08	13.0	41.0	154	9.6	64.5		12,839	20.746	2.50
1986	15.83	26.0	52.6	123.4	10.6	45.2	8	13,544	12.553	0.20
1987	6.17	33.0	41.2	145	14.0	82.4	9.5	23,536	8.219	7.40
1988	4.43	48.0	46.6	176.6	10.9	33.0	12	15,211	8.001	10.50
1989	3.04	30.0	36.7	87.1	7.2	80.0	9	13,574	9.000	5.50
1990	3.66	218.2	35.9	96	5.6	48.1	3.2	9,216	6.000	4.40
1991	1.12	13.0	15.4	35.7	7.7	64.0	1.5	7,117	9.000	0.80
1992	2.96	18.9	29.6	39.3	3.7	41.7	8	10,259	10.000	0.60
1993	2.96	11.8	31.0	90.5	8.2	69.4	5.5	9,673	7.600	0.50
1994	4.93	17.5	24.0	94.6	8.7	45.8	3	9,900	4.700	0.50
1995	6.98	1.5	29.7	132.5	8.2	73.2	7.5	12,500	15.200	0.30
1996	7.82	4.5	22.4	80.8	4.8	30.7	4.1	5,900	8.700	0.10
1997	12.70	9.8	22.6	70.8	6.5	50.5	4.6	3,656	7.400	0.10
1998	2.27	2.3	17.5	60.7	4.3	25.0	1.5	3,273	7.400	0.13
1999	3.53		15.3	86.9	7.5	44.1	4.3	3,815	3.800	0.06
2000	1.73	17.85	14.2	79.9	6.6	25.1	10	1,330	1.200	0.07
2001	0.57	0.7	8.1	30	1.9	9	4	1,285	1.100	0.04
2002	1.15	1.4	16.0	41	4.9	36.8	6	1,569		0.02
2003	1.54	0.539	8.9	55				1,231		0.02
2004	1.52	0.381	7.0	20				506		0.03

Table 1.4.9.3 Re-stocking of glass eel. Numbers of glass eels (in millions) re-stocked in (eastern) Germany (D east), the Netherlands (NL), Sweden (S), Poland (PO), Northern Ireland (N.Irl.), and Belgium (Flanders).

	D EAST	NL	SE	PO	N.IRL.	FLANDERS
1945					17.0	
1946		7.3			21.0	
1947		7.6				
1948		1.9				
1949		10.5				
1950	0.0	5.1				
1951	0.0	10.2				
1952	0.0	16.9		17.6		
1953	2.2	21.9		25.5		
1954	0.0	10.5		26.6		
1955	10.2	16.5		30.8	0.5	
1956	4.8	23.1		21.0		
1957	1.1	19.0		24.7		
1958	5.7	16.9		35.0		
1959	10.7	20.1		52.5	0.7	
1960	13.7	21.1		64.4	25.9	
1961	7.6	21.0		65.1	16.7	
1962	14.1	19.8		61.6	27.6	
1963	20.4	23.2		41.7	28.5	
1964	11.7	20.0		39.2	10.0	
1965	27.8	22.5		39.8	14.2	
1966	21.9	8.9		69.0	22.7	
1967	22.8	6.9		74.2	6.7	
1968	25.2	17.0			12.1	
1969	19.2	2.7			3.1	
1970	27.5	19.0			12.2	
1971	24.3	17.0			14.1	
1972	31.5	16.1			8.7	
1973	19.1	13.6			7.6	
1974	23.7	24.4			20.0	
1975	18.6	14.4			15.1	
1976	31.5	18			9.9	
1977	38.4	25.8			19.7	
1978	39.0	27.7			16.1	
1979	39.0	30.6			7.7	
1980	39.7	24.8			11.5	
1981	26.1	22.3			16.1	
1982	30.6	17.2			24.7	
1983	25.2	14.1			2.9	
1984	31.5	16.6			12.0	
1985	6.0	11.8			13.8	
1986	23.8	10.5			25.4	
1987	26.3	7.9			25.8	
1988	26.6	8.4			23.4	
1989	14.3	6.8			9.9	
1990	10.65	6.1	0.7		13.3	
1991	2.01	1.9	0.3		3.5	
1992	6.36	3.5	0.3		9.4	
1993	7.62	3.8	0.6		9.9	0.8
1994	7.6	6.2	1.7		16.4	0.5
1995	0.99	4.8	1.5		13.5	0.5
1996	0.05	1.8	2.4		11.1	0.5
1997	0.38	2.3	2.5		10.9	0.4
1998	0.3	2.5	2.1		6.2	0.0
1999	0.0	2.9	2.3		12.0	0.8
2000	0.0	2.8	1.3		5.4	0.0
2001		0.9	0.8		3.04	0.2
2002		1.6	1.4		6.6	0
2003		1.6	0.6		9.2	4.5
2004		0.3	0.8		3.0	0

Table 1.4.9.4 Re-stocking of young yellow (bootlace) eel. Numbers of young yellow eels (in millions) re-stocked in (eastern) Germany (D east), the Netherlands (NL), Sweden (S), Denmark (DK), and Belgium (Flanders).

	D EAST	NL	SE	DK	FLANDERS
1945					
1946					
1947		1.6			
1948		2.0			
1949		1.4			
1950	0.9	1.6			
1951	0.9	1.3			
1952	0.6	1.2			
1953	1.5	0.8			
1954	1.1	0.7			
1955	1.2	0.9			
1956	1.3	0.7			
1957	1.3	0.8			
1958	1.9	0.8			
1959	1.9	0.7			
1960	0.8	0.4			
1961	1.8	0.6			
1962	0.8	0.4			
1963	0.7	0.1			
1964	0.8	0.3			
1965	1.0	0.5			
1966	1.3	1.1			
1967	0.9	1.2			
1968	1.4	1.0			
1969	1.4	0.0			
1970	0.7	0.2			
1971	0.6	0.3			
1972	1.9	0.4			
1973	2.7	0.5			
1974	2.4	0.5			
1975	2.9	0.5			
1976	2.4	0.5			
1977	2.7	0.6			
1978	3.3	0.8			
1979	1.5	0.8			
1980	1.0	1.0			
1981	2.7	0.7			
1982	2.3	0.7			
1983	2.3	0.7			
1984	1.7	0.7			
1985	1.1	0.8			
1986	0.0	0.7			
1987	0.0	0.4		1.6	
1988	0.0	0.3		0.8	
1989	0.0	0.1		0.4	
1990	0.1	0.0	0.8	3.5	
1991	0.1	0.0	0.9	3.1	
1992	0.1	0.0	1.1	3.9	
1993	0.2	0.2	1.0	4.0	0.2
1994	0.2	0.0	1.0	7.4	0.1
1995	0.7	0.0	0.9	8.4	0.1
1996	0.9	0.2	1.1	4.6	0.1
1997	1.5	0.4	1.1	2.5	0.1
1998	1.2	0.6	0.9	3.0	0.1
1999	1.1	1.2	1.0	4.1	0.1
2000	1.0	1.0	0.7	3.8	0.0
2001		0.1	0.4	1.7	0.0
2002	0.4	0.1	0.3	2.4	
2003		0.1	0.3	2.2	
2004		0.1	0.1		

Table 1.4.9.5 Aquaculture production of European eel in Europe and Japan. Compilation of production estimates (tonnes) derived from reports of previous WG meetings, FAO, FEAP and others. Data for Sweden and the Netherlands have been revised.

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Japan		3000															10000			
Sum EU	1950	2229	3448	4729	5517	5159	6667	6098	6818	7721	7689	8935	9031	10646	11059	10839	10510	8435		
Czech. Rep.									2	4	4	3	3	3	1	1	1	1		
Hungary					90	39	73	33		50		50			19	19				
Croatia								7	5	5	7	6	7							
Yugoslavia	44	52	48	49	19	10	5	1	8	2	9	5	5	5	6	6	5	4		
Macedonia									1	0	70	83	60	72	60	50	32			
Turkey																				
Greece			6	4	10	54	94	132	337	341	659	550	312	500	500	300	600	735		
Italy	2600	2800	4200	4600	4250	4500	3700	4185	3265	3000	2800	3000	3000	3100	3100	3100	2750	2500	1900	
Tunisia							150	151	250	260	108	158	147	108						
Algeria					72	53	22	1	0	22	20	17	17	17	22	15	18	20		
Morocco							35	41	68	85	55	55	56	42	27	28	60	28		
Portugal	60	60	590	566	501	6	270	622	505	979	200	110	200	200	200	200				
Spain	15	20	25	37	32	57	98	105	175	134	214	249	266	270	300	425	200	259		
Belgium/Lux.					30	30	125	125	125	125	150	140	150	150	40	20	50	55		
Netherlands				100	300	200	600	900	1100	1300	1450	1540	2800	2450	3250	3500	3800	4000	4000	*4200*
Germany										100	100	100	150	150	150	150	300	160		
UK				20	30	0	0				25		25							
Ireland																	100			
Denmark	18	40	200	240	195	430	586	866	748	782	1034	1324	1568	1913	2483	2718	2674	2000	1880	2050
Sweden	12	41	51	90	203	166	157	141	171	169	160	139	161	189	204	222	273	200	167	170
Norway										120	200	200	200	200						

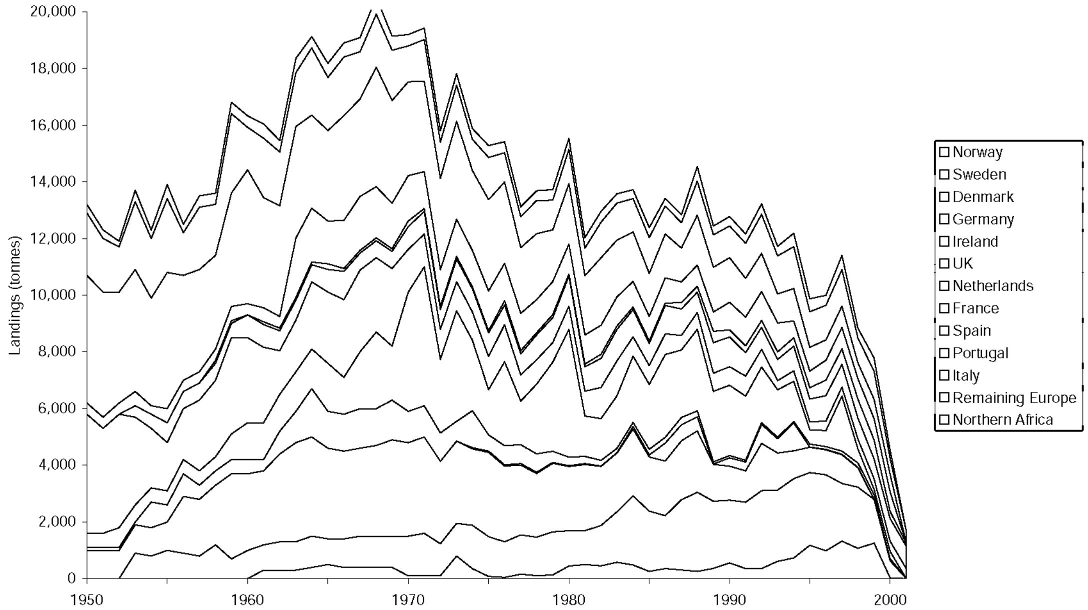


Figure 1.4.9.1 Landing statistics of the European eel in the past 50 years.
FAO data, with minor corrections. Data for 2000 and later are incomplete.

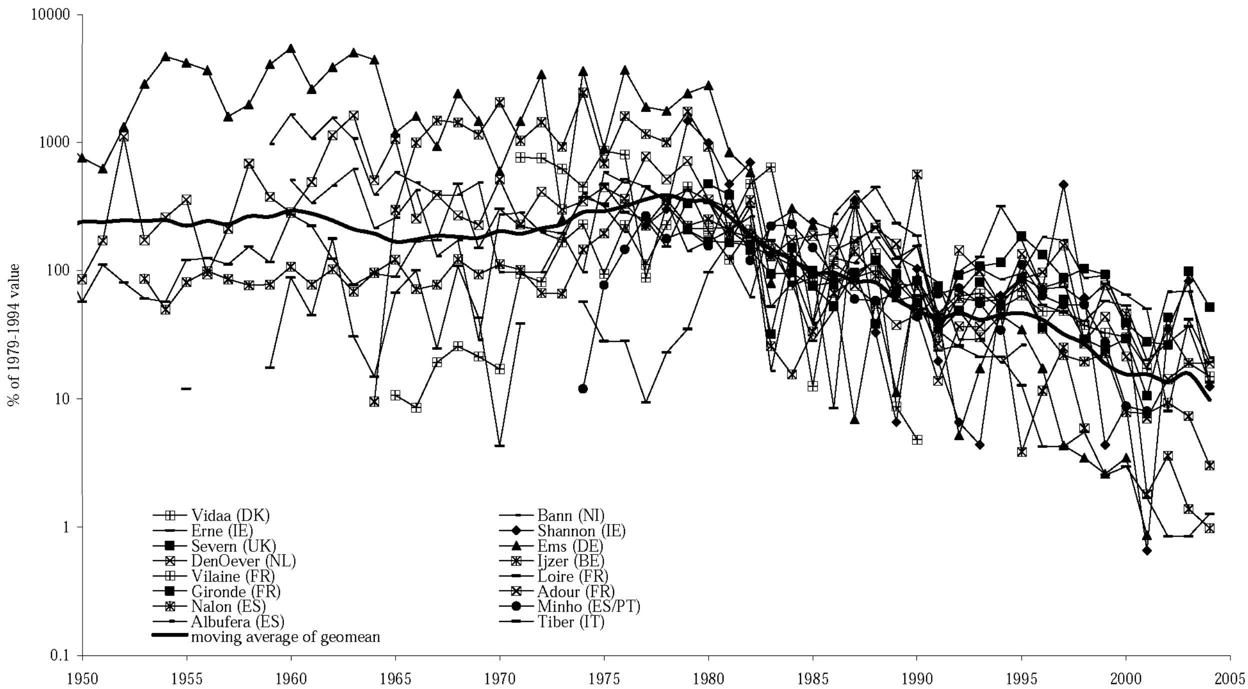


Figure 1.4.9.2 Time-series of glass eel monitoring in Europe. Each series has been scaled to the 1979–1994 average. The heavy line indicates the geometric mean of the series from Loire (F), Ems (D), Göta Älv (S), and DenOever (NL), which are the longest and most consistent time-series.

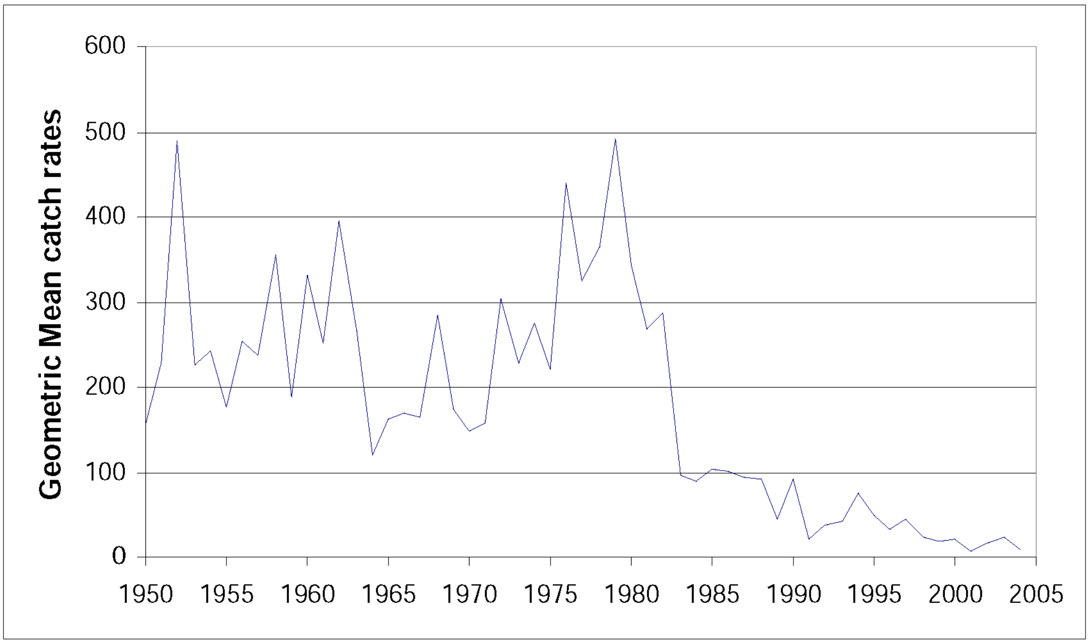


Figure 1.4.9.3 Time-series of glass eel monitoring in Europe. The line indicates the geometric mean of the series from Loire (F), Ems (D), and DenOever (NL), which are the longest and most consistent time-series. Each series has been scaled to the 1979–1994 average.

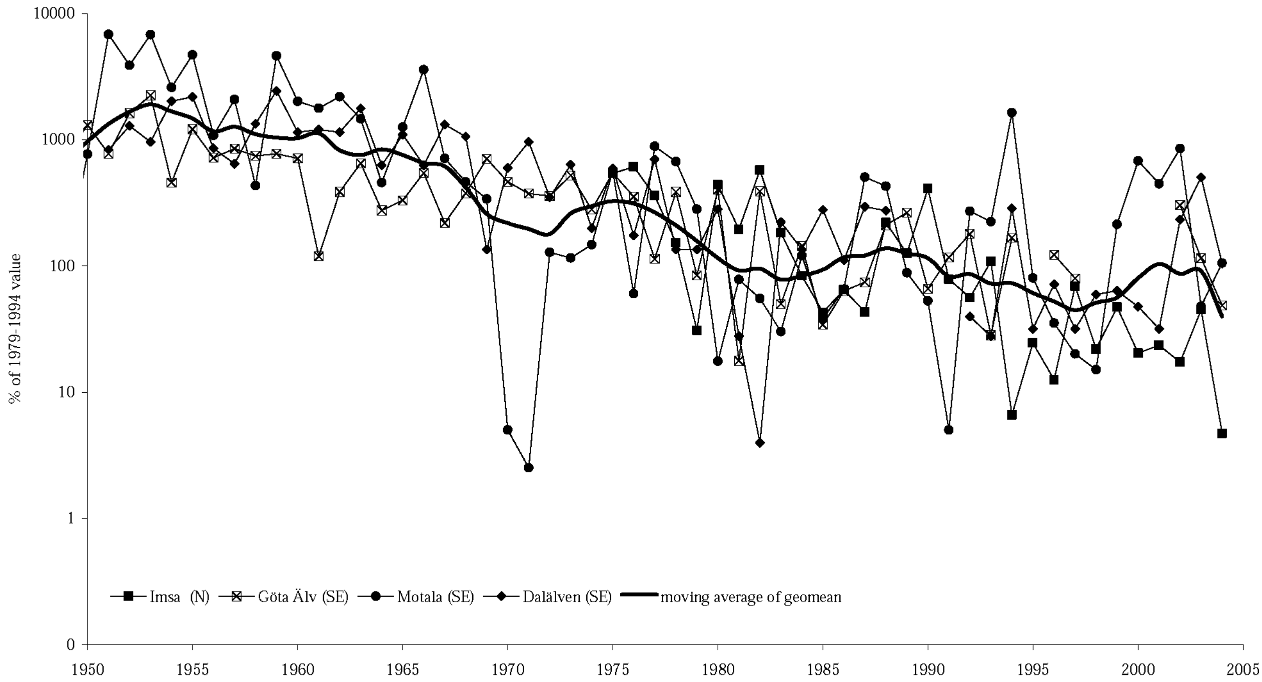


Figure 1.4.9.4 Time-series of yellow eel recruitment (older than one year). Each series has been scaled to the 1979–1994 average. The heavy line indicates the geometric mean of all time-series.

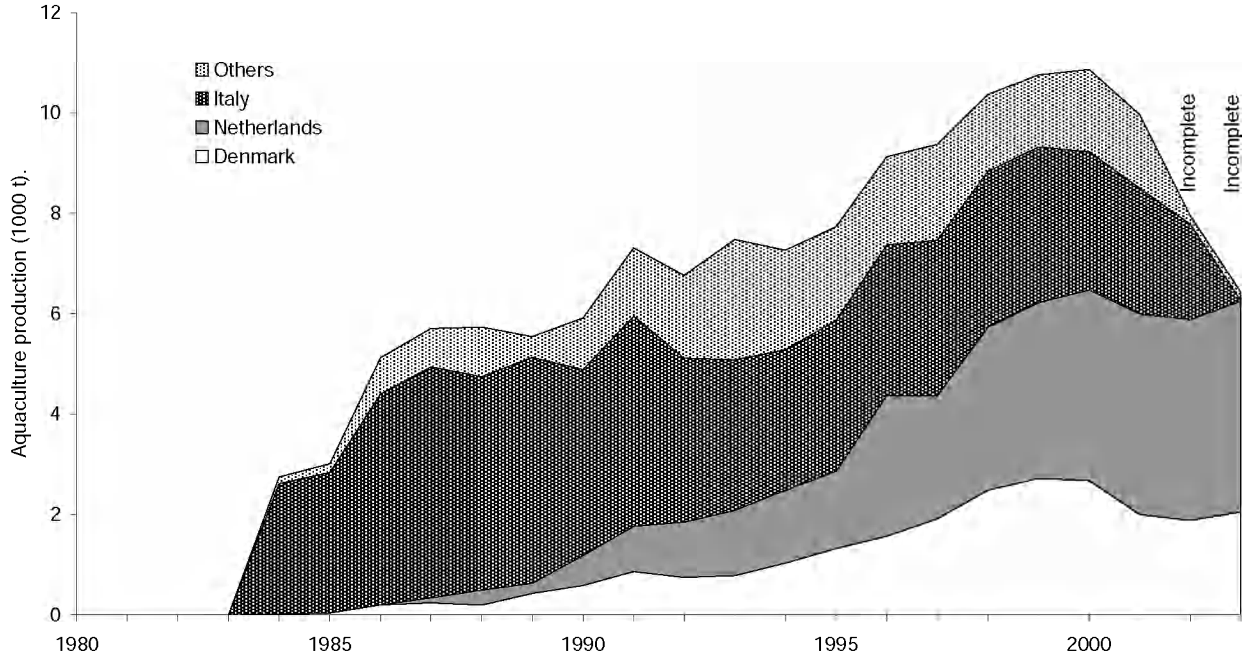


Figure 1.4.9.5 Trends in aquaculture production of the European eel.

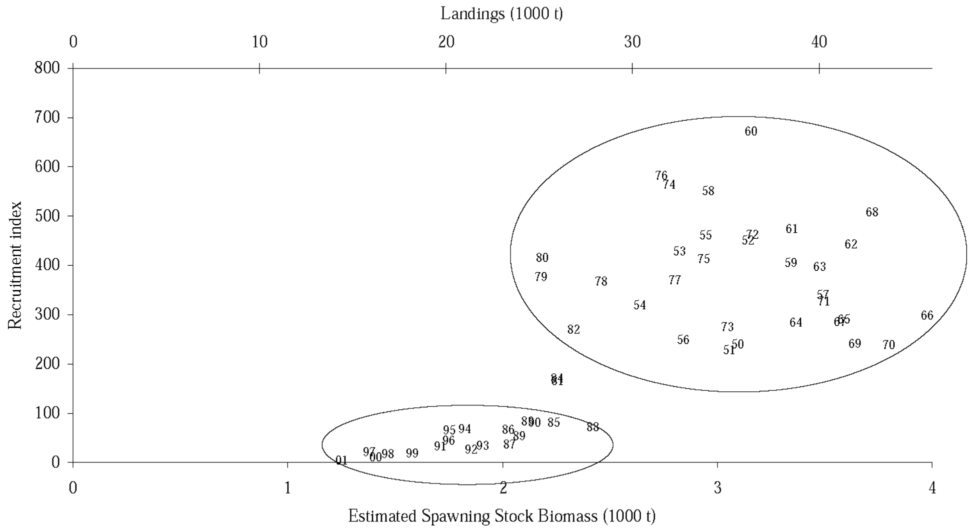


Figure 1.4.9.6 Estimated stock-recruitment relationship for the European eel. Numbers indicate the year of recruitment. The spawning stock is assumed proportional to the landings from the continental stock.