

9.4.2 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	Fishing mortality in relation to target fishing mortality (F)	Comment
Uncertain	Harvested unsustainably	Exploited above F _{0.1}	Above target	

Based on the most recent estimates of fishing mortality, ICES classifies the stock as being harvested unsustainably. Fishing mortality in 2005 is estimated to be at F_{lim} (0.26). Because of the unknown levels of underreporting in the catch, SSB in recent years relative to B_{pa} cannot be accurately estimated, but indications are that SSB has increased over the last 3 years and is now around B_{pa} . The stock has been showing much more variable recruitment over the recent four years compared to the past. The 2000 and 2003 year classes are estimated to be poor, while both the 2001 and the 2002 year classes are above average. The 2002 year class is estimated to be the highest in the time-series. There is insufficient information on the size of the 2004 and 2005 year classes.

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 (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 $F_{pa} = 0.17$ is to have a high probability of avoiding exploiting the stock above 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 of the stock decreasing below 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 B_{lim} .	B_{pa} be set at 2.3 million t.
F_{lim} is 0.26, the fishing mortality estimated to lead to potential stock collapse.	F_{pa} be set at 0.17. This F is considered to provide approximately 95% probability of avoiding F_{lim} , taking into account the uncertainty in the assessments.
Target reference points	F_v is not defined.

Technical basis:

	$B_{pa} = B_{loss}$ in Western stock raised by 15%: = 2.3 million t.
$F_{lim} = F_{loss} = 0.26.$	$F_{pa} = F_{lim} * 0.65.$

The estimate of $F_{0.1}$ is 0.19.

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 imply catches between 390 000 t and 509 000 t in 2007.

Short-/medium-term implications

Outlook for 2007

Basis: Catch(2006) = 429 (TAC plus 20 reported discards minus 35 that the UK and Ireland have agreed not to fish); $F(2006) = 0.18$; $SSB(2006) = 2449$.

Projections are based on uncertain estimates of stock size, but indicate that a catch corresponding to $F = 0.17$ in 2007 would allow continued rebuilding.

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

Rationale	Catches(2007)	F(2007 & 2008)	Basis	SSB(2007) Spawning time	SSB(2008) Spawning time
Zero catch	0	0	$F=0$	2628	3118
<i>Status quo</i>	646	0.260	2005	2407	2374
	136	0.050	F(management plan upper bound) *0,25	2584	2955
	265	0.100	F(management plan upper bound) *0,5	2541	2802
	390	0.150	F(management plan lower bound)	2498	2659
	438	0.170	F_{pa}	2481	2604
	509	0.200	F(management plan upper bound)	2456	2525
	555	0.220	F(management plan upper bound) *1,1	2440	2473
	623	0.250	F(management plan upper bound) *1,25	2415	2398
	817	0.340	$F_{pa} * 2$	2343	2190

Weights in '000 t. Catches for 2007 include minimum discards estimated at about 5%.

Shaded scenarios are not considered consistent with the management plan.

Management considerations

The exploitation boundaries in relation to the management plan given above are based on ICES interpretation that the fishing mortality (F) should not exceed 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 boundary of 0.20.

Between 1992 and 2002, there was 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. The current assessment indicates that the biomass has increased since 2002. Also, currently the stock appears to be subject to increased variability in recruitment and, should this continue, the stock trajectory may be more variable in the future. This should be taken into consideration in developing a harvest control rule.

The estimates of catches by ICES have exceeded the annual TACs in most years, sometimes by a considerable amount, in particular when the TACs are lower.

There are indications of substantial underreporting of catches for this stock which is a matter of concern. The stock projections have been performed using the TAC for 2006 (444 kt) plus known discarding (20 kt) and minus 35 kt which UK & Ireland agreed not to fish. This results in a catch estimate of 429 kt. The estimate of discarding and slipping is based on actual observation and is not raised to the fleet, as it is not clear whether the observations are representative. Important initiatives in enforcement were taken by the UK and Ireland in 2005/06, which included severe punitive measures. ICES expects that these will lead to better compliance, at least in these countries in 2006 and beyond, and therefore lead to a closer correspondence between predictions and ACFM catch. The preliminary analyses carried out by ICES suggest an underestimation of catch by 60% or more compared to the ACFM catches that included discarding and additions for known misreporting. Such an underestimation of the catches by 60% or more is not taken into consideration in the estimates of SSB as well as the predicted landings, and their actual values would be scaled accordingly.

These observations imply that estimates of SSB, the forecast landings, and probably even B_{pa} are biased. The advice on landings from a given SSB relative to the B_{pa} is only meaningful in relative terms.

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 ICES is not able to provide a reliable estimate of F_{msy} directly. A suitable proxy would be $F_{0.1}$ which has been stable at 0.19 for the last 5 years at least.

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 overexploitation, recruitment has failed since 1969, leading to a decline in the stock. The North Sea spawning component has increased since 1999 but continued protection is needed as it is still very small. Given that the stock is currently increasing, it is recommended that a new management plan be developed.

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. However, misreporting from IVa to VIa continues to occur.

In the southern part of the distribution area, Atlantic mackerel (*Scomber scombrus*) can be caught together with Spanish mackerel (*Scomber japonicus*). In recent years, catches of Spanish mackerel have increased. The catch in 2005 was the highest since 1982. Catches of both species are landed separately. ICES advice applies to Atlantic mackerel only.

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).

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 0.23 to 0.44. The current assessment shows reduced F and increased biomass after the reductions in reported catches in 2003 and beyond.

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 stock 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 surveys in the North Sea with limited spatial and temporal coverage both indicate a higher egg production in the North Sea area than in 1999. Though the North Sea spawning component has increased since 1999, it is still very small.

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 1972–2005 and egg survey estimates of SSB from 1992, 1995, 1998, 2001, and 2004. Exploratory assessments using different assessment models gave comparable results. 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. Better information on these practices is required in the future.

Acoustic surveys are available for this stock but have not been used in the assessment because 1) they do not cover the entire geographic range, 2) there are difficulties with the estimation of fish density, and 3) there could be species identification issues in some areas.

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.

The estimates of SSB and fishing mortality are becoming increasingly uncertain as there is no new fishery-independent data since 2004. The next egg survey is scheduled for 2007.

There is no information on the size of the 2004 and 2005 year classes from the commercial catches. Such information is obtained from surveys. Existing surveys have the potential to estimate recruitment, but this will need to be investigated further.

Preliminary studies of the total levels of fishing mortality and natural mortality using egg surveys and tag mortality have provided a clear indication of substantial levels of unaccounted removals. It is furthermore shown to be unlikely that natural mortality is underestimated and that there is a substantial unaccounted fishing mortality, implying a 95% probability of catches being underestimated by at least 60%. 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 some revision of catch from 1999 to 2004 following information on underreporting, and catch numbers-at-age for 2005 added. The result is in line with last year's assessment with a small downward revision in recent SSB and upward revision in F . Comparative assessments performed with different models gave similar results.

In 2004, 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. In 2005, 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, Galway, Ireland, 5–14 September 2006 (ICES CM 2006/ACFM:36).

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: F_{pa}	642	612	579	2	675
2001	F=0.17: F_{pa}	665	670	620	1	687
2002	F=0.17: F_{pa}	694	683	688	24	727
2003	F=0.17: F_{pa}	542	583	580	9	617
2004	F=0.17: F_{pa}	545	532	559	11	611
2005	F=0.15 to 0.20	[320-420]	422	458	20	543
2006	F=0.15 to 0.20	[373-487]	444			
2007	F=0.15 to 0.20	[390-509]				

Weights in '000 t.

¹Data on discards and slipping from only two fleets. ²Landings and discards from IIa, IIIa, IV, Vb, VI, VII, VIII, and IXa. ³All areas except some catches in international waters in II. ⁴Catches 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 = $F_{0.1}$; TAC; closed area; landing size	430	573	36	656
1989	Halt SSB decline; TAC	355	495	7	571
1990	TAC; F = $F_{0.1}$	480	525	16	606
1991	TAC; F = $F_{0.1}$	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	20	494
2006	No separate advice	-	392		
2007	No separate advice	-			

Weights in '000 t.

¹TAC for mackerel taken in all areas VI, VII, VIIIa,b,d, Vb, IIa, IIIa, IVa. ²Landings and discards of Western component; includes some catches of North Sea component. ³Catch at *status quo* F. ⁴Catches 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	LPL	83.1	- ⁴
1994	Maximum protection; closed areas and seasons; min landing	LPL	95.7	- ⁴
1995	Maximum protection; closed areas and seasons; min landing	LPL	76.3	- ⁴
1996	Maximum protection; closed areas and seasons; min landing	LPL	52.8	- ⁴
1997	Maximum protection; closed areas and seasons; min landing	LPL	52.8	- ⁴
1998	Maximum protection; closed areas and seasons; min landing	LPL	62.5	- ⁴
1999	Maximum protection; closed areas and seasons; min landing	LPL	62.5	- ⁴
2000	Maximum protection; closed areas and seasons; min landing	LPL	69.7	- ⁴
2001	Maximum protection; closed areas and seasons; min landing	LPL	71.4	- ⁴
2002	Maximum protection; closed areas and seasons; min landing	LPL	72.9	- ⁴
2003	Maximum protection; closed areas and seasons; min landing	LPL	62.5	- ⁴
2004	Maximum protection; closed areas and seasons; min landing	LPL	57.7	- ⁴
2005	Maximum protection; closed areas and seasons; min landing	LPL	44.9	- ⁴
2006	Maximum protection; closed areas and seasons; min landing	LPL	47.1	- ⁴
2007	Maximum protection; closed areas and seasons; min landing			

Weights in '000 t.

¹Subarea IV and Division IIIa. ²TAC for Subarea IV, Divisions IIIa, IIIb,c,d (EU zone), and Division IIa (EU zone).

³Estimated landings of North Sea component. ⁴No 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	50
2006	No separate advice	-	26.18	
2007	No separate advice	-		

Weights in '000 t.

¹Division VIIIc, Subareas IX and X, and CECAF Division 34.1.1 (EU waters only). ²Catches updated in 2003 with revisions from SGDRAMA in 2002.

Mackerel (combined Southern, Western & N.Sea spawn.comp.)

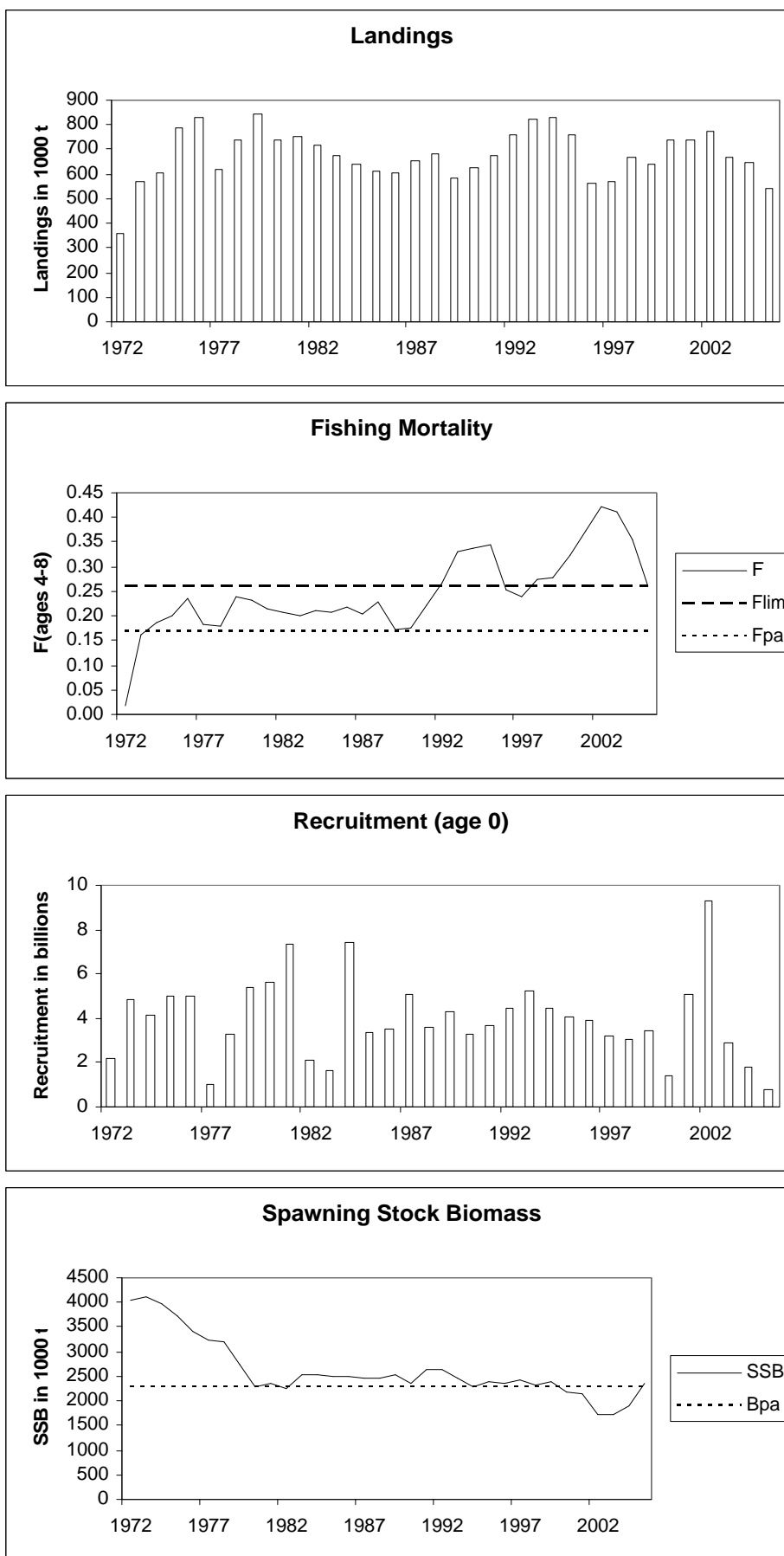


Figure 9.4.2.1

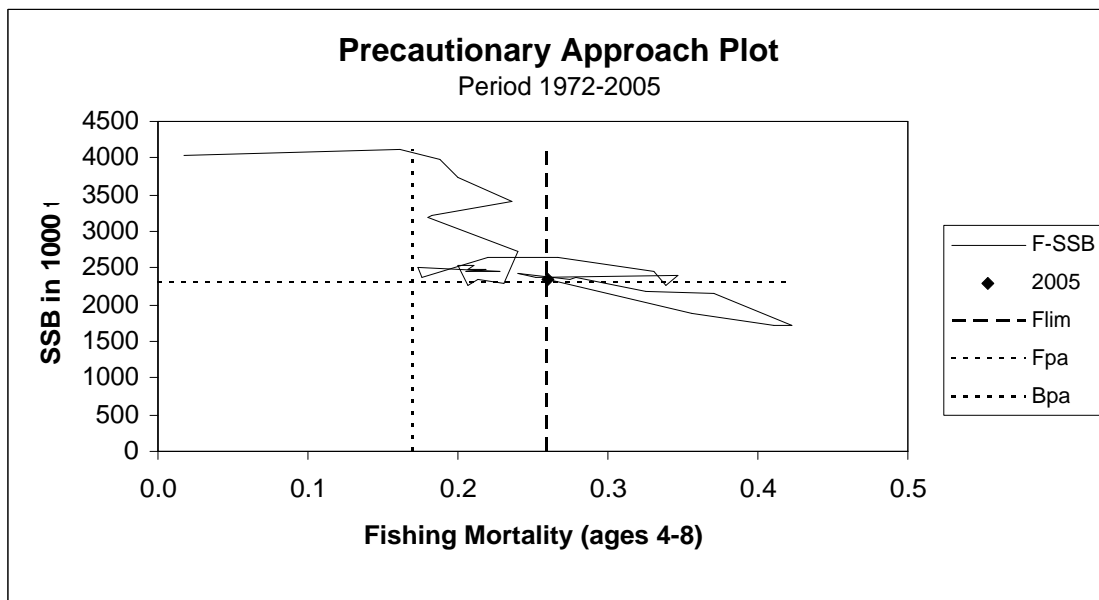
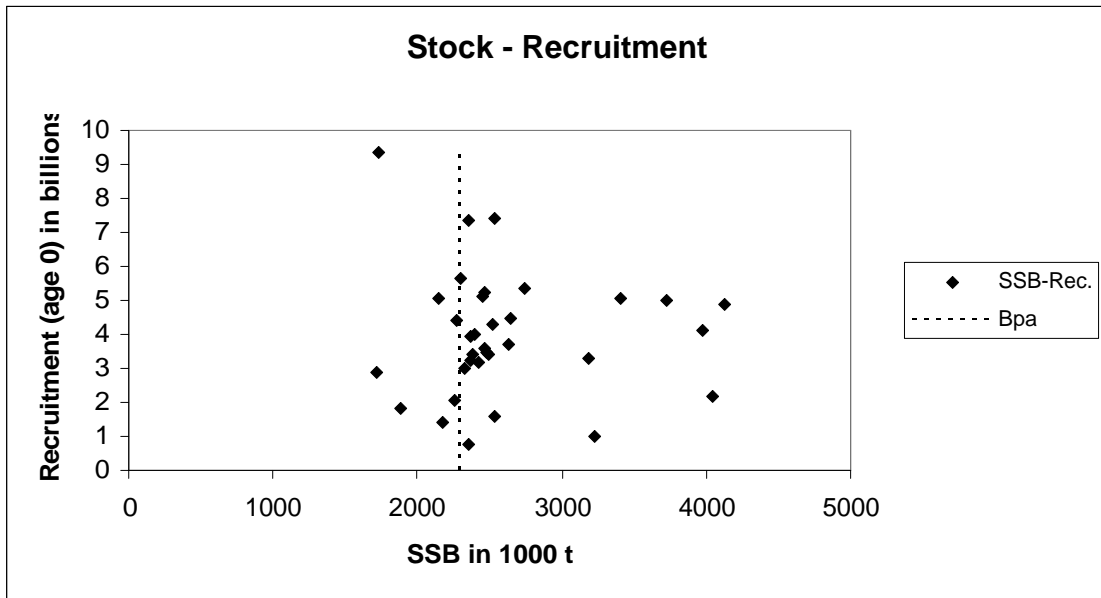


Figure 9.4.2.2

Mackerel (combined Southern, Western & N.Sea spawn.comp.)

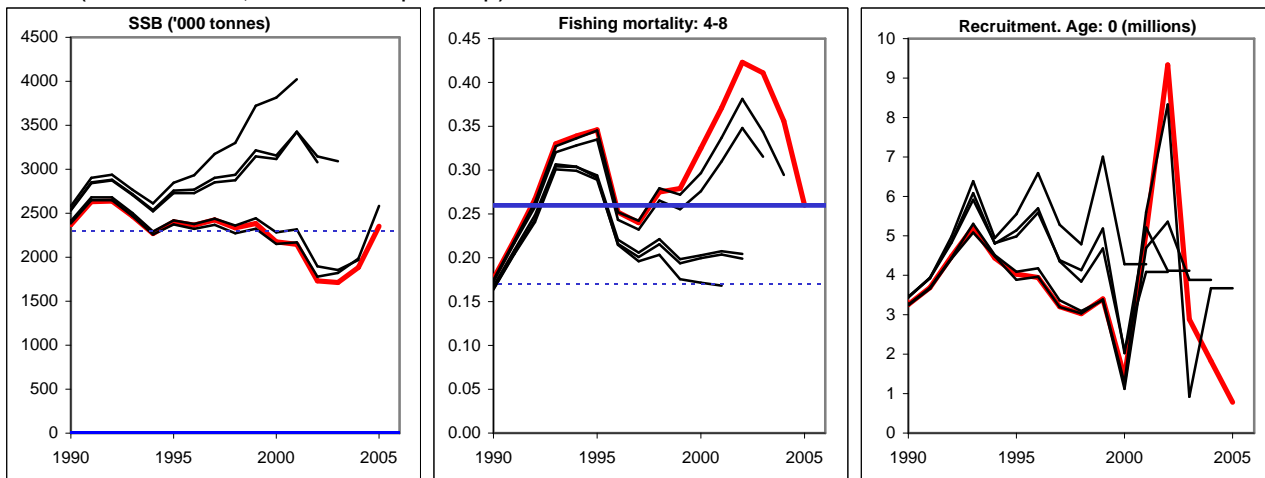


Figure 9.4.2.3 Mackerel (combined Southern, Western & N.Sea spawn.comp.) Historical performance of the assessment (SSB, Fishing mortality and recruitment)

Table 9.4.2.1 NEA Mackerel. Catches (in tonnes) by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

Year	Subarea VI			Subarea VII and Divisions VIIIa,b,d,e			Subareas IV and III			Subareas I,II & Divs. Vb ¹	Divs. VIIIc, IXa	Total		
	Landings	Discards	Catch	Landings	Discards	Catch	Landings	Discards	Catch			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		40,889	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 ^{2,3}	116,362	§	116,362	94,290	§	94,290	313,014	§	313,014	72,848	43,796	640,311	§	640,311
2000 ^{2,3}	187,595	1	187,595	115,566	1,918	117,484	285,567	165	304,898	92,557	36,074	736,524	2084	738,608
2001 ^{2,3}	143,142	83	143,142	142,890	1,081	143,971	327,200	24	339,971	67,097	43,198	736,274	1,188	737,462
2002 ^{2,3}	136,847	12,931	149,778	102,484	2,260	104,744	375,708	8,583	394,878	73,929	49,576	749,131	23,774	772,905
2003 ³	142,728	91	142,819	89,492		89,492	334,639	9,390	357,766	53,701	25,823	660,119	9,481	669,600
2004 ³	134,251	240	134,491	99,922	1,862	101,784	300,768	8,870	316,620	62,486	34,840	639,248	10,972	650,221
2005	79,960	11,400	91,361	90,278	5,878	96,156	249,740	2,482	252,223	54,129	49,618	523,726	19,760	543,486

*Preliminary.

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

²Data revised for Northern Ireland; ³Data revised for unallocated catch.

§ Discards reported as part of unallocated catches.

Table 9.4.2.2

Mackerel (combined Southern, Western & N.Sea spawn.comp.)

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1972	2190480	4038603	361262	0.018
1973	4880250	4128482	570719	0.161
1974	4113000	3976210	607473	0.188
1975	5014750	3724320	784329	0.200
1976	5035560	3400480	828434	0.236
1977	1014280	3230685	620016	0.182
1978	3288700	3192117	736519	0.180
1979	5363800	2740188	842739	0.240
1980	5664020	2300859	734950	0.231
1981	7365370	2349329	754045	0.213
1982	2080800	2256416	716987	0.206
1983	1613650	2529253	672283	0.200
1984	7398800	2528343	641928	0.210
1985	3385430	2493292	614371	0.206
1986	3482600	2483426	602200	0.218
1987	5090890	2455434	654992	0.205
1988	3588520	2461642	680491	0.228
1989	4294500	2520997	585920	0.173
1990	3258290	2368842	626107	0.176
1991	3688430	2632082	675665	0.220
1992	4480660	2638896	760690	0.267
1993	5218570	2467288	824568	0.330
1994	4437980	2268604	829087	0.339
1995	4028980	2402407	756277	0.346
1996	3945160	2364841	563472	0.252
1997	3204550	2424819	573029	0.240
1998	3026300	2333705	666316	0.275
1999	3400800	2383006	640309	0.279
2000	1426200	2175396	738606	0.325
2001	5087070	2145921	737463	0.371
2002	9335000	1731017	772905	0.423
2003	2882660	1712998	669600	0.411
2004	1827930	1884198	650221	0.356
2005	780230	2352719	543486	0.260
Average	3967477	2620495	677572	0.246