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Book 6
North Sea

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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BOOK 6

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6 NORTH SEA

6.1 Ecosystem overview

This Section has not been updated in 2011. The most recent ecosystem overview is available in ICES Advisory Report 2008, Section 6.1. This overview can also be found on the ICES website:
http://www.ices.dk/committe/acom/comwork/report/2008/2008/6.1-6.2%20North%20Sea%20ecosystem%20overview.pdf.

6.2 Human impacts on the ecosystem

6.2.1 Fishery effects on benthos and fish communities

This Section has not been updated in 2011. The most recent description on Fishery effects on benthos and fish communities is available in ICES Advisory Report 2008, Section 6.2. This description can also be found on the ICES website: http://www.ices.dk/committe/acom/comwork/report/2008/2008/6.1-6.2%20North%20Sea%20ecosystem%20overview.pdf.

6.3 Assessments and Advice

6.3.1 Assessment and advice regarding protection of biota and habitats

In 2011, ICES has not provided advice regarding protection of biota and habitats for this area.

6.3.2 Assessments and Advice regarding fisheries

6.3.2.1 Mixed fisheries and fisheries interactions

This Section has not been updated in 2011. The most recent description on Mixed fisheries and fisheries interactions is available in ICES Advisory Report 2008, Section 6.3. This description can also be found on the ICES website: http://www.ices.dk/committe/acom/comwork/report/2008/2008/6.3%20North%20Sea%20fisheries%20advice.pdf

6.3.2.2 Assessments and advice regarding fisheries

In 2007 the timing of the advisory process for the North Sea was changed at the request of ICES clients. This means that the fisheries advice is delivered in the first half of the year instead of in October. To evaluate whether new information that becomes available after the advice is released would form a basis to update the advice ICES has developed a generic approach (AGCREFA, 2008a). The approach is based on a statistical evaluation of the importance of that information (e.g. new survey information available in August/September). On this basis, the advice for saithe (section 6.4.12b) was updated in November 2011.

The state and the limits to exploitation of the individual stocks are presented in the stock sections. The state of the North Sea stocks and single-stock exploitation boundaries are summarized in table 6.3.2.1 below.

For the stocks of elasmobranchs (rays, skates, sharks), *Nephrops* in Division IIIa, and deep-water species, ICES provides advice every second year. The 2010 advice for these stocks can be found in table 6.3.2.2 and 6.3.2.3 and is valid for both 2011 and 2012.

Sources of information

ICES. 2008a. Report of the Ad hoc Group on Criteria for Reopening Fisheries Advice (AGCREFA), 20–22 August 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:60.
ICES. 2008b.ICES Advisory Report 2008, Book 6.

Single-stock exploitation boundaries and critical stocks

Table 6.3.2.1 Single stock advice for North Sea stocks, summary of state of stocks and single-stock exploitation boundaries. The state and the limits to exploitation of the individual stocks are presented in the stock sections.

Stock	**State of the stock**				**Outlook options**			**ICES advice for 2012** (in tonnes or effort)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary limits (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary limits (B_{PA}/B_{lim})**	**MSY approach** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Cod in Kattegat	Unknown	Unknown	Undefined	Reduced reproductive capacity	No forecast	No directed fisheries, minimise bycatch and discards	No forecast	Precautionary considerations: 0 t
Cod in the North Sea, Eastern Channel and Skagerrak	Above target	Increased risk	Below trigger	Reduced reproductive capacity	9500 t to 42 000 t for transition to the MSY framework by 2012 to 2015, respectively	Zero	31 800 t	Management plan: 31 800 t
Haddock in the North Sea and Division IIIaN	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Less than 43 000 t Human Consumption	Less than 86 000 t Human Consumption	41 575 t Human Consumption	Management plan: 41 575 t Human Consumption
Whiting in Division IIIa	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Catches should be reduced	n/a	Precautionary considerations: Reduce catches
Whiting in the North Sea and Eastern Channel[1]	Undefined	Undefined	Undefined	Undefined	n/a	n/a	24 300 t Human Consumption	Management plan: 24 300 t Human Consumption
Plaice in Division IIIa	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Catches should be reduced	n/a	Precautionary considerations: Reduce catches
Plaice in the North Sea	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Less than 74 000 t	Less than 155 500 t	Management plan 1st stage: 84 410 t	Management plan: 84 410 t
Plaice in the Eastern Channel	Unknown	Unknown	Unknown	Unknown	n/a	Catches should not be allowed to increase, discards should be reduced	n/a	Precautionary considerations: No increase in catches, reduce discards
Sole in Division IIIa	Below target	Increased risk	Below trigger	Undefined	Less than 610 t	Less than 520 t	n/a	MSY framework: < 610 t

[1] North Sea whiting advice was corrected in October 2011

Stock	**State of the stock**				**Outlook options**			**ICES advice for 2012** (in tonnes or effort)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary limits (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary limits (B_{PA}/B_{lim})**	**MSY approach** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Sole in the North Sea	Above target ✗	Harvested sustainably ✓	Above trigger ✓	Full reproductive capacity ✓	Less than 15 100 t	Less than 19 700 t	Management plan 1st stage: 15 700 t	Management plan: 15 700 t
Sole Eastern Channel	Below target ✓	Increased risk o	Above trigger ✓	Full reproductive capacity ✓	MSY transition: Less than 5600 t	Less than 5700 t	n/a	MSY transition: < 5600 t
Saithe in the North Sea, Division IIIa and Subarea VI [2]	Above target ✗	Harvested sustainably ✓	Below trigger ✗	Increased risk o	Less than 71 000 t	Less than 67 000 t	87 550 t	Management plan: 87 550 t
Nephrops in Division IIIa (FUs 3 and 4)	Appropriate ✓	Undefined ?	Undefined ?	Undefined ?	Landings no more than 6000 t	n/a	n/a	MSY framework: < 6000 t
Nephrops in Subarea IV, FU6	Appropriate ✓	Undefined ?	Above trigger ✓	Undefined ?	MSY transition: Less than 1400 t	n/a	n/a	MSY transition: < 1400 t
Nephrops in Subarea IV, FU7	Below target ✓	Undefined ?	Above trigger ✓	Undefined ?	MSY framework: Less than 14 100 t	n/a	n/a	MSY framework: < 14 100 t
Nephrops in Subarea IV, FU8	Above target ✗	Undefined ?	Above trigger ✓	Undefined ?	MSY transition: Less than 1700 t	n/a	n/a	MSY transition: < 1700 t
Nephrops in Subarea IV, FU9	Below target ✓	Undefined ?	Above trigger ✓	Undefined ?	MSY framework: Less than 1100 t	n/a	n/a	MSY framework: < 1100 t
Herring in IIIa and Subdivisions 22-24 (spring spawners)	Above target ✗	Undefined ?	Below trigger ✗	Undefined ?	MSY framework: Less than 42 700 t herring catches for the whole area	n/a	n/a	MSY framework: < 42 700 t
Herring in the North Sea, VIId and IIIa (autumn spawners)	Below target ✓	Harvested sustainably ✓	Undefined ?	Full reproductive capacity ✓	Less than 478 000 t for the A fleet (see scenarios for other fleets)	Less than 478 000 t for the A fleet (see scenarios for other fleets)	230 000 t for the A fleet (see scenarios for other fleets)	Management plan: 230 000 t for the A fleet.
Sprat in Division IIIa	Insufficient information ?	Insufficient information ?	Insufficient information ?	Insufficient information ?	n/a	Catches should be reduced	n/a	Precautionary considerations: Reduce catches

[2] Saithe advice was updated on the basis of summer survey information, November 2011

Stock	State of the stock				Outlook options			ICES advice for 2012 (in tonnes or effort)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary limits (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary limits (B_{PA}/B_{lim})**	**MSY approach** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Sprat in the North Sea	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Catches should be reduced	n/a	Precautionary considerations: Reduce catches
Norway pout North Sea	Undefined	Undefined	Above trigger	Full reproductive capacity	No fishery	No fishery	n/a	MSY framework: 0 t
Sandeel in Division IIIa and Subarea IV [3]:								
Dogger Bank area (SA1) [3]	Undefined	Undefined	Above trigger	Full reproductive capacity	MSY framework (short-lived species) less than 320 000 t	n/a	n/a	MSY framework: < 320 000 t in 2011
South Eastern North Sea (SA 2) [3]	Undefined	Undefined	Above trigger	Full reproductive capacity	MSY framework (short-lived species) less than 34 000 t	n/a	n/a	MSY framework: < 34 000 t in 2011
Central Eastern North Sea (SA 3) [3]	Undefined	Undefined	Above trigger	Full reproductive capacity	MSY framework (short-lived species) No fishery	n/a	n/a	MSY framework: 0 t in 2011
Central Western North Sea (SA 4) [3]	Unknown	Unknown	Unknown	Unknown	n/a	A TAC in the range 5000–10 000 t will imply a low risk of overfishing	n/a	Precautionary considerations: 5000-10 000 t
Viking and Bergen Bank area (SA 5) [3]	Unknown	Unknown	Unknown	Unknown	n/a	no increase of the fisheries should take place unless there is evidence that this will be sustainable	n/a	Precautionary considerations: No increase in fisheries
Division IIIa East (Kattegat, SA 6) [3]	Unknown	Unknown	Unknown	Unknown	n/a	- „ -	n/a	Precautionary considerations: No increase in fisheries
Shetland area (SA 7) [3]	Unknown	Unknown	Unknown	Unknown	n/a	- „ -	n/a	Precautionary considerations: No increase in fisheries

[3] The sandeel stock is subdivided into 7 Sandeel Areas since 2010. Advice presented here is in year advice for 2011, advice for 2012 will be presented in February 2012.

Stock	**State of the stock**				**Outlook options**			**ICES advice for 2012** (in tonnes or effort)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary limits (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary limits (B_{PA}/B_{lim})**	**MSY approach** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Pandalus in the Fladen Ground	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Catches should not be allowed to increase unless there is evidence this will be sustainable	n/a	Precautionary considerations: No increase in catches
Pandalus in the Skagerrak and Norwegian Deep	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Catches and discards should be reduced	n/a	Precautionary considerations: Reduce catches and discards
Mackerel in the North Sea*[4]	Above target	Increased risk	Above trigger	Full reproductive capacity	n/a,	No fishery in IIIa and IVb,c; No fishery in IVa between 15 February–31 July; Minimum landing size of 30 cm should be maintained.	n/a	Precautionary considerations: Existing measure to be maintained.
Horse mackerel in the North Sea	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Catches should be reduced	n/a	Precautionary considerations: Reduce catches
Pollack in the North Sea [5]	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	This is the first time data are analysed, stock definition is not clear and there is no TAC. Catches should not be allowed to increase	n/a	Precautionary considerations: No increase in catches

[4] Mackerel advice is presented in ICES 2011 section 9.4.2

[5] New stock in 2011

Table 6.3.2.2 North Sea stocks with biennial advice.

Advice from 2011 valid for 2012 and 2013

Stock	State of the stock				Outlook options			ICES advice for 2012
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary limits (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary limits (B_{PA}/B_{lim})**	**MSY approach** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Turbot in the North Sea	Insufficient information	Insufficient information	Considered stable		n/a	Bycatch species, effort in main fisheries reduced, catches should not increase	n/a	Precautionary considerations: No increase in catches
Brill in the North Sea	Insufficient information	Insufficient information	Insufficient information	Insufficient information	n/a	Bycatch species, effort in main fisheries reduced, catches should not increase	n/a	Precautionary considerations: No increase in catches
Dab in the North Sea	Insufficient information	Insufficient information	Considered to increase in the main area		n/a	Bycatch species, effort in main fisheries reduced, catches should not increase	n/a	Precautionary considerations: No increase in catches
Flounder in the North Sea	Insufficient information	Insufficient information	Considered to increase in the main area		n/a	Bycatch species, effort in main fisheries reduced, catches should not increase	n/a	Precautionary considerations: No increase in catches
Lemon sole in the North Sea	Insufficient information	Insufficient information	Considered stable		n/a	Bycatch species, effort in main fisheries reduced, catches should not increase	n/a	Precautionary considerations: No increase in catches
Witch in the North Sea	Insufficient information	Insufficient information	Considered variable without trend at low level		n/a	Bycatch species, survey and landing data have reduced, catches should be reduced	n/a	Precautionary considerations: Reduce catches

Table 6.3.2.2 continued North Sea stocks with biennial advice.

Advice from 2010, valid for 2011 and 2012.

Stock	**State of the stock**				**ICES advice summary**			**ICES advice for 2012**
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary limits (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary limits (B_{PA}/B_{lim})**	**Transition to an MSY approach** with caution at low stock size	Cautiously avoid impaired recruitment (**Precautionary Approach**)	Cautiously avoid impaired recruitment and achieve other objective(s) of a **management plan** (e.g. catch stability)	
Nephrops in Subarea IV, FU5	Unknown	Unknown	Unknown	Unknown	Reduce landings from recent level	Less than 980 t	n/a	MSY approach: Reduce catches
Nephrops in Subarea IV, FU10	Unknown	Unknown	Unknown	Unknown	n/a	n/a	n/a	2011 precautionary considerations: Reduce catches
Nephrops in Subarea IV, FU32	Unknown	Unknown	Unknown	Unknown	Reduce landings from recent level	Less than 640 t	n/a	MSY approach: Reduce catches
Nephrops in Subarea IV, FU33	Unknown	Unknown	Unknown	Unknown	Reduce landings from recent level	Less than 1 200 t	n/a	MSY approach: Reduce catches
Nephrops in Subarea IV, 'Other areas'	Unknown	Unknown	Unknown	Unknown	n/a	Less than 1 900 t	n/a	2011 precautionary considerations: No increase in catches
Demersal elasmobranchs in the North Sea Combined	[6]	[6]	[6]	[6]	Less than 2 700 t for the main species[7]	Less than 2 700 t for the main species No targeted fishery for *Raja undulata* (undulate ray) and the *Dipturus batis* complex[7]	n/a	MSY approach: < 2700 t for main species [7]

[6] See table 6.3.2.3 Demersal elasmobranchs in the North Sea by species

Table 6.3.2.3 Individual advice for demersal elasmobranchs in the North Sea. The advice from 2010 is valid for 2011 and 2012.

Species	**Area**	**State of stock**	**Advice**
Common skate (*Dipturus batis*) complex	IVa (likely merging with VI & IIa)	Depleted	**Zero catch. Retain on prohibited species list**
R. clavata (thornback ray)	IVc, VIId	Stable/increasing	**Status quo catch**
	IVa,b	Uncertain	**Reduce catch from recent level**
R. montagui (spotted ray).	IVb,c	Stable/increasing	**Status quo catch**
A. radiata (starry ray).	IVa,b, IIa	Stable	**Status quo catch**
L. naevus (cuckoo ray)	IVa,b (may extend into VI)	Stable	**Status quo catch**
R. brachyura (blonde ray)	IVc, VIId (patchy occurrence)	Uncertain	**No advice**
R. undulata (undulate ray)	VIId, merges with VIIe	Uncertain. Locally common in discrete areas	**No targeted fishery**
Scyliorhinus canicula (lesser spotted dogfish)	IVa,b,c, VIId	Increasing	**Status quo catch**
Mustelus spp. (smooth hounds)	IVa,b,c, VIId	Increasing	**Status quo catch**
Squatina squatina (angel shark)	IVa,b,c, VIId	Presumed extirpated in this region	**Zero catch. Retain on prohibited species list**

Table 6.3.2.4 Summary of the state of the stock and advice in the North Sea.

In this ecoregion, 46 stocks or stock complexes are given advice for, of which ICES provides advice on the basis of a forecast for 20 stocks (43%).

State of stock	Criteria	Number of stocks for which criteria are defined	Percentage of stocks for which criteria are met
Stocks fished at or below MSY level	$F_{2010} \leq F_{MSY}$	15	60%
Stocks fished precautionary	$F_{2010} \leq F_{PA}$	9	56%
Stocks above MSY $B_{trigger}$ biomass	$SSB_{2011} \geq$ MSY $B_{trigger}$	17	76%
Stocks above precautionary biomass	$SSB_{2011} \geq B_{PA}$	13	77%
Stocks within safe biological limits	$F_{2010} \leq F_{PA}$ and SSB2011 $\geq B_{PA}$	8	50%
Stocks without a forecast for which the advice is “do not allow catches to increase”	Trends based assessment with non-reduction advice	25	44%

6.3.3 Special Requests

6.3.3.1 Special request Advice April 2011

ECOREGION North Sea
SUBJECT Joint EU-Norway request on management plan for North Sea herring

Advice for 2012

The management plan (See Annex 6.3.3.1) appears to perform well in relation to the objectives of providing sustainable fisheries and stable yield in conformity with the precautionary approach. The current fishing mortality target (F_{2-6}) of 0.25 is consistent with the MSY approach under the current low recruitment regime. There is no basis to further adjust the harvest control rule to account for recruitment variability or trends. Rather than within-year revisions of the TAC, ICES considers that it is better to have a management plan that is can respond to large changes in the biology of the stock or assessment uncertainty. ICES would favour a collaborative iterative process between scientists, managers, and stakeholders if the management plan is revisited in 2011.

Request

JOINT EU–NORWAY REQUEST ON THE EVALUATION OF THE LONG-TERM MANAGEMENT PLAN FOR HERRING

The objectives of the long-term management plan for herring of North Sea origin and allocation of catches agreed between Norway and the European Union is to provide for sustainable fisheries with high and stable yields in conformity with the precautionary approach.

ICES is requested by 30 June 2011:

1. *To evaluation the performance of the plan in meeting its objectives, identifying any weaknesses in design or implementation that undermine its effectiveness;*
2. *To evaluate whether the values assigned to the precautionary reference points remain appropriate;*
3. *To indicate whether the target fishing mortalities rate of 0.25 for the 2-ringers and older and no more than 0.05 for 0-1-ringers, are consistent with MSY for the stock; and*
4. *To indicate any adjustments that should be made to harvest control rules to take into account low levels of recruitment.*
5. *In view of exceptional increase in the estimated SSB in 2010, to comment on whether an in-year revision of the TAC in similar circumstances is consistent with the objectives of the LTMP.*

Elaboration on the Advice

Request 1. Evaluate the performance of the plan in meeting its objectives, identifying any weaknesses in design or implementation that undermine its effectiveness.

The management plan appears to perform well in relation to the objectives of providing sustainable fisheries with stable yield in conformity with the precautionary approach. The management plan is also considered consistent with the MSY approach. In relation to the objectives of achieving high and stable yield, the change in the perception of the stock for 2010 is a type of situation that has not been part of the evaluations so far. Only by testing the HCR within a Management Strategy Evaluation will it be possible to judge the implications of this kind of uncertainty on the trade-off between high and stable yield.

The evaluation was done in a single species framework and thus did not consider multispecies interactions and the role of herring in the North Sea ecosystem.

Request 2. Evaluate whether the values assigned to the precautionary reference points remain appropriate.

F_{lim} is not defined for this stock. ICES considers that F_{pa} has been addressed at length in the past and still considers the value appropriate.

For North Sea herring, B_{lim} is set at the level below which there is an increased probability of reduced recruitment at 800 000 t. This value has been analysed several times (Patterson *et al*., 1997; ICES, 2008) since it was implemented and has always come out as an appropriate value.

ICES finds that using B_{pa} has so far been effective at keeping the SSB above B_{lim} under the precautionary approach framework. Therefore, B_{pa} at 1.3 million t is still considered appropriate as a precautionary reference point.
The management plan has shifted the biomass break point to 1.5 million tonnes and B_{pa} is therefore no longer considered in the management plan.

Request 3. Indicate whether the target fishing mortality rate of 0.25 for the 2- ringers and older and no more than 0.05 for 0-1 ringers, are consistent with MSY for the stock.

The current target fishing mortalities of the management plan are consistent with the MSY approach under the current low recruitment regime.

Request 4. Indicate any adjustments that should be made to harvest control rules to take account of recent low levels of recruitment.

As the management plan has already been adjusted (in 2008) to account for the lower productive regime since the 2001 year class and there has been no observed change to the pattern of recruitment, ICES considers that there is no basis to further adjust the harvest control rule to account for changes in recruitment.

Request 5. In view of the exceptional increase in the estimated SSB in 2010, comment on whether an in-year revision of the TAC in similar circumstances is consistent with the objectives of the LTMP.

There are technical difficulties in evaluating in-year revisions of the TAC under exceptional circumstances. Moreover, within-year revisions of the TAC could result in management responding to noise in the biological signal. Therefore ICES considers that it is better to have a management plan that can respond to large changes in the biology of the stock or assessment uncertainty, rather than within-year revisions of TACs.

If clients consider it necessary to revisit the management plan in 2011 ICES would favour a collaborative iterative process between scientists, managers, and stakeholders.

Sources

ICES. 1998. Report of the Study Group on the Precautionary Approach to Fisheries Management. 3–6 February 1998. ICES CM 1998/ACFM:10.

ICES. 2008. Report of the Workshop on Herring Management Plans (WKHMP), 4–8 February 2008, ICES CM 2008/ACOM:27.

ICES. 2011. Report of the Workshop on the evaluation of the long-term management plan for North Sea herring (WKHERMP), 14–15 March 2011. ICES CM 2011/ACOM:55.

Patterson, K. R., Skagen, D., Pastoors, M., and Lassen, H. 1997. Harvest control rules for North Sea herring. WD to ACFM 1997.

Annex 6.3.3.1 Agreed Management Plan for North Sea herring

According to the EU Norway agreement:

The Parties agreed to continue to implement the management system for North Sea herring, which entered into force on 1 January 1998 and which is consistent with a precautionary ap-proach and designed to ensure a rational exploitation pattern and provide for stable and high yields. This system consists of the following

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 800,000 tonnes (Blim).*
2. *Where the SSB is estimated to be above 1.5 million tonnes the Parties agree to set quotas for the directed fishery and for bycatches in other fisheries, reflecting a fishing mortality rate of no more than 0.25 for 2 ringers and older and no more than 0.05 for 0 - 1 ringers.*
3. *Where the SSB is estimated to be below 1.5 million tonnes but above 800,000 tonnes, the Parties agree to set quotas for the direct fishery and for bycatches in other fisheries, reflecting a fishing mortality rate on 2 ringers and older equal to:*

    0.25-(0.15(1,500,000-SSB)/700,000) for 2 ringers and older,*
    and no more than 0.05 for 0 - 1 ringers

4. *Where the SSB is estimated to be below 800,000 tonnes the Parties agree to set quotas for the directed fishery and for bycatches in other fisheries, reflecting a fishing mortality rate of less than 0.1 for 2 ringers and older and of less than 0.04 for 0-1 ringers.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15 % from the TAC of the preceding year the parties shall fix a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.*
6. *Notwithstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15 % compared to the TAC of the preceding year.*
7. *Bycatches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted.*
8. *The allocation of the TAC for the directed fishery for herring shall be 29 % to Norway and 71 % to the Community. The bycatch quota for herring shall be allocated to the Community.*
9. *A review of this arrangement shall take place no later than 31 December 2011.*
10. *This arrangement enters into force on 1 January 2009.*

ECOREGION North Sea
SUBJECT Joint EU–Norway request on a future long-term management plan of North Sea whiting

Advice summary

Recruitment for North Sea whiting is considered to be low (poor) when the geometric mean of the recent 3–5 years falls below 1.25 billion individuals at age 1. ICES considers that 4 years may be an appropriate period to respond to a change in recruitment. When such low recruitment occurs, even a reduction of 33% and 50% in fishing mortality had limited impact on the already low probability (i.e. between 7% and 8%) of the stock going below the lowest observed SSB in the time-series (B_{loss} = 100 000 t). Using a constant F = 0.27 in the long term resulted in around 5% probability of SSB falling below B_{loss}, irrespective of changes in the recruitment regime but providing that recruitment remained within the range of observed values. Removing TAC constraints when the recruitment becomes low reduces the probability of the stock falling below B_{loss}. In all cases examined, the reductions in the probabilities of the stock falling below the lowest SSB observed are small.

Request

The response to the Joint EU-Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) from ICES in September 2010 stated that "maintaining fishing mortality at its current level of 0.3 would be consistent with long-term stability if recruitment is not poor".

Consequently the EU and Norway have agreed to interim management of whiting at this level of total fishing mortality, conditional on a 15% TAC constraint.

On the basis that the whiting stock exhibits no relationship between spawning biomass and recruitment, ICES is requested to conduct an evaluation of:

1) *The level and number of years for which recruitment is considered poor;*
2) *The lower level to which fishing mortality should be reduced;*
3) *The rate of reduction to the lower level in the event of poor recruitment.*

Elaboration on Advice

Request 1. To conduct an evaluation of the level and number of years for which recruitment is considered poor.

Estimates of low (poor) recruitment that result in a similar risk of SSB falling below the lowest observed value (B_{loss} = 100 000 t), are in the range of 1.25 to 1.5 billion individuals. Using a threshold of 1.5 billion results in a similar risk of SSB falling below B_{loss} but is likely to result in more 'false alarms' (invoking a reduction in F when estimates of recruitment in the next year would reveal that this was not necessary). Thus, the best estimate of low recruitment is when the geometric mean of the recent 3–5 years falls below 1.25 billion individuals at age 1. Noise in recruitment estimation may result in a false reaction for the shorter 3-year period and after 5 years management action may need to be more severe. Therefore, 4 years may be a more appropriate period to respond to a change in recruitment.

Request 2. To conduct an evaluation of the lower level to which fishing mortality should be reduced.

Simulation studies indicate that with a target F = 0.3 and a 15% TAC constraint, a 33% and 50% reduction in fishing mortality rate when recruitment became low had limited impact on the probability (i.e. between 7% and 8%) of the stock going below B_{loss} (Annex 6.3.3.2.1). However, simulations with a constant fishing mortality rate of 0.27 had around 5% probability of SSB falling below B_{loss} in the long term, irrespective of changes in the recruitment regime and providing that the recruitment remained within the range of observed recruitment values. There is some associated loss of yield at lower fishing mortality rate but this strategy would avoid potential false alarms triggered by noise and retrospective bias currently associated with the estimation of North Sea whiting recruitment.

If a target F = 0.3 and 15% TAC constraint are maintained, the approach of reducing fishing mortality when recruitment becomes low would be appropriate. However, the simulation studies suggest that a 50% reduction in F from 0.3 to 0.15 results in some decrease (i.e. from about 8% to 4–5%) in the risk of SSB falling below B_{loss}, but only if the TAC constraint is moved below the trigger recruitment. For other scenarios examined, ICES notes that the probability of SSB falling below B_{loss} is marginally above 5%.

Request 3. To conduct an evaluation of the rate of reduction to the lower level in the event of poor recruitment.

A proportional reduction in fishing mortality (i.e. from F = 0.3 to F = 0.2 or 0.15) when recruitment becomes low (see illustration in Annex 6.3.3.2.2) as discussed under request 2, while maintaining the 15% TAC constraint would result in a small (1–2%) reduction in the probability that SSB will fall below the lowest observed value. Reducing the fishing mortality while removing the TAC constraint when recruitment becomes low would reduce this probability by a further 1–2% to about 4–5% (Annex 6.3.3.2.3).

Another option would be to keep F at 0.3 and remove the TAC constraint when recruitment becomes low. In that case, the risk that SSB will decline below the lowest observed value is about 6%, slightly lower than when the TAC constraint is maintained.

ICES concludes that fishing at F = 0.3 with a 15% TAC constraint already has a relatively low probability of SSB declining below the lowest observed value in the time-series, albeit slightly above 5%. Reductions in fishing mortality during periods of low recruitment would be appropriate even though it is not expected to significantly reduce the risk. If F is kept constant at 0.3, relaxing the TAC constraint will lead to very similar results in terms of risk. In all cases examined, the reductions of the risk of the stock falling below the lowest SSB observed are small.

Basis of advice

Background

The dynamics of the whiting stock are heavily dependent on the abundance of recruitment entering the stock. Whiting grow quickly and mature at an early age (11% at age 1 (recruits to the fishery), 92% at age 2, and 100% for ages 3+). Fish at ages 1 and 2 make a substantial contribution to the spawning stock; however, there is no apparent dependence of recruitment on spawning biomass.

A response to the Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) from ICES in September 2010 stated that “maintaining fishing mortality at its current level of 0.3 would be consistent with long-term stability if recruitment is not poor” (ICES, 2010). Consequently the EU and Norway agreed to interim management of whiting at this level of total fishing mortality for 2011, conditional on a 15% TAC constraint as follows:

The TAC for whiting for 2011 will be fixed by applying an interim management plan consisting of the following elements:

1. For 2011 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.3 for appropriate age-groups.
2. Where the rule in paragraph 1 would lead to a TAC, which deviates by more than 15% from the TAC of the preceding year, the Parties shall establish a TAC that is no more than 15% greater or 15% less than the TAC of the preceding year.
3. During 2011, after obtaining advice from ICES, the Parties will refine the management plan, in particular to allow for a reduction in the target fishing mortality when recruitment to the stock has been low for a period of years.

Subsequently, a study presented at the EU–Norway negotiations during 2010 determined that fishing at an F = 0.3, with a 15% TAC constraint, would result in increasing spawning biomass with a low risk of decreasing below the lowest observed values in the time-series at the historical average recruitment abundance and variability. However, if recruitment remained for a protracted period at the 2003–2007 level of abundance there is an increasing risk of the stock declining below the lowest recorded biomass.

Due to time constraints on the analysis no information could be provided by the preliminary study as to the extent to which F might need to be reduced following such a protracted period of low recruitment. The parties agreed an interim management plan for whiting in which the total fishing mortality is maintained at 0.3, conditional on a 15% TAC constraint. At the same time, a request was made to ICES to evaluate:

1) the level and number of years for which recruitment is considered poor;
2) the lower level to which fishing mortality should be reduced;
3) the rate of reduction to the lower level in the event of poor recruitment.

This is the request being addressed by this document.

ICES notes that no determination was made to ascertain that F of 0.3 is equivalent to F_{MSY}.

Methods

A standard Management Strategy Evaluation (MSE with FLR) method of evaluating harvest control rules was used, based on an underlying simulated population (operating model) that characterizes the North Sea whiting population and a management system model that simulates the fishery operation. This structure allows errors in sampling of data, the assessment process, and the management implementation to be simulated independently. The analysis included a simulation of the auto-correlated dynamics of North Sea whiting recruitment, with alternating periods of variable duration of three different recruitment regimes (high, medium, and low).

To provide an estimate of the level and number of years for which recruitment is considered poor, simulated fishing at a constant F = 0.3 was used to establish a base run. Each of the 200 simulations were then examined to determine the distribution of the geometric mean recruitment calculated over 3, 4, and 5 years prior to the spawning biomass being reduced to the lowest observed SSB (B_{loss} = 100 000 t) or below. The 95th percentile of the 5- and 3-year geometric mean recruitment were taken as an example of the upper thresholds for recruitment (Rt).

When the geometric mean recruitment calculated over consecutive periods of 3 years is at or below 1.25 billion individuals at age 1, simulations suggest that the SSB has a high probability of being below the lowest observed SSB the following year. When the geometric mean recruitment calculated over consecutive periods of 5 years is at or below 1.5 billion, simulations suggest the SSB has a high probability of being below the lowest observed SSB the following year.

To provide answers to the remainder of the request, two categories of harvest control rules were evaluated using the MSY with FLR method:

1) Constant fishing mortality with no TAC constraint or with TAC constraints of 15%, 20%, and 30%;
2) Fishing mortality constant at a specified target when the recent recruitment average was above a specified upper recruitment abundance threshold (Rt) with a proportional reduction in fishing mortality subject to a 15% TAC constraint below Rt down to a lower constant rate of fishing mortality (F_{low}) at a lower recruitment threshold (R_{low}) (see Annex 6.3.3.2.1 and Annex 6.3.3.2.3).

To allow comparison between harvest control rule evaluations, the same series of 200 simulations of recruitment time-series projections were used with each analysis.

Sources

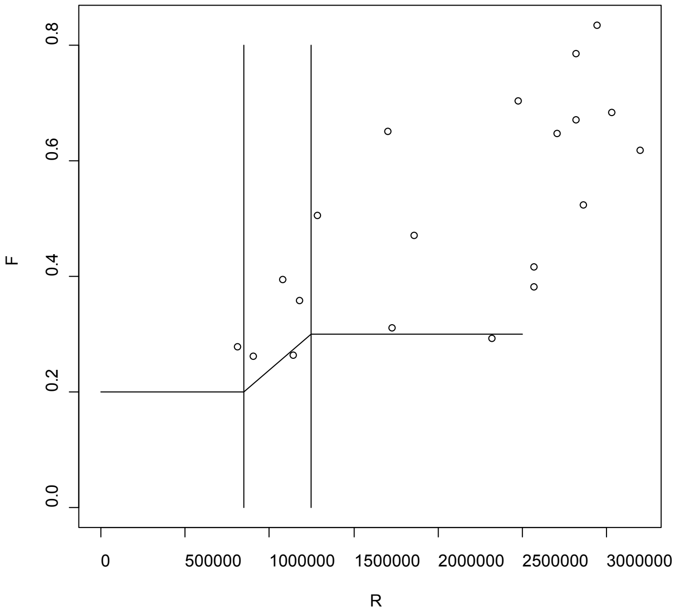
ICES 2010. Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Report of the ICES Advisory Committee, 2010. ICES Advice, 2010, Book 6: 17–19.

ICES 2011. Report on the Joint ICES–STECF Workshop on management plan evaluations for roundfish stocks (WKROUNDMP/EWG 11-01), June 20–24, 2011. ICES CM 2011/ACOM: 55.

Annex 6.3.3.2.1 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Simulation metrics based on fishing a simulated stock at a constant fishing mortality rate or under a harvest control rule in which fishing mortality is adjusted according to the level of recent recruitment. Note: This initial set of scenarios was run with inter-annual TAC constraint applied to the catch rather than landings. This was corrected in the second set of scenarios presented in Annex 6.3.3.2.3. Given that the discard ratio in catch numbers-at-age is constant throughout the simulations (average 2008–2010), this was not considered to affect significantly the medium- and long-term results of the simulations below.

.							Median SSB			Median catch			Realised F	
Rule	Target F	Constraint %	F low	GM Years	Rt (billions)	R low (billions)	All yrs	P(<Bref)	2015<Bref	All yrs	2010 - 2015	2010 - 2030	All yrs	Bias
48	0.3	-	N/A	N/A	N/A	N/A	203	0.07	0.05	42	39	44	0.32	1.07
50	0.3	15	N/A	N/A	N/A	N/A	204	0.08	0.04	42	36	44	0.32	1.07
51	0.3	20	N/A	N/A	N/A	N/A	203	0.07	0.04	42	37	44	0.32	1.07
52	0.3	30	N/A	N/A	N/A	N/A	203	0.07	0.05	42	38	44	0.32	1.07
53	0.3	15	0.2	4	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
54	0.3	15	0.2	4	1.50	0.85	208	0.06	0.03	41	35	44	0.31	1.03
55	0.3	15	0.2	3	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
56	0.3	15	0.2	3	1.50	0.85	209	0.06	0.03	41	36	44	0.31	1.03
57	0.3	15	0.2	5	1.25	0.85	207	0.07	0.04	41	36	44	0.32	1.07
58	0.3	15	0.2	5	1.50	0.85	208	0.06	0.04	41	35	44	0.31	1.03
59	0.3	15	0.15	4	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
60	0.3	15	0.15	4	1.50	0.85	210	0.06	0.03	41	35	44	0.30	1.00
61	0.3	15	0.15	3	1.25	0.85	208	0.06	0.04	41	36	44	0.31	1.03
62	0.3	15	0.15	3	1.50	0.85	211	0.06	0.03	41	36	44	0.30	1.00
63	0.3	15	0.15	5	1.25	0.85	207	0.07	0.04	41	36	44	0.31	1.03
64	0.3	15	0.15	5	1.50	0.85	210	0.06	0.03	41	35	44	0.30	1.00
71	0.25	15	N/A	N/A	N/A	N/A	225	0.03	0.03	39	33	41	0.26	1.04
72	0.25	20	N/A	N/A	N/A	N/A	224	0.03	0.03	39	33	41	0.26	1.04
73	0.25	30	N/A	N/A	N/A	N/A	224	0.03	0.03	39	34	41	0.26	1.04
74	0.25	-	N/A	N/A	N/A	N/A	223	0.03	0.03	39	35	41	0.26	1.04
65	0.25	15	0.15	4	1.25	0.85	228	0.03	0.03	39	32	41	0.26	1.04
66	0.25	15	0.15	4	1.50	0.85	229	0.02	0.03	38	32	41	0.25	1.00
67	0.25	15	0.15	3	1.25	0.85	228	0.03	0.03	39	33	41	0.25	1.00
68	0.25	15	0.15	3	1.50	0.85	230	0.02	0.02	38	32	41	0.25	1.00
69	0.25	15	0.15	5	1.25	0.85	228	0.03	0.03	39	33	41	0.26	1.04
70	0.25	15	0.15	5	1.50	0.85	229	0.03	0.02	38	32	41	0.25	1.00

Annex 6.3.3.2.2 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). An illustration of a harvest control rule in which fishing mortality is adjusted according to the level of recruitment, with the historical recruitment and fishing mortality pairs for the years 1990–2009.



Annex 6.3.3.2.3 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Additional simulation metrics based on a simulated stock exploited at a constant fishing mortality rate or under a harvest control rule in which fishing mortality is adjusted according to the level of recent recruitment. Note: constraint applied to the landings.

Rule	Target F	TAC Constraint above Rt (%)	TAC Constraint below Rt (%)	F Low	Recruitment trigger (Rt) (billions)	Mean SSB (kt)	Probability (SSB<Bloss)	Mean catch (kt)	Mean F
50	0.3	15	N/A*	N/A	N/A	204	0.070	41	0.32
59_2	0.3	15	None	0.3	1.25	206	0.066	41	0.32
60_2	0.3	15	None	0.3	1.5	205	0.062	42	0.31
53_1	0.3	15	None	0.2	1.25	207	0.057	41	0.31
54_1	0.3	15	None	0.2	1.5	209	0.046	41	0.3
59_1	0.3	15	None	0.15	1.25	209	0.052	41	0.31
60_1	0.3	15	None	0.15	1.5	211	0,040	41	0.3
75	0.27	15	N/A*	N/A	N/A	217	0.042	40	0.28

* No recruitment trigger is used.

ECOREGION North Sea
SUBJECT Joint EU–Norway request on the evaluation of the long-term management plan for cod

Advice summary

ICES advises that the objectives for the North Sea cod EU–Norway long-term management plan, put in place in 2009, have not been met in terms of reductions of fishing mortality (F). There have been continued, though minor, reductions in F and increases in SSB since the introduction of the current plan, but ICES notes that the HCR has not been implemented as stipulated in the plan so far. ICES highlights a number of weaknesses in the design and implementation of the plan, including: 1) discards and unallocated (unaccounted) removals constitute a significant proportion of the total removals and these quantities are difficult to accurately estimate. This has often resulted in underestimating the actual removals; 2) control instruments have been inadequate in that TACs on landings and effort reductions (which are part of the EU plan) have not been effective in reducing fishing mortality as stipulated in the management plan so far, although discards have been reduced. To illustrate the point, recorded landings from 2005–2010 have fluctuated between 35% and 59% of the estimated total removals; and 3) incoherence in some aspects of the EU effort regime (EU plan) are apparent. For example, under Article 13, lower reductions in effort can be allowed given the percentage of cod in the catch, while it would be more appropriate to base these reductions on expected cod catches.

ICES advises that it is appropriate for EU–Norway to continue to use the current values of precautionary reference points as defined by ICES. In response to a similar request in 2008 (ICES, 2008), ICES concluded that F = 0.4 is not necessarily an appropriate proxy for F_{MSY} for North Sea cod. The range of possible fishing mortalities consistent with F_{MSY} for this stock (0.16 to 0.42 as estimated in ICES, 2010a) depends, among other things, on the choice of the appropriate stock–recruitment model, which is uncertain. Since 2010, ICES uses 0.19 as F_{MSY} proxy for this stock, based on the clear peak at F = 0.19 (F_{max}) in the yield-per-recruit curve.

Finally, ICES advises that if the Harvest Control Rule is implemented as stipulated in the plan then there is no need to make any adjustments to the rule to account for low recruitment.

Request

The objectives of the long-term management plan for cod of North Sea origin and allocation of catches agreed between Norway and the European Union is to provide for sustainable fisheries with high and stable yields in conformity with the precautionary approach.

ICES is requested:

1. *To evaluate the performance of the plan in meeting its objectives, identifying any weaknesses in design or implementation that undermine its effectiveness, including the problem of discards and unaccounted mortality.*

2. *To evaluate whether the values assigned to the precautionary reference points remain appropriate;*

3. *To indicate whether the target fishing mortalities rate of 0.4 is consistent with MSY for the stock; and*

4. *To indicate any adjustments that should be made to harvest control rules to take into account recent low levels of recruitment.*

Elaboration on Advice

Request 1. To evaluate the performance of the plan in meeting its objectives, identifying any weaknesses in design or implementation that undermine its effectiveness, including the problem of discards and unaccounted mortality.

i. Regarding the success of the plan in meeting its objectives:

   Objectives for the North Sea cod current management plan implemented in 2009 have not been met in terms of F. F has declined since 1999 and SSB has increased since 2007, prior to the introduction of the current management plan. There have been continued but minor reductions in F and increases in SSB since the introduction of the current plan.

The current plan specified that F in 2009 should have been 75% of F in 2008 and F in 2010 should have been 65% of F in 2008. As estimated in 2011, F in 2009 was 98% of F in 2008 and F in 2010 was 97% of F in 2008. F in 2010 (ICES, 2011a) was 0.68, but according to the current management plan it should have been 0.45. The SSB in 2011 remains below B_{lim}.

ii. Regarding weaknesses in design or implementation that undermine its effectiveness, including the problem of discards and unaccounted mortality:

Uncertainties related to Forecast and Advice

The proportion of landings, discards, and unallocated (unaccounted) removals is difficult to anticipate and this is a weakness in the estimation of predicted landings, and thus of the TAC advice.

In 2007, ICES provided advice based on total removals. The corresponding value was taken to set the TAC on landings. In 2008–2010, ICES advice for TAC assumed that all unallocated removals were caused by fishing and were partitioned using the proportion of the landings in the catch (landings plus discards). It was expected that there would be no unallocated removals in the TAC year. This assumption proved to be incorrect, and in 2011 ICES gives a forecast for all the components (landings, discards, and unallocated removals) in the TAC year and advice for TAC using the landings value.

Surveys indicate that the year classes are being depleted faster than one would expect from the catches, and point to unallocated removals. There is no documented information on the source of these unallocated removals; while it has been previously assumed that these removals originate mostly from fishing activities, changes in natural mortality may also have an influence. Plausible fishery-based contributions to these unallocated removals are discards (undersized cod, highgrading, and over-quota catches) that do not count against quota, and mis- and under-reporting of landings. Recorded landings from 2005–2010 fluctuated between 35% and 59% of the estimated total removals, indicating that the management system has not been effective in controlling removals.

In addition, as for other stocks, short-term forecasts for North Sea cod are performed using several assumptions for the intermediate year, mostly on F and recruitment. For example, F in the intermediate year is supposed to follow the management plan (some % reduction compared to F in 2008) but this has consistently not been achieved because discards and unallocated removals have been different than predicted. Recruitment used in the short-term predictions was set in the range of the recent low values. However, recent recruitment estimates have been revised downwards, particularly the relatively abundant 2005 year class which has been revised downwards by 46% from the first estimate in 2007.

ICES stated in 2009 and 2010 that the TAC forecasts would only be valid under the assumption that the management plan is implemented and enforced adequately and that the objectives of the plan during the intermediate year are met (ICES, 2009, 2010c). Although ICES indicated in the advice that this was unlikely to be achieved, the TACs for 2010 and 2011 were set under the assumption that the objectives were met for the intermediate year (i.e. reduction in F during the intermediate year) and that there are no unallocated removals during the TAC year. Both assumptions turned out to be wrong according to the latest assessment, making the successive forecasts too optimistic. This is considered to have contributed to the objectives of the plan not being met.

Inadequate control instruments

TACs on landings and effort reductions have not been effective in reducing fishing mortality as stipulated in the management plan so far, although discards have been reduced.

North Sea single-stock long-term management plans have been designed without taking account of the fishing opportunities for other species. Mixed fisheries simulations (ICES, 2010b; Ulrich *et al.*, 2011) give an indication of the potential implementation error in North Sea cod advice, with actual F being higher than stipulated in the cod long-term management plan if there is continued fishing for other species with higher TACs as well as the potential overshooting or underutilization of TACs.

EU effort regime

The implementation of the plan within the EU includes an effort regime (EU management plan) to try to control F on North Sea cod. Even though the allowed effort for each year is based on the same reduction rate in F compared to the previous year, there are several concerns:

- In the first year of the plan (2009), the allowed efforts for the different fleets were set on the basis of the effort calculated over the period 2004–2006 or 2005–2007 (the baseline). This reference period differs from the reference year on which the stipulated F reductions are based on (2008).
- Different methodologies have been used to calculate effort from the reference years compared to those used to report effort usage within the plan. This resulted in higher than intended effort.
- The effort reduction is highly dependent on the estimate of F in the last year; this estimate is uncertain.
- It is generally acknowledged that reductions in effort do not necessarily imply a reduction in F by a similar proportion. Often, the achieved reduction in F is smaller than the effort reduction.

Article 13 of the EU management plan aims to promote the use of highly selective gear and cod-avoidance fishing trips by offering compensation in terms of lower reductions in effort than would otherwise result from direct application of Article 12. The way in which Article 13 is formulated makes it a novel management instrument, as it allows flexibility in the way Member States manage their allocated effort and the mechanisms deployed to achieve cod avoidance. This is left to be devised and decided by Member States and the industry, promoting participatory governance and results-based management, in line with the Green Paper on the reform of the CFP. This may also provide an instrument to help to reconcile different catch objectives for different species in a mixed fishery context. ICES considers that an incentive-based approach may produce real reductions in F, but these have not yet been realized. Potential weaknesses identified in Article 13 are:

- Most of the provisions of Article 13 (excepting Article 13.2 c) do not seem to link the allowed effort with the intended reduction in F according to the HCR of the plan. It is therefore difficult to evaluate the appropriateness of those provisions in achieving the intended F reduction rates.
- In relation to Articles 13.2 a and b, a low percentage of cod catch could be due to local depletion of cod or to increased amounts of catch of other species (while keeping the cod catch constant), in which cases it may not correspond to a low F for cod. Additionally, if the number of vessels or trips with low percentages of cod catch is large, the total amount of cod caught by them may still be high. These points (also affecting to a large extent Article 11) constitute a fundamental flaw in the design of the plan. A system based on the expected cod outtake under these provisions with respect to the whole cod fishery would be more appropriate. Allocating a proportion of the total catch to a fleet, which is then expected to demonstrate it does not exceed that catch seems a better approach.

Article 17 allows Member States to transfer effort allocations between gear groupings in the same geographical area. The catch per unit effort (cpue) of the donor and receiving groups are used to calculate the increase in effort allocated to the receiving group. Two issues require further attention:

- A lower cpue does not necessarily imply a lower exploitation impact on the stock, as the latter is highly dependent on the exploitation pattern (at length or age). A fleet with lower cpue that catches smaller fish may have a stronger impact on the stock than a fleet with higher cpue that catches larger fish or vice-versa, depending on their total catch.
- The measure currently used for effort (and, hence, intervening in the catch per unit effort computation in Article 17) is kW-days, which may not be appropriate for gillnets, trammelnets, and longline gear groupings. This is a general point affecting effort measurement.

Request 2. To evaluate whether the values assigned to the precautionary reference points remain appropriate.

The North Sea cod assessment underwent an in-depth review in February 2011 (ICES, 2011b), which resulted in a change of assessment model and exclusion of one survey series. Although the new assessment model and configuration settings are considered the most appropriate that could be fitted in the time available, aspects remain to be investigated. As a result, precautionary reference points have not been re-examined. ICES intends to re-examine precautionary reference points once the new assessment approach is consolidated. For the time being, and given that the historical perception of the stock has not changed markedly with the new assessment model, ICES concludes that the current ICES values of PA reference points should be used.

Request 3. To indicate whether the target fishing mortalities rate of 0.4 is consistent with MSY for the stock.

ICES responded to a similar request in 2008 (ICES, 2008) and concluded that F = 0.4 is not necessarily an appropriate proxy for F_{MSY} for North Sea cod. The range of possible fishing mortalities consistent with F_{MSY} for this stock (0.16 to 0.42 as estimated in ICES, 2010a) depends, among other things, on the choice of the appropriate stock–recruitment model, which is uncertain. Since 2010, ICES has used 0.19 as F_{MSY} proxy for this stock, based on the clear peak at F = 0.19 (F_{max}) in the yield-per-recruit curve.

Request 4. To indicate any adjustments that should be made to harvest control rules to take into account recent low levels of recruitment.

ICES (ICES, 2011c) has conducted a Management Strategy Evaluation (MSE) study to test the robustness of the harvest control rule in the EU–Norway long-term management plan under a range of assumptions about population dynamics and errors in the input data for assessment. This evaluation assumed that the HCR would be implemented as stipulated in the plan. Starting from the most recent ICES assessment (ICES, 2011a) and assuming low future recruitments, all scenarios considered led to SSB larger than B_{lim} in 2015. For those scenarios, the probability that SSB is larger than B_{pa} in 2015 ranged from 0.44 to 0.98. For the two scenarios most consistent with the way the stock is currently assessed the probabilities of SSB being larger than B_{pa} in 2015 were 0.69 and 0.98, depending on population dynamics assumptions. Therefore, ICES advises that there is no need to make any adjustments to account for low recruitment providing that the Harvest Control Rule is implemented as stipulated.

ICES notes, however, that the HCR has not been implemented as stipulated so far. Consequently, additional projections have been conducted assuming the observed F reductions (about 1.5% per year) since the plan was put in place. The results suggest a high probability of exceeding B_{lim} in 2015, but a very low probability of exceeding B_{pa} if recruitment remains low.

Basis of advice

Background

Cod is widely distributed throughout the North Sea; it is targeted by some fleets, but it is also caught as part of a mixed fisheries catching haddock, whiting, *Nephrops*, plaice, and sole. Cod discards have declined from 45% in 2008 to 20% in 2010 as a proportion of the total cod catches by weight.

There has been a gradual improvement in the status of the stock over the last few years. SSB has increased from the historical low in 2006, but remains below B_{lim}. Fishing mortality declined from 2000, but is estimated to be well above F_{MSY}, and just above F_{pa}. Recruitment since 2000 has been poor.

The EU–Norway agreement management plan was updated in December 2008. The plan aims to be consistent with the precautionary approach and is intended to provide for sustainable fisheries and high yield leading to a target fishing mortality of 0.4 (Annex 6.3.3.3.1). The EU has adopted a long-term plan for this stock with the same aims (Council Regulation (EC) 1342/2008). ICES evaluated both plans in 2009 and concluded they are in accordance with the precautionary approach if implemented and enforced adequately.

In both plans fishing mortality should be reduced to 75% of F_{2008} in 2009 and 65% of F_{2008} in 2010. Until the long-term phase of the management plans has been reached, further annual reductions of 10% must be applied.

In addition to the EU–Norway agreement the EU plan also includes effort restrictions, reducing kW-days available to community vessels in the main metiers catching cod in direct proportion to reductions in fishing mortality until the target F of 0.4 has been reached.

Results and conclusions

There have been many changes in the way the fisheries on North Sea cod have been managed since the introduction of the plan. The intention of most of these changes has been to encourage improvement in fishing practices, with intentional cod avoidance or a reduction of discards being rewarded by measures such as additional days at sea or increased quota. Several countries (principally Scotland, England, Denmark, and Sweden) have implemented catch-quota schemes for cod, which feature discard bans monitored by CCTV systems and associated additional quota. Scotland has also developed a system of real-time closures, intended to move vessels away from cod aggregations.

While there has been some limited progress in reducing the overall F for North Sea cod, and the observed discard rate has been reduced (particularly for older fish), cod avoidance has proved more difficult to achieve, particularly in northern areas where cod abundance would appear to be increasing at a faster rate than elsewhere. Studies (e.g. Needle and Catarino, 2011) have shown that, while vessels will move to areas of lower cod density when impacted by real-time closures, they will move back again when the closed areas reopen and the net effect on mortality is difficult to quantify. Furthermore, the initial reduction in F outlined in the plan was large and therefore likely difficult to attain. Finally, ICES notes that the HCR has not been implemented as stipulated in the plan so far, due to inadequate control on removals which have resulted in actual removals that were considerably higher than forecast removals.

This has led to the advised quota for 2008–2011 being too high, and may have contributed to the lack of a rapid reduction in F. This has been taken into account in the advice for 2012.

Methods

This section provides background on the methods used to answer Request 4. More detail can be found in Annex 13 of the report on the Joint ICES–STECF Workshop on management plan evaluations for roundfish stocks (ICES, 2011c). The simulations method for North Sea cod was developed from the stochastic projection software used to provide catch options advice for North Sea cod (see Annex 2 in ICES, 2011b). This is because the MSE framework used for earlier impact assessments for North Sea cod were designed for B-Adapt, and not for the SAM model now used for North Sea cod, which is structurally different to B-Adapt.

The following scenarios were considered:

Operating Model (OM), reflecting different assumptions about the population and fishery dynamics, considers the existence of unallocated removals, which could arise from 2 different sources:

- Scenario “cat”: catch is not correctly reported (this could be due to a variety of misreporting issues with landings or estimation errors, e.g. in discards).
- Scenario “m”: natural mortality is changing in ways not known or expected.

Recruitment (SR) scenarios: In the OM, recruitment is simulated randomly with noise around a stock–recruitment relationship and with scenarios as follows:

- Scenario “1”: Standard recruitment (the stock–recruitment relationship is fitted to the full time-series of stock and recruitment estimates obtained in the most recent ICES assessment, see ICES, 2011a).
- Scenario “0.5”: Low recruitment (same stock–recruitment relationship as in Scenario “1”, but halving the slope at the origin).

Observation Error Model (OEM), which captures the way in which the stock assessment is conducted:

- Scenario “cat”: the assessment model allows for the existence of unallocated removals and estimates those as part of the fishing mortality.
- Scenario “m”: the assessment model allows for the existence of unallocated removals and estimates those as part of the natural mortality.
- Scenario “wg”: the assessment model assumes that there are no unallocated removals.

TAC constraints (TAC con):

- Scenario “20%”: 20% maximum inter-annual variations permitted in TAC.
- Scenario “-“: no TAC constraints.

The catch forecasted for the TAC year by applying the HCR defined in the EU–Norway management plan is subtracted from the population, hence assuming that the HCR is implemented as stipulated in the plan.

Table 1 presents the results of this Management Strategy Evaluation analysis, where each row corresponds to a combination of OM, SR, OEM, and TAC scenarios and columns 6–17 refer to stock status in 2015, as follows:

- Prob$\geq B_{lim}$, Prob$\geq B_{pa}$: probability that SSB at the start of 2015 is at or above precautionary reference points.
- Prob$\leq F_{msylo}$, Prob$\leq F_{msy}$, Prob$\leq F_{msyhi}$: probability that fishing mortality during 2015 is at or below $F_{msylo} = 0.16$, $F_{msy} = 0.19$ or $F_{msyhi} = 0.42$.
- SSB: spawning-stock biomass at the start of 2015, in thousands of tonnes.
- L, D, C: landings, discards, and total catch during 2015, in thousands of tonnes.
- FL, FD, FC: fishing mortality values corresponding to landings, discards, and total catch during 2015.

It is known that the HCR has so far not been implemented in accordance to the plan and only fairly modest reductions in F have taken place during 2009 and 2010. To get an idea of the impact of the implementation problems on future stock prospects, a further, simpler simulation study was undertaken, considering F reductions of 1.5% each year, without TAC constraints or feedback from the management plan. Hence, only the OM and SR components of the MSE framework were used. Results are presented in Table 2.

The reply to Request 4 is based on the metrics Prob≥$B_{lim,}$ and Prob≥$B_{pa,}$ from Tables 1 and 2. From Table 1, the low recruitment scenarios (SR = 0.5) with 20% TAC constraints (as established in the plan) are considered, with special attention given to rows 7 and 10, which are the most consistent with the way the North Sea cod stock is currently assessed (OEM "cat" scenario).

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Ulrich, C., Reeves, S. A., Vermard, Y., Holmes, S. J., and Vanhee, W. 2011. Reconciling single-species TACs in the North Sea demersal fisheries using the Fcube mixed-fisheries advice framework. ICES Journal of Marine Science, 68: 1535–1547.

Annex 6.3.3.3.1

EU–Norway management plan

In 2008 the EU and Norway renewed their initial agreement from 2004 and *"agreed to implement a long-term management plan for the cod stock, which is consistent with the precautionary approach and is intended to provide for sustainable fisheries and high yield."*

Transitional arrangement

F will be reduced as follows: 75% of F in 2008 for the TACs in 2009, 65% of F in 2008 for the TACs in 2010, and applying successive decrements of 10% for the following years.

The transitional phase ends as from the first year in which the long-term management arrangement (paragraphs 3–5) leads to a higher TAC than the transitional arrangement.

Long-term management

1. *If the size of the stock on 1 January of the year prior to the year of application of the TACs is:*

    a. *Above the precautionary spawning biomass level, the TACs shall correspond to a fishing mortality rate of 0.4 on appropriate age groups;*
    b. *Between the minimum spawning biomass level and the precautionary spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate on appropriate age groups equal to the following formula:*

        *0.4 - (0.2 * (Precautionary spawning biomass level - spawning biomass) / (Precautionary spawning biomass level - minimum spawning biomass level))*

    c. *At or below the limit spawning biomass level, the TAC shall not exceed a level corresponding to a fishing mortality rate of 0.2 on appropriate age groups.*

2. *Notwithstanding paragraphs 2 and 3, the TAC for 2010 and subsequent years shall not be set at a level that is more than 20 % below or above the TACs established in the previous year.*
3. *Where the stock has been exploited at a fishing mortality rate close to 0.4 during three successive years, the parameters of this plan shall be reviewed on the basis of advice from ICES in order to ensure exploitation at maximum sustainable yield.*
4. *The TAC shall be calculated by deducting the following quantities from the total removals of cod that are advised by ICES as corresponding to the fishing mortality rates consistent with the management plan:*

    a. *A quantity of fish equivalent to the expected discards of cod from the stock concerned;*
    b. *A quantity corresponding to other relevant sources of cod mortality.*
5. *The Parties agree to adopt values for the minimum spawning biomass level (70,000 tonnes), the precautionary biomass level (150,000 tonnes) and to review these quantities as appropriate in the light of ICES advice.*

Procedure for setting TACs in data-poor circumstances

6. *If, due to a lack of sufficiently precise and representative information, it is not possible to implement the provisions in paragraphs 3 to 6, the TAC will be set according to the following procedure.*

    a. *If the scientific advice recommends that the catches of cod should be reduced to the lowest possible level the TAC shall be reduced by 25% with respect to the TAC for the preceding year;*
    b. *In all other cases the TAC shall be reduced by 15% with respect to the TAC for the previous year, unless the scientific advice recommends otherwise.*

This plan shall be subject to triennial review, the first of which will take place before 31 December 2011. It enters into force on 1 January 2009.

The main changes between this and the plan of 2004 is the phasing (transitional and long-term phase) and the inclusion of an F reduction fraction.

EU management plan

In December 2008 the European Council agreed on a new cod management plan implementing the new system of effort management and a target fishing mortality of 0.4 (EC 1342/2008). The HCR for setting TAC for the North Sea cod stock is copied below.

Articles 7 1(a) and 7.1(b) are required for interpretation of Article 8.

Article 7: Procedure for setting TACs for cod stocks in the Kattegat the west of Scotland and the Irish Sea

1. *Each year, the Council shall decide on the TAC for the following year for each of the cod stocks in the Kattegat, the west of Scotland and the Irish Sea. The TAC shall be calculated by deducting the following quantities from the total removals of cod that are forecast by STECF as corresponding to the fishing mortality rates referred to in paragraphs 2 and 3:*
   (a) a quantity of fish equivalent to the expected discards of cod from the stock concerned;
   (b) as appropriate a quantity corresponding to other sources of cod mortality caused by fishing to be fixed on the basis of a proposal from the Commission. […]

Article 8: Procedure for setting TACs for the cod stock in the North Sea

1. *Each year, the Council shall decide on the TACs for the cod stock in the North Sea. The TACs shall be calculated by applying the reduction rules set out in Article 7 paragraph 1(a) and (b).*
2. *The TACs shall initially be calculated in accordance with paragraphs 3 and 5. From the year where the TACs resulting from the application of paragraphs 3 and 5 would be lower than the TACs resulting from the application of paragraphs 4 and 5, the TACs shall be calculated according to the paragraphs 4 and 5.*
3. *Initially, the TACs shall not exceed a level corresponding to a fishing mortality which is a fraction of the estimate of fishing mortality on appropriate age groups in 2008 as follows: 75 % for the TACs in 2009, 65 % for the TACs in 2010, and applying successive decrements of 10 % for the following years.*
4. *Subsequently, if the size of the stock on 1 January of the year prior to the year of application of the TACs is:*
   (a) above the precautionary spawning biomass level, the TACs shall correspond to a fishing mortality rate of 0,4 on appropriate age groups;
   *(b) between the minimum spawning biomass level and the precautionary spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate on appropriate age groups equal to the following formula: 0,4 – (0,2 * (Precautionary spawning biomass level – spawning biomass) / (Precautionary spawning biomass level – minimum spawning biomass level))*
   (c) at or below the limit spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate of 0,2 on appropriate age groups.
5. *Notwithstanding paragraphs 3 and 4, the Council shall not set the TACs for 2010 and subsequent years at a level that is more than 20 % below or above the TACs established in the previous year.*
6. *Where the cod stock referred to in paragraph 1 has been exploited at a fishing mortality rate close to 0,4 during three successive years, the Commission shall evaluate the application of this Article and, where appropriate, propose relevant measures to amend it in order to ensure exploitation at maximum sustainable yield.*

Article 9: Procedure for setting TACs in poor data conditions

Where, due to lack of sufficiently accurate and representative information, STECF is not able to give advice allowing the Council to set the TACs in accordance with Articles 7 or 8, the Council shall decide as follows:

(a) where STECF advises that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25 % reduction compared to the TAC in the previous year;

(b) in all other cases the TACs shall be set according to a 15 % reduction compared to the TAC in the previous year, unless STECF advises that this is not appropriate.

Article 10: Adaptation of measures

1. *When the target fishing mortality rate in Article 5(2) has been reached or in the event that STECF advises that this target, or the minimum and precautionary spawning biomass levels in Article 6 or the levels of fishing mortality rates given in Article 7(2) are no longer appropriate in order to maintain a low risk of stock depletion and a maximum sustainable yield, the Council shall decide on new values for these levels.*
2. *In the event that STECF advises that any of the cod stocks is failing to recover properly, the Council shall take a decision which:*
   (a) sets the TAC for the relevant stock at a level lower than that provided for in Articles 7, 8 and 9;
   (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12;
   (c) establishes associated conditions as appropriate.

Article 11 Fishing effort regime

1. *The TACs set out in Articles 7, 8 and 9 shall be complemented by a fishing effort regime whereby fishing opportunities in terms of fishing effort are allocated to Member States on an annual basis.*

2. The Council may, acting on a Commission proposal and on the basis of the information provided by Member States and the advice of STECF referred to in paragraph 3, exclude certain groups of vessels from the application of the effort regime provided that:
(a) appropriate data on cod catches and discards are available to allow STECF to assess the percentage of cod catches made by each group of vessels concerned;
(b) the percentage of cod catches as assessed by STECF does not exceed 1,5 % of the total catches for each group of vessels concerned; and
(c) the inclusion of these groups of vessels in the effort regime would constitute an administrative burden disproportionate to their overall impact on cod stocks. If STECF is not in position to assess that these conditions remain fulfilled, the Council shall include each group of vessels concerned in the effort regime.
3. Member States shall provide annually appropriate information to the Commission and STECF to establish that the above conditions are and remain fulfilled in accordance with detailed rules to be adopted by the Commission.

Article 12: Fishing effort allocations
1. Each year, the Council shall decide on the maximum allowable fishing effort for each effort group by Member State.
2. The maximum allowable fishing effort shall be calculated by means of a baseline established as follows:
(a) for the first year of application of this Regulation the baseline shall be established for each effort group as the average effort in kW-days spent during the years 2004-2006 or 2005-2007, according to the preference of the Member State concerned, based on the advice of STECF;
(b) for the subsequent years of application of this Regulation the baseline shall be equal to the maximum allowable fishing effort of the previous year.
3. The effort groups for which an annual adjustment in the maximum allowable fishing effort shall be applied shall be decided on the following basis:
(a) the catches of cod taken by vessels in each of the effort groups shall be evaluated on the basis of data submitted by Member States in accordance with Articles 18, 19 and 20 of Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy (1);
(b) a list shall be compiled for each of the areas defined in Annex I to this Regulation of the aggregated effort groups and their corresponding cod catches, including discards. This list shall be arranged in ascending order of cod catch in each effort group;
(c) the cumulative catches of cod in the lists established according to point (b) shall be calculated in following way. For each aggregated effort group, the sum shall be calculated of the cod catch by that effort group and the cod catches made by all aggregated effort groups in the preceding entries in the list;
(d) the cumulative catches calculated according to point (c) shall be calculated as a percentage of the total cod catch by all aggregated effort groups in the same area.
4. For aggregated effort groups where the percentage cumulative catch calculated according to paragraph 3(b) is equal to or exceeds 20 %, annual adjustments shall apply to the effort groups concerned. The maximum allowable fishing effort of the groups concerned shall be calculated as follows:
(a) where Articles 7 or 8 applies, by applying to the baseline the same percentage adjustment as that set out in those Articles for fishing mortality;
(b) where Article 9 applies, by applying to the baseline the same percentage adjustment in fishing effort as the reduction of the TAC.
5. For effort groups other than those referred to in paragraph
4, the maximum allowable fishing effort shall be maintained at the level of the baseline.

Article 13: Allocation of additional fishing effort for highly selective gear and cod-avoiding fishing trips
1. Member States may increase the maximum allowable fishing effort for effort groups for which the effort has been adjusted in accordance with Article 12(4) and subject to the conditions set out in paragraphs 2 to 7.
2. The maximum allowable fishing effort may be increased within effort groups in which the fishing activity of one or more vessels:
(a) is carried out having on board only one regulated gear the technical attributes of which result, according to a scientific study evaluated by STECF, in catching less than 1 % cod (highly selective gear);
(b) results in a catch composition of less than 5 % cod per fishing trip (cod-avoiding fishing trips);
(c) is conducted in accordance with a cod avoidance or discard reduction plan which reduces fishing mortality for cod among participating vessels by at least as much as the effort adjustment referred to in Article 12(4); or

(d) is carried out in the west of Scotland area to the west of a line drawn by sequentially joining with rhumb lines the positions laid down in Annex IV measured according to the WGS84 coordinate system, provided that the participating vessels are equipped with satellite-based vessel monitoring systems (VMS).

3. Vessels referred to in paragraph 2 shall be subject to increased frequency of monitoring, concerning in particular:

(a) the exclusive use of the highly selective gear during the fishing trips concerned in accordance with paragraph 2(a);

(b) the amount of discards in compliance with paragraph 2(b);

(c) the reduction in fishing mortality in accordance with paragraph 2(c);

(d) the amount of catches and discards occurring to the west of the line specified in paragraph 2(d); and subject to arrangements for the regular provision of data to the Member State concerning the respect of the special conditions laid down in those points.

4. The increase of fishing effort under this Article shall be calculated for each of the vessels in the effort groups concerned that operate under special conditions referred to in paragraph 2, points (a), (b), (c) and (d), and shall be no more than the amount needed to compensate the effort adjustment referred to in Article 12(4) for the gears involved in those actions.

5. Any increases of the fishing effort allocation carried out by the Member States shall be notified to the Commission, by April 30 of the year during which the compensation for the effort adjustment shall take place. The notification shall include details of the vessels operating under the special conditions referred to in points (a), (b), (c) and (d) of paragraph 2, the fishing effort per effort group that the Member State expects to be carried out by those vessels during that year, and the conditions under which the effort of the vessels is being monitored, including control arrangements.

6. Member States shall report to the Commission by 1 March each year at the latest about the amounts of effort used within the actions during the previous year.

7. The Commission shall request STECF to compare annually the reduction in cod mortality which would result from the application of point (c) of paragraph 2 with the reduction it would have expected to occur as a result of the effort adjustment referred to in Article 12(4). In light of this advice the Commission may propose adjustments in effort that may be applied for the relevant gear grouping the following year.

Article 17 Exchange of maximum allowable fishing effort across effort groups

1. A Member State may amend its effort allocations by transferring fishing capacity across effort groups, under the conditions set out in paragraphs 2 to 5.

2. The transfer shall be allowed between gear groupings but not between geographical areas, provided that the Member State concerned provides the Commission with information on the catch per unit effort (cpue) of its donor and receiving gear group, averaged over the last three years.

3. Where the cpue of the donor gear group is higher than the cpue of the receiving gear group, the transfer shall in general be made on a 1 kW-day to 1 kW-day basis.

4. Where the cpue of the donor gear group is lower than the cpue of the receiving gear group, the Member State shall apply a correction factor to the amount of effort in the receiving gear group so that the latter fs higher cpue is compensated for.

5. The Commission shall request STECF to develop standard correction factors that might be used to facilitate the transfer of effort across gear groups with different cpue.

Table 1 Results in 2015 from the Management Strategy Evaluation (MSE) assuming HCR in the EU–Norway long-term plan implemented as stipulated in the plan. The highlighted lines correspond to the way the assessment is conducted. OM – Operating Model; SR – Recruitment scenarios; OEM – Observation Error Model; L – Landings; D – Discards; C – Catch; FL – F due to Landings; FD – F due to Discards; FC – F due to Catch. See further details in method section above.

	OM	SR	OEM	TAC con	Prob $\geq B_{lim}$	Prob $\geq B_{pa}$	Prob $\leq F_{MSYlo}$	Prob $\leq F_{MSY}$	Prob $\leq F_{MSYhi}$	SSB	L	D	C	FL	FD	FC
1	**cat**	**1**	**cat**	**20%**	**1.00**	**1.00**	**0.99**	**1.00**	**1.00**	**370**	**53.3**	**14.8**	**68.2**	**0.06**	**0.02**	**0.08**
2	cat	1	m	20%	1.00	1.00	0.98	1.00	1.00	357	56.8	15.7	72.9	0.06	0.02	0.09
3	cat	1	wg	20%	1.00	1.00	0.82	0.94	1.00	330	70.9	20.6	92.0	0.09	0.03	0.12
4	m	1	cat	20%	1.00	0.99	0.99	1.00	1.00	264	39.8	12.0	52.0	0.06	0.02	0.08
5	m	1	m	20%	1.00	0.99	0.98	1.00	1.00	256	42.2	12.7	55.2	0.07	0.02	0.09
6	m	1	wg	20%	1.00	0.95	0.80	0.93	1.00	239	53.0	16.6	69.8	0.09	0.03	0.12
7	**cat**	**0.5**	**cat**	**20%**	**1.00**	**0.98**	**0.65**	**0.84**	**1.00**	**241**	**52.2**	**11.6**	**64.1**	**0.11**	**0.04**	**0.14**
8	cat	0.5	m	20%	1.00	0.96	0.53	0.75	1.00	227	54.1	12.1	66.4	0.12	0.04	0.16
9	cat	0.5	wg	20%	1.00	0.83	0.10	0.25	0.98	197	67.7	16.4	84.7	0.17	0.06	0.23
10	m	0.5	cat	20%	1.00	0.69	0.56	0.79	1.00	170	38.7	9.5	48.3	0.11	0.04	0.15
11	m	0.5	m	20%	1.00	0.64	0.48	0.73	1.00	162	39.1	9.8	49.5	0.12	0.04	0.16
12	m	0.5	wg	20%	1.00	0.44	0.08	0.22	0.98	143	49.5	13.1	63.4	0.17	0.06	0.23
13	cat	1	cat	-	1.00	1.00	0.08	0.17	1.00	324	131.5	40.1	173.8	0.18	0.06	0.24
14	cat	0.5	cat	-	1.00	0.97	0.02	0.05	0.98	219	86.1	20.4	107.8	0.21	0.07	0.28

Weights in ´000 tonnes.

Table 2 Results in 2015 from projections assuming 1.5% reductions in F each year, without TAC constraints or feedback from the management plan and using the Observation Error Model used in the assessment (Catch). OM – Operating Model; SR – Recruitment scenarios; L – Landings; D – Discards; C – Catch; FL – F due to Landings; FD –F due to Discards; FC – F due to Catch.

	OM	SR	Prob $\geq B_{lim}$	Prob $\geq B_{pa}$	Prob $\leq F_{MSYlo}$	Prob $\leq F_{MSY}$	Prob $\leq F_{MSYhi}$	SSB	L	D	C	FL	FD	FC
1	**cat**	**1**	**0.99**	**0.36**	**0.00**	**0.00**	**0.00**	**134**	**128.4**	**46.4**	**176.6**	**0.40**	**0.14**	**0.54**
4	m	1	0.98	0.26	0.00	0.00	0.50	126	93.0	34.1	128.4	0.31	0.11	0.42
7	**cat**	**0.5**	**0.85**	**0.04**	**0.00**	**0.00**	**0.00**	**94**	**74.6**	**21.9**	**96.7**	**0.40**	**0.14**	**0.54**
10	m	0.5	0.78	0.02	0.00	0.00	0.50	87	53.5	16.1	69.9	0.31	0.11	0.42

Weights in ´000 tonnes.

ECOREGION North Sea

SUBJECT Joint EU–Norway request on interim advice on the North Sea herring management plan

Advice for 2012

Based on the assumption that the current low productivity regime for North Sea herring (observed since 2002 onward) will continue, ICES concludes that the current Harvest Control Rule (HCR)—as well as each of the four tested alternative HCRs— is compatible with the precautionary approach as the risk of SSB falling below B_{lim} is low. The current HCR, with the 15% constraint, allows a slow increase in TAC and gives similar or better stability in annual TACs than any of the other HCR options. However, this result is attained at the expense of lower average yields, even in the medium term. The other HCR options provide similar average yields in the medium term, but differ with respect to TAC stability. Although the management plan options evaluated by ICES are appropriate given the uncertainty in the current population size, the analyses conducted do not provide a full Management Strategy Evaluation (MSE). In case the management plan is revisited to do a full MSE, ICES favours a collaborative iterative process between scientists, managers, and stakeholders.

Request

Joint EU–Norway additional request on North Sea herring advice for 2012

In view of exceptional increase in the estimated SSB in 2010, the EU and Norway requested ICES to comment on whether an in-year revision of the TAC in similar circumstances is consistent with the objectives of the long term management plan for herring in the North Sea. In its response, ICES stated that rather than within-year revisions of the TAC, it is better to have a management plan that can respond to large changes in the biology of the stock or assessment uncertainty. In order to address this issue, ICES indicated that it would favor a collaborative iterative process between scientists, managers, and stakeholders if the management plan is revisited in 2011.

The stakeholders agree that the plan is effective in ensuring the long term sustainability of the stock, but are concerned that the inter-annual TAC constraints are preventing the stock from being exploited at the maximum sustainable yield.

In view of this, ICES is requested by the EU and Norway to evaluate, by 31 October 2011, the impact the following options would have on the performance of the plan in relation to the objectives of providing sustainable fisheries with stable yield in conformity with the precautionary approach:

1. *Remove the TAC constraints when they would lead to a fishing mortality that is outside a predefined range, for example 0.2 to 0.3.*

2. *Introducing a different mechanism to attenuate inter-annual TAC variations, such as setting the TAC as the average of that corresponding to the target fishing mortality and the previous year's TAC.*

ICES is also asked by the EU and Norway to evaluate the implications for the long term objectives of the plan if a TAC increase of more than 15% were to be allowed for 2012, taking into account the continuing low recruitment to the stock.

Elaboration on the Advice

To meet this request, ICES evaluated whether the management plan with the following options is precautionary*, based on the assumption that the current low productivity regime (2002–2010) will continue. The term 'the preliminary TAC' is used in the rest of the document for the TAC derived from the fishing mortality defined in the current HCR without any TAC constraining measures.

1. Current HCR: This option is included as a baseline for general comparison. If the preliminary TAC deviates less than 15% from the TAC in the year before, the preliminary TAC is kept. If not, a constrained TAC is set

* based on the precautionary approach validation as laid down between ICES and STECF at WKOMSE (the ICES–STECF Workshop on Fishery Management Plan Development and Evaluation; ICES, 2009).

that deviates 15% from the TAC the year before. If the constrained TAC leads to an SSB< 800 kt (B_{lim}), the preliminary TAC is kept.

2. Current HCR without constraint: this option is included as a baseline in relation to performance indicators for stability in the TAC. Without exception, the TAC is set based on the F resulting from the currently agreed HCR without applying the TAC constraint.
3. 0.2–0.3 HCR: this option is the ICES interpretation of ToR-1. If the preliminary TAC deviates less than 15% from the TAC in the year before, the preliminary TAC is kept. If it deviates more than 15%, the TAC change is constrained to a maximum of 15%, unless the constrained TAC implies that the consequent $F_{2\text{-}6}$ falls outside the range of 0.2–0.3, in which case the preliminary TAC is maintained.
4. 50–50 HCR: this option is the ICES interpretation of ToR-2. The TAC is set at the average of the preliminary TAC and the agreed TAC the previous year using equal weights (50–50%) for both years.
5. Current HCR without constraint in 2012: the TAC for 2012 is set according to the current HCR without applying the 15% TAC constraint in 2012. From 2013 onwards the constraint is applied according to the current HCR.

The above five options were tested and evaluated in light of a range of performance indicators. Four indicators have been selected to inform decisions on the stock sustainability (indicator 1 and 2), yield (indicator 3), and stability of the TAC (indicator 4).

Indicator 1) Risk: percentage of simulations in which SSB falls below B_{lim} at least once during the simulation period
Indicator 2) Stock performance: SSB in 2020 (median of all simulations)
Indicator 3) Yield: Mean catch of A-fleet over the simulation period
Indicator 4) Stability in TAC: Mean % absolute TAC change between consecutive years over the simulation period: [abs(TAC year2–TAC year1)]/TAC year2 * 100. The lower the value, the more stable is the TAC.

Results

The main results of the evaluation are presented in the Table below. Figure 6.3.3.4.1 show the results from the simulations performed for each HCR option.

HCR option	**Risk < B_{lim}**	**Stock performance (SSB 2020, '000 t)**	**Yield ('000 t)**	**Stability in TAC (mean TAC change)**
1. Current HCR	0%	1 500	350	11.8%
2. Current HCR without constraint	0%	1 420	370	22.8%
3. 0.2–0.3 HCR	0%	1 400	370	18.1%
4. 50–50 HCR	0%	1 380	360	12.5%
5. Current HCR without constraint in 2012	1%	1 410	370	16.8%

1. Current HCR.
   This option was evaluated to be in conformity with the precautionary approach. It showed a slightly higher SSB in 2020 and the lowest mean yield compared to the other HCRs. The option showed a high stability in TAC.

2. Current HCR without constraint.
   This option was evaluated to be in conformity with the precautionary approach. It resulted in an average SSB in 2020 as well as a similar mean yield compared to the other HCRs (options 2–5). Of all five options the TAC stability in this one was the poorest.

3. 0.2–0.3 HCR.
   This option was evaluated to be in conformity with the precautionary approach. It resulted in an average SSB in 2020 as well as a similar mean yield compared to the other HCRs (options 2–5). The stability in TAC was intermediate.

4. 50–50 HCR.
   This option was evaluated to be in conformity with the precautionary approach. It resulted in an average SSB in 2020 as well as a similar mean yield compared to the other HCRs (options 2–5). The option showed a high stability in TAC.

5. Current HCR without constraint in 2012.
   This option was evaluated to be in conformity with the precautionary approach. It resulted in an average SSB in 2020 as well as a similar mean yield compared to the other HCRs (options 2–5). The stability in TAC was intermediate.

Conclusions

ICES considers that all options are compatible with the precautionary approach, as the risk of SSB falling below B_{lim} is always low under the assumed conditions.

The current HCR (option 1), with the 15% constraint, allows a slow increase in TAC from the low in 2011. It provides a similar or better TAC stability than the other options, but it does so at the expense of a lower average yield, even in the medium term (average F is 0.18).

The remaining four options are similar in respect to average yields in the medium term and they lead to an average F that is close to 0.25 (see Figure 6.3.3.4.1), which is regarded as F_{MSY} (ICES, 2011c). They do differ with respect to stability in TAC: the current HCR without TAC constraint (option 2) is the least stable, while the 50–50 option 4 gives most stability.

The stochastic simulation model has been designed to explicitly incorporate the natural and stock assessment variability as observed over the recent years, which has led to considerable revisions in recruitment and spawning-stock biomass. The evaluation presented here shows that the evaluated HCRs are all robust against this variability. However, the different options have not been evaluated against exceptional variations in biology which are beyond the variation observed in history, nor have the options been tested for robustness under varying starting conditions in population size. These analyses, therefore, can be viewed as appropriate given the assumed starting conditions and uncertainty in the current population size and they answer the request fully. However, they do not provide a full Management Strategy Evaluation.

Basis of advice

The evaluation of the harvest rules was conducted using simulations of the projected population from 2011 to 2020. The approach used here is similar to previous evaluations of the long-term management plan (ICES, 2008), but performed with updated data-series and software. The model simulates the biological North Sea herring population and the behaviour of the fishing fleets and surveys, while the stock assessment is mimicked to estimate the stock status. Finally, the management advice and implementation are based on the adjusted management plan scenarios. In turn, management feeds back into the biological population and the fishery the year after. The simulations were run with 100 Monte Carlo realisations which were considered a sufficient number to represent a broad range of possible outcomes given the variability in the input data (Figure 6.3.3.4.2). Stochasticity (randomness) was added to variables and parameters to ensure that they reflect biological variation, and the uncertainty in the historical perception of the stock was thus reflected. The analysis was conducted using R (R Development Core Team, 2011) and FLR libraries (Kell *et al.*, 2007).

Sources

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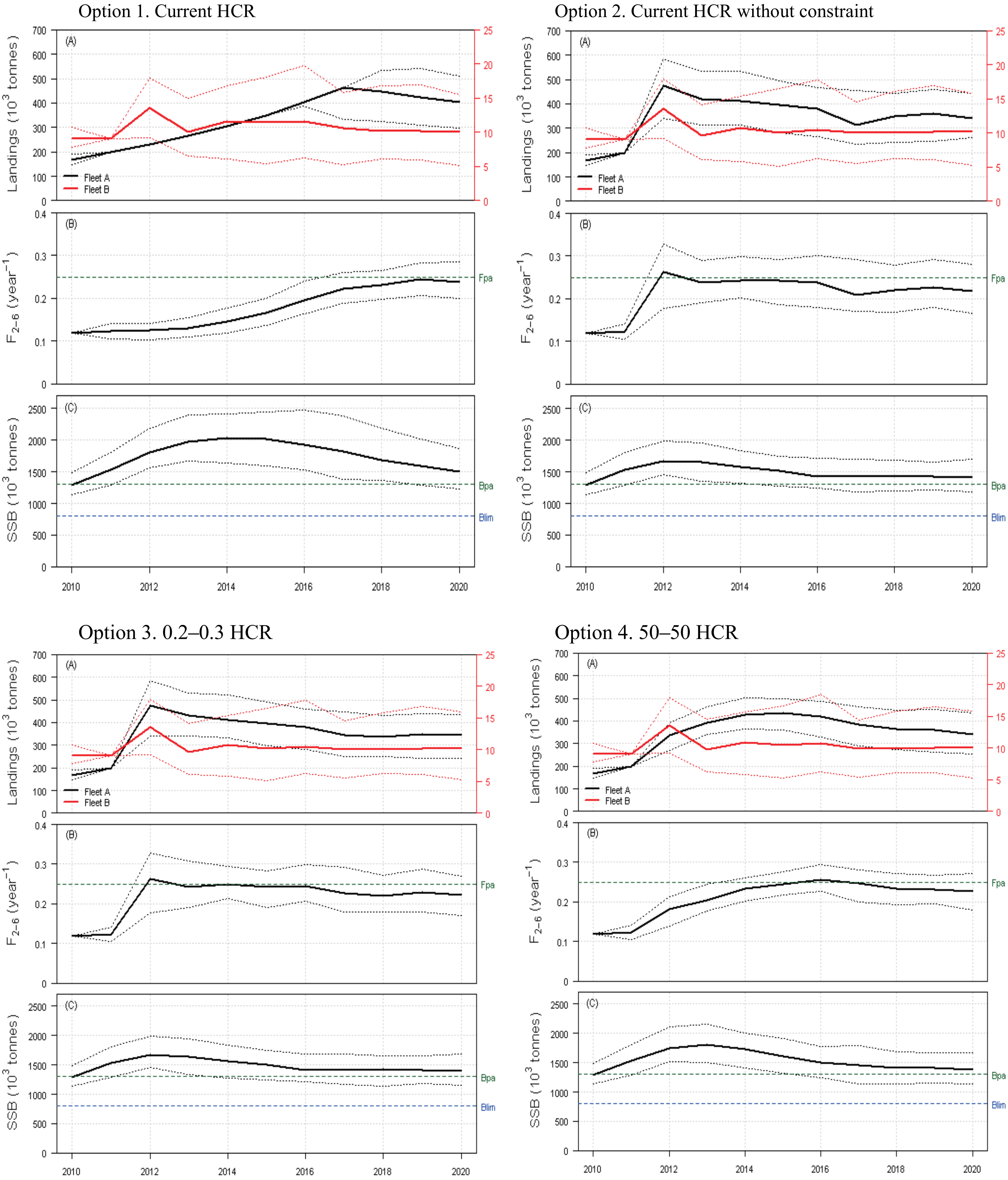

Figure 6.3.3.4.1 North Sea herring management plan interim options, with the trajectory from 2010–2020 per option. Top: Landings (by fleets A and B, in '000 tonnes), Middle: Fishing mortality (ages 2–6), and Bottom: SSB (in '000 t). Solid lines represent the median of the 100 Monte Carlo simulations and dashed lines the 5th and 95th percentiles.

Option 5. Current HCR without constraint in 2012

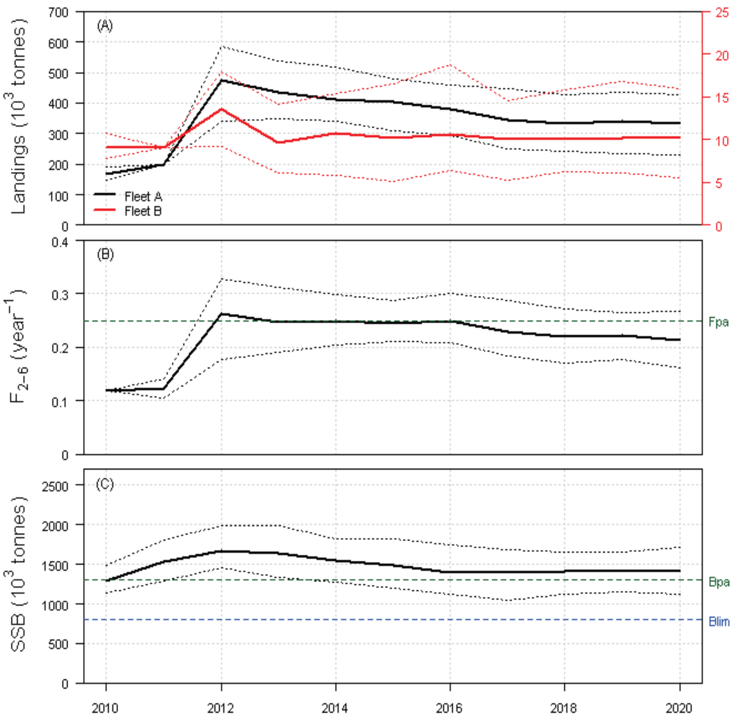

Figure 6.3.3.4.1 **Continued:** North Sea herring management plan interim options, with the trajectory from 2010–2020 per option. Top: Landings (by fleets A and B, in '000 tonnes), Middle: Fishing mortality (ages 2–6), and Bottom: SSB (in '000 t). Solid lines represent the median of the 100 Monte Carlo simulations and dashed lines the 5th and 95th percentiles.

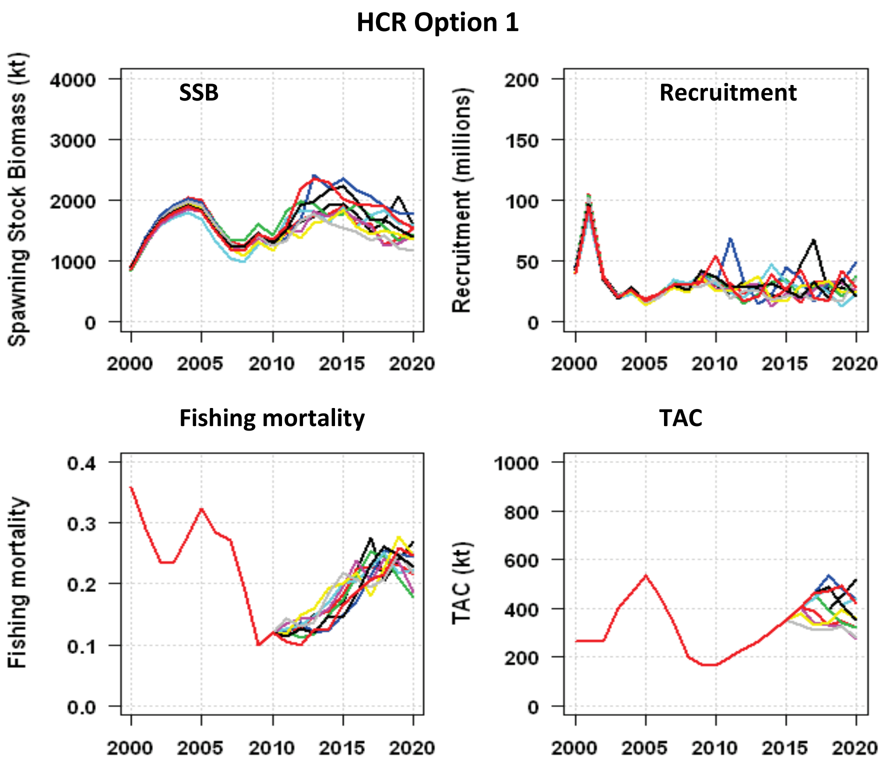

Figure 6.3.3.4.2 North Sea herring management plan interim options: For illustrative purposes, the first 10 (out of 100) Monte Carlo simulations for Harvest Control Rule (Option 1), between 2000 and 2020. Lines represent the trajectories of SSB, recruitment, fishing mortality, or TAC as they occurred within one simulation. The combination of these 10 simulations shows that dynamics are erratic and not smooth as given in the median + CI plots.

ECOREGION North Sea
STOCK Cod in Division IIIa East (Kattegat)

Advice for 2012

ICES advises on the basis of precautionary considerations that there should be no directed fisheries and bycatch and discards should be minimised.

Stock status

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	?	Unknown
Management plan (F_{MP})	?	?	?	Unknown
SSB (Spawning Stock Biomass)				
	2009	2010	2011	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	✗	✗	✗	Reduced reproductive capacity
Management plan (SSB_{MP})	✗	✗	✗	Below target

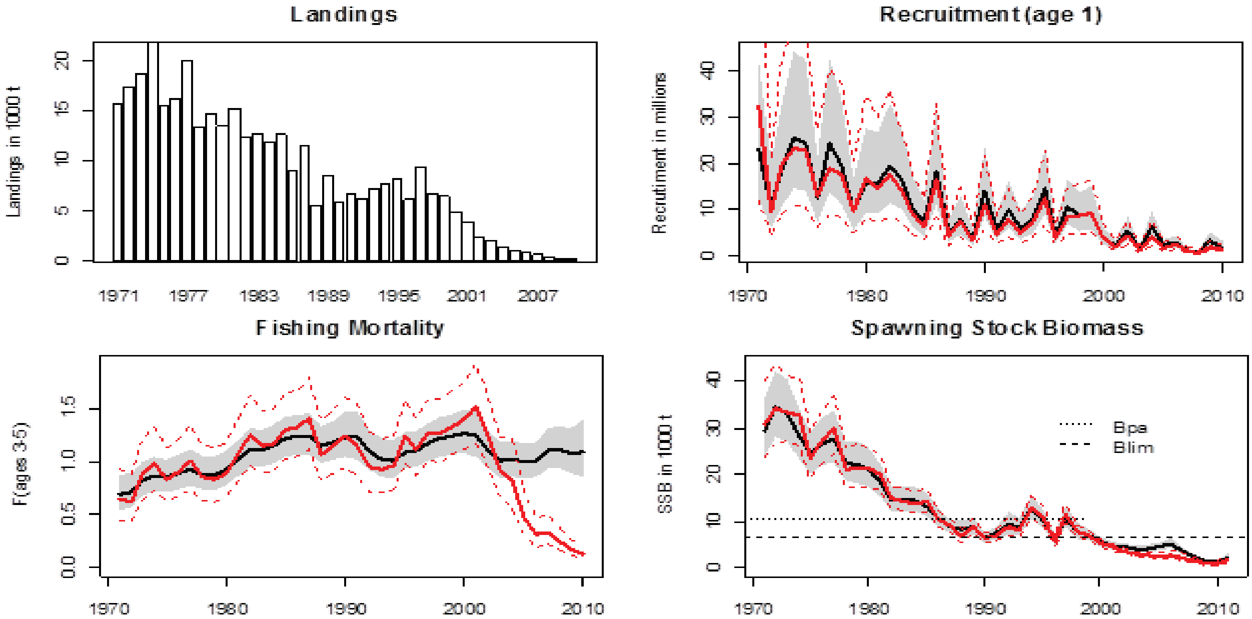

Figure 6.4.1.1 Cod in Division IIIa East (Kattegat). Summary of stock assessment (weights in '000 tonnes) represented by two runs with (black line) and without (red line) estimating unallocated removals. Shaded area and dashed lines represent 95% confidence intervals for the runs with and without estimating unallocated removals, respectively.

Spawning stock biomass has been at a historically lowest level since 2000. Recruitment in recent years has been among the lowest in the time series. Current level of fishing mortality is uncertain and is likely somewhere in between the estimates from the two runs, with and without estimating unallocated removals.

Management plans

A multi-annual plan has been agreed by the EU in 2008 ((EC) No 1342/2008). According to the management plan, TAC and effort should be reduced by 25% in cases when it is advised that the catches of cod should be reduced to the lowest possible level. ICES evaluated this plan in 2009 and concluded it was in accordance with the precautionary approach if implemented and enforced adequately; however, this evaluation is not expected to be realistic in a situation where unaccounted removals may be 5-8 times the TAC.

A joint ICES-STECF group is conducting a historical evaluation of these plans in the first semester of 2011, with a possible view to developing a new plan if the evaluation points to such a need (ICES, 2011b).

Biology

Existence of separate stock units influences population dynamics in the Kattegat. In addition to local stock units, which are spawning in the Kattegat, there is a significant transportation of cod larvae/ juveniles from the North Sea and Sound stocks into the Kattegat. Return migration to the North Sea/ Sound occurs at ages 2- 3. An increasing proportion of fish originating from other stocks due to the decline of the Kattegat cod could thus seriously affect estimations of population parameters and bias the fishing mortality estimates.

Environmental influence on the stock

An analysis of the possible effect of environment and climate change on this stock has shown that fishing mortality has been the major driver of the long-term dynamics of the stock.

The fisheries

Kattegat cod are mainly landed by trawls and Danish seines. In recent years cod is caught as bycatch in the *Nephrops* fishery. Discarding of young cod and possibly also high-grading of marketable cod takes place. The use of the Swedish sorting grid has increased in 2009 and 2010 and it is now the main gear used in Swedish Nephrops fisheries. The increased use of the sorting grid has reduced discards of cod in Swedish fisheries in recent years. Further development and introduction of selective trawls with low catchability on cod is recommended.

Catch by fleet	Total landings (2010) 155 t (of which 74% Nephrops trawl, 10% > 100 mm trawl, 8% gill nets). Estimated total removals from the stock: 1283 t (95% confidence intervals 866-1900 t) due to a combination of fisheries and biological issues

Effects of the fisheries on the ecosystem

The fish community in the Kattegat has changed profoundly over the last 100 yrs. Due to fishing, some species such as halibut, haddock, ling and pollack are no longer present or are now extremely rare, and the size composition of species such as cod, and plaice have all decreased during the 20th century.

Quality considerations

In recent years, reported landings do not represent total removals from the stock; unaccounted removals have been 5-8 times the reported landings. At present, the relative proportion of unallocated removals due to fishing and biology driven factors cannot be specified. Therefore, current level of fishing mortality cannot be reliably estimated. The SSB estimated from assessment is in line with the independent estimates of cod biomass based on data from the joint Swedish-Danish fishermen-scientist survey conducted since 2008.

Scientific basis

Assessment type	Age based analytical assessment (stochastic state-space model SAM)
Input data	4 survey indices (IBTS-Q1; IBTS-Q3; Havfisken-Q1; Havfisken-Q4)
Discards and by-catch	Discards not included in the assessment
Indicators	Data from joint Swedish-Danish fishermen-scientists survey
Other information	benchmark done in 2009
Working group report	WGBFAS

ECOREGION **North Sea**
STOCK **Cod in Division IIIa East (Kattegat)**

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	6400	B_{lim}
	F_{MP}	0.4	Same as for other cod stocks
MSY Approach	MSY $B_{trigger}$	Not defined	
	F_{MSY}	Not defined	
Precautionary Approach	B_{lim}	6400 t	lowest observed SSB before the late 1990s.
	B_{pa}	10 500 t	B_{lim}*exp(1.645*0.3).
	F_{lim}	Not defined	
	F_{pa}	Not defined	

(unchanged since: 2011)

Outlook for 2012

Due to uncertainty in the recent estimates, especially concerning fishing mortality, reliable predictions cannot be presented.

Management plan

According to the long-term management plan, the fishing mortality in 2012 shall be reduced by 25 % compared with the fishing mortality rate in 2010, unless the target 0.4 is reached. The current level of fishing mortality on cod in the Kattegat cannot be reliably estimated. According to Article 9 in the management plan, TAC should be reduced by 25 % in cases when it is advised that the catches of cod should be reduced to the lowest possible level. An exploratory evaluation (see section below) that assumed no bias in the TAC implementation shows that SSB will recover before 2015 to within precautionary limits; however, this evaluation is not expected to be realistic in a situation where unaccounted removals may be 5-8 times the TAC.

Precautionary considerations

The stock size is considered to be far below possible reference points, while the exploitation status is uncertain. Therefore, there should be no directed fisheries and bycatch and discards should be minimised.

Additional considerations

Even though a management plan has been in place since 2005, the stock biomass has continued to decline. Total removals in the last 3 years have been estimated up to 5-8 times higher than the reported landings. No information is available on the nature of the unallocated removals but this information is essential to managers in order to take the appropriate management measures. Potential sources of unallocated removals are discarding of young ages and possibly also high-grading of marketable cod. Furthermore, migration of cod to other areas and unaccounted catches in recreational fisheries may contribute to the discrepancy between the reported landings and the estimates of total removals.

Management plan evaluations

ICES has conducted exploratory evaluation of the long-term management plan for cod in the Kattegat as specified by Council Regulation (EC) No 1342/2008 of 18 December 2008. The results showed that the present low TAC and the 20% TAC constraint in the long-term plan will allow a steep increase of SSB to above B_{pa} even though scenario recruitment is assumed to be at a low level. This conclusion is based on no bias in the TAC implementation, which is not expected to be realistic. Due to uncertainties related to the historical and future bias in catch reporting and the extend of inflow of recruits from the North Sea and Western Baltic stocks and their homing at age 2-3 it is not possible to quantify the effect on the SSB of the local Kattegat stock spawning in the area.

Regulations and their effects

Since 2004, the use of trawls with codend mesh sizes below 90 mm in the *Nephrops* fisheries has only been permitted if the trawl was equipped with a sorting grid. In 2008, due to effort restrictions imposed between 1 February and 30 April the usage of trawls equipped with sorting grid (which allows most cod to escape from the trawl) increased considerably in Swedish fisheries, as this type of trawl is not effort regulated. In Danish fisheries, since 1st February 2008, the usage of the panel exit-window with square-meshes at a minimum 120 mm has been mandatory, but there is no evidence to show that this is effective for cod (Frandsen, *et al*., 2009). The Danish minimum landing size was reduced to 30 cm in February 2008.

In 2009, Denmark and Sweden introduced protected areas on historically important cod spawning grounds, in order to help to rebuild the cod stock. The protected zone consists of three different areas in which the fisheries are either completely forbidden or limited to certain selective gears during all or different periods of the year.

In 2009, a new effort system was introduced in Kattegat due to the introduction of the new management plan (EC No. 1342/2008) for North Sea (incl. Kattegat) cod. In this system each Member State is given amounts of kWdays for different gear groups. The amount of kWdays for gear groups catching cod will be subject to yearly cuts as long as the cod stock is below reference points in the management plan. MS can apply for derogation from the kWdays system if the catches in a certain part of the fleet can be shown (after evaluation by STECF) to consist of less than 1.5% cod (article 11(2)(b)). Sweden did so in 2009 and obtained a derogation from the kWdays system for *Nephrops* trawlers using the Swedish sorting grid. The use of sorting grid in the Swedish trawl fisheries has increased in 2010 and has decreased the discard of cod in 2010 compared to 2009. In 2010, Danish obtained partial derogation (article 13) for the *Nephrops* fisheries, allowing no further decrease of the effort ceiling on the basis of the cod avoidance measures described above (panel window and closed area).

Data and methods

Reported landings and data from four scientific surveys were available for the assessment of this stock. Discard data were not used in the assessment. The assessment is based on stochastic state-space model (SAM) that provides statistically sound estimates of uncertainty in the model results. The model allows estimating potential additional removals from the stock, not represented by reported landings. The stock estimates for these years consequently rely more on survey information.

The model estimates significant unallocated removals from the stock between 2003 and 2010. At present, the relative proportion of unallocated removals due to fishing and biology driven factors (migration patterns) cannot be specified. Therefore, both runs with and without estimating unallocated removals are presented (Figure 6.4.1.1). Estimates of F in either runs are not considered reliable and the fishing mortality is considered to be somewhere in between the estimates from the two runs.

Information from the fishing industry

In December 2008-2010, extensive joint Swedish-Danish cod surveys in Kattegat were conducted by fisheries research institutes in Denmark and Sweden in collaboration with the fishing industry. The data from these surveys were used to provide an independent estimate of biomass of adult cod in the Kattegat. The results were in line with the estimates from the assessment.

Uncertainties in assessment and forecast

In recent years, reported landings appeared not to represent total removals from the stock. Significant bias in removals was estimated for 2003–2010. At present, the relative proportion of unallocated removals due to fishing and biology driven factors cannot be specified. Recent tagging studies suggest that the Kattegat may function as a nursery area for North Sea cod, and that return migration to the North Sea are common (Svedäng *et al.,* 2007) and the same issue may apply for migration to and from the Western Baltic. There are some indications that the proportion of recruits of North Sea origin has increased in recent years. The migration of this stock component out of the area at an older age could contribute to the estimate of unallocated removals in the latest years. Because of these uncertainties, the current level of fishing mortality cannot be reliably estimated.

Concerning SSB, the estimates are considered imprecise, however both the assessment with and without estimating unallocated removals indicate historically lowest SSB in recent years (in the range of 620 and 1600 tonnes in 2010). The level of SSB estimated from the assessment is in line with the independent estimates of cod biomass based on data from the joint Swedish-Danish fishermen-scientist survey conducted in 2010. In benchmark assessment 2009, the estimates of SSB showed also to be robust for uncertainties concerning natural mortality and discards of young fish.
The assessment cannot be used as a basis for forecast.

Comparison with previous assessment and advice

The overall perception of the state of the stock is unchanged compared to last year. The basis for the advice is similar to last year.

Sources

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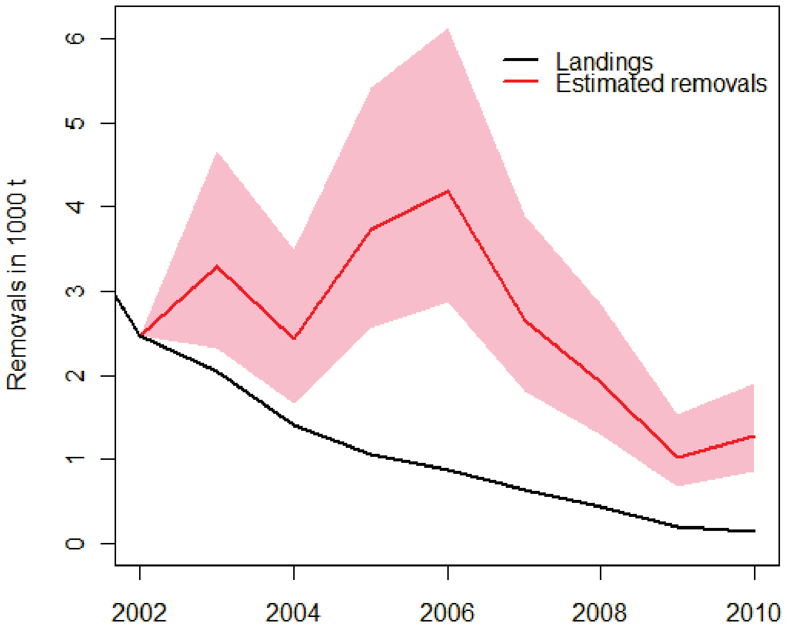


Figure 6.4.1.2 Cod in Division IIIa East (Kattegat). Total removals from the stock estimated by SAM model, compared to reported landings. Shaded area is the 95% confidence interval around the estimated removals.

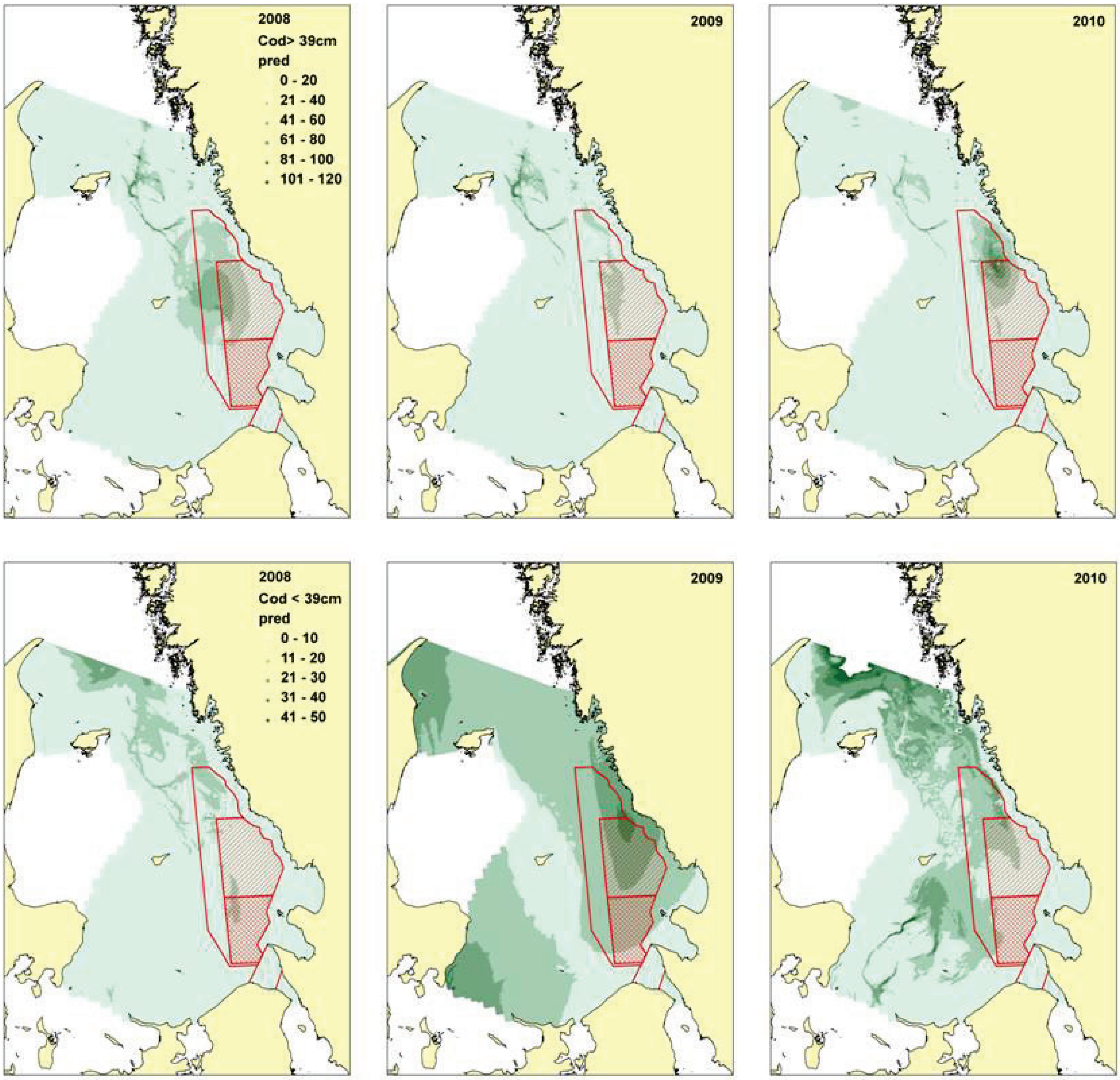


Figure 6.4.1.3 Cod in Division IIIa East (Kattegat). Spatial distribution of catch per unit effort (cpue in kg per hour) of cod in the Kattegat estimated for cod >39 cm (upper panels) and for cod <39 cm (lower panels) in length in 2008, 2009 and 2010. Red lines mark the borders of closed areas in the Kattegat.

Table 6.4.1.1 Cod in Division IIIa East (Kattegat). ICES advice, management and landings.

Year	ICES Advice / 2005 onwards: Single-stock exploitation boundaries	Predicted catch corresp. to advice	Agreed TAC	ICES landings
1987	Reduction in F	< 13.0	15.5	11.5
1988	Reduction in F	< 15.0	15	5.5
1989	TAC	10	12.5	8.6
1990	TAC	7	8.5	5.9
1991	TAC	6.3	6.65	6.8
1992	30% reduction in fishing effort	-	6.65	6.3
1993	Limit fishing effort to 70% of 1991 effort	-	6.8	7.2
1994	Reduction in catch from 1991–1992	< 6.3–6.8	6.7	7.8
1995	Precautionary TAC based on recent catches	6–7	6.7	8.2
1996	30% Reduction in fishing effort from 1994 level	-	7.7	6.1
1997	Fishing effort should not exceed 70% of the 1994 level	-	8.5	9.5
1998	Fishing effort should not exceed 70% of the 1994 level	-	7.5	6.8
1999	F = 0.6	4.5	6.3	6.6
2000	At least 40% reduction in F	6.4	7	4.9
2001	F = Fpa = 0.6	4.7	6.2	3.9
2002	No fishery	0	2.8	2.3
2003	No fishery	0	2.3	2
2004	No fishery	0	1.363	1.4
2005	No fishery	0	1	1.1
2006	No fishery	0	0.85	0.9
2007	No fishery	0	0.731	0.6
2008	No catch	0	0.673	0.45
2009	No catch	0	0.505	0.197
2010	No catch	0	0.379	0.155
2011	No directed fisheries, minimise by-catches	0	0.190	
2012	No directed fisheries, minimise by-catch and discards	0		

Weights in ‘000 t.

Table 6.4.1.2 Cod in Division IIIa East (Kattegat). Officially reported landings (in tonnes).

Year	Kattegat			Total
	Denmark	Sweden	Germany[1]	
1971	11,748	3,962	22	15,732
1972	13,451	3,957	34	17,442
1973	14,913	3,850	74	18,837
1974	17,043	4,717	120	21,880
1975	11,749	3,642	94	15,485
1976	12,986	3,242	47	16,275
1977	16,668	3,400	51	20,119
1978	10,293	2,893	204	13,390
1979	11,045	3,763	22	14,830
1980	9,265	4,206	38	13,509
1981	10,693	4,380	284	15,337
1982	9,320	3,087	58	12,465
1983	9,149	3,625	54	12,828
1984	7,590	4,091	205	11,886
1985	9,052	3,640	14	12,706
1986	6,930	2,054	112	9,096
1987	9,396	2,006	89	11,491
1988	4,054	1,359	114	5,527
1989	7,056	1,483	51	8,590
1990	4,715	1,186	35	5,936
1991	4,664	2,006	104	6,834
1992	3,406	2,771	94	6,271
1993	4,464	2,549	157	7,170
1994	3,968	2,836	98	7,802 [2]
1995	3,789	2,704	71	8,164 [3]
1996	4,028	2,334	64	6,126 [4]
1997	6,099	3,303	58	9,460 [5]
1998	4,207	2,509	38	6,835
1999	4,029	2,540	39	6,608
2000	3,285	1,568	45	4,897
2001	2,752	1,191	16	3,960
2002	1,726	744	3	2,470
2003	1,441	603 [7]	1	2,045
2004	827	575	1	1,403
2005	608	336	10	1,070 [6]
2006	540	315	21	876
2007	390	247	7	645
2008	296	152	1	449
2009	134	62	0.3	197
2010	117	38	0.3	155

[1] Landings statistics incompletely split on the Kattegat and Skagerrak.

[2] Including 900 t reported in Skagerrak.

[3] Including 1.600 t misreported by area.

[4] Excluding 300 t taken in Sub-divisions 22–24.

[5] Including 1.700t reported in Sub-division 23.

[6] Including 116 t reported as pollack

[7] the catch reported to the EU exceeds the catch reported to the WG (shown in the table) by 40%

Table 6.4.1.2 Cod in Division IIIa East (Kattegat). Reported landings and estimated discards (from observer data), and the total fisheries catch (sum of landings and discards, in tons). "Landings multiplier" (shown as a mean value and the 95% confidence intervals) from 2003 onwards is estimated from SAM model based on survey information. "Landings multiplier" multiplied by reported landings represents the removals from the stock in excess to the assumed natural mortality.

Year	Landings	Discards	Catch	Landings multiplier	95% confidence intervals
1997	9460	881	10341		
1998	6835	664	7499		
1999	6608	764	7372		
2000	4897	992	5889		
2001	3960	823	4783		
2002	2470	577	3047		
2003	2045	750	2795	1.61	1.14-2.28
2004	1403	1063	2466	1.73	1.19-2.49
2005	1070	575	1645	3.48	2.39-5.05
2006	876	849	1725	4.79	3.27-7.00
2007	645	577	1222	4.11	2.80-6.04
2008	449	259	708	4.29	2.89-6.36
2009	197	127	323	5.20	3.45-7.84
2010	155	147	302	8.28	5.59-12.26

ECOREGION North Sea

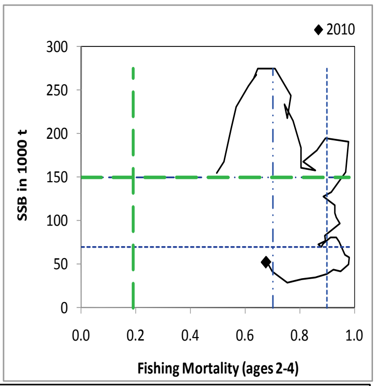
STOCK Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak)

Advice for 2012

ICES advises on the basis of the EU–Norway management plan that landings in 2012 should be no more than 31 800 t.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	O	O	O	Increased risk
Management plan (F_{MP})	✗	✗	✗	Above target
SSB (Spawning-Stock Biomass)	**2009**	**2010**	**2011**	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	✗	✗	✗	Reduced reproductive capacity
Management plan (SSB_{MP})	✗	✗	✗	Below trigger



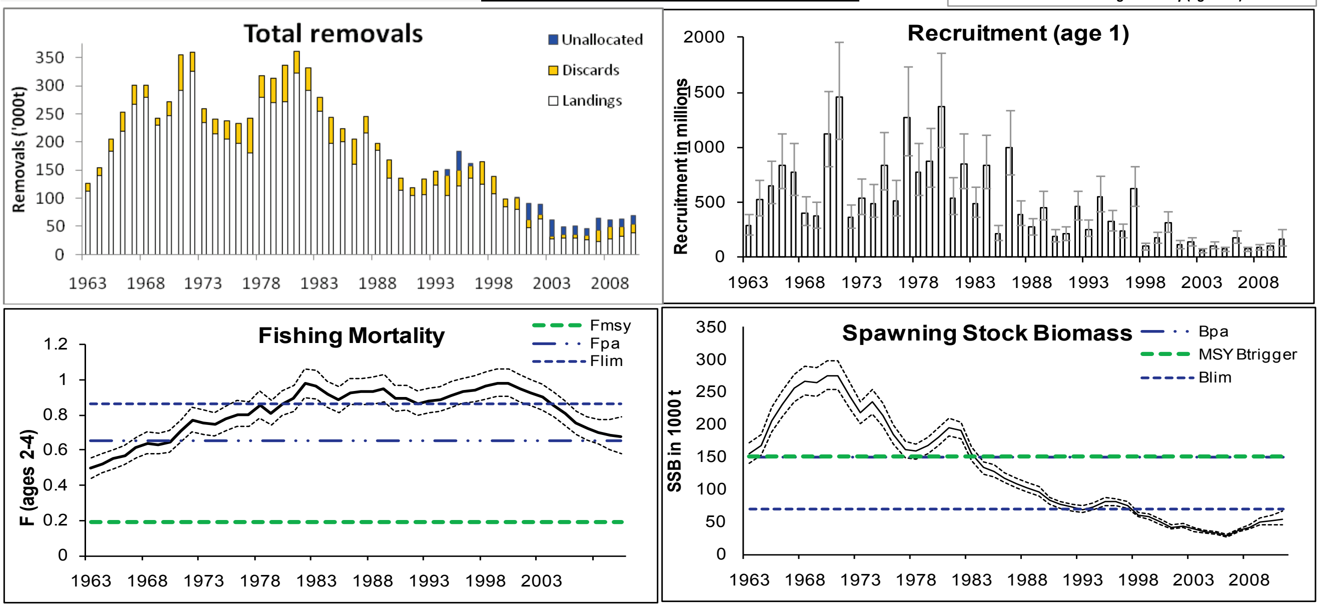


Figure 6.4.2.1 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Summary of stock assessment with point-wise 95% confidence intervals, catch estimated, and adjusted for unallocated removals (from 1993). Weights in tonnes.

There has been a gradual improvement in the status of the stock over the last few years. SSB has increased from the historical low in 2006, but remains below B_{lim}. Fishing mortality declined from 2000, but is estimated to be well above F_{MSY}, and is just above F_{pa}. Recruitment since 2000 has been poor. Although discards are still high, there has been a decreasing trend since 2008.

Management plans

The EU–Norway agreement management plan was updated in December 2008 (Annex 6.4.2). The EU has adopted a long-term plan for this stock with the same aims (Council Regulation (EC) 1342/2008). ICES evaluated both plans in 2009 and concluded they are in accordance with the precautionary approach if implemented and enforced adequately.

A joint ICES–STECF group is currently conducting a historical evaluation of the effectiveness of these plans (ICES, 2011b).

Biology

Cod are widely distributed throughout the North Sea, but there are indications of sub-stocks. Genetic studies have indicated two subpopulations with long-term differences in recruitment trends, and largely inhabiting different regions of the North Sea, with cod from the deep-water subpopulation not expected to re-colonize areas depleted in the southern North Sea (ICES, 2011c).

Environmental influence on the stock

Recent recruitments have been low, with possible influence of changes in the availability of food resources for cod larvae to increasing predation pressure. There is evidence of cannibalism and seal predation. Multispecies model runs estimate a decrease in cannibalism rates for age 1 and age 2 cod at current low stock levels, while seal predation on ages 3 to 6 has increased over the years due to an increase in seal abundance.

The fisheries

Cod are taken by towed gears in mixed demersal fisheries. Cod are targeted by some fleets, but are also caught as part of mixed fisheries catching haddock, whiting, *Nephrops*, plaice, and sole. Cod discards have declined from 45% in 2008 to 20% in 2010 as a proportion of the total cod catches by weight.

Catch by fleet	ICES estimates total removals (2010) at around 69 kt, with 39.0 kt estimated landings (64% demersal trawls and seines >100 mm, 12% *Nephrops* trawls 70–99 mm, 12% gillnets, and 8% beam trawls) and 14.4 kt estimated discards. Unaccounted removals are estimated at around 30% (between 6% and 59%) of the catch in 2010.

Effects of the fisheries on the ecosystem

Gillnet fishery for cod takes bycatches of harbour porpoise. Since 2001, effort reductions in this fishery have likely led to decreased bycatches. Hiddink *et al.* (2006) estimates that in areas of bottom trawl activity in the North Sea,benthic biomass and production is reduced by 56% and 21%, respectively, compared with an unfished situation.

Quality considerations

The main source of uncertainty for the advice forecast is the assumption of fishing mortality in 2011. Rather than assuming a *status quo* F in 2011, which would imply a TAC overshoot of 50%, the projections assume that the effort reductions in the management plan have resulted in a 15% decrease in F between 2010 and 2011.

A new stochastic assessment model was used in 2011 which shows less interannual variation in fishing mortality. Discards are estimated from relatively few samples. Discard information in the correct form or of sufficient quality was not available for Dutch, French, and Belgian fleets, respectively accounting for 7%, 6%, and 2% of cod landings in 2010. These are sources of added uncertainty in the assessment.

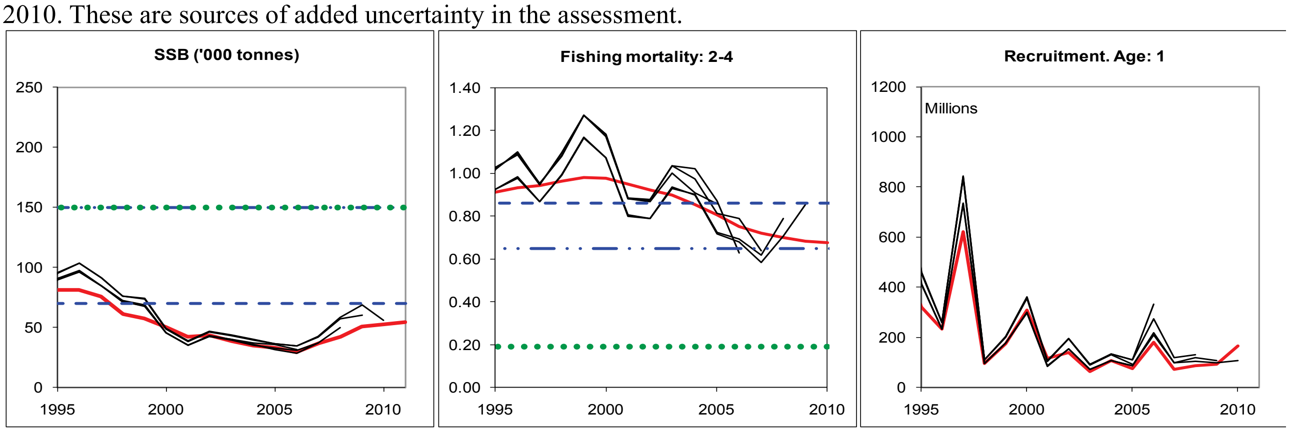


Figure 6.4.2.2 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	A state–space age-structured assessment model with estimates of unaccounted removals (SAM), and a stochastic age-based model with estimates of unaccounted removals (B-ADAPT) used as comparison.
Input data	One survey index (from IBTS Q1 survey).
Discards and bycatch	Included in the assessment (since 2004).
Indicators	None.
Other information	Latest full benchmark was performed in 2009 with an inter benchmark meeting in 2011.
Working group report	WGNSSK

ECOREGION North Sea
STOCK Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	150 000 t	= $\mathbf{B_{pa}}$
	F_{MP}	0.4	Mortality rate when SSB > SSB_{MP}.
MSY Approach	MSY $B_{trigger}$	150 000 t	The default option of B_{pa}
	F_{MSY}	0.19	F_{max} 2010, within the range of fishing mortalities consistent with F_{MSY} (0.16–0.42).
Precautionary approach	B_{lim}	70 000 t	B_{loss} (~1995)
	B_{pa}	150 000 t	B_{pa} = Previous MBAL and signs of impaired recruitment below 150 000 t.
	F_{lim}	0.86	$F_{lim} = F_{loss}$ (~1995).
	F_{pa}	0.65	F_{pa} = Approx. 5th percentile of F_{loss}, implying an equilibrium biomass > B_{pa}.

(unchanged since: 2011)

Outlook for 2012

Basis: Management plan assumption mean F (2011) = mean F(2010)×0.85 = 0.58; Recruitment (2011) re-sampled 1998–2010 = 107 million; SSB (2012) = 66.9; HC landings (2011) = 41.8; Discards (2011) = 14.8; Unallocated removals = 15.8.

Rationale	**Landings[1] (2012)**	**Basis**	$\mathbf{F_{total}}$ **(2012)**	$\mathbf{F_{land}}$ **(2012)**	$\mathbf{F_{disc}}$ **(2012)**	$\mathbf{F_{unal}}$[2] **(2012)**	**Disc (2012)**	**Unal[2] (2012)**	**SSB (2013)**	**%SSB[3] Change**	**%TAC[4] Change**
Management Plan	31.8	F_{08}*0.45 with TAC constraint	0.32	0.18	0.07	0.07	8.0	11.1	107.4	+ 60 %	- 1 %
MSY framework	9.5	F_{MSY}* $SSB_{2012}/B_{trigger}$	0.08	0.05	0.02	0.02	2.3	3.3	134.6	+ 101 %	- 71 %
MSY transition	42.0	Transition rule	0.44	0.25	0.09	0.10	10.6	14.6	95.1	+ 42 %	+ 30 %
Zero Catch	0.0	F=0	0.00	0.00	0.00	0.00	0.0	0.0	146.2	+ 119 %	- 100 %
Status quo	20.3	F_{MSY}	0.19	0.11	0.04	0.04	5.0	7.0	121.3	+ 81 %	- 37 %
	26.0	TAC_{2011}–20%	0.25	0.14	0.05	0.05	6.4	9.0	114.4	+ 71 %	- 20 %
	38.6	TAC_{2011}+20%	0.40	0.23	0.09	0.09	9.7	13.5	99.1	+ 48 %	+ 20 %
	51.8	F_{2011}	0.58	0.33	0.13	0.13	13.2	18.1	83.2	+ 24 %	+ 61 %

Units: ‘000 tonnes.
[1] Landings do not include unallocated mortality.
[2] Unallocated removals (calculated by dividing total by average catch multiplier in last three years).
[3] SSB 2013 relative to SSB 2012.
[4] Landings 2012 (not including unallocated removals) relative to TAC 2011.

Management plan

The EU–Norway agreement management plan as updated in December 2008 aims to be consistent with the precautionary approach and is intended to provide for sustainable fisheries and high yield leading to a target fishing mortality of 0.4 (for details see Annex 6.4.2).

The EU has adopted a long-term plan for this stock with the same aims (Council Regulation (EC) 1342/2008). In addition to the EU–Norway agreement the EU plan also includes effort restrictions, reducing kW-days available to community vessels in the main metiers catching cod in direct proportion to reductions in fishing mortality until the target F of 0.4 has been reached. This implies a 15.4% reduction in effort in 2011.

In both plans fishing mortality should be reduced to levels corresponding to 75% of F_{2008} in 2009 and 65% of F_{2008} in 2010. Until the long-term phase of the management plans has been reached, further annual reductions of 10% must be applied which lead to an F in 2012 equal to 45% of F_{2008}. This would lead to a TAC reduction within the limits of the 20% TAC constraint. According to these rules, landings should be 31 800 t in total for Subarea IV and Divisions IIIa West and VIId in 2012.

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.08 (lower than F_{MSY} because SSB 2012 < MSY $B_{trigger}$), resulting in landings of less than 9500 t in 2012. This is expected to lead to an SSB of 134 600 t in 2013.

To follow the transition scheme towards the ICES MSY framework the fishing mortality must be reduced to (0.6*0.68) + (0.4*(0.19*0.40)) = 0.44, which is lower than F_{pa}. This results in landings of less than 42 000 t in 2012, which is expected to lead to an SSB of 95 100 t in 2013.

The stock is below B_{lim} and recruitment remains poor. Therefore, a more rapid transition to the MSY framework may be necessary to rectify the situation. ICES highlights catch options for transition periods ranging from one to four years (2012 to 2015, respectively).

PA approach

Even a zero catch in 2012 is not expected to result in SSB reaching B_{pa} in 2013.

Additional considerations

Uncertainty in the assessment

Because of the differing levels of noise associated with the data sets on discards and landings, the current SAM assessment model was adopted by the benchmark workshop for North Sea cod in February 2011 (ICES, 2011c) for an interim period until further refinements can be made that account for discards and landings separately. Two alternative assessment methods (SAM and B-Adapt models) using the same set of input data provide similar perceptions of the stock over time and in the most recent year.

The IBTS Q3 survey is no longer included in the assessment because of the conflicting trends between the IBTS Q1 and Q3 indices used in the assessment, possibly resulting from changes in the catchability/availability of cod in Q3 related to recent changes in fish distribution. Future re-inclusion of the IBTS Q3 survey is envisaged once a detailed investigation is carried out; the February 2011 benchmark has recommended that a working group on improving the use of survey data for assessment and advice be established for this purpose.

Historically high recruitment estimates have been revised downward, which may influence the stock recruitment relationship and may therefore affect the revision of reference points in future.

MSY reference points

The choice of the proxy F_{max} as a candidate for F_{MSY} was based on the clear peak at F = 0.19 in the yield-per-recruit analysis in 2010. Extensive simulations and investigations of the productivity of the stock provide a range of possible candidate values (F_{MSY} = 0.16 to 0.42). The estimate of F_{MSY} is strongly dependent on the choice of stock–recruitment (S–R) model.

Management considerations

The assessment estimates that SSB in 2012 is still below B_{lim} and F is still largely above any management target, indicating that the LTMP objective of reducing fishing mortality by 35% in 2010 compared to 2008 has likely not been achieved (the decrease in F from 2008 to 2010 is estimated to be around 3%, Figure 6.4.2.1).

Fishing mortality rates have been reduced from 2000 and the stock has increased since 2006. The low average age of the spawning stock may reduce its reproductive capacity as first-time spawners may reproduce less successfully than older fish, a factor that could be a contributor to continued low recruitment.

Mixed-fisheries considerations are of primary importance for the management of North Sea cod. Single-stock management is a cause of discarding in mixed fisheries, because individual management objectives may not be consistent with each other. As such, the TAC of one species may be exhausted before the TAC of another, leading to catches of valuable fish that cannot be landed legally. It was estimated that the single-species management targets for North Sea cod cannot be achieved unless substantial reductions in TACs of all other stocks and corresponding effort reductions are applied (Ulrich *et al.*, 2011). ICES WGMIXFISH provides annual catch option scenarios to evaluate the consistency of the North Sea demersal single-stock exploitation boundaries in a mixed-fisheries and fleet-based perspective.

A joint ICES–STECF WG meeting will be held in the first half of 2011 to evaluate the effectiveness of the plan (ICES, 2011b).

Surveys indicate that the year classes are depleting faster than one would expect from the catches, and point to unaccounted removals. There is no documented information on the source of these unaccounted removals; while it has been previously assumed that these removals originate mostly from fishing activities, changes in natural mortality may also have an influence. Plausible fishery-based contributions to these unaccounted removals are discards (undersized cod, highgrading, and over-quota catches) that do not count against quota, and mis- and under-reporting of catches. The recorded landings from 2005–2010 fluctuated between 35% and 59% of the estimated total removals, indicating that the management system has not been effective in controlling the removals.

In the catch options table separate categories are included for projected landings, discards, and unallocated removals.

Several nations, who make substantial landings of cod, have not supplied ICES with estimates of discards that can be used within the assessment process, despite the requirement of the EU data collection regulations. In order to improve the quality of the assessment, and hence management advice, these nations should be encouraged to do so.

Management plan evaluations

ICES has evaluated the EC management plan (EC 1342/2008 and Annex 6.4.2) and the EU–Norway agreed long-term plan in March 2009 and concluded that this management plan is in accordance with the precautionary approach only if implemented and enforced adequately. A joint ICES–STECF group is currently conducting a historical evaluation of the effectiveness of these plans.

Regulations and their effects

The North Sea cod benchmark (ICES, 2011c) investigated the incidence of underreporting for the main fishing nations. Underreporting by the Scottish fleet fishing for cod has declined significantly since 2003, and is likely to have been low since 2006. Similarly, based on several indicators (including comparisons between the total quantity of cod registered in logbooks and those registered in sales receipts), the Danish Directorate of Fisheries estimates that the placement of illegal fish on the market does not occur on a large scale.

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management program switched from a days-at-sea to a kW-day system (2009 Council Regulation (EC) N° 43/2009), in which different amounts of kW-days are allocated within each area by member state to different groups of vessels, depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed annual monitoring of effort trends since 2004. Overall effort (kW-days) by demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced (−30% between 2003 and 2009; STECF, 2011). Following the introduction of days at sea regulations in 2003, there was a substantial switch from the larger mesh (>100 mm, TR1) gear to the smaller mesh (70–99 mm, TR2) gear. Subsequently, effort by TR1 has been relatively stable, whereas effort in TR2, beam trawl (80–120 mm, BT2), and gillnet has shown a continuous decline (−23%, −38%, and −31%, respectively, between 2003 and 2009).

Fishing mortality in the period 2003–2009 decreased by 23%, and preliminary analyses suggested that correlation between F and effort trends were significant. From 2009 on though, these patterns may change, as increasing proportions of effort fall under derogations of the cod management plan (articles 11 and 13), which reward cod avoidance and discard reduction behaviour with additional effort ceilings.

Scotland implemented in February 2008 a national scheme known as the ‘Conservation Credits Scheme’. The principle of this two-part scheme involves additional time at sea in return for the adoption of measures which aim to reduce mortality on cod and lead to a reduction in discard numbers. ICES notes that from the initial year of operation (2008) cod discarding rates in Scotland have decreased from 62% to 36% in 2010. In 2010 there were 165 closures, and from July 2010 the area of each closure increased (from 50 square nautical miles to 225 square nautical miles). Recent work tracking Scottish vessels in 2009 has concluded that vessels did indeed move from areas of higher to lower cod concentration following real-time closures during the first and third quarters (there was no significant effect during the second and fourth quarters (Needle and Catarino, 2011).

The introduction of the one-net rule is likely to have improved the accuracy of reporting of metier-based landings from 2008 onwards. Scottish legislation implemented in January 2008, which bans the use of multi-rigs (>2 rigs per trawl), could limit the potential of uncontrolled increase in effort.

A rights-based regulation (FKA – Vessel Quota Share) was put in force in Denmark from the 1st of January 2007. Individual vessels have been allocated a yearly share of the Danish quota, which can be taken at any time of the year. There is also a possibility to trade it, exchange it, or pool it with other fishers. This system gives the industry a possibility to plan better and is expected to lead to a more efficient fishery with less discards; however, the consequences of these measures have not yet been evaluated.

Changes in fishing technology and fishing patterns

The expansion of the Closed Circuit TV (CCTV)/ fully documented fisheries programmes in 2010 (and subsequently in 2011) in Scotland, Denmark, and England is expected to have reduced cod mortality; vessels carrying CCTV systems are not permitted to discard cod.

Environmental influence

There has been an apparent northerly shift in the mean latitudinal distribution of the stock in the North Sea. However, this is not thought to be due to cod migrating from the south to the north in response to climate change. More likely, cod in the North Sea are composed of a complex of more or less isolated sub-stocks and the southern units have been subjected to disproportionately high rates of mortality. The contracted range of the North Sea cod stock can be linked to reduced abundance as well as climate factors.

The consumption of cod in the North Sea in 2002 by grey seals has been estimated by Hammond and Grellier (2006). For the North Sea it was estimated that in 1985 grey seals consumed 4150 tonnes of cod (95% confidence intervals; 2484–5760 tonnes), and in 2002 the population tripled in size (21 000–68 000 individuals) and consumed 8344 tonnes (95% confidence intervals; 5028–14 941 tonnes). Grey seals have not been accounted for in multispecies models since 2005, therefore the current level of predation by seals is unknown.

Data and methods

The assessment uses combined landings and discards, calibrated with one survey index (from IBTS quarter 1 survey). For ICES Subarea IV and Division VIId, discards were estimated from the Scottish discards sampling programme up until 2005 and raised to the total international fleet. The coverage of national discard data has subsequently improved.

Information from the fishing industry

Comparison between the fishers' North Sea stock survey (Napier, 2011) and the IBTS survey data has been shown in previous years the time-series are broadly in agreement in recording a stable overall stock abundance until 2003–2005, followed by a more recent increase. Because of the inherent spatial variation the IBTS surveys have more variability, but exhibit similar trends in the same areas as the fishers' survey, showing significant increases in stock abundance in the north and west, and less in the south.

Both the Danish REX and UK northeast coast cod surveys (collaborative research projects with the fishing industry) indicate that catch rates of cod are significantly greater on the hard ground compared to the soft ground. The Danish REX survey also indicates much higher catch rates of cod in the first quarter compared to the third quarter for a trawler and Danish seines, but not for a gillnetter, possibly explained by the high water turbidity caused by the more frequent storm events in the first quarter (the gillnetter is not affected by this to the same extent as the other two vessels). A UK whitefish survey, initiated in 2009, indicates that catches of older cod are more frequent and less noisy in this survey than in the IBTS Q3 survey. This is supported by results from the Danish REX survey, which shows good agreement with the IBTS Q3 survey for younger ages, but not for older ages.

Comparison with previous assessment and advice

The SAM model was considered to be the most appropriate because it considers additional variability/uncertainty in various components, making it less reactive to noise in the catch/survey data, or to potential changes to survey catchability than B-ADAPT. Last year, a *status quo* F was assumed for the current year. This year, the projections assume that the effort reductions in the management plan have resulted in a 15% decrease in F between 2010 and 2011.

Last year's advice was based on different scenarios. This year´s advice is based on the EC management plan.

Sources

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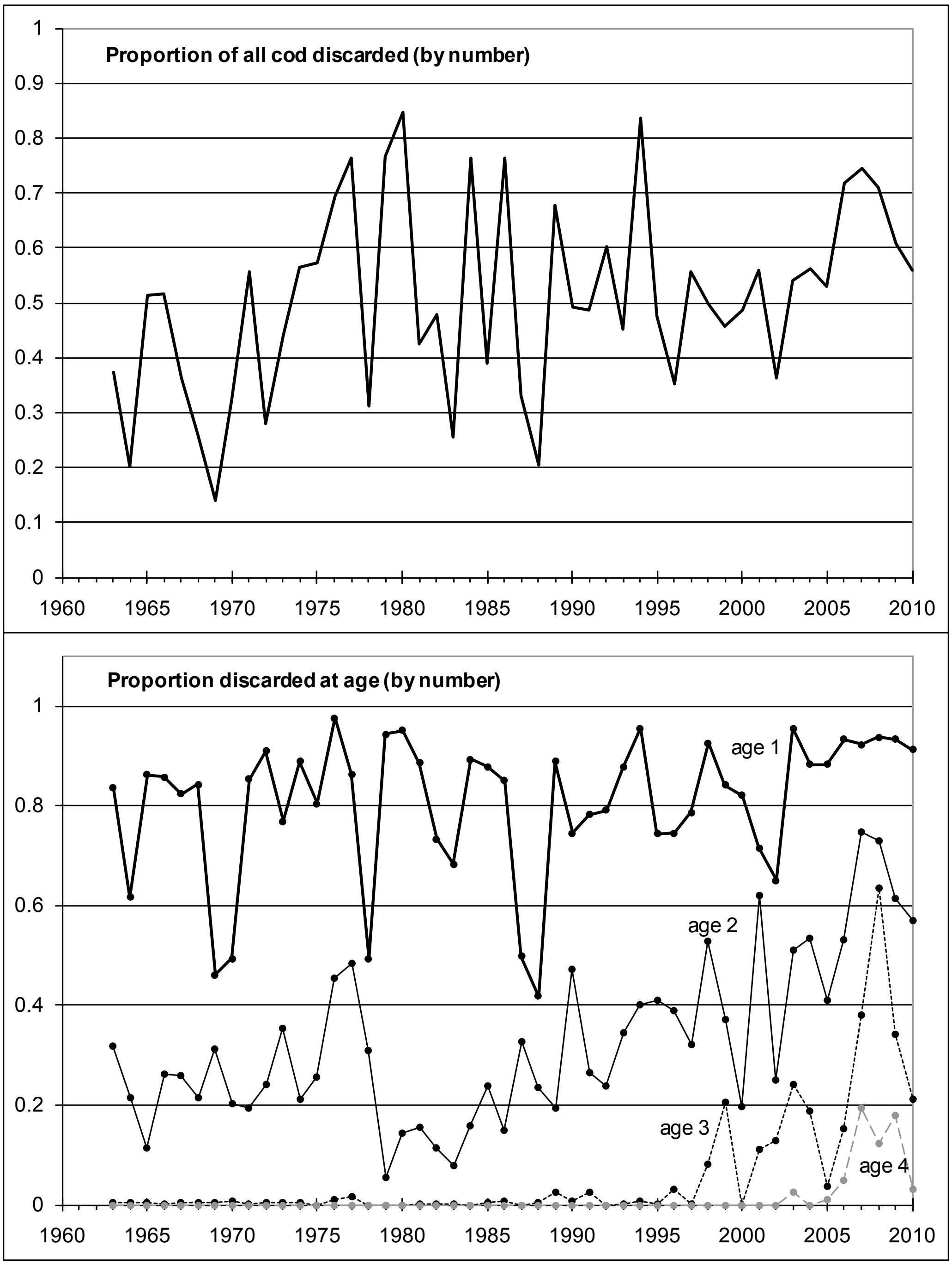


Figure 6.4.2.3 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Proportion of total numbers caught that are discarded in total and at age. In 2010, 91% of 1-year-old, 57% of 2-year-old, 21% of 3-year-old, and 3% of 4-year-old cod were discarded.

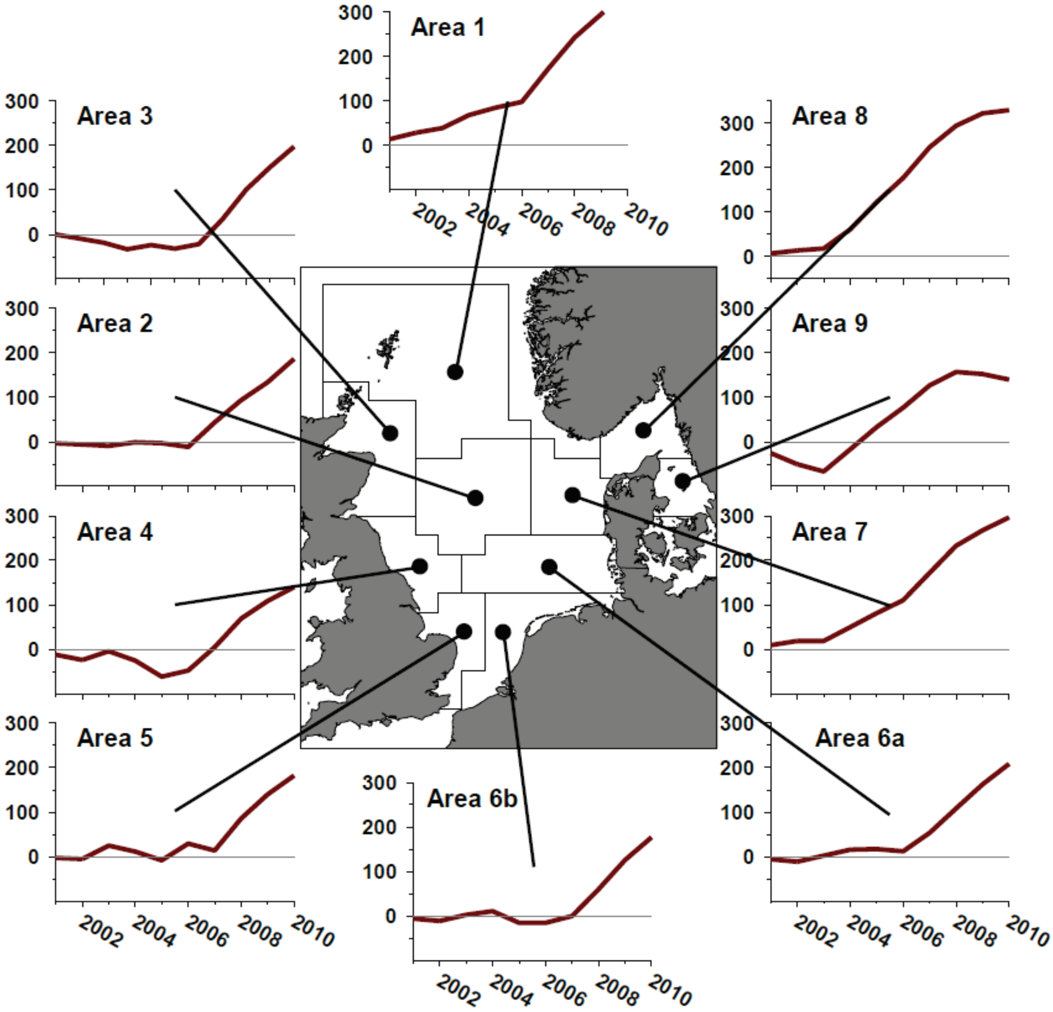


Figure 6.4.2.4 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel),and IIIa (Skagerrak). Results of the North Sea Commission fishers' survey perceptions of abundance by area, 2010.

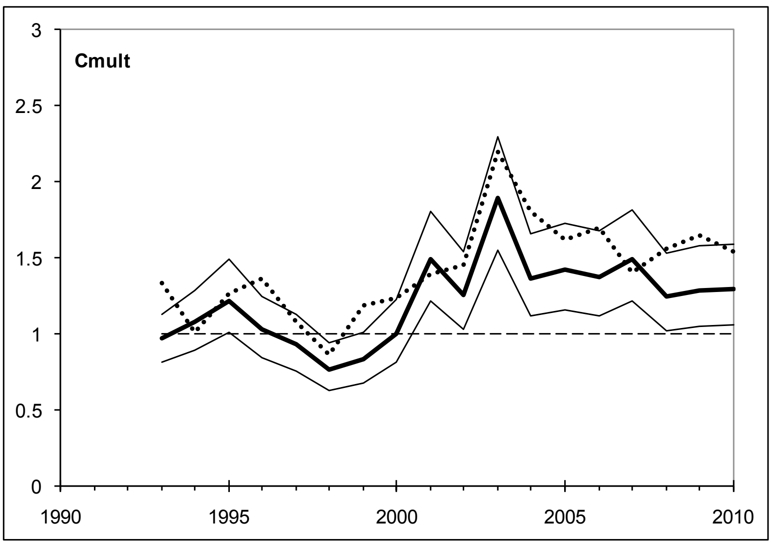


Figure 6.4.2.5 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak). Estimates of factor for unallocated removals (catch multiplier) from SAM (bold line with 95% confidence limits) and B-Adapt (dotted line).

Table 6.4.2.1 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak). ICES advice, management, and catch/landings. Landings for each of the three parts of this combined-area assessment and for all areas combined are given in Table 6.4.2.2.

North Sea (Subarea IV)

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC	Official landings	ICES landings
1987	SSB recovery; TAC	100–125	175	167	182
1988	70% of F(86); TAC	148	160	142	157
1989	Halt SSB decline; protect juveniles; TAC	124	124	110	116
1990	80% of F (88); TAC	113	105	99	105
1991	70% of effort (89)		100	87	89
1992	70% of effort (89)		100	98	97
1993	70% of effort (89)		101	94	105
1994	Significant effort reduction		102	87	95
1995	Significant effort reduction		120	112	120
1996	80% of F(94) = 0.7	141	130	104	107
1997	80% of F(95) = 0.65	135	115	100	102
1998	F(98) should not exceed F(96)	153	140	114	122
1999	F = 0.60 to rebuild SSB	125	132	80	78
2000	F less than 0.55	< 79	81	62	59
2001	lowest possible catch	0	48.6	42.3	41
2002	lowest possible catch	0	49.3	44.2	44.3
2003	Closure	0	27.3	27.4	NA
2004	Zero catch	0	27.3	23.4	NA
2005	Zero catch	0	27.3	23.9	NA
2006	Zero catch	0	23.2	22.2	NA
2007	Zero catch	0	20.0	19.7	NA
2008	Exploitation boundaries in relation to precautionary limits Total removals < 22 000 t	< 22	22.2	22.2	NA
2009	Zero catch	0	28.8	25.7	NA
2010	Management plan F (65% of F_{2008})	< 40.3 [1)]	33.6	31.4	NA
2011	See scenarios	-	26.8		
2012	Management plan F (45% of F_{2008})	< 31.8 [1)]			

Weights in '000 t.

[1)] For Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak).

Table 6.4.2.1 Continued

Skagerrak (Division IIIa)

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC[1]	Official landings	ICES landings[1]
1987	$F = F_{max}$	<21	22.5	19.9	20.9
1988	Reduce F		21.5	17.0	16.9
1989	F at F_{med}	<23	20.5	18.7	19.6
1990	F at F_{med}; TAC	21.0	21.0	17.8	18.6
1991	TAC	15.0	15.0	12.1	12.4
1992	70% of F(90)		15.0	14.0	14.8
1993	Precautionary TAC		15.0	14.7	15.3
1994	No long-term gain in increased F + precautionary TAC		15.5	13.3	13.9
1995	If required precautionary TAC; link to North Sea		20.0	12.1	12.1
1996	If required precautionary TAC; link to North Sea		23.0	16.2	16.4
1997	If required precautionary TAC; link to North Sea		16.1	14.9	14.9
1998	If required precautionary TAC; link to North Sea	21.9	20.0	15.3	15.3
1999	F = 0.60 to rebuild SSB	17.9	19.0	11.0	11.0
2000	F less than 0.55	<11.3	11.6	9.3	9.3
2001	lowest possible catch	0	7.0	7.1	7.1
2002	lowest possible catch	0	7.1	7.5	7.5
2003	Closure	0	3.9	3.8	NA
2004	Zero catch	0	3.9	3.8	NA
2005	Zero catch	0	3.9	3.8	NA
2006	Zero catch	0	3.3	3.4	NA
2007	Zero catch	0	2.9	2.9	NA
2008	Exploitation boundaries in relation to precautionary limits Total removals less than 22 000 t	< 22	3.2	3.3	NA
2009	Zero catch	0	4.1	3.9	NA
2010	Management plan F (65% of F2008)	< 40.3[2)]	4.8	4.3	NA
2011	See scenarios	-	3.8		
2012	Management plan F (45% of F_{2008})	< 31.8 [2)]			

Weights in '000 t.

[1)] Norwegian fjords not included.

[2)] For Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak).

Table 6.4.2.1 Continued

Eastern Channel (Division VIId)

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC [1)]	Official landings	ICES landings
1987	Not assessed	-	-	9.4	14.2
1988	Precautionary TAC	-	-	10.1	10.7
1989	No increase in F; TAC	10.0 [2)]	-	n/a	5.5
1990	No increase in F; TAC	9.0 [2)]	-	n/a	2.8
1991	Precautionary TAC	3.0 [2)]	-	n/a	1.9
1992	If required, precautionary TAC	5.5 [2)]	-	2.7	2.7
1993	If TAC required, consider SSB decline	-	-	2.5	2.4
1994	Reduce F+ precautionary TAC		-	2.9	2.9
1995	Significant effort reduction; link to North Sea		-	4.0	4.0
1996	Reference made to North Sea advice		-	3.5	3.5
1997	No advice		-	7.2	7.0
1998	Link to North Sea	4.9	-	8.7	8.6
1999	F = 0.60 to rebuild SSB	4.0	-	n/a	6.9
2000	F less than 0.55	< 2.5	-	3.6	2.3
2001	lowest possible catch	0	-	2.0	1.6
2002	lowest possible catch	0	-	1.6	3.1
2003	Closure	0	-	1.3	NA
2004	Zero catch	0	-	0.2	NA
2005	Zero catch	0	-	0.7	NA
2006	Zero catch	0	-	1.1	NA
2007	Zero catch	0	-	1.7	NA
2008	Exploitation boundaries in relation to precautionary limits Total removals less than 22 000 t	< 22	-	1.4	NA
2009	Zero catch	0	1.7	1.2	NA
2010	Management plan F (65% of F2008)	< 40.3 [3)]	2.0	1.8	NA
2011	See scenarios	-	1.6		
2012	Management plan F (45% of F_{2008})	< 31.8 [3)]			

Weights in '000 t.

[1)] Until 2008 this area was included in the TAC for Subarea VII (except Division VIIa). From 2009 a separate TAC is set.

[2)] Including Division VIIe.

[3)] For Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak).

Table 6.4.2.2 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Nominal landings (in tonnes) as officially reported to ICES, and ICES estimates of catches.

Sub-area IV										
Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	2,331	3,356	3,374	2,648	4,827	3,458	4,642	5,799	3,882	3,304
Denmark	18,997	18,479	19,547	19,243	24,067	23,573	21,870	23,002	19,697	14,000
Faroe Islands	23	109	46	80	219	44	40	102	96	.
France	975	2,146	1,868	1,868	3,040	1,934	3,451	2,934	.	1,222
Germany	7,278	8,446	6,800	5,974	9,457	8,344	5,179	8,045	3,386	1,740
Greenland	-	-	-	-	-	-	-	-	-	-
Netherlands	6,831	11,133	10,220	6,512	11,199	9,271	11,807	14,676	9,068	5,995
Norway	6,022	10,476	8,742	7,707	7,111	5,869	5,814	5,823	7,432	6,410
Poland	15	-	-	-	-	18	31	25	19	18
Sweden	784	823	646	630	709	617	832	540	625	640
UK (E/W/NI)	14,249	14,462	14,940	13,941	14,991	15,930	13,413	17,745	10,344	6,543
UK (Scotland)	29,060	28,677	28,197	28,854	35,848	35,349	32,344	35,633	23,017	21,009
Total Nominal Catch	86,565	98,107	94,380	87,457	111,468	104,407	99,423	114,324	77,566	60,881
Unallocated landings	1,968	-758	10,200	7,066	8,555	2,161	2,746	7,779	826	-1,114
WG estimate of total landings	**88,533**	**97,349**	**104,580**	**94,523**	**120,023**	**106,568**	**102,169**	**122,103**	**78,392**	**59,767**
Agreed TAC	**100,000**	**100,000**	**101,000**	**102,000**	**120,000**	**130,000**	**115,000**	**140,000**	**132,400**	**81,000**

Division VIId										
Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	182	187	157	228	377	321	310	239	172	110
Denmark	-	1	-	9	-	-	-	-	-	-
France	.	2,079	1,771	2,338	3,261	2,808	6,387	7,788	.	3,084
Netherlands	-	2	-	-	-	-	-	19	3	4
UK (E/W/NI)	341	443	530	312	336	414	478	618	454	385
UK (Scotland)	2	22	2	<0.5	<0.5	4	3	1	-	-
Total Nominal Catch	525	2,734	2,460	2,887	3,974	3,547	7,178	8,665	629	3,583
Unallocated landings	1,361	-65	-28	-37	-10	-44	-135	-85	6,229	-1,258
WG estimate of total landings	**1,886**	**2,669**	**2,432**	**2,850**	**3,964**	**3,503**	**7,043**	**8,580**	**6,858**	**2,325**

Division IIIa (Skagerrak)**										
Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Denmark	10,294	11,187	11,994	11,921	15,888	14,573	12,159	12,339	8,682	7,656
Germany	3	-	530	399	285	259	81	54	54	54
Norway	924	1,208	1,043	850	1,039	1,046	1,323	1,293	1,146	926
Sweden	3,846	2,523	2,575	1,834	2,483	1,986	2,173	1,900	1,909	1,293
Others	38	102	88	71	134	-	-	-	-	-
Norwegian coast *	854	923	909	760	846	748	911	976	788	624
Danish industrial by-catch *	953	1,360	511	666	749	676	205	97	62	99
Total Nominal Catch	15,105	15,020	16,230	15,075	19,829	17,864	15,736	15,586	11,791	9,929
Unallocated landings	-3,046	-1,018	-1,493	-1,814	-7,720	-1,615	-790	-255	-817	-652
WG estimate of total landings	**12,059**	**14,002**	**14,737**	**13,261**	**12,109**	**16,249**	**14,946**	**15,331**	**10,974**	**9,277**
Agreed TAC	**15,000**	**15,000**	**15,000**	**15,500**	**20,000**	**23,000**	**16,100**	**20,000**	**19,000**	**11,600**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined										
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total Nominal Catch	102,195	115,861	113,070	105,419	135,271	125,818	122,337	138,575	89,986	74,393
Unallocated landings	283	-1,841	8,679	5,215	825	502	1,821	7,439	6,239	-3,024
WG estimate of total landings	**102,478**	**114,020**	**121,749**	**110,634**	**136,096**	**126,320**	**124,158**	**146,014**	**96,225**	**71,369**

** Skaggerak/Kattegat split derived from national statistics

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

. Magnitude not available - Magnitude known to be nil <0.5 Magnitude less than half the unit used in the table n/a Not applicable

Division IIIa (Skagerrak) landings not included in the assessment										
Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Norwegian coast *	854	923	909	760	846	748	911	976	788	624
Danish industrial by-catch *	953	1,360	511	666	749	676	205	97	62	99
Total	**1,807**	**2,283**	**1,420**	**1,426**	**1,595**	**1,424**	**1,116**	**1,073**	**850**	**723**

Table 6.4.2.2.cont

Sub-area IV

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	2,470	2,616	1,482	1,627	1,722	1,309	1,009	894	946	666
Denmark	8,358	9,022	4,676	5,889	6,291	5,105	3,430	3,831	4,402	5,686
Faroe Islands	9	34	36	37	34	3	-	16	45	32
France	717	1,777	620	294	664	354	659	573	928	775
Germany	1,810	2,018	2,048	2,213	2,648	2,537	1,899	1,736	2,374	2,844
Greenland	-	-	-	-	35	23	17	17	11	.
Netherlands	3,574	4,707	2,305	1,726	1,660	1,585	1,523	1,896	2,649	2,656
Norway	4,369	5,217	4,417	3,223	2,900	2,749	3,057	4,128	4,234	4,483
Poland	18	39	35	-	-	-	1	2	3	.
Sweden	661	463	252	240	319	309	387	439	378	362
UK (E/W/NI)	4,087	3,112	2,213	1,890	1,270	1,491	1,587	1,546	2,384	
UK (Scotland)	15,640	15,416	7,852	6,650	4,936	6,857	6,511	7,185	9,052	
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14,112
Others	-	-	-	-	-	786	.	.	.	.
Norwegian indust by-catch *	.	.	.	.	.	48	101	22	4	201
Danish industrial by-catch *	.	.	.	.	.	34	18	46	76	11
Total Nominal Catch	41,713	44,421	25,936	23,789	22,479	23,108	20,080	22,263	27,406	31,616
Unallocated landings	-740	-121	-89	-240	1,391	-1,012	-336	-68	-1,778	-317
WG estimate of total landings	**40,973**	**44,300**	**25,847**	**23,549**	**23,870**	**22,096**	**19,744**	**22,195**	**25,628**	**31,300**
Agreed TAC	**48,600**	**49,300**	**27,300**	**27,300**	**27,300**	**23,205**	**19,957**	**22,152**	**28,798**	**33,552**

Division VIId

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	93	51	54	47	51	80	84	154	73	57
Denmark	-	-	-	-	-	-	.	.	.	.
France	1,677	1,361	1,730	810	986	1,124	1,743	1,326	1,761	1,565
Netherlands	17	6	36	14	9	9	59	30	35	43
UK (E/W/NI)	249	145	121	103	184	267	175	144	134	
UK (Scotland)	-	-	-	-	-	1	12	7	3	
UK (conbined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	127
Total Nominal Catch	2,036	1,563	1,941	974	1,230	1,481	2,073	1,661	2,006	1,792
Unallocated landings	-463	1,534	-707	-167	-197	-353	-331	-307	-759	0
WG estimate of total landings	**1,573**	**3,097**	**1,234**	**807**	**1,033**	**1,128**	**1,742**	**1,354**	**1,247**	**1,792**
Agreed TAC									**1,678**	**1,955**

Division IIIa (Skagerrak)**

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Denmark	5,870	5,511	3,054	3,009	2,984	2,478	2,228	2,552	3,023	3,289
Germany	32	83	49	99	86	84	67	52	55	56
Norway	762	645	825	856	759	628	681	779	440	434
Sweden	1,035	897	510	495	488	372	370	365	459	458
Others	-	-	27	24	21	373	385	13	2	26
Norwegian coast *	846	.	.	720	759	524	494	498	342	369
Danish industrial by-catch *	687	.	.	10	18	9	.	-	1	0
Total Nominal Catch	7,699	7,136	4,465	4,483	4,338	3,935	3,731	3,761	3,979	4,263
Unallocated landings	-613	332	-674	-696	-533	-569	-784	-463	-101	-175
WG estimate of total landings	**7,086**	**7,468**	**3,791**	**3,787**	**3,805**	**3,366**	**2,947**	**3,298**	**3,878**	**4,089**
Agreed TAC	**7,000**	**7,100**	**3,900**	**3,900**	**3,900**	**3,315**	**2,851**	**3,165**	**4,114**	**4,793**

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

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Nominal Catch	51,448	53,120	32,342	29,246	28,047	28,524	25,884	27,685	33,391	37,672
Unallocated landings	-1,816	1,745	-1,470	-1,103	661	-1,934	-1,451	-838	-2,638	-492
WG estimate of total landings	**49,632**	**54,865**	**30,872**	**28,143**	**28,708**	**26,590**	**24,433**	**26,847**	**30,753**	**37,180**

** Skaggerak/Kattegat split derived from national statistics

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

. Magnitude not available - Magnitude known to be nil <0.5 Magnitude less than half the unit used in the table n/a Not applicable

Division IV and IIIa (Skagerrak) landings not included in the assessment

Country	2001	2002	2002	2004	2003	2006	2007	2008	2009	2010
Norwegian coast *	846	.	.	720	759	524	494	498	342	369
Norwegian indust by-catch *	.	.	.	.	.	48	101	22	4	201
Danish industrial by-catch *	687	.	.	10	18	43	18	46	77	11
Total	**1,533**	**.**	**.**	**730**	**777**	**615**	**613**	**566**	**423**	**582**

Table 6.4.2.3a Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Summary of stock assessment (weights in tonnes). Estimated recruitment (age 1, in thousands), total stock biomass (TSB), spawning-stock biomass (SSB), total removals (including unallocated mortality), and average fishing mortality for ages 2 to 4 (Fbar 2–4). Low = lower limit and High = higher limit of 95% confidence interval.

Year	Recruits age 1 ('000)	Low	High	TSB (tons)	Low	High	SSB (tons)	Low	High	Total removals (tons)	Low	High	Fbar 2-4	Low	High
1963	285501	209274	389493	435391	392320	483190	154817	139522	171789	126754	112862	142355	0.495	0.440	0.557
1964	520216	384985	702949	562418	500122	632472	168215	152762	185232	154662	139522	171446	0.521	0.468	0.579
1965	654090	487332	877911	702219	628396	784714	206489	188528	226160	205664	183964	229924	0.548	0.496	0.606
1966	838190	623697	1126448	852561	762052	953820	230729	211785	251368	252458	226533	281350	0.567	0.514	0.625
1967	771429	572759	1039011	932850	838034	1038394	255250	234729	277565	301040	269328	336487	0.611	0.555	0.673
1968	404740	298009	549696	830680	759118	908989	267533	246389	290492	301342	272949	332688	0.640	0.582	0.704
1969	371016	274301	501832	704328	642490	772119	264607	243725	287278	241591	221448	263566	0.633	0.576	0.695
1970	1122423	832560	1513204	999490	856634	1166168	275130	253004	299192	271848	239300	308824	0.647	0.590	0.710
1971	1452795	1075870	1961775	1113479	967612	1281336	275406	253966	298655	353982	308666	405950	0.708	0.648	0.774
1972	358255	265052	484232	852561	768190	946199	244019	224970	264680	359691	316868	408300	0.768	0.700	0.842
1973	533919	395632	720543	689692	625353	760650	218382	202009	236081	259886	237116	284844	0.755	0.691	0.826
1974	490902	363691	662609	633490	574460	698586	234451	215729	254797	240145	216634	266208	0.744	0.680	0.813
1975	836515	611616	1144113	678744	597284	771315	214701	197981	232832	237281	212029	265540	0.776	0.711	0.848
1976	515555	375998	706911	557936	501077	621247	184241	170416	199188	233748	205610	265737	0.804	0.735	0.880
1977	1266794	926751	1731606	747882	634685	881267	161135	149378	173819	242316	209719	279980	0.803	0.735	0.878
1978	771429	569048	1045787	844922	730593	977143	158419	147343	170328	317109	270146	372236	0.856	0.784	0.935
1979	866312	639716	1173170	807744	717731	909045	167879	156044	180612	312388	276223	353288	0.811	0.743	0.885
1980	1368191	1004158	1864195	896273	779631	1030365	181317	168634	194953	337055	294212	386136	0.863	0.794	0.938
1981	533919	394376	722838	815046	726974	913788	194853	181725	208929	360411	314985	412388	0.893	0.823	0.969
1982	842391	628493	1129087	801307	707968	906953	190613	177942	204186	331705	294549	373547	0.977	0.898	1.063
1983	483110	362885	643167	641138	570891	720028	155593	145249	166673	278730	245553	316390	0.967	0.891	1.049
1984	832343	624346	1109633	625934	550177	712122	133252	124511	142607	243531	215595	275087	0.914	0.844	0.991
1985	218163	162615	292687	480220	433377	532126	128412	119887	137543	223463	196832	253697	0.886	0.815	0.962
1986	999490	748660	1334357	570918	489722	665575	117830	110075	126131	204843	179030	234378	0.927	0.855	1.005
1987	389648	293256	517725	568638	499839	646907	109098	101870	116839	245242	210866	285221	0.929	0.857	1.006
1988	268874	202400	357182	450900	406893	499665	103570	96672	110960	197402	177435	219617	0.933	0.861	1.01
1989	452254	337743	605591	413329	363487	470007	96858	90160	104053	167209	148306	188522	0.946	0.872	1.027
1990	192529	145002	255633	308970	278536	342730	82537	76890	88598	135131	119760	152475	0.892	0.820	0.969
1991	214058	161058	284498	284077	256118	315088	76726	71776	82018	119134	107336	132227	0.893	0.824	0.969
1992	459549	345760	610785	374745	323932	433528	72548	67723	77716	133786	116633	153462	0.866	0.798	0.939
1993	254486	191680	337871	341465	304852	382475	69633	65246	74316	147561	129041	168740	0.877	0.809	0.950
1994	553491	412116	743363	397122	347101	454353	73571	68889	78570	150844	133108	170943	0.886	0.818	0.960
1995	321258	241987	426497	432787	382235	490024	81471	76129	87188	183139	159409	210402	0.912	0.842	0.987
1996	233982	175849	311334	368428	331982	408875	81064	75913	86565	161943	144921	180965	0.933	0.863	1.010
1997	620946	464000	830979	450449	383516	529064	75735	70940	80855	165049	141998	191843	0.944	0.874	1.020
1998	96858	71898	130483	282095	250262	317978	61451	57550	65617	139525	120672	161324	0.965	0.893	1.042
1999	173685	129752	232494	213203	193439	234986	57526	53734	61586	98322	89022	108592	0.981	0.906	1.062
2000	310519	233029	413776	246965	214401	284474	50161	46609	53984	101114	87598	116715	0.979	0.905	1.060
2001	116658	86308	157680	196222	176130	218605	42489	39746	45421	90853	80130	103011	0.949	0.878	1.026
2002	139107	103910	186227	205664	184436	229336	43827	40929	46930	88965	79352	99743	0.922	0.851	0.999
2003	63959	47923	85361	128541	117601	140498	38949	36154	41959	61574	55457	68366	0.898	0.829	0.973
2004	107045	80436	142455	117948	106386	130767	34718	32343	37267	49021	44277	54272	0.856	0.789	0.929
2005	75282	56735	99894	118658	107315	131200	32958	30680	35405	50262	44790	56402	0.807	0.742	0.879
2006	181317	136459	240920	122272	109672	136318	29437	27392	31634	46351	41493	51778	0.753	0.689	0.822
2007	72620	54753	96319	157000	140687	175204	36864	34173	39768	65186	57039	74496	0.720	0.656	0.790
2008	87728	65891	116803	155438	141690	170519	42362	39056	45948	61390	55771	67575	0.699	0.631	0.774
2009	94750	68241	131558	167209	149951	186453	50767	46038	55982	63831	57390	70996	0.684	0.605	0.772
2010	165215	106483	256340	187963	161259	219089	52733	46518	59778	69286	60927	78792	0.676	0.579	0.790
2011							54721	44838	66783						

Table 6.4.2.3b Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak). Summary of the assessment: estimates of landings, discards, and catch from the SAM model (in thousand tonnes). A catch multiplier is included in the model from 1993 onwards. "Total Removals" are obtained by multiplying the "Catch" column with the "Catch multiplier" column.

Year	Landings	Discards	Catch	Catch multiplier
1963	112758	14118	126754	
1964	140787	13837	154662	
1965	183322	22181	205664	
1966	218819	33456	252458	
1967	266199	34648	301040	
1968	279568	21703	301342	
1969	229120	12585	241591	
1970	246965	25034	271848	
1971	291268	63070	353982	
1972	325462	34372	359691	
1973	234920	24810	259886	
1974	214915	25135	240145	
1975	205048	32177	237281	
1976	197205	36425	233748	
1977	179872	62380	242316	
1978	278452	38754	317109	
1979	270493	41940	312388	
1980	270763	66237	337055	
1981	322223	38216	360411	
1982	291851	39895	331705	
1983	253723	25160	278730	
1984	197798	45844	243531	
1985	201189	22248	223463	
1986	160492	44445	204843	
1987	215777	29437	245242	
1988	184795	12640	197402	
1989	134996	32338	167209	
1990	113664	21397	135131	
1991	104715	14464	119134	
1992	106831	27011	133786	
1993	126694	26148	152899	0.97
1994	104349	35721	140154	1.08
1995	122165	27423	149661	1.22
1996	135372	21912	157280	1.03
1997	133517	44090	177546	0.93
1998	139145	41826	180822	0.77
1999	101165	17499	118600	0.83
2000	79549	21070	100622	1.00
2001	47830	13156	60986	1.49
2002	62941	7636	70541	1.26
2003	27313	5221	32537	1.89
2004	28852	7039	35916	1.36
2005	29466	6005	35454	1.42
2006	26001	7718	33721	1.37
2007	22707	20982	43714	1.49
2008	27155	22099	49233	1.25
2009	32653	16798	49498	1.29
2010	38963	14401	53336	1.30

Annex 6.4.2

EU–Norway management plan

In 2008 the EU and Norway renewed their initial agreement from 2004 and *"agreed to implement a long-term management plan for the cod stock, which is consistent with the precautionary approach and is intended to provide for sustainable fisheries and high yield."*

Transitional arrangement:

F will be reduced as follows: 75% of F in 2008 for the TACs in 2009, 65% of F in 2008 for the TACs in 2010, and applying successive decrements of 10% for the following years.

The transitional phase ends as from the first year in which the long-term management arrangement (paragraphs 3–5) leads to a higher TAC than the transitional arrangement.

Long-term management

1. If the size of the stock on 1 January of the year prior to the year of application of the TACs is:

    a. Above the precautionary spawning biomass level, the TACs shall correspond to a fishing mortality rate of 0.4 on appropriate age groups;
    b. Between the minimum spawning biomass level and the precautionary spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate on appropriate age groups equal to the following formula:

        0.4 - (0.2 * (Precautionary spawning biomass level - spawning biomass) / (Precautionary spawning biomass level - minimum spawning biomass level))

    c. At or below the limit spawning biomass level, the TAC shall not exceed a level corresponding to a fishing mortality rate of 0.2 on appropriate age groups.

2. Notwithstanding paragraphs 2 and 3, the TAC for 2010 and subsequent years shall not be set at a level that is more than 20 % below or above the TACs established in the previous year.
3. Where the stock has been exploited at a fishing mortality rate close to 0.4 during three successive years, the parameters of this plan shall be reviewed on the basis of advice from ICES in order to ensure exploitation at maximum sustainable yield.
4. The TAC shall be calculated by deducting the following quantities from the total removals of cod that are advised by ICES as corresponding to the fishing mortality rates consistent with the management plan:

    a. A quantity of fish equivalent to the expected discards of cod from the stock concerned;
    b. A quantity corresponding to other relevant sources of cod mortality.
5. The Parties agree to adopt values for the minimum spawning biomass level (70,000 tonnes), the precautionary biomass level (150,000 tonnes) and to review these quantities as appropriate in the light of ICES advice.

Procedure for setting TACs in data-poor circumstances

6. If, due to a lack of sufficiently precise and representative information, it is not possible to implement the provisions in paragraphs 3 to 6, the TAC will be set according to the following procedure.

    a. If the scientific advice recommends that the catches of cod should be reduced to the lowest possible level the TAC shall be reduced by 25% with respect to the TAC for the preceding year;
    b. In all other cases the TAC shall be reduced by 15% with respect to the TAC for the previous year, unless the scientific advice recommends otherwise.

This plan shall be subject to triennial review, the first of which will take place before 31 December 2011. It enters into force on 1 January 2009.

The main changes between this and the plan of 2004 is the phasing (transitional and long-term phase) and the inclusion of an F reduction fraction.

EU management plan

In December 2008 the European Council agreed on a new cod management plan implementing the new system of effort management and a target fishing mortality of 0.4 (EC 1342/2008). The HCR for setting TAC for the North Sea cod stock are as follows:

Article 7 1.(a) and 1.(b) are required for interpretation of Article 8.

Article 7: Procedure for setting TACs for cod stocks in the Kattegat the west of Scotland and the Irish Sea

1. *Each year, the Council shall decide on the TAC for the following year for each of the cod stocks in the Kattegat, the west of Scotland and the Irish Sea. The TAC shall be calculated by deducting the following quantities from the total removals of cod that are forecast by STECF as corresponding to the fishing mortality rates referred to in paragraphs 2 and 3:*
   (a) a quantity of fish equivalent to the expected discards of cod from the stock concerned;
   (b) as appropriate a quantity corresponding to other sources of cod mortality caused by fishing to be fixed on the basis of a proposal from the Commission. [...]

Article 8: Procedure for setting TACs for the cod stock in the North Sea

1. *Each year, the Council shall decide on the TACs for the cod stock in the North Sea. The TACs shall be calculated by applying the reduction rules set out in Article 7 paragraph 1(a) and (b).*
2. *The TACs shall initially be calculated in accordance with paragraphs 3 and 5. From the year where the TACs resulting from the application of paragraphs 3 and 5 would be lower than the TACs resulting from the application of paragraphs 4 and 5, the TACs shall be calculated according to the paragraphs 4 and 5.*
3. *Initially, the TACs shall not exceed a level corresponding to a fishing mortality which is a fraction of the estimate of fishing mortality on appropriate age groups in 2008 as follows: 75 % for the TACs in 2009, 65 % for the TACs in 2010, and applying successive decrements of 10 % for the following years.*
4. *Subsequently, if the size of the stock on 1 January of the year prior to the year of application of the TACs is:*
   (a) above the precautionary spawning biomass level, the TACs shall correspond to a fishing mortality rate of 0,4 on appropriate age groups;
   *(b) between the minimum spawning biomass level and the precautionary spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate on appropriate age groups equal to the following formula: 0,4 – (0,2 * (Precautionary spawning biomass level – spawning biomass) / (Precautionary spawning biomass level – minimum spawning biomass level))*
   (c) at or below the limit spawning biomass level, the TACs shall not exceed a level corresponding to a fishing mortality rate of 0,2 on appropriate age groups.
5. *Notwithstanding paragraphs 3 and 4, the Council shall not set the TACs for 2010 and subsequent years at a level that is more than 20 % below or above the TACs established in the previous year.*
6. *Where the cod stock referred to in paragraph 1 has been exploited at a fishing mortality rate close to 0,4 during three successive years, the Commission shall evaluate the application of this Article and, where appropriate, propose relevant measures to amend it in order to ensure exploitation at maximum sustainable yield.*

Article 9: Procedure for setting TACs in poor data conditions

Where, due to lack of sufficiently accurate and representative information, STECF is not able to give advice allowing the Council to set the TACs in accordance with Articles 7 or 8, the Council shall decide as follows:

(a) where STECF advises that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25 % reduction compared to the TAC in the previous year;

(b) in all other cases the TACs shall be set according to a 15 % reduction compared to the TAC in the previous year, unless STECF advises that this is not appropriate.

Article 10: Adaptation of measures

1. *When the target fishing mortality rate in Article 5(2) has been reached or in the event that STECF advises that this target, or the minimum and precautionary spawning biomass levels in Article 6 or the levels of fishing mortality rates given in Article 7(2) are no longer appropriate in order to maintain a low risk of stock depletion and a maximum sustainable yield, the Council shall decide on new values for these levels.*
2. *In the event that STECF advises that any of the cod stocks is failing to recover properly, the Council shall take a decision which:*
   (a) sets the TAC for the relevant stock at a level lower than that provided for in Articles 7, 8 and 9;
   (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12;
   (c) establishes associated conditions as appropriate.

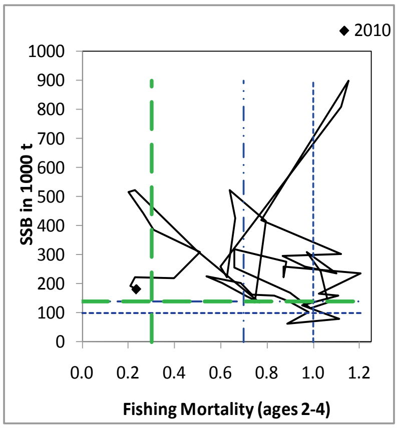
ECOREGION North Sea
STOCK Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak)

Advice for 2012

ICES advises on the basis of the EU-Norway management plan that landings in 2012 should be 41 575 t.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target
	SSB (Spawning Stock Biomass)			
	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above trigger



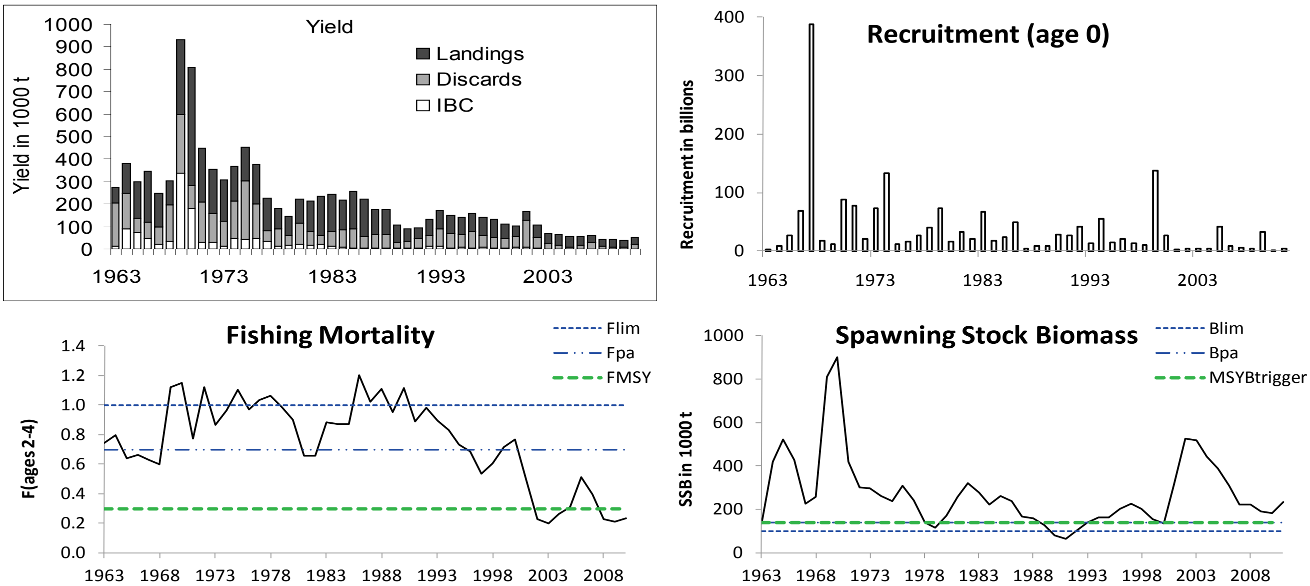


Figure 6.4.3.1 Haddock in Subarea IV (North Sea) and IIIa West (Skagerrak). Summary of stock assessment (weights in '000 tonnes), including intermediate-year forecasts for 2011. Top right: SSB and F over the years

Fishing mortality has been below F_{pa} and SSB has been above MSY $B_{trigger}$ since 2001. Recruitment is characterized by occasional large year classes, the last of which was the strong 1999 year class. Apart from the 2005 and 2009 year classes which are about average, recent recruitment has been poor.

Management plans

A management plan has been agreed by EU and Norway in 2008 (see Annex 6.4.3). ICES has evaluated the plan and concludes that it is can be accepted as precautionary.

Biology

The North Sea haddock stock exhibits sporadically high recruitment leading to dominant year classes in the fishery. These large year classes often grow more slowly than less abundant year classes, possibly due to density dependent effects. Recruitment appears poorly determined by either spawning stock biomass or egg production. Haddock primarily prey on benthic and epibenthic invertebrates, sandeels, and herring eggs. Haddock are an important prey species, mainly for saithe and other large gadoids.

Environmental influence on the stock

Haddock growth may be linked to water temperature. Warmer waters may lead to faster growth in early life stages, but also to faster maturation and a lower maximum size. There are indications that haddock recruitment success is determined, in part, by the available area of suitable substrate at settlement time.

The fisheries

Haddock are primarily caught by demersal trawlers (single, twin and pair), and (to a lesser extent) by seiners. Haddock is a specific target for some fleets, but is also caught as part of a mixed fishery catching cod, whiting and *Nephrops*. The minimum permitted mesh size for targeted fisheries was increased to 120 mm in 2002. Estimates of haddock bycatch in the industrial fishery are low based on the assumption that bycatch rates remain as observed in recent years, when the industrial fisheries were at a low level.

Catch by fleet	Total catch (2010) 39.6 kt where 73% landings (proportions 2009: 80% demersal trawl and seine >100mm, 10% *Nephrops* trawl 70-99 mm, 10% others), 26% discards, 1% industrial by-catch.

Effects of the fisheries on the ecosystem

Trawling impacts the benthos, as summarised in the North Sea ecosystem overview. Trawl gear are also relatively non-selective in terms of species caught, and trawl fisheries have a bycatch of non-commercial species that are important components of the North Sea ecosystem.

Quality considerations

The assessment and forecast are largely influenced by the 2005 and 2009 year classes.

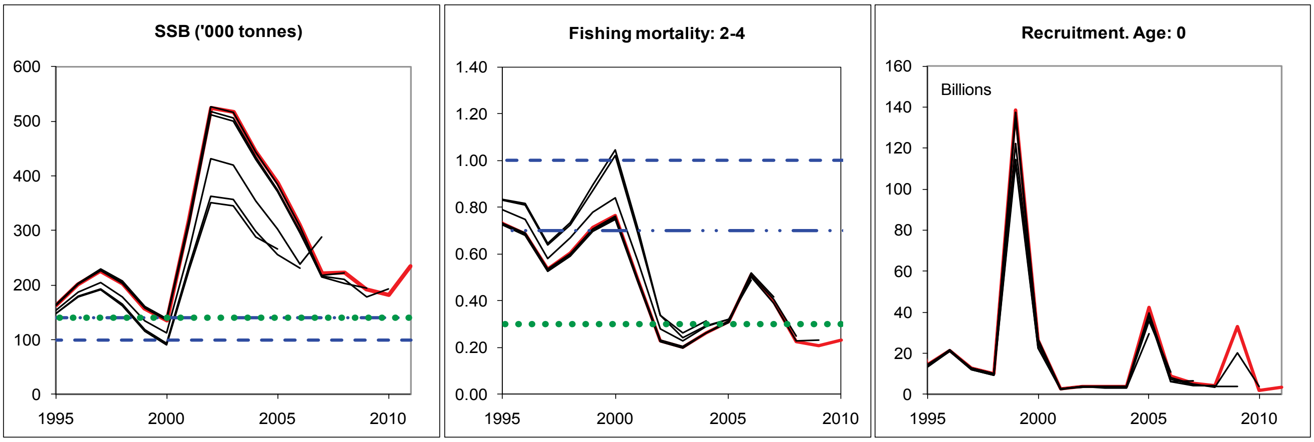


Figure 6.4.3.2 Haddock in Subarea IV (North Sea) and IIIa West (Skagerrak). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age based analytical assessment (XSA)
Input data	3 survey indices: IBTS Q1, ScoGFS Q3, EngGFS Q3.
Discards and bycatch	Discards and industrial bycatch are included in the assessment (since 1963)
Indicators	None
Other information	Benchmark was conducted in early 2011 (WKBENCH 2011).
Working group report	WGNSSK

ECOREGION North Sea

STOCK Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	F_{MP}	0.3	
	SSB_{MP}	100 000 t	Trigger value B_{lim}
MSY Approach	MSY $B_{trigger}$	140 000 t	Default to value of B_{pa}
	F_{MSY}	0.3	Provisional proxy is the management target F_{mgt}, within the range of Fishing mortalities consistent with F_{MSY} (0.25 – 0.48)
Precautionary Approach	B_{lim}	100 000 t	Smoothed B_{loss}.
	B_{pa}	140 000 t	B_{pa} = 1.4 * B_{lim}.
	F_{lim}	1.0	F_{lim}= 1.4 * F_{pa}.
	F_{pa}	0.7	10% probability that SSBMT < B_{pa}.

(unchanged since: 2011)

Yield and spawning biomass per Recruit F-reference points (2011)

	Fish Mort Ages 2-4	Yield/R	SSB/R
Average last 3 years	0.22	0.0031	0.0262
F_{max}	0.43	0.0034	0.0141
$F_{0.1}$	0.26	0.0032	0.0227
F_{med}	0.53	0.0034	0.0111

Outlook for 2012

Basis: F(2011) = status quo F = 0.233; SSB (2012) = 256; HC landings (2011) = 32; Discards (2011) = 21; Industrial bycatch (2011) = 1; Recruitment (2011) = trimmed GM = 3663 millions.

Rationale	Human consumption (2012)	Basis	F (2012)	F HC (2012)	F Disc (2012)	F ind. Bycatch (2012)	Discards (2012)	Ind. Bycatch (2012)	Catch (2012)	SSB (2013)	%SSB change[1)]	%TAC change[2)]
Management plan	41 575	Management plan	0.287	0.181	0.105	0.001	14	0	55	230	-10%	+15%
MSY framework	43	F_{MSY}	0.300	0.189	0.110	0.001	14	0	58	227	-11%	+20%
Precautionary approach	86	F_{pa}	0.700	0.441	0.257	0.001	28	0	114	170	-34%	+137%
Zero catch	0	0	0.001	0.000	0.000	0.001	0	0	0	287	+12%	-100%
	18	0.5 * F_{2010}	0.117	0.073	0.043	0.001	6	0	24	262	+2%	-50%
	26	0.75 * F_{2010}	0.175	0.110	0.064	0.001	9	0	35	250	-2%	-27%
	31	0.87 * F_{2010} 15% TAC decrease	0.205	0.129	0.075	0.001	10	0	41	244	-5%	-15%
	31	0.9 * F_{2010}	0.210	0.132	0.077	0.001	10	0	42	244	-5%	-13%
Status quo	34	F_{2010}	0.233	0.146	0.085	0.001	11	0	46	239	-7%	-5%
	36	1.06 * F_{2010} Roll-over TAC	0.246	0.154	0.090	0.001	12	0	48	237	-7%	0%
	42	1.23 * F_{2010} 15% TAC increase	0.287	0.181	0.105	0.001	14	0	55	230	-10%	15%
	42	1.25 * F_{2010}	0.291	0.184	0.107	0.001	14	0	56	229	-11%	17%

Weighs in ‘000 tonnes.
Under the assumption that effort is linearly related to fishing mortality
[1)] SSB 2013 relative to SSB 2012.
[2)] Human Consumption 2012 relative to TAC 2011

The landings in Division IIIa are calculated as 6% of the combined area total. The figure 6% has been used as the basis of the TAC split for the past 3 years.

Management plan

In 2008 the EU and Norway agreed a revised management plan for this stock, which states that every effort will be made to maintain a minimum level of SSB greater than 100 000 t (B_{lim}). Furthermore, fishing was restricted on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups, along with a limitation on interannual TAC variability of ±15%. Following a minor revision in 2008, interannual quota flexibility ("banking and borrowing") of up to ±10% is permitted (although this facility has not yet been used). The stipulations of the management plan have been adhered to by the EU and Norway since its implementation in January 2007.

Following the management plan implies a TAC of 41 575 t in 2012 which is expected to lead to a TAC increase of 15% and an F increase of 23%.

MSY approach

Following the ICES MSY framework implies fishing mortality to be increased to 0.3, resulting in human consumption landings of less than 43 000 t in 2012. This would be expected to lead to an SSB of 227 000 t in 2013.

PA approach

The fishing mortality in 2011 should be no more than F_{pa} corresponding to human consumption landings of less than 86 000 t in 2011. This is expected to keep SSB above B_{pa} in 2013.

Additional considerations

Adherence to the EU–Norway management plan has contributed to lower fishing mortality levels, increased yield and greatly improved stability of yield.

Within an ecosystem context, species-specific assessments and the latest developments in mixed fisheries approaches need to be considered. A reduction in direct effort on one stock may lead to a reduction or an increase in effort on another and, hence, the implications of any changes need to be identified and carefully evaluated.

Management plan evaluations

The evaluations of the management plan that were carried out during 2007 and 2008 used a recruitment model which is thought to capture the sporadic nature of haddock recruitment. On this basis, a target F = 0.3 with TAC constraint ±15% leads to a low risk (<12% in any year) of $B < B_{lim}$ over the next 20 years, and a mean risk of 5% over all years. Lower Fs lead to lower risks. Interannual quota flexibility (banking and borrowing) has also been evaluated and it is concluded that this has no significant impact on sustainability.

ICES concludes that the management plan can be accepted as precautionary and can be used as the basis for advice.

Regulation and their effects

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management program switched from a days at sea to a kW*day system (2009 Council Regulation (EC) N°43/2009), in which different amounts of kWdays are allocated within each area by Member State to different groups of vessels depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed annual monitoring of effort trends since 2004. Overall effort (kWdays) by demersal trawls, seines, beam trawls and gillnets in the North Sea, Skagerrak and Eastern Channel had been substantially reduced (-30% between 2003 and 2009, STECF, 2011). Following the introduction of days at sea regulations in 2003, there was a substantial switch from the larger mesh (>100mm, TR1) gear to the smaller mesh (70-99, TR2) gear. Subsequently, effort by TR1 has been relatively stable, whereas effort in TR2 and beam trawl (80-120 mm, BT2) has shown a continuous decline (-23% and -38% respectively between 2003 and 2009).

Scotland implemented in February 2008 a national scheme known as the 'Conservation Credits Scheme'. The principle of this scheme involves additional time at sea in return for the adoption of measures (real time closures and technical measures) which aim to reduce mortality on cod and lead to a reduction in discard numbers. In 2010 there were 165 closures, and from July 2010 the area of each closure increased (from 50 square nautical miles to 225 square nautical miles). The effects of this regulation on the behaviour of the fleet and on the haddock stock are still under investigation.

Changes in fishing technology and fishing patterns

The change in mesh size (to 120 mm in 2002) might have been expected to shift exploitation patterns to older ages and increase the weight-at-age for retained fish from younger age classes. While reduced exploitation on more abundant cohorts can be seen, overall improvements in the exploitation pattern have not been observed. It was not possible to determine if this is due to confounding effects from other fleet segments. The effort in the UK large-mesh demersal trawl fleet category (>100 mm, 4A) has been reduced by decommissioning and days-at-sea regulations to 40% of the levels recorded in the EU reference year of 2001. There was a movement of effort into the 70–90 mm sector to increase days-at-sea in 2002 and 2003, but the level of effort in this sector stabilized in 2004.

There were a number of specific changes with the Scottish fleet in 2009. Many vessels were spending more time (in some cases, the first four months of the year) in Division VIa and Rockall in order to save their more limited North Sea days allocation. Reduced numbers of larger haddock around Shetland led to some vessels fishing off north-east Scotland instead at certain times. Some vessels found that reduced haddock quotas combined with increased costs of leasing have diminished their ability to predominately fish haddock. Reduced whiting quota led other vessels to focus more specifically on haddock.

The expansion of the Closed Circuit TV (CCTV)/ fully documented fisheries programmes in 2010 (and subsequently in 2011) in Scotland, Denmark and England may have affected haddock mortality – vessels carrying CCTV systems are not permitted to discard cod, and may preferentially target haddock to prevent exhausting cod quota and having to tie up.

Information from the fishing industry

The 2011 report of the North Sea Stock Survey (Napier, 2011) shows that the industry perception is of increasing haddock abundance in all areas of the North Sea in 2010. This survey is in line with scientific surveys except for the southern North Sea where research-vessel survey data do not show an increase.

Effect of the environment on the stock

Baudron et al (2011) has suggested that haddock growth may be linked to temperature. Warmer waters lead to faster growth in early life stages, but also faster maturation and hence a lower maximum size. Other ongoing work (unpublished, Marine Scotland) has indicated that haddock recruitment is only weakly linked to spawning-stock biomass, being more obviously determined by that area of available suitable substrate at settlement time.

Revisions in data and methodologies

The approach used to collate discard data has changed to conform with the EU Data Collection Framework (DCF), beginning with the 2009 data year. Direct comparisons with the previous method are not available, but analysis shows that the 2009 estimates are well within the range of recent variation. This suggests that the new collation method has not changed the perception of discard rates for haddock.

Uncertainties in assessment and forecast

The principal change in forecast methodology in 2011 is the use of linear cohort-based models to forecast future weights-at-age, following the analysis of Jaworski (2011). Methods are otherwise unchanged.

Comparison with previous assessment and advice

The basis of the assessment and advice is the same as last year, apart from the change to forecast growth models mentioned above. The assessment is sensitive to the estimation of a few large cohorts, so the variability in estimates among assessment years is to be expected. There are no indications of assessment bias.

Last year's advice was based on MSY considerations and the agreed management plan. The basis for the advice this year is the agreed management plan.

Assessment and management area

The advice for this stock is given for Subarea IV (North Sea) and Division IIIaN (Skagerrak), while the TACs for this stock are set for Division IIa (EU waters) and Subarea IV, and the whole of Subarea III, respectively.

Sources

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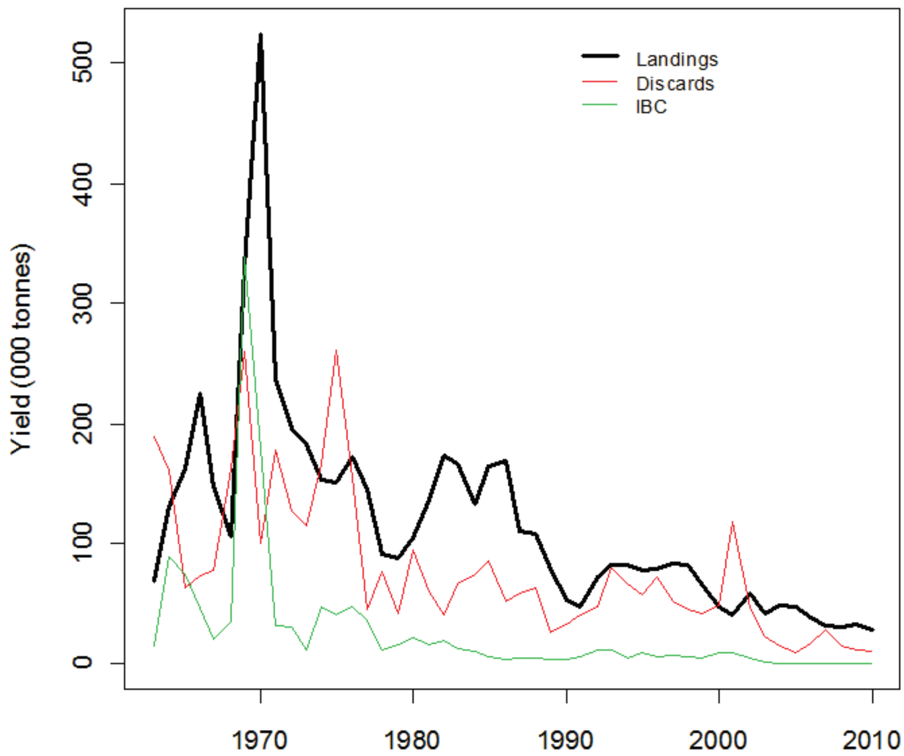

Figure 6.4.3.3 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Catches (in '000 t) subdivided by landings, discards and industrial bycatches (IBC).

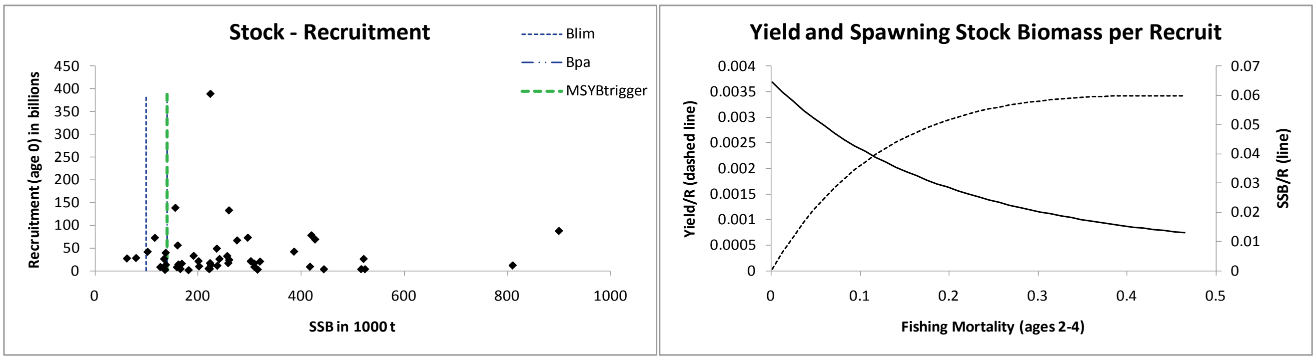

Figure 6.4.3.4 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Stock–recruitment (left) and yield per recruit plot (right).

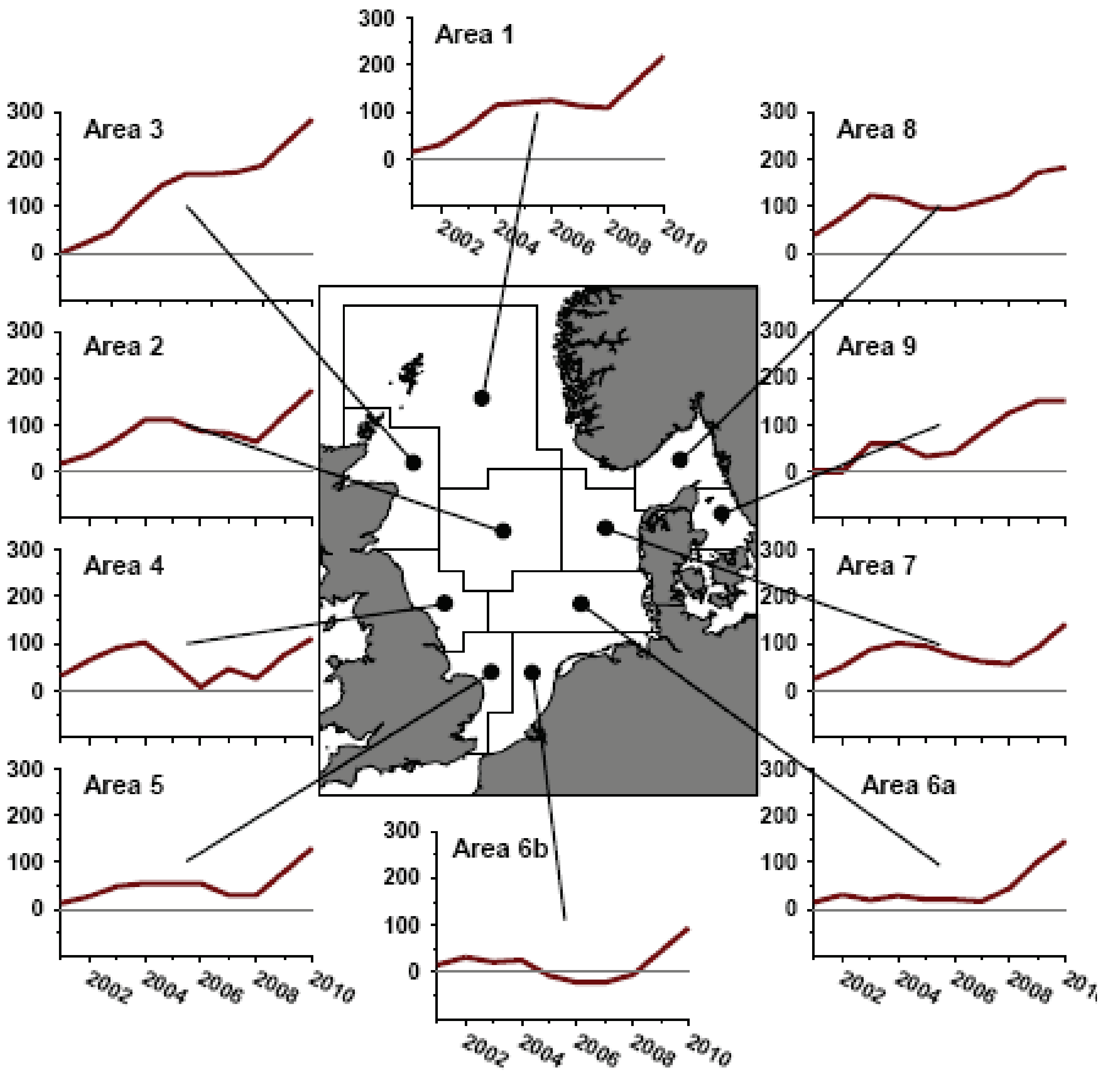

Figure 6.3.3.5 Haddock in Subarea IV and Division IIIa. Results of 2010 North Sea Stock Survey abundance index (Napier, 2011). Each plot presents a summary of the responses by North Sea roundfish reporting area.

Table 6.4.3.1 Haddock in **Subarea IV (North Sea)**. ICES advice, management and catch.

Year	ICES Advice	Predicted landings corresp. to advice[1]	Agreed TAC	Off. lndgs.	ICES catches Hum. Cons.	Disc Slip.	Indust. bycatch	Total
1987	80% of F(85)	105	140	109	108	59	4	172
1988	77% of F(86); TAC	185	185	105	105	62	4	171
1989	Reduce decline in SSB; TAC; protect juveniles	68	68	64	76	26	2	104
1990	80% of F(88); TAC	50	50	43	51	33	3	87
1991	70% of effort (89)		50	45	45	40	5	90
1992	70% of effort (89)		60	51	70	48	11	129
1993	70% of effort (89)		133	80	80	80	11	170
1994	Significant reduction in effort; mixed fishery		160	87	81	65	4	150
1995	Significant reduction in effort; mixed fishery		120	75	75	57	8	140
1996	Mixed fishery to be taken into account		120	75	76	73	5	154
1997	Mixed fishery to be taken into account		114	73	79	52	7	138
1998	No increase in F	100.3	115	72	77	45	5	128
1999	Reduction of 10% F(95–97)	72	88.6	64	64	43	4	111
2000	F less than F_{pa}	<51.7	73.0	47	45	47	8	100
2001	F less than F_{pa}	<58.0	61	40	39	118	8	165
2002	F less than F_{pa}	<94.0	104.0	54	53	45	4	101
2003	No cod catches	-	52	42	42	23	1	76
2004	Mixed fisheries consideration / F should be below F_{pa}	No forecast [3]	85	48	47	17	1	65
2005	Mixed fisheries consideration / F should be below F_{pa}	92 [3]	66	31	48	10	0	57
2006	Mixed fisheries consideration / F < 0.3	39 [3]	52	36	36	17	0	55
2007	Mixed fisheries consideration / F < 0.3	55.4 [3]	55	31	31	30	0	61
2008	Mixed fisheries consideration / 15% TAC reduction	49.3 [2-3]	46	30	29	13	0	42
2009	Mixed fisheries consideration / Apply management plan	44.7 [2-3]	42	31	31	10	0	41
2010	Mixed fisheries consideration / Apply management plan	38 [2-3]	36		28	10	0	38
2011	See scenarios	-	34					
2012	Apply management plan	41.575 [2-3]						

Weights in '000 t.

[1] Only pertaining to the North Sea.

[2] Including industrial bycatch.

[3] The exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits.

Table 6.4.3.2 Haddock in **Division IIIaW (Skagerrak)**. ICES advice, management and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	ICES Catches			
				Hum. Cons.	Disc Slip.	Indust. bycatch	Total
1987	Precautionary TAC	-	11.5	3.8		1.4	5.3
1988	Precautionary TAC	-	10.0	2.9		1.5	4.3
1989	Precautionary TAC	-	10.0	4.1		0.4	4.5
1990	Precautionary TAC	-	10.0	4.1		2.0	6.1
1991	Precautionary TAC	4.6	4.6	4.1		2.6	6.7
1992	TAC	4.6	4.6	4.4		4.6	9.0
1993	Precautionary TAC	-	4.6	2.0		2.4	4.4
1994	Precautionary TAC	-	10.0	1.8		2.2	4.0
1995	If required, precautionary TAC; link to North Sea	-	10.0	2.2		2.2	4.4
1996	If required, precautionary TAC; link to North Sea	-	10.0	3.1		2.9	6.1
1997	Combined advice with North Sea	-	7.0	3.4		0.6	4.0
1998	Combined advice with North Sea	4.7	7.0	3.8		0.3	4.0
1999	Combined advice with North Sea	3.4	5.4	1.4		0.3	1.7
2000	Combined advice with North Sea	<1.8	4.5	1.5		0.6	2.1
2001	Combined advice with North Sea	<2.0	4.0	1.9		0.2	2.1
2002	Combined advice with North Sea	<3.0	6.3	4.1		0.06	4.1
2003	Combined advice with North Sea	-	3.2	1.8	0.2	n/a	1.8
2004	Combined advice with North Sea / F should be below F_{pa}	No forecast	4.9	1.4	0.1	n/a	1.4
2005	Combined advice with North Sea / F should be below F_{pa}	-	4.0	0.8	0.2	0	0.8
2006	Combined advice with North Sea / F < 0.3	-	3.2	1.5	1.0	0	1.5
2007	Combined advice with North Sea / F < 0.3	-	3.4	1.6	0.8	0	2.5
2008	Combined advice with North Sea / 15% TAC reduction	2.9	2.9	1.4	0.6	0	2.0
2009	Combined advice with North Sea / Apply management plan	-	2.6	1.5	0.6	0	2.1
2010	Combined advice with North Sea / Apply management plan	-	2.2	1.3	0.6	0	1.9
2011	See scenarios	-	2.1				
2012	Apply management plan	-					

Weights in '000 t.
n/a = not available.

Table 6.4.3.3 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Landings and catches by country and area.

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Division IIIa										
Belgium	0	0	0	0	0	0	0	0		
Denmark	3791	1741	1116	615	1001	1054	1052	1263	19	
Germany	239	113	69	69	186	206	87	105	65	
Netherlands	0	6	1	0	0	0	0	0	1	
Norway	149	211	154	93	113	152	170	121	95	
Portugal	0	0	0	0	30	37	0	0		
Sweden	393	165	158	180	246	278	276	166	126	
UK -E+W+NI	0	0	0	0	0	0	0	0		
UK - Scot	0	0	0	0	0	0	0	0		
Official landings	4572	2236	1498	957	1576	1727	1585	1655		
WG landings	4137	1808	1443	764	1537	1515	1374	1515	1287	
WG discards		195	112	217	970	816	646	556	608	
WG total catch	4137	2003	1555	981	2507	2332	2020	2072	1896	
TAC	6300	3150	4940	4018	3189	3360	2856	2590	2201	2095
Subarea IV										
Belgium	559	374	373	190	105	179	113	108	78	
Denmark	5123	3035	2075	1274	759	645	501	553	725	
Faeroe Islands	25	12	22	22	4	0	3	32	5	
France	914	1108	552	439	444	498	448	125	271	
Germany	852	1562	1241	733	725	727	393	657	634	
Netherlands	359	187	104	64	33	55	29	24	41	
Norway	2404	2196	2258	2089	1798	1706	1482	1278	1114	
Poland	17	16	0	0	8	8	16	0	0	
Portugal	0	0	0	0	76	0	0	0		
Sweden	572	477	188	135	100	130	83	141	89	
UK - E+W+NI	3647	1561	1159	651	485	1799	1378	2155		
UK – Scot	39624	31527	39339	25319	31905	24919	25987	26238		
UK – all									24980	
Official landings	54096	42055	47311	30916	36442	30666	30433	31311		
WG landings	54171	40140	47253	47616	36074	29418	28893	31264	27770	
WG discards	45892	23499	15439	8416	16943	27805	12532	9986	9515	
WG IBC	3717	1150	554	168	535	48	199	52	431	
WG total catch	103780	64788	63246	56200	53551	57271	41624	41302	37717	
TAC	104000	51735	77000	66000	51850	54640	46444	42110	35794	34057
Total IIIa & IV										
WG landings	58308	41948	48697	48380	37611	30934	30267	32779	29058	
WG discards	45892	23694	15550	8633	17913	28621	13178	10543	10124	
WG IBC	3717	1150	554	168	535	48	199	52	431	
WG total catch	107917	66792	64800	57181	56058	59603	43644	43374	39612	
TAC	110300	54885	81940	70018	55039	58000	49300	44700	37995	36152
WG quota uptake	53%	76%	59%	69%	68%	53%	61%	73%	76%	

Table 6.4.3.4 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Summary of stock assessment.

	Recruitment	TSB	SSB	Catch	Landings	Discards	Bycatch	Yield/SSB	Mean F(2-4)
	Thousands	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes		
1963	2314960	3412683	137050	271851	68821	189330	13700	0.502	0.745
1964	9155375	1281817	417713	379915	131006	160309	88600	0.314	0.794
1965	26286881	1080997	521738	299343	162418	62325	74600	0.311	0.639
1966	68923158	1480495	427838	346349	226184	73465	46700	0.529	0.662
1967	388351133	5527447	224790	246664	147742	78222	20700	0.657	0.626
1968	17114813	6852013	259397	301821	105811	161810	34200	0.408	0.597
1969	12133861	2477679	810544	930043	331625	260065	338353	0.409	1.121
1970	87605720	2541768	900221	805776	524773	101274	179729	0.583	1.152
1971	78203289	2546401	420401	446824	237502	177776	31546	0.565	0.773
1972	21425991	2182179	302976	353084	195545	127954	29585	0.645	1.119
1973	72938535	4087838	297147	307594	181592	114735	11267	0.611	0.866
1974	132845377	4710721	260752	366992	153057	166429	47505	0.587	0.962
1975	11406566	2385147	238279	453205	151349	260370	41487	0.635	1.102
1976	16397329	1097473	309487	375305	172680	154462	48163	0.558	0.973
1977	26203002	1069043	242297	224516	145118	44376	35022	0.599	1.033
1978	39808657	1137542	138098	179375	91683	76789	10903	0.664	1.062
1979	72620594	1352096	117086	145019	87069	41710	16240	0.744	0.987
1980	15795472	1470716	169227	222127	105041	94614	22472	0.621	0.899
1981	32606103	996405	257248	213240	136132	60067	17041	0.529	0.659
1982	20488195	1091776	320939	233283	173335	40564	19383	0.54	0.659
1983	66943546	2253195	276470	244212	165337	65977	12898	0.598	0.884
1984	17180273	1690885	224030	218946	133568	75298	10080	0.596	0.873
1985	23917418	1188181	261091	255366	164119	85249	5998	0.629	0.872
1986	49002387	1941134	237140	223081	168236	52203	2643	0.709	1.203
1987	4154844	1097088	166839	173852	110299	59143	4410	0.661	1.024
1988	8337202	630204	159929	173124	106973	62148	4002	0.669	1.108
1989	8604153	623382	127707	106526	78439	25677	2410	0.614	0.952
1990	28334295	1581748	80676	88934	53780	32565	2589	0.667	1.114
1991	27456974	1551974	63074	93287	47715	40185	5386	0.756	0.888
1992	41943346	1363931	103105	131650	72790	47934	10927	0.706	0.98
1993	13122801	1018311	138475	172551	82176	79609	10766	0.593	0.896
1994	55983396	1485103	161327	151020	82074	65370	3576	0.509	0.83
1995	14292721	1170059	162662	142524	77458	57371	7695	0.476	0.733
1996	21442638	1058031	201674	156609	79148	72461	5000	0.392	0.688
1997	12752842	975541	225758	141347	82574	52089	6684	0.366	0.537
1998	9957388	791581	202849	131316	81054	45160	5101	0.4	0.604
1999	138417502	3673171	156880	112021	65588	42598	3835	0.418	0.714
2000	26490420	3556209	135081	104457	47553	48770	8134	0.352	0.765
2001	2843508	1236908	316340	166960	40856	118225	7879	0.129	0.492
2002	3727538	896641	524367	107923	58348	45857	3717	0.111	0.229
2003	3898976	781120	517010	66805	41964	23691	1150	0.081	0.201
2004	3716574	775860	444700	64839	48734	15551	554	0.11	0.263
2005	42319097	2836645	386936	57162	48357	8637	168	0.125	0.31
2006	9031849	1422690	310074	56056	37613	17908	535	0.121	0.511
2007	5287388	775740	221317	59643	30939	28657	48	0.14	0.398
2008	4293403	605339	223563	43640	30248	13193	199	0.135	0.227
2009	33107554	1950891	192276	43407	32807	10548	52	0.171	0.209
2010	1794179	633149	182559	39640	29054	10155	431	0.159	0.233
2011	3662978		235072						

Annex 6.4.3 EU and Norway Management plan

"The plan shall consist of the following elements:

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass greater than 100,000 tonnes (Blim).*
2. *For 2009 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.3 for appropriate age-groups, when the SSB in the end of the year in which the TAC is applied is estimated above 140,000 tonnes (Bpa).*
3. *Where the rule in paragraph 2 would lead to a TAC, which deviates by more than 15 % from the TAC of the preceding year, the Parties shall establish a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.*
4. *Where the SSB referred to in paragraph 2 is estimated to be below Bpa but above Blim the TAC shall not exceed a level which will result in a fishing mortality rate equal to 0.3-0.2*(Bpa-SSB)/(Bpa-Blim). This consideration overrides paragraph 3.*
5. *Where the SSB referred to in paragraph 2 is estimated to be below Blim the TAC shall be set at a level corresponding to a total fishing mortality rate of no more than 0.1. This consideration overrides paragraph 3.*
6. *In the event that ICES advises that changes are required to the precautionary reference points Bpa (140,000t) or Blim, (100,000t) the Parties shall meet to review paragraphs 1-5.*
7. *In order to reduce discarding and to increase the spawning stock biomass and the yield of haddock, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from inter alia ICES.*
8. *No later than 31 December 2010, the parties shall review the arrangements in paragraphs 1 to 7 in order to ensure that they are consistent with the objective of the plan. This review shall be conducted after obtaining inter alia advice from ICES concerning the performance of the plan in relation to its objective.*
9. *This arrangement enters into force on 1 January 2009."*

6.4.4 **Advice June 2011**

ECOREGION North Sea
STOCK Whiting in Division IIIa (Skagerrak – Kattegat)

Advice for 2012

ICES advises on the basis of precautionary considerations that catches should be reduced.

Stock status

F (Fishing Mortality)		
	2008 - 2010	
Qualitative evaluation	?	Insufficient information

SSB (Spawning Stock Biomass)		
	2008 - 2010	
Qualitative evaluation	?	Insufficient information

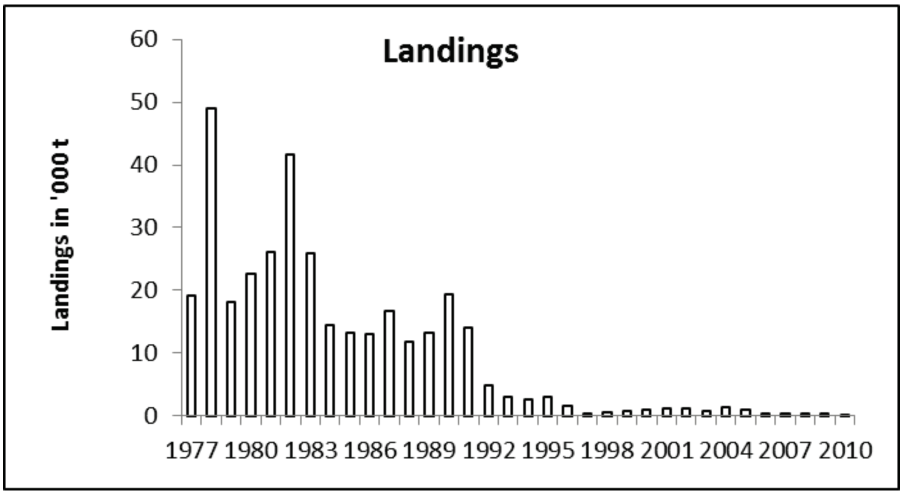

Figure 6.4.4.1 Whiting in Division IIIa (Skagerrak – Kattegat). Total landings (weights in '000 tonnes).

The available landing data provide insufficient information on the stock status.

Management plans

No specific management objectives are known to ICES.

The fisheries

The major part of the catch is taken as a bycatch in small-mesh fisheries, which seems to have reduced substantially in recent years. ICES estimates of discards are 291 tonnes.

Catch by fleet	Total catch (2010) 536 t comprising 15 % landings, discards* 54 %, 31 % industrial by-catch.

Scientific basis

Assessment type	No assessment is performed
Input data	Catch statistics
Discards and by-catch	Not included in the assessment*Discards estimates provided by Sweden
Indicators	None
Other information	Exploratory analysis were made (SURBAR)
Working group report	WGNSSK

6.4.4 Supporting information June 2011

ECOREGION North Sea
STOCK Whiting in Division IIIa (Skagerrak – Kattegat)

Reference points

No reference points have been defined for this stock.

Outlook for 2012

No reliable assessment can be presented for this stock. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information is insufficient to evaluate stock trends and exploitation status. Therefore, catches should be reduced.

Additional considerations

An exploratory assessment was performed but the results were highly uncertain and could not be used as a basis to characterise stock trends or exploitation.

Comparison with previous assessment and advice

No advice was given last year. This year, ICES gives advice for this stock based on precautionary considerations.

Sources

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4-10 May 2011 ICES CM 2011/ACOM:13.

Table 6.4.4.1 Whiting in Division IIIa (Skagerrak – Kattegat). ICES advice, management, and catch.

Year	ICES Advice / Single-Stock Exploitation Boundaries 2)	Predicted catch corresp. to advice	Agreed TAC	ICES landings1)	ICES catches1)
1987	Precautionary TAC	-	17.0	16.7	16.7
1988	Precautionary TAC	-	17.0	11.8	11.8
1989	Precautionary TAC	-	17.0	13.3	13.3
1990	Precautionary TAC	-	17.0	19.4	19.4
1991	TAC	-	17.0	14.0	14.0
1992	No advice	-	17.0	4.9	4.9
1993	Precautionary TAC	-	17.0	3.0	3.0
1994	If required, precautionary TAC	-	17.0	2.5	2.5
1995	If required, precautionary TAC	-	15.2	3.0	3.1
1996	If required, precautionary TAC	-	15.2	1.5	1.5
1997	If required, TAC equal to recent catches	-	15.2	0.4	0.4
1998	No advice		15.2	0.5	0.5
1999	TAC, average period 1993–1996	6.0	8.0	0.9	0.9
2000	TAC, average period 1996–1998	1.5	4.0	1.0	1.0
2001	TAC, average period 1996–1998	1.5	2.5	1.2	1.2
2002	TAC, average period 1996–1998	1.5	2.0	1.2	1.2
2003	TAC, average period 1996–1998	1.5	1.5	0.8	1.3
2004	TAC, average period 1996–1998	1.5	1.5	1.3	2.2
2005	average period 1996–1998 2)	1.5	1.5	1.0	1.3
2006	average period 1996–1998 2)	1.5	1.5	0.4	0.8
2007	average period 1996–1998 2)	1.5	1.5	0.4	1.0
2008	Recent average catches 2)	1.050	1.050	0.4	0.6
2009	Same advice as last year 2)	1.050	1.050	0.3	0.4
2010	Same advice as last year 2)	1.050	1.050	0.2	0.5
2011	No advice	-	1.050		
2012	Reduce catch	-			

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

Table 6.4.4.2 Whiting in Division IIIa (Skagerrak – Kattegat). Landings by country in tonnes and ICES estimates of discards.

Year	Denmark (1)			Norway	Sweden	Others	Total	WG estimate of Discards
1975	19,018			57	611	4	19,690	
1976	17,870			48	1,002	48	18,968	
1977	18,116			46	975	41	19,178	
1978	48,102			58	899	32	49,091	
1979	16,971			63	1,033	16	18,083	
1980	21,070			65	1,516	3	22,654	
	Total consumption	Total industrial	Total					
1981	1,027	23,915	24,942	70	1,054	7	26,073	
1982	1,183	39,758	40,941	40	670	13	41,664	
1983	1,311	23,505	24,816	48	1,061	8	25,933	
1984	1,036	12,102	13,138	51	1,168	60	14,417	
1985	557	11,967	12,524	45	654	2	13,225	
1986	484	11,979	12,463	64	477	1	13,005	
1987	443	15,880	16,323	29	262	43	16,657	
1988	391	10,872	11,263	42	435	24	11,764	
1989	917	11,662	12,579	29	675	-	13,283	
1990	1,016	17,829	18,845	49	456	73	19,423	
1991	871	12,463	13,334	56	527	97	14,041	
1992	555	3,340	3,895	66	959	1	4,921	
1993	261	1,987	2,248	42	756	1	3,047	
1994	174	1,900	2,074	21	440	1	2,536	
1995	85	2,549	2,634	24	431	1	3,090	
1996	55	1,235	1,290	21	182	-	1,493	
1997	38	264	302	18	94	-	414	
1998	35	354	389	16	81	-	486	
1999	37	695	732	15	111	-	858	
2000	59	777	836	17	138	1	992	
2001	61	970[1]	1,031[1]	27	126	+	1,184[1]	
2002	101	975[1]	1,076[1]	23	127	1	1,227[1]	
2003	93	654[1]	747[1]	20	71.9	2	840.9[1]	429
2004	93	1,120[1]	1,213[1]	17	74	1	1,305[1]	909
2005	49	907[1]	956[1]	13	73	0	1,042[1]	299
2006	59[1]	290[1]	349[1]	n/a	85.9[2]	n/a	434.9[2]	331
2007	53[2]	278[2]	331[2]	14	82	1	428[2]	561
2008	52[2]	288[2]	340[2]	14	52	n/a	406[2]	241
2009	71[2]	173[2]	244[2]	10.3	33.8[2]	-	288.1[2]	128
2010	41	165	206	9.7	29.7	-	245.4	291

[1] Values from 1992 updated by WGNSSK (2007).
[2] Values updated by WGNSSK (2011).

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

Advice for 2012

ICES advises on the basis of the EU–Norway interim management plan TAC of 24 300 t (human consumption for the combined area) in 2012.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	→	→	→	Stable
SSB (Spawning-Stock Biomass)	**2009**	**2010**	**2011**	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↗	↗	At recent average

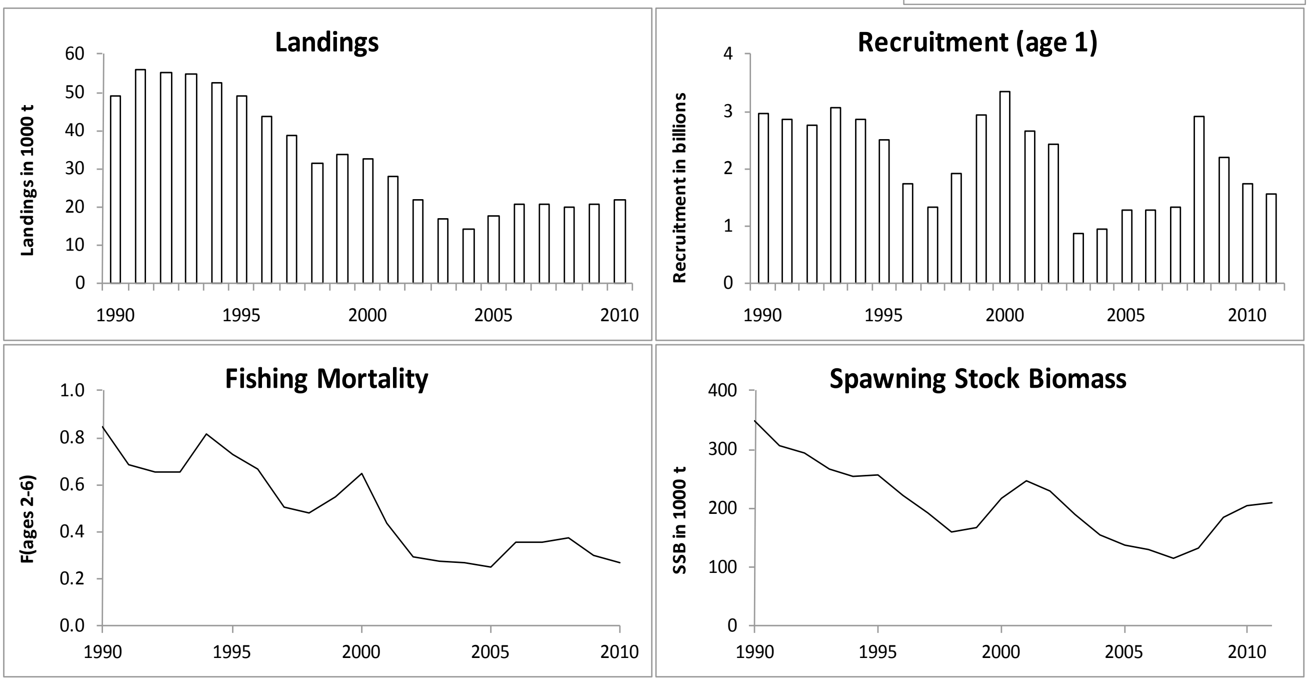

Figure 6.4.5.1 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Summary of stock assessment (weights in '000 tonnes), including intermediate year forecasts for 2011. Top right: SSB/F over the years.

SSB in 2010 is slightly higher than in 2009 and is around the long-term average. Fishing mortality has been stable since 2003. Recruitment has been very low between 2003 and 2007, with above-average recruitments estimated in 2008 and 2009. Whiting is no longer considered to be in a period of impaired recruitment.

Management plans

The EU and Norway have agreed to interim management of whiting (Annex 6.4.5) where the total fishing mortality is maintained at 0.3, conditional on a 15% TAC constraint. ICES considers this F target consistent with long-term stability if recruitment is not poor (ICES, 2010). ICES is in the process of developing and evaluating a management plan (ICES, 2011b).

Biology

Whiting are largely mature from age 2 so that at low stock sizes recruitment can heavily influence the SSB in the following year. The distribution of whiting is considered to have changed over the last decade. This may represent a contraction to a sub-stock structure coinciding with the main spawning areas in the North Sea.

The fisheries

Whiting are caught in mixed demersal roundfish fisheries, fisheries targeting flatfish, the *Nephrops* fisheries, and as bycatches in the industrial sandeel and Norway pout fisheries. Cod recovery measures since 2002 have influenced the fisheries effort and local distribution as well as the selectivity by increasing minimum mesh sizes and implementing selective gear. Industrial fisheries have reduced considerably since 1995 due to low TACs. The Human Consumption TAC for this stock has been restrictive since 2000.

Catch by fleet	Total catch (2010) = 31.6 kt, where 18.2 kt are landings (~70% demersal trawls North Sea, 20% demersal trawls Eastern Channel, and 10% beam trawls and static gear), 11.6 kt discards, and 1.8 kt industrial bycatch.

Quality considerations

The assessment is considered uncertain. Catch rates from local fleets may not represent trends in the overall North Sea and English Channel stock. The localized distribution of the population results in substantial differences in the quota uptake rate, likely to result in local discarding problems. Since 2007, the IBTS Q1 and Q3 surveys used in the assessment have been underestimating the numbers of young fish and thus, underestimating recruitment. Current advice depends to a large extent on recruitment assumptions in the forecast and the estimation of recent recruitment.

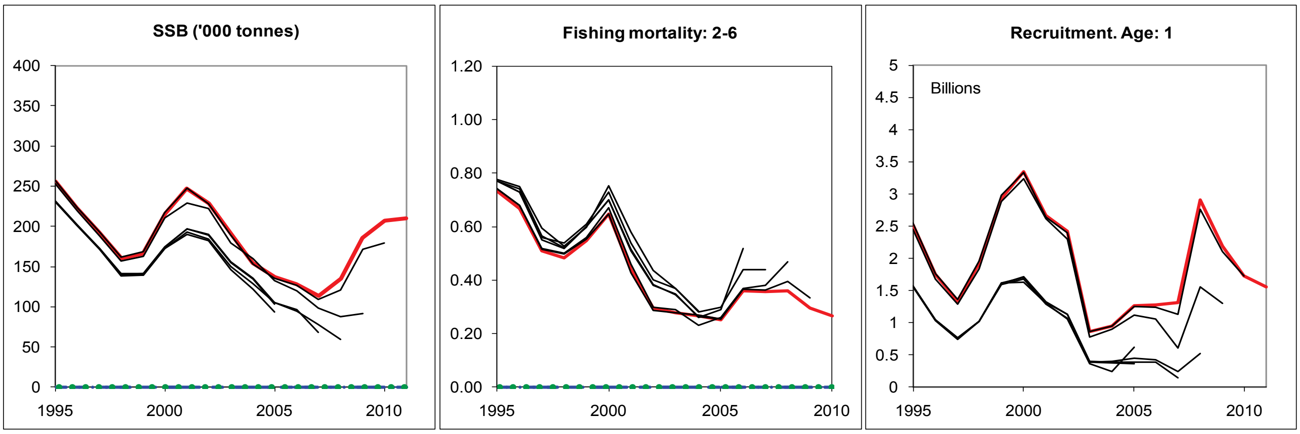

Figure 6.4.5.2 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Historical assessment results (final year recruitment estimates included). The change in assessments results since 2009 is caused by the use of increased values of natural mortality, particularly at age 1 (increased from 0.95 to 1.4–1.7 based on ICES, 2008).

Scientific basis

Assessment type	Age-based analytical (XSA).
Input data	Two survey indices (IBTS Q1 & Q3 ages 1 to 5).
Discards and by-catch	Included in the assessment for IV and VIId since 1990.
Indicators	None.
Other information	This assessment was benchmarked in 2009 (WKROUND).
Working group report	WGNSSK

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Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	Undefined.	
	F_{MP}	0.3	
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	Undefined.	
Precautionary approach	B_{lim}	Undefined.	
	B_{pa}	Undefined.	
	F_{lim}	Undefined.	
	F_{pa}	Undefined.	

Yield and spawning biomass per Recruit F-reference points (2011):

	Fish Mort Ages 2–6	Yield/R	SSB/R
Average last 3 years	0.32	0.01	0.10
F_{max}*	-	-	-
$F_{0.1}$**	-	-	-
F_{med}	0.33	0.01	0.10

[*] F_{max} is not well defined.
[**] $F_{0.1}$ is not well defined.

Outlook for 2012

Basis: F (2011) = Mean F pattern (2008–2010) scaled to F (2010) = 0.27; R(2011) = RCT3 = 1563 million; landings (2011) = 24.4; discards (2011) = 10.7; SSB (2011) = 205 SSB (2012) = 200.0.

Rationale	Total Human Cons Landings 2012	IV Human Cons Landings 2012	Total Catch 2012	Basis	F Total 2012	F HC 2012	F Disc 2012	F Ind 2012	Disc Catch 2012	Ind Catch 2012	SSB 2013	% SSB change [1)]	%TAC change [3)]
Management plan	24.3	19.4	35.7	TAC +15% F_{sq}*0.96	0.26	0.18	0.07	0.01	10.1	1.3	207	+ 4%	+ 15 %
No directed fishery	0.0	0.0	1.4	F = 0	0.01	0.00	0.00	0.01	0.0	1.4	238	+ 19%	-100 %
Stable SSB 2011	25.8	20.6	37.8	SSB 2011 = SSB 2013	0.28	0.19	0.08	0.01	10.7	1.3	205	*0 %* [2)]	+ 22 %
Status quo	6.9	5.5	11.1	F_{sq}*0.25	0.08	0.05	0.02	0.01	2.8	1.4	229	+ 15%	-68 %
	13.3	10.7	20.2	F_{sq}*0.5	0.14	0.09	0.04	0.01	5.5	1.4	221	+ 11%	-37 %
	18.0	13.3	26.8	TAC -15% F_{sq}*0.69	0.19	0.13	0.05	0.01	7.4	1.3	215	+ 8%	-15 %
	21.1	16.9	31.1	TAC_{sq} F_{sq}*0.82	0.23	0.15	0.06	0.01	8.7	1.3	211	+ 6%	0 %
	25.2	20.2	37.0	F_{sq}	0.27	0.19	0.07	0.01	10.4	1.3	206	+ 3%	+ 19 %
	27.4	21.9	40.1	F_{sq}*1.1	0.30	0.21	0.08	0.01	11.4	1.3	203	+ 2%	+ 29 %
	30.6	24.5	44.7	F_{sq}*1.25	0.34	0.23	0.09	0.01	12.8	1.3	199	-1%	+ 45 %
	35.8	28.6	52.0	F_{sq}*1.5	0.40	0.28	0.11	0.01	15.0	1.3	193	-4%	+ 69 %
	40.6	32.5	59.0	F_{sq}*1.75	0.47	0.33	0.13	0.01	17.1	1.2	187	-7%	+ 92 %
	45.2	36.1	65.6	F_{sq}*2	0.53	0.37	0.15	0.01	19.2	1.2	181	-10%	+113%

Weights in '000 tonnes.
[1)] SSB 2013 relative to SSB 2012.
[2)] SSB 2013 relative to SSB 2011.
[3)] Human consumption for Subarea IV in 2012 relative to TAC for Subarea IV and Division IIa in 2011 (14 800 t).

The total human consumption landings for the combined area (Subarea IV and Division VIId) are estimated to consist of 80% landings from Subarea IV and 20% landings from Division VIId, on the basis of the division in estimated landings for the past three years.

Management plan

The response to the Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) from ICES in September 2010 stated that "maintaining fishing mortality at its current level of 0.3 would be consistent with long-term stability if recruitment is not poor" (ICES, 2010). Consequently the EU and Norway have agreed to interim management of whiting at this level of total fishing mortality for 2011, conditional on a 15% TAC constraint. ICES are in the process of developing and evaluating the management plan (ICES,2011b).

Following the management plan for 2011 in 2012 as well implies a TAC of 24 300 in 2012, which corresponds to a 15% increase in TAC and an effort decrease of 4% in 2012. The implied TACs for Subarea IV and Division VIId would be 17 000 t and 7300 t.

MSY approach

There are no reference points to enable MSY advice.

PA considerations

There are no reference points to enable precautionary advice.

Additional considerations

In the absence of reference points ICES advice in 2009 and 2010 was based on the objective that SSB at the end of the TAC year should be equal to SSB at the start of the assessment year. This *ad hoc* rule was implemented considering the series of low recruitment in the recent years. However, for whiting a large part of SSB consists of age 2 fish, which means that the SSB estimate at the end of the TAC year is to a very large extent dependent on the last recruitment estimate and on the estimated recruitment for the current year. In addition, the most recent biomass estimate is highly uncertain and the retrospective pattern is large (ICES, 2011), which may potentially induce large variability in the advice from one year to another. Therefore, this SSB-based target would not normally be considered robust for precautionary considerations.

Between 2003 and 2007 the whiting stock produced the lowest recruitments in the series. Whiting recruitment estimated largely from the IBTS Q1 and IBTS Q3 surveys was underestimated substantially in 2007 and 2008.

Whiting abundance estimated from the IBTS Q1 and Q3 surveys show different trends in the northern and southern North Sea. Since 2005, the fitted trends suggest that the northern component is declining whereas the southern component is increasing or stable.

Whiting bycatch occurs in the industrial Norway pout and sandeel fisheries, which have recently declined. Industrial bycatches are considered low in the forecast. A larger catch allocation for bycatch may be required if industrial effort increases (see Norway pout advice, Section 6.4.20).

Bycatches of whiting occur in the industrial fisheries (included in the assessment) and in fisheries targeting flatfish and *Nephrops*. Based on ecosystem considerations, species-specific assessments and the latest developments in mixed fisheries approaches need to be considered. A reduction in direct effort on one stock may lead to a reduction or an increase in effort on another and, hence, the implications of any changes need to be identified and carefully evaluated.

Regulations and their effects

The minimum mesh size was increased to 120 mm in the northern area in 2002 and this may have contributed to the substantial decrease in landings. Landing compositions from the northern area, in 2006 to 2009, indicate improved survival of older ages. In addition, the total number of fish discarded appears to have been reduced since 2003, from around 60% in 2003 to around 47% in 2009. However, because of the restrictive TACs discard rates have increased in 2010 and are expected to be high again in 2011.

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management programme switched from a days-at-sea to a kW-day system (2009 Council Regulation (EC) N° 43/2009), in which different amounts of kW-days are allocated within each area by member state to different groups of vessels, depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed annual monitoring of effort trends since 2004. Overall effort (kW-days) by demersal trawls, seines, and beam trawls in the North Sea, Skagerrak, and Eastern Channel has been substantially reduced since 2002

(STECF, 2011). Following the introduction of days-at-sea regulations in 2003, there was a substantial switch from the larger mesh (>100 mm, TR1) gear to the smaller mesh (70–99, TR2) gear. Subsequently, effort by TR1 has been relatively stable, whereas effort in TR2 and beam trawl (80–120 mm, BT2) has shown a continuous decline (−23% in 70–99 mm trawl between 2003 and 2009).

Fishing mortality for whiting declined between 2003 and 2005 concomitant with this effort reduction, but F increased again between 2006 and 2008 despite a further nominal reduction in effort.

Data and methods

Discards were previously estimated based on data from Scotland, England, Denmark, and Germany and raised to the total international fleet in the North Sea. Since 2010, discard information for a major component of the catch from French fleets fishing in Subarea IV and Division VIId is incorporated into the assessment from 2003 onwards.

Discard age compositions are available from France for 2003 to 2007 and 2009 to 2010 for Division VIId. To include these data, discards from Division VIId were estimated for 1990 to 2002 and 2008 using an estimated ogive based on the 2003 to 2007 data. This resulted in a minor increase in the whole stock through a minor increase in recruitment estimates.

Uncertainties in the assessment

The distribution of whiting is considered to have changed over the last decade (Figure 6.4.5.5). This may represent a contraction to a sub-stock structure coinciding with the main spawning areas in the North Sea. Furthermore, whiting abundance estimated from the IBTS Q1 and Q3 surveys show different trends in the northern and southern North Sea. Since 2005, the fitted trends suggest that the northern component is declining whereas the southern component is increasing or stable.

The uncertainties introduced into the assessment through the raising procedure of discard data are unknown. Discards could consist of highgrading, over quota, and catches below minimum landing size. The sampling program may not sufficiently cover these components.

Age compositions are not available for the industrial bycatch component of the catch. A mean age composition is assumed for 2006 to 2009. This does not take into account the age structure in the population. A better option may be to use the age structure from groundfish surveys as was the approach from 1985 to 1990.

There are considerable discrepancies in stock trends prior to 1990 between the survey time-series and the assessment based on commercial catch data. Calibration data prior to 1990 were therefore omitted from the time-series.

Information from the fishing industry

The report of the North Sea Fishers' Survey (Napier, 2011) shows that the industry's perception of increasing whiting abundance in the southern North Sea is broadly in line with evidence from the IBTS surveys. However, in the northern North Sea the perception of increasing whiting abundance is at odds with evidence from the IBTS surveys which show a general decline.

The UK industry has highlighted the continuing problem of the effect of the reduced TAC for whiting in specific areas of the North Sea where whiting abundance has been increasing, in contrast to the decline in other areas of the North Sea. Whiting has been attracting high market value in the last three years and the cost of whiting quota has increased substantially, resulting in higher discarding in some areas of high abundance due to the unavailability of affordable quota. This observation is consistent with the ICES advice that the localized distribution of the population is known to be resulting in substantial differences in the quota uptake rate.

Comparison with previous assessment and catch options

Whiting is no longer considered to be in a period of impaired recruitment based on evidence from the IBTS surveys. The estimation of recruitment in the forecast is now based on the entire series rather than the five lowest recruitments.

Compared to last year's forecast, SSB in 2010 has been revised upward by 16% and F in 2009 downward by 18%. Last year's advice was based on preventing a decline in SSB. This year´s advice is based on the same assumption in lieu of other reference points.

Last year, the advice was based on precautionary considerations, this year's advice is based on the EU–Norway interim management plan.

Differences between assessment area and management area

Advice is given for Subarea IV and Division VIId combined. However, TACs are set for Subarea IV and Divisions VIIb–k separately and there is no way of controlling how much of the Divisions VIIb–k TAC is taken from Division VIId. There should be explicit management advice for Division VIId. As a first step there should be a specific TAC for Division VIId and advice would be given as part of a standard forecast for the stock. This would follow the same process as for Division VIId for cod since 2009.

Sources

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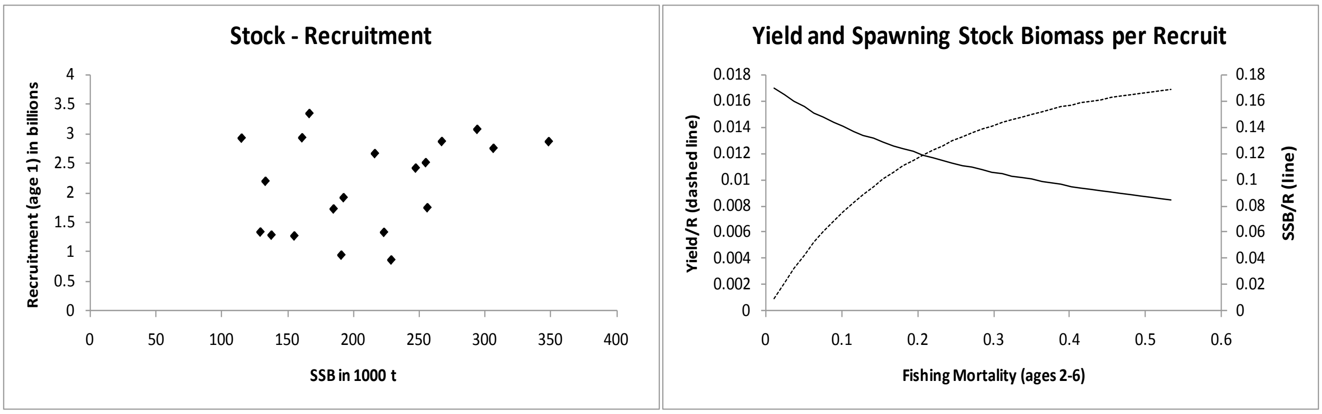

Figure 6.4.5.3 Whiting in Subarea IV and Division VIId. Stock–recruitment and yield-per-recruit plot.

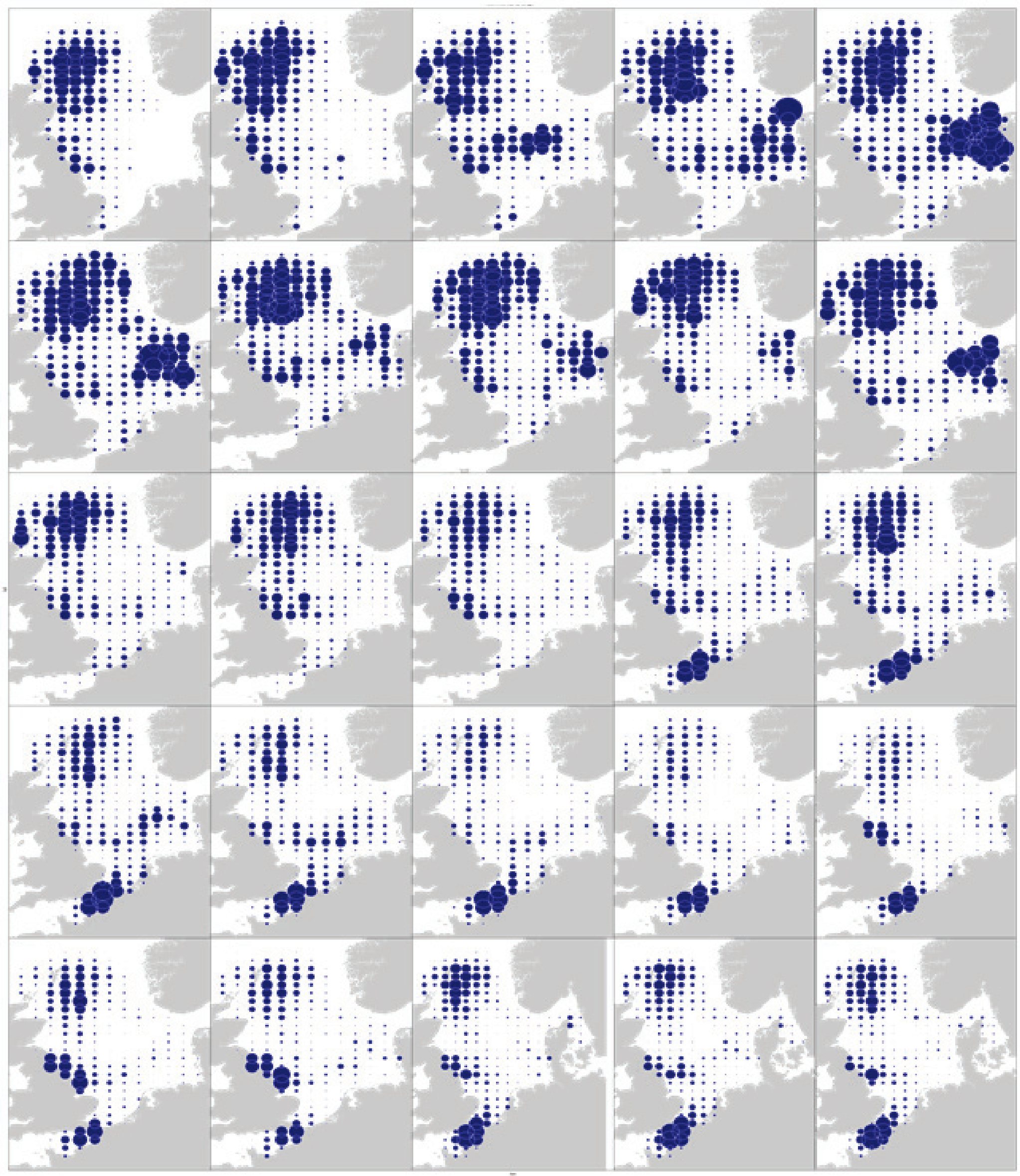

Figure 6.4.5.4 Whiting in Subarea IV and Division VIId. Commercial landings (human consumption and industrial fisheries in tonnes) by ICES statistical rectangle over the years 1986 to 2010. The same scaling is used in each map. Danish industrial bycatch data was available from 1988. French human consumption landings were available from 1999.

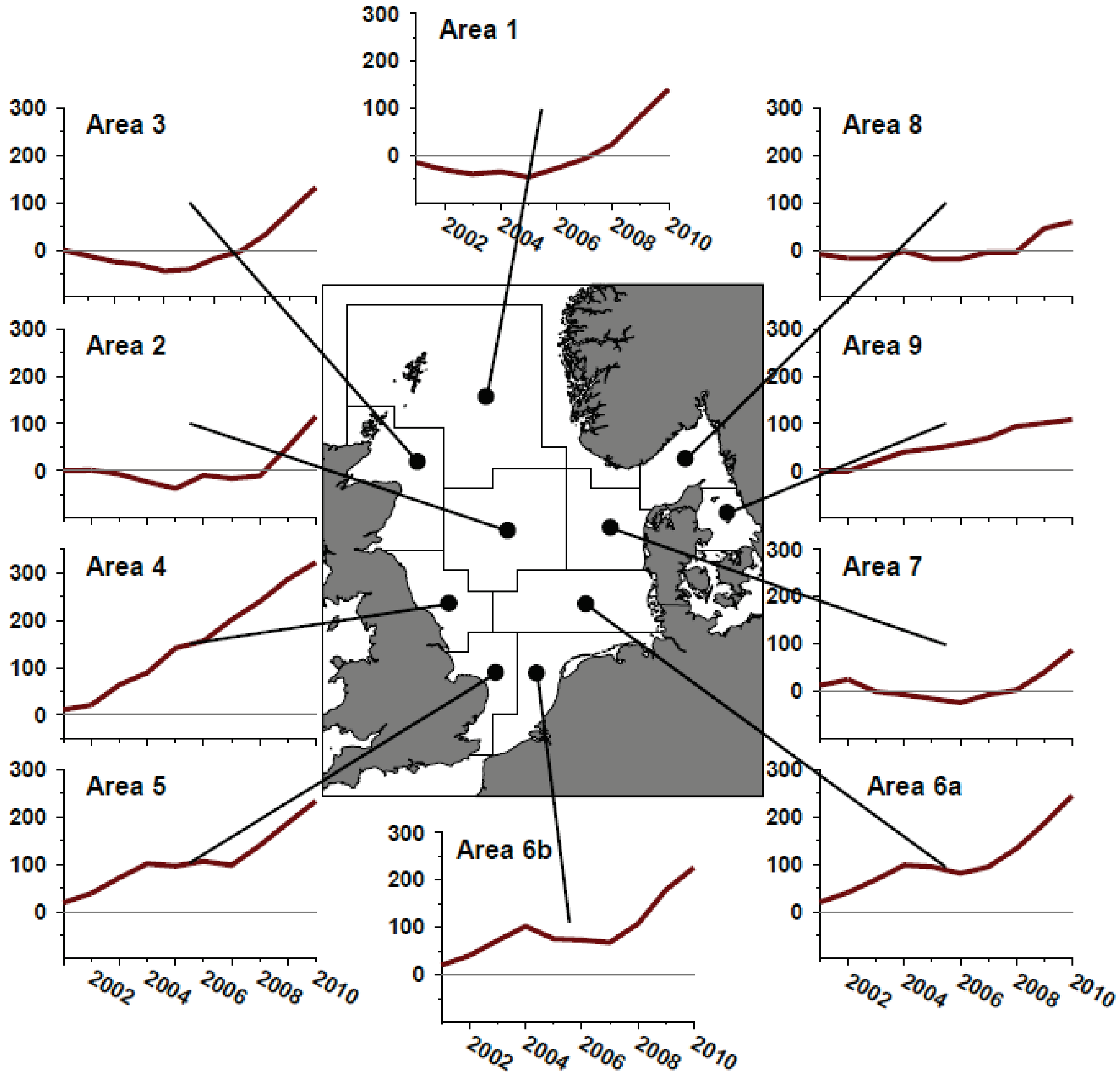

Figure 6.4.5.5 Whiting in Subarea IV and Division VIId. Results of the North Sea Commission fisher's survey 2010.

Table 6.4.5.1 Whiting in **Subarea IV (North Sea)**. ICES advice, management, and catch.

Year	ICES Advice	Predicted landings corresp. to advice*	Agreed TAC	Off. Lndgs.	ICES figures			
					Hum. Cons.	Indust. bycatch	Disc. slip.	Total catch
1989	Protect juveniles	-	115	40	41	43	36	120
1990	80% of F(88); TAC	130	125	41	43	51	56	150
1991	70% of effort (89)	-	141	47	47	38	34	119
1992	70% of effort (89)	-	135	47	46	27	31	104
1993	70% of effort (89)	-	120	47	48	20	43	111
1994	Significant reduction in effort; mixed fishery	-	100	42	43	10	33	86
1995	Significant reduction in effort; mixed fishery	-	81	41	41	27	30	98
1996	Mixed fishery; take into account cod advice	-	67	35	36	5	28	69
1997	Mixed fishery; take into account cod advice	-	74	32	31	6	17	54
1998	No increase from 1996 level	54	60	24	24	3	13	40
1999	at least 20% reduction of F(95–97)	40.4	44	25	26	5	22	52
2000	lowest possible catch	0	30	24	24	9	22	55
2001	60% reduction of F(97–99)	19.4	30	19	19	1	16	36
2002	F not larger than 0.37	≤33	32	16	15	7	17	39
2003	No cod catches	-	16	11	10	3	26	39
2004	No cod catches. Fishing mortality in 2004 should be < F_{pa}	No increase compared to recent years	16	9	9	1	18	28
2005	No cod catches. Less than recent avg	52	28.5	10	11	1	10	22
2006	No cod catches. Less than recent avg	< 17.3	23.8	15	15	2	14	31
2007	No cod catches. Less than recent avg	<15.1	23.8	16	16	1	5	22
2008	No cod catches. Less than recent avg	<15.1	17.9	13	13	1	8	23
2009	No cod catches. F < F_{max}	< 11	15.2	13	12	1	5	18
2010	No cod catches. Stable SSB	<6.8	12.9	12	12	2	8	22
2011	No cod catches. Stable SSB	<9.5	14.8					
2012	Management plan	<17						

Weights in '000 t.
*) including Division VIId from 2005 onwards.

Table 6.4.5.2 Whiting in **Division VIId (Eastern Channel)**. ICES advice, management, and catch/landings.

Year	ICES Advice	Predicted landings corresp. to advice*	Agreed TAC[1]	Official landings	ICES landings
1989	Precautionary TAC	-	-	n/a	4.2
1990	No increase in F; TAC	8.0[2]	-	n/a	3.5
1991	F_{sq}; TAC	5.1	-	n/a	5.7
1992	If required, precautionary TAC	6.0[2]	-	5.9	5.7
1993	No basis for advice	-	-	5.4	5.2
1994	No long-term gains in increasing F	-	-	7.1	6.6
1995	Significant reduction in effort; link to North	-	-	5.6	5.4
1996	Reference made to North Sea advice	-	-	5.1	5.0
1997	Reference made to North Sea advice	-	-	4.8	4.6
1998	Reference made to North Sea advice	5.8	27	4.8	4.6
1999	Reference made to North Sea advice	3.9	25	0.2	4.4
2000	Lowest possible catch	0	22	6.1	4.3
2001	60% reduction of F_{sq}	2.5	21	6.6	5.8
2002	F not larger than 0.37	<=4	31.7	5.4	5.8
2003	No cod catches	-	27	7.0	5.7
2004	No cod catches. Fishing mortality should be $<F_{pa}$	Catch should not increase compared	21.6	5.3	4.4
2005	No cod catches	-	19.9	4.9	4.8
2006	No cod catches. Less than recent average	< 17.3	19.9	3.7	3.4
2007	No cod catches. Less than recent average	<15.1	19.9	3.4	3.3
2008	No cod catches. Less than recent average	<15.1	19.9	3.2	4.5
2009	No cod catches. $F < F_{max}$	< 11	16.9	6.5	6.6
2010	No cod catches. Stable SSB	<6.8	14.4	6.1	6.0
2011	No cod catches. Stable SSB	<3.2	16.6		
2012	Management plan	<7.3			

Weights in '000 t.
[1] Included in TAC for Subarea VII (except Division VIIa).
[2] Including Division VIIe.
*) Includes both areas (Subarea IV and Division VIId).
n/a = Not available.

Table 6.4.5.3 Whiting in Subarea IV and Division VIId. Landings (in tonnes) by country and by area, and ICES estimates of catches.

Subarea IV

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	529	536	454	270	248	144	105	93	45	115	162	147
Denmark	58	105	105	96	89	62	57	251	78.5	42	80	158
France	0	2527	3455	3314	2675	1721	1261	2711	3312	3051	2304	2631
Germany	176	424	402	354	334	296	149	252	76	76	125	156
Netherlands	1795	1884	2478	2425	1442	977	805	702	618	656	718	615
Norway	68	33	44	47	38.5	23	16	17	11	92	73	118
Sweden	9	4	6	7	10	2	0	1	1	1	4	8
UK (E.&W)	2268	1782	1301	1322	680	1209	2560	3539	3048	1541	1397	
UK (Scotland)	17206	17158	10589	7756	5734	5057	3441	8093	9063	8850	7456	
UK (Total)												7841
Total	**22109**	**24453**	**18834**	**15591**	**11251**	**9491**	**8394**	**15659**	**16253**	**14424**	**12319**	**11674**
Unallocated landings	3591	-173	426	-721	-800.5	-541	2286	-562	-587	-945	-545	-607
WG estimate of H.Cons. landings	25700	24280	19260	14870	10450	8950	10680	15097	15666	13479	11774	12281
WG estimate of discards	22109	21931	16130	17144	26135	18142	10300	14018	5206	8356	5223	7853
WG estimate of Ind. By-catch	5040	9160	940	7270	2730	1210	890	2190	1240	1020	1350	1750
WG estimate of total catch	**52849**	**55371**	**36330**	**39284**	**39315**	**28302**	**21870**	**31305**	**22112**	**22855**	**18347**	**21884**

Division VIId

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	48	65	75	58	67	46	45	73	75	69	71	88
France		5875	6338	5172	6654	5006	4638	3487	3135	2875	6266	5436
Netherlands	6	14	67	19	175	132	128	117	118	162	112	270
UK (E.&W)	135	118	134	112	109	99	90	53	50	54	86	253
Total	**189**	**6072**	**6614**	**5361**	**7005**	**5283**	**4901**	**3730**	**3378**	**3160**	**6535**	**6074**
Unallocated	4241	-1772	-814	439	-1295	-933	-111	-287	-124	1311	111	765
W.G Estimate of H.Cons. landings	4430	4300	5800	5800	5710	4350	4790	3443	3254	4471	6646	5939
WG estimate of discards	3571	4129	3109	1356	604	907	2219	2291	1763	1943	2477	3727
W.G. estimate Catch	**8001**	**8429**	**8910**	**7156**	**6315**	**5258**	**7010**	**5735**	**5018**	**6415**	**9123**	**9666**

Table 6.4.5.4 Whiting in Subarea IV and Division VIId. Summary of stock assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2–6
1990	2971000	348629	48993	0.846
1991	2868000	306532	56154	0.685
1992	2755000	294136	55041	0.653
1993	3075000	267201	54794	0.657
1994	2870000	254974	52340	0.817
1995	2513000	256180	49182	0.732
1996	1751000	223116	43869	0.666
1997	1335000	192360	38558	0.508
1998	1921000	160789	31505	0.482
1999	2933000	166311	33701	0.548
2000	3343000	216173	32709	0.646
2001	2666000	247301	28170	0.437
2002	2421000	228661	22026	0.295
2003	868000	190625	16765	0.277
2004	950000	154820	14208	0.267
2005	1274000	137425	17690	0.252
2006	1288000	128993	20832	0.359
2007	1340000	114696	20684	0.354
2008	2927000	132864	19894	0.373
2009	2198000	184734	20897	0.300
2010	1730000	205826	21947	0.272
2011	1562674	205282		
Average	2161803	210047	33331	0.496

Annex 6.4.5 Interim management plan for whiting

From the EU–Norway agreement 2010:

The TAC for whiting for 2011 will be fixed by applying an interim management plan consisting of the following elements:

1. For 2011 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.3 for appropriate age-groups.
2. Where the rule in paragraph 1 would lead to a TAC, which deviates by more than 15 % from the TAC of the preceding year, the Parties shall establish a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.
3. During 2011, after obtaining advice from ICES, the Parties will refine the management plan, in particular to allow for a reduction in the target fishing mortality when recruitment to the stock has been low for a period of years.

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

Advice for 2012

ICES advises on the basis of the EU–Norway interim management plan TAC of 21 300 t (human consumption for the combined area) in 2012.

Stock status

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	→	→	→	Stable
SSB (Spawning-Stock Biomass)				
	2009	2010	2011	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↗	↗	At recent average

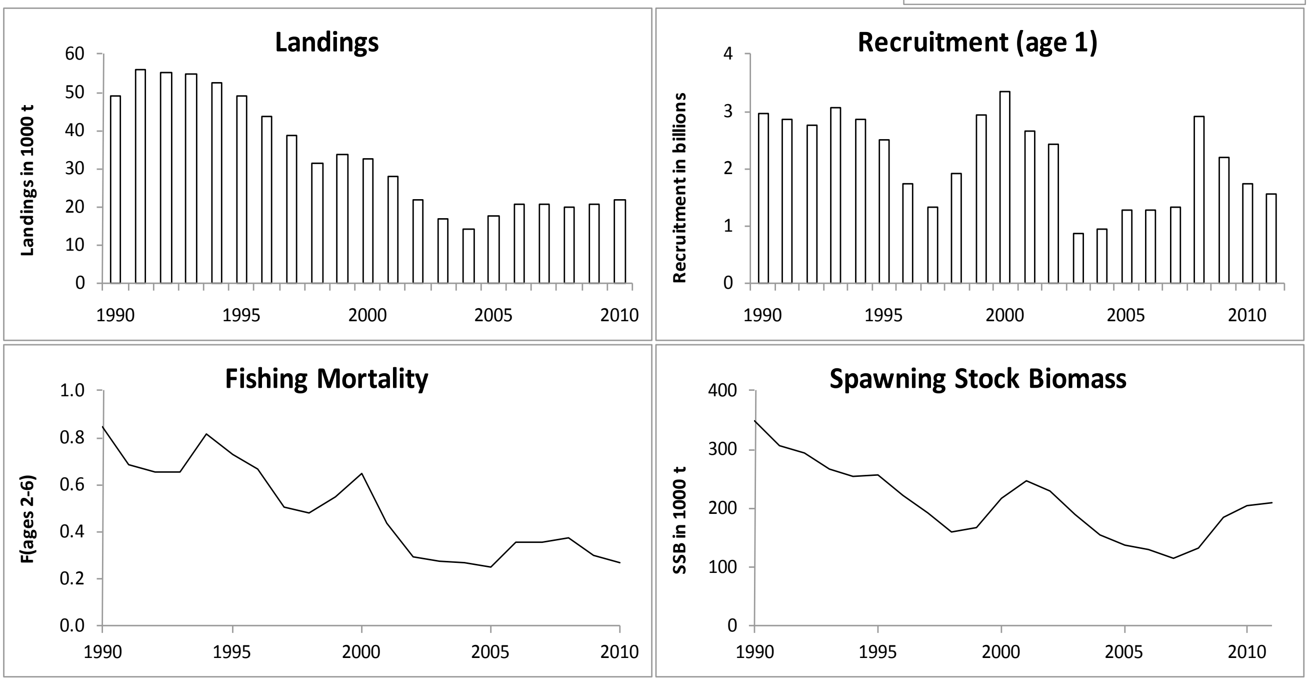

Figure 6.4.5.b.1 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Summary of stock assessment (weights in '000 tonnes), including intermediate year forecasts for 2011. Top right: SSB/F over the years.

SSB in 2010 is slightly higher than in 2009 and is around the long-term average. Fishing mortality has been stable since 2003. Recruitment has been very low between 2003 and 2007, with above-average recruitments estimated in 2008 and 2009. Whiting is no longer considered to be in a period of impaired recruitment.

Management plans

The EU and Norway have agreed to interim management of whiting (Annex 6.4.5) where the total fishing mortality is maintained at 0.3, conditional on a 15% TAC constraint. ICES considers this F target consistent with long-term stability if recruitment is not poor (ICES, 2010). ICES is in the process of developing and evaluating a management plan (ICES, 2011b).

Biology

Whiting are largely mature from age 2 so that at low stock sizes recruitment can heavily influence the SSB in the following year. The distribution of whiting is considered to have changed over the last decade. This may represent a contraction to a sub-stock structure coinciding with the main spawning areas in the North Sea.

The fisheries

Whiting are caught in mixed demersal roundfish fisheries, fisheries targeting flatfish, the *Nephrops* fisheries, and as bycatches in the industrial sandeel and Norway pout fisheries. Cod recovery measures since 2002 have influenced the fisheries effort and local distribution as well as the selectivity by increasing minimum mesh sizes and implementing selective gear. Industrial fisheries have reduced considerably since 1995 due to low TACs. The Human Consumption TAC for this stock has been restrictive since 2000.

Catch by fleet	Total catch (2010) = 31.6 kt, where 18.2 kt are landings (~70% demersal trawls North Sea, 20% demersal trawls Eastern Channel, and 10% beam trawls and static gear), 11.6 kt discards, and 1.8 kt industrial bycatch.

Quality considerations

The assessment is considered uncertain. Catch rates from local fleets may not represent trends in the overall North Sea and English Channel stock. The localized distribution of the population results in substantial differences in the quota uptake rate, likely to result in local discarding problems. Since 2007, the IBTS Q1 and Q3 surveys used in the assessment have been underestimating the numbers of young fish and thus, underestimating recruitment. Current advice depends to a large extent on recruitment assumptions in the forecast and the estimation of recent recruitment.

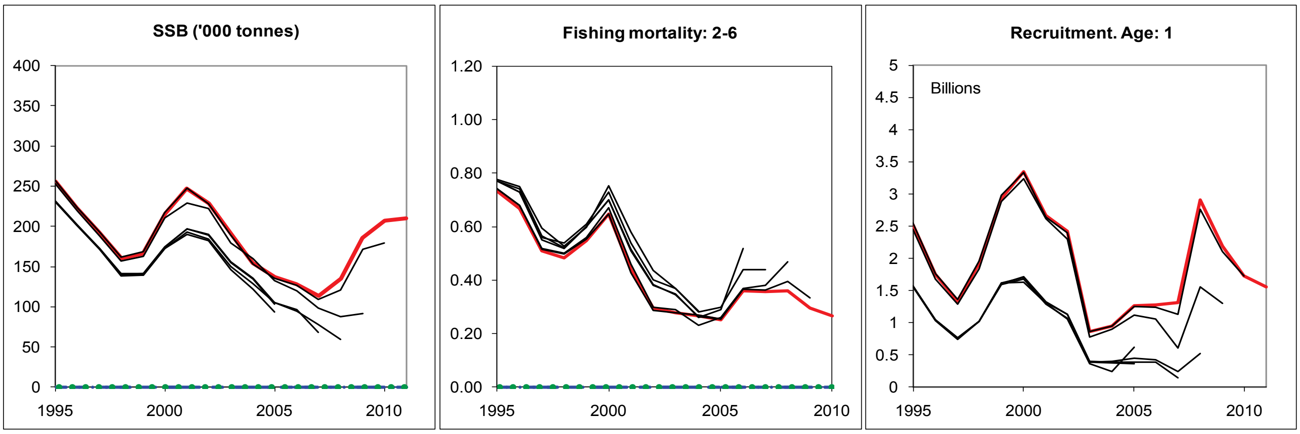

Figure 6.4.5.b.2 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Historical assessment results (final year recruitment estimates included). The change in assessments results since 2009 is caused by the use of increased values of natural mortality, particularly at age 1 (increased from 0.95 to 1.4–1.7 based on ICES, 2008).

Scientific basis

Assessment type	Age-based analytical (XSA).
Input data	Two survey indices (IBTS Q1 & Q3 ages 1 to 5).
Discards and by-catch	Included in the assessment for IV and VIId since 1990.
Indicators	None.
Other information	This assessment was benchmarked in 2009 (WKROUND). The forecast in the June advice was corrected in October.
Working group report	WGNSSK

ECOREGION North Sea

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

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	Undefined.	
	F_{MP}	0.3	
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	Undefined.	
Precautionary approach	B_{lim}	Undefined.	
	B_{pa}	Undefined.	
	F_{lim}	Undefined.	
	F_{pa}	Undefined.	

(unchanged since 2011)

Yield and spawning biomass per Recruit F-reference points (2011):

	Fish Mort Ages 2–6	Yield/R	SSB/R
Average last 3 years	0.32	0.01	0.10
F_{max}*	-	-	-
$F_{0.1}$**	-	-	-
F_{med}	0.33	0.01	0.10

[*] F_{max} is not well defined.
[**] $F_{0.1}$ is not well defined.

Outlook for 2012

Basis: F (2011) = Mean F pattern (2008–2010) scaled to F (2010) = 0.27; R(2011) = RCT3 = 1563 million; landings (2011) = 24.4; discards (2011) = 10.7; SSB (2011) = 205 SSB (2012) = 200.0.

Rationale	Total Human Cons Landings 2012	IV Human Cons Landings 2012	Total Catch 2012	Basis	F Total 2012	F HC 2012	F Disc 2012	F Ind 2012	Disc Catch 2012	Ind Catch 2012	SSB 2013	% SSB change [1]	%TAC change [3]
Management plan	21.3	17.1	31.5	TAC +15% F_{sq}*0.83	0.23	0.16	0.06	0.01	8.8	1.3	211	+ 5%	+ 15 %
No directed fishery	0.0	0.0	1.4	F = 0	0.01	0.00	0.00	0.01	0.0	1.4	238	+ 19%	-100 %
Stable SSB 2011	25.8	20.6	37.8	SSB 2011 = SSB 2013	0.28	0.19	0.08	0.01	10.7	1.3	205	*0 %* [2]	+ 39 %
Status quo	6.9	5.5	11.1	F_{sq}*0.25	0.08	0.05	0.02	0.01	2.8	1.4	229	+ 14%	-63 %
	13.3	10.7	20.2	F_{sq}*0.5	0.14	0.09	0.04	0.01	5.5	1.4	221	+ 10%	-28 %
	15.9	12.7	23.7	TAC -15% F_{sq}*0.6	0.17	0.11	0.05	0.01	6.5	1.4	218	+ 9%	-15 %
	18.5	14.8	27.5	TAC_{sq} F_{sq}*0.71	0.20	0.13	0.05	0.01	7.6	1.3	214	+ 7%	0 %
	25.2	20.2	37.0	F_{sq}	0.27	0.19	0.07	0.01	10.4	1.3	206	+ 3%	+ 36 %
	27.4	21.9	40.1	F_{sq}*1.1	0.30	0.21	0.08	0.01	11.4	1.3	203	+ 2%	+ 48 %
	30.6	24.5	44.7	F_{sq}*1.25	0.34	0.23	0.09	0.01	12.8	1.3	199	-1%	+ 65 %
	35.8	28.6	52.0	F_{sq}*1.5	0.40	0.28	0.11	0.01	15.0	1.3	193	-4%	+ 93 %
	40.6	32.5	59.0	F_{sq}*1.75	0.47	0.33	0.13	0.01	17.1	1.2	187	-7%	+ 119 %
	45.2	36.1	65.6	F_{sq}*2	0.53	0.37	0.15	0.01	19.2	1.2	181	-10%	+144 %

Weights in '000 tonnes.
[1] SSB 2013 relative to SSB 2012.
[2] SSB 2013 relative to SSB 2011.
[3] Human consumption for Subarea IV in 2012 relative to TAC for Subarea IV and Division IIa in 2011 (14 800 t).

The total human consumption landings for the combined area (Subarea IV and Division VIId) are estimated to consist of 80% landings from Subarea IV and 20% landings from Division VIId, on the basis of the division in estimated landings for the past three years.

Management plan

The response to the Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) from ICES in September 2010 stated that "maintaining fishing mortality at its current level of 0.3 would be consistent with long-term stability if recruitment is not poor" (ICES, 2010). Consequently the EU and Norway have agreed to interim management of whiting at this level of total fishing mortality for 2011, conditional on a 15% TAC constraint. ICES are in the process of developing and evaluating the management plan (ICES,2011b).

Following the management plan for 2011 in 2012 as well implies a TAC of 21 300 in 2012, which corresponds to a 15% increase in TAC and an effort decrease of 17% in 2012. The implied TACs for Subarea IV and Division VIId would be 17 100 t and 4200 t.

MSY approach

There are no reference points to enable MSY advice.

PA considerations

There are no reference points to enable precautionary advice.

Additional considerations

In the absence of reference points ICES advice in 2009 and 2010 was based on the objective that SSB at the end of the TAC year should be equal to SSB at the start of the assessment year. This *ad hoc* rule was implemented considering the series of low recruitment in the recent years. However, for whiting a large part of SSB consists of age 2 fish, which means that the SSB estimate at the end of the TAC year is to a very large extent dependent on the last recruitment estimate and on the estimated recruitment for the current year. In addition, the most recent biomass estimate is highly uncertain and the retrospective pattern is large (ICES, 2011), which may potentially induce large variability in the advice from one year to another. Therefore, this SSB-based target would not normally be considered robust for precautionary considerations.

Between 2003 and 2007 the whiting stock produced the lowest recruitments in the series. Whiting recruitment estimated largely from the IBTS Q1 and IBTS Q3 surveys was underestimated substantially in 2007 and 2008.

Whiting abundance estimated from the IBTS Q1 and Q3 surveys show different trends in the northern and southern North Sea. Since 2005, the fitted trends suggest that the northern component is declining whereas the southern component is increasing or stable.

Whiting bycatch occurs in the industrial Norway pout and sandeel fisheries, which have recently declined. Industrial bycatches are considered low in the forecast. A larger catch allocation for bycatch may be required if industrial effort increases (see Norway pout advice, Section 6.4.20).

Bycatches of whiting occur in the industrial fisheries (included in the assessment) and in fisheries targeting flatfish and *Nephrops*. Based on ecosystem considerations, species-specific assessments and the latest developments in mixed fisheries approaches need to be considered. A reduction in direct effort on one stock may lead to a reduction or an increase in effort on another and, hence, the implications of any changes need to be identified and carefully evaluated.

Regulations and their effects

The minimum mesh size was increased to 120 mm in the northern area in 2002 and this may have contributed to the substantial decrease in landings. Landing compositions from the northern area, in 2006 to 2009, indicate improved survival of older ages. In addition, the total number of fish discarded appears to have been reduced since 2003, from around 60% in 2003 to around 47% in 2009. However, because of the restrictive TACs discard rates have increased in 2010 and are expected to be high again in 2011.

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management programme switched from a days-at-sea to a kW-day system (2009

Council Regulation (EC) N° 43/2009), in which different amounts of kW-days are allocated within each area by member state to different groups of vessels, depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed annual monitoring of effort trends since 2004. Overall effort (kW-days) by demersal trawls, seines, and beam trawls in the North Sea, Skagerrak, and Eastern Channel has been substantially reduced since 2002 (STECF, 2011). Following the introduction of days-at-sea regulations in 2003, there was a substantial switch from the larger mesh (>100 mm, TR1) gear to the smaller mesh (70–99, TR2) gear. Subsequently, effort by TR1 has been relatively stable, whereas effort in TR2 and beam trawl (80–120 mm, BT2) has shown a continuous decline (−23% in 70–99 mm trawl between 2003 and 2009).

Fishing mortality for whiting declined between 2003 and 2005 concomitant with this effort reduction, but F increased again between 2006 and 2008 despite a further nominal reduction in effort.

Data and methods

Discards were previously estimated based on data from Scotland, England, Denmark, and Germany and raised to the total international fleet in the North Sea. Since 2010, discard information for a major component of the catch from French fleets fishing in Subarea IV and Division VIId is incorporated into the assessment from 2003 onwards.

Discard age compositions are available from France for 2003 to 2007 and 2009 to 2010 for Division VIId. To include these data, discards from Division VIId were estimated for 1990 to 2002 and 2008 using an estimated ogive based on the 2003 to 2007 data. This resulted in a minor increase in the whole stock through a minor increase in recruitment estimates.

Uncertainties in the assessment

The distribution of whiting is considered to have changed over the last decade (Figure 6.4.5.b.5). This may represent a contraction to a sub-stock structure coinciding with the main spawning areas in the North Sea. Furthermore, whiting abundance estimated from the IBTS Q1 and Q3 surveys show different trends in the northern and southern North Sea. Since 2005, the fitted trends suggest that the northern component is declining whereas the southern component is increasing or stable.

The uncertainties introduced into the assessment through the raising procedure of discard data are unknown. Discards could consist of highgrading, over quota, and catches below minimum landing size. The sampling program may not sufficiently cover these components.

Age compositions are not available for the industrial bycatch component of the catch. A mean age composition is assumed for 2006 to 2009. This does not take into account the age structure in the population. A better option may be to use the age structure from groundfish surveys as was the approach from 1985 to 1990.

There are considerable discrepancies in stock trends prior to 1990 between the survey time-series and the assessment based on commercial catch data. Calibration data prior to 1990 were therefore omitted from the time-series.

Information from the fishing industry

The report of the North Sea Fishers' Survey (Napier, 2011) shows that the industry's perception of increasing whiting abundance in the southern North Sea is broadly in line with evidence from the IBTS surveys. However, in the northern North Sea the perception of increasing whiting abundance is at odds with evidence from the IBTS surveys which show a general decline.

The UK industry has highlighted the continuing problem of the effect of the reduced TAC for whiting in specific areas of the North Sea where whiting abundance has been increasing, in contrast to the decline in other areas of the North Sea. Whiting has been attracting high market value in the last three years and the cost of whiting quota has increased substantially, resulting in higher discarding in some areas of high abundance due to the unavailability of affordable quota. This observation is consistent with the ICES advice that the localized distribution of the population is known to be resulting in substantial differences in the quota uptake rate.

Comparison with previous assessment and catch options

Whiting is no longer considered to be in a period of impaired recruitment based on evidence from the IBTS surveys. The estimation of recruitment in the forecast is now based on the entire series rather than the five lowest recruitments.

Compared to last year's forecast, SSB in 2010 has been revised upward by 16% and F in 2009 downward by 18%. Last year's advice was based on preventing a decline in SSB. This year´s advice is based on the same assumption in lieu of other reference points.

Last year, the advice was based on precautionary considerations, this year's advice is based on the EU–Norway interim management plan.

Differences between assessment area and management area

Advice is given for Subarea IV and Division VIId combined. However, TACs are set for Subarea IV and Divisions VIIb–k separately and there is no way of controlling how much of the Divisions VIIb–k TAC is taken from Division VIId. There should be explicit management advice for Division VIId. As a first step there should be a specific TAC for Division VIId and advice would be given as part of a standard forecast for the stock. This would follow the same process as for Division VIId for cod since 2009.

Sources

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ICES. 2010. Joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). *In* Report of the ICES Advisory Committee, 2010. ICES Advice, 2010. Book 6, Section 6.3.3.3.

ICES. 2011a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

ICES. 2011b. Joint EU–Norway request on a future long-term management plan of North Sea whiting. *In* Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.3.3.2.

Napier, I. R. 2011. Fishers' North Sea stock survey 2010. NAFC Marine Centre, Shetland, Scotland.

STECF. 2011. Report of the SGMOS-10-05 Working Group on Fishing Effort Regimes Regarding Annexes IIA, IIB and IIC of TAC & Quota Regulations, Celtic Sea and Bay of Biscay. 27 September–1 October 2010, Edinburgh Scotland.

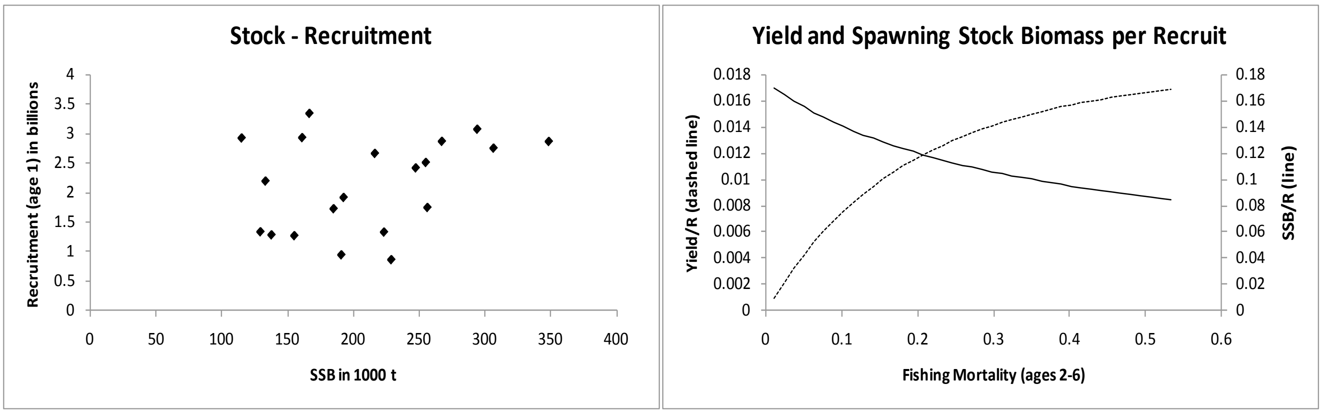


Figure 6.4.5.b.3 Whiting in Subarea IV and Division VIId. Stock–recruitment and yield-per-recruit plot.

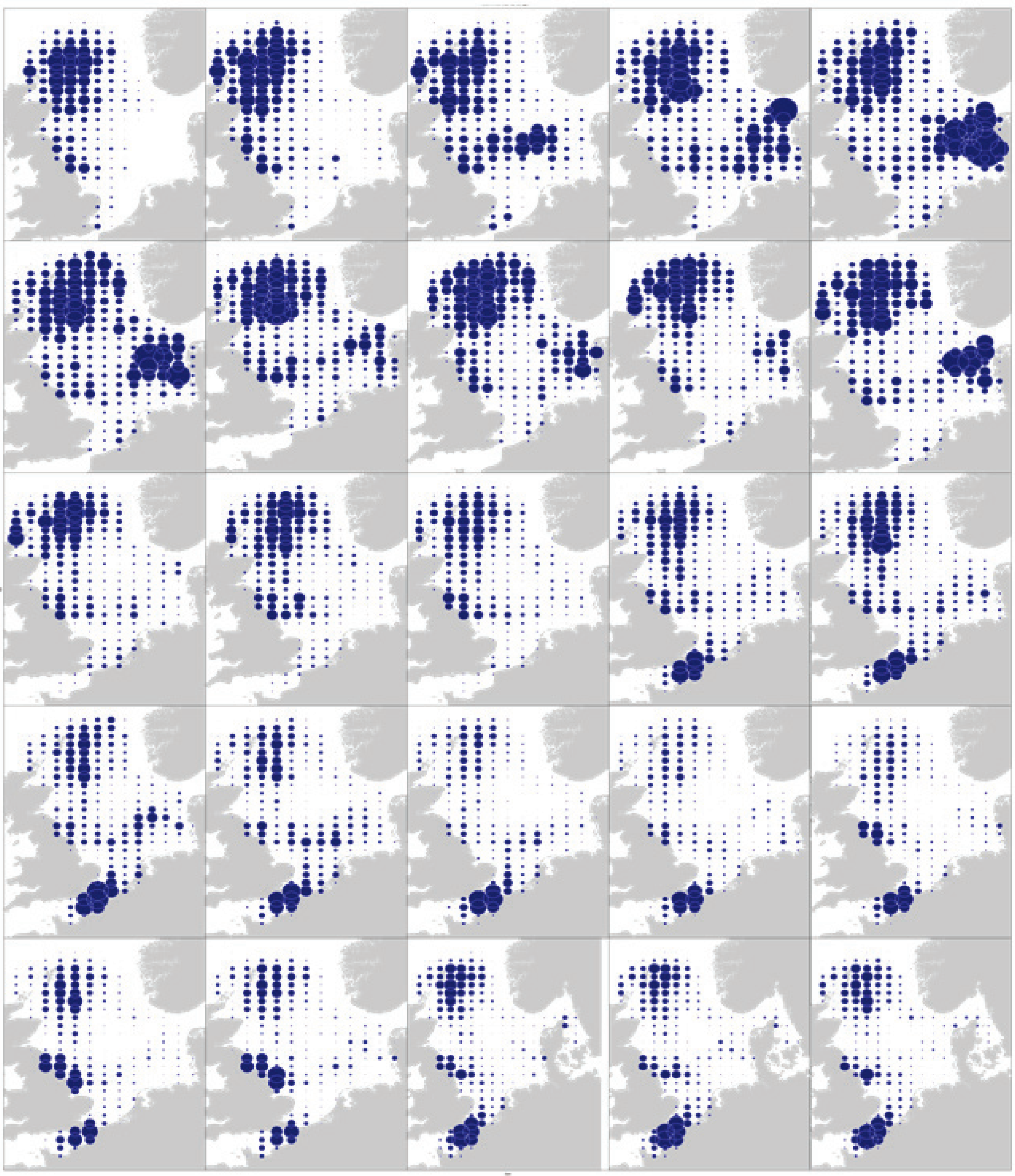


Figure 6.4.5.b.4 Whiting in Subarea IV and Division VIId. Commercial landings (human consumption and industrial fisheries in tonnes) by ICES statistical rectangle over the years 1986 to 2010. The same scaling is used in each map. Danish industrial bycatch data was available from 1988. French human consumption landings were available from 1999.

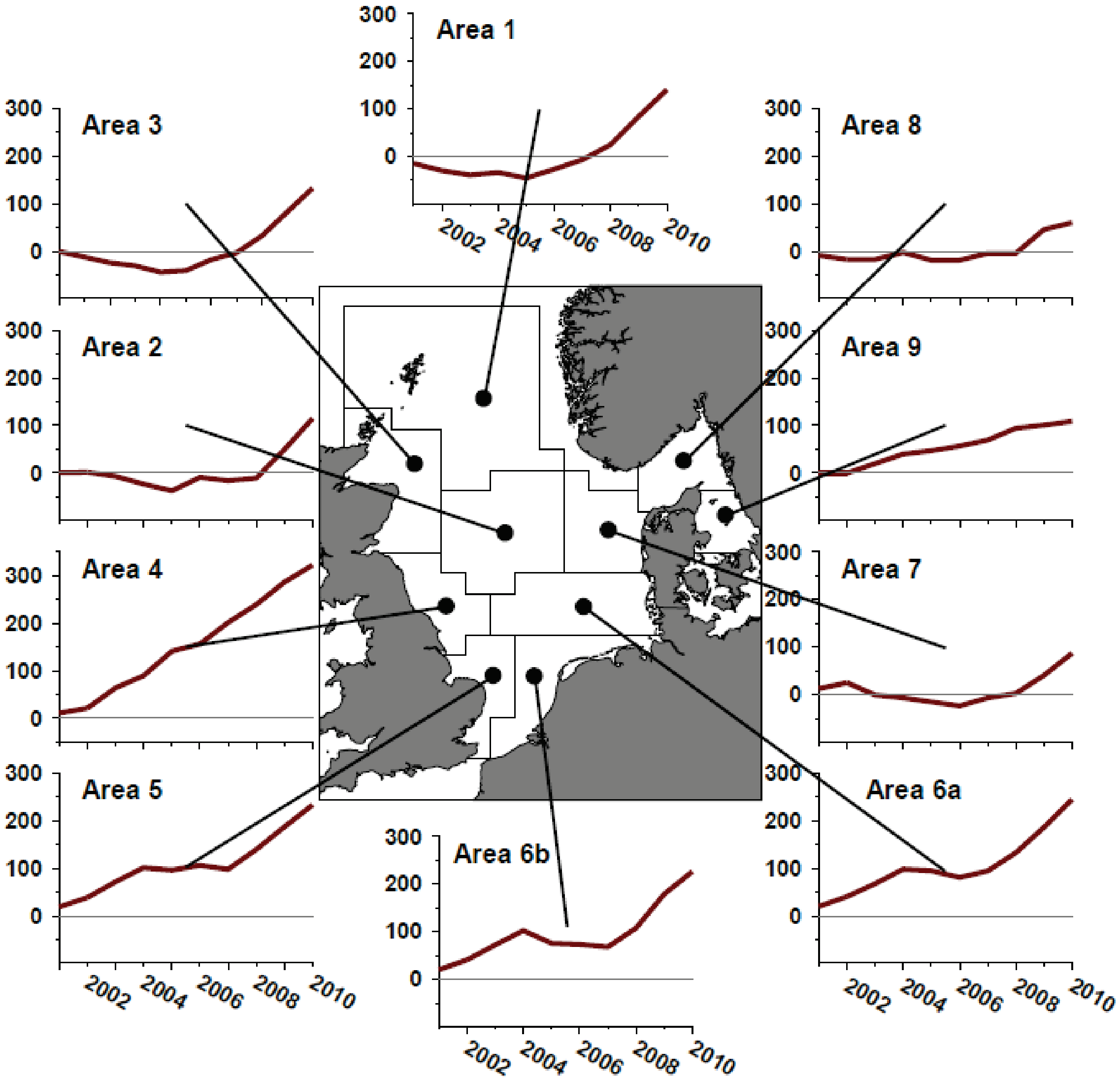


Figure 6.4.5.b.5 Whiting in Subarea IV and Division VIId. Results of the North Sea Commission fisher's survey 2010.

Table 6.4.5.b.1 Whiting in **Subarea IV (North Sea)**. ICES advice, management, and catch.

Year	ICES Advice	Predicted landings corresp. to advice*	Agreed TAC	Off. Lndgs.	ICES figures			
					Hum. Cons.	Indust. bycatch	Disc. slip.	Total catch
1989	Protect juveniles	-	115	40	41	43	36	120
1990	80% of F(88); TAC	130	125	41	43	51	56	150
1991	70% of effort (89)	-	141	47	47	38	34	119
1992	70% of effort (89)	-	135	47	46	27	31	104
1993	70% of effort (89)	-	120	47	48	20	43	111
1994	Significant reduction in effort; mixed fishery	-	100	42	43	10	33	86
1995	Significant reduction in effort; mixed fishery	-	81	41	41	27	30	98
1996	Mixed fishery; take into account cod advice	-	67	35	36	5	28	69
1997	Mixed fishery; take into account cod advice	-	74	32	31	6	17	54
1998	No increase from 1996 level	54	60	24	24	3	13	40
1999	at least 20% reduction of F(95–97)	40.4	44	25	26	5	22	52
2000	lowest possible catch	0	30	24	24	9	22	55
2001	60% reduction of F(97–99)	19.4	30	19	19	1	16	36
2002	F not larger than 0.37	≤33	32	16	15	7	17	39
2003	No cod catches	-	16	11	10	3	26	39
2004	No cod catches. Fishing mortality in 2004 should be < F_{pa}	No increase compared to recent years	16	9	9	1	18	28
2005	No cod catches. Less than recent avg	52	28.5	10	11	1	10	22
2006	No cod catches. Less than recent avg	< 17.3	23.8	15	15	2	14	31
2007	No cod catches. Less than recent avg	<15.1	23.8	16	16	1	5	22
2008	No cod catches. Less than recent avg	<15.1	17.9	13	13	1	8	23
2009	No cod catches. F < F_{max}	< 11	15.2	13	12	1	5	18
2010	No cod catches. Stable SSB	<6.8	12.9	12	12	2	8	22
2011	No cod catches. Stable SSB	<9.5	14.832					
2012	Management plan	<17.1						

Weights in '000 t.
*) including Division VIId from 2005 onwards.

Table 6.4.5.b.2 Whiting in **Division VIId (Eastern Channel)**. ICES advice, management, and catch/landings.

Year	ICES Advice	Predicted landings corresp. to advice*	Agreed TAC[1]	Official landings	ICES landings
1989	Precautionary TAC	-	-	n/a	4.2
1990	No increase in F; TAC	8.0[2]	-	n/a	3.5
1991	F_{sq}; TAC	5.1	-	n/a	5.7
1992	If required, precautionary TAC	6.0[2]	-	5.9	5.7
1993	No basis for advice	-	-	5.4	5.2
1994	No long-term gains in increasing F	-	-	7.1	6.6
1995	Significant reduction in effort; link to North	-	-	5.6	5.4
1996	Reference made to North Sea advice	-	-	5.1	5.0
1997	Reference made to North Sea advice	-	-	4.8	4.6
1998	Reference made to North Sea advice	5.8	27	4.8	4.6
1999	Reference made to North Sea advice	3.9	25	0.2	4.4
2000	Lowest possible catch	0	22	6.1	4.3
2001	60% reduction of F_{sq}	2.5	21	6.6	5.8
2002	F not larger than 0.37	<=4	31.7	5.4	5.8
2003	No cod catches	-	27	7.0	5.7
2004	No cod catches. Fishing mortality should be $<F_{pa}$	Catch should not increase compared	21.6	5.3	4.4
2005	No cod catches	-	19.9	4.9	4.8
2006	No cod catches. Less than recent average	< 17.3	19.9	3.7	3.4
2007	No cod catches. Less than recent average	<15.1	19.9	3.4	3.3
2008	No cod catches. Less than recent average	<15.1	19.9	3.2	4.5
2009	No cod catches. $F < F_{max}$	< 11	16.9	6.5	6.6
2010	No cod catches. Stable SSB	<6.8	14.4	6.1	6.0
2011	No cod catches. Stable SSB	<3.2	16.6		
2012	Management plan	<4.2			

Weights in '000 t.
[1] Included in TAC for Subarea VII (except Division VIIa).
[2] Including Division VIIe.
*) Includes both areas (Subarea IV and Division VIId).
n/a = Not available.

Table 6.4.5.b.3 Whiting in Subarea IV and Division VIId. Landings (in tonnes) by country and by area, and ICES estimates of catches.

Subarea IV

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	529	536	454	270	248	144	105	93	45	115	162	147
Denmark	58	105	105	96	89	62	57	251	78.5	42	80	158
France	0	2527	3455	3314	2675	1721	1261	2711	3312	3051	2304	2631
Germany	176	424	402	354	334	296	149	252	76	76	125	156
Netherlands	1795	1884	2478	2425	1442	977	805	702	618	656	718	615
Norway	68	33	44	47	38.5	23	16	17	11	92	73	118
Sweden	9	4	6	7	10	2	0	1	1	1	4	8
UK (E.&W)	2268	1782	1301	1322	680	1209	2560	3539	3048	1541	1397	
UK (Scotland)	17206	17158	10589	7756	5734	5057	3441	8093	9063	8850	7456	
UK (Total)												7841
Total	**22109**	**24453**	**18834**	**15591**	**11251**	**9491**	**8394**	**15659**	**16253**	**14424**	**12319**	**11674**
Unallocated landings	3591	-173	426	-721	-800.5	-541	2286	-562	-587	-945	-545	-607
WG estimate of H.Cons. landings	25700	24280	19260	14870	10450	8950	10680	15097	15666	13479	11774	12281
WG estimate of discards	22109	21931	16130	17144	26135	18142	10300	14018	5206	8356	5223	7853
WG estimate of Ind. By-catch	5040	9160	940	7270	2730	1210	890	2190	1240	1020	1350	1750
WG estimate of total catch	**52849**	**55371**	**36330**	**39284**	**39315**	**28302**	**21870**	**31305**	**22112**	**22855**	**18347**	**21884**

Division VIId

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Belgium	48	65	75	58	67	46	45	73	75	69	71	88
France		5875	6338	5172	6654	5006	4638	3487	3135	2875	6266	5436
Netherlands	6	14	67	19	175	132	128	117	118	162	112	270
UK (E.&W)	135	118	134	112	109	99	90	53	50	54	86	253
Total	**189**	**6072**	**6614**	**5361**	**7005**	**5283**	**4901**	**3730**	**3378**	**3160**	**6535**	**6074**
Unallocated	4241	-1772	-814	439	-1295	-933	-111	-287	-124	1311	111	765
W.G Estimate of H.Cons. landings	4430	4300	5800	5800	5710	4350	4790	3443	3254	4471	6646	5939
WG estimate of discards	3571	4129	3109	1356	604	907	2219	2291	1763	1943	2477	3727
W.G. estimate Catch	**8001**	**8429**	**8910**	**7156**	**6315**	**5258**	**7010**	**5735**	**5018**	**6415**	**9123**	**9666**

Table 6.4.5.b.4 Whiting in Subarea IV and Division VIId. Summary of stock assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2–6
1990	2971000	348629	48993	0.846
1991	2868000	306532	56154	0.685
1992	2755000	294136	55041	0.653
1993	3075000	267201	54794	0.657
1994	2870000	254974	52340	0.817
1995	2513000	256180	49182	0.732
1996	1751000	223116	43869	0.666
1997	1335000	192360	38558	0.508
1998	1921000	160789	31505	0.482
1999	2933000	166311	33701	0.548
2000	3343000	216173	32709	0.646
2001	2666000	247301	28170	0.437
2002	2421000	228661	22026	0.295
2003	868000	190625	16765	0.277
2004	950000	154820	14208	0.267
2005	1274000	137425	17690	0.252
2006	1288000	128993	20832	0.359
2007	1340000	114696	20684	0.354
2008	2927000	132864	19894	0.373
2009	2198000	184734	20897	0.300
2010	1730000	205826	21947	0.272
2011	1562674	205282		
Average	2161803	210047	33331	0.496

Annex 6.4.5 Interim management plan for whiting

From the EU–Norway agreement 2010:

The TAC for whiting for 2011 will be fixed by applying an interim management plan consisting of the following elements:

1. For 2011 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.3 for appropriate age-groups.
2. Where the rule in paragraph 1 would lead to a TAC, which deviates by more than 15 % from the TAC of the preceding year, the Parties shall establish a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.
3. During 2011, after obtaining advice from ICES, the Parties will refine the management plan, in particular to allow for a reduction in the target fishing mortality when recruitment to the stock has been low for a period of years.

ECOREGION North Sea
STOCK Plaice in Division IIIa (Skagerrak – Kattegat)

Advice for 2012

ICES advises on the basis of precautionary considerations that catches in 2012 should be reduced. This advice does not take into account the mixing with the increasing North Sea plaice stock in the Skagerrak.

Stock status

F (Fishing Mortality)		
		2008-2010
Qualitative evaluation	?	Insufficient information

SSB (Spawning-Stock Biomass)		
		2008-2010
Qualitative evaluation	?	Insufficient information

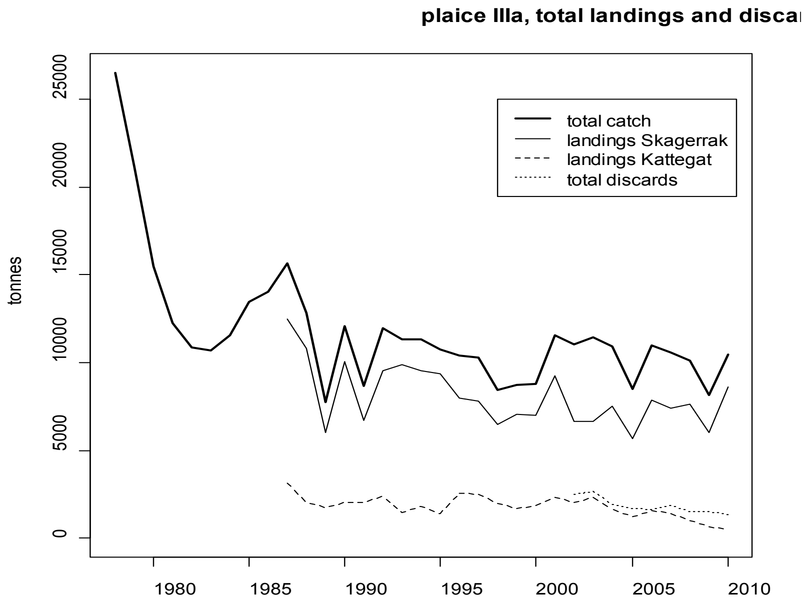


Figure 6.4.6.1 Plaice in Division IIIa (Skagerrak – Kattegat). Total landings and discards (weights in tonnes).

The assessment is exploratory only and the different approaches give uncertain and conflicting results with regard to trends in SSB and recruitment. Survey information (covering mainly the less fished eastern side of the area) indicates that there have been a number of large year classes over the period 2000–2006, but that the recent year classes have been lower. Fishing mortality is unknown. The level of mixing with the increasing North Sea plaice stock is unknown, but likely high in the Skagerrak. Catches are mainly taken close to the border with the North Sea, and have increased in 2010.

Management plans

No specific management objectives are known to ICES.

Biology

Plaice aggregate at spawning grounds in the first quarter of the year. It is considered that the current stock boundaries are inappropriate, due to potentially large connectivity between areas occurring through spawning migration, larval drift and juvenile homing. Furthermore, growth patterns for plaice in this area are highly variable, likely because of the great diversity of the local hydrographical conditions in the Skagerrak and Kattegat.

The fisheries

Plaice is caught all year round with a predominance from spring to autumn. In Skagerrak, plaice is taken both in a directed fishery and in a mixed cod-*Nephrops*-sole-plaice fishery, especially with trawlers with 90 mm mesh size.

Catch by fleet	Total catch (2010) = 10.5 kt, where 87% are landings and 13% discards. Proportion of landings by gear: 38% demersal seine, 34% demersal trawl, 18% beam trawl.

Quality considerations

An exploratory assessment is conducted every year. The analyses indicate that a number of issues regarding uncertainty in the catch-at-age information and inappropriate survey spatial coverage are largely unresolved, and cannot be easily addressed. The catch-at-age issues relate both to the fisheries mainly taking place in the Skagerrak where mixing occurs with North Sea plaice, and to intrinsic variability in growth within the distribution area, which cannot be captured with the current sampling. The survey covers only the eastern side of the stock distribution where limited fishing occurs.

Scientific basis

Assessment type	No assessment is performed.
Input data	Four survey indices (IBTS Q1, IBTS Q3, KASU Q4, KASU Q1); two commercial indices (DK gillnetters, DK seiners).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Exploratory analysis were made with XSA and SAM.
Working group report	WGNSSK

6.4.6 Supporting information June 2011

ECOREGION North Sea
STOCK Plaice in Division IIIa (Skagerrak – Kattegat)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	Undefined.	
Precautionary approach	B_{lim}	Undefined.	
	B_{pa}	24 000 t	Smoothed B_{loss} (no sign of impairment).
	F_{lim}	Undefined.	
	F_{pa}	0.73	F_{med}

(unchanged since: 1998)

Outlook for 2012

No reliable assessment can be presented for this stock and therefore, fishing possibilities cannot be projected.

Precautionary considerations

There is conflicting information on stock trends, and stock status and fishing mortality are unknown. Therefore, catches in 2012 should be reduced. This advice does not take into account the mixing with the increasing North Sea plaice stock in the Skagerrak.

Additional considerations

In 2007, ICES identified key issues hampering the assessment of the stock. The landings-at-age matrix does not show proper tracking of the cohorts, probably due to mixing of the Division IIIa stock with the North Sea plaice stock in Skagerrak, where most landings occur, and large variability in growth that cannot be easily monitored with the current levels of sampling. These issues have been further investigated in 2010–2011 but have not been resolved. In addition, the survey coverage and timing is not fully appropriate, with the surveys being concentrated on the eastern part of the area where little fishing occurs.

Plaice in Skagerrak might be partly recruited from the North Sea, and a component of the population may migrate to the North Sea to spawn before returning to the Skagerrak. There is evidence of local populations in the Kattegat and the Western Baltic, with connectivity between these near the boundaries. Furthermore, it is estimated that significant proportions of larval and egg in the Eastern Skagerrak and Kattegat may have drifted from the North Sea, especially during windy winters. These fish settle in Division IIIa nurseries and recruit to the fishery, before migrating northwestwards at first spawning. This component of the population could potentially outnumber the local plaice stocks.

It is therefore inappropriate to put forward an assessment for the Kattegat – Skagerrak area alone, also because 95% of landings are taken in the Skagerrak, where there is some uncertainty as to the stock origin of the catches.

The IBTS survey or other scientific monitoring should be intensified in the Skagerrak.

The surveys (covering mainly the less fished eastern side of the area) are not in agreement, but they tend to indicate that there has been a number of large year classes over the period 2000–2006, but that the recent year classes have been lower.

The effects of regulations

TACs are set for Kattegat and Skagerrak separately. Only the TAC for Skagerrak is fully utilized. There have been a number of regulatory changes on the fisheries in this area, in particular with regards to the protection of the cod stock in Kattegat. As a consequence, the mixed demersal trawl fishery (TR1) has almost disappeared in Kattegat, and the landings from this area represent now only 5% of the total landings for the stock.

Uncertainties in assessment and forecast

As last year, exploratory analyses were conducted with XSA and SAM. The conflicting results from the different assessment approaches with regard to F, SSB, and R indicate that the issues have not been resolved.

Following the conclusion of the flatfish benchmark (ICES, 2010) it is recommended to explore the potential to perform an integrated assessment of the continuum of plaice stocks from the Baltic to the English Channel. It is suggested that a dedicated Study Group be established, investigating the issues of identification, assessment, and management of the stocks of plaice from the Baltic to the English Channel.

Comparison with previous assessment and advice

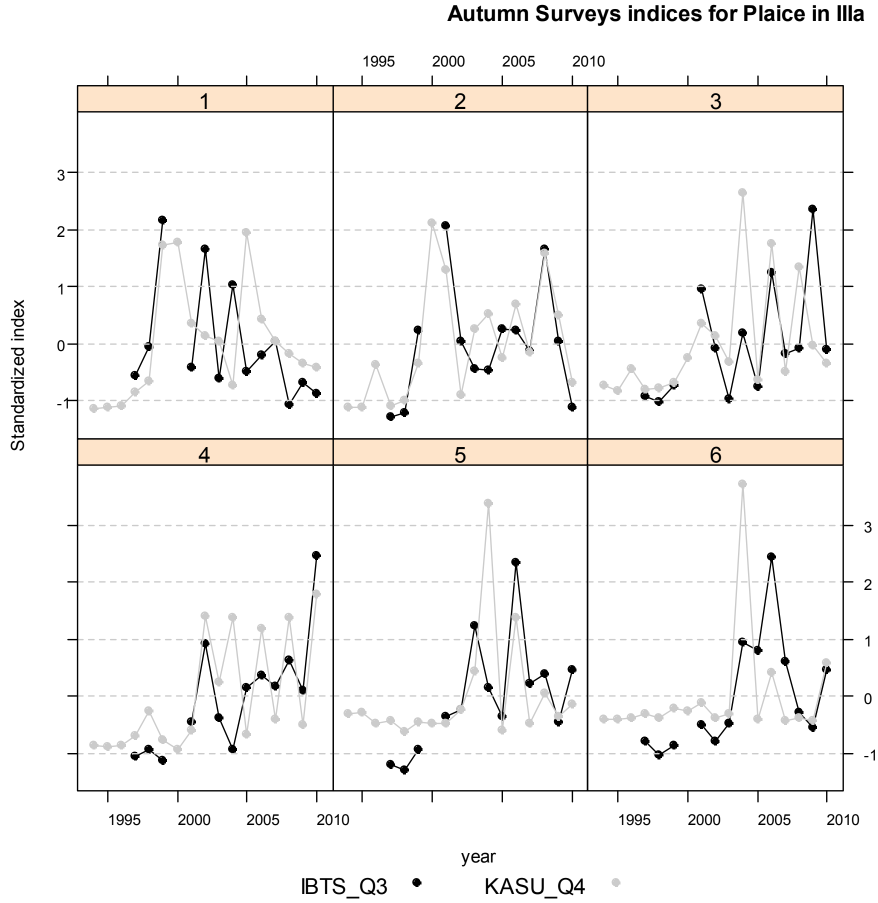
The basis for the assessment is the same as last year.

Last year, the advice was based on precautionary and MSY considerations to maintain average catches (2007-2009). This year, ICES advice to reduce catches on this stock is based on precautionary considerations in the new framework for stocks without population size estimates.

Sources

ICES. 2010. Report of the Benchmark Workshop on Flatfish (WKFLAT), 25 February–4 March 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:37.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.



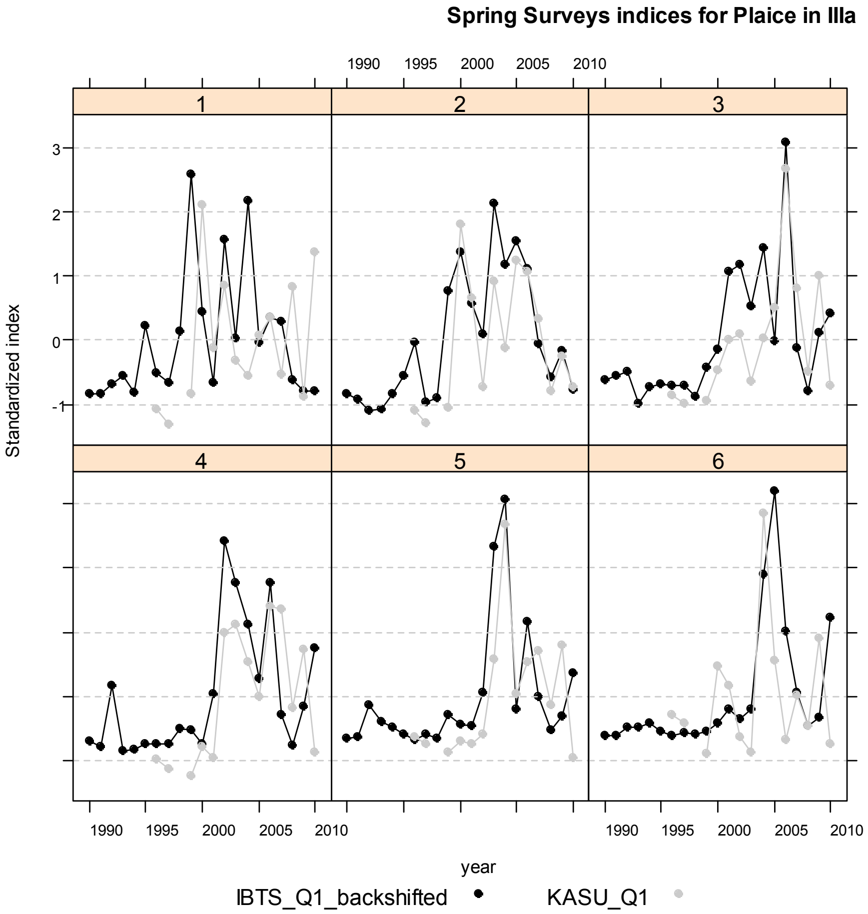


Figure 6.4.6.2 Plaice in Division IIIa (Skagerrak – Kattegat). The standardized cpue index by ages 2–6, for four different surveys.

Table 6.4.6.1 Plaice in Division IIIa (Skagerrak – Kattegat). ICES advice, management, and catch.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC Kattegat	Agreed TAC Skagerrak	ICES landings
1992	TAC	14.0	2.8	11.2	11.9
1993	Precautionary TAC	-	2.8	11.2	11.3
1994	If required, precautionary TAC	-	2.8	11.2	11.3
1995	If required, precautionary TAC	-	2.8	11.2	10.8
1996	If required, precautionary TAC	-	2.8	11.2	10.5
1997	No advice	-	2.8	11.2	10.1
1998	No increase in F from the present level	11.9	2.8	11.2	8.4
1999	No increase in F from the present level	11.0	2.8	11.2	8.5
2000	$F < F_{pa}$	11.8	2.8	11.2	8.8
2001	$F < F_{pa}$	9.4	2.35	9.4	11.7
2002	$F < F_{pa}$	8.5[1]	1.6[2]	6.4[2]	8.7
2003	$F < F_{pa}$	18.4	3.0	10.4	8.9
2004	$F < F_{pa}$[3]	[3]	1.8	9.5	9.1
2005	$F < F_{pa}$	< 9.5	1.9	7.6	6.9
2006	No increase in F	< 9.6	1.9	7.6	9.4
2007	Maintain current TAC	<9.6	2.1	8.5	8.8
2008	No increase in catch	<9.4	2.3	9.3	8.6
2009	Same advice as last year	<9.4	2.3	9.3	6.7
2010	Same advice as last year	<9.4	2.3	9.3	9.1
2011	Last three years average landings (2007–2009)	<8.0	2.0	7.9	
2012	Reduce catch	-			

Weights in '000 t.

1) In March 2002 ACFM revised its advice to 11.6 for both areas combined.

2) The TAC for the two areas combined was adjusted to 11 200 tonnes in mid-2002.

3) The exploitation of this stock should be conducted in the context of mixed fisheries.

Table 6.4.6.2 Plaice in Division IIIa **(Kattegat).** ICES estimates of landings by country in tonnes.

Year	Denmark	Sweden	Germany	Belgium	Norway	Total
1972	15,504	348	77			15,929
1973	10,021	231	48			10,300
1974	11,401	255	52			11,708
1975	10,158	296	39			10,493
1976	9,487	177	32			9,696
1977	11,611	300	32			11,943
1978	12,685	312	100			13,097
1979	9,721	333	38			10,092
1980	5,582	313	40			5,935
1981	3,803	256	42			4,101
1982	2,717	238	19			2,974
1983	3,280	334	36			3,650
1984	3,252	388	31			3,671
1985	2,979	403	4			3,386
1986	2,470	202	2			2,674
1987	2,846	307	3			3,156
1988	1,820	210	0			2,030
1989	1,609	135	0			1,744
1990	1,830	202	2			2,034
1991	1,737	265	19			2,021
1992	2,068	208	101			2,377
1993	1,294	175	0			1,469
1994	1,547	227	0			1,774
1995	1,254	133	0			1,387
1996	2,337	205	0			2,542
1997	2,198	255	25			2,478
1998	1,786	185	10			1,981
1999	1,510	161	20			1,691
2000	1,644	184	10			1,838
2001	2,069	260				2,329
2002	1,806	198	26			2,030
2003	2,037	253	6			2,296
2004	1,395	137	77			1,609
2005	1,104	100	47			1,251
2006	1,355	175	20			1,550
2007	1,198	172	10			1,380
2008	866	136	6			1,008
2009	570	84	5			659
2010	428	66	3			497

Table 6.4.6.3 Plaice in Division IIIa **(Skagerrak)**. ICES estimates of landings by country in tonnes.

Year	Denmark	Sweden	Germany	Belgium	Norway	Netherlands	Total
1972	5,095	70			3		5,168
1973	3,871	80			6		3,957
1974	3,429	70			5		3,504
1975	4,888	77			6		4,971
1976	9,251	51		717	6		10,025
1977	12,855	142		846	6		13,849
1978	13,383	94		371	9		13,857
1979	11,045	67		763	9		11,884
1980	9,514	71		914	11		10,510
1981	8,115	110		263	13		8,501
1982	7,789	146		127	11		8,073
1983	6,828	155		133	14		7,130
1984	7,560	311		27	22		7,920
1985	9,646	296		136	18		10,096
1986	10,645	202		505	26		11,378
1987	11,327	241		907	27		12,502
1988	9,782	281		716	41		10,820
1989	5,414	320		230	33		5,997
1990	8,729	779		471	69		10,048
1991	5,809	472	15	315	68		6,679
1992	8,514	381	16	537	106		9,554
1993	9,125	287	37	326	79		9,854
1994	8,783	315	37	325	91		9,551
1995	8,468	337	48	302	224		9,379
1996	7,304	260	11		428		8,003
1997	7,306	244	14		249		7,813
1998	6,132	208	11		98		6,449
1999	6,473	233	7		336		7,049
2000	6,680	230	5		67		6,982
2001	9,045	125			61		9,231
2002	6,470	140	3		58		6,671
2003	4,847	143	8		74	1,584	6,656
2004	5,717	179			106	1,511	7,513
2005	4,515	144			116	915	5,690
2006	6,334	175	14		142	1,190	7,855
2007	5,467	159	21		100	1,659	7,406
2008	6,901	219	5		79	403	7,607
2009	5,617	92	13		60	253	6,035
2010	7,092	111	14		49	1,332	8,598

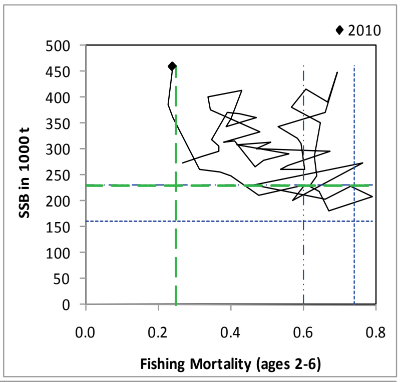
ECOREGION North Sea
STOCK Plaice in Subarea IV (North Sea)

Advice for 2012

ICES advises on the basis of the first stage of the EU management plan (Council Regulation No. 676/2007) that landings in 2012 should be no more than 84 410 t. ICES notes that according to the management plan, transitional arrangements to the second stage of the plan should be established since both North Sea plaice and sole have now been within safe biological limits for two consecutive years.

Stock status

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target
SSB (Spawning-Stock Biomass)				
	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above target



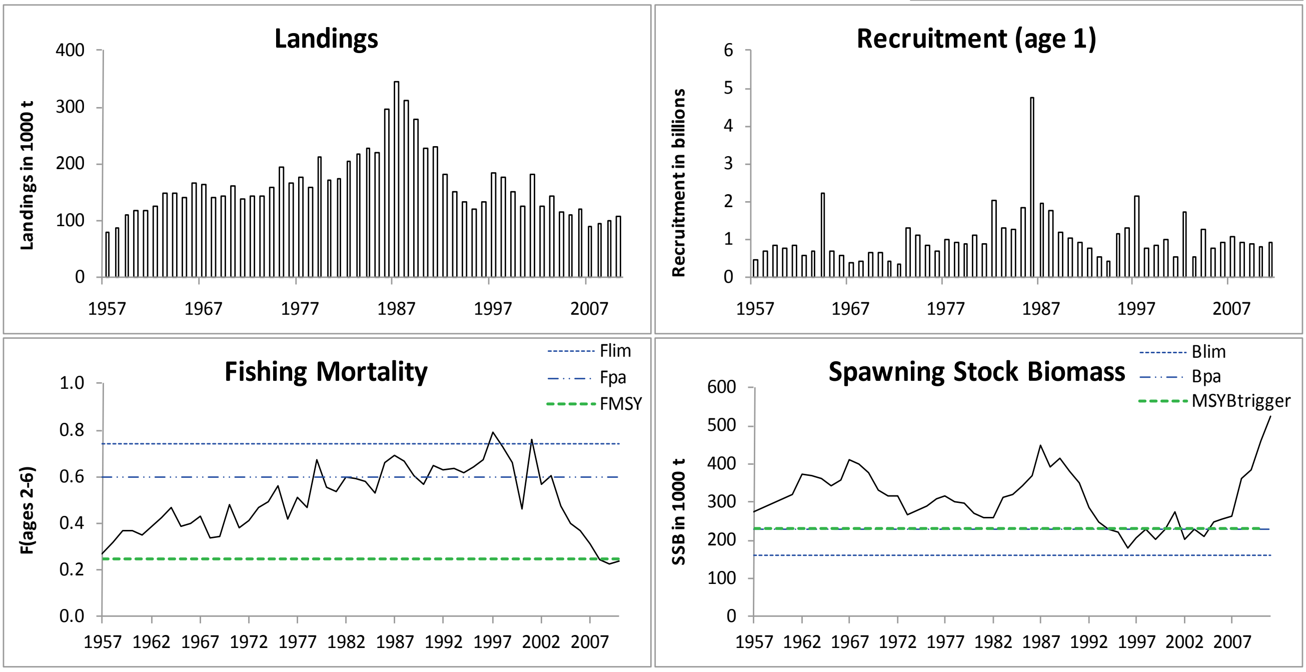


Figure 6.4.7.1 Plaice in Subarea IV (North Sea). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

The stock is well within precautionary boundaries, and has reached its highest levels in recorded history. Recruitment has been around the long-term average from 2005 onwards.

Management plans

Stage 1 in the EU management plan for North Sea plaice and sole (Council Regulation (EC) No. 676/2007, see Appendix 6.4.7) results in a 15% TAC increase for plaice. An evaluation of the plan (ICES, 2010) concluded that the management plan is precautionary.

Biology

Plaice is a bottom dwelling species, mainly feeding on annelids and molluscs. Plaice aggregate at spawning grounds in the first quarter of the year. The condition factor for plaice is highest in summer/autumn on the more dispersed feeding grounds. These feeding grounds are generally located more northerly than the spawning grounds

Environmental influence on the stock

Juvenile plaice have been distributed more offshore in recent years. This could be linked to environmental changes in the productivity or changes in the temperature of the southern North Sea, but these links have not been shown conclusively. The distribution shift of plaice increased the bycatch of small plaice further offshore.

The fisheries

Plaice is predominantly caught by beam trawlers in the central part of the North Sea with a minimum mesh size of 100–120 mm depending on area. A mixed fishery with sole in the southern North Sea takes place with a minimum mesh size of 80 mm. This mesh size catches plaice under the minimum landing size of 27 cm, which induces high discard rates (in the range of 50% by weight).

Catch by fleet	Total catch (2010) = 106 kt, where 57% are landings (53% beam trawl, 27% otter trawl, and 20% other gears) and 43% discards.

Effects of the fisheries on the ecosystem

The mixed plaice and sole fishery is dominated by bottom trawls, with bycatch of both commercial and non-commercial species and a physical impact on the seabed. Bottom trawling impacts biomass, production, and species richness. For plaice, the size selectivity may lead to a shift in the age and size at maturation, which means individuals start spawning earlier.

Quality considerations

The assessment is considered to be uncertain, partly because discards form a substantial part of the total catch and cannot be well estimated from the low number of annual sampling trips, but most importantly due to the large differences in abundance observed in the different regions of the North Sea.

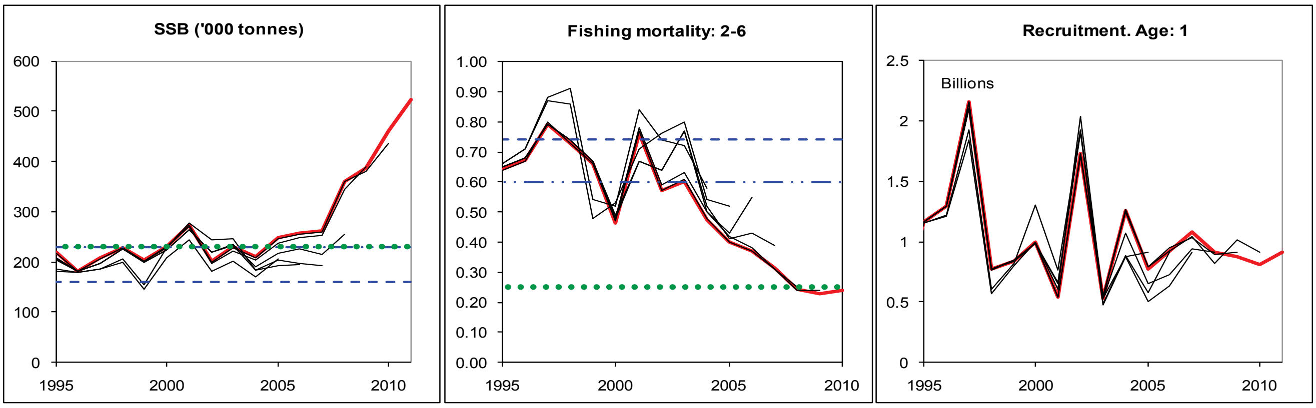


Figure 6.4.7.2 Plaice in Subarea IV (North Sea). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Three survey indices (BTS-Tridens, BTS-Isis, SNS).
Discards and bycatch	Included in the assessment (since 2004).
Indicators	None.
Other information	This stock was benchmarked in 2009 (WKFLAT).
Working group report	WGNSSK

ECOREGION North Sea
STOCK Plaice in Subarea IV (North Sea)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	230 000 t	Stage one: Article 2.
	F_{MP}	0.6 0.3	Stage one: Article 2; Stage two: Article 4.
MSY Approach	MSY $B_{trigger}$	230 000 t	Default to value of B_{pa}.
	F_{MSY}	0.25	Simulation studies and equilibrium analyses taking into account a number of possible stock–recruitment relationships (range of 0.2–0.3).
Precautionary approach	B_{lim}	160 000 t	B_{loss} = 160 000 t, the lowest observed biomass in 1997 as assessed in 2004.
	B_{pa}	230 000 t	Approximately 1.4 B_{lim}.
	F_{lim}	0.74	F_{loss} for ages 2–6.
	F_{pa}	0.60	5th percentile of F_{loss} (0.6) and implies that B_{eq}>B_{pa} [1)] and a 50% probability that SSB_{MT} ~ B_{pa}.

(unchanged since: 2011)

Outlook for 2012

Basis: F(2011) = mean(F2008–2010) scaled to 2010 = 0.24; R(2011) = GM(1957–2008) = 915 million; Landings(2011) = 69; Discards(2011) = 49; SSB(2012) = 556.

Rationale	Landings (2012)	Basis	F(2–6) total (2012)	F(2–6) HC (2012)	F(2–3) Disc (2012)	Disc (2012)	Catch (2012)	SSB (2013)	% SSB change [1)]	%TAC change [2)]
EU mgt plan Stage 1	84.410	TAC + 15%	0.29	0.15	0.3	53.5	137.9	587.6	+ 6%	+ 15%
EU mgt plan Stage 2	87.1	$F_{MP} = F_{sq}$*1.25	0.3	0.16	0.31	55	142	583.4	+ 5%	+ 19%
MSY framework	74	F_{MSY}	0.25	0.13	0.26	47.2	121.1	604.7	+ 9%	+ 1%
Precautionary approach	155.5	F_{PA}	0.6	0.32	0.62	93.4	248.7	474.8	- 15%	+ 112%
zero catch	0	F=0	0	NA	NA	0	0	727.7	+ 31%	- 100%
Status quo	62.6	TAC-15% (F_{sq} *0.87)	0.208	0.11	0.21	40.2	102.7	623.3	+ 12%	- 15%
	64.8	F_{sq} *0.9	0.216	0.11	0.22	41.6	106.3	619.7	+ 12%	- 12%
	71.3	F_{sq} *1	0.24	0.13	0.25	45.6	116.8	609.1	+ 10%	- 3%
	73.4	TAC_{sq} (F_{sq} *1.03)	0.248	0.13	0.25	46.9	120.2	605.6	+ 9%	0%
	77.7	Fsq*1.1	0.264	0.14	0.27	49.5	127	598.6	+ 8%	+ 6%
	87.3	F_{sq} *1.25	0.301	0.16	0.31	55.2	142.4	583	+ 5%	+ 19%
	102.3	F_{sq} *1.5	0.361	0.19	0.37	64	166.2	558.8	+ 1%	+ 39%

Weights in '000 t.

1) SSB 2013 relative to SSB 2012.

2) Landings 2012 relative to TAC 2011.

Management plan

Both the North Sea plaice and sole stocks have been within safe biological limits in the last two years. According to the management plan (Article 3.2), this signals the end of stage one. Transitional arrangements for stage two (Article 5) should amend the objectives and the procedures for setting TACs and effort limitations, but these have not been decided on yet. Therefore, ICES advice is limited to the procedures defined for stage one.

Following the first stage of the EU management plan would imply increasing F to the target value of 0.3, with a maximum TAC increase of 15%. For 2012 the latter applies, resulting in a TAC of 84 410 t (F = 0.29). This is expected to increase the SSB to 587 600 t in 2013.

Following the second stage of the EU management plan would imply increasing F to the target value of 0.3 without TAC constraint (Article 4). This would result in a TAC of 87 100 t. This is expected to increase the SSB to 583 400 t in 2013.

ICES has evaluated this management plan and considers it precautionary.

MSY approach

Following the ICES MSY framework implies fishing mortality to be increased to 0.25, resulting in landings of 74 000 t in 2012. This is expected to lead to an SSB of 604 700 t in 2013.

Given that the current (2010) estimate of fishing mortality is only slightly below F_{MSY} there is no need to follow a transition scheme towards this reference value.

PA approach

The fishing mortality in 2012 should be no more than F_{pa} (0.6) corresponding to landings of less than 155 500 t in 2012. This is expected to keep SSB above B_{pa} in 2013.

Additional considerations

MSY reference points

F_{MSY} has been set to 0.25 based on simulation studies and equilibrium analyses, taking into account a number of stock–recruitment relationships that generated a range of values between 0.2 and 0.3.

Impacts of fisheries on the ecosystems

Currently the mixed plaice and sole fishery is dominated by beam trawls, with bycatch of both commercial and non-commercial species and a physical impact on the seabed. Bottom trawling can impact biomass, production, and species richness. For the North Sea, an ecosystem model showed that the beam-trawl fleet reduced benthic biomass and production by 56% and 21%, respectively, compared with an un-fished situation (Hiddink *et al.*, 2006; Hinz *et al.*, 2008). Chronic fishing has caused a shift from communities dominated by relatively sessile, emergent, and high biomass species to communities dominated by infaunal, smaller-bodied fauna (Kaiser *et al.*, 2000). Within species, the size selectivity may lead to a shift in the age and size at maturation. For example, in recent years plaice and sole have become mature at younger ages and at smaller sizes than in the past (Grift *et al*., 2003).

Regulations and their effects

Plaice is predominantly caught by beam trawlers in the central part of the North Sea and in a mixed fishery with sole in the southern North Sea. Technical measures applicable to the mixed flatfish beam-trawl fishery affect both sole and plaice. The minimum mesh size of 80 mm selects sole at the minimum landing size. However, this mesh size generates high discards of plaice with a larger minimum landing size than sole. Recent discard estimates indicate fluctuations around 50% discards in catch by weight. Mesh enlargement would reduce the catch of undersized plaice, but would also result in loss of marketable sole.

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management programme switched from a days-at-sea to a kW-day system (2009 Council Regulation (EC) N° 43/2009), in which different amounts of kW-days are allocated within each area by member state to different groups of vessels depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed annual monitoring of effort trends since 2004. Overall effort (kW-days) by demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced (−30% between 2003 and 2009; STECF, 2011). Effort by beam trawl in both small mesh size (80–120 mm, BT2) and large mesh size (BT1) has shown a continuous decline (−38% and −70% ,respectively, between 2003 and 2009).

Changes in fishing technology and fishing patterns

The overall capacity and effort of North Sea beam-trawl vessels has been substantially reduced since 1995, including the decommissioning of 25 vessels in 2008. The current combined sole and plaice long-term management plan specifically reduces effort as a management measure and is likely to continue to do so in the immediate future, given the slower rate of recovery of the sole stock. This reduction in fishing effort is reflected in reductions in estimated fishing mortality.

The combination of days-at-sea regulations, high oil prices, and the constraining TAC for plaice and the relatively stable TAC for sole, lead to a more southern fishing pattern in the North Sea. This concentration of fishing effort results in increased discarding of juvenile plaice that are mainly distributed in those areas. This process could be aggravated by movement of juvenile plaice to deeper waters in recent years, where they become more susceptible to the fishery. Lpue data also show a slower recovery of stock size in the southern regions that may be caused by higher fishing effort in the more coastal regions.

Technical management measures have caused a shift towards two categories of vessels: 2000 HP (the maximum engine power allowed) and 300 HP. The 300 HP vessels are allowed to fish within the 12-nautical mile coastal zone and in the Plaice Box.

The Plaice Box is a partially closed area along the continental coast that was implemented in phases, starting in 1989. The area has been closed to most categories of vessels >300 HP all year round since 1995. The most recent EU-funded evaluation by Beare *et al.* (2010) reported the Plaice Box as having very little impact on the plaice stock.

The increased use of “SumWing” and electric “Pulse trawls” will increasingly affect catchability and selectivity of North Sea sole, but their potential future impact either on the sole stock itself or the stock assessment is currently uncertain. Furthermore, the introduction of a new mesh meter (the Omega meter) may have increased the effective mesh size of the fishery.

Impacts of the environment on the fish stock

Adult North Sea plaice have an annual migration cycle between spawning and feeding grounds. The spawning grounds are located in the central and southern North Sea and the eastern English Channel, overlapping with the distribution area of sole. The feeding grounds are located more northerly than the sole distribution areas. Juveniles are concentrated in shallow inshore waters and move gradually offshore as they become larger. The nursery areas on the eastern side of the North Sea contribute most of the total recruitment. Sub-populations have strong homing behavior to specified spawning grounds and rather low mixing rate with other sub-populations during the feeding season.

Juvenile plaice have been distributed more offshore in recent years. Surveys in the Wadden Sea have shown that 1-group plaice are almost absent in areas where they were very abundant in earlier years. This could be linked to environmental changes in the productivity or changes in the temperature of the southern North Sea, but these links have not been shown conclusively. The distribution shift of plaice may be the cause of the different abundance estimates in the different tuning series used in the assessment.

Information from the fishing industry

A self-sampling programme by the Dutch beam-trawl fleet has been in place since 2004. This sampling programme indicates spatial and temporal trends in discarding (higher discards are observed in coastal regions and late summer), but it was considered unreliable for overall estimates of discarding because of differences in the implementations of sampling methods. In 2009, a new self-sampling programme was launched to address this. For the 2009 and 2010 assessments, discarded numbers-at-age for the Netherlands have been estimated using data from both the self-sampling and the observer programmes. It is noted that estimates of discard numbers in 2010 differed considerably between the two programmes.

The Fishers’ North Sea stock survey again took place in 2010 (Napier, 2011; Figure 6.4.7.4).

About two-thirds of respondents (68%) reported that plaice were ‘more’ or ‘much more’ abundant in 2010 than in 2009. The overall perceptions of the fishing industry reflect the high abundances of plaice estimated by ICES.

Uncertainties in assessment and forecast

The different survey tuning series in different areas of the North Sea indicate opposite trends for the 1–3 year old plaice in the most recent development of the stock, both in terms of recruitment and SSB. The change in distribution of juvenile plaice further offshore has resulted in conflicting estimates of abundance between the SNS survey (mainly inshore) and the Tridens and BTS-Isis surveys (offshore). This resulted in a persistent underestimation of recruits, which were then revised upwards in subsequent years as signs of abundance in old age classes became apparent. This historical pattern has not been present the last two years.

The estimated increase in SSB is a consequence of an increase in plaice observed in the survey in the northwestern part of the North Sea. The surveys in the southeastern part indicate that the stock has increased less. This has previously resulted in a relatively strong retrospective pattern, a pattern that has diminished in the last year. The different trends in abundance in the two areas may indicate a change in distribution of older plaice, as has also been observed for juvenile plaice. However, it may also be explained by different exploitation rates in the two areas, with individual plaice in the more northern part being more susceptible to a much lower fishing mortality.

Following the conclusion of the flatfish benchmark (ICES, 2010) it is recommended to explore the potential to perform an integrated assessment of the continuum of plaice stocks from the Baltic to the English Channel. It is suggested that a dedicated Study Group be established, investigating the issues of identification, assessment, and management of the stocks of plaice from the Baltic to the English Channel.

Discards form a substantial part of the total catch. Improving discard estimates over the time-series would greatly improve the assessment retrospective.

Management objectives

The EU adopted a management plan for flatfish in the North Sea in June 2007 (Council Regulation (EC) No. 676/2007, see Annex 6.4.10). This plan has two stages. The first stage aims at an annual 10% reduction of fishing mortality in relation to the fishing mortality estimated for the preceding year until an F of 0.6 is reached, with a maximum change in TAC of 15% until the precautionary reference points have been reached for both sole and plaice for two successive years. 2011 is the second year with sole and plaice simultaneously within safe biological limits.

In the second stage, the management plan aims for exploitation of plaice at F = 0.3.

In a recent evaluation of the management plan it was concluded that this plan is precautionary (ICES, 2010).

Comparison with previous assessment and advice

The 2011 assessment is in very close agreement with that of 2010. In 2010 advice was based on the precautionary and MSY approach, in 2011 the advice is based on the EU management plan.

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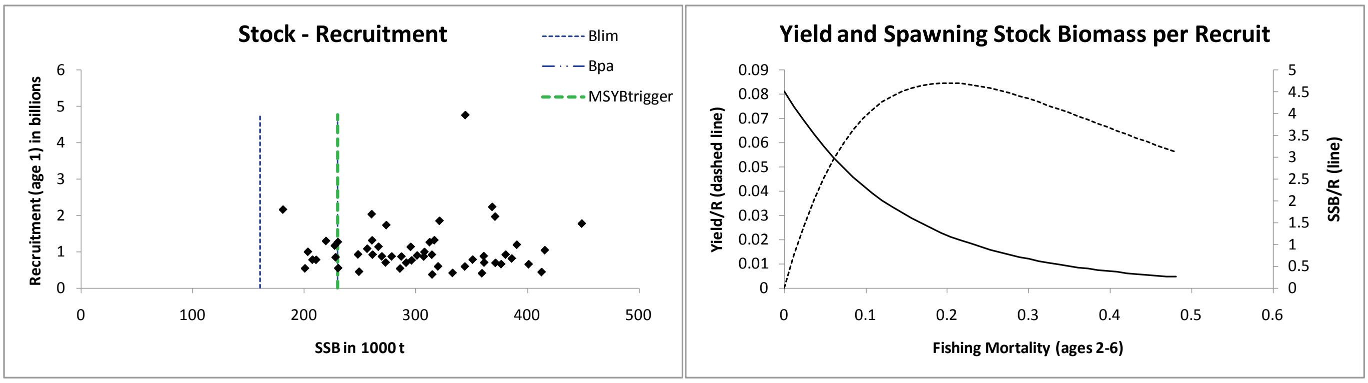


Figure 6.4.7.3 Plaice in Subarea IV (North Sea). Stock–recruitment plot and yield-per-recruit analysis.

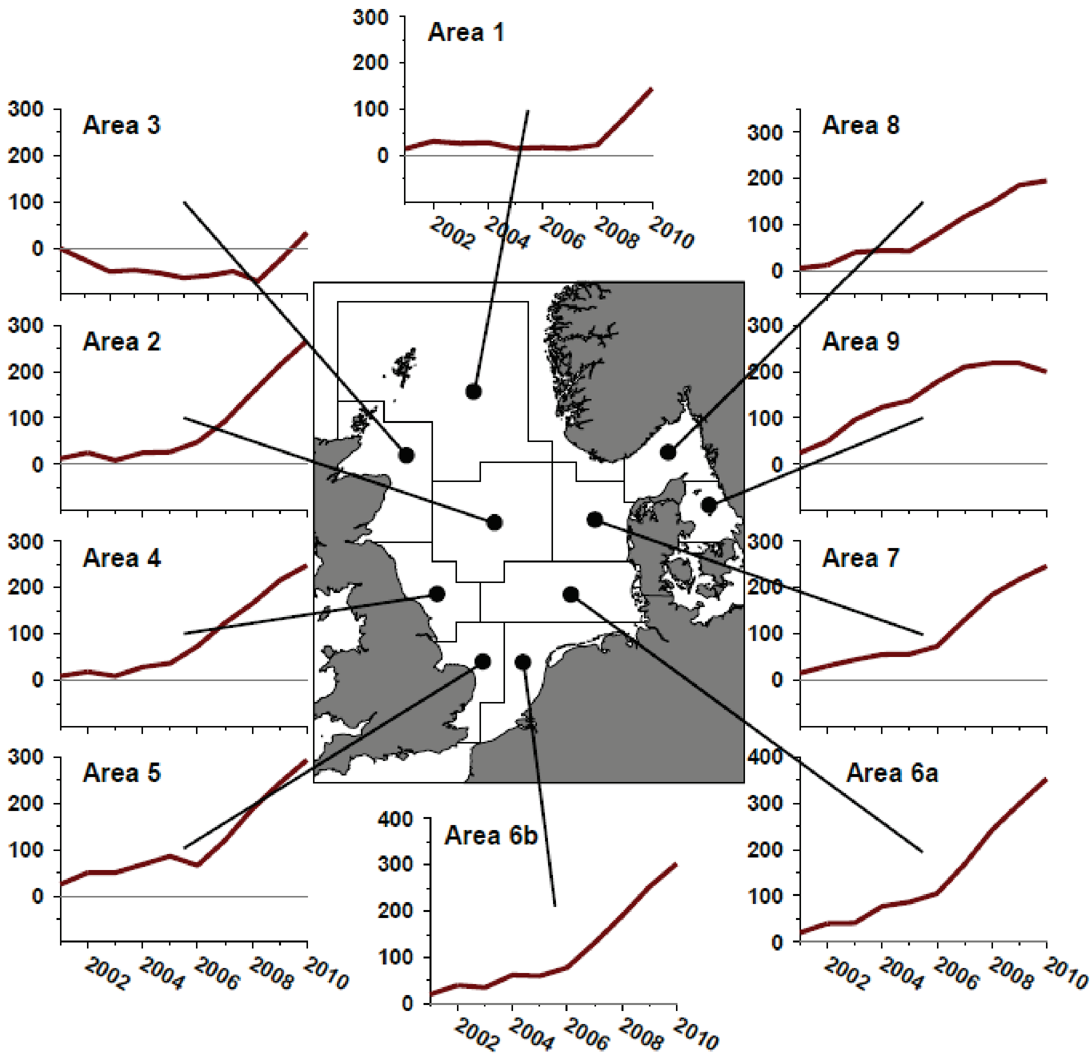


Figure 6.4.7.4 Plaice in Subarea IV (North Sea). Abundance estimates by the North Sea Commission fisher's survey 2010.

Table 6.4.7.1 Plaice in Subarea IV (North Sea). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC	Official landings	ICES landings
1987	F<F(84); TAC	120	150	131	154
1988	70% of F(85); TAC	150	175	138	154
1989	Reduce F; Buffer SSB	<175	185	152	170
1990	*status quo* F; TAC	171	180	156	156
1991	No increase in F; TAC	169	175	144	148
1992	No long-term gains in increasing F	-[1]	175	123	125
1993	No long-term gains in increasing F	170[1]	175	115	117
1994	No long-term gains in increasing F	-[1]	165	110	110
1995	Significant reduction in F	87[2]	115	96	98
1996	Reduction in F of 40%	61	81	80	82
1997	Reduction in F of 20%	80	91[3]	82	83
1998	Fish at F=0.3	82	87	70	72
1999	Fish at F=0.3	106	102	79	81
2000	Fish at F=0.3	95	97	84	81
2001	Fish at F=0.26	78	78	80	82
2002	$F<F_{pa}$	<77	77	70	70
2003	Fish at F=0.23	60[4]	73	66	67
2004	Recovery plan		61	61	61
2005	Rebuild the SSB above B_{pa} in 2006	35[4]	59	55	56
2006	Rebuild the SSB above B_{pa} in 2007	48[4]	57	56	58
2007	Rebuild the SSB above B_{pa} in 2008	<32[4]	50	49	50
2008	Rebuild the SSB above B_{pa} in 2009	<35[4]	49	48	49
2009	Limit total landings to 55 500 t	< 55.5[4]	55.5	NA	55
2010	Limit total landings to 63 825 t	< 63.8[4]	63.8	51	61
2011	See scenarios	< 64.2	73.4		
2012	Apply first stage of the management plan	< 84.410			

Weights in ‘000t.
1) Catch at *status quo* F.
2) Catch at 20% reduction in F.
3) After revision from 77 000 t.
4) Landings.
NA = not available.

Table 6.4.7.2 Plaice in Subarea IV (North Sea). Nominal landings by country and area (tonnes).

YEAR	Belgium	Denmark	France	Germany	Netherlands	Norway	Sweden	UK	Others	Total	Unallocated	WG estimate	TAC
1980	7005	27057	711	4319	39782	15	7	23032		101928	38023	139951	
1981	6346	22026	586	3449	40049	18	3	21519		93996	45701	139697	105000
1982	6755	24532	1046	3626	41208	17	6	20740		97930	56616	154546	140000
1983	9716	18749	1185	2397	51328	15	22	17400		100812	43218	144030	164000
1984	11393	22154	604	2485	61478	16	13	16853		114996	41153	156149	182000
1985	9965	28236	1010	2197	90950	23	18	15912		148311	11527	159838	200000
1986	7232	26332	751	1809	74447	21	16	17294		127902	37445	165347	180000
1987	8554	21597	1580	1794	76612	12	7	20638		130794	22876	153670	150000
1988	11527	20259	1773	2566	77724	21	2	24497	43	138412	16063	154475	175000
1989	10939	23481	2037	5341	84173	321	12	26104		152408	17410	169818	185000
1990	13940	26474	1339	8747	78204	1756	169	25632		156261	-21	156240	180000
1991	14328	24356	508	7926	67945	560	103	27839		143565	4438	148003	175000
1992	12006	20891	537	6818	51064	836	53	31277		123482	1708	125190	175000
1993	10814	16452	603	6895	48552	827	7	31128		115278	1835	117113	175000
1994	7951	17056	407	5697	50289	524	6	27749		109679	713	110392	165000
1995	7093	13358	442	6329	44263	527	3	24395		96410	1946	98356	115000
1996	5765	11776	379	4780	35419	917	5	20992		80033	1640	81673	81000
1997	5223	13940	254	4159	34143	1620	10	22134		81483	1565	83048	91000
1998	5592	10087	489	2773	30541	965	2	19915	1	70365	1169	71534	87000
1999	6160	13468	624	3144	37513	643	4	17061		78617	2045	80662	102000
2000	7260	13408	547	4310	35030	883	3	20710		82151	-1001	81150	97000
2001	6369	13797	429	4739	33290	1926	3	19147		79700	2147	81847	78000
2002	4859	12552	548	3927	29081	1996	2	16740		69705	512	70217	77000
2003	4570	13742	343	3800	27353	1967	2	13892		65669	820	66489	73250
2004	4314	12123	231	3649	23662	1744	1	15284		61008	428	61436	61000
2005	3396	11385	112	3379	22271	1660	0	12705		54908	792	55700	59000
2006	3487	11907	132	3599	22764	1614	0	12429		55933	2010	57943	57441
2007	3866	8128	144	2643	21465	1224	4	11557		49031	713	49744	50261
2008	3396	8229	125	3138	20312	1051	20	11411		47682	1193	48875	49000
2009	3474	N/A*	N/A*	2931	29142	1116	1	13143		N/A*	-	54973	55500
2010	3699	435	383	3601	26689	1089	5	14765		50666	10008	60674	63825
2011													73400

* Official estimates not available.

Table 6.4.7.3 Plaice in Subarea IV (North Sea). Summary of stock assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Discards tonnes	Mean F Ages 2–6
1957	458000	273000	70563	7880	0.269
1958	698000	287100	73354	14837	0.321
1959	863000	296300	79300	29864	0.367
1960	757000	307200	87541	29793	0.368
1961	861000	319900	85984	32490	0.348
1962	589000	371300	87472	37903	0.390
1963	688000	368400	107118	41258	0.423
1964	2232000	361200	110540	37031	0.469
1965	695000	343900	97143	43080	0.388
1966	587000	359200	101834	64718	0.399
1967	401000	412600	108819	54546	0.429
1968	434000	401000	111534	27987	0.336
1969	649000	376400	121651	21169	0.345
1970	651000	332900	130342	29640	0.480
1971	410000	314700	113944	22995	0.382
1972	367000	316600	122843	19632	0.412
1973	1312000	266600	130429	13354	0.466
1974	1133000	278400	112540	44945	0.491
1975	865000	291400	108536	86699	0.561
1976	693000	307700	113670	53247	0.416
1977	989000	314400	119188	57501	0.510
1978	912000	301200	113984	45655	0.469
1979	891000	295400	145347	67935	0.674
1980	1129000	269600	139951	31080	0.557
1981	866000	260500	139747	33031	0.538
1982	2031000	260900	154547	49127	0.602
1983	1308000	312400	144038	74483	0.593
1984	1259000	321200	156147	70816	0.583
1985	1848000	344300	159838	60549	0.530
1986	4765000	371000	165347	129953	0.661
1987	1964000	448600	153670	190524	0.692
1988	1771000	390400	154475	156423	0.666
1989	1187000	415500	169818	107793	0.608
1990	1037000	380400	156240	71225	0.566
1991	915000	350900	148004	80935	0.647
1992	777000	285900	125190	57049	0.630
1993	531000	249200	117113	35016	0.638
1994	443000	227500	110392	23785	0.616
1995	1164000	219600	98356	21828	0.642
1996	1291000	181100	81673	52049	0.671
1997	2157000	207500	83048	100145	0.790
1998	775000	228200	71534	103751	0.729
1999	842000	203400	80662	70976	0.660
2000	992000	230500	81148	44311	0.463
2001	542000	273600	81963	100309	0.763
2002	1729000	200800	70217	54390	0.571
2003	535000	230200	66502	77792	0.603
2004	1261000	210800	61436	54466	0.476
2005	771000	248300	55700	53876	0.400
2006	920000	256500	57943	61846	0.369
2007	1078000	261300	49744	39435	0.313
2008	915000	360800	48874	45875	0.242
2009	873000	385900	54973	45225	0.228
2010	808000	460700	60674	45817	0.240
2011	915399	522891			
Average	1046080	310313	106530	56075	0.500

6.4.7 Appendix

Extract from Council Regulation (EC) No 676/2007 of 11 June 2007 establishing a multiannual plan for fisheries exploiting stocks of plaice and sole in the North Sea:

Article 2 Safe biological limits

1. *For the purposes of this Regulation, the stocks of plaice and sole shall be deemed to be within safe biological limits in those years in which, according to the opinion of the Scientific, Technical, and Economic Committee for Fisheries (STECF), all of the following conditions are fulfilled:*
    (a) the spawning biomass of the stock of plaice exceeds 230 000 tonnes;
    (b) the average fishing mortality rate on ages two to six years experienced by the stock of plaice is less than 0,6 per year;
    (c) the spawning biomass of the stock of sole exceeds 35 000 tonnes;
    (d) the average fishing mortality rate on ages two to six years experienced by the stock of sole is less than 0,4 per year.
2. *If the STECF advises that other levels of biomass and fishing mortality should be used to define safe biological limits, the Commission shall propose to amend paragraph 1*

Article 3 Objectives of the multiannual plan in the first stage

1. *The multiannual plan shall, in its first stage, ensure the return of the stocks of plaice and of sole to within safe biological limits.*
2. *The objective specified in paragraph 1 shall be attained by reducing the fishing mortality rate on plaice and sole by 10 % each year, with a maximum TAC variation of 15 % per year until safe biological limits are reached for both stocks.*

Article 4 Objectives of the multiannual plan in the second stage

1. *The multiannual plan shall, in its second stage, ensure the exploitation of the stocks of plaice and sole on the basis of maximum sustainable yield.*
2. *The objective specified in paragraph 1 shall be attained while maintaining the fishing mortality on plaice at a rate equal to or no lower than 0,3 on ages two to six years.*
3. *The objective specified in paragraph 1 shall be attained while maintaining the fishing mortality on sole at a rate equal to or no lower than 0,2 on ages two to six years.*

Article 5 Transitional arrangements

1. *When the stocks of plaice and sole have been found for two years in succession to have returned to within safe biological limits the Council shall decide on the basis of a proposal from the Commission on the amendment of Articles 4(2) and 4(3) and the amendment of Articles 7, 8 and 9 that will, in the light of the latest scientific advice from the STECF, permit the exploitation of the stocks at a fishing mortality rate compatible with maximum sustainable yield.*

Article 7 Procedure for setting the TAC for plaice:

1) *The Council shall adopt the TAC for plaice at that level of catches which, according to a scientific evaluation carried out by STECF is the higher of:*
    a) *that TAC the application of which will result in a 10 % reduction in the fishing mortality rate in its year of application compared to the fishing mortality rate estimated for the preceding year;*
    b) *that TAC the application of which will result in the level of fishing mortality rate of 0.3 on ages two to six years in its year of application.*
2) *Where application of paragraph 1 would result in a TAC which exceeds the TAC of the preceding year by more than 15 %, the Council shall adopt a TAC which is 15 % greater than the TAC of that year.*
3) *Where application of paragraph 1 would result in a TAC which is more than 15 % less than the TAC of the preceding year, the Council shall adopt a TAC which is 15 % less than the TAC of that year.*

6.4.8 Advice June 2011

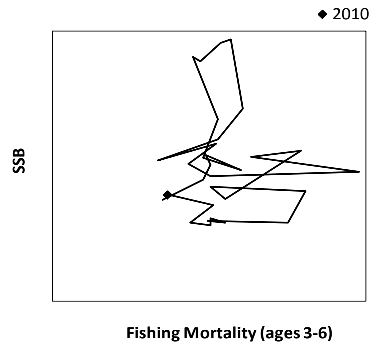
ECOREGION North Sea
STOCK Plaice in Division VIId (Eastern Channel)

Advice for 2012

ICES advises on the basis of precautionary considerations that catches of plaice should not be allowed to increase in 2012, and discarding should be reduced.

Stock status

F (Fishing Mortality)		
		2008-2010
MSY (F_{MSY})		Unknown
Precautionary approach (F_{pa},F_{lim})		Unknown
Qualitative evaluation		Indications of reduction
SSB (Spawning-Stock Biomass)		
		2009-2011
MSY ($B_{trigger}$)		Unknown
Precautionary approach (B_{pa},B_{lim})		Unknown
Qualitative evaluation		Slight increase, from lowest level



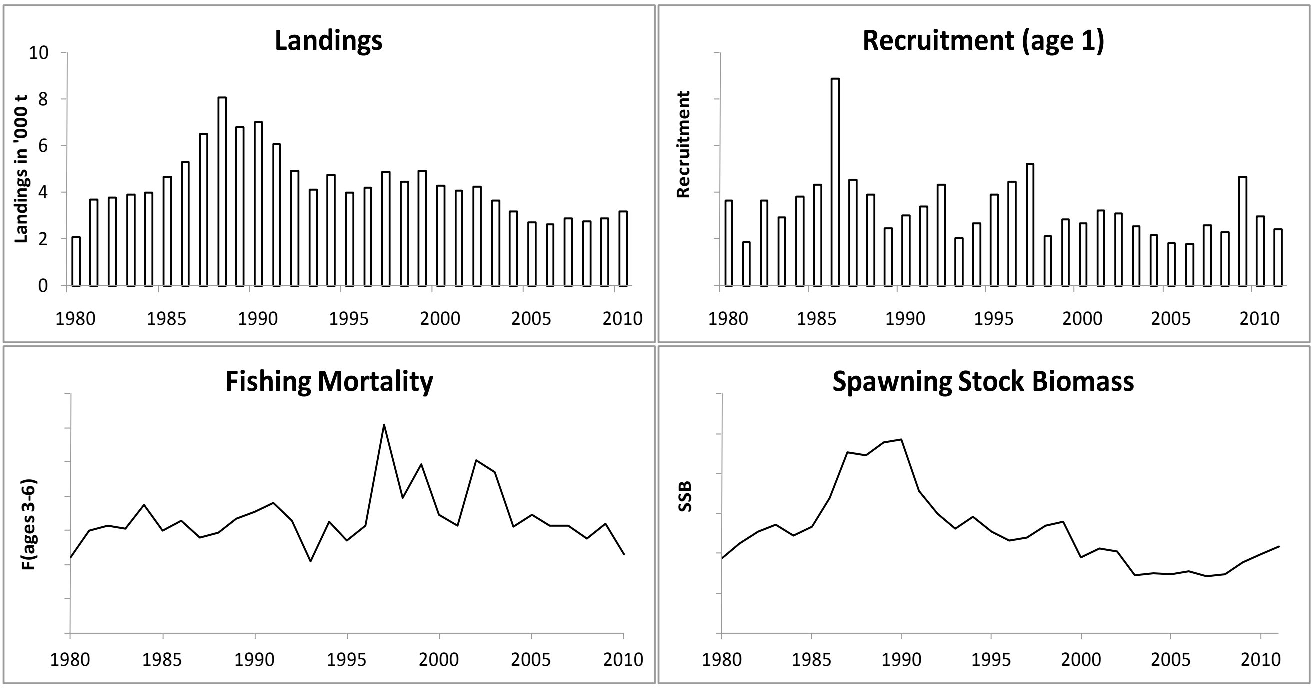


Figure 6.4.8.1 Plaice in Division VIId (Eastern Channel). Summary of stock trends (weights in '000 tonnes, Y-axis starts at 0). Top right: SSB and F over the years.

The assessment is to be used only for trends. Fishing mortality has declined since the mid 1990s and is presently among the lowest in the time-series. Spawning-stock biomass declined from the 1990s to a record low (2003–2008) and has subsequently slightly increased.

Management plans

No specific management objectives are known to ICES.

Biology

Plaice aggregate at spawning grounds in the first quarter of the year. The condition factor for plaice is highest in summer/autumn on the more dispersed feeding grounds. Tagging studies show that spawning migrations from Division VIIe and Subarea IV occur during the first quarter of the year. Based on these published tagging results and previous studies, the catch-at-age is adjusted in this year's assessment. It is assumed that first quarter plaice catch in Division VIId consists of 50% fish coming from North Sea to spawn in Division VIId and 15% fish from Division VIIe. Suitable sites for nurseries are located in shallow waters, close to fresh and cool seasonal water input.

Environmental influence on the stock

It has been shown that the biodiversity and distribution of the benthic community in the eastern English Channel is strongly correlated with the environmental conditions. The substratum type is a major factor in determining plaice distribution, especially in the juvenile stage.

The fisheries

Plaice is mainly caught in 80 mm beam-trawl (Belgian and English) fisheries for sole or in mixed demersal fisheries using otter trawls (mainly French). There is also a directed fishery during parts of the year by inshore trawlers and netters. Fisheries operating on the spawning aggregation in the beginning of the year catch plaice that originate from the North Sea, Divisions VIId and VIIe components. Since the 80 mm mesh size does not match the minimum landing size for plaice (27 cm), a large number of undersized plaice are discarded, but no discard time-series is available yet.

Catch by fleet	Total landings of plaice in Division VIId (2010) = 3.81 kt (55% beam trawl, 35% otter trawl, 7% trammelnets, and 3% other gears).

Effects of the fisheries on the ecosystem

The mixed plaice and sole fishery is dominated by bottom trawls, with bycatch of both commercial and non-commercial species and a physical impact on the seabed. Bottom trawling impacts biomass, production, and species richness.

Quality considerations

The time-series of discards is not yet long enough to be used in an analytical assessment. Survey information indicates percentages of discards up to 50% in number, depending on the trip and on fishing practices.

There is also uncertainty about the stock structure due to large migration between this area and the North Sea and the western Channel during the spawning period.

Scientific basis

Assessment type	Trends-based assessment (XSA).
Input data	Three survey indices (UK-BTS, FGFS, YFS until 2007); one commercial indices: Belgian beam-trawler commercial fleets.
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Last benchmark performed in 2010.
Working group report	WGNSSK

ECOREGION North Sea
STOCK Plaice in Division VIId (Eastern Channel)

Reference points

No reference points are defined for this stock.

Outlook for 2012

No reliable assessment can be presented for this stock (ICES, 2010a). Additional work is required to allow the incorporation of discards estimates in the assessment, improve the relevance of the commercial tuning series, and examine the sensitivity of the assessment to the 65% adjustment to the Q1 catch-at-age. Therefore, no forecast is presented.

Precautionary considerations

The SSB is considered to be slightly increasing in recent years, while the exploitation rate is being reduced. Therefore, catches of plaice should not be allowed to increase and measures to reduce discarding should be introduced.

Additional considerations

The effects of regulations

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

In previous years, effort from the beam-trawl fleet has hardly been restricted. The effort reductions implemented by EU Council Regulation (EC) Nos. 43/2009, 53/2010, and 57/2011 vary between countries at around 5–10% each year, in line with the effort reductions applied in the North Sea for the sole/plaice management plan (Council Regulation (EC) N° 676/2007).

Uncertainties in assessment and forecast

There is uncertainty about the stock structure. Tagging studies show that there is adult migration between the North Sea and the Channel during the spawning period (e.g. Burt *et al.,* 2006; Hunter *et al*., 2004; Kell *et al.,* 2004). These studies showed that 65% of the plaice caught during the first quarter in Division VIId were migrants from the North Sea and Division VIIe. For the assessment, the catch statistics for the first quarter of the year are adjusted accordingly.

The available information also suggests that plaice may migrate from Division VIId into Division VIIe and the North Sea after spawning.

Following the conclusion of the flatfish benchmark (ICES, 2010a) it is recommended to explore the potential for performing an integrated assessment of the continuum of plaice stocks from the Baltic to the English Channel. It is suggested that a dedicated Study Group be established, investigating the issues of identification, assessment, and management of the stocks of plaice from the Baltic to the English Channel.

Routine discard sampling began in 2003 following the introduction of the EU Data Collection Regulation and indicates percentages of discards up to 50% in number, depending on the trip and on fishing practices. However, the time-series of discards is not yet long enough to be used in an analytical assessment.

Comparison with previous assessment and advice

Last year’s advice was based on MSY and precautionary considerations. This year the advice is based on precautionary considerations.

Assessment and management area

The stock is assessed for ICES Division VIId but is managed for ICES Divisions VIId and VIIe combined. The advice for Division VIIe plaice can be found in Section 5.4.9 .

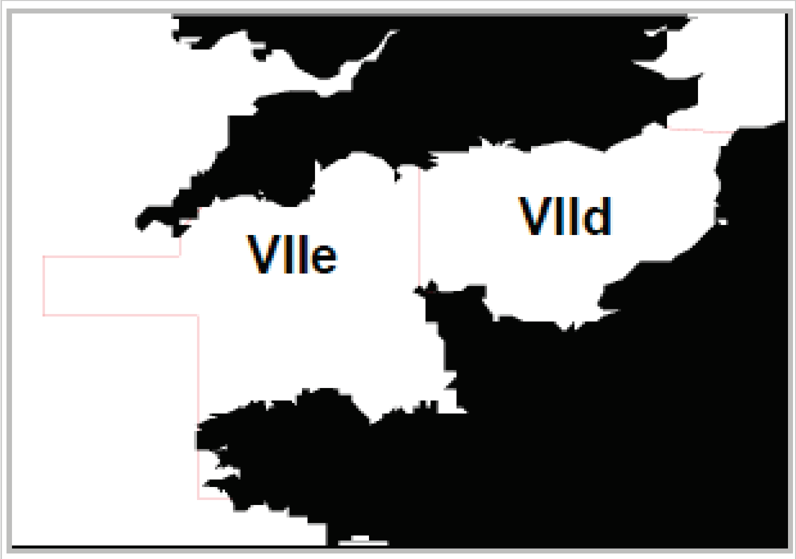


Figure 6.4.8.2 Plaice in Division VIId (Eastern Channel). Assessment in Division VIId and TAC area Divisions VIId,e.

Sources

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Table 6.4.8.1 Plaice in Division VIId (Eastern Channel). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch	Agreed TAC[1]	Official Landings[4]	ICES landings[4]
1987	Precautionary TAC[1]	6.8[1]	8.3	7.9	8.4
1988	Precautionary TAC[1]	6.9[1]	9.96	9.1	10.4
1989	No increase in effort[1]	11.7[1]	11.7	6.7[2]	8.8
1990	No increase in F; TAC	10.7[1]	10.7	7.8[2]	9.0
1991	TAC	8.8[1]	10.7	7.4[2]	7.8
1992	*Status quo* F gives mean SSB	7.6[3]	9.6	6.2	6.3
1993	Within safe biological limits	6.4[3]	8.5	4.8	5.3
1994	No long-term gains in increased F	-	9.1	5.6	6.1
1995	No increase in F	5.6	8.0	4.6	5.1
1996	No long-term gains in increasing F	6.5	7.53	4.6	5.4
1997	No advice	-	7.09	5.3	6.3
1998	Reduce F in 98 by 30% from 96 value	4.3	5.7	4.8	5.8
1999	Fishing at F_{pa}	6.3	7.4	5.4	6.3
2000	Fishing at F_{pa}	4.9	6.5	5.2	6.0
2001	Fishing at $<F_{pa}$	<4.4	6.0	5.0	5.3
2002	Fishing at $<F_{pa}$	<5.8	6.7	5.5	5.8
2003	Fishing at $<F_{pa}$	<5.3	6.0	4.6	4.5
2004	Fishing at $<F_{pa}$ [*)]	<5.4	6.06	4.3	4.0
2005	Fishing at $<F_{\mathbf{pa}}$ [*)]	<4.4	5.15	3.7	3.4
2006	No effort increase [*)]		5.15	3.5	3.3
2007	Average landings [*)]	<4.0	5.08	3.8	3.7
2008	Average landings [*)]	<3.5	5.05	3.6	3.5
2009	Average landings (2006–2008) [*)]	<3.5	4.64	3.4	3.5
2010	Average landings (2007–2009)	<3.5	4.274	3.8	3.8
2011	Average landings (2008–2010)	<3.5	4.665		
2012	No increase in catches and reduce discards	-			

Weights in '000 t.
[1]TACs for Divisions VIId,e.
[2]For France Division VIId landings are estimated by ICES from the combined Divisions VIId,e landings.
[3] Catch at *status quo* F.
[4] Tota Division VIId, taking into account fish caught in the first quarter in Division VIId that come from Division VIIe and Subarea IV to spawn.
[*)] Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.

Table 6.4.8.2 Plaice in Division VIId (Eastern Channel). Catches/landings by country (in t) as officially reported and as estimated by ICES.

Year	Belgium	Denmark	France	UK(E+W)	Others	Total reported	Un-allocated	Total landings VIId	Quarter1 removal	Total as used by WG [5]	Total landings reported in VIIe [6]	Agreed TAC [4]
1976	147	1[1]	1439	376	-	1963	-	1963		1963	640	
1977	149	81[2]	1714	302	-	2246	-	2246		2246	702	
1978	161	156[2]	1810	349	-	2476	-	2476		2476	784	
1979	217	28[2]	2094	278	-	2617	-	2617		2617	977	
1980	435	112[2]	2905	304	-	3756	-1106	2650	590	2060	1215	
1981	815	-	3431	489	-	4735	34	4769	1063	3706	1746	
1982	738	-	3504	541	22	4805	60	4865	1084	3781	1938	
1983	1013	-	3119	548	-	4680	363	5043	1124	3919	1754	
1984	947	-	2844	640	-	4431	730	5161	1151	4011	1813	
1985	1148	-	3943	866	-	5957	65	6022	1342	4680	1751	
1986	1158	-	3288	828	488 [2]	5762	1072	6834	1523	5311	2161	
1987	1807	-	4768	1292	-	7867	499	8366	1864	6502	2388	8300
1988	2165	-	5688 [2]	1250	-	9103	1317	10420	2322	8098	2994	9960
1989	2019	+	3265 [1]	1383	-	6667	2091	8758	1951	6807	2808	11700
1990	2149	-	4170 [1]	1479	-	7798	1249	9047	2016	7031	3058	10700
1991	2265	-	3606 [1]	1566	-	7437	376	7813	1741	6072	2250	10700
1992	1560	1	3099	1553	19	6232	105	6337	1412	4925	1950	9600
1993	877	+[2]	2792	1075	27	4771	560	5331	1188	4143	1691	8500
1994	1418	+	3199	993	23	5633	488	6121	1364	4757	1471	9100
1995	1157	-	2598 [2]	796	18	4569	561	5130	1143	3987	1295	8000
1996	1112	-	2630 [2]	856	+	4598	795	5393	1202	4191	1321	7530
1997	1161	-	3077	1078	+	5316	991	6307	1435	4872	1654	7090
1998	854	-	3276 [2,3]	700	+	4830	932	5762	1295	4467	1430	5700
1999	1306	-	3388 [2,3]	743	+	5437	889	6326	1375	4951	1616	7400
2000	1298	-	3183	752	+	5233	781	6014	1721	4293	1678	6500
2001	1346	-	2962	655	+	4963	303	5266	1183	4083	1379	6000
2002	1204		3454	841		5499	278	5777	1521	4256	1608	6700
2003	998	-	2893	756	3	4650	-114	4536	871	3665	1478	6000
2004	954		2766	582	10	4312	-305	4007	824	3183	1402	6060
2005	832		2432	421	21	3706	-260	3446	724	2722	1370	5150
2006	1024		1935	549	17	3525	-220	3305	662	2643	1466	5080
2007	1355		2017	461	12	3845	-171	3674	785	2889	1184	5050
2008	1386		1740	466	17	3609	-118	3491	728	2763	1144	4646
2009	1002		1802	612	16	3432	71	3503	614	2889	1043	4274
2010	1123		2106	515	60	3804	8	3812	635	3177		4665

1 Estimated by the working group from combined Division VIId+e.
2 Includes Division VIIe.
3 Provisional.
4 TACs for Divisions VII d, e.
5 Takes into account the removal of 65% of the Quarter 1 catches.
6 Plaice in Division VIIe. Nominal landings (t) in Division VIIe, as used by ICES.

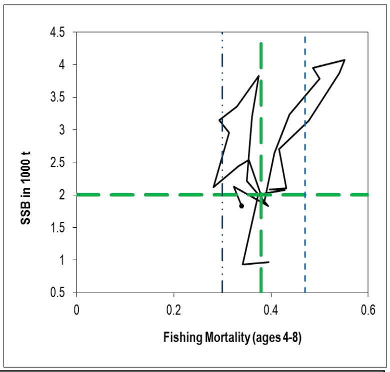
ECOREGION North Sea
STOCK Sole in Division IIIa and Subdivisions 22-24 (Skagerrak, Kattegat, and the Belts)

Advice for 2012

ICES advises on the basis of the MSY approach that landings in 2012 should be no more than 610 t.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	✗	✓	✓	Below target
Precautionary approach (F_{pa},F_{lim})	✗	O	O	Increased risk
SSB (Spawning-Stock Biomass)	**2009**	**2010**	**2011**	
MSY ($B_{trigger}$)	✓	✗	✗	Below target
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined



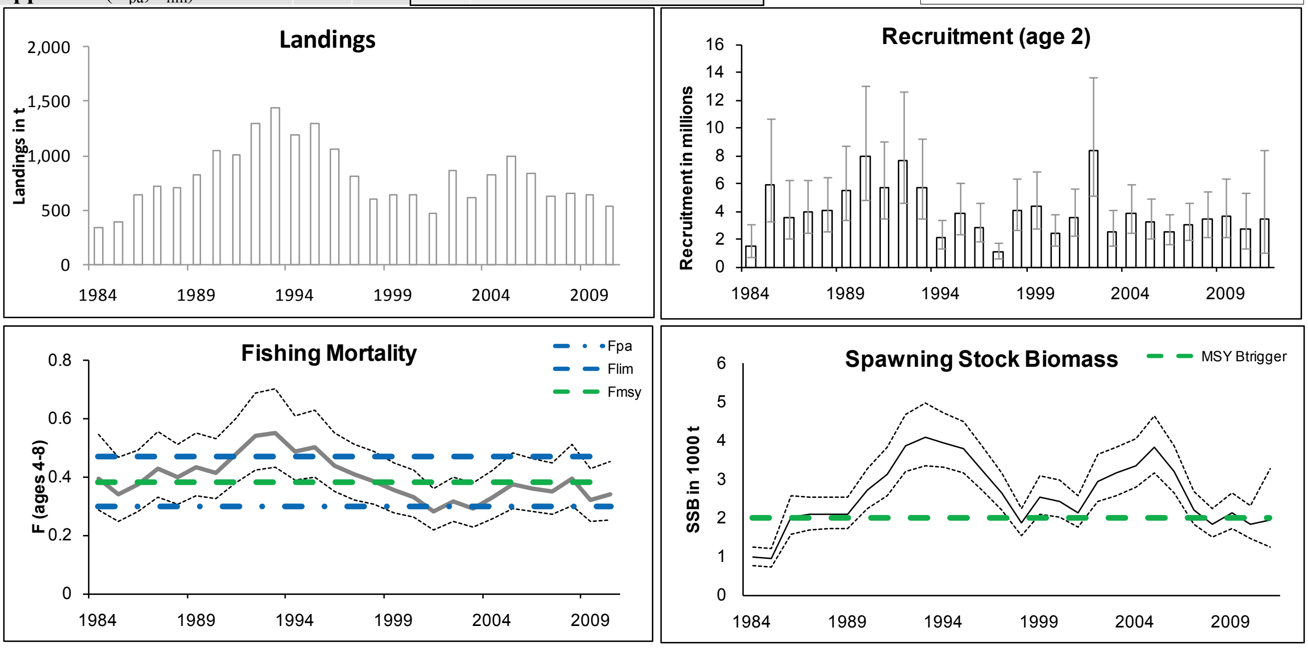


Figure 6.4.9.1 Sole in Division IIIa and Subdivisions 22–24. Summary of stock assessment (weights in '000 tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Top right: SSB and F over the years.

SSB has decreased from 2005, and has fluctuated around MSY $B_{trigger}$ since 2008. Fishing mortality has been stable since 2005, just below F_{MSY}. Recruitment has been about average since 2003.

Management plans

No specific management objectives are known to ICES.

Biology

Sole is a nocturnal predator and therefore more susceptible to capture by fisheries at night than in daylight.

The fisheries

Sole is taken in a directed trawl fishery with bycatch of *Nephrops*, plaice and cod, the main season being in autumn–winter. Also, sole is taken as bycatch in the *Nephrops* trawl fishery. In addition there is a directed gillnet fishery for sole, mainly in Skagerrak in spring and summer.

Catch by fleet	Total catch (2010) = 538 t, where 98% are landings (43% trawl, 43% gillnets, and 14% unknown) and 2% discards.

Quality considerations

Sampling of landings is considered insufficient and this contributes to the uncertainty of the assessment estimates. The 2010 assessment model provides confidence limits on the final estimates, which is an improvement over the previous model. Introduction of a survey designed for sole improves fishery-independent information. The inclusion of information from the Western Baltic (Subdivisions 22–24) into the assessment has improved the coverage of the complete population entity.

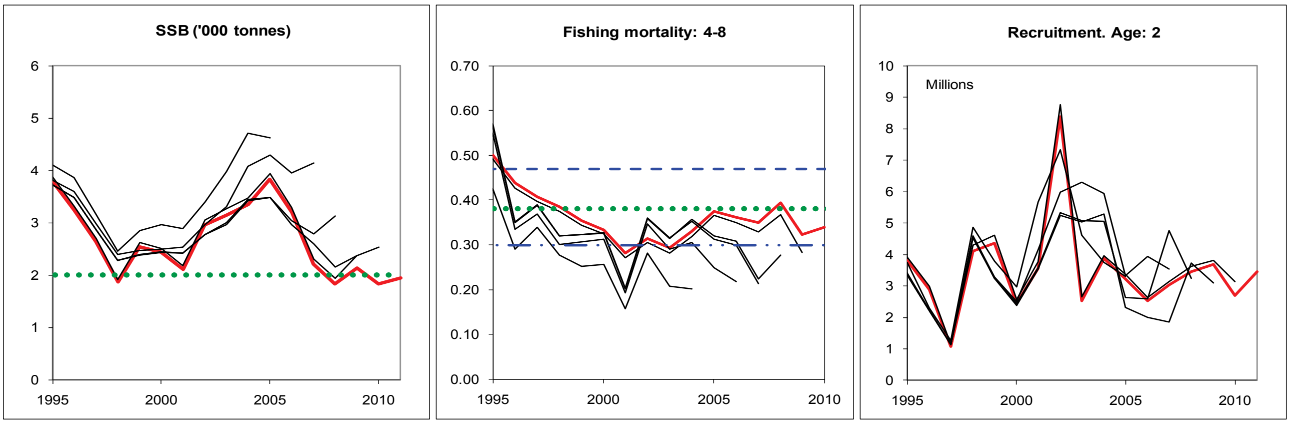


Figure 6.4.9.2 Sole in Division IIIa and Subdivisions 22–24. Historical performance of the assessments. The assessments before 2009 do not include Subdivisions 22–24.

Scientific basis

Assessment type	Age-based analytical stochastic assessment (SAM).
Input data	One survey index (Fisherman-DTU Aqua survey); three commercial cpue indices (official logbook trawlers, private logbook trawlers, and gillnetters).
Discards and bycatch	Not included –approximately 2%.
Indicators	None.
Other information	Benchmark done in 2010 (WKFLAT 2010).
Working group report	WGBFAS

ECOREGION North Sea
STOCK Sole in Division IIIa and Subdivisions 22-24 (Skagerrak, Kattegat, and the Belts)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	2000 t	lowest observed SSB excluding 1984-85 low SSB's (WKFLAT 2010).
	F_{MSY}	0.38	Provisional value based on Stochastic simulations. F associated with highest yield and low prob. of SSB<Btrigger (WKFLAT 2010).
Precautionary Approach	B_{lim}	Undefined.	
	B_{pa}	Undefined.	
	F_{lim}	0.47	F_{med} 98 excluding the abnormal years around 1990.
	F_{pa}	0.30	Consistent with F_{lim}.

(unchanged since 2010)

Yield and spawning biomass per Recruit F-reference points (2011):

	Fish Mort Ages 4–8	Yield/R	SSB/R
Average last 3 years	0.35	0.20	0.73
F_{max}*	-	-	-
$F_{0.1}$	0.20	0.18	1.08
$F_{35\%SPR}$	0.21	0.18	1.05

* F_{max} is not well defined.

Outlook for 2012

Basis: F2011 = F_{sq} = mean F(2008–10) unscaled = 0.35; SSB (2012) = 1.91 kt; R (2011) = GM(1994-2008) = 3444; landings (2011) = 0.56 kt.

Rationale	**Landings (2012)**	**Basis**	**F (2012)**	**SSB (2013)**	**%SSB change** [1]	**%TAC change** [2]
MSY framework	0.61	F_{MSY} *SSB_{2012}/MSY $B_{trigger}$	0.36	1.99	+ 6%	-8%
Precautionary approach	0.52	Fpa = F_{2011}*0.85	0.30	2.20	+ 10%	-21%
Zero catch	0.00	F_{2011}*0.0	0.00	2.73	+ 37%	-100%
Status quo	0.32	F_{2011}*0.5	0.18	2.40	+ 20%	-52%
	0.57	F_{2011}*0.93	0.33	2.15	+ 8%	-15%
	0.60	F_{2011}	0.35	2.12	+ 6%	-10%
	0.62	F_{2011}*1.05	0.37	2.09	+ 5%	-6%
	0.64	F_{MSY}	0.38	2.08	+ 4%	-10%
	0.65	F_{2011}*1.1	0.39	2.07	+ 4%	-2%
	0.66	F_{2011}* 1.13	0.40	2.05	+ 3%	0%

Weights in '000 tonnes.
[1] SSB 2013 relative to SSB 2012.
[2] Landings 2012 relative to TAC 2011.

MSY approach

Because SSB in the beginning of 2012 is below MSY $B_{trigger}$, the ICES MSY framework implies a fishing mortality of F_{MSY} *SSB_{2012}/MSY $B_{trigger}$ of 0.36. This results in landings of no more than 610 t in 2012. This is expected to lead to an SSB of 2 000 t in 2013.

PA approach

The fishing mortality in 2011 should be no more than F_{pa}, corresponding to landings of no more than 520 t in 2012.

Additional considerations

For the majority of sole stocks assessed by ICES an F_{MSY} is defined around 0.25. For Kattegat sole the F_{MSY} is estimated considerably higher (= 0.38) because of a different growth pattern. Given the SSB has fluctuated around MSY $B_{trigger}$ (lowest observed SSB) the application of the MSY framework will likely maintain the stock at $B_{trigger}$.

Prior to 2010, the sole assessment covered Division IIIa only. The present advice applies to the Division IIIa and Subdivisions 22–24 (i.e. the Skagerrak, the Kattegat, the Belts, and the Western Baltic). This extension to the stock assessment area for sole is based on a continuous and increased fishery into the Belts (Subdivision 22) along with high indices from surveys adjacent to the Belts, that both indicate a continuum of the stock into Subdivisions 22–24. This change should better reflect the management regime that sets a TAC for the entire area of Division IIIa and the Baltic Sea.

Because of limiting TACs and weekly quota the period 2002–2004 saw considerable misreporting. Since mid-2005, the increase in TAC and improved control has resulted in negligible misreporting.

Cod in the Kattegat is depleted and any bycatches of cod should be avoided.

Changes in fishing technology and fishing patterns

There are no major changes in the sole-directed fishery in recent years. Changes in the regulations for the *Nephrops* fishery, with the introduction of a sorting grid system in the trawls, may have resulted in smaller bycatch and improved selectivity on sole. Since 1 February 2008 exit square-meshed panels have been mandatory in the trawl fishery to prevent bycatches of cod. This device is not expected to influence the sole catches.

Spatial and temporal fishing area closures were implemented in the Kattegat in January 2009 to reduce fishing mortality on cod. This closure might influence the effort distribution on sole, and effects of the spatial restrictions on the sole stock will be evaluated some years after the implementation.

Regulations and their effects

The Danish fishery has in the past been regulated by half-monthly quotas which depended on vessel length and varied over the year. From 2007 a vessel quota share system (VQS) was put in force, allowing fishers to trade quotas and to decide when to fish them. The VQS was fully implemented in late 2007. The logbook data do not indicate any effects of the VQS on seasonal/spatial effort distribution. In addition, an effort regulation system (kW-days) has been in force since 2009, limiting the single vessel according to its engine power. This system allows trading with kW-days. In 2010 this effort regulation might potentially have restricted the principal fleets targeting sole.

The management area includes Division IIIa plus the Belts (Subdivisions 22–24). Danish vessel quota shares cover the management area and there is therefore no incentive to misreport sole taken in Division IIIa into the Belts.

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Data and methods

The stochastic analytical assessment (SAM) includes cpue data from three commercial tuning series (reference fleets) and one scientific survey series along with catch-at-age information. The assessment model assumes uncertainty associated to all input data, including the catch-at-age information.

Discarding is not assumed to occur to any degree of importance to the assessment and is not included. Discard observations in 2010 suggest discarding in the order of 2% by weight.

Uncertainties in assessment and forecast

The stock assessment provides confidence limits on the estimates of F, SSB, and R.

The proportion of fishery-independent information to the assessment has increased markedly with the inclusion of the Fishers–DTU Aqua sole survey and the similar discontinuance of two commercial series.

The addition of the Western Baltic and the Belts (Subdivisions 22–24) into the assessed stock is expected to improve the quality of the assessment since the effects of assumed migrations between the Belts and the Kattegat is eliminated.

Sampling of landings is considered insufficient and this contributes to the uncertainty of the assessment estimates.

Comparison with previous assessment and advice

This year's assessment of SSB_{2010} is 28% lower and F_{2009} is estimated to be 14% higher than the assessment results last year.

The advice in 2010 was based on multiple options, while this year the advice is based on the MSY framework.

Source

ICES. 2011. Report of the Baltic Fisheries Assessment Working Group. Copenhagen, 12–19 April 2011. ICES CM 2011/ACOM:10.

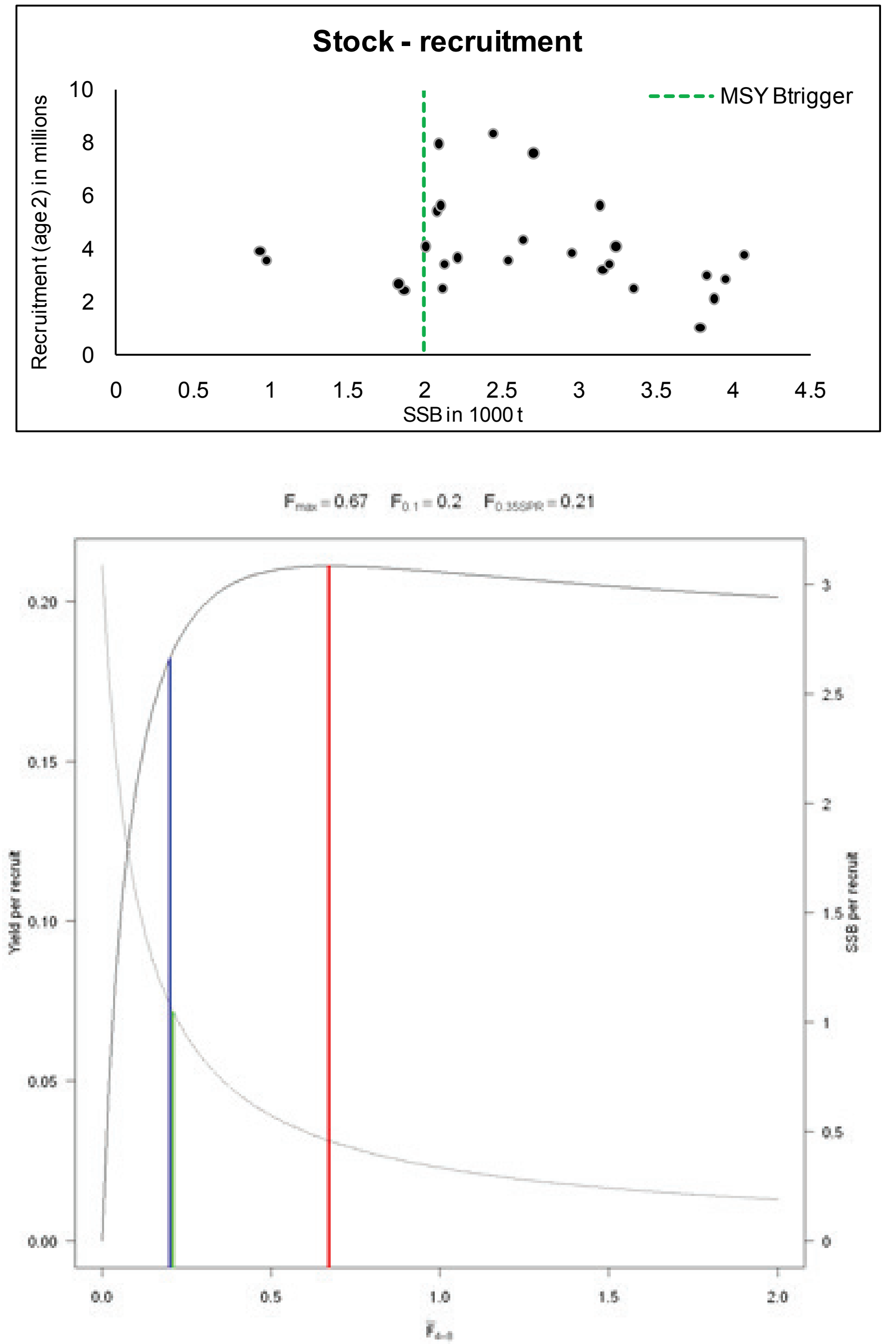


Figure 6.4.9.3 Sole in Division IIIa and Subdivisions 22–24. Stock–recruitment (top) and yield-per-recruit analysis plot (bottom). The vertical lines represent biological reference points.

Table 6.4.9.1 Sole in Division IIIa and Subdivisions 22–24**.** ICES advice, management, and landings.

Year	ICES Advice / Single-stock exploitation boundaries since 2004	Predicted catch corresp. to advice	Agreed TAC[2]	ICES landings[3]
1987	-	-	0.85	0.72
1988	-	-	0.95	0.71
1989	TAC	<0.8	0.80	0.82
1990	Precautionary TAC	0.6	0.50	1.05
1991	TAC	1.0	1.00	-[1]
1992	TAC	1.0	1.40	-[1]
1993	TAC at recent catch levels	1.0	1.60	-[1]
1994	No advice due to uncertain catches	-	2.10	1.20
1995	No advice	-	2.25	1.30
1996	No advice	-	2.25	1.10
1997	No advice	-	2.25	0.81
1998	No advice	-	1.80	0.61
1999	No increase in F	0.8	1.35	0.64
2000	No increase in F	0.65	0.95	0.65
2001	No increase in F	0.7	0.70	0.48
2002	F below F_{pa}	0.5	0.50	0.86
2003	F below F_{pa}	0.3	0.35	0.62
2004	F below F_{pa}	0.5	0.52	0.82
2005	No increase in F	0.85	0.90	0.99
2006	F below F_{pa}	0.82	0.90	0.84
2007	Limit catches to 2002–2005 average	0.74	0.90	0.63
2008	F below F_{pa}	0.97	0.94	0.66
2009	F below F_{pa}	0.80	0.80	0.64
2010	F below F_{pa}	0.62	0.70	0.54
2011	See scenarios	-		
2012	MSY Framework	0.61		

Weights in '000 t.
1) Uncertain.
2) TAC applies to Division IIIa and the EC waters of Divisions IIIb and IIIc, d.
3) Landings includes Divisions IIIa and Subdivisions 22–24.

Table 6.4.9.2 Sole in Division IIIa and Subdivisions 22–24. Catches (tonnes), official statistics and ICES corrections. For Sweden there is no information 1962–1974.

Year	Denmark Kattegat	Skagerrak	The Belts	Sweden Skag+Kat	Germany Kat+Skag	Belgium Skagerrak	Netherlands Skagerrak	ICES Corrections	Total
1984	235	76		13	13		54	-54	337
1985	275	102		19	1	+	132	-132	397
1986	456	158		26	1	2	109	-109	643
1987	564	137		19		2	70	-70	722
1988	540	138		24		4			706
1989	578	217		21	7	1			824
1990	464	128		29	-	2		+427	1050
1991	746	216		38	+			+11	1011[1]
1992	856	372		54				+12	1294[1]
1993	1016	355		68	9			-9	1439[1]
1994	890	296		12	4			-4	1198
1995	850	382		65	6			-6	1297
1996	784	203		57	612			-597	1059
1997	560	200		52	2				814
1998	367	145		90	3				605
1999	431	158		45	3				637
2000	399	320	13	34	11			-132[2]	645[2]
2001	249	286	21	25				-103[2]	478[2]
2002	360	177	18	15	11			+281[3]	862
2003	195	77	17	11	17			+301[3]	618
2004	249	109	40	16	18			+392[3]	824
2005	531	132	118	30	34	Norway		+145[3]	990
2006	521	114	107	38	43	9	4		836
2007	366	81	93	45	39	9			633
2008	353	102	113	34	35	7	3		655
2009	325	103	145	37	27	4			640
2010	273	61	125	46	26	3	3		538

Table 6.4.9.3 Sole in Division IIIa and Subdivisions 22–24. Summary of stock assessment (weights in tonnes). Estimated recruitment (age 2, in thousands), Total stock biomass (TSB), spawning-stock biomass (SSB), and average fishing mortality for ages 4 to 8 (F48). Low = lower limit and High = higher limit of 95% confidence interval.

Year	Recruits	Low	High	TSB	Low	High	SSB	Low	High	F48	Low	High
1984	1513	739	3099	1249	959	1627	972	758	1247	0.395	0.286	0.545
1985	5946	3306	10694	1966	1390	2782	932	723	1201	0.341	0.248	0.469
1986	3589	2048	6290	2597	2025	3332	2005	1566	2568	0.374	0.283	0.493
1987	3930	2460	6279	2709	2208	3325	2081	1695	2554	0.428	0.329	0.557
1988	4100	2578	6522	2741	2239	3356	2089	1710	2552	0.397	0.307	0.514
1989	5455	3414	8715	3060	2476	3781	2100	1736	2539	0.431	0.337	0.551
1990	7970	4860	13071	4140	3283	5220	2705	2226	3287	0.416	0.327	0.529
1991	5658	3547	9028	4124	3367	5052	3139	2585	3812	0.478	0.379	0.602
1992	7621	4582	12675	5497	4415	6844	3873	3217	4663	0.541	0.424	0.689
1993	5657	3462	9243	5079	4143	6227	4072	3336	4971	0.551	0.432	0.703
1994	2131	1343	3383	4319	3627	5142	3948	3309	4710	0.486	0.389	0.608
1995	3812	2404	6043	4500	3778	5359	3787	3182	4507	0.500	0.399	0.628
1996	2883	1813	4583	3745	3138	4469	3237	2711	3865	0.438	0.348	0.550
1997	1073	655	1759	2853	2385	3413	2640	2200	3168	0.407	0.322	0.514
1998	4114	2641	6410	2530	2076	3084	1868	1545	2258	0.385	0.304	0.488
1999	4369	2788	6848	3248	2653	3978	2540	2087	3093	0.354	0.279	0.448
2000	2437	1553	3824	2852	2351	3461	2440	2007	2966	0.333	0.263	0.422
2001	3564	2233	5689	2772	2260	3401	2116	1746	2565	0.281	0.219	0.362
2002	8388	5131	13711	4398	3479	5560	2955	2408	3627	0.314	0.247	0.399
2003	2523	1559	4085	3591	2960	4357	3152	2589	3838	0.293	0.226	0.379
2004	3878	2511	5987	4144	3426	5011	3356	2779	4053	0.330	0.258	0.422
2005	3223	2099	4948	4448	3681	5375	3830	3161	4640	0.375	0.292	0.480
2006	2523	1653	3849	3706	3078	4461	3198	2642	3872	0.361	0.282	0.462
2007	3033	1982	4640	2851	2358	3448	2212	1835	2666	0.350	0.273	0.448
2008	3444	2184	5431	2572	2077	3184	1831	1498	2238	0.394	0.302	0.514
2009	3686	2146	6331	2909	2296	3684	2131	1722	2637	0.323	0.246	0.426
2010	2704	1378	5305	2532	1924	3332	1834	1450	2320	0.339	0.252	0.455
2011	3444						1944					

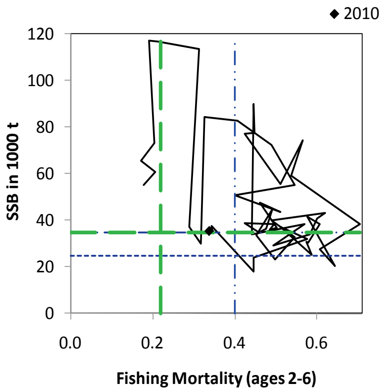
ECOREGION North Sea
STOCK Sole in Subarea IV (North Sea)

Advice for 2012

ICES advises on the basis of the first stage of the EU management plan (Council Regulation No. 676/2007) that landings in 2012 should be no more than 15 700 t. ICES notes that according to the management plan, transitional arrangements to the second stage of the plan should be established since both North Sea sole and plaice have now been within safe biological limits for two consecutive years.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target
SSB (Spawning-Stock Biomass)	**2009**	**2010**	**2011**	
MSY ($B_{trigger}$)	✗	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	○	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✗	✓	✓	Above target



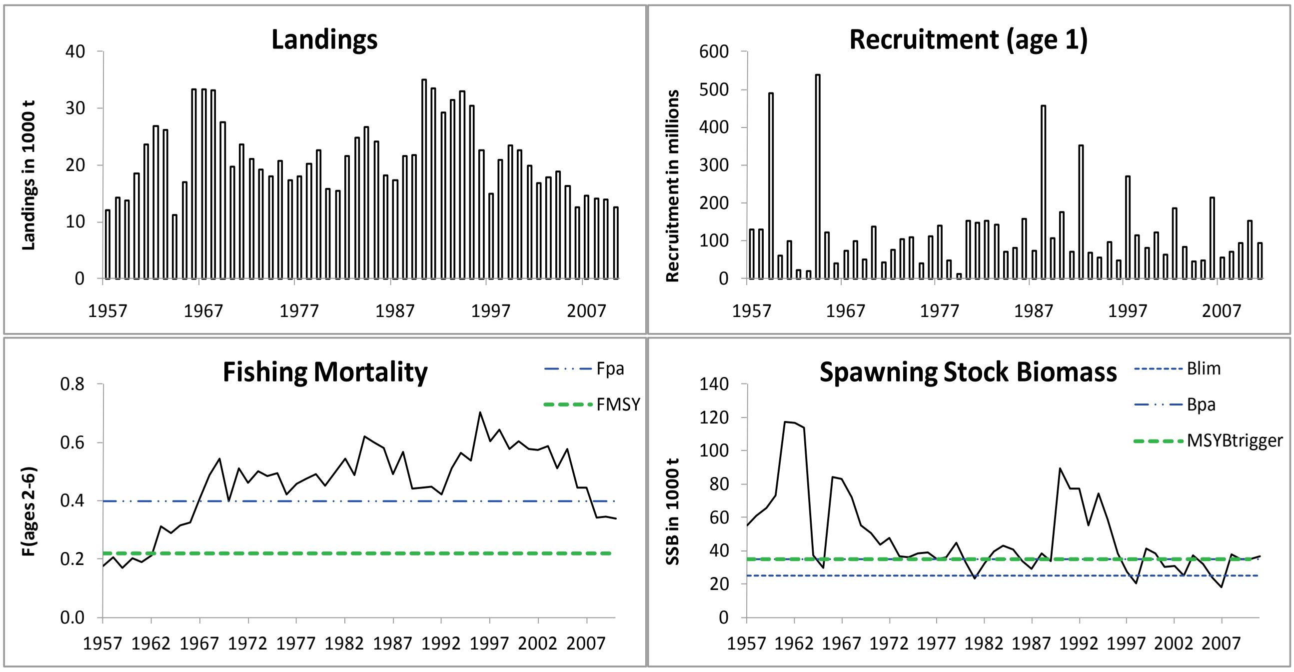


Figure 6.4.10.1 Sole in Subarea IV (North Sea). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

SSB has fluctuated around the precautionary reference points for the last decade and is estimated to be above B_{pa} in 2010. Fishing mortality has shown a declining trend since 1995 and is estimated to be below F_{pa} since 2008.

Management plans

The management plan for North Sea sole and plaice (Council Regulation (EC) No. 676/2007, see Appendix 6.4.10) stage 1 results in a TAC of 15 700 t for sole, with an effort/F reduction of 10% compared to F *status quo* assumption. An evaluation of the plan (ICES, 2010) concluded that the management plan is precautionary.

Biology

Sole is a nocturnal predator and therefore more susceptible to capture by fisheries at night than in daylight.

Environmental influence on the stock

In the southern North Sea, water temperature has increased since 1989 which has increased sole growth rates, the duration of its growing period, and the quality of shallow, nursery areas available.

The fisheries

Sole is mainly caught by the beam-trawl fleet working with 80 mm mesh. Fishing effort by the Dutch fleet peaked in the mid-1990s and has decreased thereafter.

Catch by fleet	Total catch (2010) = 12.6 kt, where 100% are landings (~75% beam trawl, 15% otter trawl, and 10% static gear).

Effects of the fisheries on the ecosystem

Days-at-sea regulations, high oil prices, and different patterns of TACs changes between plaice and sole have led to a transfer of fishing effort from the northern to the southern North Sea where sole and juvenile plaice tend to be more abundant, leading to an increase in discarding of small plaice. Trawling impact differs among benthic habitats and is likely to be more important in deeper water with silty sediments than in shallow areas characterized by sandy grounds. In offshore areas of the North Sea, benthic biomass and biodiversity has been shown to decrease with trawling disturbance.

Quality considerations

There are divergent signals in the survey and commercial data used to 'tune' the sole assessment. A shortening of the commercial cpue time-series at the 2010 benchmark has reduced the retrospective bias in the assessment.

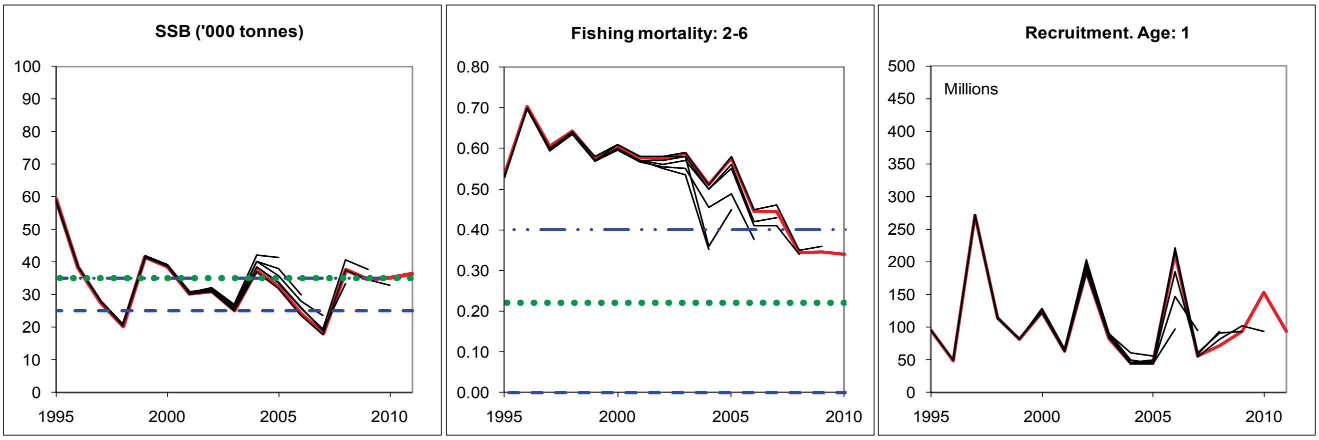


Figure 6.4.10.2 Sole in Subarea IV (North Sea). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Two survey indices (BTS-ISIS, SNS); one commercial index (NL BT).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Benchmarked February 2010 (WKFLAT).
Working group report	WGNSSK

ECOREGION North Sea
STOCK Sole in Subarea IV (North Sea)

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	35 000 t	Stage one: Article 2.
	F_{MP}	0.4 0.2	Stage one: Article 2; Stage two: Article 4.
MSY Approach	MSY $B_{trigger}$	35 000 t	Default to value of B_{pa}.
	F_{MSY}	0.22	Median of stochastic MSY analysis assuming Ricker Stock-Recruit relationship (range of 0.2-0.25).
Precautionary Approach	B_{lim}	25 000 t	B_{loss}
	B_{pa}	35 000 t	B_{pa} 1.4*B_{lim}
	F_{lim}	Not defined.	
	F_{pa}	0.4	F_{pa} = 0.4 implies $B_{eq} > B_{pa}$ and $P(SSB_{MT} < B_{pa}) < 10\%$

(unchanged since: 2011)

Outlook for 2012

Basis: F (2011) = F_{sq} = mean (F2008–2010) scaled to 2010 = 0.34; R(2011) = GM(1957–2008) = 94 million; Landings(2011) = 15.8; SSB (2012) = 45.5.

Rationale	**Landings (2012)**	**Basis**	**F (2012)**	**SSB (2013)**	**% SSB change** [1)]	**% TAC change** [2)]
Management plan Stage 1	15.7	F_{sq}*0.9	0.31	45.6	0 %	+ 11 %
Management plan Stage 2	11	F_{sq} * 0.6	0.2	50.1	+ 10 %	-22 %
MSY framework	11.8	F_{MSY}	0.22	49.3	+ 8 %	-16 %
MSY transition	15.1	F_{MSY} Transition= ((0.34*0.6) + (0.22 *0.4))	0.29	46.2	+ 1 %	+ 7 %
Precautionary approach	19.7	F_{pa}	0.4	41.7	-8 %	+ 40 %
Zero catch	0	F=0	0	60.8	+ 33 %	-100 %
Status quo	4.9	F_{sq} *0.25	0.09	56	+ 23 %	-65 %
	9.3	F_{sq} *0.5	0.17	51.8	+ 14 %	-34 %
	12	TAC - 15% (F_{sq} * 0.66)	0.22	49.1	+ 8 %	-15 %
	14.2	TAC_{sq} (F_{sq} * 0.80)	0.27	47	+ 3 %	+ 1 %
	15.7	F_{sq} * 0.9	0.31	45.6	0 %	+ 11 %
	16.2	TAC + 15% (F_{sq} * 0.93)	0.32	45.1	-1 %	+ 15 %
	17.2	F_{sq}	0.34	44.2	-3 %	+ 22 %

Weights in '000 t.
[1)] SSB(2013) relative to SSB(2012).
[2)] Calculated landings (2012) relative to TAC 2011 (14 100 t).

Management plan

Both the North Sea sole and plaice stocks have been within safe biological limits in the last two years. According to the management plan (Article 3.2), this signals the end of stage one. Transitional arrangements for stage two (Article 5) should amend the objectives and the procedures for setting TACs and effort limitations, but these have not been decided on yet. Therefore, ICES advice is limited to the procedures defined for stage one.

Following the first stage of the EU management plan would imply a 10% reduction of F to 0.31, resulting in a TAC of 15 700 t in 2012 and implying a 10% reduction in fishing effort. This is expected to lead to an SSB of 45 600 t in 2013. The TAC increase of 11% is within the 15% bounds of the management plan TAC change constraints.

Following the second stage of the EU management plan would imply decreasing F to 0.2 (Article 4), resulting in a TAC of 11 000 t in 2012. This is expected to lead to an SSB of 50 100 t in 2013.

ICES has evaluated this management plan and considers it can be accepted as precautionary.

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.22 (F_{MSY}, as SSB 2012 > MSY $B_{trigger}$), resulting in landings of less than 11 800 t in 2012. This is expected to lead to an SSB of 49 300 t in 2013.

Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to ((0.34*0.6) + (0.22 *0.4)) = 0.29, which will result in landings of less than 15 100 t in 2012. This is expected to lead to an SSB of 46 200 t in 2013.

PA approach

The precautionary F_{pa} for North Sea sole is 0.4. This would lead to landings of 19 700 t in 2012 (a 40% increase in TAC) and an SSB of 41 700 t in 2013.

Additional considerations

Sole are mainly caught in a mixed beam-trawl fishery with plaice and other flatfish using 80 mm mesh in the southern North Sea. The minimum mesh size in the mixed beam-trawl fishery in the southern North Sea means that large numbers of undersized plaice are discarded. There are indications that in recent years sole discarding has taken place. Measures to reduce discarding in the mixed beam-trawl fishery would greatly benefit these stocks. An increase in the minimum landing size of sole could provide an incentive to fish with larger mesh sizes and would therefore mean a reduction in the discarding of plaice. The minimum landing size of North Sea sole is 24 cm. An increased mesh size in the fishery would reduce the catch of undersized plaice, but would also result in a loss of marketable sole.

The peaks in the historical time-series of SSB of North Sea sole correspond with the occasional occurrence of strong year classes. Due to a high fishing mortality the SSB has declined during the nineties. The SSB and landings have in recent years been dominated by 2005 year classes. The effect of the 2005 year class is now, however, starting to decline. The 2009 year class, which will enter into the SSB in 2012, is above average.

ICES has developed a generic approach to evaluate whether new survey information that becomes available in September forms a basis to update the advice. If this is the case, ICES will publish new advice in November 2011.

Impacts of the environment on the fish stocks

There has been an overall increase in the growth rate of North Sea sole until the late 1970s, followed by a decline correlated with the temporal patterns in eutrophication, in particular the discharge of dissolved phosphates by the Rhine.

In the Plaice Box the spatial distribution of juvenile and adult sole remains constant (Grift *et al.*, 2004), following the removal of a large amount of effort. The proportion of undersized sole (<24 cm) did not change after closure and remained stable at a level of 60–70% (Grift *et al.*, 2004). Different length groups showed different patterns in abundance. Sole of around 5 cm showed a decrease in abundance from 2000 onwards, while the groups of 10 and 15 cm seemed rather stable. The largest groups showed a declining trend in abundance, which had already set in years before the closure.

Impacts of fisheries on the ecosystems

Currently the mixed sole and plaice fishery is dominated by bottom trawls, with bycatch of both commercial and non-commercial species and a physical impact on the seabed. Bottom trawling can impact biomass, production, and species richness. For the North Sea, an ecosystem model showed that the bottom-trawl fleet reduced benthic biomass and production by 56% and 21%, respectively, compared with an un-fished situation (Hiddink *et al.*, 2006; Hinz *et al.*, 2008). Chronic fishing has caused a shift from communities dominated by relatively sessile, emergent, and high biomass species to communities dominated by infaunal, smaller-bodied fauna (Kaiser *et al.*, 2000). Within species, the size selectivity may lead to a shift in the age and size at maturation. For example, in recent years plaice and sole have become mature at younger ages and at smaller sizes than in the past.

Changes in fishing technology and fishing patterns

The overall capacity and effort of North Sea beam trawl vessels has been substantially reduced since 1995, including the decommissioning of 25 vessels in 2008.

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management programme switched from a days-at-sea to a kW-day system (2009 Council Regulation (EC) N° 43/2009), in which different amounts of kW-days are allocated within each area by member state to different groups of vessels depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed annual monitoring of effort trends since 2004. Overall effort (kW-days) by demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced (−30% between 2003 and 2009; STECF, 2011). Effort by beam trawl in both small mesh size (80–120 mm, BT2) and large mesh size (BT1) has shown a continuous decline (−38% and −70%, respectively, between 2003 and 2009).

This reduction in fishing effort is reflected in reductions in estimated fishing mortality.

The combination of days-at-sea regulations, high oil prices, and the constraining TAC for plaice and the relatively stable TAC for sole, lead to a more southern fishing pattern in the North Sea. This concentration of fishing effort results in increased discarding of juvenile plaice that are mainly distributed in those areas. This process could be aggravated by the movement of juvenile plaice to deeper waters in recent years where they become more susceptible to the fishery. Lpue data also show a slower recovery of stock size in the southern regions that may be caused by higher fishing effort in the more coastal regions.

The increased use of “SumWing” and electric “Pulse trawls” will increasingly affect catchability and selectivity of North Sea sole, but the potential future impact either on the sole stock itself or the stock assessment is still unknown. Furthermore, the introduction of a new mesh meter (the Omega meter) may have increased the effective mesh size in the fishery.

Information from the fishing industry

The Fishers’ North Sea stock survey again took place in 2010 (Napier, 2011; Figure 6.4.10.4). Overall, about two-thirds of respondents (65%) reported that sole were ‘more’ or ‘much more’ abundant in 2010, a somewhat smaller proportion than in 2009 (78%). The 2011 assessment, however, shows stable abundance between 2009 and 2010. The fishers’ survey is in agreement with the assessment, suggesting higher than average levels of recruitment.

Management objectives

The EU adopted a management plan for flatfish in the North Sea in June 2007 (Council Regulation (EC) No. 676/2007, see Annex 6.4.10). This plan has two stages. The first stage aims at an annual 10% reduction of fishing mortality in relation to the fishing mortality estimated for the preceding year until an F of 0.2 is reached, with a maximum change in TAC of 15% until the precautionary reference points are reached for both sole and plaice for two successive years. 2011 is the second year with sole and plaice simultaneously within safe biological limits.

In the second stage, the management plan objective is exploitation at F = 0.2.

In a recent evaluation of the management plan it was concluded that this plan is precautionary (ICES, 2010).

Uncertainties in the assessment and forecast

Estimations of sole stock status appear to have a retrospective under-estimation of fishing mortality and over-estimation of SSB, which have resulted in forecast bias.

The main explanation for the reduction of fishing mortality seems to be a reduction of capacity in the beam-trawl fleet and a limitation of fishing effort. Also, high fuel prices have contributed to the decrease in fishing mortality.

Comparison of previous assessment and advice

The survey data suggest higher fishing mortalities than the commercial data. The conclusion reached at the 2010 benchmark assessment was to base advice on the results of an XSA model tuned with commercial fleet data cut off before 1997. This eliminated the retrospective bias problem because the smaller subset of the commercial data clearly has less of a problem with time-dependent or evolving catchability, although the basic problem remains a concern.

In 2010 advice was based on the precautionary and MSY approach and the management plan, in 2011 the advice is based on the EU management plan.

Sources

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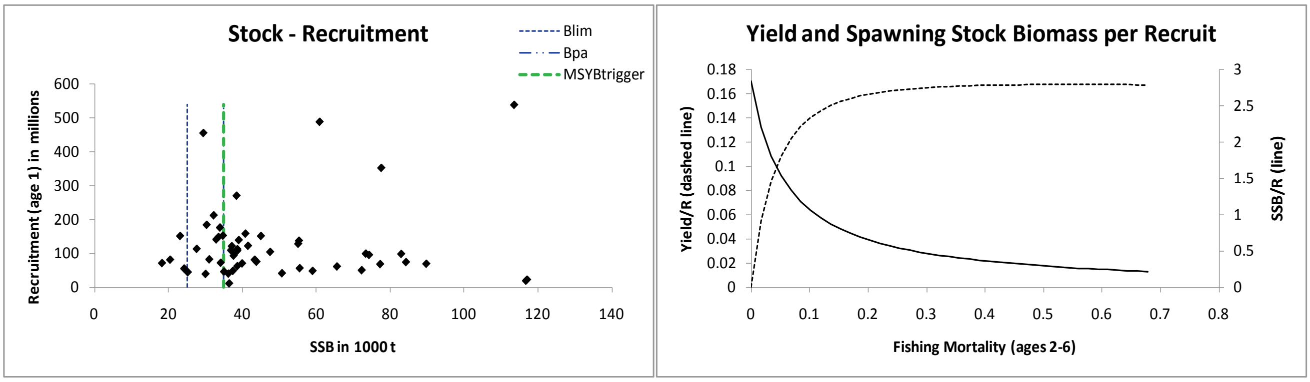


Figure 6.4.10.3 Sole in Subarea IV (North Sea). Stock–recruitment and yield-per-recruit analysis plot.

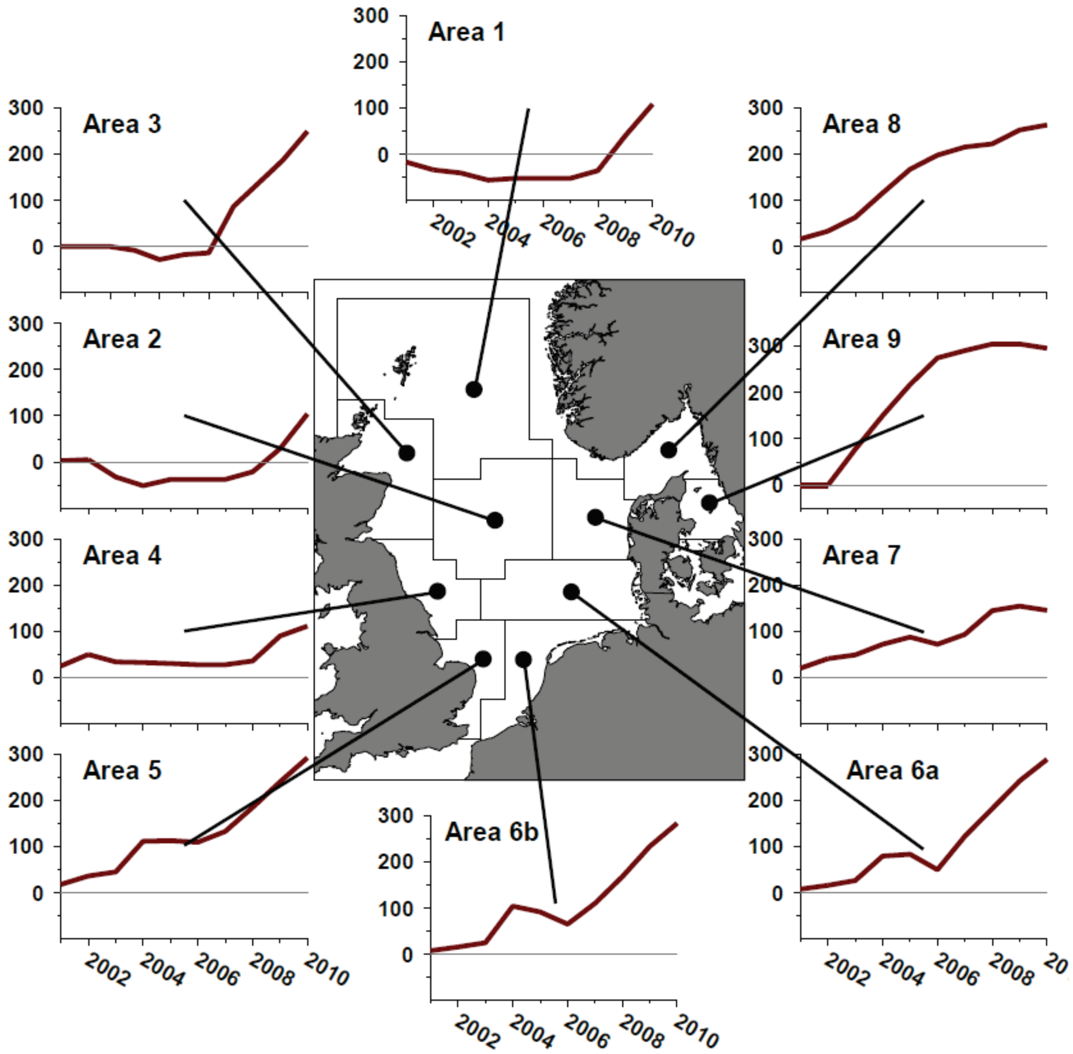


Figure 6.4.10.4 Sole in Subarea IV (North Sea). Results of North Sea Commission fisher's survey 2010.

Table 6.4.10.1 Sole in Subarea IV (North Sea). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC	Official landings	ICES landings
1987	Rebuild SSB to 40 000 t; TAC	11.0	14.0	13.8	17.4
1988	Increase SSB towards 50 000 t; TAC	11.0	14.0	13.4	21.6
1989	Increase SSB towards 50 000 t; TAC	14.0	14.0	14.5	21.8
1990	80% of F(88); TAC	25.0	25.0	26.5	35.1
1991	SSB>50 000 t ; TAC	27.0	27.0	27.6	33.5
1992	TAC	21.0	25.0	26	29.3
1993	no long-term gains in increased F	29.0[1]	32.0	29.8	31.5
1994	no long-term gains in increased F	31.0[1]	32.0	31.3	33
1995	no long-term gains in increased F	28.0[1]	28.0	28.8	30.5
1996	Mixed fishery, link plaice advice	23.0[1]	23.0	20.4	22.7
1997	<80% of F(95)	14.6	18.0	13.7	15
1998	75% of F(96)	18.1	19.1	19.7	20.9
1999	$F<F_{pa}$ (80% of F(97))	20.3	22.0	22	23.5
2000	$F< F_{pa}$	<19.8	22.0	20.7	22.5
2001	$F< F_{pa}$	<17.7	19.0	16.4	19.9
2002	F<0.37	<14.3	16.0	16	16.9
2003	$F< F_{pa}$	<14.6	15.85	17.1	17.9
2004	$F< F_{pa}$	<17.9	17.0	17.8	17.1
2005	$F< F_{pa}$	<17.3	18.6	15.6	16.4
2006	Keep SSB above B_{pa}	<11.9	17.67	11,9	12.6
2007	SSB above B_{pa}	<10.8	15.0	13.8	14.6
2008	SSB above B_{pa}	<9.8	12.8	13.4	14.1
2009	Apply management plan	<14.0	14.0	NA	14.0
2010	Apply management plan	<14.1	14.1	12.1	12.6
2011	See scenarios	-	14.1		
2012	Apply first stage of the management plan	<15.7			

Weights in '000 t.
[1] Catch *status quo* F.

Table 6.4.10.2 Sole in Subarea IV (North Sea). Official landings and landings as estimated by the Working Group (tonnes).

Year	Belgium	Denmark	France	Germany	Netherlands	UK (E/W/NI)	Other countries	Total reported	Unallocated landings	WG Total	TAC
1982	1900	524	686	266	17686	403	2	21467	112	21579	21000
1983	1740	730	332	619	16101	435		19957	4970	24927	20000
1984	1771	818	400	1034	14330	586	1	18940	7899	26839	20000
1985	2390	692	875	303	14897	774	3	19934	4314	24248	22000
1986	1833	443	296	155	9558	647	2	12934	5266	18200	20000
1987	1644	342	318	210	10635	676	4	13829	3539	17368	14000
1988	1199	616	487	452	9841	740	28	13363	8227	21590	14000
1989	1596	1020	312	864	9620	1033	50	14495	7311	21806	14000
1990	2389	1427	352	2296	18202	1614	263	26543	8577	35120	25000
1991	2977	1307	465	2107	18758	1723	271	27608	5905	33513	27000
1992	2058	1359	548	1880	18601	1281	277	26004	3337	29341	25000
1993	2783	1661	490	1379	22015	1149	298	29775	1716	31491	32000
1994	2935	1804	499	1744	22874	1137	298	31291	1711	33002	32000
1995	2624	1673	640	1564	20927	1040	312	28780	1687	30467	28000
1996	2555	1018	535	670	15344	848	229	21199	1452	22651	23000
1997	1519	689	99	510	10241	479	204	13741	1160	14901	18000
1998	1844	520	510	782	15198	549	339	19742	1126	20868	19100
1999	1919	828		1458	16283	645	501	21634	1841	23475	22000
2000	1806	1069	362	1280	15273	600	539	20929	1603	22532	22000
2001	1874	772	411	958	13345	597	394	18351	1593	19944	19000
2002	1437	644	266	759	12120	451	292	15969	976	16945	16000
2003	1605	703	728	749	12469	521	363	17138	782	17920	15850
2004	1477	808	655	949	12860	535	544	17828	-681	17147	17000
2005	1374	831	676	756	10917	667	357	15579	776	16355	18600
2006	980	585	648	475	8299	910		11933	667	12600	17670
2007	955	413	401	458	10365	1203	5	13800	835	14635	15000
2008	1379	507	714	513	9456	851	15	13435	710	14145	12800
2009	1353	NA	NA	555	12038	951	1	NA	NA	13952	14000
2010	1268	406	621	537	8770	526	1	12129	474	12603	14100
2011											14100

Table 6.4.10.3 Sole in Subarea IV (North Sea). Summary of stock assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2–6
1957	129000	55100	12100	0.178
1958	129000	60900	14300	0.207
1959	489000	65600	13800	0.171
1960	62000	73400	18600	0.204
1961	100000	117100	23600	0.190
1962	23000	116800	26900	0.213
1963	20000	113600	26200	0.313
1964	539000	37100	11300	0.289
1965	122000	30000	17000	0.317
1966	40000	84300	33300	0.325
1967	75000	83000	33400	0.406
1968	99000	72300	33200	0.489
1969	51000	55300	27600	0.546
1970	138000	50700	19700	0.399
1971	42000	43800	23700	0.510
1972	76000	47500	21100	0.461
1973	105000	36900	19300	0.502
1974	110000	36200	18000	0.486
1975	41000	38600	20800	0.496
1976	113000	39000	17300	0.423
1977	140000	35000	18000	0.459
1978	47000	36400	20300	0.476
1979	12000	45000	22600	0.492
1980	152000	33500	15800	0.453
1981	149000	23100	15400	0.498
1982	152000	32900	21600	0.545
1983	142000	39900	24900	0.489
1984	71000	43300	26800	0.620
1985	82000	40800	24200	0.600
1986	159000	34100	18200	0.582
1987	73000	29400	17400	0.493
1988	456000	38600	21600	0.569
1989	108000	33900	21800	0.441
1990	177000	89800	35100	0.445
1991	70000	77600	33500	0.447
1992	353000	77300	29300	0.423
1993	69000	55500	31500	0.510
1994	57000	74300	33000	0.566
1995	96000	59000	30500	0.537
1996	49000	38400	22700	0.704
1997	271000	27600	14900	0.606
1998	114000	20400	20900	0.643
1999	82000	41500	23500	0.577
2000	123000	38600	22600	0.606
2001	63000	30300	19900	0.578
2002	185000	31000	16900	0.574
2003	83000	25200	17900	0.587
2004	45000	37400	18800	0.511
2005	49000	32200	16400	0.577
2006	213000	24200	12600	0.445
2007	56000	18200	14600	0.445
2008	72000	37600	14100	0.343
2009	94000	34700	14000	0.345
2010	153000	35200	12600	0.339
2011	93627	36550		
Average	123884	48466	21391	0.456

6.4.10 Appendix

Extract from *Council Regulation (EC) No 676/2007 of 11 June 2007 establishing a multiannual plan for fisheries exploiting stocks of plaice and sole in the North Sea*

Article 2 Safe biological limits

1. *For the purposes of this Regulation, the stocks of plaice and sole shall be deemed to be within safe biological limits in those years in which, according to the opinion of the Scientific, Technical, and Economic Committee for Fisheries (STECF), all of the following conditions are fulfilled:*
   (a) the spawning biomass of the stock of plaice exceeds 230 000 tonnes;
   (b) the average fishing mortality rate on ages two to six years experienced by the stock of plaice is less than 0,6 per year;
   (c) the spawning biomass of the stock of sole exceeds 35 000 tonnes;
   (d) the average fishing mortality rate on ages two to six years experienced by the stock of sole is less than 0,4 per year.
2. *If the STECF advises that other levels of biomass and fishing mortality should be used to define safe biological limits, the Commission shall propose to amend paragraph 1*

Article 3 Objectives of the multiannual plan in the first stage

1. *The multiannual plan shall, in its first stage, ensure the return of the stocks of plaice and of sole to within safe biological limits.*
2. *The objective specified in paragraph 1 shall be attained by reducing the fishing mortality rate on plaice and sole by 10 % each year, with a maximum TAC variation of 15 % per year until safe biological limits are reached for both stocks.*

Article 4 Objectives of the multiannual plan in the second stage

1. *The multiannual plan shall, in its second stage, ensure the exploitation of the stocks of plaice and sole on the basis of maximum sustainable yield.*
2. *The objective specified in paragraph 1 shall be attained while maintaining the fishing mortality on plaice at a rate equal to or no lower than 0,3 on ages two to six years.*
3. *The objective specified in paragraph 1 shall be attained while maintaining the fishing mortality on sole at a rate equal to or no lower than 0,2 on ages two to six years.*

Article 5 Transitional arrangements

1. *When the stocks of plaice and sole have been found for two years in succession to have returned to within safe biological limits the Council shall decide on the basis of a proposal from the Commission on the amendment of Articles 4(2) and 4(3) and the amendment of Articles 7, 8 and 9 that will, in the light of the latest scientific advice from the STECF, permit the exploitation of the stocks at a fishing mortality rate compatible with maximum sustainable yield.*

Article 8 Procedure for setting the TAC for sole:

1) *The Council shall adopt a TAC for sole at that level of catches which, according to a scientific evaluation carried out by STECF is the higher of:*
   a) *that TAC the application of which will result in the level of fishing mortality rate of 0,2 on ages two to six years in its year of application;*
   b) *that TAC the application of which will result in a 10 % reduction in the fishing mortality rate in its year of application compared to the fishing mortality rate estimated for the preceding year.*
2) *Where the application of paragraph 1 would result in a TAC which exceeds the TAC of the preceding year by more than 15 %, the Council shall adopt a TAC which is 15 % greater than the TAC of that year.*
3) *Where the application of paragraph 1 would result in a TAC which is more than 15 % less than the TAC of the preceding year, the Council shall adopt a TAC which is 15 % less than the TAC of that year.*

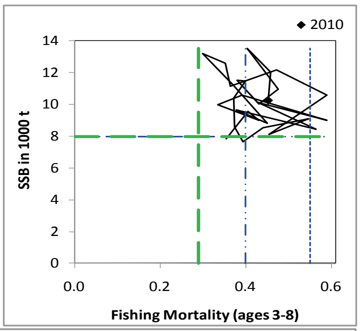
ECOREGION North Sea
STOCK Sole in Division VIId (Eastern Channel)

Advice for 2012

ICES advises on the basis of the transition to the MSY approach that landings in 2012 should be no more than 5600 t.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	O	O	Risk harvested unsustainably
SSB (Spawning-Stock Biomass)	**2009**	**2010**	**2011**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



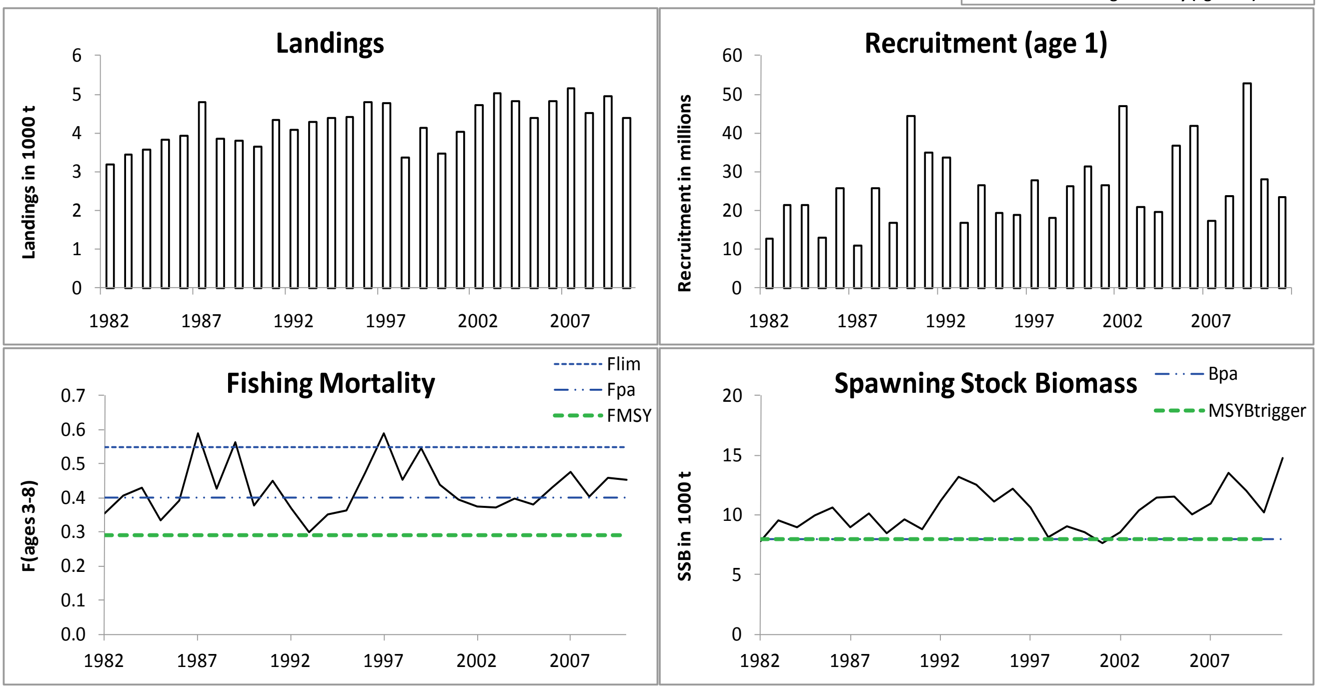


Figure 6.4.11.1 Sole in Division VIId (Eastern Channel). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

The spawning-stock biomass has increased since 2002 and is above MSY $B_{trigger}$. Since 2005, fishing mortality has been slightly above F_{pa}. The 2008 year class is the highest in the time-series and the 2001, 2004, and 2005 year classes were above average.

Management plans

No specific management objectives are known to ICES.

Biology

Sole is a nocturnal predator and therefore more susceptible to capture by fisheries at night than in daylight.

The fisheries

Sole is mainly caught in 80 mm beam-trawl fisheries with plaice or in mixed demersal fisheries using otter trawls. There is also a directed fishery during parts of the year by inshore trawlers and netters on the English and French coasts.

Catch by fleet	Total catch (2010) = 4391 t, where 4391 t are landings (60% beam trawls, 22% trammelnets, 15% otter trawls, and 3% other gears).

Effects of the fisheries on the ecosystem

The mixed sole and plaice fishery is dominated by beam trawls with a mesh size of 80 mm, with bycatch of both commercial and non-commercial species and a physical impact on the seabed. Bottom trawling impacts biomass, production, and species richness.

Quality considerations

Under-reporting of catches and misreporting of sole into Division VIId from Division VIIe was thought to be significant but this is now less of an issue. However, the assessment has been corrected for this misreporting.

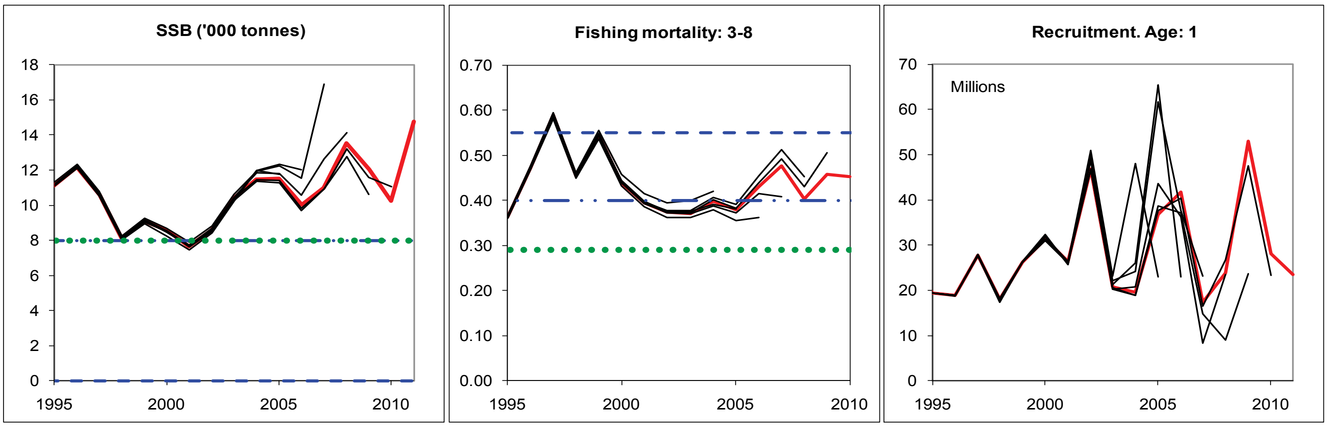


Figure 6.4.11.2 Sole in Division VIId (Eastern Channel). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Three survey indices (UK(E&W)-BTS, UK(E&W)-YFS, FR-YFS). Two commercial indices (BE-CBT,UK(E&W)-CBT).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	This stock was benchmarked in 2009.
Working group report	WGNSSK

ECOREGION North Sea
STOCK Sole in Division VIId (Eastern Channel)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	8000 t	B_{pa}
	F_{MSY}	0.29	Stochastic simulations assuming a smooth hockey-stick relationship.
Precautionary approach	B_{lim}	Not defined.	Poor biological basis for definition.
	B_{pa}	8000 t	This is the lowest observed biomass at which there is no indication of impaired recruitment. Smoothed B_{loss}.
	F_{lim}	0.55	F_{loss}, but poorly defined; analogy to North Sea and setting of 1.4 F_{pa} = 0.55. This is a fishing mortality at or above which the stock has shown continued decline.
	F_{pa}	0.4	Between F_{med} and 5th percentile of F_{loss}; SSB>B_{pa} and probability (SSB_{mt}<B_{pa}), 10%: 0.4.

(unchanged since: 2010)

Outlook for 2012

Basis: F(2011) = TAC constraint = 0.36 ; R(2011) = GM(1982–2007) = 23 500; Landings(2011) = 4852; SSB(2012) = 15 000.

Rationale	Landings (2012)	Basis	F(2012)	SSB(2013)	%SSB change [1)]	%TAC Change [2)]
MSY framework	4300	F_{MSY}	0.29	15 000	0%	-11%
MSY transition	5600	(F(2010)*0.6)+(F_{MSY}*0.4)	0.39	13 600	-9%	+15%
Precautionary approach	5700	F_{pa}	0.40	13 600	-9%	+17%
Zero catch	0	F=0	0	19 700	+31%	-100%
Status quo	4000	F_{sq}*0.6	0.27	15 300	+2%	-17%
	4100	F_{sq}*0.62(TAC -15%)	0.28	15 200	+1%	-15%
	4600	F_{sq}*0.7	0.31	14 700	-2%	-5%
	5100	F_{sq}*0.8	0.36	14 100	-6%	+6%
	5600	F_{sq}*0.89(TAC +15%)	0.39	13 600	-9%	+15%
	6200	F_{sq}	0.44	13 000	-13%	+27%

Weights in tones.
[1)] SSB 2013 relative to SSB 2012.
[2)] Landings 2012 relative to TAC 2011.

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.29 resulting in landings of less than 4300 t in 2012. This is expected to lead to a record high SSB of 15 000 t in 2013.

Following the transition scheme towards the ICES MSY framework implies that (F(2010)*0.6) + (0.4*F_{MSY}) is 0.39, resulting in landings of less than 5600 t in 2012. This is expected to lead to an SSB of 13 600 t in 2013.

PA approach

The fishing mortality in 2012 should be no more than F_{pa}, corresponding to landings of less than 5700 t in 2012. This is expected to keep SSB well above B_{pa} in 2013.

Additional considerations

Factors affecting the fisheries and the stock

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

Regulations and their effects

The minimum landing size for sole is 24 cm. Demersal gears are permitted to catch sole with mesh size 80 mm for beam and otter trawling. For static gear the minimum mesh size is 120 mm, with exceptions for trammelnets (100 mm) and static gear targeting red mullet and sea bass (90 mm).

In previous years, effort reductions for the beam trawl fleet have not been restrictive. The effort reductions implemented by EU Council Regulation (EC) Nos. 43/2009, 53/2010, and 57/2011 vary between countries at around 5–10% each year, in line with the effort reductions applied in the North Sea for the sole/plaice management plan (Council Regulation (EC) N° 676/2007).

Changes in fishing technology and fishing patterns

Effort for the Belgian beam trawl fleet increased to the highest level in 2007. This was mainly due to the unrestrictive “days-at-sea” EU regulation in ICES Division VIId from 2006 until 2008.

The 80 mm mesh size for sole is not matched to the minimum landing size of plaice. Measures to reduce discarding of plaice in the sole fishery would greatly benefit the plaice stock and future yields of plaice, but would also result in loss of marketable sole landings.

Uncertainties in assessment and forecast

Under-reporting from the inshore fleets and misreporting into Division VIId by beam trawlers fishing in VIIe was significant, but this is now less of an issue. Historical landings have been adjusted for misreporting between the Eastern and Western Channel since 1986. In recent years there have been substantial changes in the estimates of recruitment that impact on the forecast. Since 2009 the Young Fish survey (YFS) was separated into two components due to the cessation of the UK component in 2007. The French Young Fish survey component introduced a much higher uncertainty in the recruitment estimates than prior to 2009 when it was used in the combined Young Fish survey.

Comparison with previous assessment and advice

The current assessment has revised the value of SSB in 2009 upward by 5% and in 2010 downward by 8%. The estimate of fishing mortality in 2009 was revised downward by 4%. Past recruitment estimates were subject to considerable annual revision. The strong year class 2008 has been revised upward in this year’s assessment by 12% and the assumed mean for the incoming 2009 year class in last year’s assessment has now been revised upward by 20%.

Last year’s advice was based on the precautionary approach and MSY considerations. This year the basis is the transition to the MSY approach.

Source

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

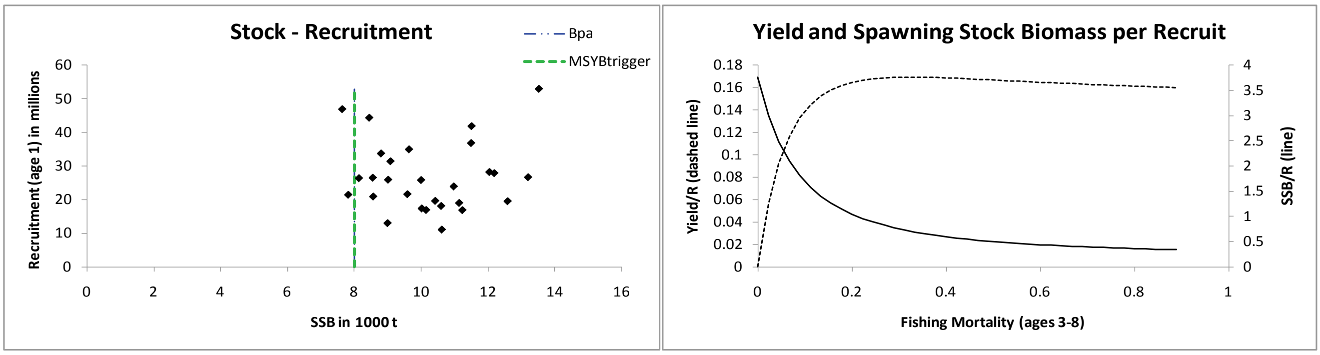


Figure 6.4.11.3 Sole in Division VIId (Eastern Channel). Yield-per-recruit analysis and stock–recruitment plot.

Table 6.4.11.1 Sole in Division VIId (Eastern Channel). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ICES landings
1987	Precautionary TAC	3.1	3.85	3.8	4.8
1988	*Status quo* (Shot) TAC	3.4	3.85	3.3	3.9
1989	*Status quo* (Shot) TAC	3.8	3.85	2.9	3.8
1990	No effort increase; TAC	3.7	3.85	3.0	3.6
1991	*Status quo* F; TAC	3.4	3.85	3.8	4.4
1992	TAC	≤2.7	3.5	3.8	4.1
1993	70% of F(91)~2 800 t	2.8	3.2	3.8	4.3
1994	Reduce F	<3.8	3.8	4.0	4.4
1995	No increase in F	3.8	3.8	3.7	4.4
1996	No long-term gain in increasing F	4.7	3.5	4.1	4.8
1997	No advice	-	5.23	3.9	4.8
1998	No increase in effort	4.5	5.23	3.0	3.4
1999	Reduce F to F_{pa}	3.8	4.7	3.9	4.1
2000	$F < F_{pa}$	<3.9	4.1	3.8	3.5
2001	$F < F_{pa}$	<4.7	4.6	4.6	4.0
2002	$F < F_{pa}$	<5.2	5.2	5.4	4.7
2003	$F < F_{pa}$	<5.4	5.4	6.2	5.0
2004	$F < F_{pa}$	<5.9	5.9	5.7	4.8
2005	$F < F_{pa}$	<5.7	5.7	4.6	4.4
2006	$F < F_{pa}$	<5.7	5.72	4.8	4.8
2007	$F < F_{pa}$	<6.44	6.22	5.3	5.2
2008	$F < F_{pa}$	<6.59	6.59	4.4	4.5
2009	$F < F_{pa}$	<4.38	5.274	5.1	5.3
2010	$F < F_{pa}$	<3.19	4.219	4.4	4.4
2011	See senarios	<4.84	4.852		
2012	MSY Transition	<5.60			

Weights in '000 t.

Table 6.4.11.2 Sole in Division VIId (Eastern Channel). Landings (tonnes) as officially reported to ICES and ICES estimates.

Year	Belgium	France		UK(E+W)	others	reported	Unallocated*	ICES Total est.	TAC
1974	159	383		309	3	854	30	884	
1975	132	464		244	1	841	41	882	
1976	203	599		404	.	1206	99	1305	
1977	225	737		315	.	1277	58	1335	
1978	241	782		366	.	1389	200	1589	
1979	311	1129		402	.	1842	373	2215	
1980	302	1075		159	.	1536	387	1923	
1981	464	1513		160	.	2137	340	2477	
1982	525	1828		317	4	2674	516	3190	
1983	502	1120		419	.	2041	1417	3458	
1984	592	1309		505	.	2406	1169	3575	
1985	568	2545		520	.	3633	204	3837	
1986	858	1528		551	.	2937	995	3932	
1987	1100	2086		655	.	3841	950	4791	3850
1988	667	2057		578	.	3302	551	3853	3850
1989	646	1610		689	.	2945	860	3805	3850
1990	996	1255		785	.	3036	611	3647	3850
1991	904	2054		826	.	3784	567	4351	3850
1992	891	2187		706	10	3794	278	4072	3500
1993	917	2322		610	13	3862	437	4299	3200
1994	940	2382		701	14	4037	346	4383	3800
1995	817	2248		669	9	3743	677	4420	3800
1996	899	2322		877	.	4098	699	4797	3500
1997	1306	1702		933	.	3941	823	4764	5230
1998	541	1703		803	.	3047	316	3363	5230
1999	880	2251		769	.	3900	235	4135	4700
2000	1021	2190		621	.	3832	-356	3476	4100
2001	1313	2482		822	.	4617	-592	4025	4600
2002	1643	2780		976	.	5399	-666	4733	5200
2003	1657	3475		1114	1	6247	-1209	5038	5400
2004	1485	3070		1112	.	5667	-841	4826	5900
2005	1221	2832		567	.	4620	-236	4384	5700
2006	1547	2627		678	.	4852	-18	4834	5720
2007	1530	2981		801	1	5313	-147	5166	6220
2008	1368	2880		724	.	4972	-455	4517	6593
2009	1475	2886		754	6	5121	145	5266	5274
2010	1294	2407	**	674		4374	17	4391	4219

* Unallocated mainly due to misreporting.

** Preliminary.

Table 6.4.11.3 Sole in Division VIId (Eastern Channel). Summary of stock assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-8
1982	12735	7824	3190	0.3546
1983	21349	9590	3458	0.4061
1984	21532	8997	3575	0.4310
1985	12913	9999	3837	0.3358
1986	25732	10616	3932	0.3917
1987	10981	9015	4791	0.5888
1988	25830	10149	3853	0.4284
1989	16808	8451	3805	0.5636
1990	44294	9638	3647	0.3786
1991	34877	8803	4351	0.4514
1992	33652	11231	4072	0.3699
1993	16787	13193	4299	0.3005
1994	26573	12581	4383	0.3532
1995	19443	11135	4420	0.3643
1996	18912	12183	4797	0.4723
1997	27791	10598	4764	0.5889
1998	18014	8143	3363	0.4541
1999	26284	9085	4135	0.5458
2000	31336	8555	3476	0.4398
2001	26428	7644	4025	0.3943
2002	46845	8569	4733	0.3747
2003	20825	10420	5038	0.3717
2004	19531	11492	4826	0.3987
2005	36749	11505	4383	0.3795
2006	41801	10018	4833	0.4307
2007	17285	10973	5166	0.4766
2008	23835	13515	4517	0.4033
2009	52897	12038	4964	0.4588
2010	28137	10224	4391	0.4531
2011	23535*	14982		
Average	26124	10365	4242	0.4262

* GM recruitment (1982–2008).

ECOREGION North Sea

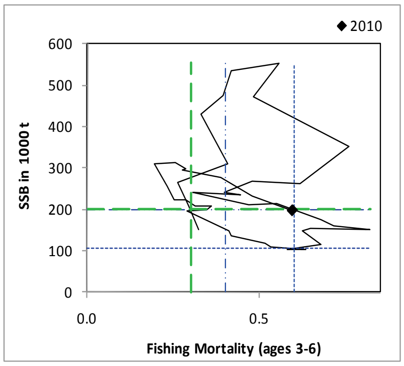
STOCK Saithe in Subarea IV (North Sea), Division IIIa (Skagerrak), and Subarea VI (West of Scotland and Rockall)

Advice for 2012

Given the recent poor recruitment and low SSB ICES advises that paragraph 6 of the EU–Norway management plan be invoked to reduce the catches beyond the 15% TAC reduction (i.e. below 87 544 t).

Stock status

F (Fishing Mortality)			
	2008	2009	2010
MSY (F_{MSY})	✗	✗	✗ Above target
Precautionary approach (F_{pa},F_{lim})	✓	O	O Increased risk
Management plan (F_{MP})	✗	✗	✗ Above target
SSB (Spawning-Stock Biomass)			
	2009	2010	2011
MSY ($B_{trigger}$)	✓	✗	✗ Below trigger
Precautionary approach (B_{pa},B_{lim})	✓	O	O Increased risk
Management plan (SSB_{MP})	✓	✗	✗ Below trigger



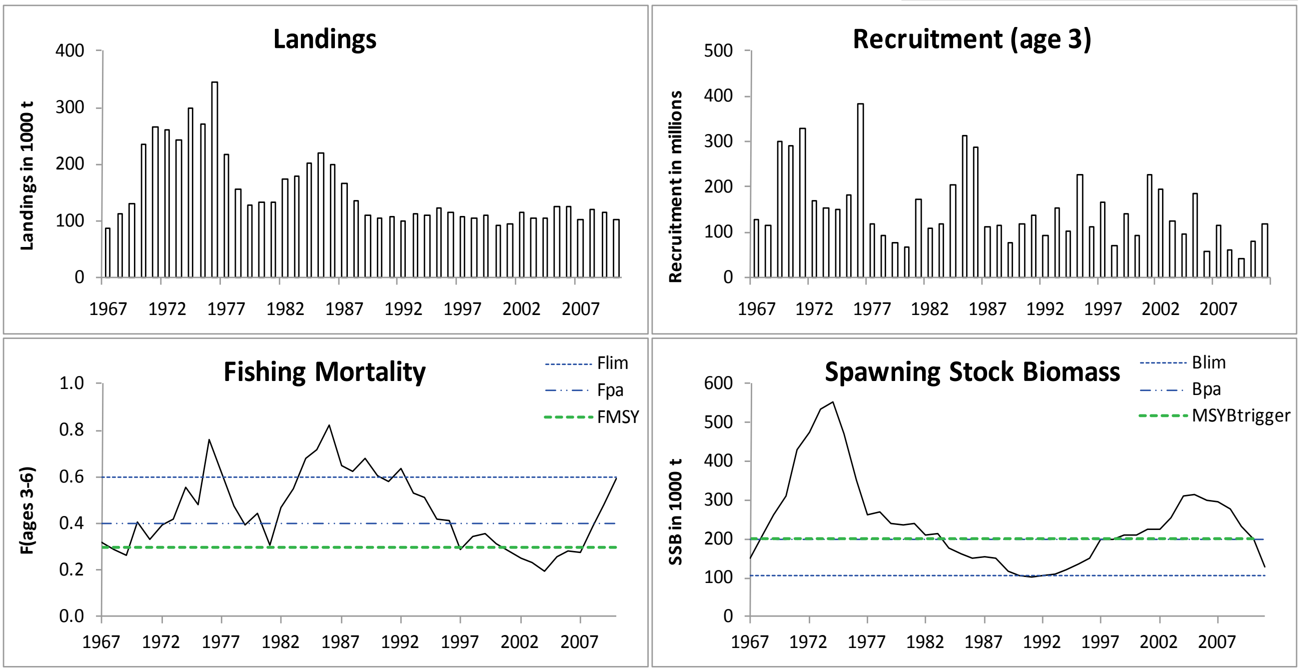


Figure 6.4.12.1 Saithe (in Subareas IV and VI, and Division IIIa. Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

The status of the stock has deteriorated in the last few years. SSB is estimated to have been above B_{pa} from 2001–2008 but has substantially declined during the last three years towards B_{lim}. From 2001–2007, F has been at or below the fishing mortality target of the management plan (0.3), but has now increased to F_{lim}. Because of lack of input data, no assessment was conducted in 2010, and these trends could not be recognized until now.

Management plans

The EU–Norway agreement management plan as updated in December 2008 (Annex 6.4.12) was evaluated by ICES (ICES, 2008), and the management plan was considered by ICES to be consistent with the precautionary approach in the short term (< 5 years).

Biology

The juveniles (ages 0–2 years) generally occur in shallow coastal areas. The fish is long-lived (20+ years) and tend to form large aggregations. Commercial catches are mostly 4–6 year old fish (1–2 kg; 50–60 cm).

Environmental influence on the stock

A decrease in the mean weight-at-age has been observed since the mid-1980s, but the trend has stopped during the last 2–3 years. There is insufficient information to establish whether these reductions are linked to changes in the environment. There is no indication that the observed decline in weight-at-age is density dependent.

The fisheries

Saithe in the North Sea are mainly taken in a direct trawl fishery in deep water along the Northern Shelf edge and the Norwegian Trench. New analyses show a substantial shift in the trawlers' fishing pattern both in time and spatial distribution. The importance of the fisheries on the spawning aggregations in the first quarter of the year has declined, and a more southern distribution of the catches has been observed, accompanied by a decrease in the main fishing area (representing > 90% of the catches). The mean age in the catches has decreased in the last year.

Catch by fleet	Catch 2010 = 102.5 kt, of which 95% are taken by bottom trawl and 5% by other gears (2009 distribution).

Effects of the fisheries on the ecosystem

Bycatch of other demersal species occurs in some trawl fisheries for saithe. Saithe is also taken as unintentional bycatch in other fisheries, and discards may occur if vessels do not have a saithe quota.

Quality considerations

The forecasts overestimated SSB and recruitment and underestimated F in the last years. The forecast conducted in 2010 used the 20-year average for recruitment assumed in 2009–2011 as the size of these year classes was unknown at the time. The present information shows that these year classes are poor. Any changes in the fishing pattern will lead to bias in the assessment. Effort should be made to completely substitute the commercial indices with data from scientific surveys in the future.

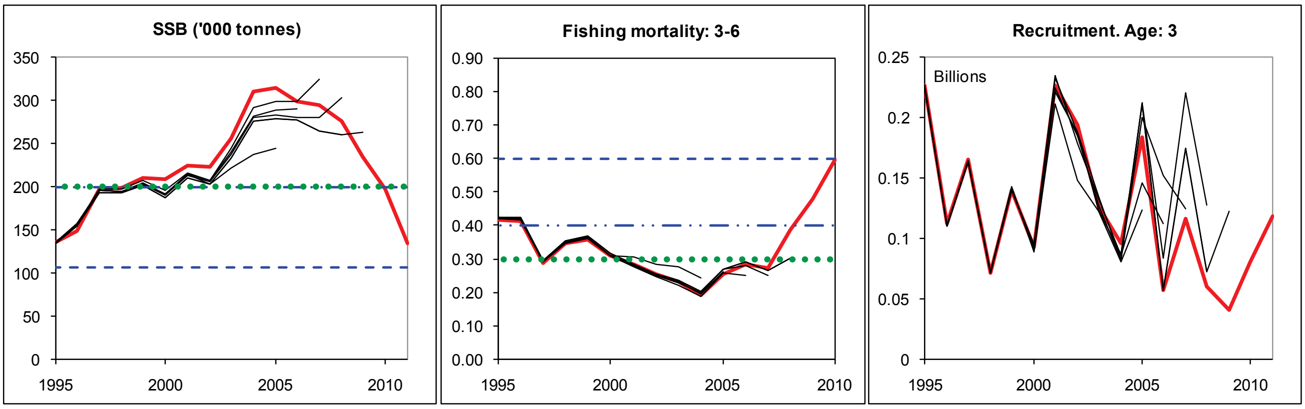


Figure 6.4.12.2 Saithe (in Subareas IV and VI, and Division IIIa. Historical assessment results (final year recruitment estimates included). The 2010 assessment is not included since this was only a forecast based on the 2009 assessment.

Scientific basis

Assessment type	Age-based assessment model (XSA).
Input data	Three survey indices (NORACU, IBTSq3, NORASS); three commercial indices (FRATRB, GEROTB, NORTR).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Benchmarked in 2011. No assessment in 2010, 2009 forecast extended by one year.
Working group report	WGNSSK

ECOREGION **North Sea**

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

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	200 000 t	B_{pa}
	F_{MP}	0.3	Or lower depending on SSB in relation to SSB target.
MSY Approach	MSY $B_{trigger}$	200 000 t	Default value B_{pa}
	F_{MSY}	0.3	Stochastic simulation using hockey-stick stock–recruitment.
Precautionary approach	B_{lim}	106 000 t	B_{loss} = 106 000 t (estimated in 1998).
	B_{pa}	200 000 t	Affords a high probability of maintaining SSB above B_{lim}.
	F_{lim}	0.6	F_{loss} the fishing mortality estimated to lead to stock falling below B_{lim} in the long term.
	F_{pa}	0.4	Implies that $B_{eq} > B_{pa}$ and $P(SSB_{MT} < B_{pa}) < 10\%$.

(unchanged since: 2011)

Yield and spawning biomass per Recruit F-reference points (2011):

	Fish Mort Ages 3–6	Yield/R	SSB/R
Average last 3 years	0.49	0.91	1.14
F_{max}	0.43	0.92	1.38
$F_{0.1}$	0.20	0.84	3.54
F_{med}	0.40	0.92	1.55

Outlook for 2012

Basis: F(2011) = estimated from landings constraint 2011 =0.61; R11–13 = GM88–08 =118.030; SSB(2012) = 106; landings (2011) = 103.

Rationale	landings 2012	landings IIIa&IV 2012[1)]	landings VI 2012[1)]	Basis	F 2012	SSB 2013	%SSB change [2)]	% TAC change [3)]
Management plan[4)] § 5	87.544	79	8.2	15 % TAC constraint	0.48	111	+ 4 %	- 15 %
MSY framework	33	30	3.1	$F_{MSY}*SSB_{2012}/B_{trigger}$	0.16	151	+ 42 %	- 68 %
MSY transition	75	68	7.1	F_{pa}	0.40	119	+ 13 %	- 27 %
Zero catch	0	0	0	F=0	0	176	+ 66 %	- 100 %
Status quo	22	19	2.0	F_{sq}*0.17	0.10	160	+ 50 %	- 79 %
	59	53	5.5	F_{MSY} (F_{sq}*0.5)	0.30	131	+ 24 %	- 43 %

Weights in '000 t.

1) Landings split according to the average in 1993–1998, i.e. 90.6% in Subarea IV and Division IIIa West and 9.4% in Subarea VI.

2) SSB 2013 relative to SSB 2012.

3) Landings 2012 relative to TAC 2011.

4) Assuming stock status is determined in the beginning of the TAC year.

Management plan

The EU–Norway agreement management plan does not clearly state whether the SSB in the intermediate year or the SSB in the beginning or end of the TAC year should be used to determine the status of the stock. ICES interprets this as being the SSB in the beginning of the intermediate year (2011). Since SSB in the beginning of 2011 is above B_{lim}, but below B_{pa}, § 3 of the harvest control rule applies. This would result in an F of 0.16 and a TAC of 33 000 t, which implies a change of more than 15%. The 15% TAC constraint (§ 5) leads to a TAC of 87 544 t, which results in SSB in 2013 of 111 000 t. In addition the management plan opens up for reductions of more than 15% where considered appropriate (§ 6).

The EU–Norway agreement management plan was evaluated by ICES in 2008 to be precautionary in the short term (~5 years). However, the HCRs in the management plan are not clear enough when the stock falls below the SSB of 200 000 t. The change in fishery distribution and stock productivity (lower growth and recruitment) imply that a re-evaluation of the management plan is needed.

MSY approach

Following the ICES MSY framework implies a fishing mortality of F_{MSY}*SSB2012/MSY $B_{trigger}$ = 0.16, which results in landings of less than 33 000 t in 2012.

The MSY transition implies a fishing mortality of $(0.6*F_{2010})+(0.4*0.16) = 0.42$, above F_{pa}. Therefore the scheme will lead to $F = F_{pa} = 0.4$ and landings of 75 000 t in 2012.

PA approach

B_{pa} cannot be reached by 2013 even with a zero catch. Advice based on the precautionary approach would give landings of 0 t in 2012.

Additional considerations

Management considerations

The change in fishery distribution and stock productivity (lower growth and recruitment) imply that a re-evaluation of the management plan is needed. This re-evaluation is envisaged for 2012.

The reported landings have been lower than the TACs during the past nine years, but the reduction of the TAC last year has lead to a gradually lower difference between landings and TAC.

Bycatch of other demersal fish species occurs in some trawl fisheries for saithe. Saithe is also taken as unintentional bycatch in other fisheries, and discards may occur if vessels do not have a saithe quota.

Regulations and their effects

Since 2009 the EU fleets fishing for saithe have fallen under the effort regime of the EU cod management plan (1342/2008). This may have contributed to a southern shift in geographical distribution and thereby a change in fishing pattern for at least the German fleet (where data has been available), which may shift the distribution of the catches toward younger ages.

Information from the fishing industry

Saithe has had growing importance for both the Danish and French fleets. The fishers' survey (Napier, 2011) shows a perception of an increasing stock which contradicts the available survey and commercial catch per unit effort indices. Reports from Norwegian fishers show concerns about increased landings from pelagic trawling and a possible change in exploitation pattern towards younger year classes.

Uncertainties in assessment and forecast

During the Benchmark (ICES, 2011b) the influence of the commercial cpue indices was reduced by using these indices to tune only the older ages (6–9) instead of using them for all ages (3–9). However, the outcome of the assessment still depends on these indices due to lack of information from scientific surveys on older age groups. Also, any changes in the fishing pattern will lead to bias in the assessment. Data on the geographical distribution of the catches have been provided during the benchmark meeting. It would improve the assessment if these data were available annually from all major fishing nations (Norway, Germany, Scotland, France). Effort should be made to completely substitute the commercial indices with data from scientific surveys in the future. Landings in 2012 and SSB in 2013 depend on the assumption of incoming recruitments (59% and 44% respectively).

Comparison with previous assessment and advice

No assessment was conducted in 2010. The forecast conducted in 2010 used a 20-year average for recruitment assumed for 2009–2011 as the size of these year classes was unknown at the time. The present information shows that these year classes are poor. SSB 2010 was corrected 15% downward in this year's assessment. Estimates of F in 2009 were revised upward by 63% between 2010 and 2011.

Last year's advice was based on scenarios for the EU–Norway management plan, the MSY framework, and the precautionary approach. The basis for the advice this year is an assessment and the management plan.

Assessment and management area

The ICES advice applies to saithe in Division IIIa, and Subareas IV and VI. For these areas, two TACs are set: one for Division IIIa and Subarea IV, and one for Subarea VI.

Sources

ICES. 2008. Norway and EC request on management plan for saithe in the North Sea and West of Scotland. ICES Advice 2008, Book 6, Section 6.3.3.3.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

Napier, I. R. 2011. Fishers' North Sea stock survey 2010. NAFC Marine Centre, Shetland, Scotland.

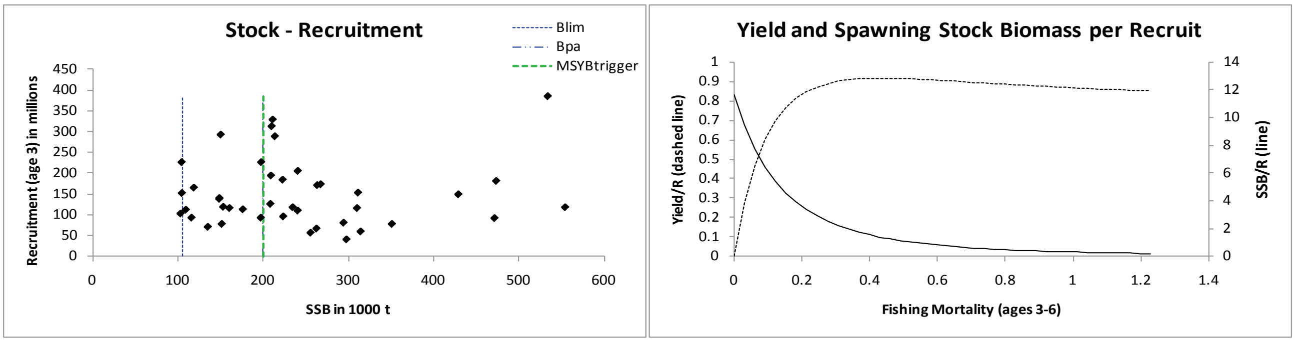


Figure 6.4.12.3 Saithe in Subareas IV and VI, and Division IIIa. Stock–recruitment plot and yield-per-recruit analysis.

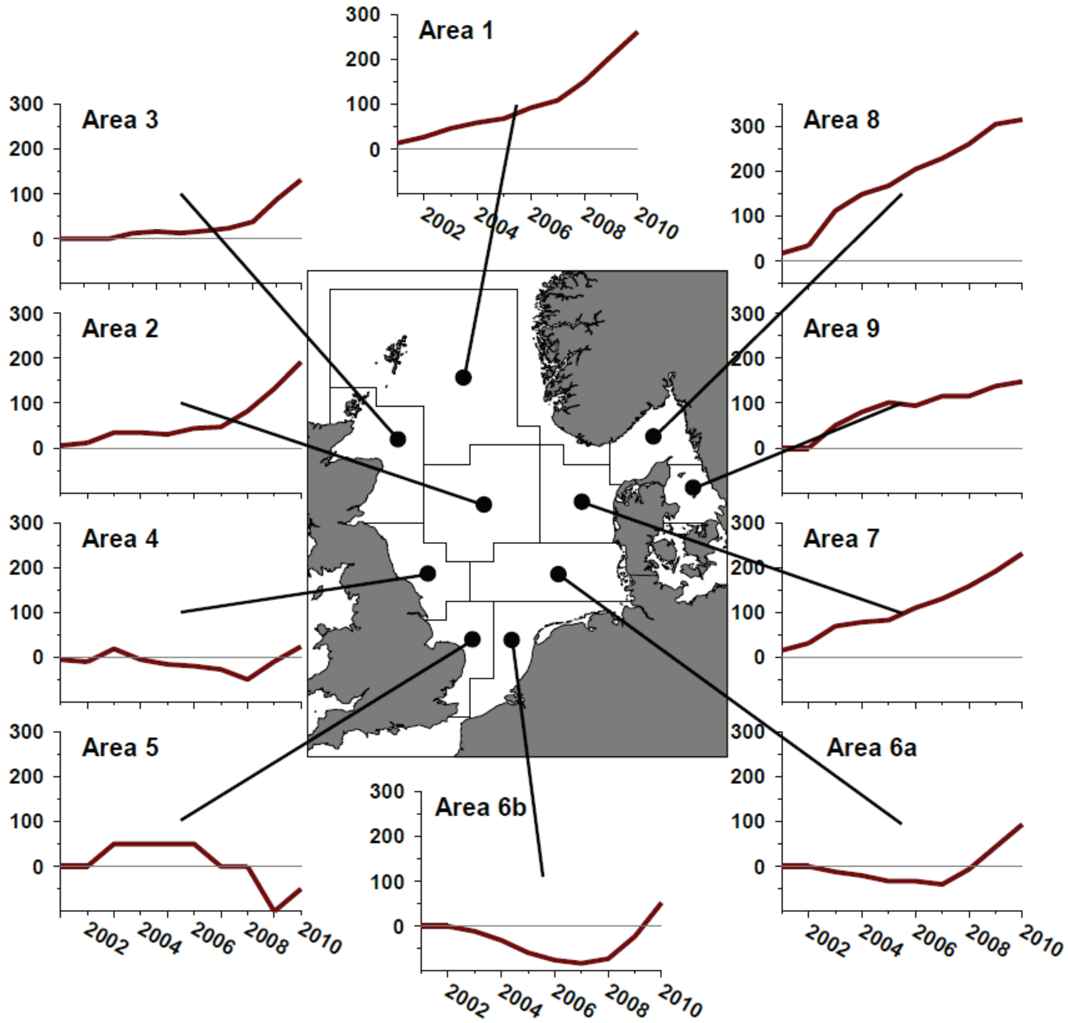


Figure 6.4.12.4 Saithe in Subareas IV and VI, and Division IIIa. Results of the North Sea Commission fishers' survey 2010 on abundance of saithe.

Table 6.4.12.1 Saithe in **Subarea IV and Division IIIa**. ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	Official landings	ICES landings
1987	Reduce F	<198	173	154	149
1988	60% of F(86); TAC	156	165	113	107
1989	No increase in F; TAC	170	170	92	92
1990	No increase in F; TAC	120	120	85	88
1991	No increase in F; TAC	125	125	93	99
1992	No increase in F; TAC	102	110	92	92
1993	70% of F(91) ~ 93 000 t	93	93	99	105
1994	Reduce F by 30%	72	97	90	102
1995	No increase in F	107	107	97	113
1996	No increase in F	111	111	96	110
1997	No increase in F	113	115	86	103
1998	Reduce F by 20%	97	97	88	100
1999	Reduce F to F_{pa}	104	110	108	107
2000	Reduce F by 30 %	75	85	85	87
2001	Reduce F by 20 %	87	87	88	90
2002	$F < F_{pa}$	<135	135	113	117
2003	$F < F_{pa}$	<176	165	105	102
2004	$F < F_{pa}$*	<211	190	87	100
2005	F according to man. plan*	<137	145	111	112
2006	F according to man. plan ($< F_{pa}$) *	<123	123	110	117
2007	F according to man. plan ($< F_{pa}$) *	<124	123	87	94
2008	F according to man. plan ($< F_{pa}$) *	<137	136	115	112
2009	F according to man. plan ($< F_{pa}$) *	<126	126	101**	106
2010	F according to man. plan ($< F_{pa}$) *	<107	107	83**	96
2011	See scenarios	-	93		
2012	Invoke § 6 of the management plan	> 15% reduction			

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

Table 6.4.12.2 Saithe in **Subarea VI**. ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC**	Official landings	ICES landings
1987	F reduced towards $\mathbf{F}_{max}$	19	27.8	32.5	31.4
1988	80% of F(86); TAC	35	35	32.8	34.2
1989	F < 0.3; TAC	20	30	22.4	25.6
1990	80% of F(88); TAC	24	29	18.0	19.9
1991	Stop SSB decline; TAC	21	22	17.9	17.0
1992	Avoid further reduction in SSB	<19	17	10.8	11.8
1993	F = 0.21	6.3	14	14.5	13.9
1994	Lowest possible F		14	13.0[2]	12.8
1995	Significant reduction in effort	-	16	10.6[2]	11.8
1996	No increase in F	10.2[1]	13	9.4[2]	9.4
1997	Significant reduction in F		12	8.6[2]	9.4
1998	60% Reduction in F	4.8	10.9	7.4[2]	8.4
1999	60% reduction in F	4.8	7.5	6.8	7.3
2000	Reduce F by 30%	6.0	7	6.4	5.9
2001	Reduce F by 20%	9.0	9	8.7	8.4
2002	F < F_{pa}	<13	14	5.6	5.2
2003	F < F_{pa}	<17	17.1	5.0	5.3
2004	F < F_{pa}*	<21	20	1.6	4.4
2005	F according to man. plan (< F_{pa}) *	<14	15	8.7	5.7
2006	F according to man. plan (< F_{pa})*	<12	13	9.4	8.6
2007	F according to man. plan (< F_{pa}) *	<12	13	6.7	6.8
2008	F according to man. plan (< F_{pa}) *	<14	14	6.0	7.2
2009	F according to man. plan (< F_{pa}) *	<13	11	6.2	7.0
2010	F according to man. plan (< F_{pa}) *	<11	11	6.2	6.9
2011	See scenarios	-	9		
2012	Invoke § 6 of the management plan	> 15% reduction			

Weights in '000 t.
[1]*Status quo* catch.
[2] Incomplete data.
* Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.
** Since 1996, the saithe in this area has been assessed together with North Sea/Skagerrak saithe. Allocation of TAC based on historical landings. In recent years TACs in Subarea VI have been included in a total TAC for Divisions VIIb and VIIc, but it is unclear if anything is added. The areas were combined shortly after the Saithe Study Group in 1995. Presumably the assessment was merged in 1996, and used in the advice for 1997.

Table 6.4.12.3 Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Officially reported landings and ICES estimates (in tonnes).

SAITHE IV and IIIa

Country	2001	2002	2003	2004*	2005*	2006	2007*	2008*	2009*	2010*
Belgium	24	107	45	22	28	16	18	7	27	15
Denmark	3575	5668	6954	7991	7498	7471	5458	8069	8802	392
Faroe Isl.	289	872	495	558	184	62	15	108	-	146
France	20472	25441	18001	13628	10768	15739	13043	15302	5445*	4582*
Germany	9479	10999	8956	9589	12401	14390	12790	14141	13689	11192
Greenland	1526[2]*	62	1616	403	-	-	-	-	-	-
Ireland	-	-	-	1	-	0	-	81	81	-
Netherlands	20	6	11*	3	40	28	5	3	17	3
Norway	44397	60013	61735	62783	67365	61268	45395	62055	57708	53031
Poland	727	752	734*	0	1100	-	-	1407	988	654
Russia	-	-	-	-	35	2	5	5	13	-
Sweden	1627	1863	1876	2249	2114	1695	1380	1639	1363	1545
UK (E/W/NI)	1186	2521	1215	457	1190	9129**	9628**	11701**	12545**	11887‘*
UK (Scotland)	5219	6596	5829	5924	7703					
Total reported	88541	114900	107467	103608	110575	109800	87377	114517	100678	83447
Unallocated	1030	1291	-5809	-3646	968	7312	6241	-3084	4851	12208
WG estimate	89571	116191	101658	99962	111543	117112	93618	111433	105529	95655
TAC	87000	135000	165000	190000	145000	123250	135900	135900	125934	107000

*Preliminary, [2]Preliminary data reported in Iva, **Scotland+E/W/NI combined

SAITHE VI

Country	2001	2002	2003	2004*	2005*	2006	2007*	2008*	2009*	2010*
Faroe Islands	-	-	2	34	21	76	32	23	-	24
France	5157	3062	3499	3053	3452	5782	3956	2617	2093*	2003
Germany	466	467	54	4	373	532	580	147	298	257
Ireland	399	91	170	95	168	243	322	208	208	519
Netherlands	-	-	-	-	-	-	-	1	-	-
Norway	31	12	28	16	20	28	377	78	68	249
Russia	1	1	6	6	25	7	2	50	4	2
Spain	15	4	6	2	3	-	-	-	-	-
UK (E/W/NI)	273	307	263	37	203	2748**	1419**	2887‘*	3501**	3168**
UK (Scotland)	2246	1567	1189	1563	4433					
Total reported	8588	5513	5215	4810	8699	9416	6688	6011	6172	6222
Unallocated	-1770	-327	35	-296	-2960	848	98	1223	791	666
WG estimate	6818	5186	5250	4514	5739	8568	6786	7234	6963	6888
TAC	9000	14000	17119	20000	15044	12787	14100	14100	13066	11000

*Preliminary **Scotland+E/W/NI combined

SAITHE IV, IIIa and VI

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*
WG estimate	96389	121377	106908	104476	117282	125680	100404	118667	112492	102543
TAC	96000	149000	182119	210000	160044	136037	150000	150000	139000	118000

Table 6.4.12.4 Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Summary of stock assessment.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3–6
1967	127000	150800	88300	0.322
1968	114000	211700	113800	0.291
1969	301000	264000	130600	0.262
1970	292000	311900	235000	0.408
1971	328000	429600	265400	0.329
1972	171000	474000	261900	0.395
1973	153000	534500	242500	0.416
1974	149000	554900	298400	0.556
1975	181000	472000	271600	0.482
1976	384000	351600	344000	0.760
1977	118000	263100	216400	0.615
1978	92000	268100	155100	0.477
1979	78000	241100	128400	0.396
1980	67000	235200	131900	0.443
1981	173000	241200	132300	0.306
1982	110000	210500	174400	0.469
1983	118000	214300	180000	0.548
1984	205000	176700	200800	0.677
1985	312000	161000	220900	0.715
1986	288000	152000	198600	0.820
1987	113000	153700	167500	0.647
1988	116000	149100	135200	0.624
1989	78000	116500	108900	0.678
1990	119000	105200	103800	0.604
1991	138000	103600	108000	0.581
1992	93000	104900	99700	0.635
1993	152000	109800	111500	0.533
1994	103000	119200	109600	0.514
1995	226000	135600	121800	0.418
1996	112000	149100	115000	0.411
1997	165000	197800	107300	0.289
1998	71000	198200	106100	0.347
1999	140000	209700	110700	0.359
2000	93000	209000	91300	0.311
2001	226000	224100	95000	0.285
2002	194000	223400	115400	0.253
2003	126000	256200	105600	0.231
2004	96000	310700	104200	0.193
2005	184000	314900	124500	0.255
2006	57000	298300	125700	0.284
2007	116000	294900	101200	0.274
2008	60000	276100	119300	0.387
2009	41000	233900	115700	0.478
2010	81065	197300	102500	0.595
2011	118030	133945		
Average	150645	238623	152177	0.452

Annex 6.4.12 Management plan

In 2008 EU and Norway renewed the existing agreement on *"a long-term plan for the saithe stock in the Skagerrak, the North Sea and west of Scotland, which is consistent with a precautionary approach and designed to provide for sustainable fisheries and high yields. The plan shall consist of the following elements.*

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 106,000 tonnes (Blim).*
2. *Where the SSB is estimated to be above 200,000 tonnes the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups.*
3. *Where the SSB is estimated to be below 200,000 tonnes but above 106,000 tonnes, the TAC shall not exceed a level which, on the basis of a scientific evaluation by ICES, will result in a fishing mortality rate equal to 0.30-0.20*(200,000-SSB)/94,000.*
4. *Where the SSB is estimated by the ICES to be below the minimum level of SSB of 106,000 tonnes the TAC shall be set at a level corresponding to a fishing mortality rate of no more than 0.1.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15 % from the TAC of the preceding year the Parties shall fix a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.*
6. *Notwithstanding paragraph 5 the Parties may where considered appropriate reduce the TAC by more than 15 % compared to the TAC of the preceding year.*
7. *A review of this arrangement shall take place no later than 31 December 2012.*
8. *This arrangement enters into force on 1 January 2009."*

ECOREGION North Sea

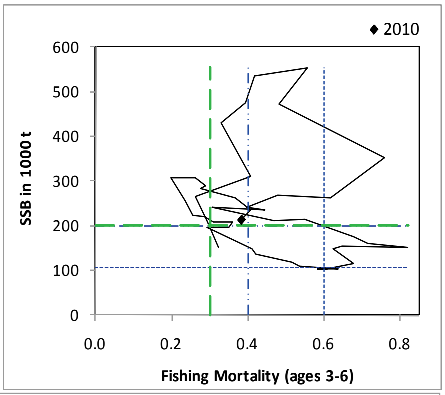
STOCK Saithe in Subarea IV (North Sea), Division IIIa (Skagerrak), and Subarea VI (West of Scotland and Rockall)

Advice for 2012 (updated June advice)

ICES concluded that the results of the 2011 summer surveys for saithe warranted updating the advice provided in June. ICES advises on the basis of the EU–Norway management plan that landings in 2012 should be no more than 87 550 t for the whole assessment area.

Stock status

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	O	✓	Harvested sustainably
Management plan (F_{MP})	✗	✗	✗	Above target
SSB (Spawning-Stock Biomass)				
	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	O	Increased risk
Management plan (SSB_{MP})	✓	✓	✗	Below trigger



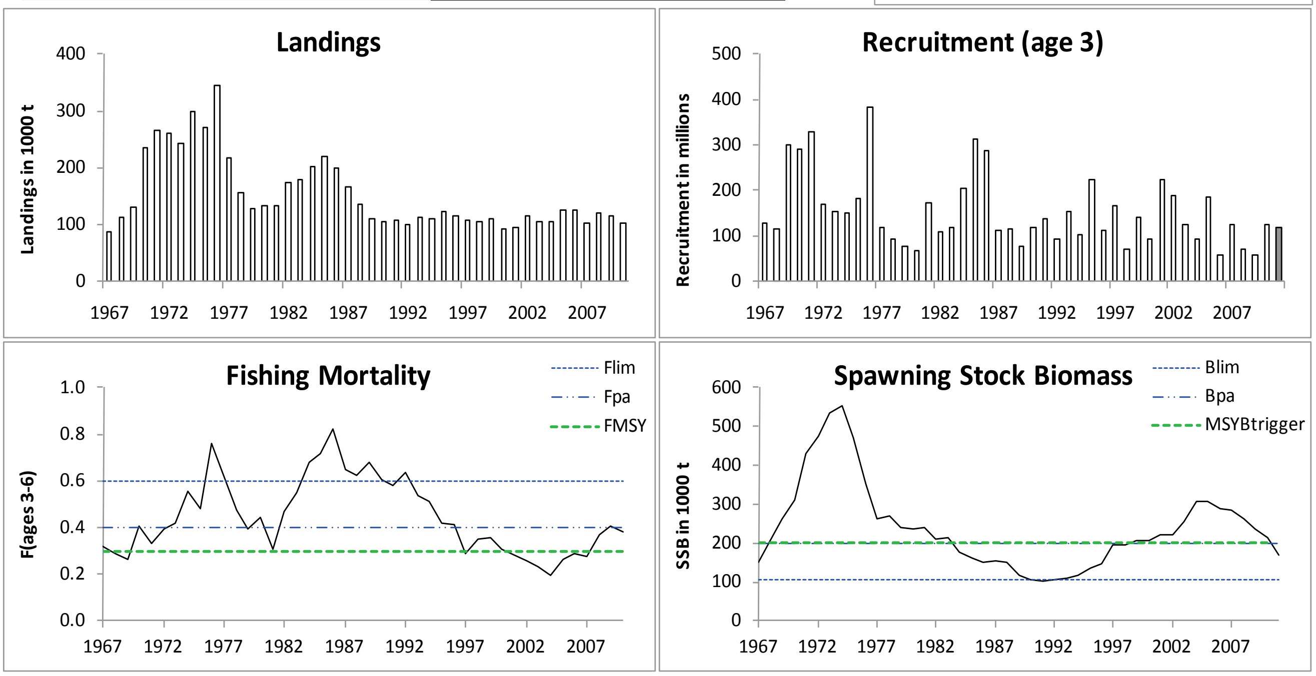


Figure 6.4.12.1b Saithe in Subareas IV and VI, and Division IIIa. Summary of stock assessment in November 2011 (weights in '000 tonnes). Top right: SSB and F over the years. Predicted values are shaded.

The status of the stock has deteriorated in the last few years. Recruitment in 2006, 2008, and 2009 was among the lowest on record. SSB was above B_{pa} during 2001–2008 but has since declined to below B_{pa}. Fishing mortality has generally increased since 2004 and is currently just below F_{pa}.

Management plans

The EU–Norway agreement management plan as updated in December 2008 (Annex 6.4.12b) was evaluated by ICES (ICES, 2008), and the management plan was considered by ICES to be consistent with the precautionary approach in the short term (< 5 years).

Biology

The juveniles (ages 0–2 years) generally occur in shallow coastal areas. The fish are long-lived (20+ years) and tend to form large aggregations. Commercial catches consist mostly of 4- to 6-year-old fish (1–2 kg; 50–60 cm).

Environmental influence on the stock

A decrease in the mean weight-at-age has been observed since the mid-1980s, but this trend has stopped in the last 2–3 years. Current information is insufficient to establish whether these reductions are linked to changes in the environment. There is no indication that the observed decline in weight-at-age is density dependent.

The fisheries

Saithe in the North Sea are mainly taken in a directed trawl fishery in deep water along the Northern Shelf edge and the Norwegian Trench. New analyses show a substantial shift in the trawlers' fishing pattern, both in time and spatial distribution. The importance of the fisheries on the spawning aggregations in the first quarter of the year has declined, and a more southern distribution of the catches has been observed, accompanied by a decrease in the main fishing area (representing >90% of the catches). The mean age in the catches has decreased in the last year.

Catch by fleet	Catch 2010 = 102.5 kt, of which 95% are taken by bottom trawl and 5% by other gears (2009 distribution).

Effects of the fisheries on the ecosystem

Bycatch of other demersal species occurs in some trawl fisheries for saithe. Saithe is also taken as unintentional bycatch in other fisheries, and discards may occur if vessels do not have a saithe quota.

Quality considerations

With the availability of the 2011 summer survey, conflicts in the survey measurements in recent years have become more apparent. In the model used this November the influence of the survey was reduced compared to that used as the basis for the June advice. Both models—the November model, which reduces the influence of the surveys, and the June model with 2011 surveys included—lead to clause 5 of the agreed management plan being used as the basis for advice. The assessment would improve if data on the geographical distribution of the catches were available annually from all major fishing nations (Norway, Germany, Scotland, and France).

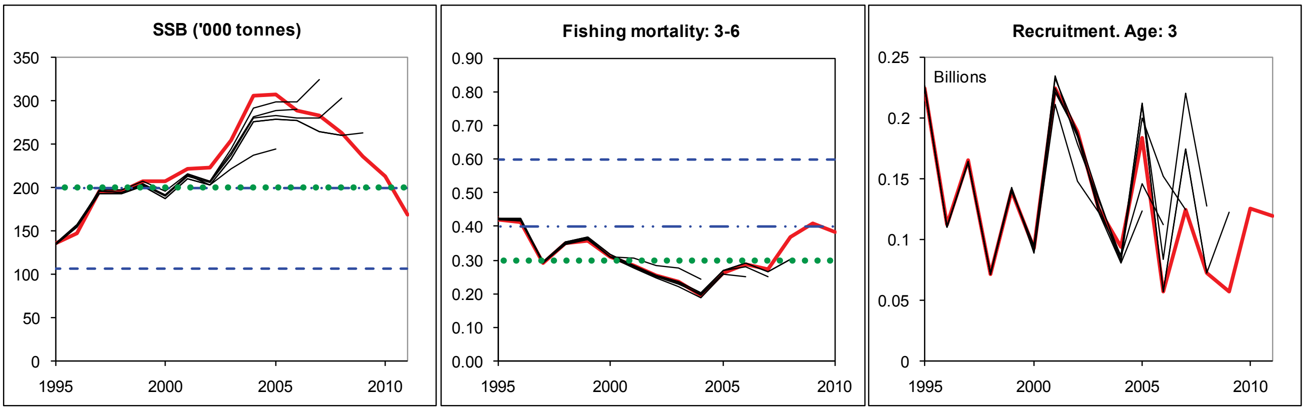


Figure 6.4.12.2b Saithe in Subareas IV and VI, and Division IIIa. Historical assessment results in November (final year recruitment estimates included). The 2010 assessment is not included since this was only a forecast based on the 2009 assessment.

Scientific basis

Assessment type	Age-based assessment model (XSA).
Input data	Three survey indices (NORACU, IBTS-Q3, NORASS); three commercial indices (FRATRB, GEROTB, NORTR).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Benchmarked in 2011. In 2011 advice was given in June using the benchmark model and updated in November using the 2010 model and 2011 summer survey results.
Working group report	WGNSSK

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

Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	200 000 t	B_{pa}
	F_{MP}	0.3	Or lower depending on SSB in relation to SSB target.
MSY Approach	MSY $B_{trigger}$	200 000 t	Default value B_{pa}
	F_{MSY}	0.3	Stochastic simulation using hockey-stick stock–recruitment.
Precautionary approach	B_{lim}	106 000 t	B_{loss} = 106 000 t (estimated in 1998).
	B_{pa}	200 000 t	Affords a high probability of maintaining SSB above B_{lim}.
	F_{lim}	0.6	F_{loss} the fishing mortality estimated to lead to stock falling below B_{lim} in the long term.
	F_{pa}	0.4	Implies that B_{eq} >B_{pa} and $P(SSB_{MT} < B_{pa})$< 10%.

(unchanged since: 2011)

Yield and spawning biomass per Recruit F-reference points (2011):

	Fish Mort Ages 3–6	Yield/R	SSB/R
Average last 3 years	0.39	0.88	1.56
F_{max}*	-	-	-
$F_{0.1}$	0.20	0.80	3.40
F_{med}	0.39	0.88	1.55

* F_{max} is considered not well defined.

Outlook for 2012 (November 2011 assessment)

Basis: F(2011) = estimated from landings constraint 2011 = 0.4; R11–13 = GM88–08 = 119.028; SSB(2012) = 166; landings (2011) = 103.

Rationale	**landings 2012**	**landings IIIa&IV 2012**[1)]	**landings VI 2012**[1)]	**Basis**	**F 2012**	**SSB 2013**	**% SSB change**[2)]	**% TAC change**[3)]
Management plan[4)] § 5	87.550	79.320	8.230	15 % TAC constraint	0.32	183	+10%	−15%
MSY framework	71	65	6.7	F_{MSY}*SSB_{2012}/$B_{trigger}$	0.25	196	+18%	−31%
Precautionary approach	67	60	6.3	SSB2013 = B_{pa}	0.23	200	+21%	−35%
Zero catch	0	0	0	F = 0	0	257	+55%	−100%
Other options	84	76	7.9	F_{MSY}	0.3	186	+12%	−19%
	103	94	9.7	F_{2011}	0.4	169	+2%	0%

Weights in '000 t.
1) Landings split according to the average in 1993–1998, i.e. 90.6% in Subarea IV and Division IIIa West and 9.4% in Subarea VI.
2) SSB 2013 relative to SSB 2012.
3) Landings 2012 relative to TAC 2011.
4) Assuming stock status is determined at the beginning of the TAC year.

Management plan

The EU–Norway agreement management plan does not clearly state whether the SSB in the intermediate year or the SSB at the beginning or end of the TAC year should be used to determine the status of the stock. ICES interprets this as being the SSB at the beginning of the intermediate year (2011). Since SSB at the beginning of 2011 (169 000 t) is above B_{lim}, (106 000 t) but below B_{pa} (200 000 t), §3 of the harvest control rule applies. This would result in an F of 0.23 and a TAC change of more than 15%. The 15% TAC constraint (§5) is therefore imposed, resulting in a TAC of 87 550 t and an SSB in 2013 of 183 000 t. The advice given in June to enact clause 6 of the Management Plan (i.e. go beyond a 15% TAC reduction) is no longer considered appropriate because with the 2011 summer survey information SSB in 2013 is now estimated to be higher than estimated in June.

The EU–Norway agreement management plan was evaluated by ICES in 2008 to be precautionary in the short term (< 5 years). However, the HCRs in the management plan are not clear enough when the stock falls below the SSB of 200 000 t. The change in fishery distribution and stock productivity (lower growth and recruitment) imply that a re-evaluation of the management plan is needed.

MSY approach

Following the ICES MSY framework implies a fishing mortality of F_{MSY}*SSB_{2012}/MSY $B_{trigger}$ = 0.25. This would result in landings less than 71 000 t in 2012 and an SSB in 2013 of 196 000 t.

PA approach

In order to increase SSB to B_{pa} by 2013, total landings should be less than 67 000 t in 2012.

Additional considerations

Management considerations

With the availability of the 2011 summer survey, conflicts in the survey measurements in recent years have become more apparent. In the model used this November the influence of the survey was reduced compared to that used as the basis for the June advice. Both models—the November model, which reduces the influence of the surveys, or the June model with 2011 surveys included—result in clause 5 of the agreed management plan being used as the basis for advice rather than clause 6, as in the June advice.

The change in fishery distribution and stock productivity (lower growth and recruitment) imply that a re-evaluation of the management plan is needed. This re-evaluation is envisaged for 2012.

The reported landings have been lower than the TACs during the past nine years, but the reduction of the TAC last year has lead to a gradually lower difference between landings and TAC.

Bycatch of other demersal fish species occurs in some trawl fisheries for saithe. Saithe is also taken as unintentional bycatch in other fisheries, and discards may occur if vessels do not have a saithe quota.

Regulations and their effects

Since 2009 the EU fleets fishing for saithe have fallen under the effort regime of the EU cod management plan (1342/2008). This may have contributed to a southern shift in geographical distribution and thereby a change in fishing pattern for at least the German fleet (where data has been available), which may shift the distribution of the catches toward younger ages.

Information from the fishing industry

Saithe has had growing importance for both the Danish and French fleets. The fishers' survey (Napier, 2011) shows a perception of an increasing stock which contradicts the available survey and commercial catch per unit effort indices. Reports from Norwegian fishers show concerns about increased landings from pelagic trawling and a possible change in exploitation pattern towards younger year classes.

Uncertainties in assessment and forecast

Estimates of recruitment are considered uncertain due to strong year effects in the surveys in the last three years. With the availability of the 2011 survey, conflicts in the survey measurements in recent years became more apparent. Therefore, the November model setup reduces the influence of the surveys on the assessment compared to the June advice.

In the last several years, the forecasts have generally overestimated SSB and recruitment and underestimated F. The forecast conducted in 2010 used the 20-year average for recruitment assumed in 2009–2011 as the size of these year classes was unknown at the time. The present information indicates that these year classes are likely to be poor.

During the benchmark (ICES, 2011b) the influence of the commercial cpue indices was reduced by using these indices to tune only the older ages (6–9) instead of using them for all ages (3–9). The latest information indicates strong year effects in the scientific surveys in the most recent years. The option to include the commercial cpue tuning fleets again at ages 3-5 was thus considered appropriate in the November update. However, the potential for bias in commercial cpue (for example hyper-stability) is a serious concern for shoaling species such as saithe and reliable survey data should be sought to redress this issue

The updated advice is based on the pre-benchmark settings of the assessment. However, had the June assessment model been used instead and updated with the summer 2011 survey results, this would not change the advice that a 15% reduction in TAC is warranted according to the management plan (ICES, 2011a).

Data were provided on the geographical distribution of the catches during the benchmark meeting. If such data were available annually from all major fishing nations (Norway, Germany, Scotland, France), it would likely improve the assessment.

Comparison with previous assessment and advice

The current assessment estimates SSB in 2011 to be 26% higher than estimated in June 2011, and fishing mortality in 2009 is 36% lower.

Based on the current assessment the June advice to enact clause 6 of the Management Plan (i.e. go beyond a 15% TAC reduction) is no longer considered appropriate.

Assessment and management area

The ICES advice applies to saithe in Division IIIa and in Subareas IV and VI. For these areas, two TACs are set: one for Division IIIa and Subarea IV, and one for Subarea VI.

Sources

ICES. 2008. Norway and EC request on management plan for saithe in the North Sea and West of Scotland. ICES Advice 2008, Book 6, Section 6.3.3.3.

ICES. 2011a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 2011. ICES CM 2011/ACOM:13.

ICES. 2011b. ICES. 2011. Report of the Benchmark Workshop on Roundfish and Pelagic Stocks (WKBENCH 2011), 24–31 January 2011, Lisbon, Portugal. ICES CM 2011/ACOM:38.

Napier, I. R. 2011. Fishers' North Sea stock survey 2010. NAFC Marine Centre, Shetland, Scotland.

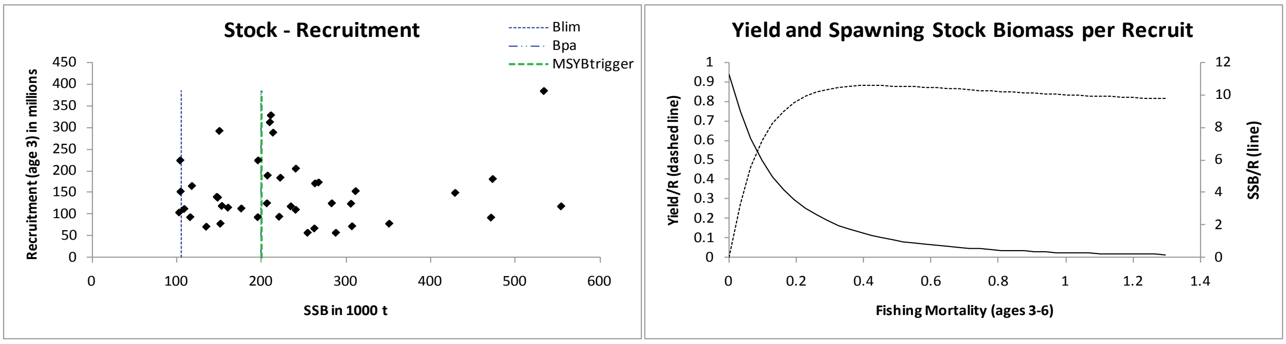


Figure 6.4.12.3b Saithe in Subareas IV and VI and in Division IIIa. Stock–recruitment plot and yield-per-recruit analysis.

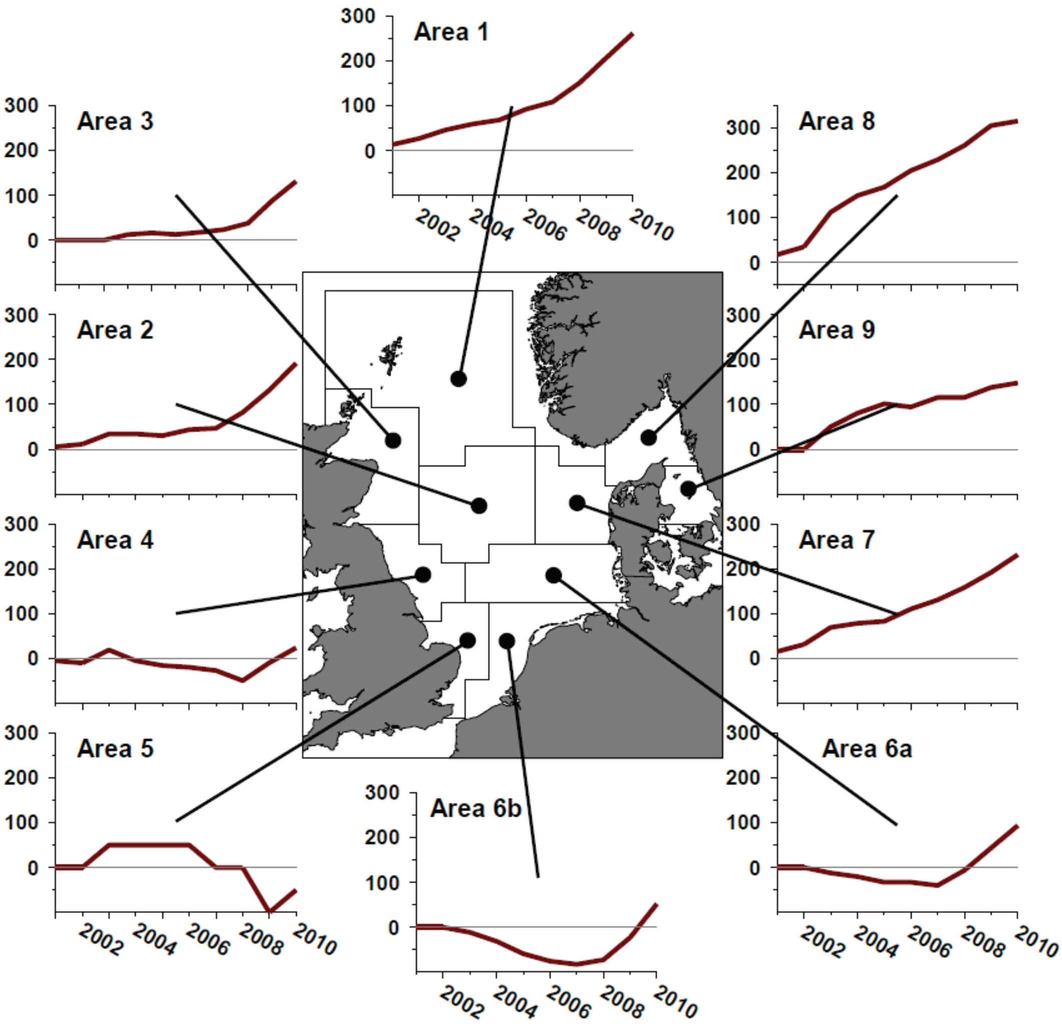


Figure 6.4.12.4b Saithe in Subareas IV and VI and in Division IIIa. Results of the North Sea Commission fishers' survey 2010 on abundance of saithe (Napier, 2011).

Table 6.4.12.1b Saithe in **Subarea IV and Division IIIa**. ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	Official landings	ICES landings
1987	Reduce F	<198	173	154	149
1988	60% of F(86); TAC	156	165	113	107
1989	No increase in F; TAC	170	170	92	92
1990	No increase in F; TAC	120	120	85	88
1991	No increase in F; TAC	125	125	93	99
1992	No increase in F; TAC	102	110	92	92
1993	70% of F(91) ~ 93 000 t	93	93	99	105
1994	Reduce F by 30%	72	97	90	102
1995	No increase in F	107	107	97	113
1996	No increase in F	111	111	96	110
1997	No increase in F	113	115	86	103
1998	Reduce F by 20%	97	97	88	100
1999	Reduce F to F_{pa}	104	110	108	107
2000	Reduce F by 30 %	75	85	85	87
2001	Reduce F by 20 %	87	87	88	90
2002	$F < F_{pa}$	<135	135	113	117
2003	$F < F_{pa}$	<176	165	105	102
2004	$F < F_{pa}$*	<211	190	87	100
2005	F according to man. plan*	<137	145	111	112
2006	F according to man. plan (< F_{pa}) *	<123	123	110	117
2007	F according to man. plan (< F_{pa}) *	<124	123	87	94
2008	F according to man. plan (< F_{pa}) *	<137	136	115	112
2009	F according to man. plan (< F_{pa}) *	<126	126	101**	106
2010	F according to man. plan (< F_{pa}) *	<107	107	83**	96
2011	See scenarios	-	93		
2012[1]	F according to man. plan (< F_{pa}) *	< 79.320			

Weights in '000 t.
* Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.
** French data are preliminary.
[1] The June advice in 2011 was updated in November 2011.

Table 6.4.12.2b Saithe in **Subarea VI**. ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC**	Official landings	ICES landings
1987	F reduced towards $\mathbf{F}_{max}$	19	27.8	32.5	31.4
1988	80% of F(86); TAC	35	35	32.8	34.2
1989	F < 0.3; TAC	20	30	22.4	25.6
1990	80% of F(88); TAC	24	29	18.0	19.9
1991	Stop SSB decline; TAC	21	22	17.9	17.0
1992	Avoid further reduction in SSB	<19	17	10.8	11.8
1993	F = 0.21	6.3	14	14.5	13.9
1994	Lowest possible F		14	13.0[2]	12.8
1995	Significant reduction in effort	-	16	10.6[2]	11.8
1996	No increase in F	10.2[1]	13	9.4[2]	9.4
1997	Significant reduction in F		12	8.6[2]	9.4
1998	60% Reduction in F	4.8	10.9	7.4[2]	8.4
1999	60% reduction in F	4.8	7.5	6.8	7.3
2000	Reduce F by 30%	6.0	7	6.4	5.9
2001	Reduce F by 20%	9.0	9	8.7	8.4
2002	$F < F_{pa}$	<13	14	5.6	5.2
2003	$F < F_{pa}$	<17	17.1	5.0	5.3
2004	$F < F_{pa}$*	<21	20	1.6	4.4
2005	F according to man. plan (< F_{pa}) *	<14	15	8.7	5.7
2006	F according to man. plan (< F_{pa})*	<12	13	9.4	8.6
2007	F according to man. plan (< F_{pa}) *	<12	13	6.7	6.8
2008	F according to man. plan (< F_{pa}) *	<14	14	6.0	7.2
2009	F according to man. plan (< F_{pa}) *	<13	11	6.2	7.0
2010	F according to man. plan (< F_{pa}) *	<11	11	6.2	6.9
2011	See scenarios	-	9		
2012[3]	F according to man. plan (< F_{pa}) *	< 8.230			

Weights in '000 t.
[1]*Status quo* catch.
[2] Incomplete data.
[3] The June advice in 2011 was updated in November 2011.
* Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.
** Since 1996, the saithe in this area has been assessed together with North Sea/Skagerrak saithe, with allocation of TAC based on historical landings. In recent years TACs in Subarea VI have been included in a total TAC for Divisions VIIb and VIIc, but it is unclear if anything is added. The areas were combined shortly after the Saithe Study Group meeting in 1995. Presumably the assessment was merged in 1996, and used in the advice for 1997.

Table 6.4.12.3b Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Officially reported landings and ICES estimates (in tonnes).

SAITHE IV and IIIa

Country	2001	2002	2003	2004*	2005*	2006	2007*	2008*	2009*	2010*
Belgium	24	107	45	22	28	16	18	7	27	15
Denmark	3575	5668	6954	7991	7498	7471	5458	8069	8802	392
Faroe Isl.	289	872	495	558	184	62	15	108	-	146
France	20472	25441	18001	13628	10768	15739	13043	15302	5445*	4582*
Germany	9479	10999	8956	9589	12401	14390	12790	14141	13689	11192
Greenland	1526[1]*	62	1616	403	-	-	-	-	-	-
Ireland	-	-	-	1	-	0	-	81	81	-
Netherlands	20	6	11*	3	40	28	5	3	17	3
Norway	44397	60013	61735	62783	67365	61268	45395	62055	57708	53031
Poland	727	752	734*	0	1100	-	-	1407	988	654
Russia	-	-	-	-	35	2	5	5	13	-
Sweden	1627	1863	1876	2249	2114	1695	1380	1639	1363	1545
UK (E/W/NI)	1186	2521	1215	457	1190	9129**	9628**	11701**	12545**	11887**
UK (Scotland)	5219	6596	5829	5924	7703					
Total reported	88541	114900	107467	103608	110575	109800	87377	114517	100678	83447
Unallocated	1030	1291	-5809	-3646	968	7312	6241	-3084	4851	12208
WG estimate	89571	116191	101658	99962	111543	117112	93618	111433	105529	95655
TAC	87000	135000	165000	190000	145000	123250	135900	135900	125934	107000

*Preliminary. [1]Preliminary data reported in Division IVa. **Scotland+E/W/NI combined.

SAITHE VI

Country	2001	2002	2003	2004*	2005*	2006	2007*	2008*	2009*	2010*
Faroe Islands	-	-	2	34	21	76	32	23	-	24
France	5157	3062	3499	3053	3452	5782	3956	2617	2093*	2003
Germany	466	467	54	4	373	532	580	147	298	257
Ireland	399	91	170	95	168	243	322	208	208	519
Netherlands	-	-	-	-	-	-	-	1	-	-
Norway	31	12	28	16	20	28	377	78	68	249
Russia	1	1	6	6	25	7	2	50	4	2
Spain	15	4	6	2	3	-	-	-	-	-
UK (E/W/NI)	273	307	263	37	203	2748**	1419**	2887**	3501**	3168**
UK (Scotland)	2246	1567	1189	1563	4433					
Total reported	8588	5513	5215	4810	8699	9416	6688	6011	6172	6222
Unallocated	-1770	-327	35	-296	-2960	848	98	1223	791	666
WG estimate	6818	5186	5250	4514	5739	8568	6786	7234	6963	6888
TAC	9000	14000	17119	20000	15044	12787	14100	14100	13066	11000

*Preliminary. **Scotland+E/W/NI combined.

SAITHE IV, IIIa and VI

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010*
WG estimate	96389	121377	106908	104476	117282	125680	100404	118667	112492	102543
TAC	96000	149000	182119	210000	160044	136037	150000	150000	139000	118000

Table 6.4.12.4b Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Summary of stock assessment in November 2011.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3–6
1967	127000	150800	88300	0.322
1968	114000	211700	113800	0.291
1969	301000	264000	130600	0.262
1970	292000	311900	235000	0.408
1971	328000	429600	265400	0.329
1972	171000	474000	261900	0.395
1973	153000	534500	242500	0.416
1974	149000	554900	298400	0.556
1975	181000	472000	271600	0.482
1976	384000	351600	344000	0.760
1977	118000	263100	216400	0.615
1978	92000	268100	155100	0.477
1979	78000	241100	128400	0.396
1980	67000	235200	131900	0.443
1981	173000	241200	132300	0.306
1982	110000	210500	174400	0.469
1983	118000	214300	180000	0.548
1984	205000	176700	200800	0.677
1985	312000	161000	220900	0.715
1986	288000	152000	198600	0.820
1987	113000	153700	167500	0.648
1988	115000	149000	135200	0.625
1989	78000	116300	108900	0.679
1990	119000	104900	103800	0.605
1991	138000	103300	108000	0.582
1992	93000	104500	99700	0.637
1993	152000	109200	111500	0.536
1994	104000	118300	109600	0.515
1995	224000	135300	121800	0.419
1996	112000	147800	115000	0.412
1997	165000	196200	107300	0.291
1998	71000	196600	106100	0.349
1999	140000	207800	110700	0.359
2000	93000	207000	91300	0.309
2001	224000	221500	95000	0.284
2002	189000	222900	115400	0.255
2003	125000	255100	105600	0.235
2004	94000	306400	104200	0.197
2005	184000	307700	124500	0.263
2006	57000	288500	125700	0.288
2007	124000	283700	101200	0.274
2008	72000	262900	119300	0.368
2009	57000	235500	115700	0.408
2010	125000	213500	102500	0.383
2011	119000*	169000		
Average	152178	238547	152177	0.446

* Geometric mean recruitment 1998–2008.

Annex 6.4.12b Management plan

In 2008 EU and Norway renewed the existing agreement on *"a long-term plan for the saithe stock in the Skagerrak, the North Sea and west of Scotland, which is consistent with a precautionary approach and designed to provide for sustainable fisheries and high yields. The plan shall consist of the following elements.*

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 106,000 tonnes (Blim).*
2. *Where the SSB is estimated to be above 200,000 tonnes the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups.*
3. *Where the SSB is estimated to be below 200,000 tonnes but above 106,000 tonnes, the TAC shall not exceed a level which, on the basis of a scientific evaluation by ICES, will result in a fishing mortality rate equal to 0.30-0.20*(200,000-SSB)/94,000.*
4. *Where the SSB is estimated by the ICES to be below the minimum level of SSB of 106,000 tonnes the TAC shall be set at a level corresponding to a fishing mortality rate of no more than 0.1.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15 % from the TAC of the preceding year the Parties shall fix a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.*
6. *Notwithstanding paragraph 5 the Parties may where considered appropriate reduce the TAC by more than 15 % compared to the TAC of the preceding year.*
7. *A review of this arrangement shall take place no later than 31 December 2012.*
8. *This arrangement enters into force on 1 January 2009."*

ECOREGION North Sea
STOCK *Nephrops* in Division IIIa

Advice 2012

ICES advises on the basis of the MSY approach that landings in 2012 should be no more than 6000 t.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	?	?	✔	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)	**2009**	**2010**	**2011**	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

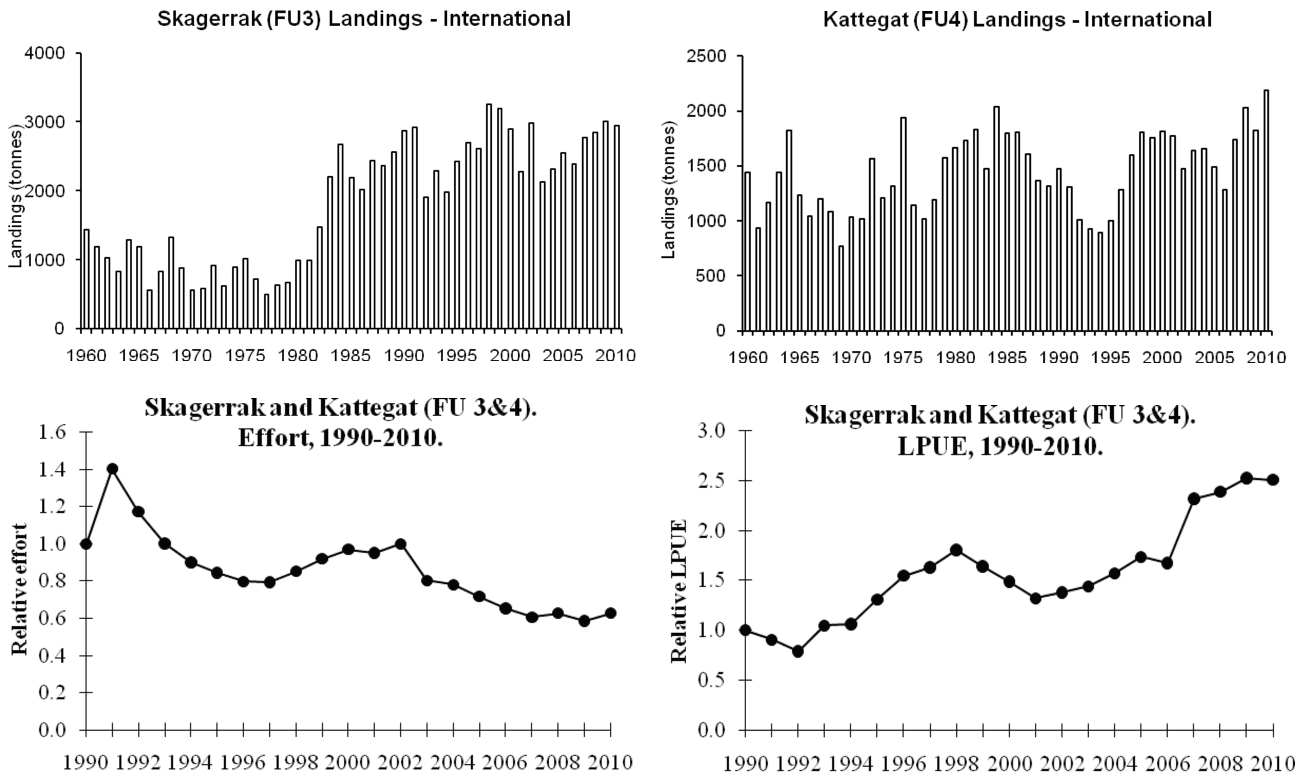


Figure 6.4.13.1 *Nephrops*, Division IIIa. Long-term trends in landings (per FU, in tonnes), and effort and lpue (combined FUs, relative).

The first absolute estimate of abundance was available in 2010 from an underwater TV (UWTV) survey. The estimate of 2010 harvest ratio (6.4%) from this UWTV survey and the fishery indices (effort and lpue) both suggest that the stock is exploited sustainably. Results from a preliminary production model support this.

Management plans

No specific management objectives are known to ICES.

Biology

Nephrops lives in burrows in suitable muddy sediments and is characterized as being omnivorous and emerging out of the burrows to feed. It can, however, also sustain itself as a suspension feeder (in the burrows). There are differences between males and females regarding growth rates and behaviour. Males normally dominate the commercial catches because of more frequent emergence from the burrows.

Environmental influence on the stock

Severe depletion in oxygen content in the water can force the animals out of their burrows, thus temporarily increasing the trawl catchability of this species during such environmental changes (Bagge and Munch-Petersen, 1979). An especially severe case was observed in the late 1980s in the southern part of Division IIIa in late summer, where initially unusually high catch rates of *Nephrops* were observed. The ability of *Nephrops* to suspension feed may contribute to maintaining a high production of this species in Division IIIa, as a result of increased organic production.

The fisheries

There are two types of fisheries: trawl fisheries and creel fisheries. Part of the trawl fisheries is operated with species-selective gears (sorting grids or SELTRA 300). Creel fisheries take place mainly on locations where trawling is impossible or difficult, along the Swedish and Norwegian coasts. As a consequence of the current minimum landing size of 40 mm carapace length, the amount of discards is large. Cod, sole, and plaice are bycatch species in these fisheries in Division IIIa.

Catch by fleet	Total catch (2010) = 8.5 kt, where 61% are landings (94% trawling, 6% creels) and 39% undersized/discards.

Effects of the fisheries on the ecosystem

The high mud content and soft nature of *Nephrops* grounds means that trawling readily marks the seabed, with trawl marks remaining visible for some time. Burrowing fauna can be seen re-emerging from freshly trawled grounds, implying that there is some resilience to trawling.

Quality considerations

The UWTV survey 2010 was conducted in two of six subdivisions in Division IIIa, covering a large proportion of the catches. The results are scaled up to the total population area in Division IIIa. The coverage is expected to be increased by the addition of Swedish survey results in the near future. The lpue data used as indicators for stock development have been standardized regarding vessel size from 2000 to 2010. However, lpue is also influenced by changes in catchability (due to sudden changes in the environmental conditions), as well as changes in selectivity and/or in gear efficiency.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data. Trend analysis of effort and lpue.
Input data	One survey index (UWTV), length–frequency data, and discard samples. One commercial index (lpue).
Discards and bycatch	Included in the assessment (since 1991).
Indicators	None.
Other information	None.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in Division IIIa

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined.	
	$F_{MSY} = F_{max}$	Harvest ratio 7.9%.	Equivalent to F_{max} Combined sex.
Precautionary Approach	Not defined.		

(Unchanged since 2011)

Harvest ratios as proxy for F_{MSY} for Division IIIa from length cohort analysis 2011 (2008–2010):

	Male	Female	Combined
F_{max}	6.8 %	10.0 %	7.9 %
$F_{0.1}$	4.9 %	7.6 %	5.6 %
$F_{35\%SPR}$	8.1 %	12.9 %	10.5 %

The estimated bias corrected burrow density in Division IIIa is medium (0.3–0.8 burrows m^{-2}) and the observed harvest ratio is higher than F_{max}. This means that F_{max} may be selected as a proxy for F_{MSY}.

MSY $B_{trigger}$ is undefined. For other *Nephrops* stocks, the underwater TV (UWTV) survey history is used to define a proxy for MSY $B_{trigger}$, either at the low point in the time-series or the point at which the stock showed signs of stress. As the survey is relatively new and the survey design is only now settled, it would be inappropriate to determine MSY $B_{trigger}$ at this point.

For background information on setting the reference points for *Nephrops* stocks, see Section 6.4.14. All F_{MSY} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

Outlook 2012

F2011 = F2010 = Harvest rate 6.4%; Bias-corrected survey index (2010) = 2952 million; Mean weight in landings (2008–2010) = 38.9 g; Discard rate (by number) = 64%; Survey bias = 1.1.

Basis	Harvest rate	Landings 2012 (tonnes)
	2.0	1 500
	4.0	3 000
	5.6	4 200
F_{2010}	6.4	4800
MSY approach	7.9	6 000
	10.5	7 900

MSY approach

Following the ICES MSY framework implies a harvest ratio of 7.9%, resulting in landings of not more than 6000 t in 2012.

Additional considerations

The main reason for the high amount of discards (39% in weight) is the high minimum landing size.

MSY approach

No precautionary reference points have been defined for *Nephrops*. Exploitation rates that are likely to generate high long-term yield (and low probability of stock overfishing) have been explored and proposed under the new ICES MSY framework. Because of the way *Nephrops* are assessed, it is not possible to estimate F_{MSY} directly and hence proxies for

F_{MSY} are determined. Three candidates for F_{MSY} are $F_{0.1}$, $F_{35\%SPR}$, and F_{max}. Many stocks show a great difference in relative exploitation rate between the sexes. To account for this values for each of the candidates have been determined individually for males, females, and the two sexes combined. The appropriate F_{MSY} candidate has been selected for each functional unit (FU) independently according to the perception of stock resilience, factors affecting recruitment, population density, knowledge of biological parameters, and the nature of the fishery (relative exploitation of the sexes and historical harvest rate *vs.* stock status).

A decision-making framework based on the table below was used in the selection of preliminary stock-specific F_{MSY} proxies (ICES, 2010). These proxies may be modified following further data exploration and analysis. The combined sex F_{MSY} proxy should be considered appropriate if the resulting percentage of virgin spawner-per-recruit for males or females does not fall below 20%. When this happens a more conservative sex-specific F_{MSY} proxy should be picked instead of the combined proxy.

		Burrow density (average burrows m^{-2})		
		Low <0.3	Medium 0.3-0.8	High >0.8
Observed harvest rate or landings compared to stock status	> F_{max}	$F_{35\%SPR}$	F_{max}	F_{max}
	F_{max}–$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$	F_{max}
	< $F_{0.1}$	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Unknown	$F_{0.1}$	$F_{35\%SPR}$	$F_{35\%SPR}$
Stock size estimates	Variable	$F_{0.1}$	$F_{0.1}$	F35%
	Stable	$F_{0.1}$	$F_{35\%SPR}$	F_{max}
Knowledge of biological parameters	Poor	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Good	$F_{35\%SPR}$	$F_{35\%SPR}$	F_{max}
Fishery history	Stable spatially and temporally	$F_{35\%SPR}$	$F_{35\%SPR}$	F_{max}
	Sporadic	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Developing	$F_{0.1}$	$F_{35\%SPR}$	$F_{35\%SPR}$

Quality considerations

The UWTV survey 2010 was conducted in two of six subdivisions in Division IIIa and scaled up to the total population area in Division IIIa. This may result in a biased total abundance estimate. To estimate the bias a correction factor of 1.1 was applied, which is low compared to some other *Nephrops* stocks. The UWTV estimates presented account for this 10% overestimate of abundance.

The F_{MSY} proxy harvest rate is considered preliminary and may be modified following further data exploration and analysis.

The lpue data used as indicators for stock development have been standardized regarding vessel size and engine. However, lpue is also influenced by changes in catchability (because of sudden changes in the environmental conditions), as well as changes in selectivity and/or in gear efficiency. The changes in management systems in 2007 in Denmark also caused a general increase in lpue values. In Division IIIa the fluctuations in catches of smaller *Nephrops* are used as indicators of recruitment.

An exploratory surplus production model analysis was conducted. The results indicated that the stock was being exploited near F_{MSY}.

Stock definition

At present there are two functional units in Division IIIa: Skagerrak (FU 3) and Kattegat (FU 4). This separation was based on observed variable differences between Skagerrak and Kattegat regarding size composition in catches in the 1980s and 1990s. However, the distribution of *Nephrops* is continuous from southern Kattegat into Skagerrak, and the exchange of recruits between the southern and northern areas is very likely. With the longer data series now available, it seems the differences in size composition between the two areas are more likely to be random or caused by factors from fishing operations. It is therefore recommended that these two FUs are treated as one single FU.

The effects of regulations

The *Nephrops* fisheries in Division IIIa are heavily influenced by the management of cod stocks. Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea–Skagerrak and Kattegat cod stocks. In 2009, the management programme switched from a days-at-sea to a kW-day system (2009 Council Regulation (EC) N° 43/2009); within each area different amounts of kW-days are allocated by member state to different groups of vessels, depending on gear and mesh size. A specific amount of kW-days is allocated to the Kattegat fisheries; the kW-days allocations in the Skagerrak are considered within a pool which includes also the North Sea (Subarea IV) and the Eastern English Channel (Division VIId).

Effort ceilings are updated annually, and have become increasingly restrictive for *Nephrops* trawls in Kattegat. In 2009, Sweden obtained full derogation (article 11) from the kW-days system for *Nephrops* trawlers using the Swedish sorting grid, leading to increasing use of this species-selective device and decreasing cod bycatch. In 2010, Denmark obtained partial derogation (article 13) that sanctioned no further decrease of the effort ceiling on the basis of cod avoidance behaviour.

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

The national management system introduced in Denmark in January 2007 where each fisher is allocated an annual share of the national quota ('vessel quota share') has lead to a more efficient effort use by fishers, making lpues more difficult to interpret as stock indicators.

Discards of *Nephrops* are known to be very high and any improvement of the size selectivity in the trawls would benefit the stock and the medium-term yield.

Impacts of the environment on the fish stock

Nephrops lives in burrows in suitable muddy sediments and is characterized by being omnivorous and emerging out of the burrows to feed. It can, however, also sustain itself as a suspension feeder (in the burrows). This ability may contribute to maintaining a high production of this species in Division IIIa, as a result of increased organic production.

Comparison with previous assessment and advice

The advice for 2011 was based on MSY and precautionary considerations and was valid for 2011 and 2012. However, in 2011 an absolute abundance index is used to provide advice based on the MSY framework. This advice overrides the 2010 advice for 2012.

Sources

ICES. 2010. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 5–11 May 2010. ICES CM 2010/ACOM:13.

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Table 6.4.13.1 *Nephrops* in Division IIIa. ICES advice, management, and landings.

Year	ICES advice	Recommended TAC	Agreed TAC	ICES landings
1987				4.0
1988				3.7
1989				3.9
1990				4.3
1991				4.2
1992		~4.0	3.5	2.9
1993		~4.3	3.5	3.2
1994		2.9	3.5	2.9
1995		2.9	4.8	3.4
1996	*Status quo* TAC	2.9	4.8	4.0
1997	*Status quo* TAC	2.9	4.8	4.2
1998		4.0	4.8	5.1
1999		4.0	4.8	4.9
2000		3.8	5.0	4.7
2001		3.8	4.5	4.1
2002	Catches to be maintained at the 2000 level	4.7	4.5	4.4
2003	Catches to be maintained at the 2000 level	4.7	4.5	3.8
2004	Catches to be maintained at the 2000 level	4.7	4.7	4.0
2005	Catches to be maintained at the 2000 level	4.7	5.2	4.0
2006	No increase in effort		5.2	3.7
2007	No increase in effort		5.2	4.5
2008	No increase in effort		5.2	4.9
2009	Current effort appears to be sustainable	< 5.2	5.2	4.8
2010	Current effort appears to be sustainable	< 5.2	5.2	5.1
2011	Recent average landings (2007-2009) [1)]	< 4.7	5.2	
2012	MSY framework1[1)]	< 6.0		

Weights in '000 t.

[1)] In 2010, biennial advice was given for both 2011 and 2012 (average landings, 4.7 kt). In 2011, new advice was drafted for 2012 because new information is available.

Table 6.4.13.2 *Nephrops* in Division IIIa. Total landings per country (tonnes).

Year	Denmark	Norway	Sweden	Germany	Total
1991	2824	185	1219		4228
1992	2052	104	749		2905
1993	2250	103	859		3212
1994	2049	62	763		2874
1995	2419	90	918		3427
1996	2844	102	1034		3980
1997	2959	117	1130		4206
1998	3541	184	1319	12	5056
1999	3486	214	1243	6	4949
2000	3325	181	1197	7	4710
2001	2880	138	1037	1	4056
2002	3293	116	1032	7	4448
2003	2757	99	898	13	3767
2004	2955	95	903	12	3965
2005	2901	83	1048	2	4034
2006	2432	91	1143	6	3672
2007	2887	145	1467	13	4512
2008	3174	158	1509	19	4860
2009	3372	128	1331	15	4846
2010	3721	124	1249	29	5123

Table 6.4.13.3 *Nephrops* in Division IIIa. Discard proportion and mean weight in the landings.

Year	Dead discard rate by Number	Dead discard rate by Weight	Mean weight in landings
2008	53.1%	38.3%	40.3
2009	56.3%	41.9%	35.8
2010	47.8%	30.7%	40.5
Average	52.4%	37.0%	38.9

ECOREGION North Sea
STOCK *Nephrops* in Subarea IV (North Sea)

Nephrops are limited to a muddy habitat. This means that the distribution of suitable sediment defines the species distribution and the stocks are therefore assessed as nine separate functional units (FUs) (Figure 6.4.14.1):

Section	FU no.	Name	ICES area	Statistical rectangles
6.4.14.1*	5	Botney Gut – Silver Pit	IVb,c	36–37 F1–F4; 35 F2–F3
6.4.14.2	6	Farn Deeps	IVb	38–40 E8–E9; 37 E9
6.4.14.3	7	Fladen Ground	IVa	44–49 E9–F1; 45–46 E8
6.4.14.4	8	Firth of Forth	IVb	40–41 E7; 41 E6
6.4.14.5	9	Moray Firth	IVa	44–45 E6–E7; 44 E8
6.4.14.6*	10	Noup	IVa	47 E6
6.4.14.7*	32	Norwegian Deep	IVa	44–52 F2–F6; 43 F5–F7
6.4.14.8*	33	Off Horn's Reef	IVb	39–41 F5–F6
**	34	Devil's Hole	IVb	41–43 F0–F1

* The advice for these stocks is biennial advice for 2011 and 2012.
** New FU, no separate advice.

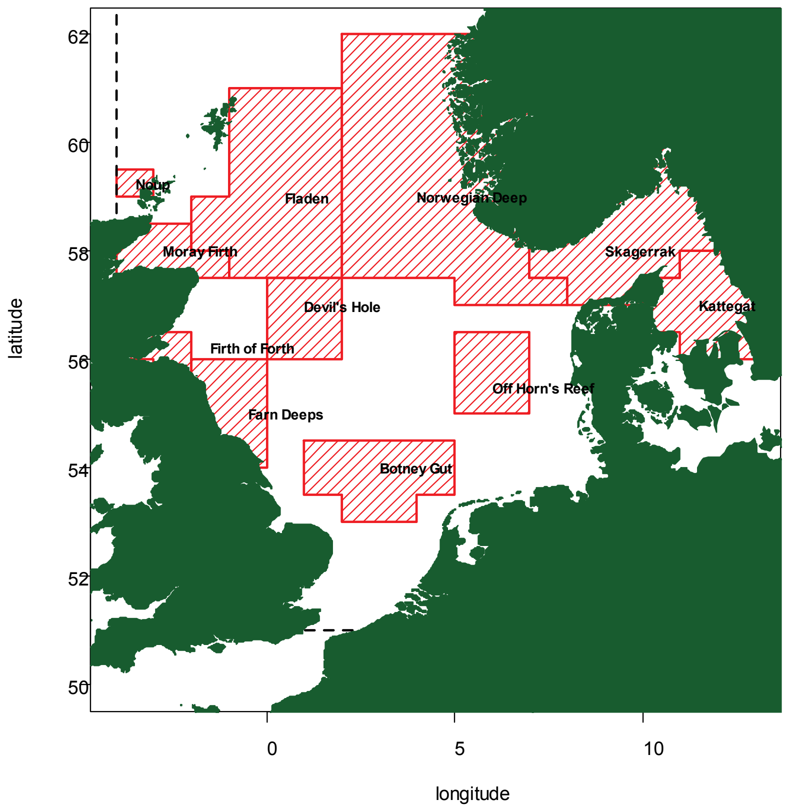

Figure 6.4.14.1 *Nephrops* functional units in the North Sea and Skagerrak/Kattegat region (see Section 6.4.13).

Advice for 2012

The advice summary for *Nephrops* stocks is given by functional units in Sections 6.4.14.1–8. A summary can be found in Table 6.4.14.1.

There is no information available on the trends in the stock or exploitation status for the rectangles outside the FUs for which ICES provides advice (‘other rectangles’). Advice for the FUs in the North Sea show increases as well as decreases. On the basis of precautionary considerations, ICES advises that the catches in the other rectangles should not increase.

Table 6.4.14.1 *Nephrops* in Subarea IV. Summary of ICES advice by functional unit plus other rectangles.

Year	Moray Firth (FU 9)	Noup (FU 10)	Fladen Ground (FU 7)	Nor-wegian Deeps (FU 32)	Farn Deeps (FU 6)	Firth of Forth (FU 8)	Botney Gut – Silver Pit (FU 5)	Off Horn’s Reef (FU 33)	Other rec-tangles [2]	Total advice [5]	Agreed TAC [1]	ICES landings
Mgt Area	MA F		MA G	MA S	MA I		MA H					
1992	~2.4		~2.7		~4.6		0.87			10.6	12.0	9.5
1993	2.4		2.7		4.17		0.87			10.2	12.0	12.7
1994	2.4		5.0		4.17		0.87			12.5	13.0	14.2
1995	2.4		5.0		4.17		0.87			12.5	15.2	14.7
1996	2.4		5.0		4.17		0.87			12.5	15.2	13.7
1997	2.4		5.0		4.17		0.87			12.5	15.2	15.2
1998	2.4		7.0		4.17		1.0			14.6	15.2	13.7
1999	2.4		7.0		4.17		1.0			14.6	15.2	16.5
2000	1.85		9.0		4.17		1.6			16.7	17.2	15.1
2001	1.85		9.0		4.17		1.6			16.7	15.48	15.9
2002	2.0		9.0	1.2	4.17		2.1			18.5	16.623	15.7
2003	2.0		9.0	1.2	4.17		2.1			18.5	16.623	15.6
2004	2.0		12.8	1.5	4.17		2.38			22.9	21.350	18.6
2005	2.0		< 12.8	1.5	4.17		2.38			22.9	21.350	21.9
2006	-		-	NA	-		2.38			-[5]	28.147	24.4
2007	2.4	0.2	< 10.9	NA	3.5	1.5	NA	NA	24.6[6]	-[5]	26.144	24.6
2008	2.4	0.2	< 10.9	NA	3.5	1.5	NA	NA	9.5[6]	-[5]	26.144	22.1
2009	< 1.8	< 0.24	< 11.3	[3]	< 3.0	< 2.5	[3]	[3]	< 1.4	-[5]	24.837	24.6
2010	< 1.4	< 0.24	< 16.4	[4]	< 1.2	< 1.6	[4]	[4]	< 1.5	-[5]	24.688	20.8
2011	< 1.3	NA	< 13.3	[7]	< 1.9	< 2.0	[7]	[7]	< 1.9	-[5]	23.454	
2012	< 1.1	[8]	< 14.1	[8]	< 1.4	< 1.7	[8]	[8]	[9]	-[5]		

Weights in ‘000 t.
[1] EU zone of Division IIa and Subarea IV.
[2] Prior to advice for 2009, landings for other rectangles were included in 'Management Areas (MA)’. This includes FU 34.
[3] No increase in effort.
[4] Biennial advice (ICES, 2010a).
[5] ICES advises that stocks should be managed by functional unit.
[6] Refers to advice for FUs 5, 32, and 33.
[7] See scenarios.
[8] Reduce catches.
[9] No increase in catches

Biology

Nephrops is limited to muddy habitat, and requires sediment with a silt and clay content of between 10–100% to excavate its burrows. This means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small scale movements (a few 100 m), but larval transfer may occur between separate mud patches in some areas. Catches typically consist of a lower proportion of females than males due to the lower burrow emergence (resulting in lower catchability) of females during the egg bearing.

Environmental influence on the stock

Cod has been identified as a major predator of *Nephrops* in some areas. The generally low level of the cod in the North Sea is likely to have resulted in reduced predation. Multi-species models applied in the past to the exploitation of Irish Sea stocks indicated that management strategies which lead to an increase in the cod stock are associated with a reduction in *Nephrops* abundance. Therefore it may be expected that *Nephrops* stocks in the North Sea may decrease when cod recovers.

Effects of the fisheries on the ecosystem

Trawling for *Nephrops* results in bycatch and discards of other species, including cod, haddock, and whiting. 80 mm is the predominant mesh size used in *Nephrops* fisheries and the resulting proportion of discarded fish can be high. Initiatives are in place to reduce discarding (see below *Factors affecting the fisheries and the stock* under *Additional considerations*).

The high mud content and soft nature of *Nephrops* grounds means that trawling readily marks the seabed, with trawl marks remaining visible for some time. Burrowing fauna can be seen re-emerging from freshly trawled grounds, implying that there is some resilience to trawling.

Additional considerations

The overriding management consideration for these stocks is that management should be at the functional unit (FU) rather than the ICES Subarea level. Management at the functional unit level should provide the controls to ensure that catch opportunities and effort are compatible and in line with the scale of the resources in each of the stocks defined by the functional units. Current management of *Nephrops* in Subarea IV (both in terms of TACs and effort) does not provide adequate safeguards to ensure that local effort is sufficiently limited to avoid depletion of resources in functional units. In the current situation vessels are free to move between grounds, allowing effort to develop on some grounds in a largely uncontrolled way and this has historically resulted in inappropriate harvest rates from some parts. This is a particular problem in the Farn Deeps where increased vessel activity from other parts of the UK occurred, resulting in low stock levels.

The advice is presented separately for each functional unit. In addition, there are increasing and significant landings from some isolated patches outside the functional units, most notably the Devil's Hole area. Table 6.4.14.2 shows that in 2010 overall landings in Subarea IV were around 20 800 tonnes. Landings from other rectangles have risen steadily and amounted to over 2300 tonnes in 2009, but fell to just over 1400 tonnes in 2010 (including landings from Devil's Hole, FU 34).

The Devil's Hole area has now been designated as a new functional unit (FU 34) and underwater TV (UWTV) surveys have been undertaken in the area. The method of advice provision using the TV survey requires a time-series of commercial catch-at-size composition data which is not available for this functional unit. However, it is anticipated that this will develop in the coming years and future advice could be provided on this basis.

MSY approach

No precautionary reference points have been defined for *Nephrops*. Under the new ICES MSY framework, exploitation rates which are likely to generate high long-term yield (and low probability of stock overfishing) have been explored and proposed for each functional unit. Owing to the way *Nephrops* are assessed, it is not possible to estimate F_{MSY} directly and hence proxies for F_{MSY} are determined. Three candidates for F_{MSY} are $F_{0.1}$, $F_{35\%SPR}$, and F_{max}. There may be strong difference in relative exploitation rates between the sexes in many stocks. To account for this values for each of the candidates have been determined for males, females, and the two sexes combined. The appropriate F_{MSY} candidate has been selected for each functional unit independently according to the perception of stock resilience, factors affecting recruitment, population density, knowledge of biological parameters, and the nature of the fishery (relative exploitation of the sexes and historical harvest rate *vs.* stock status).

A decision-making framework based on the table below was used in the selection of preliminary stock-specific F_{MSY} proxies (ICES, 2010a). These proxies may be modified following further data exploration and analysis. The combined sex F_{MSY} proxy should be considered appropriate if the resulting percentage of virgin spawner-per-recruit for males or females does not fall below 20%. When this does happen a more conservative sex-specific F_{MSY} proxy should be picked instead of the combined proxy.

		Burrow density (average burrows m^{-2})		
		Low <0.3	Medium 0.3-0.8	High >0.8
Observed harvest rate or landings compared to stock status	> F_{max}	$F_{35\%SPR}$	F_{max}	F_{max}
	F_{max} - $F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$	F_{max}
	< $F_{0.1}$	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Unknown	$F_{0.1}$	$F_{35\%SPR}$	$F_{35\%SPR}$
Stock size estimates	Variable	$F_{0.1}$	$F_{0.1}$	F35%
	Stable	$F_{0.1}$	$F_{35\%SPR}$	F_{max}
Knowledge of biological parameters	Poor	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Good	$F_{35\%SPR}$	$F_{35\%SPR}$	F_{max}
Fishery history	Stable spatially and temporally	$F_{35\%SPR}$	$F_{35\%SPR}$	F_{max}
	Sporadic	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Developing	$F_{0.1}$	$F_{35\%SPR}$	$F_{35\%SPR}$

Preliminary MSY $B_{trigger}$ were proposed at the lowest observed UWTV abundance.

Impacts of fisheries on the ecosystem

In general, catches of cod in the *Nephrops* fisheries have been relatively low, particularly in recent years in inshore grounds of Subarea IV, but can vary amongst functional units. However, it is important that emerging year classes of cod should not be subjected to high discard mortality. The capture of juvenile fish or other species such as whiting and haddock is also a problem in some of the functional units and discarding of these is a problem in some years. This problem is being addressed with the use of more selective gear and efforts are already being made in Scotland through the Conservation Credits scheme, requiring vessels targeting *Nephrops* to use gear with larger square-meshed panels (110 mm). Subject to evaluation of the effectiveness of these measures, further action may be required to reduce discards.

Trawling for *Nephrops* results in bycatch and discards of other species, including cod, haddock, and whiting. 80 mm is the predominant mesh size used in *Nephrops* fisheries and the resulting proportion of fish discarded can be high. Initiatives are in place to reduce discarding (see below *Factors affecting the fisheries and the stock*).

The high mud content and soft nature of *Nephrops* grounds means that trawling readily marks the seabed, with trawl marks remaining visible for some time. Burrowing fauna can be seen re-emerging from freshly trawled grounds, implying that there is some resilience to trawling.

Cod has been identified as a major predator of *Nephrops* in some areas. The generally low level of the cod in the North Sea is likely to have resulted in reduced predation. Multispecies models applied in the past to the exploitation of Irish Sea stocks indicated that management strategies which lead to an increase in the cod stock are associated with a reduction in *Nephrops* abundance. Therefore it may be expected that *Nephrops* stocks in the North Sea may decrease when cod recovers.

Factors affecting the fisheries and the stock

The implementation of the “buyers and sellers” regulations in the UK in 2006 considerably tightened up the levels of reporting for *Nephrops*, and the landings figures since then are considered to be more reliable. Recent increases in landings and lpue may result from the increase in reporting levels and do not necessarily reflect changes to the stock.

A ban on the use of multitrawl gears (three or more trawls) for all Scottish boats was introduced from April 2008, limiting the expansion of effective effort.

Effort restrictions in the EC were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea cod stock. In 2009, the management programme switched from a days-at-sea to a kW-day system (2009 Council Regulation (EC) N° 43/2009): within each area different amounts of kW-days are allocated by member state to different groups of vessels, depending on gear and mesh size. Effort ceilings are updated annually.

The STECF has performed an annual monitoring of effort trends since 2004. Overall effort (kW-days) by demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel have been substantially reduced (−30% between 2003 and 2009; STECF, 2011). Following the introduction of the days-at-sea regulations in 2003, there was a substantial switch from the larger mesh (>100 mm, TR1) gear to the smaller mesh (70–99 mm, TR2) gear. Subsequently, effort by TR1 has been relatively stable, whereas effort in TR2 has shown a continuous decline (−23% between 2003 and 2009).

Nephrops fisheries in this area have a bycatch of cod. In 2005, a high abundance of 0-group cod was recorded in Scottish surveys. This year class of cod has subsequently contributed to a slightly improved cod stock biomass and efforts are being made to avoid the capture of cod so that the stock can build further. The Scottish industry operates under the Conservation Credits scheme and has implemented improved selectivity measures in gears which target *Nephrops* as well as real-time closures with a view to reducing unwanted bycatch of cod and other species. In 2010–2011, many vessels are reported to be using large square-meshed panels (160 mm).

Data and methods

Assessments of the *Nephrops* functional units of Subarea IV utilized a number of approaches, including underwater TV (UWTV) surveys, length composition information, and basic fishery data such as landings and effort. Owing to uncertainties in the accuracy of historical landings and to inaccurate effort figures in some fisheries, increasing attention is paid to survey information and size composition data as an indicator of stock status.

For those stocks without UWTV surveys, assessment is made on the basis of analysis of length compositions, trends in mean length for recruit classes, and commercial cpue. Biennial advice for these stocks is given for 2011 and 2012.

In 2009 there were important developments in the methodology to assess the status of *Nephrops* stocks. The use of UWTV surveys has enabled the development of fishery-independent indicators of abundance. STECF (2005) had suggested that a combination of an absolute abundance estimate from an UWTV survey and a harvest rate based on $F_{0.1}$ from a combined sex–length cohort analysis (LCA) and the mean weight and selection pattern from the commercial fishery, could be used to calculate appropriate landings. The approach has been further developed and evaluated by ICES workshops in 2007 and 2009 (ICES, 2007, 2009). The 2009 workshop addressed concerns raised regarding factors which could potentially bias the UWTV survey results. Major sources of bias were quantified for each survey and an overall bias correction factor derived which, when applied to the estimates of abundance from the UWTV survey allows them to be treated as absolute abundance levels.

In particular the workshop concluded that the burrows of *Nephrops* detected in the UWTV surveys are considerably smaller than the sizes of the *Nephrops* taken by the fishery. Therefore, the abundance estimates used to calculate the harvest ratios presented in the 2009 advice include a component of the stock that is too small to be exploited by the fishery. This has resulted in calculated harvest ratios appearing to have decreased in the current advice compared to previous estimates of harvest ratios. In essence, this is a scaling issue, not a change in exploitation rate. The previous proportion corresponding to fishing at $F_{0.1}$ were in the range of 15–20%, whereas the revised values from the benchmark in 2009 are in the range of 8–10%.

Information from the fishing industry

In 2010, it is reported that effort for *Nephrops* vessels is becoming limited as vessels are remaining in port for longer periods during strong tides or other periods of likely low catchability.

Trends according to the Fishers' North Sea stock survey are discussed in specific FUs.

Uncertainties in assessment and forecast

For moderate exploitation rates the UWTV assessment provides an adequate basis for predicting catches. ICES has worked to reduce uncertainty and increase precision in the interpretation of survey data.

There is a gap of at least 12 months (more commonly 18 months) between the survey and the start of the TAC year. It is assumed that the stock is stable during this period (i.e. recruitment and growth balance mortality). The effect of this assumption on realised harvest rates has not been investigated.

The UWTV survey does not cover the complete spatial distribution of the stock, covering six of nine functional units and not the area outside the functional units. The area covered by the UWTV survey accounts for over 90% of the North Sea *Nephrops* landings in 2010, although for two of the surveyed functional units, this information is not yet used in the provision of advice. Landings from outside the FUs account for 3.3% of total landings. Vessel Monitoring System (VMS) data for vessels >15 meters are being successfully used to match survey and fishery areas.

The harvest ratios equivalent to F_{MSY} proxies are based on yield-per-recruit analyses from length cohort analyses. These analyses utilize average length–frequency data, discarding rates, and mean weight taken over a 3-year period. The benchmark in 2009 used data from 2005–2007 and changes in selection, discarding rates, and mean weights appear to have occurred since then. Consequently the harvest rates used as F_{MSY} proxies have been recalculated this year.

Prior to the implementation of the UK "buyers and sellers" legislation in 2006 reporting rates are considered to have been low and hence the estimated harvest ratios prior to 2006 are also likely to have been underestimated. The reliability of fishery statistics is improving, but the transition period is accompanied in some cases by large changes in landings which produces significant changes in the lpue and cpue series that cannot be completely attributed to changes in stock. Until a sufficient time-series of reliable data has been built up, the use of commercial catch per unit effort data in the assessment process should be avoided unless there are no other informative data available.

Comparison with previous assessment and advice

For those stocks without UWTV surveys, advice given in 2010 is biennial and applicable for 2011 and 2012.

The advice basis for stocks with UWTV has not changed from last year. The MSY framework and transition are used based on the situation of the stock.

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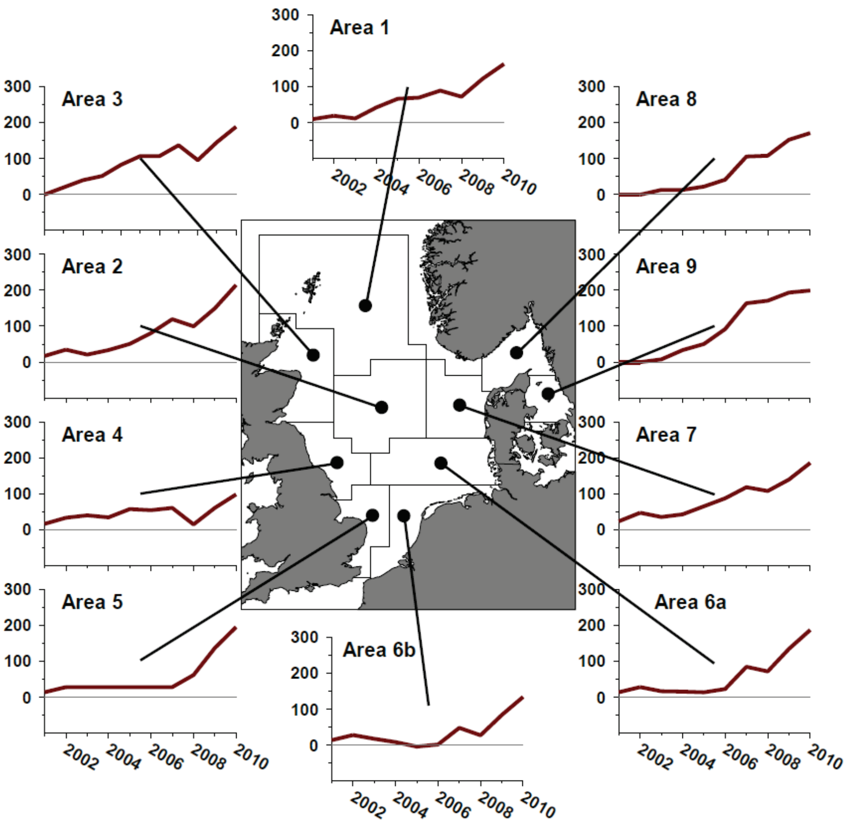


Figure 6.4.14.2 *Nephrops* in Subarea IV. Results of the North Sea Commission fishers' survey perceptions of the abundance 2010.

Table 6.4.14.2 *Nephrops* in Subarea IV. Officially reported landings (tonnes) by functional unit plus other rectangles.

Year	FU 5	FU 6	FU 7	FU 8	FU 9	FU 10	FU 32	FU 33	FU 34	Other **	Total
1981		1073	373	1006	1416	36				76	3980
1982		2524	422	1195	1120	19				157	5437
1983		2078	693	1724	940	15				101	5551
1984		1479	646	2134	1170	111				88	5628
1985		2027	1148	1969	2081	22				139	7386
1986		2015	1543	2263	2143	68				204	8236
1987		2191	1696	1674	1991	44				195	7791
1988		2495	1573	2528	1959	76				364	8995
1989		3098	2299	1886	2576	84				233	10176
1990		2498	2537	1930	2038	217				222	9442
1991	862	2063	4223	1404	1519	196				560	10827
1992	612	1473	3363	1757	1591	188				401	9385
1993	721	3030	3493	2369	1808	376	339	160		434	12730
1994	503	3683	4569	1850	1538	495	755	137		703	14233
1995	869	2569	6440	1763	1297	280	489	164		844	14715
1996	679	2483	5217	1688	1451	344	952	77		808	13699
1997	1149	2189	6171	2194	1446	316	760	276		662	15163
1998	1111	2177	5136	2145	1032	254	836	350		694	13735
1999	1244	2391	6521	2205	1008	279	1119	724		988	16479
2000	1121	2178	5569	1785	1541	275	1084	597		900	15050
2001	1443	2574	5541	1528	1403	177	1190	791		1268	15915
2002	1231	1954	7247	1340	1118	401	1170	861		1383	16705
2003	1144	2245	6294	1126	1079	337	1089	929		1390	15633
2004	1070	2153	8729	1658	1335	228	922	1268		1224	18587
2005	1099	3094	10685	1990	1605	165	1089	1050		1120	21897
2006	974	4903	10791	2458	1803	133	1028	1288		1249	24627
2007	1294	2966	11910	2652	1842	155	755	1467		1637	24678
2008	963	1218	12240	2450	1514	173	675	1444		1673	22350
2009	728	2703	13327	2662	1067	89	477	1163		2367	24583
2010*	959	1443	12825	1871	1032	38	407	806	757	695	20833

*** Provisional.**

**** Devil's Hole landings only separated from 2011.**

6.4.14.1 Advice June 2011

ECOREGION North Sea
STOCK *Nephrops* in Botney Gut – Silver Pit (FU 5)

Advice for 2012

The 2010 advice for this *Nephrops* stock is biennial and valid for 2011 and 2012 (see ICES 2010). This year ICES adopts the transition to the MSY approach as the basis for advice, which corresponds to reducing catches.

To protect the stock in this functional unit, management should be implemented at the functional unit level.

Sources

ICES. 2010. Report of the ICES Advisory Committee 2010. ICES Advice, 2010. Book 6, Section 6.4.14.
ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

Table 6.4.14.1.1 *Nephrops* in Botney Gut – Silver Pit (FU 5). ICES advice and landings.

Year	ICES advice	Recommended landings	ICES Landings[1)]
1991			0.9
1992		0.87	0.6
1993		0.87	0.7
1994		0.87	0.5
1995		0.87	0.9
1996		0.87	0.7
1997		0.87	1.1
1998		1.0	1.1
1999		1.0	1.2
2000		1.6	1.1
2001		1.6	1.4
2002		2.1	1.2
2003		2.1	1.1
2004		2.38	1.1
2005		2.38	1.1
2006		2.38[2)]	1.0
2007	No increase in effort	-	1.3
2008	No new advice, same as for 2007	-	0.9
2009	No increase in effort	-	0.7
2010	No new advice, same as for 2009	-	1.0
2011	See scenarios	-	
2012	Reduce catches	-	

Weights in '000 t.
1) Does not include discards.
2) Includes Off Horns Reef FU 33.

Table 6.4.14.1.2 *Nephrops* in Botney Gut – Silver Pit (FU 5). Total landings per country (tonnes).

	Belgium	Denmark	Netherlands	Germany	UK	Total**
1991	682	176	na		4	862
1992	571	22	na		19	612
1993	694	20	na		7	721
1994	494	0	na		9	503
1995	641	77	148		3	869
1996	266	41	317		55	679
1997	486	67	540		56	1149
1998	372	88	584	39	28	1111
1999	436	53	538	59	158	1244
2000	366	83	402	52	218	1121
2001	353	145	553	114	278	1443
2002	281	94	617	88	151	1231
2003	265	36	661	24	158	1144
2004	171	39	646	16	198	1070
2005	109	87	654	51	198	1099
2006	77	24	444	99	330	974
2007	75	3	464	201	551	1294
2008	49	29	268	108	509	963
2009	52	3	288	98	287	728
2010*	48	5	354	140	411	959

na = not available.
* Provisional.
** Totals for 1991–94 do not include landings by the Netherlands.

ECOREGION North Sea
STOCK *Nephrops* in Farn Deeps (FU 6)

Advice for 2012

ICES advises on the basis of the MSY transition that landings in 2012 should be no more than 1400 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	✓	✗	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)				
	2008	2009	2010	
MSY ($B_{trigger}$)	✓	✗	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

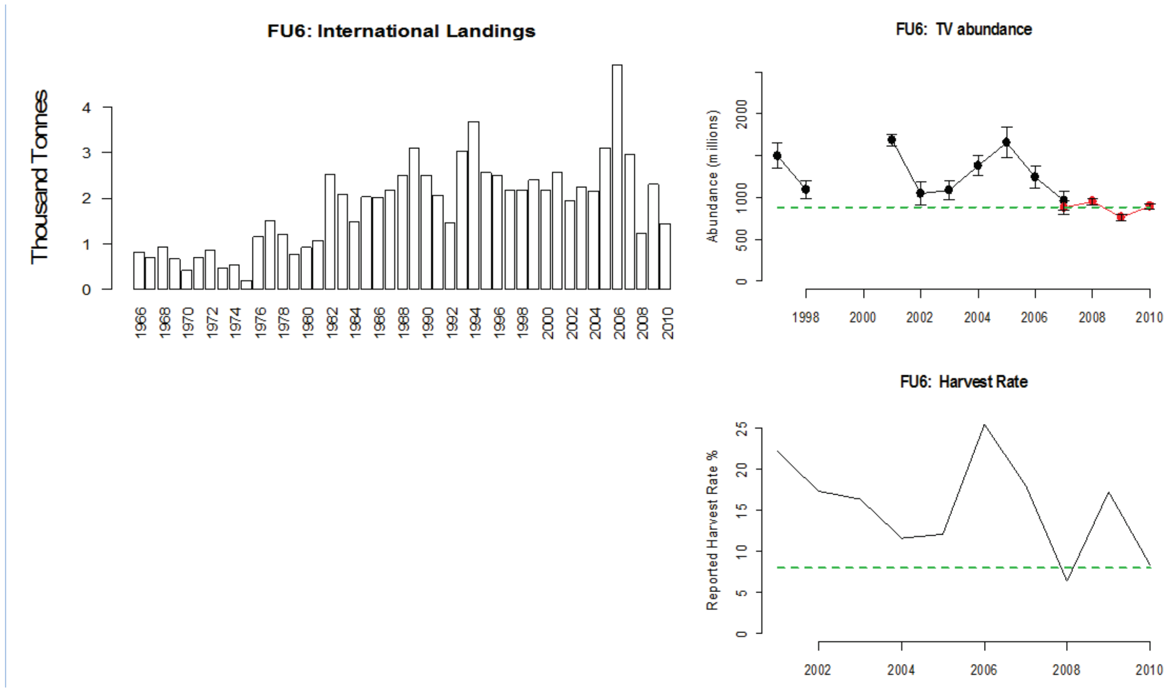


Figure 6.4.14.2.1 *Nephrops* in Farn Deeps (FU 6). Long-term trends in landings, harvest rate, and UWTV abundance (used as F and SSB proxies. Weights in '000 t, UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. For the UWTV abundance calculation a geostatistical method has been determined from 2007 onwards (red line).

The UWTV survey indicates that the stock status has been fluctuating around MSY $B_{trigger}$ since 2007. Changes in survey methodology in 2007 make comparison with the preceding series difficult.

Management plans

No specific management objectives are known to ICES.

The fisheries

Nephrops in FU 6 are predominantly caught in trawl fisheries using meshes in the 80–99 mm category. A small amount of creeling takes place. Increases in the numbers of vessels using twin-rig and multi-rig gears observed in this area are likely to have increased the effective fishing power per kW hour. Fishing effort decreased substantially in 2010 to a level not seen since the 1980s.

Catch by fleet	Landings (2010) = 1443 t. Almost entirely taken in demersal trawl fisheries, either directed *Nephrops* or mixed *Nephrops*/demersal fish. 23% discards in numbers.

Quality considerations

Market sampling misses portions of the tailed category of landings. For the purposes of assessment, only sampling of the full unsorted catch is used to estimate removals. Improvements in the recording of position (GPS) for the underwater TV survey from 2007 permit a more accurate estimate of absolute abundance than previously possible. Prior to this date there is a potential upward bias in the absolute estimate due to underestimation of the distance covered. The method used to raise the abundances in previous years has been found to be statistically flawed and a new raising procedure has been developed to avoid these errors. The 2010 assessment has reworked the abundance indices back to 2007, resulting in a change in the MSY $B_{trigger}$ proxy.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	One survey index (UWTV -aut); Length–frequency data from the fishery.
Discards and bycatch	Included in the assessment.
Indicators	None.
Other information	Latest benchmark was performed in 2009.
Working group report	WGNSSK

6.4.14.2 Supporting information June 2011

ECOREGION North Sea
STOCK *Nephrops* in Farn Deeps (FU 6)

Reference points

	Type	*Value*	*Technical basis*
MSY	MSY $B_{trigger}$	879 million	Bias-corrected UWTV survey index at start of current decline (2007) as measured by a geostatistical method.
Approach	F_{MSY}	Harvest rate 8%.	Equivalent to $F_{35\%SPR}$ male sin 2011.
Precautionary	$F_{0.1}$	Not agreed.	
Approach	F_{max}	Not agreed.	

(unchanged since: 2011)

Harvest rate reference points (2011):

	Male	Female	Combined
F_{max}	9.5 %	20.0 %	12.1 %
$F_{0.1}$	6.4 %	12.7 %	7.2 %
$F_{35\%SPR}$	8 %	18.7 %	11.5 %

For this functional unit (FU), the exploitation rate on males is usually considerably higher than on females and there is evidence of sperm-limitation following harvest rates in the region of 20%. There is evidence to suggest that in both 2006 and 2010 mature females have not been able to successfully mate and therefore a larger male spawning potential is desirable. To this effect the harvest rate equivalent to fishing at $F_{35\%SPR}$ for males is suggested as a proxy for F_{MSY} ($F_{35\%SPR}$, males = 8%).

Outlook for 2012

Basis: F2011 = average harvest rate over 2008–2010 = 10.7%; Bias-corrected survey index (2010) = 892 million; Mean weight in landings (2008–2010) = 25.0 g; Discard rate (dead, by number) = 25.5%; Survey bias = 1.2.

Basis	Harvest rate	Landings
	2.0%	330
	4.0%	670
	6.0%	1000
	7.0%	1200
F_{MSY}	8.0%	1300
MSY transition	8.2%	1400
F_{2011}	10.7%	1800
	11.5%	1900
	12.1%	2000
	12.7%	2100
	14.0%	2300
	16.0%	2700

MSY approach

Following the ICES MSY framework implies a harvest rate of 8%, resulting in landings of 1300 t in 2012.

Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to $(0.6*F_{2010} + 0.4*F_{MSY}) = 8.2\%$, corresponding to landings of no more than 1400 t in 2012.

Additional considerations

Increases in abundance in other FUs (i.e. Firth of Forth and the Fladen grounds) are likely to translate to increases in the overall TAC for Subarea IV, increasing the risk of higher effort being deployed in this FU. The high cost of fuel combined with the relative coastal proximity of this ground may result in it attracting additional fishing effort which would be inadvisable, given the current low level of the stock.

The stock has shown signs of overexploitation in recent years, with unbalanced sex ratio leading to poor recruitment. Without suitable controls on the movement of effort between functional units there is nothing to prevent the effort in 2012 returning to levels observed prior to 2008, most of which have been above the level of F_{MSY}.

The effects of regulations

The minimum landing size for *Nephrops* in the North Sea is 25 mm carapace length. Discarding rates of *Nephrops* are fairly stable between 2003 to 2010 at around 25% by number.

Changes in fishing technology and fishing patterns

There has been a general increase in the number of vessels using multi-rig gear, which has a higher fishing power than single rigs for *Nephrops*.

Information from the fishing industry

The most recent North Sea stock survey was carried out in mid-2010. In the opinion of the industry the stock is increasing in the area with good recruitment, a higher level of discarding and a good spread of sizes. This is not supported by the reported lpue levels for 2010, which show a decline and the lack of small *Nephrops* in the catch samples.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.14.

The UWTV survey in the Farn Deeps for 2009 was hampered by poor weather and reduced visibility, especially in the areas which historically have given consistent high densities. The loss of these stations may have reduced the overall density estimate. A comparison with the 2008 data suggests that of the ~19% decrease, ~9% may be due to the missing stations with the rest due to genuine decreased abundance. The survey in 2010 did not suffer from poor weather.

Comparison with previous assessment and advice

The perception of the state of the stock has not changed since the assessment in 2010.

The advice in 2008 was based on recent landings as the UWTV surveys were considered inappropriate to use as absolute indices of abundance. Following the outcome of the benchmark in 2009, the major concerns of the UWTV survey have been addressed and the survey is now considered a reliable estimate of absolute abundance. This year's advice is based on the transition to the MSY transition.

Source

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

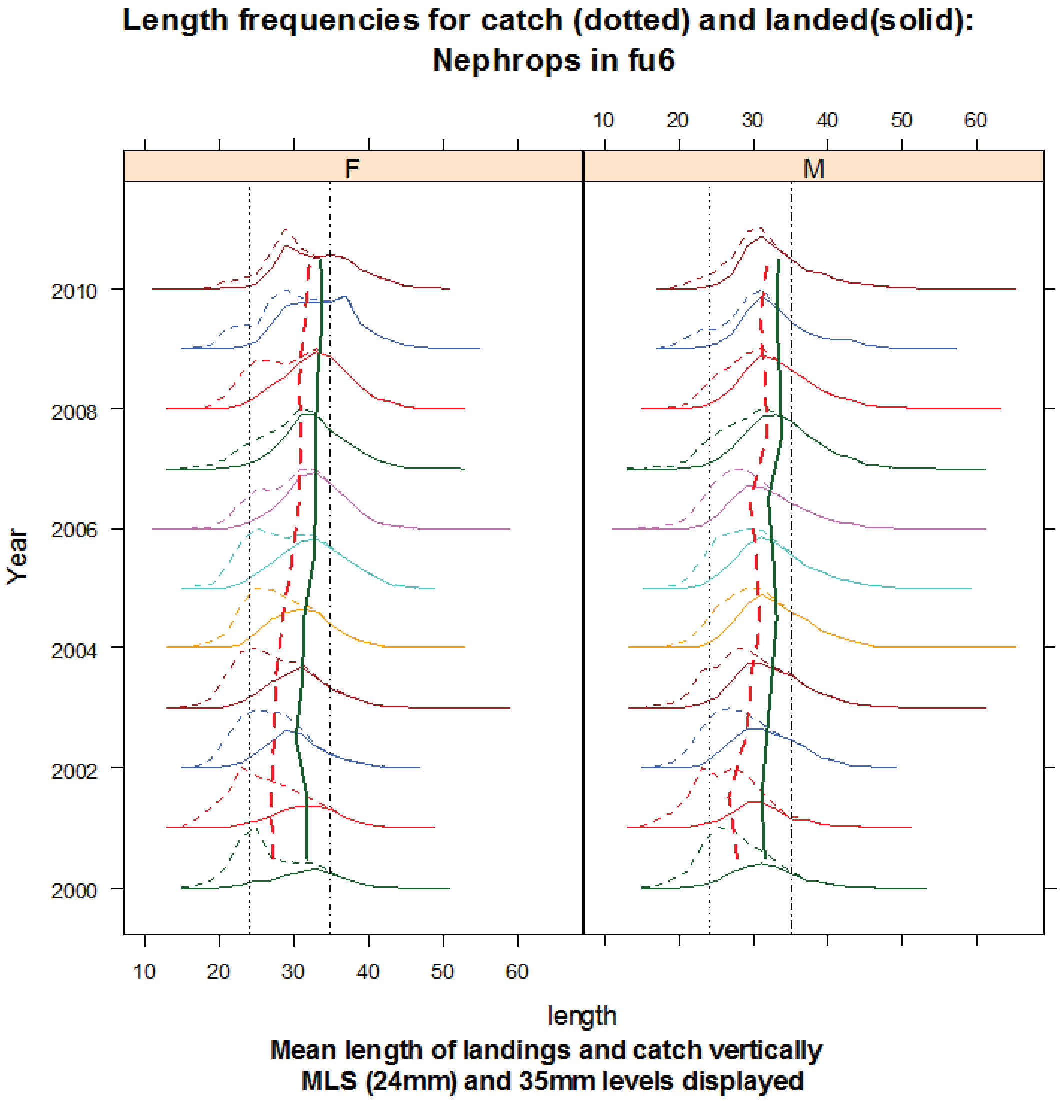


Figure 6.4.14.2.2 *Nephrops* Farn Deeps (FU 6). Length composition of catch (dotted) and landed (solid) of males (right) and females left from 1996 (bottom) to 2010 (top). Mean sizes of catch and landings (using same line types) is shown in relation to Minimum Landing Size (MLS).

Table 6.4.14.2.1 *Nephrops* Farn Deeps (FU 6). ICES advice, management, and landings.

Year	ICES advice	Recommended landings Farn Deeps (FU 6)	Recommended landings FU 6+FU 8	ICES landings FU 6[1]
1987				2.2
1988				2.5
1989				3.1
1990				2.5
1991				2.1
1992			~4.6	1.5
1993			4.17	3.0
1994			4.17	3.7
1995			4.17	2.6
1996			4.17	2.5
1997			4.17	2.2
1998			4.17	2.2
1999			4.17	2.4
2000			4.17	2.2
2001			4.17	2.6
2002			4.17	2.0
2003			4.17	2.2
2004			4.17	2.2
2005			4.17	3.1
2006	No increase in effort		-	4.9
2007	No increase in effort, harvest rate <15%	3.5	5.0	3.0
2008	No new advice, same as for 2007	3.5	5.0	1.2
2009	No increase in effort and landings (2007)	< 3.0	-[2]	2.7
2010	Harvest Rate no greater than that equivalent to fishing at F_{2008}	<1.2	-[2]	1.4
2011	MSY transition	<1.9	-[2]	
2012	MSY transition	<1.4	-[2]	

Weights in '000 t.

[1] Does not include discards.

[2] Advice given at FU level only.

Table 6.4.14.2.2 *Nephrops* Farn Deeps (FU 6). Official landings (tonnes).

Year	UK England & N. Ireland	UK Scotland	Sub total	Other countries**	Total
1981	1006	67	1073	0	1073
1982	2443	81	2524	0	2524
1983	2073	5	2078	0	2078
1984	1471	8	1479	0	1479
1985	2009	18	2027	0	2027
1986	1987	28	2015	0	2015
1987	2158	33	2191	0	2191
1988	2390	105	2495	0	2495
1989	2930	168	3098	0	3098
1990	2306	192	2498	0	2498
1991	1884	179	2063	0	2063
1992	1403	60	1463	10	1473
1993	2941	89	3030	0	3030
1994	3530	153	3683	0	3683
1995	2478	90	2568	1	2569
1996	2386	96	2482	1	2483
1997	2109	80	2189	0	2189
1998	2029	147	2176	1	2177
1999	2197	194	2391	0	2391
2000	1947	231	2178	0	2178
2001	2319	255	2574	0	2574
2002	1739	215	1954	0	1954
2003	2031	214	2245	0	2245
2004	1952	201	2153	0	2153
2005	2936	158	3094	0	3094
2006	4430	434	4864	39	4903
2007	2525	437	2962	4	2966
2008	976	244	1218	0	1218
2009	2289	414	2703	0	2703
2010*	1258	185	1443	0.039	1443

* Provisional.

** Other countries includes Netherlands, Belgium, and Denmark.

Table 6.4.14.2.3 *Nephrops* Farn Deeps (FU 6). Summary of the assessment.

Year	Bias-corrected TV abundance index	Landings (t)	Discard rate	Mean Weight (g)	N removed	Observed Harvest Rate
2001	*1685*	2574	66.40%	20.67	374	22.2%
2002	*1048*	1953	45.00%	20.53	182	17.3%
2003	*1085*	2245	41.30%	22.27	177	16.3%
2004	*1377*	2152	33.90%	23.58	160	11.6%
2005	*1657*	3094	33.90%	23.74	200	12.1%
2006	*1244*	4858	31.40%	22.55	317	25.5%
2007	801	2966	26.10%	25.00	158	18.1%
2008	949	1213	27.30%	25.41	61	6.4%
2009	759	2711	26.60%	24.60	131	17.3%
2010	892	1443	22.60%	25.00	74	8.3%

ECOREGION North Sea
STOCK *Nephrops* in Fladen Ground (FU 7)

Advice summary for 2012

ICES advises on the basis of the MSY approach that landings in 2012 should be no more than 14 100 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)				
	2008	2009	2010	
MSY (F_{MSY})	✓	✓	✓	Below target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)				
	2008	2009	2010	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

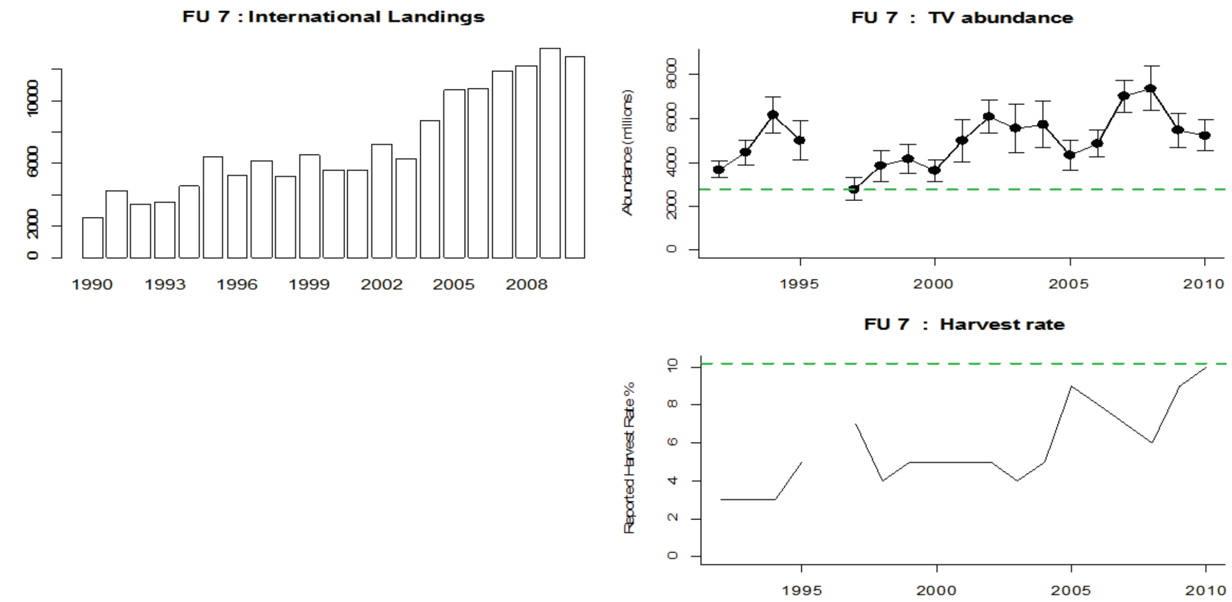


Figure 6.4.14.3.1 *Nephrops* in Fladen Ground (FU 7). Long-term trends in landings, harvest rate, and bias-adjusted UWTV abundance (used as F and SSB proxies. Weights in '000 tonnes, UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock remains at a high level, well above MSY $B_{trigger}$. The harvest rate has been increasing but is still below F_{MSY}.

Management plans

No specific management objectives are known to ICES.

Biology

See Section 6.4.14 for general comments. The *Nephrops* population at the Fladen is characterized by a low density of animals compared to other FUs, and in addition there appear to be fewer competing burrowing species in this area.

The fisheries

Over 95% of the landings are taken by Scottish vessels. Nearly three quarters of the landings are made by single-rig vessels and one-quarter by twin-rig vessels. 80 mm mesh is the most common mesh size. Whitefish represents an important bycatch for a significant component of the Scottish *Nephrops* trawlers operating at the Fladen.

Catch by fleet	Total catch (2010) = 13.2 kt. 97.3% are landings taken in demersal trawl fisheries, either directed *Nephrops* or mixed *Nephrops*/demersal fish, and 2.7% are discards in weight.

Quality considerations

See Section 6.4.14 for general comments. The UWTV survey in this area is conducted over the main part of the ground, representing an area of around 28 200 km^2 of suitable mud substrate (the largest ground in Europe). The Fladen Ground functional unit contains several patches of mud to the north of the ground which are fished, bringing the overall area of substrate to 30 633 km^2. This area is not surveyed but would add to the abundance estimate. The bias-corrected absolute abundance estimate for this ground is therefore likely to be underestimated by the current methodology.

Scientific basis

Assessment type	Analysis of length compositions, mean length of recruit classes, and UWTV survey.
Input data	One survey index (UWTV-Sco-J); Catch length–frequency data.
Discards and bycatch	Included in the assessment.
Indicators	None.
Other information	Latest benchmark (on the use of UWTV survey) was performed in 2009.
Working group report	WGNSSK

ECOREGION **North Sea**
STOCK ***Nephrops* in Fladen Ground (FU 7)**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	2767 million individuals.	Bias-adjusted lowest observed UWTV survey estimate of abundance.
	F_{MSY}	Harvest rate 10.3%.	Equivalent to $F_{0.1}$ combined sex in 2011.
Precautionary Approach	Not defined.		

(unchanged since: 2011)

Harvest rate reference points (2011):

	Male	Female	Combined
F_{max}	16.2 %	24.1 %	18.5 %
$F_{0.1}$	9.5 %	12.1 %	10.3 %
$F_{35\%}$	11.4 %	14.4 %	12.4 %

For this FU, the absolute density observed on the UWTV survey is low (average of just over 0.2 burrows m^{-2}), suggesting the stock may have low productivity. Historical harvest ratios in this FU have been below that equivalent to fishing at $F_{0.1}$, and therefore an appropriate proxy for F_{MSY} would be $F_{0.1}$ for combined sexes.

The F_{MSY} proxy harvest rate values were updated by the 2011 WG from the per-recruit analysis based on input parameters from a combined sex length cohort analysis of 2008–2010 catch-at-length data. Previous analysis used 2005, 2006, and preliminary 2007 data which showed substantially greater discard rates than have recently been observed. The new F_{MSY} proxy harvest rate ($F_{0.1}$ for combined sexes) is 10.3% compared to 10.2% used last year.

Outlook for 2012

Basis: F_{2011} = 9.8% (=$F_{2010,}$ most recent year estimate used as increasing trend); Bias-corrected survey index (2010) = 5224 million; Mean weight in landings (2008–2010) = 27.59 g; Discard rate (dead, by number) = 5% (average 2008–2010); Survey bias = 1.35.

	Harvest rate	Landings (tonnes)
	5.0%	6800
	8.0%	11000
	9.0%	12300
F_{2011}	9.8%	13400
	10.0%	13700
MSY framework	10.3%	14100
	12.4%	17000
	15.0%	20500
	18.5%	25300
	20.0%	27400

MSY approach

Following the ICES MSY framework implies a harvest rate lower than 10.3%, corresponding to landings of less than 14 100 t in 2012.

Additional considerations

In the Fladen area the *Nephrops* stock is restricted to a generally continuous area of muddy sediments extending from 57°30'N to 60°N, and from 1°W to 1°30'E, with other smaller patches to the north. The Fladen Ground is the largest known *Nephrops* ground; fishing activity can shift spatially so that effort can vary on parts of the ground.

The effects of regulations

The minimum landing size for *Nephrops* in the North Sea is 25 mm carapace length. Discarding of both undersize and poor quality *Nephrops* takes place at sea, and appears to have fallen in recent years with values of around 5% by number compared to over 10% in the early 2000s. Discard rates in this FU have historically been low compared to other North Sea functional units because of the generally larger size of *Nephrops* found at the Fladen.

Changes in fishing technology and fishing patterns

In the early years of the fishery, effort was primarily directed to a region that could be reached within 12 hours steaming from ports along the northeast coast of Scotland. In recent years, logbook information and VMS show that vessels are fishing more widely over the ground, including to the far eastern and northern edges of the extensive mud area.

The reduction in the discard rate since 2000 has not been associated with a significant change in the size composition of the catch and appears rather to be caused by increased retention of small individuals (lower mean sizes of the < 35 mm component of the landings in recent years).

Information from the fishing industry

The Fishers' North Sea stock survey (Figure 6.4.14.2) suggests that moderate or high amounts of recruits were apparent in Area 1 (within which the Fladen FU largely lies) in 2010 compared to 2009. The time-series of perceived abundance in Area 1 increases up to 2010. Opinions on discards appear to be split fairly evenly between lower, higher, and no change. Anecdotal information from the Scottish fishing industry suggests that their fishing activity is being increasingly restricted by real-time closures.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.14.

The fishery in this area has expanded since 2003. As a result the population has not been well-studied and biological parameters such as growth are considered particularly uncertain.

The UWTV survey is conducted over the main part of the ground, representing an area of around 28 200 km^2 of suitable mud substrate (the largest ground in Europe). The Fladen Ground functional unit contains several patches of mud to the north of the ground which are fished, bringing the overall area of substrate to 30 633 km^2. This area is not surveyed but would add to the abundance estimate. The absolute abundance estimate for this ground is therefore likely to be underestimated by the current methodology.

Comparison with previous assessment and advice

The perception of the state of the stock in 2009 has not changed since the assessment in 2010.

The advice given in 2011 is based on the MSY framework (as last year).

Source

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

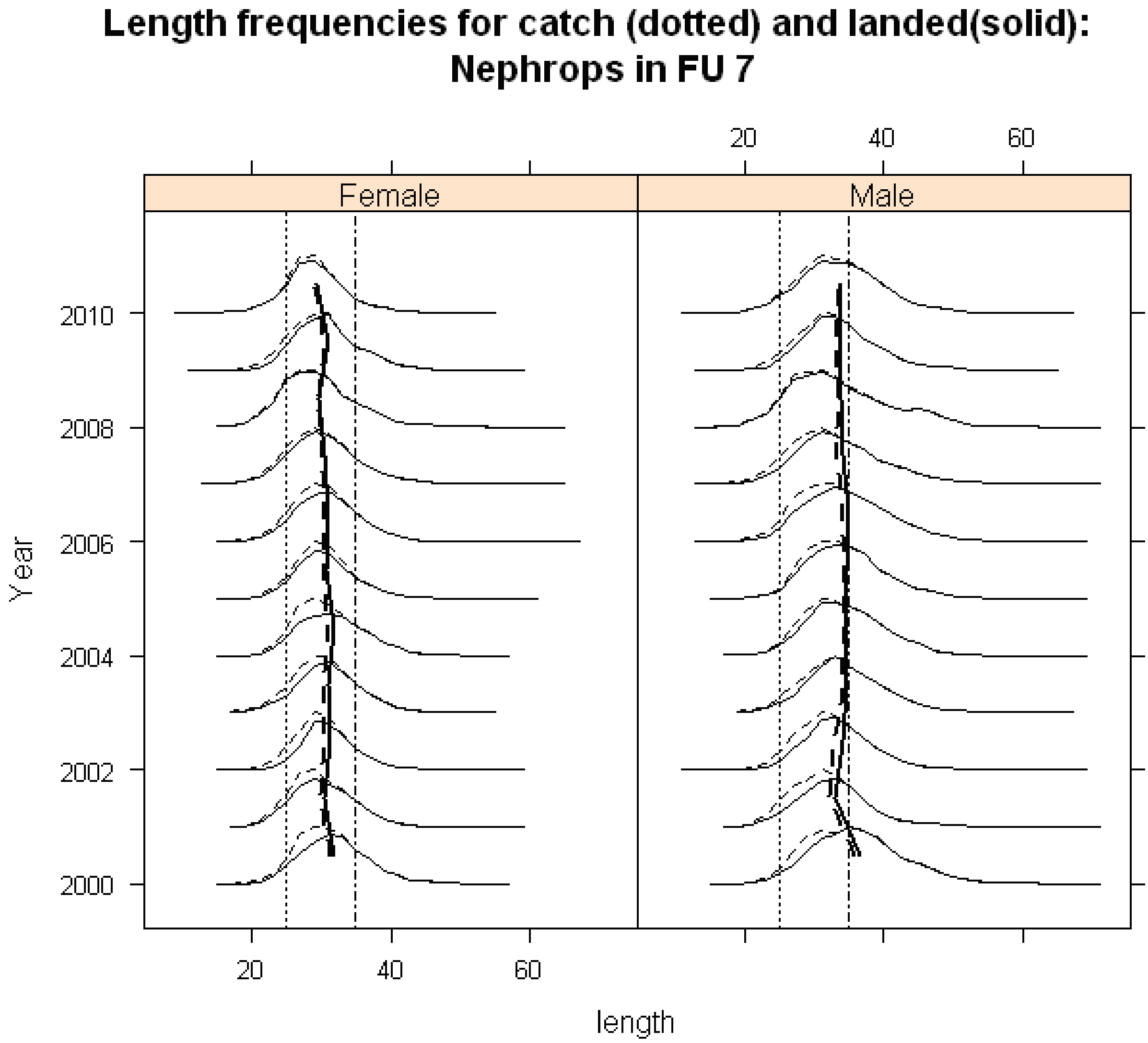


Figure 6.4.14.3.2 *Nephrops*, Fladen (FU 7). Catch length–frequency distribution and mean sizes in the catch and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

Table 6.4.14.3.1 *Nephrops* in Fladen Ground (FU 7). ICES advice, management, and landings.

Year	ICES advice	Recommended landings, Fladen grounds (FU 7)	ICES landings FU 7[1]
1989			2.3
1990			2.5
1991			4.2
1992		~2.7	3.4
1993		2.7	3.5
1994		5.0	4.6
1995		5.0	6.4
1996		5.0	5.2
1997		5.0	6.2
1998		7.0	5.1
1999		7.0	6.5
2000		9.0	5.6
2001		9.0	5.5
2002		9.0	7.2
2003		9.0	6.3
2004		12.8	8.7
2005		<12.8	10.7
2006	No increase of effort	-	10.8
2007	No increase in effort and harvest rate below 7.5%	<10.9	11.9
2008	No new advice, same as for 2007	<10.9	12.24
2009	No increase in effort and recent average landings	<11.3	13.33
2010	Harvest Rate no greater than that equivalent to fishing at $F_{0.1}$	<16.4	12.82
2011	MSY framework	< 13.3	
2012	MSY framework	< 14.1	

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

Table 6.4.14.3.2 *Nephrops* in Fladen Ground (FU 7). Nominal landings (tonnes) of *Nephrops*, as reported to ICES.

Year	Denmark	UK Scotland			Other countries **	Total
		Nephrops trawl	Other trawl	Sub-total		
1981	0	304	69	373	0	373
1982	0	382	40	422	0	422
1983	0	548	145	693	0	693
1984	0	549	97	646	0	646
1985	7	1016	125	1141	0	1148
1986	50	1398	95	1493	0	1543
1987	323	1024	349	1373	0	1696
1988	81	1306	186	1492	0	1573
1989	165	1719	415	2134	0	2299
1990	236	1703	598	2301	3	2540
1991	424	3024	769	3793	6	4223
1992	359	1794	1179	2973	31	3363
1993	224	2033	1233	3266	3	3493
1994	390	1817	2356	4173	6	4569
1995	439	3569	2428	5997	4	6440
1996	286	2338	2592	4930	1	5217
1997	235	2713	3221	5934	2	6171
1998	173	2291	2672	4963	0	5136
1999	96	2860	3549	6409	16	6521
2000	103	2915	2546	5461	5	5569
2001	64	3539	1936	5475	2	5541
2002	173	4513	2546	7059	15	7247
2003	82	4175	2033	6208	4	6294
2004	136	7274	1319	8593	0	8729
2005	321	8849	1514	10363	1	10685
2006	283	9396	1101	10497	11	10791
2007	119	11055	733	11788	3	11910
2008	133	11432	667	12099	8	12240
2009	130	12696	491	13187	10	13327
2010*	124	12410	279	12689	12	12825

* Provisional.

** Other countries includes Belgium, Norway, and UK (England).

Table 6.4.13.3.3 *Nephrops* in Fladen Ground (FU 7). Results of the 1992–2010 TV surveys (bias-adjusted).

Year	Stations	Abundance	Mean density	95% confidence interval
		millions	burrows m^{-2}	millions
1992	69	3661	0.17	376
1993	74	4450	0.21	569
1994	59	6170	0.3	814
1995	61	4987	0.24	896
1996	No survey			
1997	56	2767	0.13	510
1998	60	3838	0.18	717
1999	62	4146	0.2	649
2000	68	3628	0.17	491
2001	50	4981	0.23	970
2002	54	6087	0.29	757
2003	55	5547	0.27	1076
2004	52	5725	0.27	1030
2005	72	4325	0.21	662
2006	69	4862	0.23	619
2007	82	7017	0.34	730
2008	74	7360	0.35	1019
2009	59	5457	0.262	772
2010	67	5224	0.25	711

Table 6.4.13.3.4 *Nephrops* in Fladen Ground (FU 7). Adjusted TV survey abundance, landings, total discard rate (proportion by number), dead discard rate (by number), and estimated harvest rate 2003–2010.

	Adjusted abundance (millions)	Landings (tonnes)	Discard rate	Dead discard rate	Harvest rate
2003	5547	6294	0.10	0.08	0.04
2004	5725	8729	0.11	0.08	0.05
2005	4325	10685	0.11	0.09	0.09
2006	4862	10791	0.13	0.1	0.08
2007	7017	11910	0.11	0.08	0.07
2008	7360	12240	0.04	0.03	0.06
2009	5457	13327	0.10	0.07	0.09
2010	5224	12825	0.06	0.05	0.10

ECOREGION North Sea
STOCK *Nephrops* in Firth of Forth (FU 8)

Advice for 2012

ICES advises on the basis of the transition to the MSY approach that landings in 2012 should be no more than 1700 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)			
	2008	2009	2010
MSY (F_{MSY})	✗	✗	✗ Above target
Precautionary approach (F_{pa},F_{lim})	?	?	? Undefined
SSB (Spawning-Stock Biomass)			
	2008	2009	2010
MSY ($B_{trigger}$)	✓	✓	✓ Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	? Undefined

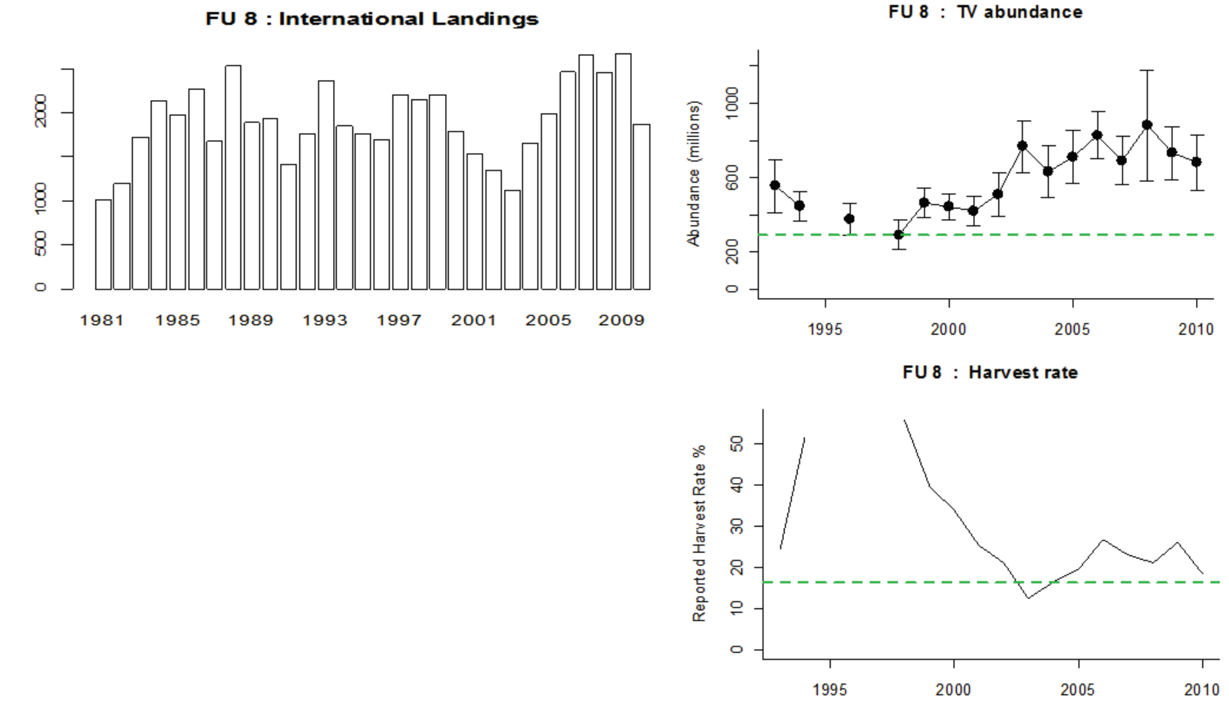


Figure 6.4.14.4.1 *Nephrops* in Firth of Forth (FU 8). Long-term trends in landings, harvest rate, and bias-adjusted UWTV biomass (used as F and SSB proxie; weights in '000 tonnes and UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock remains at a high level, well above MSY $B_{trigger}$. The harvest rate remains slightly above F_{MSY}.

Management plans

No specific management objectives are known to ICES.

Biology

The population of *Nephrops* in the Firth of Forth appears to consist of a high density of small individuals in comparison to other FUs.

The fisheries

The *Nephrops* fishery in the Firth of Forth is dominated by UK (Scotland) vessels with low landings reported by other UK nations. *Nephrops* discard rates are high (30% by number and 17% by weight in 2010) and unwanted bycatch of haddock and whiting occurs. There is a need to reduce these and to improve the exploitation pattern of the 80 mm fisheries.

Catch by fleet	Total catch (2010) = 2.23 kt, where 83% are landings taken in demersal trawl fisheries, either directed *Nephrops* or mixed *Nephrops*/demersal fish, and 17% are discards in weight.

Quality considerations

See Section 6.4.14 for general comments.

Scientific basis

Assessment type	Analysis of length compositions, mean length of recruit classes, and UWTV survey index.
Input data	One survey index (UWTV-Sco-A); Catch length–frequency data.
Discards and bycatch	Included in the assessment.
Indicators	None.
Other information	Latest benchmark (on use of UWTV survey) was performed in 2009.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in Firth of Forth (FU 8)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	292 million individuals.	Bias-adjusted lowest observed UWTV survey estimate of abundance.
	F_{MSY}	Harvest rate 16.3%.	Equivalent to F_{max} combined sex in 2011.
Precautionary Approach	Not defined.		

(unchanged since: 2011)

Harvest rate reference points (2011):

	Male	Female	Combined
F_{max}	12.7 %	26.7 %	16.3 %
$F_{0.1}$	7.7 %	15.2 %	9.4 %
$F_{35\%}$	9.4 %	18.3 %	12.7 %

For this FU, the absolute density observed on the UWTV survey is relatively high (average of ~ 0.8 burrows m^{-2}). A long time-series of relatively stable landings (average reported landings ~ 2000 tonnes), well above those predicted by currently fishing at F_{max} while the stock abundance has been stable, suggest a productive stock. It is suggested that F_{max} for combined sexes is chosen as the F_{MSY} proxy.

The F_{MSY} proxy harvest rate values were updated in 2011 on the basis of per-recruit analysis based on input parameters from a combined sex length cohort analysis of 2008–2010 catch-at-length data. Previous analysis used 2005, 2006, and preliminary 2007 data which showed greater discard rates than those observed recently. The new F_{MSY} proxy harvest rate (F_{max} for combined sexes) is 16.3%, compared to the 15% used last year.

Outlook for 2012

Basis: F_{2011} = average harvest rate of 2008–2010 = 21.8%; Bias-corrected survey index (2010) = 682 million; Mean weight in landings (2008–2010) = 18.8 g; Discard rate (dead, by number) = 25.3% (average 2008–2010); Survey bias = 1.18.

	Harvest rate	Landings (tonnes)
	5.0%	500
	9.4%	900
	10.0%	1000
	12.7%	1200
MSY framework	16.3%	1600
MSY transition	17.5%	1700
	20.0%	1900
F_{2011}	21.8%	2100

MSY approach

To follow the ICES MSY framework the harvest rate should be reduced to 16.3%, corresponding to maximum landings of 1600 t in 2012.

To follow the transition scheme towards the ICES MSY framework the harvest rate should be reduced to 17.5% (0.6* F_{2010}+ 0.4* F_{MSY}), corresponding to landings of no more than 1700 t in 2012 (where F_{2010} is the observed harvest rate in 2010 (18.4%)).

Additional considerations

Factors affecting the fisheries and the stock

Landings from the Firth of Forth fishery are predominantly reported from Scotland, with very small contributions from England. The area is periodically visited by vessels from other parts of the UK. The Firth of Forth is close inshore and is of small geographic size so that any significant increase of effort could rapidly lead to overexploitation.

Catches of marketable bycatch fish are small from this area and there are few other species in the area for vessels to target.

Estimated discarding rates of *Nephrops* are 30% by number in the Firth of Forth in 2010. This arises from the use of mainly small-meshed (80 mm) nets and the population size structure which appears to arise from slower growth. Local markets for small whole *Nephrops* are seasonally important.

The effects of regulations

The minimum landing size for *Nephrops* in the North Sea is 25 mm carapace length. The apparent small size of *Nephrops* in this area results in high discard rates.

Changes in fishing technology and fishing patterns

The Firth of Forth resident fleet contains numerous small boats which are generally restricted to more sheltered inshore waters. There are, however, observations of shifts of *Nephrops* fishing by larger vessels from the fleet to grounds such as the Devil's Hole.

Information from the fishing industry

The Fishers' North Sea stock survey (Figure 6.4.14.2) does not include specific information for the Firth of Forth. Area 3 shows increased perceived abundance in 2010, but this covers the Moray Firth and parts of the Devil's Hole in addition to the Firth of Forth.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.14.

Comparison with previous assessment and advice

The perception of the state of the stock in 2009 has not changed since the assessment in 2010.

The advice given in 2011 is based on the MSY transition scheme (as in 2010).

Source

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

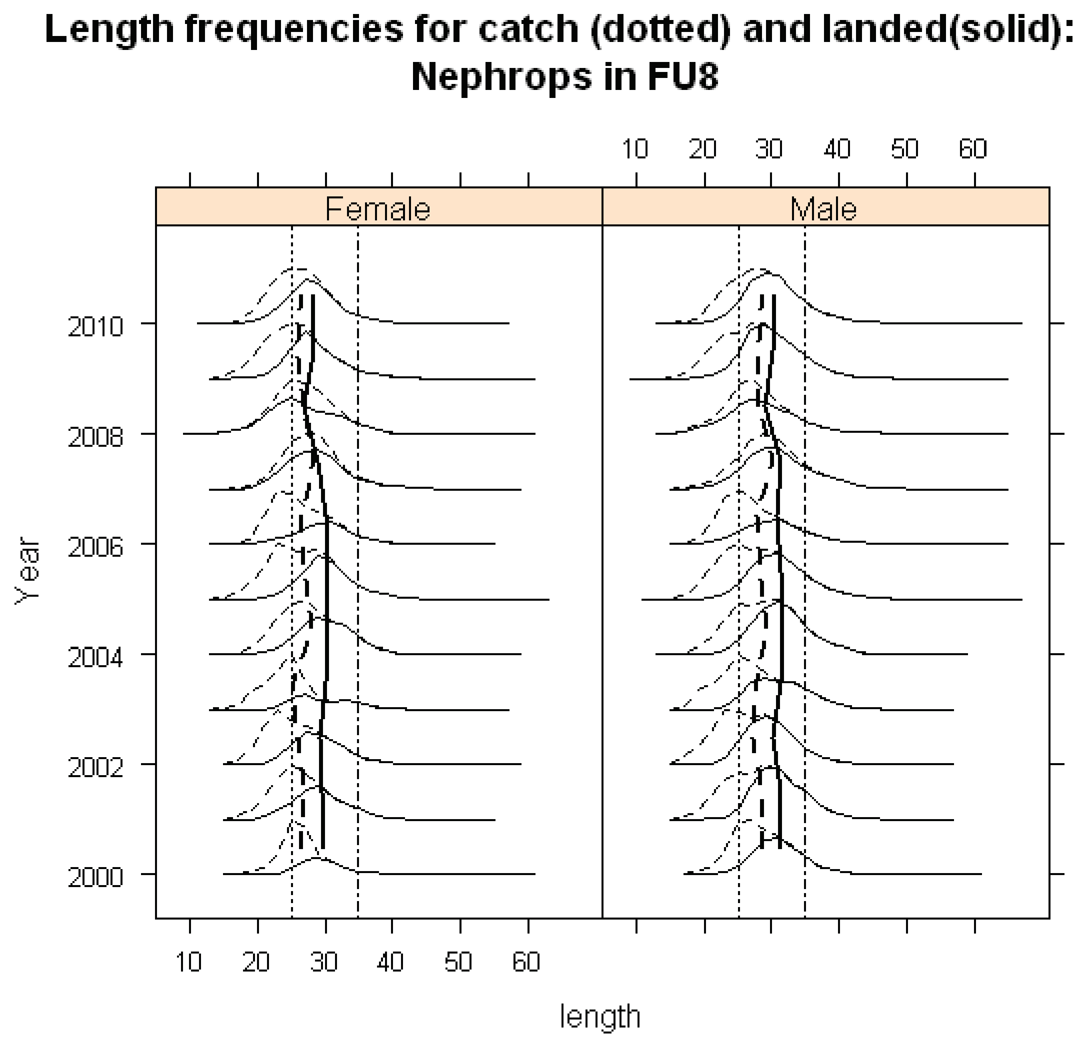


Figure 6.4.14.4.2 *Nephrops* in Firth of Forth (FU 8). Catch length–frequency distribution and mean sizes in the catch and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

Table 6.4.14.4.1 *Nephrops* in Firth of Forth (FU 8). ICES advice, management, and landings.

Year	ICES advice	Recommended landings Firth of Forth (FU 8)	Recommended landings FU 6+FU 8	ICES landings FU 8[1)]
1992			~4.6	1.8
1993			4.17	2.4
1994			4.17	1.9
1995			4.17	1.8
1996			4.17	1.7
1997			4.17	2.2
1998			4.17	2.1
1999			4.17	2.2
2000			4.17	1.8
2001			4.17	1.5
2002			4.17	1.3
2003			4.17	1.1
2004			4.17	1.7
2005			4.17	2.0
2006	No increase in effort		-	2.4
2007	No increase in effort, harvest rate <15%	1.5	5.0	2.6
2008	No new advice, same as for 2007	1.5	5.0	2.5
2009	No increase in effort and recent average landings	< 2.5	2.4	2.7
2010	Harvest Rate no greater than that equivalent to fishing at F_{max}	< 1.6	--[2)]	1.9
2011	MSY transition	< 2.0	--[2)]	
2012	MSY transition	< 1.7		

Weights in ‘000 t.
[1)] Does not include discards.
[2)] It is not advised to manage these stocks as a single unit.

Table 6.4.14.4.2 *Nephrops* in Firth of Forth (FU 8). Nominal landings (tonnes) of *Nephrops*, as reported to ICES.

Year	UK Scotland				UK (E, W & NI)	Total **
	Nephrops trawl	Other trawl	Creel	Sub-total		
1981	945	61	0	1006	0	1006
1982	1138	57	0	1195	0	1195
1983	1681	43	0	1724	0	1724
1984	2078	56	0	2134	0	2134
1985	1908	61	0	1969	0	1969
1986	2204	59	0	2263	0	2263
1987	1582	92	0	1674	0	1674
1988	2455	73	0	2528	0	2528
1989	1833	52	0	1885	1	1886
1990	1901	28	0	1929	1	1930
1991	1359	45	0	1404	0	1404
1992	1714	43	0	1757	0	1757
1993	2349	18	0	2367	2	2369
1994	1827	17	0	1844	6	1850
1995	1708	53	0	1761	2	1763
1996	1621	66	1	1688	0	1688
1997	2137	55	0	2192	2	2194
1998	2105	38	0	2143	2	2145
1999	2192	9	1	2202	3	2205
2000	1775	9	0	1784	1	1785
2001	1484	35	0	1519	9	1528
2002	1302	31	1	1334	6	1340
2003	1115	8	0	1123	3	1126
2004	1651	4	0	1655	3	1658
2005	1973	0	6	1979	11	1990
2006	2437	4	12	2453	5	2458
2007	2628	9	8	2645	7	2652
2008	2435	3	7	2445	5	2450
2009	2626	1	26	2653	9	2662
2010*	1848	3	12	1862	9	1871

* Provisional.

** There are no landings by other countries from this FU.

Table 6.4.14.4.3 *Nephrops* in Firth of Forth (FU 8): Results of the TV surveys (bias-adjusted).

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1993	37	0.72	555	142
1994	30	0.58	448	78
1995	no survey			
1996	27	0.48	375	88
1997	no survey			
1998	32	0.38	292	81
1999	49	0.60	463	78
2000	53	0.57	443	70
2001	46	0.54	419	78
2002	41	0.66	508	119
2003	36	0.99	767	138
2004	37	0.81	630	140
2005	54	0.92	710	143
2006	43	1.07	827	126
2007	49	0.90	692	132
2008	38	1.14	881	297
2009	45	0.94	732	142
2010	39	0.88	682	147

Table 6.4.14.4.4 *Nephrops* in Firth of Forth (FU 8): Adjusted TV survey abundance, landings, total discard rate (proportion by number), dead discard rate (by number), and estimated harvest rate.

	Adjusted abundance (millions)	Landings (tonnes)	Discard rate	Dead discard rate	Harvest rate
2003	767	1126	0.54	0.47	0.12
2004	630	1658	0.35	0.29	0.16
2005	710	1990	0.42	0.35	0.19
2006	827	2458	0.55	0.48	0.27
2007	692	2652	0.25	0.2	0.23
2008	881	2450	0.29	0.24	0.21
2009	732	2662	0.34	0.28	0.26
2010	682	1871	0.3	0.24	0.18

ECOREGION North Sea
STOCK *Nephrops* in Moray Firth (FU 9)

Advice for 2012

ICES advises on the basis of the MSY approach that landings in 2012 should be no more than 1100 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)				
	2008	2009	**2010**	
MSY (F_{MSY})	✗	✓	✓	Below target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning Stock Biomass)				
	2008	2009	**2010**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

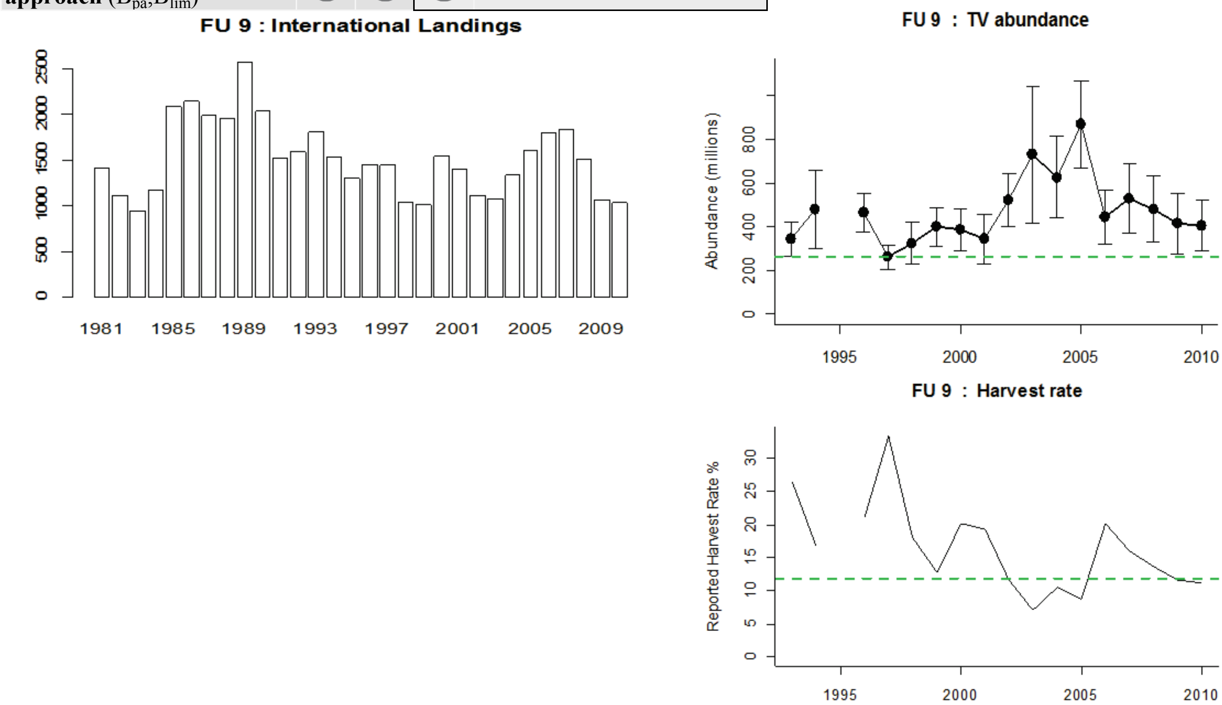


Figure 6.4.14.5.1 *Nephrops* in Moray Firth (FU 9). Long-term trends in landings, harvest rate, and bias-adjusted UWTV abundance (used as F and SSB proxies; weights in '000 tonnes and UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock remains above MSY $_{Btrigger}$. The harvest rate has declined since 2006 and is now at F_{MSY}.

Management plans

No specific management objectives are known to ICES.

Biology

See Section 6.4.14 for general comments.

The fisheries

The Moray Firth *Nephrops* fishery is essentially a Scottish fishery with only occasional landings made by vessels from elsewhere in the UK. Vessels typically conduct day trips from the nearby ports along the Moray Firth coast. Occasionally larger vessels fish the outer Moray Firth grounds on their way to/from the Fladen or in times of poor weather.

Catch by fleet	Total catch (2010) = 1.13 kt, where 91% are landings taken in demersal trawl fisheries, either directed *Nephrops* or mixed *Nephrops*/demersal fish, and 9% are discards in weight.

Quality considerations

See Section 6.4.14 for general comments.

Scientific basis

Assessment type	Analysis of length compositions, mean length of recruit classes, and commercial cpue.
Input data	One survey index (UWTV-Sco-A); Catch length–frequency data.
Discards and bycatch	Included in the assessment.
Indicators	None.
Other information	Latest benchmark was performed in 2009.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in Moray Firth (FU 9)

Reference points

	Type	*Value*	*Technical basis*
MSY	MSY $B_{trigger}$	262 million individuals.	Bias-adjusted lowest observed UWTV survey estimate of abundance (1997).
Approach	F_{MSY}	Harvest rate 11.8%.	Proxy, equivalent to $F_{35\%SPR}$ combined sex in 2011.
Precautionary Approach	Not defined.		

(unchanged since: 2011)

Harvest rate reference points (2011):

	Male	Female	Combined
F_{max}	12.3 %	23.8 %	14.9 %
$F_{0.1}$	7.2 %	11.6 %	7.8 %
$F_{35\%}$	9.1 %	17.1 %	11.8 %

Moderate absolute densities are generally observed on the UWTV survey of this FU. Although variable, harvest ratios (which are likely to have been underestimated prior to 2006) appear to have been around or above $F_{35\%SPR}$ and in addition there is a long time-series of relatively stable landings (average reported landings ~ 1500 tonnes, above those predicted by currently fishing at $F_{35\%SPR}$). It is suggested that $F_{35\%SPR(T)}$ is chosen as the F_{MSY} proxy.

The F_{MSY} proxy harvest rate values were updated in 2011 on the basis of per-recruit analysis based on input parameters from a combined sex length cohort analysis of 2008–2010 catch-at-length data. Previous analysis used 2005, 2006 and preliminary 2007 data. The new F_{msy} proxy harvest rate ($F_{35\%SPR}$ for combined sexes) is 11.8%, compared to the 12.7% used last year.

Outlook for 2012

Basis: F_{2011} = 11.2% (based on F_{2010} as declining trend); Bias-corrected survey index (2010) = 406 million; Mean weight in landings (2008–2010) = 25.23 g; Discard rate (dead, by number) = 10.3% (average 2008–2010); Survey bias = 1.21.

	Harvest rate	Landings (tonnes)
	5.0%	500
	7.8%	700
	10.0%	900
F_{2011}	11.2%	1000
MSY framework	11.8%	1100
	15.0%	1400
	14.9%	1400
	20.0%	1800

MSY approach

Following the ICES MSY framework implies the harvest rate should be less than 11.8%, resulting in landings of less than 1100 t in 2012.

Additional considerations

See Section 6.4.14 for general comments.

Changes in fishing technology and fishing patterns

Discarding rates of dead individuals averaged over the period 2006–2010 for this stock were about 10% by number. This represents a reduction in discarding rate compared to the average for the period 2003–2005. This may arise from the increasing use of larger mesh sizes in the northern North Sea, although reduction in recruitment may also account for this change.

Information from the fishing industry

The Fishers' North Sea stock survey (Figure 6.4.14.2) does not include specific information for the Moray Firth. Area 3 shows a perception of increased abundance in 2010, but this covers the Firth of Forth and parts of the Devil's Hole in addition to the Moray Firth.

Comparison with previous assessment and advice

The perception of the state of the stock in 2009 has not changed since the assessment in 2010.

The advice in 2011 is based on the MSY framework, because F2010 is below F_{MSY} proxy. In 2010 advice was provided on the basis of transition to MSY.

Sources

ICES. 2009. Report of the Benchmark Workshop on *Nephrops* (WKNEPH), 2–6 March 2009, Aberdeen, UK. ICES CM 2009/ACOM:33. 156 pp.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

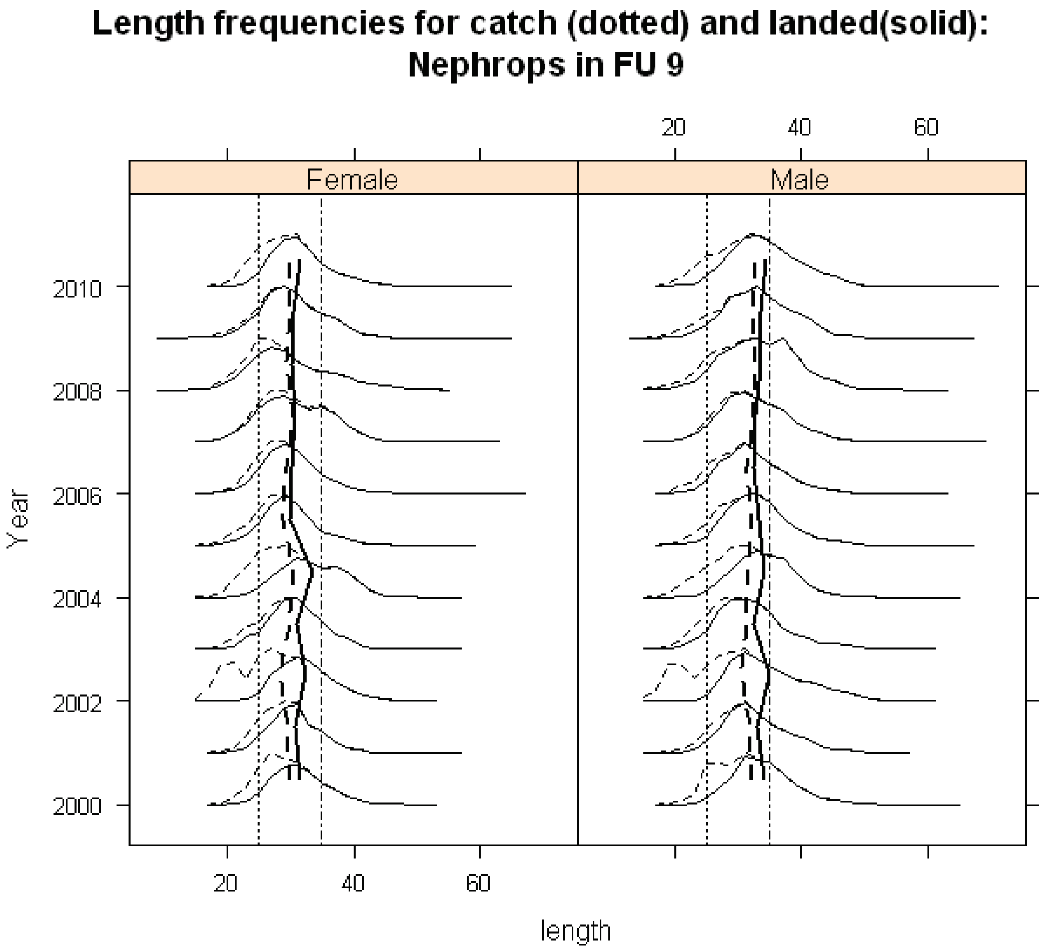


Figure 6.4.14.5.2 *Nephrops*, Moray Firth (FU 9). Catch length–frequency distribution and mean size in catches and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

Table 6.4.14.5.1 *Nephrops* in Moray Firth (FU 9). ICES advice, management, and landings.

Year	ICES advice	Recommended landings Moray Firth (FU 9)	Recommended landings FU 9+FU 10	ICES landings FU 9[1)]
1987				2.0
1988				2.0
1989				2.6
1990				2.0
1991				1.5
1992			~2.4	1.6
1993			2.4	1.8
1994			2.4	1.5
1995			2.4	1.3
1996	*Status quo* TAC		2.4	1.5
1997	*Status quo* TAC		2.4	1.4
1998			2.4	1.0
1999			2.4	1.0
2000			1.85	1.5
2001			1.85	1.4
2002	Catches to be maintained at the 2000 level		2.0	1.1
2003	Catches to be maintained at the 2000 level		2.0	1.1
2004	Catches to be maintained at the 2000 level		2.0	1.3
2005	Catches to be maintained at the 2000 level		2.0	1.6
2006	No increase in effort		-	1.8
2007	No increase in effort, and harvest rate below 15%	2.4	2.64	1.8
2008	No new advice, same as for 2007	2.4	2.64	1.5
2009	No increase in effort and recent average landings	< 1.8		1.1
2010	Harvest Rate no greater than that equivalent to fishing at F_{2008}	< 1.4	--[2)]	1.0
2011	MSY transition	< 1.3	--[2)]	
2012	MSY framework	< 1.1		

Weights in '000 t.

[1)] Does not include discards.

[2)] It is not advised to manage these stocks as a single unit.

Table 6.4.14.5.2 *Nephrops* in Moray Firth (FU 9). Nominal landings (tonnes) of *Nephrops*, as reported to ICES.

Year	UK Scotland				UK England	Total **
	Nephrops trawl	Other trawl	Creel	Sub-total		
1981	1298	118	0	1416	0	1416
1982	1034	86	0	1120	0	1120
1983	850	90	0	940	0	940
1984	960	210	0	1170	0	1170
1985	1908	173	0	2081	0	2081
1986	1933	210	0	2143	0	2143
1987	1723	268	0	1991	0	1991
1988	1638	321	0	1959	0	1959
1989	2101	475	0	2576	0	2576
1990	1698	340	0	2038	0	2038
1991	1285	234	0	1519	0	1519
1992	1285	306	0	1591	0	1591
1993	1505	303	0	1808	0	1808
1994	1178	360	0	1538	0	1538
1995	967	330	0	1297	0	1297
1996	1084	364	1	1449	2	1451
1997	1102	343	0	1445	1	1446
1998	739	289	4	1032	0	1032
1999	813	193	2	1008	0	1008
2000	1344	194	3	1541	0	1541
2001	1188	213	2	1403	0	1403
2002	884	232	2	1118	0	1118
2003	874	194	11	1079	0	1079
2004	1223	103	9	1335	0	1335
2005	1526	64	12	1602	3	1605
2006	1718	73	11	1802	1	1803
2007	1816	17	7	1840	2	1842
2008	1443	67	4	1514	0	1514
2009	1042	22	2	1066	1	1067
2010*	999	24	10	1032	0	1032

* Provisional.

** No landings by other countries from this FU.

Table 6.4.14.5.3 *Nephrops* in Moray Firth (FU 9): Results of the 1993–2010 TV surveys (bias-adjusted).

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1993	31	0.19	345	78
1994	29	0.39	702	176
1995	no survey			
1996	27	0.26	465	90
1997	34	0.14	262	55
1998	31	0.18	323	95
1999	52	0.22	400	87
2000	44	0.21	386	98
2001	45	0.19	345	112
2002	31	0.29	521	121
2003	32	0.40	729	314
2004	42	0.35	626	186
2005	42	0.48	869	198
2006	50	0.25	446	124
2007	40	0.29	530	157
2008	45	0.26	478	151
2009	50	0.23	415	140
2010	43	0.22	406	115

Table 6.4.14.5.4 *Nephrops* in Moray Firth (FU 9): Adjusted TV survey abundance, landings, total discard rate (proportion by number), dead discard rate (by number), and estimated harvest rate.

	Adjusted abundance (millions)	Landings (tonnes)	Discard rate	Dead discard rate	Harvest rate
2003	730	1079	0.14	0.11	0.07
2004	626	1335	0.33	0.27	0.11
2005	869	1605	0.15	0.12	0.09
2006	445	1803	0.13	0.1	0.20
2007	531	1842	0.08	0.06	0.16
2008	481	1514	0.11	0.09	0.14
2009	415	1067	0.08	0.06	0.12
2010	406	1032	0.2	0.16	0.11

ECOREGION North Sea
STOCK *Nephrops* in Noup (FU 10)

Advice for 2012

The 2010 advice for this *Nephrops* stock was biennial and valid for 2011 and 2012 (see ICES, 2010) and indicated that there is no basis for advice. Based on the 2012 advisory framework in these circumstances, ICES advises on the basis of precautionary considerations that catches should be reduced.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

	F (Fishing Mortality)	
	2008 - 2010	
Qualitative evaluation	?	Insufficient information

	SSB (Spawning-Stock Biomass)	
	2008 – 2010	
Qualitative evaluation	?	Insufficient information

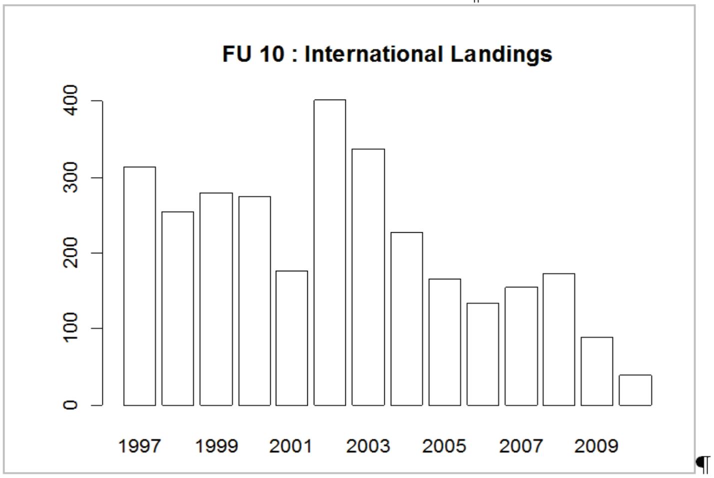


Figure 6.4.14.6.1 *Nephrops* in Noup (FU 10). Landings (tonnes).

The state of the stock is unknown.

Management plans

No specific management objectives are known to ICES.

Biology

See Section 6.4.14 for general comments.

The fisheries

The *Nephrops* fishery at the Noup is prosecuted by only 3–4 vessels on a regular basis and landings are < 1% of the North Sea total. There is no discard information for this fishery.

Quality considerations

The time series of UWTV survey data is incomplete and no survey has been conducted in 2009 or 2010. There are no reliable effort data for this FU and therefore no resulting lpue.

Scientific basis

Assessment type	No assessment – only landings data and landings length–frequencies.
Input data	Occasional UWTV surveys (incomplete time-series).
Discards and bycatch	No discard information available.
Indicators	None.
Other information	None.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in Noup (FU 10)

Reference points

No reference points are defined for this stock.

Outlook for 2012

No reliable assessment can be presented for this stock. The main cause of this is a lack of data. The time-series of UWTV survey data is incomplete and no survey has been conducted since 2007. There are no reliable effort data for this FU and therefore no resulting lpue.

Precautionary considerations

Trends in the stock are unknown and there is no information on exploitation status. Therefore, catches should be reduced.

Additional considerations

See Section 6.4.14 for general comments.

Comparison with previous assessment and advice

The perception of the state of the stock in 2009 has not changed since the assessment in 2010.

There was no advice for 2011. The 2012 advice is based on precautionary considerations.

Sources

ICES. 2010. Report of the ICES Advisory Committee 2010. ICES Advice, 2010. Book 6, Section 6.4.14.
ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

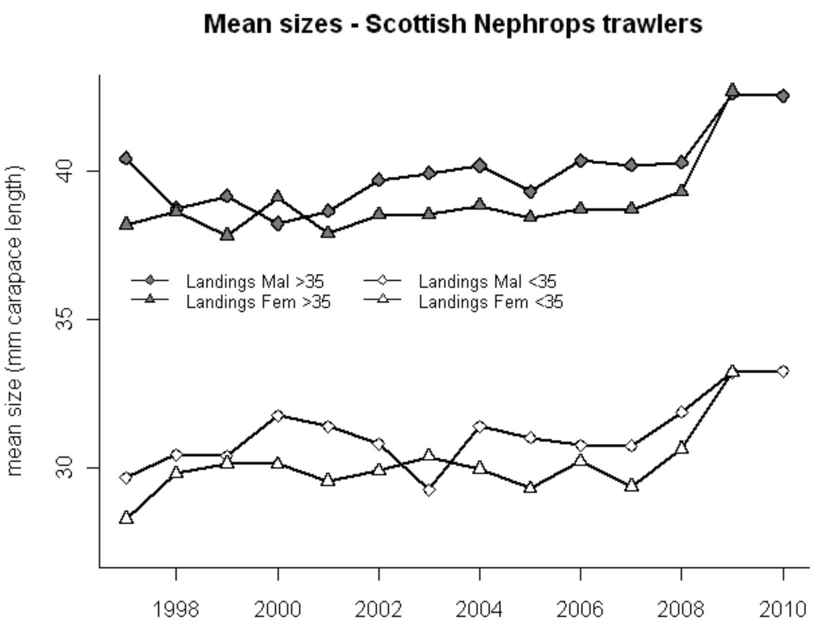


Figure 6.4.14.6.2 *Nephrops* in Noup (FU 10). Mean size in the landings divided by male and female, above and below 35 cm.

Table 6.4.14.6.1 *Nephrops* in Noup (FU 10). ICES advice, management, and landings.

Year	ICES advice	Recommended landings Noup (FU 10)	Recommended landings FU 9+FU 10	ICES landings [1]
1987				0.04
1988				0.08
1989				0.08
1990				0.22
1991				0.19
1992			~2.4	0.19
1993			2.4	0.38
1994			2.4	0.50
1995			2.4	0.28
1996	*Status quo* TAC		2.4	0.34
1997	*Status quo* TAC		2.4	0.32
1998			2.4	0.25
1999			2.4	0.28
2000			1.85	0.28
2001			1.85	0.18
2002	Catches to be maintained at the 2000 level		2.0	0.40
2003	Catches to be maintained at the 2000 level		2.0	0.34
2004	Catches to be maintained at the 2000 level		2.0	0.23
2005	Catches to be maintained at the 2000 level		2.0	0.17
2006	No increase in effort		-	0.13
2007	No increase in effort, and recent average landings	0.24	2.64	0.15
2008	No new advice, same as for 2007	0.24	2.64 [2]	0.17
2009	No increase in effort, and average landings 2003–2005	< 0.24		0.09
2010	No new advice, same as for 2009	< 0.24		0.04
2011	No advice	-		
2012	Reduce catch	-		

Weights in ‘000 t.
[1] Does not include discards.
[2] Based on a 15% harvest rate applied to TV survey abundance data. Includes Moray Firth (FU 9).

6.4.14.7 **Advice June 2011**

ECOREGION North Sea
STOCK *Nephrops* in the Norwegian Deep (FU 32)

Advice for 2012

The 2010 advice for this *Nephrops* stock is biennial and valid for 2011 and 2012 (see ICES, 2010). This year ICES adopt the transition to the MSY approach as the basis for advice, which corresponds to reducing catches.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Sources

ICES. 2010. Report of the ICES Advisory Committee 2010. ICES Advice, 2010. Book 6, Section 6.4.14.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

Table 6.4.14.7.1 *Nephrops* in the Norwegian Deep (FU 32). ICES advice, management, and landings.

Year	ICES advice	Recommended landings	TAC [1]	ICES landings
1987				< 0.1
1988				< 0.1
1989				< 0.1
1990				0.2
1991				0.2
1992				0.2
1993				0.3
1994				0.8
1995				0.5
1996				1.0
1997				0.8
1998				0.8
1999				1.1
2000				1.1
2001				1.2
2002		1.2	No TAC agreed	1.2
2003		1.2	No TAC agreed	1.1
2004		1.5	1.0	0.9
2005		1.5	1.0	1.1
2006	No increase in effort		1.3	1.0
2007	No increase in effort		1.3	0.8
2008	No new advice, same as for 2007		1.3	0.7
2009	No increase in effort		1.2	0.5
2010	No new advice, same as for 2009		0	0.4
2011	See scenarios	-	1.2	
2012	Reduce catches	-		

Weights in '000 t.
[1] Norwegian zone of Subarea IV.

ECOREGION North Sea
STOCK *Nephrops* off Horn's Reef (FU 33)

Advice for 2012

The 2010 advice for this *Nephrops* stock is biennial and valid for 2011 and 2012 (see ICES, 2010). This year ICES adopts the transition to the MSY approach as basis for advice, which corresponds to reducing catches.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Sources

ICES. 2010. Report of the ICES Advisory Committee 2010. ICES Advice, 2010. Book 6, Section 6.4.14.
ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4–10 May 2011. ICES CM 2011/ACOM:13.

Table 6.4.14.8.1 *Nephrops* off Horn's Reef (FU 33). ICES advice, management, and landings.

Year	ICES advice	Recommended landings	ICES landings[1)]
1992		0.87	
1993		0.87	0.2
1994		0.87	0.1
1995		0.87	0.2
1996		0.87	<0.1
1997		0.87	0.3
1998		1.0	0.3
1999		1.0	0.7
2000		1.6	0.6
2001		1.6	0.8
2002		2.1	0.9
2003		2.1	0.9
2004		2.38	1.3
2005		2.38	1.1
2006		2.38[2)]	1.3
2007	No increase in effort	-	1.5
2008	No new advice, same as for 2007	-	1.1
2009	No increase in effort	-	1.2
2010	No new advice, same as for 2009	-	0.8
2011	See scenarios	-	
2012	Reduce catches	-	

Weights in '000 t.
1) Does not include discards.
2) Includes Farn Deeps (FU6).

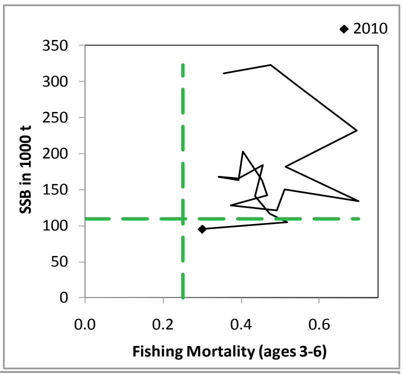
ECOREGION North Sea
STOCK Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners)

Advice for 2012

ICES advises on the basis of the MSY framework that catches in 2012 should be no more than 42 700 t.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	✗	✗	✗	above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
	SSB (Spawning Stock Biomass)			
	2009	2010	2011	
MSY ($B_{trigger}$)	✗	✗	✗	below trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined



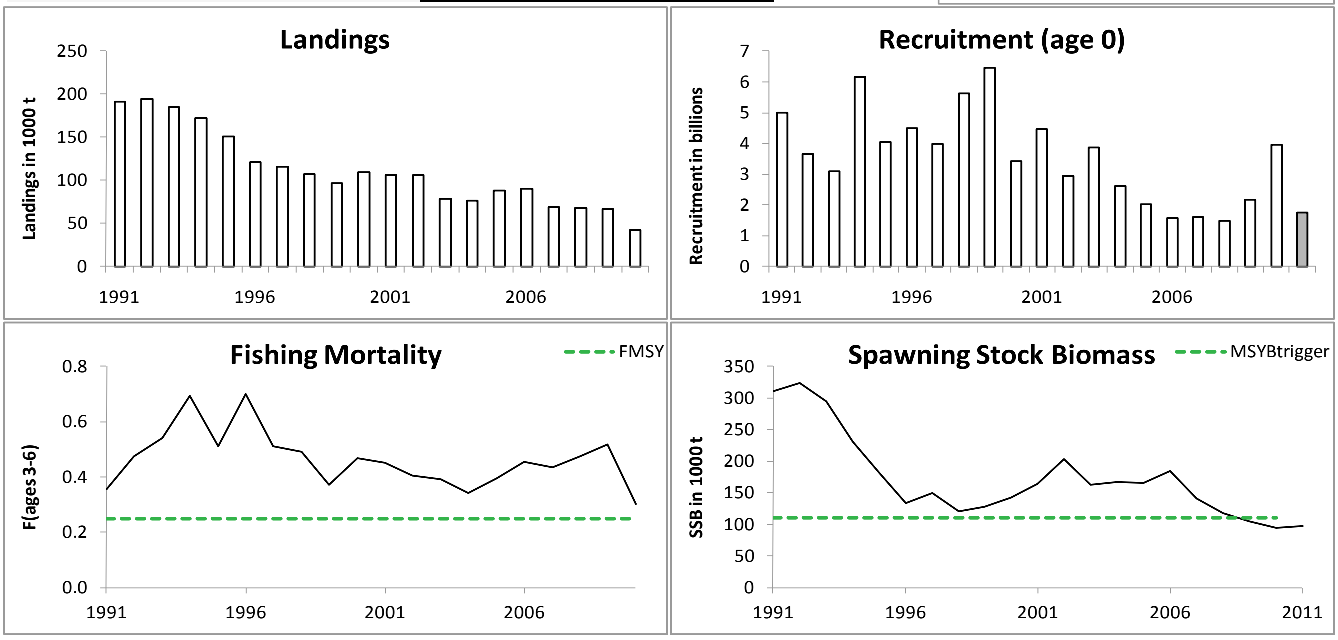


Figure 6.4.15.1 Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). Summary of stock assessment (predicted values are shown in grey). Top right: SSB and F over the years.

Catches have declined since the early 1990s and SSB has been decreasing in recent years and has reached the lowest in the time-series in 2010. Fishing mortality has been increasing since 2005, but dropped to 0.30 in 2010 (still higher than the target F_{MSY} of 0.25). The most recent recruitment is estimated to be near the long-term average.

Management plans

No specific management objectives are known to ICES.

Biology

Herring in Division IIIa and Subdivisions 22–24 (WBSS) migrate from the western Baltic into the more saline waters of Division IIIa and the eastern parts of Division IVa in search of food in summer. In these areas they mix with North Sea autumn-spawning (NSAS) herring. Herring is considered to have a major impact on other fish stocks as predator, and as prey for other species including seabirds and marine mammals.

Environmental influence on the stock

The reasons for the reduction in recruitment during the period 2004–2009 in Western Baltic herring are currently unknown. There are no indications of systematic changes in growth or age-at-maturity, and reduced recruitment is probably due to increased mortality at the egg or the larval stage. Further investigation of the causes of the poor recruitment will require targeted research projects.

The fisheries

Misreporting by the C-fleet in Division IIIa is assumed to have stopped since 2009 due to new national regulations. Discards are considered to be low.

Area where WBSS are being caught	Fleet	Fishery	WBSS 2010 catch	NSAS 2010 catch
Division IIIa	C	Directed herring fisheries with purse-seiners and trawlers.	22 975 t	11 978 t
	D	Bycatches of herring caught in the small-mesh fisheries.	549 t	1 781 t
SD 22–24	F	All herring fisheries in Subdivisions 22–24.	17 917 t	-
Division IVa East	A	Directed herring fisheries with purse-seiners and trawlers.	772 t	-

Quality considerations

The main causes for uncertainty are: lack of a firm basis to predict the fraction of NSAS in the catches in the Kattegat and Skagerrak, the variability in the proportions of the two stocks (WBSS and NSAS), and the distribution of the fishery between years. ICES uses a geometric mean recruitment from 2005–2009 (weaker year classes) for the short-term prediction. *Ad hoc* management measures in 2011 allowing a 50% transfer of quota from Division IIIa to the North Sea reduced the validity of the 2011 forecasts, which assumed no transfer.

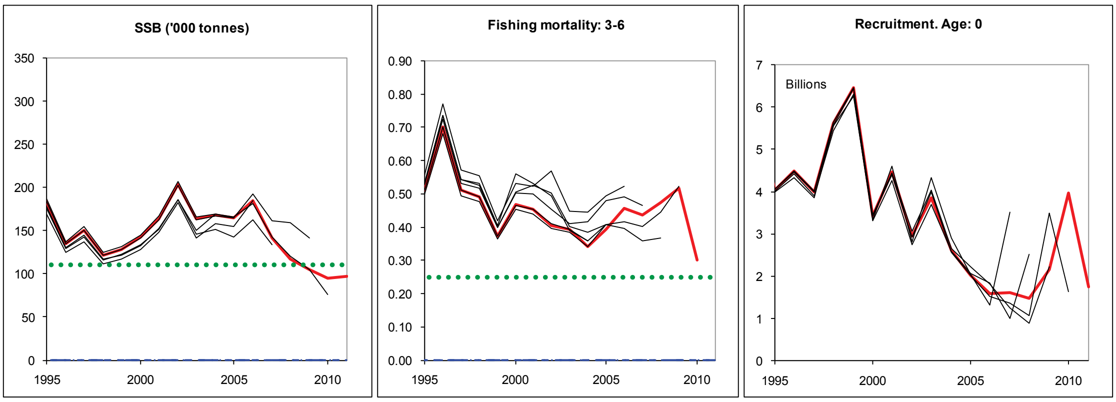


Figure 6.4.15.2 Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). Historical assessment results (final year predicted SSB and recruitment as a 5 year GM included).

Scientific basis

Assessment type	Age-based analytical assessment (FLICA).
Input data	2 acoustic and 1 larval survey indices (HERAS, GerAS (BIAS), N20). Catch statistics + Corrections for historical area misreporting. Otolith microstructure and morphometric methods to calculate the proportion of NSAS in the catches.
Discards and bycatch	Discards not included in the assessment and considered low.
Indicators	None.
Other information	The last benchmark took place in 2008.
Working group report	HAWG

ECOREGION North Sea
STOCK Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners)

Reference points

	Type	Value	Technical basis
MSY approach	MSY $B_{trigger}$	110 000 t	Based on management plan development and the lowest observed SSB in the 2008 assessment
	F_{MSY}	0.25	Management plan evaluations (ICES, 2008)
Precautionary approach	B_{lim}	-	Not defined
	B_{pa}	-	Not defined
	F_{lim}	-	Not defined
	F_{pa}	-	Not defined

Unchanged since 2010.

Since this stock has always been fished at fishing mortality rates considerably higher than F_{MSY}, the MSY $B_{trigger}$ of 110 000 t (based on the lowest SSB in the assessment conducted in 2008) is likely to underestimate the true lower limit of SSB when the stock is fished at F_{MSY}.

Yield and spawning stock biomass per recruit F-reference points (2011):

	Fish Mort Ages 3–6	Yield/R	SSB/R
Average last 3 years	0.43	0.03	0.05
F_{max}	0.73	0.03	0.03
$F_{0.1}$	0.24	0.03	0.09
F_{med}	0.47	0.03	0.05

Outlook for 2012

Basis (for Western Baltic spring-spawning herring, WBSS): F(2011) =0.19 [catch constraint]; R10-12 = GM(2005–2009) = 1754 million; SSB(2011) = 97; catch (2011) = 29 [a].
Catches are for all herring in Division IIIa and Subdivisions 22–24, see further in Section 6.4.16 on North Sea autumn-spawning herring (NSAS).

Rationale	Catch options and results for WBSS herring only: Division IIIa, Subdivisions 22–24 and IVaE [1]									
	Catch 2012	Basis	F 2012	22–24	IIIa		IVaE	SSB 2012 [3]	SSB 2013 [3]	% SSB change [4]
				Fleet F	Fleet C	Fleet D	Fleet A [2]			
MSY framework	42.7	F_{msy}	0.25	20.9	19.6	1.4	0.8	123	137	11%
Zero catch	0	F = 0	0	0	0	0	0	126	174.8	39%
Status quo	37.1	F_{sq}*0.5	0.21	18.2	17.0	1.2	0.8	123	142	15%
	43.6	F_{sq}*0.59	0.26	21.4	20.0	1.4	0.8	123	136	11%
	50.2	F_{sq}*0.7	0.30	24.7	23.0	1.7	0.8	122	130	7%

Rationale	Catch options for WBSS and NSAS herring in: Division IIIa and Subdivisions 22–24 [1]				
	Catch 2012	22–24	IIIa		% TAC change [5]
		Fleet F	Fleet C	Fleet D	
MSY framework	50.7	20.9	26.4	3.4	-3%
Zero catch	0	0	0	0	-100%
Status quo	44.0	18.2	22.9	2.9	-15%
	51.8	21.4	27.0	3.4	-1%
	59.7	24.7	31.1	3.9	15%

Weights in ‘000 t.

[a] Assuming a utilization in 2012 of the WBSS part of the TAC/bycatch ceiling of 100% (F-fleet), 100% (C-fleet), and 45% (D-fleet).

[1] The ratio of herring catches between different fleets and areas in 2012 is based on a fifty-fifty allocation of fishing opportunities between Division IIIa and Subdivisions 22–24 as communicated by the EC, and the ratio between the different herring stocks in Division IIIa is based on the 2008–2010 catch proportions. The later proportions cannot be predicted and may therefore deviate significantly from the assumed ratio.

[2] As in 2010 a catch of 800 t of WBSS herring taken in the transfer area in Division IVa East is assumed. The amount of this catch is highly variable since it is dependent on the geographical distribution of the stock components in Division IVa East.

[3] For spring-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries between 1st January and spawning time.

[4] SSB (2013) relative to SSB (2012).

[5] Catches (2012) relative to TAC 2011 (SD 22–24 + IIIa + IIIa bycatch ceiling = 15.9 kt + 30 kt + 6.7 kt = 52.5 kt).

To derive the total herring catch for Division IIIa (right hand side of the table), predicted catches of NSAS (as advised in Section 6.4.16) have to be added to the advised maximum catches of WBSS in the area. The total catch by fleet is only compatible with the advice for WBSS if the values given for NSAS are treated as maximum catches. Thus the resulting catch options were also used as constraints for catch options for the NSAS herring (Section 6.4.16). Note that the right hand side of the table is for illustrative purposes only and is not part of the ICES advice; the ratio of TACs between areas is not fixed and there are several options for TACs compatible with the removal of WBSS advised by ICES.

Explanation on fleet coding:

Area	Fleet	Description
North Sea	A	Directed herring fisheries with purse-seiners and trawlers. Bycatches in industrial fisheries by Norway are included.
	B	Bycatches of herring taken under EU regulations.
Division IIIa	C	Directed herring fisheries with purse-seiners and trawlers.
	D	Bycatches of herring caught in the small-mesh fisheries.
Subdivisions 22–24	F	All herring fisheries in Subdivisions 22–24.

MSY approach

Following the ICES MSY framework implies a fishing mortality F_{MSY} of 0.25. There is no need to reduce F as SSB_{2012} is estimated to be above MSY $B_{trigger}$. This results in catches of no more than 42 700 t in 2012 from the whole distribution area. This is expected to lead to an SSB of above 137 000 t in 2013.

Precautionary approach

No PA reference points have been set for this stock. It is therefore not possible to give advice based on these.

Additional considerations

Recruitment of Western Baltic herring decreased from 2004 to 2008, but the two latest year classes are estimated to be more abundant. Management measures have reduced F in 2010, and F is expected to remain below the target F_{MSY} with the agreed 2011 quota. However, the poor year-classes are now negatively influencing the SSB and there is no robust indicator of strong recruitment.

The stock is below the MSY $B_{trigger}$ in 2011, but with the present management measures, the SSB is expected to be above the MSY-$B_{trigger}$ in 2012. However, ICES notes that the present flexibility in taking a proportion of the Division IIIa TAC in the North Sea introduces significant uncertainties in the forecasts.

The advice forecast is based on the assumption that the 2012 TAC for Division IIIa will be caught in the area without transfer options. To protect mature adults, catches of Western Baltic herring in the North Sea should not be allowed to increase.

Management considerations

In 2011, management regulations allowed 50% of the TAC for Division IIIa to be caught in the North Sea. The forecast for 2012 for both WBSS and NSAS herring is based on the assumption that in 2011 the total amount of 50% of the TAC was actually transferred to the North Sea. The actual quantity may be less, and this adds to the uncertainty of the assessment. The forecasts for 2012 assumed that in 2012 there will be no transfer allowed. Other calculations could be made if such management measures are considered.

In 2009, national regulation and control initiatives stopped misreporting of catches taken in the North Sea into Division IIIa, which before 2009 amounted to more than 30% of reported Division IIIa catches. This resulted in a continued increase in fishing mortality in 2009 and a decrease in SSB. However, the reduction of the TAC in 2010 resulted in an important decline in landings and fishing mortality. SSB continued to decrease due to poor year-classes.

The quota for the C fleet and the bycatch quota for the D fleet (see above) are set for the NSAS and the WBSS stocks together. ICES recommends that the TAC setting for Division IIIa consider the requirements for MSY of Western Baltic spring spawners before those of North Sea autumn-spawning herring, because the WBSS is in a poorer state than the NSAS.

The apparent underutilization of the TAC in Subdivisions 22–24 is caused by a different interpretation of which area one particular square belongs to.

Information from the fishing industry

Area misreporting from the North Sea to the Skagerrak is no longer an issue for the Danish and the Swedish parts of the C-fleet.

The industry expects to utilize the 50% transfer of quotas from the mixed catches in the C-fleet in Division IIIa to the NSAS catches in the A-fleet in the North Sea in 2011.

Comparison with previous assessment and advice

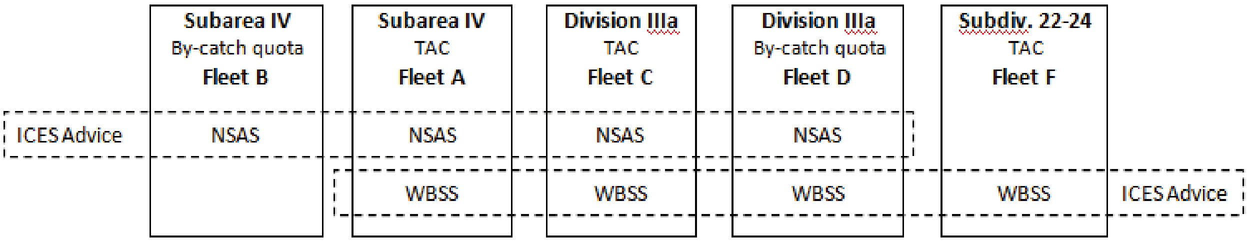
The update assessment this year shows a decline of 2% in the estimated fishing mortality in 2009 and no change for the SSB in 2009. There is, however, a 38% decline in recruitment in 2009, highlighting the uncertainty in the estimates of this parameter.

Last year’s advice was based on the transition scheme towards the ICES MSY framework and the estimate of the SSB in 2011 was below the candidate trigger of 110 000 t. This year´s advice is based on the target F_{MSY}=0.25, and the estimate of SSB in 2012 is above the trigger of 110 000 t.

Assessment and management area

Catch options for the whole stock of WBSS are partitioned into catches by area. In the mixing area in Division IIIa, catches of WBSS herring in Division IIIa also imply catches of North Sea autumn-spawning (NSAS) herring which constitute part of the total catch in that area.

ICES advises on catch options by fleet for the entire distribution of the two herring stocks separately. However, the stocks are managed by areas covering the geographical distribution of the stocks (see the following text diagram).



The calculation of the intermediate year (2011) catch and the catch options for 2012 are based on:

1. the 2008–2010 patterns of the proportion of the two stocks in catches of the different fleets; and
2. a fifty-fifty allocation of fishing opportunities between Division IIIa and Subdivisions 22–24 as communicated by the EC plus the 2010 catch of WBSS taken by the A-fleet in Division IVa East.

For the intermediate year ICES assumes the transfer of 50% of the Division IIIa quotas to be taken in the North Sea. Short-term predictions are based on an expected catch in 2011 of 29 000 t of the Western Baltic spring-spawning stock, including a catch of 800 t of WBSS in Division IVa East. To make catch options by fleet for 2012 it is assumed that each fleet will take its full share of the total TAC and that TACs are set proportional to the full TACs for 2011. The average proportions of WBSS in the 2008–2010 catches were 74% in the C-fleet, 42% in the D-fleet, and 100% in the F-fleet.

Additionally, it is assumed that a catch of 800 t of WBSS will be caught by the A-fleet in Division IVa East in 2011 and 2012. These catches of WBSS herring are taken in the North Sea under the North Sea TAC in the transfer area in Division IVa East during the Q2 and Q3 summer feeding period. It is likely that the 2012 TAC for NSAS will increase, therefore a larger proportion of WBSS may be taken outside the management areas. To protect mature adults, catches of WBSS herring in the North Sea should not be allowed to increase.

Sources

ICES. 2007. Report of the Herring Assessment Working Group for the Area South of 62°N, 13–22 March 2007. ICES CM 2007/ACFM:11.

ICES. 2008. Report of the Workshop on Herring Management Plans (WKHMP) 4–8 February, ICES Headquarters. ICES 2008/ACOM:27.

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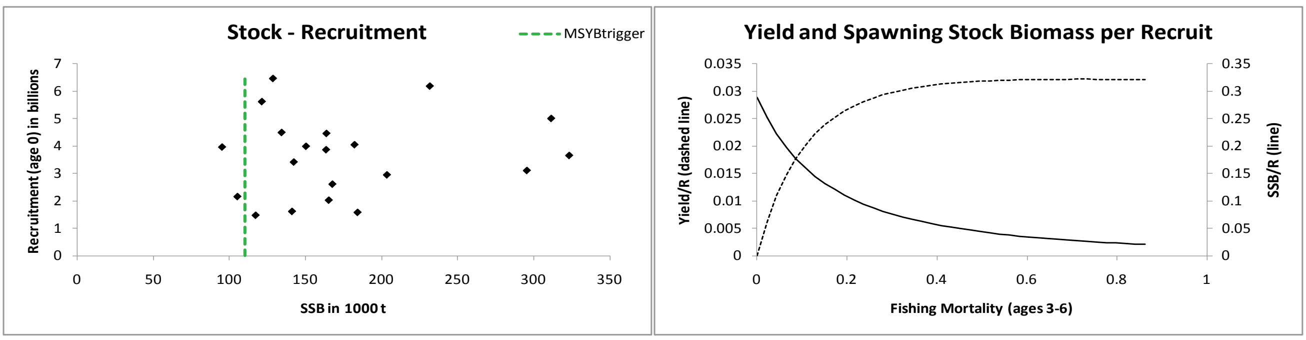


Figure 6.4.15.3 Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). Stock recruitment and Yield- and SSB-per-Recruit plot.

Table 6.4.15.1 Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). ICES advice, management, and catches.

Year	ICES Advice	Pred. catch corresp. to advice	Agreed TAC IIIa[2]	ICES catch of Stock			
				22–24	IIIa	IV	Total
1987	Reduction in F	224	218	102	59	14	175
1988	No increase in F	196	218	99	129	23	251
1989	TAC	174	218	95	71	20	186
1990	TAC	131	185	78	118	8	204
1991	TAC	180	155	70	112	10	192
1992	TAC	180	174	85	101	9	195
1993	Increased yield from reduction in F; reduction in juvenile catches	188	210	81	95	10	186
1994	TAC	130–180	191	66	92	14	172
1995	If required, TAC not exceeding recent catches	168–192	183	74	80	10	164
1996	If required, TAC not exceeding recent catches	164–171	163	58	71	1	130
1997	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	66–85[1]	100	68	55	1	124
1998	Should be managed in accordance with North Sea autumn spawners	-	97	51	53	8	112
1999	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-	99	50	43	5	98
2000	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60 for Subdivs. 22–24	101	54	57	7	118
2001	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Subdivs. 22–24	101	64	42	6	112
2002	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~50 for Subdivs. 22–24	101	53	47	7	107
2003	Reduce F	<80	101	40	36	2	78
2004	Separate management regime for this stock Reduce F	<92	91	42	24	7	77
2005	Separate management regime for this stock *Status quo* F	95	120	44	38	7	89
2006	Separate management regime for this stock *Status quo* F	95	102[3]/47.5*	42	36	11	89
2007	Separate management regime for this stock *Status quo* F	99	69[3]/49.5*	40	28	1	68
2008	Separate management regime for this stock Reduce F by 20% towards $F_{0.1}$	71	51.7[3]/45*	43	25	0	68
2009	Separate management regime for this stock Reduce F to F = 0.25	< 32.8	37.7[3]/27.2*	31	32	4	67
2010	Separate management regime for this stock Reduce F to F = 0.25	< 39.8	33.9[3]/22.7*	18	24	1	42
2011	MSY transition in 1–5 years and no increase in catches of WBSS herring in the North Sea	26.5 – 53.6	30[3]/15.8*				
2012	F_{MSY} = 0.25 and no increase in catches of WBSS herring in the North Sea	<42.7					

Weights in '000 t.
[1]Catch in Subdivisions 22–24.
[2]Including mixed clupeoid TAC and bycatch ceiling in small-mesh fishery.
[3] Human consumption in Division IIIa, not including industrial bycatch or mixed clupeoids, but including North Sea autumn spawner catch in fleet C.
* Separate TAC for Subdivisions 22–24.

Table 6.4.15.2 Herring in Subdivisions 22–24 and Division IIIa (spring and autumn spawners). Landings (‘000 t) by area and country.

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 [2]	1999 [2]
Skagerrak											
Denmark	47.4	62.3	58.7	64.7	87.8	44.9	43.7	28.7	14.3	10.3	10.1
Faroe Islands											
Germany											
Lithuania											
Norway	1.6	5.6	8.1	13.9	24.2	17.7	16.7	9.4	8.8	8.0	7.4
Sweden	47.9	56.5	54.7	88.0	56.4	66.4	48.5	32.7	32.9	46.9	36.4
Total	96.9	124.4	121.5	166.6	168.4	129.0	108.9	70.8	56.0	65.2	53.9
Kattegat											
Denmark	57.1	32.2	29.7	33.5	28.7	23.6	16.9	17.2	8.8	23.7	17.9
Sweden	37.9	45.2	36.7	26.4	16.7	15.4	30.8	27.0	18.0	29.9	14.6
Total	95.0	77.4	66.4	59.9	45.4	39.0	47.7	44.2	26.8	53.6	32.5
Sub. Div. 22+24											
Denmark	21.7	13.6	25.2	26.9	38.0	39.5	36.8	34.4	30.5	30.1	32.5
Germany	56.4	45.5	15.8	15.6	11.1	11.4	13.4	7.3	12.8	9.0	9.8
Poland	8.5	9.7	5.6	15.5	11.8	6.3	7.3	6.0	6.9	6.5	5.3
Sweden	6.3	8.1	19.3	22.3	16.2	7.4	15.8	9.0	14.5	4.3	2.6
Total	92.9	76.9	65.9	80.3	77.1	64.6	73.3	56.7	64.7	49.9	50.2
Sub. Div. 23											
Denmark	1.5	1.1	1.7	2.9	3.3	1.5	0.9	0.7	2.2	0.4	0.5
Sweden	0.1	0.1	2.3	1.7	0.7	0.3	0.2	0.3	0.1	0.3	0.1
Total	1.6	1.2	4.0	4.6	4.0	1.8	1.1	1.0	2.3	0.7	0.6
Grand Total	**286.4**	**279.9**	**257.8**	**311.4**	**294.9**	**234.4**	**231.0**	**172.7**	**149.8**	**169.4**	**137.2**

Year	2000	2001 [5]	2002 [4]	2003	2004	2005	2006 [1,3]	2007	2008	2009	2010 [1]
Skagerrak											
Denmark	16.0	16.2	26.0	15.5	11.8	14.8	5.2	3.6	3.9	12.7	5.3
Faroe Islands						0.4			0.0	0.6	0.4
Germany				0.7	0.5	0.8	0.6	0.5	1.6	0.3	0.1
Lithuania											0.4
Norway	9.7							3.5	4.0	3.3	3.3
Sweden	45.8	30.8	26.4	25.8	21.8	32.5	26.0	19.4	16.5	12.9	17.4
Total	71.5	47.0	52.3	42.0	34.1	48.5	31.8	26.9	26.0	29.7	27.0
Kattegat											
Denmark	18.9	18.8	18.6	16.0	7.6	11.1	8.6	9.2	7.0	4.9	7.6
Sweden	17.3	16.2	7.2	10.2	9.6	10.0	10.8	11.2	5.2	3.6	2.7
Germany										0.6	0.0
Total	36.2	35.0	25.9	26.2	17.2	21.1	19.4	20.3	12.2	9.1	10.3
Sub. Div. 22+24											
Denmark	32.6	28.3	13.1	6.1	7.3	5.3	1.4	2.8	3.1	2.1	0.8
Germany	9.3	11.4	22.4	18.8	18.5	21.0	22.9	24.6	**22.8**	16.0	12.2
Poland	6.6	9.3		4.4	5.5	6.3	5.5	2.9	5.5	5.2	1.8
Sweden	4.8	13.9	10.7	9.4	9.9	9.2	9.6	7.2	7.0	4.1	2.0
Total	53.3	62.9	46.2	38.7	41.2	41.8	39.4	37.6	38.5	27.4	16.8
Sub. Div. 23											
Denmark	0.9	0.6	4.6	2.3	0.1	1.8	1.8	2.9	5.3	2.8	0.1 [7]
Sweden	0.1	0.2		0.2	0.3	0.4	0.7		0.3	0.8	0.9
Total	1.0	0.8	4.6	2.6	0.4	2.2	2.5	2.9	5.7	3.6	1.0
Grand Total	**162.0**	**145.7**	**128.9**	**109.5**	**92.8**	**113.6**	**93.0**	**87.7**	**82.3**	**69.9**	**55.2**

[1] Preliminary data.
[2] Revised data for 1998 and 1999
Bold= German revised data for 2008 (in HAWG 2010)
[3] 2000 tonnes of Danish landings are missing, see text section 3.1.2 (HAWG 2007)
[4] The Danish national management regime for herring and sprat fishery in Subdivision 22 was changed in 2002
[5] The total landings in Skagerrak have been updated for 1995-2001 due to Norwegian misreportings into Skagerrak.
[7] Official reported catches: 3,103 tonnes, see text section 3.2.1

Table 6.4.15.3 Herring in Subdivisions 22–24 and Division IIIa (spring spawners). Summary of the assessment.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3–6
1991	5001715	311499	191573	0.3557
1992	3654685	323333	194411	0.4752
1993	3108187	295501	185010	0.5426
1994	6178461	231703	172438	0.6950
1995	4046433	182207	150831	0.5125
1996	4491298	134287	121266	0.7013
1997	3988814	150316	115588	0.5107
1998	5614285	121287	107032	0.4920
1999	6455978	128609	97240	0.3733
2000	3415970	142270	109914	0.4669
2001	4456945	163748	105803	0.4525
2002	2949392	203513	106191	0.4040
2003	3864124	163523	78309	0.3928
2004	2611938	167665	76815	0.3420
2005	2028331	165279	88406	0.3941
2006	1585196	184202	90549	0.4550
2007	1620155	141118	68997	0.4352
2008	1479130	117197	68484	0.4742
2009	2159680	105222	67262	0.5174
2010	3961260	95152	42214	0.3018
2011*	1754829	97452		
Average	3544134	172623	111917	0.4647

* Recruitment is Geometric Mean 2005–2009. SSB is predicted.

ECOREGION North Sea
STOCK Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)

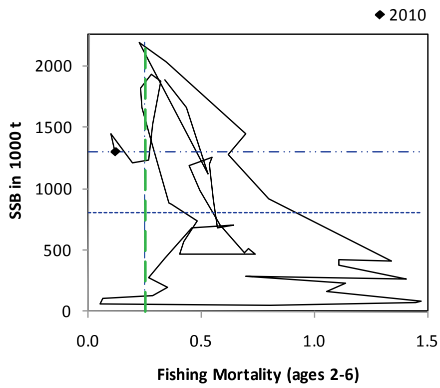
Advice for 2012

ICES advises on the basis of the agreed EU/Norway management plan that catches in 2012 should be no more than 248 000 t, including 230 000 t for the A-fleet.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	✓	✓	✓	Below target
Precautionary approach (F_{pa})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target
	SSB (Spawning Stock Biomass)*			
	2008	2009	2010	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	O	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	O	O	O	Between lower and upper trigger

* at spawning time in autumn.



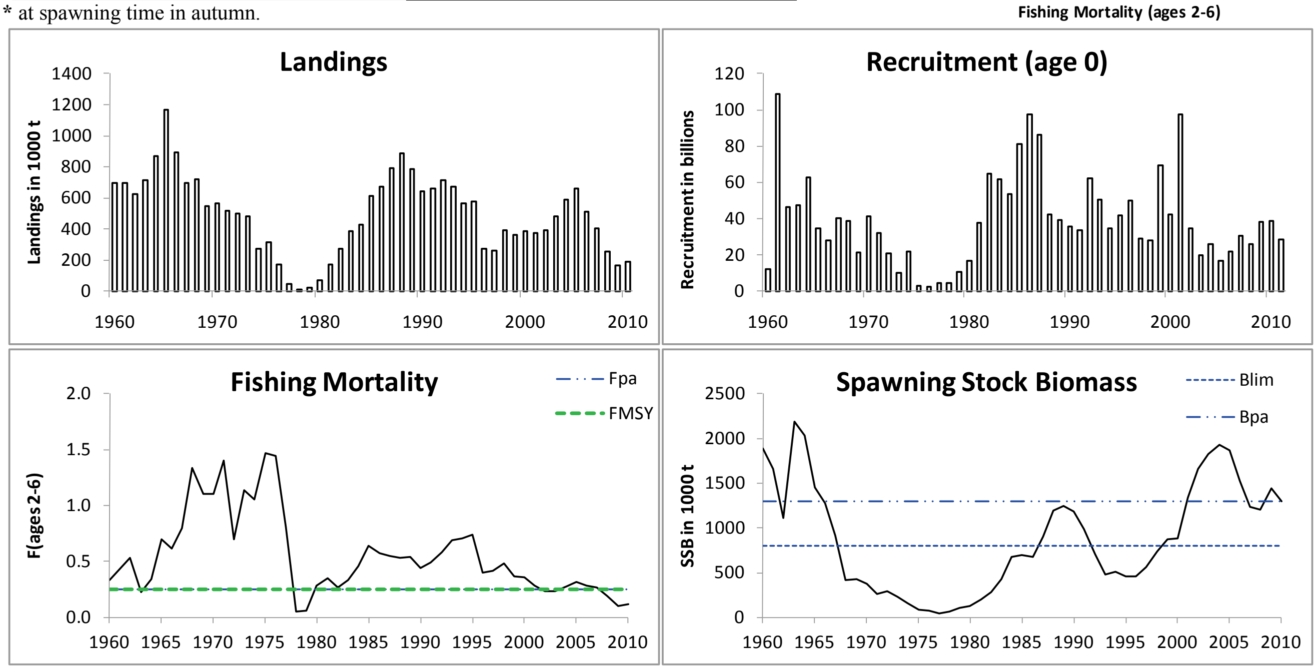


Figure 6.4.16.1 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Summary of stock assessment. Top right: SSB and F over the years.

ICES classifies the stock as being at full reproductive capacity and as being harvested sustainably and below management plan and F_{MSY} targets. The year classes from 2002 to 2007 are estimated to be among the weakest since the late 1970s. The year classes 2008 and 2009 are estimated to be above the long-term geometric mean, but ICES considers that the stock is still in a low productivity phase.

Management plans

A management plan was agreed by EU and Norway in 2008 (see Annex 6.4.16). ICES has evaluated this management plan and concluded that the plan is consistent with the precautionary approach and the MSY approach. The EU–Norway agreement calls for a review of the current plan no later than December 2011.

Biology

Herring is considered to have a major impact on other fish stocks as prey and predator and is itself prey for seabirds and marine mammals in the North Sea area. Herring spawning and nursery areas are sensitive and vulnerable to anthropogenic influences. Extraction of marine aggregates (such as gravel and sand) and other activity (e.g. construction) that have an impact on the sea bed may be expected to impact on herring spawning. Herring abandon and repopulate spawning grounds and an absence of spawning in any particular year does not mean that the spawning ground is not required to maintain a resilient herring population. The 2007 year class was unusually immature in 2010 (45% mature compared to the expected 75–85% mature). The reasons for this are unknown.

Environmental influence on the stock

North Sea herring has recently produced seven poor year-classes in a row (2002–2007), which has never before been observed when SSB was above 800 000 t. The survival of the larvae during this time has been poor (Payne *et al*., 2009). The productivity of the stock appears correlated to climatic forcing of the North Atlantic, via the NAO (North Atlantic Oscillation) and the AMO (Atlantic Multidecadal Oscillation) (Gröger *et al.,* 2010).

The fisheries

North Sea herring is caught for human consumption and as a bycatch of industrial fisheries. It is also caught in Division IIIa by both human consumption and industrial fisheries. In the eastern North Sea and Division IIIa it is caught mixed with western Baltic spring spawning herring. The fishery is seasonal, taking place mostly in the late spring and summer in the central and northern North Sea, and in the autumn and winter in the southern North Sea.

Catch by fleet	Total catch (2010): 165 kt directed NS fisheries fleet A; 9 kt bycatches fleet B; 12 kt directed IIIa fisheries fleet C; 2 kt bycatch IIIa fisheries fleet D.

Effects of the fisheries on the ecosystem

The human consumption fisheries for herring have little by-catch of other fish and cause almost no disturbance to the seabed. Evidence from observer programmes suggest that discarding of herring is not wide-spread and bycatch of sea mammals is low. Juvenile herring are caught as bycatch in the industrial fisheries.

Quality considerations

The fishing mortality is reliably estimated by the stock assessment. Fishing mortality is now well below the target set by the management plan. The estimation of SSB is currently less precise as a result of revisions to recruiting year-class estimates (year classes 2006, 2007, and 2008). This revises the numbers of fish in the stock upwards. These revisions are thought to be due to the relatively low F in the fishery on juveniles and the relative increase in the Downs component, reducing the precision of the estimates of recruitment from the surveys.

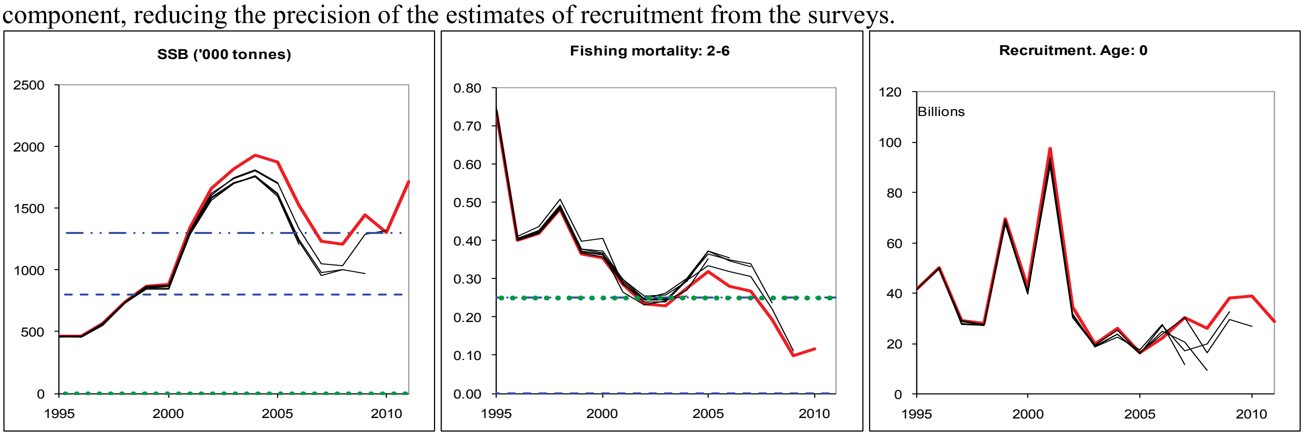


Figure 6.4.16.2 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical (FLICA).
Input data	Commercial catches and 4 survey indices (IBTS Q1 1–5+wr, IBTS0, MLAI, HERAS).
Discards and bycatch	Included in the assessment.
Indicators	None
Other information	The last benchmark for this stock occurred in 2006. A benchmark is scheduled for 2012.
Working group report	HAWG

ECOREGION North Sea

STOCK Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)

Reference points

	Type	Value	Technical basis
Management plan	F_{MP}	$F_{0\text{-}1} = 0.05$ $F_{2\text{–}6} = 0.25$	If SSB greater than SSB_{MP} upper trigger of 1.5 million t (based on simulations).
		$F_{0\text{-}1} = 0.05$ $F_{2\text{–}6} = 0.25 – (0.15*(1500000\text{-}SSB)/700000)$	If SSB between SSB_{MP} triggers 0.8 and 1.5 million t (based on simulations).
		$F_{0\text{-}1} = 0.04$ $F_{2\text{–}6} = 0.10$	If SSB less than SSB_{MP} lower trigger of 0.8 million t (based on simulations).
MSY Approach	MSY $B_{trigger}$	not defined	
	F_{MSY}	0.25	Simulations under different productivity regimes, research between 1996 and 2010.
Precautionary approach	B_{lim}	800 000 t	< 0.8 million t; poor recruitment has been experienced. Defined in 1997/2008.
	B_{pa}	1.3 million t	B trigger in the previous harvest control rule.
	F_{lim}	not defined	
	F_{pa}	$F_{2\text{-}6} = 0.25$	Target Fs in the harvest control rule.

(Unchanged since 2011, the provisional MSY $B_{trigger}$ proposed in 2010 by ICES is not repeated this year as the management rule with two trigger biomasses has primacy).

Yield and spawning stock biomass per Recruit F-reference points(2011):

	Fish Mort Ages 2–6	Yield/R	SSB/R
Average last 3 years	0.14	0.01	0.08
F_{max}	0.46	0.01	0.02
$F_{0.1}$	0.14	0.01	0.08
F_{med}	0.54	0.01	0.02

Outlook for 2012

Since the current management plan only stipulates overall fishing mortalities for juveniles and adults, making fleet-wise predictions for the four fleets that are more or less independent provides different options for 2012. The consequence of other combinations of catch options can be explored on request. Fleet definitions are given below the outlook table.

Catch forecasts and resulting total fishing mortality are presented below for five different scenarios of sharing the catch amongst fleets. The five scenarios presented are based on an interpretation of the harvest control rule as well as other options and are only illustrative of the wide ranges of possible scenarios:

i. No fishing;
ii. The EU–Norway management plan (which invokes the 15% limit on TAC change);
iii. A roll-over TAC from 2011 to 2012 of 200 000 t for the A-fleet;
iv. The EU–Norway Harvest Control Rule as implemented within the management plan (no restriction on TAC change); this is also the option for F_{MSY} and F_{pa};
v. A 15% decrease in the A-fleet TAC in 2012.

For the intermediate year, no overshoot for the A fleet was assumed, as the catches corresponded to the TAC in 2009 and 2010. However, an additional 15 000 t was included to account for the Division IIIa TAC transfer agreement.

For the B-fleet (small-meshed EU fleet in the North Sea) the same proportion of the uptake of the bycatch ceiling as observed in 2010 was used. For the C- and D-fleets the same fraction of the North Sea autumn spawners in the catch as last year was assumed.

Basis: Intermediate year (2011) with catch constraint for fleet A, and for fleet B assuming the same proportion of the bycatch ceiling that is taken in 2010. Recruitment = 28.7 billion.

F fleet A	F fleet B	F fleet C	F fleet D	F_{0-1}	F_{2-6}	Catch fleet A	Catch fleet B	Catch fleet C	Catch fleet D	SSB 2011
0.116	0.022	0.002	0.004	0.031	0.125	215.0[1]	11.0	3.9	1.7	1714

[1] Includes a transfer of 50% of the Norwegian quota in Division IIIa to the A-fleet and an additional 50% of the remaining Division IIIa TAC from the C-fleet to the A-fleet.

Scenarios for prediction year (2012)

	F-values by fleet and total						Catches by fleet				Biomass[1)]			
	FLEET A	FLEET B	FLEET C	FLEET D	F_{0-1}	F_{2-6}	FLEET A	FLEET B	FLEET C	FLEET D	**SSB 2012**	**SSB 2013** [4)]	**%SSB change** [2)]	**%TAC change fleet A** [3)]
i	0	0	0	0	0	0	0	0	0	0	2177	2602	27%	-100%
ii	0.107	0.034	0.004	0.006	0.046	0.120	230.0	17.9	6.8	1.9	2013	2166	17%	+15%
iii	0.092	0.034	0.004	0.006	0.046	0.106	200.0	17.9	6.8	1.9	2033	2215	19%	0%
iv	0.236	0.035	0.004	0.006	0.050	0.250	478.4	17.9	6.8	1.9	1845	1778	8%	+139%
v	0.078	0.034	0.004	0.006	0.045	0.091	170.0	17.9	6.8	1.9	2053	2265	20%	-15%

Weights in '000 t.
All numbers apply to North Sea autumn-spawning herring only.
1) For autumn-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries between 1st January and spawning.
2) SSB (2012) relative to SSB (2011).
3) Calculated landings (2012) relative to TAC 2011 for the A-fleet.
4) Assuming same F in 2013 as in 2012.

Fleet definitions:
Fleet A: Directed herring fisheries with purse-seiners and trawlers (32 mm minimum mesh size) in the North Sea. Bycatches in the Norwegian industrial fisheries are included.
Fleet B: Herring taken as bycatch in the small-mesh fisheries in the North Sea under EU regulations (mesh size less than 32 mm).
Fleet C: Directed herring fisheries in Skagerrak and Kattegat with purse-seiners and trawlers (32 mm minimum mesh size).
Fleet D: Bycatches of herring caught in the small-mesh fisheries (mesh size less than 32 mm) in Skagerrak and Kattegat.

Management plan

The agreed management plan (Annex 6.4.16) between EU and Norway has been evaluated (ICES, 2011b) and ICES concluded that the plan is consistent with the precautionary approach and the MSY approach. The management plan has primacy over the ICES MSY framework when providing advice.

Following the agreed management plan between EU and Norway implies imposing the maximum 15% increase in TAC which results in a TAC of 230 000 t for the A fleet in 2012 (Scenario ii), which would lead to an SSB of 2.0 million tonnes at spawning time in 2012.

MSY approach

As no MSY $B_{trigger}$ has been identified for this stock, the ICES MSY framework has been applied with F_{MSY} without consideration of SSB in relation to MSY $B_{trigger}$.

Following the ICES MSY framework implies raising the fishing mortality to 0.25, resulting in catch of less than 478 000 t in 2012 (Scenario iv). This is expected to lead to an SSB of more than 1.8 million tonnes in 2012.

Precautionary approach

The fishing mortality in 2012 should be no more than F_{pa}, corresponding to catches of less than 478 000 t in 2012 (Scenario iv). The SSB is expected to remain above B_{pa} in 2012.

Additional considerations

The stock is managed according to the EU–Norway management agreement which was updated in November 2008. In 2011 ICES re-examined the management plan and concluded that the management plan appears to operate well in relation to the objectives of consistency with the precautionary approach and a rational exploitation pattern.

The EU–Norway agreement calls for a review of the current plan no later than December 2011. With the current rate of increase in the stock size, the main unsatisfactory issue relative to achieving simultaneous stable and high yields appears to be the 15% inter annual variability limit on TAC change.

The current estimates of the 2008 and 2009 year classes are above the geometric mean of the time-series, and the year classes of 2007 and 2008 have been revised upwards. However, ICES still considers the stock to be in a low productivity phase as the survival ratio between newly hatched larvae and recruits is still much lower than prior to 2001. The management plan has proved to be an effective tool for maintaining sustainable exploitation and conserving the North Sea herring stock in this lower productivity regime.

The fishing mortality is reliably estimated by the stock assessment. Fishing mortality is now well below the target set by the management plan. The estimation of SSB is currently less precise as a result of revisions to recruiting year-class estimates (year classes 2006, 2007, and 2008). This revises the numbers of fish in the stock upwards. These revisions are thought to be due to a result of both the relatively low F in the fishery on juveniles and the relative increase in the Downs component, reducing the precision of the estimates of recruitment from the surveys.

The 2007 year class was unusually immature in 2010 (45% mature compared to the expected 75–85% mature). The reasons for this are unknown. Thus, the SSB in 2010 is smaller than anticipated if average maturity was assumed.

North Sea herring and Western Baltic spring-spawning herring are managed under mixed quotas in some areas of the North Sea, Skagerrak, and Kattegat. With the decline of the WBSS herring, conservation of this stock needs to be considered when setting TACs. With the mixing of stocks within a fishery, primary consideration should be given to protection of the stock most vulnerable to exploitation in the area of overlap. Hence ICES suggests that the TAC setting for Division IIIa should consider the requirements for MSY of Western Baltic spring spawners before those of North Sea autumn-spawning herring.

Catches in the transfer area in Division IVa East are generally assumed to be dominated by Western Baltic spring spawners. The current method of estimation (vertebral counts) is not considered robust.

The options selected for the C- and D-fleets of 3.9 and 1.7 thousand tonnes of North Sea autumn-spawning herring, respectively, for 2011 are compatible with the advised exploitation of Western Baltic spring spawners for the C- and D-fleets.

Downs herring

The sub-TAC for Divisions IVc and VIId was established for the conservation of the spawning aggregation of Downs herring. The Downs herring has returned to its pre-collapsed state and is now again a major component of the stock (Payne, 2010). It is probable that exploitation of Downs herring has been relatively high. In the absence of data to the contrary ICES proposes that a share of 11% of the total North Sea TAC (average share 1989–2002) would still be appropriate for Downs herring.

Information from the fishing industry

The fishing industry have commented that the stock is migrating further north, out of the North Sea in summer. If this is the case both the assumptions associated with the catch information and the acoustic survey would be compromised. ICES, at present, has no evidence to support these comments. The fishery reports that the fleets have been operating further west in recent years.

Changes in fishing patterns

Apart from a reduction in misreporting of catch, there have been no major changes to fishing patterns.

Changes in the ecosystem

There is still a low productivity regime although absolute recruitment has increased in 2008 and 2009. The survival ratio of recruits to newly hatched larvae is low. A large population of herring in the North Sea may repress cod recruitment (Spiers *et al*., 2010).

Data issues

The quality of the biomass estimates has been substantially affected by uncertainty in the estimation of recruitment. It is probably caused by the increasing Downs component, resulting in an underestimation of the IBTS-0 index. In addition, the low by-catches in the industrial fisheries do not provide clear information on year-class strength.

Estimation of stock identity of herring from the transfer area in Subdivision IVa East is still poor. This is likely to affect the quality of the western Baltic spring-spawning herring assessment. There have been no revisions of the data or the methods used.

Bycatch data from industrial fisheries are available from Norway and Denmark. Discard information is included in the Scottish catch and monitored in the Dutch, English, and German fisheries.

Comparison with previous assessment and advice

The present assessment is consistent with the assessment of 2010, although the strengths of the 2007 and 2008 year classes was previously underestimated. The updated assessment this year shows an increase in SSB of 12% for 2009 and a decrease in F of 9% for 2009.

The basis for the advice is the same as last year.

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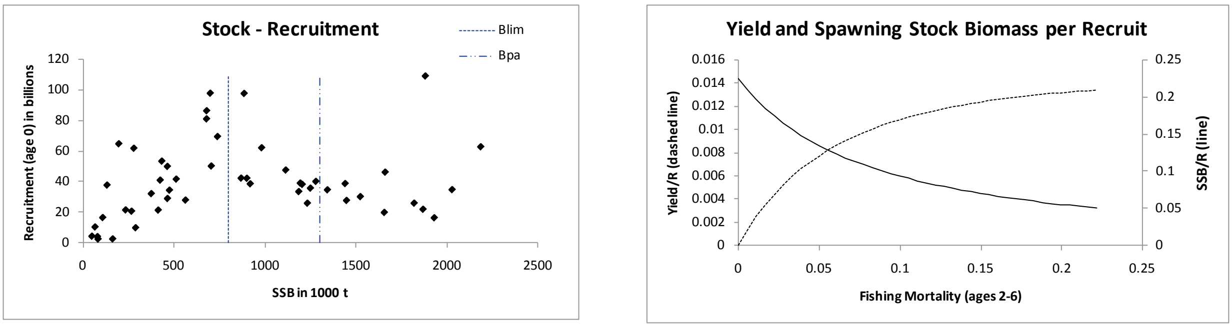


Figure 6.4.16.3 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Stock–recruitment plot and yield-per-recruit analysis.

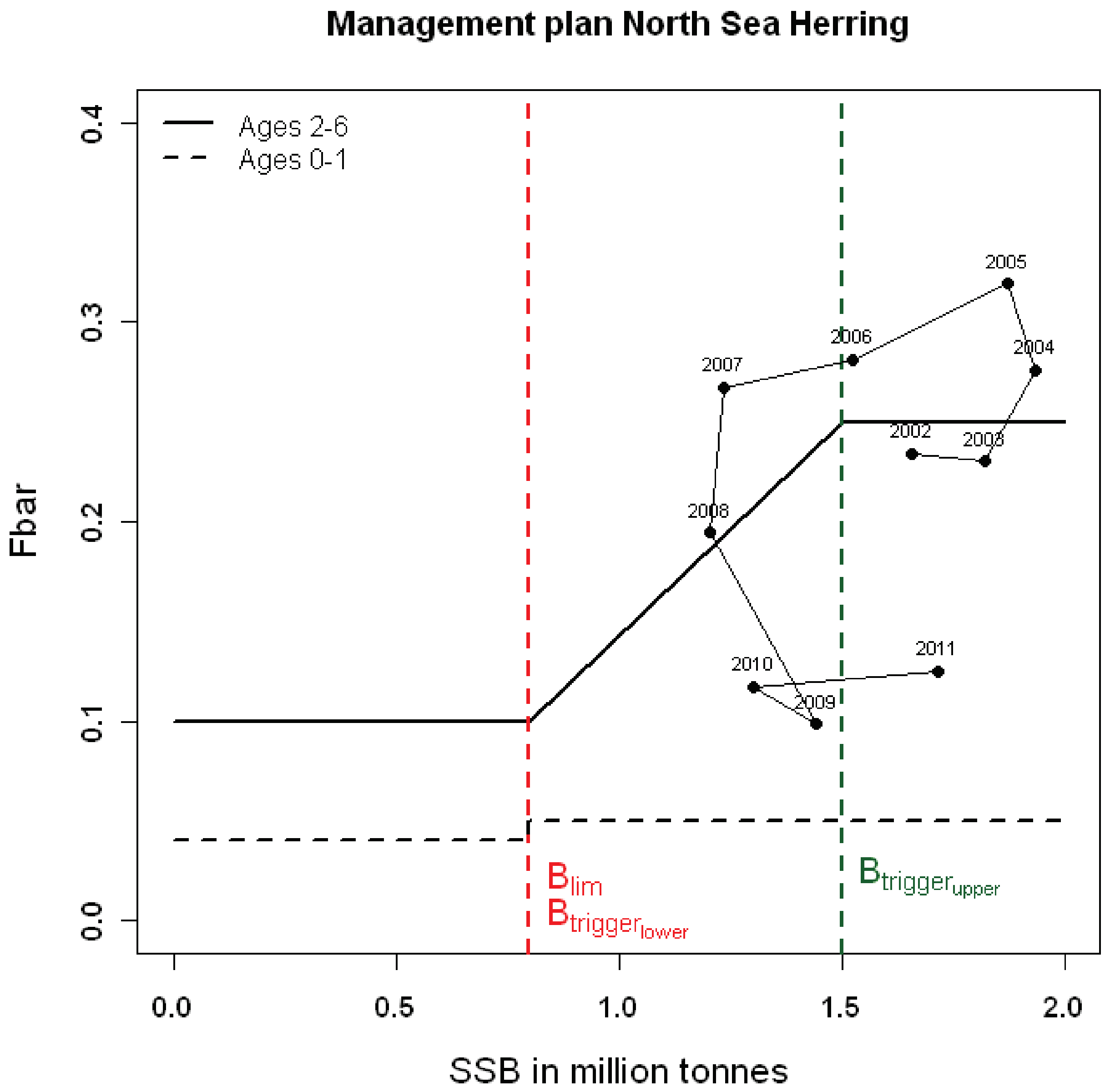


Figure 6.4.16.4 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Agreed management plan for adult fishery (A-fleet, ages 2-6) including trigger biomass points. Black dots represent realised estimated fishing mortalities from 2002 untill 2011. Fishing mortality in 2011 is estimated based on the agreed TACS for the A-fleet from the short-term prediction.

Table 6.4.16.1 Herring caught in the North Sea (Subarea IV and Division VIId). Single-stock exploitation boundaries (advice), management, and catch/landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Bycatch ceiling Fleet B	ICES Lndgs.[4] IV, VIId	ICES Catch[5] IV, VIId	ICES Catch Autumn spawners IIIa, IV, VIId
1987	TAC	610	600		625	625	792
1988	TAC	515	530		710	710	888
1989	TAC	514	514		669	717	787
1990	TAC	403	415		523	578	646
1991	TAC	423	420		537	588	657
1992	TAC	406	430		518	572	716
1993	No increase in yield at F > 0.3	340[1]	430		495	540	671
1994	No increase in yield at F > 0.3	346[1]	440		463	498	571
1995	Long-term gains expected at lower F	429[1]	440		510	516	579
1996	50% reduction of agreed TAC[2]	156[1]	156[3]	44	207	233	275
1997	F = 0.2	159[1]	159	24	175	238	264
1998	F(adult) = 0.2, F(juv)< 0.1	254[1]	254	22	268	338	392
1999	F(adult) = 0.2, F(juv)< 0.1	265[1]	265	30	290	333	363
2000	F(adult) = 0.2, F(juv)< 0.1	265[1]	265	36	284	346	388
2001	F(adult) = 0.2, F(juv)< 0.1	See scenarios	265	36	296	323	363
2002	F(adult) = 0.2, F(juv)< 0.1	See scenarios	265	36	304	353	372
2003	F(adult) = 0.25, F(juv)=0.12	See scenarios	400	52	414	450	480
2004	F(adult) = 0.25, F(juv)=0.1	See scenarios	460	38	484	550	567
2005	F(adult) = 0.25, F(juv)=0.1	See scenarios	535	50	568	639	664
2006	F(adult) = 0.25, F(juv)=0.12	See scenarios	455	43	490	511	515
2007	Bring SSB above B_{pa} by 2008	See scenarios	341	32	361	388	407
2008	F(adult) = 0.17, F(juv)=0.08 (MP)	See scenarios	201	19	228	245	258
2009	Adopt one of the new proposed HCRs	See scenarios	171	16	167	166	168
2010	F(adult) = 0.15, F(juv)=0.05 (MP)	See scenarios	164	14	175	175	188
2011	See scenarios	See scenarios	200	16			
2012	Management plan	See scenarios					

Weights in '000 t.
[1]Catch in directed fishery in Divisions IV and VIId.
[2]Revision of advice given in 1995.
[3]Revised in June 1996, down from 263.
[4] Landings are provided by the working group and do not in all cases correspond to official statistics.
[5]ICES catch includes unallocated and misreported landings, discards, and slipping.

Table 6.4.16.2 Herring caught in the North Sea (Subarea IV and Division VIId). Catch in tonnes by country, 2001–2010. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2001	2002	2003	2004	2005
Belgium	-	23	5	8	6
Denmark [6]	67096	70825	78606	99037	128380
Faroe Islands	1082	1413	627	402	738
France	24880	25422	31544	34521	38829
Germany	29779	27213	43953	41858	46555
Netherlands	51293	55257	81108	96162	81531
Norway [1]	75886	74974	112481	137638	156802
Poland	-	-	-	-	458
Sweden	3695	3418	4781	5692	13464
USSR/Russia	-	-	-	-	99
UK (England)	14582	13757	18639	20855	25311
UK (Scotland)	26719	30926	40292	45331	73227
UK (N.Ireland)	1018	944	2010	2656	2912
Unallocated landings	27362 [5]	31552 [5]	31875 [5]	48898 [5]	57788
Total landings	323392	335724	445921	533058	626101
Discards	-	17093	4125	17059	12824
Total catch	**323392**	**352817**	**450046**	**550117**	**638925**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	6449	6652	2821	7079	7039
Thames estuary [2]	107	60	84	62	74
Others [3]	1097	0	308	0	0
Norw. Spring Spawners [4]	7108	4069	979	452	417

Country	2006	2007	2008	2009	2010
Belgium	3	1	-	-	-
Denmark [6]	102322	84697	62864	46238	45869
Faroe Islands	1785	2891	2014	1803	3014
France	49475	24909	30347	18114	17745
Germany	40414	14893	8095	5368	7670
Netherlands	76315	66393	23122	24552	23872
Norway [1]	135361	100050	59321	50445	46816
Lithuania	-	-	-	-	90
Sweden	10529	15448	13840	5299	4395
Russia	-	-	-	-	-
UK (England)	22198	15993	11717	652	10770
UK (Scotland)	48428	35115	16021	14006	14373
UK (N.Ireland)	3531	638	331	-	-
Unallocated landings	18764	26641	17151	-726	0
Total landings	509125	387669	244823	165751	174614
Discards	1492	93	224	91	13
Total catch	**510617**	**387762**	**245047**	**165842**	**174627**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	10954	1070	124	3941	774
Thames estuary [2]	65	2	7	48	85
Others [3]	0	0	0	0	0
Norw. Spring Spawners [4]	626	685	2721	44560	56900

[1] Catches of Norwegian spring spawners removed (taken under a separate TAC).
[2] Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
[3] Caught in the whole North Sea, partly included in the catch figure for the Netherlands.
[4] These catches (including some local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.
[5] May include misreported catch from VIaN and discards.
[6] Including any by-catches in the industrial fishery.

Table 6.4.16.3 Herring caught in the North Sea. Catch in tonnes in Division IVa West. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2001	2002	2003	2004	2005
Denmark [1]	17770	26422	48358	48128	80990
Faroe Islands	192	-	95	-	
France	8164	10522	11237	10941	13474
Germany	17753	15189	25796	17559	22278
Netherlands	17503 [3]	18289	25045	43876	36619
Norway	11653	10836	34443	36119	66232
Poland	-	-	-	-	458
Sweden	1418	2397	2647	2178	8261
Russia	-	-	-	-	99
UK (England)	12283	10142	12030	13480	15523
UK (Scotland)	25105	30014	39970	43490	71941
UK (N. Ireland)	1018	944	2010	2656	2912
Unallocated landings	24725 [2]	14201 [2]	14115 [2]	28631 [2]	39324 [2]
Misreporting from VIa North					
Total Landings	137584	138956	215746	247058	358111
Discards		17093	4125	15794	10861
Total catch	**137584**	**156049**	**219871**	**262852**	**368972**

Country	2006	2007	2008	2009	2010
Denmark [1]	60462	45948	28426	16550	25092
Faroe Islands	580	1118	2	288	1110
France	18453	8570	13068	7067	6412
Germany	18605	4985	498	-	505
Netherlands	39209	42622	11634	11017	13593
Norway	38363	40279	40304	25926	38897
Lithuania	-	-	-	-	90
Sweden	4957	7658	7025	1435	2310
Russia	-	-	-	-	-
UK (England)	12031	11833	8355	578	7384
UK (Scotland)	47368	35115	14727	10249	13567
UK (N. Ireland)	3531	638	331	-	-
Unallocated landings	10981 [2]	22215	14952	-977	0
Misreporting from VIa North					
Total Landings	253048	220981	139322	72133	108960
Discards	1492	93	194	91	13
Total catch	**254540**	**221074**	**139516**	**72224**	**108973**

[1] Including any bycatches in the industrial fishery.
[2] May include misreported catch from VIaN and discards.
[3] Including 1057 t of local spring spawners.

Table 6.4.16.4 Herring caught in the North Sea. Catch in tonnes in Division IVa East. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	**2001**	**2002**	**2003**	**2004**	**2005**
Denmark [1]	18466	17846	7401	16278	5761
Faroe Islands	890	1365	359	-	738
France	-	-	-	-	-
Germany	-	81	54	888	-
Netherlands	-	-	-	-	-
Norway [2]	56904	63482	62306	100443	89925
Sweden	517	568	1529	1720	3510
Unallocated landings	0	3959	9988	0	0
Total landings	76777	87301	81637	119329	99934
Discards	-	-	-	-	-
Total catch	**76777**	**89303**	**83640**	**119329**	**99934**
Norw. Spring Spawners [4]	7108	4069	979	452	417

Country	**2006**	**2007**	**2008**	**2009**	**2010**
Denmark [1]	8614	2646	1587	499	-
Faroe Islands	975	577	400	700	719
France	-	-	-	-	-
Germany	34	-	-	-	-
Netherlands	-	263	-	-	-
Norway [2]	90065	54424	17474	6981	7362
UK (Scotland)	83	-	-	-	-
Sweden	2857	640	-	1735	1505
Unallocated landings	0	-96 [3]	0	0	0
Total landings	102628	58454	19461	9915	9586
Discards	-	-	-	-	-
Total catch	**102628**	**58454**	**19461**	**9915**	**9586**
Norw. Spring Spawners [4]	626	685	2721	44560	56900

[1] Including any bycatches in the industrial fishery.

[2] Catches of Norwegian spring-spawning herring removed (taken under a separate TAC).

[3] Negative unallocated catches due to misreporting into other areas.

[4] These catches (including some fjord-type spring spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.

Table 6.4.16.5 Herring caught in the North Sea. Catch in tonnes in Division IVb. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2001	2002	2003	2004	2005
Denmark 1	30277	26387	22574	33857	41423
Faroe Islands	-	48	173	402	-
France	7796	4214	7918	10592	10205
Germany	8340	7577	12116	13823	14381
Netherlands	24160	13154	19115	23649	10038
Norway	7329	656	15732	1076	645
Sweden	1760	453	605	1794	1694
UK (England)	814	317	2632	2864	3869
UK (Scotland)	1614	289	322	1841	1286
Unallocated landings 3	-22885	4052	-2401	8300	10233
Total landings	59205	57147	78786	98198	93774
Discards 2				1265	1963
Total catch	**59205**	**57147**	**78786**	**99463**	**95737**
Country	**2006**	**2007**	**2008**	**2009**	**2010**
Denmark 1	32277	35990	32230	29164	19671
Faroe Islands	200	1196	1612	815	1185
France	17385	8421	9687	4316	2349
Germany	14222	2205	2415	1061	1994
Netherlands	13363	8550	904	3164	830
Norway	6933	5347	1543	17538	557
Sweden	2715	7150	6815	2129	580
UK (England)	4924	577	833	2	1577
UK (Scotland)	977	-	1293	3757	805
Unallocated landings 3	2364	-203	-904	-166	0
Total landings	95360	69233	56428	61780	29548
Discards 2			30		
Total catch	**95360**	**69233**	**56458**	**61780**	**29548**

[1] **Including any bycatches in the industrial fishery.**
[2] **Discards partly included in unallocated landings.**
[3] **Negative unallocated catches due to misreporting from other areas.**

Table 6.4.16.6 Herring caught in the North Sea. Catch in tonnes in Divisions IVc and VIId. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	**2001**	**2002**	**2003**	**2004**	**2005**
Belgium	-	23	5	8	6
Denmark	583	170	273	774	206
France	8750	10686	12389	12988	15150
Germany	3686	4366	5987	9588	9896
Netherlands	9630	23814	36948	28637	34874
UK (England)	1485	3298	3977	4511	5919
UK (Scotland)	-	623	-	-	-
Unallocated landings	25522 [3]	5336	8170	9963	8231
Total landings	49656	50318	67749	68473	74282
Discards [2]		-	-	-	-
Total catch	**49656**	**50318**	**67749**	**68473**	**74282**
Coastal spring spawners included above [1]	147 [4]	60	84	62	74

Country	**2006**	**2007**	**2008**	**2009**	**2010**
Belgium	3	1	-	-	-
Denmark	969	113	621	25	1106
Faroe Islands	30	-	-	-	-
France	13637	7918	7592	6731	8984
Germany	7553	7703	5182	4307	5171
Netherlands	23743	14958	10584	10371	9449
UK (England)	5243	3583	2529	72	1809
UK (Scotland)	-	-	1	-	1
Unallocated landings	5419	4725	3103	417	0
Total landings	56597	39001	29612	21923	26520
Discards [2]	-	-	-		
Total catch	**56597**	**39001**	**29612**	**21923**	**26520**
Coastal spring spawners included above [1]	65	2	7	48	85

[1] **Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).**
[2] **Discards partly included in unallocated landings.**
[3] **May include misreported catch and discards.**
[4] **Thames/Blackwater herring landings: 107 t, others included in the catch figure for the Netherlands.**

Table 6.4.16.7 Herring in Subarea IV and Divisions IIIa and VIId (autumn spawners). "The Wonderful table". Values in thousand tonnes.

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Sub-Area IV and Division VIId: TAC (IV and VIId)														
Recommended Divisions IVa, b	254	265	265	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	-	-
Recommended Divisions IVc, VIId	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	- [11]	-	-
Expected catch of spring spawners														
Agreed Divisions IVa,b [1]	229	240	240	240	223	340.5	393.9	460.7	404.7	303.5	174.6	147.4	149.0	173.5
Agreed Div. IVc, VIId	25	25	25	25	42.7	59.5	66.1	74.3	50.0	37.5	26.7	23.6	15.3	26.5
Bycatch ceiling in the small mesh fishery	22	30	36	36	36	52.0	38.0	50.0	42.5	31.9	18.8	16.0	13.6	16.5
CATCH (IV and VIId)														
National landings Divisions IVa,b [2]	245	261	261	272	261	354.5	427.7	502.3	439.2	326.8	201.2	145.0	148.1	
Unallocated landings Divisions IVa,b	44	22	35	2	24	23.7	36.9	49.6	13.3	21.9	14.0	-1.1	0.0	
Discard/slipping Divisions IVa,b [3]	-	-	-	-	17	4.1	17.1	12.8	1.5	0.1	0.2	0.1	0.0	
Total catch Divisions IVa,b [4]	289	283	296	273	303	382.3	481.6	564.6	454.0	348.8	215.4	143.9	148.1	
National landings Divisions IVc, VIId [3]	23	29	23	24	43	59.5	56.5	66.1	51.2	34.3	26.5	21.5	26.5	
Unallocated landings Divisions IVc,VIId	27	22	27	26	7	8.2	12.0	8.2	5.4	4.7	3.1	0.4	0	
Discard/slipping Divisions IVc, VIId [3]	-	-	-	-	0	-	-	-	-	-	-	-	-	
Total catch Divisions IVc, VIId	49	50	50	50	50	67.7	68.5	74.3	56.6	39.0	29.6	21.9	26.5	
Total catch IV and VIId as used by ICES [4]	**338**	**333**	**346**	**323**	**353**	**450.0**	**550.1**	**638.9**	**510.62**	**387.8**	**245.0**	**165.8**	**174.6**	
CATCH BY FLEET/STOCK (IV and VIId) [7]														
North Sea autumn spawners directed fisheries (Fleet A)	316	313	322	296	323	434.9	529.5	610.0	487.1	379.6	236.3	152.1	164.8	
North Sea autumn spawners industrial (Fleet B)	14	15	18	20	22	12.3	13.6	21.8	11.9	7.1	8.6	9.8	9.1	
North Sea autumn spawners in IV and VIId total	**330**	**329**	**339**	**317**	**346**	**447.2**	**543.0**	**631.9**	**499.0**	**386.7**	**244.9**	**161.9**	**173.9**	
Baltic-IIIa-type spring spawners in IV	8	5	7	6	7	2.8	7.1	7.0	11.0	1.1	0.1	3.9	0.8	
Coastal-type spring spawners	0.1	0.1	0.1	1.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	
Norw. Spring Spawners caught under a separate quota in IV [14]	29	32	26	7	4	1.0	0.5	0.4	0.6	0.7	2.7	44.6	56.9	
Division IIIa: TAC (IIIa)														
Predicted catch of autumn spawners	58	43	53	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	
Recommended spring spawners	- [12]	- [12]	- [12]	- [12]	- [12]	- [12]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	
Recommended mixed clupeoids	-	-	-	-	-	-	-	-	-	-	-	-	-	
Agreed herring TAC	80	80	80	80	80	80.0	70.0	96.0	81.6	69.4	51.7	37.7	33.9	30.0
Agreed mixed clupeoid TAC														
Bycatch ceiling in the small mesh fishery	17	19	21	21	21	21.0	21.0	24.2	20.5	15.4	11.5	8.4	7.5	6.7
CATCH (IIIa)														
National landings	120	86	108	90	79	76.0	61.1	90.8	88.9	47.3	38.2	38.8	37.3	
Catch as used by ICES	108	79	99	82	73	68.1	52.7	69.6	51.2	47.4	38.2	38.8	37.3	
CATCH BY FLEET/STOCK (IIIa) [7]														
Autumn spawners human consumption (Fleet C)	59	28	36	34	17	24.1	13.4	22.9	11.6	16.4	9.2	5.1	12.0	
Autumn spawners mixed clupeoid (Fleet D) [13]	6	8	13	12	9	8.4	10.8	9.0	3.4	3.4	3.7	1.5	1.8	
Autumn spawners other industrial landings (Fleet E)														
Autumn spawners in IIIa total	**61**	**34**	**49**	**46**	**26**	**32.5**	**24.2**	**31.9**	**15.0**	**19.8**	**12.9**	**6.5**	**13.8**	
Spring spawners human consumption (Fleet C)	40	40	45	33	38	31.6	16.8	32.5	30.2	25.3	23.0	29.4	23.0	
Spring spawners mixed clupeoid (Fleet D) [13]	3	3	5	3	9	4.0	11.2	5.1	5.9	2.3	2.2	2.9	0.5	
Spring spawners other industrial landings (Fleet E)														
Spring spawners in IIIa total	**43**	**43**	**50**	**36**	**47**	**35.6**	**28.0**	**37.6**	**36.1**	**27.6**	**25.2**	**32.3**	**23.5**	
North Sea autumn spawners Total as used by ICES	**392**	**363**	**388**	**363**	**372**	**479.7**	**567.2**	**663.8**	**514.6**	**406.5**	**257.9**	**168.4**	**187.6**	

1 IVa,b and EC zone of IIa. 2 Provided by Working Group members. 3 Incomplete, only some countries providing discard information. 4 Includes spring spawners not included in assessment. 5 Based on F=0.3 in directed fishery only; TAC advised for IVc, VIId subtracted. 6 130-180 for spring spawners in all areas. 7 Based on sum-of-products (number x mean weight at age). 8 Status quo F catch for fleet A. 9 The catch should not exceed recent catch levels. 10 During the middle of 1996 revised to 50% of its original agreed TAC. 11 Included in IVa,b. 12 Managed in accordance with autumn spawners. 13 Fleet D and E are merged from 1999 onwards. 14 These catches (including local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area. 15 See catch option tables for different fleets.

Table 6.4.16.8 Herring in Subarea IV, Divisions IIIa and VIId (autumn spawners). Summary of the assessment.

	Recruits* (millions)	TSB (tonnes)	SSB** (tonnes)	Landing (tonnes)	F2-6	F0-1
1960	12092	3747903	1884122	696200	0.337	0.141
1961	108850	4364354	1662930	696700	0.432	0.074
1962	46272	4397754	1115220	627800	0.529	0.047
1963	47658	4628953	2189201	716000	0.226	0.069
1964	62787	4797400	2031515	871200	0.343	0.161
1965	34895	4344785	1450013	1168800	0.695	0.127
1966	27859	3316825	1281010	895500	0.619	0.103
1967	40256	2814536	919752	695500	0.798	0.162
1968	38699	2521305	412840	717800	1.336	0.168
1969	21582	1905139	423877	546700	1.105	0.169
1970	41073	1921888	374629	563100	1.105	0.152
1971	32308	1849446	266051	520100	1.405	0.318
1972	20861	1549562	288353	497500	0.696	0.318
1973	10102	1156018	233410	484000	1.135	0.36
1974	21700	912051	162051	275100	1.052	0.263
1975	2826	680402	81658	312800	1.472	0.423
1976	2722	358662	77952	174800	1.444	0.198
1977	4329	210504	47622	46000	0.803	0.198
1978	4596	224925	64889	11000	0.053	0.123
1979	10603	382131	107141	25100	0.064	0.125
1980	16720	630494	131011	70764	0.284	0.12
1981	37864	1158667	195611	174879	0.352	0.384
1982	64755	1843295	278530	275079	0.264	0.28
1983	61830	2719425	432633	387202	0.338	0.326
1984	53461	2865147	679075	428631	0.455	0.216
1985	80940	3463006	699476	613780	0.644	0.234
1986	97653	3473722	679590	671488	0.572	0.189
1987	86232	3938023	901038	792058	0.552	0.267
1988	42292	3622901	1195264	887686	0.537	0.352
1989	39184	3312158	1251149	787899	0.544	0.28
1990	35867	2978465	1186874	645229	0.442	0.256
1991	33636	2716907	982498	658008	0.489	0.213
1992	62152	2438080	705132	716799	0.581	0.342
1993	50270	2520045	474742	671397	0.69	0.399
1994	34560	2026875	512077	568234	0.707	0.236
1995	41739	1846118	463304	579371	0.739	0.307
1996	50017	1629136	463868	275098	0.402	0.164
1997	29137	1957688	563131	264313	0.419	0.034
1998	28103	2086762	739391	391628	0.483	0.086
1999	69450	2371556	869482	363163	0.366	0.042
2000	42390	2929463	886094	388157	0.355	0.06
2001	97487	3364925	1344693	374065	0.285	0.048
2002	34766	4166329	1658085	394709	0.234	0.036
2003	20060	3913739	1822444	482281	0.23	0.056
2004	26095	3635587	1933120	587698	0.276	0.045
2005	16577	3171867	1871370	663813	0.319	0.116
2006	22114	2621499	1526159	514597	0.281	0.061
2007	30340	2392366	1234365	406482	0.267	0.058
2008	26079	2394029	1206034	257870	0.195	0.042
2009	38290	2610448	1442422	168443	0.099	0.021
2010	38849	2859555	1301092	187611	0.118	0.025
2011	28718	3213354***	1714498***			
2012	27088$					

* age 1 – 0wr.
** value at spawning time.
*** predicted.
$ geometric mean (year classes 2001–2009).

Annex 6.4.16 Agreed Management Plan for North Sea herring

According to the EU–Norway agreement (November 2008):

The Parties agreed to continue to implement the management system for North Sea herring, which entered into force on 1 January 1998 and which is consistent with a precautionary approach and designed to ensure a rational exploitation pattern and provide for stable and high yields. This system consists of the following

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 800,000 tonnes (Blim).*
2. *Where the SSB is estimated to be above 1.5 million tonnes the Parties agree to set quotas for the directed fishery and for bycatches in other fisheries, reflecting a fishing mortality rate of no more than 0.25 for 2 ringers and older and no more than 0.05 for 0 - 1 ringers.*
3. *Where the SSB is estimated to be below 1.5 million tonnes but above 800,000 tonnes, the Parties agree to set quotas for the direct fishery and for bycatches in other fisheries, reflecting a fishing mortality rate on 2 ringers and older equal to:*

    0.25-(0.15(1,500,000-SSB)/700,000) for 2 ringers and older,*
    and no more than 0.05 for 0 - 1 ringers

4. *Where the SSB is estimated to be below 800,000 tonnes the Parties agree to set quotas for the directed fishery and for bycatches in other fisheries, reflecting a fishing mortality rate of less than 0.1 for 2 ringers and older and of less than 0.04 for 0-1 ringers.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15 % from the TAC of the preceding year the parties shall fix a TAC that is no more than 15 % greater or 15 % less than the TAC of the preceding year.*
6. *Notwithstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15 % compared to the TAC of the preceding year.*
7. *Bycatches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted.*
8. *The allocation of the TAC for the directed fishery for herring shall be 29 % to Norway and 71 % to the Community. The bycatch quota for herring shall be allocated to the Community.*
9. *A review of this arrangement shall take place no later than 31 December 2011.*
10. *This arrangement enters into force on 1 January 2009.*

ECOREGION **North Sea – Baltic**
STOCK **Sprat in Division IIIa (Skagerrak – Kattegat)**

Advice for 2012

ICES advises on the basis of precautionary considerations that catches should be reduced.

Stock status

	F (Fishing Mortality)	
	2008 - 2010	
Qualitative evaluation	?	Insufficient information

	SSB (Spawning Stock Biomass)	
	2008 – 2010	
Qualitative evaluation	?	Insufficient information

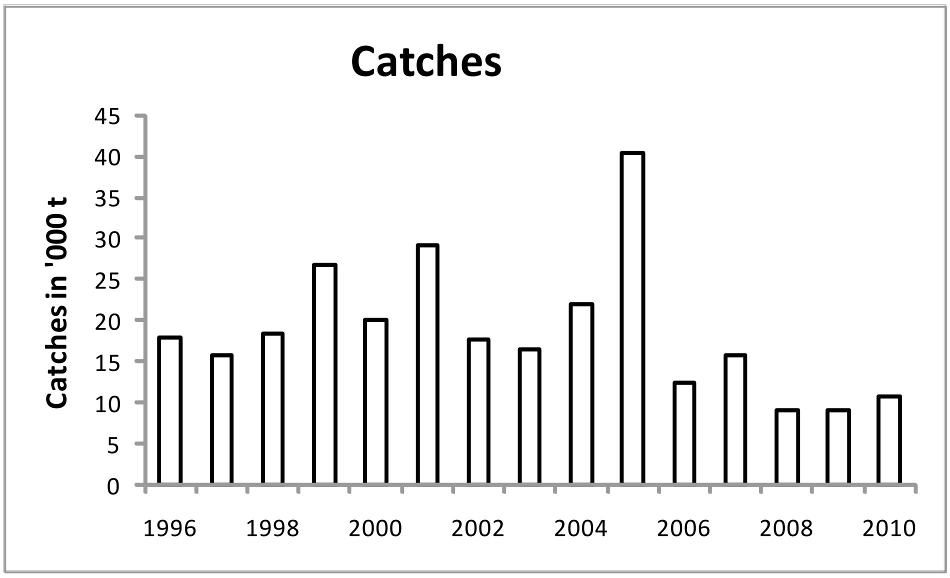


Figure 6.4.17.1 Sprat in Division IIIa (Skagerrak – Kattegat). ICES estimates of catches (in '000 tonnes).

The available information is inadequate to evaluate stock status. The available survey results are not reliable indicators of sprat abundance in Division IIIa

Management plans

No specific management objectives are known to ICES.

Biology

Sprat is short-lived with large annual natural fluctuations in recruitment and stock size.

Environmental influence on the stock

No information of the ecosystem and the accompanying considerations are known at present. Sprat is one of the important prey species in the ecosystem, as prey for both fish and seabirds.

The fisheries

Sprat in Division IIIa is mainly fished together with juvenile herring and the exploitation of sprat is limited by the restrictions imposed on fisheries for juvenile herring. Sprat cannot be fished without bycatches of herring except in years with high sprat abundance or low herring recruitment. With the current management regime, the sprat fishery is managed by bycatch ceilings of herring as well as bycatch percentage limits and quota restriction on sprat.

Effects of the fisheries on the ecosystem

The sprat fishery in Division IIIa is mainly performed by small meshed net (16 mm mesh). Fisheries with small meshed net will catch a relatively high amount of small and juvenile fish.

Quality considerations

The sampling intensity for biological samples of commercial catches is regarded as adequate. An accurate abundance index is currently not available.

Scientific basis

Assessment type	No assessment
Input data	3 survey indices (IBTS-Q1&3, HERAS) Commercial landings
Discards and by-catch	None
Indicators	None
Other information	A benchmark for this stock is suggested for 2013
Working group report	HAWG

ECOREGION North Sea – Baltic
STOCK Sprat in Division IIIa (Skagerrak – Kattegat)

Reference points

No reference points are defined for this stock.

Outlook for 2012

The available survey results are not reliable indicators of sprat abundance in Division IIIa. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information is inadequate to evaluate stock strends and exploitation status. Therefore, catches should be reduced.

Additional considerations

Data exploration

The IBTS and the catch data series were explored in order to find out whether they could provide some information about the exploitation level of the sprat stock. The 1st quarter IBTS index for 1-year-olds appears to have rather similar pattern with the annual catch numbers of 1-year-olds, and a regression analysis suggests a relatively high correlation between these two time series. The correspondence of the total IBTS index for all age classes and total annual catch biomass is much poorer, and the correlation coefficient is low. The working group suggest further exploring the possible utility of these data.

There is a problem with the quality of the maturity staging and age reading of sprat in the acoustic survey. Therefore, no reliable abundance index can be provided on this basis.

Comparison with previous assessment and catch options

Like last year, there is no basis for an assessment.

No advice was given last year. This year, ICES gives advice for this stock based on precautionary considerations.

Sources

ICES. 2011a. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 16–24 March 2011, ICES Headquarters, Copenhagen, Denmark. ICES CM 2011/ACOM:06.

ICES 2011b. Report of the Working Group for International Pelagic Surveys (WGIPS), 17-21 January 2011, Bergen, Norway. ICES CM 2011/SSGESST:02.

Table 6.4.17.1 Sprat in Division IIIa (Skagerrak – Kattegat). ICES advice, management and catches and landings.

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC[1]	Official landings[2]	ICES catch
1987	-	-	80	68	14
1988	TAC for "mixed clupeoid" fishery	80[1]	80	63	9
1989	Lowest possible level; TAC for "mixed clupeoid" fishery	80[1]	80	62	10
1990	Lowest possible level; TAC for "mixed clupeoid" fishery	60[1]	65	43	10
1991	Lowest possible level; Zero TAC for "mixed clupeoid" fishery	-	50	44	14
1992	No advice for sprat; Zero TAC for "mixed clupeoid" fishery	-	50	40	11
1993	No advice for sprat	-	45	36	9
1994	Separate sprat TAC based on recent catches	10–14	43	67	96
1995	Separate sprat TAC based on recent catches	9–14	43	45	56
1996	No advice	-	43	28	18
1997	Reduce by-catch of herring	-	40	19	16
1998	Limited by restriction on juvenile herring catches	-	40	26	18
1999	Limited by restriction on juvenile herring catches	-	50	35	27
2000	Limited by restriction on juvenile herring catches	-	50	28	20
2001	Limited by restriction on juvenile herring catches	-	50	34	29
2002	Limited by restriction on juvenile herring catches	-	50	31	18
2003	Limited by restriction on juvenile herring catches	-	50	33	17
2004	Limited by restriction on juvenile herring catches	-	50	32	20
2005	Limited by restriction on juvenile herring catches	-	50	48	40
2006	Limited by restriction on juvenile herring catches	-	52	23	13
2007	Limited by restriction on juvenile herring catches	-	52	21	16
2008	Limited by restriction on juvenile herring catches	-	52	12	9
2009	Same advice as last year	-	52	n.a	9
2010	Same advice as last year	-	52	n.a	11
2011	No advice [3]	-	52		
2012	Reduce catches [3]	-			

Weights in '000 t.
[1] TAC applies to all species in "mixed clupeoid" catches.
[2] Includes other species in "mixed clupeoid" catches.
[3] Limited by restriction on juvenile herring catches

Table 6.4.17.2 Sprat in Division IIIa (Skagerrak – Kattegat). Landings in (000't) by country, as estimated by ICES.

	Skagerrak				Kattegat			Div. IIIa total
	Denmark	Sweden	Norway	Total	Denmark	Sweden	**Total**	
1996	7.0	3.5	1.0	11.5	3.4	3.1	6.5	18.0
1997	7.0	3.1	0.4	10.5	4.6	0.7	5.3	15.8
1998	3.9	5.2	1.0	10.1	7.3	1.0	8.3	18.4
1999	6.8	6.4	0.2	13.4	10.4	2.9	13.3	26.7
2000	5.1	4.3	0.9	10.3	7.7	2.1	9.8	20.1
2001	5.2	4.5	1.4	11.2	14.9	3.0	18.0	29.1
2002	3.5	2.8	*	6.3	9.9	1.4	11.4	17.7
2003	2.3	2.4	0.8	5.6	7.9	3.1	10.9	16.5
2004	6.2	4.5	1.1	11.8	8.2	2.0	10.2	22.0
2005	12.1	5.7	0.7	18.5	19.8	2.1	21.8	40.3
2006	1.2	2.8	0.3	4.3	6.6	1.6	8.2	12.5
2007	1.4	2.8	1.6	5.9	8.5	1.3	9.8	15.7
2008	0.3	1.5	0.9	2.6	5.6	0.9	6.5	9.1
2009	1.1	1.4	0.7	3.2	5.8	0.2	6.0	9.2
2010	3.4	1.2	0.9	5.4	5.0	0.2	5.3	10.7

* < 50 t

ECOREGION North Sea
STOCK Sprat in Subarea IV (North Sea)

Advice for 2011 (in year advice) and 2012

ICES advises on the basis of precautionary considerations that catches should be reduced in 2011 and 2012.

Stock status

F (Fishing Mortality)		
	2008 - 2010	
Qualitative evaluation	?	Insufficient information

SSB (Spawning Stock Biomass)		
	2008 - 2010	
Qualitative evaluation	?	Insufficient information

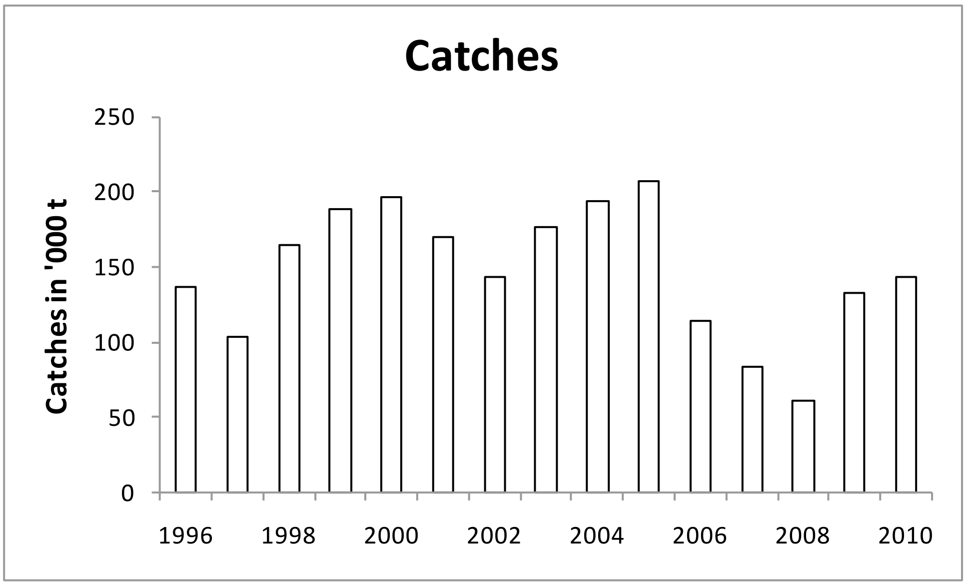


Figure 6.4.18.1 Sprat in Subarea IV (North Sea). ICES estimates of catches (in '000 tonnes).

The available information is inadequate to evaluate stock status and therefore the state of the stock is unknown. In the past, in-year assessments were done for this stock. In the absence of an analytical assessment, no in-year information for 2011 is available.

Management plans

No specific management objectives are known to ICES.

Biology

Sprat in the North Sea is short-lived and the catch is dominated by young fish. The stock size is mostly driven by the recruiting year class. Thus, the fishery in a given year is dependent on that year's incoming year class.

Environmental influence on the stock

The zooplankton community structure that is sustaining the sprat stocks appears to be changing, and there has been a long-term decrease in total zooplankton abundance in the northern North Sea (Reid *et al.*, 2003; Beaugrand, 2003; ICES, 2006a). The implications of the environmental change for sprat are unknown.

The fisheries

The majority of the sprat landings are taken in the Danish industrial small-meshed trawl fishery. The Norwegian sprat fishery is mainly carried out by purse seiners. Landings are used for reduction for fish meal and fish oil. In the last decade, also the UK occasionally lands small amounts of sprat. To avoid misreporting Norwegian vessels are not allowed to fish in the Norwegian zone until the quota in the EU-zone has been taken. These vessels are not allowed to fish in the 2nd quarter and July in the EU and the Norwegian zone.

Effects of the fisheries on the ecosystem

Sprat is an important prey species in the North Sea ecosystem. The effects of the sprat fishery on other fish species, marine mammals and seabirds are at present unknown.

Quality considerations

An accurate abundance index is currently not available. The sampling intensity in Subarea IV is regarded as too low, particularly in Division IVc where the majority of the fisheries takes place.

Scientific basis

Assessment type	There is currently no analytical assessment for this stock.
Input data	3 survey indices (IBTS Q1&3, HERAS) Commercial landings
Discards and bycatch	Bycatches from the Danish sprat fishery (Table 8.2.1)
Indicators	None
Other information	The benchmark meeting in 2009 did not manage to present a suitable assessment method.
Working group report	HAWG

ECOREGION North Sea
STOCK Sprat in Subarea IV (North Sea)

Reference points

No reference points are defined for this stock.

Outlook for 2011 and 2012

No reliable assessment can be presented for this stock. The main cause of this is a lack of quality input data: survey data are too variable or short. Due to large but unknown bycatches of juvenile North Sea herring in the industrial sprat fisheries prior to 1996, sprat landings are only considered reliable from 1996 onwards. The sprat fishery is considered opportunistic (and thus influenced by external factors such as abundance and price of other species), and therefore landings probably do not reflect the stock status. This makes quality assured (in-year) ICES advice impossible at present. The available survey results and catch statistics are not reliable indicators of sprat abundance in Subarea IV. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information is inadequate to evaluate stock strends and exploitation status. Therefore, catches in 2011 and 2012 should be reduced.

Additional considerations

Data exploration

The time series indices of the IBTS Q1 and Q3 surveys was recalculated following the method described in ICES 2009. The acoustic survey (HERAS) abundance estimates by statistical rectangle was extrapolated to cover unsampled rectangles, and subsequently averaged over the whole area to provide a HERAS index.

Even though the survey indices are highly variable and dominated by few large hauls; visual inspection of the time series did indicate some correlation between the three independent data sources. However this correlation was not significant at a 0.05 level. Further analysis of the survey data may increase the signal-to-noise ratio.

This year, the bottom trawl survey (IBTS) and the catch data series were explored to determine whether they could provide some information about the exploitation level of the sprat stock. The IBTS-Q1 index for 1-year-olds appears to have rather similar pattern with the annual catch numbers of 1-year-olds. The correspondence of the total IBTS index for all age classes and total annual catch biomass is much poorer, and the correlation coefficient is low.

Comparison with previous assessment and catch options

No advice was given last year. In the past, in-year assessments were done for this stock. In the absence of analytical assessments, this year ICES advises on the basis of precautionary considerations for both 2011 and 2012.

Sources

Beaugrand, G. 2003. Long-term changes in copepod abundance and diversity in the north-east Atlantic in relation to fluctuations in the hydroclimatic environment. Fisheries Oceanography, 12: 270 283.

ICES. 2006a. Report of the Study Group on Recruitment Variability in North Sea Planktivorous Fish (SGRECVAP). ICES CM 2006/LRC:03. 82 pp.

ICES. 2006b. Report of the Herring Assessment Working Group South of 620 N (HAWG), 14 -23 March, ICES Headquarters. ICES CM 2006/ACFM:20. 647 pp.

ICES. 2008. Report of the Herring Assessment Working Group South of 62 N (HAWG), 11- 19 March 2008, ICES Headquarters, Copenhagen. ICES CM 2008/ACOM:02. 601 pp.

ICES. 2011. Report of the Herring Assessment Working Group for the Area South of 62n (HAWG), 16– 24 March 2011, ICES Headquarters, Copenhagen, Denmark. ICES CM 2011/ACOM:06.

Reid, P. C., Edwards, M., Beaugrand, G., Skogen, M., and Stevens, D. 2003. Periodic changes in the zooplankton of the North Sea during the twentieth century linked to oceanic inflow. Fisheries Oceanography, 12: 260–269.

Table 6.4.18.1 Sprat in Subarea IV (North Sea). ICES advice, management and catch.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Catches	ICES Catch
1987	Catch at lowest practical level	0	57	78	32
1988	TAC < recent catches, preferably zero	0	57	93	87
1989	No advice	-	59	50	63
1990	No advice	-	59	49	73
1991	No advice	-	55	92	112
1992	No advice	-	55	72	124
1993	No advice	-	114	127	200
1994	No advice for sprat; maintain bycatch regulations	-	114	184	320
1995	No advice	-	175	190	357
1996	No advice	-	200	141	136
1997	Enforce by-catch regulations	-	150	123	103
1998	Limited by restrictions on juvenile herring	-	150	175	163
1999	Limited by restrictions on juvenile herring	-	225	167	188
2000	Limited by restrictions on juvenile herring	-	225	208	196
2001	Catch prediction	225	225	180	170
2002	Catch prediction	160	232	167	144
2003	Catch prediction	175	257		177
2004	Catch prediction	171	257		194
2005	Catch prediction	244	257		206
2006	Catch predictions	< 250	175		114
2007	Catch prediction	< 195	175		84
2008	Catch prediction	< 170	170		61
2009	No advice	-	170		133
2010	No advice	-	170		143
2011	Reduce catches	-	170[2]		
2012	Reduce catches				

Weights in ‘000 t.
[1] EU zone.
[2] Provisional.

Table 6.4.18.2 Sprat in Subarea IV (North Sea) Catches ('000 t). See ICES 2006b. for earlier catch data. Catch in fjords of western Norway excluded. (ICES estimates except where indicated). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes. The IVb catches for 2000–2007 divided by IVbW and IVE can be found in ICES 2008.

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
		Division IVa													
Denmark	0.3			0.7		0.1	1.1		*		*	0.8	*	*	
Norway														*	
Sweden						0.1									
Total	0.3			0.7		0.2	1.1		*		*	0.8	*	*	
		Division Ivb													
Denmark	76.5	93.1	119.3	160.3	162.9	143.9	126.1	152.9	175.9	204.0	79.5	55.5	51.4	115.6	80.8
Norway	52.8	3.1	15.3	13.1	0.9	5.9	*		0.1		0.8	3.7	1.3	4.0	8.0
Sweden	0.5		1.7	2.1		1.4				*				0.3	0.6
UK(Engl.&Wales)														*	
UK(Scotland)				1.4								0.1		2.5	1.1
Total	129.8	96.2	136.3	176.9	163.8	151.2	126.1	152.9	176.0	204.1	80.3	59.3	52.7	122.4	90.4
		Division IVc													
Denmark	3.9	5.7	11.8	3.3	28.2	13.1	14.8	22.3	16.8	2.0	23.8	20.6	8.1	8.2	48.5
Netherlands				0.2											
Norway		0.1	16.0	5.7	1.8	3.6					9.0	2.9		1.8	3.2
Sweden														0.6	0.6
UK(Engl.&Wales)	2.6	1.4	0.2	1.6	2.0	2.0	1.6	1.3	1.5	1.6	0.5	0.3	*	*	0.8
UK(Scotland)													0.2		
Total	6.5	7.2	28.0	10.8	32.0	18.7	16.4	23.6	18.3	3.6	33.4	23.8	8.4	10.6	53.0
		Total North Sea													
Denmark	80.7	98.8	131.1	164.3	191.1	157.1	142.0	175.2	192.7	206.0	103.4	76.8	59.6	123.8	129.3
Netherlands				0.2											
Norway	52.8	3.2	31.3	18.8	2.7	9.5	*		0.1		9.8	6.7	1.3	5.8	11.1
Sweden	0.5		1.7	2.1		1.5				*				0.9	1.2
UK(Engl.&Wales)	2.6	1.4	0.2	1.6	2.0	2.0	1.6	1.3	1.5	1.6	0.5	0.3	*	*	0.8
UK(Scotland)				1.4								0.1	0.2	2.5	1.1
Total	136.6	103.4	164.3	188.4	195.9	170.2	143.6	176.5	194.3	207.7	113.7	83.8	61.1	133.1	143.5

* < 50 t

ECOREGION North Sea
STOCK Horse mackerel (*Trachurus trachurus*) in Divisions IIIa, IVb,c, and VIId (North Sea stock)

Advice for 2012

ICES advises on the basis of the precautionary considerations to reduce catch.

Stock status

F (Fishing Mortality)		
	2008–2010	
Qualitative evaluation	?	**Insufficient information**

SSB (Spawning-stock Biomass)		
	2008–2010	
Qualitative evaluation	?	**Insufficient information**

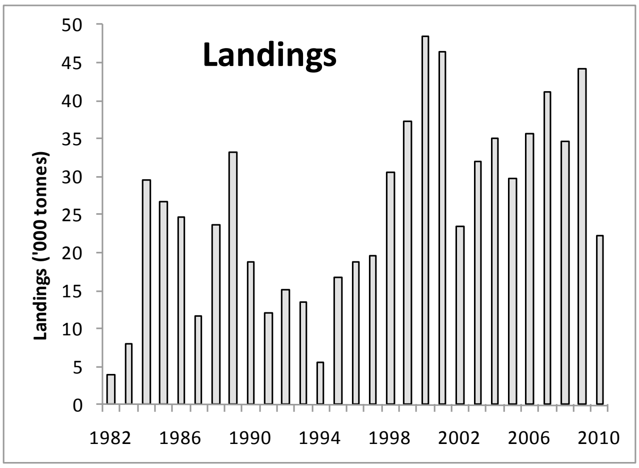


Figure 6.4.19.1 Horse mackerel in Divisions IIIa, IVa,b,c, and VIId (North Sea stock). Landings from Divisions IIIa, IVa, IVb,c, and VIId since 1982 (thousand tonnes).

The available information is insufficient to evaluate stock trends and exploitation status. Therefore, the state of the horse mackerel in the North Sea is unknown.

Management plans

No specific management objectives are known to ICES.

The fisheries

In previous years most of the catches from the North Sea stock were taken as bycatch in the small-mesh industrial fisheries in the fourth quarter carried out mainly in Divisions IVb and VIId. In recent years, a larger portion of catches has been taken in a directed horse mackerel fishery for human consumption.

Catch by fleet	Total catch (2010) = 22 255 tonnes (mainly trawl); discards are considered negligible.

Scientific basis

Assessment type	No assessment.
Input data	None.
Discards and bycatch	Discard data not included, but considered negligible.
Indicators	Only landings data are available.
Other information	None.
Working group report	WGWIDE

6.4.19 Supporting information September 2011

ECOREGION North Sea

STOCK Horse mackerel (*Trachurus trachurus*) in Divisions IIIa, IVb,c, and VIId (North Sea stock)

Reference points

No reference points are defined for this stock.

Outlook for 2012

No assessment can be presented for this stock. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

Since 1998 catches have been substantially higher than in the years prior to 1998, but the sustainability of these recent catches cannot currently be assessed. Given that the exploitation status is unknown and there is no reliable information on stock trends, the advice for 2012 is to reduce catch.

Additional considerations

During 1982–2010, annual catches varied between 4000 t (1982) and 48 000 t (2000). Catches before 1997 were lower than they have been in recent years. A catch curve analysis suggests increased total mortality rates in the late 1990s to the mid-2000s (Figure 6.4.19.2). The age composition of the catches from 1998 onwards shows a large number of age groups (1–15+) and several good year classes (Figure 6.4.19.3). However, the status of the stock cannot be accurately determined because the available data are inadequate to estimate either the current population size or the intensity of fishing.

Assessment and management area

Since 2010, the EU TAC for the North Sea area has included Divisions IVb,c and VIId. In the past, Division VIId was not considered in the North Sea TAC regulation area. The assessment area of North Sea horse mackerel also includes catches from Division IVa during the first two quarters of the year. The TAC for Division IVa is included in a different management area together with Divisions IIa, VIIa–c, VIIe–k, VIIIa, VIIIb, VIIId, VIIIe, Subarea VI, EU and international waters of Division Vb, and international waters of Subareas XII and XIV. There is no TAC for Division IIIa.

Comparison with previous assessment and advice

While the data and information on this stock has not changed markedly in recent years, the wording of the current advice is different than that given previously (except for 2010 where no advice was provided) to conform with the MSY framework for stocks with unknown stock trend and exploitation status (See Section 1.2. General context of ICES advice). However, in previous years, ICES advised that catches should not increase above the 1982–1997 average (<18 000 t). Maintaining catches less than 18 000 t implies a reduction in catches and as such this advice is consistent with that of previous years.

Source

ICES. 2011. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 23–29 August 2011. ICES CM 2011/ACOM:15.

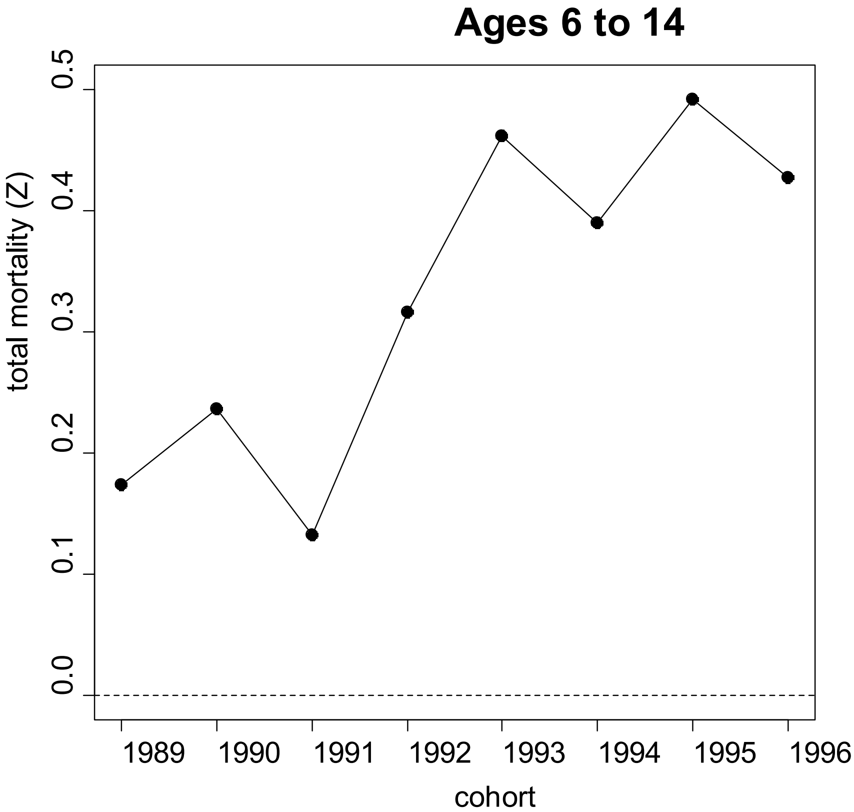


Figure 6.4.19.2 Horse mackerel in Divisions IIIa, IVa,b,c, and VIId (North Sea stock). Total mortality (Z) estimated from the 1989–1996 cohorts catch curves.

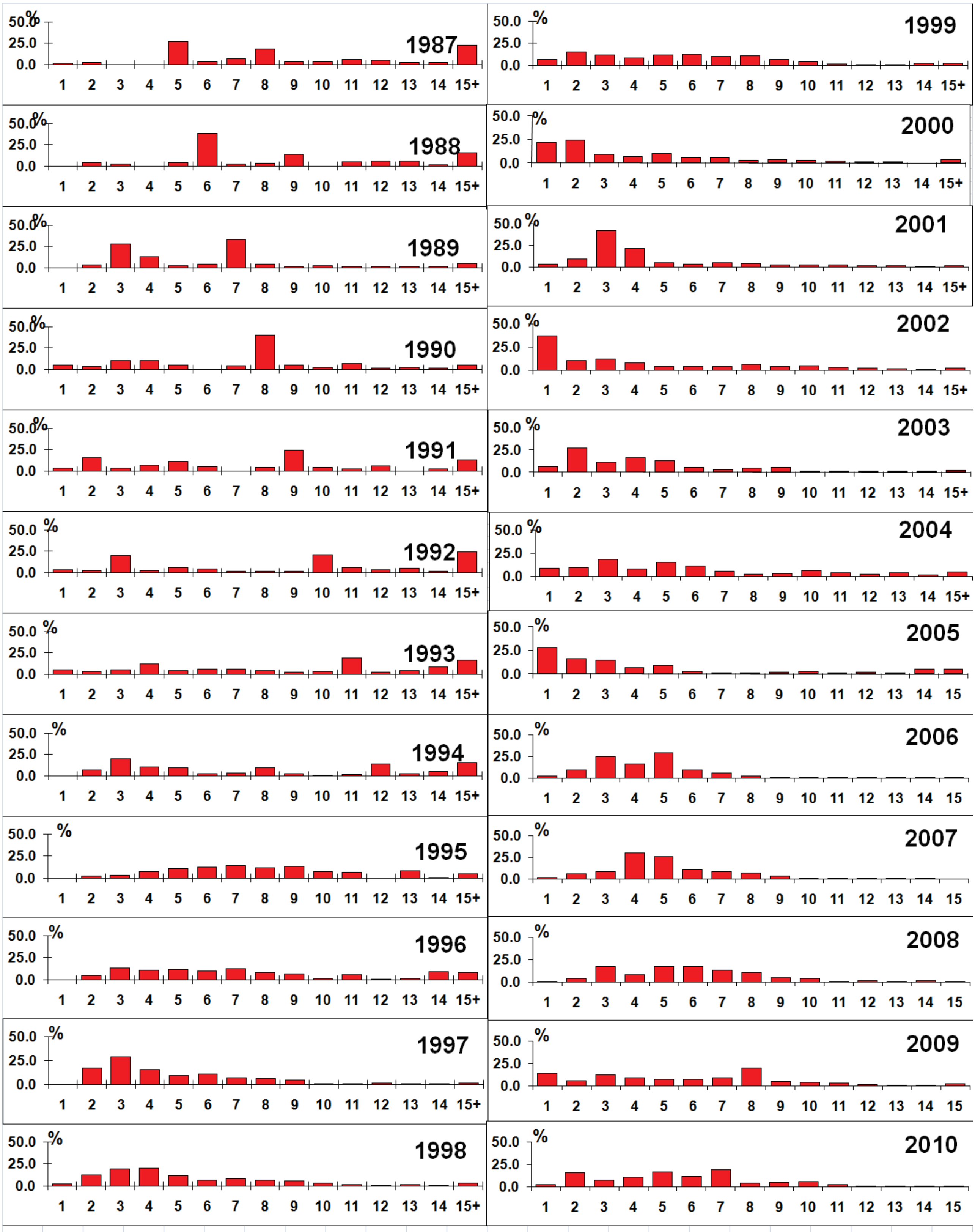


Figure 6.4.19.3 Horse mackerel in Divisions IIIa, IVa,b,c, and VIId (North Sea stock). Age distribution in the catches of North Sea horse mackerel 1987–2010.

Table 6.4.19.1 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed[4] TAC	ICES landings[2]
1987	Not assessed	-	30[1]	12
1988	No advice	-	50[1]	24
1989	No advice	-	45[1]	33
1990	No advice	-	40[1]	19
1991	No advice	-	45[1]	12
1992	No advice	-	55[1]	15
1993	No advice	-	60[1]	14
1994	No advice	-	60[1]	6
1995	No advice	-	60[1]	17
1996	No advice	-	60[1]	19
1997	No advice	-	60[1]	20
1998	Develop and implement management plan	-	60[1]	31
1999	Develop and implement management plan	-	60[1]	37
2000	Develop and implement management plan	-	51[1]	48
2001	No increase in catch	-	51[1]	46
2002	No increase in catch from 1982–1997 average	<18	58[1]	23
2003	No increase in catch from 1982–1997 average	<18	50[1]	32
2004	No increase in catch from 1982–1997	<18	42[1]	35
2005	No increase in catch from 1982–1997	<18	43[1]	29
2006	No increase in catch from 1982–1997	<18	43[1]	36
2007	No increase in catch from 1982–1997	<18	43[1]	41
2008	No increase in catch from 1982–1997	<18	39[1]	35
2009	Same advice as last year	< 18	39[1]	44
2010	Same advice as last year	< 18	47[3]	22
2011	No advice	-		
2012	Reduce catches	-		

Weights in '000 t.
[1]Division IIa and Subarea IV (EU waters only).
[2]Catch of North Sea stock (Divisions IVa (quarters 1–2), IIIa (except western part in quarters 3–4), IVb,c, and VIId).
[3]Divisions IVb,c and VIId.
[4] Applies to EU waters only.

Table 6.4.19.2 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Landings and discards (t) by Division.

Year	IIIa	IVa	IVb,c	Discards	VIId	**North Sea Stock**
1982	2788[1]		-		1247	4035
1983	4420[1]		-		3600	8020
1984	25893[1]		-		3585	29478
1985	-		22897		2715	26750
1986	-		19496		4756	24648
1987	1138		9477		1721	11634
1988	396		18290		3120	23671
1989	436		25830		6522	33265
1990	2261		17437		1325	18762
1991	913		11400		600	12000
1992			13955	400	688	15043
1993			3895	930	8792	13617
1994			2496	630	2503	5689
1995	112		7948	30	8666	16756
1996	1657		7558	212	9416	18843
1997			14078	10	5452	19540
1998	3693		10530	83	16194	30500
1999			9335		27889	37224
2000			25954		22471	48425
2001	85	69	8157		38114	46356
2002			12636	20	10723	23379
2003	48	623	10309		21098	32078
2004	351		18348		16455	35154
2005	357		13892	62	15460	29711
2006	1099	2661	7998	78	23790	35626
2007	63	2056	9118	139	29788	41164
2008	27	1003	2330		31389	34749
2009	38	72	18711	1036	24366	44223
2010	+	100	1965	2	20188	22255

[1]Divisions IIIa and IVb,c combined.

ECOREGION North Sea

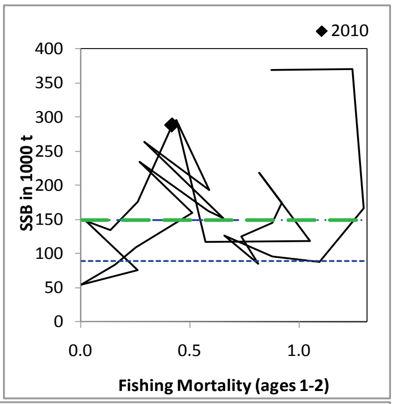
STOCK Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)

Advice for 2011

ICES advises on the basis of the MSY approach that landings in 2011 should be no more than 6000 t.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↗	↗	Below average
	SSB (Spawning-Stock Biomass)			
	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



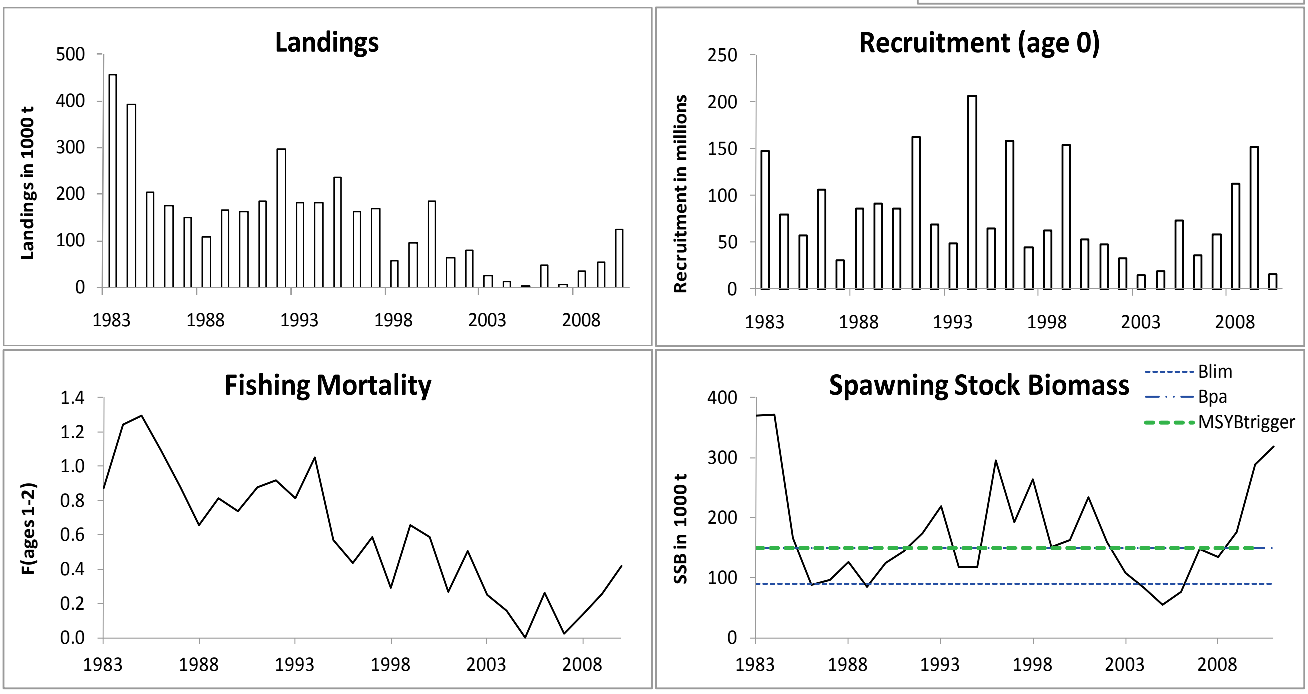


Figure 6.4.20.1 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Summary of stock assessment (weights in '000 tonnes). MSY $B_{trigger}$ should be read as MSY $B_{escapement}$. Top right: SSB and F over the years.

The stock size has increased since 2004 and is above MSY $B_{escapement}$. Recruitment was well above average in 2009, but very low in 2010. Fishing mortality has been lower than the natural mortality for this stock and has decreased in recent years to well below the long-term average F (0.6). The status of the stock is mainly determined by natural processes and recruitment.

Management plans

No specific management objectives are known to ICES for this stock. Due to the short-lived nature of this species a preliminary TAC is set every year, which is updated on the basis of advice in the first half of the year (using the escapement management strategy approach).

Biology

Norway pout is a short-lived species and most likely a one-time spawner. The population dynamics are very dependent on changes caused by variations in recruitment and in predation (or other natural) mortality, and less by the fishery. Recruitment is highly variable and influences spawning stock and total biomass rapidly, due to the short life span of the species. Furthermore, 10–20% of age 1 is considered mature and is included in the SSB. Therefore, the recruitment in the year after the assessment year does influence the SSB in the following year.

Environmental influence on the stock

Only limited knowledge is available on the influence of environmental factors, such as temperature, on Norway pout recruitment.

The fisheries

The fisheries for Norway pout are conducted with small-meshed trawl gears. Historically, the fisheries included bycatches of especially of whiting, haddock, saithe, and herring. Bycatches of these species have been low in the recent decade. The directed fishery for Norway pout was closed in 2005, the first half of 2006, and in 2007 as well as in 2011. Fishing effort and catches have been low in 2008 and 2009, but increased in 2010.

Catch by fleet	Total catch (2010) = 126.0 kt, where more than 99 % of the landings were taken by the small-meshed trawl fleet. The fishery has a 11.2 kt bycatch of other species (mainly blue whiting).

Effects of the fisheries on the ecosystem

Bycatches in the Norway pout fisheries can influence the state of stocks such as whiting and herring. Additionally, Norway pout is an important prey species for a variety of fish species (e.g. saithe, cod, haddock, saithe, and mackerel).

Quality considerations

The assessment uses constant natural mortality, although natural mortality is known to vary. There is uncertainty in the maturity-at-age and weight-at-age, which may have a large impact on the predictions and estimates of the SSB because the stock consists of very few year classes.

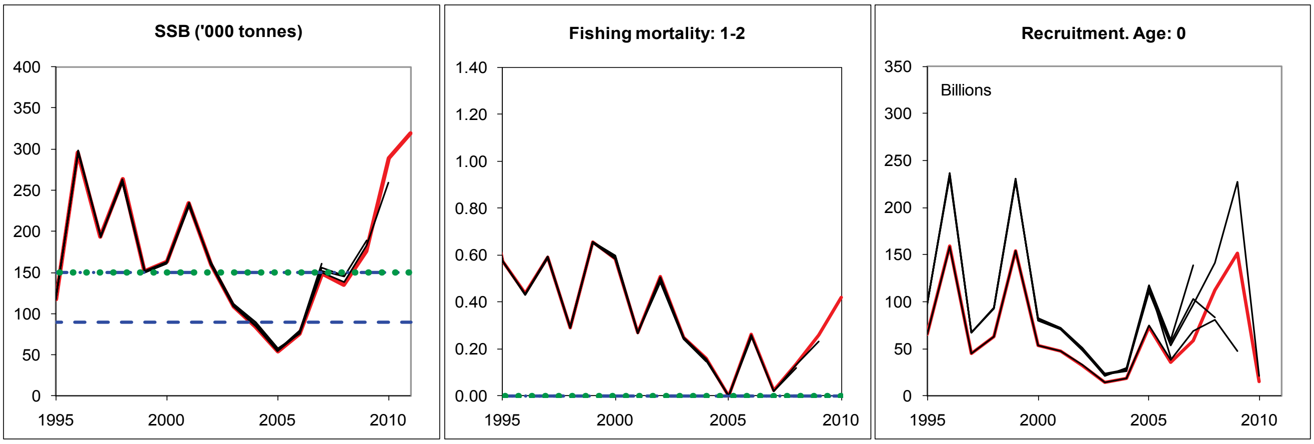


Figure 6.4.20.2 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat) Historical assessment results (final year recruitment estimates included). The two recruitment levels represent third quarter recruitment (real-time spring assessment) and second quarter recruitment (real-time autumn assessment).

Scientific basis

Assessment type	Age-based analytical (seasonal XSA).
Input data	Four survey indices (IBTS Q1&Q3, EGFS Q3, SGFS Q3); three quarterly commercial fleet cpue indices with data included up to 2006 (CFQ1,Q3,Q4).
Discards and bycatch	Not included in the assessment. No significant discards.
Indicators	None.
Other information	This stock is assessed twice a year. The spring assessment provides stock status up to 1st of April of the current year. The autumn assessment provides stock status for the current year and a forecast of fishing possibilities in the next year. This approach follows the escapement management strategy. A benchmark assessment is planned for 2012.
Working group report	WGNSSK

ECOREGION North Sea
STOCK Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{escapement}$	150 000 t	= B_{pa}
	F_{MSY}	Undefined.	None advised.
Precautionary approach	B_{lim}	90 000 t	$B_{lim} = B_{loss}$, the lowest observed biomass in the 1980s.
	B_{pa}	150 000 t	= $B_{lim}\ e^{0.3*1.65}$
	F_{lim}	Undefined.	None advised.
	F_{pa}	Undefined.	None advised.

(unchanged since: 2010)

Outlook for 2011 (in-year advice)

Basis: F (2010) = Fbar(1–2) = 0.420; Landings (2010) = 126; R(2011) = 25% of long-term recruitment (1983–2010) = ~ 47 billion; SSB (2011) = 319 kt.

Rationale	Landings 2011	Basis	F 2011	SSB 2012	%SSB change[1)]
MSY approach	6	MSY $B_{escapement}$	0.02	150	−53 %
Precautionary approach	6	B_{pa}	0.02	150	−53 %
Zero Catch	0	No fishery	0	154	−51 %
Status quo	50	Fixed TAC Strat.	0.21	124	−61 %
	82	Fixed F Strat.	0.35	106	−67 %
	101	B_{lim}	0.40	90	−72 %

Weights in '000 tonnes.
[1)] SSB 2012 relative to SSB 2011.

Management strategy options

ICES has evaluated and commented on three management strategies, although these have not yet been decided on. Following the escapement strategy (maintaining SSB above a 150 000 t by 1st of January 2011) results in catches of less than 6000 t in 2011, corresponding to F around 0.02. Under a fixed F management strategy with F around 0.35, catches of around 82 000 t can be taken in 2011. Under a fixed TAC strategy a TAC of 50 000 t can be taken in 2011, corresponding to an F around 0.21. In recent years the escapement strategy has been used.

MSY approach

To maintain the spawning-stock biomass above a reference level of MSY $B_{escapement}$ by 1st of January 2012 a catch of no more than 6000 t can be taken in 2011. This implies that fishing mortality needs to be reduced significantly from 2010 to 2011.

PA approach

This is the same as the MSY approach.

Additional considerations

The TAC has not been taken in 2008, 2009, and 2010 because of high fishing (fuel) costs in these years, as well as bycatch regulations in 2009 and 2010 (mainly in relation to whiting bycatch).

Biannual information is available to perform real-time monitoring and management of the stock. Advice (forecast) and management options for 2012 will be provided in autumn 2011.

Norway pout is a short-lived species and most likely a one-time spawner. The population dynamics of Norway pout in the North Sea and Skagerrak are very dependent on changes caused by recruitment variation and variation in predation (or other natural) mortality, and less by the fishery. Recruitment is highly variable and influences SSB and TSB rapidly because of the short life span of the species (Sparholt *et al.*, 2002a, 2002b; Lambert *et al.*, 2009). Furthermore, 10% of age 1 is considered mature and is included in the SSB. Therefore, the recruitment in the year after the assessment year influences the SSB in the following year. Also, Norway pout is to a limited extent exploited from age 0. Norway pout should be managed as a short-lived species.

Bycatches and selective measures

Historically, the fishery includes bycatches, especially of haddock, whiting, saithe, and herring. Existing technical measures to protect these bycatch species should be maintained or improved. Bycatches of these species have been low in the recent decade. Sorting grids, possibly in combination with square-meshed panels have been shown to reduce bycatches of whiting and haddock by 57% and 37%, respectively (Eigaard and Holst, 2004; Nielsen and Madsen, 2006; Eigaard and Nielsen, 2009). ICES suggests that these devices (or modified forms of those) should be brought into use in the fishery. The introduction of these technical measures should be followed up by adequate control measures of landings or catches at sea to ensure effective implementation of the existing bycatch measures.

Management plan evaluations

No management objectives have been set for this stock. With present fishing mortality levels the status of the stock is more determined by natural processes and less by the fishery.

ICES has evaluated and commented on three management strategies, following requests from managers – fixed fishing mortality (0.35), fixed TAC (50 000 t), and a variable TAC escapement strategy. The evaluation shows that all three management strategies are capable of generating stock trends that keep the stock at or above B_{pa} and stay away from B_{lim} with a high probability in the long term and are therefore considered to be in accordance with the precautionary approach. The escapement strategy has a higher long-term average yield compared with the fixed fishing mortality strategy (and the fixed TAC strategy), but at the cost of a substantially higher probability of having closures in the fishery. If the continuity of the fishery is an important property, then the fixed F (equivalent to fixed effort) strategy will perform better. There should be no shift in management strategies between years. In recent years the escapement strategy has been practised.

Impacts of fisheries on the ecosystems

Norway pout is an important prey species for a variety of fish species (e.g. saithe, haddock, cod, and mackerel). Natural mortality levels by age and season used in the stock assessment reflect the predation mortality levels estimated for this stock in the most recent multispecies stock assessment performed by ICES. Growth and mean weight-at-age for the above-mentioned predators seems independent of the stock size of Norway pout.

Regulations and their effects

The Norway pout fishery is regulated through a single-species TAC and by technical measures such as minimum mesh size in the trawls, fishing area closures (e.g. the Norway pout box in the northwestern part of the North Sea), and bycatch regulations in the fishery to protect other species. Bycatch regulations in force have reduced bycatches in recent years.

Comparison with previous assessment and advice

The estimates of the SSB, recruitment, and of the average fishing mortality of ages 1 and 2 are consistent with the estimates of previous year's assessment.

Last year's advice was based on the MSY and the precautionary approach. The basis for the advice this year is the MSY approach.

Sources

Eigaard, O. R., and Holst, R. 2004. The effective selectivity of a composite gear for industrial fishing: a grid in combination with a square mesh window. Fisheries Research, 68: 99–112.

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Sparholt, H., Larsen, L. I., and Nielsen, J. R. 2002a. Verification of multispecies interactions in the North Sea by trawl survey data on Norway pout (*Trisopterus esmarkii*). ICES Journal of Marine Science, 59: 1270–1275.

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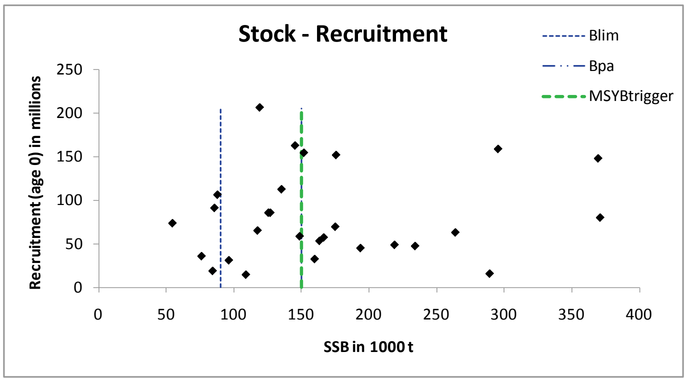

Figure 6.4.20.3 Norway pout in Subarea IV and Division IIIa. Stock-recruitment relationship.

Table 6.4.20.1 Norway pout in Subarea IV and Division IIIa**.** ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ICES landings
1987	No advice	-	200	215	147
1988	No advice	-	200	187	102
1989	No advice	-	200	276	167
1990	No advice	-	200	212	140
1991	No advice	-	200	223	155
1992	No advice	-	200	335	255
1993	No advice	-	220	241	176
1994	No advice	-	220	214	176
1995	Can sustain current F	-	180	289	181
1996	Can sustain current F; take bycatches into consid.	-	220	197	122
1997	Can sustain current F; take bycatches into consid.	-	220	155	133
1998	Can sustain current F; take bycatches into consid.	-	220	72	62
1999	Can sustain current F; take bycatches into consid.	-	220	93	85
2000	Can sustain current F; take bycatches into consid.	-	220	182	175
2001	Can sustain current F; take bycatches into consid.	-	211	63	57
2002	Can sustain current F; take bycatches into consid.	-	198	93	74
2003	Can sustain current F; take bycatches into consid.		198	24	21
2004	The stock is in risk of decreasing below B_{lim}		198	16	14
2005	Fishery should be closed		5	1	2
2006	Fishery closed until 4th August where a TAC of 95 000 t was set.		95	54	47
2007	Fishery closed because SSB <B_{pa} in 2008.	0	5	6	6
2008	F=0.35 or 50 000 t for first half of 2008	< 50 in 1st 6 m	41		
In year[2]:	Maintain SSB > B_{pa}	< 148	115	39	36
2009	Reduce F to increase SSB > B_{pa}	< 35	28.3 (EU)		
In year[2]:	Maintain SSB > B_{pa}	< 157	116 (EU)	55	56
2010	Maintain SSB > B_{pa}	< 307	76 (EU)		
In year[2]:	Maintain SSB > MSY $B_{escapement}$	< 434	162	137	126
2011	Maintain SSB > MSY $B_{escapement}$	< 6			
2012	Advice for 2012 will be given in Oct. 2011.				

Weights in '000 t.

[1] Divisions IIa(EU) and IIIa, and Subarea IV(EU).

[2] For Norway pout preliminary advice is given in autumn, while the in year advice is given on the basis of the first surveys and catches in the TAC year.

Table 6.4.20.2 Norway pout in Subarea IV and Division IIIa**.** National landings (t) by quarter (as submitted to ICES). Norwegian landing data include landings of bycatch of other species. Includes bycatch of Norway pout in other (small-meshed) fisheries.

Year	Denmark		Faroes	Norway	Sweden	UK (Scotland)	Others	Total
	North Sea	Skagerrak						
1961	20,5	-	-	8,1	-	-	-	28,6
1962	121,8	-	-	27,9	-	-	-	149,7
1963	67,4	-	-	70,4	-	-	-	137,8
1964	10,4	-	-	51	-	-	-	61,4
1965	8,2	-	-	35	-	-	-	43,2
1966	35,2	-	-	17,8	-	-	+	53,0
1967	169,6	-	-	12,9	-	-	+	182,5
1968	410,8	-	-	40,9	-	-	+	451,7
1969	52,5	-	19,6	41,4	-	-	+	113,5
1970	142,1	-	32	63,5	-	0,2	0,2	238,0
1971	178,5	-	47,2	79,3	-	0,1	0,2	305,3
1972	259,6	-	56,8	120,5	6,8	0,9	0,2	444,8
1973	215,2	-	51,2	63	2,9	13	0,6	345,9
1974	464,5	-	85,0	154,2	2,1	26,7	3,3	735,8
1975	251,2	-	63,6	218,9	2,3	22,7	1	559,7
1976	244,9	-	64,6	108,9	+	17,3	1,7	437,4
1977	232,2	-	48,8	98,3	2,9	4,6	1	387,8
1978	163,4	-	18,5	80,8	0,7	5,5	-	268,9
1979	219,9	9	21,9	75,4	-	3	-	329,2
1980	366,2	11,6	34,1	70,2	-	0,6	-	482,7
1981	167,5	2,8	16,4	51,6	-	+	-	238,3
1982	256,3	35,6	12,3	88	-	-	-	392,2
1983	301,1	28,5	30,7	97,3	-	+	-	457,6
1984	251,9	38,1	19,11	83,8	-	0,1	-	393,01
1985	163,7	8,6	9,9	22,8	-	0,1	-	205,1
1986	146,3	4	2,5	21,5	-	-	-	174,3
1987	108,3	2,1	4,8	34,1	-	-	-	149,3
1988	79	7,9	1,3	21,1	-	-	-	109,3
1989	95,7	4,2	0,8	65,3	+	0,1	0,3	166,4
1990	61,5	23,8	0,9	77,1	+	-	-	163,3
1991	85	32	1,3	68,3	+	-	+	186,6
1992	146,9	41,7	2,6	105,5	+	-	0,1	296,8
1993	97,3	6,7	2,4	76,7	-	-	+	183,1
1994	97,9	6,3	3,6	74,2	-	-	+	182
1995	138,1	46,4	8,9	43,1	0,1	+	0,2	236,8
1996	74,3	33,8	7,6	47,8	0,2	0,1	+	163,8
1997	94,2	29,3	7,0	39,1	+	+	0,1	169,7
1998	39,8	13,2	4,7	22,1	-	-	+	57,7
1999	41	6,8	2,5	44,2	+	-	-	94,5
2000	127	9,3	-	48	0,1	-	+	184,4
2001	40,6	7,5	-	16,8	0,7	+	+	65,6
2002	50,2	2,8	3,4	23,6	-	-	-	80,0
2003	9,9	3,4	2,4	11,4	-	-	-	27,1
2004	8,1	0,3	-	5	-	-	0,1	13,5
2005	0.9*	-	-	1	-	-	-	1,9
2006	35,1	0,1	-	11,4	-	-	-	46,6
2007	2.0**	-	-	3,7	-	-	-	5,7
2008	30,4	-	-	5,7	+	-	+	36,1
2009	17,5	-	-	37,0	+	-	+	54,5
2010	64,9	0,2	-	60,9	+	+	+	126,0

* 781 t taken in a trial fishery; 160 t in by-catches in other (small meshed) fisheries.

** 681 t taken in trial fishery; 1300 t in by-catches in other (small meshed) fisheries.

Table 6.4.20.3 Norway pout in Subarea IV and Division IIIa**.** Summary of stock assessment.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1–2
1983	147976	369522	457.6	0.873
1984	80005	371015	393.01	1.242
1985	57167	166377	205.1	1.296
1986	106282	87714	174.3	1.093
1987	31003	96154	149.3	0.878
1988	85557	126856	109.3	0.659
1989	91121	85488	166.4	0.813
1990	85639	125452	163.3	0.736
1991	162754	145172	186.6	0.876
1992	69508	174922	297	0.920
1993	48709	218802	183	0.816
1994	206484	118979	182	1.051
1995	65163	117389	237	0.573
1996	158806	295459	164	0.436
1997	45016	193585	169.7	0.590
1998	62962	263826	58	0.291
1999	154416	151706	95	0.655
2000	53309	163257	184	0.585
2001	47347	234024	66	0.269
2002	32439	159675	80	0.509
2003	14484	108764	27	0.250
2004	18798	84146	14	0.159
2005	73565	54405	2	0.000
2006	35734	75927	47	0.262
2007	58558	148575	6	0.023
2008	112529	135132	36	0.137
2009	151852	175524	55	0.259
2010	15671	289223	126	0.420
2011		319002		
Average	81173	174347	144	0.595

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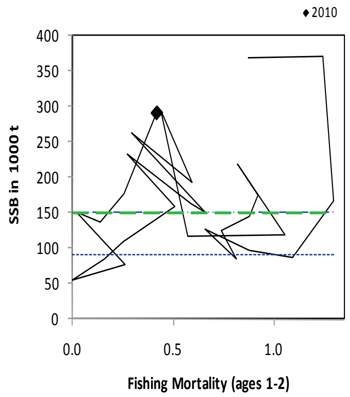
Advice for 2012

ICES advises on the basis of the MSY approach that there should be no catches of Norway pout in 2012 according to the escapement strategy.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↗	↗	Below average
	SSB (Spawning-Stock Biomass)			
	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



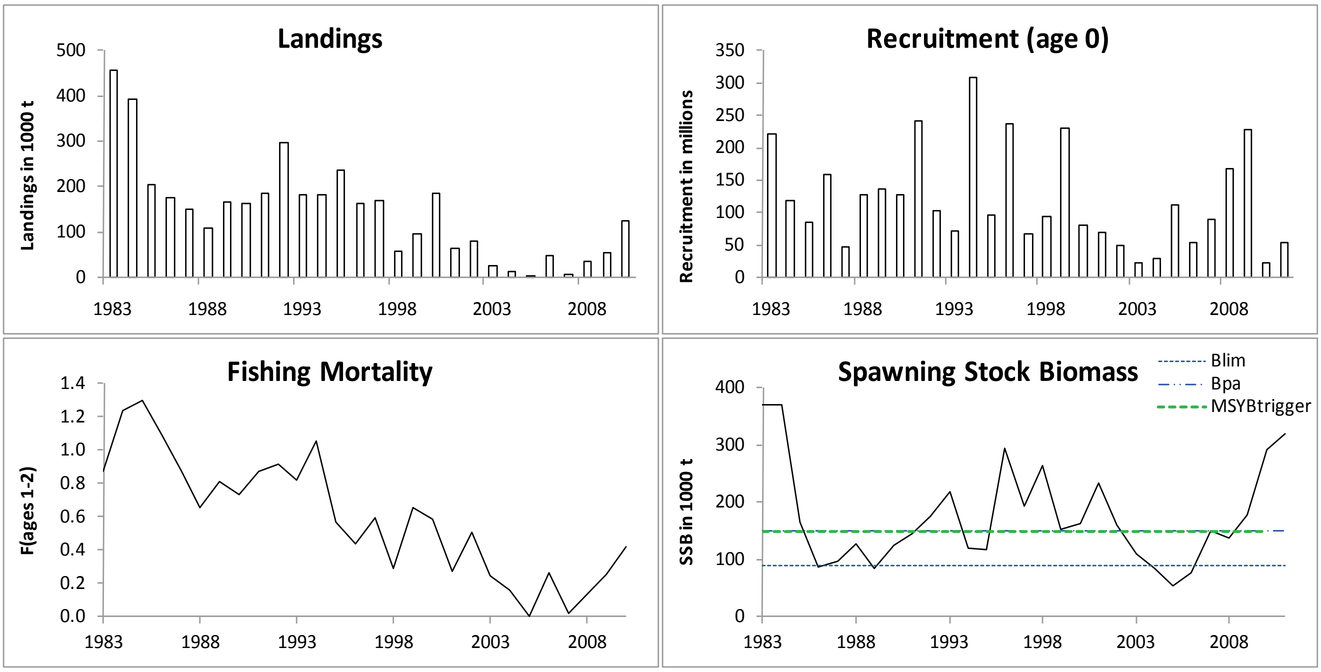


Figure 6.4.20b.1 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Summary of stock assessment (weights in '000 tonnes). MSY $B_{trigger}$ should be read as MSY $B_{escapement}$. Top right: SSB and F over the years.

The stock size has increased since 2004 and is above MSY $B_{escapement}$. Recruitment was well above average in 2009, but very low in 2010 and 2011 and this is expected to bring SSB below the MSY $B_{escapement}$ in 2012. Fishing mortality has been lower than the natural mortality for this stock and has decreased in recent years to well below the long-term average F (0.6). The status of the stock is mainly determined by natural processes and recruitment.

Management plans

No specific management objectives are known to ICES for this stock. Due to the short-lived nature of this species a preliminary TAC is set every year, which is updated on the basis of advice in the first half of the year (using the escapement management strategy approach).

Biology

Norway pout is a short-lived species and most likely a one-time spawner. The population dynamics are very dependent on changes caused by variations in recruitment and in predation (or other natural) mortality, and less by the fishery. Recruitment is highly variable and influences spawning stock and total biomass rapidly, due to the short life span of the species. Furthermore, 10–20% of age 1 is considered mature and is included in the SSB. Therefore, recruitment in the year after the assessment year does influence the SSB in the following year.

Environmental influence on the stock

Only limited knowledge is available on the influence of environmental factors, such as temperature, on Norway pout recruitment.

The fisheries

The fisheries for Norway pout are conducted with small-meshed trawl gears. The directed fishery for Norway pout was closed in 2005, the first half of 2006, and in 2007 as well as in first half of 2011. Fishing effort and catches have been low in 2008 and 2009, but increased in 2010. Historically, the fisheries have resulted in bycatches of other species, particularly whiting, haddock, saithe, and herring. Bycatches of these species have been low in the recent decade.

Catch by fleet	Total catch (2010) = 126.0 kt, where more than 99% of the landings were taken by the small-meshed trawl fleet. The fishery has a 11.2 kt bycatch of other species (mainly blue whiting).

Effects of the fisheries on the ecosystem

Bycatches in the Norway pout fisheries can influence the state of stocks such as whiting and herring. Additionally, Norway pout is an important prey species for a variety of fish species (e.g. saithe, cod, haddock, and mackerel).

Quality considerations

The assessment uses constant natural mortality, although natural mortality is known to vary. There is uncertainty in the maturity-at-age and weight-at-age, which may have a large impact on the predictions and estimates of the SSB because the stock consists of very few year classes.

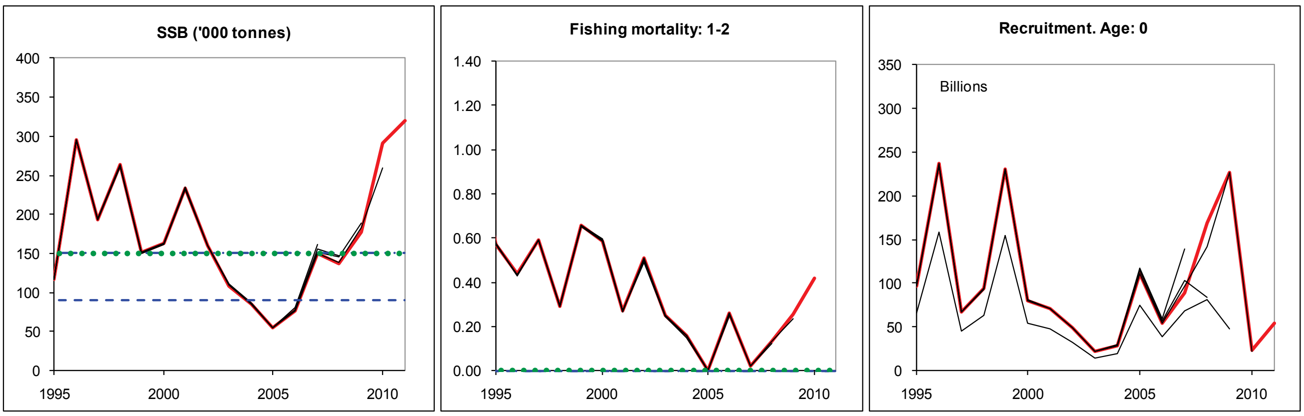


Figure 6.4.20b.2 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Historical assessment results (final-year recruitment estimates included). The two recruitment levels represent third quarter recruitment (real-time spring assessment) and second quarter recruitment (real-time autumn assessment).

Scientific basis

Assessment type	Age-based analytical (seasonal XSA).
Input data	Four survey indices (IBTS Q1&Q3, EGFS Q3, SGFS Q3); three quarterly commercial fleet cpue indices with data included up to 2006 (CFQ1,Q3,Q4).
Discards and bycatch	Not included in the assessment. No significant discards.
Indicators	None.
Other information	This stock is assessed twice a year. The spring assessment provides stock status up to 1st of April of the current year. The autumn assessment provides stock status for the current year and a forecast of fishing possibilities in the next year. This approach follows the escapement management strategy. A benchmark assessment is planned for 2012.
Working group report	WGNSSK

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Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{escapement}$	150 000 t	$= B_{pa}$
	F_{MSY}	Undefined.	None advised.
Precautionary approach	B_{lim}	90 000 t	$B_{lim} = B_{loss}$, the lowest observed biomass in the 1980s.
	B_{pa}	150 000 t	$= B_{lim}\, e^{0.3*1.65}$
	F_{lim}	Undefined.	None advised.
	F_{pa}	Undefined.	None advised.

(unchanged since: 2010)

Outlook for 2012
Basis: F (2011) = Catch constraint of 6 kt = 0.043; R(2012) = 25% of long-term recruitment (1983–2011) = ~ 67 billion (2nd quarter); SSB (2012) = 146; landings (2011) = 6.

Rationale	Landings 2012	Basis	F 2012	SSB 2013	%SSB change[1)]
Zero catch	0	No fishery	0	119	−18%
Status quo	60	B_{lim}	0.73	90	−38%
	50	Fixed TAC strategy	0.59	94	−36%
	31	Fixed F strategy	0.35	103	−29%

Weights in '000 tonnes.
1) SSB 2013 relative to SSB 2012.

Management plans

ICES has evaluated and commented on three management strategies, although these have not yet been decided on. When combining a fixed F-management-strategy (F around 0.35 in 2012) with a fixed TAC strategy (a TAC of 50 000 t in 2012) the SSB is expected to decline below B_{pa} and MSY $B_{escapement}$ by 1 January 2013.

MSY approach

To maintain the spawning-stock biomass above a reference level of MSY $B_{escapement}$ by 1 January 2013, no catch of Norway pout can be taken according to the MSY approach in 2012. This is because the SSB is expected to fall below MSY $B_{escapement}$ due to the very low 2010 and 2011 recruitment and the high natural mortality of the stock.

PA approach

The PA approach (to maintain SSB(2012) above B_{pa} = MSY $B_{escapement}$) is similar to the MSY approach for this species.

Additional considerations

The TAC has not been taken in 2008, 2009, and 2010 because of high fishing (fuel) costs in these years, as well as bycatch regulations in 2009 and 2010 (mainly in relation to whiting bycatch).

Norway pout is a short-lived species and most likely a one-time spawner. The population dynamics of Norway pout in the North Sea and Skagerrak are very dependent on changes caused by recruitment variation and variation in predation (or other natural) mortality, and less by the fishery. Recruitment is highly variable and influences SSB and TSB rapidly because of the short life span of the species (Sparholt *et al.*, 2002a, 2002b; Lambert *et al.*, 2009). Furthermore, 10% of age 1 is considered mature and is included in the SSB. Therefore, the recruitment in the year after the assessment year influences the SSB in the following year. Also, Norway pout is to a limited extent exploited from age 0. Norway pout should be managed as a short-lived species.

Bycatches and selective measures

Historically, the fishery includes bycatches, especially of haddock, whiting, saithe, and herring. Existing technical measures to protect these bycatch species should be maintained or improved. Bycatches of these species have been low in the recent decade. Sorting grids, possibly in combination with square-meshed panels have been shown to reduce bycatches of whiting and haddock by 57% and 37%, respectively (Eigaard and Holst, 2004; Nielsen and Madsen, 2006; Eigaard and Nielsen, 2009). ICES suggests that these devices (or modified forms of those) should be brought into use in the fishery. The introduction of these technical measures should be followed up by adequate control measures of landings or catches at sea to ensure effective implementation of the existing bycatch measures.

Management plan evaluations

No management objectives have been set for this stock. With the present fishing mortality levels the status of the stock is more determined by natural processes and less by the fishery.

ICES has evaluated and commented on three management strategies, following requests from managers – fixed fishing mortality (0.35), fixed TAC (50 000 t), and a variable TAC escapement strategy. The evaluation shows that all three management strategies are capable of generating stock trends that keep the stock at or above B_{pa} and avoid falling below B_{lim} with a high probability in the long term and they are therefore considered to be in accordance with the precautionary approach. The escapement strategy has a higher long-term average yield compared with the fixed fishing mortality strategy (and the fixed TAC strategy), but at the cost of a substantially higher probability of having closures in the fishery. If the continuity of the fishery is an important property, then the fixed F (equivalent to fixed effort) strategy will perform better. There should be no shift in management strategies between years. In recent years the escapement strategy has been practised.

Impacts of fisheries on the ecosystems

Norway pout is an important prey species for a variety of fish species (e.g. saithe, haddock, cod, and mackerel). Natural mortality levels by age and season used in the stock assessment reflect the predation mortality levels estimated for this stock in the most recent multispecies stock assessment performed by ICES. Growth and mean weight-at-age for the above-mentioned predators seems independent of the stock size of Norway pout.

Regulations and their effects

The Norway pout fishery is regulated through a single-species TAC and by technical measures such as minimum mesh size in the trawls, fishing area closures (e.g. the Norway pout box in the northwestern part of the North Sea), and bycatch regulations in the fishery to protect other species. Bycatch regulations in force have reduced bycatches in recent years.

Comparison with previous assessment and advice

The estimates of the SSB, recruitment, and of the average fishing mortality of ages 1 and 2 are consistent with the estimates of last year's assessment.

Last year's advice was based on the MSY and the precautionary approach. The basis for the advice this year is the MSY approach.

Sources

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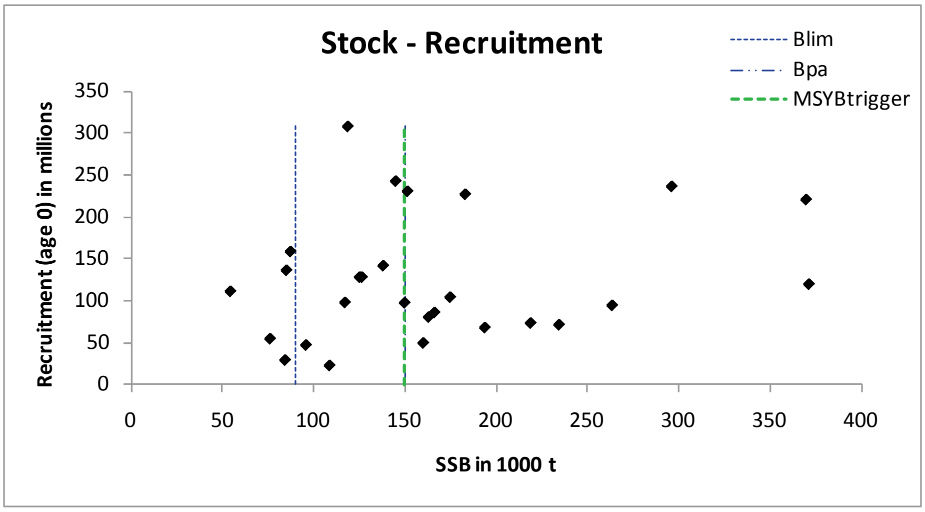


Figure 6.4.20b.3 Norway pout in Subarea IV and Division IIIa. Stock-recruitment relationship.

Table 6.4.20b.1 Norway pout in Subarea IV and Division IIIa**.** ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ICES landings
1987	No advice	-	200	215	147
1988	No advice	-	200	187	102
1989	No advice	-	200	276	167
1990	No advice	-	200	212	140
1991	No advice	-	200	223	155
1992	No advice	-	200	335	255
1993	No advice	-	220	241	176
1994	No advice	-	220	214	176
1995	Can sustain current F	-	180	289	181
1996	Can sustain current F; take bycatches into consid.	-	220	197	122
1997	Can sustain current F; take bycatches into consid.	-	220	155	133
1998	Can sustain current F; take bycatches into consid.	-	220	72	62
1999	Can sustain current F; take bycatches into consid.	-	220	93	85
2000	Can sustain current F; take bycatches into consid.	-	220	182	175
2001	Can sustain current F; take bycatches into consid.	-	211	63	57
2002	Can sustain current F; take bycatches into consid.	-	198	93	74
2003	Can sustain current F; take bycatches into consid.		198	24	21
2004	The stock is in risk of decreasing below B_{lim}		198	16	14
2005	Fishery should be closed		5	1	2
2006	Fishery closed until 4th August where a TAC of 95 000 t was set.		95	54	47
2007	Fishery closed because SSB <B_{pa} in 2008.	0	5	6	6
2008	F=0.35 or 50 000 t for first half of 2008	<50 in 1st 6 months	41		
In year[2]:	Maintain SSB > B_{pa}	< 148	115	39	36
2009	Reduce F to increase SSB > B_{pa}	< 35	28.3 (EU)		
In year[2]:	Maintain SSB > B_{pa}	< 157	116 (EU)	55	56
2010	Maintain SSB > B_{pa}	< 307	76 (EU)		
In year[2]:	Maintain SSB > MSY $B_{escapement}$	< 434	162	137	126
2011	No directed fisheries	0			
In year[2]	Maintain SSB > MSY $B_{escapement}$	< 6	3 + 4.5 [3]		
2012	No fisheries	0			

Weights in '000 t.
[1] Divisions IIa(EU) and IIIa, and Subarea IV(EU).
[2] For Norway pout preliminary advice is given in autumn, while the in-year advice is given on the basis of the first surveys and catches in the TAC year.
[3] TACs set by Norway and EU, respectively.

Table 6.4.20b.2 Norway pout in Subarea IV and Division IIIa**.** National landings (t) by quarter (as submitted to ICES), including bycatch of Norway pout in other (small-meshed) fisheries. Norwegian landing data include landings of bycatch of other species.

Year	Quarter	Denmark									Norway		Total
	Area	IIIaN	IIIaS	Div. IIIa	IVaE	IVaW	IVb	IVc	Div. IV	Div. IV + IIIaN	IVaE	Div. IV	Div. IV + IIIaN
1996	1	1,231	164	1,395	6,133	3,149	658	2	9,943	11,174	10604	10604	21,778
	2	7,323	970	8,293	1,018	452	1,476	-	2,946	10,269	4281	4281	14,550
	3	20,176	836	21,012	7,119	17,553	1,517	-	26,188	46,364	27466	27466	73,830
	4	5,028	500	5,528	9,640	25,498	42	-	35,180	40,208	5466	5466	45,674
	Total	33,758	2,470	36,228	23,910	46,652	3,692	2	74,257	108,015	47,817	47817	155,832
1997	1	2,707	460	3,167	6,203	2,219	7	-	8,429	11,137	4183	4183	15,320
	2	5,656	200	5,857	141	-	45		185	5,842	8466	8466	14,308
	3	16,432	649	17,081	19,054	21,024	740	-	40,818	57,250	21546	21546	78,796
	4	4,464	1,042	5,505	6,555	38,202	7		44,765	49,228	4884	4884	54,112
	Total	29,259	2,351	31,610	31,953	61,445	799	-	94,197	123,456	39,079	39079	162,535
1998	1	1,117	317	1,434	7,111	2,292	-	-	9,403	10,520	8913	8913	19,433
	2	3,881	103	3,984	131	5	124	-	259	4,140	7885	7885	12,025
	3	6,011	406	6,417	7,161	1,763	2,372	-	11,297	17,308	3559	3559	20,867
	4	2,161	677	2,838	1,051	17,752	77	-	18,880	21,041	1778	1778	22,819
	Total	13,171	1,503	14,673	15,454	21,811	2,573	-	39,838	53,009	22,135	22135	75,144
1999	1	4	12	15	2,769	1,246	1	-	4,016	4,020	3021	3021	7,041
	2	1,568	36	1,605	953	361	418	-	1,731	3,300	10321	10321	13,621
	3	3,094	109	3,203	7,500	3,710	2,584	-	13,794	16,887	24449	24449	41,336
	4	2,156	517	2,673	3,577	16,921	928	1	21,426	23,583	6385	6385	29,968
	Total	6,822	674	7,496	14,799	22,237	3,931	1	40,968	47,790	44,176	44176	91,966
2000	1	0	11	12	3,726	1,038	-	-	4,764	4,765	5440	5440	10,205
	2	929	15	944	684	22	227	-	933	1,862	9779	9779	11,641
	3	7,380	139	7,519	1,708	5,613	515	-	7,836	15,216	28428	28428	43,644
	4	947	209	1,157	1,656	111,732	76	-	113,464	114,411	4334	4334	118,745
	Total	9,257	375	9,631	7,774	118,406	818	-	126,998	136,255	47,981	47981	184,236
2001	1			302	7,341	9,734	103	72	17,250	17,250	3838	3838	21,088
	2			2,174	31	30	269	-	330	330	9268	9268	9,598
	3			2,006	15	154	191	-	360	360	2263	2263	2,623
	4			3,059	2,553	19,826	329	-	22,708	22,708	1426	1426	24,134
	Total			7,541	9,940	29,744	892	72	40,648	40,648	16,795	16795	57,443
2002	1	-	1	1	4,869	1,660	114	-	6,643	6,643	1896	1896	8,539
	2	883	161	1,045	56	9	22	-	87	970	5563	5563	6,533
	3	1,567	213	1,778	2,234	14,739	104	-	17,077	18,644	14147	14147	32,791
	4	393	100	492	1,787	24,273	335	-	26,395	26,788	2033	2033	28,821
	Total	2,843	475	3,316	8,946	40,681	575	-	50,202	53,045	23,639	23639	76,684
2003	1	-	1	1	615	581	22	-	1,218	1,218	1977	1977	3,195
	2	246	160	406	76	-	22	-	98	344	2773	2773	3,117
	3	2,984	1,005	3,989	172	1,613	89	-	1,874	4,858	5989	5989	10,847
	4	188	547	735	0	6270	457	-	6,727	6,915	644	644	7,559
	Total	3,418	1,713	5,131	863	8,464	590	-	9,917	13,335	11,383	11,383	24,718
2004	1	316	-	316	87	650	-	-	737	1,053	989	989	2,042
	2	-	-	-	-	-	7	-	7	7	660	660	667
	3	14	-	14	289	1,195	9	-	1,493	1,507	2484	2484	3,991
	4	13	-	13	93	5,683	107	-	5,883	5,896	865	865	6,761
	Total	343	-	343	469	7,528	123	-	8,120	8,463	4,998	4,998	13,461
2005	1	-	-	-	9	-	-	-	9	9	12	12	21
	2	-	-	-	151	-	-	-	151	151	352	352	503
	3	-	-	-	781	-	-	-	781	781	387	387	1,168
	4	-	-	-	-	-	-	-	-	-	211	211	211
	Total	-	-	-	941	-	-	-	941	941	962	962	1,903
2006	1	-	-	-	75	83	-	-	158	158	2,205	2205	2,363
	2	-	-	-	-	-	15	-	15	15	2,846	2846	2,861
	3	114	-	114	-	649	20	-	669	783	5,749	5749	6,532
	4	3	-	3	-	34,262	-	-	34,262	34,265	605	605	34,870
	Total	117	-	117	75	34,994	35	-	35,104	35,221		11,405	46,626
2007	1	-	-	-	561	789	-	-	1,350	1,350	74	74	1,424
	2	-	-	-	4	-	-	-	4	4	1,097	1097	1,101
	3	1	2	3	-	-	-	-	-	1	2,429	2429	2,430
	4	-	-	-	-	682	-	-	682	682	155	155	837
	Total	1	2	3	565	1,471	-	-	2,036	2,037		3,755	5,792
2008	1	125	-	125	19	86	123	-	228	353	7	7	360
	2	-	-	-	-	-	30	-	30	30	1,803	1803	1,833
	3	-	-	-	-	6,102	-	-	6,102	6,102	3,582	3582	9,684
	4	-	-	-	-	22,686	1,239	-	23,925	23,925	336	336	24,261
	Total	125	-	125	19	28,874	1,392	-	30,285	30,410		5,728	36,138
2009	1	1	-	1	22	515	-	-	537	538	2	2	540
	2	-	-	-	-	-	-	-	-	-	4,026	4026	4,026
	3	2	-	2	-	11,567	-	-	11,567	11,569	31,251	31251	42,820
	4	-	-	-	-	5,399	4	-	5,403	5,403	1,736	1736	7,139
	Total	3	-	3	22	17,481	4	-	17,507	17,510	37,015	37,015	54,525
2010	1	-	-	-	-	194	-	-	194	194	104	104	298
	2	157	-	157	-	478	59	-	537	694	17,906	17906	18,600
	3	37	-	37	-	33,618	213	-	33,831	33,868	41,883	41883	75,751
	4	8	-	8	-	30,276	38	-	30,314	30,322	984	984	31,306
	Total	202	-	202	-	64,566	310	-	64,876	65,078	60,877	60,877	125,955
2011	1	0	-	0	-	-	-	-	-	0	-	0	0
	2	0	-	0	-	-	-	-	-	0	188	188	188
	Total	0	-	0	-	-	-	-	-	0	188	188	188

Table 6.4.20b.3 Norway pout in Subarea IV and Division IIIa**.** Summary of stock assessment.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1–2
1983	220769	369531	457600	0.873
1984	119362	371051	393010	1.242
1985	85313	166410	205100	1.296
1986	158606	87741	174300	1.093
1987	46258	96211	149300	0.877
1988	127648	126943	109300	0.659
1989	135929	85530	166400	0.813
1990	127756	125479	163300	0.736
1991	242671	145171	186600	0.876
1992	103641	174890	296800	0.920
1993	72663	218616	183100	0.818
1994	307865	118844	182000	1.053
1995	97216	117307	236800	0.573
1996	236427	295216	163800	0.436
1997	67206	193402	169700	0.591
1998	93817	263168	57700	0.291
1999	230284	151507	94500	0.655
2000	79749	163047	184400	0.585
2001	70491	233904	65600	0.269
2002	48782	159885	80000	0.507
2003	21783	108749	27100	0.251
2004	28355	84660	13500	0.158
2005	111084	54881	1900	0.000
2006	53906	76763	46600	0.260
2007	88631	150676	5700	0.020
2008	168752	136906	36100	0.135
2009	227166	177901	54500	0.254
2010	23625	291277	126000	0.418
2011	53868	320529		
Average	118953	174696	143954	0.595

ECOREGION North Sea
STOCK Sandeel in Division IIIa and Subarea IV

Sandeel are largely stationary after settlement and there is a complex of local (sub-) stocks in the North Sea. To avoid local depletion, ICES advice for sandeel is provided for seven areas in Division IIIa and Subarea IV (Figure 6.4.21.1).

Section	Sandeel Area (SA)	Name	Rectangles
6.4.21.1	1	Dogger Bank area	31-34 E9-F2; 35 E9- F3; 36 E9-F4; 37 E9-F5; 38-40 F0-F5; 41 F5-F6
6.4.21.2	2	South Eastern North Sea	31-34 F3-F4; 35 F4-F6; 36 F5-F8; 37-40 F6-F8; 41 F7-F8
6.4.21.3	3	Central Eastern North Sea	41 F1-F4; 42-43 F1-F9; 44 F1-G0; 45-46 F1-G1; 47 G0
6.4.21.4	4	Central Western North Sea	38-40 E7-E9; 41-46 E6-F0
6.4.21.5	5	Viking and Bergen Bank area	47-51 E6 + F0-F5; 52 E6-F5
6.4.21.6	6	Division IIIa East (Kattegat)	41-43 G0-G3; 44 G1
6.4.21.7	7	Shetland area	47-51 E7-E9

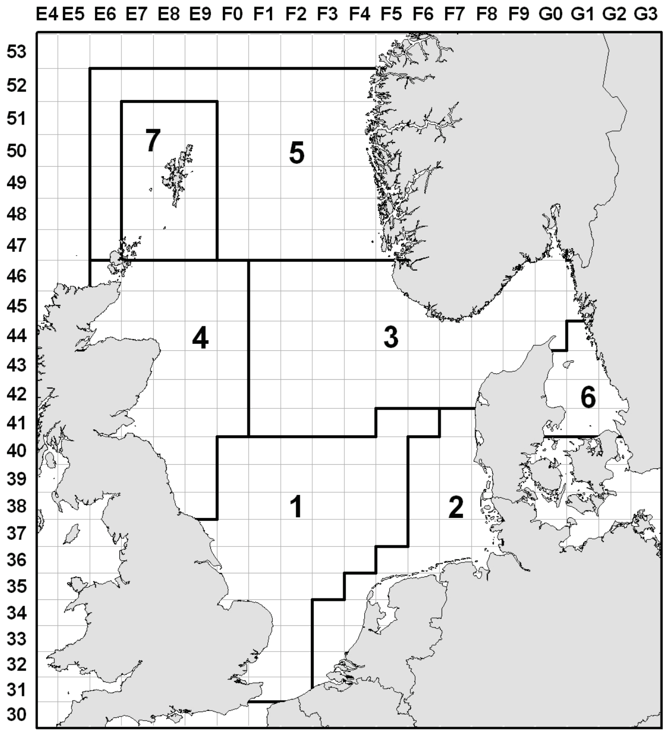


Figure 6.4.21.1 Sandeel in Division IIIa and Subarea IV. Map of Sandeel Areas (SA).

Advice for 2011

Following the ICES advice provided in October 2010, dredge survey information from December 2010 became available and was used to estimate recruitment for 2010 and to conduct forecasts for 2011. Updated advice is given for Sandeel Areas 1, 2, 3 and 4. For the other three areas, the information provided in 2010 is extended. The advice summary for sandeel in different areas is given in sections 6.4.21.1–7. A summary can be found in table 6.4.2.1.1.

Prior to 2010, ICES presented advice for this region in three units: North Sea excluding the Shetland area, the Shetland area and the Skagerrak Kattegat. From 2010 onward, ICES advice is provided for these seven areas to better reflect the stock structure and to enable management to direct action avoiding local depletions, as has been repeatedly advised in recent years. The amount of scientific and fisheries information differs by area and so does the level of detail per advice.

Table 6.4.21.1 Sandeel in Division IIIa and Subarea IV. Advice overview for all areas.

Year	Sandeel Area 1	Sandeel Area 2	Sandeel Area 3	Sandeel Area 4	Sandeel Area 5	Sandeel Area 6	Sandeel Area 7	Agreed TAC [1)]	ICES landings
2005 [2]	-	-	-	-	-	No advice	No advice	661	172
2006 [2]	-	-	-	-	-	No advice	No advice	300	288
2007 [2]	-	-	-	-	-	No advice	No advice	173	206
2008 [2]	-	-	-	-	-	No advice	No advice	400	335
2009 [2]	-	-	-	-	-	No advice	No advice	400	347
2010	-	-	-	-	-	No advice	No advice	400	398[3]
2011	< 320	< 34	0	5–10	No advice, no increase in effort unless evidence that this is sustainable				

Weights in '000 t
[1] Advice for Subarea IV excluding the Shetland area.
[2] Set for zone IIIa, EC waters of Division IIa and Subarea IV.
[3] Preliminary

Biology

Sandeel is a short-lived species. The high natural mortality of sandeel and the few age groups in the fishery imply that stock size and catch opportunities are largely dependent on the abundance of incoming year classes. Sandeel are largely stationary after settlement and there is a complex of local (sub-) stocks in the North Sea. Whilst recruitment to individual fishing banks is largely related to the local (sub-) stock, some interchange can occur between (sub-) stocks before sandeel larvae settle.

Environmental influence on the stock

Sandeel is a prey for many predators. Changes in the abundances of predators will have affect sandeel natural mortality.

There are indications that the survival of sandeel larvae is linked to the availability of copepod prey in the early spring, especially *Calanus finmarchicus* supports the survival of sandeel larvae, and that climate-generated shifts in the *Calanus* species composition lead to a mismatch in timing between food availability and the early life history of lesser sandeel (Wright and Bailey, 1996; van Deurs *et al.,* 2009).

The fisheries

Sandeel is taken by trawlers using small-mesh demersal gear. The fishery is seasonal, taking place mostly in the spring and summer. Most of the catch consists of *Ammodytes marinus*, but other sandeel species are caught as well.

Effects of the fisheries on the ecosystem

Sandeel fisheries have a low percentage of bycatch of other fish species, including species for which a TAC has been set (ICES, 2010). A major function of sandeel in the North Sea ecosystem is the provision of food to predators, including fish, marine mammals, and seabirds. As previously noted by ICES, local depletion of sandeel aggregations at a distance less than 100 km from seabird colonies may affect some species of birds, especially black-legged kittiwake and terns, whereas the more mobile marine mammals and fish may be less vulnerable.

Additional considerations

MSY reference points

For short-lived species such as sandeel, the ICES interpretation of the MSY concept uses B_{pa} estimates as the default value for MSY $B_{escapement}$. ICES advice is based on the sandeel stock being at or above MSY $B_{escapement}$ in the year after the advised fishery has taken place. This escapement strategy should allow for sufficient stock to remain for successful recruitment and providing adequate resource for predators of sandeel.

Regulations and their effects

In the light of studies linking low sandeel availability to poor breeding success of kittiwake, all commercial fishing in the Firth of Forth (SA 4) has been prohibited since 2000, except for a limited opening for fishery in May and June of each year to monitor the stock.

Since 2004, sandeel catch regulation has been based on the abundance of 1-group sandeel, as estimated from an exploratory fishery in the beginning of the fishing season.

The number of Danish vessels has declined from 200 vessels in 2004 to 84 in 2009, leading to a 43% reduction in total kilowatt days. In 2007, the Danish industrial vessels were given individual tradable quotas (ITQ) on sandeel which prompted a change towards fewer and larger vessels. The Norwegian fleet fishing for sandeel declined from 90 to 33 vessels between 2002 and 2009.

Changes in fishing technology and fishing patterns

Before 2004, a targeted 0-group fishery occurred in autumn (3rd quarter). This fisheries subsequently ceased.

Uncertainties in assessment and forecast

The quality of the current assessment is considered much improved compared to the combined assessment for whole North Sea conducted before 2010. This is because the stock assessment areas used now better reflect the actual spatial stock structure and dynamics of sandeel. The use of fishery independent data from dredge surveys has also improved the quality of the assessment. Application of the new statistical assessment model "SMS-effort" in combination with the area-based assessment approach has removed retrospective bias in F and SSB for the most recent years. This is probably due to the robust model assumption of fishing mortality being proportional to fishing effort.

The confidence limits of the model estimates of F, SSB and recruitment indicate a high to medium precision for the SA 1 assessment, a medium precision for the SA 2 assessment and a lower precision for the SA 3 assessment.

The sources of uncertainty within the new assessment and forecast framework are derived from the following sources:

- Use of common, time-invariant natural mortality values over all areas.
- Assumption of correspondence between commercial effort and fishing mortality.
- Observations of effort are only available from the Danish fishery (which also has the largest catches).
- Age and length sampling uncertainty (as with any stock).
- Assumption that the maturity pattern in the forecast year is the long term average.

Comparison with previous assessment and advice

The 2010 dredge survey results confirmed a large 2009 year classes in area 1, 2 and 4 and a modest 2009 year class in area 3. For all areas the 2010 year class was estimated to be low.

Sources

ICES. 2010. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 5–11 May 2010 ICES CM 2010/ACOM13.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, ICES CM 2011/ACOM13.

van Deurs, M., van Hal, R., Tomczak, M.T., Jónasdóttir, S.H., Dolmer, P. 2009. Recruitment of lesser sandeel *Ammodytes marinus* in relation to density dependence and zooplankton composition. Marine Ecology Progress Series, 381: 249–258.

Wright, P.J., Bailey, M.C. 1996. Timing of hatching in Ammodytes marinus from Shetland waters and its significance to early growth and survivorship. Marine Biology 126:143–152

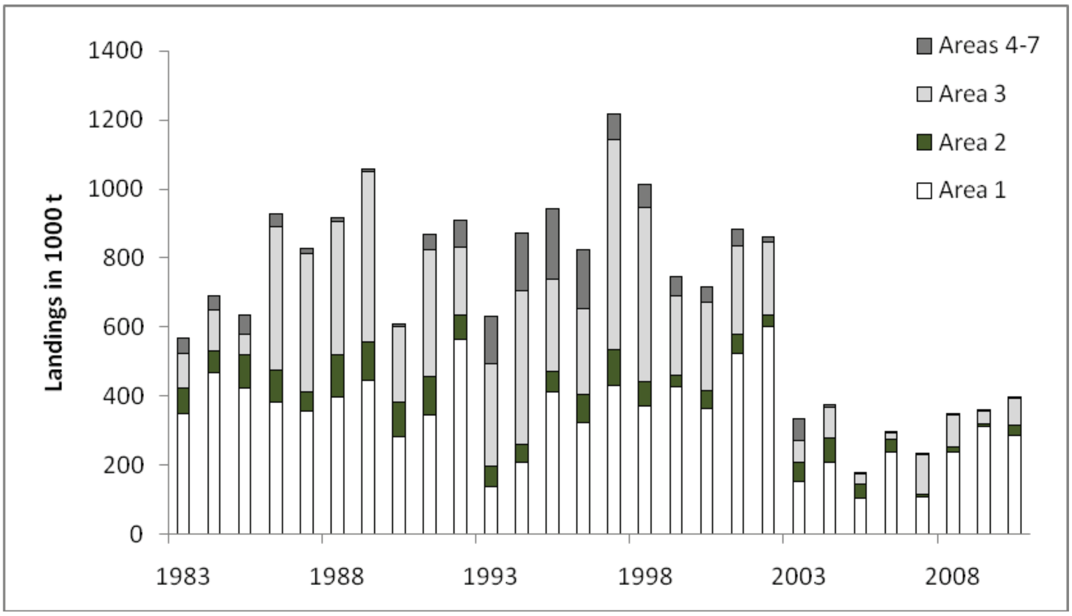


Figure 6.4.21.2 Sandeel in Division IIIa and Subarea IV. Total landings by Sandeel Area ('000 tonnes).

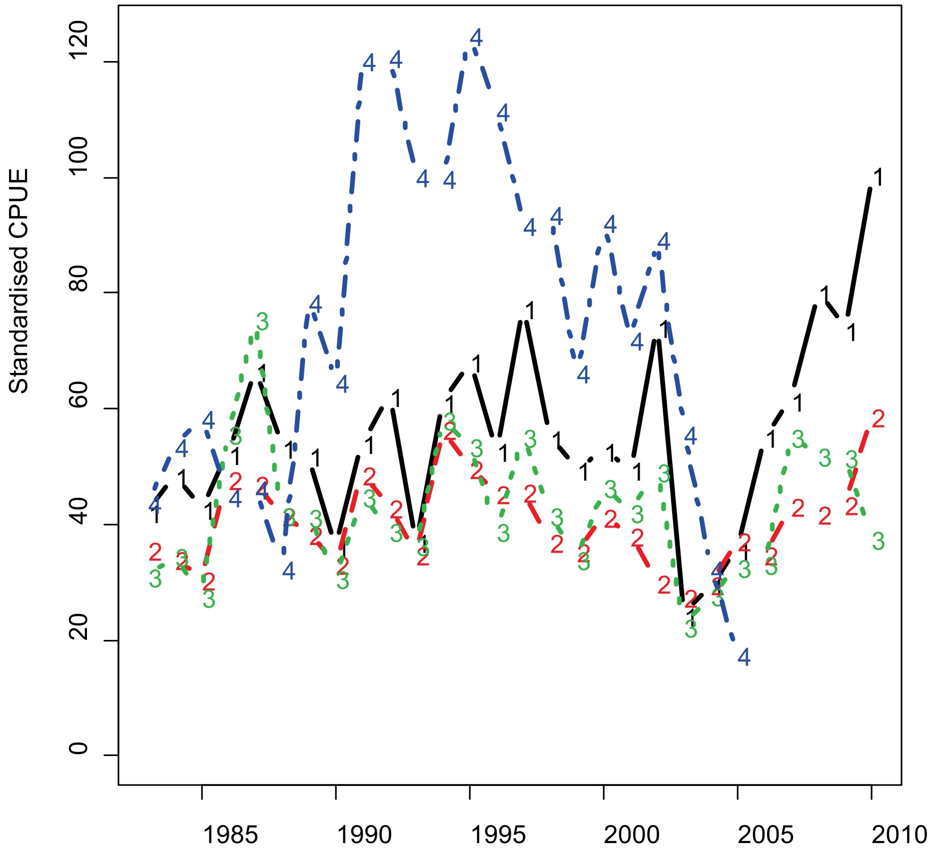


Figure 6.4.21.3 Sandeel in Division IIIa and Subarea IV. Catch (tonnes) per day fishing for a standardised 200GT vessel for Sandeel Area 1-4. Figure labels correspond to area.

Table 6.4.21.2 Sandeel in Division IIIa and Subarea IV. Total landings (tonnes) by Sandeel Area reported to ICES. Yield values used for assessments per area are corrected for SOP (Sum of Products of catch numbers by mean weight at age) and hence may differ slightly from landings values in this table.

Year	SA 1	SA 2	SA 3	SA 4	SA 5	SA 6	SA 7	All
1983	349,397	74,479	100,330	2,588	2,815	0	37,201	566,810
1984	467,664	63,077	118,651	2,443	6,103	0	33,161	691,098
1985	424,058	96,658	57,835	37,060	2,929	0	17,320	635,858
1986	382,912	93,104	414,911	12,505	10,517	0	14,023	927,973
1987	357,714	53,292	400,402	8,108	1,535	0	7,367	828,417
1988	398,221	120,387	387,994	1,324	2,450	0	4,953	915,330
1989	446,151	109,830	492,999	4,389	2,040	909	0	1,056,318
1990	283,148	100,920	219,023	3,313	605	499	0	607,508
1991	347,102	107,812	368,801	41,429	2,532	17	0	867,694
1992	564,287	69,848	195,733	68,905	4,551	4,277	0	907,600
1993	136,600	59,848	296,232	133,197	401	4,490	0	630,768
1994	209,631	50,648	444,084	159,789	2,765	3,748	0	870,666
1995	410,687	60,143	266,720	52,759	150,637	1,830	0	942,776
1996	324,561	80,205	250,252	162,338	6,176	1,263	0	824,796
1997	431,871	102,730	608,164	59,353	11,279	2,373	2,068	1,217,839
1998	371,060	68,950	507,269	58,460	2,984	936	5,182	1,014,841
1999	428,307	32,117	228,163	53,959	140	134	4,263	747,083
2000	363,356	52,235	256,250	37,748	325	680	4,370	714,964
2001	521,724	58,645	253,088	47,828	1,687	312	976	884,260
2002	599,585	35,553	209,344	12,213	10	2,378	521	859,604
2003	150,711	56,262	62,569	64,002	44	869	261	334,718
2004	206,696	71,426	87,695	6,915	0	570	0	373,302
2005	103,777	41,447	29,667	1,486	0	262	0	176,640
2006	238,296	35,392	18,867	85	0	161	0	292,802
2007	109,363	5,910	113,905	11	4	661	0	229,855
2008	238,523	13,065	94,576	1,201	0	472	0	347,836
2009	310,471	10,239	34,052	0	0	260	0	355,022
2010	285,794	30,530	78,067	262	0	132	0	394,785
arith. mean	337,917	62,670	235,559	36,917	7,590	973	4,702	686,327

Table 6.4.21.3 Sandeel in Division IIIa and Subarea IV. Landings ('000 t) per country as provided by Working Group members.

Year	Denmark	Germany	Faroes	Ireland	Netherlands	Norway	Sweden	UK	Lithuania	Total
1952	1.6	-	-	-	-	-	-	-		1.6
1953	4.5	+	-	-	-	-	-	-		4.5
1954	10.8	+	-	-	-	-	-	-		10.8
1955	37.6	+	-	-	-	-	-	-	-	37.6
1956	81.9	5.3	-	-	+	1.5	-	-	-	88.7
1957	73.3	25.5	-	-	3.7	3.2	-	-	-	105.7
1958	74.4	20.2	-	-	1.5	4.8	-	-	-	100.9
1959	77.1	17.4	-	-	5.1	8.0	-	-	-	107.6
1960	100.8	7.7	-	-	+	12.1	-	-	-	120.6
1961	73.6	4.5	-	-	+	5.1	-	-	-	83.2
1962	97.4	1.4	-	-	-	10.5	-	-	-	109.3
1963	134.4	16.4	-	-	-	11.5	-	-	-	162.3
1964	104.7	12.9	-	-	-	10.4	-	-	-	128.0
1965	123.6	2.1	-	-	-	4.9	-	-	-	130.6
1966	138.5	4.4	-	-	-	0.2	-	-	-	143.1
1967	187.4	0.3	-	-	-	1.0	-	-	-	188.7
1968	193.6	+	-	-	-	0.1	-	-	-	193.7
1969	112.8	+	-	-	-	-	-	0.5	-	113.3
1970	187.8	+	-	-	-	+	-	3.6	-	191.4
1971	371.6	0.1	-	-	-	2.1	-	8.3	-	382.1
1972	329.0	+	-	-	-	18.6	8.8	2.1	-	358.5
1973	273.0	-	1.4	-	-	17.2	1.1	4.2	-	296.9
1974	424.1	-	6.4	-	-	78.6	0.2	15.5	-	524.8
1975	355.6	-	4.9	-	-	54.0	0.1	13.6	-	428.2
1976	424.7	-	-	-	-	44.2	-	18.7	-	487.6
1977	664.3	-	11.4	-	-	78.7	5.7	25.5	-	785.6
1978	647.5	-	12.1	-	-	93.5	1.2	32.5	-	786.8
1979	449.8	-	13.2	-	-	101.4	-	13.4	-	577.8
1980	542.2	-	7.2	-	-	144.8	-	34.3	-	728.5
1981	464.4	-	4.9	-	-	52.6	-	46.7	-	568.6
1982	506.9	-	4.9	-	-	46.5	0.4	52.2	-	610.9
1983	485.1	-	2.0	-	-	12.2	0.2	37.0	-	536.5
1984	596.3	-	11.3	-	-	28.3	-	32.6	-	668.5
1985	587.6	-	3.9	-	-	13.1	-	17.2	-	621.8
1986	752.5	-	1.2	-	-	82.1	-	12.0	-	847.8
1987	605.4	-	18.6	-	-	193.4	-	7.2	-	824.6
1988	686.4	-	15.5	-	-	185.1	-	5.8	-	892.8
1989	824.4	-	16.6	-	-	186.8	-	11.5	-	1039.1
1990	496.0	-	2.2	-	0.3	88.9	-	3.9	-	591.3
1991	701.4	-	11.2	-	-	128.8	-	1.2	-	842.6
1992	751.1	-	9.1	-	-	89.3	0.5	4.9	-	854.9
1993	482.2	-	-	-	-	95.5	-	1.5	-	579.2
1994	603.5	-	10.3	-	-	165.8	-	5.9	-	785.5
1995	647.8	-	-	-	-	263.4	-	6.7	-	917.9
1996	601.6	-	5.0	-	-	160.7	-	9.7	-	776.9
1997	751.9	-	11.2	-	-	350.1	-	24.6	-	1137.8
1998	617.8	-	11.0	-	+	343.3	8.5	23.8	-	1004.4
1999	500.1	-	13.2	0.4	+	187.6	22.4	11.5	-	735.1
2000	541.0	-	-	-	+	119.0	28.4	10.8	-	699.1
2001	630.8	-	-	-	-	183.0	46.5	1.3	-	861.6
2002	629.7	-	-	-	-	176.0	0.1	4.9	-	810.7
2003	274.0	-	-	-	-	29.6	21.5	0.5	-	325.6
2004	277.1	2.7	-	-	-	48.5	33.2	+	-	361.5
2005	154.8	-	-	-	-	17.3	-	-	-	172.1
2006	250.6	3.2	-	-	-	5.6	27.8	-	-	287.9
2007	144.6	1.0	2.0	-	-	51.1	6.6	1.0	-	206.3
2008	234.4	4.4	2.4	-	-	81.6	12.4	-	-	335.2
2009	285.7	12.2	2.5	-	1.8	27.4	12.1	3.6	2.0	347.4
2010	275.1	13.0	-			78.0	32.0		0.2*	398.3*

* Preliminary
+ = less than half unit.
- = no information or no landings.

ECOREGION North Sea
STOCK Sandeel in the Dogger Bank area (SA 1)

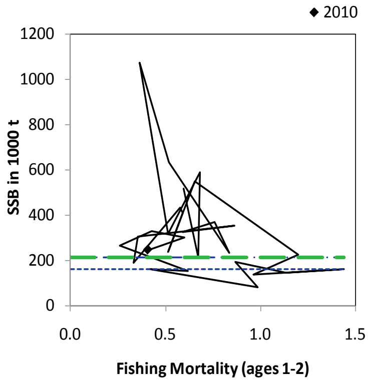
Advice for 2011

ICES advises on the basis of the MSY approach that the catch in 2011 should be less than 320 000 t to maintain SSB in 2012 above MSY $B_{escapement}$.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
	SSB (Spawning Stock Biomass)			
	2009	2010	2011	
MSY ($B_{escapement}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



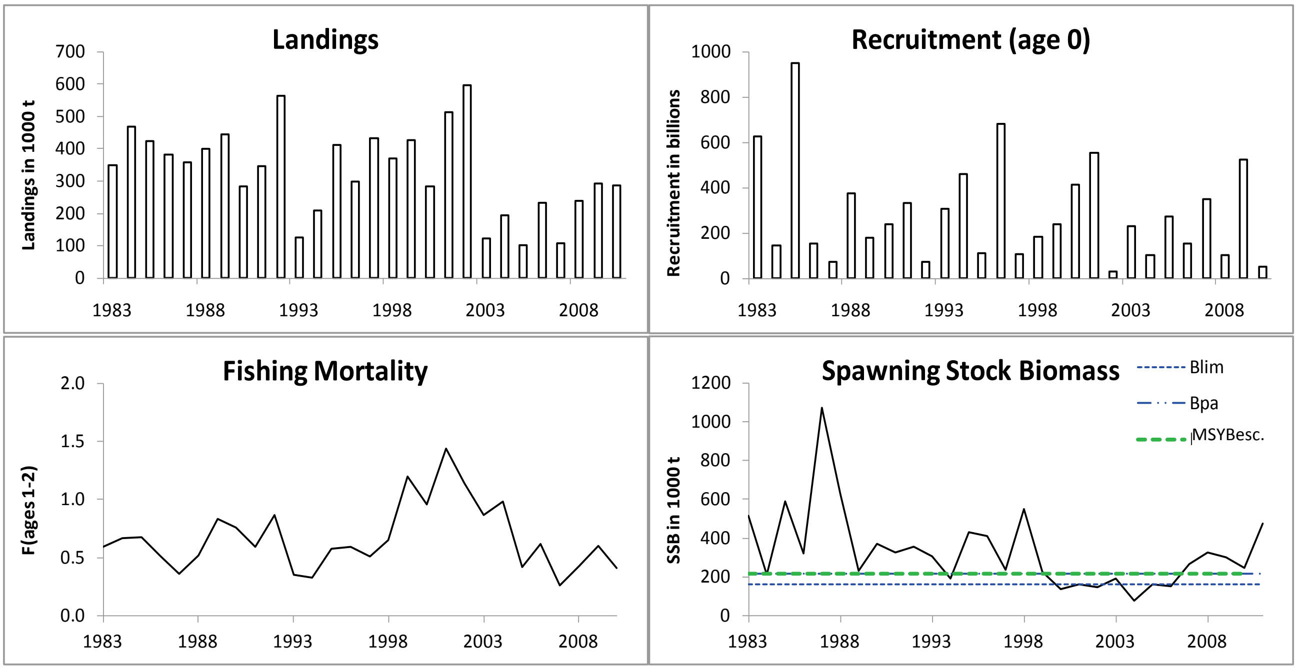


Figure 6.4.21.1.1 Sandeel in the DoggerBank area (SA1). Summary of stock assessment (weights in '000 t). Top right: SSB and F over the years.

The stock at the start of 2011 is expected to be at full reproductive capacity owing to the large recruitment in 2009. Fishing mortality decreased in 2005 from a high level and has since fluctuated without trend.

Management plans

No specific management objectives are known to ICES.

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5. ICES notes that the TAC and the stock assessment areas do not match.

Fisheries

Catch by fleet	Total catch (2010) 286 kt where 100% landings by industrial fisheries

Quality considerations

The December 2010 dredge survey results confirmed the very large 2009 year class observed in the fishery in 2010. Although there is high uncertainty on the absolute size of the 2010 year class, the survey index suggests that this cohort is likely to be in the very low end of the historical time series.

Scientific basis

Assessment type	Seasonal age based analytical (SMS-effort)
Input data	1 survey index in December (Dredge survey 2004-)
	Total international fishing effort
Discards and bycatch	Not included in the assessment
Indicators	None
Other information	Last benchmark in 2010.
Working group report	WGNSSK

6.4.21.1 **Supporting information February 2011**

ECOREGION **North Sea**
STOCK **Sandeel in the Dogger Bank area (SA 1)**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{escapement}$	215 000 t	= B_{pa}
	F_{MSY}	Not defined	
Precautionary Approach	B_{lim}	160 000 t	Median SSB in the years (2000–2006) of lowest SSB and no impaired recruitment (ICES, 2010)
	B_{pa}	215 000 t	$B_{pa}=B_{lim}*\exp^{(\sigma*1.645)}$ with σ=0.18 estimated from assessment uncertainty in the terminal year (ICES, 2010)
	F_{lim}	Not defined	
	F_{pa}	Not defined	

(unchanged since: 2010)

Outlook for 2011

Basis: Fsq=F(2010)=0.34; Yield(2010)=286; Recruitment(2010)=50 billion; Recruitment(2011)= geometric mean (GM 83-09) = 223 billion; SSB(2011)=430

Rationale	Landings (2011)	Basis	F (2011)	SSB (2012)	%SSB change[1]
Zero catch	0	F=0	0	410	-4%
	50	Fsq*0.25	0.08	380	-11%
	96	Fsq*0.50	0.17	350	-18%
	140	Fsq*0.75	0.25	330	-24%
Status quo	180	Fsq*1	0.34	300	-30%
	210	Fsq*1.25	0.42	280	-35%
	250	Fsq*1.50	0.50	260	-40%
	280	Fsq*1.75	0.59	240	-45%
	310	Fsq*2	0.67	220	-49%
MSY-approach	320	Fsq*2.08	0.70	220	-50%

Weights in ‘000 t.
[1)] SSB 2012 relative to SSB 2011.

MSY approach
Following the ICES MSY framework for a short lived species the fishery in 2011 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of less than 320 000 t in 2011.

Policy paper
In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5, because this is a short lived species. ICES notes that the TAC and the stock assessment areas do not match.

Additional considerations

Uncertainties in assessment and forecast

The dredge survey results are is sufficiently robust to provide a reliable estimate of the incoming 1-group. Hence, fishing opportunities for 2011 can be established based on this information.

Management plans

A management plan needs to be developed. The ICES approach for MSY based management of a short-lived species as sandeel is an escapement strategy, i.e. to maintain SSB above MSY $B_{escapement}$ after the fishery has taken place. With the current MSY $B_{escapement}$ at B_{pa} (215 000 t) the outlook table indicates that the 2011 catch according to the MSY approach will require an F at 0.70, which is twice the F value in 2010. However, taking the historical F and stock development into account an F value above 0.6 is probably not recommendable. As effort is assumed proportional to F, effort must be doubled to take the TAC in 2012. A management plan should include an upper limit on effort estimated on the basis of the effort applied in the most recent years.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, ICES CM 2011/ACOM13.

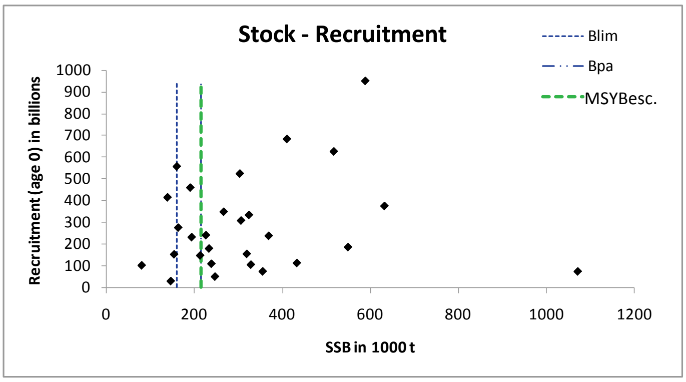


Figure 6.4.21.1.2 Sandeel in the Dogger Bank area (SA1). Stock–recruitment plot.

Table 6.4.21.1.1 Sandeel in the Dogger Bank area (SA1). ICES advice, management and landings

Year	ICES Advice	Catch corresponding to advice	TAC [2]	ICES Landings SA1	ICES Landings Total
2005 [1]	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class	-	661	104	172
2006 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007.	-	300	238	288
2007 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2008.	-	173	109	206
2008 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2009.	-	400	239	335
2009 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2010	-	400	310	347
2010 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2011	-	400	286	402
2011	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 320			

Weights in '000 t.

[1] Advice for Subarea IV excluding the Shetland area.

[2] Set for zone IIIa, EC waters of Division IIa and Subarea IV.

Table 6.4.21.1.4 Sandeel in the Dogger Bank area (SA1). Summary of the assessment.

Year	Recruits (million)	TSB (tonnes)	SSB (tonnes)	Yield (tonnes)	Mean F ages 1-2
1983	624999	705504	516578	349232	0.593
1984	146868	1502250	212681	467609	0.671
1985	949287	1002100	588145	424114	0.679
1986	154159	2291220	318719	382735	0.513
1987	73517	1607230	1071200	357671	0.362
1988	374394	782061	631713	398271	0.518
1989	178837	816099	232759	445695	0.833
1990	237255	705553	368557	283040	0.759
1991	333141	1083600	323676	347096	0.590
1992	73641	1315990	354859	564298	0.864
1993	307426	551211	305634	124082	0.352
1994	458848	826458	190239	209538	0.331
1995	112303	1802890	432631	410513	0.578
1996	682124	699271	410037	298702	0.589
1997	108893	2102340	238242	431808	0.511
1998	185283	899570	548917	371117	0.652
1999	240085	606838	225830	427691	1.198
2000	414021	704641	138388	284521	0.960
2001	556016	873627	159572	513068	1.437
2002	29121	1376710	145830	596049	1.136
2003	230977	265522	193364	121863	0.865
2004	101371	508802	79690	195274	0.983
2005	274993	400372	162804	100835	0.418
2006	152165	772613	153474	231448	0.616
2007	347812	598874	266195	108600	0.258
2008	104680	1151790	328004	237447	0.427
2009	523224	671086	302830	291247	0.598
2010	49689	1534960	246330	285540	0.407
2011			473850		
arith. Mean	286612	1005685	331750	330682	0.668
geo. Mean[1]	222948				

1) Period 1983-2009

ECOREGION North Sea
STOCK Sandeel in the South Eastern North Sea (SA 2)

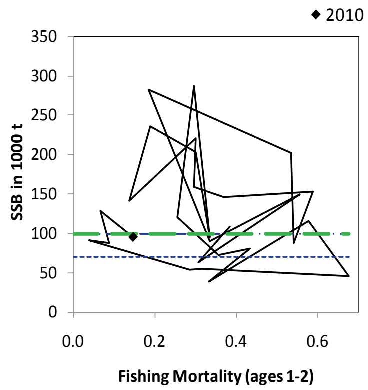
Advice for 2011

ICES advises on the basis of the MSY approach that catch in 2011 should be less than 34 000 t in 2011 to maintain SSB in 2012 above MSY $B_{escapement}$.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

	F (Fishing Mortality)			
	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
	SSB (Spawning Stock Biomass)			
	2009	2010	2011	
MSY ($B_{escapement}$)	✔	✘	✔	Above trigger
Precautionary approach (B_{pa},B_{lim})	✔	O	✔	Full reproductive capacity



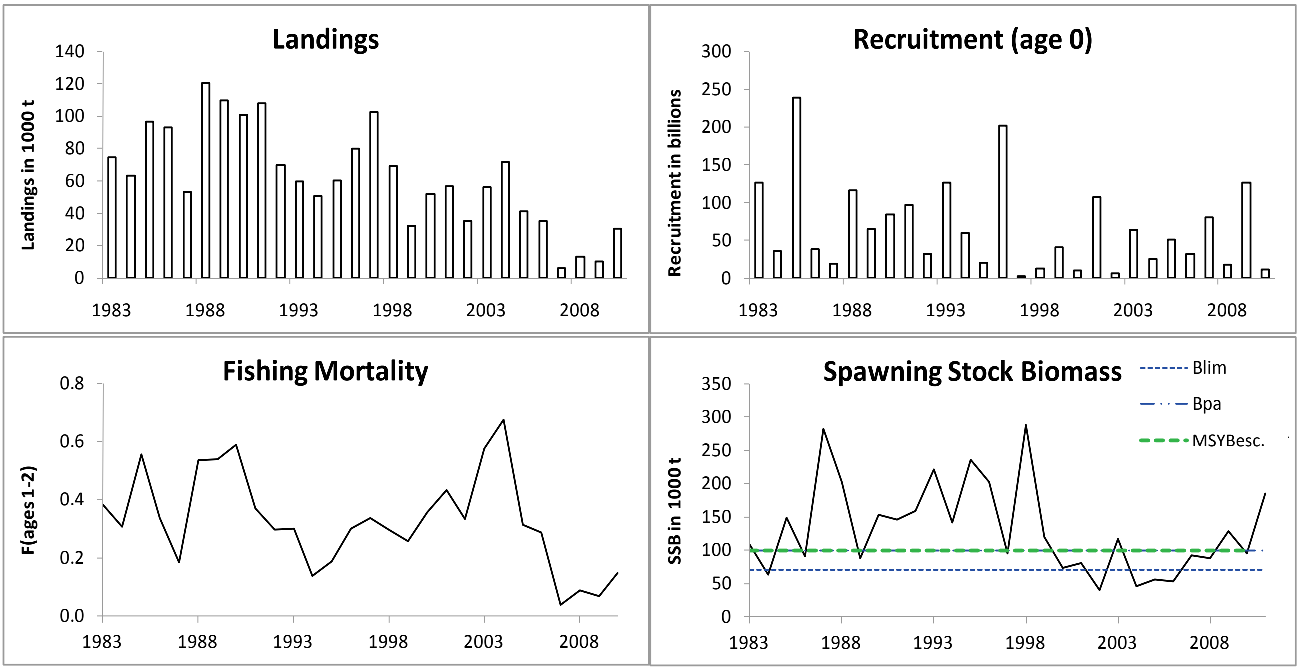


Figure 6.4.21.2.1 Sandeel in the South Eastern North Sea (SA2). Summary of stock assessment (weights in '000 t). Top right: SSB and F over the years

Due to low values of F (~ 0.1) since 2007 and the strong 2009 year class, SSB in 2011 is estimated around twice as high as B_{pa}.

Management plans

No specific management objectives are known to ICES.

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5. ICES notes that the TAC and the stock assessment areas do not match.

Fisheries

Catch by fleet	Total catch (2010) 31 kt where 100 % landings by industrial fisheries.

Quality considerations

The December 2010 dredge survey results confirmed the very large 2009 year class observed in the fishery in 2010. Although there is high uncertainty on the absolute size of the 2010 year class, the survey index suggests that this cohort is likely to be in the very low end of the historical time series.

Scientific basis

Assessment type	Seasonal age based analytical (SMS-effort)
Input data	1 survey index (Dredge survey, 2004-) from Area 1 is applied Total international fishing effort
Discards and bycatch	Not included in the assessment
Indicators	None
Other information	Last benchmark in 2010.
Working group report	WGNSSK

6.4.21.2 Supporting information February 2011

ECOREGION **North Sea**
STOCK **Sandeel in the South Eastern North Sea (SA 2)**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{escapement}$	100 000 t	= B_{pa}
	F_{MSY}	Not defined	
Precautionary Approach	B_{lim}	70 000 t	Median SSB in the years (2000–2006) of lowest SSB and no impaired recruitment (ICES, 2010)
	B_{pa}	100 000 t	$B_{pa}=B_{lim}*exp^{(\sigma*1.645)}$ with σ=0.23 estimated from assessment uncertainty in the terminal year (ICES, 2010)
	F_{lim}	Not defined	
	F_{pa}	Not defined	

(unchanged since: 2010)

Outlook for 2011

Basis: Fsq=F(2010)=0.14; Yield(2010)=31; Recruitment(2010)=11 billion; Recruitment(2011)= geometric mean (GM 83-09) = 45 billion; SSB(2011)=188.

Rationale	Landings (2011)	Basis	F (2011)	SSB (2012)	%SSB change[1]
Zero Catch	0	F=0	0	130	-33%
	7	Fsq*0.25	0.04	120	-36%
	13	Fsq*0.50	0.07	120	-38%
	19	Fsq*0.75	0.11	110	-41%
Status quo	25	Fsq*1	0.14	110	-43%
	31	Fsq*1.25	0.18	100	-45%
MSY-approach	34	Fsq*1.40	0.20	100	-47%
	36	Fsq*1.50	0.21	98	-48%
	41	Fsq*1.75	0.25	94	-50%
	47	Fsq*2	0.28	90	-52%

Weights in '000 t.
[1)] SSB 2012 relative to SSB 2011.

MSY approach

Following the ICES MSY framework for a short lived species the fishery in 2011 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of less than 34 000 t in 2011.

Policy paper

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5, because this is a short-lived species. ICES notes that the TAC and the stock assessment areas do not match.

Additional considerations

Uncertainties in assessment and forecast

There appears to be a sufficiently robust relationship between the recruitments in SA 1 and SA 2 to be able to use the same data sources and procedures from SA 1 for the estimation of the incoming year class strength. The dredge survey was expanded in 2010 to cover area 2.

Management plans

A management plan needs to be developed. The ICES approach for MSY based management of a short-lived species as sandeel is the escapement strategy, i.e. to maintain SSB above MSY $B_{escapement}$ after the fishery has taken place. Such an approach does not include an upper limit on F. However, taking the historical F and stock development into account an F value above 0.4-0.5 is probably not recommendable. Such an F ceiling can be expressed as an effort limit for management usage as fishing mortality is assumed proportional to effort.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, ICES CM 2011/ACOM:13.

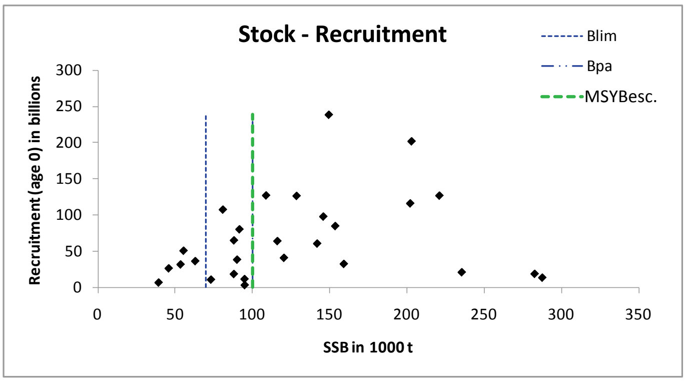


Figure 6.4.21.2.2 Sandeel in the South Eastern North Sea (SA2). Stock–recruitment plot.

Table 6.4.21.2.1 Sandeel in the South Eastern North Sea (SA2). ICES advice, management and landings

Year	ICES Advice	Catch corresponding to advice	TAC [2]	ICES Landings SA2	ICES Landings Total
2005 [1]	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class	-	661	41	172
2006 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007.	-	300	35	288
2007 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2008.	-	173	6	206
2008 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2009.	-	400	13	335
2009 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2010	-	400	10	347
2010 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2011	-	400	31	402
2011	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 34			

Weights in '000 t.

[1] Advice for Subarea IV excluding the Shetland area.

[2] Set for zone IIIa, EC waters of Division IIa and Subarea IV.

Table 6.4.21.2.4 Sandeel in the South Eastern North Sea (SA2). Summary of the assessment.

Year	Recruits (million)	TSB (tonnes)	SSB (tonnes)	Yield (tonnes)	Mean F ages 1-2
1983	127058	151775	108802	74481	0.383
1984	36278	326571	62947	63046	0.306
1985	238563	248260	149408	96645	0.555
1986	38332	586268	90031	93146	0.335
1987	18705	415460	282628	53284	0.184
1988	116061	240438	202090	120382	0.535
1989	64956	271447	88007	109703	0.540
1990	84749	277160	153555	100917	0.587
1991	97869	418513	145842	107795	0.369
1992	32427	436339	159113	69825	0.297
1993	126814	353954	220981	59652	0.301
1994	60542	516387	141866	50656	0.138
1995	20914	452347	235459	60138	0.188
1996	201859	309225	202961	80012	0.300
1997	3145	649194	94993	102726	0.335
1998	13433	349607	287570	68953	0.296
1999	40814	177520	120354	32108	0.256
2000	10702	236062	73132	52228	0.355
2001	107467	134520	80838	56934	0.433
2002	6658	318847	39240	35494	0.332
2003	63967	159762	116110	55924	0.576
2004	26297	228285	45770	71413	0.676
2005	50677	135432	55374	41420	0.315
2006	31683	220979	53449	35351	0.286
2007	80246	208715	91560	5911	0.039
2008	18446	308837	87941	13064	0.088
2009	126414	193851	128541	10240	0.067
2010	11481	401504	94852	30531	0.147
2011			184604		
arith. mean	66306	311688	130966	62571	0.329
geo. mean[1]	44626				

1) Period 1983–2009

ECOREGION North Sea
STOCK Sandeel in the Central Eastern North Sea (SA 3)

Advice for 2011

ICES advises on the basis of the MSY approach that no catches of sandeel in area 3 should be allowed in 2011.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

	F (Fishing Mortality)		
	2008	2009	**2010**
MSY (F_{MSY})	?	?	? Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	? Undefined
	SSB (Spawning Stock Biomass)		
	2009	2010	**2011**
MSY ($B_{escapement}$)	✗	✓	✓ Above trigger
Precautionary approach (B_{pa},B_{lim})	✗	✓	✓ Full reproductive capacity

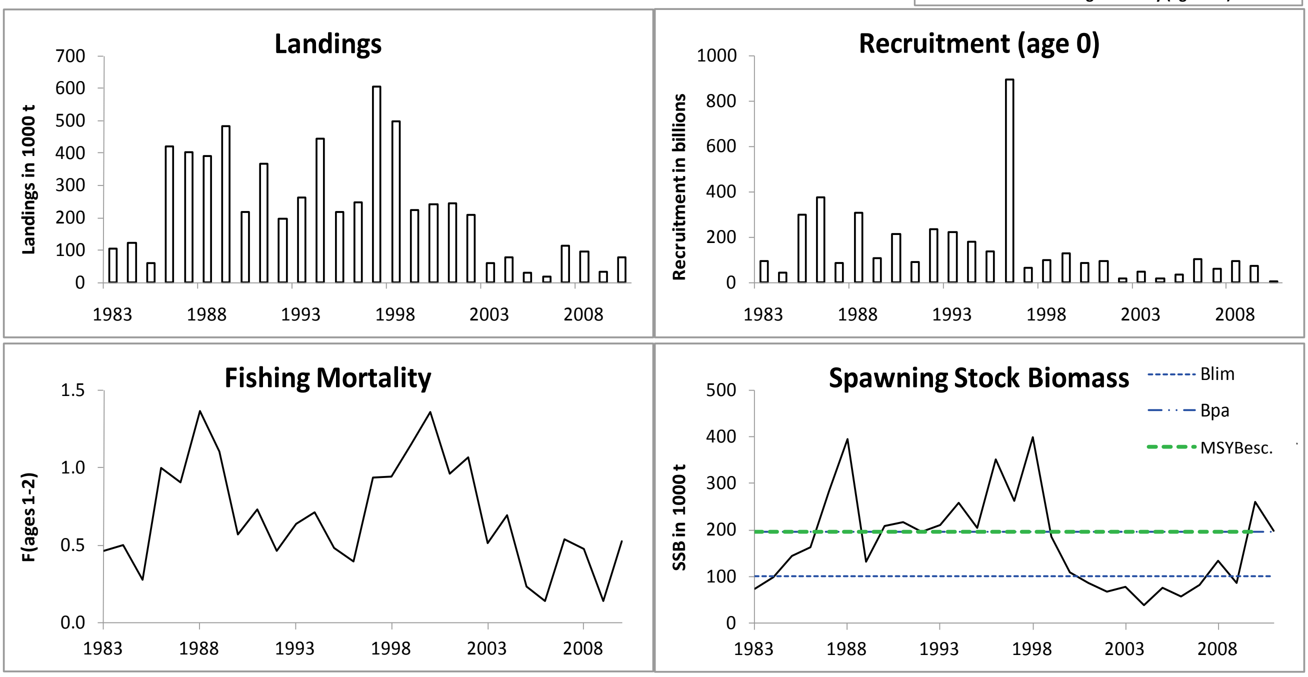


Figure 6.4.21.3.1 Sandeel in the Central Eastern North Sea (SA3). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

The stock has increased from a record low SSB in 2004 (at half of B_{lim}) to above B_{pa} in 2010. SSB in 2011 is estimated to be just above B_{pa} and MSY $B_{escapement}$. Recruitment was above the long term mean in 2001 and has been below since with a very low recruitment in 2010. Since 2004, F has been highly variable between years and below the long-term mean.

Management plans

No specific management objectives are known to ICES.

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5. ICES notes that the TAC and the stock assessment areas do not match.

The fisheries

Catch by fleet	Total catch (2010) 78 kt where 100 % landings by industrial fisheries

Quality considerations

The assessment is considered less robust than the assessments for SA 1 and SA 2. The dredge survey only covers the southern part of Area 3. Therefore the very low estimate of recruitment in 2010 is considered uncertain.

Scientific basis

Assessment type	Seasonal age based analytical (SMS-effort)
Input data	1 survey index available in January (Dredge survey, 2004-)
	Total international catch and effort
Discards and bycatch	Not included in the assessment
Indicators	None
Other information	Last benchmark in 2010.
Working group report	WGNSSK

ECOREGION North Sea
STOCK Sandeel in the Central Eastern North Sea (SA 3)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{escapement}$	195 000 t	= B_{pa}
	F_{MSY}	Not defined	
Precautionary Approach	B_{lim}	100 000 t	The highest SSB (in 2001) in the period (2001–2007) with the lowest SSB and low recruitment (ICES, 2010)
	B_{pa}	195 000 t	$B_{pa}=B_{lim}*\exp^{(\sigma*1.645)}$ with σ=0.40 estimated from assessment uncertainty in the terminal year (ICES, 2010)
	F_{lim}	Not defined	
	F_{pa}	Not defined	

(unchanged since: 2010)

Outlook for 2011

Basis: Fsq=F(2010)=0.43; Yield(2010)=78; Recruitment(2010)=4 billion; Recruitment(2011)= geometric mean (GM 83-09) = 105 billion; SSB(2011)=166.

Rationale	Landings (2011)	Basis	F (2011)	SSB (2012)	%SSB change[1]
Zero catch	0	F=0	0	120	-27%
	10	Fsq*0.25	0.10	110	-32%
	20	Fsq*0.50	0.22	110	-36%
	29	Fsq*0.75	0.32	100	-40%
	37	Fsq*1	0.43	95	-43%
	45	Fsq*1.25	0.54	89	-46%
	53	Fsq*1.50	0.64	84	-49%

Weights in '000 t.
1) SSB 2012 relative to SSB 2011.

MSY approach

Following the ICES MSY framework for a short lived species the fishery in 2011 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. ICES advises a zero catch in 2011 as even this will not allow SSB to increase above MSY $B_{escapement}$ in 2012.

Policy paper

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5, because this is a short-lived species. ICES notes that the TAC and the stock assessment areas do not match.

Additional considerations

Uncertainties in assessment and forecast

The assessment is considered less robust than the assessments for SA 1 and SA 2.

No Norwegian effort data are available to ICES with the appropriate resolution. Norwegian fishing effort has therefore been estimated on the basis of Norwegian landings and the assumption that Danish and Norwegian cpue are similar. Observed Norwegian effort would probably increase the quality of the assessment as the Norwegian fleet generally fishes more northerly than the Danish fleet, especially in the most recent years with Danish limitations on the access to the Norwegian EEZ.

The dredge survey covers mainly the southern part of SA 3. A northerly extension of the survey area and coverage of the Skagerrak area would probably increase the quality of the survey results for assessment purpose.

The Benchmark group (ICES, 2010) concluded that the dredge survey estimates of the incoming year class appear less robust for area 3 and it is therefore appropriate that in-season monitoring (e.g. acoustic monitoring and age-based commercial cpue) should continue in area 3. The survey index for the 2010 year-class is very low and outside the range of previously observed values; this might reflect a very low recruitment or simply poor survey coverage. However, the ICES advice from October 2010 indicated that even with zero TAC in 2011 a recruitment higher than 60% of long term average would be required to increase SSB above MSY $B_{escapement}$ in 2012.

Management considerations

Extension of the area covered by the dredge survey will probably reduce the assessment uncertainty.

Pre-season estimates of the incoming year class appear less robust for this area and it is therefore appropriate that in-season monitoring (e.g. acoustic monitoring and age-based commercial cpue) to continue in SA 3. The quality (internal and external consistency) of the acoustic survey is not yet known and the dredge survey results in SA 3 are less consistent than in the other areas.

Norway has set a national quota at 60 000 t in 2011 in three management boxes in the Norwegian EEZ in SA 3, whereas two other management boxes will remain closed. The Norwegian quota is based on acoustic monitoring in April/May 2010. An upcoming acoustic survey in April/May 2011 in Norwegian EEZ will update the information on the stock status; however, the estimated stock abundance from the survey will not be used to change the national quota in SA 3. The sandeel fishery in the Norwegian EEZ was closed in 2009 and no effort data from the 2010 fishery in the Norwegian EEZ were included in the ICES estimates for SA 3. This renders the assessment highly uncertain.

The Norwegian management plan is based on preserving local spawning stocks using a rotational system of opening and closing fishing grounds. The Norwegian EEZ has been divided into six areas, five of which are located in SA 3. If the abundance of sandeel in an area is above a predefined level, half of the area will be opened for fishing. If sandeel abundance remains above the predefined level, the second half of the area will be opened for fishing the following year and the first half will then be closed. ICES has not evaluated the Norwegian management plan for sandeel in the Norwegian part of SA 3.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, ICES CM 2011/ACOM13.

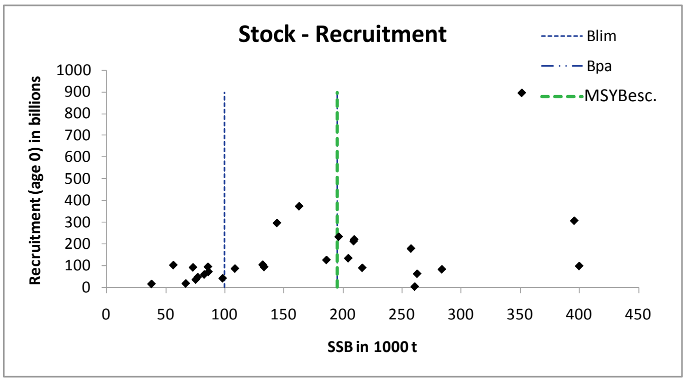


Figure 6.4.21.3.2 Sandeel in the Central Eastern North Sea (SA3). Stock–recruitment plot

Table 6.4.21.3.1 Sandeel in the Central Eastern North Sea (SA3). ICES advice, management and landings

Year	ICES Advice	Catch corresponding to advice	TAC [2]	ICES Landings SA3	ICES Landings Total
2005 [1]	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class	-	661	30	172
2006 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007.	-	300	19	288
2007 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2008.	-	173	114	206
2008 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2009.	-	400	95	335
2009 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2010	-	400	34	347
2010 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2011	-	400	78	402
2011	No fishery	0			

Weights in '000 t.
[1] Advice for Subarea IV excluding the Shetland area.
[2] Set for zone IIIa, EC waters of Division IIa and Subarea IV.

Table 6.4.21.3.4 Sandeel in the Central Eastern North Sea (SA3). Summary of the assessment.

Year	Recruits (million)	TSB (tonnes)	SSB (tonnes)	Yield[1] (tonnes)	Mean F ages 1-2
1983	92758	212748	73212	105946	0.465
1984	42576	303276	98284	123635	0.498
1985	296767	256659	144227	59083	0.274
1986	373688	777859	162984	420341	0.997
1987	83827	1082840	283715	403908	0.906
1988	307226	655548	395663	391081	1.365
1989	105207	814245	132104	481893	1.102
1990	213244	449784	209168	219183	0.568
1991	90715	752755	216384	368105	0.728
1992	233592	396339	196446	195700	0.466
1993	221185	739822	209529	263954	0.640
1994	179289	701169	257567	444119	0.713
1995	134746	591643	204541	218922	0.482
1996	894735	776379	351306	247397	0.394
1997	63391	1661550	262786	604159	0.938
1998	99007	595816	399834	499333	0.940
1999	126854	405745	186104	223160	1.147
2000	87267	416370	108675	242732	1.361
2001	95479	299116	85852	245290	0.961
2002	18789	298045	67089	209302	1.066
2003	47851	126557	77218	58942	0.514
2004	16809	148769	38127	79234	0.692
2005	36661	120188	75562	29677	0.232
2006	103184	148729	56591	18863	0.138
2007	60029	360019	82761	113232	0.536
2008	94415	318333	133409	94491	0.473
2009	72280	321592	86326	33350	0.143
2010	4420	440423	260710	78051	0.525
2011			197580		
arith. mean	149857	506154	174267	231182	0.688
geo. mean[1]	105252				

1) Period 1983-2009

ECOREGION North Sea
STOCK Sandeel in the Central Western North Sea (SA 4)

Advice for 2011

For 2011, ICES advises that a catch between 5000 and 10 000 tonnes is likely to impose a low risk to the sandeel stock in area 4. This is based on precautionary considerations founded on fishery independent data indicating an increasing stock size in recent years.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

F (Fishing Mortality)	2008	2009	2010	
MSY (F_{MSY})	?	?	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	?	Unknown
Qualitative evaluation	→	→	→	Stable and very low

SSB (Spawning Stock Biomass)	2009	2010	2011	
MSY ($B_{escapement}$)	?	?	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	?	?	Unknown
Qualitative evaluation	?	↗	↗	Increase

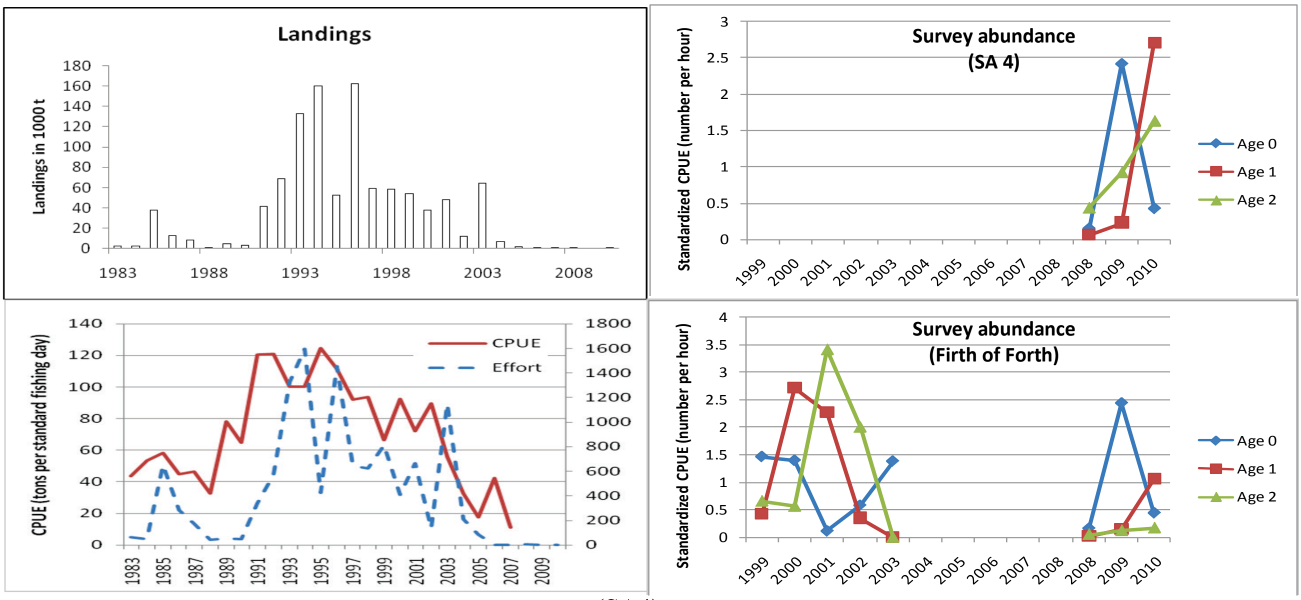


Figure 6.4.21.4.1 Sandeel in the Central Western North Sea (SA4). Top left: landings, bottom left: effort (days fishing/standard 200GT vessel) and catch per unit effort (tons per standard fishing day). Right: catch indices from the dredge survey (number per hour standardized to mean) in the entire Area 4 (top) and in Firth of Forth only (bottom).

Catch and survey data are not sufficient to conduct a traditional age-based assessment. The result from the dredge survey indicates that recruitment (measured as cpue of 0-group) was high in 2009 and low in 2010 as observed in SA 1 and 2. Based on the 3 years of data the temporal changes in 0-group abundance for the whole area 4 appears to follow that in the Firth of Forth. The very limited effort applied in the area indicates a very low fishing mortality.

Management plans

No specific management objectives are known to ICES.
In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5. ICES notes that the TAC and the stock assessment areas do not match.

Fisheries

Because low sandeel availability affects the breeding success of kittiwake, all commercial fishing in the Firth of Forth has been prohibited since 2000, except for a limited fishery conducted in May and June to monitor the stock. This closure includes most of the fishing banks in SA 4. A few banks (e.g. Turbot bank) outside the closed area have historically provided large landings. Almost no sandeel fishery occurred in SA 4 in 2010, probably due to very high catch rates on other fishing banks closer to the landing sites in Denmark and Norway.

Catch by fleet	Total catch (2010) 0.26 kt where 100 % landings by industrial fisheries.

Quality considerations

Prior to the establishment of dedicated recruitment survey in 2008, dredge sampling intensity was low in this area. The Benchmark group (ICES, 2010) noted that because commercial fishing effort has been very low in recent years there was insufficient overlap between dredge and commercial cpue time series to provide reliable estimates of incoming 1-group strength. There are limited data to estimate the risk of overfishing, since fishing effort also depends on fishing opportunities in other areas.

Scientific basis

Assessment type	Trends based assessment
Input data	1 survey index available in January (Dredge survey)
	Total international catch and effort
Discards and bycatch	Not included in the assessment
Indicators	None
Other information	Last benchmark in 2010.
Working group report	WGNSSK

6.4.21.4 Supporting information February 2011

ECOREGION North Sea
STOCK Sandeel in the Central Western North Sea (SA 4)

Reference points

No reference points are defined for this stock.

Outlook for 2011

No forecast can be presented for this stock because catch and survey data are insufficient to conduct a traditional age-based assessment.

PA considerations

The fishery independent data indicate that the recruitment was high in 2009 and low in 2010 as observed in SA 1 and SA 2. Given the large 2009 year class and the moratorium of Firth of Forth since 2000, ICES advises that a TAC in the range of 5000–10 000 t is likely to imply a low risk of overfishing while allowing catches at the low end of the historical range.

Policy paper

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 5, because this is a short-lived species. ICES notes that the TAC and the stock assessment areas do not match.

Additional considerations

It is important to continue the Scottish dredge survey in this area, even though the overlap between this survey and the commercial cpue time series is currently too short to provide reliable estimates of incoming 1-group strength. Little or no information is available for this area from the in-year monitoring system in recent years because of low fishing effort. Until there is sufficient overlap in the time series of dredge survey and commercial data there will be no scientific basis to present a catch forecast.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, ICES CM 2010/ACOM13.

Table 6.4.21.4.1 Sandeel in the Central Western North Sea (SA4). ICES advice, management and landings

Year	ICES Advice	Catch corresponding to advice	TAC [2]	ICES Landings SA4	ICES Landings Total
2005 [1]	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class	-	661	1.49	172
2006 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007.	-	300	0.09	288
2007 [1]	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2008.	-	173	0.01	206
2008 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2009.	-	400	1.20	335
2009 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2010	-	400	0	347
2010 [1]	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2011	-	400	0.26	402
2011	A TAC at 5000 – 10 000 tonnes will impose a low risk of overfishing sandeel in area 4.	5-10			

Weights in '000 t.
[1] Advice for Subarea IV excluding the Shetland area.
[2] Set for zone IIIa, EC waters of Division IIa and Subarea IV.

Table 6.4.21.4.2 Sandeel in the Central Western North Sea (SA4). Abundance index (average CPUE) from the Scottish December dredge survey for a) the whole area 4 and b) Firth of Forth. No data were collected in 2004–2007.

	a) Area 4			**b) Firth of Forth**		
Year	**Age 0**	**Age 1**	**Age 2**	**Age 0**	**Age 1**	**Age 2**
1999				615	494	301
2000				586	3170	258
2001				48	2656	1561
2002				243	404	916
2003				580		
2004-2007	-	-	-	-	-	-
2008	52	24	18	68	24	24
2009	832	87	38	1023	174	56
2010	147	1032	67	186	1244	78

ECOREGION North Sea
STOCK Sandeel in the Viking and Bergen Bank area (SA 5)

Advice for 2011

There is no basis for an advice. Therefore no increase of the fisheries should take place unless there is evidence that this will be sustainable.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

	F (Fishing Mortality)		
	2008	2009	**2010**
MSY (F_{MSY})	?	?	? Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	? Unknown
	SSB (Spawning Stock Biomass)		
	2009	2010	**2011**
MSY ($B_{escapement}$)	?	?	? Unknown
Precautionary approach (B_{pa},B_{lim})	?	?	? Unknown

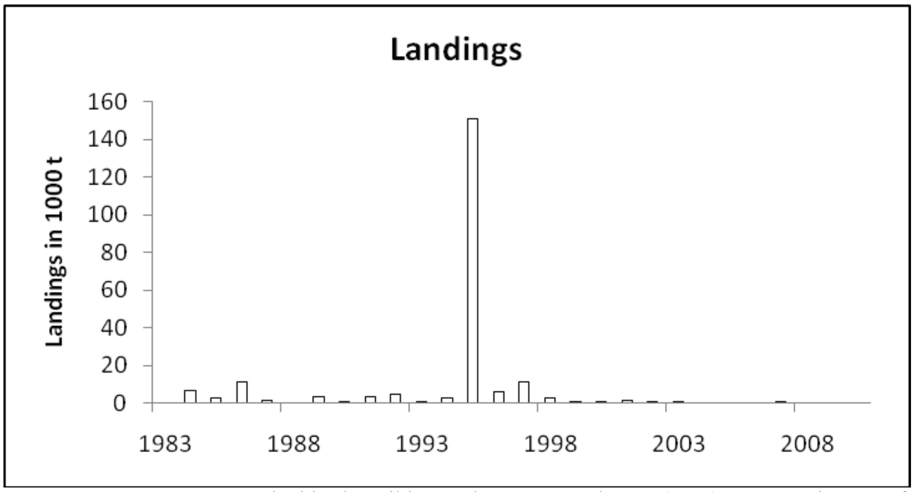


Figure 6.4.21.5.1 Sandeel in the Viking and Bergen Bank area (SA5). ICES estimates of landings (in '000 tonnes).

Catch statistics and acoustic data are available for this stock. The available information is inadequate to evaluate stock status or trends. The state of the stock is therefore unknown.

Management plans

No specific management objectives are known to ICES.

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 11. ICES notes that the TAC and the stock assessment areas do not match.

Catch by fleet Total catch (2010) 0 kt

Scientific basis

Assessment type	No assessment
Input data	Catch statistics
Discards and bycatch	Not included in the assessment
Indicators	Acoustic measurements in the Norwegian zone
Other information	Last benchmark in 2010.
Working group report	WGNSSK

6.4.21.5 **Supporting information February 2011**

ECOREGION North Sea
STOCK Sandeel in the Viking and Bergen Bank area (SA 5)

Reference points

No reference points are defined for this stock.

Outlook for 2011

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

Policy paper

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock assessment area is classified under category 11 because there is no TAC advice for this area. ICES notes that the TAC and the stock assessment areas do not match.

Additional considerations

Norway has closed fisheries on the Viking Bank Area in 2011 because of very low estimates of sandeel abundance as measured using acoustics in 2007–2010 (ICES, 2010b).

Sources

ICES. 2010a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 5-11 May 2010 ICES CM 2010/ACOM13.

ICES. 2010b. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

6.4.21.6 **Advice February 2011**

ECOREGION **North Sea**
STOCK **Sandeel in Division IIIa East (Kattegat, SA6)**

Advice for 2011

There is no basis for an advice. Therefore no increase of the fisheries should take place unless there is evidence that this will be sustainable.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

	F (Fishing Mortality)		
	2008	2009	**2010**
MSY (F_{MSY})	?	?	? Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	? Unknown
	SSB (Spawning Stock Biomass)		
	2009	2010	**2011**
MSY ($B_{escapement}$)	?	?	? Unknown
Precautionary approach (B_{pa},B_{lim})	?	?	? Unknown

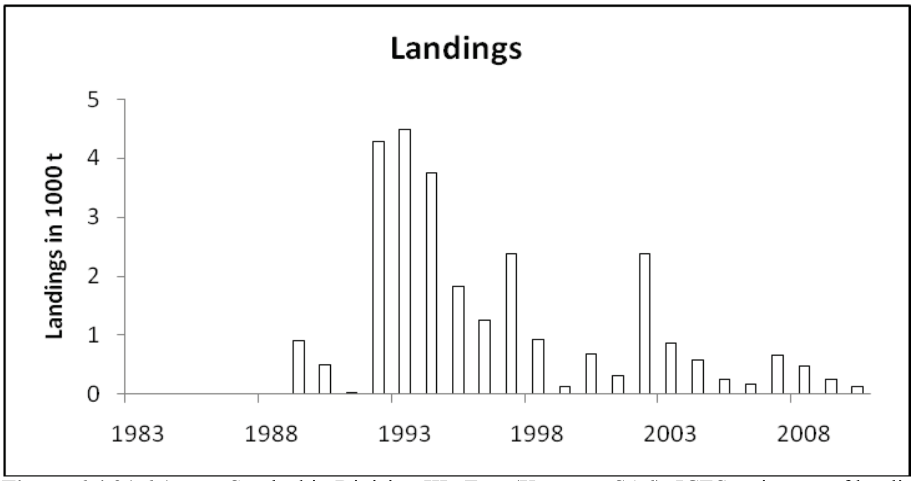


Figure 6.4.21.6.1 Sandeel in Division IIIa East (Kattegat, SA6). ICES estimates of landings (in '000 tonnes).

Only catch statistics are available for this stock. The available information is inadequate to evaluate stock status or trends. The state of the stock is therefore unknown.

Management plans

No specific management objectives are known to ICES.

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 11. ICES notes that the TAC and the stock assessment areas do not match.

Catch by fleet	Total catch (2010) 0.1 kt where 100% landings by industrial fisheries

Scientific basis

Assessment type	No assessment
Input data	Catch statistics
Discards and bycatch	Not included in the assessment
Indicators	None
Other information	Last benchmark in 2010
Working group report	WGNSSK

ECOREGION **North Sea**
STOCK **Sandeel in Division IIIa East (Kattegat, SA6)**

Reference points

No reference points are defined for this stock.

Outlook for 2011

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

Policy paper

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock assessment area is classified under category 11 because there is no advice for this area. ICES notes that the TAC and the stock assessment areas do not match.

Sources

ICES. 2010. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 5-11 May 2010 ICES CM 2010/ACOM13.

ECOREGION North Sea
STOCK Sandeel in the Shetland area (SA 7)

Advice for 2011

There is no basis for an advice. Therefore no increase of the fisheries should take place unless there is evidence that this will be sustainable.

To protect the stock on a local scale, management should be implemented on the area level.

Stock status

	F (Fishing Mortality)		
	2008	2009	2010
MSY (F_{MSY})	?	?	? Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	? Unknown
	SSB (Spawning Stock Biomass)		
	2009	2010	**2011**
MSY ($B_{escapement}$)	?	?	? Unknown
Precautionary approach (B_{pa},B_{lim})	?	?	? Unknown

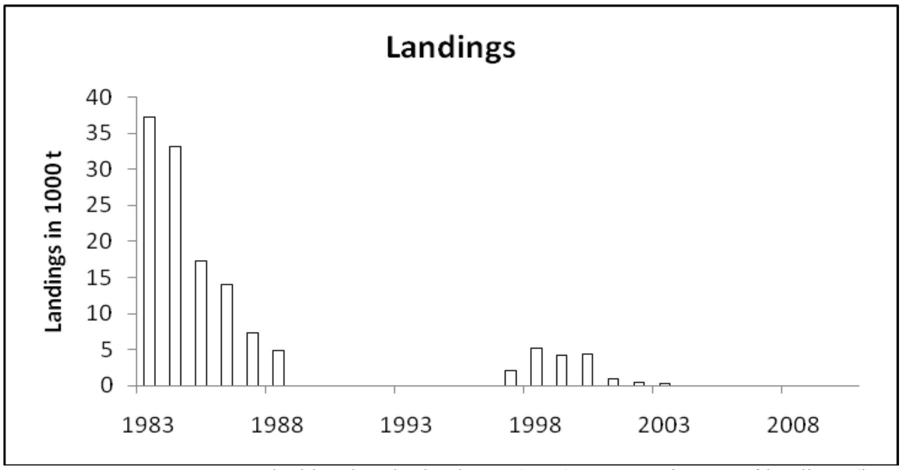


Figure 6.4.21.7.1 Sandeel in The Shetland area (SA7). ICES estimates of landings (in '000 tonnes).

Catch statistics and trawl survey data are available for this stock. The available information is inadequate to evaluate stock status or trends. The state of the stock is therefore unknown.

Management plans

Since 2007, a national management plan has regulated the inshore sandeel fisheries. This plan takes account of both fisheries and wildlife conservation concerns. ICES has not evaluated the management plan.

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock is classified under category 11.

Catch by fleet Total catch (2010) 0 kt

Scientific basis

Assessment type	No assessment
Input data	Catch statistics
Discards and bycatch	Not included in the assessment
Indicators	Stock monitoring took place between 1985-2007 by a trawl survey
Other information	Last benchmark in 2010
Working group report	WGNSSK

6.4.21.7 Supporting information February 2011

ECOREGION **North Sea**
STOCK **Sandeel in the Shetland area (SA 7)**

Reference points

No reference points are defined for this stock.

Outlook for 2011

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

Management plan

A national management plan has been in place for this stock since 2007. Sandeel fishing around Shetland is restricted to small inshore grounds. The fishery is managed by the Scottish Government. Since 2007 the management regime has included (a) a precautionary TAC of 1000 tonnes; (b) closure of grounds south of 60° 10' N, including around Foula and Fair Isle; (c) a seasonal closure of the fishery in June and July during the chick rearing period of seabirds and (d) a vessel length restriction of 20 metres. ICES has not evaluated this management plan.

Policy paper

In light of the EU policy paper on fisheries management (17 May 2010, COM(2010) 241) this stock assessment area is classified under category 11 because there is no advice for this area.

Sources

ICES. 2010. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 5–11 May 2010 ICES CM 2010/ACOM13.

ECOREGION North Sea
STOCK Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)

Advice for 2012

There is insufficient information to evaluate the status of the stock. Therefore, based on precautionary considerations, ICES advises that no increase of the catch should take place unless there is evidence that this will be sustainable.

Stock status

	F (Fishing Mortality)	
	2008–2010	
Qualitative evaluation	?	Insufficient information

	SSB (Spawning-Stock Biomass)	
	2008–2010	
Qualitative evaluation	?	Insufficient information

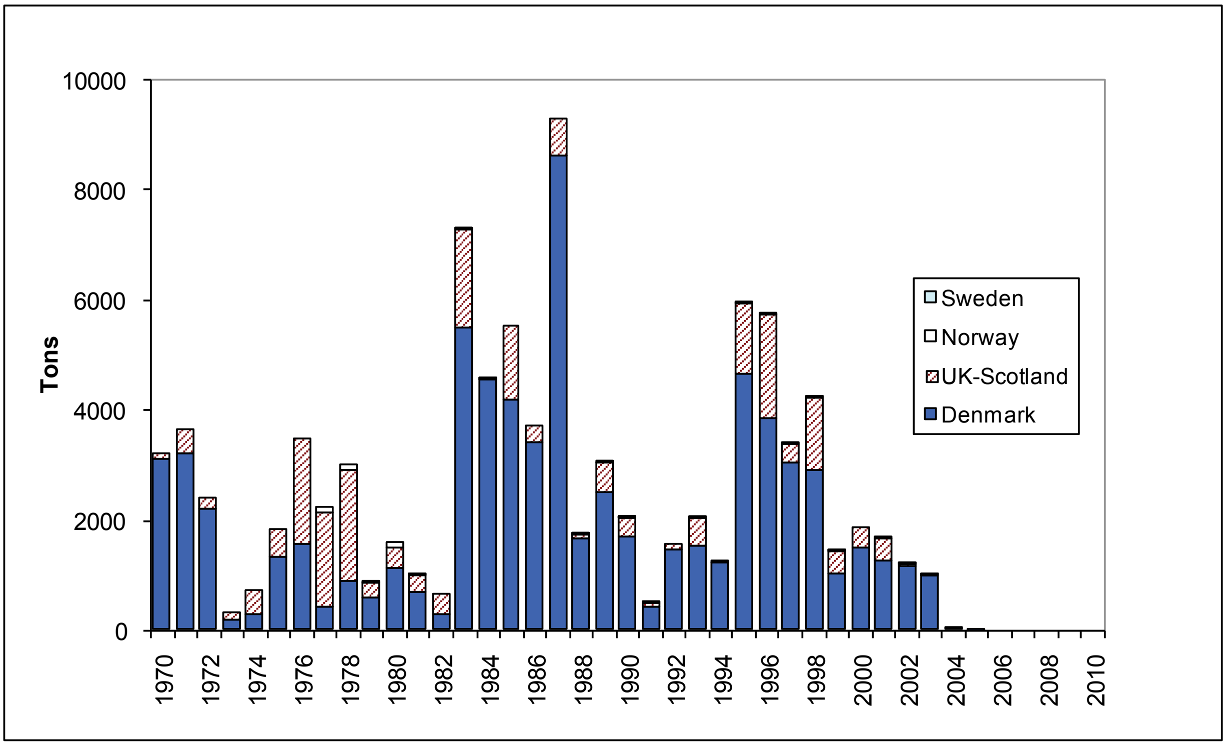


Figure 6.4.22.1 Northern shrimp in Division IVa (Fladen Ground). Total landings (in tonnes) as estimated by ICES.

The available information is inadequate to evaluate stock trends. The state of the stock is therefore unknown. The stock has not been exploited since 2005.

Management plans

No specific management objectives are known to ICES.

Scientific basis

Assessment type	No assessment.
Input data	-
Discards and bycatch	Not included in the assessment.
Indicators	Catch statistics.
Other information	None.
Working group report	NIPAG

ECOREGION North Sea
STOCK Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)

Reference points

No reference points are defined for this stock.

Outlook for 2012

The available information is inadequate to evaluate stock trends. The state of the stock is therefore unknown and fishing possibilities cannot be projected.

PA considerations

There is insufficient information to evaluate the status of the stock. Therefore, based on precautionary considerations, ICES advises that no increase of the catch should take place unless there is evidence that this will be sustainable.

Additional considerations

No fishery has existed from 2006 onwards. No new data are available on the stock.

If the landings of this fishery return to substantial levels, a data collection programme should be implemented.

Assessment and management area

No TAC is set for northern shrimp in Division IVa (Fladen Ground). Since no fishery has existed for this stock in recent years, the lack of a TAC is presently not a problem.

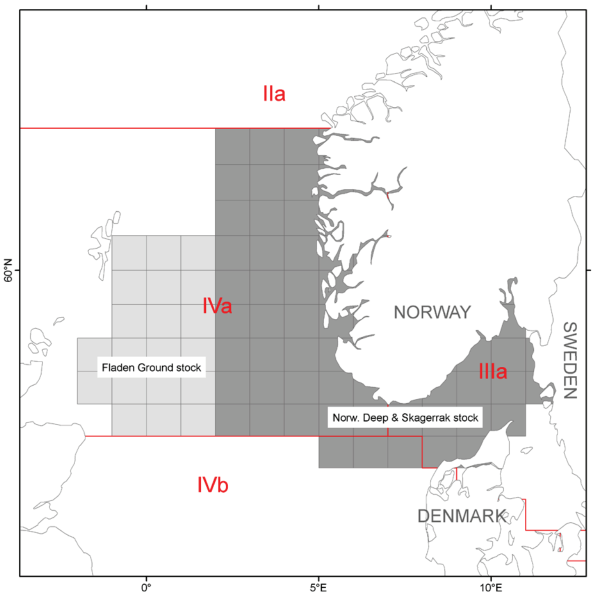


Figure 6.4.22.2 Northern shrimp in Division IVa (Fladen Ground). The light grey area is the assessment area in the North Sea. The stock in Divisions IIIa and IVa East is described in Section 6.4.23.

Source

ICES. 2011. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 19–26 October 2011. ICES CM 2011/ACOM:14.

Table 6.4.22.1 Northern shrimp in Division IVa (Fladen Ground). ICES advice, management, discards, and landings.

Year	ICES advice	Predicted landings corresp. to advice	TAC	ICES landings
2006	Average landings (2001–2003)	< 1.3	-	0
2007	No increase in effort to levels above the average for the years where fishing activity took place. Mandatory data collection program for catch and effort data on both target and bycatch fish	-	-	0
2008	Same advice as last year	-	-	0
2009	Same advice as last year	-	-	0
2010	Same advice as last year	-	-	
2011	Average landings (1999–2003), mandatory data collection programme	< 1.4		
2012	No increase in catch	-		

Weights in '000 t.

Table 6.4.22.2 Northern shrimp in Division IVa (Fladen Ground). Total landings by country (in tonnes) as estimated by ICES.

Year	Denmark	Norway	Sweden	UK–Scotland	Total
1970	3115			104	3219
1971	3216			436	3685
1972	2204			187	2391
1973	157			163	320
1974	282			434	716
1975	1308			525	1833
1976	1552			1937	3489
1977	425	112		1692	2229
1978	890	81		2027	2998
1979	565	44		268	877
1980	1122	76		377	1575
1981	685	1		347	1033
1982	283			352	635
1983	5492	8		1827	7327
1984	4553	13		25	4591
1985	4188			1341	5529
1986	3416			301	3717
1987	8620			686	9306
1988	1662	2		84	1748
1989	2495	25		547	3067
1990	1681	3	4	365	2053
1991	422	31		53	506
1992	1448			116	1564
1993	1521	38		509	2068
1994	1229	0		35	1264
1995	4659	15		1298	5972
1996	3858	32		1893	5783
1997	3022	9		365	3396
1998	2900	3		1365	4268
1999	1005	9		456	1470
2000	1482			378	1860
2001	1263	18		397	1678
2002	1147	9		70	1226
2003	999	8	1		1008
2004	23	0	0	0	23
2005	10	0	0	0	10
2006	0	0	0	0	0
2007	0	0	0	0	0
2008	0	0	0	0	0
2009	0	0	0	0	0
2010	0	0	0	0	0

ECOREGION North Sea

STOCK Northern shrimp (*Pandalus borealis*) in Divisions IIIa and IVa East (Skagerrak and Norwegian Deep)

Advice for 2012

ICES advises based on precautionary considerations, that catches in 2012 should be reduced. Additionally, measures should be taken to address discarding.

Stock status

	F (Fishing Mortality)	
	2008–2010	
Qualitative evaluation	?	Insufficient information

	SSB (Spawning-Stock Biomass)	
	2008–2010	
Qualitative evaluation	↘	Decrease

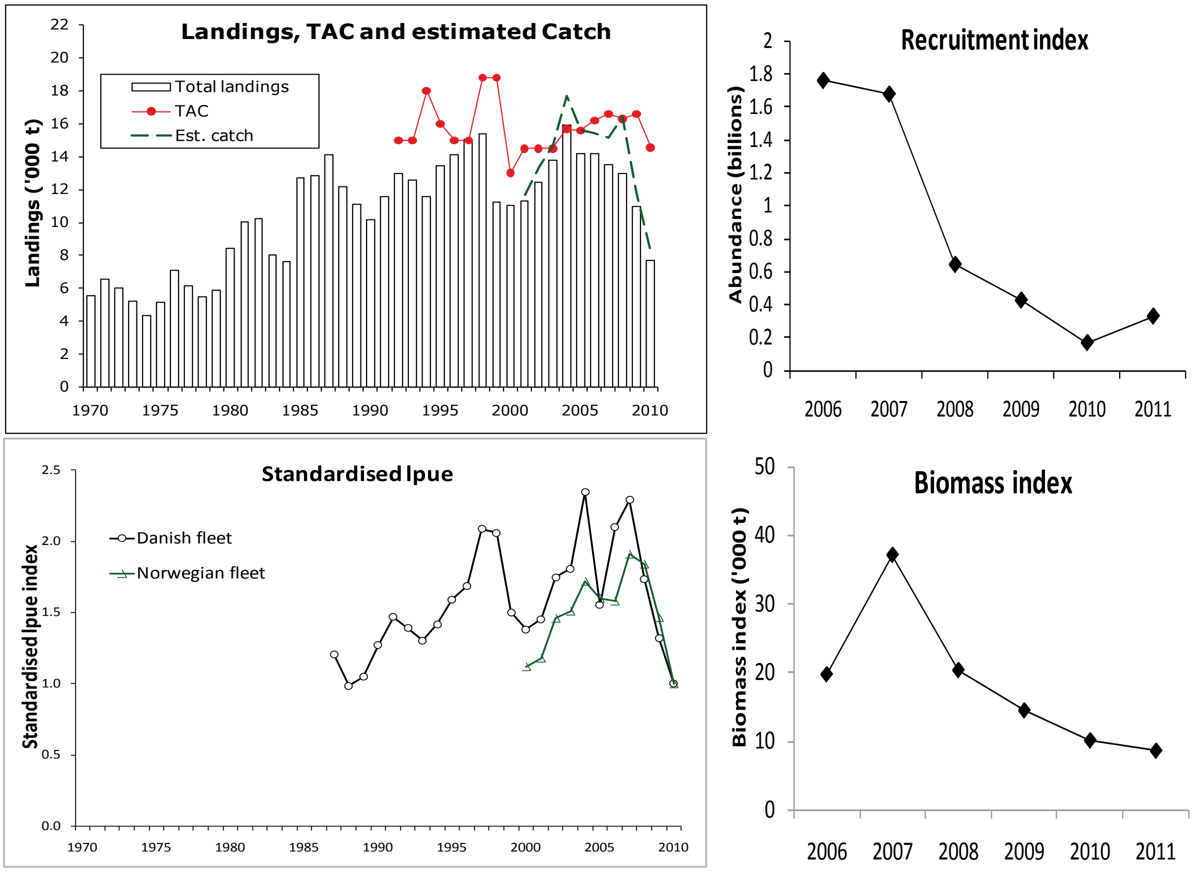


Figure 6.4.23.1 Northern shrimp in Divisions IIIa and IVa East. Summary of the assessment. Recruitment indices from the Norwegian shrimp survey calculated as the abundance of age 1 shrimp. Biomass index estimated from Norwegian surveys. Error bars are standard errors.

Landing per unit effort (lpue) indices, which fluctuated without trend from the mid-1990s through the mid-2000s, have declined from 2008 onward. Survey biomass indices have also declined since 2007. Recruitment indices in 2008–2010 are lower than those in 2006 and 2007. The 2011 recruitment index, although higher than that in 2010, is low.

Management plans

No specific management objectives are known to ICES.

Biology

Several fish and marine mammal species prey on Northern shrimp and may, under certain circumstances, be important in driving Northern shrimp stock dynamics. Natural mortality for *Pandalus borealis* in Divisions IIIa and IVa East is probably substantially higher than fishing mortality.

The fisheries

Northern shrimps are mainly caught by 35–45 mm single- and twin-trawl nets (minimum legal mesh size is 35 mm). A larger number of vessels use sorting grids on a voluntary basis. The number of Danish trawlers has declined over the last 20 years, whereas the Norwegian fleet of <11 m vessels has expanded. No significant changes took place in the Swedish fishery during the last decade except for an increase in the use of twin trawls in the last two years. Because of this development (and the accompanying increase in the size of the trawls), the efficiency of the fisheries has increased.

Catch by fleet	Total catch (2010) = 8.3 kt, where 92.2% are landings (100% trawl) and 7.8% discards.

Effects of the fisheries on the ecosystem

When sorting grids are not used bycatch species, dominated by saithe and cod, may constitute up to 30% of the landed catch. In addition, the shrimp survey indicates that deep-sea species such as argentines, roundnose grenadier, rabbitfish, and sharks are frequently caught in shrimp trawls in the deeper parts of Skagerrak and the Norwegian Deep. A legislation of species-selective grids would reduce bycatches of fish.

Quality considerations

The estimate of the Danish lpue is based on fishing trips where the landing value of *Pandalus* catches was at least 50% of the landing value of all species. This threshold was selected to ensure the exclusion of trips where *Pandalus* is landed as a bycatch rather than as a target species. Uncertainties on discards and highgrading estimates should be reduced following discard data collection in the European Data Collection Framework.

Scientific basis

Assessment type	Trends-based assessment.
Input data	One survey index (Norwegian shrimp survey since 2006); two commercial indices (Danish and Norwegian standardized lpue) and standardized effort.
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	A benchmark is scheduled for 2012.
Working group report	NIPAG

6.4.23 Supporting information November 2011

ECOREGION North Sea

STOCK Northern shrimp (*Pandalus borealis*) in Divisions IIIa and IVa East (Skagerrak and Norwegian Deep)

Reference points

No reference points have been defined for this stock.

Outlook for 2012

No analytical assessment can be presented for this stock. Therefore, fishing possibilities cannot be projected.

PA considerations

Given the recent declines in survey biomass indices and the very low recruitment indices, a reduction in landing is warranted.

The management of this stock should address the discarding of small shrimps, which occurs mainly in the Swedish fleet due to highgrading as a consequence of restrictive TACs. In 2010, estimated discards amounted to 8% of the total catch (weight). All vessels, including the increasing number of small Norwegian vessels (<11 m), should be required to complete and provide logbooks. Additionally, sorting grids should be mandatory in all areas to minimize bycatch.

Additional considerations

Survey biomass indices declined 15% from 2010 to 2011. A reduction of at least 15% of the recent landings (2010) could therefore be appropriate. This corresponds to landings in 2012 of less than 6 500 t.

Highgrading, due to TAC constraints, occurs in several fleets.

As many fish species prey on Northern shrimp, predators (e.g. cod and saithe) have a significant effect on the stock dynamics of Northern shrimp.

The effect of temperature changes in recent years on Northern shrimp in the North sea area is not known. The cold winter in 2009 to 2010 caused a cooling of the surface water which sank into the deeper part of the Norwegian Deep. Bottom water temperatures were still unusually cold in January 2011, with the mean bottom temperature in the Skagerrak 1.5–2°C below the mean during 2006-2010. A similar situation with unusual cold bottom water occurred in mid-1960´s and coincided with a sharp decline in the *Pandalus* stock.

During 2011–2013 a joint Nordic–EU project (Interreg IV) will investigate the stock structure of *P. borealis* using genetics and fisheries data through an extensive collaboration with the industry. This should lead to a considerable improvement of the assessment of the Northern shrimp stocks in the North Sea–Skagerrak area, as well as in the management of the fisheries.

Regulations and their effects

The main regulatory measure is a TAC, which is not fully utilized by all countries. Highgrading (discarding of small and medium-sized, low-value shrimp) occurs in the Swedish fishery, and in the most recent years discarding of small shrimp has also been documented in the Danish and Norwegian fisheries. The estimated discards are included in the total catch. Minimum legal mesh size is 35 mm, but an increasing number of shrimp vessels use 45 mm mesh in the codend.

Changes in fishing technology and fishing patterns

The number of Danish shrimp vessels has decreased from 191 in 1987 to only 12 in 2010. Most of the vessels leaving the fishery have been small trawlers; the mean size of the vessels remaining in the fishery has increased from 20 to 26 m. The efficiency of the Danish shrimp fleet has increased due to the introduction of twin-trawl technology and increasing trawl size.

In the Norwegian fleet the number of small vessels (10–10.99 m) has increased, and these small vessels are now the most numerous, as a licence to fish is not required for vessels <11 m. Quantitative information on gear changes in the Norwegian fleet is available from interviews with ship owners.

In the Swedish fishery recent years have shown an increasing use of trawls equipped with sorting grids and a shift towards vessels using twin trawls.

Comparison with previous assessment and advice

Since 2006, only qualitative assessments have been conducted, based on trends in standardized lpue indices and abundance indices from surveys. In 2006 and 2007 only Danish lpue's were used in the assessment due to low coverage of the Norwegian logbook data and a short survey series. Since the 2008 assessment, Norwegian lpue and survey data have been included in the assessment.

This year's advice is based on the Danish and Norwegian lpue data, and Norwegian survey biomass and recruitment indices (1 group abundance index) from 2006 onwards.

Assessment and management area

TAC areas in this region are set for Division IIIa (EU and Norwegian share) and for the Norwegian zone of the North Sea south of 62°N.

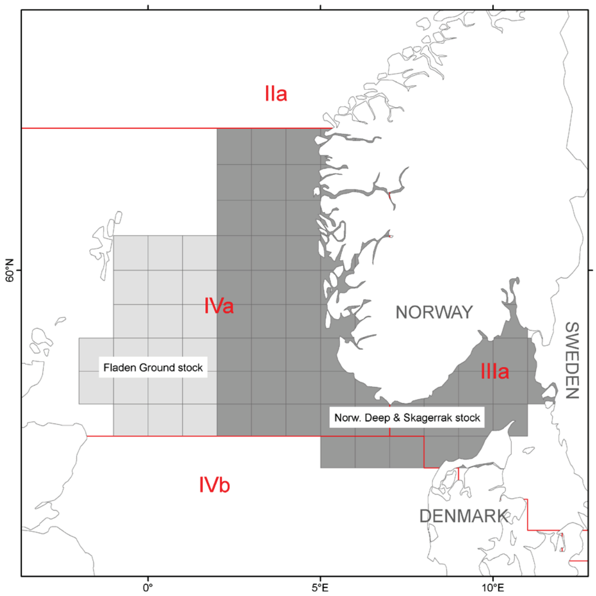


Figure 6.4.23.2 Northern shrimp in Divisions IIIa and IVa East. Assessment areas in the North Sea and Skagerrak are shaded. The Fladen ground stock is described in Section 6.4.22.

Sources

ICES. 2011. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 19–26 October 2011. ICES CM 2011/ACOM:14.

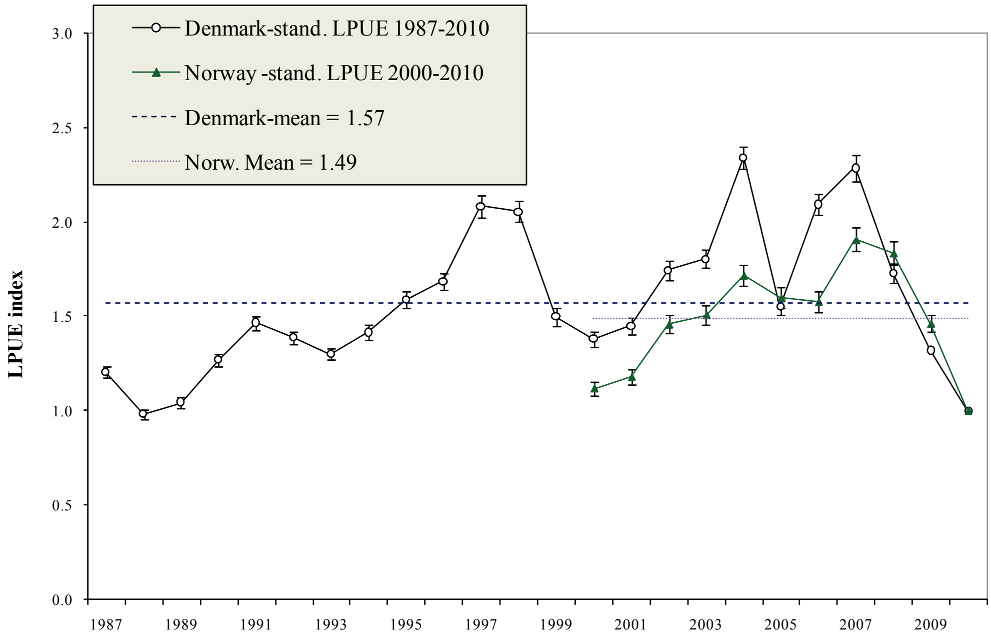


Figure 6.4.23.3 Northern shrimp in Divisions IIIa and IVa East. Standardized landings per unit effort (lpue) for the Danish and Norwegian data, with their respective means. Error bars are standard deviations.

Table 6.4.23.1 Northern shrimp in Divisions IIIa and IVa East. ICES advice, management, discards, landings, and catch.

Year	ICES advice	Predicted landings corresp. to advice[1]	TAC Division IIIa	TAC Div. IIa + IIIa + IV	Discards	Landings	ICES catch (Disc. + Landings)
1987	Not assessed				0.7	14.2	14.9
1988	Catches significantly below 1985–1986[3]				0.8	12.2	12.9
1989	No advice		3.1[1]		1.1	11.1	12.1
1990	IIIa: F as F(pre-85); Iva East: No increase in F	10.0	2.75[1]		1.2	10.2	11.4
1991	No increase in F; TAC	12.0	8.55		0.5	11.6	12.1
1992	Within safe biological limits	15[2]	10.50	15.0	0.5	13.0	13.6
1993	Within safe biological limits	13[2]	10.50	15.0	0.9	12.6	13.5
1994	Within safe biological limits	19[2]	12.60	18.0	0.2	11.5	11.7
1995	Within safe biological limits	13[2]	11.20	16.0	0.3	13.4	14.5
1996	No advice	11[2]	10.50	15.0	0.3	14.1	14.5
1997	No advice	13[2]	10.50	15.0	1.0	15.1	16.1
1998	No increase in F; TAC	19[2]	13.16	18.8	0.4	15.4	15.8
1999	Maintain F	19[2]	13.16	18.8	0.6	11.3	11.9
2000	Maintain F	<11.5[2]	9.10	13.0	0.7	11.0	11.5
2001	Maintain F	13.4	10.15	14.5	0.74[4]	11.3	11.7
2002	Long-term average landings	12.6	10.15	14.5	0.9[4]	12.5	13.4
2003	Maintain F	14.7	10.15	14.5	0.9[4]	13.8	14.7
2004	No increase in F[3]	15.3[3]	10.71	15.7	1.8[4]	15.9	17.7
2005	No increase in catch above recent level	~13[3]	10.71	15.6	1.5[4]	14.2	15.7
2006	No increase in catch above recent level	~13.5[3]	11.2	16.2	1.2[4]	14.2	15.3
2007	No increase in landings above recent level	~14.0[3]	11.62	16.6	1.7[4]	13.5	15.2
2008	No increase in landings above recent level	~15[3]	11.62	16.3	3.4	13.0	16.4
2009	Same advice as last year	~15[3]	11.62	16.6	0.8	11.0	11.8
2010	No increase in landings above 2008 level	~13[3]	9.8	14.558	0.6	7.7	8.3
2011	At least 30% decrease of landings '07–'09, reduce discards, mandatory sorting grids	< 8.8	8.3	12.4			
2012	Reduce catches and reduce discards	-					

Weights in '000 t.
[1] EU zone only.
[2] Catch at *status quo* F.
[3] Single-stock boundaries and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits.
[4] Discards due to Swedish highgrading and Norwegian discards of non-marketable shrimp <15 mm CL (from 2007).

Table 6.4.23.2 Northern shrimp in Divisions IIIa and IVa East. Landings, discards, catches (in tonnes) as estimated by ICES, and TACs.

Year	Denmark	Norway*)	Sweden *)	Total landings	Estim. Swedish high grading	Estim. Norwegian discards	Estim. Danish discards	TAC	Estimated catch
1970	1102	1729	2742	5573					
1971	1190	2486	2906	6582					
1972	1017	2477	2524	6018					
1973	755	2333	2130	5218					
1974	530	1809	2003	4342					
1975	817	2339	2003	5159					
1976	1204	3348	2529	7081					
1977	1120	3004	2019	6143					
1978	1459	2440	1609	5508					
1979	1062	3040	1787	5889					
1980	1678	4562	2159	8399					
1981	2593	5183	2241	10017					
1982	3766	5042	1450	10258					
1983	1804	5361	1136	8301					
1984	1800	4783	1022	7605					
1985	4498	6646	1571	12715					
1986	4866	6490	1463	12819					
1987	4488	8343	1322	14153					
1988	3240	7661	1278	12179					
1989	3242	6411	1433	11086					
1990	2479	6108	1608	10195					
1991	3583	6119	1908	11610					
1992	3725	7136	2154	13015				15000	
1993	2915	7371	2300	12586				15000	
1994	2134	6813	2601	11548				18000	
1995	2460	8095	2882	13437				16000	
1996	3868	7878	2371	14117				15000	
1997	3909	8565	2597	15071				15000	
1998	3330	9606	2469	15406				18800	
1999	2072	6739	2445	11256				18800	
2000	2371	6444	2225	11040				13000	
2001	1953	7266	2108	11327	375			14500	11702
2002	2466	7703	2301	12470	908			14500	13378
2003	3244	8178	2389	13811	868			14500	14679
2004	3905	9544	2464	15913	1797			15690	17710
2005	2952	8959	2257	14168	1483			15600	15651
2006	3061	8669	2488	14218	1186			16200	15404
2007	2380	8686	2445	13511	1124	526		16600	15161
2008	2259	8260	2479	12998	2003	1408		16300	16409
2009	2155	6364	2483	11002	678	115	36	16600	11831
2010	1229	4673	1781	7683	558	63	30	14558	8334

*) Swedish (all years)and Norwegian landings (2000–09) have been corrected for loss in weight due to boiling.

Table 6.4.23.3 Northern shrimp in Divisions IIIa and IVa East. Bycatch in the shrimp fishery in 2010. Combined data from Danish and Swedish logbooks and Norwegian landings (tonnes).

	SubDiv. IIIa, no grid		SubDiv. IIIa, grid		SubDiv. IVa East, no grid	
Species:	Total	% of total catch	Total	% of total catch	Total	% of total catch
Pandalus	5026	77.3	364	96.2	1810	77.0
Norway lobster	45	0.7	2	0.6	25	1.0
Angler fish	56	0.9	0	0.0	67	2.8
Whiting	15	0.2	0	0.0	3	0.1
Haddock	41	0.6	0	0.0	19	0.8
Hake	22	0.3	0	0.1	35	1.5
Ling	41	0.6	0	0.0	34	1.4
Saithe	642	9.9	7	1.9	193	8.2
Witch flounder	59	0.9	0	0.1	2	0.1
Norway pout	0	0.0	0	0.0	0	0.0
Cod	382	5.9	2	0.7	70	3.0
Other market fish	168	2.6	2	0.4	93	3.9

6.4.24 **Advice October 2011**

ECOREGION **North Sea, Skagerrak, Kattegat and eastern Channel**
STOCK **Demersal Elasmobranchs Demersal elasmobranchs in the North Sea, Skagerrak, and Eastern Channel**

Advice for 2012

The advice given in 2010 for these stocks is biennial and valid for 2011 and 2012 (see ICES, 2010). This year ICES adopts the transition to the MSY approach as the basis for advice, which corresponds to landings less than 2700 t for the main species of skates and rays, and no increase in catches for *Scyliorhinus canicula* (Lesser-spotted dogfish). Advice given for individual stocks is given below.

Advice for 2011 and 2012 by individual stocks

Species	**Area**	**Advice**
Common skate (*Dipturus batis*) complex	IVa (likely merging with VI & IIa)	Zero catch. Retain on prohibited species list
R. clavata (thornback ray)	IVc, VIId	Status quo catch
	IVa,b	Reduce catch from recent level
R. montagui (spotted ray).	IVb,c	Status quo catch
A. radiata (starry ray).	IVa,b, IIa	Status quo catch
L. naevus (cuckoo ray)	IVa,b (may extend into VI)	Status quo catch
R. brachyura (blonde ray)	IVc, VIId (patchy occurrence)	No advice
R. undulata (undulate ray)	VIId, merges with VIIe	No targeted fishery
Scyliorhinus canicula (lesser spotted dogfish)	IVa,b,c, VIId	Status quo catch
Mustelus spp. (smooth hounds)	IVa,b,c, VIId	Status quo catch
Squatina squatina (angel shark)	IVa,b,c, VIId	Zero catch. Retain on prohibited species list

Sources

ICES. 2010. Report of the ICES Advisory Committee, 2010. ICES Advice, 2010, Section 6.4.24.

Table 6.4.24.1 Demersal elasmobranchs in the North Sea, Skagerrak, Kattegat and eastern Channel.. ICES advice, management and landings for rays and skates.

Year	ICES Advice	Predicted catch corresponding to advice	Agreed TAC[1]	ICES landings
1992	No advice			5.8
1993	No advice			5.8
1994	No advice			6.4
1995	No advice			6.3
1996	No advice			6.4
1997	No advice			4.6
1998	No advice			4.6
1999	No advice		6.1	4.0
2000	No advice		6.1	4.0
2001	No advice		4.8	4.0
2002	Reduce exploitation		4.8	3.9
2003	No advice		4.1	3.8
2004	No advice		3.5	3.2
2005	No advice		3.2	3.0
2006	Zero catch	0	2.7	2.8
2007	Zero catch	0	2.2	2.7
2008	Zero catch	0	1.6	2.5
2009	Combined catches of recent average landings (2002-2006)	< 3.1(2)	2.8(3)	(1.8)(4)
2010	Same advice as 2009	< 3.1(2)	2.3	
2011	Recent average landings (2006-2008) for the main species 5)	< 2.7		
2012	No new advice, same as for 2011	< 2.7		

Weights in ‘000 t
1) EU only
2) Subject to the individual recording of landed species, no targeted fisheries and minimal bycatch of common skate and undulate ray, and no landings of angel shark
3) TAC split in three components 1) IIa and IV, 2) IIIa and 3) VIId
4) Preliminary data. Does not include landings by France
5) No targeted fishery for *Raja undulata* (undulate ray) and the *Dipturus batis* complex

ECOREGION North Sea
STOCK Pollack in Subarea IV and Division IIIa

Advice for 2012

This is the first time that ICES analyses data for pollack in the North Sea. Currently there is no TAC for this species in this area and it is not clear whether there should be one or several management units. There is insufficient information to evaluate the status of pollack in the North Sea. Therefore, based on precautionary consideration, ICES advises that catches should not be allowed to increase in 2012.

State of the stock

F (Fishing Mortality)	
	2008-2010
Qualitative evaluation	? Insufficient information
SSB (Spawning Stock Biomass)	
	2008-2010
Qualitative evaluation	? Insufficient information

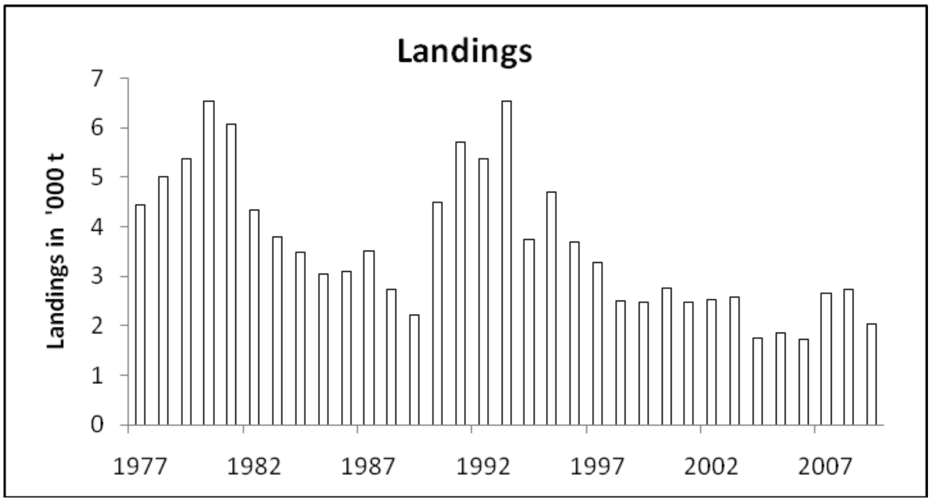


Figure 6.4.25.1 Pollack in Subarea IV and Division IIIa. Official landings (in tonnes).

The landings data are insufficient to evaluate stock trends and therefore the state of the stock is unknown.

Management plans

No specific management objectives are known to ICES.

Biology

Pollack is benthopelagic, found mostly close to the shore with a preference for wrecks and rocky bottom. It usually occurs at 40-100 m depth but is found down to 200 m. A maximum size of 130 cm, a maximum weight of 18.1 kg and a maximum age of 15 years are reported. Growth is thus fairly rapid, approaching 10 cm per year. There is a migration from the coast to deeper waters as it grows. Maturity occurs at approximately 3 years and spawning occurs mainly in the first half of the year, at about 100 m depth. 0-group pollack are found in shallow coastal waters and may therefore be protected from fisheries in the early life stages.

Environmental influence on the stock

Increase in landings from Division IIa during the recent warm period may be a response to environmental change.

The fisheries

Pollack appears to be mainly caught as a bycatch in different fisheries.

Catch by fleet	Total landings (2009) 2022 t. Other removals unknown.

Quality considerations

Pollack's preference for wrecks and rocky bottom, makes it difficult to catch with trawls and is therefore poorly monitored by existing research surveys. Some length frequency data from landings are available for recent years, but data on life history parameters are missing. Data on growth and maturity, as well as more information from the fisheries are needed. Landings figures are clearly incomplete before 1977 and should not be used as indicator of any trends.

Scientific basis

Assessment type	No analytical assessment
Input data	Catch statistics
Discards and by-catch	Not available
Indicators	None
Other information	2011 was the first year ICES reported on this species in this area
Working group report	WGNSSK

ECOREGION North Sea
STOCK Pollack in Subarea IV and Division IIIa

Reference points

No reference points have been defined for this stock.

Outlook for 2012

No reliable assessment can be presented in this Ecoregion and it is not clear which management units advice should apply to.

Precautionary considerations

This is the first time that ICES analyses data for pollack in the North Sea. There is insufficient information to evaluate stock trends and exploitation status. Stock identity is unknown. Therefore, ICES advises that catches should not be allowed to increase in 2012.

Additional considerations

Pollack's preference for wrecks and rocky bottom, makes it difficult to catch with trawls and is therefore poorly monitored by existing research surveys. Some length frequency data from landings are available for recent years, but data on life history parameters are missing. Data on growth and maturity, as well as more information from the fisheries are needed. Landings figures are clearly incomplete before 1977 and should not be used as indicator of any trends.

The ICES landings statistics imply two fairly distinct centres of distribution in the Northeast Atlantic: one in the northern North Sea/Skagerrak extending north along the Norwegian coast, and one in the Western Channel extending into the Eastern Channel, the Celtic Sea, the Irish Sea, and the northern part of the French west coast. Landings from the intermediate areas (VIa and IVc) are generally small.

Sources

ICES. 2011. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 4-10 May 2011 ICES CM 2011/ACOM:13

Table 6.4.25.1 Pollack in Subarea IV and Division IIIa. ICES advice, management and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Total Official landings Subarea IV	Total Official landings Division IIIaW	Total Official landings
2000		-	0.5	2.3	2.8
2001		-	0.5	2.0	2.5
2002		-	0.5	2.0	2.5
2003		-	0.4	2.1	2.6
2004		-	0.4	1.4	1.8
2005		-	0.5	1.4	1.9
2006		-	0.3	1.4	1.7
2007		-	0.5	2.2	2.6
2008		-	0.4	2.3	2.7
2009		-	0.5	1.6	2.0
2010		-			
2011		-			
2012	No increase in catches	-			

Weights in ‘000 t.

Table 6.4.25.2 Pollack in **Division IIIa**. Official landings by country (tonnes).

	ICES Division IIIa							
	Belgium	**Denmark**	**Germany**	**Netherl.**	**Norway**	**Sweden**	**UK**	**Total**
1977	10	1 764		3	449	706		2932
1978	1	2 077			556	794		3428
1979	13	1 898			824	1 066		3801
1980	13	1 860			987	1 584		4444
1981	5	1 661			839	1 187	1	3693
1982	1	1 272			575	417		2265
1983	2	972			438	288		1700
1984	2	930			371	276		1579
1985		824			350	356		1530
1986	4	759			374	271		1408
1987	6	665			342	246		1259
1988	4	494			350	136		984
1989	3	554			313	152		1022
1990	8	1 842			246	253		2349
1991	2	1 824			324	281		2431
1992	8	1 228			391	320		1947
1993	6	1 130	1		364	442		1943
1994	5	645			276	238		1164
1995	10	497			322	271		1100
1996		680			309	273		1262
1997		364			302	178		844
1998		299			330	105		734
1999		192			342	88		622
2000		199			268	33		500
2001		201	1		253	46		501
2002		228	3		202	44		477
2003		168	3	1	236	17		425
2004		140	2	4	179	34		359
2005		160	5	7	173	153		498
2006		103	10	3	178	36		330
2007		172	9		245	38		464
2008		161	5		247	33		446
2009		206	7		220	38		471

Table 6.4.25.3 Pollack in **Subarea IV**. Official landings by country (tonnes).

	ICES Subarea IV*										
	Belgium	**Denmark**	**Faroes**	**France**	**Germany**	**Netherl.**	**Norway**	**Poland**	**Sweden**	**UK**	**Total**
1977	121	275		75	142	38	419	9		442	1521
1978	102	249		98	154	21	492	2		471	1589
1979	62	333		72	64	8	563	11	31	429	1573
1980	82	407		66	58	2	1095		38	355	2103
1981	59	500		173	21	2	1261		12	362	2390
1982	46	431		59	40	1	1169	33	23	270	2072
1983	58	481		79	44	1	1081		57	300	2101
1984	52	402		108	37		880	2	106	315	1902
1985	14	308		69	23		686		51	363	1514
1986	44	550		45	21		602		67	362	1691
1987	21	427		988	21		471		40	290	2258
1988	32	432		367	30	10	560		20	296	1747
1989	31	273			21	4	568		37	269	1203
1990	44	924			34	3	651		126	366	2148
1991	31	1464			48	4	887		153	684	3271
1992	49	794		18	59	7	1051		141	1310	3429
1993	46	1161		8	161	19	1429		217	1561	4602
1994	42	635		12	55	14	845		113	872	2588
1995	56	532	1	7	84	18	1203		175	1525	3601
1996	13	366		4	99	13	909		82	945	2431
1997	20	272	1	1	115	11	733		82	1185	2420
1998	21	265		7	44	5	567		75	780	1764
1999	21	288			62	5	768		72	636	1852
2000	45	291		24	38	5	880		91	877	2251
2001	36	156		6	40	1	860		63	809	1971
2002	27	234		6	112		879		68	711	2037
2003	13	191		9	82	1	971		36	837	2140
2004	28	162		5	57	0	517		16	612	1397
2005	26	173		3	128	3	511		46	477	1367
2006	18	152		4	80	1	545		12	587	1399
2007	18	192		130	137	2	754		43	905	2181
2008	15	150		129	114	1	840		46	999	2294
2009	13	121	3	5	50	1	668		32	658	1551

*Allocation of landings to Divisions in Subarea IV missing for some countries in some years.

ECOREGION North Sea
STOCK Turbot in Subarea IV and Division IIIa

Advice for 2012 and 2013

ICES advises on the basis of precautionary considerations that catches should not increase.

Stock status

	F (Fishing Mortality)	
	2007 - 2009	
Qualitative evaluation	?	Insufficient information
	TSB (Total Stock Biomass)	
	2007 – 2009	
Qualitative evaluation	➡	Stable

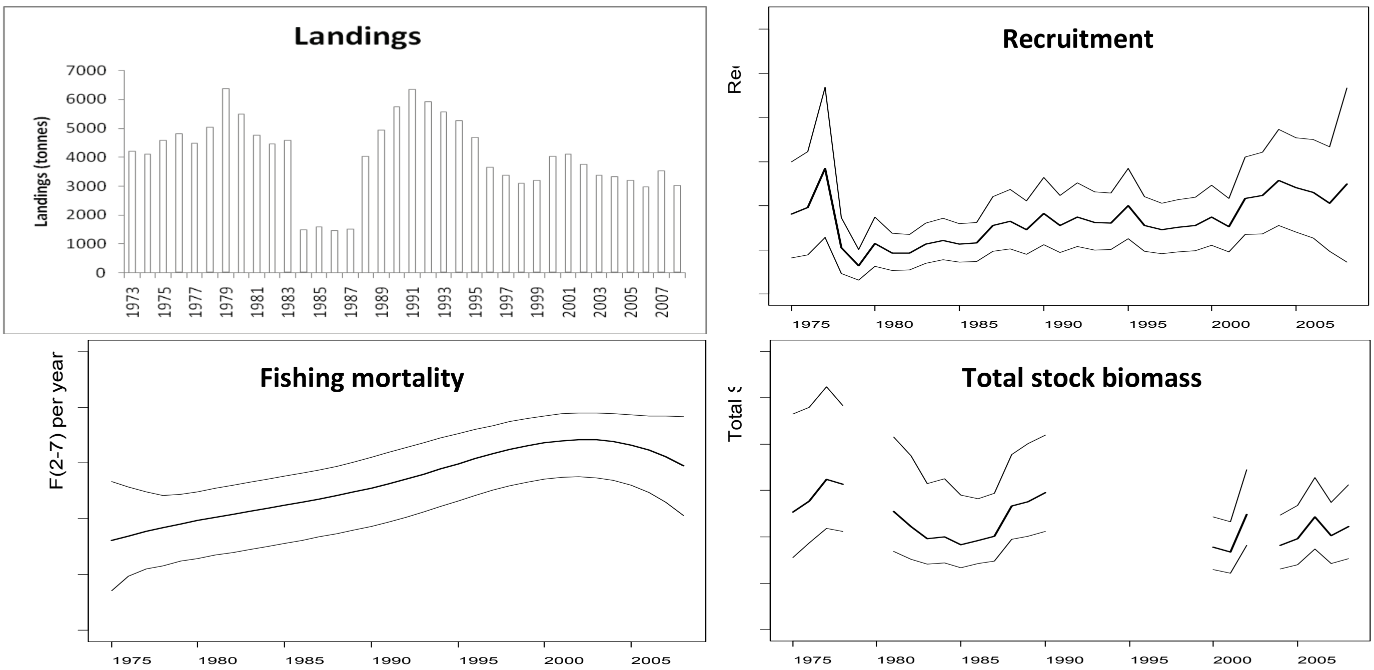


Figure 6.4.26.1 Turbot in Subarea IV and Division IIIa. Landings for the whole area (in tonnes, not all data available for the period 1984-1987) and summary of the trends based assessment for Subarea IV. Centre line indicates model estimate. Top and bottom lines indicate 95% confidence limits. TSB is only inserted where age data are available.

A trends based assessment for turbot in the North Sea is presented, which is taken to represent the stock throughout the area. Landings have been stable since 1995, and fishing mortality has declined since 2002. Recruitment has shown an increase since 2000 and total stock biomass has been stable in that period.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with brill (ICES, 2011).

Biology

Turbot is one of the fastest growing flatfish. Turbot is a typical visual feeder and feeds mainly on other bottom living fishes and small pelagic fish and could be regarded as a top predator. In general, turbot is a rather sedentary species, but there are some indications of migratory patterns. For example in the North Sea, migrations from the nursery grounds in the south-eastern part to more northerly areas have been recorded. Adult turbot are more tolerant of the colder conditions in the northern areas of the North Sea where temperatures are too low for juveniles to survive.

The fisheries

Turbot is a valuable bycatch in the fishery for flatfish and demersal species and takes place with beam trawls, otter trawl and static gear. There is a targeted gill net fishery that takes less than 10% of the total catch. Discarding in the trawl fisheries for turbot is low. No official minimum landing size has been set, but part of the fisheries adopted a voluntary minimum landing size of 30 cm. A reduction in fishing effort on target flatfish species such as plaice and sole (sections 6.4.7 and 6.4.10) may have influenced the level of bycatch.

Quality considerations

Age data only exist for several short periods. The collection of data needs to be continued for the whole area in order to get a better understanding of the stock identity and state of turbot stocks in the Northeast Atlantic area.

Scientific basis

Assessment type	Trends based assessment (Aarts and Poos)
Input data	Catch statistics together with SNS, BTS-Isis and BTS-Tridens surveys.
Discards and bycatch	Not included in the assessment
Indicators	None
Other information	Beam trawl surveys IBTS-Q1, EVHOE-WIBTS-Q4 2011 was the first year ICES reported on this species in this area
Working group report	WGNEW

ECOREGION North Sea
STOCK Turbot in Subarea IV (North Sea)

Reference points

No reference points have been defined.

Outlook for 2012 and 2013

No reliable assessment can be presented. The main cause of this is a lack of data. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information suggests that total stock biomass varies without trend, and fishing mortality has decreased recently. Effort for the main fleet with turbot bycatches (beam trawls) in the North Sea and Skagerrak has declined 40% between 2003 and 2009. Based on these considerations ICES advises that catches should not increase.

Additional considerations

Turbot is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

The collection of data needs to be continued in order to get a better understanding of stock identity and the state of turbot stocks in the Northeast Atlantic.

Assessment and management area

Stock identity of turbot in the Northeast Atlantic is not fully understood, but 90% of the catches in the Northeast Atlantic are taken in the North Sea. Therefore, the North Sea can be used as a provisional management unit.

Sources

ICES.2010. Report of the Working Group on Assessment of New MoU Species (WGNEW) 11-15 October 2010 ICES HQ, Denmark, ICES CM 2010/ACOM: 21

ICES.2011. Brill in Division IV, Subdivision IIIa and VIId,e, Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.27.

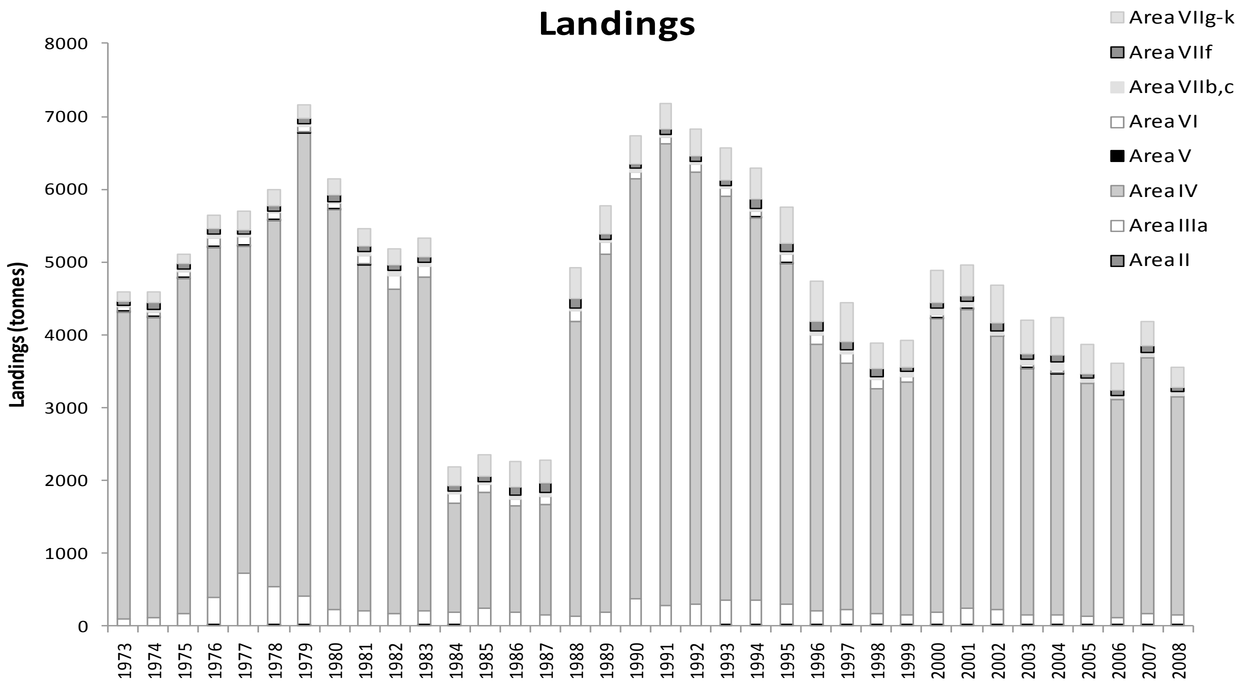


Figure 6.4.26.2 Turbot in European waters. Official landings per area (in vertical order, in tonnes). Note that for the period 1984-1987 no Dutch landings data are available, causing the low landing estimates in that period.

Table 6.4.26.1 Turbot in Subarea IV. ICES advice, management and official landings

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] turbot & brill	Official landings turbot
2000		-	9	6.4
2001		-	9	6.3
2002		-	6.750	6.0
2003		-	5.738	5.6
2004		-	4.877	5.6
2005		-	4.550	5.4
2006		-	4.323	5.1
2007		-	4.323	5.7
2008		-	5.263	5.0
2009		-	5.263	
2010		-	5.263	
2011		-	4.642	
2012	No increase in catches	-		
2013	No new advice, same as for 2012			

[1)] EU combined TAC for turbot and brill in EU areas IIa and IV.

Table 6.4.26.2 Turbot in European waters. Official landings per area (in tonnes).

	II	IV	V	VI	VIIb,c	VIIf	VIIg-k	TOT
1973	0	4212	1	70	19	57	136	4495
1974	0	4116	2	86	21	96	154	4475
1975	0	4588	3	94	31	75	139	4930
1976	5	4814	3	122	48	75	188	5255
1977	0	4484	3	131	35	58	242	4953
1978	17	5034	1	100	25	74	211	5462
1979	8	6364	2	86	29	72	191	6752
1980	0	5485	1	82	34	77	237	5916
1981	0	4755	20	103	60	70	241	5249
1982	0	4453	0	174	80	70	224	5001
1983	2	4575	0	162	52	68	256	5115
1984	1	1497	0	138	36	61	273	2006
1985	0	1588	0	112	39	73	306	2118
1986	0	1453	0	102	56	99	351	2061
1987	0	1511	0	118	46	134	309	2118
1988	0	4041	0	160	31	126	418	4776
1989	0	4927	0	162	31	79	385	5584
1990	0	5750	0	103	45	54	398	6350
1991	0	6340	0	100	29	83	353	6905
1992	0	5933	0	98	45	62	370	6508
1993	13	5546	0	98	42	78	430	6207
1994	11	5244	1	96	33	130	421	5936
1995	6	4671	1	124	46	101	495	5444
1996	6	3644	0	141	60	114	561	4526
1997	6	3382	0	128	51	112	545	4224
1998	6	3086	0	124	46	107	350	3719
1999	6	3187	0	81	64	58	365	3761
2000	7	4025	1	48	89	80	448	4698
2001	7	4100	1	43	67	83	427	4728
2002	4	3749	1	31	55	98	524	4462
2003	5	3374	3	48	69	80	468	4047
2004	7	3317	1	52	101	94	513	4085
2005	7	3195	0	27	45	67	408	3749
2006	6	2976	0	18	42	69	372	3483
2007	7	3508	0	23	51	81	335	4005
2008	6	3005	0	14	48	67	265	3405

6.4.27 Advice June 2011

ECOREGION North Sea
STOCK Brill in Subarea IV and Divisions IIIa and VIId,e

Advice for 2012 and 2013

ICES advises on the basis of precautionary considerations that catches should not increase.

Stock status

	F (Fishing Mortality)	
	2007–2009	
Qualitative evaluation	?	Insufficient information
	SSB (Spawning-Stock Biomass)	
	2007–2009	
Qualitative evaluation	?	Insufficient information

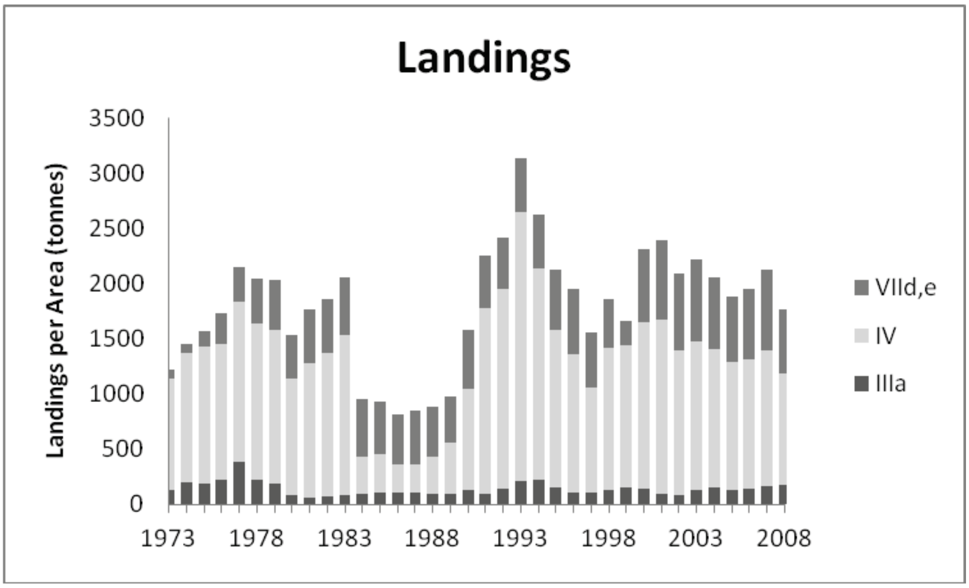


Figure 6.4.27.1 Brill in Subarea IV and Divisions IIIa and VIId,e. Landings per area (in tonnes). Not all data are available for the period 1984–1987.

The available information is inadequate to evaluate stock trends. There is no information on the stock identity of this species.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of ICES Division IIa and Subarea IV together with turbot (ICES, 2011).

Biology

Brill is a shallow-water flatfish found mainly in areas close inshore. It prefers sandy bottoms, but can sometimes also be found on gravel and muddy grounds. Mature brill are rarely observed inshore, whereas immature specimens are often caught near the coast and even in estuaries. Small brill feeds on small benthic fishes, sandeels, sand gobies, anchovy, and crabs; with increasing length the diet moves to small gadoids. Brill grows relatively fast and generally reaches a certain length faster (at younger ages) than flatfish such as sole and plaice in the same areas.

The fisheries

Brill is mainly caught as a valuable by-atch species in the beam-trawl fisheries targeting flatfish, and to a lesser extent in the otter trawl and fixed-net fisheries. Locally, a minimum landing size of 30 cm is used.

Catch by fleet	Beam-trawl fisheries > 95%, pairtrawl and others < 5%.

Quality considerations

Surveys need to be developed to effectively monitor the status of this species.

Scientific basis

Assessment type	No assessment.
Input data	Catch statistics.
Discards and by-catch	Not included in the assessment.
Indicators	None.
Other information	Bottom trawl surveys NL and UK BTS and (EngGFS) IBTSQ3. 2011 was the first year ICES reported on this species in this area.
Working group report	WGNEW

ECOREGION North Sea
STOCK Brill in Subarea IV and Divisions IIIa and VIId,e

Reference points

No reference points have been defined.

Outlook for 2012 and 2013

No reliable assessment can be presented. The main cause of this is lack of data. Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information is insufficient to evaluate stock trends and exploitation status. Landings have been relatively stable since 1998. Effort for the main fleet with brill bycatches (beam trawls) in the North Sea and Skagerrak has declined 40% between 2003 and 2009. Based on these considerations ICES advises that catches should not increase.

Additional considerations

Brill is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

The data that have currently been collected do not allow an evaluation of stock trends for brill in the different areas. Commercial Belgian beam-trawl information shows big differences in landed weight and effort between areas (Figure 6.4.27.2).

The stock structure of brill is currently unknown, but there are indications that the population can be separated into two groups: a first group of brill occupying the Bay of Biscay, the English Channel, the Celtic Sea, and the Irish Sea, and a second group in the North Sea, Skagerrak, and Kattegat. An ongoing study to unravel the genetic structure of brill is expected to reveal new information on the stock structure.

An assessment of brill in the Channel fisheries using the data sampled by France and the UK (Dunn *et al*., 1996) concluded that in the Channel, brill was not heavily overexploited, but that a reduction in fishing effort was required to get an increase of 10% of the observed production. The maximum annual production was found to be around 400 t.

Data requirements

The collection of data needs to be continued in order to get a better understanding of stock identity and the state of brill stocks in the Northeast Atlantic. Surveys need to be developed to effectively monitor the status of this species.

Sources

Dunn, M. R., Rogers, S. I., Morizur, Y., Tetard, A., Aublet, B., Le Niliot, P., and Miossec, D. 1996. Biological sampling of non quota species. Final Report for EC Study Contract C934CO18.

ICES. 2010. Report of the Working Group on Assessment of New MoU Species (WGNEW), 11–15 October 2010, ICES HQ, Denmark. ICES CM 2010/ACOM: 21.

ICES. 2011. Turbot in Subarea IV (North Sea). *In* Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.26.

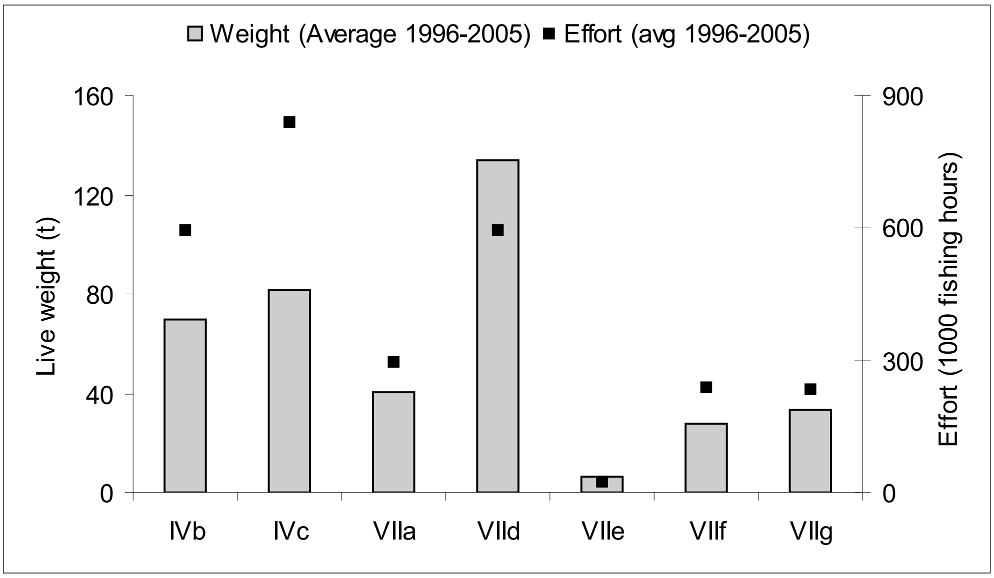


Figure 6.4.27.2 Brill in Subarea IV and Divisions IIIa and VIId,e. Average effort and average landings of brill for the Belgian beam-trawl fleet for the period 1996–2005**.**

Table 6.4.27.1 Brill in Subarea IV and Divisions IIIa and VIId,e. ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] turbot & brill	Official landings Brill
2000		-	9	2.3
2001		-	9	2.4
2002		-	6.750	2.1
2003		-	5.738	2.2
2004		-	4.877	2.1
2005		-	4.550	1.9
2006		-	4.323	1.9
2007		-	4.323	2.1
2008		-	5.263	1.8
2009		-	5.263	
2010		-	5.263	
2011		-	4.642	
2012	No increase in catch	-		
2013	No new advice, same as for 2012	-		

Weights in ‘000 t.
[1)] EU combined TAC for turbot and brill in EU areas of ICES Division IIa and Subarea IV.

Table 6.4.27.1 Brill in **Subareas II–XIV**. Official landings per area (in tonnes). Note that for the period 1984–1987 no Dutch landings data are available, causing low landing estimates in that period.

	II	Baltic	IIIa	IIIb-d	IV	V	VI	VIIa	VIIb,c	VIId,e	VIIf-k	VIII	IX	X	XIV	TOT
1973	0	0	134	16	1002	20	26	124	48	90	165	309	-	0	0	1934
1974	0	0	202	30	1167	0	44	100	20	81	80	0	-	0	0	1724
1975	0	0	189	43	1242	0	41	117	28	135	120	50	-	0	0	1965
1976	0	0	227	50	1223	1	57	94	43	283	156	35	-	0	0	2169
1977	0	0	389	70	1447	0	63	121	35	319	241	261	-	0	0	2946
1978	1	0	218	43	1418	0	53	113	36	408	122	28	-	0	0	2440
1979	2	0	184	31	1393	1	49	129	26	457	126	25	-	0	0	2423
1980	0	0	82	26	1054	0	37	131	32	400	213	50	-	0	0	2025
1981	0	0	59	23	1226	0	31	105	30	484	452	55	-	0	0	2465
1982	0	0	74	20	1300	0	32	94	23	480	179	58	-	0	0	2260
1983	0	13	83	13	1455	0	28	136	19	523	206	71	-	0	0	2547
1984	0	12	97	13	333	0	39	147	18	526	179	96	-	0	0	1460
1985	0	0	109	18	343	0	46	234	25	484	187	91	-	0	0	1537
1986	0	19	106	20	262	0	27	245	46	445	224	134	10	0	0	1538
1987	0	15	103	17	260	0	30	251	22	483	226	155	24	0	0	1586
1988	0	10	101	10	336	0	27	248	16	447	206	199	28	0	0	1628
1989	0	10	97	10	460	0	28	121	12	423	185	214	36	0	0	1596
1990	0	12	127	13	923	0	17	138	10	535	229	188	54	0	0	2246
1991	0	17	99	17	1682	0	27	137	10	470	230	131	40	0	0	2860
1992	0	34	146	36	1810	0	43	173	20	456	278	167	53	0	24	3240
1993	0	35	212	46	2439	0	38	116	26	486	221	154	65	0	0	3838
1994	0	62	220	69	1916	0	28	130	25	485	269	137	49	1	0	3391
1995	0	101	151	106	1434	0	25	131	27	540	353	139	57	0	0	3064
1996	0	62	111	64	1247	0	25	121	41	598	369	120	498	0	0	3256
1997	0	28	106	28	957	0	40	156	50	491	397	125	434	0	0	2812
1998	0	25	132	25	1283	0	42	153	18	441	260	112	52	0	0	2543
1999	0	28	157	29	1280	0	30	130	18	227	183	17	62	0	0	2161
2000	0	33	142	34	1508	0	16	103	44	661	239	131	63	0	0	2974
2001	0	23	98	23	1573	0	15	119	21	721	251	122	70	0	0	3036
2002	0	30	89	32	1302	0	12	107	34	700	255	160	55	0	0	2776
2003	0	40	129	43	1346	0	36	131	33	744	249	155	45	0	0	2951
2004	0	48	156	51	1249	0	20	87	21	651	293	165	62	0	0	2803
2005	0	63	133	63	1160	0	13	102	17	590	279	135	60	0	0	2615
2006	0	60	140	61	1175	0	10	79	17	634	264	140	57	0	0	2637
2007	0	71	160	71	1239	0	6	77	20	730	244	139	37	0	0	2794
2008	0	107	181	106	1004	0	8	71	18	580	184	60	47	0	0	2366

6.4.28 **Advice June 2011**

ECOREGION North Sea
STOCK Dab in Subarea IV and Division IIIa

Advice for 2012 and 2013

ICES advises on the basis of precautionary considerations that catches should not increase.

Stock status

	F (Fishing Mortality)	
	2007 – 2009	
Qualitative evaluation	?	Insufficient information

	TSB (Total Stock Biomass)	
	2007 – 2009	
Qualitative evaluation	↗	Increase in the main area

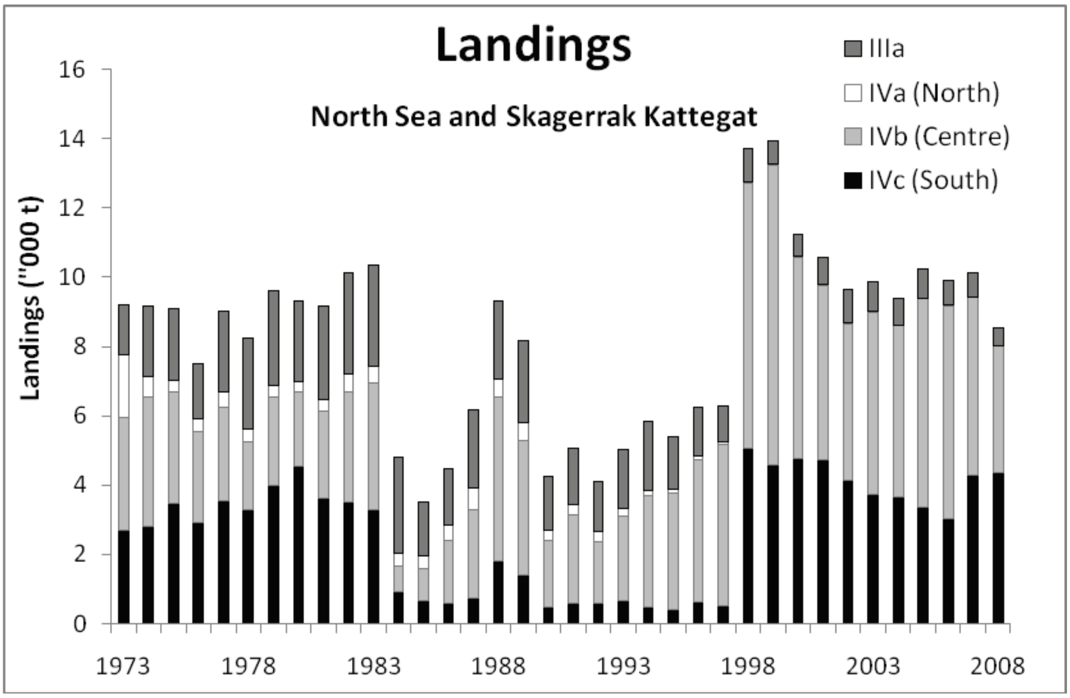


Figure 6.4.28.1 Dab in Subarea IV and Division IIIa. Official landings per area (in '000 t).. Note that reporting may be incomplete before 1998.

There is no information on the stock identity of this species. Landing data are not complete and are probably not indicative for catches since discard rates are variable. The mixed TAC with flounder reduces the accuracy of catch statistics per species. Different surveys (Figure 6.4.28.2) show a stable to increasing total biomass for the main area (IV) in which the fisheries are conducted.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with flounder (ICES, 2011).

Biology

Dab is a widespread demersal species on the Northeast Atlantic shelf and distributed from the Bay of Biscay to Iceland and Norway; including the Barents Sea and the Baltic. Dab is one of the most abundant demersal species in the North Sea with its centre of distribution in the Southern North Sea. Because of its sedentary nature, dab has proved to be a valuable indicator in eco-toxicological studies.

The fisheries

Dab is a bycatch in the fishery for flatfish, shrimp and demersal species, mainly in the beam trawl fisheries. Dab catches are generally discarded based on the availability of target species and market price.

Quality considerations

Landings data are not complete, and are probably not always indicative of catches. The mixed TAC with flounder reduces the accuracy of catch statistics per species.

Scientific basis

Assessment type	No assessment
Input data	Landing statistics, BTS, IBTSQ1 and IBTSQ3
Discards and by-catch	Not used
Indicators	None
Other information	2011 was the first year ICES reported on this species in this area
Working group report	WGNEW

ECOREGION North Sea
STOCK Dab in Subarea IV and Division IIIa

Reference points

No reference points have been defined.

Outlook for 2012 and 2013

No reliable assessment can be presented. The main cause of this is lack of data (exact catches and biological survey results). Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information shows an increase in total biomass for the main area (IV) in which the fisheries are conducted. Exploitation status is unknown. Effort for the main fleet with dab bycatches (beam trawls) in the North Sea and Skagerrak has declined 40% between 2003 and 2009. Based on these considerations ICES advises that catches should not increase.

Additional considerations

Dab is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

The available sample data on catches and discards need to be more fully utilized.

Sources

ICES. 2010. Report of the Working Group on Assessment of New MoU Species (WGNEW), 11-15 October 2010, ICES HQ, Denmark. ICES CM 2010/ACOM: 21.

ICES.2011. Flounder in Division IIIa and Subarea IV, Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.29.

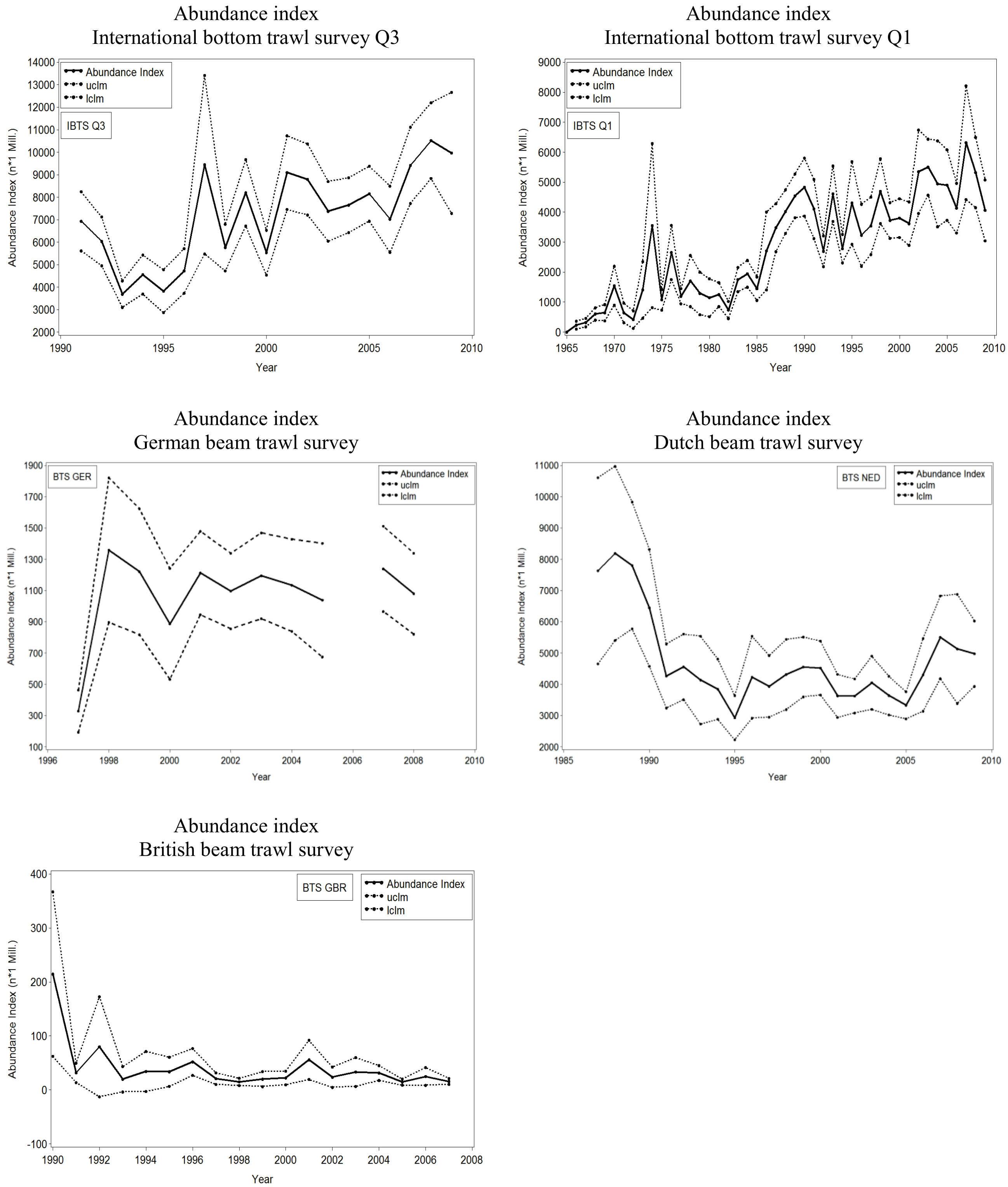


Figure 6.4.28.2 Dab in **Subarea IV**. North Sea abundance indices (numbers in millions). Confidence intervals (dashed lines) were set at the 95% level of significance of the stratified mean. Note that indices before 1990 may not have been fully recorded.

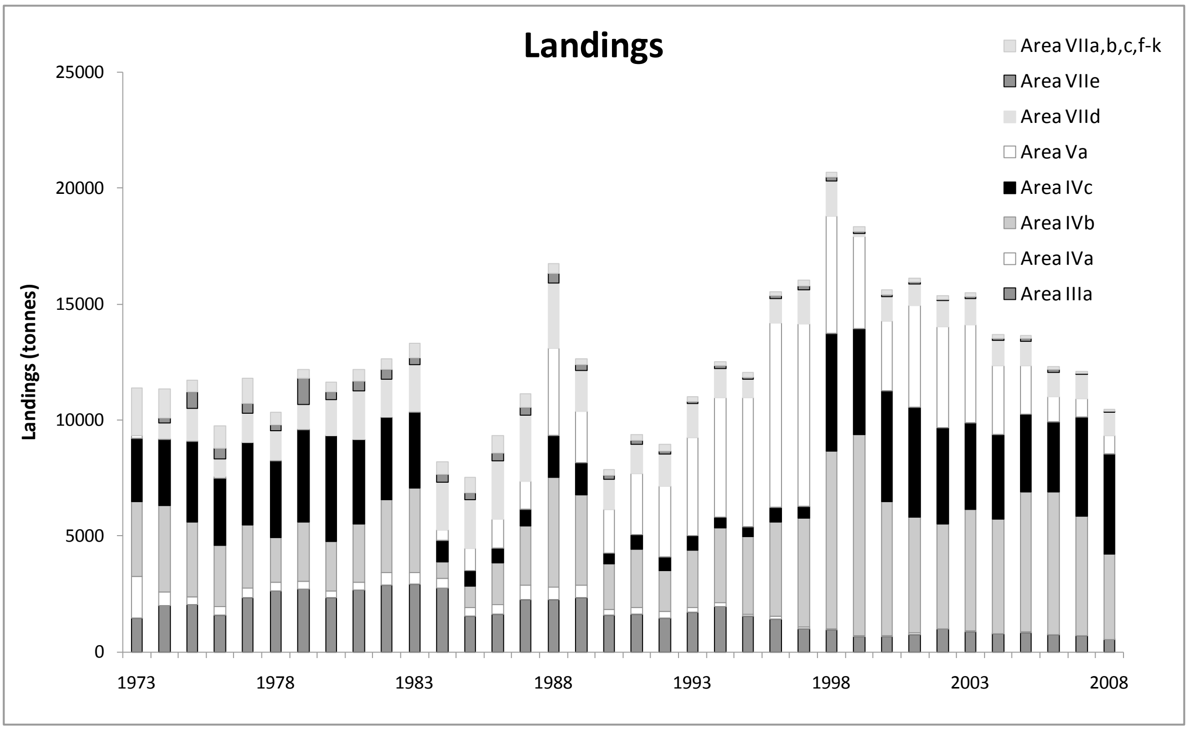


Figure 6.4.28.3 Dab in Division IIIa and Subareas IV, V and VII. Official landing statistics by area.

Table 6.4.28.1 Dab in Subarea IV and Division IIIa. ICES advice, management and official landings

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] dab & flounder	Official landings Dab
2006		-	17.1	12.3
2007		-	17.1	12.1
2008		-	18.81	10.5
2009		-	18.81	
2010		-	18.81	
2011		-	18.434	
2012	No increase in catch	-		
2013	No new advice, same as for 2012	-		

1) EU combined TAC for dab and flounder in EU areas IIa and IV.

Table 6.4.28.2 Dab in Division IIIa, and Subarea IV, V and VII. Official landings per area (in tonnes).

Year	IIIa	IVa	IVb	IVc	Va	VIId	VIIe	VIIa,b,c,f-k	Total
1973	1449	1812	3241	2705	132	-	-	2051	11390
1974	2003	591	3743	2812	76	658	223	1225	11331
1975	2049	345	3197	3488	56	1386	710	491	11722
1976	1583	370	2641	2906	63	772	437	996	9768
1977	2318	443	2715	3544	9	1280	419	1072	11800
1978	2630	373	1931	3304	34	1270	272	534	10348
1979	2716	322	2567	3988	32	1031	1148	382	12186
1980	2333	301	2153	4527	5	1573	337	415	11644
1981	2679	333	2526	3627	<0.5	2107	407	510	12189
1982	2902	506	3175	3528	<0.5	1657	405	459	12632
1983	2906	507	3660	3270	25	2003	310	619	13300
1984	2769	395	727	922	447	2074	313	576	8223
1985	1545	388	898	681	949	2117	281	685	7544
1986	1608	448	1804	598	1254	2512	337	770	9331
1987	2258	621	2552	730	1186	2850	347	589	11133
1988	2254	527	4737	1797	3777	2802	440	395	16729
1989	2346	526	3889	1397	2237	1747	233	262	12637
1990	1574	281	1947	462	1897	1302	149	258	7870
1991	1609	291	2545	606	2636	1272	145	251	9355
1992	1454	276	1799	572	3046	1408	118	268	8941
1993	1723	194	2470	645	4222	1454	92	191	10991
1994	1963	149	3246	466	5159	1243	115	166	12507
1995	1530	98	3361	406	5557	813	101	195	12061
1996	1409	121	4071	642	7954	1051	112	191	15551
1997	1015	82	4660	517	7891	1450	182	258	16055
1998	963	47	7639	5073	5061	1535	144	228	20690
1999	675	25	8671	4580	3981	131	67	193	18323
2000	660	39	5788	4768	3015	1045	90	200	15605
2001	766	42	5027	4730	4373	915	83	192	16128
2002	979	29	4517	4132	4358	1123	80	142	15360
2003	869	32	5259	3717	4213	1153	85	143	15471
2004	782	14	4944	3650	2953	1078	92	177	13690
2005	841	15	6041	3346	2117	1056	93	156	13665
2006	725	13	6157	3019	1081	1081	113	117	12306
2007	694	10	5154	4268	810	1037	51	83	12107
2008	522	13	3673	4343	798	970	64	81	10464

Note that reporting may be incomplete, particularly missing NL 1984-1987, 1990-1997; D 1995

ECOREGION North Sea
STOCK Flounder in Division IIIa and Subarea IV

Advice for 2012 and 2013

ICES advises on the basis of precautionary considerations that catches should not increase.

Stock status

F (Fishing Mortality)		
	2008 - 2010	
Qualitative evaluation	?	Insufficient information
TSB (Total Stock Biomass)		
	2008 – 2010	
Qualitative evaluation	↗	Increase in the main area

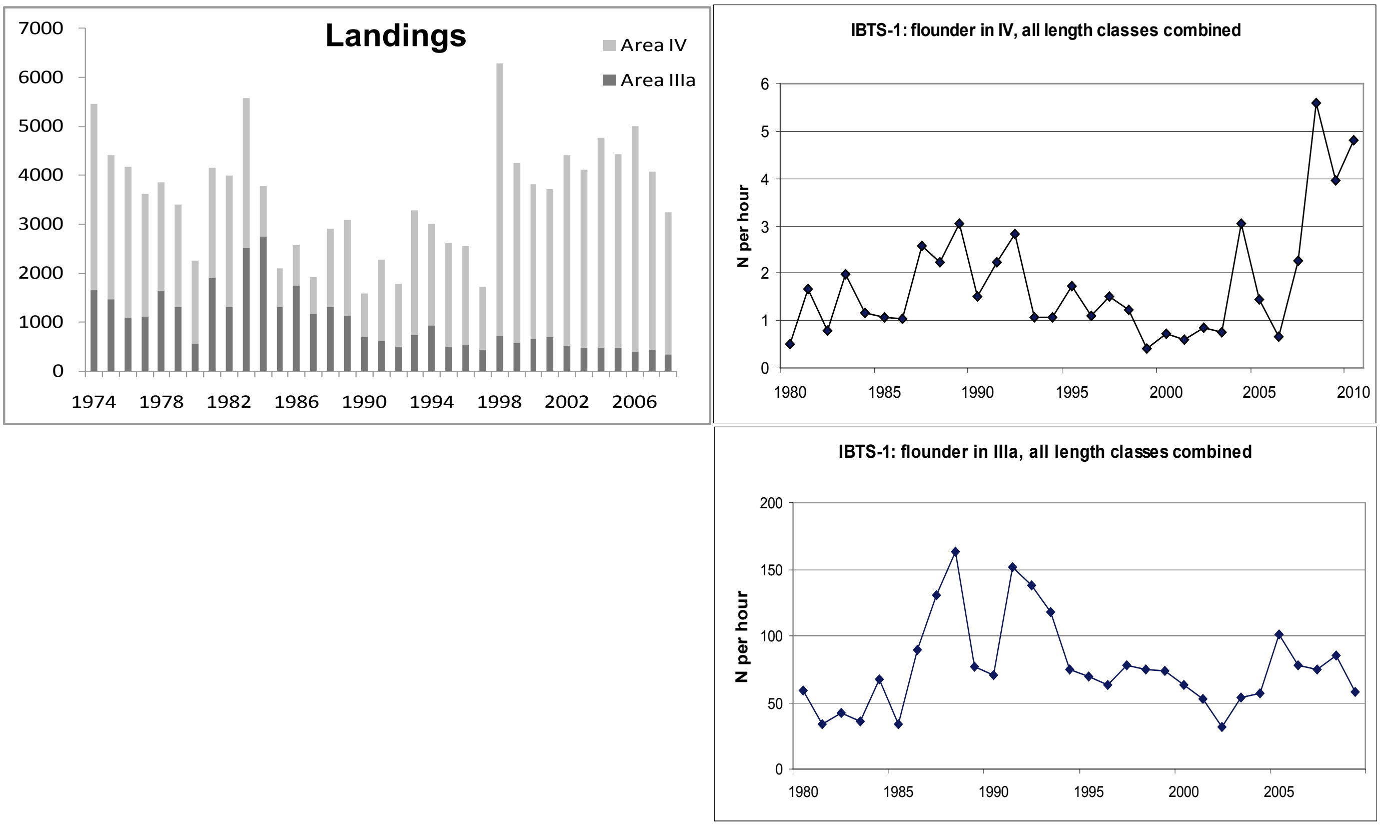


Figure 6.4.29.1 Flounder in Division IIIa and Subarea IV. Left: Official landings by area (in tonnes). Right: Exploratory abundance indices (number caught per hour) for IBTS quarter 1 in Subarea IV (top) and Division IIIa (below).

The available survey information indicates stable (IIIa) or increasing (IV) stock abundance. Subarea IV is the main fishing area where around 87% of the landings are taken. There is no information on the stock identity of this species. Landing data are not indicative for catches since discard rates are variable.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with dab (ICES 2011).

Biology

Flounder is a coastal species that spends part of its life cycle in brackish and freshwater habitats, but they spawn offshore in deeper water of higher salinity. Spawning occurs between February and April. After spawning they migrate to inshore and sometimes brackish waters. The shallow coastal zone and in particular the Wadden Sea are important nursery areas. The species feeds on a wide variety of invertebrates and fish in some areas.

The fisheries

Flounder is a bycatch in the fishery for flatfish and demersal species, mainly in the beam trawl fisheries. Discard rates can vary considerably, depending on availability of the main target species and market price.

Quality considerations

Landings data are not complete, and are probably not always indicative of catches. The mixed TAC with dab reduces the accuracy of catch statistics per species. International sampling effort for this species is at a very low level as only the Netherlands is collecting data. An increase in sampling intensity should be considered.

Scientific basis

Assessment type	Survey trends
Input data	Landing statistics, IBTS1, DFS
Discards and by-catch	Not available
Indicators	None
Other information	2011 was the first year ICES reported on this species in this area
Working group report	WGNEW

ECOREGION North Sea
STOCK Flounder in Division IIIa and Subarea IV

Reference points

No reference points have been defined.

Outlook for 2012 and 2013

No reliable assessment can be presented. The main cause of this is lack of data (exact catches and biological survey results). Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available information shows an increase in total biomass for the main area (IV) in which the fisheries are conducted. Exploitation status is unknown. Effort for the main fleet with flounder bycatches (beam trawls) in the North Sea and Skagerrak has declined 40% between 2003 and 2009. Based on these considerations ICES advises that catches should not increase.

Additional considerations

Flounder is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

For flounder in the North Sea, only the Netherlands collect biological data. An increase in sampling intensity should be considered.

Sources

ICES. 2010. Report of the Working Group on Assessment of New MoU Species (WGNEW), 11-15 October 2010, ICES HQ, Denmark. ICES CM 2010/ACOM: 21.

ICES.2011. Dab in Division IIIa, and Subarea IV, V and VII, Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.28.

Table 6.4.29.1 Flounder in Division IIIa and Subarea IV. ICES advice, management and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] dab & flounder	Official landings Flounder
2006		-	17.1	5.0
2007		-	17.1	4.1
2008		-	18.81	3.2
2009		-	18.81	
2010		-	18.81	
2011		-	18.434	
2012	No increase in catch	-		
2013	No new advice, same as for 2012	-		

[1)] EU combined TAC for dab and flounder in EU areas IIa and IV.

Table 6.4.29.2 Flounder in Division IIIa and Subarea IV. Official landings per area (in tonnes).

	Area IIIa	Area IV
1974	1658	3790
1975	1467	2939
1976	1099	3079
1977	1119	2505
1978	1648	2211
1979	1319	2077
1980	561	1698
1981	1905	2248
1982	1311	2689
1983	2512	3069
1984	2746	1030
1985	1305	793
1986	1751	814
1987	1169	754
1988	1313	1598
1989	1129	1951
1990	708	881
1991	624	1659
1992	507	1276
1993	743	2545
1994	943	2063
1995	498	2125
1996	542	2005
1997	437	1290
1998	725	5560
1999	588	3672
2000	656	3165
2001	705	3022
2002	524	3890
2003	473	3637
2004	478	4294
2005	482	3946
2006	393	4614
2007	445	3622
2008	346	2895

ECOREGION North Sea
STOCK Lemon sole in Subarea IV and Divisions IIIa and VIId

Advice for 2012 and 2013

ICES advises on the basis of precautionary considerations that catches should not increase.

Stock status

	F (Fishing Mortality)	
	2007–2009	
Qualitative evaluation	?	Insufficient information
	TSB (Total Stock Biomass)	
	2007–2009	
Qualitative evaluation	➡	Stable

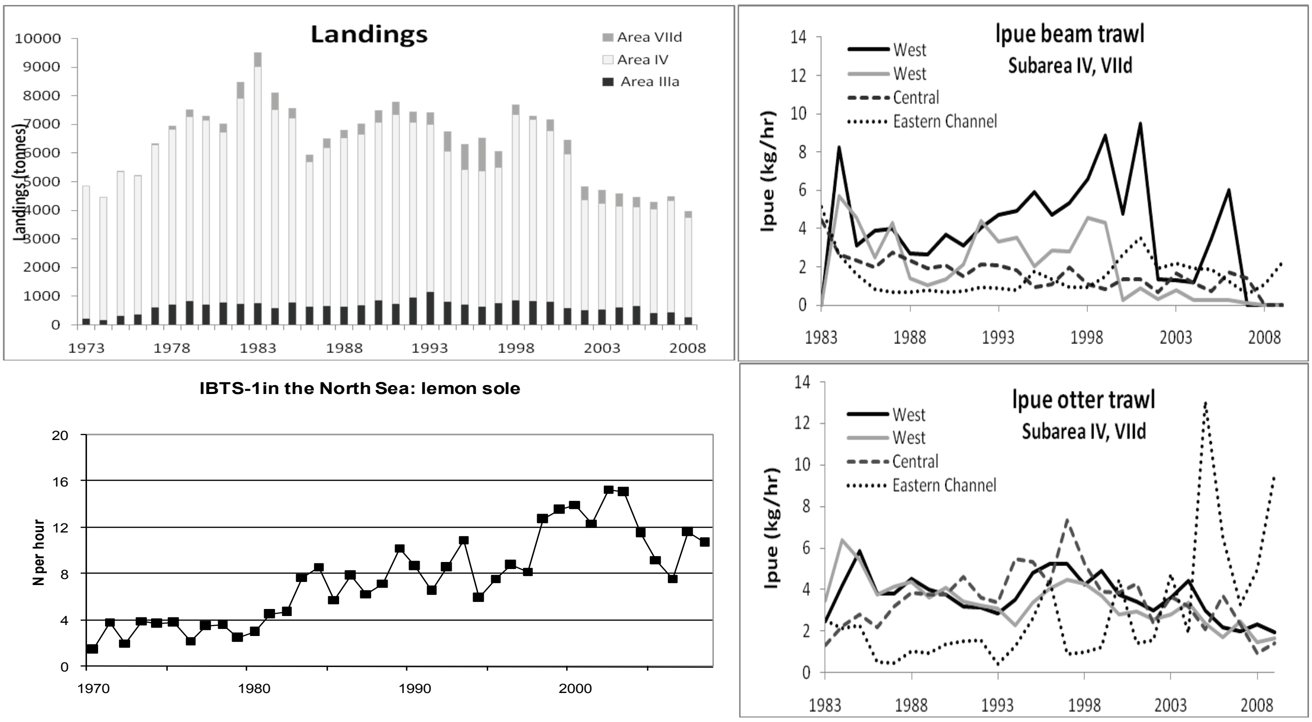


Figure 6.4.30.1 Lemon sole in Subarea IV and Divisions IIIa and VIId. Top left: Official landings per area (in tonnes). Bottom left: For Subarea IV – abundance indicator IBTS quarter 1 catches (number per hour). Right: Landings per unit effort (kg/hr) by otter trawlers and beam trawlers in different survey areas in the North Sea.

The available survey information indicates stable abundance in recent years at a high level. There is no information on the stock identity of this species. Landing data show a declining long-term trend.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of ICES Division IIa and Subarea IV together with witch (ICES, 2011).

Biology

Lemon sole is a widespread demersal species of shelf waters of the North Atlantic, from the White Sea and Iceland southward to the Bay of Biscay. In the English Channel, investigations of habitat association for plaice, sole, and lemon sole indicated that distribution was restricted to a few sites and that lemon sole appeared to prefer sandy and gravelly strata, living deeper and at higher salinity and lower temperature than plaice or sole.

Lemon sole spawn in the northwest of the North Sea in April and spawning spreads north and east as the season progresses. There is little information available on lemon sole stock identity.

The fisheries

Lemon sole are generally caught in mixed fisheries by beam trawlers and otter trawlers. There is no minimum landing size for lemon sole.

Quality considerations

In general, a great deal of data is already available for lemon sole and needs to be analyzed. Commercial catch samples are needed from all countries involved in the fisheries.

Scientific basis

Assessment type	Survey trends.
Input data	Landing statistics, commercial lpue and IBTSQ1.
Discards and bycatch	Not used.
Indicators	French CGFS, UK (E&W)-Q3-BTS and IBTSQ3.
Other information	2011 was the first year ICES reported on this species in this area.
Working group report	WGNEW

ECOREGION North Sea
STOCK Lemon sole in Subarea IV and Divisions IIIa and VIId

Reference points

No reference points have been defined.

Outlook for 2012 and 2013

No reliable assessment can be presented. The main cause of this is lack of data (e.g. age, effort, and cpue data for countries that take the majority of landings). Therefore, fishing possibilities cannot be projected.

Precautionary considerations

The available survey information indicates stable abundance in recent years at a high level. There is no information on the stock identity of this species Landing data show a declining long-term trend. Effort for the main fleet with lemon sole bycatches (otter trawls) in the North Sea and Skagerrak has declined 23% between 2003 and 2009. Based on these considerations ICES advises that catches should not increase.

Additional considerations

Lemon sole is mainly a bycatch species in mixed fisheries. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

In general, there is a great deal of data already available for lemon sole. Commercial catch samples are needed from all countries involved in the fisheries. Survey data other than the IBTS should be analyzed.

Sources

ICES. 2010. Report of the Working Group on Assessment of New MoU Species (WGNEW), 11–15 October 2010, ICES HQ, Denmark. ICES CM 2010/ACOM: 21.

ICES.2011. Witch in Subarea IV and Divisions IIIa and VIId. *In* Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.31.

Table 6.4.30.1 Lemon sole in Subarea IV and Divisions IIIa and VIId. ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] Lemon sole & witch	Official landings Lemon sole
2006		-	6.175	0.3
2007		-	6.175	0.2
2008		-	6.793	0.2
2009		-	6.793	
2010		-	6.521	
2011		-	6.391	
2012	No increase in catch	-		
2013	No new advice, same as for 2012	-		

Weights in '000 t
[1)] EU combined TAC for lemon sole and witch in EU areas of ICES Division IIa and Subarea IV.

Table 6.4.30.2 Lemon sole in Subarea IV and Divisions IIIa and VIId. Official landings per area (in tonnes).

	Area IIIa	Area IV	Area VIId
1973	214	4639	0
1974	183	4277	0
1975	317	5029	33
1976	361	4830	42
1977	627	5661	36
1978	705	6108	139
1979	833	6428	260
1980	722	6424	152
1981	793	5933	290
1982	735	7168	584
1983	759	8257	491
1984	595	6930	586
1985	793	6435	347
1986	639	5047	251
1987	669	5516	310
1988	642	5898	258
1989	693	5967	364
1990	872	6190	423
1991	734	6618	428
1992	952	6126	364
1993	1156	5839	422
1994	803	5262	695
1995	714	4712	877
1996	635	4737	1151
1997	768	4727	563
1998	868	6466	346
1999	844	6316	140
2000	803	5980	388
2001	584	5389	483
2002	522	3827	474
2003	541	3698	471
2004	607	3543	424
2005	674	3444	350
2006	417	3627	246
2007	432	3892	164
2008	276	3466	234

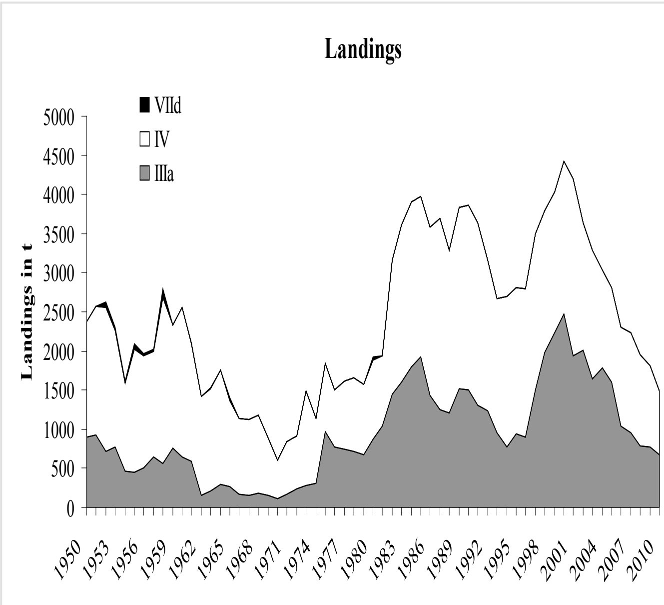
ECOREGION North Sea
STOCK Witch in Subarea IV, Division IIIa and VIId

Advice for 2012 and 2013

ICES advises on the basis of precautionary considerations that catches should be reduced.

Stock status

	F (Fishing Mortality)	
	2008 - 2010	
Qualitative evaluation		Insufficient information
	TSB (Total Stock Biomass)	
	2008 - 2010	
Qualitative evaluation		Variable without trend at low level



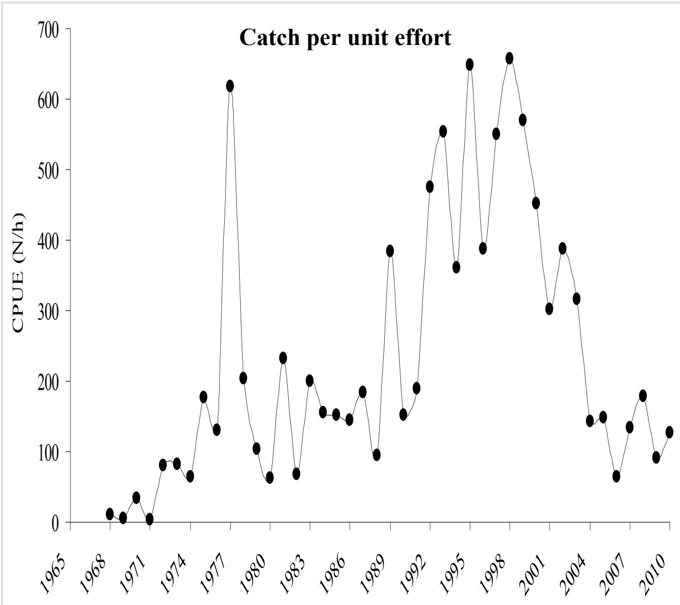


Figure 6.4.31.1 Witch in Subarea IV, Division IIIa and VIId. Catch per unit of effort (Number/hour) obtained from the IBTS survey in the first quarter. Note that indices before 1990 may not have been fully recorded.

The available survey information indicates a declining trend of abundance since 2000 and recent indices are low. There is no information on the stock identity of this species. Landing data show a decline over the same period.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with lemon sole witch (ICES 2011).

Biology

Witch is common in the northern North Sea, west of the British Isles, in Icelandic waters and along the North American east coast. The species is mainly found on soft bottoms, mostly clay or clean sandy bottoms around 100–400 m depth. The main diet consists of crustaceans, worms, brittle stars and fishes. Spawning occurs from summer to autumn, with the Kattegat as a possible separate spawning stock. Growth rate can vary considerably across the area.

The fisheries

Witch is an important bycatch in Nephrops fisheries. A directed fishery exists in the Skagerrak. In Sweden and Denmark a minimum landing size of 28 cm is set.

Quality considerations

Age readings and maturity status evaluation techniques are still uncertain and under development.

Scientific basis

Assessment type	No assessment
Input data	Landing statistics, survey cpue from IBTS-Q1
Discards and by-catch	Not used
Indicators	Commercial cpue
Other information	2011 was the first year ICES reported on this species in this area
Working group report	WGNEW

ECOREGION North Sea
STOCK Witch in Subarea IV, Division IIIa and VIId

Reference points

No reference points have been defined.

Outlook for 2012 and 2013

No reliable assessment can be presented.

Precautionary considerations

The available survey information indicates a declining trend of abundance since 2000 and recent indices are low. There is no information on the stock identity of this species. Landing data show a decline over the same period. Based on these considerations ICES advises that catches should be reduced.

Additional considerations

Witch is caught both as a target (IIIa) and as bycatch (IV) species in mixed fisheries. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

Age readings and maturity status evaluation techniques are still uncertain and under development.

Sources

ICES. 2010. Report of the Working Group on Assessment of New MoU Species (WGNEW), 11-15 October 2010, ICES HQ, Denmark. ICES CM 2010/ACOM: 21.
ICES.2011. Lemon sole in Subarea IV, Division IIIa and VIId, Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.30.

Table 6.4.31.1 Witch in Subarea IV, Division IIIa and VIId. ICES advice, management and landings

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] Lemon sole & witch	Official landings Witch
2006		-	6.175	2.3
2007		-	6.175	2.2
2008		-	6.793	2.0
2009		-	6.793	1.8
2010		-	6.521	1.5
2011		-	6.391	
2012	Reduce catches	-		
2013	No new advice, same as for 2012	-		

Weights in ‘000 t
[1)] EU combined TAC for lemon sole and witch in EU areas IIa and IV.

Table 6.4.31.2 Witch in Subarea IV, Division IIIa and VIId. Official landings per country and area (in tonnes).

	Belgium	Denmark		Faeroe Islands	France	Germany	Netherlands		Norway		Sweden [1]		UK - Eng+Wales+N.Irl. [2 3]		Scotland		
Year/Area	IV	IIIa	IV	IV	IV	III a	IV	IV	IIIa	IV	IIIa	IV	IV	VII d	IV	VII d	Total
1950	224	70	63				20		43	17	789	313	120		720		2379
1951	88	106	100				17		89	31	728	308	86	1	1015		2569
1952	60	57	44				6	1	82	15	574	283	81		1351		2554
1953	21	65	61				7	1	81	11	621	329	111		955		2263
1954	10	58	34				11		59	16	346	191	129		736		1590
1955	9	71	28				4		48	11	331	130	153		1242		2027
1956	5	96	24				2	1	72	8	334	126	146		1122		1936
1957	16	176	28				20		52		415	204	136		944		1991
1958	8	137	43				12		43	37	379	224	136		1659		2678
1959	28	257	52				20		24	47	471	90	174	2	1170		2335
1960	29	208	159				16		22	36	410	164	156		1363		2563
1961	21	165	98				24		21	20	408	105	152		1079		2093
1962	29	138	109				19		10	21		430	117	1	976		1850
1963	34	187	94				9		22	12		344	84	6	1081		1873
1964	37	262	92		61		15		26	18		365	79	1	1170		2126
1965	12	236	91		122		4		24	14		296	88		765		1652
1966	5	166	71		45		3		9	7		218	59		772		1355
1967	15	136	85		41		7		16	3			69		753		1125
1968	15	173	108				21		12	5			90	1	750		1175
1969	3	150	153				9		6	7			72		491		891
1970	5	108	112				5		10	9			66		282		597
1971	6	142	191				6		20	16			101		361		843
1972		219	221				12		16	16			90		334		908
1973		253	215				25		24	516		211	114		347		1705
1974		291	221				18		13	3		228	121		471		1366
1975		484	242				20		14	2	474	20	155		430		1841
1976		441	175				24		18	3	319	5	133		378		1496
1977		444	92				73		13	2	281		226		487		1618
1978		473	87		1		37		14	1	232		184		635		1664
1979		456	91		3		7		21	1	201		167		625		1572
1980		569	111		2		23		49	2	256		165		706		1883
1981		643	123				17		94	2	307		160		587		1933
1982		953	495				16		79	2	421	4	437		748		3155
1983		1108	685		5		19		99	2	391	1	287		1009		3606
1984		1158	687		4		11		158	3	480	3	220		1179		3903
1985		1374	460		1		21		98	2	449	3	145		1426		3979
1986		992	436		12		18		82	2	352	3	143		1539		3579
1987		894	571		35		7		86	5	272	3	187		1640		3700
1988		810	447		13		6	9	74	9	326	3	191		1402		3290
1989		963	452		14		5	10	164	15	393	4	172		1649		3841
1990		994	532		20		3	4	157	40	347	6	132		1627		3862
1991		789	512		9		3	2	160	75	352	12	139		1588		3641
1992		609	460		13		5	7	134	46	494	5	118		1273		3164
1993		453	383		14		3	13	100	52	397	3	115		1140		2673
1994		400	458	1	2		5	14	61	57	310	3	127		1258		2696
1995		513	384	4			9	7	86	14	340	2	129		1322		2810
1996		563	434				7		66	14	273	2	100		1331		2790
1997		1074	488	1			9	1	76	10	352	3	110		1370		3494
1998		1430	476	1			13	4	112	27	444	4	132		1143		3786
1999		1629	486	1		1	8	9	111	23	499	2	132		1124	1	4026
2000		1821	517				13	7	85	12	571	8	103		1285		4422
2001		1304	744				8	1	72	16	563	12	107		1379		4206
2002		1364	543				5		66	16	576	8	62		1000		3640
2003		1036	771				2		64	23	546	3	52		784		3281
2004		1188	623			1	3	1	51	36	549	3	30		545		3030
2005		1006	715			3	4	4	42	40	557	2	25		418		2816
2006		635	654			2	6	3	37	31	369	2	28		536		2303
2007		618	531			2	10	7	45	28	284	6	50		656		2237
2008		476	351			1	6	19	46	58	260	19	17		700		1953
2009		593	350				5	12	28	57	152	5	40		574		1816
2010		536	250			1	7	9	25	40	112	1	507				1488

[1] Sweden reported catches as IIIa and IVa+b (not specified) during the years 1961-1965 and 1972-1973
[2] UK reported catches as VII d+e (not specified)
[3] Catches in 2010 are reported as England but are probably also including UK landing in Scotland.