ICES ADVICE 2012

AVIS DU CIEM

Books 1 – 10

Report of the ICES Advisory Committee 2012

Book 6
North Sea

International Council for the Exploration of the Sea

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Report of the ICES Advisory Committee 2012.

Books 1 - 10
December 2012

Recommended format for purposes of citation:

ICES. 2012. Report of the ICES Advisory Committee 2012. ICES Advice, 2012. Book 6, 447 pp.

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ISBN 978-87-7482-119-9

BOOK 6

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6 NORTH SEA

6.1 Ecosystem overview

This Section has not been updated in 2012. 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 2012. 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 2012 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, there was no need to update advice in this ecoregion.

The state and the limits to exploitation of the individual stocks are presented in the stock sections. The state of and advice for the North Sea stocks are summarized in table 6.3.2.1 below. Biennial advice valid for 2012 and 2013 is presented in table 6.3.2.2, and advice valid for 2013 and 2014 can be found in table 6.3.2.3.

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.

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

Stock	State of the stock				Outlook options for 2013			ICES advice for 2013 (in tonnes)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})**	**MSY approach/DLS[1]** (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	Harvested sustainably	Below trigger	Reduced reproductive capacity	Landings no more than 27 600 t for transition to the MSY approach	Zero catch	25 441 t	Management plan: 25 441 t
Haddock in the North Sea and Division IIIaN	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Landings of no more than 49 000 t Human Consumption	No more than 96 000 t Human Consumption	TAC of 47 811 t Human Consumption	Management plan: 47 811 t Human Consumption
Whiting in Division IIIa	Insufficient information		Insufficient information		Catches (including discards) of no more than 500 t	-	-	Precautionary considerations: < 500 t
Whiting in the North Sea and Eastern Channel	Undefined	Undefined	Qualitative evaluation: At recent average		-	Landings of no more than 26 000 t – based on rescaled MP target	27 242 t Human Consumption landings – but plan no longer considered relevant	Precautionary considerations: < 19 000 t North Sea < 7000 t East. Channel Human consumption landings
Plaice in Skagerrak [2]	Unknown	Unknown	Qualitative evaluation: West: Increasing East: Decreasing at historical low		Catches no more than 8400 t – minimise catches in the Eastern Skagerrak	-	-	Data-limited stock approach: < 8400 t – minimise fisheries in East
Plaice in the North Sea	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	No more than 90 000 t	No more than 189 500 t	Management plan 1st stage: 97 070 t	Management plan: 97 070 t
Plaice in the Eastern Channel	Qualitative evaluation: Lowest in time series		Qualitative evaluation: Increasing		Catches no more than 4300 t	-	-	Data-limited stock approach: < 4300 t

[1] Data Limited Stock.

[2] New stock in 2012 – split from plaice in IIIa (Skagerrak and Kattegat). Advice was corrected in October

Stock	State of the stock				Outlook options for 2013			ICES advice for 2013 (in tonnes)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})**	**MSY approach/DLS[1]** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Sole in Division IIIa	Below target	Increased risk	Below trigger	Undefined	Landings no more than 560 t	Landings no more than 490 t	-	MSY approach: < 560 t
Sole in the North Sea	Above target	Harvested sustainably	Above trigger	Full reproductive capacity	Landings no more than 14 000 t	Landings no more than 19 000 t	Management plan 1st stage: 14 000 t	Management plan: 14 000 t
Sole Eastern Channel	Above target	Increased risk	Above trigger	Full reproductive capacity	MSY transition: Landings no more than 5900 t	Landings no more than 6300 t	-	MSY transition: < 5600 t
Saithe in the North Sea, Division IIIa and Subarea VI	Appropriate	Harvested sustainably	Above trigger	Full reproductive capacity	Landings no more than 113 100 t	Landings no more than 143 000 t	Landings of 100 684 t	Management plan: 100 684 t
Nephrops in Division IIIa (FUs 3 and 4)	Appropriate	Undefined	Undefined	Undefined	Landings no more than 5200 t	-	-	MSY approach: < 5200 t
Nephrops in Subarea IV, FU5	Unknown		Unknown		Data limited approach: landings no more than 1000 t	-	-	Data limited approach: < 1000 t in 2013 and 2014
Nephrops in Subarea IV, FU6	Above target	Undefined	Below trigger	Undefined	MSY transition: landings no more than 1300 t	-	-	MSY transition: < 1300 t
Nephrops in Subarea IV, FU7	Below target	Undefined	Above trigger	Undefined	MSY approach: landings no more than 10 000 t	-	-	MSY approach: < 10 000 t
Nephrops in Subarea IV, FU8	Above target	Undefined	Above trigger	Undefined	MSY transition: landings no more than 1400 t	-	-	MSY transition: < 1400 t
Nephrops in Subarea IV, FU9	Above target	Undefined	Above trigger	Undefined	MSY approach: landings no more than 950 t	-	-	MSY approach: < 950 t
Nephrops in Subarea IV, FU10	Insufficient information		Insufficient information		Data limited approach: landings no more than 50 t	-	-	Data limited approach: < 50 t in 2013 and 2014
Nephrops in Subarea IV, FU32	Qualitative evaluation: Below possible reference points		Qualitative evaluation: Stable		Data limited approach: landings no more than 800 t	-	-	Data limited approach: < 800 t in 2013 and 2014
Nephrops in Subarea IV, FU33	Unknown		Qualitative evaluation: Increasing		Data limited approach: landings no more than 1100 t	-	-	Data limited approach: < 1100 t in 2013 and 2014

Stock	State of the stock				Outlook options for 2013			ICES advice for 2013 (in tonnes)
	Fishing mortality in relation to F_{MSY}	Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})	Spawning biomass in relation to MSY $B_{trigger}$	Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})	MSY approach/DLS[1] (within the precautionary approach)	Precautionary approach / considerations	Management plan	
Nephrops in Subarea IV, FU34[2]	Insufficient information		Qualitative evaluation: Declining		Data limited approach: landings no more than 600 t	-	-	Data limited approach: < 600 t in 2013 and 2014
Nephrops in Subarea IV, 'Other areas'	Insufficient information		Qualitative evaluation: Decreasing		Data limited approach: landings no more than 820 t	-	-	Data limited approach: < 820 t in 2013 and 2014
Herring in IIIa and Subdivisions 22-24 (spring spawners)	Appropriate	Undefined	Above trigger	Undefined	MSY approach: Catches no more than 51 900 t WBSS and 63 300 t herring	-	-	MSY approach: < 63 300 t herring of which 51 900 t is WBSS
Herring in the North Sea, VIId and IIIa (autumn spawners)	Below target	Harvested sustainably	Undefined	Full reproductive capacity	MSY approach: Catch no more than 514 700 t for the A fleet (see scenarios for other fleets)	Catch no more than 514 700 t for the A fleet (see scenarios for other fleets)	465 750 t for the A fleet (see scenarios for other fleets)	Management plan: 465 750 t for the A fleet.
Sprat in Division IIIa	Insufficient information		Insufficient information		Data limited approach: catches no more than 8200 t	-	-	Data limited approach: < 8200 t in 2012
Sprat in the North Sea	Insufficient information		Qualitative evaluation: Increasing		Data limited approach: catches no more than 134 000 t	-	-	Data limited approach: < 134 000 t in 2012
Norway pout North Sea	Qualitative evaluation: Below average		Above trigger	Full reproductive capacity	If catch(2012) = 0: catches < 458 000t. If catch(2012) = 101 000 t: catches < 393 000 t	See MSY approach	-	MSY approach: < 393 000 t – 458 000 t depending on 2012 catches.
Sandeel in Division IIIa and Subarea IV [3]:								
Dogger Bank area (SA1) [3]	Undefined	Undefined	Above escapement level	Full reproductive capacity	MSY approach (short-lived species) catches no more than 23 000 t	-	-	MSY approach: < 23 000 t in 2012
South Eastern North Sea (SA 2)[3]	Undefined	Undefined	Below escapement level	Increased risk	MSY approach Catch for real time monitoring, no more than 5 000 t	-	-	MSY approach: < 5000 t for monitoring in 2012

[3] 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 for 2013			ICES advice for 2013 (in tonnes)
	Fishing mortality in relation to F_{MSY}	**Fishing mortality in relation to precautionary approach (F_{PA}/F_{lim})**	**Spawning biomass in relation to MSY $B_{trigger}$**	**Spawning biomass in relation to precautionary approach (B_{PA}/B_{lim})**	**MSY approach/DLS[1]** (within the precautionary approach)	**Precautionary approach / considerations**	**Management plan**	
Central Eastern North Sea (SA 3) [3]	Undefined 	Undefined 	Below escapement level 	Increased risk 	MSY approach Catch for real time monitoring, no more than 5 000 t	-	-	MSY approach: < 5000 t for monitoring in 2012
Central Western North Sea (SA 4) [3]	Qualitative evaluation: Stable and very low 		Qualitative evaluation: Stable 			Catch for monitoring no more than 5 000 t	-	Precautionary considerations: < 5000 t for monitoring in 2012
Viking and Bergen Bank area (SA 5) [3]	Qualitative evaluation: Very low 		Insufficient information 		-	No increase in the fisheries unless there is evidence that this will be sustainable	-	Precautionary considerations: No increase in fisheries
Division IIIa East (Kattegat, SA 6) [3]	Insufficient information 		Insufficient information 		-	No increase in the fisheries unless there is evidence that this will be sustainable	-	Precautionary considerations: No increase in fisheries
Shetland area (SA 7) [3]	Qualitative evaluation: Very low 		Insufficient information 		-	No increase in the fisheries unless there is evidence that this will be sustainable	-	Precautionary considerations: No increase in fisheries
Pandalus in the Fladen Ground	Insufficient information 		Insufficient information 		-	Catches should not increase unless there is evidence this will be sustainable, zero catch	-	Precautionary considerations: Zero catches
Pandalus in the Skagerrak and Norwegian Deep	Insufficient information 		Qualitative evaluation: Decreasing 		Data limited approach: landings no more than 5800 t and reduce discards	-	-	Data limited approach: < 5800 t and reduce discards
Horse mackerel in the North Sea	Insufficient information 		Insufficient information 		Data limited approach: catch no more than 25 500 t	-	-	Data limited approach: < 25 500 t
Pollack in the North Sea	Insufficient information 		Qualitative information: IV: Insufficient information  IIIa: Below possible reference points 		Data limited approach: catch in IV no more than 1300 t, no catches in IIIa and minimise discards	-	-	Data limited approach: IV: < 1300 t IIIa: zero catch and minimise discards For 2013 and 2014

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 2013
	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 →		-	Bycatch species, effort in main fisheries reduced, catches should not increase	-	Precautionary considerations: No increase in catches
Brill in the North Sea	Insufficient information ?	Insufficient information ?	Insufficient information ?	Insufficient information ?	-	Bycatch species, effort in main fisheries reduced, catches should not increase	-	Precautionary considerations: No increase in catches
Dab in the North Sea	Insufficient information ?	Insufficient information ?	Considered to increase in the main area ↗		-	Bycatch species, effort in main fisheries reduced, catches should not increase	-	Precautionary considerations: No increase in catches
Flounder in the North Sea	Insufficient information ?	Insufficient information ?	Considered to increase in the main area ↗		-	Bycatch species, effort in main fisheries reduced, catches should not increase	-	Precautionary considerations: No increase in catches
Lemon sole in the North Sea	Insufficient information ?	Insufficient information ?	Considered stable →		-	Bycatch species, effort in main fisheries reduced, catches should not increase	-	Precautionary considerations: No increase in catches
Witch in the North Sea	Insufficient information ?	Insufficient information ?	Considered variable without trend at low level →		-	Bycatch species, survey and landing data have reduced, catches should be reduced	-	Precautionary considerations: Reduce catches

Table 6.3.2.3 Individual advice for demersal elasmobranchs in the North Sea. The advice from 2012 is valid for 2013 and 2014.

Species	Area	State of stock Fishing mortality	State of the stock Biomass	Advice based on Data limited approach – No TAC and:
R. brachyura (blonde ray)	IVc and VIId,e	Unknown	Unknown	Catch should decrease by at least 20%
R. clavata (thornback ray)	IV, VIId, IIIa	Unknown	Increasing	Catch can increase by a maximum of 20%
R. microocellata (small-eyed ray)	VIId,e	Unknown	Unknown	Catch should decrease by at least 20%
R. montagui (spotted ray).	IV, VIId, IIIa	Unknown	Increasing	Catch can increase by a maximum of 20%
R. undulata (undulate ray)	VIId, e	Unknown	Unknown	No targeted fishery
L. naevus (cuckoo ray)	IV, VIId, IIIa	Unknown	Increasing	Catch can increase by a maximum of 20%
Common skate (*Dipturus batis*) complex	IV, VIId, IIIa	Unknown	Depleted	No targeted fishery
A. radiata (starry ray).	IV, VIId, IIIa	Unknown	Declining	Status quo catch
Other species of rays and skates	IV, VIId, IIIa	Unknown	Unknown	Catch should decrease by at least 20%
Scyliorhinus canicula (lesser spotted dogfish)	IVa,b,c, VIId	Decreasing	Increasing	Catch can increase by a maximum of 20%
Squatina squatina (angel shark)	IV, VIId		Presumed extirpated in this region	No landings

Table 6.3.2.4 Summary of the state of the stock and advice in the North Sea (see section 1.2 for categories definitions).

Total Number of stock in the ecoregion	56
Data rich stocks	31
Data-limited stocks	25

Table 6.3.2.5 Status of data rich stocks (n=31) for the North Sea ecoregion relative to MSY and PA reference points for Fishing Mortality (F) and Spawning Stock Biomass (SSB). Table shows percentage of stocks per stock status. Values in brackets denote the number of data rich stocks per stock status.

			Spawning Stock Biomass… is at or above MSY $B_{trigger}$ $SSB_{2012} \geq$ MSY $B_{trigger}$	is below MSY $B_{trigger}$ $SSB_{2012} <$ MSY $B_{trigger}$	is not defined
MSY Approach	**Fishing Mortality…**		✓	✗	?
	is at or below MSY ($F_{2011} \leq F_{MSY}$)	✓	16% (5)	3% (1)	6% (2)
	is above MSY ($F_{2011} > F_{MSY}$)	✗	13% (4)	6% (2)	
	is not defined	?	6% (2)	6% (2)	42% (13)
			is at or above PA $SSB_{2012} \geq B_{pa}$	is at increased risk $B_{pa} > SSB_{2012} > B_{lim}$	is below limit $SSB_{2012} < B_{lim}$	is not defined
Precautionary Approach	**Fishing Mortality…**		✓	○	✗	?
	is at or below PA ($F_{2011} \leq F_{pa}$)	✓	16% (5)		3% (1)	
	is at increased risk ($F_{lim} > F > F_{pa}$)	○	3% (1)			3% (1)
	is above PA ($F_{2011} > F_{pa}$)	✗				
	is not defined	?	6% (2)	6% (2)	3% (1)	58% (18)

Table 6.3.2.6 Summary of the catch advice of Data Limited Stocks (n=25) in relation to recent catch, as an indicator of the stock status. Table shows percentage of stocks within each DLS category for which the advice corresponds to an increase or decrease in relation to recent catch. Values in brackets denote the number of stocks.

DLS Category[4]	Catch Advice Increase	Catch Advice Decrease	Zero catch advised	No increase in catch advised
2			4% (1)	
3	19% (5)	4% (1)		4% (1)
4		4% (1)		15% (4)
5		23% (6)	4% (1)	12% (3)
6		4% (1)	8% (2)	

[4] Detailed categories are available under section 1.2.

6.3.3 Special Requests

6.3.3.1 Special request, Advice May 2012

ECOREGION North Sea
SUBJECT Sandeel real-time monitoring assessment

Advice summary

ICES reviewed the approach for real-time monitoring proposed by the Danish Ministry of Food, Agriculture and Fisheries (Annex 1) and considers that it is suitable for monitoring sandeel abundance in Sandeel Area 1, provided that the amount of fishery data collected is sufficient to deliver a reliable index of stock abundance. Annex 1 also suggested that, if the catch per unit effort in the second half of April 2012 was higher than the 2007–2011 average for the same period, fishing in 2012 could continue beyond the original quota until updated advice becomes available. This proposal has not been evaluated and ICES, therefore, does not recommend using it.

ICES advises that no catches of sandeel should be taken in the North Sea Sandeel Area 1 in 2012. No new information is available to reconsider the advice provided by ICES in March 2012 for the other sandeel areas.

Request

The ICES assessment and advice for sandeel, provided in March 2012, estimates of a low TAC (23 000 t) of sandeel in Area IV for 2012, due to very low 2010 and 2011 year classes. Information for the 2011 year-class is entirely based on observation from a dredge survey that took place during December 2011. It is possible that bad weather conditions during the 2011 survey might have biased the estimate of the 2011 year-class. In view of these concerns, the Danish Ministry for Food, Agriculture & Fisheries have proposed an alternative approach to monitoring the fishery based on real-time monitoring. This is described in the attached document [Annex 1].

ICES are requested to;

i. *review this document and to advise on the suitability of the approach described for monitoring sandeel abundance, and;*
ii. *to advise on the implications for management of the sandeel fishery during 2012.*

Elaboration on advice

i. Review of the document and to advise on the suitability of the approach for monitoring sandeel abundance

ICES (2012a) reviewed the proposed methodology to estimate sandeel abundance through real-time monitoring (RTM) in the commercial fishery in Sandeel Area 1 (Annex 1). The aim of RTM of sandeel is to use observations of catch per unit effort (cpue) from the commercial fishery in April in the estimation of stock abundance. This cpue information is considered a good index of stock abundance for the years 1999–2012. The RTM cpue time-series is incorporated as an additional stock abundance index per age class in the ICES assessment for Sandeel Area 1 (ICES, 2010, 2012), and the result of the updated assessment provides the basis for the updated catch recommendation for 2012. ICES considers that the approach is suitable for monitoring sandeel abundance in Sandeel Area 1, provided that the amount of fishery data collected is sufficient to deliver a reliable index of stock abundance. The following elements should be taken into consideration:

- All data available from the April fishery should be included and the sampling period should be long enough to ensure a sufficient number of samples and logbook records. The minimum number of samples and records needed can be evaluated through statistical analysis. The age distribution of the commercial catch is obtained from biological sampling at harbours and by the fishing industry at sea (sampling every third haul to reduce correlation). All years included in the RTM cpue series have at least 45 samples and many have more than 100 samples (Rindorf and Vinther, 2012), which is considered sufficient to provide a robust estimate of the age distribution. A reduction in the sampling level may still deliver a sufficiently robust estimate, but this should be preceded by statistical evaluations.
- As noted by Rindorf and Vinther (2012), in the most recent five years several large vessels (>700 GT) have entered the April fishery. In the first years of participation in the April fishery the effort of these vessels was low, and they have participated in the fishery for less than half of the years since 1999. It is, therefore, not currently possible to evaluate whether the inclusion of these vessels would affect the accuracy of the RTM and they have not been incorporated in the construction of the RTM cpue index. This decision should be re-evaluated when more data become available.

- The proposed approach (Annex 1) suggested that, after April and until the updated advice is available, the fishery could probably continue (even if the original Danish quota had already been taken) if the cpue in the second half of April exceeded the average of the same period in the years 2007–2011, when the stock was above B_{pa}. As no quantitative analyses were performed, ICES was not able to evaluate whether this suggestion is appropriate and can therefore not recommend using it.
- It is noted that the formula for cpue calculation presented in Annex 1 ("Data and methods" section) erroneously included a factor 1/N. The correct version of the formula is the same, but without the 1/N factor.
- The RTM procedure uses cpue from the commercial fishery, which could result in biased sandeel abundance indices, as fishing effort is likely to be concentrated on grounds with the highest cpue. Changes in stock abundance may not be as apparent in fishery-dependent as in fishery-independent indices. Nevertheless, the document presented in Annex 1 and further work by Rindorf and Vinther (2012) show good agreement between the RTM cpue and the dredge survey index (the abundance index used in the ICES assessment), as well as good agreement between the RTM cpue for age 1 and the model estimates of stock abundance for that age (when both the dredge survey index and the RTM cpue are used in the model). Hence, the approach followed seems valid.
- The approach in Annex 1 is only for Sandeel Area 1 and not for the entire North Sea. Applying a similar approach in Sandeel Areas 2 or 3 (for which the assessment model is similar to the one used for Sandeel Area 1) would require having an appropriate RTM cpue index for those areas, that could be incorporated in the stock assessments. As no assessment model exists currently for Sandeel Areas 4–7, the approach would not be applicable to them.

ii. Advice on the implications for management of the sandeel fishery during 2012

The results of the RTM in April 2012 for Sandeel Area 1 are described in Rindorf and Vinther (2012) and lead to the following outlook table:

Outlook for 2012

Basis: F_{2011} = sum of half yearly Fs = 0.47; Yield(2011) = 310; Recruitment(2011) = 33; Recruitment(2012) = geometric mean (GM 83–10) = 202 billion; SSB(2012) = 266.

Rationale	Landings (2012)	Basis	F (2012)	SSB (2013)	%SSB change[1)]	%TAC change[2)]
Zero catch	0	F=0	0	205	-23%	-100%
Other options	32	F_{2011}*0.25	0.12	183	-31%	-90%
	61	F_{2011}*0.5	0.23	164	-38%	-80%
	87	F_{2011}*0.75	0.35	147	-45%	-72%
	110	F_{2011}	0.47	132	-51%	-65%

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

MSY approach

Following the ICES MSY framework for a short-lived species, the fishery in 2012 should retain a stock of sandeel that is sufficient for successful recruitment (at MSY $B_{escapement}$ = 215 000 t). This implies a zero catch in Sandeel Area 1 in 2012.

Suggestions

Additional research should be conducted to better understand the factors impacting sandeel recruitment. Knowing whether critical environmental factors caused the decline in the last two cohorts or whether this was a result of the high abundance of older individuals (*i.e.* density dependence) would improve both the knowledge of the stock's dynamics and the ability to manage the fishery.

Sources

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ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 27 April–03 May 2012. ICES CM 2012/ACOM:13.
Rindorf, A., and Vinther, M. 2012. Updated assessment of sandeel in IV, Area 1. May update of the WGNSSK report March 2012. ICES CM 2012/ACOM:65.

Annex 1

Attachment to the request:

DTU Aqua

DTU

MEMO

To Ministry for Food, Agriculture and Fisheries

Reg. Real Time Monitoring of the area 1 sandeel stock in 2012

From DTU Aqua

22 March 2012
AR/MV

REAL TIME MONITORING OF THE AREA-1 SANDEEL STOCK IN 2012

1 Background

The ICES assessment and advice, March 2012 (ICES 2012), estimates of a low TAC (23 000 t) of sandeel in Area for 2012, due to very low 2010 and 2011 year classes. Information for the 2011 year-class is entirely based on observation from a dredge survey, December 2011. However, bad weather conditions during the 2011 survey might have biased the estimate of the 2011 year-class and may indicate the relevancy of an analysis of Real Time Monitoring (RTM) for 2012 (ICES 2012).
This document outlines data and method to be used for the 2012 RTM.

2 Data and methods

The aim RTM of sandeel is to estimate stock abundance of sandeel from observations of catch per unit effort (CPUE) from the fishery in April 2012. This information is then used as a stock abundance index together with similar information for the period since 1999 to update the ICES assessment, which finally will be the basis for the final setting of the TAC for 2012.
Stock abundance is measured as CPUE in number per age class, which is derived from CPUE measured as landed weight per effort unit and information on age composition of the catch. Effort is measured as number days absent from harbour for the individual fishing trips, standardised to an average vessel size of 200 GT:

$$\overline{CPUE} = \frac{1}{N} \frac{\sum_1^N Catch_i}{\sum_1^N Daysabsent_i * \left(\frac{GT_i}{200}\right)^{0.449}}$$

Where *N* is the number of trips, *Catch* is the catch in tonnes on a given trip, *Daysabsent* is the number of days absent on a given trip, GT is the gross tonnage of the vessel and 0.449 is the average effect of vessel size as measured over the period 2002 to 2011 using data from all months and the method described in ICES (ICES 2010). Effort (days absent), vessel GT and total catch weight of sandeel by trip are obtained from log book data extracted from the Danish AgriFish Agency's database. Age distribution of the catch is obtained from samples taken by the Danish AgriFish Agency; ideally one sample from each landing. Samples taken at sea by the industry from every third haul, with detailed informa-

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tion on catch position and time will also be used when available to estimate the age distribution of the catch.

The default ICES assessment did not include the new time series of CPUE in April. Figure 1 presents the output of the default assessment and an assessment using the new index for the period 1999-2011. It is clearly seen that the two assessments give almost identical result, however fishing mortality is slightly higher in the assessment with use of the new abundance index. Survey residuals for the Dredge survey in the new assessment (Figure 2) show a very similar picture compared to the default assessment (ICES 2012, Figure 4.2.5). The "RTM April" index shows in general a good correlation between CPUE in April and the year class strength. The CV of the catchability of the RTM age 1 index (0.35) is lower than the CV for the 0-group from the dredge survey (0.44) (Table 1).

The Danish fishery will be opened the 15 April. Catches and effort for the period up to the 1st May (or until the Danish quota has been taken) will be used to calculate the RTM abundance indices for 2012. After the 1st May it will take at least a week before biological samples are analysed so data can be applied in the new assessment and advice. During the period from May 1st to the new assessment and advice is available, DTU Aqua considers that the fishery can continue (even if the Danish Quota has already been taken) without probable harm to the stock if the CPUE in the second half of April exceeds the average of the same period in the years 2007 to 2011, where the stock was above Bpa. This level amounts to an average of 18 ton/day absent for a standard vessel of 200 GT. Catch rates of vessels of other size are standardised using the equation given above.

References

ICES 2010. Report of the Benchmark Workshop on Sandeel. ICES CM 2010/ACOM: 57

ICES 2012. ICES WGNSSK REPORT 2012.

http://www.ices.dk/reports/ACOM/2012/WGNSSK/Sec%2004%20Sandeel.pdf

Table 1. Statistics for abundance indices in sandeel assessment including the RTM time series.

Survey catchability:

	age 0	age 1	age 2	age 3	age 4
Dredge survey 2004-2011	2.068	1.604			
RTM April. 1999-		1.734	1.610	1.041	1.041

sqrt(Survey variance) ~ CV:

	age 0	age 1	age 2	age 3	age 4
Dredge survey 2004-2011	0.44	1.26			
RTM April. 1999-		0.35	0.66	0.66	0.66

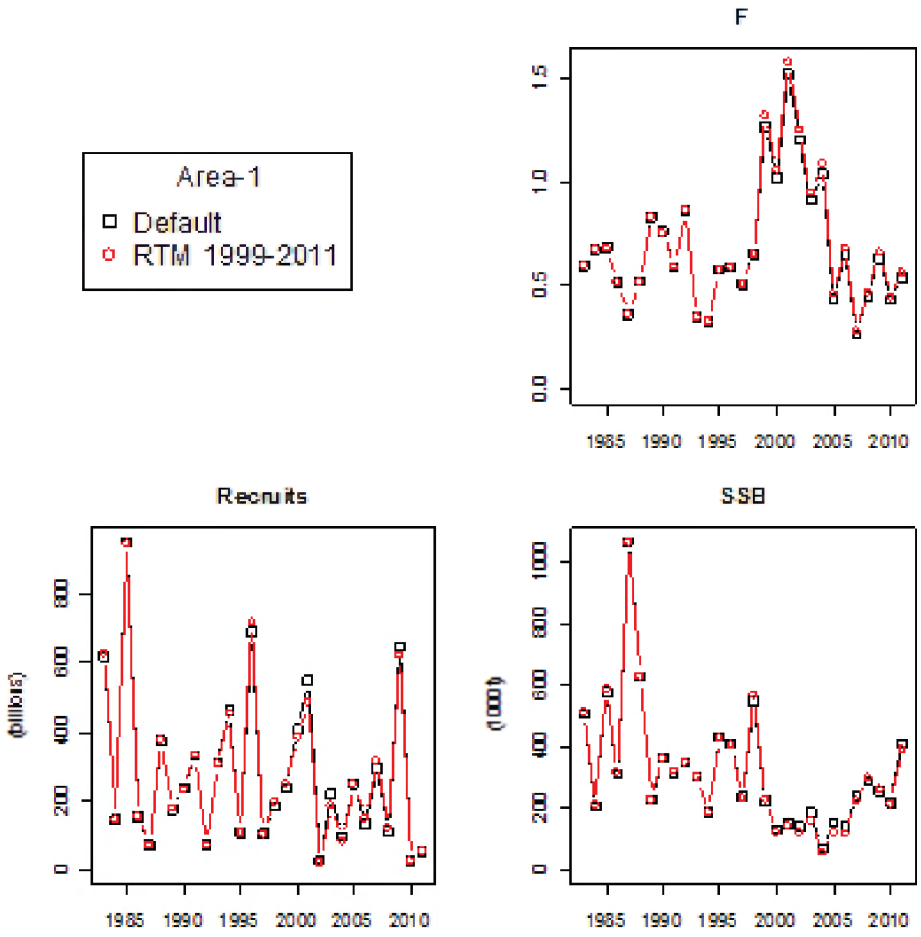


Figure 1. Assessment results from the default ICES assessment of area 1 sandeel (ICES, 2012) and the same assessment updated with e new Real Time Monitoring abundance index obtained from the fishery in April.

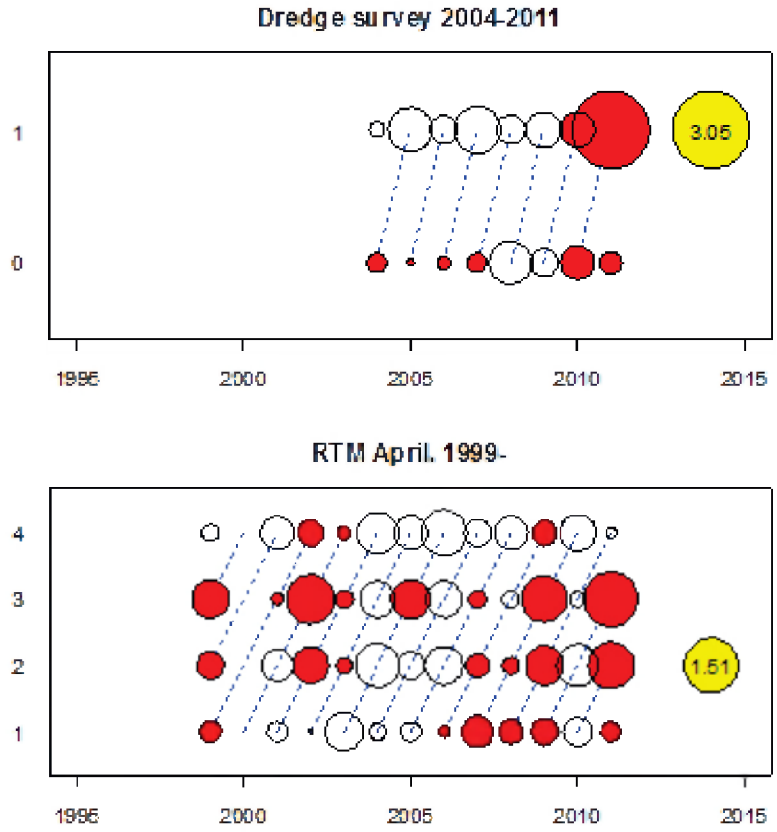


Figure 2. Residual plots from abundance indices. The area of the dots is proportional to the absolute value of the residual. Red dots show that the observed CPUE is higher than the expected.

[Tekst]

5

6.3.3.2 Special request Advice June 2012

ECOREGION **North Sea**
SUBJECT **Joint EU–Norway request on management measures for plaice in the Skagerrak**

Advice summary

The plaice stock in the Skagerrak and adjacent waters consists of several local components. The Skagerrak stock consists of an Eastern and a Western component, and the Skagerrak is closely associated with the North Sea stock.

One option for a trends-based Harvest Control Rule (HCR) for plaice in Skagerrak was studied and is considered useful as an ***interim*** rule until further quantitative evaluations can take place. It is important to develop a way to integrate spatial knowledge to improve protection of local components in the eastern and western parts of Skagerrak.

Request

With the objective of establishing a long-term management plan for plaice in Skagerrak to provide for sustainable fisheries with high and stable yield in conformity with the MSY approach, ICES is requested by 30 June 2012:

1. *To consider the stock identities of plaice in the Skagerrak and adjacent waters.*
2. *To evaluate possible approaches to develop a long-term management plan for plaice in Skagerrak, including a possible link with trends in the status of the plaice stock in the North Sea.*

Elaboration on the advice

1. *The stock identities of plaice in the Skagerrak and adjacent waters.*

ICES evaluated the stock identity of plaice in the Skagerrak and Kattegat (ICES, 2012a, 2012b) for which combined advice has been given until now. Adjacent waters, such as the North Sea in the west and the Belts and Sound in the east are taken into account due to known migration of local components between their spawning and feeding grounds. Although work on stock identity is still under development, the collected information on biology and fishery of plaice in Division IIIa and adjacent waters is considered to imply changes in assessment units as well as in management areas. Three management areas are suggested:

- **Plaice in Skagerrak** (Subdivision (SD) 20) is considered to be closely associated with plaice in the North Sea, although it is recognised that local components (Eastern and Western) are present in the area. In the Western component, where 90–95% of the catches are taken, local populations intermingle with the North Sea stock. In the Eastern component, several local adult populations are found, but nursery grounds also host North Sea juveniles that stay in the area parts of their lives.
- **Plaice in Kattegat, the Belts, and the Sound** (SDs 21, 22, and 23) is considered a stock unit with separate local components and spawning grounds are observed in the Kattegat (east and west), the Belts, and the Sound. Hydrographic conditions support recruitment to nursery grounds along the Danish and Swedish coasts in Kattegat.
- **Plaice in the Baltic** (SDs 24–32) is considered a stock unit. There are indications that the spawning areas are likely located in the southern parts of SDs 25 and 26, but the exact spawning locations are not known. The fishery is mainly concentrated around Bornholm (SDs 24 and 25) and has increased in recent years.

2. *Evaluation of possible approaches to develop a long-term management plan for plaice in Skagerrak, including a possible link with trends in the status of the plaice stock in the North Sea.*

Biological studies concluded that the plaice in Skagerrak is linked to the North Sea, as plaice from both areas are caught across the border. The largest part of the fisheries takes place in the western Skagerrak closest to the North Sea, possibly on North Sea plaice that migrate into the Skagerrak temporarily. A logical approach would be to include the Skagerrak information with the broader North Sea and perform a combined assessment. However, a precautionary approach would call for particular considerations of the dynamics of the local populations, which are estimated to be currently very low and unproductive along the eastern coast in the Skagerrak.

A pragmatic management approach would therefore integrate an indexing of the Skagerrak TAC to the North Sea TAC, but with provisions explicitly linked to a monitoring of the dynamics in local components within Skagerrak (Figure 6.3.3.2.1). The preservation of the local components should be explicitly addressed in the management harvest control rules, through the use of a survey-based index of the different sub-components (Cardinale *et al.*, 2010; Figure 6.3.3.2.2).

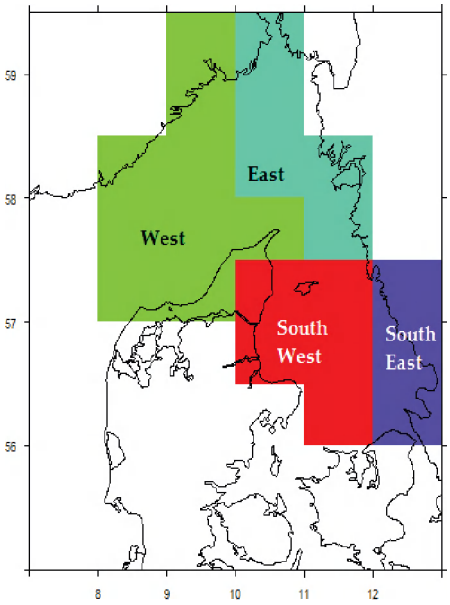


Figure 6.3.3.2.1 Plaice in the Skagerrak and Kattegat. Local components in the area (based on putative spawning subareas) in ICES statistical rectangles. The light blue and green areas describe the Eastern and Western Skagerrak stock components; the dark blue and red areas describe the Eastern and Western Kattegat stock components.

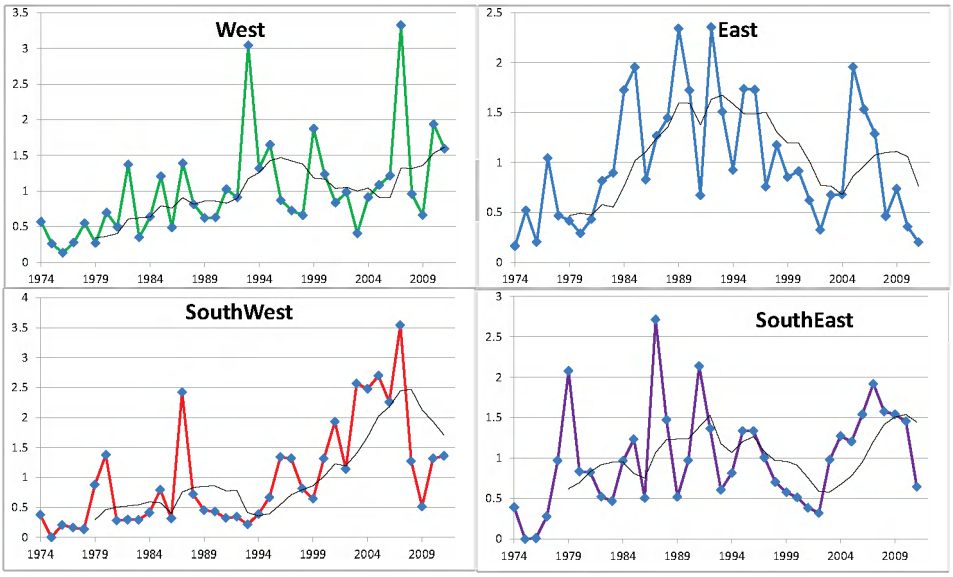


Figure 6.3.3.2.2 Plaice in the Skagerrak and Kattegat. Trends in the relative index of local components in the Skagerrak and Kattegat (adapted from Cardinale *et al.*, 2010). The thin black line is a 6-year moving average.

If the assessments for North Sea and Skagerrak plaice are combined in future, a procedure is needed to allocate part of the combined North Sea and Skagerrak plaice catch advice to plaice in Skagerrak. A proposal to achieve this was put forward by the North Sea RAC (ICES, 2012a), based on the status and trend of the North Sea plaice SSB in relation to the MSY biomass trigger, and on the trends in commercial landings per unit effort (lpue) of the Skagerrak stock. This overall approach seems relevant and globally sensible. However, the rule as it was put forward was not considered precautionary in a few situations (for instance where the North Sea stock is rising and the Skagerrak stock is declining) because the local components would not be sufficiently protected. Additionally, there are concerns about the use of commercial lpue as abundance indices, and survey-based alternatives would be preferred. Spatially explicit abundance indices of aggregation during spawning developed by Cardinale *et al.* (2010) are available as a suitable alternative (Figure 6.3.3.2.2). A further lower abundance threshold was added to the rule to avoid a decline of the stock in case of low biomass situations. Additionally, a method to define quantitative rules to identify increasing and declining trends needs to be developed.

It should be kept in mind that the Skagerrak survey abundance is split over local components, and the rule currently does not facilitate decisions in cases where the trends between the Eastern and Western components diverge.

Incorporating comments from scientists, an ***interim*** HCR could look like this:

a) If the survey abundance is at or below the lower abundance threshold*, then advise a decrease or no fishing.
b) If the survey abundance is above the lower abundance threshold* then:

North Sea SSB		**Skagerrak Survey abundance**	
		RISING	STABLE / FALLING
Above MSY $B_{trigger}$	RISING	Skagerrak TAC increases with same rate as NS SSB** *(a)*	Skagerrak TAC remains at same level as previous year *(b)*
	STABLE / FALLING	Skagerrak TAC remains at same level as previous year *(c)*	Skagerrak TAC decreases with same rate as NS SSB ** *(d)*
Below MSY $B_{trigger}$	RISING	Skagerrak TAC remains at same level as previous year *(e)*	Skagerrak TAC remains at same level as previous year *(f)*
	STABLE / FALLING	Skagerrak TAC decreases with same rate as NS SSB ** *(g)*	Skagerrak TAC decreases with the rate of the NS SSB ** *(h)*

* Lower abundance threshold to be decided.
** It could be considered to use the rate of the North Sea TAC increases/decreases rather than the SSB value.

Without having finalized a management strategy evaluation (MSE) on this design, ICES considers that a pragmatic approach along similar lines might form the basis of an ***interim*** management plan which needs to be evaluated, especially in the current period of high North Sea plaice abundance. This approach will have to be adapted to respond to discrepancies in trends between local components (both between North Sea and Skagerrak and between East and West Skagerrak).

New tagging, biological, and genetic data need to be collected and analyzed to update the knowledge base behind the underlying assumptions and develop quantitative analysis of the amount of mixing between both components. A revised management plan for the wider North Sea could include procedures to allocate catches in Skagerrak.

Sources

Cardinale, M., Bartolino, V., Llope, M., Maiorano, L., Sköld, M., and Hagberg, J. 2010. Historical spatial baselines in conservation and management of marine resources. Fish and Fisheries, 12(3): 289–298.

Clausen, L. A. W, Bekkevold, D., Hatfield, E. M. C., and Mosegaard, H. 2007. Application and validation of otolith microstructure as a stock identification method in mixed Atlantic herring (*Clupea harengus* L.) stocks in the North Sea and western Baltic. ICES Journal of Marine Science, 64: 377–385.

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ECOREGION North Sea
SUBJECT Joint EU–Norway request on management measures for Norway pout

Advice summary

ICES advises that the proposed management strategies (Options 1, 2, and 3) are in accordance with the precautionary approach and lead to sustainable yields, under certain constraints.

For option 1, the minimum annual TAC should be at 27 000 tonnes or lower, whereas for options 2 and 3, fixed initial TACs (TAC for the first half of the year) up to 50 000 tonnes are possible. For option 2, the TAC for the second half of the year should not exceed 70% of the value corresponding to an annual F = 0.35 after subtracting the catch taken in the first half of the year.

A main constraint in all options is that future fishing capacity should not exceed the range of the values observed in the last decade. This constraint is not critical if a maximum annual TAC of 100 000 tonnes or less is applied in option 1, or if the fixed TAC for the first half of the year does not exceed 25 000 tonnes in option 2. High values of the maximum TAC in option 1 (250 000 tonnes), of the fixed initial TAC in option 2 (50 000 tonnes), and even low values of the fixed initial TAC in option 3 (25 000 tonnes), should be complemented with effort management to ensure that fishing mortality remains within the range of values observed for the last decade. Alternatively, the application of a maximum value for F as part of the management strategies could be explored.

Request

The European Union and Norway jointly request ICES to advice on the management of Norway Pout in ICES Subarea IV (North Sea) and ICES Division IIIa (Skagerrak-Kattegat) and to evaluate the following options:

1. *Whether a management strategy is precautionary if TAC is constrained to be within the range of 20,000 - 250,000 tonnes, or another range suggested by ICES, based on the existing escapement strategy;*
2. *A management strategy with a fixed initial TAC in the range of 20,000 - 50,000 tonnes. The final TAC is to be set by adding to the preliminary TAC around (50%) of the amount that can be caught in excess of 50,000 tonnes, based on a target F of 0.35;*
3. *A management strategy with a fixed initial TAC in the range of 20,000- 50,000 tonnes. The final TAC is to be set by adding to the preliminary TAC around (50 %) of what can be caught in excess of 50,000, based on the escapement strategy.*

Elaboration on the advice

Interpretation of the request:

Some aspects of the request from the European Union and Norway are not clear and ICES has interpreted it in the following way:

1. Management Strategy 1 (MS1): This is a Management Strategy (MS) based on the existing ICES escapement strategy for Norway pout (catch should not exceed an amount that allows stock biomass to be above 150 000 tonnes at the beginning of the following year), modified to include absolute constraints on the annual TAC (a minimum TAC higher than zero and a ceiling on the TAC). In the present management system, ICES conducts assessments and provides advice twice per year: in September, including all information from the first half of the year and indices (including recruitment) from bottom trawl surveys in quarter 3; and in May, including all information from the first quarter of the year. In some years, the September advice has been used to update the TAC in-year (for quarter 4), whereas in other years it has been used to set the initial TAC for the following year. The May advice is used to update the TAC in-year (for quarters 3 and 4).

   For this MS, ICES has chosen only to evaluate the option where the September assessment is used for the TAC for the next calendar year (with an in-year update in May, but not in September). This option, where the TAC for quarter 4 is set from the May assessment without knowing the recruitment indices from the third quarter, is less robust than the alternative, which has an additional in-year update in September.

2. Management Strategy 2 (MS2): This MS has a fixed TAC for the first six months of the year, followed by a TAC for the second half of the year, calculated based on the assessment conducted in May. The TAC for the second half

of the year is based on achieving an annual F = 0.35 (accounting also for the catch taken in the first half of the year).

By having a fixed TAC for the first six months of the year irrespective of the state of the stock, there is no reason to conduct an assessment in September.

3. Management Strategy 3 (MS3): This MS is the same as MS2, but the TAC for the second half of the year is based on the escapement strategy (SSB above MSY $B_{escapement}$ on January 1st of the following year).

   A main difference between MS1 and MS3 is that the fixed TAC in MS3 applies exclusively to the first six months of the year, and the fishery may be closed in the second half of the year. By contrast, the minimum TAC in MS1 is assumed to be valid for the whole calendar year, irrespective of the May assessment results.

ICES Response

ICES has evaluated the performance of the management strategies in relation to their conformity with the precautionary approach. Risks (probability of SSB being below B_{lim}) were considered in the short term (for each of the years 2013–2016) and in the long term (average of the years 2017–2026). Risk values in the short term are highly influenced by the current population state, which is estimated to be high at present due to the very strong incoming recruitment observed in 2012. This leads to low short-term risks. Long-term risks are strongly dependent on assumptions about future recruitment, which have been based on historically observed recruitments (assuming a stock–recruitment relationship with deviations around it). Detailed results for risk under different configurations of the management strategies are presented in the "Results and conclusions" section, below.

All management strategies are considered to be in accordance with the precautionary approach, resulting in risks below 5%, under certain conditions. For MS2, this requires that the TAC for the second half of the year is set no higher than 70% of the originally intended value (the value that would lead to an annual F = 0.35, according to ICES interpretation of MS2). For MS1, risks of 5% or less are obtained if the minimum TAC value does not exceed 27 000 tonnes, whereas for MS2 and MS3 the fixed TAC for the first half of the year can take values up to 50 000 tonnes.

A main constraint required for obtaining low risks in many configurations of the management strategies is that future fishing mortality should not significantly exceed the range of the values observed in the last decade. A high value for the maximum TAC in MS1 (250 000 tonnes), for the fixed initial TAC in MS2 (50 000 tonnes), and even a lower value for the fixed initial TAC in MS3 (25 000 tonnes), results in increased risk if F is allowed to increase significantly above this range. The evaluations assumed that fishing mortality would not exceed a certain value (cap F), and that the TAC would not be fully taken when it corresponded to values of F larger than cap F. Values of cap F above 0.6 led to increased risk for many configurations of the management strategies, although the results are case-specific. TACs should be complemented with effort management to ensure that fishing mortality remains within the range of values observed for the last decade. Given the good historical relationship observed between (standardized) fishing effort and fishing mortality in the Norway pout fishery, an upper limit on effort would be effective in setting an upper limit on fishing mortality. Alternatively, the application of a maximum value for F as part of the harvest control rules could be explored.

Basis of advice

Background

ICES evaluated and commented on three management strategies in 2007, following requests from managers: fixed fishing mortality (0.35), fixed TAC (50 000 t), and an escapement strategy based on recruitment indices. The evaluation showed that all three management strategies could maintain SSB above B_{lim} with high probability and the management strategies were, therefore, considered to be in accordance with the precautionary approach. None of them has been chosen by managers as the basis for managing the Norway pout fishery, and the present management is based on TAC advice according to the escapement strategy.

In the beginning of 2011 the SSB was more than twice the value of B_{pa}, but the advice for 2011 was initially zero catch (later raised to 6000 t). The zero catch advice for 2011 was due to low recruitment in 2010 (and 2011) in combination with the escapement strategy, which is based on SSB being above B_{pa} after the fishery has taken place. The high stock size in the beginning of 2011 and a closed fishery were seen by industry as conflicting and as a suboptimal utilization of the resource. The new management strategy options proposed in this request include a minimum TAC to avoid closure of the fishery. This minimum TAC would be guaranteed in all circumstances, and not be conditional on an initial large stock size, as observed in 2011.

Results and conclusions

Long-term risks (average probability of SSB being below B_{lim} during 2017–2026) were investigated for each of the management strategies with various configurations of minimum and maximum TAC values. The following results were obtained (ICES, 2012a):

Management Strategy 1: A range of values was considered for the minimum and maximum annual TAC. Assuming a maximum TAC of 200 000 tonnes and a cap on annual F at 0.6, the long-term risk is in the range of 0–10% for minimum TAC values between 0 and 50 000 tonnes, and below 5% for minimum TACs less than 27 000 tonnes, approximately (Figure 6.3.3.3.1). Long-term median values of F, SSB, and yield are not sensitive to the choice of minimum TAC (particularly when this does not exceed 27 000 tonnes). Assuming a minimum TAC of 27 000 tonnes and a cap on annual F at 0.6, the choice of maximum TAC has very little effect on the risk, which is less than 5% for maximum TAC values in the range of 100 to 250 000 tonnes. However, for a high maximum TAC value (250 000 tonnes) this result relies on the assumption of a cap on annual F at 0.6, and the risk increases above 5% for larger values of the cap on F (Figure 6.3.3.3.2). For a maximum TAC of 100 000 tonnes, the risk remains below 5% even when the assumed cap on F is considerably above 0.6.

Management Strategy 2: Values between 0 and 50 000 tonnes were considered for the TAC in the first half of the year. When the TAC in the second half of the year is based on achieving an annual F = 0.35 (taking also into account the catch taken in the first half of the year), the long-term risk is always above 5%, independently of the TAC value for the first half of the year. If the TAC thus calculated for the second half of the year is reduced by 30% (i.e. TAC set at 70% of the amount calculated), then the long-term risk is about 5% or less. However, if the fixed TAC for the first half of the year is high (50 000 tonnes), this result relies on the assumption of a cap on annual F at 0.6, and the risk increases for larger values of the cap on F (Figure 6.3.3.3.3). If the TAC for the first half of the year is low (25 000 tonnes), the risk remains at around 5% even when the assumed cap on annual F is considerably above 0.6.

Management strategy 3: Values between 0 and 50 000 tonnes were considered for the TAC in the first half of the year. The long-term risk with this MS is always below 5%, under the assumption of a cap on annual F at 0.6. However, the risk increases for larger values of the cap on F (Figure 6.3.3.3.4), especially for larger values of the TAC in the first half of the year (e.g. 50 000 tonnes).

Short-term risks were also investigated for each of the years 2013–2016 and shown in Figures 6.3.3.3.1–6.3.3.3.4. Due to the high recruitment in 2012 (ICES, 2012b), the current stock biomass is high and short-term risks are lower than the long-term averages.

Long-term distributions of SSB, yield, and F for the three management strategies are displayed in Figure 6.3.3.3.5. MS2 (fixed F strategy) provides a lower long-term yield and a higher SSB than the escapement strategies (MS1 and MS3), which is typical for short-lived species. The escapement strategies give a more variable fishing mortality and effort from one year to the next. Stability in landings is also lower for the escapement strategies.

Methods

A Management Strategy Evaluation (MSE) analysis was conducted to investigate the properties of the proposed management strategies (ICES, 2012a). The analysis was based on settings very similar to the ICES assessment from May 2012, with a quarterly time-step, but was implemented with a different assessment model (SMS) which allows quantifying uncertainty in the outputs. This leads to only minor differences with the ICES assessment. The internal SMS population structure is used to project the population forward, under application of different management strategies. Forward simulations use historical averages of weights-at-age and exploitation patterns by age and quarter. Future recruitments are generated stochastically around a hockey-stick fit to the historically observed stock–recruitment values. Assessment errors were included in the MSE loop by generating a perceived population stochastically around the true population. Management strategies were applied to generate the TAC for 2013 and subsequent years and no implementation error was assumed. However, when catching the TAC would lead to an annual F in excess of 0.6 (split into F = 0.13 for the first half of the year and F = 0.47 for the second half of the year), this value is imposed as a cap on F and the full TAC is not taken. Simulations (1000 iterations) were run for the period 2013–2026.

The following results were presented for each of the three management strategies in various alternative configurations:

- annual risks (probability of SSB being below B_{lim}) for years 2013–2016 (short-term risk),
- average risk over the period 2017–2026 (long-term risk),
- histograms of long-term distributions of SSB, yield, and F (and their medians and means),
- histograms of the long-term distributions of relative changes in SSB, yield, and F between consecutive years.

Sources

ICES. 2012a. Evaluation of management strategies for Norway pout in the North Sea and Skagerrak. ICES CM 2012/ACOM:69.

ICES. 2012b. Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak-Kattegat). Advice October 2012. *In* Report of the ICES Advisory Committee 2012. ICES Advice, 2012. Book 6, Section 6.4.20.

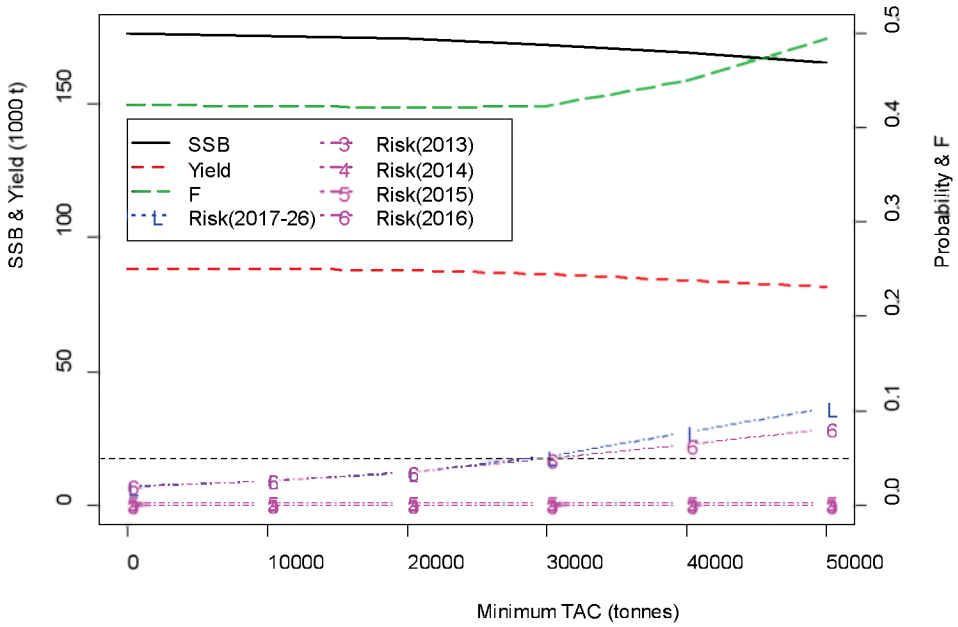


Figure 6.3.3.3.1 Management Strategy 1 with maximum TAC at 200,000 tonnes and a cap on F at 0.6. The graph shows the short- and long-term risks (probability of SSB below B_{lim}) for different values of minimum TAC. The horizontal line corresponds to 5% risk. Long-term median SSB, yield, and fishing mortality are also shown.

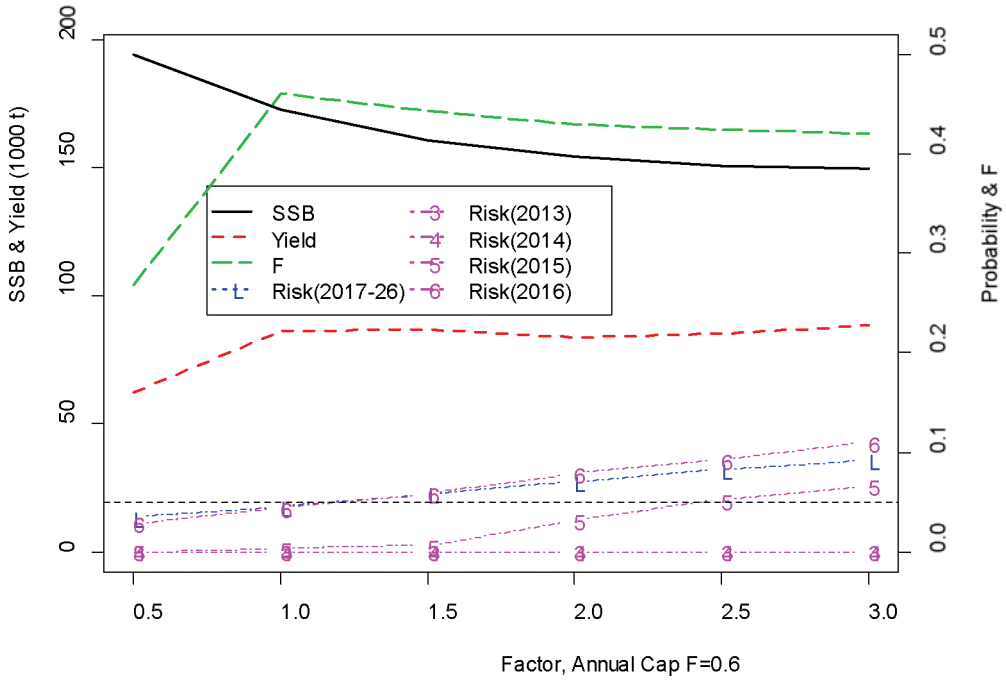


Figure 6.3.3.3.2 Management Strategy 1 with minimum TAC at 27,000 tonnes and maximum TAC at 250,000 tonnes. The graph shows the short- and long-term risks under different values of cap F. The horizontal axis shows the multiplicative factor of 0.6 to which the cap F corresponds (e.g. a factor 2.0 corresponds to a cap F value of 1.2). The horizontal line corresponds to the 5% risk. Long-term median SSB, yield, and fishing mortality are also shown.

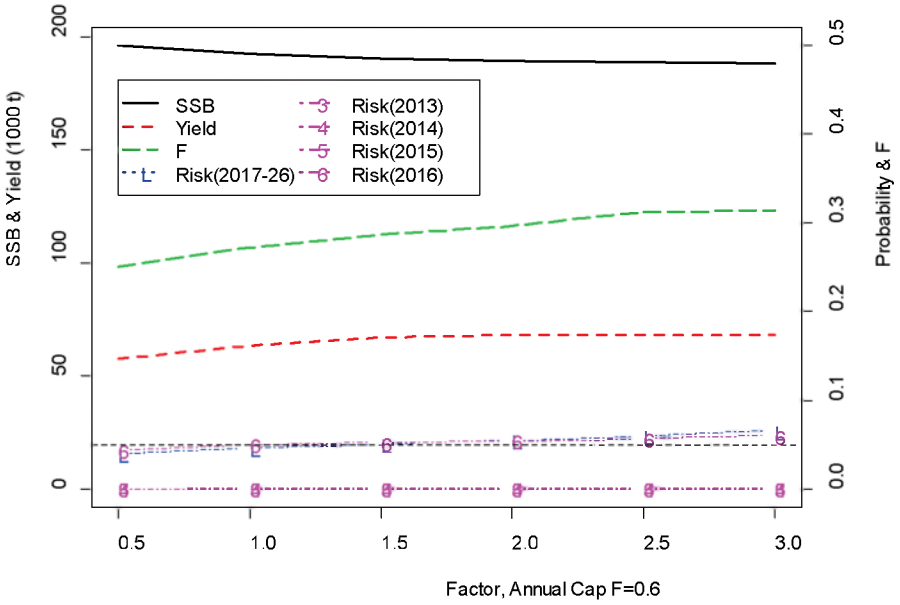


Figure 6.3.3.3.3 Management Strategy 2 with fixed TAC for the first half of the year at 50 000 tonnes and TAC for the second half of the year at 70% of the amount that would lead to annual F = 0.35 (accounting also for the catch in the first half of the year). The graph shows the short- and long-term risks under different values of cap F. The horizontal axis shows the multiplicative factor of 0.6 to which the cap F corresponds (e.g. a factor 2.0 corresponds to a cap F value of 1.2). The horizontal line corresponds to 5% risk. Long-term median SSB, yield, and fishing mortality are also shown.

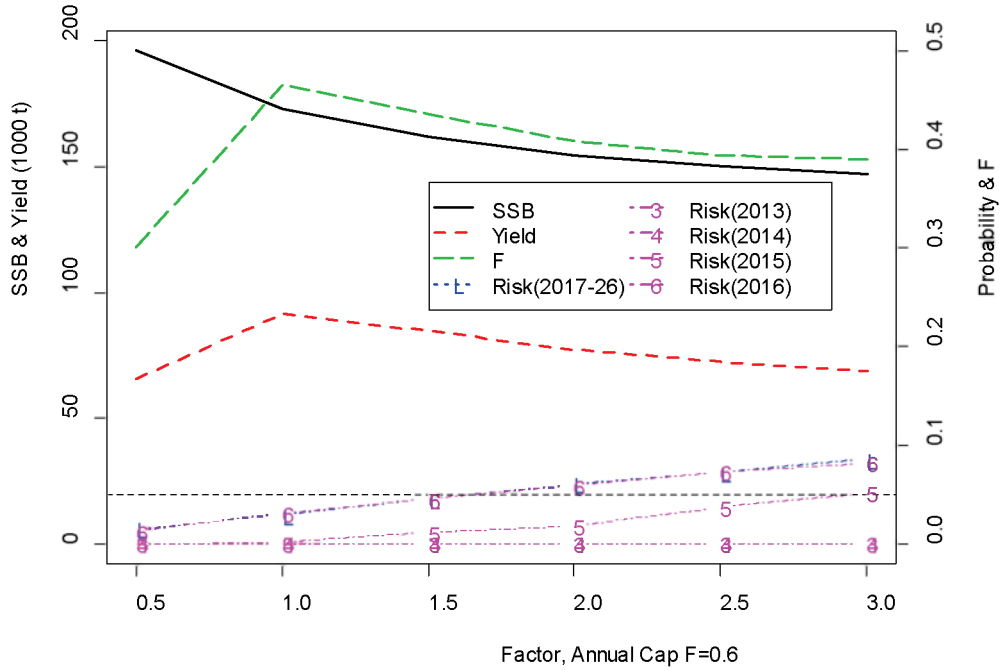


Figure 6.3.3.3.4 Management Strategy 3 with fixed TAC for the first half of the year at 25 000 tonnes. The graph shows the short- and long-term risks under different values of cap F. The horizontal axis shows the multiplicative factor of 0.6 to which the cap F corresponds (e.g. a factor 2.0 corresponds to a cap F value of 1.2). The horizontal line corresponds to 5% risk. Long-term median SSB, yield, and fishing mortality are also shown.

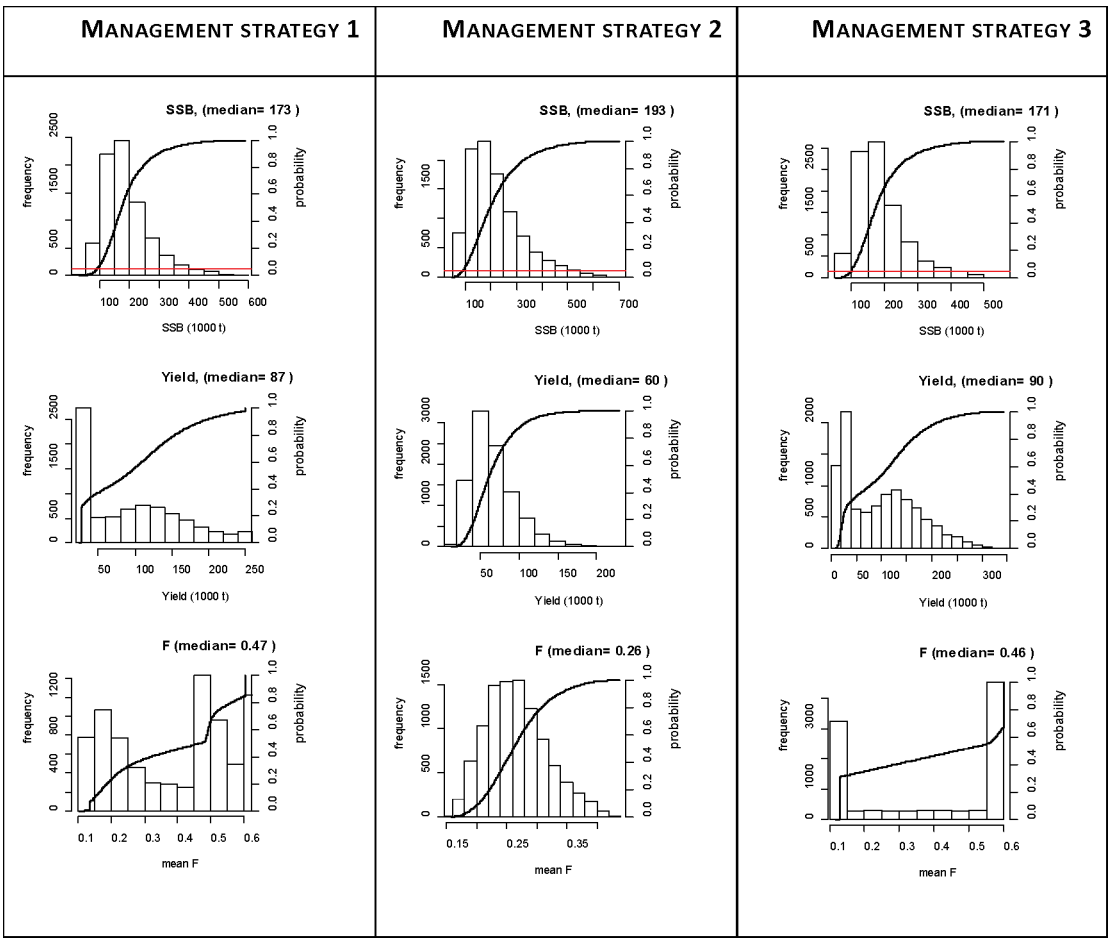


Figure 6.3.3.3.5 Long-term distribution of SSB, yield, and F, including cumulative probabilities, for MS1 (with annual TAC constrained between 27 000 and 250 000 tonnes), MS2 (with 25 000 tonnes TAC in the first half of the year and TAC for the second half of the year at 70% of the amount that would lead to annual F = 0.35 (accounting also for the catch in the first half of the year), and MS3 (with 25 000 tonnes TAC in the first half of the year).

ECOREGION North Sea
SUBJECT Request from the Netherlands on the North Sea flatfish Management Plan

Advice summary

ICES has assessed the proposed changes to the EU multi-annual plan for fisheries exploiting stocks of plaice and sole in the North Sea and concludes that the proposal is consistent with the precautionary approach and the principle of maximum sustainable yield (MSY).

Request

ICES is requested to:

> *"to assess whether two proposed changes to articles 4 and 9 of the multiannual plan are consistent with the precautionary and MSY approach (in conformity with ICES criteria)."*

In summary, the proposed amendments comprise a change in the target fishing mortality for sole from 0.20 to 0.25 and ceasing reductions of the Maximum Allowable Effort:

Article 4: change F_{MP} (second phase) for sole to 0.25 (plaice remains the same).
Article 9: freeze the effort when the stocks are within safe biological limits and use TAC/quota restraints to reach the long-term objectives (F_{MP} second phase). When one or both stocks fall back outside safe limits (i.e. $F > F_{pa}$ and $SSB < B_{pa}$), then a reduction in effort (kW days) should help to recover the stock(s).

Elaboration on the advice

ICES has identified separate ranges of fishing mortalities consistent with MSY for the North Sea plaice and the sole stocks (Sections 6.4.7 and 6.4.10 in ICES, 2011). The target fishing mortalities in the proposed management plan are at the upper end of these ranges, but do not affect long-term risk to the stocks in relation to B_{lim}. In other words, the proposed management plan is considered precautionary. At the same time the results show that exploitation in the proposed plan is closer to MSY than with the current plan.

Basis of the advice

Background

The EU established a multi-annual plan for fisheries exploiting stocks of plaice and sole in the North Sea (Council Regulation (EC) No. 676/2007). Machiels *et al.* (2008) presented an evaluation of the management plan. Their evaluation was based on a range of scenarios concerning stock dynamics, technical interactions between sole and plaice fishing, and interpretations of the regulation itself. ICES concluded (Section 6.4.7 in ICES, 2008) that the management plan was only partly precautionary as various aspects, particularly concerning the plaice stock, were undetermined.

Subsequently, in August 2010, ICES received a further request from the Netherlands to review a revised evaluation report (Miller and Poos, 2010). This second evaluation took account of the review comments from the 2008 evaluation, and also considered the latest available data and assessment models for the stocks. The 2008 evaluation only considered the precautionary aspects of the plan, whereas the 2010 evaluation attempted to address whether the long-term management of the stocks was consistent with maximum sustainable yield.

The 2010 evaluation report was inconclusive concerning whether the management plan is consistent with the principle of maximum sustainable yield. Uncertainty exists as to whether the MSY targets can be reached simultaneously for both stocks. ICES concluded that the plan remains in line with the precautionary approach (Sections 6.3.3.4 and 6.4.7 in ICES, 2010). However, while a single-species harvest control rule may be precautionary, the overall plan may not if fishing is allowed to continue on one stock after the TAC has been attained for the other stock. Catches of the latter stock will then be discarded, resulting in a fishing mortality above the harvest control rule target.

In 2011 the re-evaluation of MSY reference points was finalized. ICES concluded in June 2011 that the North Sea plaice and sole stocks had both been within safe biological limits for two consecutive years, and that the first stage of the plan was achieved. Following article 5 of the multi-annual plan the Commission should propose amendments to the

plan in relation to the target fishing mortality for plaice and sole, and on fishing effort limitation, with a view to permitting exploitation in accordance with the principles of MSY.

ICES received the present special request from the Netherlands in April 2012 to evaluate whether a number of proposed amendments to the plan are in accordance with the precautionary approach and consistent with MSY. An *ad hoc* group consisting of scientists from IMARES (the Netherlands) worked to address the issues and produced a report (Coers *et al.*, 2012). ICES reviewed this work and concluded that the methods applied were appropriate.

Methods

In order to further study the interplay between the biological dynamics of the stocks and the dynamics of the fleet, an evaluation of the current and the proposed management plans was undertaken, adapting the numerical simulation model as used in 2010 (Miller and Poos, 2010). Table 6.3.3.4.1 summarizes a comparison between the starting conditions, stock recruitment assumptions, and fleet structures in the model used in the 2010 and the current evaluations.

Table 6.3.3.4.1 Assumptions used in the 2010 and 2012 evaluations.

Evaluation 2010	Evaluation 2012
Starting conditions	
Results of the *XSA* assessment done by ICES WGNSSK in 2009.	Results of the *XSA* assessment done by ICES WGNSSK in 2012.
Stock recruitment functions	
Geometric mean with error based on that observed in the historical period.	Modelled stochastically using either a Ricker or a segmented regression function (based on Simmonds *et al.* (2010)).
Fleet structure	
Dutch beam trawl fleet (80 mm mesh, targeting plaice and sole), a BT1 fleet for other countries (100 mm mesh, targeting plaice only), and a BT2 fleet for other countries (80 mm mesh, targeting plaice and sole).	BT2 Dutch beam trawl fleet (80 mm mesh, targeting plaice and sole), a Dutch fleet with gears other than BT2 (targeting plaice), and a fleet for other countries (targeting plaice).
Effort management	
Effort restrictions linked to effort required to land TAC.	Two scenarios were examined: 1. Effort cap set at the 2012 level; 2. Effort adjusted in relation to the proposed adjustment in F (10% change limit), taking account of the more vulnerable stock, i.e. by following the largest decrease or the smallest increase."

Results and conclusions

Evaluations were performed jointly for each stock; the outcomes are summarized below.

Risk: Regardless of risk definition, the risk of stocks falling below B_{lim} is not greater than 5%. The stocks are projected with probabilities relative to precautionary reference points (namely, probabilities of falling either below B_{pa} or above F_{pa}) under the current as well as the proposed management plans.

Table 6.3.3.4.2 Risk shown as probability that SSB is below B_{lim} *at least once* during the simulated time period, calculated as the proportion of runs in which SSB went below B_{lim} at least once; probability that SSB is less than B_{pa} *at least once* during the period of years considered in each case is also shown. Landings weights are in tonnes.

	North Sea plaice		**North Sea sole**	
	Current plan	Proposed plan	Current plan	Proposed plan
Effect on the stocks				
P SSB< B_{lim} (2013–2015)	0	0	0	0
P SSB< B_{lim} (2015–2020)	0	0	0.005	0.005
P SSB< B_{lim} (2016–2025)	0	0	0.015	0.015
P F>F_{pa} or B<B_{pa} (2013–2015)	0	0	0.007	0.005
P F>F_{pa} or B<B_{pa} (2015–2020)	0	0	0.022	0.033
P F>F_{pa} or B<B_{pa} (2016–2025)	0	0.002	0.016	0.041
P F≤ F_{target} in 2015	0.98	0.99	0.52	0.73

Effect on the fishery				
Median landings (2013–2015)	104 830	105 900	14 227	15 095
Median landings (2015–2020)	112 101	115 198	16 179	17 887
Median landings (2016–2025)	112 952	117 239	17 385	19 063

Simulated catch, exploitation, and biomass: For sole, SSB in both the current and the proposed management plans remains on average at a level well above B_{pa}. In both the current and the proposed management plan the probability of falling below B_{pa} and above F_{pa} are low (< 5%). The probability of reaching the management plan fishing mortality targets by 2015 for each species is higher for the proposed management plan than for the current management plan, although this should not be overly interpreted as it is a consequence of the TAC constraint (Table 6.3.3.4.2). Sole landings are expected to be somewhat higher under the proposal in comparison to the current plan (by approximately 6% and 10% in the short and long term, respectively).

For plaice, the lower bound of the SSB confidence intervals, for both the current and the proposed management plans, is kept well above B_{pa} throughout the simulated time period. The long-term median SSB is similar for both management plans. Because of the TAC constraint in the HCR the expected median fishing mortality will be below the target F over the simulation period. The mean F in the current management plan appears to be slightly lower than for the proposed management plan because the Maximum Allowable Effort (MAE) is frozen at the 2012 level and is constraining catches in fewer cases than in the current plan. This results in slightly higher catches under the proposed plan than under the current plan in the long term. In the short term, both plans show that median catches are expected to increase to around 115 000 t in 2015. The disaggregation of F into human consumption and discards showed that the long-term projected F for discards was around 0.1 $year^{-1}$, with the F of the proposed management plan slightly above the one for the current plan.

Discussion

The proposed amendments to the current management plan are in accordance with the precautionary approach and consistent with the MSY approach.

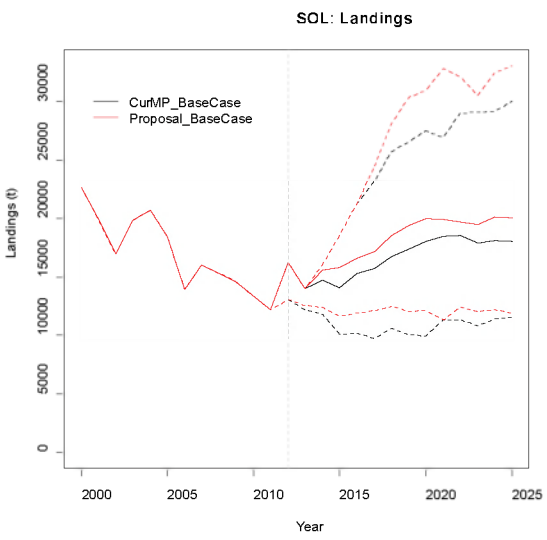
The current management plan states that if SSB falls below B_{lim}, effort must be decreased to rebuild the stock to healthy levels. The process, including the size of the effort reduction, is not described in the management plan. This situation has occurred in too few cases in the simulations presented here to draw any conclusions on the functionality of Article 18 of the current plan (6.3.3.4.1 Annex).

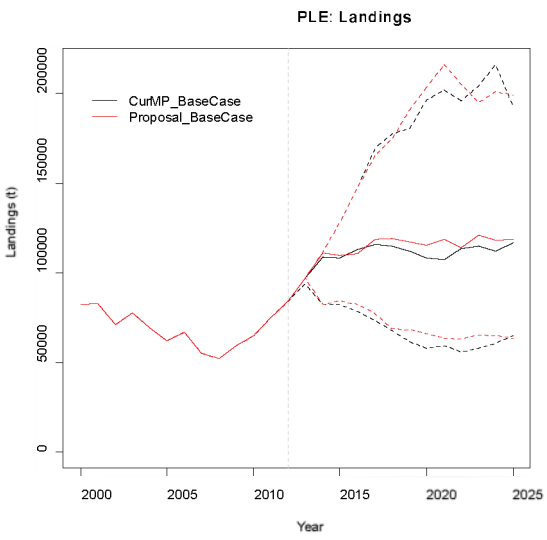
The past reservations on consistency with the MSY approach have been addressed in the latest evaluations, following ICES re-evaluation of the MSY reference points in 2011. Target Fs leading to similar MSY values are, for plaice, in the range of 0.2–0.3 and for sole, in the range of 0.2–0.25.

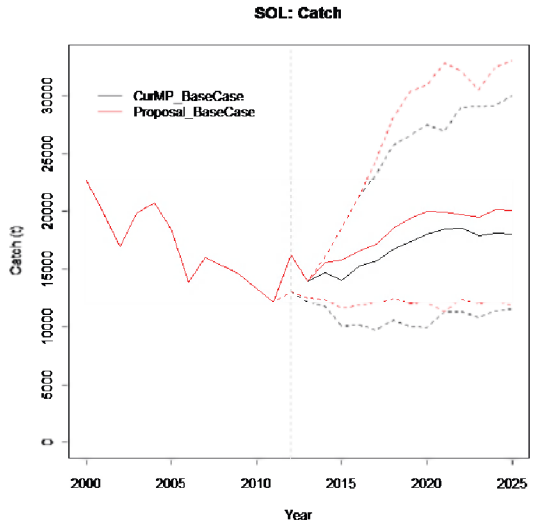
The new evaluations consider the potential for fleets to be adaptive in their targeting of sole and plaice. Sole is the most profitable contribution to the landings although it has the lower TAC and is likely to be limiting since fishing for plaice alone would be unprofitable once the sole quota has been exhausted. Although the presented results are based on the assumption that fleets are capable of perfectly partitioning their effort such that they fully utilize both TACs without being forced to discard over quota catches, alternative assumptions reflecting a situation in which this is not the case were modeled as well. The results for these scenarios did not change the conclusions in relation to the proposal being in compliance with the precautionary or MSY approach. For this reason they are not included here, but can be found in the report by Coers *et al.* (2012).

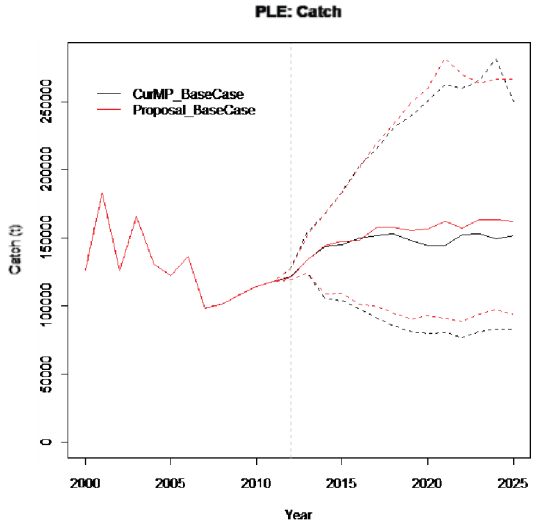
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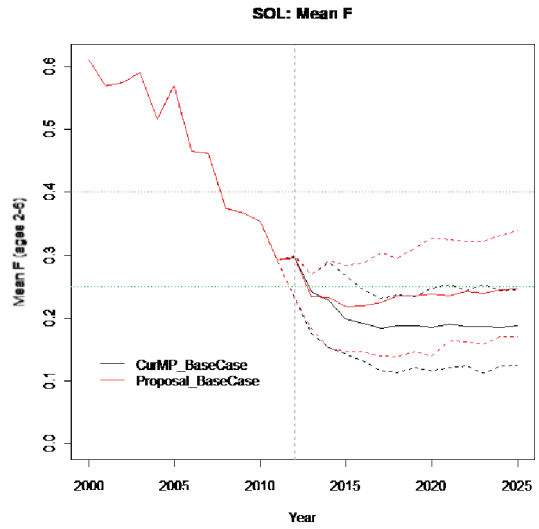
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Simmonds, E. J., Miller, D. C. M., Bartelings, H., and Vanhee, W. 2010. Report of the Sub Group on Management Objectives and Strategies (SGMOS 10-06). Part b) Impact assessment of North Sea plaice and sole multi-annual plan. EUR 24629 EN, ISBN 978-92-79-18743-8. 127 pp.

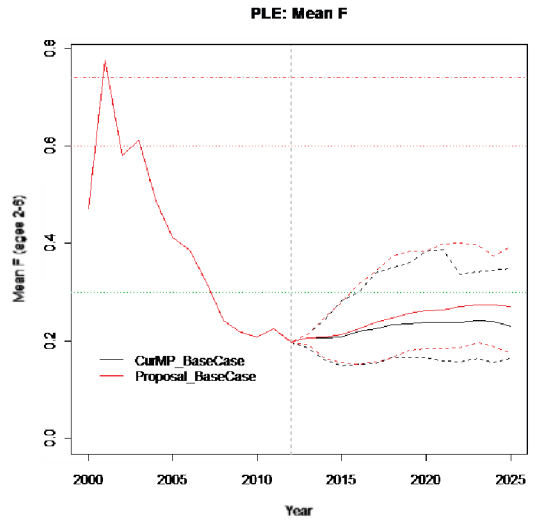

SOL: Landings
CurMP_BaseCase
Proposal_BaseCase
Landings (t)
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25000
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2000
2005
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2020
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PLE: Landings
CurMP_BaseCase
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Landings (t)
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100000
150000
200000
2000
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2015
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2025
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SOL: Catch
CurMP_BaseCase
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PLE: Catch
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SOL: Mean F
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Proposal_BaseCase
Mean F (ages 2-6)
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PLE: Mean F
CurMP_BaseCase
Proposal_BaseCase
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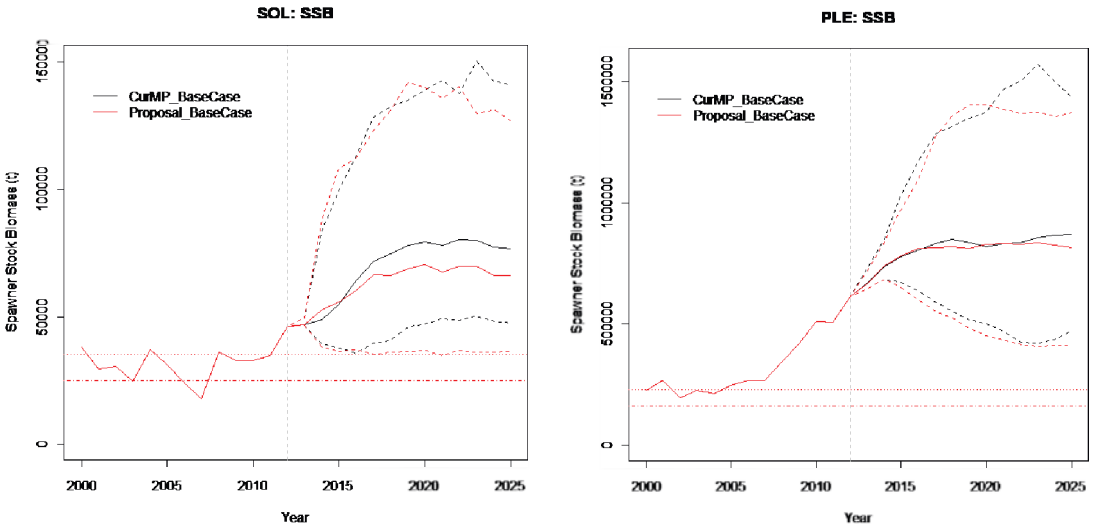


Figure 6.3.3.4.1 Projected landings, catch, fishing mortality, and SSB for North Sea sole and plaice under the current and the proposed management plans.

6.3.3.4.1 Annex

Extract from Council Regulation (EC) No. 676/2007 of 11 June 2007, establishing a multi-annual 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.*

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.

Article 9 Fishing effort limitation

1) When a stock is outside biological limits, the TACs referred to in Chapter II shall be complemented by a system of fishing effort limitation established in Community legislation,

…..

6) *Notwithstanding paragraph 4, fishing effort shall not increase above the level allocated in 2006 and not be lower than the level allocated in 2011.*

Article 18 Special circumstances

In the event that STECF advises that the spawning stock size of either or both plaice or of sole is suffering reduced reproductive capacity, the Council shall decide by qualified majority on the basis of a proposal from the Commission on a TAC for plaice that is lower than that provided for in Article 7, on a TAC for sole that is lower than that provided for in Article 8, and on levels of fishing effort that are lower than those provided for in Article 9.

ECOREGION North Sea
SUBJECT Joint EU–Norway request to ICES on options to revise the Long-Term Management Plan for saithe in the North Sea

Advice summary

ICES advises that all harvest control rule (HCR) options in request items 1 to 4 result in less than 5% annual risks of the stock being below the limit biomass reference point (B_{lim}) in the short term (next 4 years). The long-term performance of the HCRs is less clear, as it is uncertain whether the stock will develop in accordance with the precautionary approach (i.e. with less than 5% risk of being below B_{lim}) in the long term. No substantial differences are found between the options in terms of risk or yield, although the stability of yield is slightly more different between options. ICES has no basis for recommending one of the HCR options over another. Interannual quota flexibility (request item 5) has not been simulation-tested.

Because the long-term performance is not clear, ICES advises that the HCR selected for management should be re-evaluated within 4 years (i.e. no later than 2016) and revised if necessary.

Request

ICES is requested to:

> *"In accordance with point 5.3.3 of the Agreed record of Fisheries Consultations between Norway and the European Union for 2012, signed on 2 December 2011, it was agreed to convene a seminar on long term management plans. The objective of this seminar was to establish the basis for further developing long-term management plans for joint stocks.*
>
> *Based on the most recent assessment of the stock of saithe in ICES Subarea IV, Division IIIa and Subarea VI, ICES is requested to conduct an evaluation, by 1 October 2012, of the current harvest control rule with the following variations:*
>
> 1. *Applying the current management plan unchanged.*
> 2. *Applying the harvest control rule with no TAC stability mechanism.*
> 3. *Applying the HCR with the following stability mechanisms when the SSB is above B_{lim}:*
>   a. *Setting a TAC in the TAC year based on the average of the projected TACs at target F over three years starting with the TAC year.*
>   b. *Setting the TAC to be the average of the current TAC and the TAC that would result from the application of the HCR for the TAC year.*
>   c. *Applying a TAC constraint of +/- 15%, but where the resulting fishing mortality is not allowed to deviate by more than 15%, 20% or 25% from the target F.*
> 4. *Applying the HCR with the above mentioned stability mechanisms, but applying them only when the stock is above B_{pa}.*
> 5. *Allowing an interannual quota flexibility of +/- 10%*
>
> *ICES is invited to suggest alternative values for the constraints and ranges where appropriate."*

Elaboration on the advice

ICES evaluated the suggested HCR options in items 1–4 of the request under two biological production regimes: a full-historical regime, based on the entire time-series 1967–2011, and the current regime (with lower recruitment and growth), based on the time-series since 1988. The conclusions are mainly based on the results for the current regime.

All options were found to result in less than 5% annual risks (probability of the stock being below B_{lim}) in the short term (next 4 years), but the risk increases slightly in the long term (based on the average risk for years 2020–2029). For three HCR options (2, 3a, and 4a, where option 4a is the counterpart of 3a but applying the TAC stability mechanism when SSB is above B_{pa} instead of B_{lim}) the long-term risk is calculated to be between 4 and 5%, whereas for all other options it is calculated to be between 6 and 9% (Table 6.3.3.5.2). Taking into account the inherent uncertainties associated with long-term simulations and some specific settings in the simulation work conducted, these long-term results are not considered to be conclusive. Therefore, it is advised that the HCR selected for management should be re-evaluated within 4 years and revised if necessary. A target F value in the HCR less than 0.3 for SSB above B_{pa} (= 200 000 t), or an

increase in the SSB threshold below which F is reduced (currently B_{pa}), would result in lower risks, although the consequences for yield have not been explored.

Expected yield does not differ significantly between the HCR options, but the options are more different in terms of the mean interannual variability in yield. The highest variability in yield is obtained under option 2 (Tables 6.3.3.5.1 and 6.3.3.5.2), which has no TAC stability mechanism, whereas the current HCR (option 1) leads to the lowest yield variability.

There is no firm basis for recommending a particular HCR within the options considered, and the choice of HCR to be implemented is seen as a management decision.

Interannual quota flexibility (request item 5) is a practical solution to facilitate fishery operations and could, therefore, also be considered in the management of the saithe fisheries. Given the wide range of forms that quota banking or banking and borrowing can take in practice, and the large amount of HCR options in the request, no simulation testing was attempted. In the limited simulation testing of this issue done for the North Sea herring stock, the risk of SSB being below B_{lim} increased by a factor of about 1.2 to 1.8 when 10% quota banking or banking and borrowing was added to the HCR. It is recommended that simulation testing is conducted for the saithe stock before such flexibility is incorporated in the HCR selected for management.

Basis of the advice

Background

ICES evaluated the current long-term management plan in 2008 (Section 6.3.3.3 in ICES, 2008) and found it to be precautionary in the short term (< 4 years). Because of the lower productivity of saithe since 1988, and the limited treatment of measurement error or implementation error in the 2008 evaluation, ICES advised that the HCR should be reviewed again within 4 years. The management plan has been used during the intervening years and the stock has been kept above B_{pa}, whereas F has been oscillating around F_{MSY} (= 0.3).

Point 7 of the management plan indicates that it should be reviewed no later than 31 December 2012. In June 2012, ICES received the current request from the EU and Norway to conduct an evaluation of the HCR in the plan with several options concerning the TAC stability mechanism (see items 1–5 in the request). The work on which this advice is based can be found in De Oliveira *et al.* (2012).

Results and conclusions

Population trajectories for North Sea saithe were explored under 12 alternative HCR options, corresponding to items 1 to 4 in the request. A difference in the recruitment and growth dynamics (level and variability) of North Sea saithe prior to and subsequent to 1988 has been estimated (ICES, 2012a). Average recruitment and stock weight-at-age decreased by a factor of about 1.5 and 1.25, respectively, after 1988. Consequently, the HCRs were tested in combination with biological production regimes based on the full history (since 1967) or the current situation (since 1988).

The HCRs were applied assuming that SSB is measured at the beginning of the intermediate year (the year previous to the one for which the HCR is intended to provide a TAC).

Six indicators were selected to evaluate the performance of the HCRs in the short term (based on year 2015) and the long term (years 2020–2029):

- Risk: probability of SSB being below B_{lim} (in 2015, or averaged over 2020–2029), expressed as a percentage. An HCR is considered to be in accordance with the precautionary approach if the risk does not exceed 5%.
- Probability of SSB being above B_{pa} (in 2015, or averaged over 2020–2029), expressed as a percentage.
- SSB (in 2015, or during 2020–2029). The median over the iterations is used.
- Yield (in 2015, or during 2020–2029). The median over the iterations is used.
- F (averaged over ages 3–6: in 2015, or during 2020–2029). The median over the iterations is used.
- TAC variability: mean percentage change (up or down) in the TAC between consecutive years, over the period 2013–2020 (short term) or 2020–2029 (long term). The median over the iterations is used.

Tables 6.3.3.5.1 and 6.3.3.5.2 show these indicators for the short and long term, respectively, for each of the 12 HCRs tested under the two biological production regimes.

Table 6.3.3.5.1 Simulation results for 2015. For SSB, Yield, F, and TAC variability, the median over the iterations is presented.

	Full-historical regime for recruitment and growth						Current regime for recruitment and growth					
HCR option (numbering as in request items)	Risk (%)	Prob SSB>B_{pa}, as %	SSB ('000 t)	Yield ('000 t)	F(3-6)	TAC var % 2013-2020	Risk (%)	Prob SSB>B_{pa}, as %	SSB ('000 t)	Yield ('000 t)	F(3-6)	TAC var % 2013-2020
1. Current Plan	0	97	378	128	0.21	12	1	74	259	114	0.30	12
2. No TAC constraint	0	95	350	145	0.29	22	2	66	237	117	0.35	25
3a. 3-year projection	0	95	349	144	0.28	17	1	64	232	118	0.35	18
3b. average TAC	0	96	376	137	0.25	12	0	74	252	117	0.32	12
3c(1). 15% max F dev	0	96	366	143	0.27	16	1	71	248	118	0.33	16
3c(2). 20% max F dev	0	96	372	139	0.26	15	1	72	252	118	0.33	15
3c(3). 25% max F dev	0	97	377	134	0.25	14	1	74	254	117	0.32	14
4a. 3-year projection	0	95	352	144	0.28	18	1	66	237	118	0.34	21
4b. average TAC	0	96	376	137	0.25	13	0	76	255	117	0.32	14
4c(1). 15% max F dev	0	96	366	143	0.27	16	1	71	248	118	0.34	18
4c(2). 20% max F dev	0	96	372	139	0.26	15	1	72	253	118	0.33	17
4c(3). 25% max F dev	0	97	377	135	0.25	15	1	74	255	117	0.32	16

Table 6.3.3.5.2 Simulation results for 2020–2029. For SSB, Yield, F, and TAC variability, the median over the iterations is presented.

	Full-historical regime for recruitment and growth						Current regime for recruitment and growth					
HCR option (numbering as in request items)	Risk (%)	Prob SSB>B_{pa}, as %	SSB ('000 t)	Yield ('000 t)	F(3-6)	TAC var % 2020-2029	Risk (%)	Prob SSB>B_{pa}, as %	SSB ('000 t)	Yield ('000 t)	F(3-6)	TAC var % 2020-2029
1. Current Plan	5	86	435	178	0.29	13	8	70	267	107	0.27	13
2. No TAC constraint	3	87	371	158	0.29	25	5	69	250	112	0.30	27
3a. 3-year projection	2	90	404	160	0.28	19	5	66	241	110	0.30	21
3b. average TAC	7	83	370	165	0.30	13	9	67	249	111	0.29	15
3c(1). 15% max F dev	4	87	381	161	0.29	18	6	70	255	112	0.29	20
3c(2). 20% max F dev	4	87	385	163	0.29	17	6	70	256	112	0.29	19
3c(3). 25% max F dev	4	87	391	165	0.29	16	6	71	260	112	0.28	18
4a. 3-year projection	2	91	411	162	0.27	19	4	72	259	113	0.29	22
4b. average TAC	6	84	375	166	0.29	15	7	69	256	114	0.29	20
4c(1). 15% max F dev	4	87	380	162	0.29	19	6	70	255	112	0.29	22
4c(2). 20% max F dev	4	87	385	162	0.29	18	6	70	256	112	0.29	20
4c(3). 25% max F dev	4	87	391	164	0.28	17	6	71	259	113	0.29	21

All HCR options result in risks below 5% in the short term (year 2015). Additional results (not shown), indicate that this holds for the next 4 years (2013–2016). Under the current biological production regime, the long-term risk is less than 10% for all HCR options, but few are below 5%. Only a slight reduction in long-term risks is found when the full-historical regime is assumed. This is understood to be a consequence of high variability in recruitment and the uncertainty in the assessment and short-term forecast assumed in the simulations. Whether the TAC stability mechanism is set for SSB above B_{lim} (HCR options 3) or SSB above B_{pa} (HCR options 4) has little influence on the results.

Expected yield does not differ significantly between the HCR options (less than 4% difference between the options in 2015, and less than 7% in the long term, under the current biological production regime). The HCRs differ more in terms of the mean interannual variability in yield (TAC variability, which, depending on the HCR, ranges from 12% to 25% in the period 2013–2020, and from 13% to 27% in the period 2020–2029). The highest variability in yield is

obtained under option 2, which has no TAC stability mechanism, whereas the current HCR (option 1) leads to the lowest yield variability.
By way of illustration, Figure 6.3.3.5.1 in Annex 1 displays simulated future stock development (Recruitment, SSB, F, and yield) for HCR option 1 under each of the two biological production regimes. Figure 6.3.3.5.1 shows that F is expected to vary around 0.3. Under the current regime, average yield and SSB will remain at levels similar to recent years, whereas these values are higher under the full-historical regime. De Oliveira *et al.*, (2012) shows similar figures for all HCR options.

It should be noted that long-term simulations have inherent uncertainties and only 250 iterations were conducted. Some of the simulated future population trajectories displayed quite high variability accompanied with very high values of F in some years, not in line with the historically estimated population dynamics. This is thought most likely to arise from certain settings in the simulations conducted. In particular, weights-at-age were assumed to be independent over time in the simulations whereas in reality they vary in a relatively smooth manner, which could lead to worse quality of the short-term forecast performed during the simulations than in reality. Further work would be required to understand these issues fully and could not be accomplished in the time available. Therefore, the results presented in Table 6.3.3.5.1 and Table 6.3.3.5.2 should be interpreted with some caution as these values may not be precise. Nevertheless, the simulation work conducted is believed to provide an appropriate basis for the advice provided at present. All HCRs result in annual risks less than 5% in the short term. There is no firm basis for recommending a particular HCR option above the others and the HCR selected for management should be re-evaluated within 4 years, i.e. no later than 2016, and revised if necessary.

Methods

A Management Strategy Evaluation (MSE) was conducted for the North Sea saithe stock. The operating model (which generates the "true" future populations in the simulations) was conditioned on the data used in the most recent ICES assessment (Section 6.4.12 in ICES, 2012b). For technical reasons, B-Adapt (with no bias estimation) was used instead of XSA as the basis for the historical assessment in this conditioning. The results were checked against the ICES assessment, which is based on XSA, and were found to be sufficiently close for the purpose of the MSE analysis.

Two alternative biological production scenarios were examined in the operating model, a full-historical regime (based on years 1967–2011) and a current regime (based on years 1988–2011). The procedure to simulate recruitment and weights-at-age was the same in both cases, but basing their simulation on the corresponding range of years for each regime. Recruitment was simulated stochastically using a log-normal distribution around a stock–recruitment fit for the corresponding range of years. Weights-at-age were resampled randomly, as a vector keeping all ages together, from those observed in the corresponding range of years. This way of simulating weights-at-age preserves correlation of weights between different ages in each year, although not across years or cohorts.

XSA was used as the assessment model within the MSE analysis, assuming that a single index of abundance-at-age is available annually, with a CV of 30% for each age. The short-term forecast required when applying the HCR was based on the same assumptions as for the ICES annual advice, in terms of intermediate year catch (assumed to be equal to the actual TAC), recruitment (geometric mean of estimated recruitment since 1988), and the most recent 3-year average for weights, maturity, and fishery selection pattern at age. However, since the weights-at-age used in the simulation are independent across years, whereas in reality they vary in a smoother manner over time, it is possible that the quality of the short-term forecast is worse in the simulations than in reality.

No implementation error was assumed, i.e. the catch taken each year was assumed to correspond to the TAC generated by application of the HCR. This seems a conservative assumption, given that discarding is considered to be low in the saithe fishery and observed landings are generally below the set TAC.

Due to time constraints, only 250 iterations could be conducted, and this should be taken into account when interpreting the results in Tables 6.3.3.5.1 and 6.3.3.5.2, as there is some imprecision around their values. Considering the 2020-2029 years jointly helps to increase precision, as it effectively merges the years and increases the sample size used to compute the values. Given that the simulated population should be close to equilibrium by 2020, this is considered an appropriate approach.

Sources

De Oliveira, J., Gillson, J., and Darby, C. 2012. North Sea saithe management strategy evaluation. ICES CM 2012/ACOM:73. 28 pp.
ICES. 2008. Report of the ICES Advisory Committee, 2008. ICES Advice, 2008.
ICES. 2012a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012, Section 11. ICES CM 2012/ACOM:11. 61 pp.
ICES. 2012b. Report of the ICES Advisory Committee, 2012. ICES Advice, 2012.

Annex 1

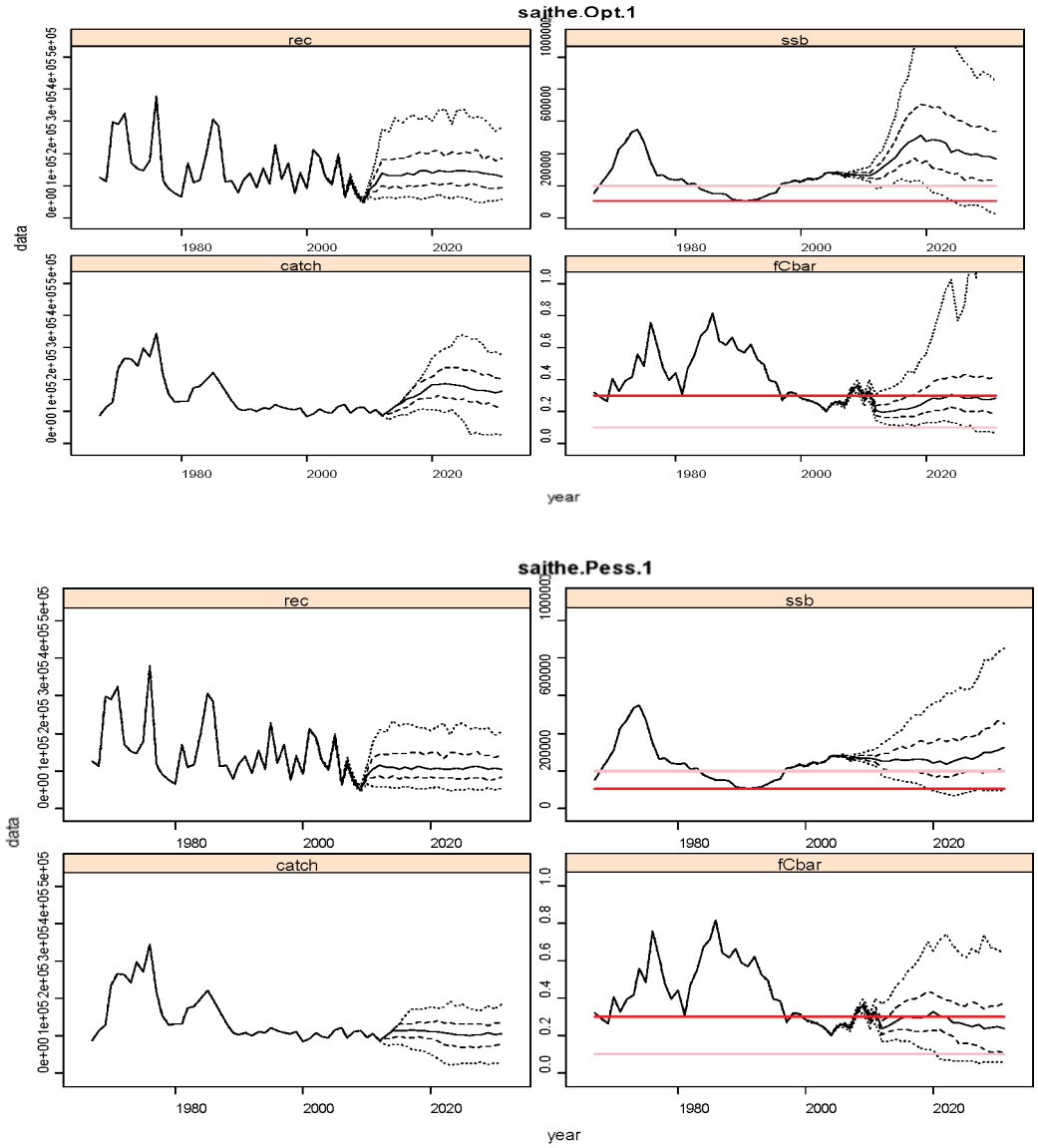


Figure 6.3.3.5.1 HCR option 1 under the full-historical biological production regime (top panels) and the current biological production regime (bottom panels). Historical and simulated recruitment, SSB, catch, and F (averaged over ages 3–6). Simulations from 2012 onwards illustrate the 5th and 95th percentiles (dotted lines), the 50th percentile (solid line), as well as the 25th and 75th percentiles (dashed lines). The horizontal lines indicate B_{pa} (pink) and B_{lim} (red) for SSB, as well as the upper and lower F targets in the HCR sliding rule (F = 0.3 in red; F = 0.1 in pink).

Annex 2

Current EU–Norway management plan for North Sea saithe

In 2008 the 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 (B_{lim}).*
2. *Where the SSB is estimated to be above 200,000 tonnes the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of no more than 0.30 for appropriate age groups.*
3. *Where the SSB is estimated to be below 200,000 tonnes but above 106,000 tonnes, the TAC shall not exceed a level which, on the basis of a scientific evaluation by ICES, will result in a fishing mortality rate equal to 0.30-0.20*(200,000-SSB)/94,000.*
4. *Where the SSB is estimated by the ICES to be below the minimum level of SSB of 106,000 tonnes the TAC shall be set at a level corresponding to a fishing mortality rate of no more than 0.1.*
5. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15% from the TAC 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
SUBJECT Joint EU-Norway request to ICES on options to revise the long-term management plan for herring in the North Sea

Advice summary

ICES has evaluated the biological precautionary reference points to be B_{lim} = 800 000 t and B_{pa} = 1 000 000 t. F_{lim} and F_{pa} are not defined. F_{MSY} (average over ages 2–6) is estimated to be within the range 0.24 to 0.30. The value of $B_{trigger}$ is conditional on the harvest control rule (HCR) selected.

ICES concludes that all harvest control rule options in the request include precautionary scenarios. Several options are considered to be operational for management of the herring fisheries and could be implemented in a revised North Sea herring long-term management plan.

Some HCR options are suggested based on their performance (yield and interannual variability in yield) and applicability for management. These include option 1 (numbers as in request), which is an updated version of the current management plan with new reference points, and options 3b and 3c, which have the ability quickly to adapt to changes in recruitment and stock biomass. Interannual quota flexibility (request item 5) is a practical solution to facilitate fishery operations and could, therefore, also be considered in the management of these fisheries. However, this feature has only been simulation tested under HCR option 1.

Density-dependent regulatory effects on the stock–recruitment relationship can neither be ruled out nor confirmed.

Request

"Joint EU Norway request to ICES on options to revise the Long-Term Management Plan for Herring in the North Sea

In accordance with point 5.3.3 of the Agreed record of Fisheries Consultations between Norway and the European Union for 2012, signed on 2 December 2011, it was agreed to convene a seminar on long-term management plans. The objective of this seminar was to establish the basis for further developing long-term management plans for joint stocks.

Based on the most recent assessment of the stock of herring in ICES Subarea IV and Divisions IIIa and VIId, it is noted that ICES has stated that a full revision of the existing management plan is needed as reference points and the current management plan are based on the former perception of the stock.

ICES is requested, by 1 October 2012, to re-evaluate the precautionary reference points (B_{lim}, B_{pa}, F_{lim} and F_{pa}) and management reference points ($B_{trigger}$, F_{msy}) for the stock and to conduct an evaluation of the harvest control rule under the following conditions:

1. *Using target F values above $B_{trigger}$ of 0.2, 0.25, 0.3 and any revised estimate of F_{msy}, which are reduced linearly to 0.1 at B_{lim}.*
2. *Applying the harvest control rule with no TAC stability mechanism.*
3. *Applying the HCR with the following stability mechanisms when the SSB is above B_{lim}:*
   a) *Setting a TAC in the TAC year based on the average of the projected TACs at target F over three years starting with the TAC year.*
   b) *Setting the TAC to be the average of the current TAC and the TAC that would result from the application of the HCR for the TAC year.*
   c) *Applying a TAC constraint of +/- 15% but where the resulting fishing mortality is not allowed to deviate by more than 15%, 20% or 25% from the target F*
4. *Applying the HCR with the above mentioned stability mechanisms, but applying them only when the stock is above $B_{trigger}$.*
5. *Allowing an interannual quota flexibility of +/-10%*
6. *Changing the target fishing mortality for 0-1 ringers over a range of values from 0.00 to 0.12*

ICES is invited to suggest alternative values for the constraints and ranges where appropriate.

ICES is further requested to advise on whether or not there is evidence of density dependent effects or increases in predation mortality that could justify an increase in the target fishing mortality at high stock sizes".

Elaboration on the advice

Re-evaluation of reference points

ICES has evaluated the biological precautionary reference points to be B_{lim}= 800 000 t and B_{pa}= 1 000 000 t. F_{MSY} (average over ages 2–6) is estimated to be within the range 0.24 to 0.30, based on alternative forms of the stock–recruitment relationship (Beverton–Holt and Ricker). There is no basis at this stage for selecting a particular F_{MSY} value within this range. Values for the management point $B_{trigger}$ were explored in combination with the different HCR options in request items 1 to 6. The choice of $B_{trigger}$ is conditional on the HCR selected (see Table 6.3.3.6.1). F_{lim} and F_{pa} are not considered main reference points for the fisheries management of the North Sea herring stock and were not investigated. F_{lim} continues to be undefined, and there is no basis for keeping the previous F_{pa} value (0.25), which had been derived under an earlier perception of the stock dynamics.

Evaluation of harvest control rules

ICES evaluated all the suggested HCR options (request items 1–6) under the assumption that the current low productivity regime observed since 2003 will continue. All options were found to contain scenarios (choices of $B_{trigger}$ and target F values) consistent with the precautionary approach, and these are the only scenarios considered in this advice.

Several options are considered to be operational for management of the herring fisheries. Some options are suggested based on their performance (yield and interannual variability in yield), including option 1, which is an updated version of the current management plan with new reference points, and options 3b and 3c, which have the ability quickly to adapt to changes in recruitment and stock biomass. Interannual quota flexibility (option 5) is a practical solution to facilitate fishery operations and could, therefore, also be considered in the management of these fisheries. However, given the wide range of forms that quota banking or banking-and-borrowing can take in practice, only limited testing of this could be done and was only conducted in the context of option 1.

HCRs without TAC stability mechanism (option 2) and HCRs based on 3-year forecasts (option 3a) could be less preferable. HCRs based on 3-year forecasts may react earlier to future stock development than more conventional rules, but the uncertainty associated with future forecasts could outweigh this potential advantage.

For each of the operational options, a scenario was selected based on maximizing average yield over the simulation period (next 10 years) combined with an acceptable (i.e. as low as possible) level of interannual variation in TAC. Table 6.3.3.6.1 presents results for these scenarios. Any of the selected scenarios could be implemented in a revised North Sea herring long-term management plan. Among these scenarios, there are trade-offs between high yields and stability of TAC.

Although all HCR options in the request were explored via simulation testing, the overall extent of the request meant that this could not be done in depth for all options. Only a limited amount of scenarios were explored for options 4 and 6.

Density dependence

The current evidence and knowledge of density-dependent processes in the biology of North Sea herring is not strong enough to justify an increase in the target F at high stock sizes. Density-dependent mechanisms cannot be ruled out at the early larval stages of herring. It is also possible that the decline in recruitment is purely environmentally driven and that the apparent synchrony with spawning biomass is a coincidence. More evidence is necessary in order to identify the regulatory mechanisms underlying the low productivity regime currently observed in North Sea herring.

Suggestions

As indicated above, simulation testing of quota banking or banking-and-borrowing was limited and only conducted for HCR option 1. For all scenarios tested, the risk of SSB being below B_{lim} increased by a factor of about 1.2 to 1.8 when adding banking or banking-and-borrowing to the HCR. It is suggested that more detailed testing takes place if such flexibility is desired in the HCR finally selected for management.

The reasons for the recent drop in recruitment at higher biomass are unknown. Modelling the spatial and temporal overlap of larvae and adult herring in combination with analysis of stomach contents (e.g. genetic probing) of adult herring encountered in areas with high larval abundance could potentially provide information on whether cannibalism is an important regulatory mechanism for North Sea herring recruitment. Suggestions on how to approach this as a joint research project between industry and science partners are given in ICES (2012b).

Basis for the advice

Background

The HCR for North Sea herring was developed in the late 1990s and amended in 2004. ICES examined the performance of the revised HCR in 2005 and considered the target F to be consistent with the precautionary approach (ICES, 2005). The HCR was again evaluated by ICES in 2008 (Section 6.3.3.4 in ICES, 2008).

During 2011 it became apparent that the 15% constraint on TAC interannual varibility was unnecessarily restrictive for the TAC and ICES was requested by the EU and Norway to evaluate whether the existing management plan would be precautionary under various alternative settings for a TAC constraint, assuming that recruitment would continue to be low (Section 6.3.3.1 in ICES, 2011). Later in 2011, the EU and Norway requested ICES to comment on whether an in-year revision of the TAC in similar circumstances would be consistent with the objectives of the long-term management plan. In its response, ICES stated 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 applying within-year revisions of the TAC (Section 6.3.3.4 in ICES, 2011).

The North Sea herring benchmark assessment in February 2012 (ICES, 2012a) resulted in a significant change in the perception of spawning-stock biomass (SSB) and fishing mortality (F) over the past twenty years. With the new assessment, the absolute estimates of SSB are generally higher throughout the time-series and fishing mortality lower, but the trends remain similar to those in the previous assessment. The estimates of recruitment have not changed.

In September 2012, the ICES Workshop for Revision of the North Sea Herring Long-term Management Plan (WKHELP) was established to conduct the scientific work required to respond to the present request by the EU and Norway. WKHELP met twice and also prepared work by correspondence. Given the revised perception of the stock, the group allocated much effort to the evaluation of reference points, as they are also key references for any evaluation of the HCRs. The HCR evaluations conducted by WKHELP have not tested the rules against exceptional variations in biology which are beyond the variation observed in history, nor have the rules been tested for robustness under varying starting conditions in population size. The analyses, however, can be viewed as appropriate given the uncertainty in the current population size and provide the basis for answering the request fully.

Interpretation of the HCR options and settings tested

The term 'preliminary TAC' is used in this section for the TAC derived from the fishing mortality defined in the HCR options without any TAC constraining measures. The options below were tested, where the numbering relates to the items in the request. For all options, $B_{trigger}$ values in the range of 1.3 to 2 Mt, in steps of 100 kt, and target F values (average over ages 2–6) of 0.24 and 0.30 above $B_{trigger}$ were explored. Target F values of 0.2 and 0.25 above $B_{trigger}$ were, additionally, also explored for HCR option 1. In total, 99 different scenarios were tested, with full results provided in the WKHELP report (ICES, 2012b). In all cases, SSB is measured at spawning time (autumn) of the year for which the HCR is intended to provide a TAC. The HCR options were interpreted as follows:

1. The current HCR with different $B_{trigger}$ points and target F values above $B_{trigger}$.
   If the preliminary TAC deviates by less than 15% from the TAC in the year before, the preliminary TAC is kept. Otherwise, the TAC is set to deviate by 15% from the TAC in the year before, except when this would lead to SSB < B_{lim}, in which case the preliminary TAC is kept.
   Applying the 15% TAC stability mechanism when SSB is above $B_{trigger}$ instead of B_{lim} was also tested.
2. The current HCR with different target F values above $B_{trigger}$ and no TAC stability mechanism.
   This option provides a baseline for comparison, especially in relation to performance indicators for stability in the TAC.
3. The current HCR with different $B_{trigger}$ points and target F values above $B_{trigger}$. The following TAC stability mechanisms were applied when SSB is above B_{lim}:
   3a) Forecasting three years ahead using the same F (the F that corresponds to applying the HCR in the TAC year) and taking the predicted average catch from those three years as the TAC;
   3b) Setting the TAC at the average of the preliminary TAC and the agreed TAC for the previous (intermediate) year, giving equal weights (50:50%) to both years;
   3c) Applying a 15% TAC constraint (as in option 1), but where the resulting fishing mortality is not allowed to deviate by more than 15% from the target F (the F value corresponding to the sliding rule in the HCR).
4. This is as option 3, applying the TAC stability mechanism when SSB is above $B_{trigger}$ instead of B_{lim}.
   Given the overall extent of the request, only a limited amount of scenarios were explored for this option.

5. Two alternative forms of interannual quota flexibility: 5a) banking only, and 5b) banking-and-borrowing, by the A fleet[1] were tested in the context of option 1.
   5a) For banking only, it was assumed that 10% is banked by the A fleet each year and reclaimed the year after. No borrowing was allowed.
   5b) For banking-and-borrowing, reclaim and repayment were fixed to the year after. In the simulated scenario, the A fleet banked 10% in the first year and did not borrow. In the second year, the quota banked in the first year was reclaimed and, additionally, 10% quota borrowing was implemented. This can lead to catches in the second year substantially above the intended TAC. From the third year onwards, only borrowing (and repayment) was carried out, with no banking.
6. The current HCR with different target F values above $B_{trigger}$ and fishing mortality on the 0- to 1-ringers equal to 0.0375 if SSB is above B_{lim} and 0.03 if it is below B_{lim}. The same TAC stability mechanism as in option 1 (15% TAC constraint when SSB is above B_{lim}) was applied.
   This option was used to explore the trade-off between the juvenile and adult herring fisheries, but given the extent of the overall request exploring this option in depth was not given high priority.

Results and conclusions

Five indicators were selected to evaluate the performance of the HCRs during the next ten years:

- Risk: probability of SSB being below B_{lim} at least once during the 10-year simulation period (calculated as the percentage of iterations in which this happens). An HCR is considered to be in accordance with the precautionary approach if the risk does not exceed 5%.
- SSB in 2022 (median of all iterations).
- Mean fishing mortality of ages 2–6 over the simulation period (mean $F_{2–6}$). This measures the ability of an HCR to result in a mean $F_{2–6}$ over the simulation period close to target F.
- Yield: mean annual catch of the A-fleet over the simulation period (Mean Yield A).
- TAC variability: mean percentage change (up or down) in the TAC for fleet A between consecutive years over the simulation period. The lower the value, the more stable the TAC.

For the HCR options considered operational, the scenario selected (within that option) was the one with the highest average yield over the simulation period, while being precautionary (< 5% risk), and combined with an acceptable interannual variation in TAC. A considerable number of scenarios with target $F_{2–6}$ = 0.3 were found not to be precautionary. The results for the selected scenarios are presented in the first five rows of Table 6.3.3.6.1. All these scenarios apply the TAC stability mechanism when SSB is above B_{lim} (not $B_{trigger}$), because this was found to result in more stable TACs. It should be noted that $B_{trigger}$ and the target $F_{2–6}$ above $B_{trigger}$ differ between the scenarios and that these values were not used for selection purposes. $B_{trigger}$ is higher for the banking and banking-and-borrowing scenarios than for the other ones, which means that the slope of the HCR (between B_{lim} and $B_{trigger}$) is less steep and the maximum F is applied at higher SSB values. All selected scenarios, except for 3c, use $F_{2–6}$ = 0.24 above $B_{trigger}$.

Table 6.3.3.6.1 Selected scenarios from HCR options tested and considered operational (top 5 rows) and current long-term management plan (LTMP) settings (bottom row).

HCR option	$B_{trigger}$ ('000 t)	F_{2-6} above $B_{trigger}$	Risk (%)	SSB in 2022 ('000 t)	Mean F_{2-6}	Mean yield of A fleet ('000 t)	TAC variability (%)	WKHELP Scenario*
1	1 300	0.24	4.6	1 220	0.22	327	13	63
3b	1 300	0.24	2.7	1 219	0.23	329	12	82
3c	1 300	0.3	4.5	1 153	0.25	348	20	46
5a	1 600	0.24	4.3	1 266	0.21	315	11	4
5b	1 600	0.24	4.3	1 284	0.22	322	15	20
Current LTMP settings (for comparison only)	1 500	0.25	4.7	1 258	0.22	321	14	71

*Scenario number (out of the 99 tested) according to the WKHELP report (ICES, 2012b).

[1] North Sea fleet definitions for the herring stock:
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).

The five selected scenarios are quite comparable in terms of mean yield (with 10% maximum difference) and are slightly more different in terms of TAC stability. The highest TAC stability is obtained with scenarios 5a and 3b. Scenario 3b has the second highest mean yield and second most stable TAC, while having the lowest risk of SSB being below B_{lim}. Scenario 3c has the highest mean yield, but at the cost of the highest interannual TAC variability.

Figures 6.3.3.6.1–6.3.3.6.5 (Annex 1) represent the five selected scenarios, including in all cases target F values above $B_{trigger}$ of 0.24 (left panels) and 0.30 (right panels), for comparison purposes. In all cases, the A fleet catches are predicted to decrease over the next ten years, after an initial rise in 2013, and SSB stabilizes at values below $B_{trigger}$. This is a consequence of the low productivity regime considered in the evaluations, reflecting the observed recruitment since 2003. The catches and SSB trends could be reversed if future recruitment is better than assumed in the evaluations, but time constraints precluded exploring this in the simulations. $F_{2–6}$ is generally below the target F values (0.24 or 0.30), which correspond to the F_{MSY} range derived considering the entire stock–recruitment time-series since 1948, illustrating that the rules are designed partly to operate on the down-slope, where SSB is below $B_{trigger}$ and target F is reduced. This makes the HCRs adaptable to changes in stock productivity, operating mostly on the slope in low productivity periods but allowing for increases in F if stock productivity increases.

Methods

Reference points

Four reference points were evaluated: B_{lim}, B_{pa}, $B_{trigger}$, and F_{MSY}. B_{lim}, B_{pa}, and F_{MSY} were derived from parameter estimates and their associated uncertainty from the single-species stock assessment. B_{lim} follows from stock–recruitment breakpoint analyses and the lowest recruitment observed in the most recent low productivity period. The assessment uncertainty is used to derive a buffer (B_{pa}) for B_{lim}, in order to ensure that there is a less than 5% risk that the actual population SSB is below B_{lim} when SSB is estimated from the assessment to be at B_{pa}. F_{MSY} follows from stochastic yield-per-recruit analyses in combination with different stock–recruitment relationships based on the entire period of available data (1948–2011). $B_{trigger}$ was determined through simulations and selected per proposed HCR option, according to the trade-offs between high yield over the 10-year simulation period, mean $F_{2–6}$, and stability in TAC, subject to the HCR being precautionary.

Simulations

A stochastic medium-term simulation model was used to carry out evaluations of the HCRs, based on their performance over the next ten years. The model simulates the dynamics of the herring population and the multi-fleet fishery. Simulated future recruitment reflects the low productivity period observed since 2003. The stock assessment is mimicked to estimate the stock status and provide input to the management decision model. The management advice and implementation are based on the proposed management plan scenarios. In turn, management feeds back into the biological population and the fishery the year after. The simulations are run with 1000 Monte Carlo realisations (i.e. 1000 iterations), each having slightly different starting conditions and historical perceptions. Stochasticity is added to variables and parameters to ensure that biological variation and variability in fisheries processes in both history and the future are reflected.

Sources

ICES. 2005. Report of the ICES Advisory Committee on Fishery Management, Advisory Committee on the Marine Environment, and Advisory Committee on Ecosystems, 2005. ICES Advice, 2005. Volumes 1–11. 1,418 pp.
ICES. 2008. Report of the ICES Advisory Committee, 2008. ICES Advice, 2008.
ICES. 2011. Report of the ICES Advisory Committee, 2011. ICES Advice, 2011.
ICES. 2012a. Report of the Benchmark Workshop on Pelagic Stocks (WKPELA). ICES CM 2012/ACOM:47. 572 pp.
ICES. 2012b. Report of the Workshop for Revision of the North Sea Herring Long-term Management Plan (WKHELP). ICES CM 2012/ACOM:72.

Annex 1

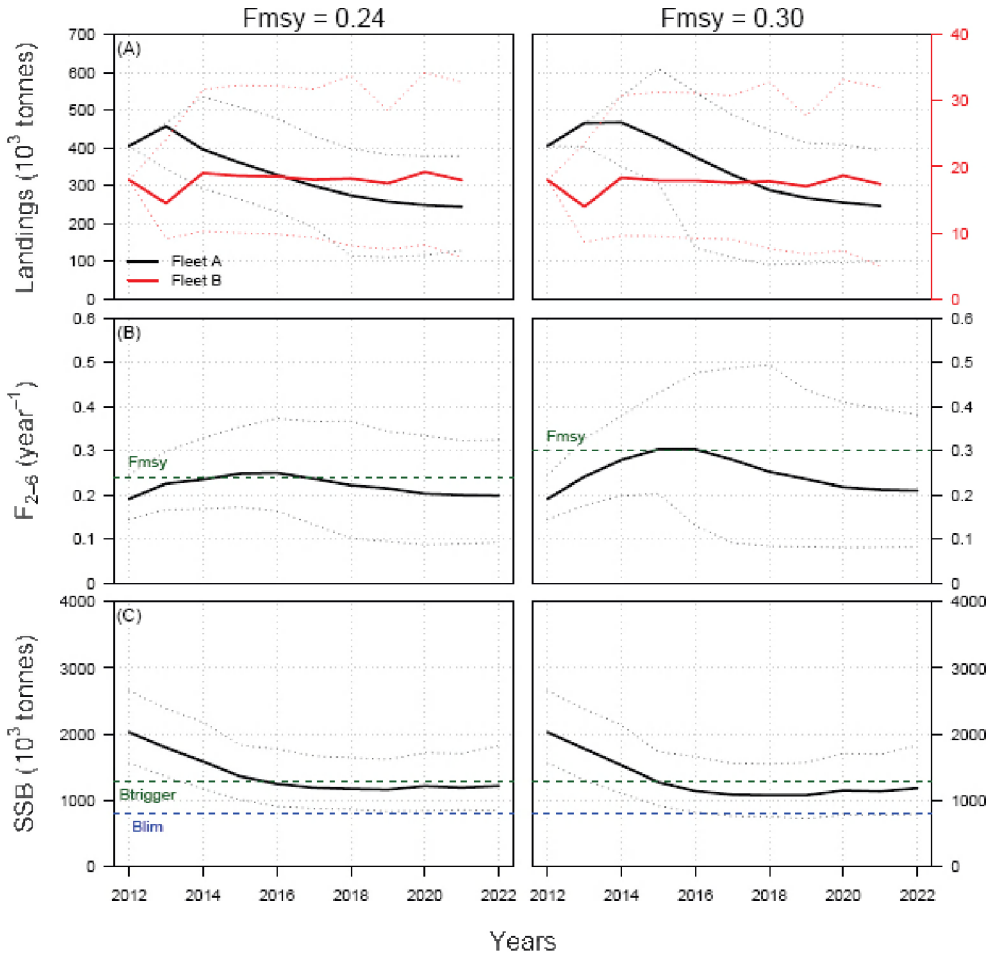


Figure 6.3.3.6.1 HCR option 1, using $B_{trigger}$ = 1.3 million tonnes and the new candidate F_{MSY} values (0.24 in left panels and 0.3 in right panels). A 15% constraint on TAC change is applied when SSB is above B_{lim}. The panels display: Landings by the A and B fleets (top), F_{2-6} (middle), and SSB (bottom), with the dotted lines indicating the 5 and 95 and the solid line the 50 percentiles of trajectories based on 1000 iterations. The scenario selected corresponds to the left panels (0.24 target F).

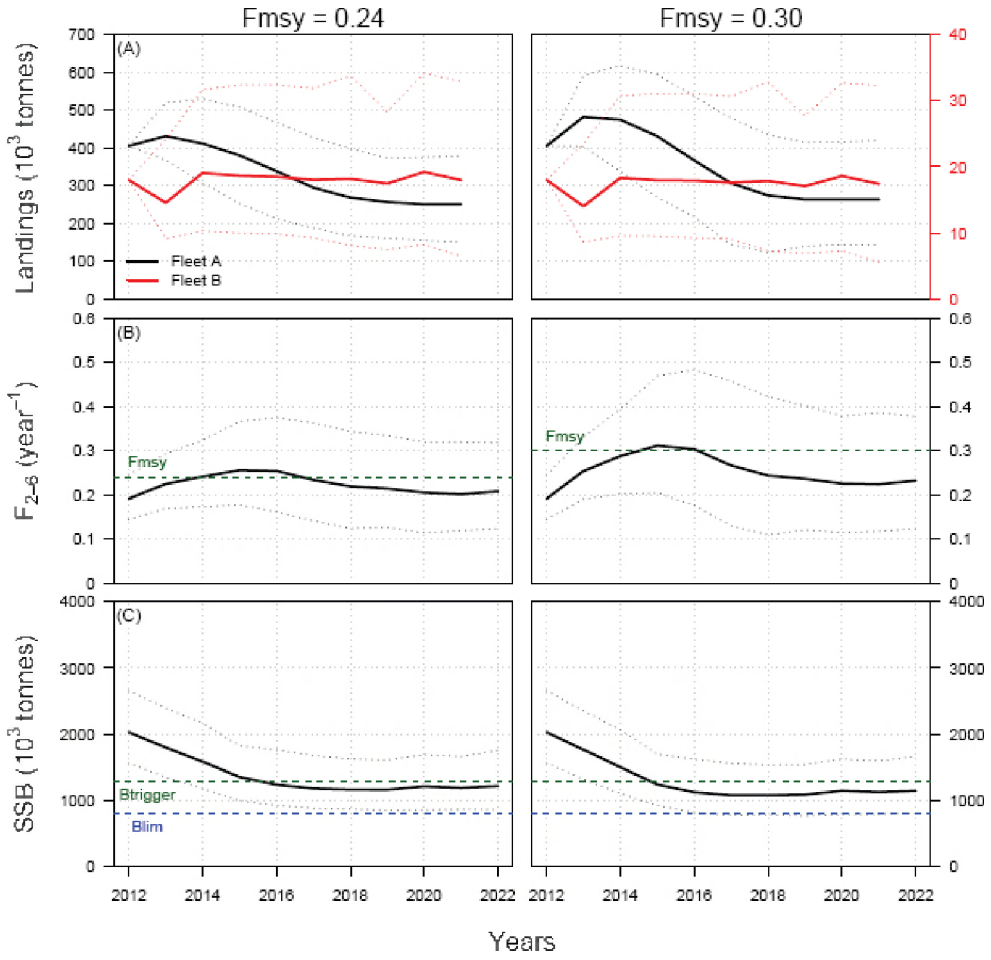


Figure 6.3.3.6.2 HCR option 3b, using $B_{trigger}$ = 1.3 million tonnes and the new candidate F_{MSY} values (0.24 in left panels and 0.3 in right panels). The following TAC stability mechanism is applied when SSB is above B_{lim}: the TAC is the average of the preliminary TAC from the HCR and the set TAC for the previous year. The panels display: Landings by the A and B fleets (top), F_{2-6} (middle), and SSB (bottom), with the dotted lines indicating the 5 and 95 and the solid line the 50 percentiles of trajectories based on 1000 iterations. The scenario selected corresponds to the left panels (0.24 target F).

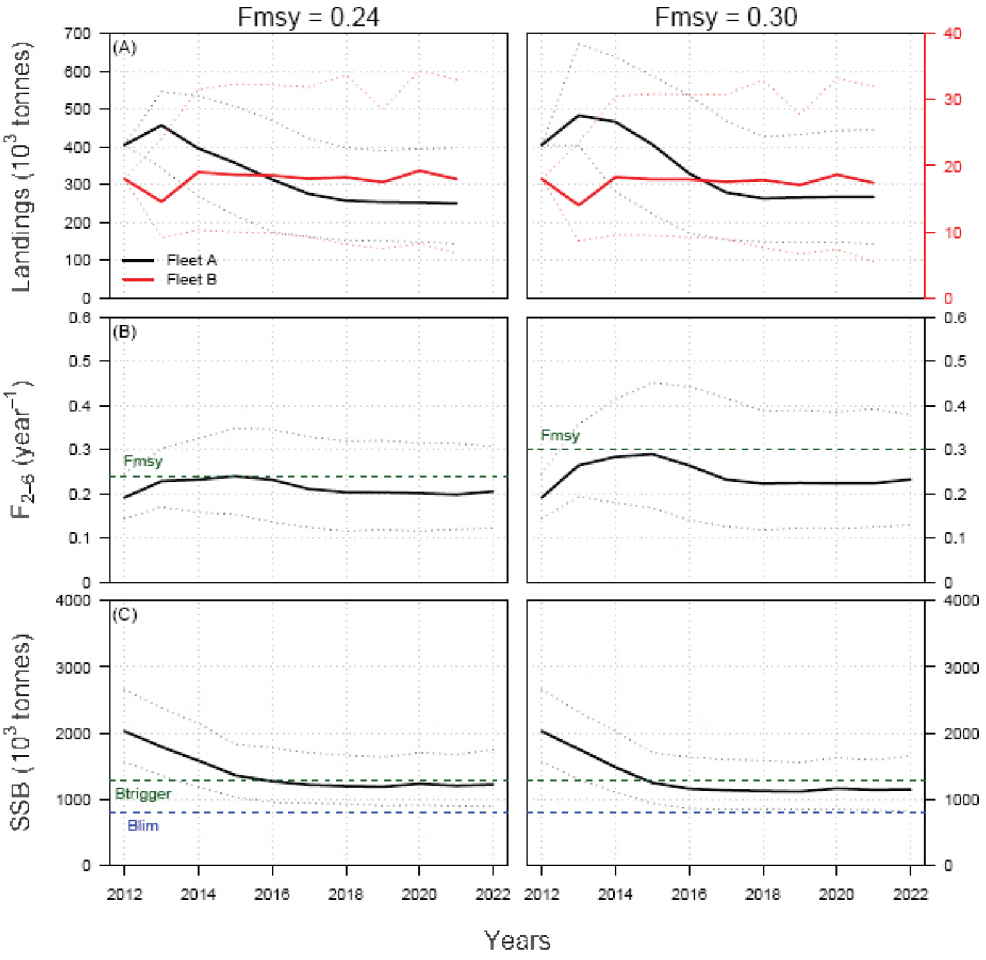


Figure 6.3.3.6.3 HCR option 3c, using $B_{trigger}$ = 1.3 million tonnes and the new candidate F_{MSY} values (0.24 in left panels and 0.3 in right panels). The following TAC stability mechanism is applied when SSB is above B_{lim}: a 15% TAC constraint on the TAC change, but where the resulting fishing mortality is not allowed to deviate by more than 15% from the target F (the F value corresponding to the sliding rule in the HCR) . The panels display: Landings by the A and B fleets (top), F_{2-6} (middle), and SSB (bottom), with the dotted lines indicating the 5 and 95 and the solid line the 50 percentiles of trajectories based on 1000 iterations. The scenario selected corresponds to the right panels (0.30 target F).

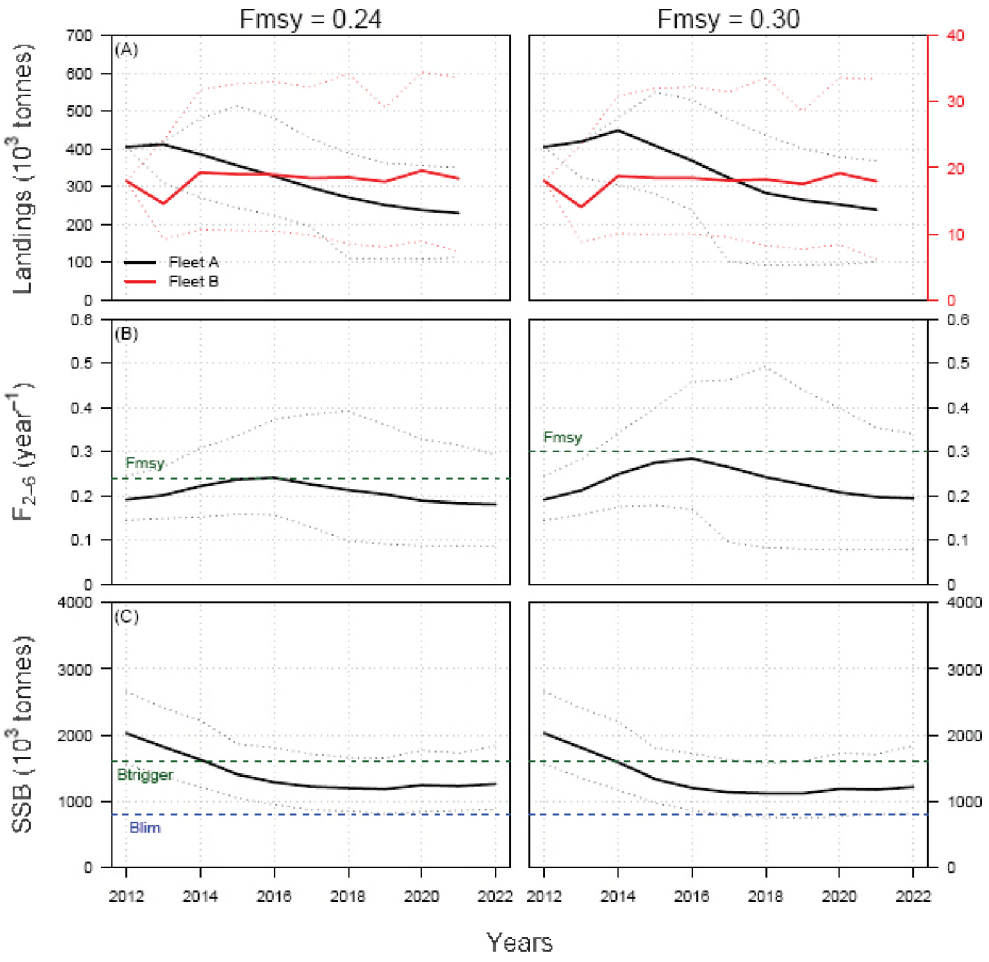


Figure 6.3.3.6.4 HCR option 5a, using $B_{trigger}$ = 1.6 million tonnes and the new candidate F_{MSY} values (0.24 in left panels and 0.3 in right panels). The TAC mechanism is as in HCR option 1 (15% constraint on TAC changes when SSB is above B_{lim}). Additionally, there is interannual quota flexibility of 10% (banking). The panels display: Landings by the A and B fleets (top), F_{2-6} (middle), and SSB (bottom), with the dotted lines indicating the 5 and 95 and the solid line the 50 percentiles of trajectories based on 1000 iterations. The scenario selected corresponds to the left panels (0.24 target F).

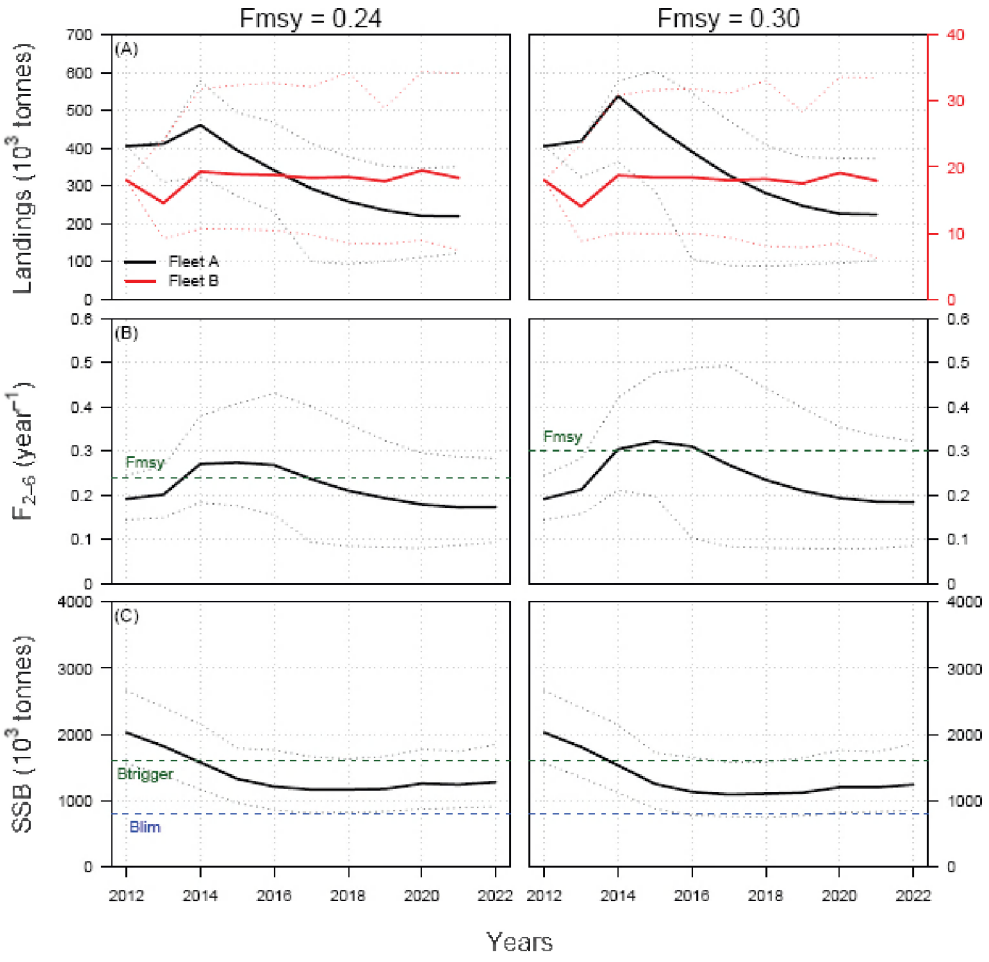


Figure 6.3.3.6.5 HCR option 5b, using $B_{trigger}$ = 1.6 million tonnes and the new candidate F_{MSY} values (0.24 in left panels and 0.3 in right panels). The TAC mechanism is as in HCR option 1 (15% constraint on TAC changes when SSB is above B_{lim}). Additionally, there is interannual quota flexibility of ±10% (banking-and-borrowing). The panels display: Landings by the A and B fleets (top), F_{2-6} (middle), and SSB (bottom), with the dotted lines indicating the 5 and 95 and the solid line the 50 percentiles of trajectories based on 1000 iterations. The scenario selected corresponds to the left panels (0.24 target F).

Annex 2

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
SUBJECT Proposed fisheries measures for the Cleaver Bank Special Area of Conservation

Advice summary[1]

ICES supports the proposal to close the area dominated with habitat type H1170 to mobile bottom-contacting fishing gear as this will contribute to achieving the conservation objects set for the Cleaver Bank.

ICES does not support the immediate ban on beam trawling in the Botney Cut as the level of beam trawling is very low and not likely to be impeding progress in achieving the conservation objectives. Further studies are needed to establish if fishing with mobile bottom-contacting fishing gear in the Botney Cut affects the adjacent reef habitat.

ICES considers the conclusion of the FIMPAS workshop to not develop site-specific measures for mammal conservation objectives for the Cleaver Bank to be appropriate.

ICES notes that for most benthic species the Cleaver Bank is an open system and recovery processes are likely to be significantly influenced by the broader ecosystem outside of the proposed closed area. Some of the typical reef species will not have commenced or completed re-colonization within the six-year period.

It is imperative that an operational framework be built around the stated conservation objectives. The establishment of a monitoring programme and selection of indicators will require further work. Indicators that are responsive to changes in pressures from the implementation of the fisheries measures and can measure trajectories towards the stated conservation objectives should be selected. It will be necessary to establish the spatial and temporal variance and patchiness of the characteristics being measured by the indicators.

Request

Given the conservation objectives for H1170, ICES is requested to advise on the degree to which the implementation of the proposed fisheries measures[2] *will progress the Cleaver Bank SAC towards the achievement of the Conservation Objectives.*

In preparing its response ICES is required to advise on the changes that can be attributed solely or primarily to the implementation of these proposed fisheries measures from the FIMPAS project.

Specifically, for the proposed fisheries measures Cleaver bank SAC, ICES is invited to describe:

i) the likely progress over a six year period towards achieving the conservation objectives that will occur as a result of implementation of the proposed measures in Cleaver Bank area;
ii) the likely long term progress towards achieving the conservation objectives that will occur beyond the six year period as a result of implementation of the proposed measures in Cleaver Bank area;
iii) how progress towards achieving the conservation objectives could be measured and when such changes can be expected to be measurable
iv) the key aspects that should be contained in an appropriate, cost effective, monitoring programme to measure progress towards achieving the conservation objectives;
v) The effort displacement within the SAC attributable to the proposed measures and the expected effects of such displacement on the achievement of the Conservation Objectives, together with any possible measures to mitigate any effects. When considering effort displacement other relevant factors causing

[1] This ICES advice is in response to specific questions on fisheries measures proposed by the Netherlands. Unless specifically stated, it is not an opinion from ICES on the designation of Natura 2000 sites or the Conservation Objectives set by the Member State. ICES facilitated input and advice in the FIMPAS process by identifying an expert who advised the process. This expert was not involved in any of the ICES review, drafting or advice approving processes. An ACOM Vice-Chair was assigned the task of following and observing the process. Expert reviewers and advice drafters were selected from independent countries as per ACOM procedures. The ICES advice drafting process was managed by the ACOM Vice-Chair; the scientific advice is the work of the independent reviewers and advice drafters.
[2] The proposed fisheries measures as submitted to ICES by the Netherlands are shown in Annex 1.

changes in fishing patterns in the Cleaver Bank (e.g. TAC/quotas, fuel cost, other spatial claims etc.) should be taken into account;

vi) any shortcomings in the proposed measures and how these might be overcome

vii) any other information ICES considers relevant for the achievement of conservation objectives in the Cleaver Bank SAC for Habitat H1170

viii) Invites ICES to comment whether the presented information on the occurrence and distribution of Habitat type H1170 justifies a change of the Southern and Northern boundaries for the Cleaver Bank proposed SAC, as described in the Cleaver Bank zoning proposal?

ix) Invites ICES to comment on the use of the available data from different sources (fishermen charts, sediment charts, expert reviews) to determine the demarcation of the Habitat type H1170, in the FIMPAS Steering Group Cleaver Bank zoning proposal

Regarding the Conservation Objectives for Harbour Porpoise, Grey Seal and Harbour Seal

xi) Invites ICES to comment on the outcome of the FIMPAS workshop not to develop site specific measures for mammal conservation objectives for Cleaver Bank SAC.

ICES advice

According to the documentation submitted to ICES together with the request, the proposed fisheries measures for the Cleaver Bank attempt

> *" to combine the knowledge of the fishing industry with the available scientific knowledge in an ecosystem based approach, incorporating the precautionary principle and using best available technology ..... to develop a more focused and proportional fisheries measure to achieve the Cleaver Banks conservation objectives..... It should result in maintaining an adequate connectivity between areas containing habitat type 1170, while facilitating traditional fishing activities in areas where this habitat type does not appear to exist."*

In order to put the request and the ICES response into context, the Conservation Objectives for the Cleaver Bank are available in Annex 2.

The main impact on the open-sea reefs of the Cleaver Bank is likely to come from fisheries (beam and otter trawling gear, gillnets), of which trawling has the biggest impact (see Annex 3). The metal shoes, tickler chains, ground rope, and net of the beam trawl dig into or slide along the seafloor, causing physical damage along its way by breaking or dislodging sessile plants and animals. The boards of the otter trawl may also dig into the surface of the seafloor in the case of soft sediments and sand or grind hard surfaces like rocks and stones. The floats and the weighted bobbins attached to the rope running along the lower mouth of the trawl may also slide along the seafloor and abrade the species growing on top of the reef.

The fisheries measures proposed for the Cleaver Bank Special Area of Conservation (SAC) envisage three different fisheries regimes for three zones, as shown in Annex 1. These are: (a) exclusion of beam trawling in the Botney Cut (but with otter trawling permitted); (b) no beam or otter trawling in the two predominately reef habitat areas; and (c) no restrictions in three predominately sandy areas. In responding to the request, ICES provides a separate response for these three different zones where appropriate.

ICES notes that the small size of the area proposed for conservation of open-sea reef habitats on Cleaver Bank suggests that for most of the benthic species it is an open system. Recovery processes that occur within it are therefore likely to be significantly influenced by the broader ecosystem outside of the proposed closed area. Harbour seals and grey seals, along with other marine mammals are transients and are not expected to be affected by the proposed management measures.

Response to Question *i) the likely progress over a six-year period*

The conservation objective is to improve the quality of the reefs. Good quality is characterized by the presence of sessile biotic communities of long-lived species. If the indicator of good quality is merely the presence of long-lived species on the reefs, these species appear to be present now and will therefore continue to be present over the first six-year period of reduced fishing pressure.

Based on studies undertaken in the early 1990s on the impacts of gravel extraction, recovery of most species is relatively fast, that is within ten years. If fishing has impacted the species on the reef, it is likely that changes will be observed in the impacted areas on similar time scales.

However, with the history of heavy beam trawling in the area dating back to the late 1970s and evidence of moving and chipping of boulders and churning of gravel beds, it is likely that most of the longer-lived species are not present in their natural abundance and population age/size structure. Of the typical animal species known to live on the reefs, the ocean quahog (*Arctica islandica*) is the longest lived with a lifespan in the order of centuries. There is speculation that the horse mussel (*Modioulus modiolus*) may also be present. This species has a long lifespan (50–100 years) with generation times of about six to ten years, and is known to have irregular recruitment and a very long pelagic larval dispersal stage. For a small area such as Cleaver Bank, recruitment of *M. modiolus* will likely depend upon sources from outside of the protected area. The encrusting coralline algae species found on the reefs, *Lithothamnion sonderi* and *Phymatolithon* sp., are slow growing (milimeters per year) and under certain conditions can form maërl. Maërl beds can build up over millennia and it is difficult to know whether or not this type of biogenic habitat could form on Cleaver Bank in the absence of fishing pressure. *L. sonderi* is only known to produce maërl in Scottish waters. These species are not likely to show measurable change over a six-year period and specialized monitoring programmes would be required to determine their status.

Response to Question *ii) the likely long-term progress*

For the reef habitat it is likely that some of the typical reef species will not have commenced or completed re-colonization within the six-year period (see discussion above for long-lived species). Recovery of habitat-forming species of the reef could take a considerable length of time and will continue for decades. A well-designed baseline study and monitoring programme will be needed to measure changes.

As an open system, changes in fish community composition occurring at large spatial scales throughout the North Sea will influence progress towards achieving conservation objectives in the Cleaver Bank. This is because many fish species prey on benthic species at some point in their life cycle and changes to the predation pressure may influence recovery trajectories of the benthos.

Environmental changes are also expected to be expressed over these longer time periods (including both predictable cycles such as the NAO as well as climate change) and will affect conservation objectives in unknown ways (new species moving in, flood waters inducing changes in water chemistry and pelagic production, etc.). Environmental change will influence rates of changes as well as changes in state. However, in general, the fisheries management measures suggested will contribute to reduce the pressure on the benthic habitat from bottom-contacting fishing gears, although the scale of this effect and consequences to the status of the habitats are not possible to predict.

Response to Question *iii) how progress could be measured and changes can be expected to be measurable*

It is imperative that an operational framework be built around the stated conservation objectives. This will entail establishment of appropriate indicators, allowing for target setting and evaluation followed by an appropriate monitoring programme (see below). Ongoing work by the ICES expert group on Ecosystem Effects of Fishing Activities (WGECO) has outlined a prioritized list of eighteen criteria that should be considered when selecting indicators (ICES, 2012a). Evaluation of indicators against these criteria considers the quality of the available data, responsiveness of the indicator to the pressure of interest, and links to conceptual and/or theoretical underpinnings. Not all of these criteria are expected to be met by any one indicator and not all may be relevant to the present application. Table 6.3.3.7.1 provides an overview of a preliminary list of generic criteria for indicators along with an evaluation of their priority for any monitoring programme. Indicator redundancy, that is groups of metrics or indicators which co-vary significantly, providing duplicate copies of a single signal rather than reflecting different independent signals, should be avoided.

Table 6.3.3.7.1 Preliminary list of priority for criteria by which the suitability of indicators may be assessed (ICES, 2012a).

Number	Criterion/Characteristic	Priority
1	Methodological approach to defining the target should be consolidated	Essential
2	Existing reference conditions	Essential
3	Relevant spatial domain	Desirable
4	Environmental fluctuations and climate	Desirable
5	Related to change in specific pressures	Essential
6	Uncertainty	Desirable
7	Relevant to management objectives	Essential
8	Relevant to management measures	Essential
9	Comprehensible	Desirable
10	Established target	Desirable
11	Pragmatic	Desirable
12	Theoretically sound	Essential
13	Early warning	?
14	Target suites	Desirable
15	Compatibility	Desirable
16	State, impact, pressure, and operational targets	Essential
17	Relevance to MSFD ecosystem components	Essential
18	Cross-application	?

Consideration of the relative importance of the indicators when assessing overall status may be required and will relate back to relative importance of the conservation objectives.

Response to Question *iv) ...an appropriate, cost effective, monitoring programme...*

Establishing a comprehensive baseline study is a priority and this should be informed by previous work on the Cleaver Bank. This is a prerequisite to designing a monitoring programme to measure progress or otherwise towards the conservation objectives. Suitable control areas should be selected, outside of the closed area where normal fishing operations are conducted. The spatial and temporal variance and patchiness of the species or ecological elements to be monitored needs to be understood and addressed in the design of a monitoring programme. Standard power curve analyses can be used to determine the precision needed to detect a difference of a given size (say a 25% increase in abundance of a population) with a specified (usually high) probability. To determine the sampling effort needed to achieve the necessary level of precision, it is then necessary to know how variance in the population estimate increases with sampling effort. For the overall objectives of improved environmental status for the communities, improvements in the more common species will contribute most to healthy functioning of ecosystem processes. Such improvements are usually best measured with a representative, spatially stratified random survey design. However, for objectives related to specifically improving the status of rarer species, particularly ones with specialized ecological requirements, targeted sampling will be more efficient. For rarer species, accurate estimates of likelihood of encounter and total range of occurrence are properties that are possible to quantify with sufficient precision to allow evaluation of trends over time.

Use of established protocols for related subjects (e.g., wind farm EIA (environmental impact assessment), or oil-spill monitoring) should be considered. Standards such as EN 16260:2012 (CEN, 2012) on visual seabed surveys and ISO 16665:2005 (ISO, 2005) on sampling marine soft-bottom macrofauna could inform this process.

The monitoring requirements of the Marine Strategy Framework Directive and developments within OSPAR will provide opportunities for incorporation of monitoring requirements into a wider monitoring programme. Currently, the ridged structure and focus on fish stock assessment of Data Collection Framework (DCF) surveys means that they could provide only limited data and information for the likely monitoring requirements on the Cleaver Bank. With minimal adjustments, DCF surveys could provide useful data on both commercial species and benthic elements.

It will be appropriate to target monitoring effort in areas which are judged to be controversial and/or sensitive, for example areas where moderate to high fishing effort has occurred prior to the closure, and across the interface between open and closed areas. Cooperation with the fishing industry could bring efficiencies and provide cost-effective access to the sites.

There are a variety of sampling and data collection methods available such as high-frequency ecograms combined with sidescan sonar, underwater video, remotely operated vehicles (ROV), bait-camera systems, grab sampling and dredge sampling, and it is likely that a combination of these and other methods will be required.

Response to Question ***v) The effort displacement within the SAC***

Except for otter board trawling in the Botney Cut, fishing activity using moving bottom-contacting gear appears to be limited on the Cleaver Bank. Therefore, based on the current level of fishing effort, effort displacement will not be an issue of concern.

Response to Question ***vi) any shortcomings in the proposed measures.....***

Green area – Low impact zone: the Botney Cut, in which beam trawling is banned but otter board trawling is allowed.

Otter trawling in the Botney Cut is evidenced from the report of the FIMPAS Workshop 2. During such fishing activity in the muddy seabed of the Botney Cut it is likely that a mud sediment plume is generated. It is unclear if this plume will result in mud settling on the adjacent reef on either side of the Cut and, if this does occur, the spatial extent of such settling. It is also unclear what effect this would have on the reef.

Information provided in FIMPAS Workshop 2 suggests that there is limited beam trawling in the Botney Cut. Beam trawling in a mud area such as the Botney Cut would produce a greater mud plume than otter trawling and would, as such, result in greater potential pressure to adjacent reef habitats.

Given the higher potential pressure from beam trawling compared to otter trawling on the reefs adjacent to the Botney Cut, ICES understands the inclination to apply the precautionary approach and to ban beam trawling in the Cut. However, as the level of beam trawling effort is very low it is unlikely that a ban on beam trawling, at its current level, will have a significant influence on achieving the conservation objectives set for the Cleaver Bank. Based on concerns with evoking the precautionary approach to ban an activity that currently is not likely to be contributing in any real sense to not achieving the conservation objectives, ICES does not support the immediate ban on beam trawling in the Botney Cut.

With regard to both otter and beam trawling, ICES advises that monitoring, supported by sediment transportation modelling, should be undertaken to verify that fishing with mobile bottom-contacting gear does not cause re-suspended mud settling on and impacting the adjacent reefs. In the event that the risk to the reefs is established from re-suspended mud relating to fisheries activities, mitigation measures should be considered and investigated. These could include seasonal and/or tidal restrictions and closed buffer zones at either side of the Botney Cut to remove or reduce the pressure on the adjacent reef.

Brown area – No mobile bottom-contacting gear fishing zone

This zone contains the reef habitat for which the Cleaver Bank is protected. The documentation provided shows that this part of the Cleaver Bank is bottom trawled throughout the year, but fishing effort is low. ICES has previously advised (ICES, 2009) that typical species of reef habitats are generally more vulnerable to impact from bottom-contacting fishing gear than those of sandbanks. Heavy bottom trawls can destroy the physical structure of reefs.

In 2009 ICES pointed out that:

- the first and second passes of a mobile, bottom-contacting fishing gear exert the most severe effect on benthic structures, communities, and species. It is likely that the reef areas with the highest potential to recover soonest to favourable conservation status are those areas with the lowest historical and current bottom trawling activity. It is also likely that areas that are trawled more than 4–5 times a year do not support self-sustaining populations of some of the characteristic benthic species most vulnerable to mobile, bottom-contacting fishing gears, particularly for reef communities.

- For protected reefs in areas frequently exposed to mobile, bottom-contacting fishing gears, complete closure may be necessary to restore habitats and species to favourable conservation status.

ICES considers these comments to be valid in the case of the Cleaver Bank and supports the proposal to close this area to fishing with mobile bottom-contacting gear.

Response to Question ***vii) any other information ... relevant for the achievement of conservation objectives....***

Monitoring of relevant, sensitive, and responsive indicators to follow the progress towards the conservation objectives is needed. Some species will be able to recolonize impacted areas quite fast while others need long(er) time. Monitoring the progress (if any) towards the conservation objectives will probably require adjustment and modification of the monitoring programme and possibly even the fisheries measures put in place.

ICES agrees that the proposed fisheries measures will contribute to the reef achieving its conservation objectives as it removes the main anthropogenic pressure acting on the reef and its communities.

Response to Question *viii) ...whether the presented information justifies a change of the Southern and Northern boundaries for the Cleaver Bank proposed SAC?*

Based on the information provided, ICES considers the change in the southern and northern boundaries to be reasonable as the new boundaries will increase the target habitat to be protected.

Response to Question *ix) ...comment on the use of the available data from different sources*

ICES notes that the demarcation of the reef habitat type is largely based on the surficial geology of the area. This is a good proxy for inferring benthic community composition. However, baseline biological data is essential in order to characterize the biota and to determine at the six-year review whether the management plan needs to be adjusted.

Response to Question xi) .....comment on the outcome of the FIMPAS workshop not to develop site specific measures for mammal conservation objectives.....

ICES has previously advised that harbour porpoise are highly mobile on spatial scales much larger than the Natura 2000 sites that have been proposed in the German EEZ (ICES, 2009). Consistent with the 2009 advice, and without effective management outside Natura 2000 sites, the full protection of marine mammals within the boundaries of the Dutch Natura 2000 sites would not ensure a high likelihood of achieving very low bycatch mortality for marine mammals in the southern North Sea.

Consequently, ICES considers the conclusion of the FIMPAS workshop to not develop site-specific measures for mammal conservation objectives for Cleaver Bank to be appropriate.

Sources

CEN. 2012. Water quality – Visual seabed surveys using remotely operated and/or towed observation gear for collection of environmental data. BS EN 16260:2012.

ICES. 2009. Report of the EMPAS project (Environmentally Sound Fisheries Management in Protected Areas), 2006–2008, an ICES–BfN project. 123 pp.

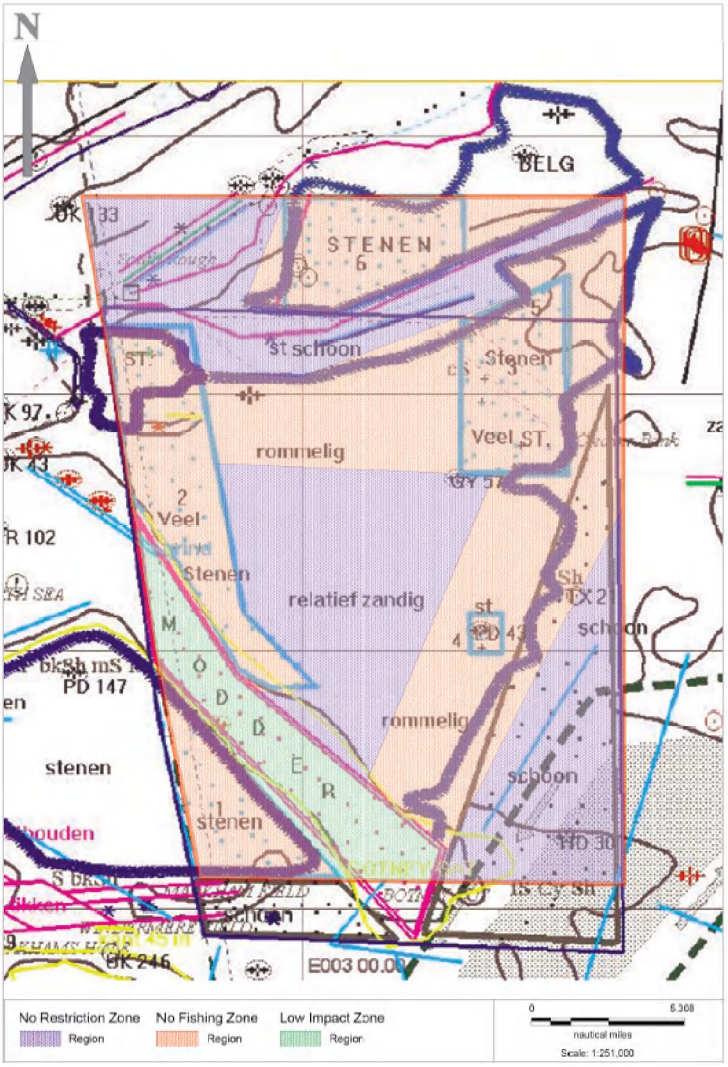
ICES. 2010. Report of the FIMPAS Workshop 2: Fishery Impact and Conflicts with Conservation Objectives, 30 June–2 July 2010, Neufchatel-Hardelot, France. ICES CM 2010/ACOM:53. 45 pp.

ICES. 2012a. Report of the Working Group on the Ecosystem Effects of Fishing Activities (WGECO), 11–18 April 2012; Copenhagen, Denmark. ICES CM 2012/ACOM:26. 192 pp.

ICES. 2012b. Material provided to ICES for advice on proposed fisheries measures for Cleaver Bank and the Frisian Front. The FIMPAS project, September 2012. ICES CM 2012/ACOM:76.

ISO. 2005. Water quality – Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna. ISO 16665:2005.

Annex 1 Proposed fisheries measures for the Cleaver Bank. From "*Request for ICES Advice Cleaver Bank and Frisian Front, FINAL VERSION, 4 Sept. 2012*". The map is from the document "*Industrial proposal on gravel content*", submitted to ICES as part of the request.



Proposed fisheries measures in the Cleaver Bank:

(a) Green – Low impact zone: the Botney Cut, in which beam trawling is banned but otter board trawling is allowed;
(b) Brown – No [mobile bottom-contacting gear][3] fishing zone: a zone with no bottom-contacting gear fisheries allowed. The zone is located in areas with a dominant presence of habitat H1170;
(c) Purple – No restriction zone: a zone with no restriction on fisheries located on predominantly sandy areas.

[3] This is incorrectly labelled on the map – it is <u>not</u> a "No Fishing Zone" but rather a "No ***mobile bottom-contacting gear*** fishing zone". This was confirmed with the Ministry of Agriculture, Nature and Food Quality, the Netherlands.

Annex 2 Extract from the document "*Conservation Objectives, Jak et al.*", submitted to ICES with the request.

Conservation objectives for the Cleaver Bank

Detailed conservation objectives: Maintain the surface area and improve quality of reefs.

Explanation: Good quality is characterized by the presence of sessile biotic communities of long-lived species. These communities are attached to the hard substrate. An improvement of the quality can be achieved if the disturbance of hard compact substrates and their biotic communities is prevented, i.e. firmly touched or their position changed.

Annex 3 Gear impact matrix developed in the FIMPAS process and supplied to ICES with the request. From "Report of the FIMPAS Workshop 3: Management proposals. 20110328", page 25

CONSERVATION OBJECTIVES	Fishing gear				
	Beam trawl	Otter trawl	Demersal seine nets	Gillnets	Midwater trawl
Habitats					
Dogger Bank H1110_C Sandbanks	High with disagreement	Medium	Low	Low	Not Relevant
Cleaver Bank H1170 Open-sea reefs	High	High	Low	Low	Not Relevant
Marine mammals					
Harbour porpoise	Low	Low	Low	Medium	Low
Harbour seal	Low	Low	Low	Low	Low
Grey seal	Low	Low	Low	Low	Low
Seabirds					
Great skua	Low	Low	Low	Low	Low
Great black-backed gull	Low	Low	Low	Low	Low
Common guillemot	Medium	Medium	Medium	High	Low
Lesser black-backed gull	Low	Low	Low	Low	Low

Gear Impact Matrix FIMPAS WS

High: *direct disturbance,* the continuity of the habitat/species is in danger.

Medium: *the effect is visible* and the conservation status will not remain the same without any measures.

Low: *the habitat/species is affected, however the conservation status of the habitat/species* is supposed to remain.

The judgement based on majority opinions. In most cells particularly for the Dogger Bank area there were a range of opinions; often industry stakeholders rated the impact lower than scientists and NGO's.

ECOREGION North Sea
SUBJECT Proposed fisheries measures for the Frisian Front Special Area of Conservation

Advice summary[1]

ICES considers the proposed ban of gillnet fishing in the Frisian Front to be precautionary. However, given the potential risk to the common guillemot from gillnets and the potential for future changes in fishing patterns for the reasons discussed below, ICES agrees with the proposed measures. Notwithstanding this view in this specific situation, ICES has concerns with evoking the precautionary approach to ban activities that currently do not take place within an area. Taking this approach could suggest the need to ban non-existing activities in areas because of the potential impact they could exert if they did take place.

ICES agrees with the conclusion of FIMPAS that additional fisheries measures within the Frisian Front to maintain the numbers of the great skua, the great black-backed gull, and the lesser black-backed gull are not likely to support the conservation objectives set for the Friesian Front.

ICES also agrees with the conclusion of FIMPAS that additional fisheries measures within the Frisian Front with regard to the interaction between the common guillemot and beam- and otter trawlers and demersal seine fishers are not warranted as they are not likely to support the conservation objectives set for the Frisian Front.

Request

Given the conservation objectives for bird species, ICES is requested to advise on the degree to which the implementation of the proposed fisheries measures will progress the Frisian Front SPA towards the achievement of the Conservation Objectives.

In preparing its response ICES is required to advise on the changes that can be attributed solely or primarily to the implementation of these proposed fisheries measures from the FIMPAS project. Specifically, for the proposed fisheries measures ICES is invited to describe:

i) the likely progress over a six year period towards achieving the conservation objectives that will occur as a result of implementation of the proposed measures in the Frisian Front;
ii) the likely long term progress towards achieving the conservation objectives that will occur beyond the six year period as a result of implementation of the proposed measures in the Frisian Front areas;
iii) how progress towards achieving the conservation objectives could be measured and when such changes can be expected to be measurable
iv) the key aspects that should be contained in an appropriate, cost effective, monitoring programme to measure progress towards achieving the conservation objectives ;
v) The effort displacement within the SAC/SPA attributable to the proposed measures and the expected effects of such displacement on the achievement of the Conservation Objectives, together with any possible measures to mitigate any effects. When considering effort displacement other relevant factors causing changes in fishing patterns in the Frisian Front (e.g. TAC/quotas, fuel cost, other spatial claims etc.) should be taken into account;
vi) any shortcomings in the proposed measures and how these might be overcome
vii) any other information ICES considers relevant for the achievement of conservation objectives in the Frisian Front SPA for birds species
x) Invites ICES to comment on the need to make a distinction between different types of gillnets deployed in the Frisian Front SPA, in terms of their impact on meeting the conservation objectives;

ICES advice

[1] This ICES advice is in response to specific questions on fisheries measures proposed by the Netherlands. Unless specifically stated, it is not an opinion from ICES on the designation of Natura 2000 sites or the Conservation Objectives set by the Member State. ICES facilitated input and advice in the FIMPAS process by identifying an expert who advised the process. This expert was not involved in any of the ICES review, drafting or advice approving processes. An ACOM Vice-Chair was assigned the task of following and observing the process. Expert reviewers and advice drafters were selected from independent countries as per ACOM procedures. The ICES advice drafting process was managed by the ACOM Vice-Chair; the scientific advice is the work of the independent reviewers and advice drafters.

ICES has decided to provide only general comments to this request because the impacts are likely to be minimal and difficult to measure. Some of the comments provided in the advice on the Cleaver Bank may also be relevant but they are not repeated here.

The Gear Impact Matrix developed in FIMPAS (Annex 1), suggests that interaction between various types of fishing gear and the great skua, great black-backed gull, and the lesser black-backed gull is low. The conservation status for these three bird species nationally in the Netherlands has been assessed as favourable. For the great skua and great black-backed gull the conservation status within the Frisian Front is assessed as unknown and for the lesser black-backed gull the conservation status in the Frisian Front was assessed as favourable. FIMPAS concluded that no proposal should be made for maintaining the number of these three species, as their numbers will likely decline with declining discards, for which no compensation could be imagined. Based on the available information and the interaction provided in the Gear Impact Matrix, ICES considers the conclusion by FIMPAS to be appropriate.

The Gear Impact Matrix identified the impact from midwater trawls on the common guillemot as low and from beam- and otter trawling and demersal seine fishing as medium. FIMPAS concluded that the medium impacts for common guillemot should not be considered further, since there is no *a priori* reason to believe that their foraging is adversely affected by the noise and light from trawling/seining operations. ICES does not have information to comment on these views. Based on the available information and the interaction provided in the Gear Impact Matrix, ICES considers the conclusion by FIMPAS to be appropriate.

The Gear Impact Matrix identified the impact from gillnets on the common guillemot as high. With regard to the common guillemot, the Frisian Front was designated as a Habitat Directive Special Protected Area (SPA) because the common guillemot occurs in the site at numbers exceeding 20 000 individuals. The conservation objective for the common guillemot is to maintain the extent and quality of habitat with the capacity to carry a population averaging 20 000 individuals in July–August. This is at a period when young common guillemots have not started to fly and the adults are unable to fly due to moulting.

Based on the information provided with the request to ICES, the gillnet fishery effort at the Frisian Front is generally zero with a very low effort along the southwestern boundary for the years 2006 to 2008. Accordingly, the risk to the population of common guillemot from gillnet fishing at the Frisian Front is very small. FIMPAS proposed a total ban on gillnet fishing in the site from June to November. In selecting this period, the precautionary approach was adopted to allow for future possibility of sea warming, which may change the period when the young and moulting common guillemots are present at the Frisian Front.

Gillnet fishery effort might increase in the future, for any of several reasons. These include: rising fuel costs that may lead to a shift from mobile gears to set nets; recovery of the North Sea cod stock, which traditionally was the main target species in gillnet fisheries, may result in renewed effort in that fishery; measures to reduce the impact of mobile, bottom-contacting fishing gears on benthic habitats and communities may result in shifts in effort from those gears to gillnets and other static gears. There is a considerable body of evidence pointing to significant bycatches of common guillemots in gillnets worldwide.

Given that gillnetting does not currently take place in the SPA, that the conservation status for this species with the SPA was assessed as favourable, and that the ban covers a period outside the period specified in the conservation objectives (July to August when there is evidence of the highest number of birds present on the site), ICES considers the proposed ban of gillnet fishing at the Frisian Front to be precautionary. However, given the potential risk to the common guillemot from gillnets and the potential for future changes in fishing patterns for the reasons discussed above, ICES agrees with the proposed measures. Notwithstanding this view in this specific situation, ICES has concerns with evoking the precautionary approach to ban activities that currently do not take place within an area. Taking this approach could suggest the need to ban non-existing activities in areas because of the potential impact they could exert if they did take place.

The conservation status of the common guillemot at the Friesian Front was assessed as favourable. The proposed measures will remove an as yet unquantifiable pressure on the guillemots and should therefore assist in maintaining this status. ICES does not see the need to comment on current monitoring and assessment methodologies as these appear to be fit for the purpose.

Sources

ICES. 2012. Material provided to ICES for advice on proposed fisheries measures for Cleaver Bank and the Frisian Front. The FIMPAS project, September 2012. ICES CM 2012/ACOM:76.

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Österblom, H., Fransson, T., and Olsson, O. 2002. Bycatches of common guillemot (*Uria aalge*) in the Baltic Sea gillnet fishery. Biological Conservation, 105 (2002): 309–319. Available from: **http://www.balticseabird.com/pdf/Bycatches%20of%20common%20guillemot.pdf.**

PROJECT GloBAL. Global bycatch assessment of long-lived species. Available from: http://bycatch.nicholas.duke.edu/species/common-murre.

Annex 1 Gear Impact Matrix: From "Report of the FIMPAS Workshop 3: Management proposals. 20110328". Page 25.

CONSERVATION OBJECTIVES	Fishing gear				
	Beam trawl	Otter trawl	Demersal seine nets	Gillnets	Midwater trawl
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Grey seal	Low	Low	Low	Low	Low
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Great black-backed gull	Low	Low	Low	Low	Low
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Gear Impact Matrix FIMPAS WS

***High*: direct disturbance,** the continuity of the habitat/species is in danger.

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***Low*: the habitat/species is affected, however the conservation status of the habitat/**species is supposed to remain.

The judgement based on majority opinions. In most cells particularly for the Dogger Bank area there were a range of opinions; often industry stakeholders rated the impact lower than scientists and NGO's.

ECOREGION North Sea
SUBJECT Proposed fisheries measures for the Dogger Bank Special Area of Conservation

Advice summary[1]

ICES considers that the diversity, and ambition, of the national conservation objectives makes development of a single management approach complicated and difficult. Reaching the stated conservation objectives is complicated in that there may be changes, both anthropogenic and natural, already imposed on the area that are irreversible. The response of the five different benthic communities to changes in fishing pressures will differ. Achieving the conservation objectives for some of the very long-lived species will, if possible, take decades. Recovery of benthic species will depend on the availability of source populations, some of which may only occur outside the closed areas. Recruitment in the entire North Sea will be affected by influences such as changes in fish community composition and climate change effects. The establishment of a monitoring programme and selection of indicators will require further work to ensure that the selected indicators are responsive to changes in pressures from mobile bottom-contacting fishing gears and that they can measure trajectories towards the stated conservation objectives. It will be necessary to establish the spatial and temporal variance and patchiness of the characteristics being measured by the indicators. ICES advises that this work be carried out in a coordinated manner across the entire Dogger Bank, drawing on, and having reference to, developments in monitoring under the Marine Strategy Framework Directive. A comparison of incremental improvement after a full six-year monitoring and assessment period could improve understanding of the implication of scale and provide better scientific guidance for the appropriate location and size of areas needed to achieve the conservation objectives.

ICES considers that the effect of seine fishing gear on the Dogger Bank sandbank habitat may not significantly impede the achievement of the conservation objectives. It is unlikely that, under the current proposal, displacement will be a significant problem but there may be increased fishing efforts along the open/closed boundaries. A mechanism to allow experimental trials with low impact gear in part of the closed area, verifying results that indicate no likely impacts on the conservation objectives, should be established. Short-term access to the closed areas at specific times may be possible without compromising the conservation objectives, but should first be thoroughly evaluated.

Request

Germany, the Netherlands, and the UK have sent the following request to ICES.

ICES is requested to advise on the degree to which the implementation of the proposed fisheries measures[2] *in the Presentation Paper will contribute to the achievement of the established conservation objectives, taking into account the wish of the Dogger Bank states to consider the Dogger Bank as one ecosystem.*

The three Member States have taken note of the ICES advice from 2008 on protection of the German Natura 2000 site on the Dogger Bank (EMPAS Advice). As the advice requested in this procedure affects the German sector, ICES is asked to provide a rationale for any deviation from the 2008 advice.

In preparing its response ICES is required to advise on the changes that can be attributed solely or primarily to the implementation of the proposed fisheries measures. Specifically, if the proposed fisheries measures described in the three proposals (closed areas to certain gear types) are implemented, ICES should describe:

i) The likely progress over a six year period towards achieving the conservation objectives that will occur as a result of implementation of the proposed measures in the closed areas and in the habitat type 1110 in the Dogger Bank SAC;

[1] This ICES advice is in response to specific questions on fisheries measures proposed by relevant authorities of Member States. Unless specifically stated, it is not an opinion from ICES on the designation of Natura 2000 sites or the Conservation Objectives set by the Member States for those sites. ICES facilitated input and advice in the Dogger Bank process by identifying an expert who advised the process. This expert was not involved in any of the ICES review, drafting or advice approving processes. An ACOM Vice-Chair was assigned the task of following and observing the process. Expert reviewers and advice drafters were selected from independent countries as per ACOM procedures. The ICES advice drafting process was managed by the ACOM Vice-Chair; the scientific advice is the work of the independent reviewers and advice drafters.

2 The proposal from Germany, the Netherlands, and the UK is shown in Annex 1.

ii) *The likely long term progress towards achieving the conservation objectives that will occur beyond the six year period as a result of implementation of the proposed measures in these areas;*

iii) *How progress towards achieving the conservation objectives could be measured and when such changes can be expected to be measurable;*

iv) *The key aspects that should be contained in an appropriate, cost effective, joint monitoring programme to measure progress towards achieving the conservation objectives;*

v) *The likely impacts of seines including fly-shooting on attaining the conservation objectives for the Dogger Bank habitat type 1110 and an assessment of the likely additional benefits for the achievements of the conservation objectives from the prohibition of these gears in the managed /closed zones and – if available data are not sufficient for a concluding analysis – identification of missing data and how to obtain such data;*

vi) *The effort displacement within the SAC attributable to the proposed measures and, the expected effects of such displacement on the achievement of the conservation objectives for habitat type 1110 in the SAC area, together with any possible measures to mitigate any effects. When considering effort displacement other relevant factors causing changes in fishing patterns in the Dogger Bank (e.g. TAC/quotas, fuel cost, other spatial claims etc.) should be taken into account;*

vii) *Any shortcomings in the proposed measures and how these might be overcome;*

viii) *Summarise under points i) to iii) in a comparative analysis the difference to the improvements to the conservation status between the implementation of the proposed measures of the DBSG, the NGO and the fishing sector proposals. The two latter proposals are described in the NSRAC Position Paper of April 2012. In this comparative analysis ICES should comment on the relationship between the size and location of the closed areas and the progress towards achieving the conservation objectives;*

ix) *Any other information on fishing impacts ICES considers relevant to the achievement of conservation objectives in the SAC area for habitat type 1110.*

ICES advice

Dogger Bank conservation objectives

In the documentation submitted to ICES with the request it is stated that

> *The purpose of fisheries measures is to reduce the pressure on the benthic habitat from bottom contacting fishing gear with a view to contributing to the achievement of the conservation objectives. The conservation status is currently assessed as unfavourable.*

In order to put the request and ICES response into context, additional information on the conservation objectives is available in Annex 2.

ICES considers that the diversity of the national conservation objectives makes development of a single management approach complicated and difficult. The different objectives (improve/restore/recover) have different outcomes and all depend on agreement on what constitutes a favourable status for habitat type 1110 with respect to stated indicators that are yet to be defined (as noted by the UK). The "improve" objective further requires knowledge of the recovery trajectories of selected indicators, which will not be linear, so that status can be evaluated along the path towards the objective state. This assumes that full recovery is possible even if some of the changes (due to both anthropogenic and natural factors) already imposed on the area may be irreversible.

More specific restoration objectives commonly agreed to by UK, Germany, and the Netherlands are listed as:

1) For abiotic and biotic factors in the area to achieve a state which enables benthic communities to reach and maintain a good state of preservation.
2) Benthic communities should be shaped by characteristic, in particular long-lived, species. Of these species individuals should be present of all typically occurring species and in natural proportions of size and age.
3) Characteristic fish species should be present in characteristic population structures and of all typical species in natural proportions of size and age.

ICES notes that these conservation and restoration objectives are very demanding. However, if their achievement is couched in terms of natural recovery following removal of fishing pressure then any change in status could be considered as achieving some degree of restoration. ICES also cautions that if the indicators that were used to assess the original determination of unfavourable status were not based on the restoration objectives noted above, then it will be important to re-evaluate current status against an agreed set of indicators so that change can be effectively tracked.

Response to *Question i) The likely progress over a six year period...*

Given the caveats noted above for framing change in status within an envelope of baseline and target conditions, in responding to this question ICES has asssumed that recovery is possible and that any changes that have occured are not irreversible. Further, ICES can only respond to this question in abstract terms given that full information on the size/age composition for most of the "typical" species (excepting lesser sandeel and plaice) is unknown.

ICES considers it likely that changes in status of the typical species in the five different benthic communities will differ due to differences in species composition, population dynamics, depth, and sensitivity to fishing impacts.

Within the list of typical species for the area, lifespans range from several years or less (e.g., *Spisula subtruncata*, *Acrocnida brachiata*, *Lanice conchilega*) to centuries (*Arctic islandica*) , although there are few species with very long lifespans. Given that the current population structure of the longest-lived species, *Arctic islandica*, appears to be altered from baseline conditions with fewer large animals found on the bank than formerly, and that restoration objective 2 noted above requires this species to be present in natural proportions of sizes and ages, it is clear that the conservation objectives will not be met in a six-year time frame.

Selecting and closing areas of the Dogger Bank particularly appropriate for supporting some now uncommon or rare benthic species will result in more progress being made in six years towards restoration of healthy populations of species characteristic of the Dogger Bank. The more areas included, the more progress made, although the relationship between the amount of area closed to fishing and the six-year progress towards restoring populations of all characteristic species is not simple and linear.

For species with lifespans of less than six years, recovery is possible provided that recruitment occurs within the area. Many short-lived species are subject to fluctuations in recruitment due to environmental conditions and detecting change in their abundance will require an appropriately designed monitoring programme. This also applies to the biogenic reefs formed by aggregations of *Lanice conchilega* tubes which appear to have good recovery potential over this time frame.

ICES notes that pelagic larval duration is an important consideration, and that the source/sink dynamics for most of the typical species are unknown; consequently source populations may occur in areas outside of the proposed closed area. For some fish populations whose effective breeding populations extend well beyond the Dogger Bank no measures applied solely on the Dogger Bank will allow recovery of the historical age and size compositions of these populations, as long as fishing, even at sustainable levels, is allowed outside the Dogger Bank. In such cases, if the source populations are impacted by ongoing fishing then no or slow rates of change may occur in the proposed closed area. Furthermore, if displaced effort increases the impact on those source populations outside the closed area, then recruitment to the closed area could be further retarded.

Response to *Question ii) The likely long term progress...*

All of the issues raised in the response to the previous question have relevance here, given the lifespan and recruitment dynamics of the typical species. The connectivity of populations on the Dogger Bank has implications for direct colonization and recovery of impacted areas. Additionally, over longer time periods (>6 years), changes in fish community composition occurring at large spatial scales throughout the North Sea could influence progress towards achieving the stated conservation objectives in the Dogger Bank. This is because many fish species prey on benthic species at some point in their life cycle and changes to the predation pressure may influence recovery trajectories of the benthos. Environmental changes such as those resulting from climate are also expected to be expressed over these longer time periods and will affect conservation objectives in unknown ways (new species moving in, changes in water chemistry and pelagic production, etc.). Environmental change will influence rates of changes as well as changes in state. In relatively high-energy environments, characteristic species and communities are all adapted to some frequency of natural disturbance. Hence, for time periods longer than six years there will continue to be an increase in the number of species that re-establish self-sustaining populations, but there will be diminishing gains over longer time periods. However, that is not cause to suspend restrictive management after six years. In general, the fisheries management measures suggested will reduce the pressure on the benthic habitats from bottom-contacting fishing gears, although the scale of this effect and consequences to the status of the habitats are not possible to predict.

Response to *Question iii) How progress could be measured and changes can be expected to be measurable*

As noted above, it is imperative that an operational framework be built around the stated conservation objectives. This will entail establishment of appropriate indicators which will allow for target setting and evaluation followed by an appropriate monitoring programme (see below). Ongoing work by ICES has outlined a prioritized list of eighteen criteria that should be considered when selecting indicators (ICES, 2012a). Evaluation of indicators against these criteria considers *inter alia* the quality of the available data, responsiveness of the indicator to the pressure of interest,

and links to conceptual and/or theoretical underpinnings. Not all of these criteria are expected to be met by any one indicator and not all may be relevant to the present application. Table 6.3.3.9.1 provides an overview of a preliminary list of generic criteria for indicators along with an evaluation of their priority for any monitoring programme. Indicator redundancy, i.e. groups of metrics or indicators that co-vary significantly, providing duplicate copies of a single signal rather than reflecting different independent signals, should be avoided.

Table 6.3.3.9.1 Preliminary list of priority for criteria by which to assess the suitability of indicators (ICES, 2012a).

Number	Criterion/Characteristic	Priority
1	Methodological approach to defining the target should be consolidated	Essential
2	Existing reference conditions	Essential
3	Relevant spatial domain	Desirable
4	Environmental fluctuations and climate	Desirable
5	Related to change in specific pressures	Essential
6	Uncertainty	Desirable
7	Relevant to management objectives	Essential
8	Relevant to management measures	Essential
9	Comprehensible	Desirable
10	Established target	Desirable
11	Pragmatic	Desirable
12	Theoretically sound	Essential
13	Early warning	?
14	Target suites	Desirable
15	Compatibility	Desirable
16	State, impact, pressure, and operational targets	Essential
17	Relevance to MSFD ecosystem components	Essential
18	Cross-application	?

ICES anticipates that different indicators will be required for each or some of the five different benthic communities identified for the Dogger Bank due to differences in species composition and response to changes in pressure. Further, more than one indicator will be required for each area, given the three conservation targets. Consideration of the relative importance of the indicators in each area when assessing overall status may be required and will relate back to relative importance of the conservation objectives.

Response to *Question iv) An appropriate, cost effective, joint monitoring programme...*

It is a priority to establish a comprehensive baseline study and this should be informed by previous work on the Dogger Bank. This is a prerequisite to designing a monitoring programme to measure progress or otherwise towards the conservation objectives. Suitable control areas, outside of the closed area where normal fishing operations are conducted, should be selected for each of the five benthic communities. The spatial and temporal variance and patchiness of the species or ecological elements to be monitored needs to be understood and addressed in the design of a monitoring programme. Standard power curve analyses can be used to determine the precision needed to detect a difference of a given size (say a 25% increase in abundance of a population) with a specified (usually high) probability. To determine the sampling effort needed to achieve the necessary level of precision, it is then necessary to know how variance in the population estimate increases with sampling effort. For the overall objectives of improved environmental status for the communities on the sand banks, improvements in the more common species will contribute most to healthy functioning of ecosystem processes. Such improvements are usually best measured with a representative, spatially stratified random survey design. However, for objectives related to specifically improving the status of rarer species, particularly ones with specialized ecological requirements, targeted sampling will be more efficient. For rarer species, having accurate estimates of likelihood of encounter and total range of occurrence are properties that are possible to quantify with sufficient precision to allow evaluation of trends over time.

ICES highly recommends that a common and coordinated monitoring programme for the entire Dogger Bank should be established and used by each country. Use of established protocols for related subjects (e.g. wind farm EIA (environmental impact assessment), or oil-spill monitoring) should be considered. Standards such as EN 16260:2012 (CEN, 2012) on visual seabed surveys and ISO 16665:2005 (ISO, 2005) on sampling marine soft-bottom macrofauna could inform this process.

The monitoring requirements of the Marine Strategy Framework Directive and developments within OSPAR will also provide an opportunity for coordination. Currently, the ridged structure and focus on fish stock assessment of Data Collection Framework (DCF) surveys means that they could provide only limited data and information for the likely

monitoring requirements on the Dogger Bank. With minimal adjustments, DCF surveys could provide useful data on commercial species such as plaice, sandeel, and possibly other elements. Current developments aiming at closer cooperation between the DCF and environmental monitoring will bring efficiencies in the coming years.

It will be appropriate to target monitoring effort in areas that are judged to be controversial and/or sensitive, for example, areas where moderate to high fishing effort has occurred prior to the closure, across the interface between open and closed areas and the transition between the different benthic communities. Cooperation with the fishing industry could bring efficiencies and provide cost-effective access to the sites.

A variety of sampling and data collection methods are available, such as high-frequency eccograms combined with sidescan sonar, underwater video, bait-camera systems, grab sampling and dredge sampling, and it is likely that a combination of these and other methods will be required.

Response to *Question v) The likely impacts of seines including fly-shooting and the likely additional benefits from the prohibition of these gears...*

Seine gear is moved while in contact with the bottom and can theoretically impact the biota and disturb the seabed. Little is known on the impacts of the various types of seine fishing gear on the benthic communities. Impacts will depend on the target species and associated substrate type, but effects on plain sand bottom are likely to be low. Given the lack of information on the impact of seining in its different forms a risk analysis such as Ecological Risk Assessment for the Effects of Fishing (ERAEF) (WGECO; ICES, 2012a) is a useful first step. This would provide an extended gear matrix to supplement the one carried out by FIMPAS. For example, comparisons with beam trawls in a relative framework, taking into account the efficiency of the fishery, the swept area, and the costs associated with gear change could be evaluated. Such a study could provide a semi-quantitative approach to evaluating the pressures on the benthic communities of different types of seine gear such as fly-shooters (Scottish seiners) and anchor seiners. However, based on current knowledge ICES considers that the effect of seine fishing gear on the Dogger Bank sandbank habitat may not significantly impede the achievement of the conservation objectives.

Response to *Question vi) The effort displacement within the SAC...*

The data appears to be available to quantify effort displacement magnitudes and costs, not only for areas within the Dogger Bank but anywhere in the southern North Sea, and ICES advises that these quantifications be undertaken.

The sandeel fishery is a specific localized activity primarily at the edges of the Dogger Bank. Closures are not proposed for the most important sandeel fishing areas. The proposal to close areas in the central part of the Dogger Bank will affect the less important sandeel fisheries thus having only a minor displacement effect on the sandeel fishing effort.

There is an important beam trawl fishery for flatfishes on the Dogger Bank. The proposed closure of areas where this beam trawl fisheries occurs will result in some displacement of this fishing effort.

In the current DBSG proposal there is no restriction on the use of seine fishing gear. The shallower areas proposed for closure to beam and otter trawling are important seine fishing grounds. ICES advises that if these shallower areas were to be closed to seine fishing it will result in substantial displacement of this fishing effort while achieving minimal reduction of the pressure on these areas.

Response to *Question vii) Any shortcomings in the proposed measures*

In the documentation supplied to ICES with the request it is stated that the fisheries management proposal for the Dogger Bank SAC shall be designed so that overall, approximately the same proportion of each benthic communities' area is protected. Given that the areas of the different communities vary widely, closing equal proportions of these areas assumes that ecological processes are scale independent. There does not seem to be scientific evidence in the supporting material for this assumption. Some minimum size may be essential for each type of benthic community, but it may not be the same for each. Furthermore, the proposal does not seem to have been developed with a focus on adaptive management relevant to both meeting conservation objectives and climate change. A comparison of incremental improvement after a full six-year monitoring and assessment could improve understanding of the implication of scale and provide better scientific guidance for the appropriate location and size of the areas needed to achieve conservation objectives.

Response to *Question viii) Summarise the difference to the improvements to the conservation status between the DBSG, the NGO and the fishing sector proposals...*

It is not possible to predict how, or over what time period, the Dogger Bank will respond to reduced pressures from fisheries or for that matter respond to wider environmental pressures such as climate change or acidification. In terms of

size of the areas to be closed, there is no "best percent". The nature of the ecosystems, the nature of the potential threats, and the nature of the management outside the protected areas combine to make the optimum area to protect a case-specific consideration. From an ecological perspective there is no need to protect all of any benthic community type or sedentary species range; as long as the areas that are protected are large enough to sustain viable populations, the current proposal seems to achieve that. As mentioned above there are some mobile fish populations whose effective breeding populations extend well beyond the Dogger Bank and no measures applied solely to the Dogger Bank will allow recovery to the historical age and size compositions of these populations, as long as fishing, even at sustainable levels, is allowed outside the Dogger Bank. Based on information provided with the request, the areas proposed by the industry may not be sufficient and the areas proposed by the NGOs may be excessive. The current proposal for fisheries measures, if implemented, will provide an opportunity to monitor and assess the response of the ecosystem to the reduced pressure from bottom-contacting fishing gear. This information is needed before it will be possible to carry out a scientific comparative analysis.

Response to *Question ix) Any other information on fishing impacts...*

Fisheries management measures will directly affect at least two different trophic levels; however, food chain effects are not evaluated with regard to achieving favourable conservation status. For mobile species (most fishes) closures will only have effects proportional to the population distribution. For more sessile species (sandeels to some degree and many invertebrates to a high degree) populations may be able to build up biomasses that may have spill-over effects which could have positive influences on commercial species yield outside the closed areas. This could result in increased fishing efforts along the open/closed boundaries and could have an adverse effect on local recruitment. Increased biomass may also attract commercial fish which prey on benthic communities and thereby reduce availability to the fishery in the open area.

Developments in low impact gear should continue and when proven not to have adverse affects on the benthic communities of the closed areas their use in these areas should be permitted. This may require experimental trials within a closed area but should only be permitted at the very late stages of a research programme and only to verify results indicating no likely impacts on the conservation objectives. ICES advises that a decision-making process should be established to consider such access.

In addition, economic mitigation measures within the closed areas that consider the spatial and temporal distribution of fishing should be considered. There may be times when, due to seasonal or tidal influences, gear/species interaction is reduced to an extent that the use of banned gear would not compromise the attainment of the conservation objectives. In these situations, the short-term pulse disturbances of such access could be tolerated. This should be evaluated and, if considered viable, a mechanism established for permitting such short-term access.

Sources

CEN. 2012. Water quality – Visual seabed surveys using remotely operated and/or towed observation gear for collection of environmental data. BS EN 16260:2012.

ICES. 2009. Report of the EMPAS project (Environmentally Sound Fisheries Management in Protected Areas), 2006–2008, an ICES–BfN project. 123 pp.

ICES. 2012a. Report of the Working Group on the Ecosystem Effects of Fishing Activities (WGECO), 11–18 April 2012; Copenhagen, Denmark. ICES CM 2012/ACOM:26. 192 pp.

ICES. 2012b. Material provided to ICES for advice on proposed fisheries measures for the Dogger Bank Special Area of Conservation. Dogger Bank Steering Group, September 2012. ICES CM 2012/ACOM:77.

ISO. 2005. Water quality – Guidelines for quantitative sampling and sample processing of marine soft-bottom macrofauna. ISO 16665:2005.

Annex 1 Extract from the document '*20120904 Dogger Bank Presentation paper final'*, submitted to ICES with the request.

Gears with bottom-contact and which are expected to have a significant effect on the habitats are banned in the closed zone. This includes beam trawls and otter board trawls and dredges. However, other bottom contacting gears are used in the Dogger Bank site which may present a risk to the achievement of the conservation objectives, i.e. seines including flyshooting as indicated by the ICES 2008 EMPAS advice. There was no consensus whether the prohibition of other bottom contacting gears, in particular seines including flyshooting, should apply to the proposed closed areas. In so far as seines including flyshooting are concerned, the DBSG considered that there was insufficient information on the adverse effects of these gears on the conservation status of the whole of the SAC. However, the DBSG recognised that the management of "all mobile bottom contacting gear" had been proposed as a part of the EMPAS advice (advice relating to the conservation of the German sector), when this was assessed in isolation in 2008. Therefore DBSG has asked ICES to advise on the potential impacts of these gears on the habitat and on additional beneficial effects that may accrue if these gears were prohibited from the overall proposed closed area;

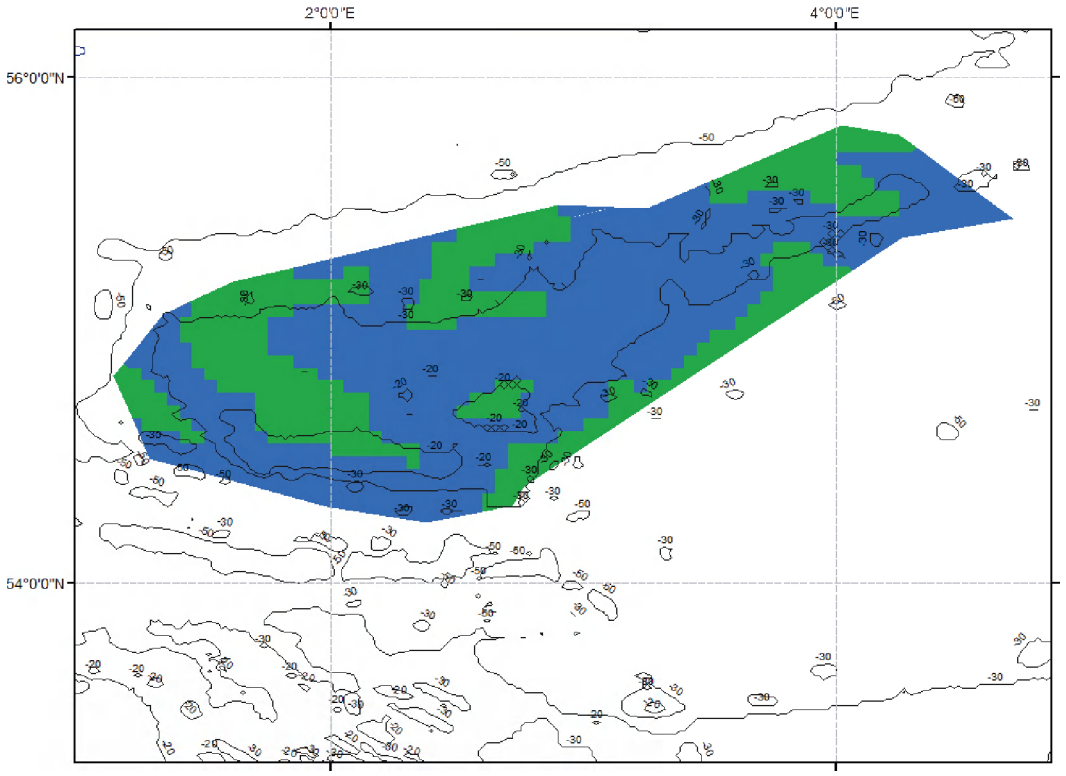


Figure 6.3.3.9.1 Proposal for closed areas including depth contours. Green: areas closed to beam and otter board trawls and dredges.

Annex 2 Extract from document '*20120904 Conservation objectives final*', submitted to ICES with the request.

- *The conservation status is currently assessed as unfavourable, due mainly to the quality of the habitat and considerations of disturbances of the biological community which result from impacts to sediments;*
- *This assessment mentions significant habitat disturbance as a result of (bottom-contacting) fishing, and that fishing has distorted the species composition – towards smaller and short-lived species;*
- *Therefore the Member States want to decrease human pressure from the habitat as a result of bottom-contacting fishing gear, with the aim to: improve the quality of the habitat (NL); restore the habitat to favourable condition (UK); conservation and restoration of a favourable conservation status of the habitattype (1110) including its characteristic and threatened communities and species (GER);*
- *In doing so, they want to establish a more natural situation in which*
    - *physical structure (the shape, form and composition of the habitat and its substrata),*
    - *diversity (the number of different biological communities or number of species within a given community),*
    - *community structure (e.g. age classes, sex ratios, distribution of species, abundance, biomass, reproductive capacity, recruitment, range and mobility), and*
    - *typical species are improved/are restored/are recovered;*

ECOREGION North Sea
SUBJECT EU–Norway request on North Sea cod discard rates

Advice summary

The fishing effort needed to catch the 2013 single-species fishing opportunities for cod is considerably smaller than for other demersal stocks caught in the same fisheries. Reducing the cod TAC by 20% in 2013 will likely result in increased cod discards, unless effort reductions or equivalent reductions in cod catchability are implemented.

Request

The application of the harvest control rule of the cod multi-annual management plan would result in a 20% decrease in the TAC for North Sea cod in 2013 compared with 2012. This decrease in the TAC would come at a time when the cod stock is slowly increasing. Moreover the TACs of species associated with cod in the mixed fisheries, notably haddock, whiting and saithe, are all expected to be significantly increased in 2013.

In view of this, ICES is requested to advise on whether a reduction of 20% in the cod TAC for 2013 is likely to increase cod discard rates at the expense of achieving the desired reduction in total catches.

Elaboration on the advice

This advice is based on the mixed-fisheries advice for the North Sea (ICES, 2012). The mixed-fisheries model estimates the effort (kW-days) required by individual fleets to fulfil their quota share of species within the 2013 single-species advice (predicted landings), assuming that the catchabilities in 2012 and 2013 for all species do not change from 2011 and that the fleet fishing pattern does not change.

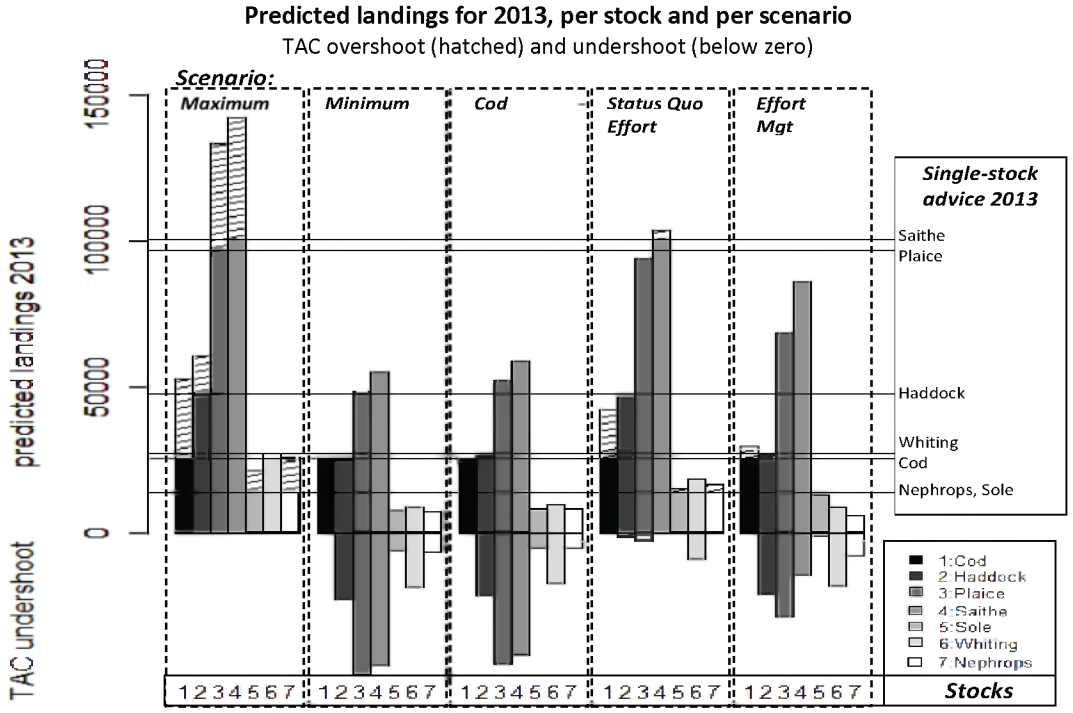


Figure 6.3.3.10.1 North Sea mixed-fisheries projections. Estimates of potential landings (in tonnes) by stock with scenarios running in 2012 and 2013. Horizontal lines correspond to the single-stock advice for 2013. Bars below the value of zero show the scale of undershoot (compared to single-stock advice) in cases where landings are predicted to be lower when applying the scenario. Hatched columns represent landings in overshoot of the single-stock advice.

There is a mismatch in the effort required to catch the various species in the single-species advice (predicted landings). For all fleets, cod requires the least fishing effort of all species indicated in Figure 6.3.3.10.1 to achieve the advised landings. If fleets stop fishing once they reach their cod quota, they will not be able to catch their full fishing opportunities for all species. Under this scenario (Cod scenario in Figure 6.3.3.10.1), a 20% decrease in the cod TAC would not result in increased discards of cod.

Conversely, if fleets continue to catch their full quota share of other species (Maximum scenario) or do not reduce their effort (*Status quo* effort scenario), the predicted cod landings will be considerably higher than their quota share, as shown in the hatched columns. In these situations, a 20% decrease in cod TAC will likely increase the discards of cod. An effort reduction is required in order to reduce the fishing mortality on cod as required by the management plan.

Assuming a one-to-one relationship between effort and fishing mortality, and the strict application of the effort reduction stated in the EC 1342/2008 (−18.2% between 2011 and 2012, and −22.2 % between 2012 and 2013, for the EU TR1 and TR2 fisheries, as well as country-dependent reduction in BT2 effort in 2012 according to the flatfish management plan), would match the 2013 fishing opportunities for cod, but would result in significant underutilization of fishing opportunities for most other demersal stocks (Effort management scenario). Underutilization is even more significant when fisheries stop as soon as cod quotas are fished (Cod scenario).

Current fishing mortality as implied by the cod plan (F_{2013} = 0.27) is broadly in line with the fishing mortalities advised for the other major target fish species caught in mixed fisheries (sole: 0.27, plaice: 0.27, whiting: 0.225, haddock: 0.29, and saithe: 0.26). It is therefore not the fishing mortality (or TAC) that is inappropriate in 2013, but rather the catchability of cod in the North Sea fisheries that is not in line with that for the other stocks. The mixed-fishery advice illustrates clearly that if changes in catchability on cod do not occur, a reduction in TAC alone would not be expected to reduce cod catches and F to the required value. To achieve the required reduction in F, and to ensure that a reduced TAC does not result in increased discarding, implies a need to change cod catchability through aspects such as gear choice, selectivity devices, and changes in the existing temporal or spatial deployment of effort.

The STECF effort report (STECF, 2012) indicates that 90% of cod catches in the North Sea come from three gear categories (TR1, TR2, and GN1). Changes in the fisheries deploying these three gears is the most important thing to consider. It would be helpful having some incentive to reduce catchability for cod, or alternatively disincentives to continuing the current cod catchability. In order to control discards, regimes such as Fully Documented Fisheries (FDF) that monitor catches are preferred, and for these regimes regulation of the fishery through catch quotas could be considered. In contrast, regimes such as 'Conservation Credits' that influence catchability in an unquantified way are less successful in changing catchability (STECF, 2012). It is expected that discarding in FDF vessels could be more easily monitored and controlled than for other vessels in the cod fisheries. If more of the fisheries using these three gears were to be carried out under an FDF regime with catch limits, changes in catchability would be expected with a higher probability.

Basis of the advice

ICES interprets this request as a clarification of the mixed-fisheries advice given earlier (ICES, 2012). Data gathered for the mixed-fisheries short-term projections in the North Sea show that several North Sea fleets catch a mixture of cod, haddock, whiting, and saithe. ICES cannot predict whether or how changes in fisher behaviour can alter the technical interactions between species between 2011 and subsequent years. The mixed-fisheries advice attempts to compare the impact of various scenarios of future effort levels by fleet, assuming the same technical interactions in 2012 and 2013 as those observed in 2011 in terms of catchability by fleet and stock, as well as the same effort distribution by fleet across métiers.

Scenario descriptions as used in the mixed-fisheries advice.

	Scenarios
Max	**'Maximum':** Fishing stops when all stocks considered have been caught up to the ICES single-stock advice. This option causes overfishing of the single-stock advice possibilities of most stocks. For 2013, the least limiting stock would be whiting for fleets representing 96% of the effort in 2011.
Min	**'Minimum':** Fishing stops when the catch for any one of the stocks considered meets the single-stock advice. This option causes underutilization of the single-stock advice possibilities of other stocks. For 2013, the limiting stock would be cod for fleets representing 100% of the effort in 2011.
Cod	**'Cod management plan':** All fleets set their effort corresponding to their cod quota share, regardless of other catches.
Sq_E	**'*Status quo* effort':** The effort is set equal to the effort in the most recently recorded year for which landings and discard data are available.
Ef_Mgt	**'Effort management':** The effort in métiers using gear controlled by the EU effort management regime have their effort adjusted according to this regime.

Sources

ICES. 2012. Mixed fisheries advice North Sea. *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.25.

STECF. 2012. Evaluation of Fishing Effort Regimes in European Waters – Part 2. STECF 12-16/EWG 12-12.

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

Advice for 2013

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)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	?	?	Unknown

SSB (Spawning Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	✗	✗	✗	Reduced reproductive capacity
Management plan (SSB_{MP})	✗	✗	✗	Below limit

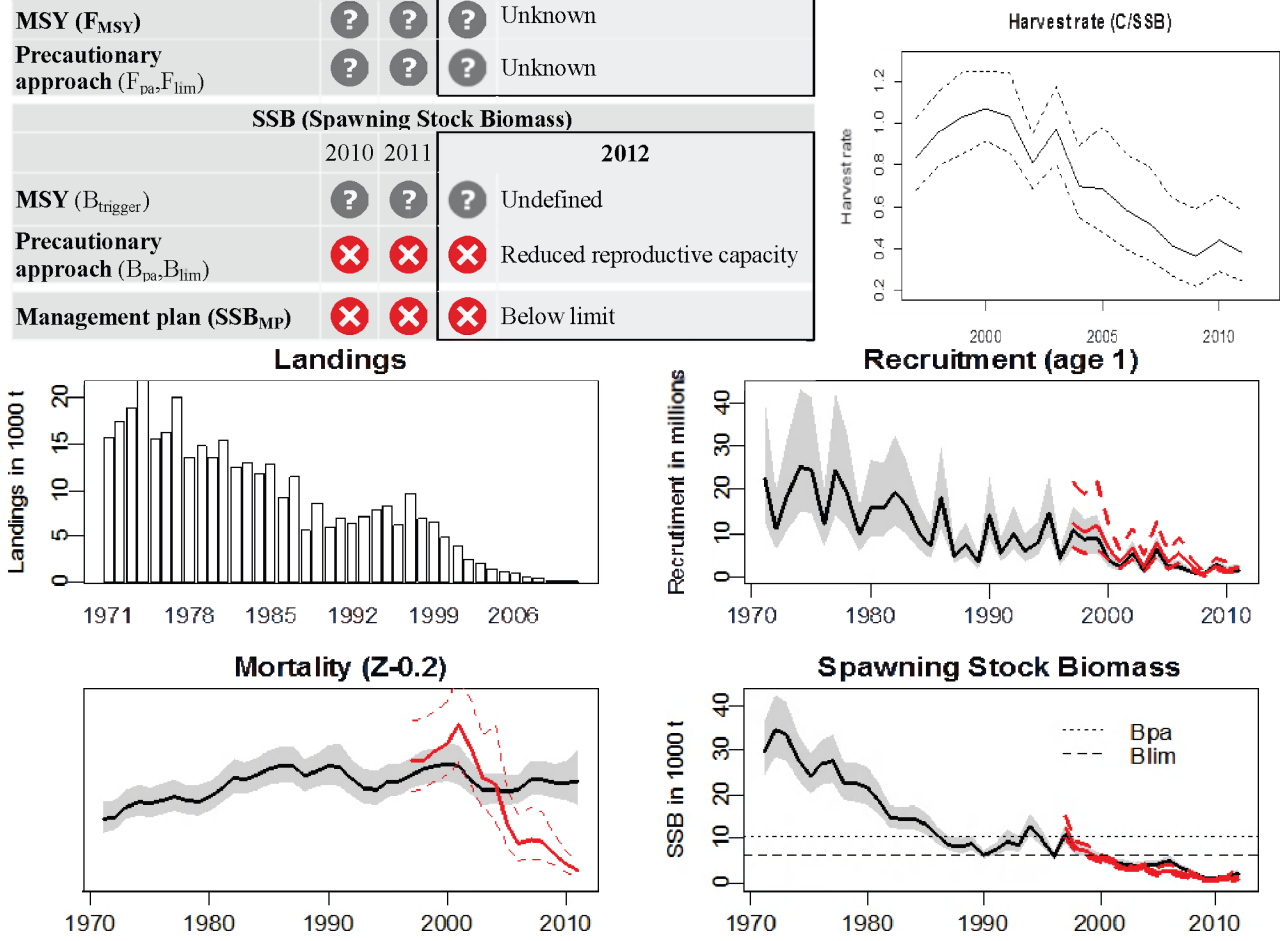


Figure 6.4.1.1 Cod in Division IIIa East (Kattegat). Summary of stock assessment (weights in '000 tonnes) represented by: Black line: reported landings and estimating total removals within model; Red line: reported landings and discards from observer data. Shaded area and dashed lines represent 95% confidence intervals for the two runs, respectively. Top right: Estimated harvest rate (catch divided by SSB) based on reported landings and estimates of discards.

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 unknown due to a pronounced difference between the catch data (landings plus discards estimated from observer data) and the total removals from the stock estimated within the model based on survey data. The harvest rate based on available catch data shows a decline from 2000 to 2009, and a stable level in 2009-2011.

Management plans

A multi-annual plan has been agreed by the EU in 2008 ((EC) No.1342/2008). At present situation, when the cod stock and the landings are very low, the implementation of management plan is focused on fishing effort and cod avoidance measures. 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 of high unaccounted removals as estimated by the present assessment model.

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 into the Kattegat. Return migration to the North Sea / Sound is believed to occur 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 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 caught by trawls and Danish seines. Bycatch of cod is taken in the *Nephrops* and sole fishery. Cod represented less than 1% of the total revenue of the Danish fishery in the Kattegat in 2010 (and less than 1.5% of the revenue from demersal fisheries alone). Discarding of young cod and possibly also high-grading of marketable cod takes place. The use of Swedish sorting grid has increased in recent years and SELTRA trawl has been made mandatory in Danish fisheries in the Kattegat from 2011. However, a total estimate of discards for the entire fleet shows an increase in 2009-2011. The harvest rate (catch/SSB) is estimated stable in 2009-2011.

Catch distribution	Total landings (2011) 145 t; estimated discards (2011) 216 t. Total removals from the stock were estimated at 1521 t (95% confidence intervals 1036-2234 t), which is likely due to a combination of fisheries and biological issues (e.g. migration).

Effects of the fisheries on the ecosystem

The fish community in the Kattegat has changed profoundly over the last 100 years. 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 and the discard estimates based on observer trips do not represent total removals from the stock. 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 discard data indicate a relatively high fishing mortality on young ages (1-2). 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.

Scientific basis

Assessment type	Age based analytical assessment (stochastic state-space model SAM)
Input data	4 bottom trawl survey indices (IBTS-Q1; IBTS-Q3; Havfisken-Q1; Havfisken-Q4)
Discards and by-catch	Discards included in one of the assessment runs
Indicators	Data from joint Swedish-Danish fishermen-scientists survey
Other information	Benchmark done in WKROUND (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 2013

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 2013 shall be reduced by 25 % compared with the fishing mortality rate in 2011, 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 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.

At present situation, where the cod landings are very low compared to the available estimates of discards and estimated unallocated removals from the stock, TAC is not effectively regulating total removals from the stock. The Articles 11 and 13 in the management, which allow Member States to avoid reductions in effort by introducing measures to avoid catching cod (closed areas, selective gears) have resulted in changes in fisheries. Evaluation of effectiveness of these measures for cod recovery and possible improvements is currently ongoing within EU STECF and bilaterally by Sweden and Denmark.

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 of high unaccounted removals as estimated by the present assessment model.

Precautionary considerations

The stock size is considered to be far below B_{lim}, 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 remained very low. Total removals in the last 3 years have been estimated at 1000-1500 t, whereas the fisheries catch (reported landings plus the estimates of discards) is estimated at about 300-400 t. No information is available on the nature of the unallocated removals. Potential sources of fishery-based unallocated removals are unaccounted discarding of young ages and possibly also high-grading of marketable cod. The discard data from observers trips indicates an increase in discards since 2009. The discard data indicates relatively high fishing mortality on young ages (1-2). Furthermore, migration of cod to other areas and unaccounted catches in recreational fisheries may contribute to the discrepancy between the catch data and the estimates of total removals.

Management plan evaluations

At present, the TAC does not control the catch from the stock. Therefore, the implementation of management plan is focused on fishing effort and cod avoidance measures. Evaluation of effectiveness of these measures for cod recovery and possible improvements is currently ongoing within EU STECF and bilaterally by Sweden and Denmark.

Regulations and their effects

Besides TAC regulation, fishing in Kattegat are restricted by effort limitations. The system was first introduced in the first cod recovery plan (EC No. 423/2004). Effort was limited by allowed number of fishing days for individual fishing vessels. In 2009, following the introduction of the new management plan (EC No. 1342/2008) for North Sea (incl. Kattegat) cod a new effort system was introduced. 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. Derogation can however be obtained from the kWdays system if the catches in a certain part of the fleet can be shown to consist of less than 1.5% cod (article 11(2)(b)) or avoid cuts (or part of cuts) if they introduce highly selective gear and cod avoidance plans (article 13).

Fisheries in Kattegat are dominantly operated with trawls and seines with mesh sizes 90-99 mm (TR2) (80% of total effort in 2010). All Danish and German effort in gear category TR2 in 2010 operated under article 13. It is mandatory in Danish fisheries to use a SELTRA trawl with 180 mm panel during the first three quarters of a year. Sweden operate partly under the derogation of article 11 by using a sorting grid (63% of the effort deployed by this country in this gear category in 2010 (STECF, 2011).

In 2009, as a part of the attempts to rebuild of the cod stock in Kattegat, Denmark and Sweden, introduced protected areas on historically important spawning grounds in South East Kattegat. The protected zone consists of three different areas in which the fisheries are either completely forbidden or limited to certain selective gears (Swedish grid and Danish SELTRA 300 trawl) during all or different periods of a year.

Data and methods

Reported landings, discard estimates from observer trips and data from four scientific surveys were available for the assessment of this stock. 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 for selected years, by scaling of catches. The stock estimates for these years consequently rely more on survey information.

The model estimates significant unallocated removals from the stock between 2003 and 2011, which is not explained by discard data alone. At present, the relative proportion of unallocated removals due to fishing and biology driven factors (migration patterns) cannot be specified. Therefore, both runs with estimating total removals within the model and the run relying on available catch data as representing total removal from the stock are presented.

Information from the fishing industry

In December 2008-2011, 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 2003–2011, which cannot be explained by available discard data. 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.

In the assessment using the estimates of discards, fishing mortality shows different trends by age, with relatively high values for young age-groups. The estimate of overall harvest rate (catch/SSB) is showing a decline until 2009 and stable values for 2009-2011. However, similarly to the F estimates, the estimate of the harvest rates relies on the catch data, while discards of cod in the Kattegat are likely underestimated.

Concerning SSB, the estimates are considered imprecise, however both the assessment with discards and with estimating total removals within the model indicate historically lowest SSB in recent years (in the range of 950 and 1700 tonnes in 2011). 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.

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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Svedäng, H., Righton, D. and Jonsson, P. 2007. Migratory behaviour of Atlantic cod *Gadus morhua*: natal homing is the prime stock-separating mechanism. Marine Ecology Progress Series, 345: 1–12..

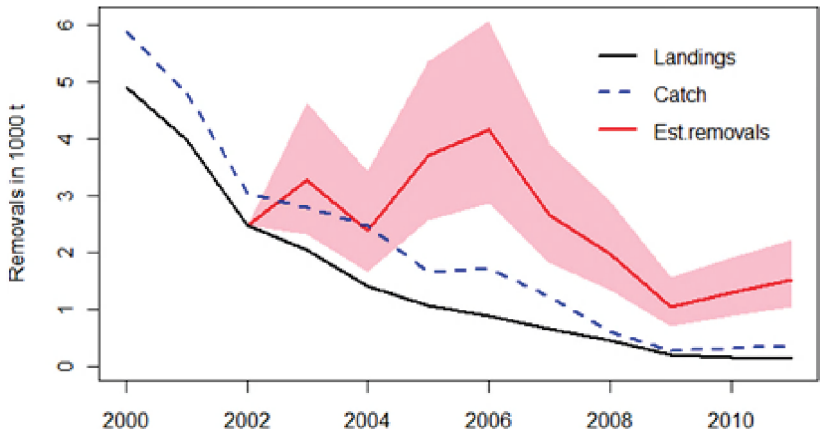


Figure 6.4.1.2 Cod in Division IIIa East (Kattegat). Total removals from the stock estimated by SAM model, compared to reported landings and total catches (landings plus discard data). Shaded area is the 95% confidence interval around the estimated removals.

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	0.145
2012	No directed fisheries, minimise by-catch and discards	0	0.133	
2013	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	11748	3962	22	15732
1972	13451	3957	34	17442
1973	14913	3850	74	18837
1974	17043	4717	120	21880
1975	11749	3642	94	15485
1976	12986	3242	47	16275
1977	16668	3400	51	20119
1978	10293	2893	204	13390
1979	11045	3763	22	14830
1980	9265	4206	38	13509
1981	10693	4380	284	15337
1982	9320	3087	58	12465
1983	9149	3625	54	12828
1984	7590	4091	205	11886
1985	9052	3640	14	12706
1986	6930	2054	112	9096
1987	9396	2006	89	11491
1988	4054	1359	114	5527
1989	7056	1483	51	8590
1990	4715	1186	35	5936
1991	4664	2006	104	6834
1992	3406	2771	94	6271
1993	4464	2549	157	7170
1994	3968	2836	98	7802 [2]
1995	3789	2704	71	8164 [3]
1996	4028	2334	64	6126 [4]
1997	6099	3303	58	9460 [5]
1998	4207	2509	38	6835
1999	4029	2540	39	6608
2000	3285	1568	45	4897
2001	2752	1191	16	3960
2002	1726	744	3	2470
2003	1441	603 [7]	1	2045
2004	827	575	1	1403
2005	608	336	10	1070 [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
2011	102	42	1.4	145

[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 6.4.1.3 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). Total removals (shown as a mean value and the 95% confidence intervals) from 2003 onwards is estimated from SAM model based on survey information, and represent the removals from the stock in excess to the reported landings and assumed natural mortality.

Year	Landings	Discards	Catch	Estimated total removals
2000	4897	992	5889	
2001	3960	823	4783	
2002	2470	577	3047	
2003	2045	750	2795	3272 (2311-4622)
2004	1403	1063	2466	2385 (1656-3437)
2005	1070	575	1645	3692 (2557-5350)
2006	876	849	1725	4161 (2856-6062)
2007	645	577	1222	2664 (1825-3896)
2008	449	165	614	1968 (1334-2898)
2009	197	77	274	1050 (702-1573)
2010	155	167	322	1287 (874-1895)
2011	145	216	361	1521 (1037-2234)

Annex 5.4.1 – management plan

The European Commission has enacted a Council Regulation ((EC) No. 1342/2008) which establishes measures for the recovery and long term management of cod stocks. The stated objective of the plan is to ensure the sustainable exploitation of the cod stocks on the basis of maximum sustainable yield while maintaining a fishing mortality of 0.4. Articles 7 – 9, describing aspects of the plan relevant for Kattegat cod, are reproduced below:

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.

2. The TAC shall, based on the advice of STECF, satisfy all of the following conditions: (a) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 25 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year; (b) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the precautionary spawning biomass level set out in Article 6 and above or equal to the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 15 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year; and (c) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be above or equal to the precautionary spawning biomass level set out in Article 6, the fishing mortality rate shall be reduced by 10 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year.

3. If the application of paragraph 2(b) and (c) would, based on the advice of STECF, result in a fishing mortality rate lower than the fishing mortality rate specified in Article 5(2), the Council shall set the TAC at a level resulting in a fishing mortality rate as specified in that Article.

4. When giving its advice in accordance with paragraphs 2 and 3, STECF shall assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year.

5. Notwithstanding paragraph 2(a), (b) and (c) and paragraph 3, the Council shall not set the TAC at a level that is more than 20 % below or above the TAC established in the previous year.

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.

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

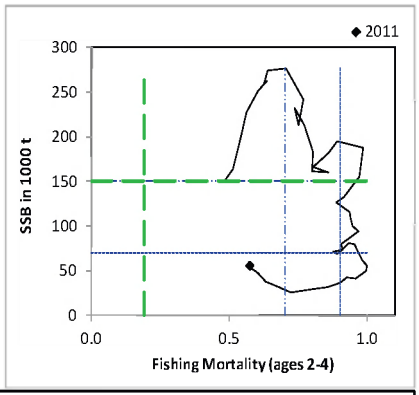
Advice for 2013

ICES advises on the basis of the EU–Norway management plan that landings in 2013 should be no more than 25 441 t.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✗	✗	✗	Above target

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	✗	✗	✗	Reduced reproductive capacity
Management plan (SSB_{MP})	✗	✗	✗	Below trigger



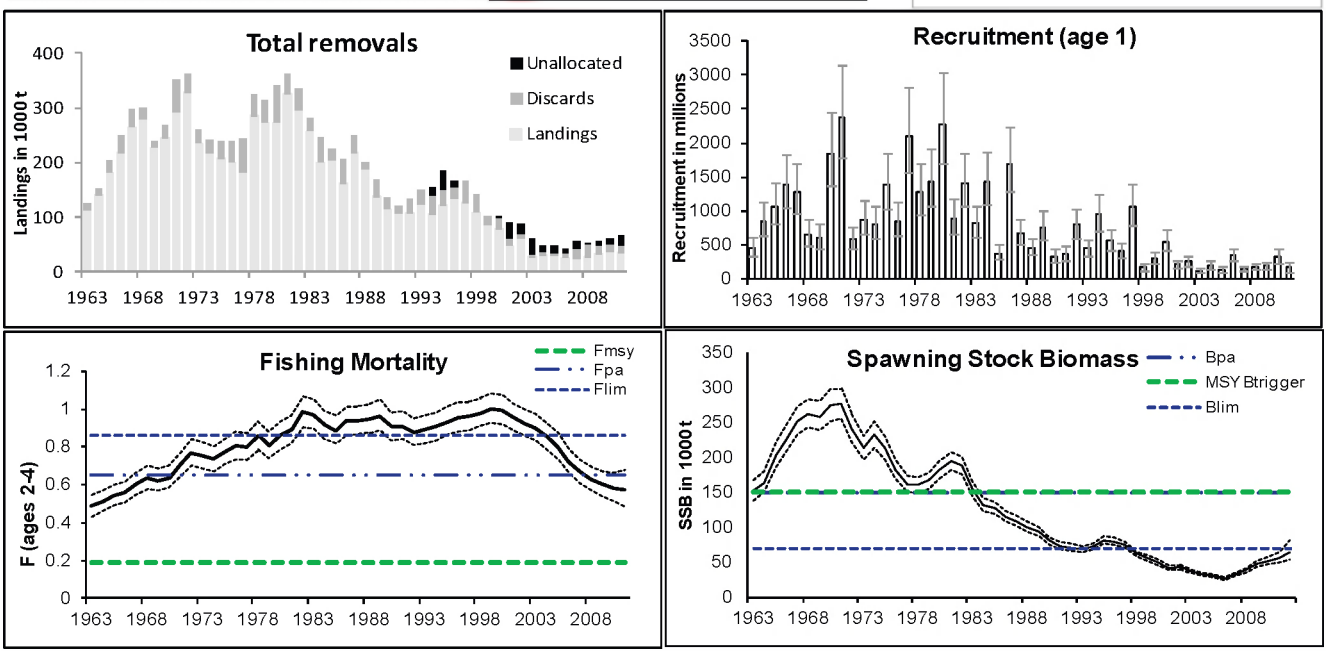


Figure 6.4.2.1 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Summary of stock assessment with point-wise 95% confidence intervals, catch estimated, and adjusted for unallocated removals (from 1993). Weights in tonnes.

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 just below B_{lim}. Fishing mortality declined from 2000 and is now below F_{pa}, but is estimated to be well above F_{MSY}. Recruitment since 2000 has been poor. The proportion of discards is still high relative to the historical period.

Management plans

The EU–Norway agreement management plan was updated in December 2008 (Annex 6.4.2), and will be re-considered during 2012. The EU has adopted a long-term plan for this stock with the same aims (Council Regulation (EC) 1342/2008). ICES evaluated the plans in 2009 and concluded that they are both in accordance with the precautionary approach if implemented and enforced adequately.

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 depleted areas in the southern North Sea.

Environmental influence on the stock

Recent recruitments have been low, possibly influenced by changes in the availability of food resources for cod larvae and 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. Harbour porpoises also take a substantial amount of cod up to age 3.

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 a mixed fisheries catching haddock, whiting, *Nephrops*, plaice, and sole. Cod discards relative to catch have declined from the highest on record in 2008 to a just above the historical average in 2011 (from 50% to 25%, weight of cod discarded from the total estimated cod catch).

Catch distribution	ICES estimates total removals (2011) at around 67 kt, with 35 kt estimated landings (59% demersal trawls and seines >100 mm, 16% gillnets, 10% *Nephrops* trawls 70–99 mm, and 6% beam trawls) and 11.7 kt estimated discards. Unallocated removals are estimated at around 43% (between 16% and 77%) of the catch in 2011.

Effects of the fisheries on the ecosystem

The 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 overall reporting (in particular through fully documented fisheries) of catch data provided to ICES has improved in 2012. The main sources of uncertainty are the estimation of unallocated removals and the assumption of fishing mortality in 2012 in the advice forecast.

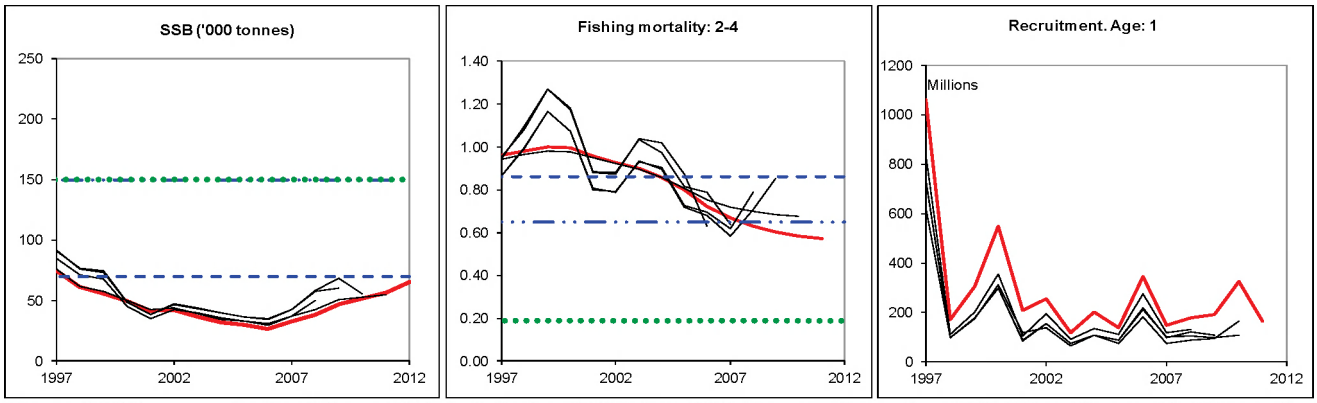


Figure 6.4.2.2 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	A state–space age-structured assessment model with estimates of unaccounted removals (SAM).
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

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Reference points

	Type	*Value*	*Technical basis*
Management Plan	SSB_{MP}	150 000 t	$= B_{pa}$
	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 2013

Two forecast tables are presented: Table A based on the management plan assumptions on reductions in F, and table B on the assumption of F reduced according to the observed trends as assumed by ICES.

Outlook Table A
Basis: Management plan assumption mean F (2012) = mean F (2011) × 0.82 = 0.47; Recruitment (2012) re-sampled 1998–2011 = 200 million; SSB (2013) = 78.3; landings (2012) = 40.3; Discards (2012) = 10.3; Unallocated removals = 13.6.

Rationale	**Landings**[1] **(2013)**	**Basis**	**F_{total} (2013)**	**F_{land} (2013)**	**F_{disc} (2013)**	**F_{unal}**[2] **(2013)**	**Disc (2013)**	**Unal**[2] **(2013)**	**SSB (2014)**	**%SSB**[3] **Change**	**%TAC**[4] **Change**
Management Plan	25.441	TAC constraint	0.26	0.15	0.06	0.05	6.5	8.6	107	+37%	−20%

Outlook Table B

Basis: F trend assumption F (2012) based on trend over 2006–2010 = 0.5; Recruitment (2012) re-sampled 1998–2011 = 200 million; SSB (2013) = 75.7; HC landings (2012) = 42.6; Discards (2012) = 10.9; Unallocated removals = 14.4.

Rationale	**Landings**[1] **(2013)**	**Basis**	**F_{total} (2013)**	**F_{land} (2013)**	**F_{disc} (2013)**	**F_{unal}**[2] **(2013)**	**Disc (2013)**	**Unal**[2] **(2013)**	**SSB (2014)**	**%SSB**[3] **Change**	**%TAC**[4] **Change**
Management Plan	25.441	TAC constraint	0.27	0.16	0.06	0.06	6.6	8.6	103	+36%	-20%
MSY framework	10	F_{MSY}* $SSB_{2013}/B_{trigger}$	0.10	0.06	0.02	0.02	2.5	3.4	123	+63%	-69%
MSY transition	28	Transition rule	0.29	0.17	0.06	0.06	7.2	9.4	101	+33%	-13%
Zero catch	0	F=0	0.00	0.00	0.00	0.00	0.0	0.0	136	+80%	-100%
Other options	19	F_{MSY}	0.19	0.11	0.04	0.04	4.9	6.4	112	+47%	-41%
	25.441	TAC_{2012}–20%	0.27	0.16	0.06	0.06	6.6	8.6	103	+36%	-20%
	38.161	TAC_{2012}+20%	0.43	0.25	0.09	0.09	10.2	13.0	87	+15%	+20%
	43	F_{2012}	0.50	0.29	0.10	0.11	11.7	14.8	81	+7%	+36%
	43	Landings 2012	0.49	0.28	0.10	0.10	11.5	14.6	82	+8%	+34%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012b)											
Maximum	49	A	0.77	NA	NA	NA	NA	NA	50	-34 %	+55 %
Minimum	25	B	0.25	NA	NA	NA	NA	NA	114	51 %	-20 %
Cod MP	25	C	0.29	NA	NA	NA	NA	NA	95	+25 %	-20 %
SQ effort	42	D	0.55	NA	NA	NA	NA	NA	68	-10%	+33 %
Effort Mgt	30	E	0.32	NA	NA	NA	NA	NA	96	+26 %	-6 %

Weights in thousand 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 2014 relative to SSB 2013.

[4] Landings 2013 (not including unallocated removals) relative to TAC 2012.

Mixed fisheries assumptions:

A. Maximum scenario: Fleets stop fishing when last quota exhausted.
B. Minimum scenario: Fleets stop fishing when first quota exhausted.
C. Cod management plan scenario: Fleets stop fishing when cod quota exhausted.
D. *Status quo (*SQ) effort scenario: Effort in 2012 and 2013 as in 2011.
E. Effort management scenario: Effort reductions according to cod and flatfish management plans.

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). This management plan will be re-considered during 2012.

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 long-term phase of the plan is reached, for which the target F is 0.4 if SSB is above B_{pa}. Following the management plan implies a reduction in effort ceilings of 18.2% in 2012 and 22.2% in 2013 compared to the preceding year.

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 to achieve an F in 2013 equal to 35% of F_{2008}. This would lead to a TAC reduction of more than 20%. The management plans limit annual TAC variations to 20%. According to these rules, landings should be no more than 25 441 t in total for Subarea IV and Divisions IIIa West and VIId in 2013 (Outlook Table A).

MSY approach

While ICES considers that a reduction in F took place, the intermediate year F assumption from the management plan is considered to be over-optimistic (Kraak *et al.*, 2012). An alternative assumption for the F in 2012 is made based on the continuation of the F trend from 2006 to 2010 (Outlook Table B). Following the ICES MSY framework requires fishing mortality to be reduced to 0.10 (lower than F_{MSY} because SSB 2013 < MSY $B_{trigger}$), resulting in landings of less than 10 000 t in 2012. This is expected to lead to an SSB of 123 000 t in 2014.

To follow the transition scheme towards the ICES MSY framework the fishing mortality must be reduced to (0.4*0.58) + (0.6*0.10) = 0.29, which is lower than F_{pa}. This results in landings of less than 27 600 t in 2013, which is expected to lead to an SSB of 101 000 t in 2014.

Precautionary approach

Even a zero catch in 2013 is not expected to result in SSB reaching B_{pa} in 2014.

Mixed fisheries

In 2012, ICES offers mixed-fisheries advice for the first time (ICES, 2012c). In contrast to single-species advice there is no single recommendation for mixed fisheries, but rather a range of plausible scenarios, assuming fishing patterns and catchability in 2012 and 2013 are unchanged from those in 2011. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the TACs corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the limiting species for the North Sea demersal fisheries in 2013. The 'minimum' and 'cod' scenarios of the mixed-fisheries analyses are both consistent with the single-species advice for cod.

Additional considerations

Data revision

Estimates of natural mortality, derived from multi-species analyses, have been updated to account for improved knowledge of predation on cod by other species (mainly seals, harbour porpoises, and grey gurnards); this update occurred in 2012 with the 2011 key run of the multispecies model (ICES, 2011d).

Uncertainty in the assessment

There is a discrepancy between the information coming from commercial catch and the scientific survey used for tuning the assessment, resulting in the estimation of unallocated mortality and catches.

The IBTS Q3 survey has not been included in the assessment since 2011 because of the conflicting trends between the IBTS Q1 and Q3 indices, possibly resulting from changes in the catchability/availability of cod in Q3 related to recent changes in fish distribution. The IBTS Q3 was considered in the assessment again this year (in addition to the Q1 survey), but was not used because of unresolved issues.

Recruitment estimates have been revised both downwards in 2011 (with the change in assessment model), and now upwards again (with the update of the natural mortality estimates by predation from multi-species work; ICES, 2011d). These revisions may influence the stock–recruitment relationship and may therefore affect the estimates of reference points.

The main source of uncertainty for the advice forecast is the assumption of fishing mortality in 2012. Rather than assuming a *status quo* F in 2012, which would imply a TAC overshoot of 48%, the projections assume that the effort reductions in the management plan have resulted in a 18% decrease in F between 2011 and 2012 (A) or a continuation of the F trend observed over 2006–2010, resulting in a 12% decrease in F between 2011 and 2012 (B).

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 although F is now below F_{pa}, it is still largely above any management target. The objective of the EU management plan to reduce fishing mortality by 45% in 2011 compared to 2008 has not been achieved. The decrease in F from 2008 to 2011 is estimated to be around 9% (Table 6.4.2.3a).

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 species including 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. For mixed-fishery results relevant to cod see 'Mixed fisheries' above.

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 2005–2011 fluctuated between 40% and 62% 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.

The overall quality of catch data provided to ICES has improved in 2012. International landings and discard rate estimates for 2011 were provided and raised according to the Data Collection Framework (DCF) métier categories. In addition the expansion of the catch quota and closed-circuit TV (CCTV) shemes (24% of landings in 2011) has likely improved the quality of catch reporting.

Management plan evaluations

ICES has evaluated the EC management plan (EC 1342/2008) and the EU–Norway agreed long-term plan in March 2009 (Annex 6.4.2) and concluded that these management plans are in accordance with the precautionary approach only if implemented and enforced (ICES, 2011a). A joint ICES–STECF group met during 2011 to conduct a historical evaluation of the effectiveness of these plans (ICES, 2011c; Kraak *et al.*, 2012). The group concluded that although there has been a gradual reduction in F and discards in recent years, the plans for North Sea cod have not controlled F as envisaged, and following the current regime is unlikely to deliver F_{MSY} by 2015.

Regulations and their effects

The North Sea cod benchmark workshop (ICES, 2011b) 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 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.

Overall nominal effort (kW-days) by European demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced (−20% between 2003 and 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 (−12%, −39%, and −35%, respectively, between 2004 and 2011) (ICES, 2012b). Nominal effort reported by Norway has increased in 2011 due to the generalization of electronic logbooks.

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 24% in 2011. In 2010 there were 185 closures, and from July 2010 the area of each closure increased (from 50 square nautical miles to 225 square nautical miles).

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.

Changes in fishing technology and fishing patterns

The expansion of the closed-circuit TV (CCTV) and fully documented fisheries (FDF) programmes in 2010–2012 in Scotland, Denmark, and England is expected to have contributed to the reduction of cod mortality. Under this scheme, UK vessels are not permitted to discard any cod, while Danish vessels are still permitted to discard undersized cod. For both nations, all cod caught are counted against the quota.

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 there do appear to be long-term differences in recruitment trends. The presence of subpopulations largely inhabiting different regions of the North Sea will mean that there is the potential for regional differences in mortality, because cod from the Northern deep-water subpopulations would not be expected to re-colonize areas depleted in the southern North Sea (ICES, 2011b). The contracted range of the North Sea cod stock can be linked to reduced abundance as well as climate factors.

The distribution of 0-group cod (recruits) over the last 10–15 years has shifted towards the eastern part of the North Sea region (i.e. the Skagerrak and Kattegat). This means that the abundance of recruits is stable and shows no trends in the eastern part, whereas in the North Sea, a pronounced decline is clearly discernible. This change in distribution of cod recruits is likely to reflect changes (erosion) of the stock structure in the North Sea, so that the only productive units left in the North Sea are those which tend to use the eastern North Sea region as a nursery area (Knutsen *et al.*, 2004; Svedäng and Svenson, 2006; Svedäng *et al.*, 2007).

Data and methods

The assessment uses combined landings and discards, calibrated with one survey index (the International Bottom Trawl Quarter 1 Survey, IBTS Q1). 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; Figure 6.4.2.6) and the IBTS survey data has shown in previous years that 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, with a leveling off in these southern areas in 2011.

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. This can possibly be 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.

There is potential for combining a number of collaborative scientific–fishing industry surveys covering parts of the North Sea (e.g. the Danish REX, UK northeast coast cod, and UK whitefish surveys) into an index of stock abundance that could contribute to an assessment, and compilation of such data should be encouraged.

Comparison with previous assessment and advice

The basis for the assessment has not changed from last year. The only change from last year's assessment has been an update of the multi-species derived natural mortality estimates; this has not changed the perception of SSB and F trends, but only of overall recruitment levels. Compared to the assessment in 2011, SSB_{2011} is estimated at around the same level and F_{2010} is estimated to be 14% lower.

As last year, the advice is based on the EC management plan.

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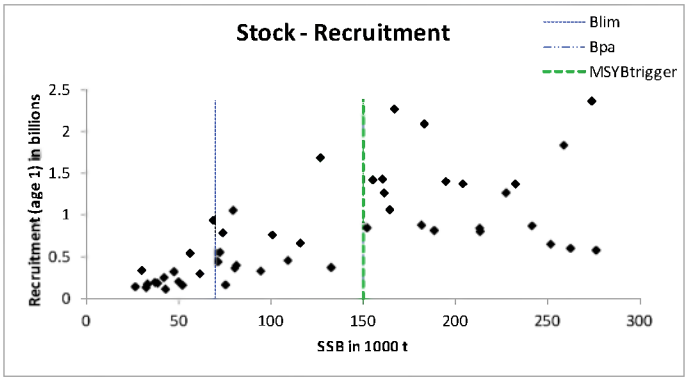


Figure 6.4.2.3 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Stock–recruitment plot.

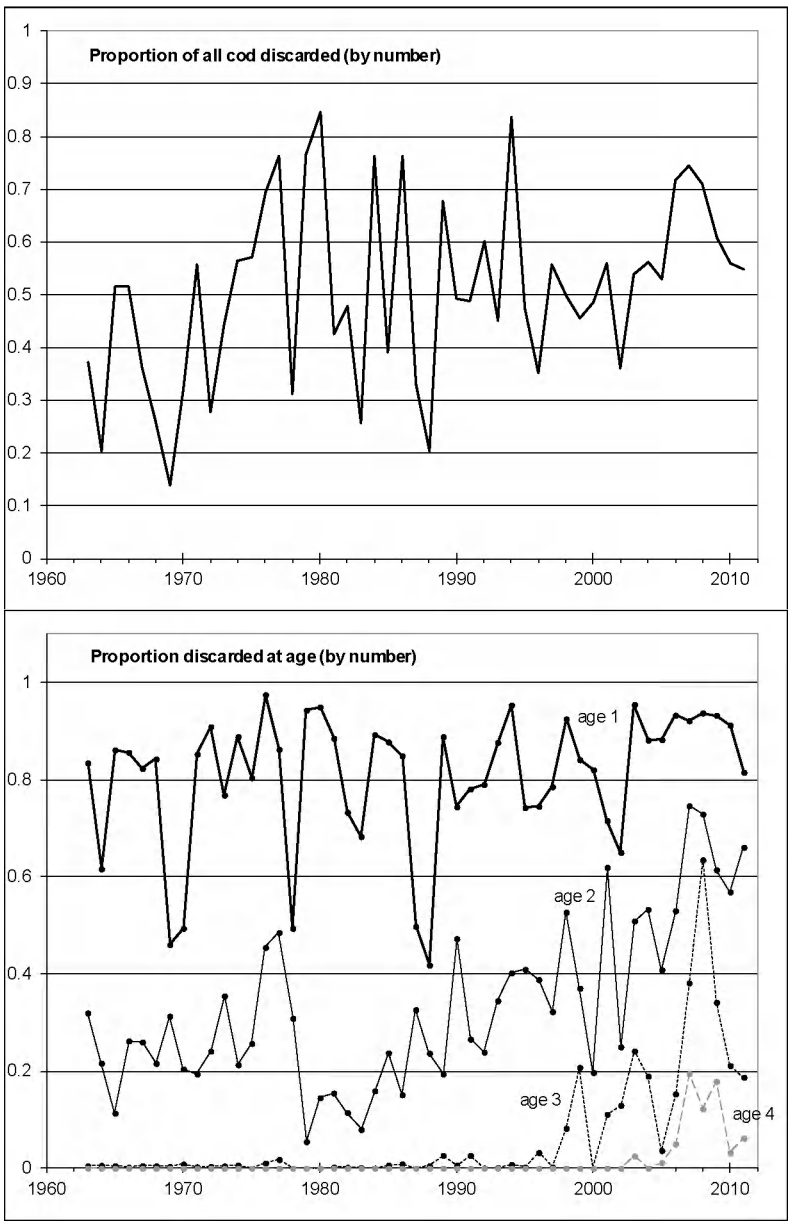


Figure 6.4.2.4 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Proportion of total numbers caught that are discarded in total and at age. In 2011, 82% of 1-year-old, 66% of 2-year-old, 19% of 3-year-old, and 6% of 4-year-old cod were discarded.

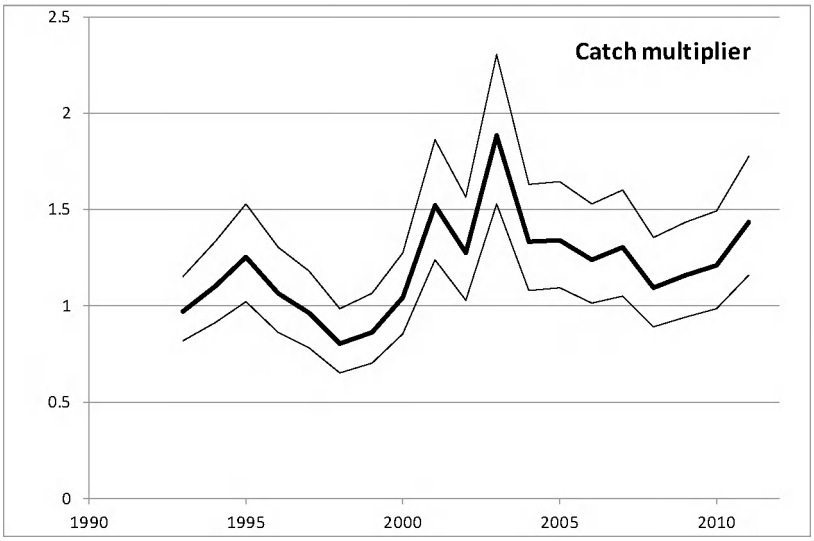


Figure 6.4.2.5 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak). Estimates of factor for unallocated removals (catch multiplier).

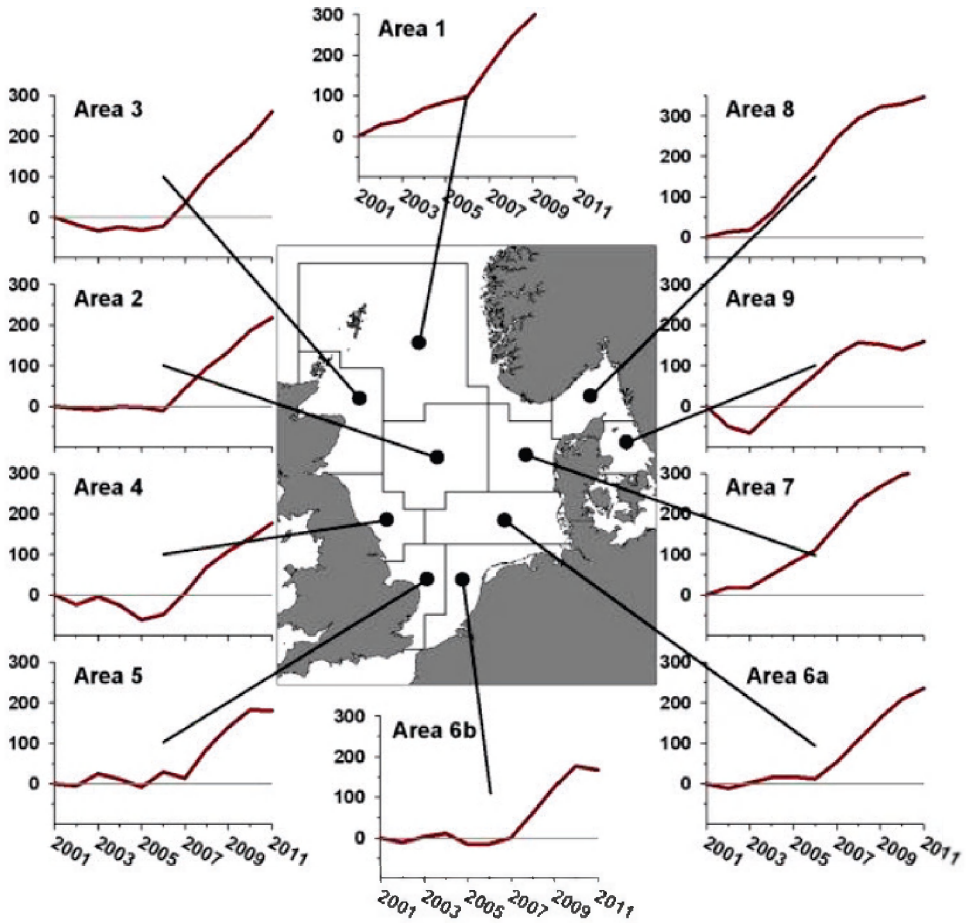


Figure 6.4.2.6 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel),and IIIa (Skagerrak). Results of the North Sea Commission fishers' survey perceptions of abundance by area, 2011.

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	25.9
2004	Zero catch	0	27.3	23.4	23.6
2005	Zero catch	0	27.3	23.9	23.9
2006	Zero catch	0	23.2	22.2	22.1
2007	Zero catch	0	20.0	19.7	19.7
2008	Exploitation boundaries in relation to precautionary limits. Total removals < 22 000 t	< 22	22.2	22.2	22.2
2009	Zero catch	0	28.8	27.4	25.6
2010	Management plan F (65% of F_{2008})	< 40.3 [1)]	33.6	31.7	31.3
2011	See scenarios	-	26.8	19.2	27.7
2012	Management plan F (45% of F_{2008})	< 31.8 [1)]	26.5		
2013	Management plan (TAC – 20%)	< 25.441 [1)]			

Weights in thousand tonnes.
[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	7.1	7.5
2003	Closure	0	3.9	4.5	3.8
2004	Zero catch	0	3.9	4.4	3.8
2005	Zero catch	0	3.9	4.3	3.8
2006	Zero catch	0	3.3	3.9	3.4
2007	Zero catch	0	2.9	3.7	3.0
2008	Exploitation boundaries in relation to precautionary limits. Total removals less than 22 000 t	< 22	3.2	3.8	3.3
2009	Zero catch	0	4.1	4.0	3.9
2010	Management plan F (65% of F2008)	< 40.3[2)]	4.8	4.3	4.1
2011	See scenarios	-	3.8	3.5	3.9
2012	Management plan F (45% of F_{2008})	< 31.8 [2)]	3.8		
2013	Management plan (TAC – 20%)	< 25.441 [1)]			

Weights in thousand tonnes.

[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	-	1.9	1.2
2004	Zero catch	0	-	1.0	0.8
2005	Zero catch	0	-	1.2	1.0
2006	Zero catch	0	-	1.5	1.1
2007	Zero catch	0	-	2.1	1.7
2008	Exploitation boundaries in relation to precautionary limits. Total removals less than 22 000 t	< 22	-	1.7	1.4
2009	Zero catch	0	1.7	2.0	1.2
2010	Management plan F (65% of F2008)	< 40.3 [3)]	2.0	1.8	1.8
2011	See scenarios	-	1.6	1.3	1.2
2012	Management plan F (45% of F_{2008})	< 31.8 [3)]	1.5		
2013	Management plan (TAC – 20%)	< 25.441 [1)]			

Weights in thousand tonnes.

[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	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Belgium	3,356	3,374	2,648	4,827	3,458	4,642	5,799	3,882	3,304	2,470
Denmark	18,479	19,547	19,243	24,067	23,573	21,870	23,002	19,697	14,000	8,358
Faroe Islands	109	46	80	219	44	40	102	96	-	9
France	2,146	1,868	1,868	3,040	1,934	3,451	2,934	.	1,222	717
Germany	8,446	6,800	5,974	9,457	8,344	5,179	8,045	3,386	1,740	1,810
Greenland	.	.	.	.	.	.	.	.	.	.
Netherlands	11,133	10,220	6,512	11,199	9,271	11,807	14,676	9,068	5,995	3,574
Norway	10,476	8,742	7,707	7,111	5,869	5,814	5,823	7,432	6,410	4,369
Poland	-	-	-	-	18	31	25	19	18	18
Sweden	823	646	630	709	617	832	540	625	640	661
UK (E/W/NI)	14,462	14,940	13,941	14,991	15,930	13,413	17,745	10,344	6,543	4,087
UK (Scotland)	28,677	28,197	28,854	35,848	35,349	32,344	35,633	23,017	21,009	15,640
Total Nominal Catch	98,107	94,380	87,457	111,468	104,407	99,423	114,324	77,566	60,881	41,713
Unallocated landings	-758	10,200	7,066	8,555	2,161	2,746	7,779	826	-1,114	-740
WG estimate of total landings	**97,349**	**104,580**	**94,523**	**120,023**	**106,568**	**102,169**	**122,103**	**78,392**	**59,767**	**40,973**
Agreed TAC	**100,000**	**101,000**	**102,000**	**120,000**	**130,000**	**115,000**	**140,000**	**132,400**	**81,000**	**48,600**

Division VIId										
Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Belgium	187	157	228	377	321	310	239	172	110	93
Denmark	1	-	9	-	-	-	-	-	-	-
France	2,079	1,771	2,338	3,261	2,808	6,387	7,788	.	3,084	1,677
Netherlands	2	-	-	-	-	-	19	3	4	17
UK (E/W/NI)	443	530	312	336	414	478	618	454	385	249
UK (Scotland)	22	2	<0.5	<0.5	4	3	1	-	-	-
Total Nominal Catch	2,734	2,460	2,887	3,974	3,547	7,178	8,665	629	3,583	2,036
Unallocated landings	-65	-28	-37	-10	-44	-135	-85	6,229	-1,258	-463
WG estimate of total landings	**2,669**	**2,432**	**2,850**	**3,964**	**3,503**	**7,043**	**8,580**	**6,858**	**2,325**	**1,573**

Division IIIa (Skagerrak)**										
Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Denmark	11,187	11,994	11,921	15,888	14,573	12,159	12,339	8,682	7,656	5,870
Germany	-	530	399	285	259	81	54	54	54	32
Norway	1,208	1,043	850	1,039	1,046	1,323	1,293	1,146	926	762
Sweden	2,523	2,575	1,834	2,483	1,986	2,173	1,900	1,909	1,293	1,035
Others	102	88	71	134	-	-	-	-	-	-
Norwegian coast *	923	909	760	846	748	911	976	788	624	846
Danish industrial by-catch *	1,360	511	666	749	676	205	97	62	99	687
Total Nominal Catch	15,020	16,230	15,075	19,829	17,864	15,736	15,586	11,791	9,929	7,699
Unallocated landings	-1,018	-1,493	-1,814	-7,720	-1,615	-790	-255	-817	-652	-613
WG estimate of total landings	**14,002**	**14,737**	**13,261**	**12,109**	**16,249**	**14,946**	**15,331**	**10,974**	**9,277**	**7,086**
Agreed TAC	**15,000**	**15,000**	**15,500**	**20,000**	**23,000**	**16,100**	**20,000**	**19,000**	**11,600**	**7,000**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined										
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total Nominal Catch	115,861	113,070	105,419	135,271	125,818	122,337	138,575	89,986	74,393	51,448
Unallocated landings	-1,841	8,679	5,215	825	502	1,821	7,439	6,239	-3,024	-1,816
WG estimate of total landings	**114,020**	**121,749**	**110,634**	**136,096**	**126,320**	**124,158**	**146,014**	**96,225**	**71,369**	**49,632**

** 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	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Norwegian coast *	923	909	760	846	748	911	976	788	624	846
Danish industrial by-catch *	1,360	511	666	749	676	205	97	62	99	687
Total	**2,283**	**1,420**	**1,426**	**1,595**	**1,424**	**1,116**	**1,073**	**850**	**723**	**1,533**

Table 6.4.2.2.cont

Sub-area IV										
Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	2,616	1,482	1,627	1,722	1,309	1,009	894	946	666	648
Denmark	9,022	4,676	5,889	6,291	5,105	3,430	3,831	4,402	5,686	4,863
Faroe Islands	34	36	37	34	3	-	16	45	32	0
France	1,777	620	294	664	354	659	573	950	781	510
Germany	2,018	2,048	2,213	2,648	2,537	1,899	1,736	2,374	2,844	2,211
Greenland	.	.	.	35	23	17	17	11	.	.
Netherlands	4,707	2,305	1,726	1,660	1,585	1,523	1,896	2,649	2,657	1,961
Norway	5,217	4,417	3,223	2,900	2,749	3,057	4,128	4,234	4,498	4,870
Poland	39	35	-	-	-	1	2	3	.	.
Sweden	463	252	240	319	309	387	439	378	363	315
UK (E/W/NI)	3,112	2,213	1,890	1,270	1,491	1,587	1,546	2,384	2,553	
UK (Scotland)	15,416	7,852	6,650	4,936	6,857	6,511	7,185	9,052	11,567	
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12,026
Others	.	.	.	.	786	.	.	.	.	.
Norwegian indust by-catch *	.	.	.	.	48	101	22	4	201	1
Danish industrial by-catch *	.	.	.	.	34	18	46	76	11	0
Total Nominal Catch	44,421	25,936	23,789	22,479	23,108	20,080	22,263	27,428	31,647	19,172
Unallocated landings	-121	-89	-240	1,391	-1,012	-336	-68	-1,800	-347	8,557
WG estimate of total landings	**44,300**	**25,847**	**23,549**	**23,870**	**22,096**	**19,744**	**22,195**	**25,628**	**31,300**	**27,728**
Agreed TAC	**49,300**	**27,300**	**27,300**	**27,300**	**23,205**	**19,957**	**22,152**	**28,798**	**33,552**	**26,842**

Division VIId										
Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	51	54	47	51	80	84	154	73	57	55
Denmark	-	-	-	-	-	.	.	.	.	.
France	1,361	1,730	810	986	1,124	1,743	1,326	1,779	1,606	1,111
Netherlands	6	36	14	9	9	59	30	35	45	52
UK (E/W/NI)	145	121	103	184	267	175	144	134	127	
UK (Scotland)	-	-	-	-	1	12	7	3	1	
UK (conbined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	119
Total Nominal Catch	1,563	1,941	974	1,230	1,481	2,073	1,661	2,024	1,836	1,336
Unallocated landings	1,534	-707	-167	-197	-353	-331	-307	-777	-44	-119
WG estimate of total landings	**3,097**	**1,234**	**807**	**1,033**	**1,128**	**1,742**	**1,354**	**1,247**	**1,792**	**1,218**
Agreed TAC								**1,678**	**1,955**	**1,564**

Division IIIa (Skagerrak)**										
Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Denmark	5,511	3,054	3,009	2,984	2,478	2,228	2,552	3,023	3,289	3,042
Germany	83	49	99	86	84	67	52	55	56	60
Norway	645	825	856	759	628	681	779	440	433	421
Sweden	897	510	495	488	372	370	365	459	458	.
Others	-	27	24	21	373	385	13	2	26	0
Norwegian coast *	.	.	720	759	524	494	498	342	369	342
Danish industrial by-catch *	.	.	10	18	9	.	-	1	0	0
Total Nominal Catch	7,136	4,465	4,483	4,338	3,935	3,731	3,761	3,979	4,262	3,523
Unallocated landings	332	-674	-696	-533	-569	-784	-463	-101	-174	402
WG estimate of total landings	**7,468**	**3,791**	**3,787**	**3,805**	**3,366**	**2,947**	**3,298**	**3,878**	**4,089**	**3,925**
Agreed TAC	**7,100**	**3,900**	**3,900**	**3,900**	**3,315**	**2,851**	**3,165**	**4,114**	**4,793**	**3,835**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined										
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Nominal Catch	53,120	32,342	29,246	28,047	28,524	25,884	27,685	33,431	37,745	24,031
Unallocated landings	1,745	-1,470	-1,103	661	-1,934	-1,451	-838	-2,678	-565	8,840
WG estimate of total landings	**54,865**	**30,872**	**28,143**	**28,708**	**26,590**	**24,433**	**26,847**	**30,753**	**37,180**	**32,871**

** 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	2002	2002	2004	2003	2006	2007	2008	2009	2010	2011
Norwegian coast *	.	.	720	759	524	494	498	342	369	342
Norwegian indust by-catch *	.	.	.	.	48	101	22	4	201	1
Danish industrial by-catch *	.	.	10	18	43	18	46	77	11	0
Total	**.**	**.**	**730**	**777**	**615**	**613**	**566**	**423**	**582**	**343**

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	465562	346383	625746	514011	458510	576230	151903	137479	16784	124991	111393	140250	0.485	0.432	0.545
1964	852561	639934	1135837	686938	598517	788423	164226	149789	180055	152818	138062	169150	0.513	0.462	0.570
1965	1069819	807469	1417407	862853	760402	979109	203822	186820	222370	203211	182158	226697	0.543	0.491	0.600
1966	1379180	1040737	1827684	1050734	922752	1196467	227294	209349	246777	249197	224021	277203	0.560	0.508	0.618
1967	1271872	957633	1689224	1135973	1004934	1284099	251450	232062	272459	298045	267223	332422	0.605	0.550	0.666
1968	656711	491089	878192	944112	855552	1041839	262236	242285	283830	299539	271759	330159	0.635	0.577	0.699
1969	606221	454794	808067	804519	723014	895212	258590	238710	280126	239666	219948	261151	0.623	0.567	0.685
1970	1839492	1383075	2446527	1333077	11151461593597		273758	252288	297055	268069	236281	304133	0.639	0.582	0.701
1971	2369051	1779851	3153300	1460077	1246602	1710110	276233	255304	298877	351864	307065	403199	0.705	0.644	0.771
1972	584201	438599	778139	976764	875190	1090126	241349	222982	261229	361855	318951	41053	0.768	0.701	0.842
1973	875018	657895	1163799	800507	713004	898748	213203	197688	229936	259627	236994	284421	0.752	0.688	0.823
1974	807744	606852	1075138	755398	675155	845178	232350	214317	25190	240867	217270	267027	0.736	0.673	0.806
1975	1377802	1024751	1852488	859409	739184	999188	212990	196802	230509	238470	213151	266797	0.772	0.706	0.843
1976	849158	629915	1144708	659344	586124	741710	182956	169538	197436	237518	209065	269844	0.803	0.734	0.879
1977	2096962	1560630	2817611	1007518	836246	1213867	161135	149748	173388	244019	211359	281725	0.798	0.730	0.873
1978	1271872	950592	1701737	1122423	957172	1316203	160332	149432	172026	323515	275897	379351	0.858	0.785	0.937
1979	1435466	1075956	1915099	1006511	878527	1153139	166708	155438	178796	314268	277926	355361	0.804	0.737	0.878
1980	2273884	1696673	3047463	1172912	1000826	1374587	181498	169274	194604	339422	296329	388783	0.860	0.791	0.935
1981	885582	663736	1181576	989544	874170	1120146	194658	181971	208230	362943	317563	414807	0.890	0.819	0.966
1982	1407042	1064675	1859503	1018661	880198	1178907	188339	176317	201182	334703	297358	376739	0.983	0.905	1.069
1983	819132	623722	1075762	817495	716778	932363	154972	145018	165610	282377	248504	320868	0.972	0.896	1.054
1984	1426879	1085140	1876239	828192	711878	963510	132455	124089	141385	246225	217735	278442	0.916	0.844	0.993
1985	378511	285758	501370	569777	510510	635924	126627	118499	135312	225709	198651	256451	0.887	0.816	0.963
1986	1692979	1284988	2230508	776848	649623	928989	115728	108388	123565	206489	180214	236594	0.936	0.864	1.015
1987	671319	512102	880038	739700	643468	850323	108989	101957	116506	248202	213131	289045	0.938	0.866	1.016
1988	462314	352561	606233	550730	487913	621635	100609	94190	107467	199586	179255	222223	0.948	0.875	1.027
1989	767582	580636	1014717	538208	462094	626858	94278	88020	10098	169058	149833	19075	0.966	0.890	1.048
1990	333701	254542	437477	378890	336702	426363	80178	74919	85805	136216	120586	153872	0.906	0.834	0.985
1991	370275	282383	485522	350459	309215	397205	73644	69101	78486	120211	108172	133589	0.910	0.839	0.987
1992	792541	604188	1039614	517622	437058	613035	71111	66579	75952	134861	117489	15480	0.877	0.808	0.951
1993	446860	341008	585569	431059	380163	488768	68597	64415	73050	149343	130422	171008	0.891	0.822	0.966
1994	944112	711976	1251934	527023	449225	618294	72114	67745	76765	153430	135498	173736	0.906	0.836	0.982
1995	557936	426053	730643	562980	489906	646955	81064	75916	86562	185907	161754	213666	0.934	0.862	1.013
1996	403528	307737	529136	459089	406639	518305	79221	74414	84339	165545	148161	184970	0.955	0.882	1.033
1997	1059174	802173	1398513	632225	526439	759268	75207	70632	80079	166375	143617	192739	0.961	0.890	1.038
1998	170587	128831	225876	342833	302889	388046	61267	57470	65316	140787	121969	162507	0.980	0.908	1.058
1999	303458	230794	399001	256530	228576	287902	55938	52441	59668	100912	91510	111279	0.999	0.924	1.081
2000	548532	418244	719405	344897	293524	405261	49662	46314	53252	101926	88540	117335	0.995	0.921	1.075
2001	208981	157475	277335	247954	220119	279310	41731	39159	44472	90853	80334	102750	0.956	0.885	1.032
2002	255761	193501	338054	266465	233606	303947	42574	39884	45445	88521	79067	99107	0.926	0.856	1.001
2003	119134	90746	15640	150995	136822	166635	36901	34378	39610	60718	54729	67363	0.901	0.833	0.975
2004	200186	152808	262252	149642	131281	17057	31984	29936	34173	47620	42977	52764	0.857	0.791	0.929
2005	137448	105169	179635	144929	129072	162734	29762	27851	31805	47052	41989	52724	0.800	0.736	0.869
2006	344897	263899	450755	156530	136450	179565	26239	24534	28062	41606	37182	46556	0.723	0.663	0.788
2007	147119	112688	19207	185535	165218	208351	32827	30557	35265	56106	49278	63880	0.669	0.611	0.732
2008	178796	136806	233673	186093	167105	207237	38254	35465	41262	54122	49147	59601	0.630	0.573	0.693
2009	191186	145402	251385	211716	187697	238808	47193	43289	51449	56897	51354	63039	0.602	0.541	0.669
2010	326440	236201	451152	246225	212427	285400	51792	46924	57166	61821	55563	68784	0.583	0.513	0.662
2011	165711	105755	259658	236807	200556	279610	56331	49366	64278	66903	59064	75782	0.572	0.485	0.676
2012				295079	208797	417016	65317	52987	80515						

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	111525	13544	124991	
1964	139525	13249	152818	
1965	181861	21199	203211	
1966	217075	32080	249197	
1967	264342	33490	298045	
1968	278730	20919	299539	
1969	227521	12139	239666	
1970	244019	24029	268069	
1971	290977	61084	351864	
1972	327420	34303	361855	
1973	235155	24588	259627	
1974	215993	24934	240867	
1975	206282	32145	238470	
1976	200186	37309	237518	
1977	180954	62881	244019	
1978	284077	39577	323515	
1979	272393	41856	314268	
1980	272938	66436	339422	
1981	324487	38216	362943	
1982	294490	40215	334703	
1983	256786	25566	282377	
1984	199786	46677	246225	
1985	203008	22788	225709	
1986	161619	44846	206489	
1987	218163	29912	248202	
1988	186652	12942	199586	
1989	136489	32598	169058	
1990	114348	21781	136216	
1991	105556	14747	120211	
1992	107796	27092	134861	
1993	126988	26340	153254	0.97
1994	104849	34971	139842	1.10
1995	121407	26981	148435	1.25
1996	134948	21454	156318	1.06
1997	131834	41785	173564	0.96
1998	136488	40255	176661	0.80
1999	100559	16868	117301	0.86
2000	78174	20082	98193	1.04
2001	47205	12703	59890	1.52
2002	62263	7480	69712	1.27
2003	27136	5152	32325	1.88
2004	28829	7041	35887	1.33
2005	29210	5933	35146	1.34
2006	25730	7798	33538	1.24
2007	22471	20702	43174	1.30
2008	27117	22357	49459	1.09
2009	32327	16506	48907	1.16
2010	37888	13224	51092	1.21
2011	34983	11679	46659	1.43

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 states:

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)

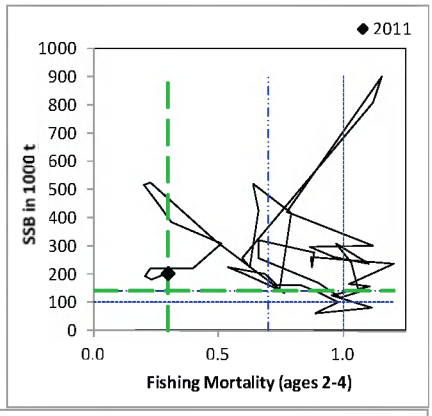
Advice for 2013

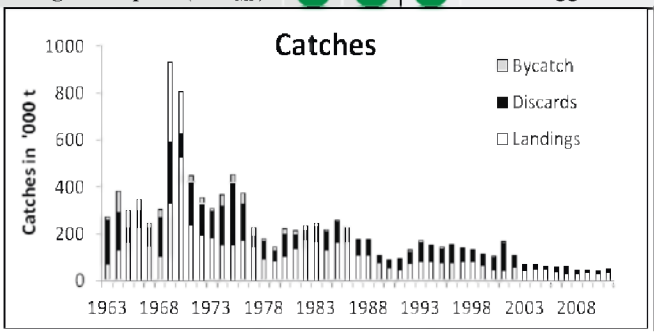
ICES advises on the basis of the EU–Norway management plan that landings in 2013 should be no more than 47 811 t.

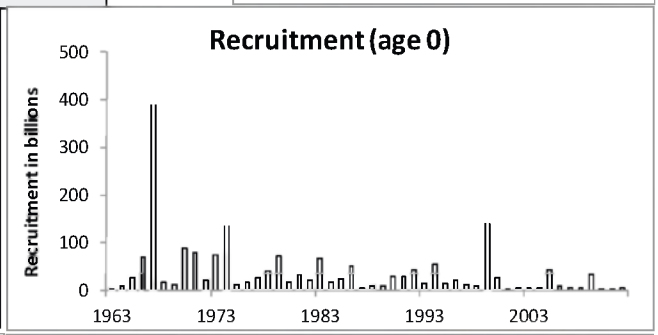
Stock status

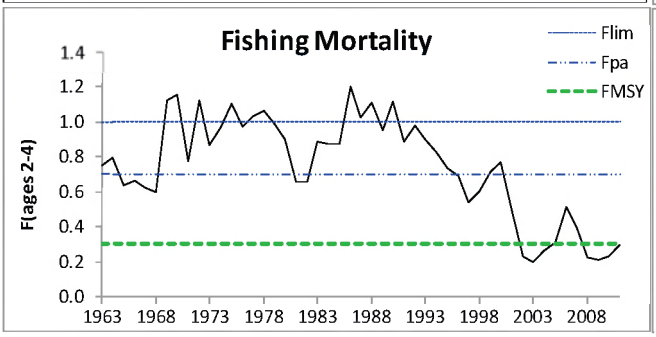
F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above trigger









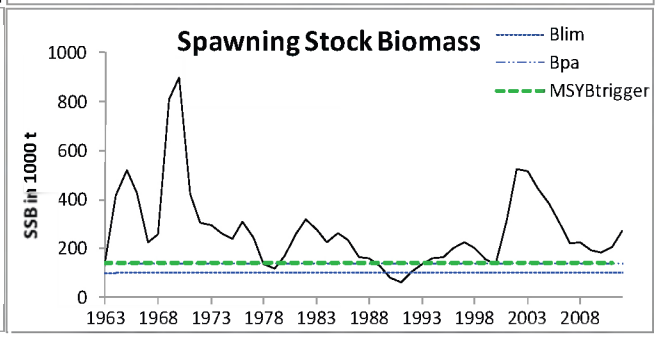


Figure 6.4.3.1 Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak). Summary of stock assessment (weights in thousand tonnes), including intermediate-year forecasts for 2012. Top right: SSB and F over the time-series used in the assessment.

Fishing mortality has been below F_{pa} and around F_{MSY} 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 was agreed by EU and Norway in 2008 (see Annex 6.4.3). ICES has evaluated the plan and concludes that it can be accepted as precautionary.

Biology

The North Sea haddock stock exhibits sporadic 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 (2011) was 34.4 kt, where 75% were landings (86% demersal trawl and seine >100 mm, 11% *Nephrops* trawl 70–99 mm, and 3% others), 25% discards, and 0% industrial bycatch.

Effects of the fisheries on the ecosystem

Trawling impacts the benthos, as summarized 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. The overall reporting (in particular through the fully documented fisheries (FDF) programme) of catch data provided to ICES has improved in 2012. International landings and discard rate estimates were provided and raised according to the Data Collection Framework (DCF) métier categories.

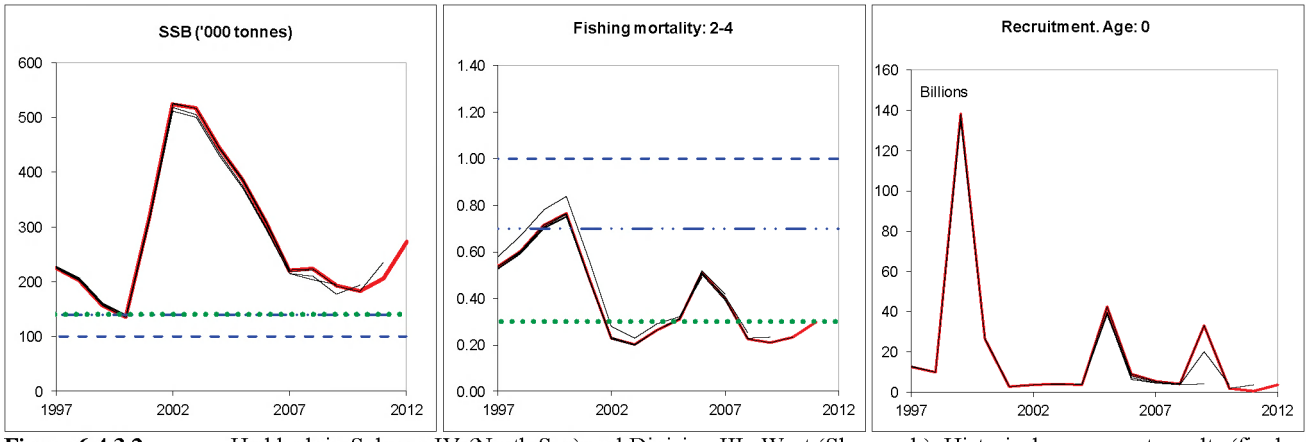


Figure 6.4.3.2 Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak). Historical assessment results (final-year recruitment estimates included).

Scientific basis

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

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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)

Outlook for 2012

Basis: F (2012) = TAC constrained F = 0.196; SSB (2013) = 255; Human consumption landings (2012) = 42; Discards (2012) = 10; Industrial bycatch (2012) = 0; Recruitment (2012) = trimmed GM = 3604 million.

Rationale	Human consumption (2013)	Basis	F 2013	F HC 2013	F Disc 2013	F ind. Bycatch 2013	Discards 2013	Ind. Bycatch 2013	Catch 2013	SSB 2014	% SSB change[1)]	% TAC change[2)]
Management plan	47.811	15% TAC increase	0.29	0.20	0.09	0.001	6	0	54	203	- 20%	+ 15%
MSY framework	49	F_{MSY}	0.30	0.21	0.09	0.001	6	0	55	202	- 21%	+ 17%
Precautionary approach	96	F_{pa}	0.70	0.48	0.22	0.001	12	0	108	144	- 43%	+ 130%
Zero catch	0	Zero catch	0.001	0	0	0.001	0	0	0	264	+ 4%	-100%
Other options	33	F_{2012}	0.20	0.13	0.06	0.001	4	0	38	221	-13%	-21%
	35.339	15% TAC decrease	0.21	0.14	0.07	0.001	4	0	40	219	- 14%	-15%
	42	Rollover TAC	0.25	0.17	0.08	0.001	5	0	47	211	- 17%	0%
	49	F_{2012}*1.5	0.30	0.20	0.09	0.001	6	0	55	202	- 20%	+17%
Mixed-fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012b)												
Maximum	56	A	0.46	NA	NA	NA	NA	NA	NA	145	- 43%	+ 34%
Minimum	25	B	0.14	NA	NA	NA	NA	NA	NA	231	- 10%	-39%
Cod MP	26	C	0.17	NA	NA	NA	NA	NA	NA	207	- 19%	- 36%
SQ effort	46	D	0.33	NA	NA	NA	NA	NA	NA	175	- 31%	+ 12%
Effort Mgt	27	E	0.17	NA	NA	NA	NA	NA	NA	217	- 15%	- 35%

Weights in thousand tonnes.
Under the assumption that effort is linearly related to fishing mortality.
[1)] SSB 2014 relative to SSB 2013.
[2)] Human Consumption 2013 relative to TAC 2012.
Mixed-fisheries assumptions:

A. Maximum scenario: Fleets stop fishing when last quota exhausted.
B. Minimum scenario: Fleets stop fishing when first quota exhausted.
C. Cod management plan scenario: Fleets stop fishing when cod quota exhausted.
D. *Status quo* (SQ) effort scenario: Effort in 2012 and 2013 as in 2011.
E. Effort management scenario: Effort reductions according to cod and flatfish management plans.

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.

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 47 811 t in 2013, which is a TAC increase of 15% and is expected to lead to an F decrease of 8%.

MSY approach

Following the ICES MSY framework implies fishing mortality to be increased to 0.3, resulting in human consumption landings of less than 49 000 t in 2012. This would be expected to lead to an SSB of 202 000 t in 2014.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to human consumption landings of less than 96 000 t in 2011. This is expected to keep SSB just above B_{pa} in 2014.

Mixed fisheries

In 2012, ICES puts forward mixed-fisheries advice for the first time (ICES, 2012b). In contrast to single-species advice there is no single recommendation but a range of plausible scenarios, assuming fishing patterns and catchability in 2012 and 2013 unchanged from those in 2011. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the TACs corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

The TAC for haddock in 2012 (15% reduction of the 2011 TAC) implies a reduction of fishing mortality in 2012 to 66% of the F in 2011 (which was at the level of the target of the management plan). This reduction means that the haddock TAC may act as a limiting factor in many fisheries in 2012.

In 2013, cod is the limiting species for all the North Sea demersal fisheries. Following the 'cod' scenario (full implementation of the cod management plan), the haddock management plan catch options could not be fully utilized.

Additional considerations

Adherence to the EU–Norway management plan has contributed to lower fishing mortality levels and greatly improved stability of yield. Discards are highly variable without obvious long-term trend but appear to be declining in recent years.

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.

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 2012.

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.

Regulations 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 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.

Overall nominal effort (kW-days) by European demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced (−20% between 2003 and 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 (−12%, −39%, and −35%, respectively, between 2004 and 2011). Nominal effort reported by Norway has increased in 2011 after the generalization of electronic logbooks (ICES, 2012b).

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). During 2011 there were 185 of these larger closures. The effects of this regulation on the behaviour of the fleet and on the haddock stock are still unclear.

Changes in fishing technology and fishing patterns

The expansion of the closed-circuit TV (CCTV) and fully documented fisheries (FDF) programmes in 2010–2012 in Scotland, Denmark, and England is expected to have contributed to the reduction of cod mortality. Under this scheme, UK vessels are not permitted to discard any cod, while Danish vessels are still permitted to discard undersize cod. For both nations, all cod caught are counted against the quota. Vessels carrying CCTV systems may preferentially target haddock to prevent exhausting the cod quota and having to tie up.

Information from the fishing industry

The 2011 report of the North Sea Stock Survey (Napier, 2011) shows the industry's perception of increasing haddock abundance in all areas of the North Sea in 2011. This does not concur with the stock assessment perception up to 2009. In the last two years both perceptions show an increasing trend.

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. Water temperature in the North Sea has increased and Wright *et al.* (2011) shows that smaller size at maturity was partly linked to temperature rises and a greater proportion of haddock maturing at a younger age. Other ongoing work (unpublished, Marine Scotland) has indicated that haddock recruitment is only weakly linked to spawning-stock biomass, being more obviously determined by the 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.

The overall reporting (in particular through the fully documented fisheries programme) of catch data provided to ICES has improved in 2012. International landings and discard rate estimates were provided and raised according to Data Collection Framework (DCF) metier categories.

Uncertainties in assessment and forecast

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.

Uncertainties in the forecast are related to the assumption on intermediate year F, which implies a 66% reduction of F in 2012.

Comparison with previous assessment and advice

There is close agreement between the assessments in 2011 and 2012.

The basis for the advice is the same as last year: 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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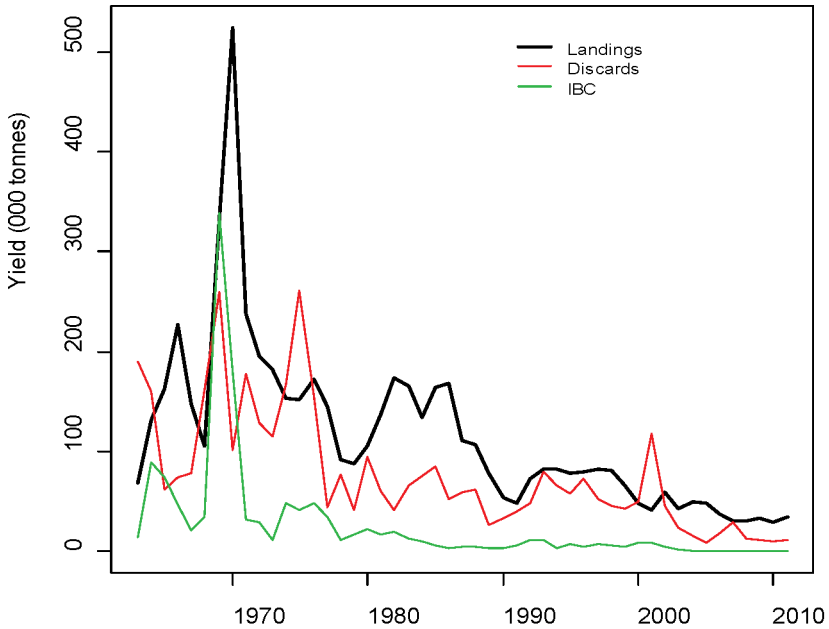


Figure 6.4.3.3 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Catch components (in '000 t) subdivided by landings, discards, and industrial bycatches (IBC).

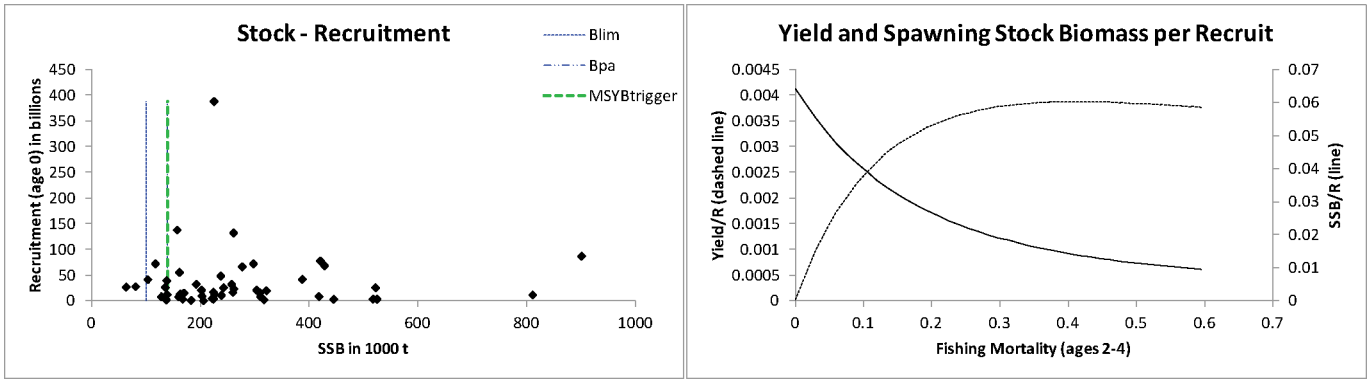


Figure 6.4.3.4 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Stock–recruitment (left) and yield-per-recruit plot (right).

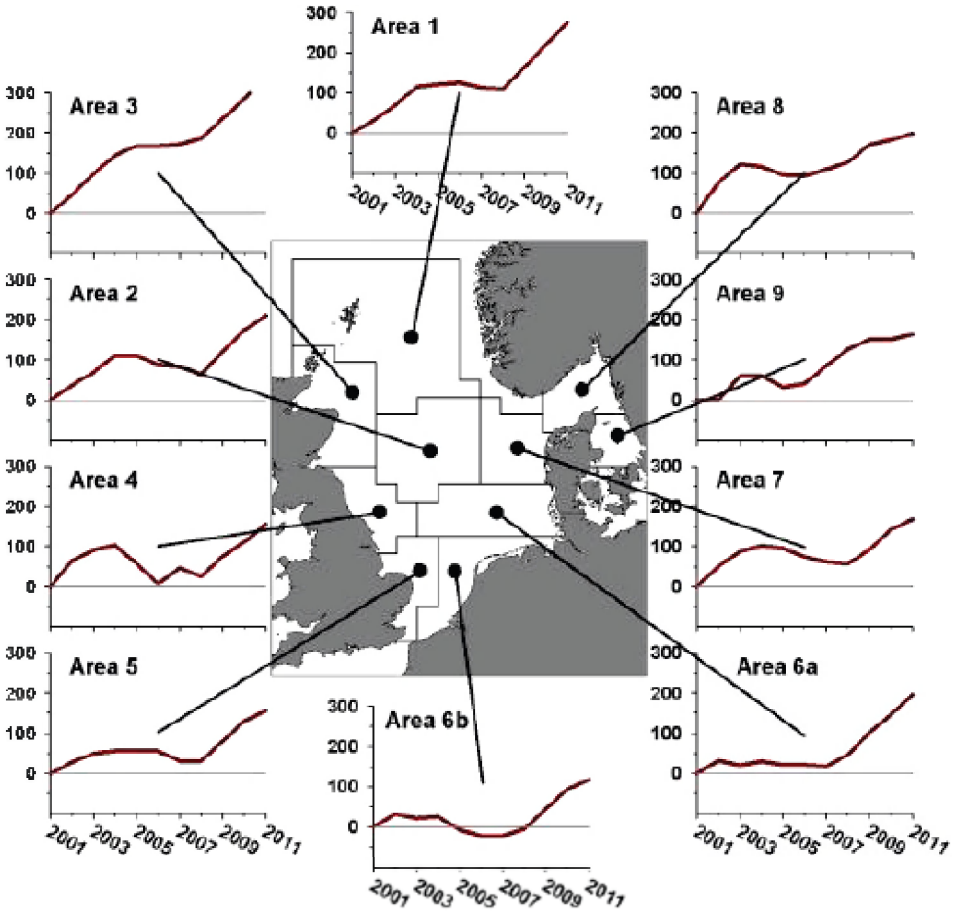


Figure 6.4.3.5 Haddock in Subarea IV and Division IIIa. Results of the 2011 North Sea Stock Survey abundance index (Napier, 2011). Each plot presents a summary of the responses by North Sea roundfish reporting area.

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

Year	ICES Advice	Predicted landings corresp. to advice	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 [2]	85	48	47	17	1	65
2005	Mixed-fisheries consideration / F should be below F_{pa}	92 [2]	66	31	48	10	0	57
2006	Mixed-fisheries consideration / F < 0.3	39 [2]	52	36	36	17	0	55
2007	Mixed-fisheries consideration / F < 0.3	55.4 [2]	55	31	31	30	0	61
2008	Mixed-fisheries consideration / 15% TAC reduction	49.3 [1-2]	46	30	29	13	0	42
2009	Mixed-fisheries consideration / Apply management plan	44.7 [1-2]	42	31	31	10	0	41
2010	Mixed-fisheries consideration / Apply management plan	38 [1-2]	36	28	28	10	0	38
2011	See scenarios	-	34	26	34	11	0	46
2012	Apply management plan	41.575 [1-2]	39					
2013	Apply management plan	47.811 [1-2]						

Weights in thousand tonnes.

[1] Including industrial bycatch.

[2] 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	9.9	1.7	0	11.6
2012	Apply management plan North Sea	-	2.4				
2013	Apply management plan North Sea	-					

Weights in thousand tonnes.
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	Division	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	III a	0	0	0	0	0	0	0	0		
Denmark	III a	3791	1741	1116	615	1001	1054	1052	1263	1139	1648
Germany	III a	239	113	69	69	186	206	87	105	65	
Netherlands	III a	0	6	1	0	0	0	0	0	1	
Norway	III a	149	211	154	93	113	152	170	121	125	
Portugal	III a	0	0	0	0	30	37	0	0		
Sweden	III a	393	165	158	180	246	278	276	166	126	193
UK -E+W+NI	III a	0	0	0	0	0	0	0	0	0	
UK - Scot	III a	0	0	0	0	0	0	0	0	0	
Official landings	III a	4572	2236	1498	957	1576	1727	1585	1655	1456	1841
WG landings	III a	4137	1808	1443	764	1537	1515	1374	1515	1287	9850
WG discards	III a		195	112	217	970	816	646	556	608	1744
WG total catch	III a	4137	2003	1555	981	2507	2332	2020	2072	1896	11595
TAC	III a	6300	3150	4940	4018	3189	3360	2856	2590	2201	2095
Belgium	IV	559	374	373	190	105	179	113	108	78	105
Denmark	IV	5123	3035	2075	1274	759	645	501	553	725	698
Faeroe Islands	IV	25	12	22	22	4	0	3	32	5	
France	IV	914	1108	552	439	444	498	448	125	277	237
Germany	IV	852	1562	1241	733	725	727	393	657	634	575
Netherlands	IV	359	187	104	64	33	55	29	24	41	72
Norway	IV	2404	2196	2258	2089	1798	1706	1482	1278	1119	1188
Poland	IV	17	16	0	0	8	8	16	0	0	
Portugal	IV	0	0	0	0	76	0	0	0		
Sweden	IV	572	477	188	135	100	130	83	141	90	128
UK - E+W+NI	IV	3647	1561	1159	651	485	1799	1378	2155	2362	
UK – Scot	IV	39624	31527	39339	25319	31905	24919	25987	26238	22622	
UK – all	IV									24984	22648
Official landings	IV	54096	42055	47311	30916	36442	30666	30433	31311	27953	25651
WG landings	IV	54171	40140	47253	47616	36074	29418	28893	31264	27770	26275
WG discards	IV	45892	23499	15439	8416	16943	27805	12532	9986	9515	10249
WG IBC	IV	3717	1150	554	168	535	48	199	52	431	23
WG total catch	IV	103780	64788	63246	56200	53551	57271	41624	41302	37717	36547
TAC	IV	104000	51735	77000	66000	51850	54640	46444	42110	35794	34057
WG landings	IV & IIIa	58308	41948	48697	48380	37611	30934	30267	32779	29058	36125
WG discards	IV & IIIa	45892	23694	15550	8633	17913	28621	13178	10543	10124	11993
WG IBC	IV & IIIa	3717	1150	554	168	535	48	199	52	431	23
WG total catch	IV & IIIa	107917	66792	64800	57181	56058	59603	43644	43374	39612	48141
TAC	IV & IIIa	110300	54885	81940	70018	55039	58000	49300	44700	37995	36152
WG quota uptake		53%	76%	59%	69%	68%	53%	61%	73%	76%	100%

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

	Recruitment Thousands	**TSB** tonnes	**SSB** tonnes	**Catch** tonnes	**Landings** tonnes	**Discards** tonnes	**Bycatch** Tonnes	**Yield/SSB**	**F(2-4)**
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	680950	415673	205468	46378	34840	11515	23	0.170	0.298
2012	3604000		272592						

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."*

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

Advice for 2013 and 2014

Based on the ICES approach for data limited stocks, ICES advises that catches should be no more than 500 tonnes.

This is the first year that ICES is providing quantitative advice for data limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)	1980–2011
Qualitative evaluation	? Insufficient information

SSB (Spawning Stock Biomass)	1980–2011
Qualitative evaluation	? Insufficient information

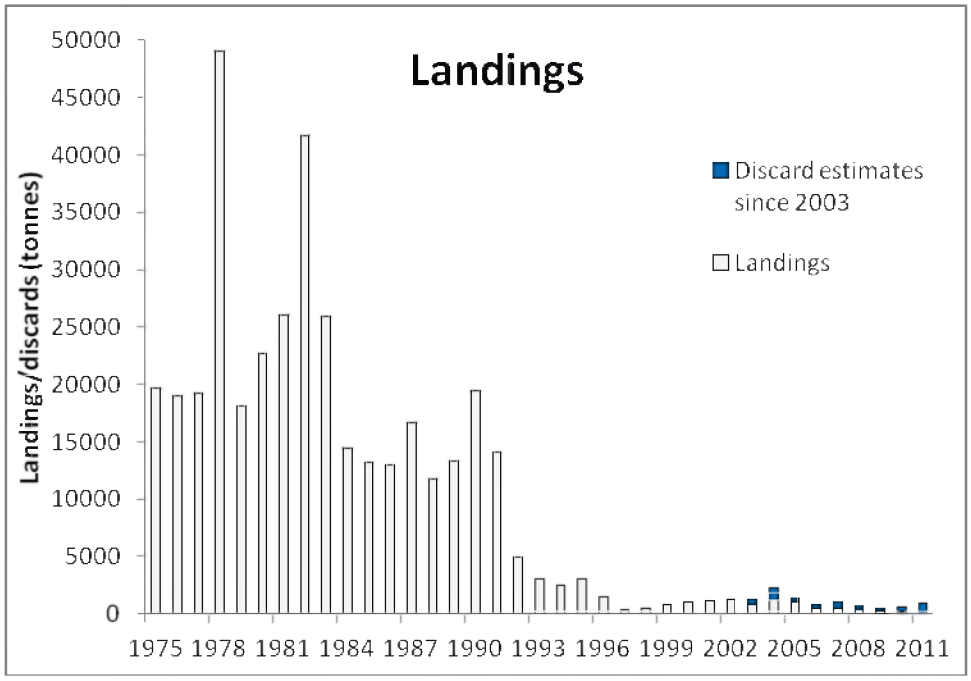


Figure 6.4.4.1 Whiting in Division IIIa (Skagerrak – Kattegat). Total landings (weights in tonnes). Estimated discards are included from 2003 to the present.

The available landing data provide tentative information on the stock status. However, due to the uncertain population structure and possible changes in fishing patterns over the studied period, as well as the low quality of existing surveys, the present lack of knowledge prevent further interpretation.

Management plans

No specific management objectives are known to ICES.

Biology

Whiting are a major prey component of the diet of many piscivorous fish and marine mammals. The spatial distribution of whiting in the neighbouring North Sea 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. Spawning occurs from January to July at 30–100 m depth. Whiting attain sexual maturity at age 2–3 yrs (28–30 cm). Maximal recorded length 70 cm, maximal age 20 yrs.

The fisheries

Whiting are taken as bycatch in the demersal fisheries, which mostly are discarded. ICES estimates of discards are 794 tonnes in 2011 which is three times higher than last year's estimate.

Catch distribution	Total catches (2011) 906.9 t comprising 7.6% landings, 88.6% discards and 4.8% industrial bycatch.

Quality considerations

Information on stock structure in IIIa and improvements on age reading are needed to be able to perform an assessment. Currently, the available survey indices show a lack of internal consistency which hinders development of an analytical assessment.

The advice is based on a precautionary reduction of catches because of missing or non representative data.

Scientific basis

Assessment type	No analytical assessment is performed.
Discards and by-catch	Discards estimates provided by Denmark and Sweden.
Indicators	Catch statistics and age based indices from surveys.
Other information	None.
Working group report	WGNSSK

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

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

ICES approach to data limited stocks

For data limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For this stock, ICES advises that catches should decrease by 20% in relation to the last three years average catch, corresponding to catches (including discards) of no more than 500 t.

Additional considerations

The lack of internal inconsistency in survey age indices hinder cohort analysis. In order to improve future assessment following issues have to be addressed: a) the stock structure in Divisions IIIa, b) age reading problems. Modelling of historical survey data may potentially resolve the question if there has been reduction in whiting biomass in the area.

Comparison with previous assessment and advice

As last year, advice for this stock was based on precautionary considerations. This year, ICES gives biennial advice for both 2013 and 2014.

Sources

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 27 April–03 May 2012 ICES CM 2012/ACOM:13.

Svedäng H. 2003 The inshore demersal fish community on the Swedish Skagerrak coast: regulation by recruitment from offshore sources. ICES Journal of Marine Science, 60: 23–31

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 landings[1]	ICES catches[1]
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	0.1	0.9
2012	Reduce catch	-			
2013	20% Reduction in catches (last 3 years average)	< 0.5			
2014	Same catch advice as for 2013	< 0.5			

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 landings	ICES 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
2011	40	44	84	8.3	20.4	0.2	112.9	794

[1] Values from 1992 updated by 2007
[2] Values updated in 2011

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

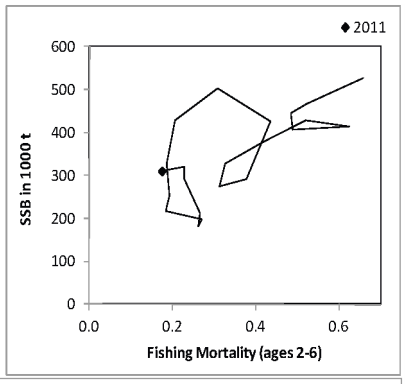
Advice for 2013

ICES advises on the basis of precautionary considerations that landings should be no more than 26 000 t (human consumption for the combined area) in 2013. Management for Division VIId should be separated from the rest of Subarea VII.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined
Qualitative evaluation	→	→	→	At recent average



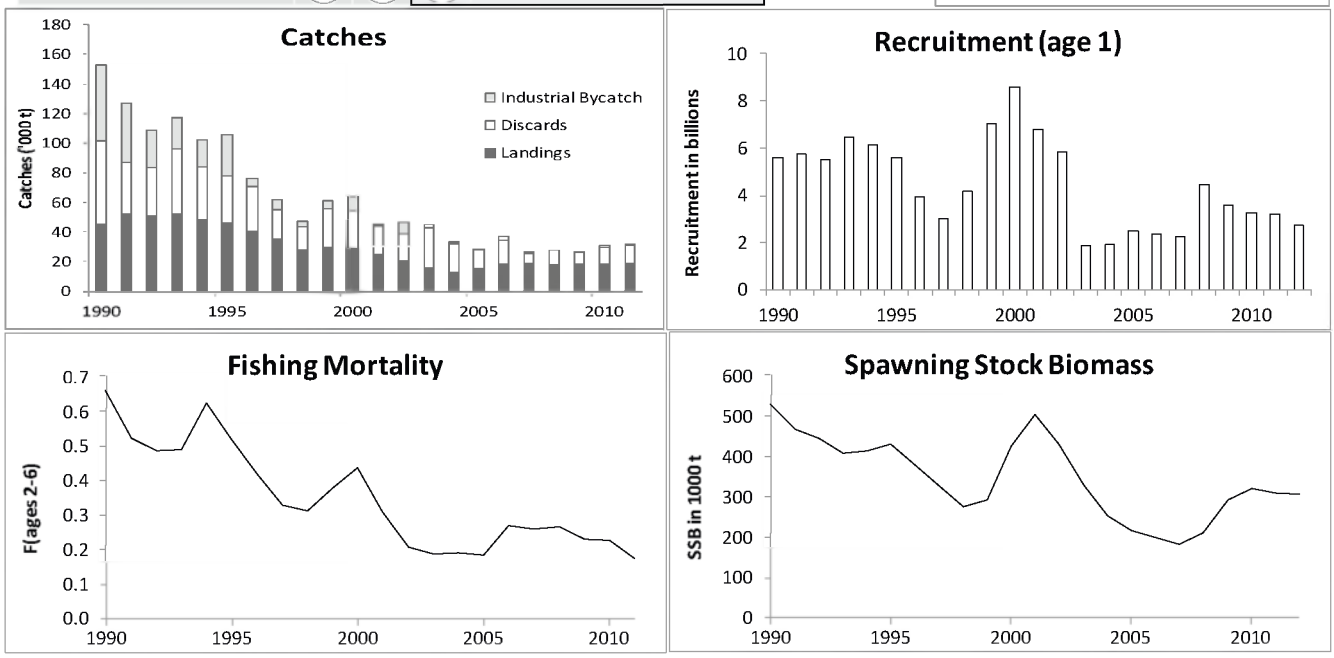


Figure 6.4.5.1 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Summary of stock assessment (weights in thousand tonnes), including intermediate-year forecasts for 2012. Top right: SSB/F for the time-series used in the assessment.

The perception of the stock abundance has been revised upwards, due to changes in predation estimates. However, the trends in stock dynamics are unchanged. SSB is around the average of the time-series. Fishing mortality has been stable with minor fluctuations since 2003. Recruitment was low between 2003 and 2007, then increased slightly, but has remained below average since 2008.

Management plans

In 2011 ICES considered an F target of 0.3 (with a 15% TAC constraint) to be consistent with long-term stability even when recruitment is poor for several consecutive years. Based on a considerable revision in the level of fishing mortality in 2012, the target F is no longer considered applicable and the management target needs re-evaluation.

Biology

Whiting are largely mature from age 2, which means recruitment can heavily influence the SSB in the following year at low stock sizes. The spatial distribution of whiting is considered to have changed over the last decade. This may represent a contraction to a sub-stock structure that coincides with the main spawning areas in the North Sea. The 2011 key run of the North Sea multispecies model (SMS), on which natural mortality estimates for this stock are based, indicates that whiting are a major prey component in the diet of many piscivorous fish and marine mammals.

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 distribution	Total landings (2011) = 31.3 kt, where 18.4 kt are landings (~39% demersal trawls and seine with mesh >= 100 mm North Sea, 28% demersal trawls mesh size 70–99 mm North Sea, 28% demersal trawls mesh size 70–99 mm Eastern Channel, and 5% other gears), 11.8 kt discards, and 1.1 kt industrial bycatch.

Quality considerations

The improvement of predation estimates as well as the quality of landings and discard data have lead to a significant revision of the perception of the stock. Overall, the quality of the assessment is considered to have improved. While catch rates from local fleets may not represent trends in the overall North Sea and English Channel stock, and the localized distribution of the population results in substantial differences in the quota uptake rate (possibly resulting in local discarding problems), the catch and survey data appear to indicate consistent stock trends. This is due in part to the improvement in the provision of discard estimates from participating countries in recent years.

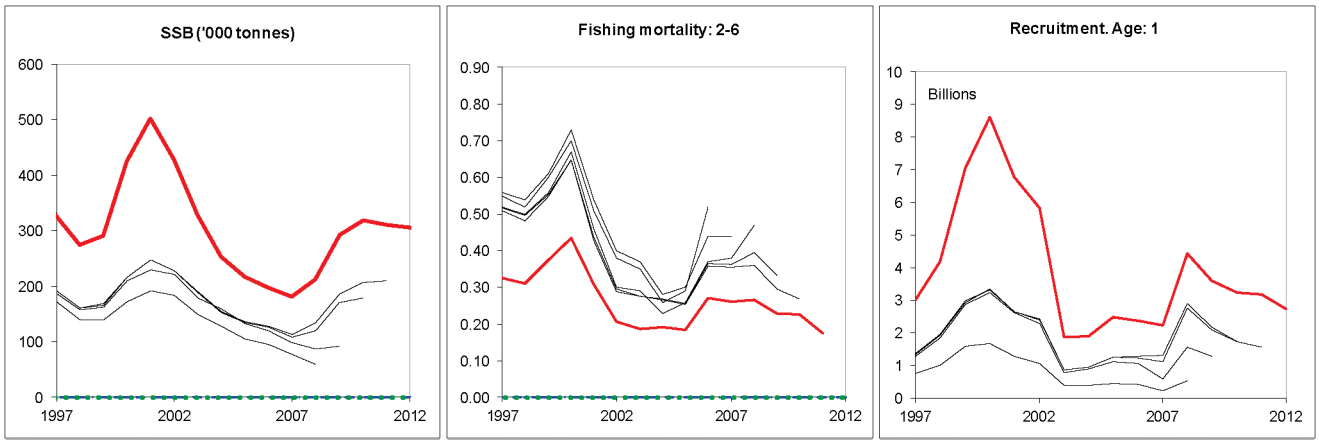


Figure 6.4.5.2 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Historical assessment results (final-year recruitment estimates included). In 2012, natural mortality estimates changed substantially taking into account additional predation mortality (increase of around 50% for ages 2–8 based on ICES, 2011b).

Scientific basis

Assessment type	Age-based analytical (XSA).
Input data	Two survey indices (IBTS Q1 & Q3 ages 1 to 5).
Discards and bycatch	Included in the assessment for Subarea IV and Division VIId since 1990.
Indicators	None.
Other information	This assessment was benchmarked in 2009 (WKROUND), and is due to be benchmarked again in 2013.
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*	Management plan.
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 2012)

** In light of the revision of the perception of the stock history, the target F is no longer considered applicable and the management target needs re-evaluation.*

Outlook for 2013

Basis: F (2012) = *status quo* F = 0.174; SSB (2013) = 313; TAC IV (2012) = 17.036; Human consumption landings (2012) = 20.2; Discards (2012) = 8.3; Industrial bycatch (2012) = 0.9; Recruitment (2012) = RCT3 forecast = 2659 millions.

Rationale	Landings IV+VIId 2013	Landings IV 2013	Landings VIId 2013	Basis	F 2013	F(landings) 2013	F(disc) 2013	F(IBC) 2013	Discards 2013	IBC 2013	Total catch 2013	SSB 2014	% SSB change[1)]	% TAC change[2)]
Management plan	27.242	19.614	7.628	15% quota increase (IV)	0.24	0.16	0.07	0.006	12	1	40	345	10%	15%
Management plan target	34	24	9	2011 MP F target	0.30	0.21	0.09	0.006	15	1	49	337	8%	41%
Precautionary approach	26	19	7	2011 MP F rescaled (0.75x0.3)	0.225	0.15	0.07	0.006	11	1	38	346	11%	11%
Zero catch	0	0	0	F = 0	0.006	0	0	0.006	0	1	1	380	21%	−100%
Other options	16	11	4	0.75 * F_{2012}	0.13	0.09	0.04	0.006	7	1	23	359	15%	−36%
	20.136	14.498	5.638	15% quota decrease (IV)	0.17	0.12	0.05	0.006	9	1	30	353	13%	−15%
	20	15	6	F_{2012}	0.17	0.12	0.05	0.006	9	1	30	353	13%	−12%
	24	17	7	Rollover TAC	0.20	0.14	0.06	0.006	10	1	35	349	12%	0%
	25	18	7	1.25 * F_{2012}	0.22	0.15	0.06	0.006	11	1	37	347	11%	6%
Mixed-fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012b)														
Maximum	25	18.0	7.0	A	0.22	NA	NA	NA	NA	NA	NA	346	11%	6%
Minimum	8.8	6.4	2.4	B	0.07	NA	NA	NA	NA	NA	NA	376	20%	−62%
Cod_MP	9.9	7.2	2.7	C	0.08	NA	NA	NA	NA	NA	NA	370	18%	−58%
SQ_Effort	19	13.7	5.3	D	0.16	NA	NA	NA	NA	NA	NA	357	14%	−22%
Effort_Mgt	9.0	6.5	2.5	E	0.07	NA	NA	NA	NA	NA	NA	374	19%	−62%

Weights in thousand tonnes.

Under the assumption that effort is linearly related to fishing mortality.

[1)] SSB 2014 relative to SSB 2013.

[2)] Human consumption for Subarea IV in 2013 relative to TAC for Subarea IV and Division IIa in 2012 (17 056 t).

Mixed-fisheries assumptions:

A. Maximum scenario: Fleets stop fishing when last quota exhausted.
B. Minimum scenario: Fleets stop fishing when first quota exhausted.
C. Cod management plan scenario: Fleets stop fishing when cod quota exhausted.
D. *Status quo* (SQ) effort scenario: Effort in 2012 and 2013 as in 2011.
E. Effort management scenario: Effort reductions according to cod and flatfish management plans.

The catch split between Subarea IV and Division VIId in 2012 is assumed to be the same as the proportion as estimated in 2011: 72% landings from Subarea IV and 28% landings from Division VIId. There should be separate management for Division VIId.

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 assumes that this approach is still in place.

Following this management plan in 2013 implies a fishing mortality of 0.3, which would increase the TAC by more than 15%. Applying the TAC constraint would lead to human consumption landings of no more than 19 614 t for the North Sea. Although not covered by the management plan, this option would lead to landings in Division VIId of no more than 7628 t.

After the considerable revisions in this year's assessment, caused by new estimates of natural mortality, the target F is no longer considered applicable and the management target needs re-evaluation.

Precautionary considerations

As an interim measure, it would be appropriate to scale the target F in the plan (0.3) according to the proportional change in F between the old and new assessment. The level of F of the whole time-series was revised downwards by around 25% between the 2011 and 2012 assessments, which would generate a target F of 0.225 (0.75 * 0.3).

Following this approach in 2013 with a target fishing mortality of 0.225 would lead to human consumption landings of no more than 19 000 t in the North Sea and 7000 t in Division VIId.

Mixed fisheries

In 2012, ICES offers mixed-fisheries advice for the first time (ICES, 2012c). In contrast to single-species advice there is no single recommendation for mixed fisheries but rather a range of plausible scenarios, assuming fishing patterns and catchability in 2012 and 2013 unchanged from those in 2011. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the TACs corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the limiting species for the North Sea demersal fisheries in 2013. Following the 'cod' scenario (full implementation of the cod management plan), the catch options resulting from the whiting single-species advice could not be fully utilized.

Additional considerations

Management plan evaluations

Following analyses and evaluation during 2010 and 2011, ICES produced advice regarding the proposed EU–Norway management plan for North Sea whiting (ICES, 2011):

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 [in simulations] 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.

With the revisions in the level of fishing mortality in 2012, these evaluations are invalidated and should be repeated with the new stock assessment results.

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 also occur 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 increased in 2010 and are expected to have been 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.

Overall nominal effort (kW-days) by European demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel has been substantially reduced (−20% between 2003 and 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 (−12%, −39%, and −35%, respectively, between 2004 and 2011) (ICES, 2012b). Nominal effort reported by Norway has increased in 2011 due to the generalization of electronic logbooks.

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 from 2003 onwards has been incorporated into the assessment for a major component of the catch from French fleets fishing in Subarea IV and Division VIId.

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. Clara

Uncertainties in the assessment

The use of updated natural mortality estimates from the 2011 key run of the North Sea multispecies model (ICES, 2011b) has resulted in considerable revisions of abundance and mortality estimates for whiting. The trends in these quantities remain the same, as the natural mortality estimates are consistent through time, but the absolute values have changed.

Discards are an important component of the catch. The sensitivity of the assessment outcomes to the raising procedure of discard data has not been explored. Discards could consist of highgrading, over quota, and catches below minimum landing size. The sampling programme may not sufficiently cover these components, although the coverage of discard sampling programmes has expanded considerably in recent years. These data are incorporated in discard estimation in a transparent and métier-based way through the ICES InterCatch procedure since 2012.

Age compositions are not available for the industrial bycatch component of the catch. A mean age composition is assumed for 2006 to 2010, while an age composition was inferred from discard samples for 2011.

There are considerable discrepancies in stock trends prior to 1990 between the survey time-series and the assessment based on commercial catch data. Since 2009, the assessment has therefore been truncated to start in 1990 only.

Information from the fishing industry

The report of the North Sea fishers' survey (Napier, 2012) demonstrates the industry's perception of increasing whiting abundance across the entire North Sea and is broadly in line with the estimated stock trends in the assessment.

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 recent years and the cost of whiting quotas has increased substantially, resulting in higher discarding in some areas of high abundance due to the unavailability of affordable quotas. This observation is consistent with ICES advice, i.e. 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

The use of new natural mortality estimates has substantially increased estimates of recruitment and SSB, and decreased estimates of fishing mortality by approximately 25%, while the trends have remained similar.

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

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 separate management for Division VIId. As a first step there should be a specific TAC for Division VIId and advice should 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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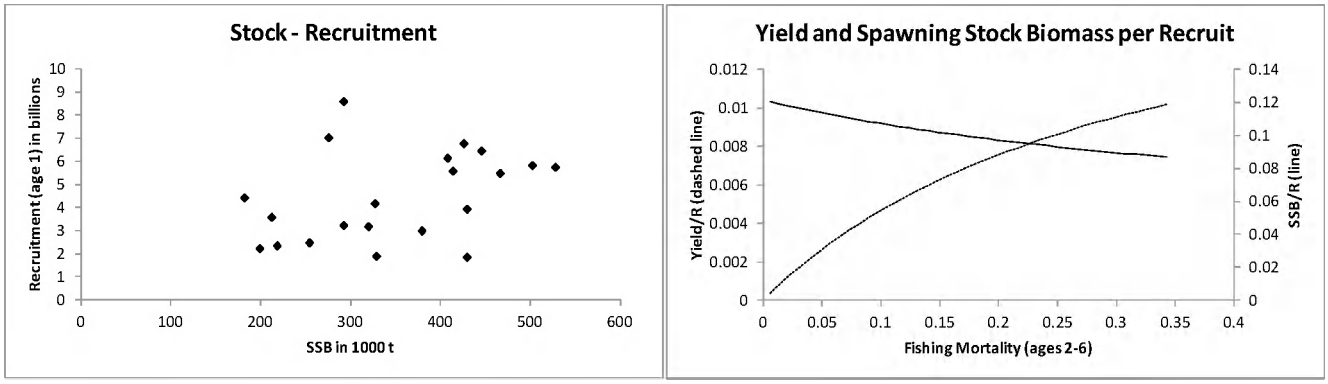


Figure 6.4.5.3 Whiting in Subarea IV and Division VIId. Stock–recruitment and yield-per-recruit plot.

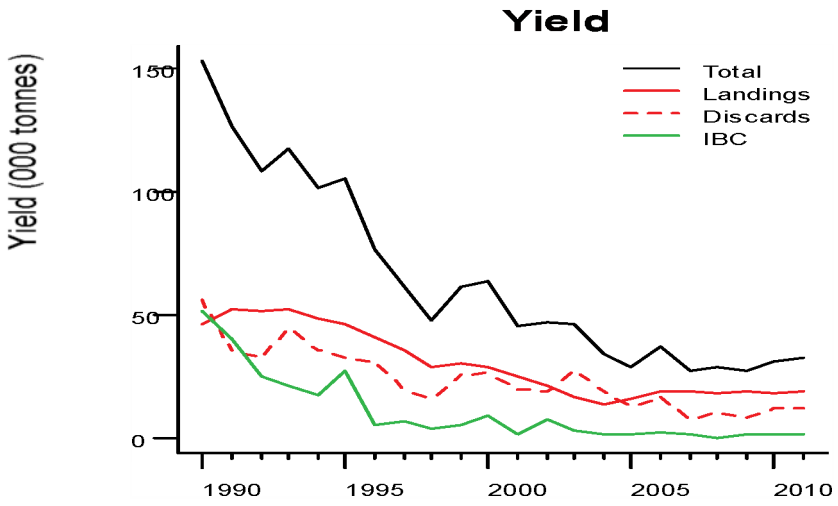


Figure 6.4.5.4 Whiting in Subarea IV and Division VIId. Trends in total yield, subdivided in landings, discards, and industrial bycatches (in thousand tonnes).

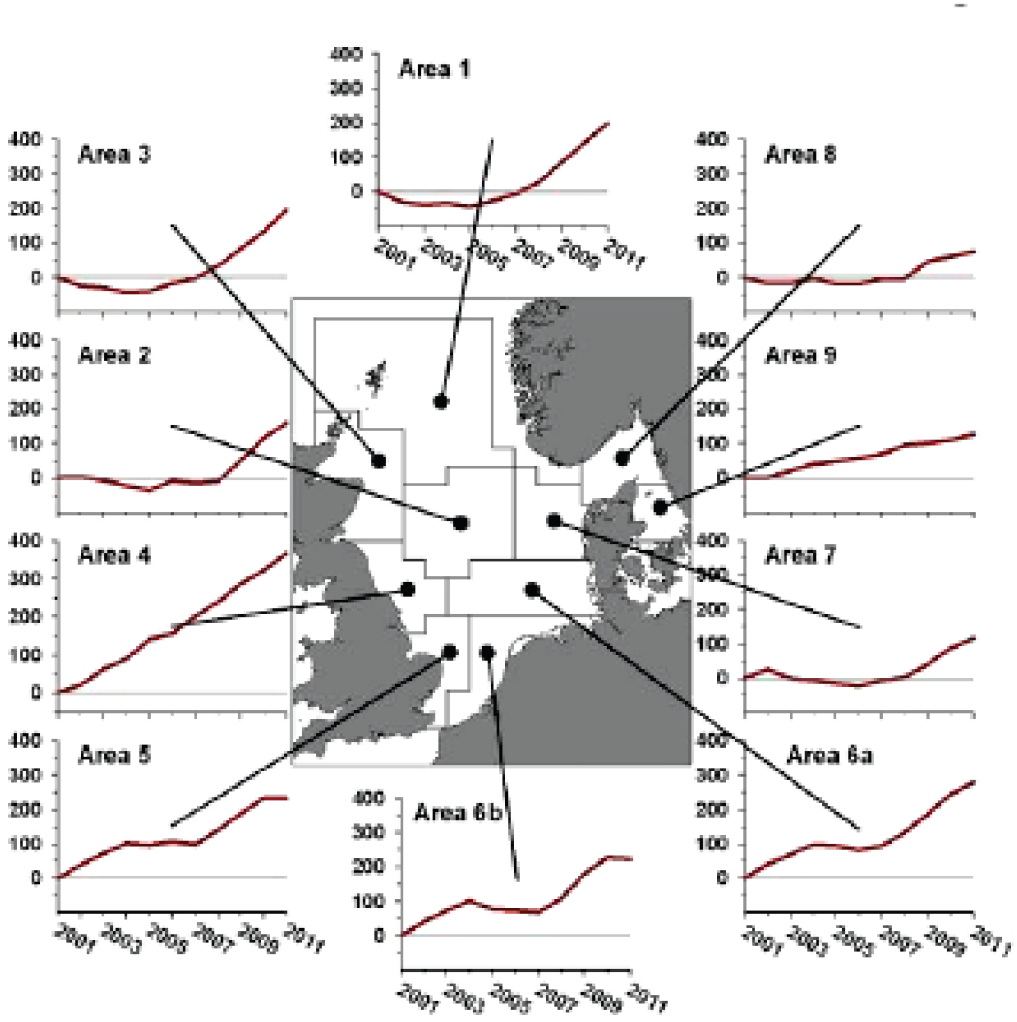


Figure 6.4.5.5 Whiting in Subarea IV and Division VIId. Results of the North Sea Commission fisher's survey 2011.

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	14.832	12	13	2	8	23
2012	Management plan	< 17.1	17.056					
2013	Precautionary considerations (F 0.225) and separate management for VIId	< 19						

Weights in thousand tonnes.
*) Including Division VIId from 2006 to 2010.

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 to recent years	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	5.2	5.3
2012	Management plan	< 4.2	19.053		
2013	Precautionary considerations (F = 0.225) and separate management for Division VIId	< 7			

Weights in thousand tonnes.
[1] Included in TAC for Subarea VII (except Division VIIa).
[2] Including Division VIIe.
*) Includes both areas (Subarea IV and Division VIId) from 2006 to 2010.
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	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	536	454	270	248	144	105	93	45	115	162	147	72
Denmark	105	105	96	89	62	57	251	78.5	42	80	158	134
France	2527	3455	3314	2675	1721	1261	2711	3312	3051	2304	2631	2648
Germany	424	402	354	334	296	149	252	76	76	125	156	111
Netherlands	1884	2478	2425	1442	977	805	702	618	656	718	615	528
Norway	33	44	47	38.5	23	16	17	11	92	73	118	28
Sweden	4	6	7	10	2	0	1	1	1	4	8	6
UK (E.&W)	1782	1301	1322	680	1209	2560	3539	3048	1541	1397		
UK (Scotland)	17158	10589	7756	5734	5057	3441	8093	9063	8850	7456		
UK (Total)											7841	8693
Total	24453	18834	15591	11251	9491	8394	15659	16253	14424	12319	11674	12220
Unallocated landings	-173	426	-721	-800	-541	2286	-562	-587	-945	-545	607	1085
ICES est. of HC landings	24280	19260	14870	10450	8950	10680	15097	15666	13479	11774	12281	13305
ICES est of discards	21931	16130	17144	26135	18142	10300	14018	5206	8356	5223	7853	8180
ICES est of IBC	9160	940	7270	2730	1210	890	2190	1240	0	1020	1350	1750
ICES est of total catch	55371	36330	39284	39315	28302	21870	31305	22112	21835	18017	21484	23235

Division VIId

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	65	75	58	67	46	45	73	75	69	71	88	74
France	5875	6338	5172	6654	5006	4638	3487	3135	2875	6266	5436	4583
Netherlands	14	67	19	175	132	128	117	118	162	112	270	288
UK (E.&W)	118	134	112	109	99	90	53	50	54	86	253	263
Total	6072	6614	5361	7005	5283	4901	3730	3378	3160	6535	6074	5208
Unallocated	-1772	-814	439	-1295	-933	-111	-287	-124	1311	111	-135	-144
ICES est of HC landings	4300	5800	5800	5710	4350	4790	3443	3254	4471	6646	5939	5064
ICES est of discards	4129	3109	1356	604	907	2219	2291	1763	1943	2477	3727	3538
ICES est of Catch	8429	8910	7156	6315	5258	7010	5735	5018	6415	9123	9666	8602

Estimated Catch Subarea IV and Division VIId

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ICES estimate	63800	45240	46440	45630	33560	28880	37040	27130	29270	27470	31550	30087

Table 6.4.5.4 Whiting in Subarea IV and Division VIId. Summary of stock assessment (weights in tonnes).

	Recruitment (age 1) (thousands)	TSB	SSB	Catch	Landings	Discards	Bycatch	Yield/SSB	Mean F(2–6)
1990	5600538	972777	527871	152603	45662	55603	51337	0.087	0.658
1991	5761512	1011925	466298	126742	51929	35057	39755	0.111	0.522
1992	5495931	876679	445489	108556	50947	32564	25045	0.114	0.485
1993	6470818	842808	407666	116911	51818	44370	20723	0.127	0.488
1994	6149817	889840	413543	101651	48486	35692	17473	0.117	0.624
1995	5595850	888263	429517	105493	45938	32176	27379	0.107	0.520
1996	3945428	723724	379105	76123	40503	30504	5116	0.107	0.417
1997	3004586	592866	326872	61435	35563	19659	6213	0.109	0.327
1998	4187074	620282	275337	47475	28288	15693	3494	0.103	0.312
1999	7046918	791687	291998	60845	30130	25677	5038	0.103	0.376
2000	8601549	1337009	425577	63806	28583	26063	9160	0.067	0.436
2001	6788457	1138123	501986	45242	25061	19237	944	0.050	0.308
2002	5836148	801466	429467	46450	20674	18501	7275	0.048	0.206
2003	1863636	432660	328637	45640	16161	26745	2734	0.049	0.187
2004	1909320	446198	253985	33558	13296	19048	1214	0.052	0.192
2005	2489654	497618	218031	28883	15470	12525	888	0.071	0.183
2006	2361740	480758	198670	37038	18535	16310	2193	0.093	0.271
2007	2232825	382210	181712	27126	18915	6971	1239	0.104	0.260
2008	4438888	630458	212099	28246	17951	10296	0	0.085	0.266
2009	3591441	602165	292164	27140	18418	7705	1016	0.063	0.229
2010	3247857	585553	319592	31147	18224	11577	1346	0.057	0.228
2011	3187491	621591	310507	31993	18901	12006	1086	0.061	0.174
2012	2745646		306814						
min	1863636	382210	181712	27126	13296	6971	0	0.048	0.174
mean	4536704	734848	347097	63823	29975	23363	10485	0.086	0.349
max	8601549	1337009	527871	152603	51929	55603	51337	0.127	0.658

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 Subdivision 20 (Skagerrak)

Advice for 2013[1]

This is the first time ICES advises on plaice in Skagerrak separately. Plaice in Skagerrak is considered to be closely associated with plaice in the North Sea, although local components are present in the area. Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 8400 tonnes. In the depleted Eastern Skagerrak, no directed fisheries should occur and bycatch and discards should be minimized.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		
		2009–2011
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
SSB (Spawning-Stock Biomass)		
		2007–2011
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	West	West: increasing
	East	East: decreasing at historical low

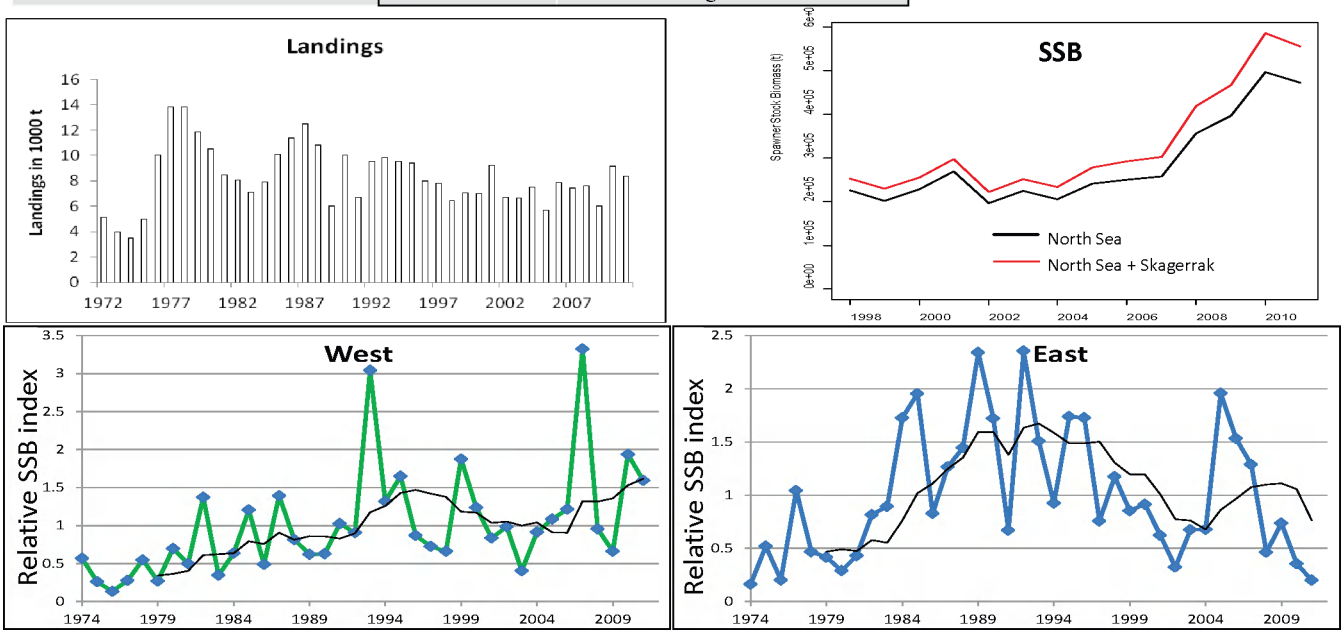


Figure 6.4.6.1 Plaice in Subdivision 20 (Skagerrak). Top: ICES landings (in 'thousand tonnes) and SSB for the North Sea stock, with and without the Skagerrak data. Below: Trends in the relative spawning-stock biomass index of the local Skagerrak components Eastern and Western (IBTS). The thin black line is a 6-year moving average.

Plaice in Skagerrak is considered to have two components: Eastern and Western, the latter of which is closely related to the North Sea stock. Catches in the Western component normally constitute at least 90–95% of the total catches. A combined assessment of the Skagerrak with the North Sea stock show an upward scaling of the total biomass by about 15%. The two local components in the Skagerrak show different trends in spawning-stock biomass. The average of the SSB index in the last two years (2010–2011) compared to the average of the three previous years (2007–2009) indicates a 7% increase in the Western and a 66% decrease in the Eastern component. The Eastern component index is around the lowest in the time-series. Fishing mortality is unknown, but effort has reduced.

[1] The advice for 2012 was corrected after the June advice

Management plans

No specific management objectives are known to ICES.

Biology

Plaice aggregate at spawning grounds in the first quarter of the year. Feeding and spawning migrations as well as larval drift occur throughout the eastern North Sea down into the Belts and Sound area. The contribution of the Skagerrak components in relation to the contribution of plaice from the North Sea in the area is unknown and cannot at present be quantified.

Environmental influence on the stock

A substantial part of juvenile plaice in the Skagerrak have their origin at spawning grounds in the North Sea, since hydrographical features suggest a drift of egg and larvae into the region. Growth patterns for plaice in this area are highly variable, likely because of the great diversity of the local hydrographical conditions.

The fisheries

Plaice is caught all year round, mainly from spring to autumn. In Skagerrak, plaice is mainly taken in a directed fishery by seiners, gillnetters, and small coastal vessels, but also in a mixed fishery together with cod and *Nephrops*. The fishery is continuously distributed from the North Sea into the western part of Skagerrak and towards Skagen. Historical information on discard ratios in Subdivisions (SDs) 20 and 21 (Skagerrak and Kattegat) is around 15–25% in weight.

Catch distribution	Total catch (2011) = 9 kt, where 92% were landings (34% demersal seine, 29% trawl, 10% gillnets, 5% beam trawl, and 24% others (mainly <10 m vessels)). 8% were discards.

Quality considerations

This is the first year ICES presents advice for the Skagerrak separate from the Kattegat. Uncertainty in the catch-at-age information and inappropriate survey spatial coverage make it difficult to conduct a separate assessment for the local components in this area, but a combined assessment with the North Sea can be performed. The advice is based on a spatially-disaggregated index from the IBTS Quarter 1, and considerations on the protection of local components together with the influence of the North Sea stock on plaice in the Skagerrak.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	Age-based analytical assessment of the Skagerrak and North Sea combined, and trends from local components.
Input data	North Sea survey indices (BTS-Isis, BTS-Tridens, SNS).
Discards and bycatch	North Sea discards data included in the assessment. Skagerrak discards data not included yet, but data available.
Indicators	IBTS Q1 index of spatial density of adult aggregation during spawning (Cardinale *et al.*, 2010).
Other information	Before 2012, advice was given for Division IIIa plaice; this advice is now split into plaice in Skagerrak and plaice in Kattegat, Belts, and Sound (SDs 21–23, Advice Section 8.4.11).
Working group report	WGNSSK, WKPESTO

ECOREGION Baltic Sea
STOCK Plaice in Subdivision 20 (Skagerrak)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No analytical assessment is available for the Skagerrak alone. Therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

A spatially-disaggregated abundance index from IBTS Quarter 1 is used as the basis of advice. This index measures the density of adult aggregation during spawning and is used as an indicator of abundance of local components outside of migration periods (Cardinale *et al.*, 2010; ICES, 2012b).

For this stock the abundance is estimated to have locally increased in the Western component by 7% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years). Considering that effort has decreased recently, no additional reductions to reduce exploitation rate are deemed necessary in this area.

However, in the Eastern component abundance is deemed to have decreased by 66% in 2007–2009 (average of the three years) and 2010–2011 (average of the two years) and the component is considered depleted. Catches in the area are low, but exploitation rate may be high due to the reduced stock status.

On these considerations, ICES advises that catches in Skagerrak could increase by 7% compared to the recent average catch of the last 3 years, corresponding to catches of no more than 8400 t. In the depleted Eastern Skagerrak, no directed fisheries should occur and bycatch and discards should be minimized.

Additional considerations

Management considerations

The flatfish benchmark group (ICES, 2010) recommended exploring the potential to perform an integrated assessment of the continuum of plaice stocks from the Baltic to the English Channel. ICES evaluated the stock identity of plaice in the Skagerrak and Kattegat (ICES, 2012a, 2012b) for which combined advice has been given until now. Adjacent waters, such as the North Sea in the Western and the Belts and Sound in the Eastern component are taken into account due to known migration of local components between their spawning and feeding grounds. Although work on stock identity is still under development, the collected information on biology and fishery of plaice in Division IIIa and adjacent waters is considered to imply changes in assessment units as well as in management areas.

Plaice in Skagerrak is considered to be closely associated with plaice in the North Sea and is proposed to be included in the North Sea plaice stock assessment, although it is recognised that local components (Figure 6.4.6.2, Eastern and Western) are present in the area. In the Western component, plaice would be constituted of a mixture of local components intermingling with the North Sea stock. In the Eastern component, adult plaice would be only constituted of local components although nursery grounds would also host North Sea juveniles. This means that while the assessment unit includes the North Sea, Division VIId, and the Skagerrak, and the assessment is run accordingly, the management harvest control rules should take into account the presence of different components in the area. The local components in the Skagerrak (adapted from Cardinale *et al.*, 2010) should thus be managed separately.

Most plaice in the Skagerrak are caught by a directed small-scale fishery operating with seines and gillnets, and the discards are estimated to be low.

Stock identity

Plaice in Skagerrak are considered to be partly recruited from the North Sea, and a component of the population migrates to the North Sea to spawn before returning to the Skagerrak. Hydrographical features in the area combined with an egg and larvae survey in the North Sea, suggest a drift of egg and larvae into the Skagerrak region. Studies suggest potential nursery grounds along the coastline in the Skagerrak. Therefore it is assumed that a substantial part of the juveniles in the Skagerrak have their origin at spawning grounds in the North Sea. Spawning grounds in the Skagerrak are assumed to be located around Skagen and west towards the North Sea, and on the Swedish Skagerrak coasts. The extensive intermingling of tagged plaice between the North Sea, Skagerrak, and the most northern part of the Kattegat (where little fishing occurs) suggest a mix of plaice within these areas, partly reflecting feeding and spawning migrations. However, the contribution of the Skagerrak in relation to the contribution of plaice from the North Sea in the area is unknown and cannot at present be quantified.

The inclusion of Skagerrak into the North Sea plaice assessment as an exploratory analysis has little effect on the fishing mortality, and a scaling effect on the stock perception. This will be explored further to improve the assessment in both areas, possibly by combining them.

The effects of regulations

Previously, TACs were set for Kattegat and Skagerrak separately, based on advice for Division IIIa plaice. From 2012 onwards ICES provides separate advice for Kattegat and Skagerrak.

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.

Overall nominal effort (kW-days) in the Skagerrak has been substantially reduced (−41% between 2003 and 2011). For trawling and Danish seines (all mesh sizes) a reduction in 40% effort was recorded.

Uncertainties in assessment and forecast

The landings-at-age matrix does not show proper tracking of the cohorts, probably due to mixing of the Skagerrak plaice with the North Sea plaice stock, and large variability in growth that cannot be easily monitored with the current levels of sampling.

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 distribution where limited fishing occurs. The IBTS survey or other scientific monitoring should be intensified in the Skagerrak.

Comparison with previous assessment and advice

The stock structure of plaice in the Skagerrak and Kattegat area is revised (ICES, 2012b). This is the first time an assessment is produced for plaice in the Skagerrak. The assessment is based on an updated version of Cardinale *et al.* (2010) indices of local adult aggregation during spawning as a monitoring of local abundance.

Last year, the advice was based on precautionary considerations to reduce catches on plaice in the Skagerrak and Kattegat. This year the advice is based on the ICES approach to data-limited stocks for Skagerrak separately.

Assessment and management area

The fishery is managed by a TAC for Subdivision 20 (Skagerrak). Plaice in the Skagerrak is closely related to the North Sea plaice stock, although it is recognised that local components are present in the area that need to be protected on a local scale. Local components for the Skagerrak are represented below in green and light blue.

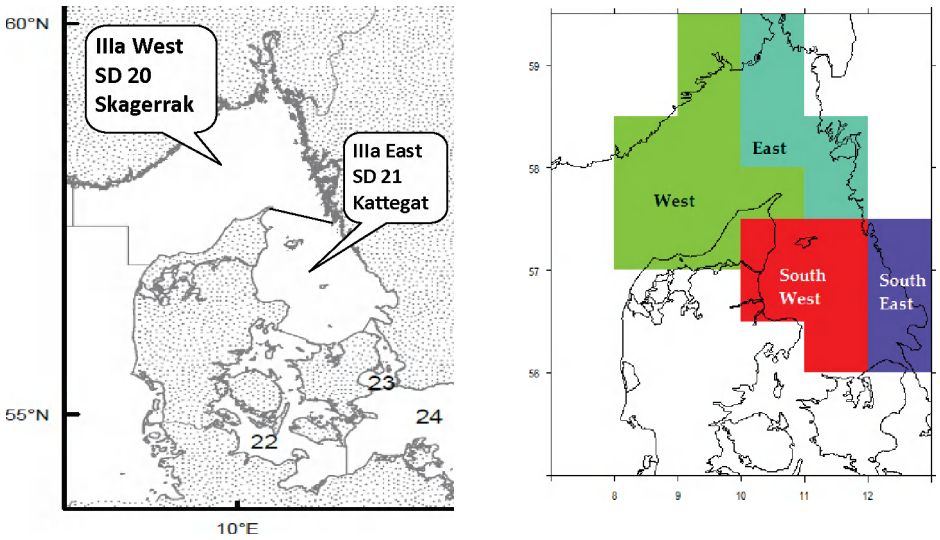


Figure 6.4.6.2 Plaice in the Skagerrak and Kattegat. Left: Subareas in the region. Right: Local components in the area (based on putative spawning subareas) in ICES statistical rectangles. The dark blue and red areas describe the Eastern and Western Kattegat components, the light blue and green areas describe the Eastern and Western Skagerrak components.

Sources

Cardinale, M., Bartolino, V., Llope, M., Maiorano, L., Sköld, M., and Hagberg, J. 2010. Historical spatial baselines in conservation and management of marine resources. Fish and Fisheries, 12(3): 289–298.

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ICES. 2012b. Report of the Workshop on the Evaluation of Plaice Stocks (WKPESTO), 28 February–1 March 2012, ICES Headquarters, Copenhagen. ICES CM 2012/ACOM:32. 60 pp.

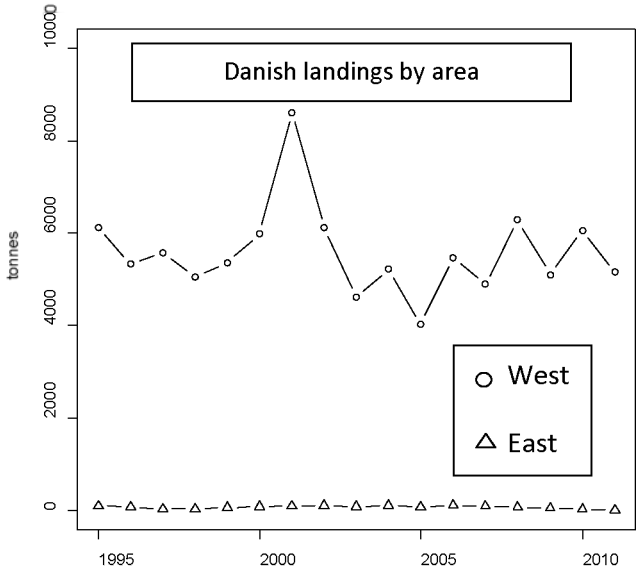


Figure 6.4.6.3 Plaice in Subdivision 20 (Skagerrak). Danish landings (80–95% of total, in tonnes) from Skagerrak, by local area. Danish landings have represented 80 to 95% of the total landings in Skagerrak. Catches in the Western component normally constitute at least 90–95% of the plaice catches in Skagerrak.

Table 6.4.6.1 Plaice in Subdivision 20 (Skagerrak) as part of the North Sea stock. ICES advice, management, and catch. **Note: until 2012, advice was given for Skagerrak and Kattegat combined.**

Year	ICES Advice	Predicted catch corresp. to advice for Skagerrak	Predicted catch corresp. to advice for Skagerrak and Kattegat combined	Agreed TAC Skagerrak	ICES landings
1992	TAC		14.0	11.2	9.6
1993	Precautionary TAC		-	11.2	9.9
1994	If required, precautionary TAC		-	11.2	9.6
1995	If required, precautionary TAC		-	11.2	9.4
1996	If required, precautionary TAC		-	11.2	8.0
1997	No advice		-	11.2	7.8
1998	No increase in F from the present level		11.9	11.2	6.4
1999	No increase in F from the present level		11.0	11.2	7.0
2000	$F < F_{pa}$		11.8	11.2	7.0
2001	$F < F_{pa}$		9.4	9.4	9.2
2002	$F < F_{pa}$		8.5[1]	6.4[2]	6.7
2003	$F < F_{pa}$		18.4	10.4	6.7
2004	$F < F_{pa}$[3]		[3]	9.5	7.5
2005	$F < F_{pa}$		< 9.5	7.6	5.7
2006	No increase in F		< 9.6	7.6	7.9
2007	Maintain current TAC		<9.6	8.5	7.4
2008	No increase in catch		<9.4	9.3	7.6
2009	Same advice as last year		<9.4	9.3	6.0
2010	Same advice as last year		<9.4	9.3	9.2
2011	Last three years average landings (2007–2009)		<8.0	7.9	8.3
2012	Reduce catch		-		
2013[4]	Increase catch by 7% – protect Eastern component	< 8.4			

Weights in thousand tonnes.

[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.

[4] The advice for 2012 was corrected after the June advice

Table 6.4.6.2 Plaice in Subdivision 20 (Skagerrak). ICES estimates of landings by country in tonnes.

Year	Denmark	Sweden	Germany	Belgium	Norway	Netherlands	Total	TAC
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	11.2
1993	9 125	287	37	326	79		9 854	11.2
1994	8 783	315	37	325	91		9 551	11.2
1995	8 468	337	48	302	224		9 379	11.2
1996	7 304	260	11		428		8 003	11.2
1997	7 306	244	14		249		7 813	11.2
1998	6 132	208	11		98		6 449	11.2
1999	6 473	233	7		336		7 049	11.2
2000	6 680	230	5		67		6 982	11.2
2001	9 045	125			61		9 231	9.4
2002	6 470	140	3		58		6 671	6.4
2003	4 847	143	8		74	1 584	6 656	10.4
2004	5 717	179			106	1 511	7 513	9.5
2005	4 515	144			116	915	5 690	7.6
2006	6 334	175	14		142	1 190	7 855	7.6
2007	5 467	159	21		100	1 659	7 406	8.5
2008	6 901	219	5		79	403	7 607	9.3
2009	5 617	92	13		60	253	6 035	9.3
2010	7 644	153	10		49	1 332	9 187	9.3
2011	7 744	179	13	185	215	6	8 342	9.3

Table 6.4.6.3 Plaice in Subdivision 20 (Skagerrak). Biomass indices per local component. NumObs = number of observations, Indices in (no/hour), sd. = standard deviation.

	West			East		
	numObs	Indices	sd.	numObs	Indices	sd.
1974	1	5.81	NA	10	0.96	1.93
1975	6	2.67	4.86	2	3.06	4.32
1976	8	1.37	1.70	5	1.19	2.32
1977	6	2.83	2.19	6	6.13	2.51
1978	8	5.59	11.59	3	2.75	4.12
1979	10	2.77	4.33	5	2.45	1.88
1980	8	7.12	7.97	5	1.71	1.28
1981	9	5.09	4.57	8	2.54	2.35
1982	7	14.02	18.30	6	4.80	3.51
1983	9	3.55	2.85	11	5.26	4.24
1984	9	6.51	6.33	11	10.14	5.65
1985	8	12.31	20.47	9	11.48	8.35
1986	8	5.00	4.94	15	4.87	4.41
1987	11	14.22	11.85	14	7.44	5.40
1988	8	8.33	8.46	10	8.50	6.79
1989	11	6.35	5.93	10	13.76	10.24
1990	9	6.42	5.30	10	10.11	5.90
1991	9	10.46	7.92	9	3.94	3.47
1992	9	9.26	5.23	9	13.84	9.56
1993	11	31.06	25.57	9	8.86	8.09
1994	10	13.48	10.10	11	5.43	5.13
1995	10	16.83	13.88	12	10.22	4.84
1996	11	8.88	8.96	11	10.15	20.59
1997	11	7.41	7.04	12	4.46	4.75
1998	11	6.76	6.13	11	6.90	4.97
1999	12	19.15	26.18	11	5.02	3.79
2000	11	12.63	7.51	39	5.37	8.18
2001	11	8.54	3.99	46	3.66	8.50
2002	11	10.06	6.93	43	1.90	3.26
2003	10	4.15	3.87	11	3.97	2.83
2004	11	9.33	8.39	11	3.99	2.88
2005	11	11.07	6.72	11	11.51	7.45
2006	11	12.40	14.43	11	9.01	6.34
2007	11	33.94	37.42	11	7.57	7.39
2008	11	9.76	6.78	11	2.73	1.90
2009	11	6.76	4.70	12	4.33	5.36
2010	11	19.77	10.44	11	2.09	1.56
2011	11	16.28	27.68	11	1.18	1.37

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

Advice for 2013

ICES advises on the basis of the EU management plan (Council Regulation No. 676/2007) that landings of plaice in Subarea IV in 2013 should be no more than 97 070 t. The implementation of stage two of the plan (as stipulated in article 5 of the EC regulation) is not yet defined.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above target

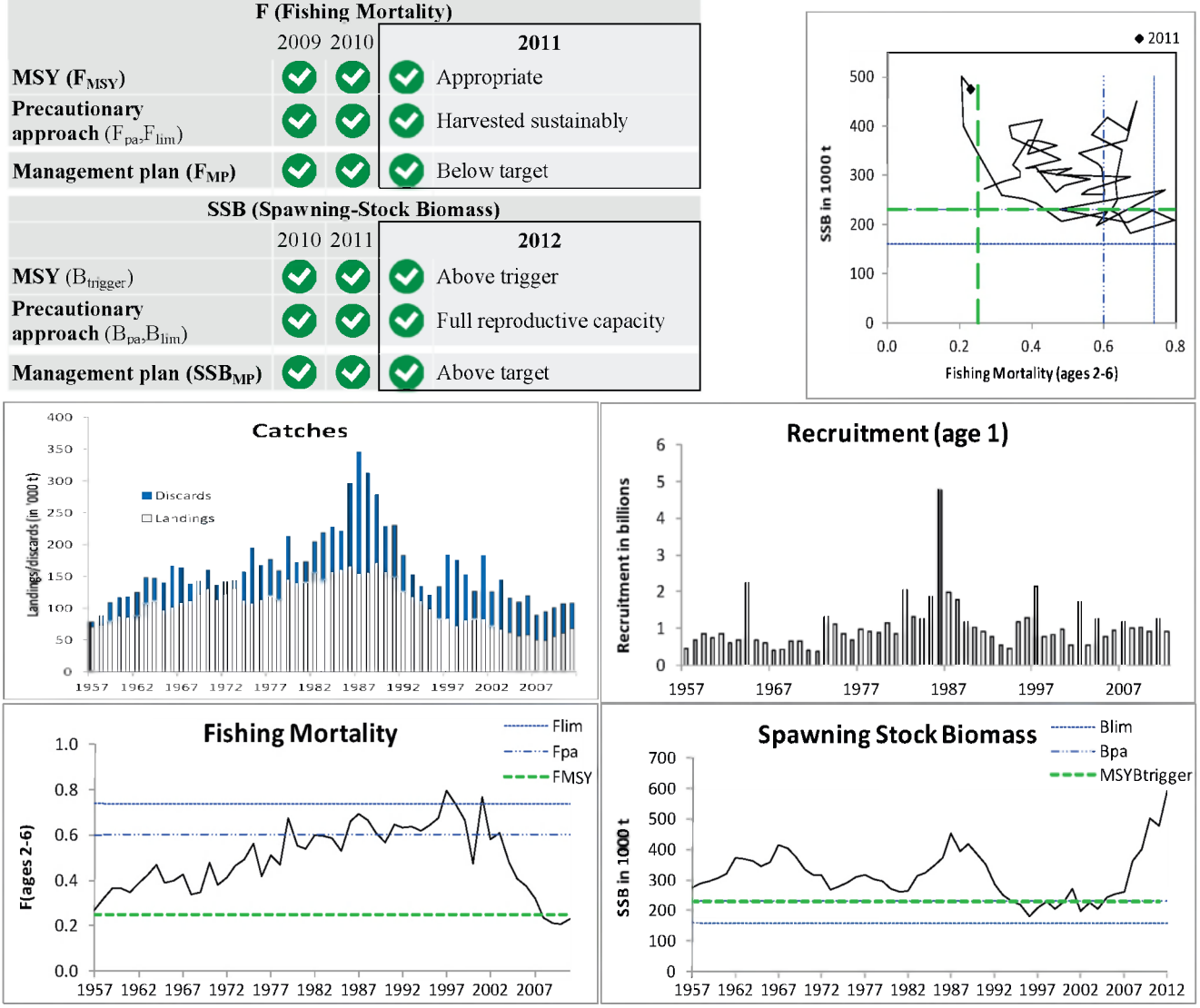


Figure 6.4.7.1 Plaice in Subarea IV (North Sea). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F for the time series used in the assessment.

The stock is well within precautionary boundaries, and has reached its highest levels in recorded history. Recruitment has been at the long-term average from 2007 onwards. Fishing mortality is estimated to be at the historic low.

Management plans

The EU management plan for North Sea plaice and sole (Council Regulation (EC) No. 676/2007, see Appendix 6.4.7). 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 causes high discard rates (in the range of 50% by weight). The discard ratio in the catch has declined in recent years.

Catch distribution	Total catch (2011) = 108.523 t, where 63% are landings (60% beam trawl, 36% otter trawl, and 5% other gears), 37% are discards and <1% industrial bycatch.

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 imprecise, partly because discards form a substantial part of the total catch. Data on the migratory behaviour of plaice in the North Sea, English Channel and the Skagerrak would improve determining stock units for management.

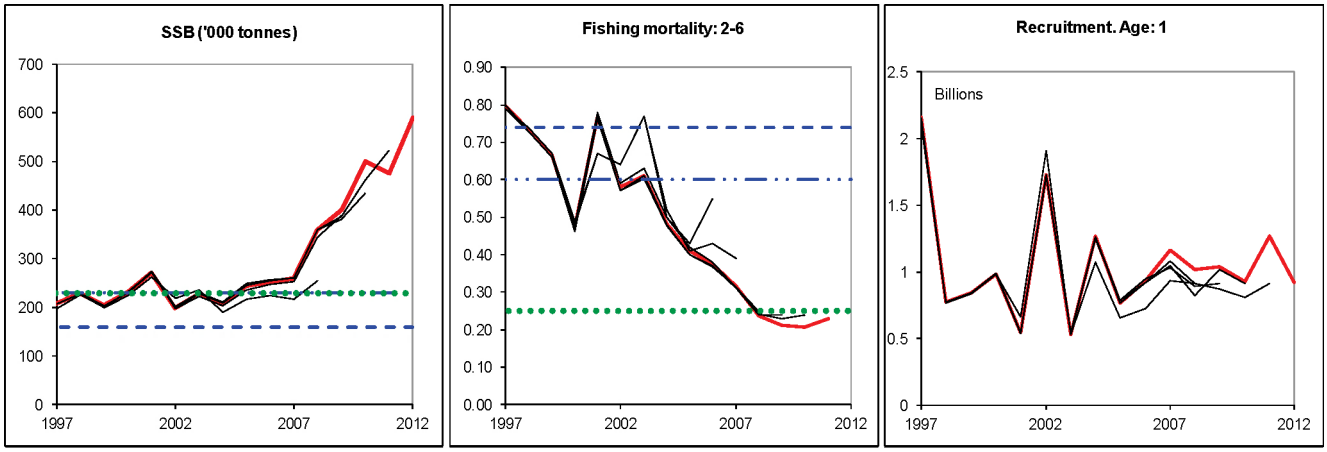


Figure 6.4.7.2 Plaice in Subarea IV (North Sea). Historical assessment results (final year recruitment estimates included).

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.
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 $SSB_{MT} \sim B_{pa}$.

(unchanged since: 2011)

Outlook for 2013

Basis: F(2012) = mean(F2009–2011) scaled to 2011 = 0.23; R(2012) = GM(1957–2008) = 922 million; Landings(2012) = 78 501; Discards(2012) = 51 192; SSB(2013) = 628 143.

Rationale	Landings (2013) [3)]	Basis	F(2–6) total (2013)	F(2–6) HC (2013)	F(2–3) Disc (2013)	Disc (2013)	Catch (2013)	SSB (2014)	% SSB change [1)]	%TAC change [2)]
Management plan	97.070	TAC + 15%	0.27	0.14	0.26	53	151	665	6	15
MSY framework	90	F_{MSY}	0.25	0.13	0.24	50	140	677	8	7
Precautionary approach	189	Fpa	0.6	0.31	0.57	100	290	523	-17	125
Zero catch	0	F=0	0	0	0	0	0	821	31	-100
Other options	26	F_{2012}*0.3	0.069	0.04	0.07	15	42	778	24	-68
	52	F_{2012}*0.6	0.14	0.07	0.13	29	81	738	17	-38
	72	TAC - 15% (=F_{2012}*0.85)	0.20	0.1	0.19	40	113	705	12	-15
	83	F_{2012}	0.23	0.12	0.22	46	129	688	10	-1
	84	Stable TAC (=F_{2012}*1.01)	0.23	0.12	0.22	47	132	689	9	0
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012b)										
Maximum	121	A	0.38	NA	NA	NA	NA	575	-9	44
Minimum	49	B	0.12	NA	NA	NA	NA	785	25	-42
Cod_MP	52	C	0.14	NA	NA	NA	NA	724	15	-38
SQ effort	94	D	0.28	NA	NA	NA	NA	639	2	12
Effort_Mgt	68	E	0.18	NA	NA	NA	NA	716	15	-19

Weights in '000 t.

[1)] SSB 2014 relative to SSB 2013.

[2)] Landings 2013 relative to TAC 2012.

[3)] Landings of plaice in Subarea IV, calculated as the projected total stock landings less the stock landings that occur in Division VIId. The subtracted value (620 t) is estimated based on the plaice catch advice for Division VIId for 2013, using the recent 3-year average (2009-2011) proportion of the Subarea IV plaice stock in the annual plaice landings in Division VIId.

Mixed Fisheries assumptions:

A. Maximum scenario: Fleets stop fishing when last quota exhausted
B. Minimum scenario: Fleets stop fishing when first quota exhausted
C. Cod management plan scenario: Fleets stop fishing when cod quota exhausted
D. SQ effort scenario: Effort in 2012 and 2013 as in 2011
E. Effort management scenario: Effort reductions according to cod and flatfish management plans

Management plan

Following the EU multiannual plan would imply a TAC of 97 070 t (F=0.27) for Subarea IV in 2013, which is a 15% increase in comparison to 2012, complying to the constraint of 15% TAC change of the plan. This is expected to lead to an SSB of 665 000 t in 2014. ICES has evaluated this management plan and considers it to be precautionary. 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. Application of the plan is on the basis of transitional arrangements until an evaluation of the plan has been conducted (as stipulated in article 5 of the EC regulation)

MSY approach

Following the ICES MSY framework implies an increase in fishing mortality to 0.25, resulting in landings of 90 000 t of plaice in Subarea IV in 2013. This is expected to lead to an SSB of 677 000 t in 2014.

Given that the current (2011) estimate of fishing mortality is only slightly below F_{MSY} there is no need to follow a transition scheme towards this reference value.

Precautionary approach

The fishing mortality in 2012 should be no more than F_{pa} (0.6) corresponding to landings of less than 189 000 t of plaice in Subarea IV in 2013. This is expected to keep SSB above B_{pa} in 2014.

Mixed fisheries

In 2012, ICES puts forward mixed fisheries advice for the first time (ICES 2012c). In contrast to single species advice there is no single recommendation but a range of plausible options, assuming fishing patterns and catchability in 2012 and 2013 similar to those in 2011. Major differences between the outcomes of the various scenarios indicate potential unbalance between single-species fishing opportunities. The consequences of this unbalance in terms of changes in fleet dynamics cannot be ascertained.

Cod is the limiting species for the North Sea demersal fisheries in 2013. Following the 'cod' scenario (full implementation of the cod management plan), the plaice management plan catch options could not be fully utilised.

Additional considerations

Management considerations

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 where sole has become relatively more abundant. 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. Discard estimates increased until the early 2000's to above 50% in catch by weight, followed by a slight decreasing trend. Mesh enlargement would reduce the catch of undersized plaice, but would also result in loss of marketable sole.

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 2012.

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 (ICES, 2011).

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

Regulated effort restrictions in the EU were introduced in 2003 (annexes to the annual TAC regulations) for the protection of the North Sea cod stock. In addition, a long-term plan for the recovery of cod stocks was adopted in 2008 (EC regulation 1342/2008). In 2009, the effort management programme switched from a days-at-sea to a kW-day system (EC regulation 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. Otter trawls (OTB) with a mesh size equal to or larger than 100 mm included in TR1, have since 2009 been affected by the regulation. The beam trawl fleet (BT2) was affected by this regulation only once in 2009 but not afterwards.

Overall nominal effort (kW-days) by European demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced (−20% between 2003 and 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), has shown a continuous decline (−12%, −39%, and −35%, respectively, between 2004 and 2011). Effort by large mesh size beam trawl (> 120 mm, BT1) has dropped to very low levels (-70%) (ICES, 2012b). Nominal effort reported by Norway has increased in 2011 due to the generalisation of electronic log-books. 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. The reduction in fishing effort is reflected in reductions in estimated fishing mortality.

Stock identity

The flatfish benchmark (ICES, 2010) recommended to explore the potential to perform an integrated assessment of the continuum of plaice stocks from the Baltic to the English Channel. ICES evaluated the stock identity of plaice in the Skagerrak and Kattegat (ICES 2012a,b) for which until now combined advice was given. Adjacent waters, such as the North Sea in the West and the Belts and Sound in the East are taken into account due to known migration of local components between their spawning and feeding grounds. Although work on stock identity is still under development the collected information on biology and fishery of plaice in IIIa and adjacent waters is considered to imply changes in assessment units as well as in management areas.

Plaice in Skagerrak is considered to be closely associated with plaice in the North Sea and is presented in 2012 for the first time as separate advice. In principle, it is proposed to include Skagerrak data in the North Sea plaice stock assessment in future, although it is recognised that local components (East and West Skagerrak) need to be protected. This year, information from the VIId plaice stock is included in this assessment, but the connection between North Sea and Skagerrak is only explored in the Skagerrak advice.

Changes in fishing technology and fishing patterns

The combination of days-at-sea regulations and the constrained TAC for plaice (due to the 15% limitation in the multiannual plan) and the relatively stable TAC for sole have lead to a more southern fishing pattern in the North Sea where sole has become relatively more abundant. In addition high oil prices may have contributed to this change in fishing pattern as well. This concentration of fishing effort in the South has resulted in high discarding of juvenile plaice that are mainly distributed in those areas. This process could be aggravated by movement of juvenile plaice from coastal nurseries 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. In 2011, approximately 30 licenses for Pulse trawls were taken into operation. Potential future impact either on the sole stock itself or the stock assessment is unknown. Furthermore, the introduction of a new mesh meter (the Omega meter) in 2010 has lead to a slight increase in the effective mesh size in the fishery.

Management plan

A multiannual plan for plaice and sole in the North Sea was adopted by the EU Council in 2007 (EC regulation 676/2007) which describes two stages: to be deemed a recovery plan during its first stage and a management plan during its second stage. ICES considers this plan to be precautionary (ICES, 2010). Objectives are defined for these two stages; to rebuild the stocks to within safe biological limits and to exploit the stocks at MSY respectively. Stage 1 is deemed to be completed when both stocks have been within safe biological limits for two consecutive years. TAC setting procedures are provided to accommodate stage 1 as well as a transitional period during which and Impact Assessment an evaluation should take place to reconsider long term objectives. The plaice stock has been within safe biological limits as defined by the plan since 2005. The sole stock has been within safe biological limits in terms of fishing mortality since 2008, while SSB has been slightly fluctuating around the biomass limit (Bpa=35 kt) since 2008. Consequently, ICES concludes that the objectives of stage 1 are currently met and provides advice based on the plan's TAC setting procedure acknowledging to be in a transitional stage at present.

The management plan prescribes effort limitations (kW-days per metier) to be adjusted in line with changes in fishing mortality. The current advice implies a reduction of 10% in effort (following a 10% reduction in F for sole).

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 inappropriate 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. From 2011 onwards, Dutch discard estimates will be derived solely from the self-sampling program. Preliminary analyses suggest that these estimates are as reliable as those from the observer program. Further analyses will be conducted in 2012 as more data from 'matched trips' (self-sampling and observer estimates from the same vessel trip) become available.

The Fishers' North Sea stock survey again took place in 2011 (Napier, 2011; Figure 6.4.7.4). Slightly less than half of the respondents (44%) reported that plaice were 'more' or 'much more' abundant in 2011 than in 2010. Ths is down from two thirds last year. There was also a slight increase in the proportion of respondents reporting a decrease in the abundance of plaice (from 9% to 19%). However, 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, which adds to the uncertainty 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.

Discards form a substantial part of the total catch. The improvement of retrospective patterns observed in the recent years might have beneficiated from increased coverage of discards estimates from the main fishing nations, through self-sampling and observers programs.

Changes in commercial fleets (e.g. from beam to pulse trawls) used for tuning the assessment may have introduced bias.

Comparison with previous assessment and advice

It has been estimated that 50% of first quarter landings taken in the Eastern Channel (VIId) are actually plaice from the North Sea stock migrating in and out of the area. These landings are usually removed from the assessment of the Eastern Channel stock. From 2012 these landings, which represent less than 1% of the total North Sea catches, are included in the assessment of the North Sea plaice stock.

The 2012 assessment is in very close agreement with that of 2011. As last year, advice is based on the EU management plan.

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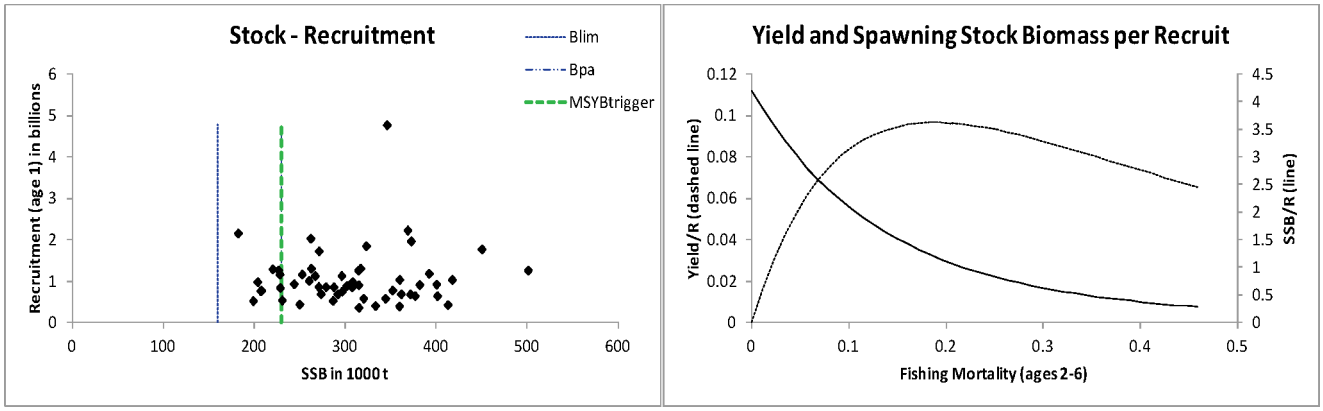


Figure 6.4.7.3 Plaice in Subarea IV (North Sea). Stock–recruitment plot and yield-per-recruit analysis.

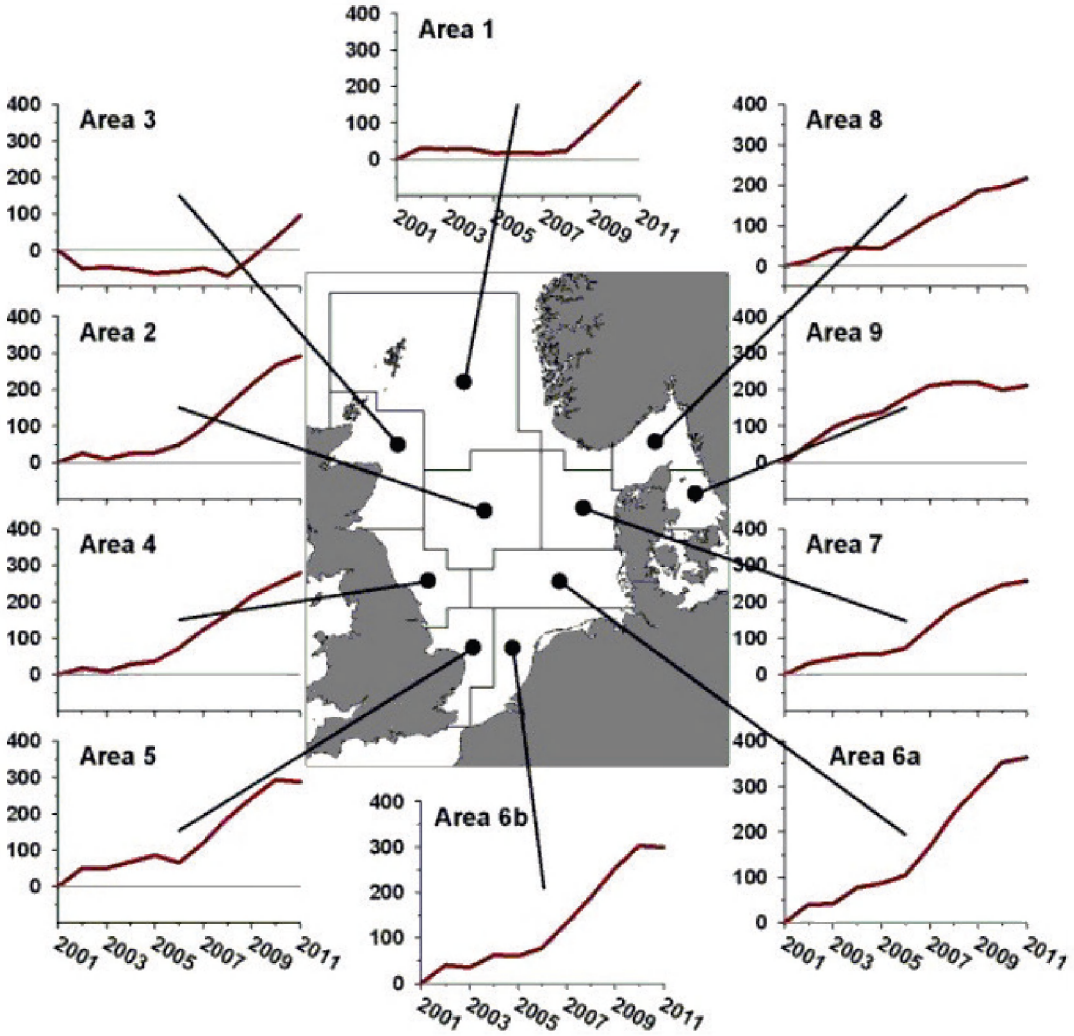


Figure 6.4.7.4 Plaice in Subarea IV (North Sea). Abundance estimates by the North Sea Commission fisher's survey 2010.

Table 6.4.7.1 Plaice in Subarea IV (North Sea). ICES advice, management, and landings. ICES landings have been updated and now include 50% of the Q1 landings of plaice in area VIId (for all years, introduced in 2012).

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	66	67
2012	Apply first stage of the management plan	< 84.410	84.4		
2013	Apply first stage of the management plan	<97.07			

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). Official landings by country and ICES estimates of landings (tonnes).

YEAR	Belgium	Denmark	France	Germany	Nether-lands	Norway	Sweden	UK	Others	Total	Un-allocated	ICES 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	4466	11634	344	3812	29272	1223	3	15169		65923	1463	67386	73400
2012													84410

*** 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	Catches tonnes	discards tonnes	Mean F Ages 2-6
1957	458000	273000	78400	7880	0.269
1958	698000	287100	88200	14837	0.321
1959	863000	296300	109200	29864	0.367
1960	757000	307200	117300	29793	0.368
1961	861000	319900	118500	32490	0.348
1962	589000	371300	125400	37903	0.390
1963	688000	368400	148400	41258	0.423
1964	2232000	361200	147600	37031	0.469
1965	695000	343900	140200	43080	0.388
1966	587000	359200	166600	64718	0.399
1967	401000	412600	163400	54546	0.429
1968	434000	401000	139500	27987	0.336
1969	649000	376400	142800	21169	0.345
1970	651000	332900	160000	29640	0.480
1971	410000	314700	136900	22995	0.382
1972	367000	316600	142500	19632	0.412
1973	1312000	266600	143800	13354	0.466
1974	1133000	278500	157500	44945	0.491
1975	865000	291500	195200	86699	0.561
1976	693000	307700	166900	53247	0.416
1977	989000	314400	176700	57501	0.510
1978	914000	301400	159600	45655	0.468
1979	895000	295800	213300	67935	0.673
1980	1134000	270500	171500	31080	0.555
1981	869000	261800	173600	33031	0.538
1982	2035000	262300	204500	49127	0.602
1983	1312000	314100	219400	74483	0.594
1984	1264000	322800	227800	70816	0.585
1985	1854000	345700	221400	60549	0.531
1986	4775000	372200	296500	129953	0.662
1987	1970000	450000	345600	190524	0.692
1988	1776000	391800	312700	156423	0.666
1989	1189000	417300	279100	107793	0.610
1990	1039000	381500	229000	71225	0.567
1991	918000	351700	230300	80935	0.649
1992	782000	286200	183300	57049	0.631
1993	533000	249500	153000	35016	0.637
1994	446000	227800	135200	23785	0.619
1995	1167000	220000	121100	21828	0.643
1996	1296000	182000	134600	52049	0.673
1997	2160000	207600	184300	100145	0.796
1998	778000	228200	176300	103751	0.735
1999	845000	203400	152700	70976	0.666
2000	987000	230400	126800	44311	0.475
2001	544000	270900	183200	100309	0.770
2002	1730000	198600	125800	54390	0.580
2003	529000	226300	145000	77792	0.610
2004	1270000	206700	116500	54466	0.481
2005	771000	243500	110100	53876	0.410
2006	937000	252300	120300	61846	0.375
2007	1168000	259900	89800	39435	0.317
2008	1015000	359400	95300	45875	0.237
2009	1041000	400100	100700	45225	0.211
2010	929000	500800	107000	45817	0.206
2011	1266000	476100	108500	40560	0.229
2012	922294*	589341			
Average	1060577	315328	162160		0.496
	* = Long term geometric mean				

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.*

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

Advice for 2013

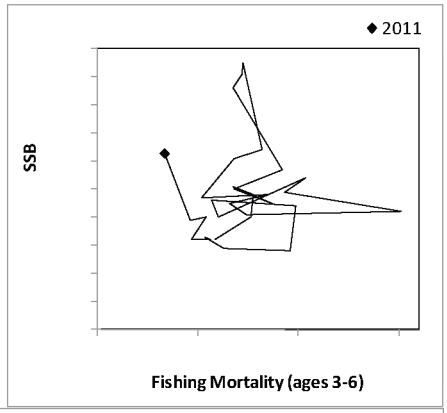
Based on the ICES approach for data limited stocks, ICES advises that catches of plaice in Division VIId should be no more than 4300 t, and discarding should be reduced.

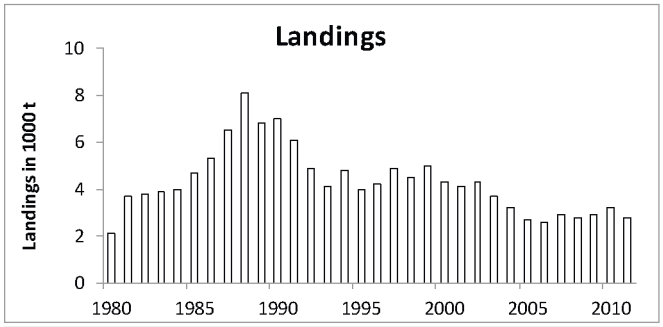
This is the first year that ICES is providing quantitative advice for data limited stocks (see Quality considerations).

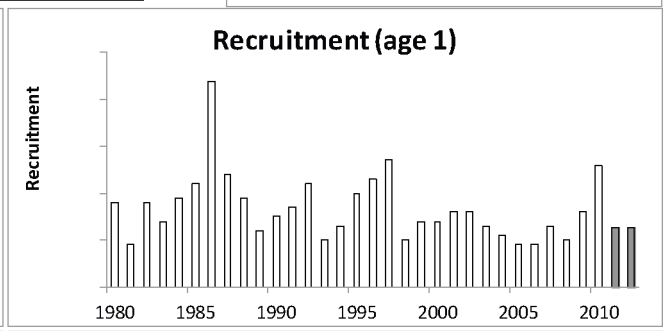
Stock status

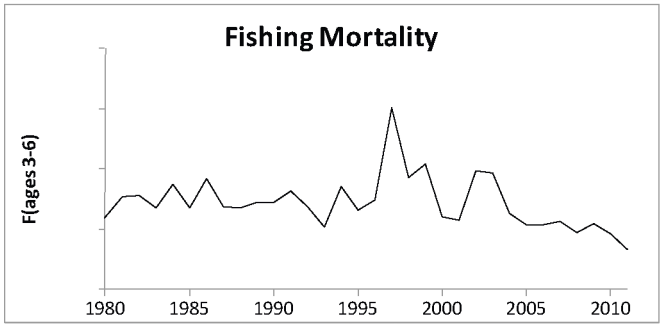
F (Fishing Mortality)		
	2009-2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	↘	Lowest in time series

SSB (Spawning-Stock Biomass)		
	2008-2012	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↗	increasing









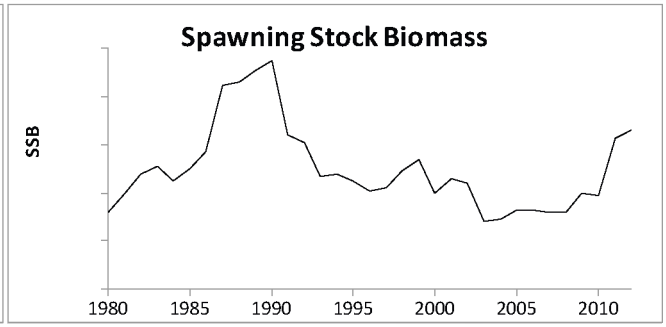


Figure 6.4.8.1 Plaice in Division VIId (Eastern Channel). Summary of stock trends (weights in '000 tonnes, Y-axis starts at 0). Predicted values are shaded. Top right: SSB and F for the time series used in the assessment.

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 increased since. The most recent two estimates of recruitment are shaded because of poor reliability of the model fit and set to the geometric mean (1999-2009).

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 substrate 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.

Catch distribution	Total landings of plaice in Division VIId (2011) = 3,537 kt (including components of the IV and VIIe coming in VIId to spawn in the beginning of the year) 48% beam trawl, 30% otter trawl, 18% trammelnets, and 4% 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. 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 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. Stock structure and mixing rate during the spawning period might be refined by new tagging, genetic or studies based on the shape of the otoliths.

The methods applied to derive quantitative advice for data limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

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

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	0.23	Simulation studies and equilibrium analyses taking into account a number of possible stock–recruitment relationships and in line with the other plaice stocks
Precautionary approach	Not defined		

(unchanged since: 2012)

Outlook for 2013
Due to uncertainty in the stock assessment, which is only considered indicative of stock trends, reliable predictions cannot be presented.

ICES approach to data limited stocks

For data limited stocks with abundance and fishing mortality information, ICES uses as harvest control rule an index-adjusted status-quo catch, further modified so as to reach the FMSY proxy in 2015. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data, and subsequently multiplied by the appropriate ratio of values of F.

For this stock, the abundance is estimated to have increased by 74% between 2008-2010 (average of the three years) and 2011-2012 (average of the two years), whereas the current fishing mortality should be reduced by 29% in 2013 as a first step to reach the FMSY proxy by 2015. Since the product of 1.74 and 0.71 is larger than 1.2, this implies an increase of catches of at most 20% in relation to last three years average landings, corresponding to catches of no more than 4300 t.

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, 57/2011 and 43/2012 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

The quality of the assessment is considered to have improved in 2012. In particular, the adjustment of the plus group from age 10 to 7 has reduced consequently the retrospective bias. However, no reliable quantitative assessment is possible due to the insufficient discard information which is a considerable part of the catch. 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. A sufficiently long time series of discards is required to improve the assessment.

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.

Comparison with previous assessment and advice

Last year's advice was based precautionary considerations. This year the advice is based on the ICES approach to data limited stocks.

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.

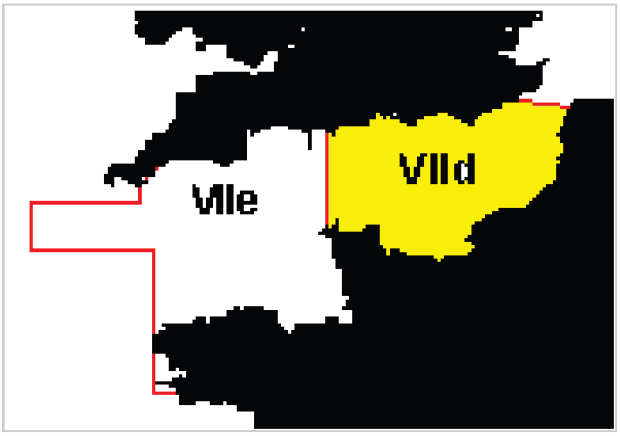


Figure 6.4.8.2 Plaice in Division VIId (Eastern Channel). Assessment in Division VIId and TAC area Divisions VIId,e.

Sources

Burt, G., Goldsmith, D., and Armstrong, M. 2006. A summary of demersal fish tagging data maintained and published by Cefas. Sci. Ser. Tech Rep., Cefas Lowestoft, 135. 40 pp.

Hunter, E. J. D., Metcalfe, G., Arnold, P., and Reynolds, J. D. 2004. Impacts of migratory behaviour on population structure in North Sea plaice. Journal of Animal Ecology, 73: 377–385.

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Kell, L. T., Scott, R., and Hunter, E. 2004. Implications for current management advice for North Sea plaice: Part I. Migration between the North Sea and English Channel. Journal of Sea Research, 51: 287–299.

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 $<F_{pa}$ *)	<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	3.6	3.6
2012	No increase in catches and reduce discards	-	4.665		
2013	Transition to F_{MSY} proxy for data limited stocks by 2015 and reduce discards	< 4.3			

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 (7)	Total landings reported in VIIe	Agreed TAC (5)
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 (23)	700	+	4830	932	5762	1295	4467	1430	5700
1999	1306	-	3388 (23)	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	471	12	3609	-118	3491	728	2763	1144	4646
2009	1002		1892	612	16	3522	-19	3503	614	2889	1043	4274
2010	1123		2190	517	62	3892	-80	3812	635	3177	2240	4665
2011	1033		2000	460	56	3549	-12	3537	750	2787	1192	4665

1 Estimated by the working group from combined Division VIId+e

2 Includes Division VIIe

3 Provisional

4 Data provided to the WG but not officially provided to ICES

5 TAC´s for Divisions VII d, e.

6 Unavailable

7 takes into account the removal of 65% of the Quarter 1 catches

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

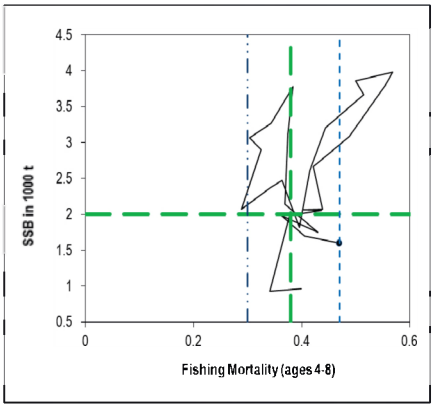
Advice for 2013

ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 560 tonnes.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✗	✓	At target
Precautionary approach (F_{pa},F_{lim})	o	o	o	Increased risk

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined



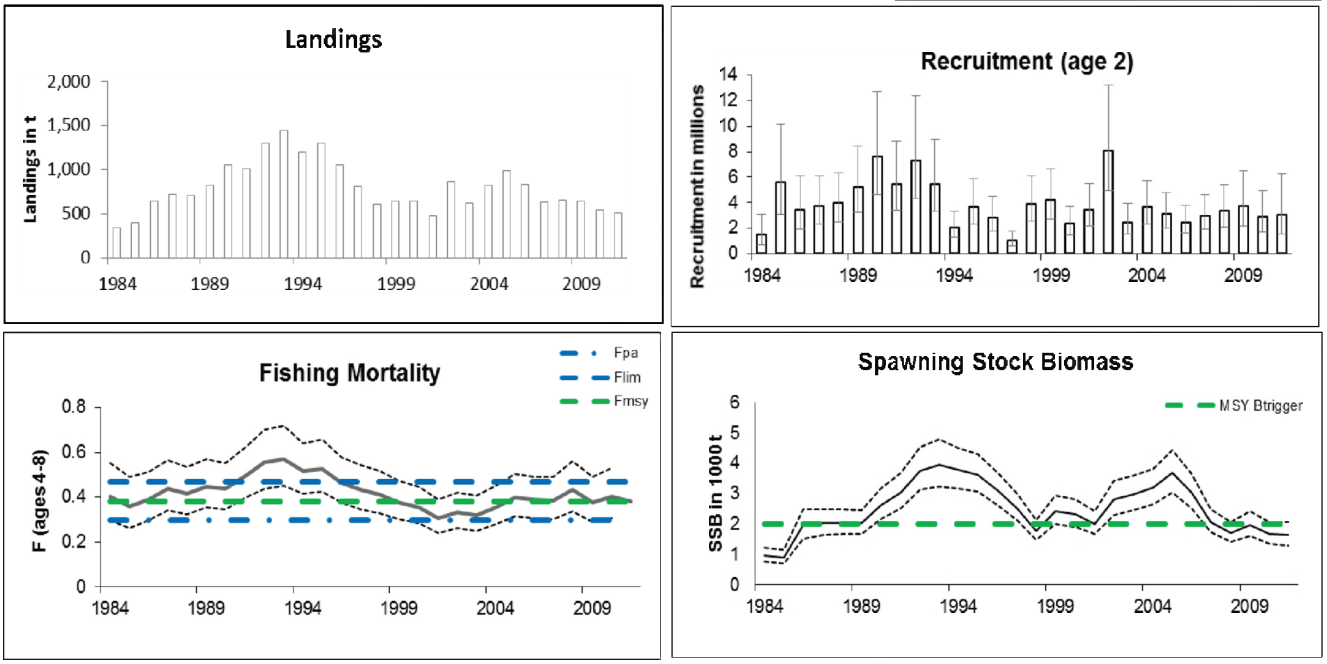


Figure 6.4.9.1 Sole in Division IIIa and Subdivisions 22–24. Summary of stock assessment (weights in '000 tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Top right: SSB and F over the years.

SSB has decreased from 2005, and has fluctuated around MSY $B_{trigger}$ since 2007 and is now below MSY $B_{trigger}$. Fishing mortality has been around F_{MSY} since 2005. The last strong year-class was in 2000 and since then recruitment has been slightly above the long-term 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 taken in a directed trawl fishery with bycatch of *Nephrops*, plaice and cod, the main season being in autumn–winter. In addition there is a directed gillnet fishery for sole, mainly in Skagerrak in spring and summer.

Catch distribution	Total landings (2011) =551 t, where 92% are landings (43% trawl, 41% gillnets, and 8% unknown) and 8% discards.

Quality considerations

Sampling of landings is complicated by the small total landings which are dispersed spatially. This effects the quality of the input data. Historically, the assessment has overestimated SSB and underestimated fishing mortality.

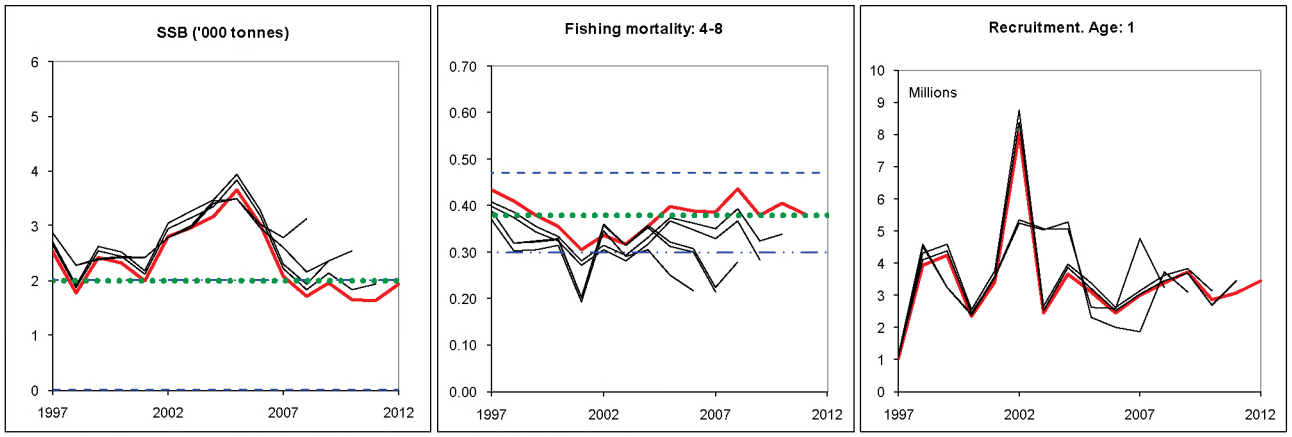


Figure 6.4.9.2 Sole in Division IIIa and Subdivisions 22–24. Historical performance of the assessments. The assessments before 2009 do not include Subdivisions 22–24.

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 in the assessment.
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 1984–1985 low SSB's (ICES, 2010).
	F_{MSY}	0.38	Provisional value based on Stochastic simulations. F associated with highest yield and low prob. of SSB<Btrigger (ICES, 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 (2012):

	Fish Mort Ages 4–8	Yield/R	SSB/R
Average last 3 years	0.35	0.20	0.73
F_{max}*	-	-	-
$F_{0.1}$	0.21	0.18	1.03
$F_{35\%SPR}$	0.22	0.18	1.00

* F_{max} is not well defined.

Outlook for 2013

Basis: F2012 = F_{sq} = mean F(2009–11) unscaled =0.39; SSB (2013) = 1.9; R (age 2 in 2012) = GM(1994–2009) = 3.1 mill; landings (2012) = 0.57.

Rationale	**Landings (2013)**	**Basis**	**F (2013)**	**SSB (2014)**	**%SSB change [1)]**	**%TAC change [2)]**
MSY framework	0.56	F_{MSY} *SSB_{2013}/MSY $B_{trigger}$	0.36	2.0	6%	-15%
Precautionary approach	0.49	Fpa = F_{2011}*0.73	0.30	2.1	11%	-27%
Zero catch	0	F = 0	0	2.6	37%	-100%
Other options	0.33	F_{2012}*0.5	0.19	2.3	19%	-51%
	0.56	F_{2012}*0.92	0.36	2.0	6%	-15%
	0.59	F_{MSY} = F_{2012}*0.99	0.38	2.0	5%	-10%
	0.61	F_{2012}	0.39	2.0	4%	-9%
	0.67	F_{2012}*1.1	0.43	1.9	1%	0%
	0.76	F_{2012}*1.3	0.52	1.8	-4%	15%

Weights in '000 tonnes.
[1)] SSB 2014 relative to SSB 2013.
[2)] Landings 2013 relative to TAC 2012.

MSY approach

Because SSB in the beginning of 2013 is below MSY $B_{trigger}$, the ICES MSY framework implies a fishing mortality of F_{MSY} *SSB_{2013}/MSY $B_{trigger}$ of 0.36. This results in landings of no more than 560 t in 2013. This is expected to lead to an SSB of 2000 t in 2014.

PA approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to landings of no more than 490 t. This is expected to bring SSB above B_{pa} in 2014.

Additional considerations

For the majority of sole stocks assessed by ICES an F_{MSY} is defined around 0.25. For this stock 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. Since then the 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 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.

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.

Discard data are not included in the assessment. Discard observations in 2011 estimates discarding in the order of 8% by weight which is an increase since 2010 (2%).

Uncertainties in assessment and forecast

The proportion of fishery-independent information to the assessment has increased markedly with the inclusion of the Fishers–DTU Aqua sole survey and the termination 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 complicated by the small total landings which are dispersed spatially. This affects the quality of the input data.

Comparison with previous assessment and advice

This year's assessment of SSB_{2011} is 8% lower and F_{2010} is estimated to be 19% higher than the assessment results last year.

The basis for the advice is the same as for last year: the MSY framework.

Source

ICES. 2010. Report of the Benchmark Workshop on Flatfish (WKFLAT), 25 February–4 March 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:37. 270 pp.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group. Copenhagen, 12–19 April 2012. ICES CM 2012/ACOM:10.

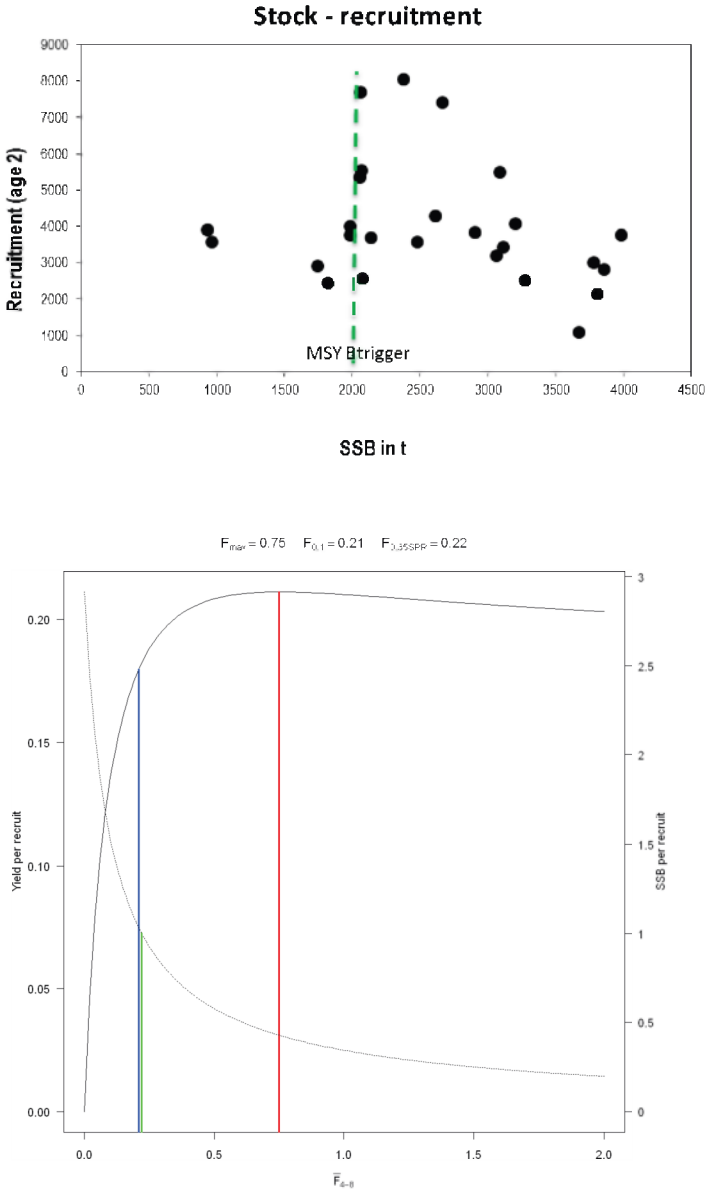


Figure 6.4.9.3 Sole in Division IIIa and Subdivisions 22–24. Stock–recruitment (top) and yield-per-recruit analysis plot (bottom). The vertical lines represent biological reference points.

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	-	0.84	0.52
2012	MSY Framework	0.61	0.61[4]	
2013	MSY Framework	0.56		

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.
[4)] No more than 461 t in IIIa

Table 6.4.9.2 Sole in Division IIIa and Subdivisions 22–24. Official landings (tonnes), and ICES corrections. For Sweden there is no information between1962–1974.

Year	Denmark			Sweden	Germany	Belgium	Netherlands		Working Group	Total
	Kattegat	Skagerrak	Belts	Skag+Kat	Kat+Belts	Skagerrak		Skagerrak	Corrections	
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
1992	856	372		54					12	1294
1993	1016	355		68	9				-9	1439
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	645
2001	249	286	21	25					-103	478
2002	360	177	18	15	11				281	862
2003	195	77	17	11	17				301	618
2004	249	109	40	16	18				392	824
2005	531	132	118	30	34	Norway			145	990
2006	521	114	107	38	43	9	4			836
2007	366	81	93	45	39	9	0			633
2008	361	102	113	34	35	7	3			655
2009	325	103	145	37	27	4				641
2010	273	61	125	46	26	3	3			538
2011	271	127	65	53	33	3				552

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 median fishing mortality for ages 4 to 8 (F(4-8)). Low = lower limit and High = higher limit of 95% confidence interval.

	Recruits	R boundaries		TSB	TSB boundaries		SSB	SSB boundaries		F(4-8)	F boundaries	
Year		Low	High		Low	High		Low	High		Low	High
1984	1476	709	3072	1230	945	1602	960	751	1227	0.405	0.296	0.554
1985	5599	3097	10125	1880	1331	2656	906	704	1166	0.361	0.265	0.492
1986	3442	1946	6089	2516	1964	3223	1948	1524	2490	0.39	0.298	0.511
1987	3780	2350	6078	2630	2147	3220	2025	1654	2478	0.439	0.341	0.565
1988	3976	2483	6366	2657	2173	3248	2025	1661	2467	0.416	0.325	0.533
1989	5220	3244	8399	2950	2390	3640	2031	1685	2449	0.448	0.354	0.568
1990	7646	4619	12658	3989	3164	5029	2613	2156	3166	0.439	0.348	0.553
1991	5455	3390	8777	3995	3266	4887	3046	2516	3688	0.497	0.397	0.621
1992	7342	4358	12370	5319	4272	6623	3756	3130	4506	0.556	0.44	0.703
1993	5425	3285	8959	4902	4007	5996	3936	3235	4789	0.569	0.45	0.72
1994	2065	1294	3296	4132	3486	4897	3772	3176	4480	0.517	0.418	0.64
1995	3685	2306	5887	4309	3634	5108	3620	3060	4283	0.527	0.424	0.656
1996	2821	1773	4488	3587	3022	4258	3091	2604	3668	0.467	0.375	0.581
1997	1053	637	1742	2725	2293	3237	2516	2113	2997	0.433	0.347	0.542
1998	3923	2507	6141	2398	1977	2907	1766	1473	2117	0.411	0.328	0.516
1999	4233	2687	6669	3103	2543	3786	2417	1995	2928	0.379	0.302	0.475
2000	2347	1487	3703	2709	2243	3272	2313	1913	2796	0.356	0.284	0.447
2001	3423	2132	5495	2626	2149	3211	1997	1657	2405	0.306	0.24	0.391
2002	8047	4909	13193	4191	3327	5279	2807	2300	3426	0.335	0.265	0.422
2003	2453	1516	3968	3398	2814	4104	2971	2454	3598	0.318	0.248	0.408
2004	3652	2348	5681	3920	3255	4722	3179	2647	3818	0.355	0.28	0.451
2005	3118	2014	4827	4262	3541	5130	3664	3038	4419	0.398	0.314	0.505
2006	2460	1601	3780	3532	2950	4228	3038	2526	3653	0.389	0.307	0.492
2007	2987	1939	4601	2701	2243	3251	2070	1733	2474	0.386	0.304	0.49
2008	3369	2114	5370	2426	1963	2999	1702	1405	2060	0.436	0.338	0.562
2009	3741	2158	6487	2746	2165	3483	1957	1595	2401	0.378	0.291	0.49
2010	2858	1659	4923	2397	1868	3077	1660	1339	2057	0.405	0.309	0.532
2011	3077	1519	6234	2436	1795	3306	1633	1288	2071	0.381	0.283	0.513
2012	3444	1073	8388				1944	1251	3268			

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

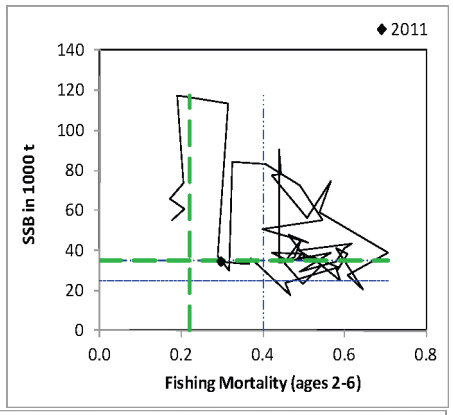
Advice for 2013

ICES advises on the basis of the EU management plan (Council Regulation No. 676/2007) that landings in 2013 should be no more than 14 000 tonnes. ICES notes that the advice is based on stage one of the plan. The implementation of stage two of the plan (as stipulated in article 5 of the EC regulation) is not yet defined.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✗	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	○	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✗	✓	✓	Above target



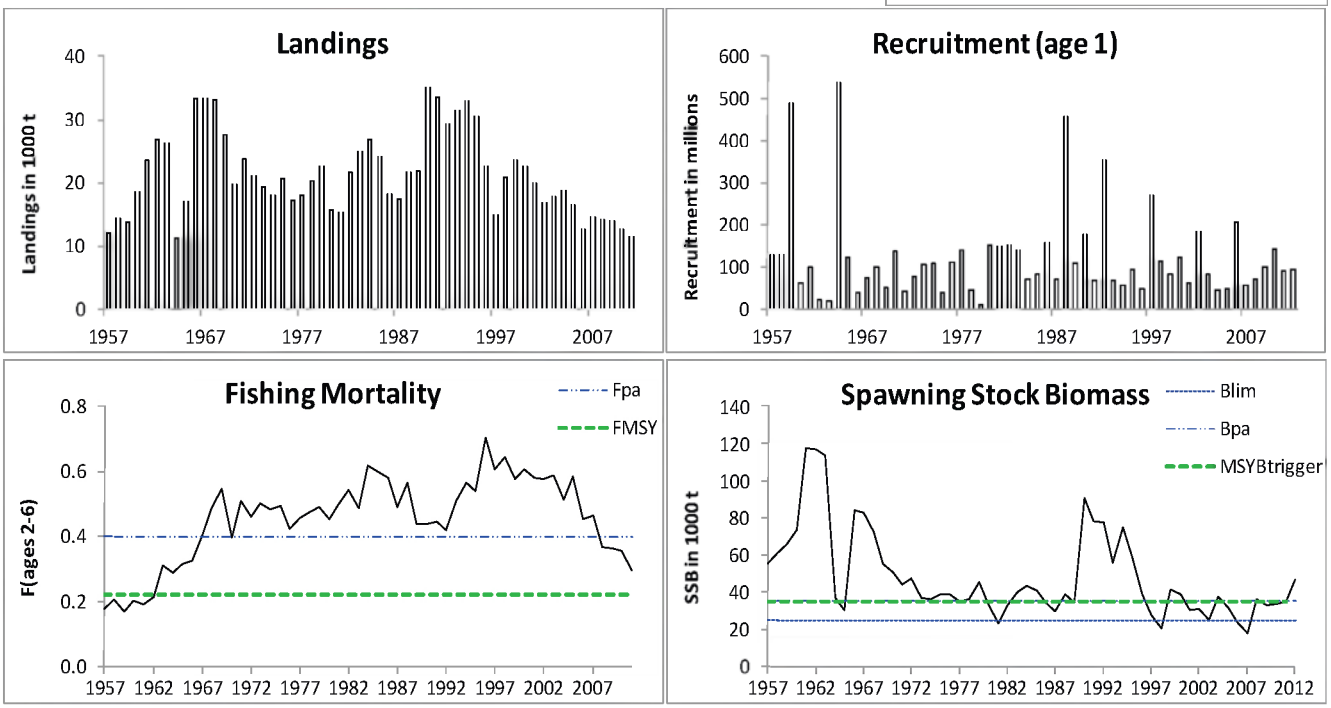


Figure 6.4.10.1 Sole in Subarea IV (North Sea). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F for the time series used in the assessment.

SSB has fluctuated around the precautionary reference points for the last decade and is estimated to be above B_{pa} in 2012. Fishing mortality has shown a declining trend since 1995 and is estimated to be between F_{MSY} and 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) An evaluation of the plan (ICES, 2010a) 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.

The fisheries

Sole is mainly caught by the beam-trawl fleet working with 80 mm mesh. In recent years, and increasing proportion of the traditional beam trawl fleet has switched to sumwing and/or pulse trawl.

Catch distribution	Total catch (2011) = 11.5 kt, where 100% are landings (~83% beam trawl, 13% gill / trammel nets, 4% otter trawl).

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. 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. Days-at-sea regulations, high oil prices, and changes in the ratio of TACs for plaice and sole have led to a transfer of fishing effort to the southern North Sea where sole and juvenile plaice tend to be more abundant, leading to an increase in discarding of small plaice in the beginning of the 2000s.

Quality considerations

There are divergent signals between the scientific survey and the commercial data used to tune the sole assessment. A survey covering the whole area would be a more suitable index of abundance. Recent increases in pulse trawlers, which have different catchabilities and selectivities as the traditional beam trawlers, may induce bias in the lpue. Data on the extent of the use of new gears is needed. In addition, discards are not included in the assessment, while they have shown a slight increase in recent years.

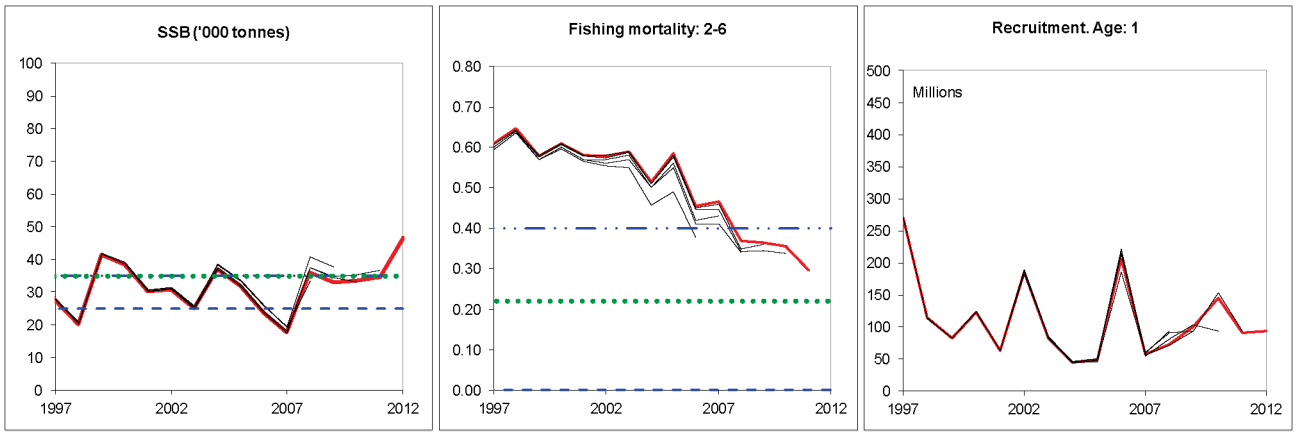


Figure 6.4.10.2 Sole in Subarea IV (North Sea). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Two survey indices (BTS-ISIS, SNS); one commercial index (NL TBB).
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 $P(SSB<B_{pa}) < 10\%$

(unchanged since: 2011)

Outlook for 2013

Basis: F (2012) = Fsq = mean (F2009–2011) scaled to 2011 = 0.30; SSB (2013) = 47; R (2012) = 94 mln = GM(1957–2009) ; Landings (2012) =15.

Rationale	Human Consumption landings (2013)	Basis	F Total (2013)	SSB (2014)	%SSB change [1]	%TAC change [2]
Management plan	14	F = 0.27 (10% reduction)	0.27	49	4 %	-15 %
MSY transition	14	$(F_{2010}*0.4)+(F_{HCR-MSY}*0.6)$	0.27	48	3 %	-13 %
MSY framework	12	F_{MSY}	0.22	51	8 %	-28 %
Precautionary approach	19	F_{pa}	0.4	43	-9 %	20 %
Zero catch	0	F = 0	0	63	34 %	-100 %
Other options	5.1	$(F_{2012}*0.3)$	0.09	58	23 %	-69 %
	13.770	TAC-15% $(F_{2012}*0.88)$	0.26	49	3 %	-15 %
	15	(F_{2012})	0.3	47	0 %	-7 %
	16	Stable TAC $(F_{2012}*1.07)$	0.32	46	-2 %	0 %
	18.630	TAC+15% $(F_{2012}*1.3)$	0.38	44	-7 %	15 %
	25	$(F_{2012}*1.9)$	0.56	37	-22 %	56 %
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012b)						
Maximum	19	A	0.42	42	-11%	+20%
Minimum	7.9	B	0.13	60	+27%	-51%
Cod_MP	8.6	C	0.15	56	+18%	-47%
SQ effort	15	D	0.30	47	+1%	-6%
Effort_Mgt	13	E	0.24	52	+10%	-21%

Weights: '000 tonnes.
[1] SSB 2014 relative to SSB 2013.
[2] Human Consumption landings 2013 relative to TAC 2012.
Mixed fisheries assumptions
A. Maximum scenario: Fleets stop fishing when last quota exhausted
B. Minimum scenario: Fleets stop fishing when first quota exhausted
C. Cod management plan scenario: Fleets stop fishing when cod quota exhausted
D. SQ effort scenario: Effort in 2012 and 2013 as in 2011
E. Effort management scenario: Effort reductions according to cod and flatfish management plans

Management plan

Following the EU multiannual plan would imply a 10% reduction of F to 0.27, resulting in a TAC of 14 000 t in 2013 (an exact 15% reduction in comparison to 2012, without applying the 15% TAC change bounds of the plan) and implying a 10% reduction in fishing effort. This is expected to lead to an SSB of 49 000 t in 2014. ICES has evaluated

this management plan and considers it to be precautionary. 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. Application of the plan is on the basis of transitional arrangements until an evaluation of the plan has been conducted (as stipulated in article 5 of the EC regulation)

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 12 000 t in 2013. This is expected to lead to an SSB of 51 000 t in 2014.

Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to 0.27 ((0.36 *0.4) + (0.22 *0.6)), which will result in landings of less than 14 000 t in 2013. This is expected to lead to an SSB of 48 000 t in 2014.

Precautionary approach

The precautionary F_{pa} for North Sea sole is 0.4. This would lead to landings of 19 000 t in 2013 and an SSB of 41 000 t in 2014.

Mixed fisheries

In 2012, ICES puts forward mixed fisheries advice for the first time (ICES, 2012c). In contrast to single species advice there is no single recommendation but a range of plausible options, assuming fishing patterns and catchability in 2012 and 2013 similar to those in 2011. Major differences between the outcomes of the various scenarios indicate potential unbalance between single-species fishing opportunities. The consequences of this unbalance in terms of changes in fleet dynamics cannot be ascertained.

Cod is the limiting species for the North Sea demersal fisheries in 2013. Following the 'cod' scenario (full implementation of the cod management plan), the sole management plan catch options could not be fully utilised.

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 increased. Reasons for the increase are unclear and should be investigated. 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 the 2005 year class. 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 2012.

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.

Regulations and their effects

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.

Overall effort (kW-days) by demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel has been substantially reduced (−20% between 2003 and 2011). Effort by beam trawl fleet in both small mesh size (80–120 mm, BT2) and large mesh size (> 120 mm, BT1) has shown a decline (−3839% and −70%, respectively) between 2003 and 2011.

Regulated effort restrictions in the EU were introduced in 2003 (annexes to the annual TAC regulations) for the protection of the North Sea cod stock. In addition, a long-term plan for the recovery of cod stocks was adopted in 2008 (EC regulation 1342/2008). In 2009, the effort management programme switched from a days-at-sea to a kW-day system (EC regulation 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. A minor part of the fleets exploiting sole, i.e. otter trawls (OTB) with a mesh size equal to or larger than 100 mm included in TR1, have since 2009 been affected by the regulation. The beam trawl fleet (BT2) was affected by this regulation only once in 2009 but not afterwards.

Changes in fishing technology and fishing patterns

The combination of days-at-sea regulations, high oil prices, and the constrained TAC for plaice (due to the 15% limitation in the multiannual plan) and the relatively stable TAC for sole have lead to a more southern fishing pattern in the North Sea, where sole has become relatively more abundant. This concentration of fishing effort in the South has resulted 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. In 2011, approximately 30 licenses for Pulse trawls were taken into operation. Potential future impact either on the sole stock itself or the stock assessment is unknown. Furthermore, the introduction of a new mesh meter (the Omega meter) in 2010 has lead to a slight increase in the effective mesh size in the fishery.

Information from the fishing industry

The Fishers' North Sea stock survey again took place in 2011 (Napier, 2011; Figure 6.4.10.4). Overall, about one-third of respondents (35%) reported that sole were 'more' or 'much more' abundant in 2011, a much lower proportion than in 2010 (65%). Fishers' perception of high recruitment in 2010 (38%) is in accordance with the strong 2009 yearclass observed in the assessment.

Preliminary observations by the industry using "Pulse trawls" in 2011 show higher catch rates of sole than traditional beam trawls.

Management plan

A multiannual plan for plaice and sole in the North Sea was adopted by the EU Council in 2007 (EC regulation 676/2007) which describes two stages: to be deemed a recovery plan during its first stage and a management plan during its second stage. ICES considers this plan to be precautionary (ICES, 2010a). Objectives are defined for these two stages; to rebuild the stocks to within safe biological limits and to exploit the stocks at MSY respectively. Stage 1 is deemed to be completed when both stocks have been within safe biological limits for two consecutive years. TAC setting procedures are provided to accommodate stage 1 as well as a transitional period during which and Impact Assessment an evaluation should take place to reconsider long term objectives. The plaice stock has been within safe biological limits as defined by the plan since 2005. The sole stock has been within safe biological limits in terms of fishing mortality since 2008, while SSB has been slightly fluctuating around the biomass limit (Bpa=35 kt) since 2008. Consequently, ICES concludes that the objectives of stage 1 are currently met and provides advice based on the plan's TAC setting procedure acknowledging to be in a transitional stage at present.

The current plan prescribes effort limitations (kW-days per metier) to be adjusted in line with changes in fishing mortality. The current advice implies a reduction of 10% in effort (following a 10% reduction in F to 0.27 for sole).

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.

An explanation for the reduction of fishing mortality in the mid 2000s seems to be a reduction of capacity in the beam-trawl fleet. Also, high fuel prices may have contributed to the decrease in fishing mortality. In the last 3 years effort limitations have not been restrictive.

Changes in commercial fleets (e.g. from beam to pulse trawls) used for tuning the assessment may have introduced bias.

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.

The 2012 assessment is in very close agreement with that of 2011. As last year, the advice is based on the EU management plan.

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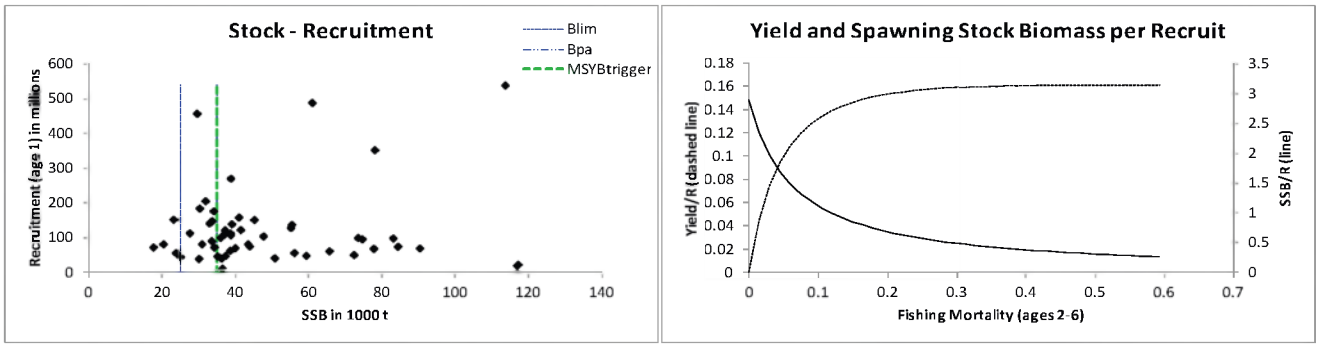


Figure 6.4.10.3 Sole in Subarea IV (North Sea). Stock–recruitment and yield-per-recruit analysis plot.

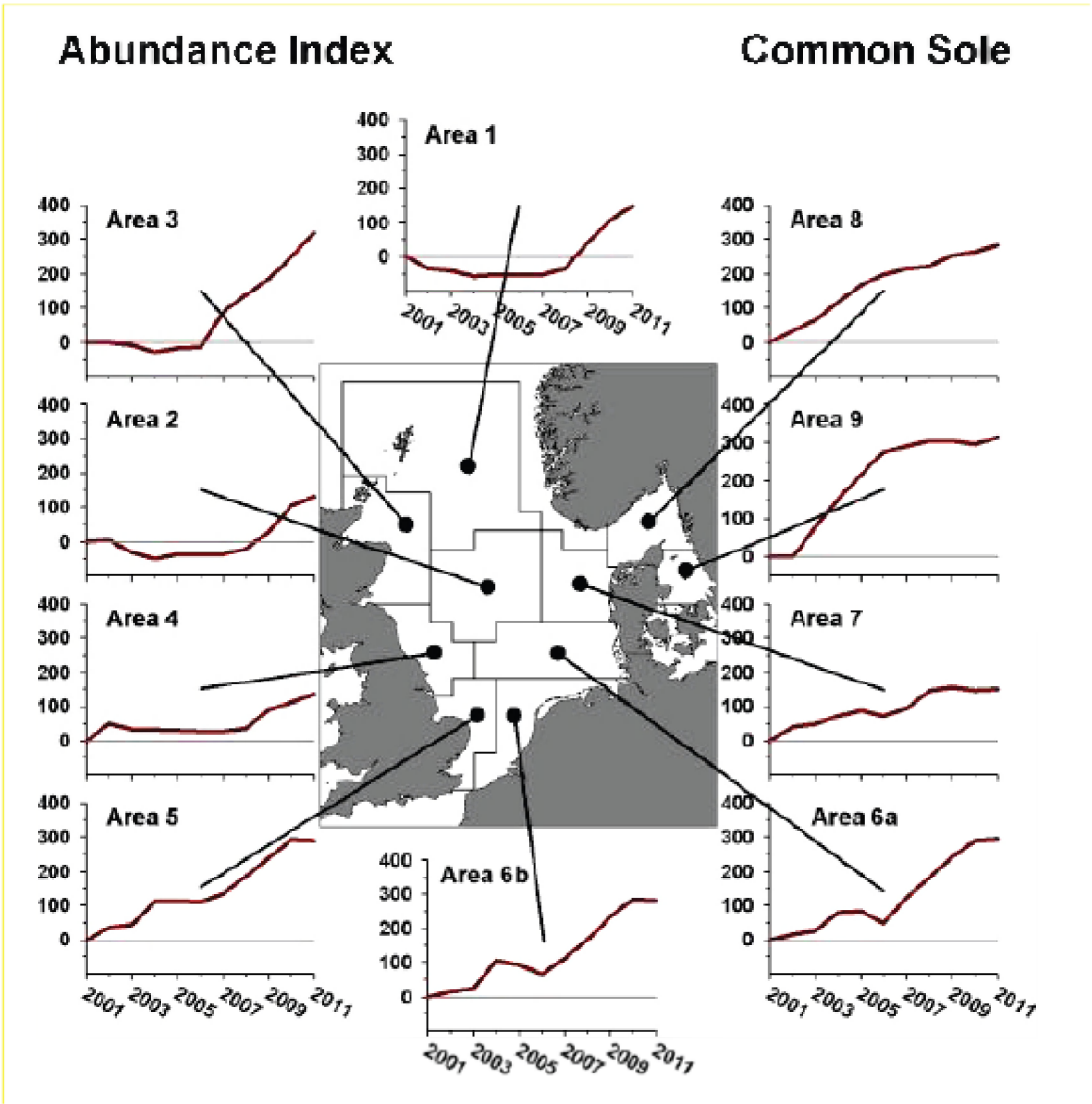


Figure 6.4.10.4 Sole in Subarea IV (North Sea). Results of North Sea Commission fisher's survey 2011 (Napier 2011).

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	11.0	11.5
2012	Apply first stage of the management plan	<15.7	16.2		
2013	Apply management plan	<14			

Weights in '000 t.
[1] Catch *status quo* F.

Table 6.4.10.2 Sole in Subarea IV (North Sea). Official landings and ICES landings (tonnes).

Year	Belgium	Denmark	France	Germany	Netherlands	UK (E/W/NI)	Other countries	Total reported	Unallocated landings	ICES 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	1.38	12129	474	12603	14100
2011	857	346	539	327	8133	786	2	10990	495	11485	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	47600	21100	0.461
1973	105000	36900	19300	0.502
1974	110000	36200	18000	0.485
1975	41000	38600	20800	0.496
1976	113000	39000	17300	0.422
1977	140000	35100	18000	0.458
1978	47000	36400	20300	0.476
1979	12000	45100	22600	0.492
1980	152000	33600	15800	0.452
1981	149000	23100	15400	0.497
1982	153000	32900	21600	0.543
1983	142000	39900	24900	0.488
1984	71000	43400	26800	0.618
1985	82000	40900	24200	0.599
1986	159000	34200	18200	0.580
1987	73000	29500	17400	0.491
1988	458000	38700	21600	0.566
1989	108000	34000	21800	0.439
1990	177000	90300	35100	0.440
1991	70000	78000	33500	0.445
1992	353000	77700	29300	0.421
1993	69000	56000	31500	0.508
1994	57000	74600	33000	0.567
1995	96000	59300	30500	0.538
1996	49000	38700	22700	0.706
1997	271000	27500	14900	0.608
1998	114000	20300	20900	0.646
1999	82000	41400	23500	0.579
2000	123000	38500	22600	0.608
2001	63000	30200	19900	0.581
2002	185000	30800	16900	0.578
2003	82000	25000	17900	0.590
2004	45000	37200	18800	0.514
2005	48000	31800	16400	0.584
2006	206000	23700	12600	0.455
2007	57000	17600	14600	0.466
2008	73000	35900	14100	0.369
2009	101000	33100	14000	0.364
2010	145000	33500	12600	0.355
2011	91000	34700	11500	0.296
2012	94000*	46700		
Average	123208	48331	21211	0.455

* long term geometric mean (1957-2009)

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)

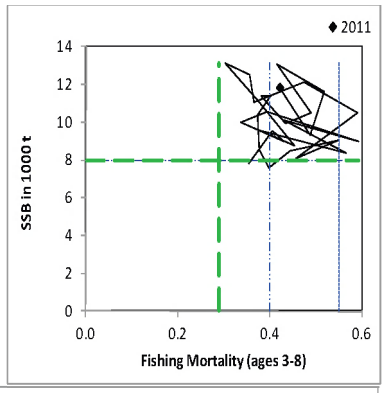
Advice for 2013

ICES advises on the basis of the transition to the MSY approach that landings in 2013 should be no more than 5900 tonnes.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	o	o	o	Increased risk

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



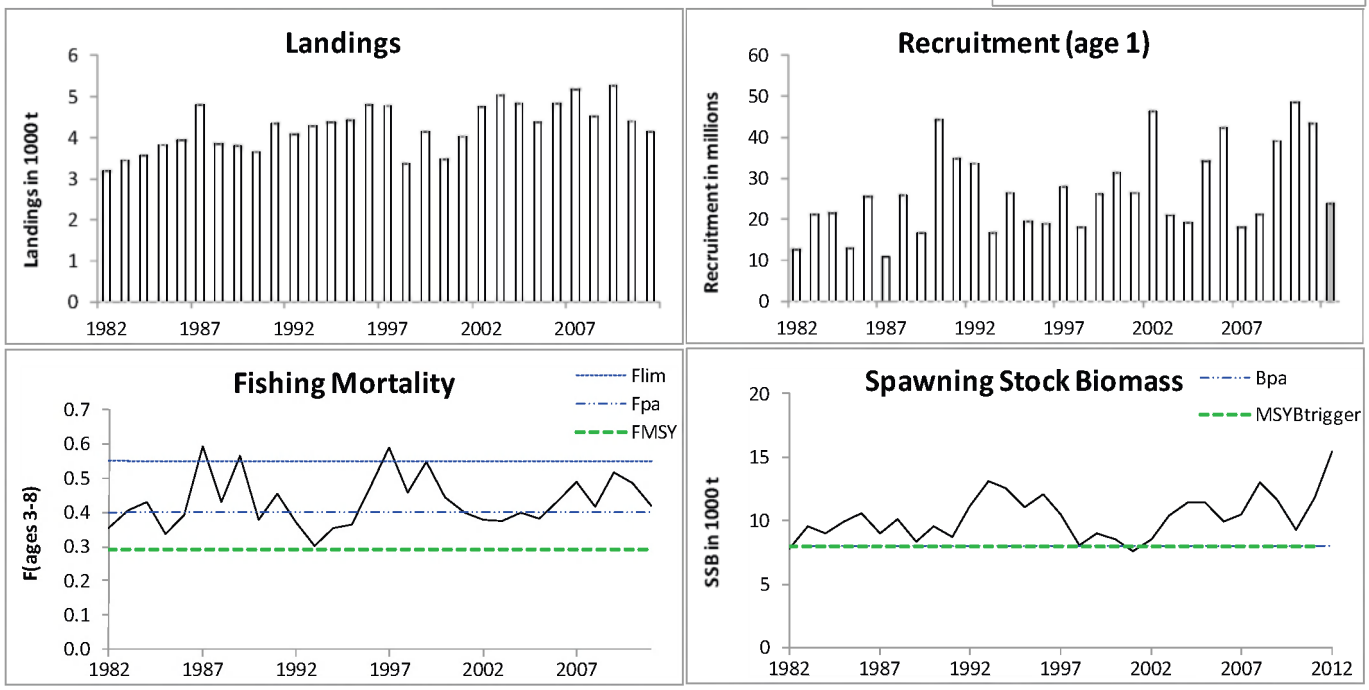


Figure 6.4.11.1 Sole in Division VIId (Eastern Channel). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F for the time series used in the assessment. Predicted values are shaded

The spawning-stock biomass has increased since 2002 and is above MSY $B_{trigger}$. Since 2005, fishing mortality has been above F_{pa}. Recent recruitment has been 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 and gill/trammel nets. There is also a directed fishery during parts of the year by inshore trawlers and netters on the English and French coasts.

Catch distribution	Total landings (2011) = 4133 t, (38% beam trawls, 44% trammel/gill nets, 16% otter trawls, and 2% other gears).

Effects of the fisheries on the ecosystem

The mixed sole and plaice fishery by beam trawls with a mesh size of 80 mm, with bycatch of both commercial and non-commercial species has 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.

A continuation of the UK component of the Young Fish survey (YFS) which was halted in 2007, would substantially improve the estimation of the incoming recruitment, and therefore also the catch forecast.

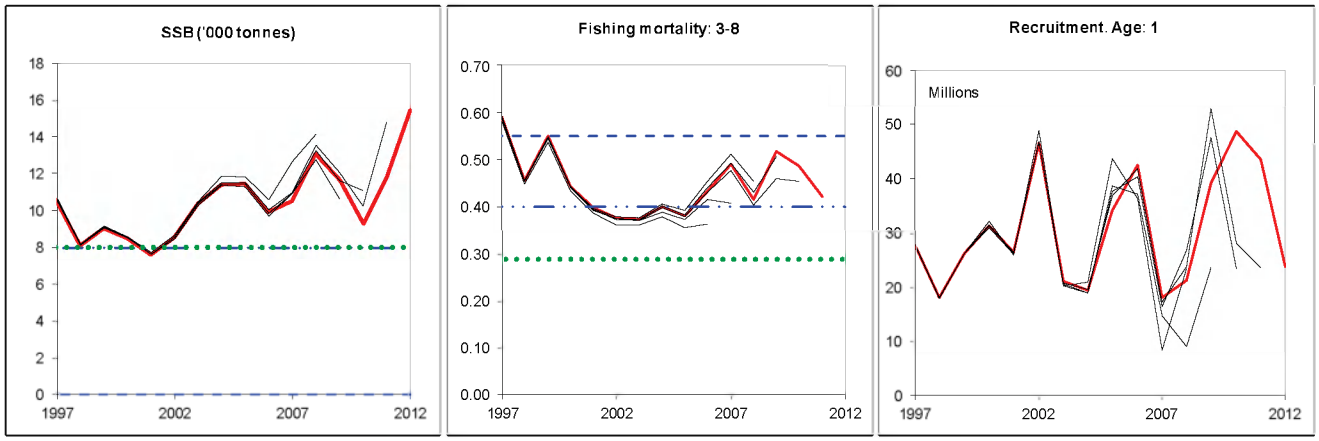


Figure 6.4.11.2 Sole in Division VIId (Eastern Channel). Historical assessment results (final year recruitment estimates included).

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, considerered not to be substantial.
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 2013

Basis: F(2012) = TAC constraint = 0.38 ; R(20132013) = GM(1982–2009) = 23 800; Landings(2012) = 5580; SSB(2013) = 23 300.

Rationale	Landings (2013)	Basis	F(2013)	SSB(2014)	%SSB change [1)]	%TAC Change [2)]
MSY framework	4800	F_{MSY}	0.29	17 200	-1%	-14%
MSY transition	5900	(F_{2010}*0.4)+(F_{MSY}*0.6)	0.37	16 000	-8%	+5%
Precautionary approach	6300	F_{pa}	0.40	15 600	-10%	+13%
Zero catch	0	F=0	0	22 200	+28%	-100%
Other options	4743	TAC -15% (F_{2012}*0.75)	0.29	17 200	-1%	-15%
	5580	Stable TAC (F_{2012}*0.99)	0.35	16 400	-6%	0%
	6100	F_{2012}	0.38	15 900	-9%	+9%
	6417	TAC +15% (F_{2012}*1.1)	0.41	15 500	-11%	+15%

Weights in tones.
[1)] SSB 2014 relative to SSB 2013.
[2)] Landings 2013 relative to TAC 2012.

MSY approach

Following the ICES MSY framework implies fishing mortality to be reduced to 0.29 resulting in landings of less than 4800 t in 2013. This is expected to lead to a record high SSB of 17 200 t in 2014.

Following the transition scheme towards the ICES MSY framework implies that (F_{2010}*0.4) + (0.6*F_{MSY}) is 0.37, resulting in landings of less than 5900 t in 2013. This is expected to lead to an SSB of 16 000 t in 2014.

PA approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to landings of less than 6300 t in 2013. This is expected to keep SSB well above B_{pa} in 2014.

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, 53/2010,57/2011 and 43/2012 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

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 area misreporting into Division VIId by beam trawlers fishing in VIIe was significant, but these are 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 2010 downward by 9% and in 2011 downward by 20%. The estimate of fishing mortality in 2010 was revised upward by 7%. Past recruitment estimates were subject to considerable annual revision. The 2009 year class has been revised upward in this year's assessment by 72% and the assumed mean for the incoming 2010 year class in last year's assessment has now been revised upward by 84%.

As last year, the basis for the advice is the transition to the MSY approach.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 27 April–03 May 2012. ICES CM 2012/ACOM:13.

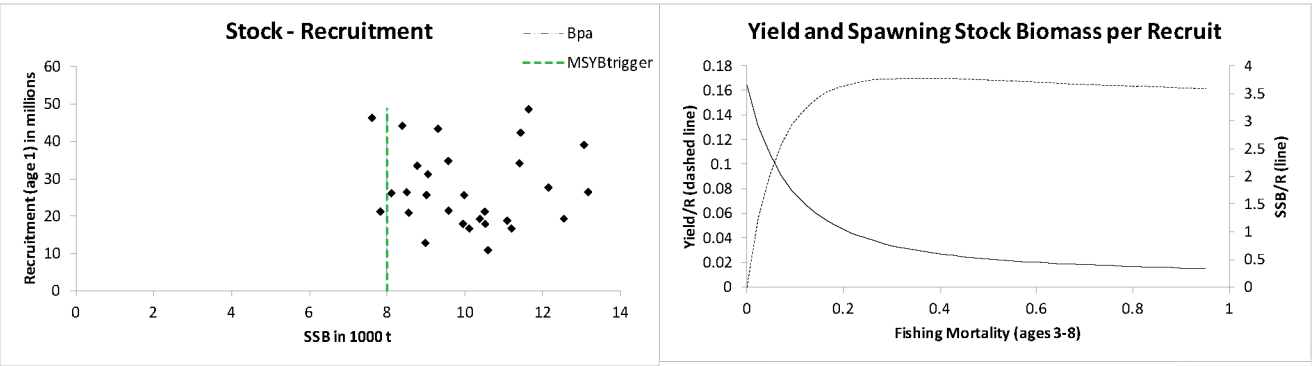


Figure 6.4.11.3 Sole in Division VIId (Eastern Channel). Yield-per-recruit analysis and stock–recruitment plot.

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	4.2	4.1
2012	MSY Transition	<5.60	5.580		
2013	MSY Transition	<5.90			

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	35	4409	4219
2011	1181	2283	**	686		4150	-17	4133	4852

* 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	12732	7813	3190	0.3548
1983	21335	9568	3458	0.4064
1984	21540	8973	3575	0.4312
1985	12905	9969	3837	0.3362
1986	25700	10583	3932	0.3938
1987	10975	9000	4791	0.5930
1988	25735	10098	3853	0.4308
1989	16795	8377	3805	0.5649
1990	44274	9560	3647	0.3800
1991	34843	8765	4351	0.4533
1992	33614	11187	4072	0.3726
1993	16789	13152	4299	0.3026
1994	26538	12530	4383	0.3552
1995	19413	11077	4420	0.3661
1996	18863	12134	4797	0.4739
1997	27766	10508	4764	0.5910
1998	18024	8101	3363	0.4565
1999	26262	9041	4135	0.5495
2000	31286	8495	3476	0.4428
2001	26483	7598	4025	0.3983
2002	46424	8540	4733	0.3774
2003	21030	10369	5038	0.3737
2004	19344	11392	4826	0.4007
2005	34218	11422	4383	0.3803
2006	42420	9936	4833	0.4335
2007	18007	10499	5166	0.4897
2008	21295	13049	4517	0.4159
2009	39186	11624	5266	0.5177
2010	48739	9296	4409	0.4866
2011	43527	11854	4133	0.4210
2012	23798*	15470		
Average	26770	10322	4249	0.4316

* GM recruitment (1982–2009).

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

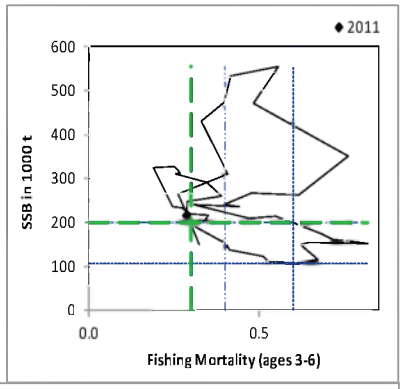
Advice for 2013

ICES advises on the basis of the EU–Norway management plan that landings in 2013 should be no more than 100 684 tonnes for the whole assessment area.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✗	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✗	✓	✓	Below limit

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above trigger



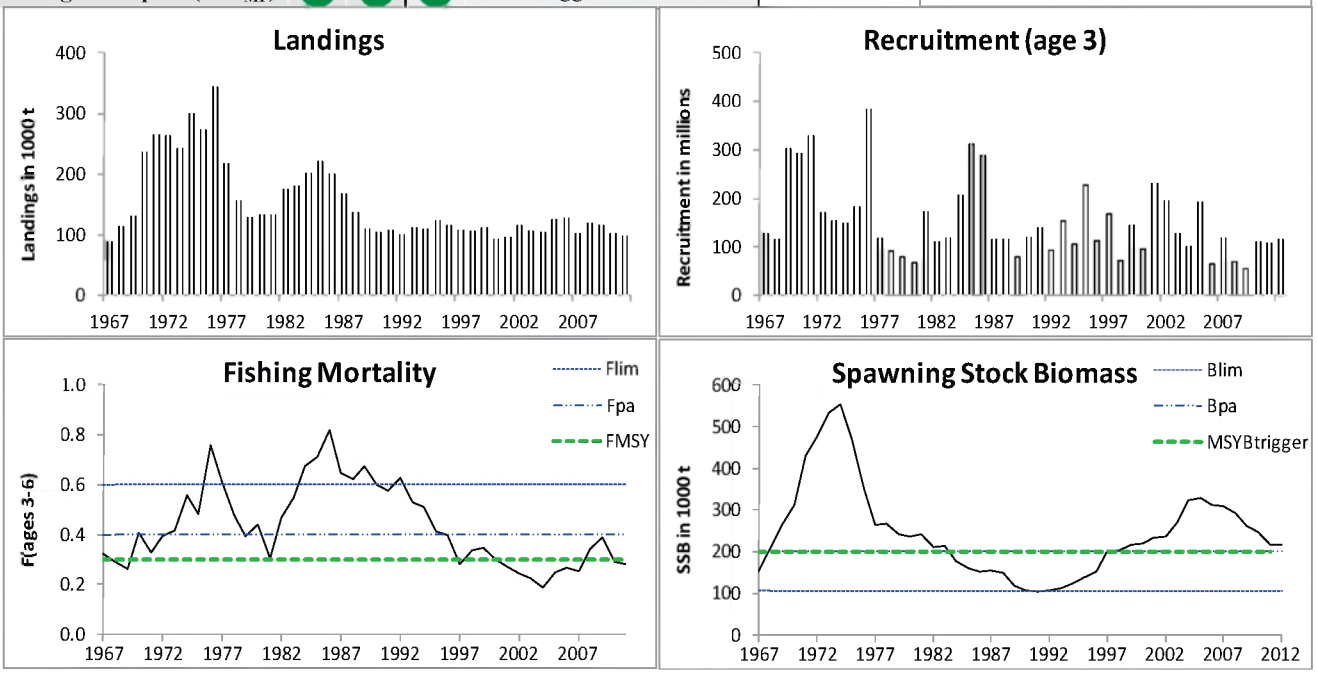


Figure 6.4.12.1 Saithe in Subareas IV and VI, and Division IIIa. Summary of stock assessment in May 2012 (weights in thousand tonnes). Top right: SSB and F for the time series used in the assessment. Predicted values are shaded.

SSB has been above B_{pa} since 1997 but has declined since 2005 towards B_{pa}. Fishing mortality has fluctuated around F_{MSY} since 1997. Recruitment has been below average since 2006.

Management plans

The EU–Norway agreed management plan as updated in December 2008 (Annex 6.4.12) was evaluated by ICES (ICES, 2008), and considered 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 where they are protected from large fisheries. The fish are long-lived (20+ years) and tend to form large aggregations to a higher extent than for instance cod. Saithe starts to mature at age 4 (15% mature) and at age 7 all fish can be regarded as being mature.

Environmental influence on the stock

A decrease in the mean weight-at-age has been observed since the mid-1980s, but this trend has now been reversed. 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. Analyses show a substantial shift in the Norwegian and German trawlers' fishing pattern after 2008, both in time and spatial distribution. The importance of the fisheries on the spawning aggregations in the first quarter of the year has declined.

Catch distribution	Catch 2011 = 97 kt, of which approximately 95% are taken by bottom trawl and 5% by other gears. Discards are low.

Effects of the fisheries on the ecosystem

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. North Sea saithe fisheries are known to have less impact on the seafloor than most other bottom trawl fisheries.

Quality considerations

Age distribution of Norwegian catch data has been revised substantially for 2010, which influences the biomass estimate in the whole assessment. Conflicting signals between the scientific surveys have become more apparent. All scientific surveys on adults have shortcomings in depth range (IBTS-Q3) or coverage (NORACU). Catches from older age classes in the surveys are not representative and therefore commercial cpue indices are used for tuning. Catch sampling data from the Norwegian fishing industry should be improved.

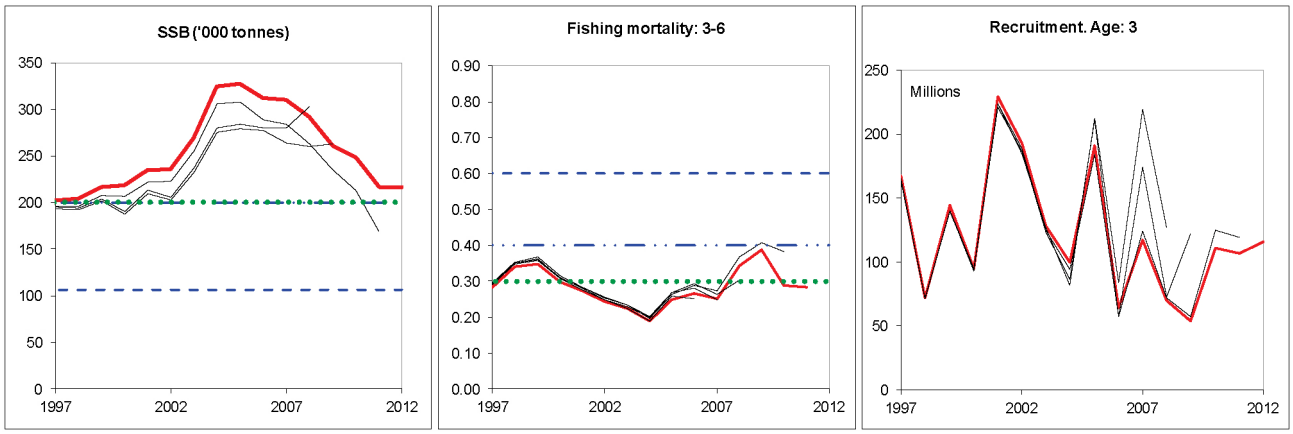


Figure 6.4.12.2 Saithe in Subareas IV and VI, and Division IIIa. Historical assessment results (final-year recruitment estimates included). The 2010 assessment is not included since this was only a forecast based on the 2009 assessment.

Scientific basis

Assessment type	Age-based assessment model (XSA).
Input data	Three survey indices (NORACU, IBTS-Q3, NORASS); three commercial indices (FRATRB_VI, GER-OTB_IV, NORTR_VI2).
Discards and bycatch	Not included in the assessment.
Indicators	None.
Other information	Benchmarked in January 2011 (revised in October 2011).
Working group report	WGNSSK

ECOREGION North Sea
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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)

Outlook for 2013

Basis: F (2012) =0.24 [TAC constraint]; R (2011–2013) = GM (1988–2011) = 115 970; SSB (2013) = 235; landings (2012) = 87.55.

Rationale	landings 2013	landings IIIa&IV 2013[1)]	landings VI 2013[1)]	Basis	F 2013	SSB 2014	% SSB change [2)]	% TAC change [3)]
Management plan	100.684	91.219	9.464	15% TAC constraint	0.26	252	+7%	+15%
MSY approach	113	102	11	F_{MSY}	0.3	241	+3%	+29%
Precautionary approach	143	130	14	Fpa	0.4	214	−9%	+63%
Zero catch	0	0	0	F = 0	0	344	+46%	−100%
Other option	94	85	8.8	F_{2012}	0.24	258	+10%	+7%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012b)								
Maximum	131	118	12	A	0.39	200	−15%	+49%
Minimum	55	50	5.2	B	0.12	316	+35%	−37%
Cod MP	59	53	5.5	C	0.14	286	+22%	−33%
SQ Effort	104	94	9.8	D	0.28	236	0%	+19%
Effor Mgt	86	78	8.1	E	0.22	261	+11%	−1%

Weights in thousand tonnes.

[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 2014 relative to SSB 2013.

[3)] Landings 2013 relative to TAC 2012.

Mixed Fisheries assumptions:

A. Maximum scenario: Fleets stop fishing when last quota exhausted.
B. Minimum scenario: Fleets stop fishing when first quota exhausted.
C. Cod management plan scenario: Fleets stop fishing when cod quota exhausted.
D. *Status quo* (SQ) effort scenario: Effort in 2012 and 2013 as in 2011.
E. Effort management scenario: Effort reductions according to cod and flatfish management plans.

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 (2012). Since SSB at the beginning of 2012 is above B_{pa}, and a F = 0.3 will give a larger change than 15%, paragraph 5 of the harvest control rule applies, resulting in a TAC of 100 684 t and an SSB in 2014 of 252 000 t.

MSY approach

Following the ICES MSY framework implies a fishing mortality of F_{MSY} = 0.3. This would result in landings of no more than 113 100 t in 2013 and an SSB in 2014 of 241 000 t.

PA approach

Fishing at F_{pa} = 0.4 results in landings of less than 143 000 t in 2013 and a SSB of 214 000 in 2014.

Mixed fisheries

In 2012, ICES puts forward mixed-fisheries advice for the first time (ICES, 2012c). In contrast to single-species advice there is no single recommendation but a range of plausible options, assuming fishing patterns and catchability in 2012 and 2013 similar to those in 2011. Major differences between the outcomes of the various scenarios indicate potential unbalance between single-species fishing opportunities. The consequences of this unbalance in terms of changes in fleet dynamics cannot be ascertained.

Cod is the limiting species for the North Sea demersal fisheries in 2013. Following the 'cod' scenario (full implementation of the cod management plan), the saithe management plan catch options could not be fully utilized.

Additional considerations

Management considerations

The stock biomass is estimated to be close to B_{pa} and recruitment estimates for the terminal year are uncertain. The forecast and resulting advice are highly sensitive to the recruitment estimate.

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 2012.

The reported landings have been lower than the TACs during the past nine years, but the reduction of the TAC in recent years has gradually lessened the difference between landings and TAC.

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 the German fleet.

Overall nominal effort (kW-days) by European demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel have been substantially reduced (−20% between 2003 and 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 (−12%, −39%, and −35%, respectively, between 2004 and 2011) (ICES, 2012b). Nominal effort reported by Norway has increased in 2011 due to the generalization of electronic logbooks.

Information from the fishing industry

Saithe has had growing importance for both the Danish and Scottish fleets. The fishers' survey (Napier, 2011) shows a perception of an increasing stock which is not in accordance with the latest assessment. Reports from Norwegian fishers show concerns about increased landings from pelagic trawling and a possible change in exploitation pattern towards younger year classes. According to a RAC-meeting between scientists and fishers in Hanstholm in April 2012, the industry was worried about the decline in mean weight-at-age after 2000 which, using a constant length–weight relationship, implies decline in mean length-at-age. French and German industry representatives confirmed changes in fishing pattern due to effort management and competition over fishing grounds between trawlers and gillnetters in Division Via, especially in 2009 and 2010. This has not led to large changes in the age distribution of the catch.

The fishing industry representatives see improved stock status in the last two years, after a period of low recruitment. The fishing industry commented on conflicting data sources and suggested that fishers' knowledge should be used for the interpretation of the data (i.e. commercial cpue indices). Survey data, especially those for young year classes before age 3, should be improved.

Uncertainties in assessment and forecast

Estimates of recruitment are considered very uncertain due to strong year effects in the surveys in the last three years.

During the benchmark assessment (ICES, 2011) and the June 2011 assessment, 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 considered appropriate in the November 2011 update, and also in the 2012 assessment. However, the potential for bias in commercial cpue (for example hyper-stability) is a general concern for shoaling species such as saithe. A reliable survey is needed to redress this issue.

In May 2012 the age distribution data in the Norwegian catches in 2010 were revised and this accounted for a great part of the difference.

Comparison with previous assessment and advice

The current assessment estimates SSB in 2012 to be 30% higher than estimated in November 2011, and fishing mortality in 2010 is estimated to be 25% lower. The change was caused mainly by the revision of age distribution in the Norwegian catches. The basis for the advice is the same as last year: the management plan.

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.

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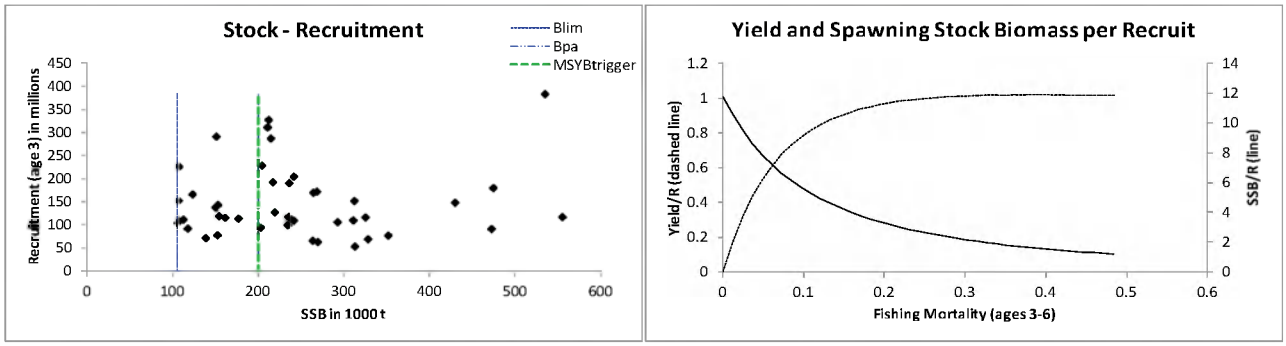


Figure 6.4.12.3 Saithe in Subareas IV and VI and in Division IIIa. Stock–recruitment plot and yield-per-recruit analysis.

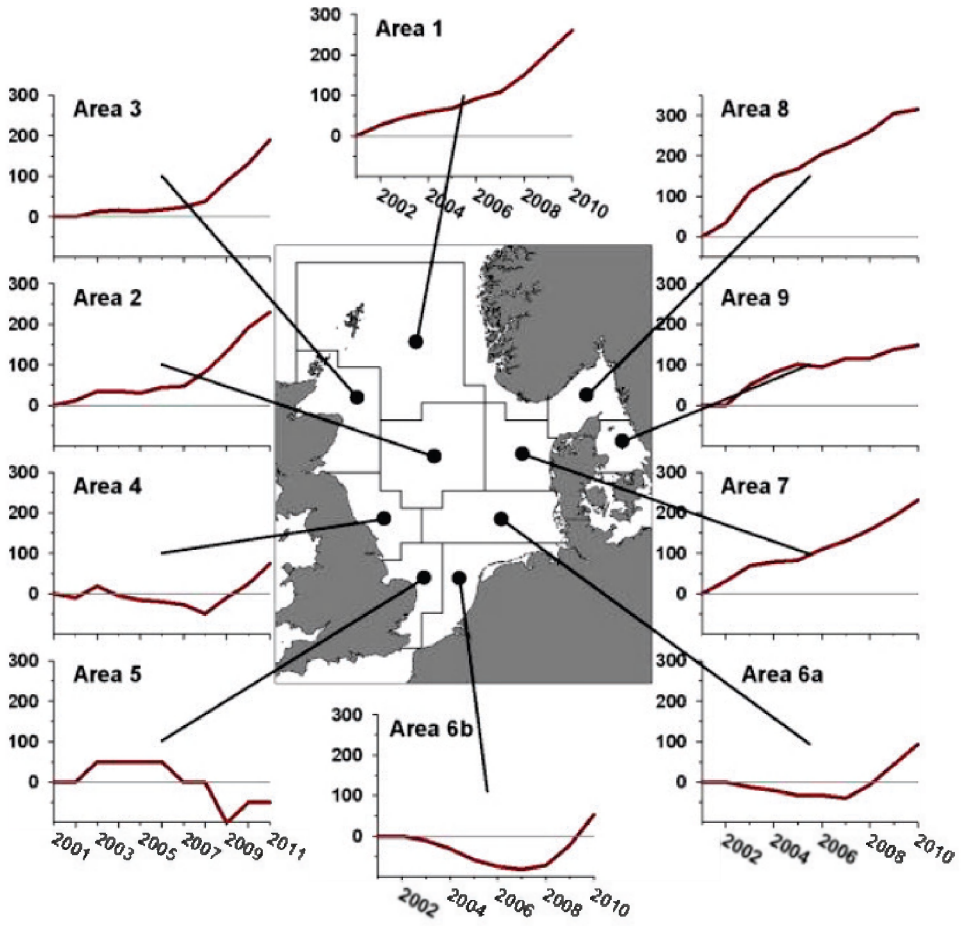


Figure 6.4.12.4 Saithe in Subareas IV and VI and in Division IIIa. Results of the North Sea Commission fishers' survey 2010 on abundance of saithe (Napier, 2011).

Table 6.4.12.1 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	91**	96
2011	See scenarios	-	93	89	90
2012[1]	F according to man. plan ($< F_{pa}$) *	< 79.320	79		
2013	Management plan (TAC + 15%)	< 91.219			

Weights in thousand tonnes.
* 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 6.4.12.2 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	13	6.2	7.0
2010	F according to man. plan ($< F_{pa}$) *	< 11	11	6.2	6.9
2011	See scenarios	-	10	7.3	7.4
2012[3]	F according to man. plan ($< F_{pa}$) *	< 8.230	8		
2013	Management plan (TAC + 15%)	< 9.464			

Weights in thousand tonnes.
[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 6.4.12.3 Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Officially reported landings and ICES estimates (in tonnes).

SAITHE IV and IIIa

Country	2000	2001	2002	2003	2004*	2005*	2006	2007*	2008*	2009	2010	2011
Belgium	122	24	107	45	22	28	16	18	7	27	15	2
Denmark	3529	3575	5668	6954	7991	7498	7471	5458	8069	8802	8019	6325
Faroe Islands		289	872	495	558	184	62	15	108	-	146	0
France	19200	20472	25441	18001	13628	10768	15739	13043	15302	5445*	4582*	13856
Germany	9273	9479	10999	8956	9589	12401	14390	12790	14141	13689	11192	10234
Greenland	60	152(	62	1616	403		-	-	-	-	-	0
Ireland	1				1		0	-	81	81 -		0
Netherlands	11	20	6		3	40	28	5	3	17	3	24
Norway	43665	44397	60013	61735	62783	67365	61268	45395	62055	57708	53031	46778
Poland	747	727	752	734*	0	1100	-	-	1407	988	654	584
Russia	67					35	2	5	5	13 -		0
Sweden	1468	1627	1863	1876	2249	2114	1695	1380	1639	1363	1545	1331
UK (E/W/NI)	1227	1186	2521	1215	457	1190	9129**	9628**	11701**	12545**	11887**	10148**
UK (Scotland)	5484	5219	6596	5829	5924	7703						
Total reported	85395	88541	114900	107467	103608	110575	109800	87377	114517	100678	91074	89282
Unallocated	2281	1030	1291	-5809	-3646	968	7312	6241	-3084	4851	4026	422
W.G. Estimate	87676	89571	116191	101658	99962	111543	117112	93618	111433	105529	95100	89704
TAC	85000	87000	135000	165000	190000	145000	123250	135900	135900	125934	107000	93600

*Preliminary, [2]Preliminary data reported in IVa

**Scotland+E/W/NI combined

Table 11.2.1 continued

SAITHE VI

Country	2000	2001	2002	2003	2004*	2005*	2006	2007*	2008*	2009	2010	2011
Faroe Islands				2	34	21	76	32	23	-	24	5
France	3310	5157	3062	3499	3053	3452	5782	3956	2617	2093	2003	2382
Germany	305	466	467	54	4	373	532	580	147	298	257	0
Ireland	410	399	91	170	95	168	243	322	208	208	519	359
Netherlands	-	-	-	-	-	-	-	-	1	-		0
Norway	58	31	12	28	16	20	28	377	78	68	249	160
Russia	25	1	1	6	6	25	7	2	50	4	2	0
Spain	3	15	4	6	2	3	-	-	-	-		0
UK (E/W/NI)	276	273	307	263	37	203	2748**	1419**	2887**	3501**	3168**	4399**
UK (Scotland)	2463	2246	1567	1189	1563	4433						
Total reported	6850	8588	5513	5215	4810	8699	9416	6688	6011	6172	6222	7305
Unallocated	-960	-1770	-327	35	-296	-2960	848	98	1223	791	666	95
W.G.Estimate	5890	6818	5186	5250	4514	5739	8568	6786	7234	6963	6840	7400
TAC	7000	9000	14000	17119	20000	15044	12787	14100	14100	13066	11000	9570

*Preliminary

**Scotland+E/W/NI combined

SAITHE IV, IIIa and VI

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
WG estimate	93566	96389	121377	106908	104476	117282	125680	100404	118667	112492	101940	97104
TAC	92000	96000	149000	182119	210000	160044	136037	150000	150000	139000	118000	103170

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	241300	132300	0.306
1982	110000	210500	174400	0.469
1983	118000	214400	180000	0.548
1984	205000	176800	200800	0.677
1985	312000	161100	220900	0.714
1986	288000	152200	198600	0.819
1987	114000	154100	167500	0.645
1988	116000	149600	135200	0.621
1989	78000	117200	108900	0.673
1990	119000	106500	103800	0.598
1991	139000	105400	108000	0.576
1992	93000	107100	99700	0.630
1993	153000	112200	111500	0.529
1994	105000	122900	109600	0.509
1995	227000	138600	121800	0.411
1996	113000	152700	115000	0.401
1997	167000	202700	107300	0.283
1998	72000	204000	106100	0.340
1999	144000	217000	110700	0.349
2000	95000	219000	91300	0.299
2001	229000	234400	95000	0.273
2002	193000	235800	115400	0.244
2003	128000	269400	105600	0.224
2004	100000	324800	104200	0.189
2005	191000	327700	124500	0.250
2006	64000	312400	125700	0.266
2007	117000	310600	101200	0.252
2008	70000	292100	119300	0.344
2009	54000	260800	115700	0.388
2010	111000	248300	101900	0.289
2011	107000	217000	97100	0.284
2012	115970*	216941		
Average	151652	245175	150940	0.434

* Geometric mean recruitment 1988–2011.

Annex 6.4.12 EU–Norway 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

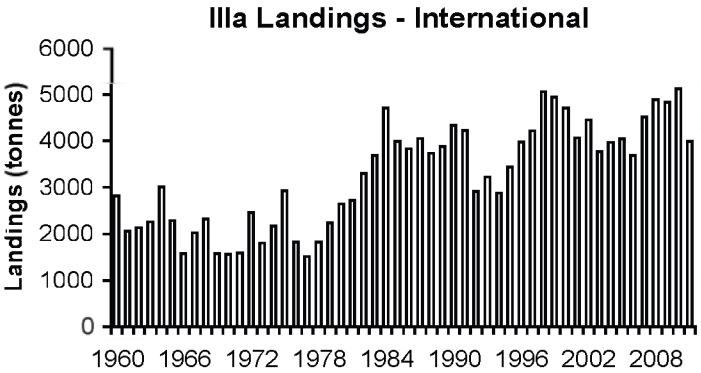
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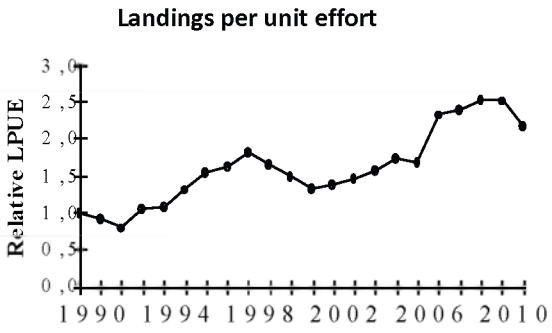
ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 5200 t.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	?	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined





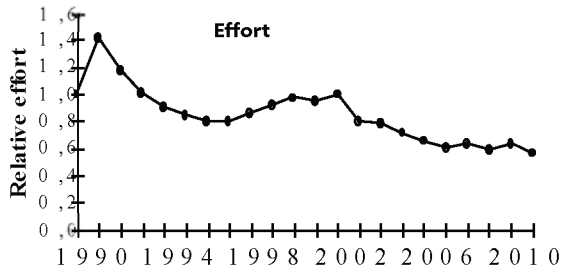


Figure 6.4.13.1 *Nephrops* in Division IIIa. Long-term trends in landings (in tonnes), landings per unit effort (lpue), and effort. Trends are relative to 1990 (=1.0).

Absolute estimates of abundance were available in 2010 and 2011 from an underwater TV (UWTV) survey. The estimated harvest ratios of 6.4% (2010) and 5.0% (2011) from these UWTV surveys together with the fishery indices (effort and lpue) suggest that the stock is exploited sustainably.

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. 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 distribution	Total catch (2011) = 6.8 kt, where 58% are landings (93% trawling, 7% creels) and 42% 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 2011 was conducted in all six main fishing areas in Division IIIa. Yearly calibrations between countries on counting *Nephrops* burrows should be continued. The lpue data used as indicators for stock development have been standardized regarding vessel size from 2000 to 2011. 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. The UWTV survey in Division IIIa should be continued as a joint survey between Denmark and Sweden.

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 between $F_{0.1}$ and F_{max}. This means that $F_{35\%SPR}$ may be selected as a proxy for F_{MSY}. $F_{35\%SPR}$ is, unusually, higher than F_{max} for this stock due to the very high discarding rates observed in the fishery. Therefore, F_{max} is chosen as a conservative 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 2013

F2012 = F2011 = Harvest rate 5.0%; Bias-corrected survey index (2011) = 3577 million; Mean weight in landings (2009–2011) = 38.0 g; Discard rate (by number, average 2009-2011) = 69%; Discard mortality = 75%; (= 52% dead discards rate by numbers); Survey bias = 1.1.

Basis	Harvest rate %	Landings 2013 (tonnes)
	2.0	1 300
	4.0	2 600
F_{2012}	5.0	3 300
	5.6	3 700
MSY approach	7.9	5 200
	10.5	6 900

MSY approach

Following the ICES MSY framework implies a harvest ratio of 7.9%, resulting in landings of not more than 5200 t in 2013.

Additional considerations

The main reason for the high amount of discards (47% in numbers, 31% in weight in 2011) is the high minimum landing size and low mesh 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	Medium	High
		<0.3	0.3–0.8	>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	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	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 2011 was conducted in the six main fishing areas in Division IIIa. 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 (ICES, 2012). 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.

The Danish 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.

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. The assessment is therefore conducted on *Nephrops* in Division IIIa as one stock.

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. The Swedish *Nephrops* quota is allocated to different gear categories (20% to creels, 50% to grid trawls, and the remaining 30% to other trawls). 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 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.

The minimum landing size for *Nephrops* in Division IIIa is 40 mm carapace length. 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. Discard mortality is assumed to be 75% (Wileman *et al.*, 1999).

Environmental influence on the 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. 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).

Comparison with previous assessment and advice

Advice for 2012 was based on the MSY framework, similar to the current advice.

Sources

Bagge, O., and Munch-Petersen, S. 1979. Some possible factors governing the catchability of Norway lobsters in the Kattegat. Rapports et Procès-Verbeaux de la Réunion du Conseil International pour l'Exploration de la Mer, Vol. 175: 143–146.

ICES. 2010. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 5–11 May 2010. ICES CM 2010/ACOM:13.

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Wileman, D. A., Sangster, G. I., Breen, M., Ulmestrand, M., Soldal, A. V., and Harris, R. R. 1999. Roundfish and *Nephrops* survival after escape from commercial fishing gear. EC Contract No: FAIR-CT95-0753. Final Report 1999. 125 pp. + appendix.

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	4.0
2012	MSY framework[1)]	< 6.0	6.0	
2013	MSY framework	< 5.2		

Weights in thousand tonnes.

[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. Official 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
2011	2937	87	945	17	3986

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
2009	58.0%	44.8%	34.2
2010	47.0%	29.7%	41.1
2011	47.0%	31.2%	38.7
Average	51.7%	36.0%	38.0

ECOREGION North Sea
STOCK *Nephrops* in Subarea IV (North Sea)

Introduction

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). The advice summary for *Nephrops* stocks is given by functional units in Sections 6.4.14.1–9.

Section	FU no.	Name	ICES division	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
6.4.14.9*	34	Devil's Hole	IVb	41–43 F0–F1

* The advice for these stocks is biennial advice for 2013 and 2014.

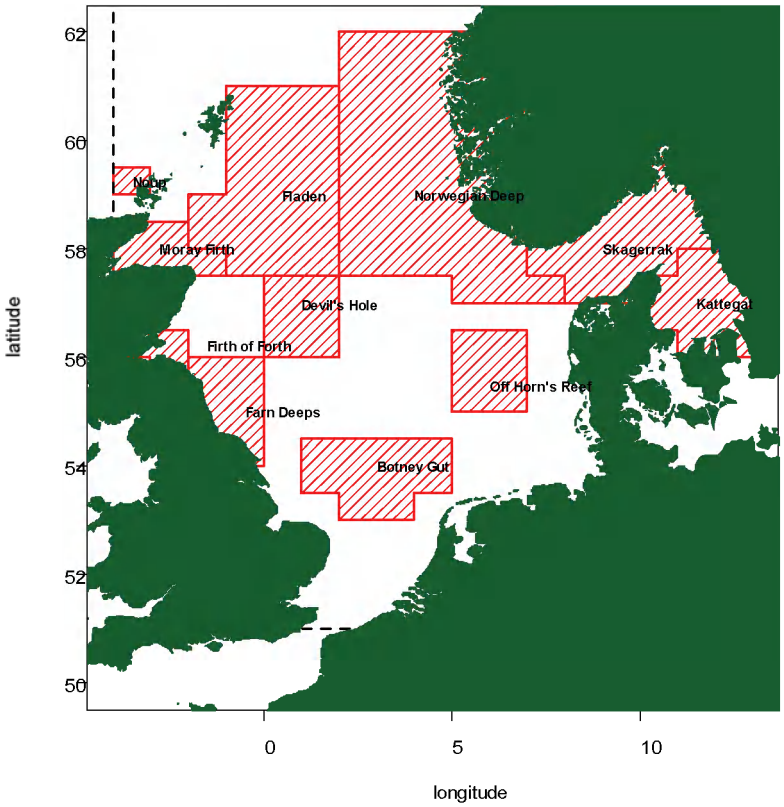


Figure 6.4.14.1 *Nephrops* functional units in the North Sea and Skagerrak/Kattegat region (see Section 6.4.13).

Summary of advice for 2013

A summary of the advice 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'). This year, advice is given for *Nephrops* in the Devil's Hole (FU 34) for the first time; in the past catches here were considered part of the 'other rectangles'.

Advice for the FUs in the North Sea show increases as well as decreases. ICES advises that the catches in the other rectangles should not change from the 2011 landings of 820 t.

Table 6.4.14.1 *Nephrops* in Subarea IV. Summary of ICES advice by functional unit plus other rectangles.

Year	Moray Firth	Noup	Fladen Ground	Norwegian Deeps	Farn Deeps	Firth of Forth	Botney Gut – Silver Pit	Off Horn`s Reef	Devils Hole	Other rectangles [2]	Total advice [5]	Agreed TAC [1]	ICES landings
FU	9	10	7	32	6	8	5	33	34				
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	12.3
1993	2.4		2.7		4.17		0.87				10.2	12.0	15.9
1994	2.4		5.0		4.17		0.87				12.5	13.0	17.1
1995	2.4		5.0		4.17		0.87				12.5	15.2	18,1
1996	2.4		5.0		4.17		0.87				12.5	15.2	17,7
1997	2.4		5.0		4.17		0.87				12.5	15.2	19.4
1998	2.4		7.0		4.17		1.0				14.6	15.2	18.8
1999	2.4		7.0		4.17		1.0				14.6	15.2	21,4
2000	1.85		9.0		4.17		1.6				16.7	17.2	19.8
2001	1.85		9.0		4.17		1.6				16.7	15.48	20.0
2002	2.0		9.0	1.2	4.17		2.1				18.5	16.623	21,2
2003	2.0		9.0	1.2	4.17		2.1				18.5	16.623	19.4
2004	2.0		12.8	1.5	4.17		2.38				22.9	21.350	22.6
2005	2.0		< 12.8	1.5	4.17		2.38				22.9	21.350	25.9
2006	-		-	NA	-		2.38				-[5]	28.147	28.3
2007	2.4	0.2	< 10.9	NA	3.5	1.5	NA	NA		24.6 [6]	-[5]	26.144	29.2
2008	2.4	0.2	< 10.9	NA	3.5	1.5	NA	NA		9.5 [6]	-[5]	26.144	27,2
2009	< 1.8	< 0.24	< 11.3	[3]	< 3.0	< 2.5	[3]	[3]		< 1.4	-[5]	24.837	29.4
2010	< 1.4	< 0.24	< 16.4	[4]	< 1.2	< 1.6	[4]	[4]		< 1.5	-[5]	24.688	26.0
2011	< 1.3	NA	< 13.3	[7]	< 1.9	< 2.0	[7]	[7]		< 1.9	-[5]	23.454	20.0
2012	< 1.1	[8]	< 14.1	[8]	< 1.4	< 1.7	[8]	[8]		[9]	-[5]		
2013	< 0.95	< 0.05	< 10	< 0.8	< 1.4	< 1.4	< 1.0	< 1.1	< 0.6	< 0.82			
2014		[4]		[4]			[4]	[4]	[4]				

Weights in thousand tonnes.

[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.

[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.

Mixed-fisheries advice

In contrast to single-stock advice there is no single recommendation for mixed fisheries but rather a range of plausible options, assuming fishing patterns and catchability in 2012 and 2013 are similar to those in 2011. Major differences between the outcomes of the various scenarios indicate potential imbalance between single-stock fishing opportunities. The consequences of this imbalance in terms of changes in fleet dynamics cannot be ascertained.

Cod is the limiting species for the North Sea demersal fisheries in 2013. The current single-stock *Nephrops* advice for each of the functional units leads to catches of cod which are potentially higher than allowed by the cod management plan, i.e. if the cod management plan is strictly enforced catches of *Nephrops* would be lower than allowed in the single-stock advice.

Table 6.4.14.2 *Nephrops* in Subarea IV. Catches of *Nephrops* according to single-stock advice and under different mixed-fisheries scenarios.

	Moray Firth	Noup	Fladen Ground	Norwegian Deeps	Farn Deeps	Firth of Forth	Botney Gut – Silver Pit	Off Horn`s Reef	Devils Hole	Other rectangles [2)]
FU	9	10	7	32	6	8	5	33	34	
Single-stock advice	**0.95**	**0.05**	**10.10**	**0.8**	**1.4**	**1.4**	**1.0**	**1.1**	**0.60**	**0.82**
Mixed-fisheries scenarios										
Maximum	1.9	0.09	11	0.51	2.9	2.7	1.4	1.5	0.56	1.3
Minimum	0.60	0.03	3.3	0.16	0.92	0.84	0.43	0.49	0.18	0.42
Cod MP	0.70	0.03	3.9	0.19	1.1	0.98	0.50	0.57	0.21	0.49
SQ effort	1.4	0.06	7.6	0.37	2.1	1.9	0.98	1.1	0.40	0.95
Effort	0.47	0.02	2.5	0.13	0.84	0.72	0.35	0.39	0.14	0.34

Weights in thousand tonnes.

Biology

Nephrops is limited to a 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 will 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*). Discarding of *Nephrops* is also high for several FUs and the mortality of *Nephrops* after discarding is considered to be high (75%, Wileman *et al.*, 1999).

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 6.4.14.3 shows that in 2011 overall landings in Subarea IV were around 20 000 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). Average landings for rectangles outside functional units since 2010 when the Devil's Hole was split off have been around 820 t.

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 that 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 differences 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, 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 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	Medium	High
		<0.3	0.3–0.8	>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	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	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.

Data-limited stocks

Not all functional units areas are covered by TV surveys and in some cases the biological data are also sparse, which has resulted in qualitative advice based on trends in catch rates and size composition. For 2012, the basis for advice has been developed from the TV survey methodology in order to provide a quantitative estimate of fishing

opportunity likely to be compliant with MSY considerations. This approach is based on habitat extent and population characteristics.

The physical area of each FU has been determined either through knowledge of the sediment type, or from the fishery itself (e.g. VMS positions). Estimates of total abundance are calculated by taking the physical area and multiplying by potential values of *Nephrops* density which are drawn either from neighbouring FUs with existing TV surveys or from preliminary TV surveys of the specific FU. The numbers removed corresponding to the average (10 years) and maximum observed landings were estimated using mean weights and appropriate discard rates. Finally, the harvest rates for these removal numbers were calculated for each of the possible density values and these are laid down in a table:

Basis: Surface area FU 5: 1850 km^2, Mean weight: 25.6 grams, Discards: 25% in number.

		Range of potential density (*Nephrops* per m^2)								
Basis	**landings**	**0.05**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7***	**0.8**
0.5 * Average landings	500	26.4%	13.2%	6.6%	4.4%	3.3%	2.6%	2.2%	**1.9%**	1.6%
Average landings (last 10 yrs)	1000	52.8%	26.4%	13.2%	8.8%	6.6%	5.3%	4.4%	**3.8%**	3.3%
Maximum historic landings	1400	73.9%	37.0%	18.5%	12.3%	9.2%	7.4%	6.2%	**5.3%**	4.6%

Shaded areas indicate Harvest Rates > range of North Sea F_{MSY} proxies of 8%–16%.
* Most recent density estimate (preliminary TV survey results).

In order to give advice, average landings of the last ten years are considered together with the relevant densities in the area (gathered through preliminary surveys or assumed based on neighbouring FUs). The resulting harvest rate is compared to harvest rates commensurate with F_{MSY} for North Sea *Nephrops* stocks, which are in the range of 8% (FU 6) to 16.3% (FU 8), at an average of 12.3%. Based on this table and these reference points, when average landings in any FU result in a harvest rate below the minimum F_{MSY} harvest rate calculated for the North Sea, this is considered a precautionary state and advice is given on the basis of landings at the average of the last 10 years. Where the harvest rate resulting from the average landings are higher, additional precautionary reductions are considered.

In lieu of sufficient data to develop a more analytic approach, advice will be given on the basis of average landings and it may not be possible to advise on increasing landings until more work is done. Methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or the stock overfished.

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 will 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.

Overall effort (kW-days) by European demersal trawls, seines, beam trawls, and gillnets in the North Sea, Skagerrak, and Eastern Channel have been substantially reduced (−20% between 2003 and 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, beam trawl (80–120 mm, BT2), and gillnet has shown a continuous decline (−12%, −39%, and −35%, respectively, between 2004 and 2011) (ICES, 2012b). Nominal effort reported by Norway has increased in 2011 due to the generalization of electronic logbooks.).

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. Since 2010 a number of vessels are reported to be using large square-meshed panels (of up to 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 the ICES approach to data-limited *Nephrops* stocks. Biennial advice for these stocks is given for 2013 and 2014.

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) 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 $F_{0.1}$ was 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

Trends according to the Fishers' North Sea stock survey are discussed in the specific FU stock summary sheets.

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 are reconsidered every year.

Comparison with previous assessment and advice

For those stocks without UWTV surveys, advice given in 2012 is biennial and applicable for 2013 and 2014. The basis for this *Nephrops* advice has changed from qualitative analysis of landings trends to advice based on habitat extent and population characteristics.

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.

Sources

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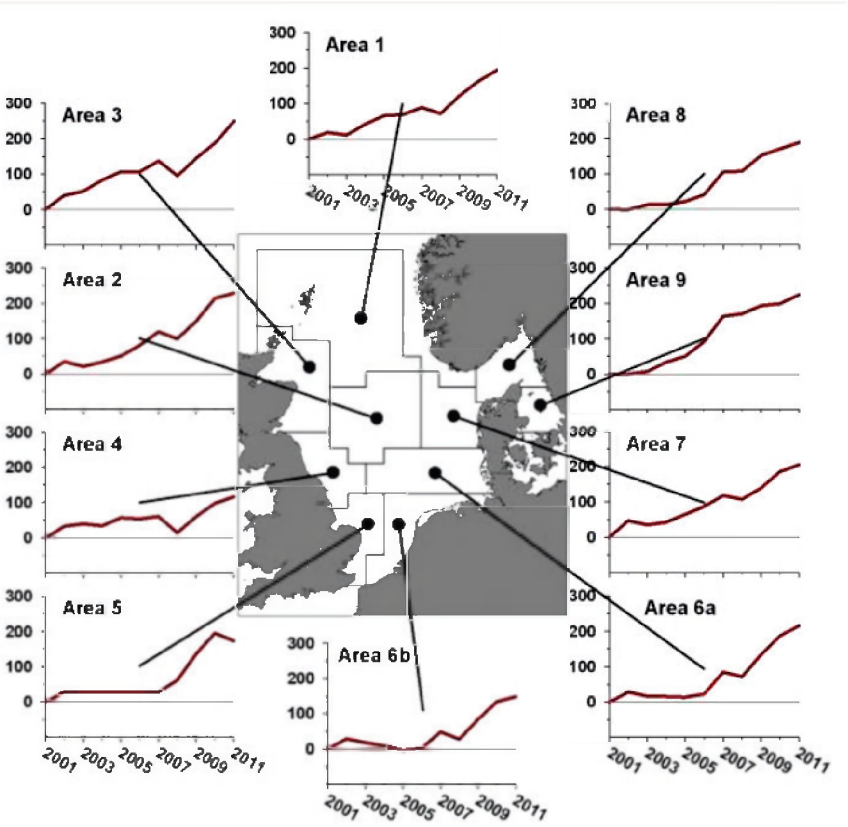


Figure 6.4.14.2 *Nephrops* in Subarea IV. Results of the North Sea Commission fishers' survey perceptions of the abundance 2011 (Napier, 2011).

Table 6.4.14.3 *Nephrops* in Subarea IV. Officially reported landings (tonnes) by functional unit plus other rectangles.

Year	FU 3	FU 4	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	2924	1304	862	2063	4223	1404	1519	196				560	15055
1992	1893	1012	612	1473	3363	1757	1591	188				401	12290
1993	2288	924	721	3030	3493	2369	1808	376	339	160		434	15942
1994	1981	893	503	3683	4569	1850	1538	495	755	137		703	17107
1995	2429	998	869	2569	6440	1763	1297	280	489	164		844	18142
1996	2695	1285	679	2483	5217	1688	1451	344	952	77		808	17679
1997	2612	1594	1149	2189	6171	2194	1446	316	760	276		662	19369
1998	3248	1808	1111	2177	5136	2145	1032	254	836	350		694	18791
1999	3194	1755	1244	2391	6521	2205	1008	279	1119	724		988	21428
2000	2894	1816	1121	2178	5569	1785	1541	275	1084	597		900	19760
2001	2282	1774	1443	2574	5541	1528	1403	177	1190	791		1268	19971
2002	2977	1471	1231	1954	7247	1340	1118	401	1170	861		1383	21153
2003	2126	1641	1144	2245	6294	1126	1079	337	1089	929		1390	19400
2004	2312	1653	1070	2153	8729	1658	1335	228	922	1268		1224	22552
2005	2546	1488	1099	3094	10685	1990	1605	165	1089	1050		1120	25931
2006	2392	1280	974	4903	10791	2458	1803	133	1028	1288		1249	28299
2007	2771	1741	1294	2966	11910	2652	1842	155	755	1467		1637	29190
2008	2851	2025	963	1218	12240	2450	1514	173	675	1444		1673	27226
2009	3004	1842	728	2703	13327	2662	1067	89	477	1163		2367	29429
2010	2938	2185	959	1443	12825	1871	1032	38	407	806	757	709***	25970
2011*	2511	1475	1053	2070	7558	1888	1391	69	395	1191	433	1166****	20034

* Provisional.

** Devil's Hole landings only separated from 2011.

*** 695 t in Subarea IV and 14t in Division IIIa.

****Subarea IV only.

ECOREGION North Sea
STOCK *Nephrops* in Botney Gut–Silver Pit (FU 5)

Advice for 2013 and 2014

Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 1000 tonnes. This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

To protect the stock in this functional unit, management should be implemented at the functional unit level.

State of the stock

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	2009–2011
Qualitative evaluation	? Unknown

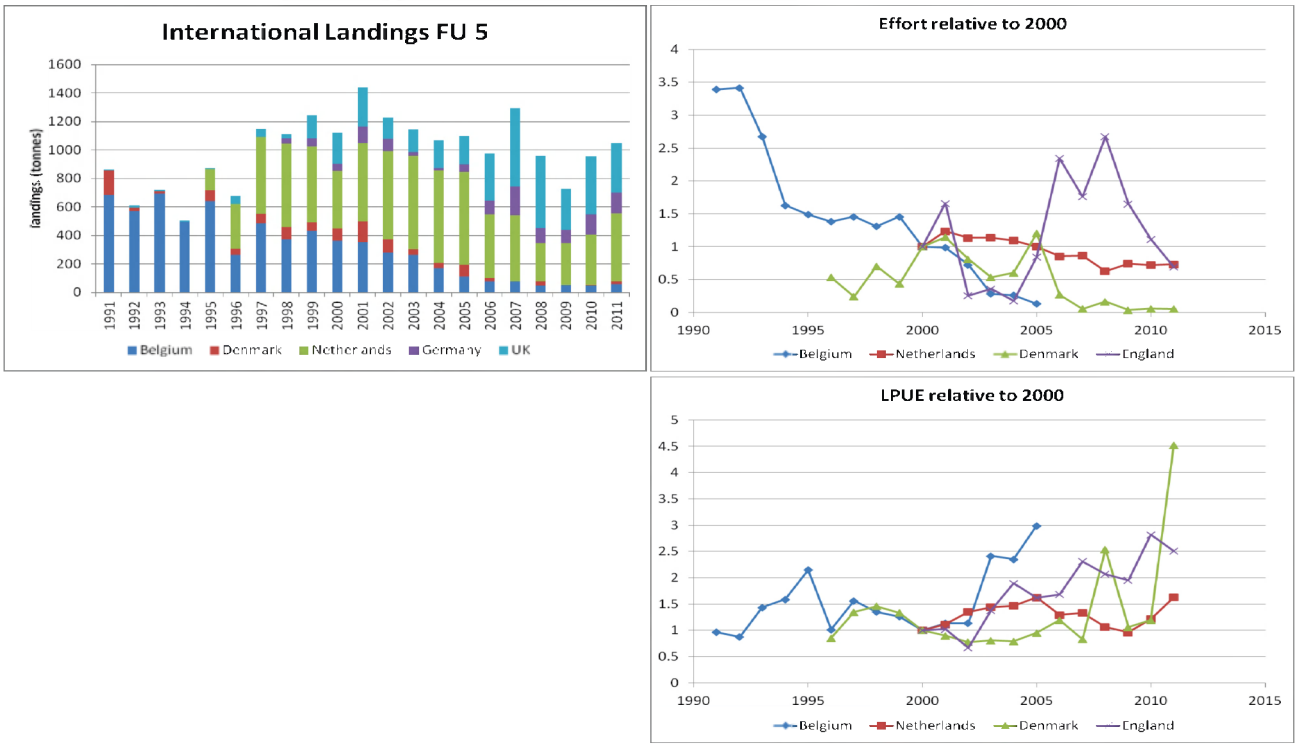


Figure 6.4.14.1.1 *Nephrops*, Botney Gut–Silver Pit (FU 5): Long-term trends in landings (tonnes), effort, lpue.

The state of this stock is unknown. Landings per unit effort (lpue) fluctuate without trend.

Management plans

No specific management objectives are known to ICES.

The fisheries

The *Nephrops* fisheries in the Botney Gut are solely bottom trawl fisheries. For many years Belgium was the only country exploiting *Nephrops* in this area. Since 2005 the Netherlands and the UK have become the most important exploiters of this stock, taking around 80% of the total international landings.

Quality considerations

The available lpue figures from the Dutch, Danish, and Belgian fisheries (up to 2005) must be viewed cautiously as stock indicators.

The advice is based on a calculation of potential landing options and harvest rates, given the known surface area of *Nephrops* habitat and assumed densities of the functional unit. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	Data-limited method for *Nephrops*.
Input data	Habitat extent, mean size, landings, discard proxy, and burrow density.
Discards and bycatch	Used in the assessment.
Indicators	None.
Other information	None.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in Botney Gut–Silver Pit (FU 5)

Reference points

No reference points are defined for this stock.

Outlook for 2013 and 2014

In the absence of a full analytical assessment, ICES bases its advice for *Nephrops* on average landings, unless this is considered to be not precautionary.

The table presents a range of harvest rates based on historical landings, the known surface area of the functional unit, and different population densities. This is not a catch options table, it is a sensitivity analysis to explore if the average landings of the last ten years would correspond to a precautionary harvest rate under a range of potential *Nephrops* density values in the FU. The shaded cells show harvest rates above 8% (MSY harvest rates vary between 8% and 16%), which are considered less precautionary.

Basis: Surface area FU 5: 1850 km^2, Mean weight: 25.6 grams, Discards: 25% in number.

		Range of potential densities (*Nephrops* per m^2)								
Basis	**landings**	**0.05**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7***	**0.8**
0.5 * Average	500	26.4%	13.2%	6.6%	4.4%	3.3%	2.6%	2.2%	1.9%	1.6%
Average landings (last 10 yrs)	1000	52.8%	26.4%	13.2%	8.8%	6.6%	5.3%	4.4%	3.8%	3.3%
Maximum historical landings	1400	73.9%	37.0%	18.5%	12.3%	9.2%	7.4%	6.2%	5.3%	4.6%

Shaded areas indicate harvest rates > range of North Sea F_{MSY} proxies of 8%–16%.
* Most recent density estimate (preliminary TV survey results).

ICES approach to data-limited stocks

For this stock, average landings of 1000 t in the last ten years correspond to a potential harvest rate of 3.8%, based on the most recent density estimate (preliminary TV survey results) of 0.7 *Nephrops* per m^2. This is considered below the range of MSY harvest rates in the North Sea (between 8%–16%) and is therefore considered precautionary.

Additional considerations

See the general considerations for *Nephrops* in the North Sea.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

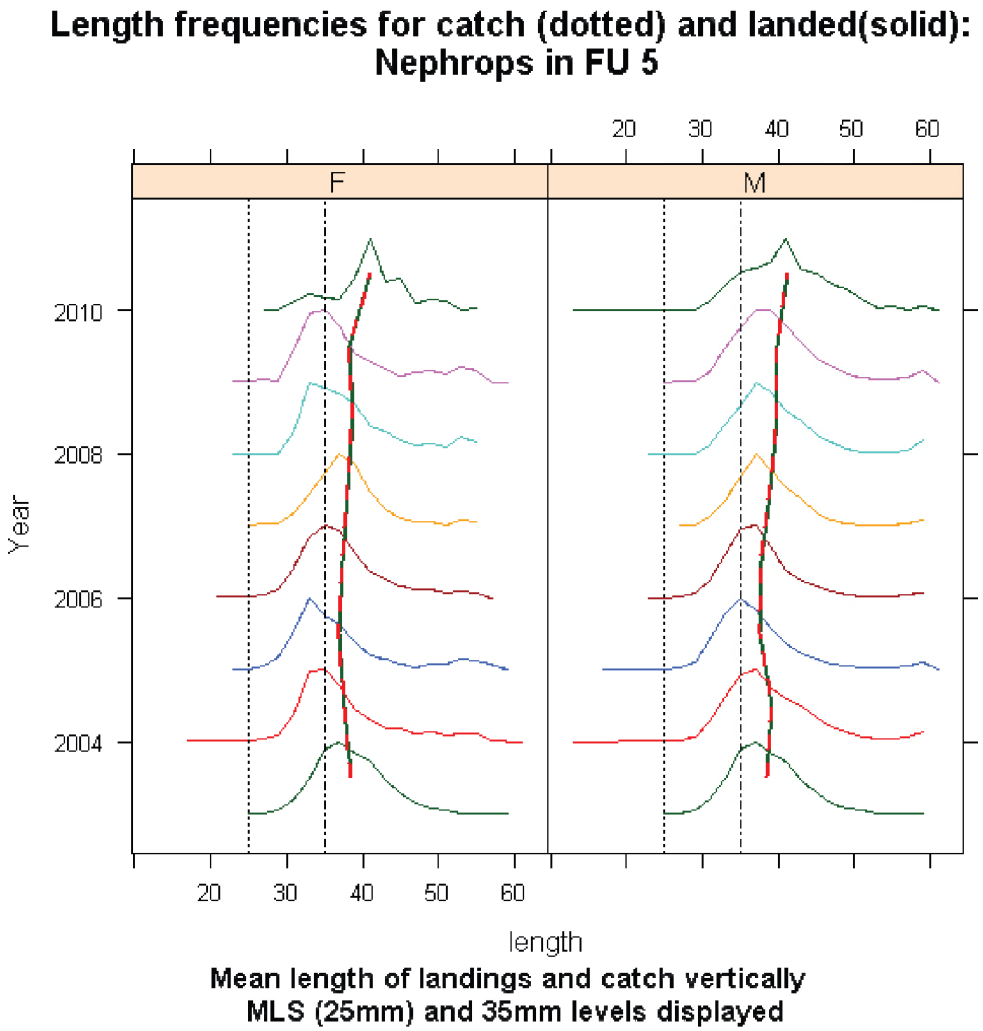


Figure 6.4.14.1.2 *Nephrops* in Botney Gut–Silver Pit (FU 5). Length composition of catch (dotted) and landed (solid) of males (right) and females (left) from 2003 (bottom) to 2011 (top). Mean sizes of catch and landings (using same line types) is shown in relation to minimum landing size (MLS).

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	-	1.0
2012	Reduce catches	-	
2013	Average landings (last 10 yrs)	< 1.0	
2014	Same catch advice as for 2013	< 1.0	

Weights in thousand tonnes.
[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). ICES 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
2011*	60	18	480	145	350	1053

* Provisional.
** Totals for 1991–1994 excluding landings by the Netherlands.
na = not available.

ECOREGION North Sea
STOCK *Nephrops* in Farn Deeps (FU 6)

Advice for 2013

ICES advises on the basis of the MSY transition that landings in 2013 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})	✗	✗	✗	Above
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2008	2009	2010	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

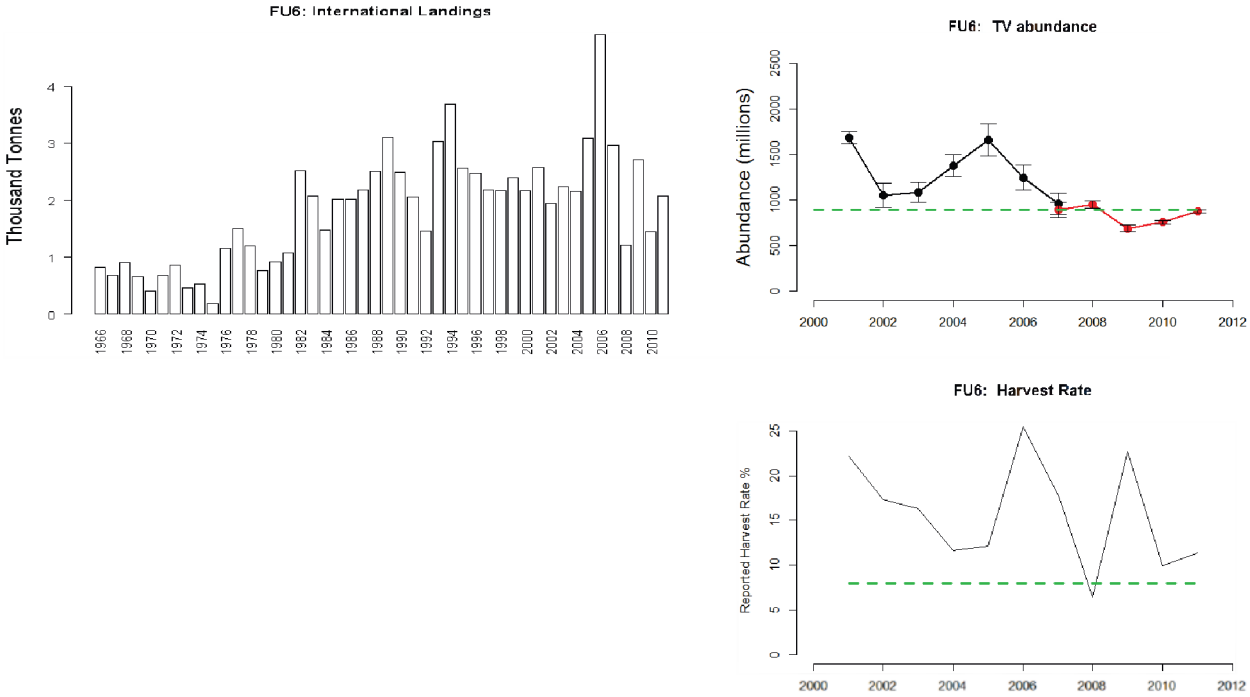


Figure 6.4.14.2.1 *Nephrops* in Farn Deeps (FU 6). Long-term trends in landings, harvest rate, and UWTV abundance (used as F and SSB proxies. Weights in thousand tonnes, UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. For the UWTV abundance calculation a geostatistical method has been determined from 2007 onwards (red line).

The UWTV survey indicates that the stock status has declined since 2005 and has been rebuilding to just below MSY $B_{trigger}$ since 2009. Changes in survey methodology in 2007 make exact comparisons with the preceding series difficult, but the general trend is considered reliable.

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 distribution	Landings (2011) = 2070 t. Almost entirely taken in demersal trawl fisheries, either a directed *Nephrops* or a mixed *Nephrops*/demersal fishery. 23% discards in numbers.

Quality considerations

Market sampling misses portions of the tailed category of landings. For assessment purposes, only sampling of the full unsorted catch is used to estimate the size composition of 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 2012 assessment has reworked the abundance indices back to 2007 following revisions to the burrow counts, resulting in changes to the MSY $B_{trigger}$ proxy and particularly to the stock level in 2010.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	One survey index (UWTV); 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

ECOREGION North Sea
STOCK *Nephrops* in Farn Deeps (FU 6)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	890 million	Bias-corrected UWTV survey index at start of current decline (2007) as measured by a geostatistical method.
	F_{MSY}	Harvest rate 8%.	Equivalent to $F_{35\%SPR}$ males in 2011.
Precautionary Approach	$F_{0.1}$	Not agreed.	
	F_{max}	Not agreed.	

(unchanged since: 2012)

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: F(2012) = average harvest rate over 2008–2010 = 13.9 %; Bias-corrected survey index (2011) = 870 million; Mean weight in landings (2009–2011) = 25.6 g; Discard rate (dead, by number) = 25.5%; Survey bias = 1.2.

Basis	Harvest rate	Landings
	2%	330
	4%	660
	6%	1000
	7%	1200
F_{MSY}	8%	1300
MSY transition	9%	1400
	10%	1700
	11%	1800
	12%	2000
	13%	2200
F_{2012}	*13.9%*	2300
	15%	2500

MSY approach

Following the ICES MSY framework implies a harvest rate of 8%, resulting in landings of 1300 t in 2013.

Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to $(0.4*F_{2010} + 0.6*F_{MSY})$ = 8.8% (biomass is just below MSY $B_{trigger}$, so no additional reductions are considered relevant), corresponding to landings of no more than 1400 t in 2013.

Additional considerations

Declines in abundance in other FUs (i.e. Firth of Forth and the Fladen grounds) may increase the risk of higher effort being deployed in this FU which would be inadvisable, given the current low level of the stock.

The stock has shown signs of overexploitation in recent years, with an 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 2013 from increasing and moving the observed harvest ratios even further beyond 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 2007 to 2011 at around 25% by number.

Changes in fishing technology and fishing patterns

The number of vessels using multi-rig gear had been increasing but now appears to have stabilized. These gears have a higher fishing power than single rigs for *Nephrops* and may have a higher environmental impact due to the additional weight required for deployment.

Information from the fishing industry

There is some consistency between the overall abundance track and the scientific survey. The Fishers' Stock Survey trajectory (Napier, 2011) for area 4 is considerably flatter than in other areas, consistent with the scientific perception that the Farn Deeps stock has not followed the increasing trend of other functional units. There is also agreement with the Stock Survey that 2011 saw an increase in abundance compared to 2010. The Fishers' Stock Survey area does not match this FU.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.14.

Revisions to the UWTV survey calculations for 2007–2010 (in 2012) have resulted in changes to the bias-corrected abundance indices, particularly in 2010 which is reduced by 15% from 892 million to 753 million (−18%). The value used for the MSY $B_{trigger}$ biomass proxy (the 2007 value) has increased from 879 million to 890 million (+2%).

Comparison with previous assessment and advice

The historical abundance is not revised from one year to the next because abundances are based on direct observation.

The basis for the advice has not changed.

Source

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

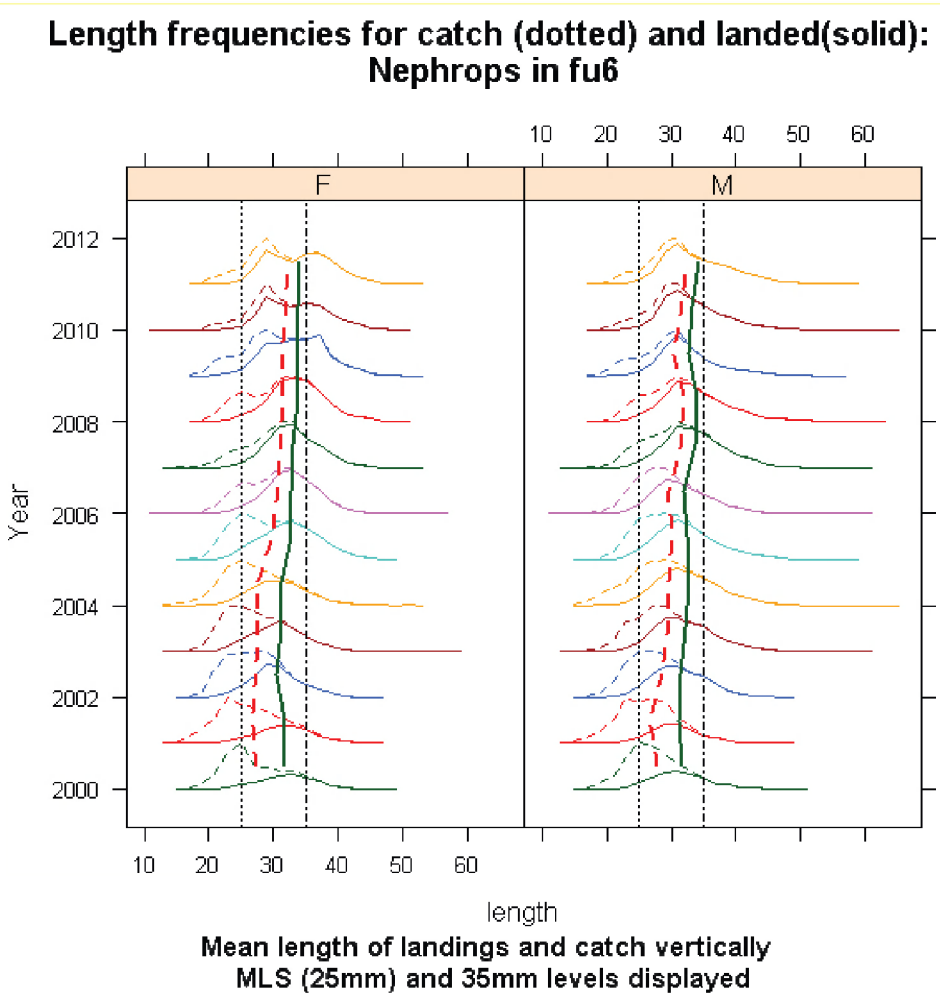


Figure 6.4.14.2.2 *Nephrops* Farn Deeps (FU 6). Length composition of catch (dotted) and landed (solid) of males (right) and females (left) from 1996 (bottom) to 2011 (top). Mean sizes of catch and landings (using same line types) is shown in relation to minimum landing size (MLS).

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 FUs 6 and 8	ICES landings FU 6[1)]
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)]	2.1
2012	MSY transition	< 1.4	-[2)]	
2013	MSY transition	< 1.4	-[2)]	

Weights in thousand tonnes.
[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
2011*	1806	250	2056	14	2070

* 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	890	2966	25.00%	24.95	158	17.8%
2008	949	1213	24.90%	26.63	61	6.4%
2009	683	2711	29.30%	24.45	155	22.7%
2010	753	1443	23.00%	25.18	74	9.9%
2011	870	2072	22.60%	27.05	99	11.4%

ECOREGION North Sea
STOCK *Nephrops* in Fladen Ground (FU 7)

Advice summary for 2013

ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 10 000 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Below target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

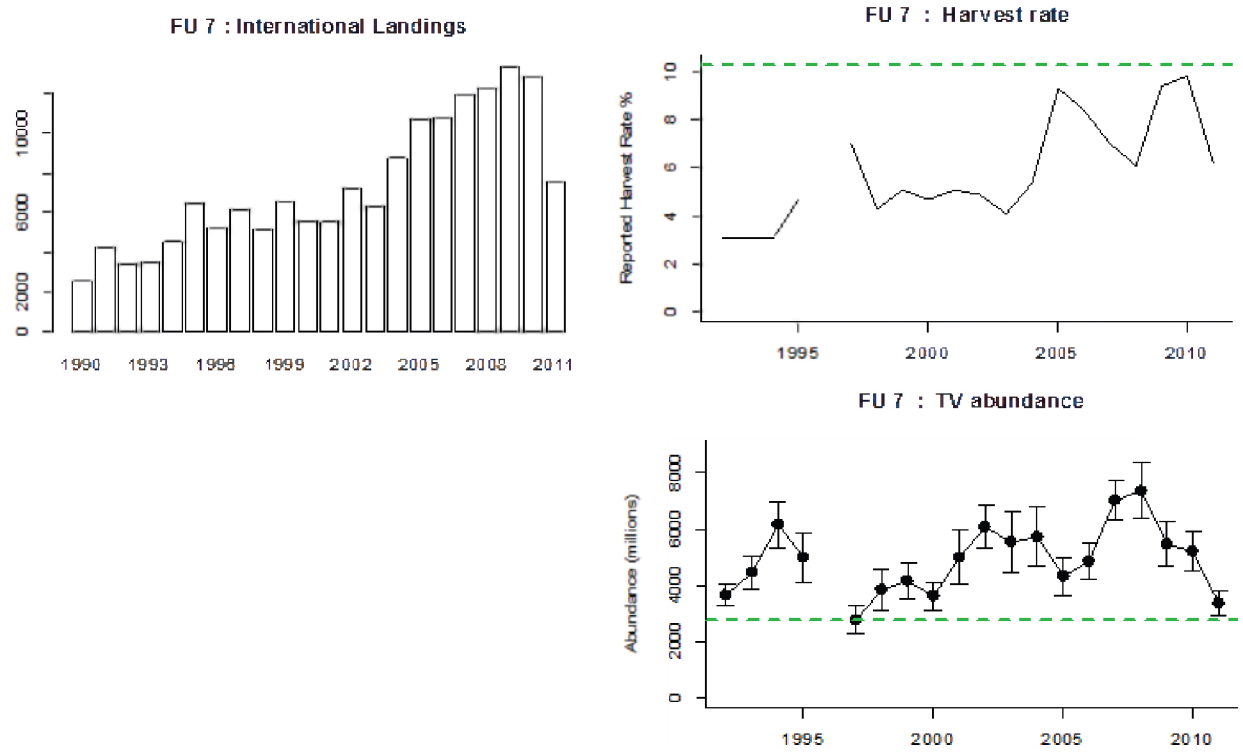


Figure 6.4.14.3.1 *Nephrops* in Fladen Ground (FU 7). Long-term trends in landings, harvest rate, and bias-adjusted UWTV abundance (used as F and SSB proxies. Weights in thousand tonnes, UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock has declined in the last three years but remains just above MSY $B_{trigger}$. The harvest rate has fluctuated around 8% in recent years, which is 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 individuals compared to other FUs. There also appears to be fewer competing burrowing species in this area.

The fisheries

Over 95% of the landings are taken by Scottish vessels. Most of the landings are made by single-rig vessels. 80 mm mesh is the most common mesh size although there is anecdotal evidence of increasing use of meshes larger than 80 mm. Whitefish represents an important bycatch for a significant component of the Scottish *Nephrops* trawlers operating at the Fladen.

Catch distribution	Total catch (2011) = 7.6 kt. Almost all landings are taken in demersal trawl fisheries, either in a directed *Nephrops* or a mixed *Nephrops*/demersal fishery. Observer trips recorded no *Nephrops* discards in 2011.

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	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	One survey index (UWTV-Sco-J); Catch length–frequency data.
Discards and bycatch	Included in the assessment.
Indicators	Size structure of catches, mean size, lpue.
Other information	Latest benchmark (based on the 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. *F_{MSY} proxy based on length-based Y/R.*
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.

Outlook for 2013

Basis: F_{2012} = 8.5% (= Average F_{2009} to F_{2011} used since harvest rate fluctuating); Bias-corrected survey index (2011) = 3382 million; Mean weight in landings (2009–2011) = 30.25 g; Discard rate (dead, by number) = 4% (average 2009–2011); Survey bias = 1.35.

	Harvest rate	Landings (tonnes)
	5.0%	4 900
	7.5%	7 400
F_{2012}	8.5%	8 300
	10.0%	9 800
MSY framework	10.3%	10 000
	12.5%	12 000
	15.0%	15 000
	17.5%	17 000
	20.0%	20 000

MSY approach

Following the ICES MSY framework implies a harvest rate lower than 10.3%, corresponding to landings of less than 10 000 t in 2013.

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* sometimes takes place at a low rate in this FU. Values have fallen in recent years, from about 10% in the early 2000s to around 5% by number in the period covered by the Y/R analysis (2008–2010); in 2011 there were zero discards of *Nephrops*. 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 farther easterly and northerly edges of the extensive mud area.

The reduction in the discard rate since 2000 appears to be caused partly by increased retention of small individuals (lower mean sizes of the < 35 mm component of the landings for part of the time-series) and possibly, in the most recent years, by a period of reduced recruitment which has led to some changes in the size composition of the catch.

Information from the fishing industry

The Fishers' North Sea stock survey (Napier, 2011) suggests that moderate or higher amounts of recruits were apparent in Area 1 (within which the Fladen FU largely lies) in 2011 compared to 2010. The time-series of perceived abundance in Area 1 increases up to 2011. Opinions on discards appear to be split fairly evenly between "higher" and "no change". Anecdotal information from the Scottish fishing industry suggests that their fishing activity is being increasingly restricted by cod avoidance real-time closures.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.14.

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 previous years has not changed (i.e. based on an absolute abundance estimate from a survey). The stock in 2011 appears to be reduced in size compared to a high point in 2008, but remains above the biomass trigger.

The advice given in 2012 is based on the MSY framework (as last year).

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

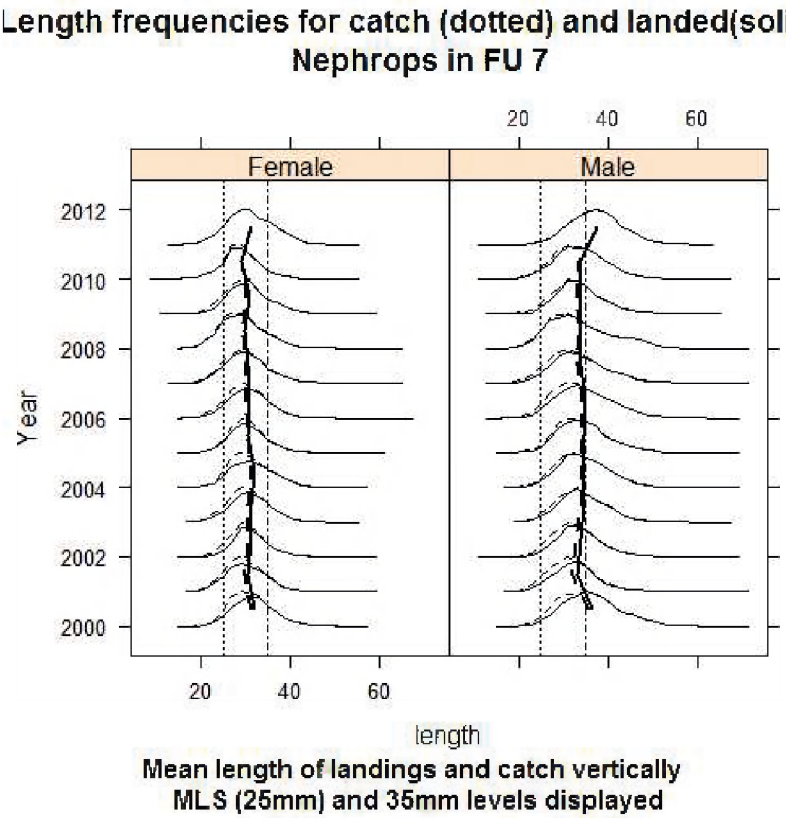


Figure 6.4.14.3.2 *Nephrops*, Fladen (FU 7). Catch length–frequency distribution and mean sizes in the catch and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

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)]
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	7.6
2012	MSY framework	< 14.1	
2013	MSY framework	< 10.	

Weights in thousand tonnes.
[1)] Does not include discards.

Table 6.4.14.3.2 *Nephrops* in Fladen Ground (FU 7). Official 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
2011*	64	***7494		7494	<0.5	7558

* provisional na = not available

** Other countries includes Belgium, Norway and UK England

*** 4 main trawl gears combined in 2011; other gears <0.5 tonnes

Table 6.4.13.3.3 *Nephrops* in Fladen Ground (FU 7). Results of the 1992–2010 TV surveys (abundances and confidence interval bias-adjusted).

Year	Stations	Abundance millions	Mean density burrows/m^2	95% confidence interval 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	0.26	772
2010	67	5224	0.25	710
2011	73	3382	0.16	435

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.

	Adjusted abundance (millions)	Landings (tonnes)	Discard rate	Dead discard rate	Harvest ratio
2003	5547	6294	0.1	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	0.1	0.07	0.09
2010	5224	12825	0.06	0.05	0.1
2011	3382	7558	0	0	0.062

ECOREGION North Sea
STOCK *Nephrops* in Firth of Forth (FU 8)

Advice for 2013

ICES advises on the basis of the transition to the MSY approach that landings in 2013 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)	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

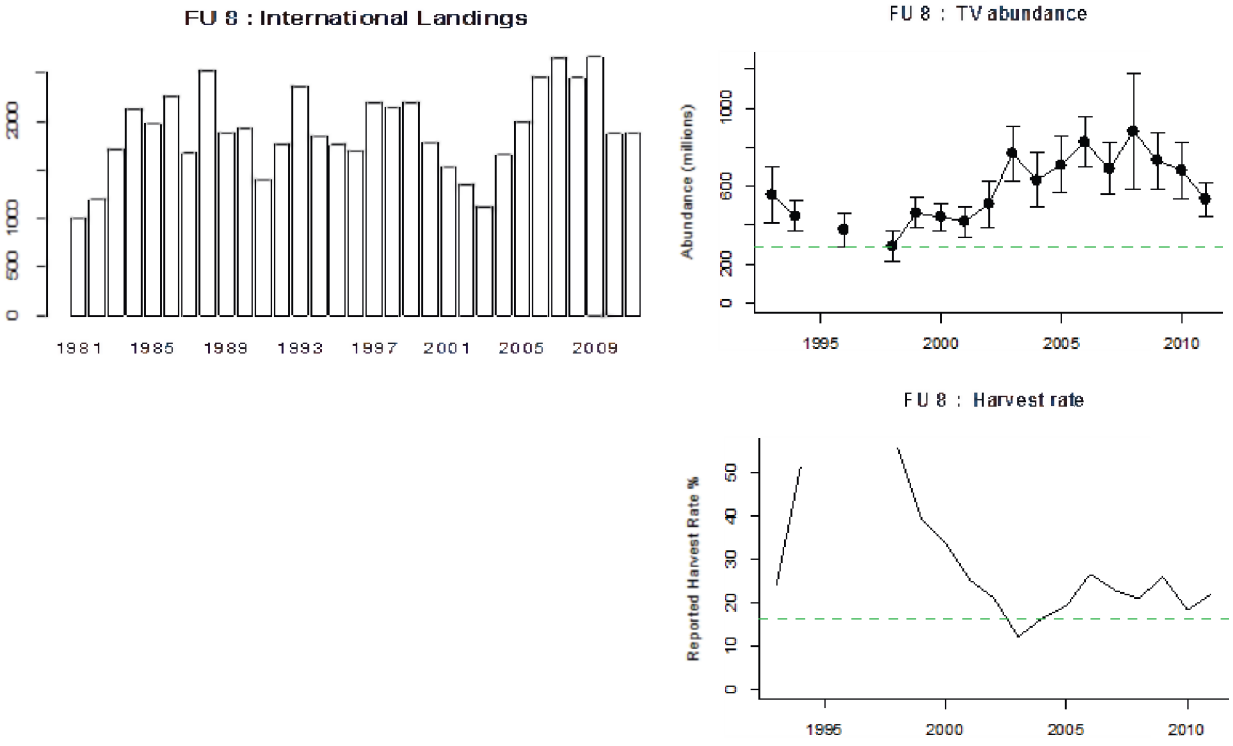


Figure 6.4.14.4.1 *Nephrops* in Firth of Forth (FU 8). Long-term trends in landings, harvest rate, and bias-adjusted UWTV biomass (used as F and SSB proxies; weights in thousand tonnes and UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock remains above MSY $B_{trigger}$ but has declined over the last three years. The harvest rate remains 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 (for example, 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 distribution	Total catch (2011) = 2.22 kt, where 90% are landings taken in demersal trawl fisheries, either a directed *Nephrops* or a mixed *Nephrops*/demersal fishery, and 10% are discards in weight.

Quality considerations

See Section 6.4.14 for general comments.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	One survey index (UWTV-Sco-A); Catch length–frequency data.
Discards and bycatch	Included in the assessment.
Indicators	Information on size structure; mean size; lpue.
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. *F_{MSY} proxy based on length-based Y/R* -
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.

Outlook for 2013

Basis: F_{2012} = average harvest rate of 2009–2011 = 22.2%; Bias-corrected survey index (2011) = 533 million; Mean weight in landings (2009–2011) = 19.6 g; Discard rate (dead, by number) = 22.3% (average 2009–2011); Survey bias = 1.18.

	Harvest rate	Landings (tonnes)
	5.0%	450
	7.5%	650
	10.0%	850
	12.5%	1100
	15.0%	1300
F_{MSY}	16.3%	1400
MSY transition	17.1%	1400
	20.0%	1700
F_{2012}	22.2%	1900
	25%	2100

MSY approach

To follow the ICES MSY framework the harvest rate should be reduced to 16.3%, corresponding to maximum landings of 1300 t in 2013.

To follow the transition scheme towards the ICES MSY framework the harvest rate should be reduced to 17.1% (0.4* F_{2010}+ 0.6* F_{MSY}), corresponding to landings of no more than 1400 t in 2013 (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 20% by number in the Firth of Forth in 2011. 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 higher discard rates than in some other areas around Scotland.

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 (FU 34).

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 2011, 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 earlier years has not changed – assessments are based on an absolute survey. The stock has declined since 2010, but remains above the biomass trigger.

The advice given for 2013 is based on the MSY transition scheme (as the advice given for 2012).

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

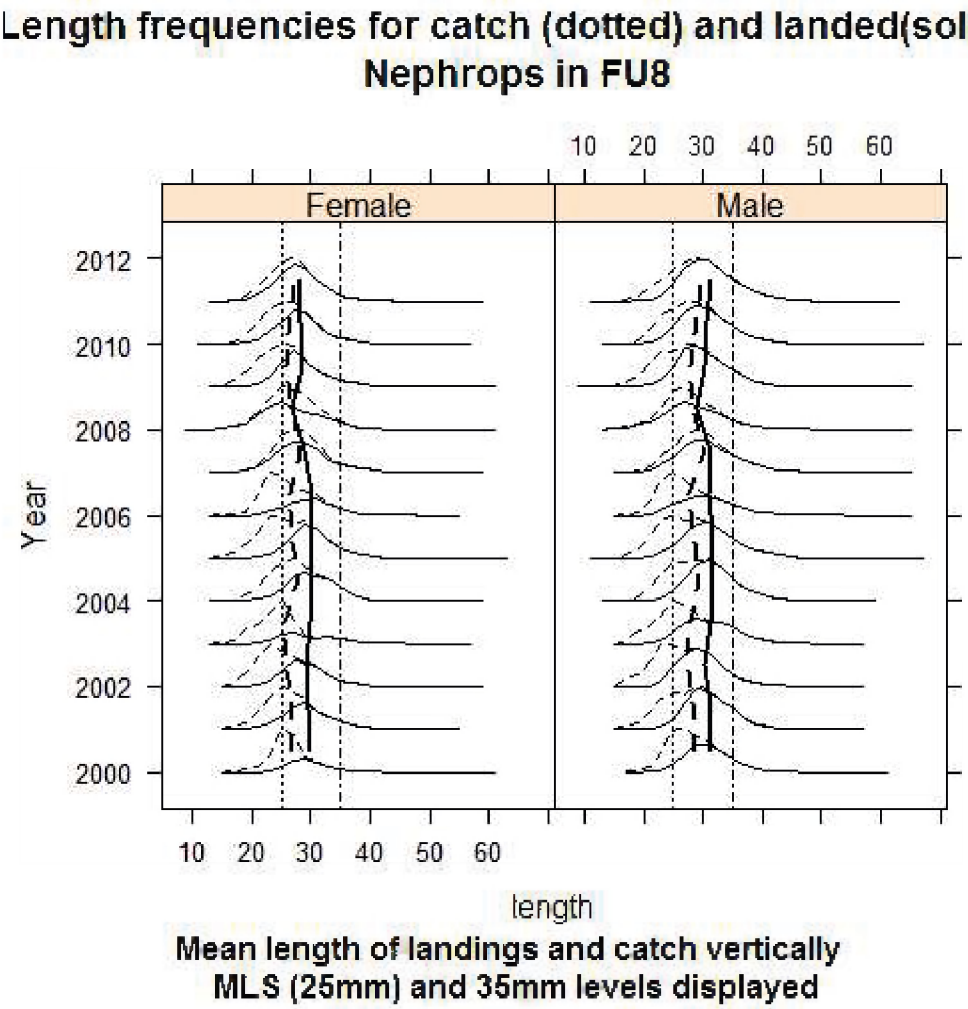


Figure 6.4.14.4.2 *Nephrops* in Firth of Forth (FU 8). Catch length–frequency distribution and mean sizes in the catch and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

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 FUs 6 and 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)]	1.9
2012	MSY transition	< 1.7		
2013	MSY transition	< 1.4		

Weights in thousand tonnes.
[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)	
	Nephrops trawl	Other trawl	Creel	Sub-total		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
2011*	***1794		89	1883	5	1888

* Provisional.

** There are no landings by other countries from this FU.

*** 4 trawl gears in 2011;also includes 5 t other gears.

na = not available.

Table 6.4.14.4.3 *Nephrops* in Firth of Forth (FU 8): Results of the TV surveys (abundance and confidence interval bias-adjusted).

Year	Stations	Mean density burrows/m²	Abundance millions	95% conf. interval 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	0.6	463	78
2000	53	0.57	443	70
2001	46	0.54	419	79
2002	41	0.66	508	119
2003	36	0.99	767	138
2004	37	0.81	630	141
2005	54	0.92	710	143
2006	43	1.07	827	125
2007	49	0.9	692	132
2008	38	1.14	881	297
2009	45	0.94	732	142
2010	39	0.88	681	147
2011	45	0.69	533	87

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 ratio
2003	767	1126	0.54	0.47	0.123
2004	630	1658	0.35	0.29	0.164
2005	710	1990	0.42	0.35	0.194
2006	827	2458	0.55	0.48	0.267
2007	692	2652	0.25	0.2	0.229
2008	881	2450	0.29	0.24	0.211
2009	732	2662	0.34	0.28	0.26
2010	682	1871	0.3	0.24	0.184
2011	533	1888	0.19	0.15	0.221

ECOREGION North Sea
STOCK *Nephrops* in Moray Firth (FU 9)

Advice for 2013

ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 950 t.

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✗	Above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2009	2010	2011	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

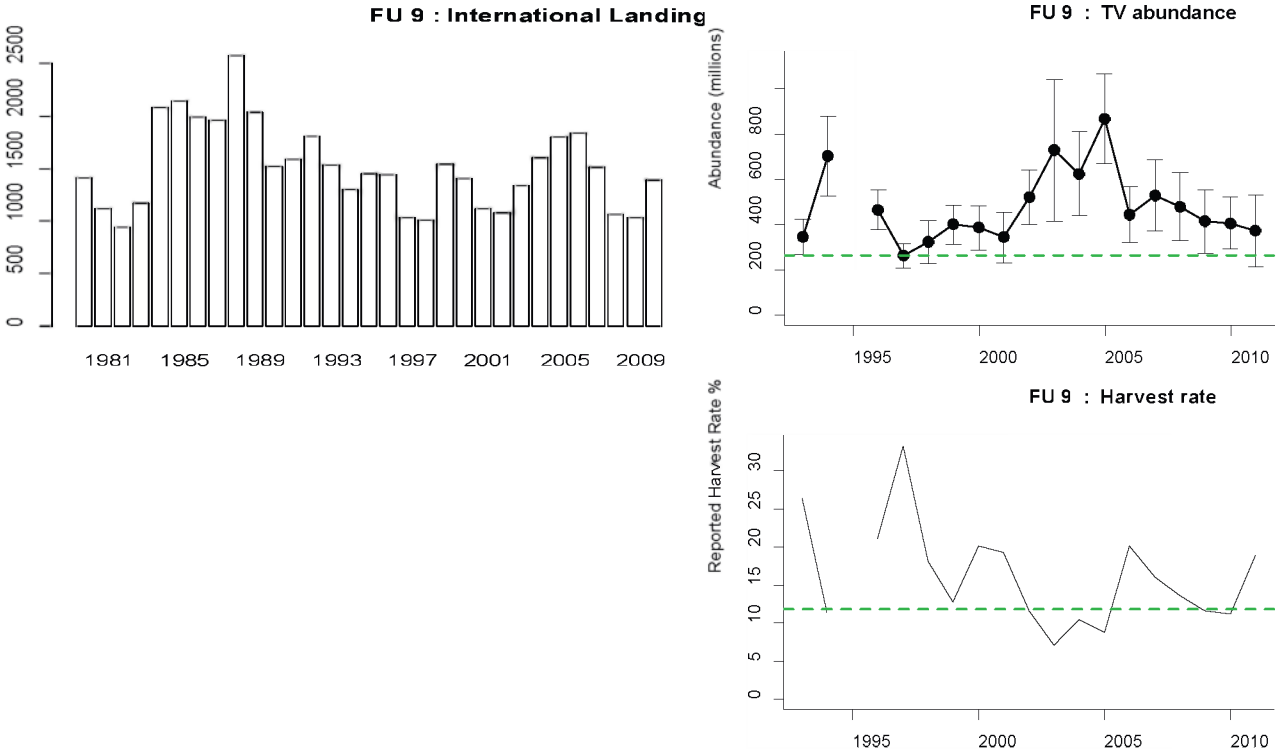


Figure 6.4.14.5.1 *Nephrops* in Moray Firth (FU 9). Long-term trends in landings, harvest rate, and bias-adjusted UWTV abundance (used as F and SSB proxies; weights in thousand tonnes and UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock is declining but remains above MSY $B_{trigger}$. The harvest rate was just below F_{MSY} in 2010, but increased in 2011.

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 distribution	Total catch (2010) = 1.5 kt, where 93% are landings taken in demersal trawl fisheries, either in a directed *Nephrops* or a mixed *Nephrops*/demersal fishery, and 7% are discards in weight.

Quality considerations

See Section 6.4.14 for general comments.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	One survey index (UWTV-Sco-A); Catch length–frequency data.
Discards and bycatch	Included in the assessment.
Indicators	Size structure information; mean size; lpue.
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 Approach	MSY $B_{trigger}$	262 million individuals.	Bias-adjusted lowest observed UWTV survey estimate of abundance (1997).
	F_{MSY}	Harvest rate 11.8%.	Proxy, equivalent to $F_{35\%SPR}$ combined sex in 2011. *F_{MSY} proxy based on length-based Y/R.*
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.

Outlook for 2013

Basis: F_{2012} = 13.9% (based on average (F_{2009} to F_{2011}); Bias-corrected survey index (2010) = 372 million; Mean weight in landings (2009–2011) = 24.01 g; Discard rate (dead, by number) = 11% (average 2009–2011); Survey bias = 1.21.

	Harvest rate	Landings (tonnes)
	5.00%	400
	7.50%	600
	10.00%	800
F_{MSY}	11.80%	950
	12.50%	1000
F_{2012}	13.90%	1200
	15.00%	1200
	20.00%	1600

MSY approach

Following the ICES MSY framework implies the harvest rate should be less than 11.8%, resulting in landings of less than 950 t in 2013.

Additional considerations

See Section 6.4.14 for general comments.

Changes in fishing technology and fishing patterns

Discarding rates 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 2011, 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 historical abundance is not revised from one year to the next because abundances are based on direct observation. The 2011 TV survey suggests a drop in abundance.

The basis for the advice is the same as last year: the MSY framework.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

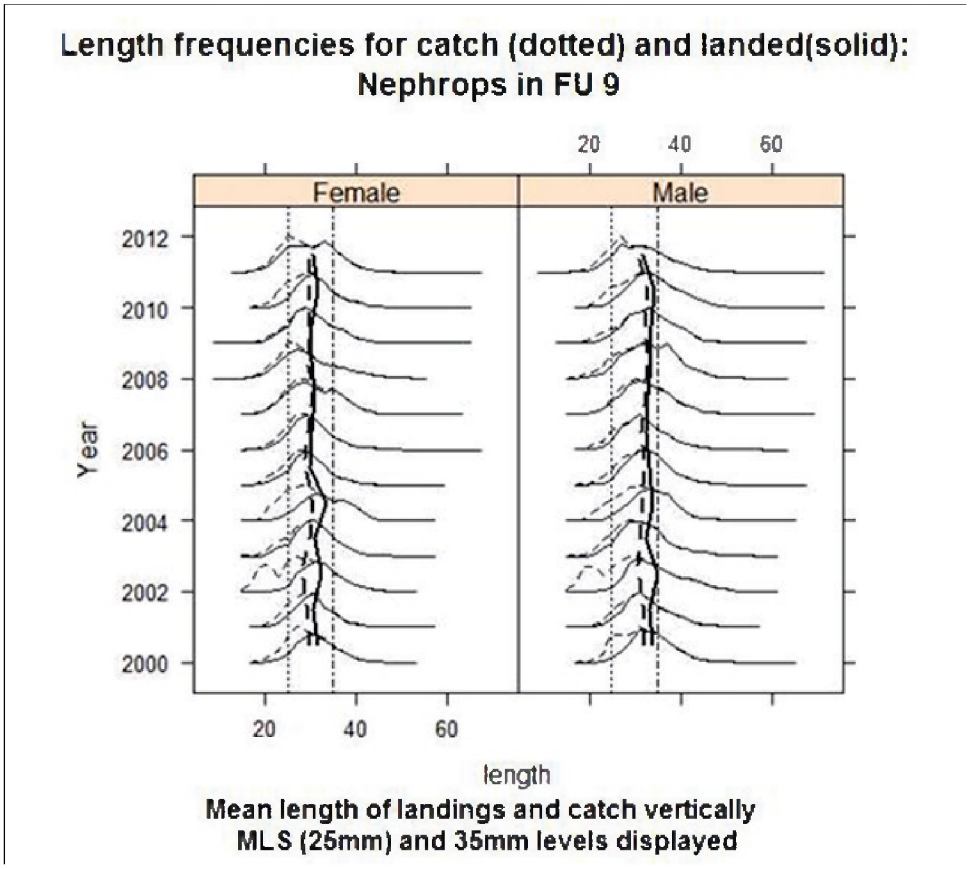


Figure 6.4.14.5.2 *Nephrops* in Moray Firth (FU 9). Catch length–frequency distribution and mean size in catches and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

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 FUs 9 and 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)]	1.4
2012	MSY framework	< 1.1		
2013	MSY framework	< 1.0		

Weights in thousand tonnes.
[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
2011*	***1381		9	1390	1	1391

* Provisional.

** No landings by non-UK countries from this FU.

*** 4 trawl gears in 2011; includes 5 t from other mobile gears.

Table 6.4.14.5.3 *Nephrops* in Moray Firth (FU 9): Results of the 1993–2010 TV surveys (abundance and confidence interval bias-adjusted).

Year	Stations	Mean density burrows/m²	Abundance millions	95% confidence interval 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	0.4	730	314
2004	42	0.35	626	186
2005	42	0.48	869	198
2006	50	0.25	445	124
2007	40	0.29	531	156
2008	45	0.26	479	151
2009	50	0.23	415	140
2010	43	0.22	406	116
2011	37	0.205	373	160

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 ratio
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	0.2
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	0.20	0.16	0.11
2011	372	1391	0.14	0.11	0.19

ECOREGION North Sea
STOCK *Nephrops* in Noup (FU 10)

Advice for 2013 and 2014

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 50 tonnes. This is the first year that ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

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

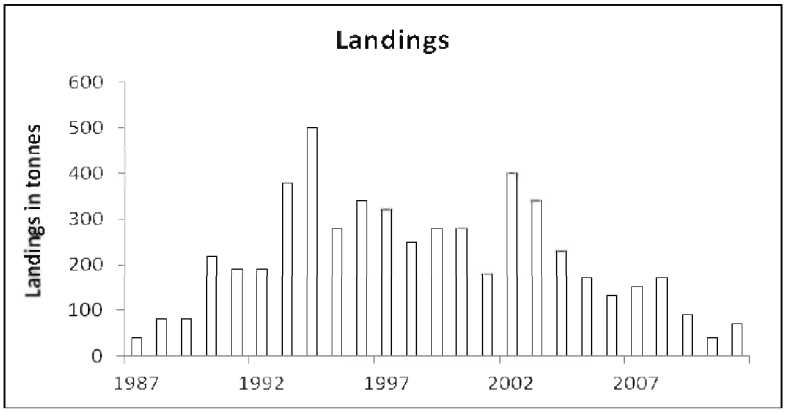


Figure 6.4.14.6.1 *Nephrops* in Noup (FU 10). Landings (tonnes).

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 since 2007. There are no reliable effort data for this FU and therefore no resulting lpue.

The advice is based on a calculation of potential landing options and harvest rates, given the known surface area of *Nephrops* habitat and assumed densities of the functional unit. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	Data-limited approach for *Nephrops*.
Input data	Habitat extent, mean size, occasional UWTV surveys (incomplete time-series).
Discards and bycatch	No discard information available.
Indicators	Size structure information; lpue.
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 2013 and 2014

In the absence of a full analytical assessment, ICES bases advice for *Nephrops* on average landings, unless this is considered to be not precautionary.

The table presents a range of harvest rates from historical landings, based on the known surface area of the functional unit and different population densities. This is not a catch options table, it is a sensitivity analysis to explore if the average landings of the last ten years would correspond to a precautionary harvest rate under a range of potential *Nephrops* density values in the FU. The shaded cells show harvest rates above 8% (MSY harvest rates vary between 8% and 16%), which are considered less precautionary.

Basis: Surface area FU 10: 409 km^2, Mean weight: 25 grams, Discards: 25% in number.

		Range of potential densities (*Nephrops* per m^2)								
Basis	**landings**	**0.05**	**0.1**	**0.2***	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**
0.5 * Average	75	18.3%	9.2%	4.6%	3.1%	2.3%	1.8%	1.5%	1.3%	1.1%
Average landings (last 10 yrs)	150	36.7%	18.3%	9.2%	6.1%	4.6%	3.7%	3.1%	2.6%	2.3%
Maximum historical landings	500		61.1%	30.6%	20.4%	15.3%	12.2%	10.2%	8.7%	7.6%

Shaded areas indicate harvest rates > range of North Sea F_{MSY} proxies of 8%–16%.
* Most recent density estimate (2007 TV survey results).

ICES approach to data-limited stocks

For this stock, average landings of 150 t for the last ten years correspond to a potential harvest rate of 9.2%, based on the 2007 density estimate of 0.2 *Nephrops* per m^2. This is considered within the range of MSY harvest rates in the North Sea (between 8% and 16%). Furthermore, as the density estimate is five years old and landings per unit effort have declined significantly since 2007, there is concern that the burrow density has declined since 2007 and the harvest rate may consequently be higher. For this reason it is not recommended to use the average landings of the last ten years as the basis for advice.

For this stock, ICES advises that catches should decrease by 20% in relation to average catches of the last three years, corresponding to catches of no more than 50 t.

Additional considerations

See Section 6.4.14 for general comments.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

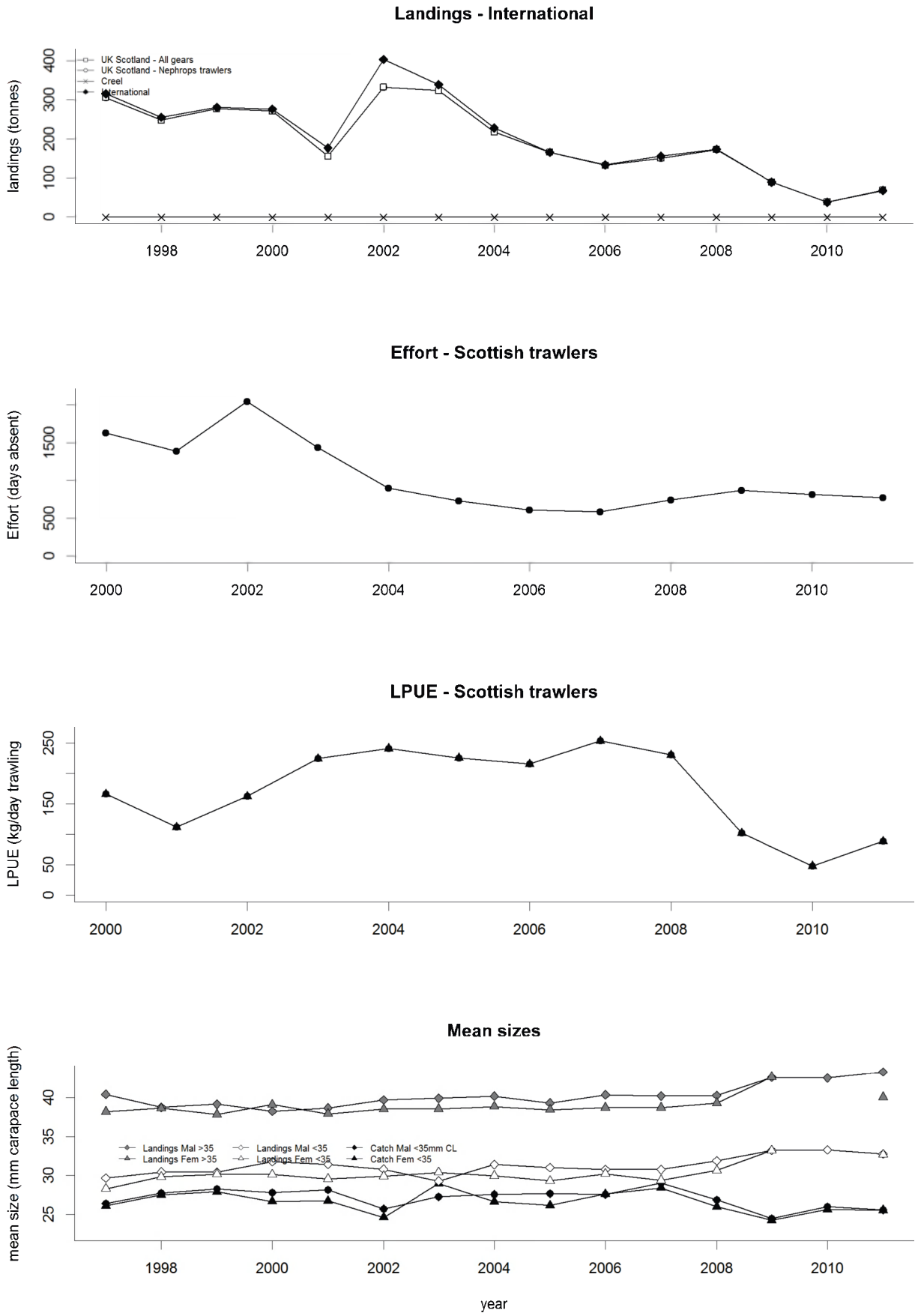


Figure 6.4.14.6.2 *Nephrops* in Noup (FU 10). Trends in landings, effort , lpue, and mean size in the landings (divided by male and female, above and below 35 cm).

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 FUs 9 and 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	0.16
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	-		0.07
2012	Reduce catch	-		
2013	20% Reduction in catches (last 3 years' average)	< 0.05		
2014	Same catch advice as for 2013	< 0.05		

Weights in thousand tonnes.
[1)] Does not include discards.
[2)] Based on a 15% harvest rate applied to TV survey abundance data. Includes Moray Firth (FU 9).

ECOREGION North Sea
STOCK *Nephrops* in the Norwegian Deep (FU 32)

Advice for 2013 and 3014

Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 800 t. This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

For the stock in this functional unit (FU), management is implemented at the functional unit level.

State of the stock

F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	✓	below poss refpoints

SSB (Spawning-Stock Biomass)		
	2009–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	→	stable

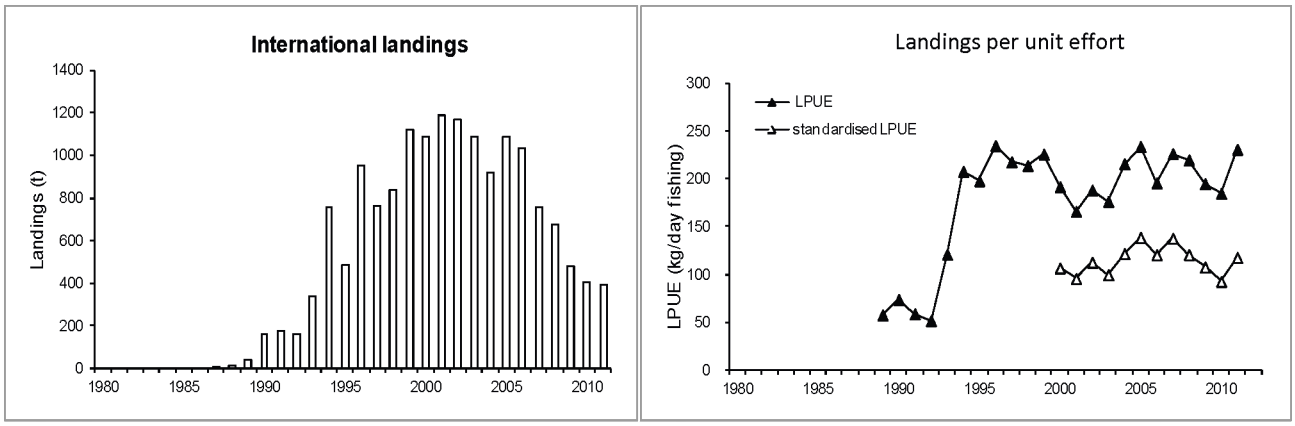


Figure 6.4.14.7.1 *Nephrops*, Norwegian Deep (FU 32): Trends in landings (tonnes) and Danish lpue (non-standardized and standardized).

Landings per unit effort (lpue) have been relatively stable over the last 18 years and suggest that current and past levels of exploitation are sustainable. Harvest rates are considered low for this stock.

Management plans

No specific management objectives are known to ICES.

Biology

In the Norwegian Deep the *Nephrops* stock inhabits a single continuous area of muddy sediment extending from 57 to 62°N.

The fisheries

Nephrops in FU 32 are caught in 120 mm trawls (mixed fishery), as bycatch in shrimp trawls and in creels. The stock is fished by Danish and Norwegian fishers, where the Danish vessels take the majority of catches (80% in 2011). Danish fishers only exploit the western part of the stock, indicating that only part of the stock is exploited at present. Sediment maps for this area indicate that there are possibilities for the fishery to expand into new grounds, which have scarcely been fished to date. The recreational fishery for *Nephrops* along the Norwegian coast has increased in recent years. The extent of this fishery is being investigated through interviews.

Catch distribution	Total catch (2011) = 395 kt, where 395 t were landings (90% trawls and 10% creels). Discards are unknown.

Effects of the fisheries on the ecosystem

Large-meshed trawls (120 mm) as implemented in the Norwegian Deep results in little discards of *Nephrops* below minimum landing size (MLS).

Quality considerations

There are concerns over effort data because of possible changes in selectivity or gear efficiency leading to "technological creeping". Lpue may be affected by changes in catchability due to sudden changes in the environmental conditions. Trends in discards and mean size of the catch are difficult to interpret without information on changes in the fishing pattern and practices.

Scientific basis

Assessment type	Data-limited approach for *Nephrops* stocks.
Input data	Habitat extent, mean size distributions from Danish and Norwegian catches and landings.
Discards and bycatch	Not included in the assessment.
Indicators	Danish commercial lpue.
Other information	None.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in the Norwegian Deep (FU 32)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	-	No reference points are defined.
	F_{MSY}	-	No reference points are defined.
Precautionary Approach	Not defined		

(unchanged since: 2010)

Outlook for 2013 and 2014

In the absence of a full analytical assessment, ICES bases its advice for *Nephrops* on average landings, unless this is considered to be not precautionary.

The table presents a range of harvest rates from historical landings, based on the known surface area of the functional unit and different population densities. This is not a catch options table, it is a sensitivity analysis to explore if the average landings of the last ten years would correspond to a precautionary harvest rate under a range of potential *Nephrops* density values in the FU. The shaded cells show harvest rates above 8% (MSY harvest rates vary between 8% and 16%), which are considered less precautionary.

Basis: Surface area FU 5: 55 564 km^2, Mean weight: 68 grams, Discards: 15% in number.

		Range of potential densities (*Nephrops* per m^2)								
Basis	landings	**0.05**	**0.1**	**0.2***	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**
0.5 * Average	400	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Average landings (last 10 yrs)	800	0.5%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Maximum historical landings	1200	0.7%	0.4%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%

* A density of 0.2 per m^2 is typical of the lowest observed density in the North Sea in FU 7 (Fladen).

ICES approach to data-limited stocks

For this stock, the last ten years' average landings of 800 t correspond to a potential harvest rate of 0.1%, based on the minimum density estimate (from Fladen grounds) of 0.2 *Nephrops* per m^2. This is considered below the range of MSY harvest rates in the North Sea (between 8% and 16%) and is therefore considered precautionary.

Additional considerations

Recent trends in overall size distribution in the catches indicate that the *Nephrops* stock in the Norwegian Deep is not overexploited. The trend in lpue does not indicate any decline in stock abundance. ICES concludes that the level of exploitation of this stock has always been sustainable. Historical average annual landings have been approximately 1000 t (2002–2007), while recent average landings are 360 t (2008–2011). The recent decrease in Danish landings is due mainly to economic reasons.

Factors affecting the fisheries and the stock

The stock is mainly exploited by Danish vessels (85–90% of the landings in most years). During the last seven years landings have decreased from 1090 t to approximately 400 t. This is due to a decrease in Danish effort and is explained by economic reasons. The Danish lpue has fluctuated around a mean of 200 kg day^{-1} for the last 18 years. Mean sizes in commercial catches are high compared to neighbouring areas (Skagerrak and Kattegat).

Regulations and their effects

The EU fisheries are managed by a separate TAC for this area, which for 2006–2008 was 1300 t, but decreased to 1200 t in 2009–2012. The TAC has not been taken the last six years. The minimum legal size is 40 mm carapace length (CL).

Due to changes in mesh size regulations in the Norwegian zone in 2002, the Danish mixed fisheries increasingly targeted *Nephrops*.

Information from the fishing industry

Logbook data from Norwegian *Nephrops* trawlers are available from 1998–2005, representing only 15–40% of the Norwegian landings. The data are not suitable for lpue analysis. The Norwegian logbook system was changed in 2011 with an introduction of electronic logbooks compulsory for all vessels > 15 m length. This will provide consistent data for part of the fleet, but as a large portion of the Norwegian fleet landing *Nephrops* in FU 32 consists of vessels < 15 m, logbook data will continue to be limited.

The Fishers' North Sea Stock Survey shows an increase in *Nephrops* between 2001 and 2002, a slight decrease to 2003, and a marked increase since then (Figure 6.4.14.2). The 2011 index is the highest in the series. This supports the perception of a healthy stock in this area. There are no indications of changes in the levels of discards or recruits.

Uncertainties in the assessment

Sampling of Norwegian commercial catches from this area has improved. The main problems with these data are that catches are often measured by total length (whole cm) and sample weight is missing. The newly implemented changes in the Danish at-sea sampling programme, with observer trips being randomly drawn from all Danish fishing trips, will afford a very slight chance of selecting one of the few fishing trips in FU 32. A satisfactory number of observer trips should be allocated to FU 32 irrespective of the new at-sea sampling programme.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

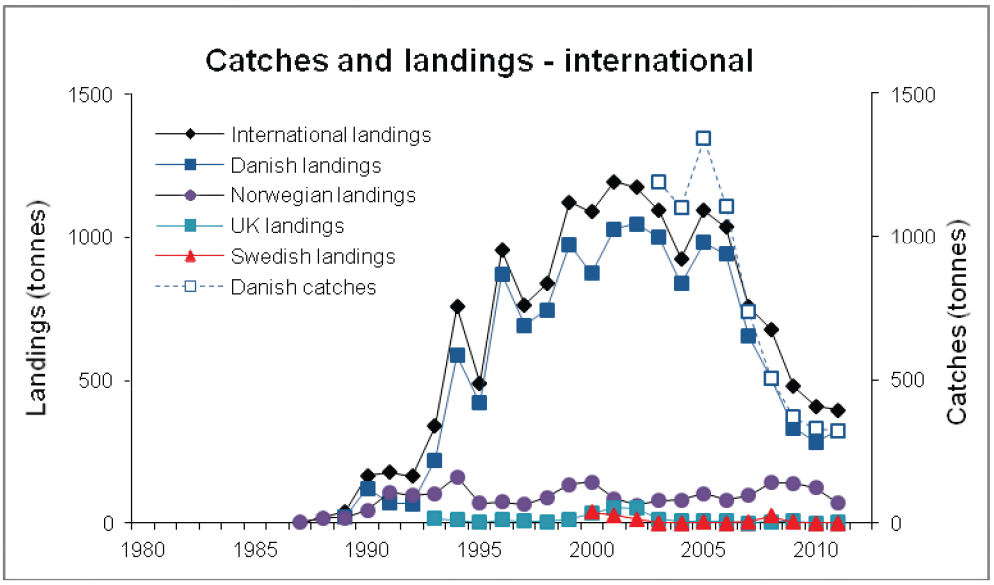


Figure 6.4.14.7.2 *Nephrops* in the Norwegian Deep (FU 32). Total landings per country (tonnes), Danish catches.

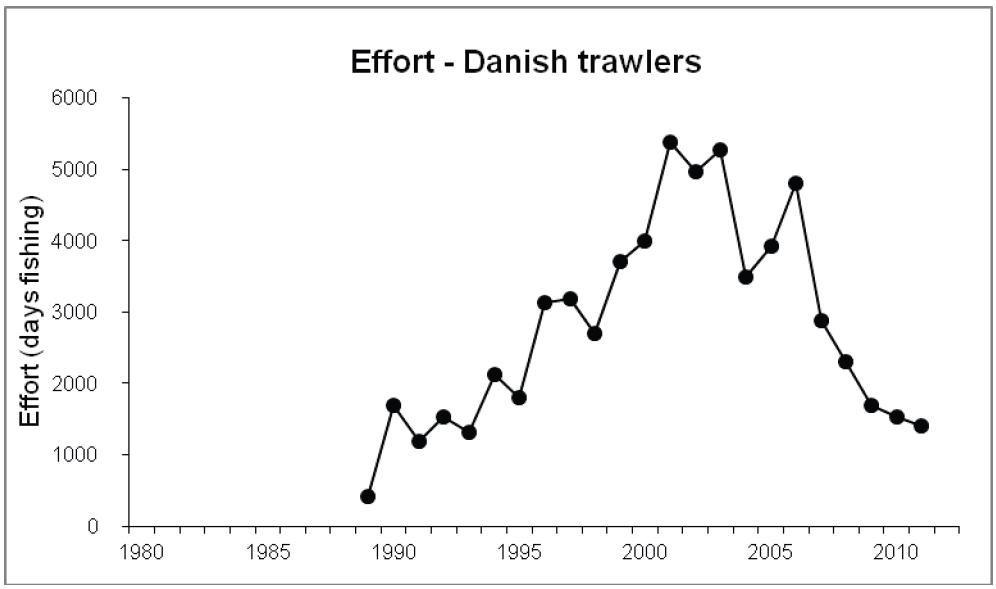


Figure 6.4.14.7.3 *Nephrops* in the Norwegian Deep (FU 32). Effort (days) of Danish trawlers.

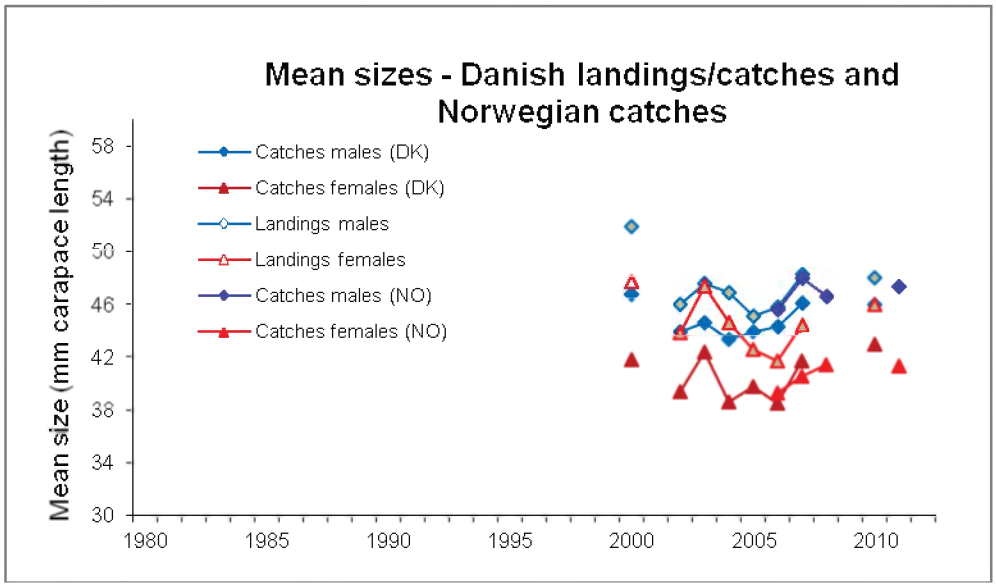


Figure 6.4.14.7.4 *Nephrops* in the Norwegian Deep (FU 32). Mean sizes of males and females in Danish catches and landings, and Norwegian catches.

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		1.2	0.4
2011	See scenarios	-	1.2	0.4
2012	Reduce catches	-	1.2	
2013	Average landings (last 10 years)	< 0.8		
2014	Same catch advice as for 2013	< 0.8		

Weights in thousand tonnes.
[1)] Norwegian zone of Subarea IV.

Table 6.4.14.7.2 *Nephrops* in the Norwegian Deep (FU 32). Landings (tonnes) by country.

Year	Denmark	Norway			Sweden	UK	Netherlands	Total
		Trawl	Creel	Sub-total				
1993	220	102	1	103		16		339
1994	584	161	0	161		10		755
1995	418	68	1	69		2		489
1996	868	73	1	74		10		952
1997	689	56	8	64		7		760
1998	743	88	1	89		4		836
1999	972	119	15	134		13		1119
2000	871	143	0	143	37	34		1085
2001	1026	72	13	85	26	53		1190
2002	1043	42	21	63	13	52		1171
2003	996	68	11	79	1	14		1090
2004	835	72	8	80	1	6		922
2005	979	89	13	102	2	6		1089
2006	939	62	19	81	1	7	5	1033
2007	652	77	20	97	5	1		755
2008	505	112	30	142	24	4		675
2009	331	107	31	138	2	6		477
2010	282	82	41	123	1	1		407
2011*	322	29	40	69	1	3		395
*Provisional.								

ECOREGION North Sea
STOCK *Nephrops* off Horn's Reef (FU 33)

Advice for 2013 and 2014

Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 1100 tonnes. This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

State of the stock

F (Fishing Mortality)		
	2009–2011	
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown

SSB (Spawning-Stock Biomass)		
	2009–2011	
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↗	Increasing

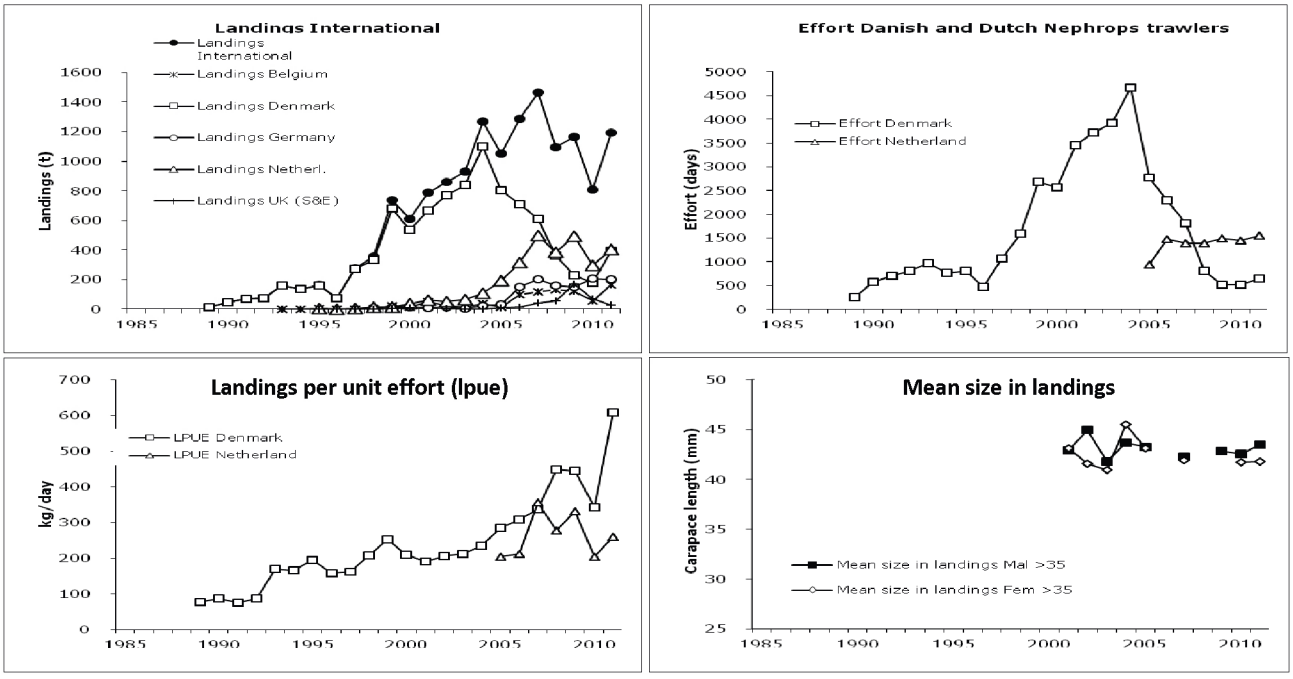


Figure 6.4.14.8.1 *Nephrops* off Horn's Reef (FU 33). Long-term trends in landings, effort, lpue, and mean sizes of males/females in landings.

The state of this stock is unknown. There is an increase in abundance over the whole period, although part of the increase may be due to an increase in gear efficiency (technological creep) in the last years.

Management plans

No specific management objectives are known to ICES.

The fisheries

The *Nephrops* fisheries in the Horn's Reef area are bottom trawl fisheries. Total landings peaked in 2007. For several years Denmark was the only country exploiting *Nephrops* in FU 33, accounting for more than 90% of total landings up to 2005. However, in recent years Germany, the Netherlands, and the UK have expanded their share of exploitation of this stock.

Quality considerations

Assessment data are sparse for this FU. As catches from the Danish fisheries after 2005 only account for a small proportion of the catch, lpue figures from the Danish fisheries after 2005 must be viewed cautiously as stock indicators.

The advice is based on a calculation of potential landing options and harvest rates, given the known surface area of *Nephrops* habitat and assumed densities of the functional unit. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	Data-limited approach for *Nephrops*.
Input data	Habitat extent, mean size and landing information.
Discards and bycatch	Not included in the assessment.
Indicators	Lpue.
Other information	None.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* off Horn's Reef (FU 33)

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	-	No reference points are defined.
	F_{MSY}	-	No reference points are defined.
Precautionary Approach	Not defined		

(unchanged since: 2010)

Outlook for 2013 and 2014

In the absence of a full analytical assessment, ICES bases advice for *Nephrops* on average landings, unless this is considered to be not precautionary.

The table presents a range of harvest rates from historical landings, based on the known surface area of the functional unit and different population densities. This is not a catch options table, it is a sensitivity analysis to explore if the average landings of the last 10 years would correspond to a precautionary harvest rate under a range of potential *Nephrops* density values in the FU. The shaded cells show harvest rates above 8% (MSY harvest rates vary between 8% and 16%) which are considered less precautionary.

Basis: Surface area FU 33: 5700 km^2, Mean weight: 40 grams, Discards: 25% in number.

		Range of potential densities (*Nephrops* per m^2)								
Basis	**landings**	**0.05**	**0.1**	**0.2***	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**
0.5 * Average	550	6.0%	3.0%	1.5%	1.0%	0.8%	0.6%	0.5%	0.4%	0.4%
Average landings (last 10 yrs)	1100	12.1%	6.0%	3.0%	2.0%	1.5%	1.2%	1.0%	0.9%	0.8%
Maximum historical landings	1400	16.4%	8.2%	4.1%	2.7%	2.1%	1.6%	1.4%	1.2%	1.0%

* A density of 0.2 per m^2 is typical of the lowest observed density in the North Sea in FU 7 (Fladen).
Shaded areas indicate harvest rates > range of North Sea F_{MSY} proxies of 8 %–16%.

ICES approach to data-limited stocks

For this stock, the last ten years' average landings of 1100 t correspond to a potential harvest rate of 3.0%. In the absence of information from the ICES area itself, this is based on an assumed low density of 0.2 *Nephrops* per m^2, corresponding to the lowest observed density in the North Sea (Fladen ground). This is considered below the range of MSY harvest rates in the North Sea (between 8% and 16%) and is therefore considered precautionary.

Additional considerations

See the general considerations for *Nephrops* in the North Sea.

Information from the fishing industry

The Fishers' North Sea stock survey (Napier, 2011) trends show an increase between 2001 and 2002, a stable period to 2004, and an increase in 2005. There were no strong indications of changes in recruitment or discarding levels.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/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	-	1.2
2012	Reduce catches	-	
2013	Average landings (last 10 years)	< 1.1	
2014	Same catch advice as for 2013	< 1.1	

Weights in thousand tonnes.
[1)] Does not include discards.
[2)] Includes Farn Deeps (FU 6).

Table 6.4.14.8.2 *Nephrops* off Horn's Reef (FU 33). Total landings per country (tonnes).

	Belgium	Denmark	Germany	Netherl.	UK	Total **
1993	0	159		na	1	160
1994	0	137		na	0	137
1995	3	158		3	1	164
1996	1	74		2	0	77
1997	0	274		2	0	276
1998	4	333	8	12	1	350
1999	22	683	14	12	6	724
2000	13	537	12	39	9	597
2001	52	667	11	61	+	791
2002	21	772	13	51	4	861
2003	15	842	4	67	1	929
2004	37	1097	24	109	1	1268
2005	16	803	31	191	9	1050
2006	97	710	151	314	15	1288
2007	118	610	201	496	42	1467
2008	130	362	160	386	58	1096
2009	121	231	150	491	170	1163
2010	56	180	206	295	69	806
2011	163	396	202	403	28	1191

* Provisional.

** Totals for 1993–94 exclusive of landings by the Netherlands.

na = not available.

ECOREGION North Sea
STOCK *Nephrops* in Devil's Hole (FU 34)

Advice for 2013 and 2014

This is the first year ICES gives advice for this functional unit separately. Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 600 tonnes. This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

To protect the stock in this functional unit (FU), management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Insufficient information

SSB (Spawning-Stock Biomass)	2009–2011
Qualitative evaluation	↘ Declining

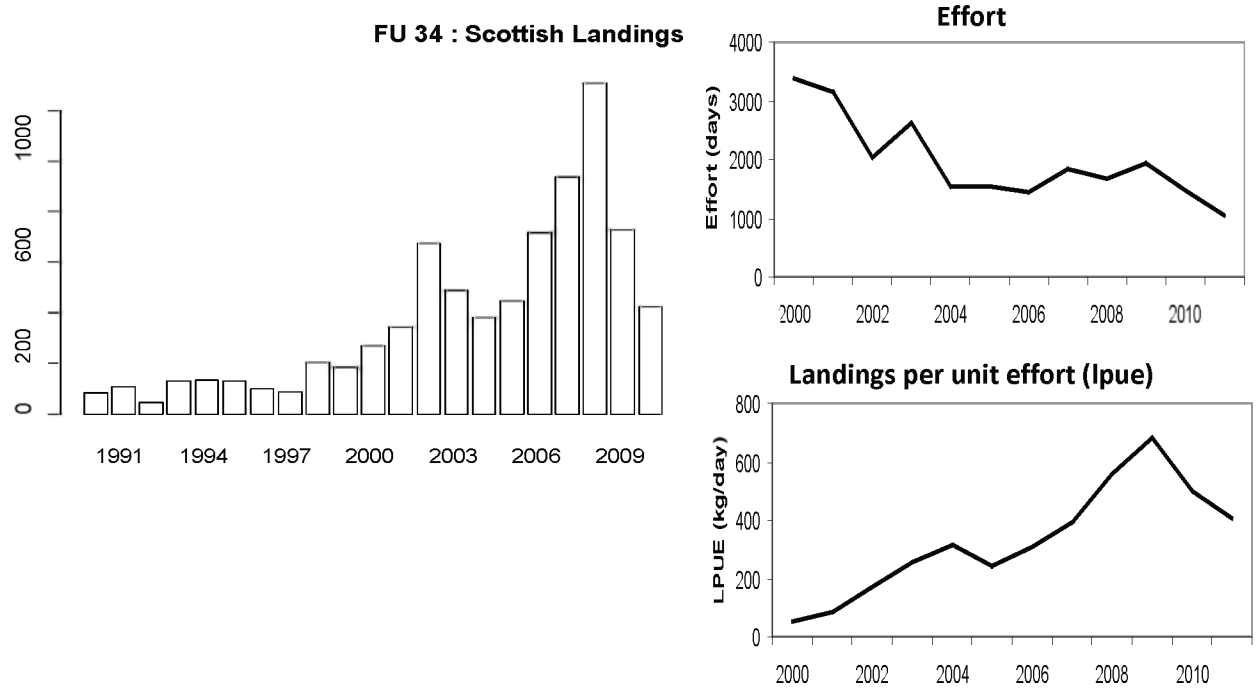


Figure 6.4.14.9.1 *Nephrops* in Devil's Hole (FU 34). Scottish landings (tonnes), effort, and lpue.

The state of the stock is unknown. Decreasing effort in combination with the recent decrease in landings per unit effort indicate the stock may be declining. The TV assessment series is too short and the ancillary data too limited to provide a full UWTV assessment for this area at the present time.

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 Devil's Hole is prosecuted by around twenty vessels on a regular basis. There is no discard information for this fishery. International landings are only available for the last couple of years. Anecdotal reports indicate that most of the landings have been made by Scottish vessels.

Quality considerations

The time series of UWTV survey data is incomplete. Surveys were conducted in 2003, 2005, and 2009–2011.

The advice is based on a calculation of potential landing options and harvest rates, given the known surface area of *Nephrops* habitat and assumed densities of the functional unit. The surface area is based on an estimate of area derived from Scottish VMS data from Scottish *Nephrops* vessels from 2006–2009. The area of ground shown in geological charts is significantly larger than this and landings have been made from these areas – therefore the area should be regarded as a minimum estimate and the harvest rate could well be lower than implied by the analysis. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	Data-limited method for *Nephrops*.
Input data	Habitat extent, mean size, occasional UWTV surveys (incomplete time-series), and landings information.
Discards and bycatch	No discard information available.
Indicators	Lpue.
Other information	None.
Working group report	WGNSSK

ECOREGION North Sea
STOCK *Nephrops* in Devil's Hole (FU 34)

Reference points

No reference points are defined for this stock.

Outlook for 2013 and 2014

In the absence of a full analytical assessment, ICES bases advice for *Nephrops* on average landings, unless this is considered to be not precautionary.

The table presents a range of harvest rates from historical landings, based on the known surface area of the functional unit and different population densities. This is not a catch options table, it is a sensitivity analysis to explore if the average landings of the last ten years would correspond to a precautionary harvest rate under a range of potential *Nephrops* density values in the FU. The shaded cells show harvest rates above 8% (MSY harvest rates vary between 8% and 16%) which are considered less precautionary.

Basis: Surface area FU 34: 1100 km^2, Mean weight: 28 grams, Discards: 5% in number.

		Range of potential densities (*Nephrops* per m^2)								
Basis	**landings**	**0.05**	**0.1**	**0.2**	**0.3***	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**
0.5 * Average	300	20.5%	10.2%	5.1%	3.4%	2.6%	2.0%	1.7%	1.5%	1.3%
Average landings (last 10 yrs)	600	40.9%	20.5%	10.2%	6.8%	5.1%	4.1%	3.4%	2.9%	2.6%
Maximum historical landings	1305	89.0%	44.5%	22.2%	14.8%	11.1%	8.9%	7.4%	6.4%	5.6%

Shaded areas indicate harvest rates > range of North Sea F_{MSY} proxies of 8 %–16%.
* Most recent density estimate (2012 preliminary TV survey results).

ICES approach to data-limited stocks

For this stock, the last ten years' average landings of 600 t correspond to a potential harvest rate of 6.8%, based on the most recent density estimate (preliminary 2012 survey results) of 0.3 *Nephrops* per m^2. This is considered below the range of MSY harvest rates in the North Sea (between 8% and 16%) and is therefore considered precautionary.

Additional considerations

See Section 6.4.14 for general comments.

Available international landings data are presently limited to the last three years and are provisional at this stage. The Scottish landings series is available for a longer time-series and comprises most of the fishing activity that has taken place at Devil's Hole – this has been used in the calculation of the 10-year average.

Comparison with previous assessment and advice

This is the first year advice is given separately for this functional unit. Before 2012, catches in this FU were incorporated in the generic advice for 'other rectangles' (in the first part of this advice sheet).

Sources

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

Table 6.4.14.9.1 *Nephrops* in Devil's Hole (FU 34). ICES advice, management, and landings.

Year	ICES advice	Recommended landings Devil's Hole [1)] (FU 34)	ICES landings [2)]
2009	No separate advice		1.3
2010	No separate advice		0.76
2011	No separate advice		0.43
2012	No separate advice	-	
2013	Average landings (last 10 yrs)	< 0.6	
2014	Same catch advice as for 2013	< 0.6	

Weights in thousand tonnes.
[1)] Based on the ten years 2002–2011 in the Scottish time-series in Table 6.4.14.9.2.
[2)] Provisional international landings, only available from 2009. Does not include discards.

Table 6.4.14.9.2 *Nephrops* in Devil's Hole (FU 34). Official landings (tonnes). Before 2009 only Scottish data are available

Year	UK Scotland				UK (E, W & NI)	Denmark	Netherlands	Total
	Nephrops trawl	Other trawl	Creel	Sub-total				
1991				83				
1992				106				
1993				44				
1994				129				
1995				132				
1996				128				
1997				99				
1998				88				
1999				202				
2000				185				
2001				270				
2002				343				
2003				674				
2004				489				
2005				379				
2006				448				
2007				715				
2008				937				
2009*	1297	8	0	1305	0	0	0	1305
2010*	712	18	0	730	25	1	1	757
2011*	423	0	0	423	10			433

* Provisional.

ECOREGION North Sea
STOCK Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners)

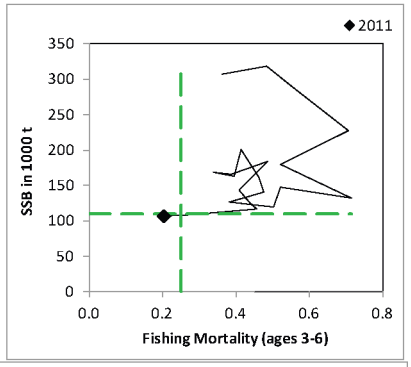
Advice for 2013

ICES advises on the basis of the MSY framework that catches in 2013 should be no more than 51 900 t. ICES recommends eliminating the *optional* transfer to Subarea IV.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✗	✗	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✗	✗	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined



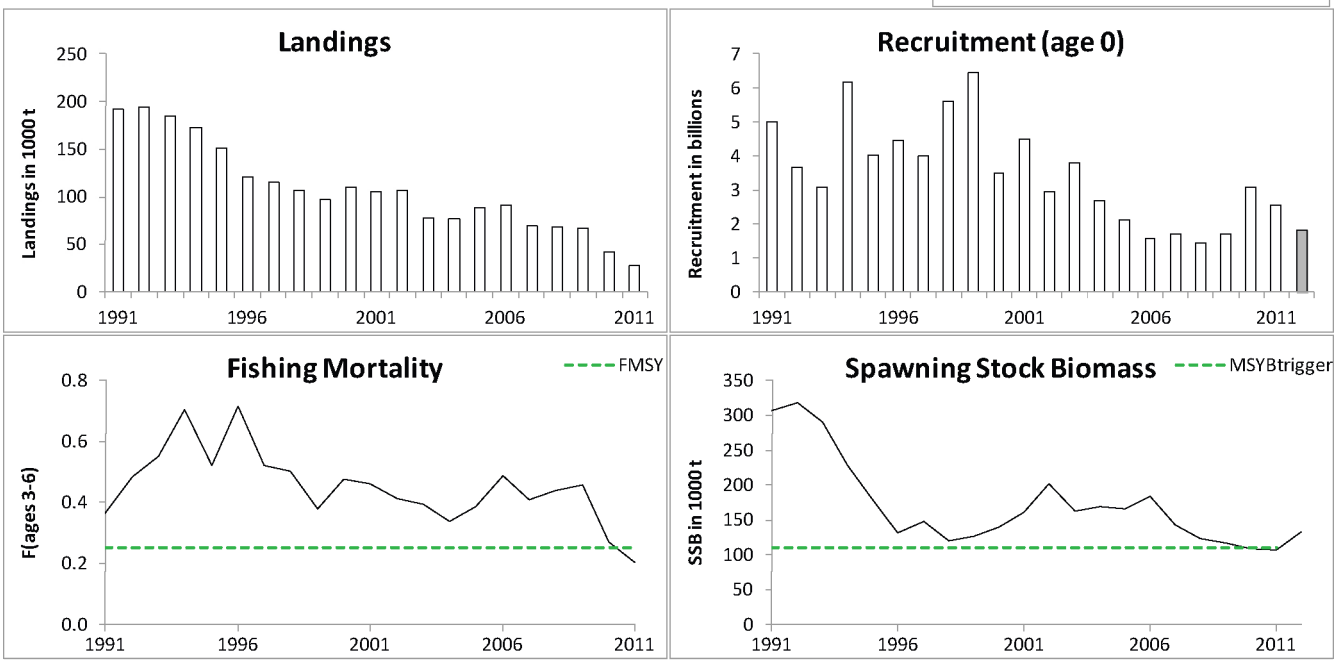


Figure 6.4.15.1 Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners). Summary of stock assessment (predicted values are shown in grey). Top right: SSB and F for the time-series used in the assessment.

Catches have declined since the early 1990s and SSB has decreased in recent years, reaching the lowest in the time-series in 2011 at MSY $B_{trigger}$. Fishing mortality has decreased in the last two years and was below F_{MSY} in 2011. The 2010 and 2011 year classes are estimated to be stronger than year classes during the low recruitment phase in the mid-2000s.

Management plans

No specific management objectives are known to ICES.

Biology

In summer herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners, 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 these areas they mix with North Sea autumn-spawning (NSAS) herring. In recent years mixing also has been detected between WBSS and central Baltic herring in Subdivisions 24–26. Herring is considered to have a major impact on other fish stocks as a predator, and as prey for other species including commercial fish species, seabirds, and marine mammals.

Environmental influence on the stock

The reasons for the reduction in recruitment during the period 2004–2009 in WBSS 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 specific research projects.

The fisheries

Area where WBSS are being caught	Fleet	Fishery	WBSS 2011 catch	NSAS 2011 catch
Division IIIa	C	Directed herring fisheries with purse-seiners and trawlers.	10 816 t	6 608 t
	D	Bycatches of herring caught in the small-mesh fisheries.	818 t	1 780 t
Subdivisions 22–24	F	All herring fisheries in Subdivisions 22–24.	15 830 t	-
Division IVa East	A	Directed herring fisheries with purse-seiners and trawlers.	308 t	-

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.

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, and the distribution of the fishery between years. The 2011 advice assumed a 50% transfer of the C-fleet quota from Division IIIa to the North Sea. With an actual transfer of 42%, forecasts are considered relatively precise; however, the inherent uncertainty in predictions could be avoided by eliminating the optional transfer of quotas between Division IIIa and Subarea IV.

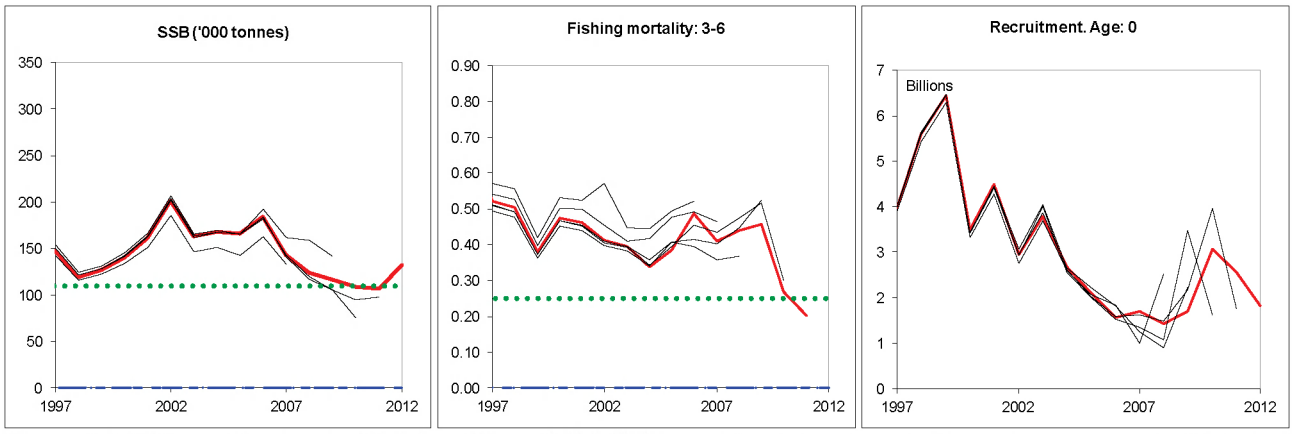


Figure 6.4.15.2 Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners). Historical assessment results (final-year predicted SSB, recruitment equal to the most recent 5-year geometric mean).

Scientific basis

Assessment type	Age-based analytical assessment (ICA).
Input data	Two acoustic and one larval survey indices (HERAS, GerAS (BIAS), N20). Catch statistics and corrections for historical area misreporting. Otolith microstructure and morphometric methods to calculate the proportion of NSAS in the catches.
Discards and bycatch	Discards are not included in the assessment and are considered to be low.
Indicators	None.
Other information	The last benchmark took place in 2008, and the next one is planned for 2013.
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.

Until 2011 fishing mortality rates were considerably higher than F_{MSY}. Therefore, 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}.

Outlook for 2013

Basis for western Baltic spring-spawning herring (WBSS): F(2012) = 0.21 [catch constraint]; R10–12 = GM(2006–2010) = 1817 million; SSB(2012) = 132; catch (2012) = 41[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 Division IVaE [1]										Catch options for WBSS and NSAS herring in: Division IIIa and Subdivisions 22–24 [1]				
	Catch 2013	Basis	F 2013	22–24	IIIa		IVaE	SSB 2013 [3]	SSB 2014 [3]	% SSB change [4]	Catch 2013	22–24	IIIa		% TAC change [5]
				Fleet F	Fleet C	Fleet D	Fleet A [2]					Fleet F	Fleet C	Fleet D	
MSY framework	51.9	F_{MSY}	0.25	25.8	24.4	1.4	0.3	168	180	7%	63.3	25.8	34.3	3.6	−12%
Zero catch	0	F = 0	0	0	0	0	0	172	230	34%	0	0	0	0	−100%
Other options	50.6	F_{2012}*1.14	0.24	25	23.6	1.4	0.3	168	181	8%	61.7	25	33.2	3.4	−15%
	59.5	F_{2012}*1.36	0.29	29.4	27.8	1.6	0.3	167	173	4%	72.6	29.4	39.1	4.1	0%
	68.5	F_{2012}*1.6	0.34	33.8	32	1.9	0.3	166	165	−1%	83.5	33.8	45	4.7	15%

Weights in '000 t.

[a] Assuming a utilization in 2012 of the WBSS part of the TAC/bycatch ceiling of 100% (F-fleet), 58% (C-fleet), and 41% (D-fleet).

[1] The ratio of herring catches between different fleets and areas in 2013 is based on a fifty-fifty allocation of fishing opportunities between Division IIIa and Subdivisions 22–24 , and the ratio between the different herring stocks in Division IIIa is based on the 2009–2011 catch proportions. The later proportions cannot be predicted and may therefore deviate significantly from the assumed ratio.

[2] As for the intermediate year, 2012, a catch of 308 t of WBSS herring taken in the transfer area in Division IV 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 (2014) relative to SSB (2013).

[5] Catches (2013) relative to TAC 2012 (Subdivisions 22–24 + Division IIIa + Division IIIa bycatch ceiling = 20.9 kt + 45 kt + 6.7 kt = 72.6 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 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_{2013} is estimated to be above MSY $B_{trigger}$. This results in catches of no more than 51 900 t in 2013 from the whole distribution area. This is expected to lead to an SSB above 180 000 t in 2014.

Additional considerations

Recruitment of WBSS herring has been historically low between 2004 and 2009, but the two latest year classes 2010 and 2011 are estimated to be more abundant though still below average. Management measures have reduced F in 2011, and F is expected to remain below the target F_{MSY} with the agreed 2012 quota provided that a similar proportion of the Division IIIa TAC is taken in Subarea IV in 2012, as in 2011.

The stock is above the MSY $B_{trigger}$ in 2012, and with the present management measures, the SSB is expected to remain above the MSY $B_{trigger}$ in 2013.

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 2013 TAC for Division IIIa will be caught in the area without transfer options. To protect mature fish, catches of WBSS 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 2013 for both WBSS and NSAS herring is based on the assumption that in 2012 the same proportion (42%) of the TAC is actually transferred to the North Sea. The actual quantity may be more or less, and this adds to the uncertainty of the assessment. The forecasts for 2013 assumed that in 2013 no transfer will be 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 the 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 is changing to an increasing trend due to the improved 2010 year class now entering the spawning stock.

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 between Subarea IV and Division IIIa be based on the status of the weaker stock, which is now the WBSS.

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.

Comparison with previous assessment and advice

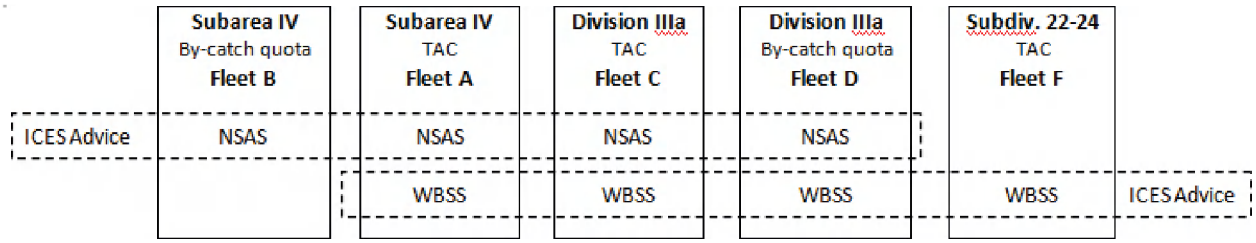
Compared to the 2011 advice the update assessment this year shows a decline of 12% in the estimated 2010 fishing mortality and a 14% increase for the SSB in 2010. There is, however, a 22% decline in the 2010 recruitment, highlighting the uncertainty in the estimates of this parameter.

Last year's advice was based on the target $F_{MSY} = 0.25$ and an estimate of the SSB in 2012 being above the candidate MSY $B_{trigger}$ of 110 000 t. This year´s advice continues to be based on the target $F_{MSY} = 0.25$, and the estimate of SSB in 2013 is above the MSY $B_{trigger}$ 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 fisheries are managed by areas covering the geographical distribution of the stocks (see the following text diagram).



The calculation of the intermediate year (2012) catch and the catch options for 2013 are based on:

1. the 2009–2011 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 plus the 2011 catch of WBSS taken by the A-fleet in Division IVa East.

For the intermediate year (2012) ICES assumes a transfer of 42% of the Division IIIa quotas to be taken in the North Sea. Short-term predictions are based on an expected catch in 2012 of 41 000 t of the western Baltic spring-spawning stock, including a catch of 300 t of WBSS in Division IVa East. To make catch options by fleet for 2013 it is assumed that each fleet will take its full share of the total TAC and that TACs are set proportional to the utilised part of the TACs for 2012. The average proportions of WBSS in the 2009–2011 catches were 71% in the C-fleet, 40% in the D-fleet, and 100% in the F-fleet.

Additionally, it is assumed that a catch of 300 t of WBSS will be caught by the A-fleet in Division IVa East in 2012 and 2013. 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 Quarter 2 and Quarter 3 summer feeding period. It is likely that the 2013 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 Headquarters. 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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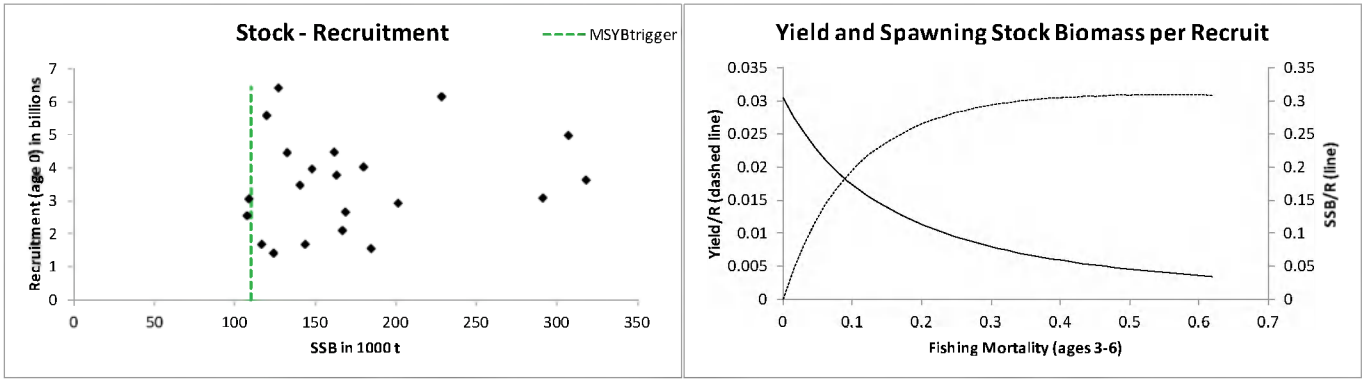


Figure 6.4.15.3 Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). Stock recruitment and Yield- and SSB-per-Recruit plots.

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 NSAS	-	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 Subdivisions 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 Subdivisions 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 Subdivisions 22–24	101	53	47	7	107
2003	Reduce F	<80	101	40	36	2	78
2004	Separate management regime. Reduce F	<92	91	42	24	7	77
2005	Separate management regime. *Status quo* F	95	120	44	38	7	89
2006	Separate management regime. *Status quo* F	95	102[3]/47.5*	42	36	11	89
2007	Separate management regime.*Status quo* F	99	69[3]/49.5*	40	28	1	68
2008	Separate management regime. Reduce F 20% towards $F_{0.1}$	71	51.7[3]/45*	43	25	0	68
2009	Separate management regime. Reduce F to F = 0.25	< 32.8	37.7[3]/27.2*	31	32	4	67
2010	Separate management regime. 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*	16	12	0.3	28
2012	F_{MSY} = 0.25 and no increase in catches of WBSS herring in the North Sea	<42.7	45[3]/20.9*				
2013	F_{MSY} = 0.25 and no *optional* transfer of catch options to the North Sea	<51.9					

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, with an optional 50% transfer from Division IIIa to Subarea IV in 2011 and 2012.

* Separate TAC for Subdivisions 22–24.

Table 6.4.15.2 Herring in Subdivisions 22–24 and Division IIIa (spring and autumn spawners). ICES landings (thousand tonnes) 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	2011 [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	3.6
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	0.1
Lithuania											0.4	
Norway	9.7							3.5	4.0	3.3	3.3	0.1
Sweden	45.8	30.8	26.4	25.8	21.8	32.5	26.0	19.4	16.5	12.9	17.4	9.5
Total	71.5	47.0	52.3	42.0	34.1	48.5	31.8	26.9	26.0	29.7	27.0	13.2
Kattegat												
Denmark	18.9	18.8	18.6	16.0	7.6	11.1	8.6	9.2	7.0	4.9	7.6	5.2
Sweden	17.3	16.2	7.2	10.2	9.6	10.0	10.8	11.2	5.2	3.6	2.7	1.7
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	6.8
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	3.1
Germany	9.3	11.4	22.4	18.8	18.5	21.0	22.9	24.6	**22.8**	16.0	12.2	8.2
Poland	6.6	9.3		4.4	5.5	6.3	5.5	2.9	5.5	5.2	1.8	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	2.2
Total	53.3	62.9	46.2	38.7	41.2	41.8	39.4	37.6	38.5	27.4	16.8	15.3
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 [6]	0.03
Sweden	0.1	0.2		0.2	0.3	0.4	0.7		0.3	0.8	0.9	0.5
Total	1.0	0.8	4.6	2.6	0.4	2.2	2.5	2.9	5.7	3.6	1.0	0.6
Grand Total	**162.0**	**145.7**	**128.9**	**109.5**	**92.8**	**113.6**	**93.0**	**87.7**	**82.3**	**69.9**	**55.2**	**35.9**

[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.
[6] Official reported catches: 3,103 tonnes, see text section 3.2.1 (HAWG 2011)

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	4990766	306843	191573	0.3626
1992	3644301	317845	194411	0.4843
1993	3097516	290995	185010	0.5516
1994	6167290	228122	172438	0.7052
1995	4038064	179570	150831	0.5216
1996	4469355	132151	121266	0.7148
1997	3976489	147601	115588	0.5219
1998	5599813	119440	107032	0.5035
1999	6432009	126726	97240	0.3804
2000	3487574	140102	109914	0.4753
2001	4486001	161426	105803	0.4617
2002	2940297	201125	106191	0.4129
2003	3789452	162782	78309	0.3947
2004	2672576	168338	76815	0.3387
2005	2112904	166503	88406	0.3864
2006	1568541	184317	90549	0.4862
2007	1697020	143326	68997	0.4094
2008	1429294	123711	68484	0.4400
2009	1695931	116377	67262	0.4565
2010	3072854	108427	42214	0.2695
2011	2563268	107342	27772	0.2021
2012*	1817402	132290		
Average	3443124	171153	107910	0.4514

* Recruitment is the geometric mean 2006–2010. SSB is predicted.

ECOREGION North Sea
STOCK Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)

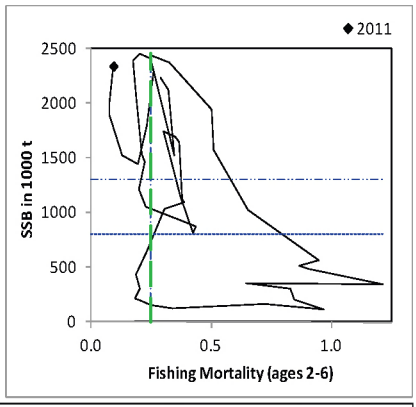
Advice for 2013

ICES advises a revision of the EU–Norway management plan. Until then, ICES advises on the basis of the agreed EU–Norway management plan that catches in 2013 should be no more than 480 200 t, including 465 750 t for the A-fleet. ICES advises that no bottom disturbing activities, e.g. aggregate extraction, should occur in areas with spawning grounds during the spawning season and within 1 month before and after this period.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	✓	✓	✓	Below target
Precautionary approach (F_{pa})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target

SSB (Spawning-Stock Biomass)*	2010	2011	2012	
* at spawning time in autumn.				
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above trigger



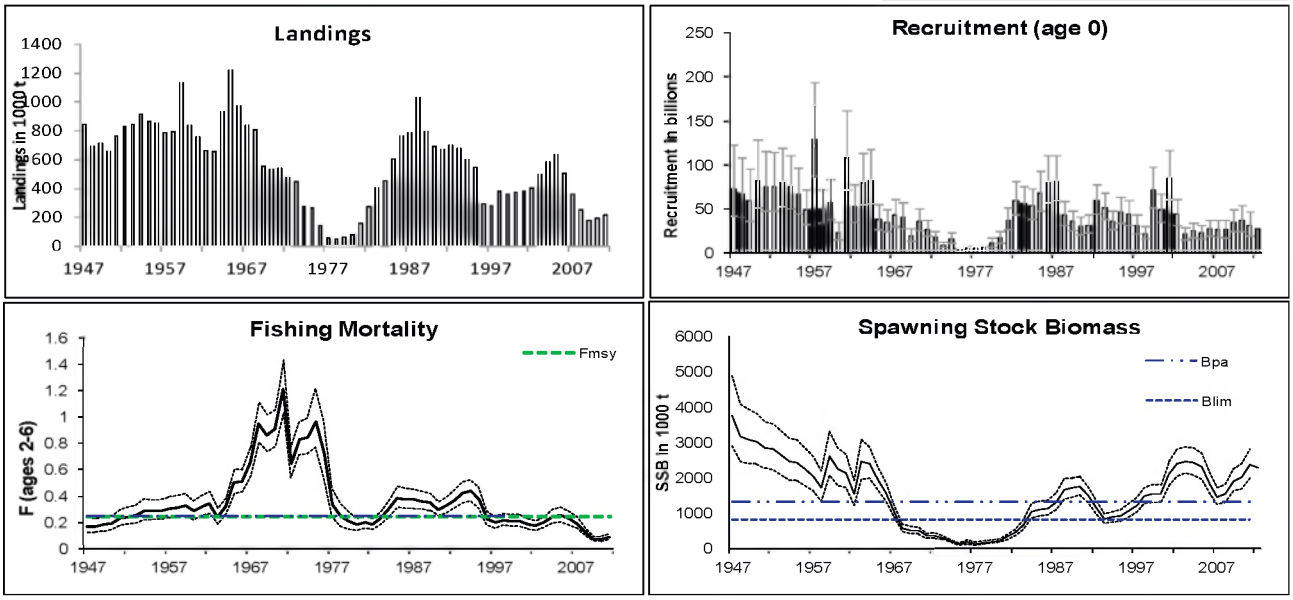


Figure 6.4.16.1 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Summary of stock assessment with 95% confidence intervals, predicted recruitment value is shaded. Top right: SSB and F for the time-series used in the assessment.

The assessment was benchmarked in 2012 and a new assessment methodology was accepted which changed the perception of the stock. ICES classifies the stock as being at full reproductive capacity and as being harvested sustainably, below the current 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 around the long-term geometric mean; however, 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. A full revision of the existing management plan is needed; until then, the current management plan is considered precautionary.

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. Trends in natural mortality-at-age (age >2) can be observed where natural mortality has increased over the period 1963–1978, decreased over 1979–1990, and increased again in the period 1991–2007. Spawning and nursery areas are sensitive and vulnerable to anthropogenic influences. Gravel extraction or disturbance in the close vicinity of any herring spawning will disturb that spawning activity and will reduce the available area for successful 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.

Environmental influence on the stock

Six poor year classes occurred between 2002 and 2007, something that had never before been observed when SSB was above the B_{lim} (800 000 t). The poor recruitment is attributed to reduced survival during the larval stage (Payne *et al.*, 2009). The productivity of the stock (in terms of recruits-per-spawner and larval survival) in the most recent years remains low. Environmental variability is hypothesized to underlie these changes, but a mechanistic understanding remains elusive.

The fisheries

North Sea herring is caught for human consumption and as a bycatch in industrial fisheries. In the transfer area 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 distribution	Total landings (2011) are 209 kt directed NS fisheries – fleet A, 9 kt bycatches – fleet B, 7 kt directed Division IIIa fisheries – fleet C, and 2 kt bycatch in Division IIIa fisheries – fleet D.

Effects of the fisheries on the ecosystem

The human consumption fisheries for herring have little bycatch 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 assessment was benchmarked in 2012 and the perception of the stock changed through this process. The assessment is considered to be an improvement to previous assessments. The absolute values of SSB compared to the estimates of 2011 have changed due to revisions in the estimated selection of the fishery and natural mortality. Sampling and estimation of stock identity of herring in the transfer area in the eastern North Sea should be improved as well as the sampling and observation of discarding behaviour in herring fisheries.

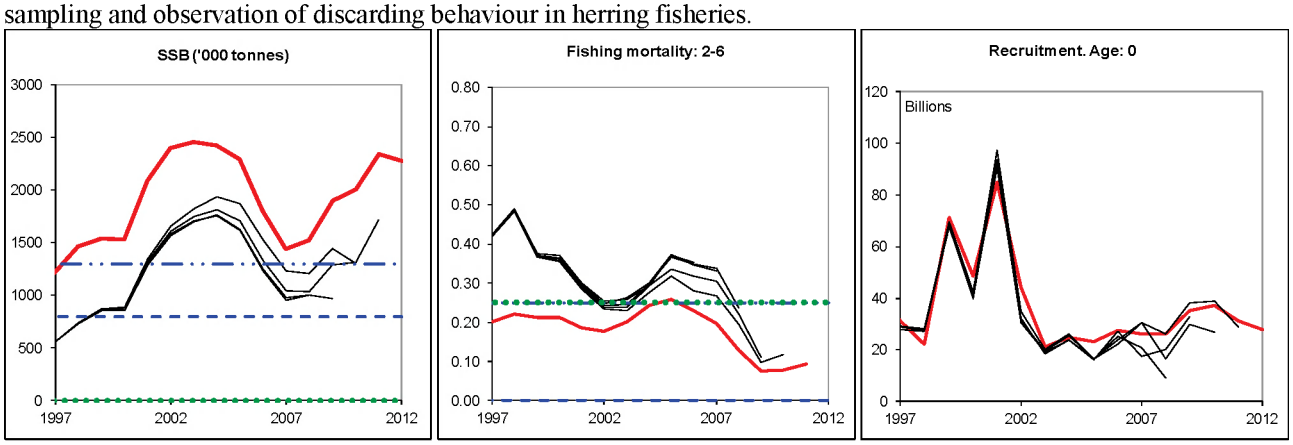


Figure 6.4.16.2 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Historical assessment results (final-year recruitment estimates included). The stock was benchmarked in 2012.

Scientific basis

Assessment type	Age-based analytical (SAM).
Input data	Commercial catches and four survey indices (IBTS Q1 1–wr, IBTS0, SCAI, HERAS).
Discards and bycatch	Included in the assessment.
Indicators	None.
Other information	The last benchmark for this stock occurred in 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}	$F_{0\text{-}1} = 0.05$ $F_{2–6} = 0.25$	SSB is greater than the SSB_{MP} upper trigger of 1.5 million t (based on simulations).
		$F_{0\text{-}1} = 0.05$ $F_{2–6} = 0.25 – (0.15*(1500000-SSB)/700000)$	SSB is between the SSB_{MP} triggers of 0.8 and 1.5 million t (based on simulations).
		$F_{0\text{-}1} = 0.04$ $F_{2–6} = 0.10$	SSB is less than the 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).

Reference points in the table above are based on the pre-benchmark perception of the stock. The benchmark assessment (ICES, 2012b) revised the perception of the stock (Figure 6.4.16.4) and the current management plan is based on the former perception of the stock. A full revision of the existing management plan is needed.

Outlook for 2013

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 2013. 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 six different scenarios of sharing the catch amongst fleets. The six 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 a 15% limit on TAC change).
iii. A roll-over TAC from 2012 to 2013 of 405 000 t for the A-fleet.
iv. MSY approach (F_{MSY}); this is also the option for the EU–Norway Harvest Control Rule as implemented within the management plan (no restriction on TAC change) and F_{pa}.
v. A 15% decrease in the A-fleet TAC in 2012.
vi. Fishing mortality F = 0.3 in the human consumption fishery.

For the intermediate year, no overshoot for the A-fleet was assumed, as the catches corresponded closely to the TAC in 2011. However, an additional 18 500 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 2011 was used. For the C- and D-fleets the same fraction of the North Sea autumn spawners (NSAS) in the catch as last year was assumed.

Basis: Intermediate year (2012) with catch constraint for fleet A, and for fleet B assuming the same proportion of the bycatch ceiling that is taken in 2011. Recruitment (2012) = 27.7 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 2012
0.181	0.026	0.001	0.006	0.03	0.18	423.5[1]	9.7	7.6	1.6	2271

[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 (2013)

		F-values by fleet and total						Catches by fleet				Biomass[1)]			
	Basis	FLEET A	FLEET B	FLEET C	FLEET D	F_{0-1}	F_{2-6}	FLEET A	FLEET B	FLEET C	FLEET D	**SSB 2013**	**SSB 2014** [4)]	**%SSB change** [2)]	**%TAC change fleet A** [3)]
i	No fishing	0	0	0	0	0	0	0	0	0	0	2362	2484	+4%	-100%
ii	Management plan	0.220	0.040	0.002	0.007	0.05	0.22	465.75	14.4	9.6	2.1	2047	1805	-10%	+15%
iii	No change in TAC	0.188	0.040	0.002	0.007	0.05	0.19	405.0	14.4	9.6	2.1	2088	1884	-8%	0%
iv	MSY approach[5)]	0.246	0.040	0.002	0.007	0.05	0.25	514.7	14.4	9.6	2.1	2013	1742	-11%	+27%
v	TAC reduction of 15%	0.158	0.040	0.002	0.007	0.05	0.16	344.25	14.4	9.6	2.1	2129	1965	-6%	-15%
vi	Human consumption fishing mortality = 0.3	0.296	0.040	0.002	0.007	0.05	0.30	606.2	14.4	9.6	2.1	1950	1628	-14%	+50%

Weights in thousand tonnes.
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 (2013) relative to SSB (2012).
[3)] Calculated landings (2013) relative to TAC 2012 for the A-fleet.
[4)] Assuming same F in 2014 as in 2013.
[5)] The analysis carried out by the benchmark (ICES, 2012b) has revised the perception of the stock, and F_{MSY} needs to be re-evaluated.
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

Following the agreed management plan between EU and Norway implies imposing the maximum 15% increase in TAC as the stock is estimated to be above the trigger biomass which results in a TAC of 465 750 t for the A-fleet in 2013 (Scenario ii), which would lead to an SSB of around 2.0 million tonnes at spawning time in 2013.

The agreed management plan (Annex 6.4.16) between EU and Norway has been evaluated (ICES, 2011a) 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. The analysis carried out by the benchmark workshop (ICES, 2012b) has revised the perception of the stock, and thus a full revision of the existing management plan for North Sea autumn spawners is needed. The use of the current management plan is considered precautionary.

MSY approach

As no MSY $B_{trigger}$ has been identified for this stock, the ICES MSY framework has been applied with F_{MSY} without considering SSB in relation to MSY $B_{trigger}$.

Following the ICES MSY framework implies raising the fishing mortality to 0.25, resulting in catches of less than 514 700 t in 2013 (Scenario iv). This is expected to lead to an SSB of around 2.0 million tonnes in 2013.

The analysis carried out by the benchmark workshop (ICES, 2012b) has revised the perception of the stock, and F_{MSY} needs to be re-evaluated.

Precautionary approach

The fishing mortality in 2013 should be no more than F_{pa}, corresponding to catches of less than 514 700 t in 2013 (Scenario iv). The SSB is expected to remain above B_{pa} in 2013.

The analysis carried out by the benchmark workshop (ICES, 2012b) has revised the perception of the stock, and precautionary reference points need to be re-evaluated.

Additional considerations

The fishery 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. An interim evaluation of the EU-Norway management plan took place in 2011 to evaluate alternative TAC setting procedures (ICES, 2011b), each of which were shown to be precautionary. 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 analysis carried out by the benchmark workshop (ICES, 2012b) has revised the perception of the stock, and reference points and the existing management plan need to be re-evaluated.

ICES still considers the stock to be in a low productivity phase as the survival ratio between newly hatched larvae and recruits remains much lower than prior to 2001. The management plan has proven an effective tool in maintaining sustainable exploitation and conserving the North Sea herring stock during this lower productivity regime.

The fishing mortality is reliably estimated by the stock assessment. The absolute values of SSB compared to the estimates of 2011 have changed due to revisions in the estimated selection of the fishery and natural mortality, but the trends remain similar.

Essential fish habitat for herring spawning is gravel substrate. 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 seabed may be expected to have a negative 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. There is enough scientific information to support the advice that no bottom disturbing activities, e.g. aggregate extraction, should occur in areas with spawning grounds during the spawning season or within 1 month before or after this period, as this coincides with herring spawning in the area and egg and larval development.

Fisheries on North Sea herring and western Baltic spring-spawning herring (WBSS) 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. ICES recommends that the TAC setting between Subarea IV and Division IIIa be based on the status of the weaker stock, which is now the WBSS.

The options selected for the C- and D-fleets of North Sea autumn-spawning herring for 2012 are compatible with the advised exploitation of western Baltic spring spawners for the C- and D- fleets.

North Sea herring components

The composition of the NSAS herring population has changed over time: in recent years the relative contribution of the spawning components has been stable (Figure 6.4.16.5).

The sub-TAC for Divisions IVc and VIId was established for the conservation of the spawning aggregation of Downs herring. The Downs herring is now again a major component of the stock (Figure 6.4.16.5; 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. The protection of the various components should be considered in the evaluation of the long-term management plan.

Information from the fishing industry

The fishing industry has 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 (Speirs *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 which is poorly represented in the survey catches. The IBTS 0 index, in its current form, does not provide any information about the individual components.

Estimation of stock identity of herring from the transfer area in Subdivision IVa East is still poor and ICES recommends increasing and/or redesigning sampling for determination of stock affiliation of herring catches in ICES Divisions IVa,b and IIIa. 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 Denmark. Discard information (including slippage and highgrading) is monitored in the Dutch, English, and German fisheries. ICES is concerned about the lack of information on unallocated removals in all herring fisheries, effort should be made to maintain observer coverage across fleets that catch a substantial proportion of pelagic fish and to report on these issues.

Comparison with previous assessment and advice

In 2012, the assessment of the North Sea herring stock was benchmarked and a new assessment model was adopted (ICES, 2012b). Changes in both the input data and the model configuration have led to a change in the perception of SSB and F compared to previous assessments of this stock. Generally speaking, absolute estimates of the SSB are higher throughout the time-series and the fishing mortality lower, but the trends remain similar; recruitment estimates have remained unchanged. SSB has been revised up by 35%, from 1.3 million tonnes to 2.0 million tonnes in 2010. F has been revised down by 33%, from 0.12 to 0.08 in 2010.

A summary of the quality improvements of the assessment is given below. See ICES (2012b) for a complete list.

- Natural mortality is assumed to be variable over age and time. Natural mortality estimates are obtained from the North Sea multispecies model (SMS) key-run evaluated in 2011 (ICES, 2011c). The estimated time-varying natural mortality is pre-smoothed prior to being used in the assessment.
- The time series of catch-at-age data has been extended to also cover the period 1947–1959. The entire time-series used within the assessment now spans 1947–2011.
- The catch-at-age data in years 1977–1978 have been excluded from the assessment. There were strong indications that catch data during the full closure of the fishery were not reliable.
- The plus-group was re-defined to age 8. Examination of the biological data suggested that there was no evidence to support an older plus group. Analyses also showed that there was insufficient information present in the data to provide reliable estimates of fishing mortality on the older ages when a 9+ age-group was used.
- The multiplicative larval abundance (MLAI) tuning index has been replaced by the spawning-component abundance (SCAI) tuning index, allowing spawning component dynamics to be monitored.
- IBTS quarter 1 ages 2–5+ indices have been excluded from the assessment. A suite of analyses suggest that the signal in the IBTS-Q1 ages 2–5+ is very poor and therefore does not contribute to the tuning of the assessment.
- The ICA assessment model has been replaced with the state-space assessment model (SAM: www.stockassessment.org). The SAM model provides a flexible and fully statistical framework for the analysis of the inputs and refinement of the model.

The basis for the advice is the management plan, which is the same as last year.

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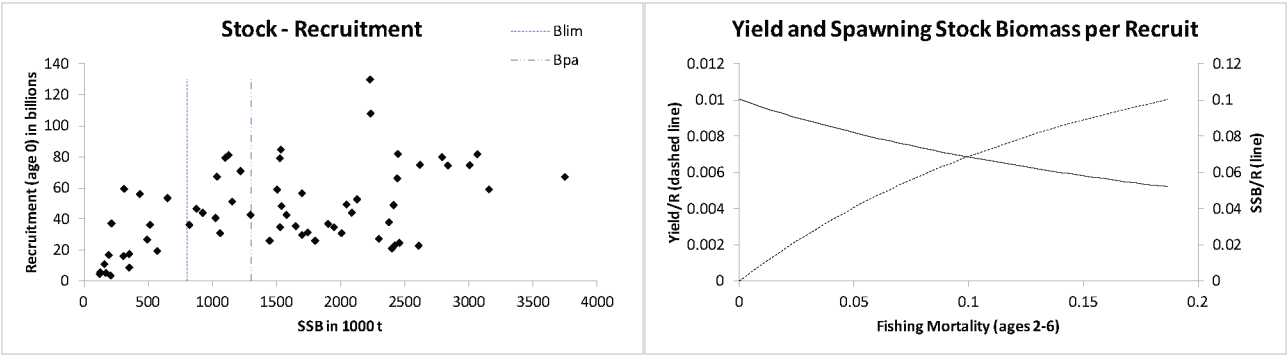


Figure 6.4.16.3 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Stock–recruitment plot and yield-per-recruit analysis.

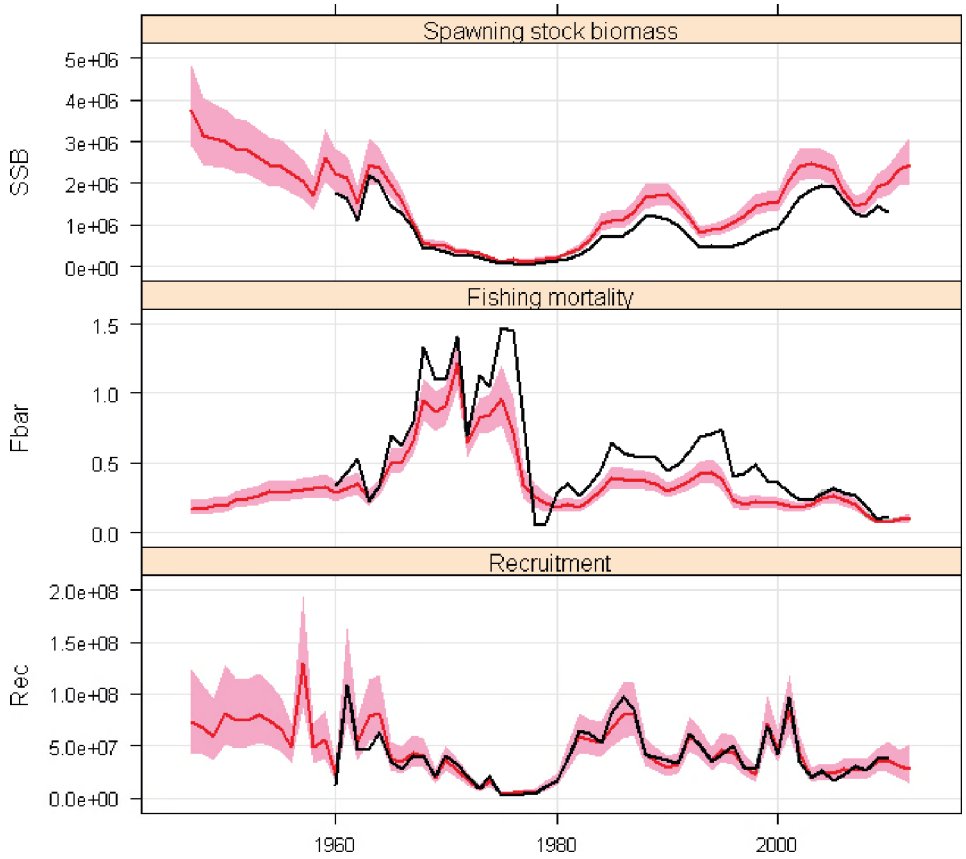


Figure 6.4.16.4 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Comparison between the 2011 assessment (black line) and the 2012 benchmarked assessment (red line with 95% confidence intervals (pink)) over the full assessment period.

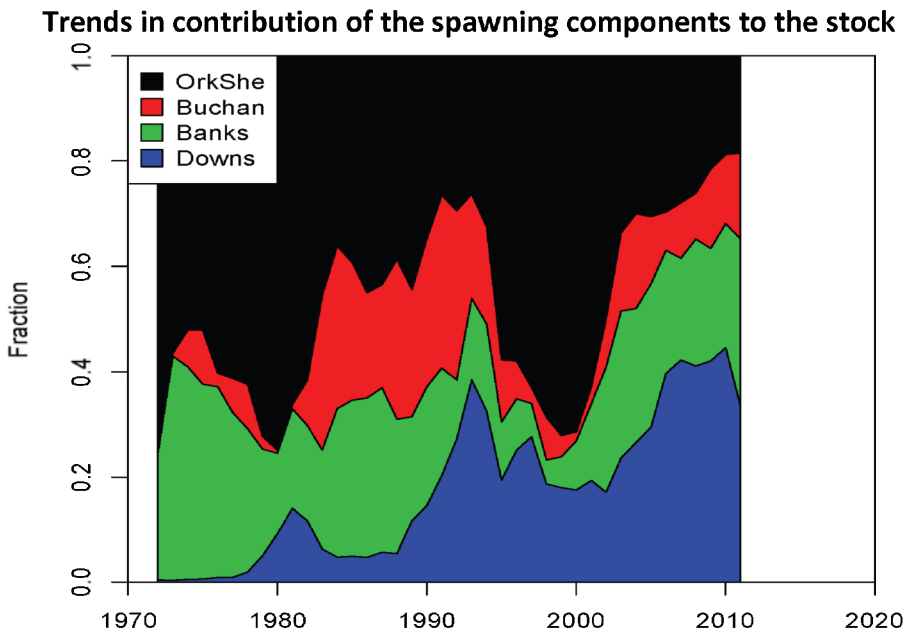


Figure 6.4.16.5 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Time-series of the contribution of each spawning component to the total stock, as estimated from the SCAI index (Payne, 2010). Areas are arranged from top to bottom according to the north-to-south arrangement of the components. Black: Orkney–Shetland component. Red: Buchan component. Green: Banks component. Blue: Downs component.

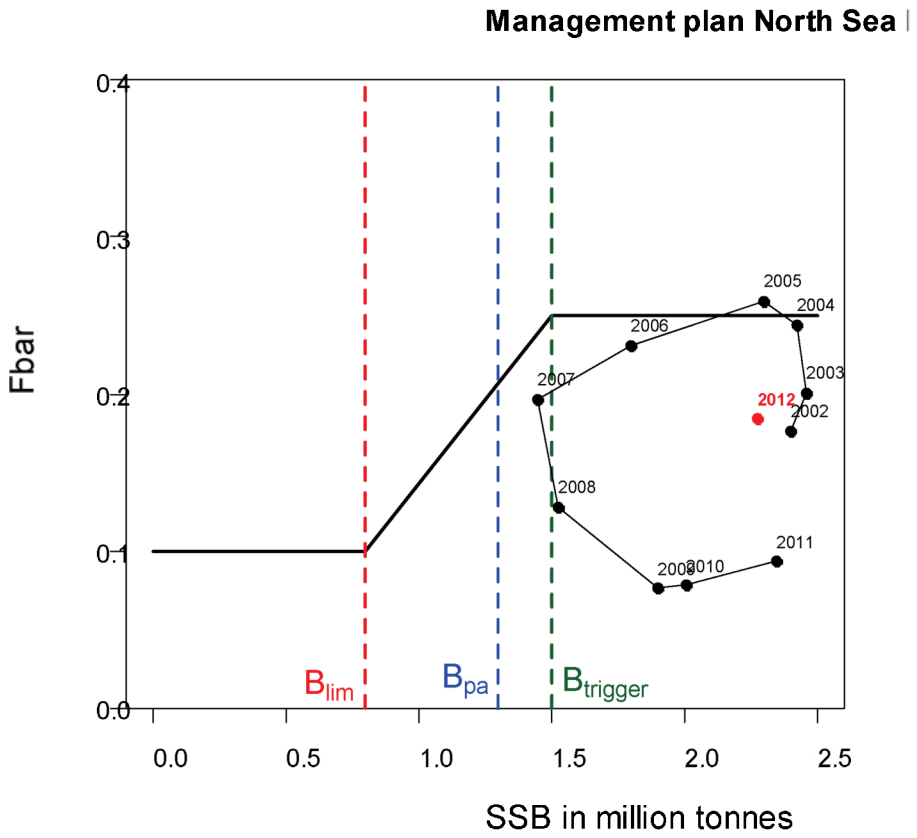


Figure 6.4.16.6 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Current management plan for adult fishery (A-fleet, ages 2–6) including trigger biomass points. Black dots represent realised estimated fishing mortalities from 2002 until 2011. Fishing mortality in 2012 (red dot) is estimated from the short-term prediction, based on the agreed TACS for the A-fleet.

Table 6.4.16.1 Herring caught in the North Sea (Subarea IV and Division VIId). ICES 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	218	218	226
2012	Management plan	See scenarios	405	18			
2013	Management plan	See scenario					

Weights in thousand tonnes.
[1]Catch in directed fishery in Subarea IV and Division 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, 2002–2011. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	2002	2003	2004	2005	2006
Belgium	23	5	8	6	3
Denmark [6]	70825	78606	99037	128380	102322
Faroe Islands	1413	627	402	738	1785
France	25422	31544	34521	38829	49475
Germany	27213	43953	41858	46555	40414
Netherlands	55257	81108	96162	81531	76315
Norway [1]	74974	112481	137638	156802	135361
Poland	-	-	-	458	-
Sweden	3418	4781	5692	13464	10529
USSR/Russia	-	-	-	99	-
UK (England)	13757	18639	20855	25311	22198
UK (Scotland)	30926	40292	45331	73227	48428
UK (N.Ireland)	944	2010	2656	2912	3531
Unallocated landings	31552 [5]	31875 [5]	48898 [5]	57788	18764
Total landings	335724	445921	533058	626101	509125
Discards	17093	4125	17059	12824	1492
Total catch	**352817**	**450046**	**550117**	**638925**	**510617**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
WBSS	6652	2821	7079	7039	10954
Thames estuary [2]	60	84	62	74	65
Others [3]	0	308	0	0	0
Norw. Spring Spawners [4]	4069	979	452	417	626

Country	2007	2008	2009	2010	2011
Belgium	1	-	-	-	4
Denmark [6]	84697	62864	46238	45869	58726
Faroe Islands	2891	2014	1803	3014	-
France	24909	30347	18114	17745	16693
Germany	14893	8095	5368	7670	9427
Netherlands	66393	23122	24552	23872	34708
Norway [1]	100050	59321	50445	46816	60705
Lithuania	-	-	-	90	-
Sweden	15448	13840	5299	4395	8086
Russia	-	-	-	-	-
UK (England)	15993	11717	652	10770	11468
UK (Scotland)	35115	16021	14006	14373	18564
UK (N.Ireland)	638	331	-	-	17
Unallocated landings	26641	17151	-726	0	0
Total landings	387669	244823	165751	174614	218398
Discards	93	224	91	13	0
Total catch	**387762**	**245047**	**165842**	**174627**	**218398**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
WBSS	1070	124	3941	774	308
Thames estuary [2]	2	7	48	85	2
Others [3]	0	0	0	0	0
Norw. Spring Spawners [4]	685	2721	44560	56900	12178

[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 Division VIaN and discards.
[6] Including any bycatches 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	2002	2003	2004	2005	2006
Denmark [1]	26422	48358	48128	80990	60462
Faroe Islands	-	95	-		580
France	10522	11237	10941	13474	18453
Germany	15189	25796	17559	22278	18605
Netherlands	18289	25045	43876	36619	39209
Norway	10836	34443	36119	66232	38363
Poland	-	-	-	458	-
Sweden	2397	2647	2178	8261	4957
Russia	-	-	-	99	-
UK (England)	10142	12030	13480	15523	12031
UK (Scotland)	30014	39970	43490	71941	47368
UK (N. Ireland)	944	2010	2656	2912	3531
Unallocated landings	14201 [2]	14115 [2]	28631 [2]	39324 [2]	10981 [2]
Misreporting from VIa North					
Total Landings	138956	215746	247058	358111	253048
Discards	17093	4125	15794	10861	1492
Total catch	**156049**	**219871**	**262852**	**368972**	**254540**

Country	2007	2008	2009	2010	2011
Denmark [1]	45948	28426	16550	25092	26523
Faroe Islands	1118	2	288	1110	-
France	8570	13068	7067	6412	7885
Germany	4985	498	-	505	2642
Netherlands	42622	11634	11017	13593	15202
Norway	40279	40304	25926	38897	45200
Lithuania	-	-	-	90	-
Sweden	7658	7025	1435	2310	5121
Russia	-	-	-	-	-
UK (England)	11833	8355	578	7384	4555
UK (Scotland)	35115	14727	10249	13567	17909
UK (N. Ireland)	638	331	-	-	17
Unallocated landings	22215	14952	-977	0	0
Misreporting from VIa North					
Total Landings	220981	139322	72133	108960	125054
Discards	93	194	91	13	0
Total catch	**221074**	**139516**	**72224**	**108973**	**125054**

[1] Including any bycatches in the industrial fishery.
[2] May include misreported catch from Division VIaN and discards.

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	2002	2003	2004	2005	2006
Denmark [1]	17846	7401	16278	5761	8614
Faroe Islands	1365	359	-	738	975
France	-	-	-	-	-
Germany	81	54	888	-	34
Netherlands	-	-	-	-	-
Norway [2]	63482	62306	100443	89925	90065
UK (Scotland)	-	-	-	-	83
Sweden	568	1529	1720	3510	2857
Unallocated landings	3959	9988	0	0	0
Total landings	87301	81637	119329	99934	102628
Discards	-	-	-	-	-
Total catch	**89303**	**83640**	**119329**	**99934**	**102628**
Norw. Spring Spawners [4]	4069	979	452	417	626

Country	2007	2008	2009	2010	2011
Denmark [1]	2646	1587	499	-	1590
Faroe Islands	577	400	700	719	-
France	-	-	-	-	-
Germany	-	-	-	-	-
Netherlands	263	-	-	-	-
Norway [2]	54424	17474	6981	7362	12922
UK (Scotland)	-	-	-	-	167
Sweden	640	-	1735	1505	150
Unallocated landings	-96 [3]	0	0	0	0
Total landings	58454	19461	9915	9586	14829
Discards	-	-	-	-	-
Total catch	**58454**	**19461**	**9915**	**9586**	**14829**
Norw. Spring Spawners [4]	685	2721	44560	56900	12178

[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	2002	2003	2004	2005	2006
Denmark [1]	26387	22574	33857	41423	32277
Faroe Islands	48	173	402	-	200
France	4214	7918	10592	10205	17385
Germany	7577	12116	13823	14381	14222
Netherlands	13154	19115	23649	10038	13363
Norway	656	15732	1076	645	6933
Sweden	453	605	1794	1694	2715
UK (England)	317	2632	2864	3869	4924
UK (Scotland)	289	322	1841	1286	977
Unallocated landings [3]	4052	-2401	8300	10233	2364
Total landings	57147	78786	98198	93774	95360
Discards [2]			1265	1963	
Total catch	**57147**	**78786**	**99463**	**95737**	**95360**

Country	2007	2008	2009	2010	2011
Denmark [1]	35990	32230	29164	19671	30498
Faroe Islands	1196	1612	815	1185	-
France	8421	9687	4316	2349	1687
Germany	2205	2415	1061	1994	1778
Netherlands	8550	904	3164	830	7314
Norway	5347	1543	17538	557	2537
Sweden	7150	6815	2129	580	2815
UK (England)	577	833	2	1577	4748
UK (Scotland)	-	1293	3757	805	488
Unallocated landings [3]	-203	-904	-166	0	0
Total landings	69233	56428	61780	29548	51865
Discards [2]		30			
Total catch	**69233**	**56458**	**61780**	**29548**	**51865**

[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	2002	2003	2004	2005	2006
Belgium	23	5	8	6	3
Denmark	170	273	774	206	969
Faroe Islands					30
France	10686	12389	12988	15150	13637
Germany	4366	5987	9588	9896	7553
Netherlands	23814	36948	28637	34874	23743
UK (England)	3298	3977	4511	5919	5243
UK (Scotland)	623	-	-	-	-
Unallocated landings	5336	8170	9963	8231	5419
Total landings	50318	67749	68473	74282	56597
Discards [2]	-	-	-	-	-
Total catch	**50318**	**67749**	**68473**	**74282**	**56597**
Coastal spring spawners included above [1]	60	84	62	74	65

Country	2007	2008	2009	2010	2011
Belgium	1	-	-	-	4
Denmark	113	621	25	1106	115
France	7918	7592	6731	8984	7121
Germany	7703	5182	4307	5171	5007
Netherlands	14958	10584	10371	9449	12192
Norway	-	-	-	-	46
UK (England)	3583	2529	72	1809	2165
UK (Scotland)	-	1	-	1	-
Unallocated landings	4725	3103	417	0	0
Total landings	39001	29612	21923	26520	26650
Discards [2]	-	-			
Total catch	**39001**	**29612**	**21923**	**26520**	**26650**
Coastal spring spawners included above [1]	2	7	48	85	2

[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.

Table 6.4.16.7 ("The Wonderful Table"). Herring caught in the North Sea. Catch in thousand tonnes in Subarea IV and in Divisions VIId and IIIa.

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sub-Area IV and Division VIId: TAC (IV and VIId)														
Recommended Divisions IVa, b	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]	-	-	
Expected catch of spring spawners														
Agreed Divisions IVa,b [1]	240	240	240	223	340.5	393.9	460.7	404.7	303.5	174.6	147.4	149.0	173.5	360.4
Agreed Div. IVc, VIId	25	25	25	42.7	59.5	66.1	74.3	50.0	37.5	26.7	23.6	15.3	26.5	44.6
Bycatch ceiling in the small mesh fishery	30	36	36	36	52.0	38.0	50.0	42.5	31.9	18.8	16.0	13.6	16.5	17.9
CATCH (IV and VIId)														
National landings Divisions IVa,b [2]	261	261	272	261	354.5	427.7	502.3	439.2	326.8	201.2	145.0	148.1	191.7	
Unallocated landings Divisions IVa,b	22	35	2	24	23.7	36.9	49.6	13.3	21.9	14.0	-1.1	0.0	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	0.0	
Total catch Divisions IVa,b [4]	283	296	273	303	382.3	481.6	564.6	454.0	348.8	215.4	143.9	148.1	191.7	
National landings Divisions IVc, VIId [3]	29	23	24	43	59.5	56.5	66.1	51.2	34.3	26.5	21.5	26.5	26.7	
Unallocated landings Divisions IVc,VIId	22	27	26	7	8.2	12.0	8.2	5.4	4.7	3.1	0.4	0	0	
Discard/slipping Divisions IVc, VIId [3]	-	-	-	0	-	-	-	-	-	-	-	-	-	
Total catch Divisions IVc, VIId	50	50	50	50	67.7	68.5	74.3	56.6	39.0	29.6	21.9	26.5	26.7	
Total catch IV and VIId as used by ICES [4]	**333**	**346**	**323**	**353**	**450.0**	**550.1**	**638.9**	**510.62**	**387.8**	**245.0**	**165.8**	**174.6**	**218.4**	
CATCH BY FLEET/STOCK (IV and VIId) [7]														
North Sea autumn spawners directed fisheries (Fleet A)	313	322	296	323	434.9	529.5	610.0	487.1	379.6	236.3	152.1	164.8	209.2	
North Sea autumn spawners industrial (Fleet B)	15	18	20	22	12.3	13.6	21.8	11.9	7.1	8.6	9.8	9.1	8.9	
North Sea autumn spawners in IV and VIId total	**329**	**339**	**317**	**346**	**447.2**	**543.0**	**631.9**	**499.0**	**386.7**	**244.9**	**161.9**	**173.9**	**218.1**	
Baltic-IIIa-type spring spawners in IV	5	7	6	7	2.8	7.1	7.0	11.0	1.1	0.1	3.9	0.8	0.3	
Coastal-type spring spawners	0.1	0.1	1.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	
Norw. Spring Spawners caught under a separate quota in IV [14]	32	26	7	4	1.0	0.5	0.4	0.6	0.7	2.7	44.6	56.9	12.2 [16]	
Division IIIa: TAC (IIIa)														
Predicted catch of autumn spawners	43	53	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	
Recommended spring spawners	- [12]	- [12]	- [12]	- [12]	- [12]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	
Recommended mixed clupeoids	-	-	-	-	-	-	-	-	-	-	-	-		
Agreed herring TAC	80	80	80	80	80.0	70.0	96.0	81.6	69.4	51.7	37.7	33.9	30.0	45.0
Agreed mixed clupeoid TAC														
Bycatch ceiling in the small mesh fishery	19	21	21	21	21.0	21.0	24.2	20.5	15.4	11.5	8.4	7.5	6.7	6.7
CATCH (IIIa)														
National landings	86	108	90	79	76.0	61.1	90.8	88.9	47.3	38.2	38.8	37.3	20.0	
Catch as used by ICES	79	99	82	73	68.1	52.7	69.6	51.2	47.4	38.2	38.8	37.3	20.0	
CATCH BY FLEET/STOCK (IIIa) [7]														
Autumn spawners human consumption (Fleet C)	28	36	34	17	24.1	13.4	22.9	11.6	16.4	9.2	5.1	12.0	6.6	
Autumn spawners mixed clupeoid (Fleet D) [13]	8	13	12	9	8.4	10.8	9.0	3.4	3.4	3.7	1.5	1.8	1.8	
Autumn spawners other industrial landings (Fleet E)														
Autumn spawners in IIIa total	**34**	**49**	**46**	**26**	**32.5**	**24.2**	**31.9**	**15.0**	**19.8**	**12.9**	**6.5**	**13.8**	**8.4**	
Spring spawners human consumption (Fleet C)	40	45	33	38	31.6	16.8	32.5	30.2	25.3	23.0	29.4	23.0	10.8	
Spring spawners mixed clupeoid (Fleet D) [13]	3	5	3	9	4.0	11.2	5.1	5.9	2.3	2.2	2.9	0.5	0.8	
Spring spawners other industrial landings (Fleet E)														
Spring spawners in IIIa total	**43**	**50**	**36**	**47**	**35.6**	**28.0**	**37.6**	**36.1**	**27.6**	**25.2**	**32.3**	**23.5**	**11.6**	
North Sea autumn spawners Total as used by ICES	**363**	**388**	**363**	**372**	**479.7**	**567.2**	**663.8**	**514.6**	**406.5**	**257.9**	**168.4**	**187.6**	**226.5**	

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 62i 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 and in Divisions IIIa and VIId (autumn spawners). Summary of the assessment. Recruits age 0 = 0 winter ringer; SSB is at spawning time. Low = lower limit and High = higher limit of 95% confidence interval.

Year	Recruits Age 0 (Thousands) Mean	Low	High	Total biomass (tonnes) Mean	Low	High	Spawning biomass (tonnes) Mean	Low	High	Landings (tonnes) Mean[(1)]	Yield / SSB (ratio) Mean	Mean F ages 2-6 Mean	Low	High	Mean F ages 0–1
1947	72492959	42611895	123327750	6983076	5657519	8619210	3745254	2890236	4853211	846614	0.226	0.175	0.126	0.242	0.002
1948	67254871	41609506	108706354	6280750	5090108	7749899	3153426	2444274	4068322	689002	0.218	0.172	0.128	0.231	0.002
1949	59233629	36842064	95234154	6022422	4925148	7364157	3063290	2395584	3917101	712831	0.233	0.186	0.138	0.249	0.002
1950	81899218	52171306	128566495	6095126	5015279	7407477	3002633	2378302	3790857	657368	0.219	0.196	0.148	0.258	0.005
1951	74850249	48311259	115967994	6205832	5139879	7492851	2833434	2259423	3553274	762990	0.269	0.234	0.182	0.302	0.016
1952	74700698	48798474	114351821	6064726	5040517	7297051	2788460	2220207	3502156	829020	0.297	0.246	0.191	0.317	0.029
1953	80117110	53520387	119930960	5950584	4965601	7130950	2615589	2072751	3300593	843234	0.322	0.261	0.202	0.337	0.041
1954	75150250	50970786	110799941	5821101	4870879	6956694	2438759	1919220	3098940	915293	0.375	0.292	0.224	0.380	0.054
1955	66386216	45253945	97386641	5471153	4590753	6520395	2409669	1900941	3054543	866312	0.360	0.289	0.223	0.375	0.083
1956	49130963	33412759	72243405	4911058	4134604	5833325	2226630	1753587	2827281	850007	0.382	0.292	0.228	0.374	0.078
1957	129994149	86938367	194373087	5576099	4604647	6752500	2043143	1609208	2594093	784655	0.384	0.306	0.239	0.393	0.099
1958	49674387	34004873	72564443	5267150	4400026	6305161	1696368	1328328	2166381	790958	0.466	0.315	0.247	0.403	0.085
1959	56911045	38393272	84360277	5460222	4591829	6492843	2605148	2048113	3313682	1131438	0.434	0.329	0.257	0.422	0.107
1960	23068993	15233227	34935372	4439268	3755204	5247943	2231088	1760269	2827837	839029	0.376	0.287	0.225	0.366	0.120
1961	108146787	71938346	162579879	5050511	4210081	6058711	2124400	1699050	2656235	756910	0.356	0.322	0.258	0.402	0.065
1962	52904555	35933278	77891361	4699657	3954726	5584905	1522707	1202341	1928435	666636	0.438	0.346	0.274	0.437	0.056
1963	79319932	55289059	113795598	5362817	4546312	6325965	2443642	1954755	3054799	658026	0.269	0.244	0.194	0.308	0.071
1964	82145285	57154164	118063975	5677378	4918211	6553727	2373794	1961772	2872351	931918	0.393	0.324	0.268	0.392	0.133
1965	38186782	26492748	55042623	5020299	4429213	5690266	1945442	1644672	2301217	1217122	0.626	0.501	0.418	0.601	0.122
1966	34935009	24499459	49815583	3886424	3445763	4383438	1575369	1335860	1857820	976764	0.620	0.510	0.433	0.602	0.112
1967	42926504	30273606	60867699	3169232	2808426	3576393	1021722	871943	1197230	835679	0.818	0.654	0.557	0.767	0.145
1968	40873807	28728379	58153929	2755198	2410356	3149377	567502	484586	664607	806936	1.422	0.948	0.808	1.113	0.153
1969	19560054	13533740	28269770	2137185	1852825	2465187	510936	416945	626116	556821	1.090	0.864	0.735	1.015	0.150
1970	36506468	26018844	51221422	2063677	1790364	2378714	489432	397927	601978	532853	1.089	0.905	0.777	1.054	0.149
1971	26990621	19401435	37548440	1947389	1695082	2237250	348363	286856	423058	540906	1.553	1.212	1.030	1.426	0.279
1972	17716377	12784177	24551443	1684535	1472877	1926608	350109	287692	426067	472598	1.350	0.645	0.541	0.769	0.296
1973	8966446	6379917	12601601	1292385	1139492	1465792	304370	253177	365915	443743	1.458	0.827	0.711	0.962	0.325
1974	16387018	11610634	23128311	949794	831115	1085418	204434	170717	244810	274581	1.343	0.845	0.718	0.995	0.257
1975	3870909	2575654	5817528	783871	666639	921719	119491	96889	147367	265136	2.219	0.968	0.773	1.211	0.302
1976	4901246	3185980	7539976	543617	453031	652316	166708	125745	221015	147709	0.886	0.723	0.539	0.972	0.116
1977	5520616	3524877	8646317	408399	329561	506097	124492	91657	169091	61023	0.490	0.337	0.245	0.464	0.091
1978	5826925	3662428	9270642	462777	369858	579040	154817	116730	205331	52680	0.340	0.250	0.178	0.350	0.097
1979	11172880	7297147	17107132	590662	480429	726188	190042	148023	243989	65578	0.345	0.207	0.151	0.286	0.104

[(1)]Assessment output.

Table 6.4.16.8 Continued

Year	Recruits Age 0 (Thousands) Mean	Low	High	Total biomass (tonnes) Mean	Low	High	Spawning biomass (tonnes) Mean	Low	High	Landings (tonnes) Mean[(1)]	Yield / SSB (ratio) Mean	Mean F ages 2-6 Mean	Low	High	Mean F ages 0–1
1980	17072849	11954673	24382280	811792	671051	982053	210660	168623	263176	81064	0.385	0.183	0.144	0.233	0.111
1981	37468083	26829592	52324957	1405635	1166582	1693676	309589	248541	385632	159213	0.514	0.201	0.160	0.252	0.283
1982	59709399	43561958	81842334	2128653	1771783	2557403	431922	349974	533058	271848	0.629	0.185	0.148	0.231	0.255
1983	56232194	41516919	76163157	2861911	2419243	3385576	647582	526540	796448	403124	0.623	0.231	0.187	0.285	0.288
1984	53650428	39361565	73126370	3602001	3092088	4196002	1034057	841173	1271168	453613	0.439	0.304	0.249	0.371	0.198
1985	67456938	48712391	93414394	4093865	3545157	4727500	1097999	908402	1327167	606221	0.552	0.388	0.316	0.475	0.199
1986	79717524	57435343	110644133	4685579	4047927	5423677	1123546	938366	1345269	766048	0.682	0.379	0.311	0.460	0.191
1987	81409294	59664156	111079642	4615820	4018764	5301578	1294972	1080393	1552170	785441	0.607	0.374	0.310	0.451	0.247
1988	42926504	31341674	58793438	4538014	3976434	5178904	1646233	1375865	1969729	1033023	0.628	0.365	0.303	0.440	0.298
1989	35640743	26070663	48723830	3801856	3375412	4282177	1696368	1451320	1982791	794923	0.469	0.350	0.292	0.420	0.242
1990	29978769	21677738	41458505	3704282	3300011	4158078	1741052	1497012	2024874	695231	0.399	0.300	0.250	0.361	0.234
1991	31642129	23121706	43302356	3433189	3058624	3853623	1501537	1292924	1743811	672663	0.448	0.329	0.275	0.393	0.207
1992	59174425	44617754	78480253	3460764	3070918	3900101	1151988	985034	1347240	698716	0.607	0.369	0.308	0.442	0.295
1993	51392356	38699189	68248827	3191495	2800386	3637227	818313	691752	968029	680784	0.832	0.422	0.351	0.508	0.324
1994	36397112	27153041	48788266	2827773	2478992	3225626	874144	743482	1027768	598391	0.685	0.437	0.362	0.527	0.202
1995	46828381	34660817	63267327	2746945	2398378	3146171	921723	777939	1092082	544705	0.591	0.379	0.308	0.465	0.204
1996	44233811	32210827	60744482	2934360	2534492	3397316	1058115	892554	1254387	297747	0.281	0.229	0.182	0.288	0.107
1997	31108760	22300802	43395521	3131429	2704621	3625590	1217122	1028476	1440371	284077	0.233	0.201	0.162	0.249	0.033
1998	22098052	15968210	30581004	3325066	2899227	3813451	1467396	1252733	1718843	384231	0.262	0.222	0.180	0.274	0.058
1999	71128595	51403067	98423642	3412651	2987781	3897939	1536473	1307959	1804911	361494	0.235	0.212	0.173	0.259	0.040
2000	48496394	35120852	66965921	4329662	3745390	5005078	1531870	1307614	1794587	373249	0.244	0.212	0.173	0.259	0.043
2001	84901303	61266172	117654345	4852478	4214505	5587024	2084418	1774048	2449087	385001	0.185	0.187	0.152	0.229	0.040
2002	44278067	31971825	61321091	5626510	4879269	6488189	2397651	2046761	2808696	407176	0.170	0.176	0.144	0.217	0.030
2003	21274080	15412928	29364082	5962498	5173494	6871832	2455891	2110996	2857134	495836	0.202	0.201	0.164	0.246	0.040
2004	24865702	18011504	34328237	5040420	4398405	5776147	2419327	2075752	2819771	584201	0.241	0.244	0.197	0.303	0.042
2005	23277552	16957568	31952954	4231216	3709107	4826819	2294441	1956166	2691214	635394	0.277	0.260	0.210	0.321	0.077
2006	27480851	19984365	37789400	3513067	3081548	4005013	1797667	1529505	2112843	507372	0.282	0.231	0.186	0.286	0.046
2007	26245366	18430075	37374739	2996633	2610917	3439333	1444105	1223784	1704090	363669	0.252	0.197	0.158	0.245	0.036
2008	26192928	18131244	37839073	3051061	2639813	3526376	1525755	1298957	1792152	252458	0.165	0.128	0.104	0.158	0.037
2009	35039971	25039321	49034858	3509556	3021796	4076047	1899308	1612966	2236483	183506	0.097	0.076	0.060	0.096	0.027
2010	37095269	25236977	54525509	4085685	3505761	4761541	2004690	1678666	2394033	192336	0.096	0.078	0.063	0.097	0.027
2011	31139884	20526868	47240154	4231216	3594376	4980889	2343134	1963435	2796262	217075	0.093	0.093	0.074	0.118	0.026
2012	27757038						2271364*								

* predicted.

[(1)]Assessment output.

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

Based on the ICES approach for data limited stocks, ICES advises that catches should be no more than 8200 tonnes.

This is the first year that ICES is providing quantitative advice for data limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		2009–2011
Qualitative evaluation	?	Insufficient information
SSB (Spawning Stock Biomass)		**2010–2012**
Qualitative evaluation	?	Insufficient information

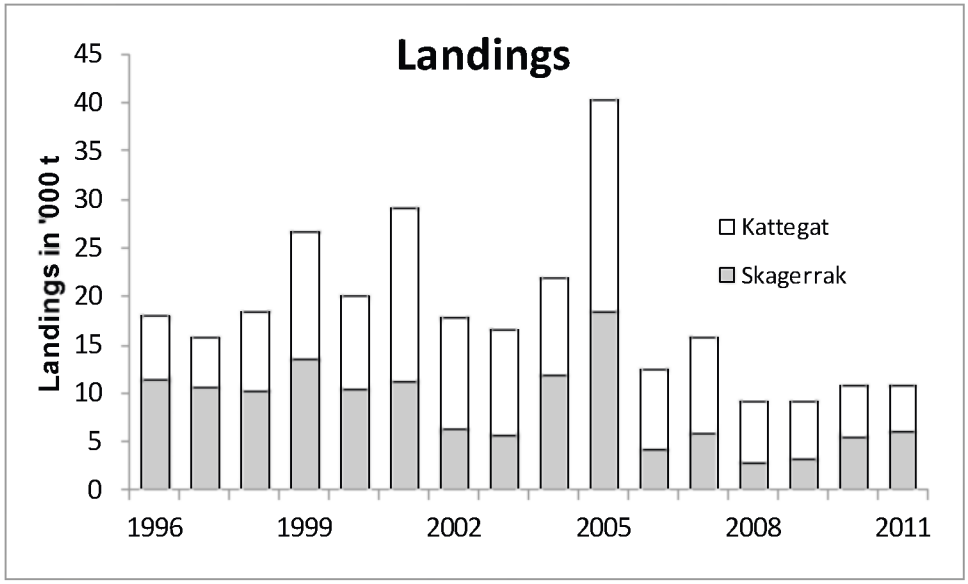


Figure 6.4.17.1 Sprat in Division IIIa (Skagerrak – Kattegat). ICES estimates of landings (in '000 tonnes).

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

The specific effect of environmental variability on this stock are unknown 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.

Catch distribution	Landings in 2011 were 10.7 kt., 6.0 kt in Skagerrak (IIIaN) and 4.8 kt in Kattegat (IIIaS)

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 whilst considered adequate should be increased. An accurate abundance index is currently not available. The advice is based on a precautionary reduction of catches because of missing or non representative data. A reanalysis of the available data during the 2012/13 benchmark should further reveal data needs. The methods applied to derive quantitative advice for data limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment
Discards and by-catch	None
Indicators	3 survey indices (IBTS-Q1&3, HERAS), commercial landings
Other information	For this short-lived stock, in year advice is given. A benchmark for this stock is planned 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.

ICES approach to data limited stocks

For data limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For this stock, ICES advises that catches should decrease by 20% in relation to the last three years average catch, corresponding to catches of no more than 8200 t in 2013.

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.

Last year, advice for this stock was based on precautionary considerations, this year the advice is based on the ICES approach to data limited stocks.

Sources

ICES. 2012. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 13–22 March 2012, ICES Headquarters, Copenhagen, Denmark. ICES CM 2012/ACOM:06.

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 landings
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	n.a	11
2012	20% Reduction in catches (last 3 years average)[3]	< 8.2	52		
2013	Advice will be given in 2013				

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
2011	3.5	1.8	0.7	6.0	4.5	0.3	4.8	10.7

* < 50 t

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

Advice for 2012 (in year advice)

Based on the ICES approach for data limited stocks, ICES advises that catches should not be more than 134 000 tonnes (catches of 2011).

This is the first year that ICES is providing quantitative advice for data limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning Stock Biomass)	2010–2012
Qualitative evaluation	Increasing

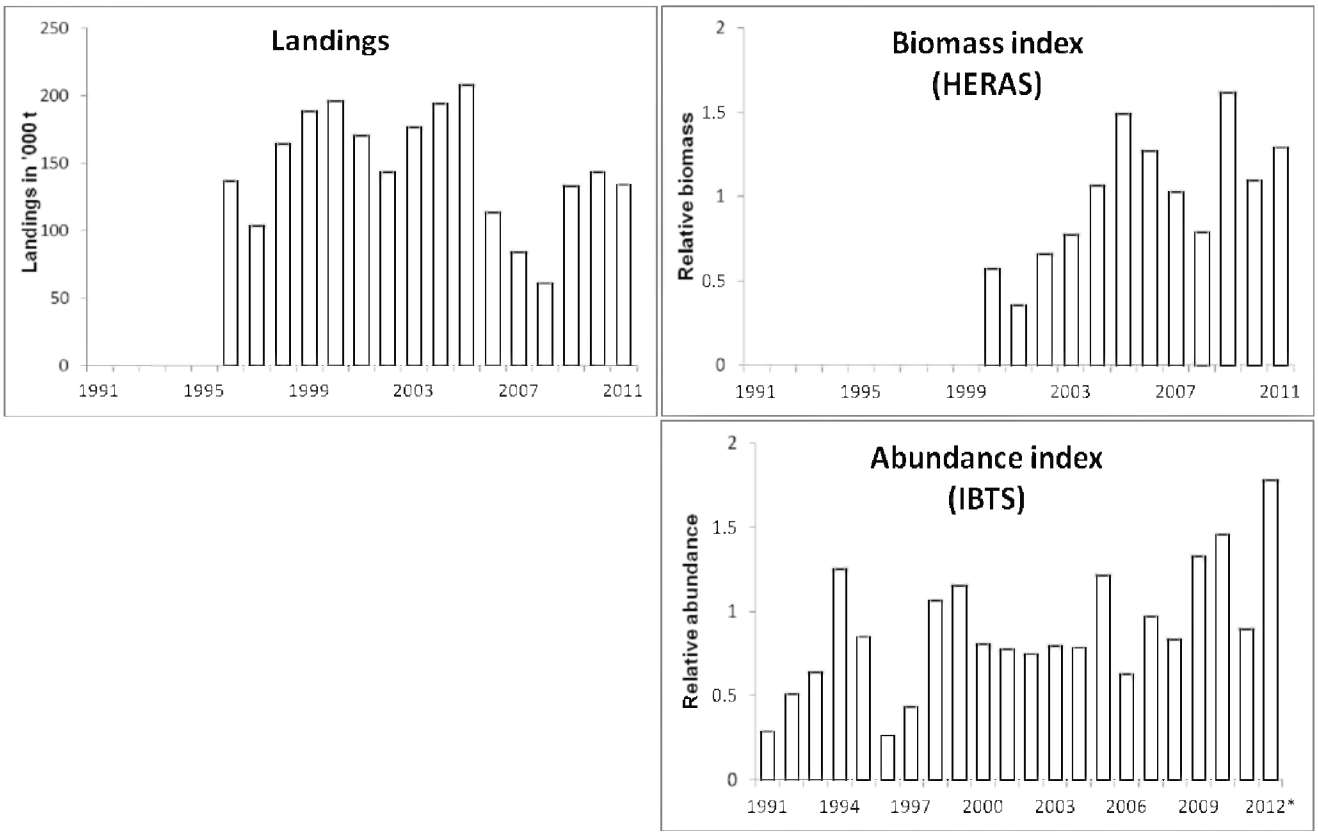


Figure 6.4.18.1 Sprat in Subarea IV (North Sea). ICES estimates of landings (in '000 tonnes), relative biomass estimate from the HERAS survey, and relative abundance estimate from the IBTS survey (* marked estimates are preliminary).

The stock appears to have increased judged from surveys as well as an exploratory assessment. The stock seems to sustain the recent catches.

Management plans

No specific management objectives are known to ICES.

Biology

Sprat in the North Sea is short-lived with high natural mortality 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 small-meshed trawl fishery. In this fishery there is about 10% bycatch of herring. The Norwegian sprat fishery is mainly carried out by purse seiners. Landings are used for reduction for fish meal and fish oil. Most sprat catches are taken in an a small meshed fishery where chatches are limited by herring bycatch restrictions. Bycatches of herring are practically unavoidable exept in years with high sprat abundance or low herring recruitment. Given the recent increase in the North Sea Autumn Spawning herring stock, the sprat fishery in has been increasingly limited by the by-catch limits.

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

Both the IBTS and the HERAS acoustic survey are currently considered to potentially provide basis for an abundance index. The sampling intensity in Subarea IV has improved in 2011, but is still below the reference level of 0.5 sample per kt in Division IVc where the majority of the fisheries takes place. A reanalysis of the data during the 2012/13 benchmark should further reveal data needs.

The methods applied to derive quantitative advice for data limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	There is currently only an explorative assessment for this stock.
Input data	3 survey indices (IBTS Q1&3, HERAS) Commercial landings
Discards and bycatch	Bycatches from the Danish sprat fishery
Indicators	None
Other information	For this short-lived stock, in year advice is given A benchmark for this stock is planned for 2013.
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 2012

No assessment can be presented for this stock. As this species has a very high natural mortality in the North Sea and the fishery is focused on the incoming year class (1 year old fish), only in year advice can be provided.

ICES approach to data limited stocks

For data limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate for the stock.

For this stock, there is currently an increasing trend in abundance while catches have remained fairly constant. Recent catches appear to be sustainable. Therefore, ICES advises that catches in 2012 (in year advice) should not increase in relation to the the 2011 value of 134 000 t.

Additional considerations

Regulations and their effects

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.

Data exploration

An exploratory assessment on the stock was performed using a stochastic assessment model (SMS). This analysis showed a very good fit of the trawl (IBTS quarter 1) and acoustic (HERAS) surveys and reasonable fit of catch composition of the main target age groups. In addition, there is a reasonable consistency of the different survey time series. All available time series show an increase in recruitment and SSB in recent years.

Comparison with previous assessment and catch options

The basis for the advice last year was precautionary considerations, this year the advice is based on the ICES advice to data limited stocks.

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. 2012. Report of the Herring Assessment Working Group for the Area South of 62n (HAWG), 13– 22 March 2012, ICES Headquarters, Copenhagen, Denmark. ICES CM 2012/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, catch and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Catches	ICES Landings
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		134
2012	Reduce catches		162		
In year	No increase in catches (2011)	< 134			
2013	Advice for 2013 will be given in 2013				

Weights in '000 t.
[1] EU zone.
[2] Provisional.

Table 6.4.18.2 Sprat in Subarea IV (North Sea). ICES landings by area (in tonnes). See ICES (2006b) for earlier landings data. Catch in fjords of western Norway excluded. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes. The Division IVb catches for 2000–2007 divided by IVbW and IVE can be found in ICES (2008).

Year	Quarter	Area				Total
		IVaW	IVaE	IVb	IVc	
2006	1	25	22	13 713	33 534	47 294
	2			190	8	198
	3			40 051	8	40 059
	4	2		26 579	77	26 658
	Total	27	22	80 533	33 627	114 209
2007	1			582	247	829
	2			241	3	244
	3			16 603		16 603
	4	769		41 850	23 531	66 150
	Total	769		59 276	23 781	83 826
2008	1			2 872	43	2 915
	2			52	*	52
	3			21 787		21 787
	4			27 994	8 334	36 329
	Total			52 706	8 377	61 083
2009	1			36	1 268	1 304
	2			2 526	1	2 527
	3		22	41 513		41 535
	4			78 373	9 336	87 709
	Total		22	122 448	10 604	133 075
2010	1			10 976	17 072	28 048
	2			3 235	3	3 238
	3			14 220		14 220
	4			62 006	35 973	97 979
	Total			90 437	53 048	143 485
2011	1	0		3747	21039	24 786
	2	0		2067	3	2 070
	3	0		22309	451	22 761
	4	8		70256	13759	84 023
	Total	8	0	98 380	35 252	133 640

* < 1 ton

ECOREGION North Sea
STOCK Horse mackerel (*Trachurus trachurus*) in Divisions IIIa, IVb,c, and VIId (North Sea stock)

Advice for 2013

Based on ICES approach to data-limited stocks, ICES advises that catches of horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock) should be no more than 25 500 t.

This is the first year ICES is providing quantitative advice for data-limited stocks (see the 'Quality considerations').

Stock status

F (Fishing Mortality)		
	2009–2011	
Qualitative evaluation	?	**Insufficient information**

SSB (Spawning-stock Biomass)		
	2010–2012	
Qualitative evaluation	?	**Insufficient information**

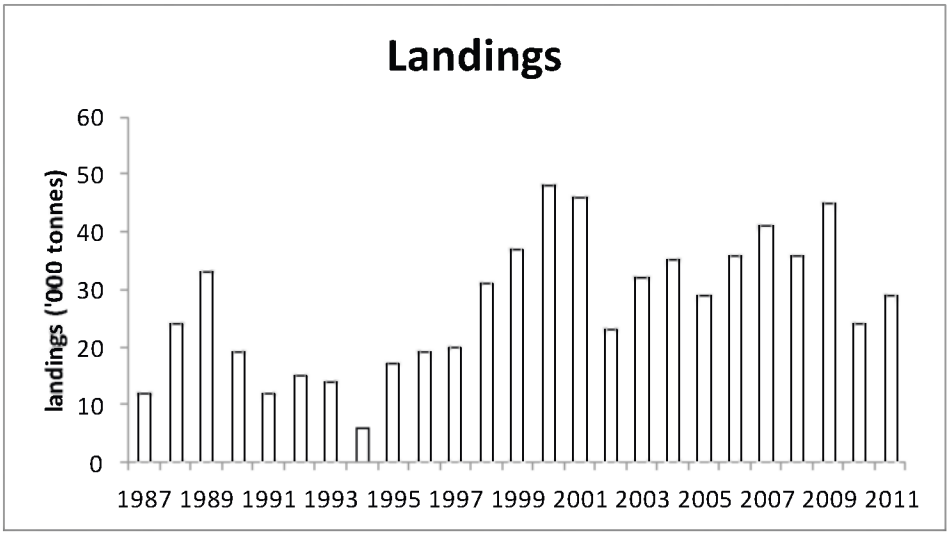


Figure 6.4.19.1 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Landings from Divisions IIIa, IVa, IVb,c, and VIId since 1987 (thousand tonnes).

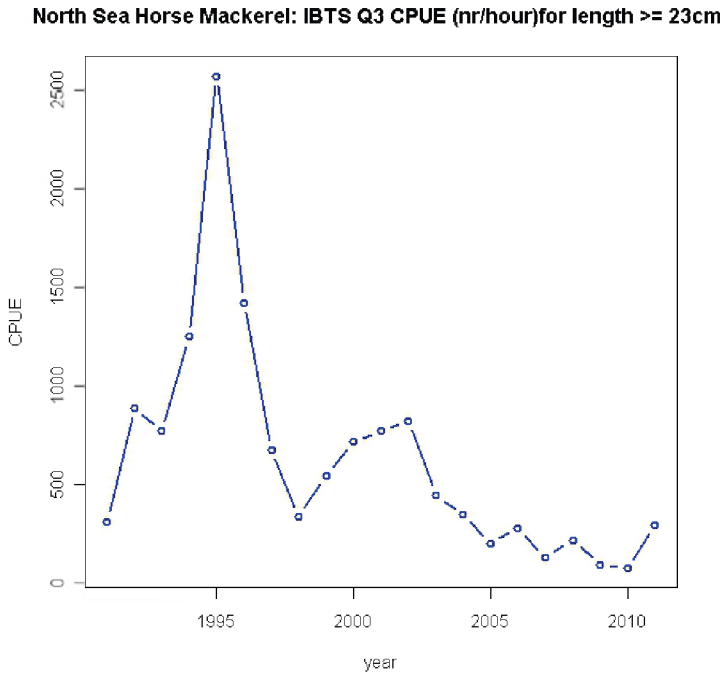


Figure 6.4.19.2 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Quarter 3 IBTS cpue index of fish ≥ 23cm long.

The available information, while broadly informative, is insufficient to evaluate recent stock trends and exploitation status. Therefore, the state of the horse mackerel in the North Sea is unknown. The IBTS index for adult horse mackerel suggests that the stock has been declining since the early 2000s and has remained at low abundance since 2005.

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 (2011) = 29 343 tonnes (mainly trawl); discards are considered negligible.

Quality considerations

The methods applied to derive quantitative advice for data limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Data-limited stocks, category 5.2.0.
Input data	Landings.
Discards and bycatch	Discards considered negligible.
Indicators	None.
Other information	IBTS cpue.
Working group report	WGWIDE

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 2013

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

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate for the stock. As there is no accepted indication of the value of F relative to proxies of F_{MSY} and no marked positive trends in stock indicators, the advice is set as the previous catch, with a precautionary buffer applied.

The previous catch for this stock can be defined as the average of the last three years, as there is no clear trend in the catch. The average for the period 2009–2011 is 31 940 t. A precautionary buffer of 20% is applied to this, leading to an advised maximum catch of 25 500 t.

As the precautionary buffer is applied in the catch advice, this advice should apply for at least three years (i.e. 2013–2015) unless new information or analyses indicate a new situation (e.g. a clearly marked increase in stock indicators).

Precautionary considerations

Since 1998 catches have been substantially higher than in earlier years, but the sustainability of these catches cannot be assessed. The IBTS index for adult horse mackerel suggests that the stock has been fluctuating at low abundance since the early 2000s. Given that the exploitation status is unknown and taking into account the trends shown by the IBTS index, the advice for 2013 is to reduce catch.

Additional considerations

A catch curve analysis based on commercial landings data suggests increased total mortality rates in the late 1990s to mid-2000s (Figure 6.4.19.3).The downward trend seen in the IBTS survey in the early 2000s follows the increase in mortality seen in the catch curve analysis. The age composition of the catches from 1998 onwards shows a large number of age groups (1–15+) and several good year classes (Figure 6.4.19.4). 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 basis of the current advice is different than that given previously (except for 2010 where no advice was provided) to conform with data limited stocks. (See Section 1.2. General context of ICES advice).

Source

ICES. 2012. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 21–27 August 2012. ICES CM 2012/ACOM:16.

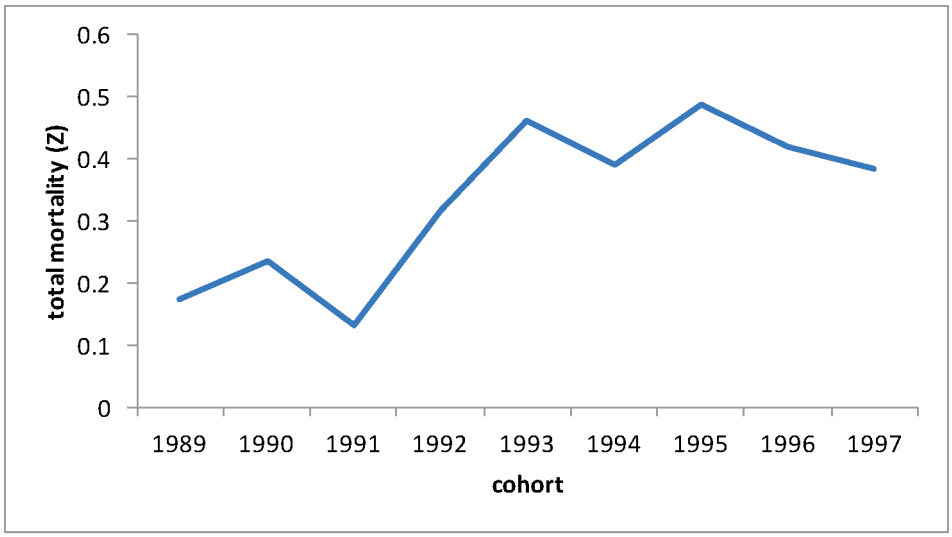


Figure 6.4.19.3 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Total mortality (Z), ages 6–14, estimated from the 1989–1997 cohorts catch curves. Based on 1989 to 2003 numbers-at-age in the catch data.

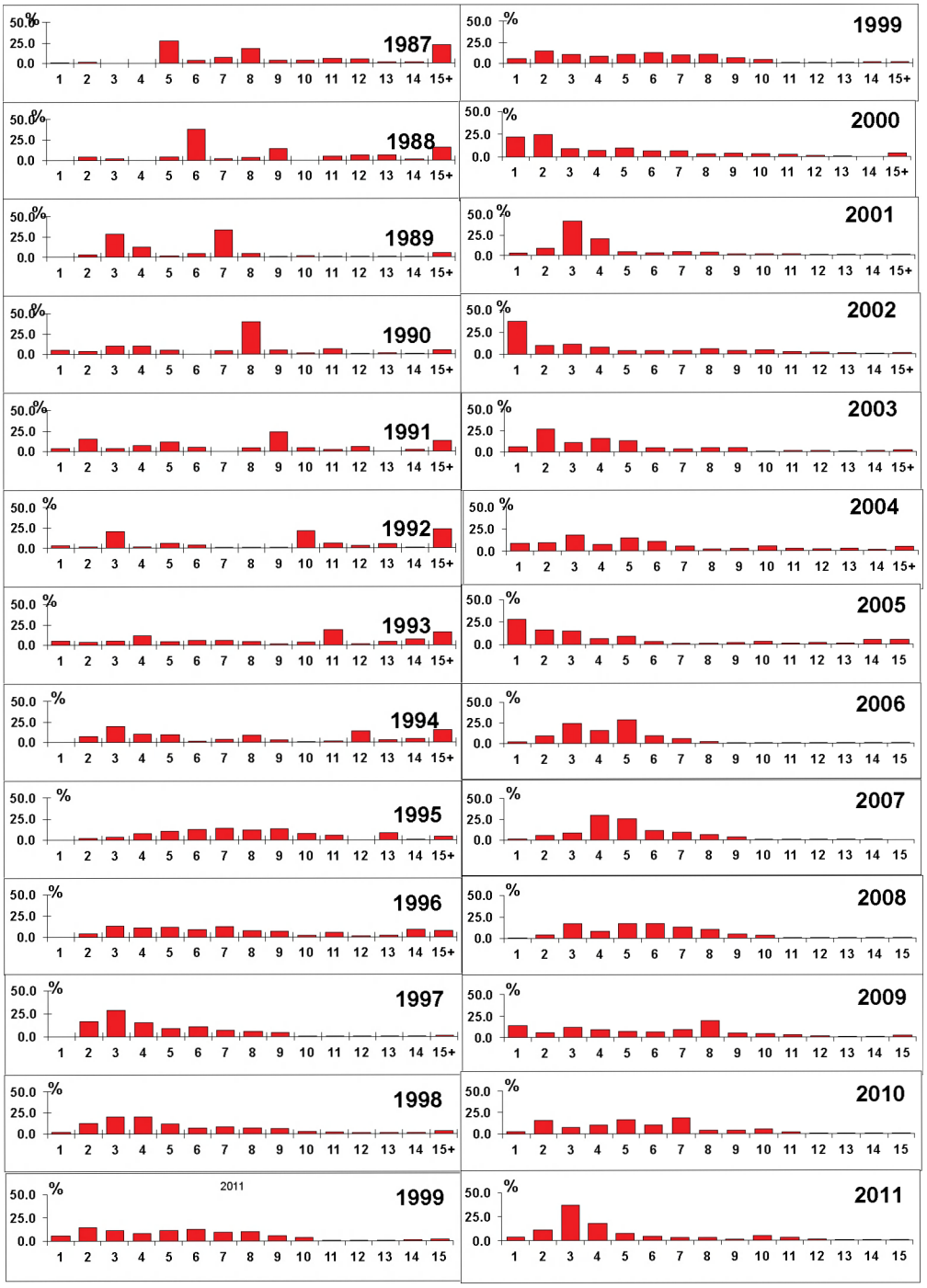


Figure 6.4.19.4 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Age distribution in the catches of North Sea horse mackerel 1987–2011.

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]	36
2009	Same advice as last year	< 18	39[1]	45
2010	Same advice as last year	< 18	47[3]	24
2011	No advice	-	40[3]	29
2012	Reduce catches	-	44[3]	
2013	Reduce catches by 20%	<25.5		

Weights in thousand tonnes.
[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

Year	IIIa	IVa	IVb,c	Discards	VIId	**Total**
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	<1	100	1965	2	20188	22255
2011	0		10458		18886	29344

[1]Divisions IIIa and IVb,c combined.

ECOREGION North Sea
STOCK Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)

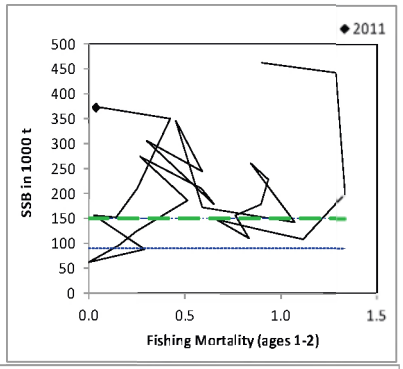
Advice for 2012

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)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↗	↘	Below average

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



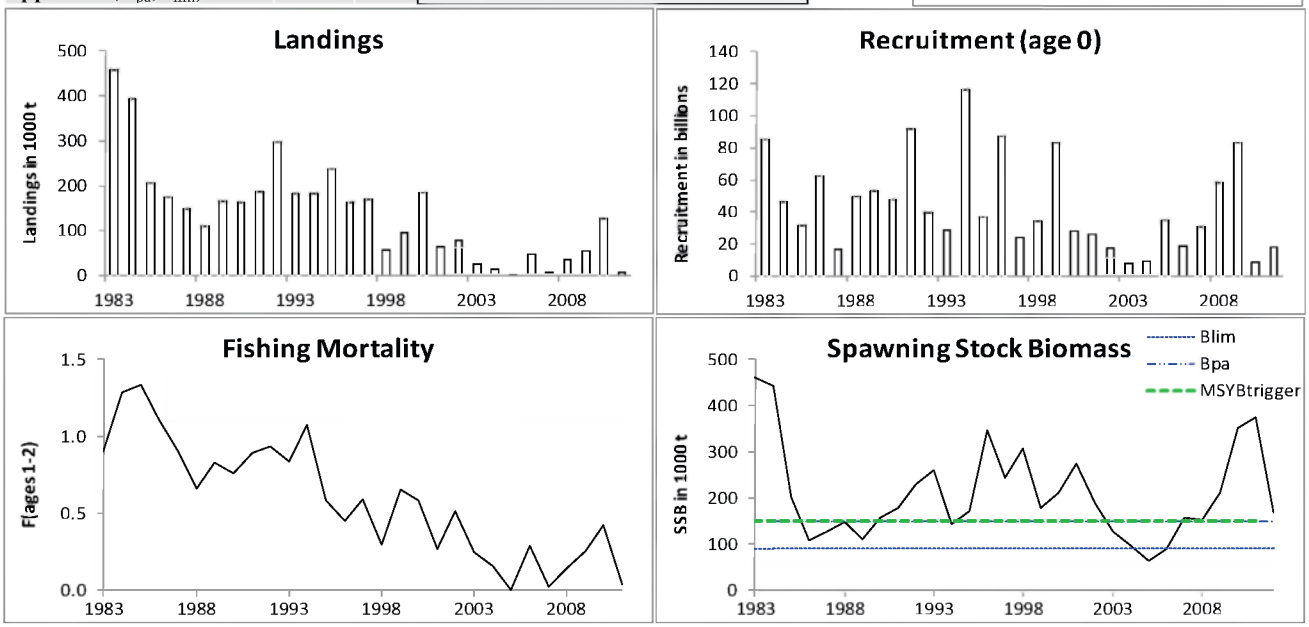


Figure 6.4.20.1 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Summary of stock assessment (weights in thousand tonnes). MSY $B_{trigger}$ should be read as MSY $B_{escapement}$. Top right: SSB and F for the time-series used in the assessment.

The stock size has decreased significantly since 2011 due to the very low recruitment in 2010 and 2011. 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, 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 the 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 the first half of 2011 and 2012. Low catch has been taken in the second half of 2011. Fishing effort and catches have been low in 2008 and 2009, but increased in 2010, and very low again in 2011. Historically, the fisheries have resulted in bycatches of other species, particularly whiting, blue whiting, haddock, saithe, and herring. Bycatches of these species have been low in the recent decade.

Catch distribution	Total catch (2011) = 6.5 kt (100% landings and no discards), > 99% taken by the small-meshed trawl fleet. The fishery has a 0.8 kt bycatch of other species (mainly blue whiting).

Effects of the fisheries on the ecosystem

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. The values for the natural mortality, maturity-at-age, and weight-at-age used in the assessment were updated in 2012. These parameters have impact on the predictions and estimates of the SSB because the stock consists of very few year classes. The change in natural mortality has resulted in a downward scaling of the time-series of recruitment.

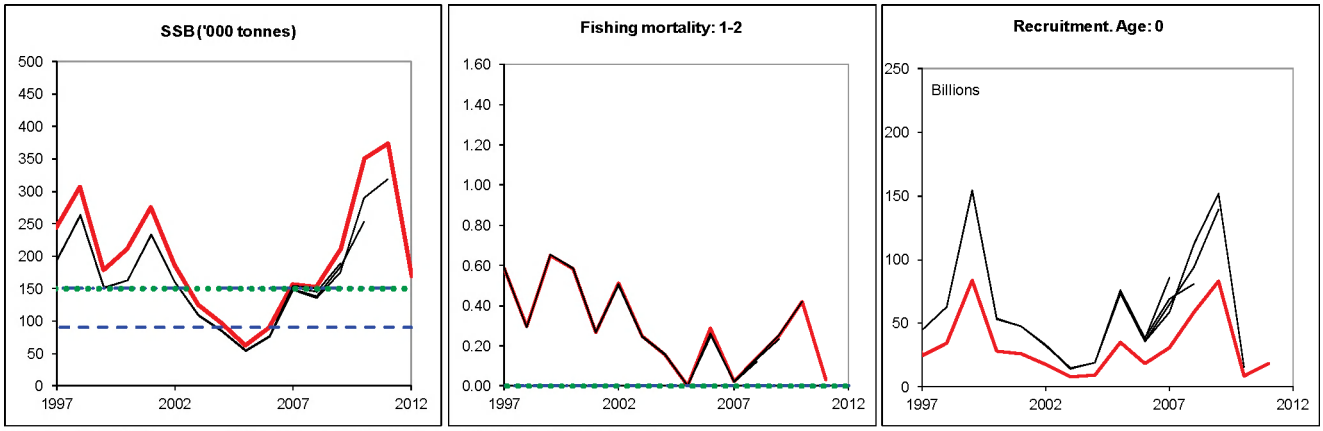


Figure 6.4.20.2 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Historical assessment results (final-year recruitment estimates included) of the June assessment.

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 in-year advice (stock status up to 1st of April). The autumn assessment provides advice for the next year. An inter-benchmark assessment has been performed in 2012 (IBPNorwayPout; ICES, 2012c).
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 2012

Basis: F (2011) = F (1,2) = 0.034; R (2012) = 25% of long-term recruitment (1983–2011) = ~ 24 billion (3rd quarter); SSB (2012) = (forecast model output) = 175; landings (2011) = 6.5.

Rationale	Landings 2012	Basis	F 2012	SSB 2013	%SSB change[1)]
Zero catch	0	No fishery	0	141	-19
Status quo	86	B_{lim}	1.12	90	-49
	50	Fixed TAC strategy	0.60	111	-37
	31	Fixed F strategy	0.35	122	-30

Weights in thousand 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. Based on a new joint EU–Norway request, management strategies will be evaluated again in summer 2012 for the stock to be available for the September 2012 ICES advice (ICES, 2012b).

MSY approach

Even without catches in 2012, the spawning-stock biomass cannot be maintained above a reference level of MSY $B_{escapement}$ by 1 January 2013, therefore 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.

Precautionary approach

Even without catches in 2012, the spawning-stock biomass cannot be maintained above B_{pa} (= MSY $B_{escapement}$) by 1 January 2013.

Additional considerations

The TAC was not 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). The TAC of 6 kt in 2011 has been taken.

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 total stock biomass (TSB) rapidly because of the short life span of the species (Nielsen *et al.*, 2012; Sparholt *et al.*, 2002a, 2002b; Lambert *et*

al., 2009). Furthermore, 20% 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.

An inter-benchmark assessment in spring 2012 (ICES, 2012c) used revised estimates of natural mortality, maturity-at–age, and mean weight-at-age in the assessment. Reference points for the stock were not revised at this stage, but it was concluded that higher escapement targets could be considered in the future based on the importance of Norway pout as a forage species in the ecosystem. The consumption amount of Norway pout by its main predators should be evaluated in relation to the production amount in the Norway pout stock under consideration of the consumption and production of other prey species for those predators in the ecosystem.

Fisheries, bycatches, and selective measures

Historically, the fishery includes bycatches, especially of haddock, whiting, saithe, and herring. Existing technical measures to avoid catches of these 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; Eigaard *et al.*, 2012). ICES suggests that these devices (or modified forms of those) are fully implemented and brought into use in the fishery.

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 practiced.

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 north-western 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 perception of stock dynamics of the SSB, recruitment, and of the average fishing mortality of ages 1 and 2 over time are consistent with the estimates of last year's assessment. However, based on the inter-benchmark assessment in spring 2012 with revised estimates of natural mortality, maturity-at-age, and mean weight-at-age, there is a consistent upward revision in SSB estimates over time for the stock in the assessment. This is because 20% of the age group 1 is considered mature compared to 10% in the previous assessments. There is also a consistent downward revision in recruitment and total stock biomass, mainly because of the revised natural mortality by age and quarter.

Last year's advice was based on the MSY and the precautionary approach. The basis for the advice this year is the MSY approach.

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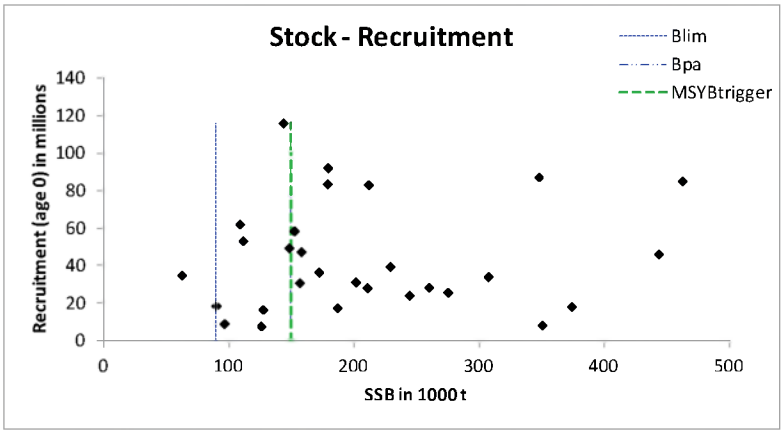


Figure 6.4.20.3 Norway pout in Subarea IV and Division IIIa. Stock-recruitment relationship.

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 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		7	7
In year[2]	Maintain SSB > MSY $B_{escapement}$	< 6	3 + 4.5 [3]		
2012	No fisheries	0	0		
In year[2]	No fisheries	0			
2013	Advice for 2013 will be given in Autumn 2012.				

Weights in thousand tonnes.

[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 6.4.20.2 Norway pout in Subarea IV and Division IIIa. Official landings (t) by country, area, and quarter (as submitted to ICES), including bycatch of Norway pout in other (small-meshed) fisheries. Norwegian landings 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	-
	2	-	-	-	-	-	-	-	-	-	188	188	188
	3	-	-	-	-	456	5	-	461	461	3,004	3,004	3,465
	4	-	-	-	-	2,853	-	-	2,853	2,853	18	18	2,871
	Total	-	-	-	-	3,309	5	-	3,314	3,314	3,210	3,210	6,524
2012	1	-	-	-	-	15	-	-	15	15	-	0	15

Table 6.4.20.3 Norway pout in Subarea IV and Division IIIa. Official landings (t) by country and ICES estimates.

Norway pout Sub-area IV and IIIa (Skagerrak) combined

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Denmark	59,069	73,194	16,649	11,345	941***	39,943	2,056	32,558	19,825	71,541	4,072
Faroe Islands	49	3,379	2,374	1,159	24	0	0	0	0	0	0
Norway	17,158	23,753	11,387	4,994	311	13,622	4,712	6,650	37,252	65,634	3,210
Sweden	780	0	0	88	0	0	0	10	0	10	1
Netherlands	0	0	0	0	0	0	0	0	22	18	0
Germany	0	0	0	107	0	34	0	3	75	0	0
UK	0	0	0	0	0	0	0	0	0	0	0
Total nominal landings	77,056	100,326	30,410	17,693	1,252	53,599	6,768	39,221	57,174	137,203	7,283
By-catch of other species and other	-11,456	-20,326	-3,310	-4,193	-	-6,973	-	-3,083	-2,674	-11,248	-759
WG estimate of total landings (IV+IIIaN)	65,600	80,000	27,100	13,500	-	46,626	-	36,138	54,500	125,955	6,524
Agreed TAC	211,200	198,000	198,000	198,000	0****	95,000	0****	114,616	116,279	162,950	6,000

* provisional
** provisional
*** 781 ton from trial fishery (directed fishery); 160 ton from by-catches in other fisheries
**** A by-catch qouta of 5000 t has been set.
***** 681 t taken in trial fishery; 1300 t in by-catches in other (small meshed) fisheries.
\+ Landings less than 1
n/a not available

Table 6.4.20.4 Norway pout in Subarea IV and Division IIIa. Summary of stock assessment.

Year	Recruitment Age 0 millions	SSB tonnes	Landings tonnes	Mean F Ages 1–2
1983	85094	462487	457600	0.901
1984	46218	443566	393010	1.285
1985	31331	201566	205100	1.334
1986	62105	108799	174300	1.112
1987	16597	127387	149300	0.906
1988	49486	148178	109300	0.661
1989	53150	111491	166400	0.833
1990	47391	157863	163300	0.761
1991	92225	179276	186600	0.894
1992	39638	229003	296800	0.934
1993	28505	260001	183100	0.840
1994	116122	143592	182000	1.073
1995	36542	172093	236800	0.587
1996	87246	347822	163800	0.449
1997	24234	244469	169700	0.590
1998	34164	307475	57700	0.299
1999	83554	178906	94500	0.651
2000	28255	210770	184400	0.583
2001	25820	275125	65600	0.266
2002	17496	186952	80000	0.513
2003	7774	125996	27100	0.248
2004	9043	96549	13500	0.157
2005	34986	62523	1900	0.000
2006	18555	89993	46600	0.290
2007	30844	156557	5700	0.025
2008	58515	152368	36100	0.139
2009	83168	211730	54500	0.252
2010	8418	350490	126000	0.422
2011	18241	374134	6500	0.034
2012		168629		
Average	43956	209526	139214	0.588

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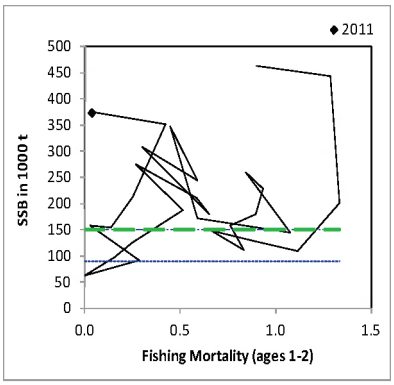
Advice for 2012 and 2013

ICES advises on the basis of the MSY approach according to the escapement strategy that catches of Norway pout in 2012 should not exceed 101 000 t. With this catch in 2012, catches in 2013 should not exceed 393 000 t. If no catch is taken in 2012, then catches in 2013 should not exceed 458 000 t.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↗	↘	Below average

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



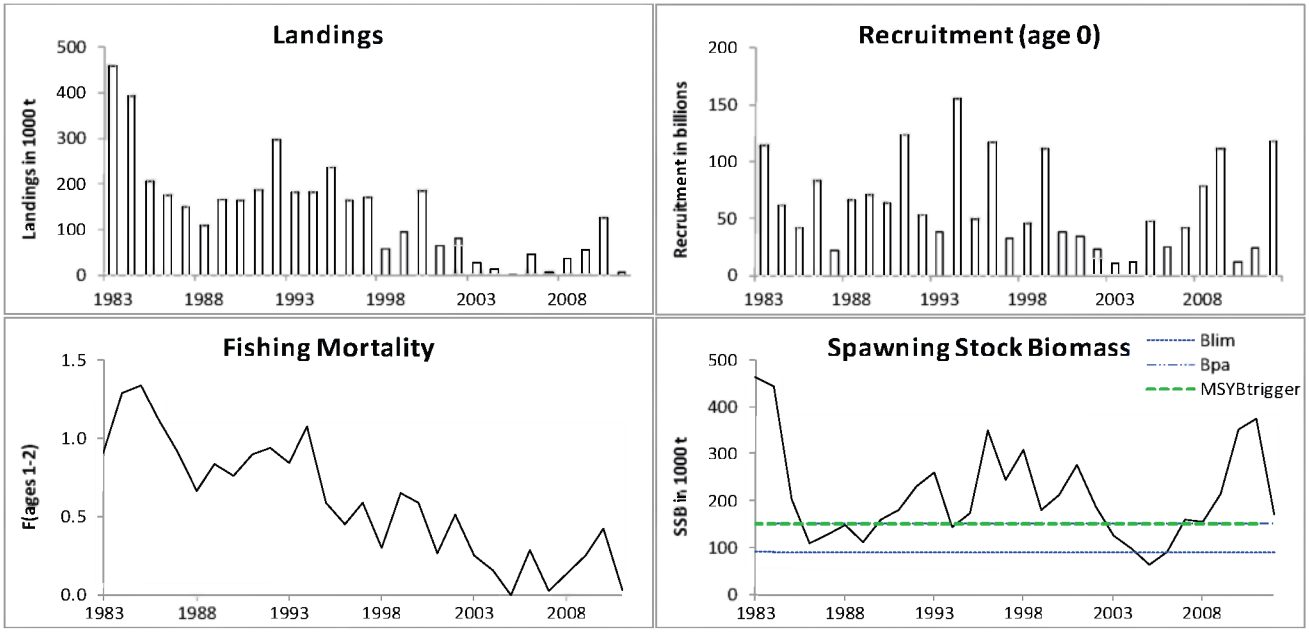


Figure 6.4.20.1 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Summary of stock assessment (weights in '000 tonnes). MSY $B_{trigger}$ should be read as MSY $B_{escapement}$. Top right: SSB and F over the years.

The stock size is above MSY $B_{escapement}$. Recruitment was low in 2010 and 2011, but very high in 2012. This is expected to maintain SSB above MSY $B_{escapement}$ in 2013. 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

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).

Long term management strategies for the stock were evaluated by ICES in September 2012 based on a joint EU-Norway request.

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, around 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 the 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 year of 2011 and 2012. Low catch has been taken in the 2nd half of 2011. Fishing effort and catches have been low in 2008 and 2009, but increased in 2010 due to the strong 2009 year class. Fishing effort was very low again in 2011, because of low recruitment in 2010 and 2011. 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 distribution	Total catch (2011) = 6.5 kt (100% landings and no discard), where more than 99% of the landings were taken by the small-meshed trawl fleet. The fishery had 0.8 kt of by-catch of other species in 2011(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. A 2012 Inter-benchmark assessment revised the values for the natural mortality, maturity-at-age and weight-at-age used in the assessment. These parameters have impact on the predictions and estimates of the SSB because the stock consists of very few year classes.

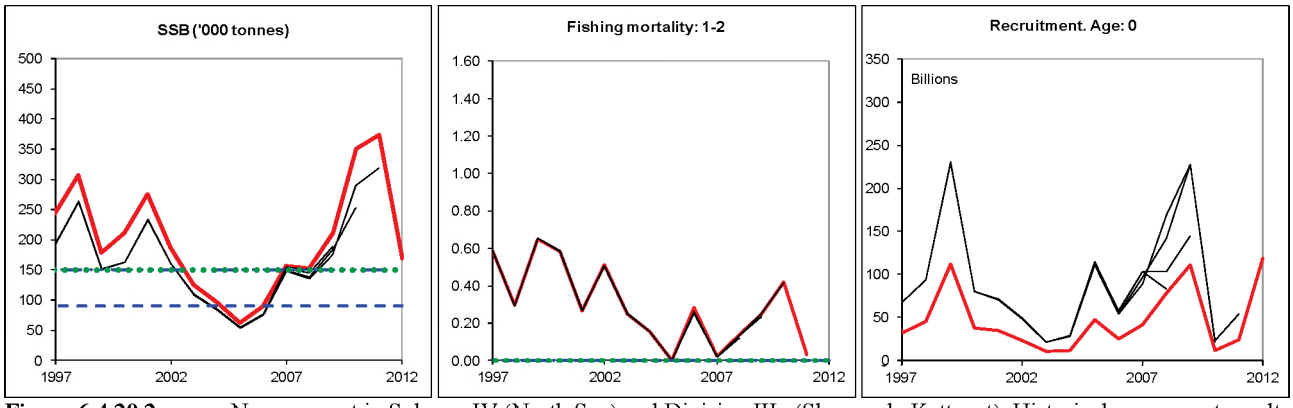


Figure 6.4.20.2 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Historical assessment results (final-year recruitment estimates included) for October advice. The difference in SSB and Recruitment levels is caused by the inter benchmark change of methodology in 2012.

Scientific basis

Assessment type	Age-based analytical (seasonal XSA).
Input data	Four research 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 rest of the year and next year. An Inter-benchmark assessment has been performed in spring 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 and 2013

New in-year advice for 2012 is presented that replaces the June 2012 advice. Two outlook options for 2013 are presented, considering if fisheries remains closed in 2012 (second table) or if fisheries is reopened (third table).

Advice for 2012 (in-year):

Basis: F (2012, Q1-Q2) = estimated from assessment = 0.002; F(2012, Q3)=0 (no fishery); R(2012) = observed recruitment (age 0 in 2nd quarter) from assessment = 118 billion; SSB (2012) = 169

Rationale	**Landings 2012**	**Basis**	**F 2012**	**SSB 2013**	**%SSB change[1)]**
MSY approach	101	MSY $B_{escapement}$	0.672	150	-11
Precautionary approach	101	B_{pa}	0.672	150	-11
Zero catch	0	No fishery	0.000	206	22
	243	B_{lim}	2.249	90	-47
	50	Fixed TAC strategy	0.298	177	5
	58	Fixed F strategy	0.35	173	2
	92	~max F last decade	0.6	155	-8

Weights in '000 tonnes.
[1)] SSB 2013 relative to SSB 2012.

Advice for 2013 assuming Catch 2012(Q3 and Q4)=0:

Basis: F (2012)= estimated from assessment (Q1+Q2)= 0.002 and no fishery (Q3+Q4) =0; R(2013) = 25 % percentile of long term recruitment (1983-2012) = 33 billion (2nd quarter); SSB (2013) = 205

Rationale	**Landings 2013**	**Basis**	**F 2013**	**SSB 2014**	**%SSB change[1)]**
MSY approach	458	MSY $B_{escapement}$	1.819	150	- 27
Precautionary approach	458	B_{pa}	1.819	150	- 27
Zero Catch	0	No fishery	0	463	126
	50	Fixed TAC Strat.	0.120	428	109
	135	Fixed F Strat.	0.35	368	80
	213	~max F last decade	0.6	314	53
	555	B_{lim}	2.759	90	- 49

Weights in '000 tonnes.
[1)] SSB 2014 relative to SSB 2013.

Advice for 2013 assuming Catch 2012(Q3 and Q4)=101 kt:

Basis: F (2012)= Catch constraint =0.67; R(2013) = 25 % percentile of long term recruitment (1983-2012) = 33 billion (2nd quarter); SSB (2013) = 150; landings (2012) = 101

Rationale	Landings 2013	Basis	F 2013	SSB 2014	%SSB change[1)]
MSY approach	393	MSY $B_{escapement}$	1.699	150	0
Precautionary approach	393	B_{pa}	1.699	150	0
Zero Catch	0	No fishery	0	421	181
	50	Fixed TAC Strat.	0.140	385	157
	118	Fixed F Strat.	0.35	337	125
	188	~max F last decade	0.6	288	92
	487	B_{lim}	2.649	90	- 40

Weights in '000 tonnes.
[1)] SSB 2014 relative to SSB 2013.

Advice for 2012 (in-year):

Management plans

No management plan is agreed at present. ICES evaluated and commented on three management strategies in 2007, none of which has been agreed for management. All management strategies were considered to be sustainable. Based on a new joint EU-Norway request, new management strategies were evaluated in September 2012 and considered to be consistent with the precautionary approach under certain constraints (ICES 2012b).

MSY approach

To maintain the spawning-stock biomass above MSY $B_{escapement}$ by January 1 2013, catches of no more than 101 000 t can be taken in 2012. This corresponds to F=0.67 in 2012.

PA approach

The precautionary approach corresponds to maintaining SSB above B_{pa} = MSY $B_{escapement}$ on January 1, 2013. Therefore, it is similar to the MSY approach for this species.

Advice for 2013:

Management plans

No management plan is agreed at present. ICES evaluated and commented on three management strategies in 2007, none of which has been agreed for management. All management strategies were considered to be sustainable. Based on a new joint EU-Norway request, new management strategies were evaluated in September 2012 and considered to be consistent with the precautionary approach under certain constraints (ICES 2012b).

MSY approach

Two catch options are provided for 2013, depending on the assumed catch for 2012.

If Catch(2012)=0: To maintain the spawning-stock biomass above MSY $B_{escapement}$ by January 1 2014, catches of no more than 458 000 t can be taken in 2013. This corresponds to F=1.82 in 2013.

If Catch(2012)=101 kt: To maintain the spawning-stock biomass above MSY $B_{escapement}$ by January 1 2014, catches of no more than 393 000 t can be taken in 2013. This corresponds to F=1.70 in 2013.

PA approach

The precautionary approach corresponds to maintaining SSB above B_{pa} = MSY $B_{escapement}$ on January 1, 2014. Therefore, it is similar to the MSY approach for this species.

Additional considerations

The TAC was not fully taken in 2008, 2009 and 2010, probably because of high fishing (fuel) costs in these years, as well as bycatch regulations in 2009 and 2010 (mainly in relation to whiting bycatch). The TAC of 6 kt in 2011 was fully taken.

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 (Nielsen *et al.*, 2012; Sparholt *et al.*, 2002a, 2002b; Lambert *et al.*, 2009). Furthermore, 20% 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.

An Inter-benchmark in spring 2012 (IBPNorwayPout, ICES 2012c) used revised estimates of natural mortality, maturity at age and mean weight at age in the assessment. The benchmark group did not recommend revised reference points for the stock at this stage, but concluded that higher escapement targets could be considered in the future based on the importance of Norway pout as a forage species in the ecosystem. The amount of Norway pout consumed by its main predators should be evaluated in relation to production in the Norway pout stock, taking into consideration the consumption and production of other prey species for those predators in the ecosystem.

Future benchmarks should evaluate the usefulness of including recent commercial fishery tuning time-series in the assessment from the Danish and Norwegian commercial fishery. This should take into consideration influence on cpue and targeting in the Norway pout fishery based on the several fishing closures (several real time management closures) in recent years, introduction of selective devices in recent years being different for Norwegian and Danish fishery, different targeting in Danish and Norwegian Norway pout fisheries (Norway pout, blue whiting), as well as yearly changes in fleet efficiency given changes in vessel sizes targeting Norway pout over time.

Mixed fisheries, bycatches and selective measures

Historically, the fishery includes bycatches, especially of haddock, whiting, saithe and herring. 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; Eigaard, Hermann and Nielsen, 2012). The use of sorting grids is now mandatory in both the Norwegian and EU fisheries for Norway pout.

Management plan evaluations

No management plan is agreed at present. With the present fishing mortality levels, the status of the stock is more determined by natural processes and less by the fishery.

ICES evaluated and commented on three management strategies in 2007, following requests from managers: fixed fishing mortality (0.35), fixed TAC (50 000 t) and a variable TAC escapement strategy. The evaluation showed 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 were, therefore, considered to be in accordance with the precautionary approach. The escapement strategy has a higher long-term average yield compared to 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 used.

Based on a new joint EU-Norway request in 2012, new long term management strategies were evaluated in September 2012 (ICES 2012b). The evaluation showed that a minimum fixed TAC of around 25-50 kt is possible only if future fishing mortality does not exceed a value of 0.6. Fishing mortality in the last decade is estimated to have been lower than 0.6.

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 are derived from survey data in years with limited fishery, but are similar to 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 north-western 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 perception of stock dynamics of the SSB, recruitment and average fishing mortality of ages 1 and 2 over time, are consistent with the estimates of the May 2012 assessment and the spring 2012 inter-benchmark assessment. Based on the Inter-Benchmark in spring 2012 with revised estimates of natural mortality, maturity at age and mean weight at age for the stock in the assessment, there is a consistent (over time) slight increase in SSB (because 20% of the age group 1 is considered mature compared to 10 % in previous assessments), and a consistent slight decrease in recruitment and total stock biomass, mainly because of the revised natural mortality by age and quarter compared to previous assessments. However, the perception of stock dynamics is similar in the 2012 assessment to previous assessments.

The basis for the advice this year is the MSY approach, similar to last year.

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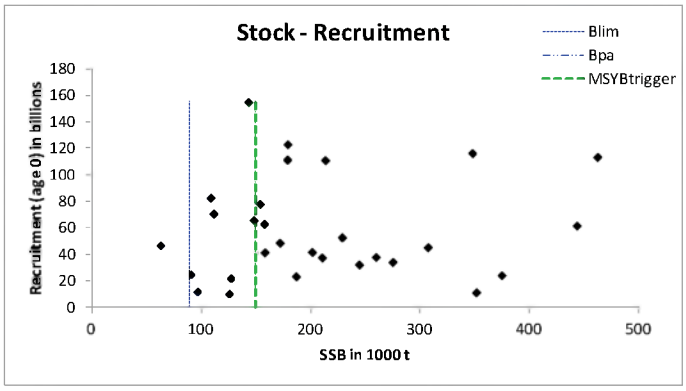


Figure 6.4.20.3 Norway pout in Subarea IV and Division IIIa. Stock-recruitment relationship.

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 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	0		
In year[4]	Maintain SSB > MSY $Be_{scapement}$	< 101			
2013	Maintain SSB > MSY $B_{escapement}$	< 458 ($Catch_{2012}$=0) < 393 ($Catch_{2012}$=101)			

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.
[4] In year advice was updated in autumn 2012.

Table 6.4.20.2 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	-
	2	-	-	-	-	-	-	-	-	-	188	188	188
	3	-	-	-	-	456	5	-	461	461	3.004	3.004	3.465
	4	-	-	-	-	2.853	-	-	2.853	2.853	18	18	2.871
	Total	-	-	-	-	3.309	5	-	3.314	3.314	3.210	3.210	6.524
2012	1	-	-	-	-	15	-	-	15	15	12	12	27
	2	-	-	-	-	-	-	-	-	-	281	281	281

Table 6.4.20.3 Norway pout in Subarea IV and Division IIIa. National landings (t) as officially reported to ICES, including bycatch of Norway pout in other (small-meshed) fisheries. Norwegian landing data include landings of bycatch of other species.

Norway pout Sub-area IV and IIIa (Skagerrak) combined

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Denmark	59,069	73,194	16,649	11,345	941***	39,943	2,056	32,558	19,825	71,541	4,072
Faroe Islands	49	3,379	2,374	1,159	24	0	0	0	0	0	0
Norway	17,158	23,753	11,387	4,994	311	13,622	4,712	6,650	37,252	65,634	3,210
Sweden	780	0	0	88	0	0	0	10	0	10	1
Netherlands	0	0	0	0	0	0	0	0	22	18	0
Germany	0	0	0	107	0	34	0	3	75	0	0
UK	0	0	0	0	0	0	0	0	0	0	0
Total nominal landings	77,056	100,326	30,410	17,693	1,252	53,599	6,768	39,221	57,174	137,203	7,283
By-catch of other species and other	-11,456	-20,326	-3,310	-4,193	-	-6,973	-	-3,083	-2,674	-11,248	-759
WG estimate of total landings (IV+IIIaN)	65,600	80,000	27,100	13,500	-	46,626	-	36,138	54,500	125,955	6,524
Agreed TAC	211,200	198,000	198,000	198,000	0****	95,000	0****	114,616	116,279	162,950	6,000

* provisional
** provisional
*** 781 ton from trial fishery (directed fishery); 160 ton from by-catches in other fisheries
**** A by-catch qouta of 5000 t has been set.
***** 681 t taken in trial fishery; 1300 t in by-catches in other (small meshed) fisheries.
\+ Landings less than 1
n/a not available

Table 6.4.20.4 Norway pout in Subarea IV and Division IIIa. Summary of stock assessment. Recruitment in quarter 2?

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1-2
1983	113729000	462497	457600	0.901
1984	61772000	443600	393010	1.284
1985	41883000	201601	205100	1.334
1986	83028000	108833	174300	1.112
1987	22183000	127454	149300	0.906
1988	66138000	148293	109300	0.661
1989	71030000	111540	166400	0.833
1990	63337000	157886	163300	0.760
1991	123215000	179281	186600	0.894
1992	52958000	228984	296800	0.934
1993	38095000	259868	183100	0.842
1994	155230000	143501	182000	1.074
1995	48855000	172098	236800	0.587
1996	116592000	347965	163800	0.448
1997	32398000	244569	169700	0.590
1998	45579000	307495	57700	0.299
1999	111690000	178881	94500	0.651
2000	37797000	210543	184400	0.585
2001	34394000	275153	65600	0.266
2002	23469000	186995	80000	0.512
2003	10497000	125735	27100	0.248
2004	12204000	96801	13500	0.156
2005	47148000	63034	1900	0.000
2006	25057000	90814	46600	0.286
2007	41620000	158201	5700	0.025
2008	78354000	153989	36100	0.137
2009	111262000	213553	54500	0.250
2010	11412000	351608	126000	0.421
2011	24356000	374920	6500	0.034
2012	118279000	169328		
Average	60785367	209834	139214	0.587

ECOREGION North Sea
STOCK Sandeel in Division IIIa and Subarea IV

Introduction

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). Generic information is given below, the advice for sandeel in each of the seven areas is given separately in Sections 6.4.21.1–7.

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 areas	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

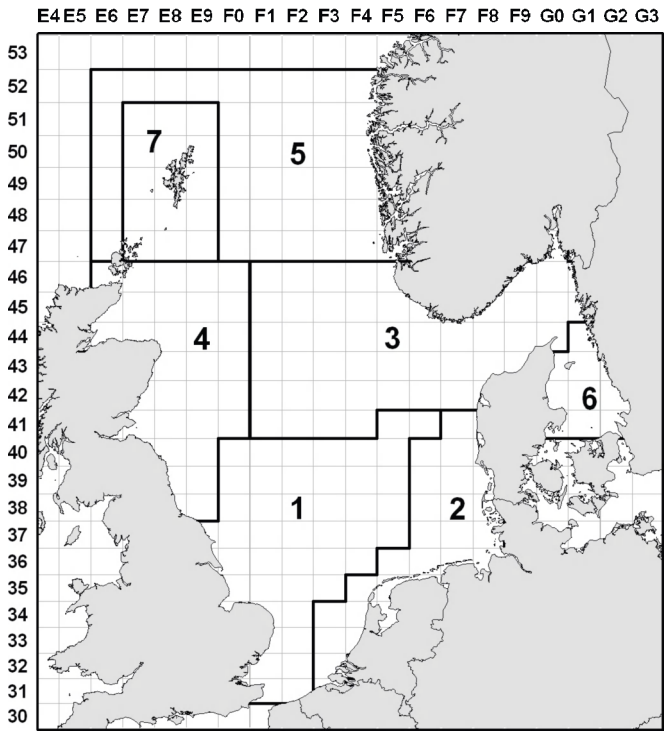


Figure 6.4.21.1 Sandeel in Division IIIa and Subarea IV. Map of Sandeel Areas (SA).

Summary of advice for 2012

An overview of the advice per SA can be found in Table 6.4.21.1.

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	EC zone TAC	NOR zone TAC	ICES landings
2005 [1]	-	-	-	-	-	No advice	No advice	661	10 [2]	177
2006 [1]	-	-	-	-	-	No advice	No advice	300	0	293
2007 [1]	-	-	-	-	-	No advice	No advice	173	51	230
2008 [1]	-	-	-	-	-	No advice	No advice	375	128	348
2009 [1]	-	-	-	-	-	No advice	No advice	377	0	353
2010	-	-	-	-	-	No advice	No advice	377	50	414
2011	< 320	< 34	0	5–10	No increase in effort unless there is evidence that this is sustainable.			374	90	438 [3]
2012	< 23	< 5	< 5	< 5	No increase in catches unless there is evidence that this is sustainable.			200	42	

Weights in '000 t.
[1] Advice for Subarea IV excluding the Shetland area.
[2] TAC set for EC fisheries 10 kt, seasonal effort limitations set for Norwegian fisheries.
[3] Preliminary.

Dredge survey information for December has been available since 2010 and was used to estimate annual recruitment and conduct forecasts for SAs 1, 2, and 3. A dredge survey is also available for SA 4, but at present there is not enough overlap with fishery data to provide a forecast. Trend-based advice is provided for the remaining three areas.

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 has been provided for seven areas to better reflect the stock structure and to enable management to take action to avoid 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 for each area's advice.

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 an important prey for many predators, including fish, marine mammals, and seabirds. Changes in the abundances of those predators will 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* which 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, *Ammodytes marinus* (Wright and Bailey, 1996; van Deurs *et al.*, 2009).

The fisheries

Sandeel is taken by trawlers using small-meshed 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 retain a stock that is sufficient for successful recruitment and which can also provide an adequate resource for predators of sandeel (ICES, 2010).

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 to fishing in May and June of each year to monitor the stock.

The sandeel stocks are not managed jointly by the coastal states. Since 2004, the sandeel catch advice provided by ICES has been based on the abundance of 1-group sandeel, as estimated from an exploratory fishery in the beginning of the fishing season (years 2004–2010) or from a dredge survey in November/December of the previous year (beginning with 2011 advice). Norway has implemented an experimental area-based sandeel management plan in the Norwegian EEZ since 2010, and regulations in the Norwegian EEZ have differed from those in the EU EEZ.

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 fishery subsequently ceased.

Uncertainties in assessment and forecast

The quality of the current assessment is considered much improved compared to the combined assessment for the whole North Sea as conducted before 2010. This is because the stock assessment areas used since 2010 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 Sandeel 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 (ICES, 2010).

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 prior to 2011 are only available from the Danish fishery (which also has the largest catches) and only few observations in the 2011 data can be used to estimate national differences in catchability.
- Age and length sampling uncertainty, in particular in the less sampled Norwegian EEZ.
- There are apparent differences in recruitment between the Norwegian EEZ and the rest of SA 3.
- Assumption that the maturity pattern in the forecast year is the long-term average.

Comparison with previous assessment and advice

For all SAs covered by dredge surveys, the 2011 surveys confirmed the estimates of the 2010 year classes and indicated a similar situation concerning the 2011 year classes.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

van Deurs, M., van Hal, R., Tomczak, M. T., Jónasdóttir, S. H., and 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., and 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.

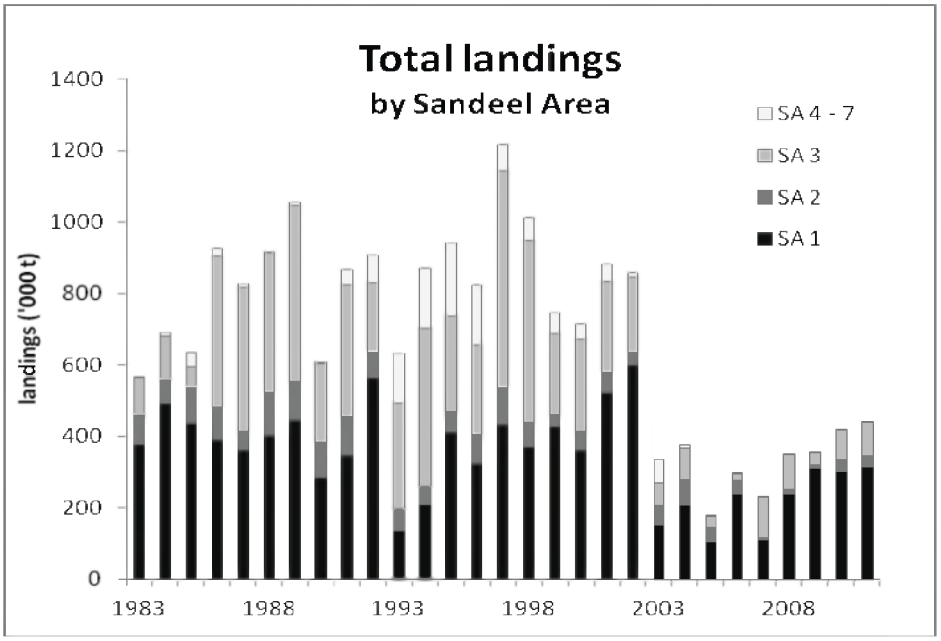


Figure 6.4.21.2 Sandeel in Division IIIa and Subarea IV. Total landings by SA ('000 tonnes).

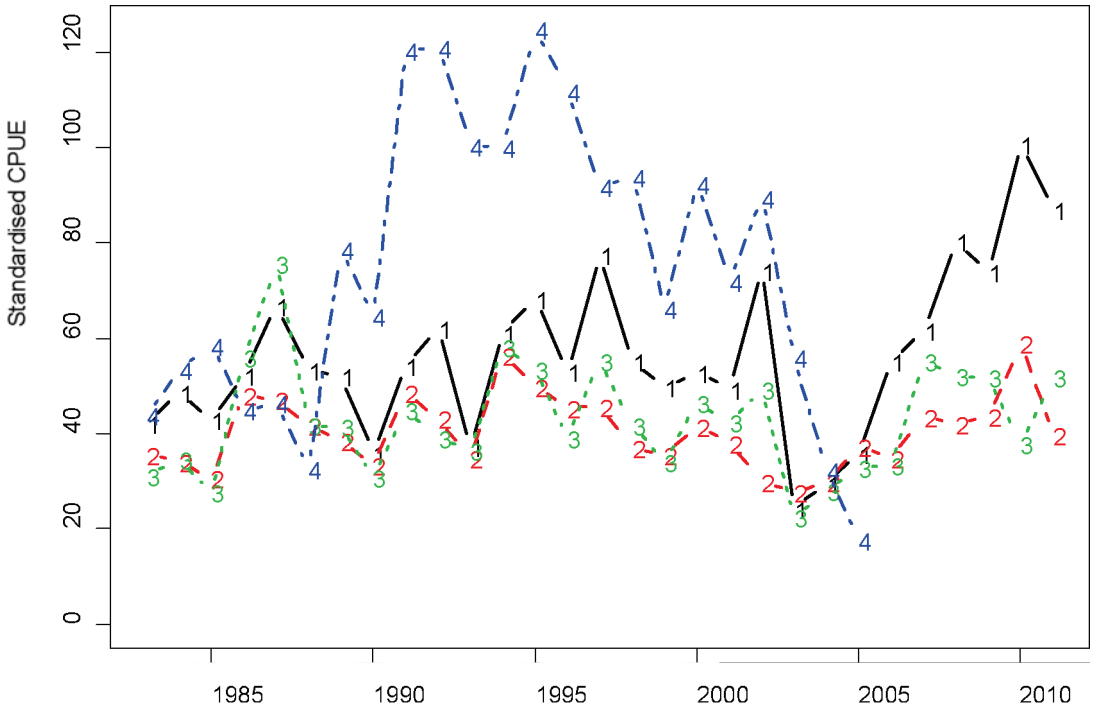


Figure 6.4.21.3 Sandeel in Division IIIa and Subarea IV. Catch (tonnes) per day fishing for a standardized 200 GT vessel for SAs 1–4. Figure labels correspond to SA numbers.

Table 6.4.21.2 Sandeel in Division IIIa and Subarea IV. Total landings (tonnes) by SA as 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	377558	80482	105974	2796	0	0	0	566810
1984	491950	66352	123639	2570	6587	0	0	691098
1985	436214	99428	59090	38123	3004	0	0	635858
1986	389081	94604	420304	12706	11277	0	0	927973
1987	360867	53761	403897	8179	1713	0	0	828417
1988	401551	121394	391050	1335	0	0	0	915330
1989	445586	109691	492395	4384	3353	909	0	1056318
1990	283259	100960	219103	3314	374	499	0	607508
1991	346621	107663	368324	41372	3697	17	0	867694
1992	564285	69848	195733	68905	4554	4277	0	907600
1993	136538	59820	296118	133136	666	4490	0	630768
1994	209631	50648	444084	159789	2765	3748	0	870666
1995	410687	60143	266720	52759	150637	1830	0	942776
1996	324561	80205	250252	162338	6176	1263	0	824796
1997	431871	102730	608164	59353	11279	2373	2068	1217839
1998	371060	68950	507269	58460	2984	936	5182	1014841
1999	428307	32117	228163	53959	140	134	4263	747083
2000	363356	52235	256250	37748	325	680	4370	714964
2001	521724	58645	253088	47828	1687	312	976	884260
2002	599585	35553	209344	12213	10	2378	521	859604
2003	150711	56262	62569	64002	44	869	261	334718
2004	206696	71426	87695	6915	0	570	0	373302
2005	103777	41447	29667	1486	0	262	0	176640
2006	238296	35392	18867	85	0	161	0	292802
2007	109363	5910	113905	11	4	661	0	229855
2008	238523	13065	94576	1201	0	472	0	347836
2009	308596	10177	33889	0	0	260	0	352922
2010	301306	31746	80725	273	0	132	0	414183
2011	311795	30264	94941	270	0	490	0	437761
arith. mean	340116	62101	231579	35707	7285	956	608	678352

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
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	282.9	-	1.4	-	-	17.2	1.1	4.2	-	306.8
1974	432.0	-	6.4	-	-	78.6	0.2	15.5	-	532.7
1975	372.0	-	4.9	-	-	54.0	0.2	13.6	-	444.7
1976	446.1	-	-	-	-	44.2	0.1	18.7	-	509.1
1977	680.4	-	11.4	-	-	78.7	6.1	25.5	-	802.1
1978	669.2	-	12.1	-	-	93.5	2.3	32.5	-	809.7
1979	483.1	-	13.2	-	-	101.4	-	13.4	-	611.1
1980	581.6	-	7.2	-	-	144.8	-	34.3	-	767.9
1981	523.8	-	4.9	-	-	52.6	-	46.7	-	628.1
1982	528.4	-	4.9	-	-	46.5	0.4	52.2	-	632.4
1983	515.2	-	2.0	-	-	12.2	0.2	37.0	-	566.8
1984	618.9	-	11.3	-	-	28.3	-	32.6	-	691.1
1985	601.7	-	3.9	-	-	13.1	-	17.2	-	635.9
1986	832.7	-	1.2	-	-	82.1	-	12.0	-	928.0
1987	609.2	-	18.6	-	-	193.4	-	7.2	-	828.4
1988	708.8	-	15.5	-	-	185.1	-	5.8	-	915.3
1989	841.6	-	16.6	-	-	186.8	-	11.5	-	1056.3
1990	512.1	-	2.2	-	0.3	88.9	-	3.9	-	607.5
1991	726.5	-	11.2	-	-	128.8	-	1.2	-	867.7
1992	803.7	-	9.1	-	-	89.3	0.6	4.9	-	907.6
1993	533.4	-	0.3	-	-	95.5	-	1.5	-	630.8
1994	688.6	-	10.3	-	-	165.8	-	5.9	-	870.7
1995	672.6	-	-	-	-	263.4	-	6.7	-	942.8
1996	649.5	-	5.0	-	-	160.7	-	9.7	-	824.8
1997	831.8	-	11.2	-	-	350.1	-	24.6	-	1217.8
1998	628.2	-	11.0	-	+	343.3	8.6	23.8	-	1014.8
1999	511.3	-	13.2	0.4	+	187.6	23.2	11.5	-	747.1
2000	557.3	-	-	-	+	119.0	28.6	10.8	-	715.7
2001	650.0	-	-	-	-	183.0	50.0	1.3	-	884.3
2002	659.5	-	-	-	-	176.0	19.2	4.9	-	859.6
2003	282.8	-	-	-	-	29.6	21.8	0.5	-	334.7
2004	288.8	2.7	-	-	-	48.5	33.3	+	-	373.3
2005	158.9	-	-	-	-	17.3	0.5	-	-	176.6
2006	255.4	3.2	-	-	-	5.6	27.9	-	-	292.8
2007	166.9	1.0	2.0	-	-	51.1	7.9	1.0	-	229.9
2008	246.9	4.4	2.4	-	-	81.6	12.5	-	-	347.8
2009	293.0	12.2	2.5	-	1.8	27.4	12.4	3.6	2.0	352.9
2010	285.9	13.0	-	-	-	78.0	32.7	4.0	0.6	414.2
2011	278.5	9.8	-	-	-	109.0	32.7	6.1	1.7	437.8

+ = less than half a unit.
- = no information or no catch.

ECOREGION North Sea
STOCK Sandeel in the Dogger Bank area (SA 1)

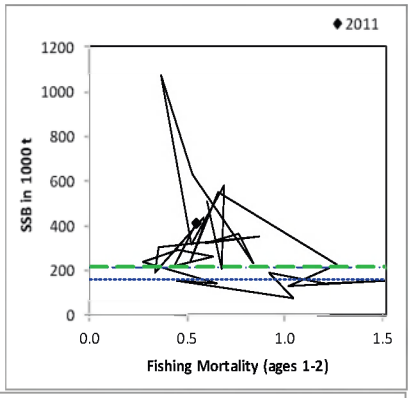
Advice for 2012

ICES advises on the basis of the MSY approach that the catch in 2012 should be no more than 23 000 t to maintain SSB in 2013 above MSY $B_{escapement}$. This value could be updated if analysis of real-time monitoring becomes available.

Stock status

F (Fishing Mortality)	2009	2010	2011
MSY (F_{MSY})	?	?	? Undefined
Precautionary approach (F_{pa}, F_{lim})	?	?	? Undefined

SSB (Spawning-Stock Biomass)	2010	2011	2012
MSY ($B_{escapement}$)	✓	✓	✓ Above escapement level
Precautionary approach (B_{pa}, B_{lim})	✓	✓	✓ Full reproductive capacity



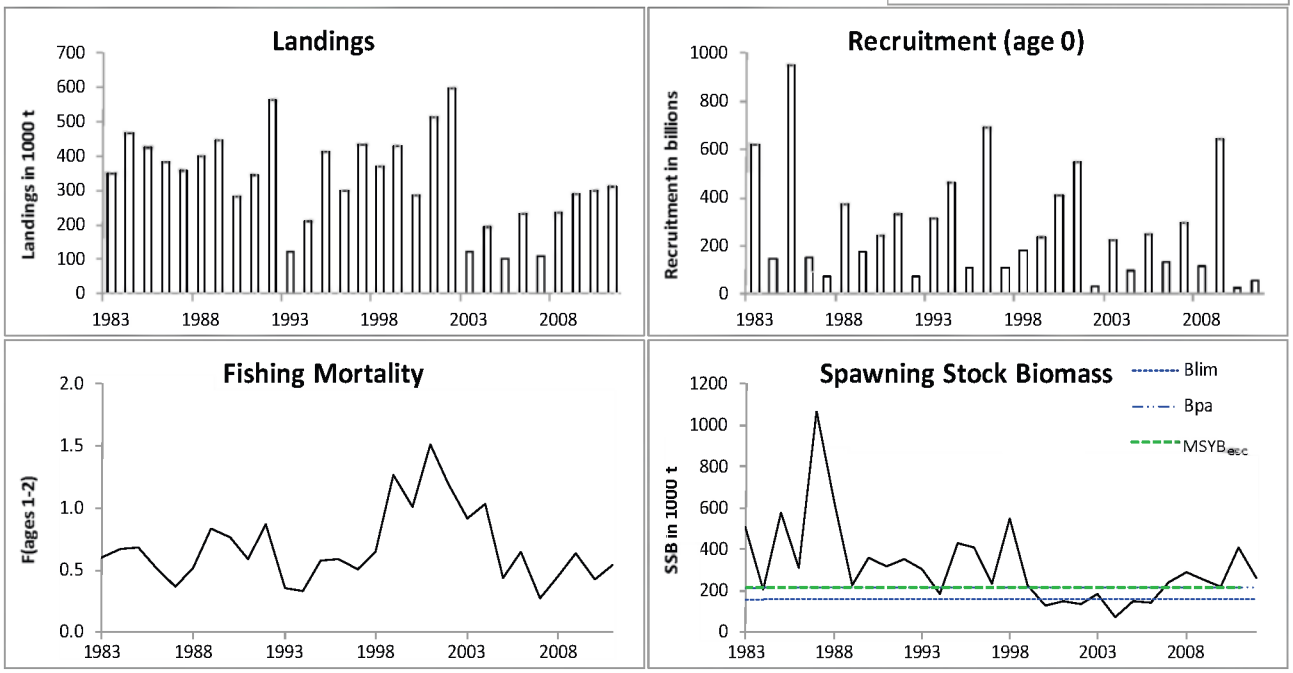


Figure 6.4.21.1.1 Sandeel in the Dogger Bank area (SA 1). Summary of stock assessment (weights in '000 t). Top right: SSB and F over the years.

The stock at the start of 2012 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. Recruitment was very low in both 2010 and 2011, and the combined recruitment of these two years is the lowest combined value of any two consecutive years in the time-series.

Management plans

No specific management objectives are known to ICES.

Fisheries

Catch distribution	Total landings (2011): 312 kt, where 100% were landings by industrial fisheries.

Quality considerations

The quality of the assessment is considered to be good. Hard weather conditions were experienced during the 2011 survey, although it is unclear whether this has affected the results. The assessment relies heavily on the assumption that the fisheries selection pattern is the same since 1999 and that the commercial fishery supplies sufficient sampling information on older age groups (which are not caught representatively in the dredge survey). If a change in the fishing pattern occurred, this would make the current advice less accurate.

Scientific basis

Assessment type	Seasonal age-based analytical (SMS-effort).
Input data	One survey index in December (dredge survey since 2004). Total international fishing effort
Discards and bycatch	Not included in the assessment, but discards are considered to be negligible.
Indicators	None.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	WGNSSK

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 2012

Basis: F(2011) = sum of half yearly Fs = 0.45; Yield(2011) = 311; Recruitment(2011) = 55 billion; Recruitment(2012) = geometric mean (GM 83–10) = 204 billion; SSB(2012) = 268.

Rationale	**Landings (2012)**	**Basis**	**F (2012)**	**SSB (2013)**	**%SSB change[1]**
MSY-approach	23	MSY	0.09	215	−20%
Zero catch	0	F=0	0	231	−14%
Other options	28	F_{2011}*0.25	0.11	212	−21%
	53	F_{2011}*0.5	0.22	195	−27%
	77	F_{2011}*0.75	0.34	180	−33%
	98	F_{2011}*1	0.45	166	−38%
	118	F_{2011}*1.25	0.56	153	−43%
	197.5	F_{2011}*2.5	1.12	103	−62%

Weights in '000 t.
[1)] SSB 2013 relative to SSB 2012.

MSY approach

Following the ICES MSY framework for a short-lived species the fishery in 2012 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of no more than 23 000 t in 2012.

The preliminary TAC set by the EU for SA 1 in 2012 (197 500 t) is expected to lead to an SSB at 64% of B_{lim} in 2013.

Additional considerations

Uncertainties in assessment and forecast

The dredge survey results are sufficiently robust to provide a reliable estimate of the incoming 1-group. Hence, fishing opportunities for 2012 can be established based on this information. However, the bad weather conditions during the 2011 survey and the very low recruitment value observed may indicate the relevancy of an analysis of real-time monitoring for 2012.

The value assumed for recruitment in 2012 has very little impact on the catch advice for 2012, since its contribution to catch in 2012 and SSB in 2013 is minimal.

Management plans

A management plan needs to be developed. The ICES approach for MSY-based management of a short-lived species like sandeel is an escapement strategy, i.e. to maintain SSB above MSY $B_{escapement}$ after the fishery has taken place. This does not include an upper limit on F. However, taking the historical F and stock development into account, an F value

above 0.6 can probably not be recommended in any year. As effort is assumed proportional to F, a management plan could include an upper limit on effort estimated on the basis of the effort applied in 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. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

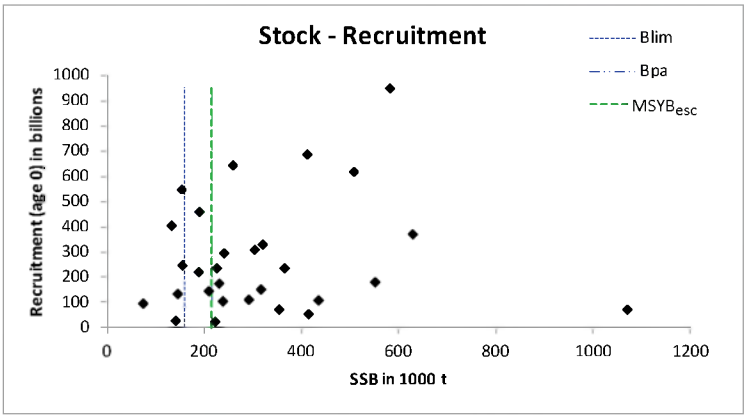


Figure 6.4.21.1.2 Sandeel in the Dogger Bank area (SA 1). Stock–recruitment plot.

Table 6.4.21.1.1 Sandeel in the Dogger Bank area (SA 1). ICES advice, management, and landings.

Year	ICES Advice	Catch corresponding to advice	TAC	ICES landingsSA 1	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 [2]	104	177
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 [2]	238	293
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 [2]	109	230
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.	-	375 [2]	239	348
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.	-	377 [2]	309	353
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.	-	377 [2]	301	414
2011	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 320	320	312 [3]	438 [3]
2012	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 23	197.5		

Weights in '000 t.
[1] Advice for Subarea IV excluding the Shetland area.
[2] Set for EC waters of Divisions IIa and IIIa and Subarea IV.
[3] Preliminary.

Table 6.4.21.1.2 Sandeel in the Dogger Bank area (SA 1). Summary of the assessment.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1–2
1983	618936000	506903	349232	0.598
1984	146686000	207960	467609	0.677
1985	950453000	580735	424114	0.686
1986	153171000	315338	382735	0.519
1987	72911000	1068990	357671	0.365
1988	372528000	627683	398271	0.524
1989	176723000	229109	445695	0.835
1990	238093000	364033	283040	0.761
1991	331319000	319061	347096	0.593
1992	73712000	352543	564298	0.867
1993	310167000	302297	124082	0.353
1994	461180000	188752	209538	0.332
1995	111006000	433700	410513	0.580
1996	688518000	410379	298702	0.591
1997	106629000	237276	431808	0.514
1998	182075000	550266	371117	0.654
1999	237703000	224556	427691	1.267
2000	406192000	131603	284521	1.015
2001	548790000	152634	513068	1.516
2002	28747000	139917	596049	1.203
2003	222248000	186983	121863	0.915
2004	97766000	72600	195274	1.040
2005	248770000	153354	100835	0.443
2006	135982000	143683	231448	0.652
2007	296534000	239449	108600	0.273
2008	113366000	290346	237447	0.453
2009	644801000	258325	291247	0.633
2010	25384000	221518	300954	0.431
2011	55481000	413173	311134	0.543
2012		265887*		
Average	277788655	319635	330540	0.684

*Mean weight-at-age from 2011.

ECOREGION North Sea
STOCK Sandeel in the South Eastern North Sea (SA 2)

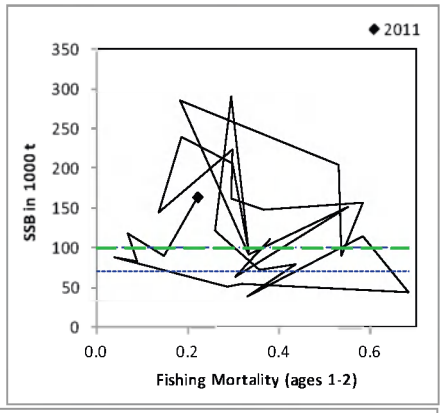
Advice for 2012

ICES advises on the basis of the MSY approach that fishery should only be allowed in 2012 if analysis of real-time monitoring is available and indicates that the stock can be rebuilt to B_{pa} by 2013. Catches for monitoring purposes should not exceed 5000 t.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa}, F_{lim})	?	?	?	Undefined

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{escapement}$)	✗	✓	✗	Below escapement level
Precautionary approach (B_{pa}, B_{lim})	o	✓	o	Increased risk



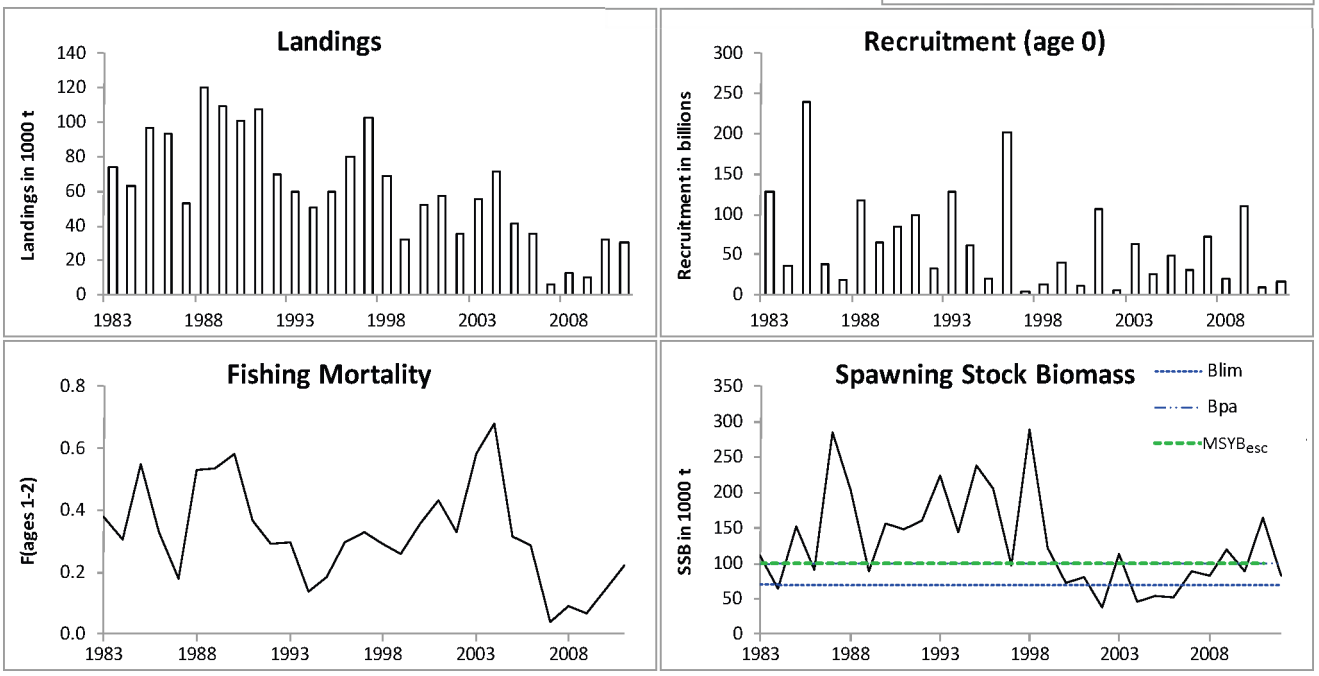


Figure 6.4.21.2.1 Sandeel in the South Eastern North Sea (SA 2). Summary of stock assessment (weights in '000 t). Top right: SSB and F over the years.

Due to low values of F (~ 0.1) during 2007–2010 and the strong 2009 year class, SSB in 2011 is estimated around twice as high as B_{pa}. SSB in 2012 has dropped below B_{pa} again. Recruitment is very low in both 2010 and 2011.

Management plans

No specific management objectives are known to ICES.

Fisheries

Catch distribution	Total landings (2011): 30 kt, where 100% were landings by industrial fisheries.

Quality considerations

The assessment relies heavily on the assumption that the fisheries selection pattern has remained the same since 1999 and that the commercial fishery supplies sufficient sampling information on older age groups. A change in the fishing pattern would make the current advice less accurate. The assessment is considered to be of medium quality, but will be further improved once a longer time-series of dredge survey catches from SA 2 (currently only available for 2010 and 2011) exists. Hard weather conditions were experienced during the 2011 survey in SA 1 (used in this assessment), although it is unclear whether this has affected the results.

Scientific basis

Assessment type	Seasonal age-based analytical (SMS-effort).
Input data	One survey index (dredge survey since 2004) from SA 1 is applied. Total international fishing effort.
Discards and bycatch	Not included in the assessment, but discards are considered to be negligible.
Indicators	None.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	WGNSSK

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 2012

Basis: F(2011) = sum of half yearly Fs = 0.19; Yield(2011) = 30; Recruitment(2011) = 17 billion; Recruitment(2012) = geometric mean (GM 83–10) = 42 billion; SSB(2012) = 87.

Rationale	Landings (2012)	Basis	F (2012)	SSB (2013)	%SSB change[1]
Zero catch	0	F=0	0	69	−21%
Other options	5	F_{2011}*0.25	0.05	66	−24%
	9	F_{2011}*0.5	0.09	63	−27%
	14	F_{2011}*0.75	0.14	60	−30%
	18	F_{2011}*1	0.19	58	−34%
	22	F_{2011}*1.25	0.23	55	−36%

Weights in '000 t.
[1)] SSB 2013 relative to SSB 2012.

MSY approach

Following the ICES MSY framework for a short-lived species, the fishery in 2012 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of 0 t in 2012 unless analysis of real-time monitoring is available and indicates that the stock can be rebuilt to B_{pa} by 2013. Catches for monitoring purposes should not exceed 5000 t.

In order to present an assessment, information on catch composition and catch per unit effort is required. The advice of a maximum of 5000 t in monitoring fisheries should provide sufficient samples and, thus, reliable estimates. This catch would result in a SSB of 94% of B_{lim} in 2013 (as opposed to 99% of B_{lim} with 0 catch).

Additional considerations

Uncertainties in assessment and forecast

There appears to be a sufficiently robust relationship between the recruitments in SA 1 and 2 (SA 1 and 2) to be able to apply the data sources and procedures from SA 1 to estimate the incoming year-class strength in SA 2 as well. The dredge survey was expanded in 2010 to cover SA 2. The bad weather conditions during the 2011 survey in SA 1 (used in this assessment) and the very low recruitment value observed may indicate the relevancy of an analysis of real-time monitoring for 2012.

The value assumed for recruitment in 2012 has very little impact on the catch advice for 2012, since its contribution to catch in 2012 and SSB in 2013 is minimal.

Management plans

A management plan needs to be developed. The ICES approach for MSY based management of a short-lived species such as sandeel is an escapement strategy, i.e. to maintain SSB above MSY $B_{escapement}$ after the fishery has taken place. This 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, assuming that fishing mortality is 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. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

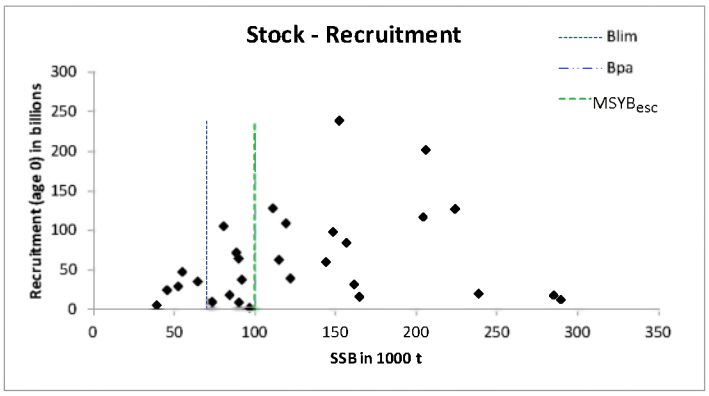


Figure 6.4.21.2.2 Sandeel in the South Eastern North Sea (SA 2). Stock–recruitment plot.

Table 6.4.21.2.1 Sandeel in the South Eastern North Sea (SA 2). ICES advice, management, and landings.

Year	ICES Advice	Catch corresponding to advice	TAC	ICES landingsSA 2	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 [2]	41	177
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 [2]	35	293
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 [2]	6	230
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.	-	375 [2]	13	348
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.	-	377 [2]	10	353
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.	-	377 [2]	32	414
2011	MSY approach: allow for sufficient stock ($MSY\ B_{escapement}$) to remain for successful recruitment.	< 34	34	30 [3]	438 [3]
2012	Catches for monitoring purposes should not exceed 5 000 t.	< 5	0		

Weights in '000 t.

[1] Advice for Subarea IV excluding the Shetland area.

[2] Set for EC waters of Divisions IIa and IIIa and Subarea IV.

[3] Preliminary.

Table 6.4.21.2.2 Sandeel in the South Eastern North Sea (SA 2). Summary of the assessment.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1–2
1983	128696000	110575	74481	0.379
1984	36492000	64022	63046	0.304
1985	239358000	151794	96645	0.550
1986	38621000	91455	93146	0.332
1987	18683000	284555	53284	0.182
1988	117693000	203883	120382	0.530
1989	65416000	89452	109703	0.536
1990	85143000	156274	100917	0.582
1991	98664000	147939	107795	0.366
1992	32608000	161011	69825	0.294
1993	128011000	223413	59652	0.298
1994	60949000	143657	50656	0.137
1995	20933000	238136	60138	0.186
1996	202269000	205280	80012	0.297
1997	3107000	96146	102726	0.332
1998	13246000	289136	68953	0.293
1999	40460000	121446	32108	0.258
2000	10520000	73052	52228	0.357
2001	106072000	80120	56934	0.434
2002	6558000	38788	35494	0.331
2003	63637000	114424	55924	0.582
2004	25458000	45085	71413	0.681
2005	48594000	54495	41420	0.318
2006	30148000	52025	35351	0.287
2007	72729000	88030	5911	0.040
2008	19296000	83802	13064	0.089
2009	109935000	118688	10240	0.069
2010	10150000	89623	31747	0.147
2011	16951000	164185	30259	0.220
2012		83007*		
Average	63806793	128783	61498	0.325

*Mean weight-at-age from 2011.

ECOREGION North Sea
STOCK Sandeel in the Central Eastern North Sea (SA 3)

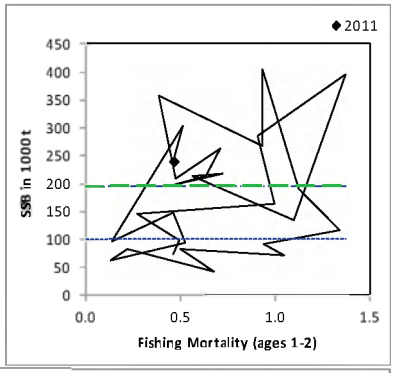
Advice for 2012

ICES advises on the basis of the MSY approach that fishery should only be allowed in 2012 if analysis of real-time monitoring is available and indicates that the stock can be rebuilt to B_{pa} by 2013. Catches for monitoring purposes should not exceed 5000 t.

Stock status

F (Fishing Mortality)	2009	2010	2011
MSY (F_{MSY})	?	?	? Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	? Undefined

SSB (Spawning Stock Biomass)	2010	2011	2012
MSY ($B_{escapement}$)	✓	✓	✗ Below escapement level
Precautionary approach (B_{pa},B_{lim})	✓	✓	o Increased risk



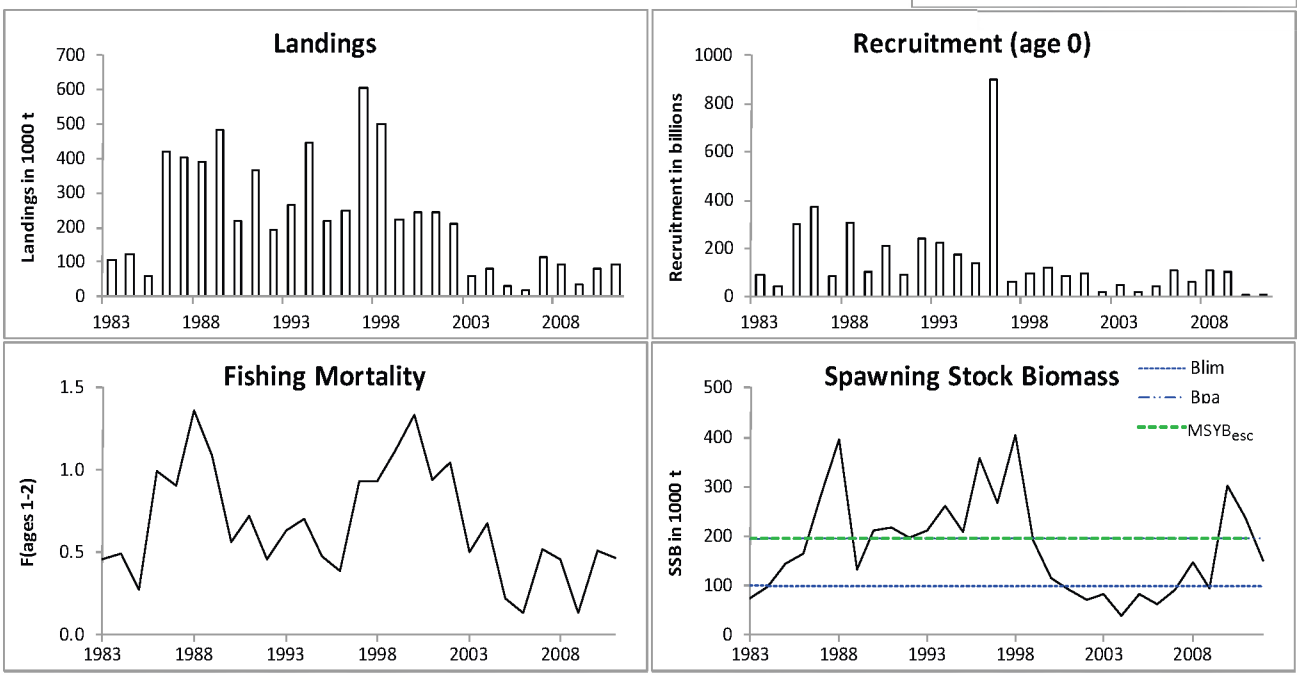


Figure 6.4.21.3.1 Sandeel in the Central Eastern North Sea (SA 3). Summary of stock assessment (weights in '000 tonnes). Top right: SSB and F over the years.

Since 2005, F has been variable between years but below the long-term mean. The stock has increased from a record low SSB in 2004 (at half of B_{lim}) to above B_{pa} in 2010, but SSB has since declined and is below B_{pa} in 2012. Recruitment in 2010 and 2011 corresponds to the two lowest historical values. The combined recruitment of these two years is less than a quarter of the next lowest combined value of any two consecutive years in the time-series.

Management plans

An experimental sandeel management plan has been applied in the Norwegian EEZ since 2010. This management plan has not been evaluated by ICES.

The fisheries

Catch distribution	Total landings (2011): 95 kt, where 100% were landings by industrial fisheries.

Quality considerations

The quality of the assessment for SA 3 is considered to be less than the assessments for SA 1 and SA 2. The dredge survey only covers the southern part of SA 3. Hard weather conditions were experienced during the 2011 survey, although it is unclear whether this has affected the results. There have been substantial differences in management in the past 5 years between the EU and Norwegian EEZs, potentially changing the selection pattern of the overall fishery (since age distributions seem to differ between the two EEZs). This raises questions regarding the reliability of a common assessment, as the current assessment relies heavily on the assumption of a constant selection pattern and on the commercial fishery supplying sufficient sampling information on the older age groups.

Scientific basis

Assessment type	Seasonal age-based analytical (SMS-effort).
Input data	One survey index available in January (dredge survey since 2004). Total international catch and effort.
Discards and bycatch	Not included in the assessment, but discards are considered to be negligible.
Indicators	None.
Other information	Last benchmark in 2010 (WKSAN, 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 2012

Basis: F(2011) = sum of half yearly Fs = 0.38; Yield(2011) = 95; Recruitment(2011) = 6 billion; Recruitment(2012) = geometric mean (GM 83–10) = 99 billion; SSB(2012) = 120.

Rationale	**Landings (2012)**	**Basis**	**F (2012)**	**SSB (2013)**	**%SSB change[1]**
Zero catch	0	F=0	0	90	−25%
Other options	5	F_{2011}*0.25	0.09	86	−28%
	10	F_{2011}*0.5	0.19	83	−31%
	15	F_{2011}*0.75	0.28	80	−33%
	19	F_{2011}*1	0.38	77	−36%
	28	F_{2011}*1.5	0.57	71	−40%
	42	F_{2011}*2.5	0.94	62	−48%

Weights in '000 t.
[1)] SSB 2012 relative to SSB 2013.

MSY approach

Following the ICES MSY framework for a short-lived species, the fishery in 2012 should retain a stock (MSY $B_{escapement}$) that is sufficient for successful recruitment. This implies a zero catch in 2012 unless analysis of real-time monitoring is available and indicates that the stock can be rebuilt to B_{pa} by 2013. Catches for monitoring purposes should not exceed 5000 t.

In order to present an assessment, information on catch composition and catch per unit effort is required. The advice of a maximum of 5000 t in monitoring fisheries should provide sufficient samples and, thus, reliable estimates. This catch would result in a SSB at 86% of B_{lim} in 2013 (as opposed to 90% with zero catch).

Management plan

Based on the Norwegian national management plan a TAC for the Norwegian EEZ of SA 3 was set at 42 000 t in 2012. This is expected to lead to a SSB at 62% of B_{lim} in 2013. This experimental management plan has been applied in the Norwegian zone since 2010 and is based on geographical areas that are opened and closed on alternate years, with an area opened only if the spawning stock is estimated by the national institute to be large and widely distributed within it. The main objective of the plan is to rebuild the spawning stock and to increase the total recruitment and catch potential.

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 for the period prior to 2011. Norwegian fishing effort has therefore been estimated on the basis of Norwegian landings and the assumption that Danish and Norwegian cpue are similar. Data from both countries were included in the 2011 assessment, but because of lack of spatial overlap between the two fleets in SA 3, only data from SA 1 were used to estimate the difference in catchability between countries. A time-series of observed Norwegian effort and a series of logbook observations overlapping in time and space would 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 fishers having limited 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 purposes. The coverage was increased to include the Skagerrak in 2011, but additional data are needed to produce a time-series. The dredge survey shows a large difference in annual recruitment between the Norwegian EEZ and the remainder of SA 3. Similar differences in age distribution are observed in the catches.

The recruitment value assumed for 2012 has very little impact on the catch advice for 2012, since its contribution to catches in 2012 and SSB in 2013 is minimal.

Management considerations

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) should continue in SA 3. The quality (internal and external consistency) of the acoustic survey in the Norwegian EEZ is not yet fully investigated and the dredge survey results in SA 3 are less consistent than in the other SAs (ICES, 2010). The survey indices for the 2010 and 2011 year classes are very low and outside the range of previously observed values; this is likely to reflect very low recruitment in SA 3. The bad weather conditions during the 2011 survey and the very low recruitment value observed could make analysis of real-time monitoring relevant this year.

Sandeel in SA 3 is not jointly managed between EU and Norway. The Norwegian national TAC for 2012 is 42 000 t to be taken from within four management subareas in the Norwegian EEZ part of SA 3. Other areas in the Norwegian EEZ part of SA 3 will remain closed. The Norwegian experimental management plan has been fully implemented in 2011. Based on historical fishing patterns and local stock developments six areas (five are located in SA 3, the sixth one is in SA 5) were defined, each divided into two subareas. The main objective of the plan is to rebuild the spawning stock in all six areas, thereby increasing the total recruitment and catch potential. Acoustic surveys and commercial information are used to estimate the abundance, age structure, and geographical distribution within each area. If the sandeel spawning stock is large and widely distributed in an area, one of its two subareas will be open. The other subarea will be open in the subsequent year if the spawning stock remains strong. The two subareas are never open in the same year. A preliminary TAC is given for the open subareas where the fleet can fish. The updated acoustic survey results in April/May are used to give in-season advice. ICES has not evaluated the Norwegian management plan.

The differences in management between the EU and Norwegian EEZs seen in recent years raise questions regarding the reliability of a common assessment, as the current assessment relies heavily on the assumption of a constant selection pattern and on the commercial fishery supplying sufficient sampling information on the older age groups.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

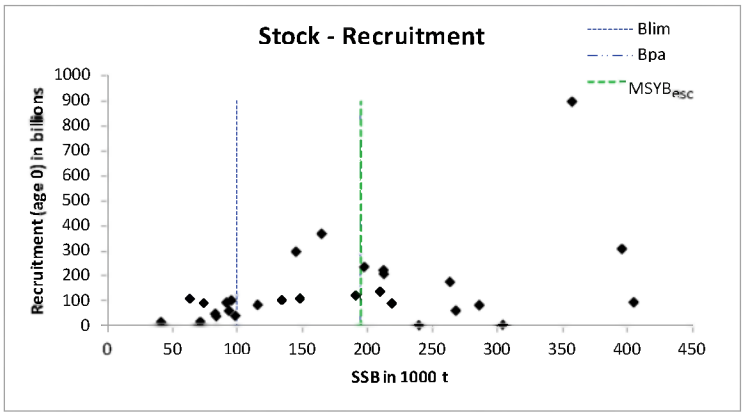


Figure 6.4.21.3.2 Sandeel in the Central Eastern North Sea (SA 3). Stock–recruitment plot.

Table 6.4.21.3.1 Sandeel in the Central Eastern North Sea (SA 3). ICES advice, management, and landings.

Year	ICES Advice	Catch corresponding to advice	EC zone TAC	NOR zone TAC	ICES landings SA 3	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 [2]	10 [3]	30	177
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 [2]	0	19	293
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 [2]	51	114	230
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.	-	375 [2]	128	95	348
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.	-	377 [2]	0	34	353
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.	-	377 [2]	50	81	414
2011	No fishery.	0	10	90	95 [4]	438 [4]
2012	Catches for monitoring purposes should not exceed 5 000 t.	< 5	0	42		

Weights in '000 t.
[1] Advice for Subarea IV excluding the Shetland area.
[2] Set for EC waters of Divisions IIa and IIIa and Subarea IV.
[3] TAC set for EC fisheries 10 kt, seasonal effort limitations set for Norwegian fisheries.
[4] Preliminary.

Table 6.4.21.3.2 Sandeel in the Central Eastern North Sea (SA 3). Summary of the assessment.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1–2
1983	93349000	73516	105946	0.464
1984	43037000	97830	123635	0.498
1985	299056000	144541	59083	0.274
1986	371351000	164221	420341	0.997
1987	85769000	285620	403908	0.905
1988	309998000	395318	391081	1.364
1989	105090000	133629	481893	1.094
1990	210121000	212091	219183	0.563
1991	91968000	218236	368105	0.723
1992	238718000	197029	195700	0.462
1993	225569000	211866	263954	0.635
1994	177963000	263068	444119	0.708
1995	138816000	209227	218922	0.478
1996	898312000	357031	247397	0.391
1997	64091000	267531	604159	0.931
1998	97066000	404355	499333	0.933
1999	123453000	190496	223160	1.121
2000	86556000	115000	242732	1.335
2001	96526000	91066	245290	0.939
2002	19136000	70816	209302	1.046
2003	51443000	82292	58942	0.503
2004	18529000	40604	79234	0.678
2005	41290000	83127	29677	0.227
2006	111003000	62738	18863	0.136
2007	62985000	92814	113232	0.525
2008	111471000	147655	94491	0.463
2009	105362000	94614	33350	0.140
2010	7419000	303702	80576	0.515
2011	5787000	239149	94946	0.466
2012		150945*		
Average	147973586	180004	226571	0.673

*Mean weight-at-age from 2011.

ECOREGION North Sea
STOCK Sandeel in the Central Western North Sea (SA 4)

Advice for 2012

ICES advises on the basis of precautionary considerations that catches for monitoring purposes should not exceed 5000 t.

Stock status

F (Fishing Mortality)	2009	2010	2011	
MSY (F_{MSY})	?	?	?	Unknown
Precautionary approach (F_{pa}, F_{lim})	?	?	?	Unknown
Qualitative evaluation	→	→	→	Stable and very low

SSB (Spawning-Stock Biomass)	2010	2011	2012	
MSY ($B_{escapement}$)	?	?	?	Unknown
Precautionary approach (B_{pa}, B_{lim})	?	?	?	Unknown
Qualitative evaluation	?	↗	→	Stable

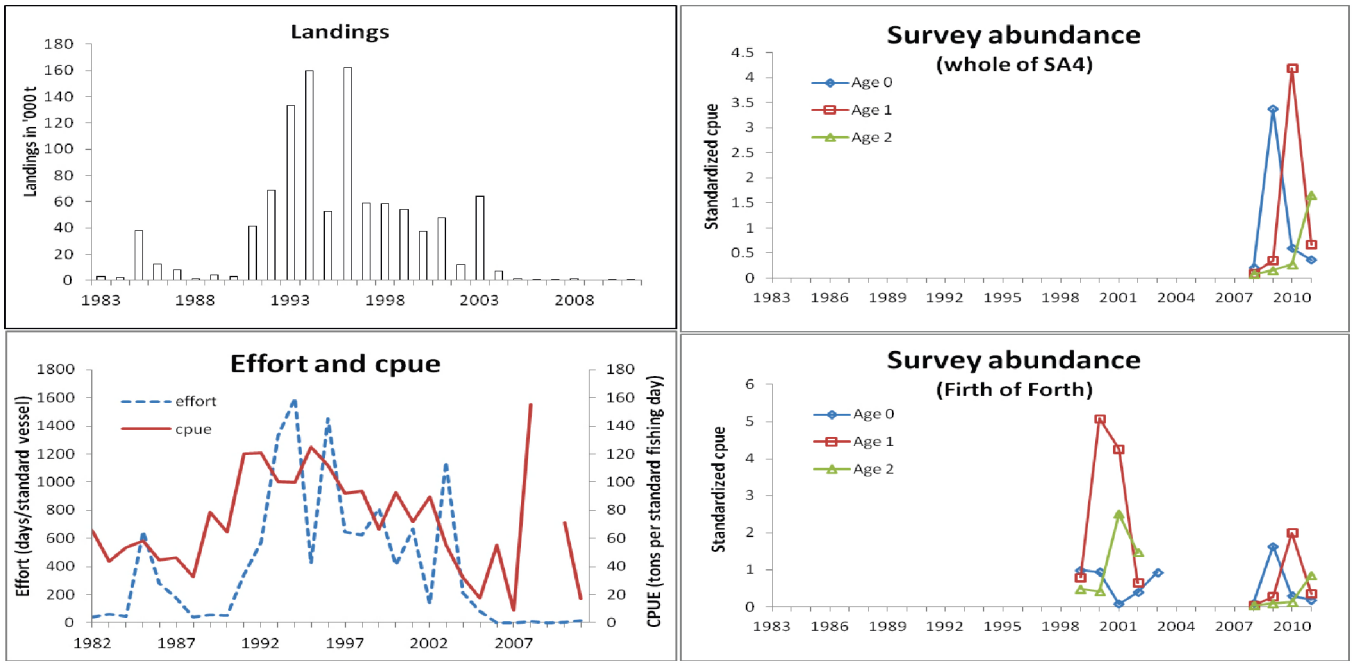


Figure 6.4.21.4.1 Sandeel in the Central Western North Sea (SA 4). Top left: landings, bottom left: effort (days fishing per standard 200 GT vessel) and catch per unit effort (tonnes per standard fishing day). Right: catch indices from the dredge survey (number per hour standardized to mean) in the entire SA 4 (top) and in the Firth of Forth only (bottom).

Survey data indicate that the strong 2009 year class has been followed by low recruitment in both 2010 and 2011. The very limited effort applied in the area suggests a very low fishing mortality.

Management plans

No specific management objectives are known to ICES.

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 2011, probably due to very high catch rates on other fishing banks closer to the landing sites in Denmark and Norway.

Catch distribution	Total landings (2011): 0.27 kt, where 100% were landings by industrial fisheries.

Quality considerations

Prior to the establishment of the dedicated Scottish dredge survey in 2008, dredge sampling intensity was low in this area. As commercial fishing effort has been very low in recent years, there is insufficient overlap between dredge and commercial cpue time-series to provide reliable estimates of incoming 1-group strength. If landings and dredge survey data would overlap sufficiently, it should be possible to make an analytical assessment similar to the assessments for SA 1–3.

Scientific basis

Assessment type	Trends-based assessment.
Input data	One survey index available in January (dredge survey). Total international catch and effort.
Discards and bycatch	Not included in the assessment, but discards are considered to be negligible.
Indicators	None.
Other information	Last benchmark in 2010 (WKSAN. 2010).
Working group report	WGNSSK

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 2012

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 stock trend is considered to be stable with recent low recruitment after a high recruitment in 2009, while the low recruitment is likely due to natural variation. The exploitation status is considered stable and very low. Therefore, catches in 2012 should remain low, and catches for monitoring purposes should not exceed 5000 t.

In order to present an assessment, information on catch composition and catch per unit effort is required. The advice of a maximum of 5000 t in monitoring fisheries should provide sufficient samples and, thus, reliable estimates.

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. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

Table 6.4.21.4.1 Sandeel in the Central Western North Sea (SA 4). ICES advice, management, and landings.

Year	ICES Advice	Catch corresponding to advice	TAC	ICES landings SA 4	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 [2]	1.49	177
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 [2]	0.09	293
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 [2]	0.01	230
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.	-	375 [2]	1.20	348
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.	-	377 [2]	0	353
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.	-	377 [2]	0.27	414
2011	A TAC at 5000–10 000 tonnes will impose a low risk of overfishing sandeel in this area.	5–10	10	0.27 [3]	438 [3]
2012	Catches for monitoring purposes should not exceed 5000 t.	< 5	0		

Weights in '000 t.
[1] Advice for Subarea IV excluding the Shetland area.
[2] Set for EC waters of Division IIa, IIIa and Subarea IV.
[3] Preliminary

Table 6.4.21.4.2 Sandeel in the Central Western North Sea (SA 4). Abundance index (average cpue) from the Scottish December dredge survey for a) the whole of SA 4 and b) the Firth of Forth. No data were collected in 2004–2007.

a) Sandeel Area 4				b) The 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		
2008	52	24	18	68	24	24
2009	832	87	38	1023	174	56
2010	147	1032	67	186	1244	78
2011	89	165	407	119	220	534

ECOREGION North Sea
STOCK Sandeel in the Viking and Bergen Bank areas (SA 5)

Advice for 2012

ICES advises on the basis of precautionary considerations that no increase in the fisheries should take place unless there is evidence that this will be sustainable.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	Very low

SSB (Spawning-Stock Biomass)	
	2009–2011
Qualitative evaluation	Insufficient information

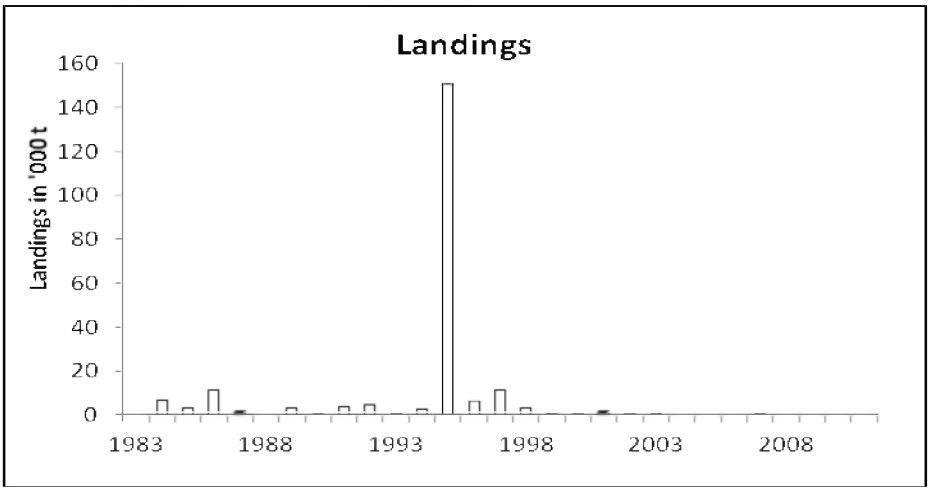


Figure 6.4.21.5.1 Sandeel in the Viking and Bergen Bank area (SA 5). ICES estimates of landings (in '000 tonnes).

Catch statistics and acoustic data are available for this stock. No landings have occurred since 2004 (except for 4 t landed in 2007). The available information is inadequate to evaluate stock status or trends. The state of the stock is therefore unknown.

Management plans

An experimental sandeel management plan has been applied in the Norwegian EEZ since 2010. This management plan has not been evaluated by ICES.

Scientific basis

Assessment type	No assessment.
Indicators	Catch statistics and acoustic data.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	WGNSSK

ECOREGION North Sea
STOCK Sandeel in the Viking and Bergen Bank areas (SA 5)

Reference points

No reference points are defined for this stock.

Outlook for 2012

No forecast can be presented for this stock because the available catch and survey data are insufficient to conduct an analytical assessment.

PA considerations

The stock trend is unknown. There has been very little or no fishery since 2004, suggesting a very low exploitation status. Therefore, catches should not be allowed to increase unless there is evidence that this will be sustainable.

Additional considerations

Norway closed fisheries on the Viking Bank area in 2011 because of very low estimates of sandeel abundance based on acoustic surveys in 2007–2010 (ICES, 2010).

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

ECOREGION North Sea
STOCK Sandeel in Division IIIa East (Kattegat, SA 6)

Advice for 2012

ICES advises on the basis of precautionary considerations that no increase of the fisheries should take place unless there is evidence that this will be sustainable.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Insufficient information

SSB (Spawning-Stock Biomass)	
	2009–2011
Qualitative evaluation	? Insufficient information

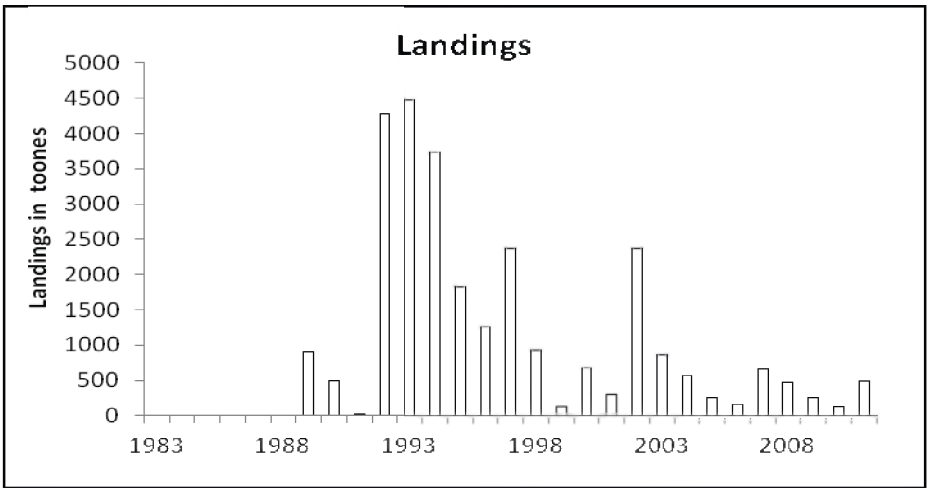


Figure 6.4.21.6.1 Sandeel in Division IIIa East (Kattegat, SA 6). ICES estimates of landings (in tonnes).

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.

Catch distribution	Total landings (2011): 0.5 kt, where 100% were landings by industrial fisheries.

Scientific basis

Assessment type	No assessment.
Indicators	Catch statistics.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	WGNSSK

ECOREGION North Sea
STOCK Sandeel in Division IIIa East (Kattegat, SA 6)

Reference points

No reference points are defined for this stock.

Outlook for 2012

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

PA considerations

The stock trend and exploitation status are unknown. Catches are low and have not shown any particular trend in over a decade. Therefore, catches should not be allowed to increase unless there is evidence that this will be sustainable.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

ECOREGION North Sea
STOCK Sandeel in the Shetland area (SA 7)

Advice for 2012

ICES advises on the basis of precautionary considerations that no increase in the fisheries should take place unless there is evidence that this will be sustainable.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	Very low

SSB (Spawning-Stock Biomass)	
	2009–2011
Qualitative evaluation	Insufficient information

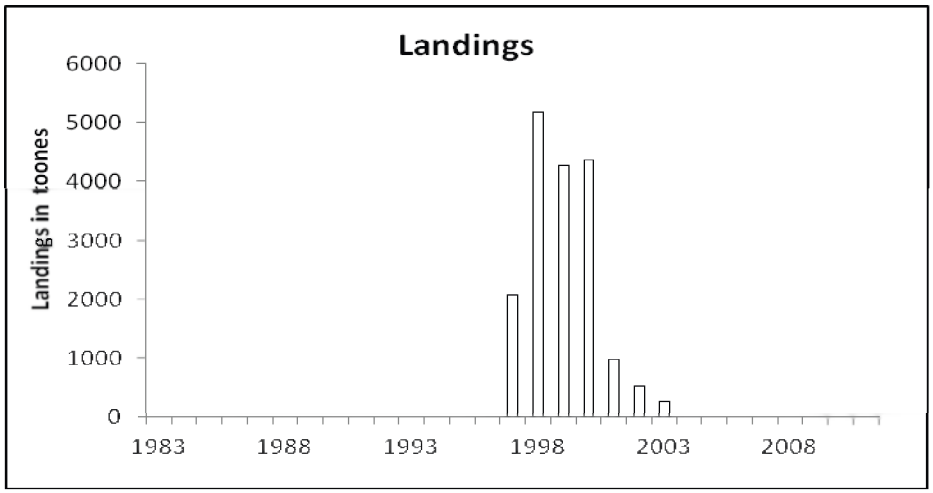


Figure 6.4.21.7.1 Sandeel in the Shetland area (SA 7). ICES estimates of landings (in tonnes).

Catch statistics and trawl survey data are available for this stock. However, 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.

Scientific basis

Assessment type	No assessment.
Indicators	Catch statistics and trawl survey data (1985–2007).
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	WGNSSK

ECOREGION North Sea
STOCK Sandeel in the Shetland area (SA 7)

Reference points

No reference points are defined for this stock.

Outlook for 2012

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

PA considerations

The stock trend is unknown. There has been very little or no fishery since 2004, suggesting a very low exploitation status. Therefore, catches should not be allowed to increase unless there is evidence that this will be sustainable.

Additional considerations

Management plan

A national management plan was in place for this stock up until 2009, overseen by the Scottish Government. This restricted sandeel fishing around Shetland to small inshore grounds. However, as there have not been any reported landings from the area since 2003 the national plan has been ended. Any future request from fishers to resume the fishery would require an evaluation of potential ecosystem implications, under the Habitats and Species Act.

Source

ICES. 2012. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–26 January 2012. ICES CM 2012/ACOM:13.

ECOREGION North Sea
STOCK Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)

Advice for 2013

ICES advises on the basis of the approach for data-limited stocks that catches should not increase, unless there is evidence that this will be sustainable. This corresponds to zero catches.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

	F (Fishing Mortality)	
	2009–2011	
Qualitative evaluation	?	Insufficient information

	SSB (Spawning-Stock Biomass)	
	2009–2011	
Qualitative evaluation	?	Insufficient information

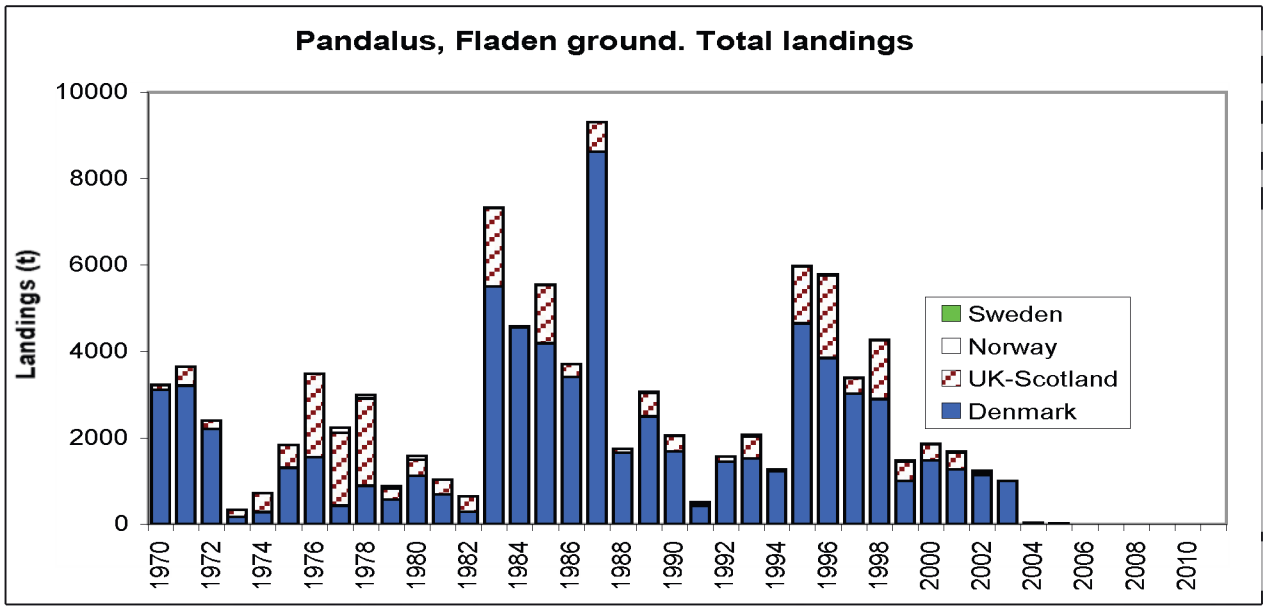


Figure 6.4.22.1 Northern shrimp in Division IVa (Fladen Ground). Total landings (in tonnes) as estimated by ICES.

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.

Quality considerations

The advice is based on precautionary low catches because of missing or non-representative data. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment (ICES data-limited stock category 6.2.1).
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 2013

The available information is inadequate to evaluate stock trends. The state of the stock is therefore unknown and fishing possibilities cannot be projected.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For this stock, since the current landings are around zero, ICES advises that catches should not increase, unless there is evidence that this will be sustainable. This corresponds to zero catches.

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.

Comparison with previous assessment and advice

Last year's advice was based on the precautionary approach, this year's advice is based on ICES approach to data-limited stocks.

Assessment and management area

A TAC is set for northern shrimp in the EU waters of Division IIa and Subarea IV. To protect the stock in the Fladen Ground, management should be implemented for this unit separately.

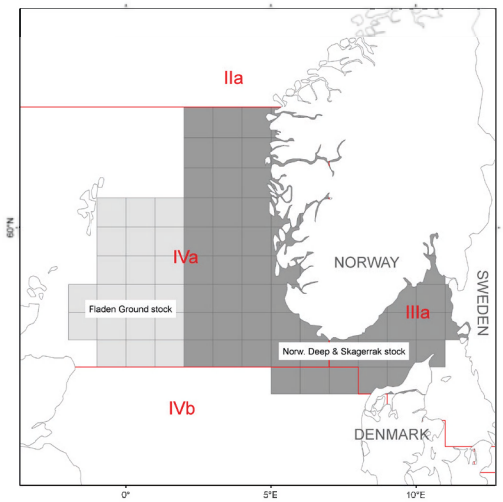


Figure 6.4.22.2 Northern shrimp in Division IVa (Fladen Ground). The light grey area is the assessment area in the North Sea. The stock in Divisions IIIa and IVa East is described in Section 6.4.23.

Source

ICES. 2012. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 17–24 October 2012, Tromsø, Norway. ICES CM 2012/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 EC waters IIa and IV	ICES landings
2006	Average landings (2001–2003)	< 1.3	4.980	0
2007	No increase in effort to levels above the average for the years where fishing activity took place. Mandatory data collection programme for catch and effort data on both target and bycatch fish	-	3.984	0
2008	Same advice as last year	-	3.984	0
2009	Same advice as last year	-	4.980	0
2010	Same advice as last year	-	4.233	0
2011	Average landings (1999–2003), mandatory data collection programme	< 1.4	3.598	0
2012	No increase in catch	-	3.058	
2013	No increase in catch unless there is evidence that this will be sustainable	0		

Weights in thousand tonnes.

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
2011	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 2013

Based on ICES approach to data-limited stocks, ICES advises that landings should be no more than 5800 tonnes. Additionally, measures should be taken to address discarding.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		
	2009–2011	
Qualitative evaluation	?	Insufficient information

SSB (Spawning-Stock Biomass)		
	2008–2012	
Qualitative evaluation	↘	Decreasing

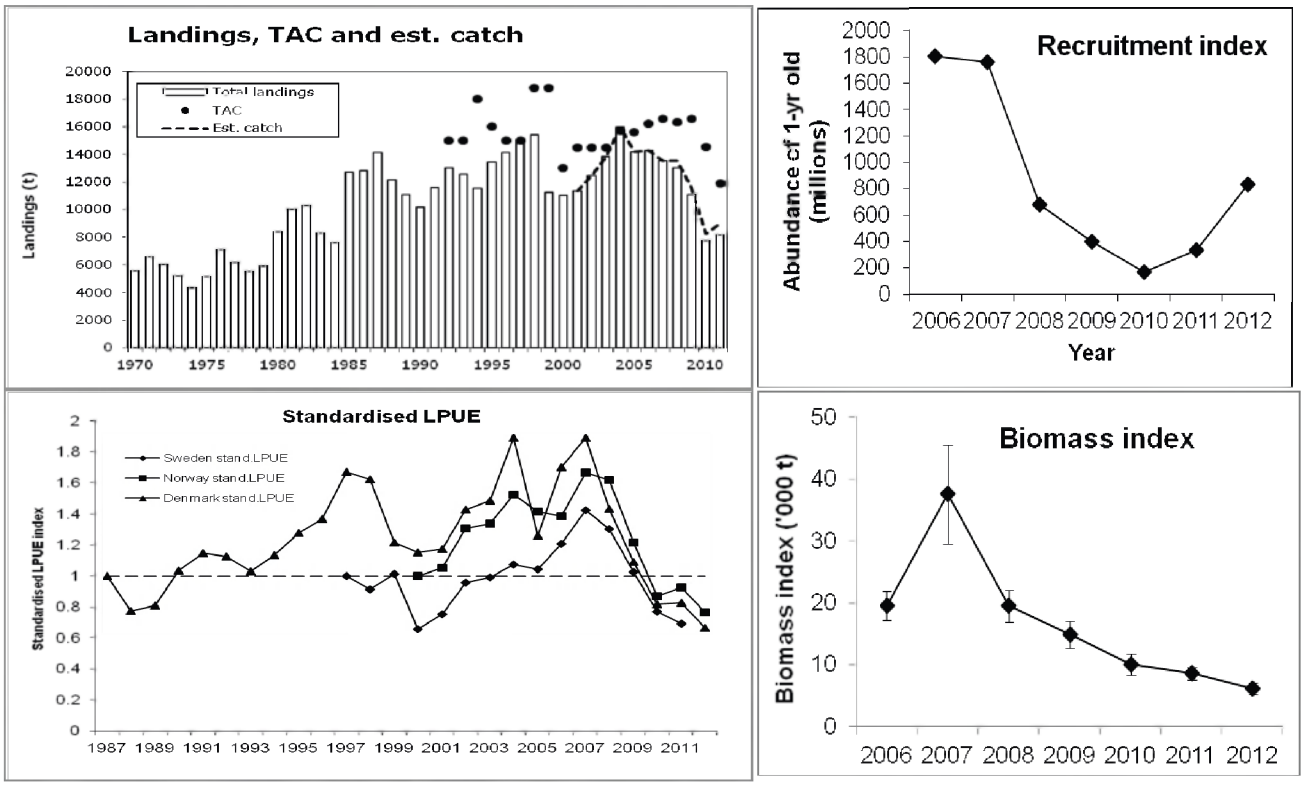


Figure 6.4.23.1 Northern shrimp in Divisions IIIa and IVa East. Top left: Landings, TAC (for Division IIIa and Norwegian waters of Division IIa and Subarea IV) and estimated catches. Below left: Standardized landings per unit effort (lpue) by country. Top right: Recruitment indices from the Norwegian shrimp survey calculated as the abundance of age 1 shrimp. Below right: Biomass index estimated from Norwegian surveys. Error bars are standard errors.

Landings per unit effort (lpue) indices, which fluctuated without trend from the mid-1990s through the mid-2000s, have declined after 2007. Survey biomass indices have also declined since 2007. The average biomass index in the last two years (2011–2012) is 50% lower than the average of the three previous years (2008–2010). The recruitment index decreased from 2007 to 2010, but increased in 2011 and further in 2012.

Management plans

No specific management objectives are known to ICES.

Biology

Northern shrimp are hermaphroditic. Individuals start out as males, but after 2–4 years they change sex and complete their lives as females. Several fish and marine mammal species prey on Northern shrimp and may, under certain circumstances, be important drivers of 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). An increasing 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 vessels < 11 m has expanded. No significant changes have taken place in the Swedish fishery during the last decade except for an increase in the use of twin trawls in the last six years. Because of this development (and the accompanying increase in the size of the trawls), the efficiency of the fisheries has increased.

Catch distribution	Total catches (2011) = 9030 kt, where 90.4% are landings (100% trawl) and 9.6% 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 electronic logbooks introduced in the Norwegian fishery in 2011 should be made compulsory for all vessels, not only vessels >15 m.

The advice is based on trends in the abundance index from one research survey (Norwegian Shrimp Survey) and three commercial indices, used as indicators of stock size. The uncertainties associated with these index values are available, except for the Swedish lpue series.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey trends (ICES data-limited stock category 3.2.0).
Input data	One survey index (Norwegian shrimp survey since 2006); three commercial indices (Danish, Swedish, and Norwegian standardized lpue) and standardized effort.
Discards and bycatch	Discard estimates are available from 2008, earlier data are considered less accurate.
Indicators	None.
Other information	A benchmark is scheduled for completion in 2013.
Working group report	NIPAG

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 2013

No analytical assessment is available for this stock. Therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the three preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have decreased by more than 20% between 2008 and 2010 (average of 14 830 t) and 2011–2012 (average of 7435 t). This implies a decrease of 20% in relation to the average of the last three years' landings, corresponding to landings of no more than 7200 t.

Additionally, considering that exploitation is unknown, ICES advises that landings should decrease by a further 20% as a precautionary buffer. This results in landings of no more than 5800 t in 2013.

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 a restrictive quota. In 2011, estimated discards amounted to 10% of the total catch (862 t). All vessels, including Norwegian vessels < 15 m that are not currently using electronic logbooks, should be required to provide logbooks. Additionally, sorting grids should be mandatory in all areas to minimize bycatch.

Additional considerations

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 unusually cold bottom water occurred in the mid-1960s and coincided with a sharp decline in the *Pandalus* stock.

A joint Nordic–EU project (Interreg IV, 2011–2013) is investigating 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. The assessment is due to be benchmarked by ICES in 2013.

The estimate of the Danish lpue is based on fishing trips where the landing value of *Pandalus* 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 high-grading estimates should be reduced following discard data collection in the European Data Collection Framework.

Regulations and their effects

The main regulatory measure is a TAC, which is not fully utilized by all countries. Discarding of small and medium-sized, low-value shrimp may occur 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 138 in 1987 to only 13 in 2011. Most of the vessels leaving the fishery have been small trawlers. The efficiency of the Danish shrimp vessels has increased due to the introduction of twin-trawl technology and increasing trawl size.

In the Norwegian fleet small vessels < 11 m are the most numerous, as a licence to fish is not required for vessels < 11 m. Information on gear use (single, twin trawl) for all vessels >15 m is available from compulsory electronic logbooks introduced in 2011.

During the last six years the number of Swedish twin trawlers has increased from 5 to 23. These twin trawlers have 50–80% higher catch rate compared to single trawls. In Swedish national waters it is mandatory to use trawls equipped with grids.

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 a Swedish lpue time-series is also included.

Last year's advice was based on the precautionary approach. This year's advice is based on ICES approach to data-limited stock, taking into account the Norwegian survey biomass index.

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.

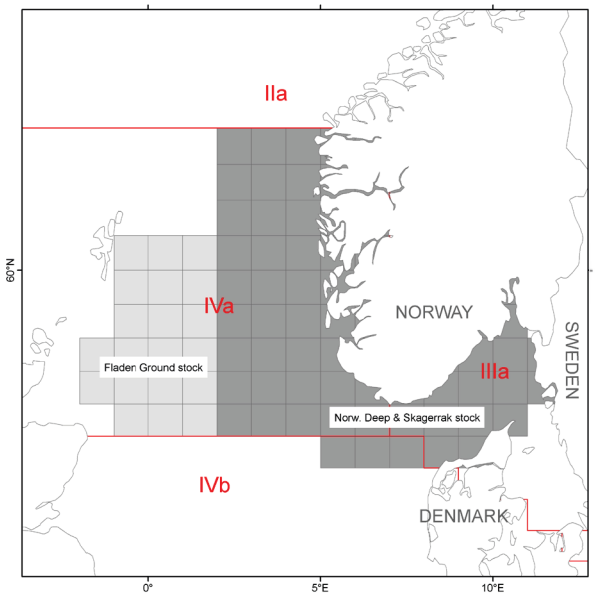


Figure 6.4.23.2 Northern shrimp in Divisions IIIa and IVa East. Assessment areas in the North Sea and Skagerrak are dark grey. The Fladen Ground stock (light grey) is described in Section 6.4.22.

Source

ICES. 2012. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 17–24 October 2012, Tromsø, Norway. ICES CM 2012/ACOM:14.

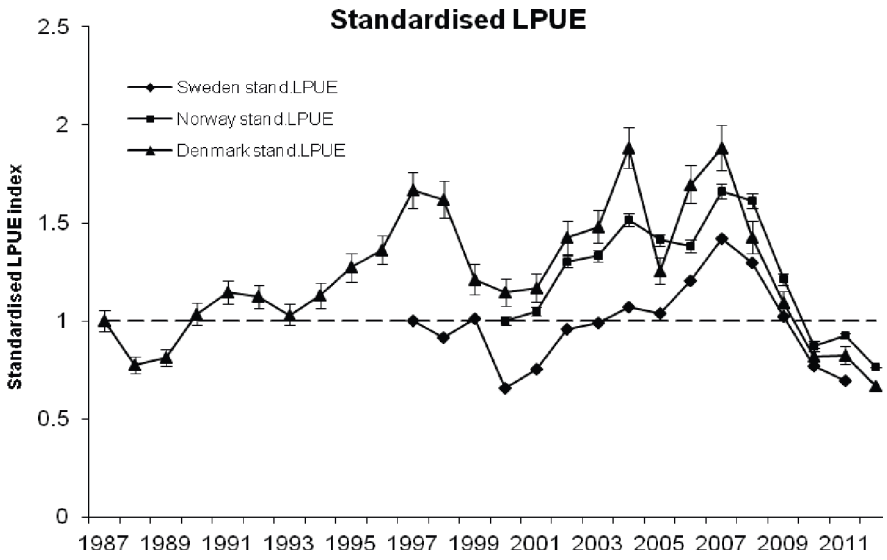


Figure 6.4.23.3 Northern shrimp in Divisions IIIa and IVa East. Standardized landings per unit effort (lpue) for the Danish and Norwegian data, with their respective means. Error bars are standard errors.

Table 6.4.23.1 Northern shrimp in Divisions IIIa and IVa East. ICES advice, management, discards, landings, and catch. In 2012 it was decided not to use discard estimates prior to 2008.

Year	ICES Advice	Predicted landings corresp. to advice	TAC Division IIIa	TAC Div. IIIa + IIa + IV [1]	TAC Div. IIa+IV EU	Discard estimates	ICES landings	ICES catch (Disc. + Landings)
1987	Not assessed							14.2
1988	Catches significantly below 1985–1986							12.2
1989	No advice		3.1 [2]					11.1
1990	IIIa: F as F(pre-1985); IVa East: No increase in F	10.0	2.75 [2]					10.2
1991	No increase in F; TAC	12.0	8.55					11.6
1992	Within safe biological limits	15 [3]	10.50	15.0				13.0
1993	Within safe biological limits	13 [3]	10.50	15.0				12.6
1994	Within safe biological limits	19 [3]	12.60	18.0				11.5
1995	Within safe biological limits	13 [3]	11.20	16.0				13.4
1996	No advice	11 [3]	10.50	15.0				14.1
1997	No advice	13 [3]	10.50	15.0				15.1
1998	No increase in F; TAC	19 [3]	13.16	18.8				15.4
1999	Maintain F	19 [3]	13.16	18.8				11.3
2000	Maintain F	<11.5 [3]	9.10	13.0	7.113			11.0
2001	Maintain F	13.4	10.15	14.5	6.504			11.3
2002	Long-term average landings	12.6	10.15	14.5	4.980			12.5
2003	Maintain F	14.7	10.15	14.5	4.980			13.8
2004	No increase in F [3]	15.3 [4]	10.71	15.7	4.980			16.0
2005	No increase in catch above recent [level]	~13 [4]	10.71	15.6	4.980			14.2
2006	No increase in catch above recent [level]	~13.5 [4]	11.2	16.2	4.980			14.3
2007	No increase in landings above recent [level]	~14.0 [4]	11.62	16.6	3.984			13.6
2008	No increase in landings above recent [level]	~15 [4]	11.62	16.3	3.984	0.5	13.0	13.6
2009	Same advice as last year	~15 [4]	11.62	16.6	4.980	0.5	11.1	11.6
2010	No increase in landings above 2008 [level]	~13 [4]	9.8	14.558	4.233	0.5	7.8	8.3
2011	At least 30% decrease of landings '07–'09, reduce discards, mandatory	< 8.8	8.3	12.4	3.598	0.9	8.2	9.0
2012	Reduce catches and reduce discards	-	7.1	10.1	3.058			
2013	Reduce landings by 36% and reduce discards	≤5.8						

Weights in thousand tonnes.

[1] Includes the Norwegian TAC in IVEast and the EU TAC in the Norwegian zone of Division IIa and Subarea IV.

[2] EU zone only.

[3] Catch at *status quo* F.

[4] Single-stock boundaries and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits.

Table 6.4.23.2 Northern shrimp in Divisions IIIa and IVa East. Nominal landings in Division IIIa and Subarea IV; landings, discards, catches (in tonnes) as estimated by ICES; and TACs. The ICES landings are used in the assessment.

Year	Nominal landings, IIIa + IV	Denmark	Norway*)	Sweden *)	ICES Total landings	Est. Sw high grading+ discards	Est. Norw discards	Est. Danish discards	TAC	Est. catch
1970	9 160	1102	1729	2742	5573					
1971	10 407	1190	2486	2906	6582					
1972	8 963	1017	2477	2524	6018					
1973	6 572	755	2333	2130	5218					
1974	5 250	530	1809	2003	4342					
1975	6 728	817	2339	2003	5159					
1976	10 858	1204	3348	2529	7081					
1977	8 679	1120	3004	2019	6143					
1978	8 631	1459	2440	1609	5508					
1979	7 351	1062	3040	1787	5889					
1980	10 358	1678	4562	2159	8399					
1981	11 083	2593	5183	2241	10017					
1982	11 343	3766	5042	1450	10258					
1983	15 675	1804	5361	1136	8301					
1984	12 493	1800	4783	1022	7605					
1985	18 608	4498	6646	1571	12715					
1986	17 212	4866	6490	1463	12819					
1987	24 088	4488	8343	1322	14153					
1988	14 475	3240	7661	1278	12179					
1989	14 789	3242	6411	1433	11086					
1990	12 838	2479	6108	1608	10195					
1991	12 253	3583	6119	1908	11610					
1992	14 764	3725	7136	2154	13015				15000	
1993	14 819	2915	7371	2300	12586				15000	
1994	12 982	2134	6813	2601	11548				18000	
1995	19 398	2460	8095	2882	13437				16000	
1996	19 705	3868	7878	2371	14117				15000	
1997	18 517	3909	8565	2597	15071				15000	
1998	19 533	3330	9606	2469	15406				18800	
1999	12 646	2072	6739	2445	11256				18800	
2000	12 424	2371	6444	2225	11040				13000	
2001	12 707	1954	7266	2108	11328				14500	11328
2002	13 202	2470	7703	2301	12474				14500	12474
2003	14 215	3270	8178	2389	13837				14500	13837
2004	15 225	3944	9544	2464	15952				15690	15952
2005	13 612	2992	8959	2257	14208				15600	14208
2006	13 651	3111	8669	2488	14268				16200	14268
2007	12 939	2422	8686	2445	13553				16600	13553
2008	12 402	2274	8260	2479	13013	540			16300	13553
2009	10 421	2224	6364	2483	11071	337	115	36	16600	11560
2010	7 166	1301	4673	1781	7755	386	75	53	14558	8269
2011	7 642	1600	4800	1768	8168	504	235	123	11928	9030

*) Swedish (all years) and Norwegian landings (2000–2011) 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 2011. 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 (t)	% of total catch	Total (t)	% of total catch	Total (t)	% of total catch
Pandalus	5249	78.4	326	98.5	2028	84.3
Norway lobster	31	0.5	2	0.6	9	0.4
Angler fish	44	0.7	0	0.0	60	2.5
Whiting	12	0.2	0	0.0	3	0.1
Haddock	56	0.8	0	0.0	8	0.3
Hake	24	0.4	0	0.0	27	1.1
Ling	47	0.7	0	0.0	39	1.6
Saithe	623	9.3	1	0.2	93	3.9
Witch flounder	67	1.0	0	0.0	2	0.1
Norway pout	1	0.0	0	0.0	0	0.0
Cod	358	5.4	0	0.1	65	2.7
Other market fish	180	2.7	2	0.5	72	3.0

Table 6.4.23.4 Northern shrimp in Divisions IIIa and IVa East. Survey indices used for trend calculations.

	survey index	SE
2006	19.55	2.30
2007	37.48	8.03
2008	19.50	2.54
2009	14.86	2.21
2010	10.10	1.73
2011	8.62	1.07
2012	6.25	0.90

ECOREGION North Sea
STOCK Rays and skates in Divisions and Subarea IIIa, IV, and VIId, e (Kattegat, Skagerrak, North Sea, and English Channel)

Introduction

There are 13 species of ray and skate (*Rajidae*) and 7–8 demersal shark species in the North Sea ecoregion. This advice section addresses the main commercial skates and rays.

Section	Stock
6.4.24.1	Blonde ray (*Raja brachyuran)* in Divisions IVc and VIId, e (Southern North Sea and English Channel)
6.4.24.2	Thornback ray (*Raja clavata)* in Subarea IV, and Divisions IIIa and VIId,e (North Sea, Skagerrak, Kattegat, and English Channel)
6.4.24.3	Small-eyed ray (*Raja microocellata*) in Divisions VIId, e (English Channel)
6.4.24.4	Spotted ray (*Raja montagui*) in Subarea IV, and Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and Eastern English Channel)
6.4.24.5	Undulate ray (*Raja undulata*) in Divisions VIId, e (English Channel)
6.4.24.6	Cuckoo ray (*Leucoraja naevus)* in Subarea IV, and Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and Eastern English Channel)
6.4.24.7	Common skate (*Dipturus batis*) complex *(Dipturus* cf. *flossada and Dipturus* cf. *intermedia)* in Subarea IV, and Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and Eastern English Channel)
6.4.24.8	Starry ray *(Amblyraja radiata)* in Subarea IV, and Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and Eastern English Channel)
6.4.24.9	Other ray and skate species in Subarea IV, and Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and Eastern English Channel)

Skates and rays fisheries are currently managed under a common TAC, although this complex comprises species that may have different vulnerabilities to exploitation. TAC advice is based on the status of the main commercial species, with species-specific advice also provided on an individual basis.

Demersal elasmobranchs in this region are caught in mixed target and non-target fisheries. TACs alone may not adequately protect these stocks as restrictive TACs may lead to high discarding.

At present ray and skate fisheries are managed by means of a generic, multi-species TAC, along with prohibitions for severely depleted species.

Management measures such as closed areas/seasons or effort restrictions may better protect demersal elasmobranchs. In particular, measures to protect spawning/nursery grounds would be beneficial. ICES could provide advice on such measures.

Advice for 2013 and 2014

ICES provides advice on the overall exploitation (landings and discards) of the ray and skates species assemblage, and also on individual species. ICES does not advise that individual TACs be established for each species, at present. This is because the catch statistics for individual species are not reliable. ICES considers the generic TAC, at best, as an ineffective measure, regulating overall outtake from the assemblage. ICES advises that a suite of species- and fishery-specific measures be developed to manage the fisheries on commercial species and achieve recovery of the depleted species. Such measures should be developed by managers involving all stakeholders; ICES could assist in the process.

Management measures should be framed in a mixed-fisheries context, considering the overall behaviour of demersal fleets, and the drivers for such behaviour. Because these species are mainly caught in mixed fisheries, when the TAC is exhausted, catches continue to take place, but are discarded. In order to achieve optimal harvesting of the commercial species, and to assist recovery of the depleted species, a suite of measures should be put in place.

Closure to fishing of spawning and/or nursery grounds, and measures to protect the spawning component of the population (e.g. maximum landing size) are powerful tools to protect rays and skates. In some cases, single-species TACs may be appropriate, especially for easily identified species, and/or discrete stocks in limited distribution areas.

Given that the European Community intends to introduce a ban on discards, minimum or maximum landing sizes should be carefully considered before they are introduced, because they could lead to increased discards. Size limits may best be applied if discard (escapee) survival can be shown to be high.

Stock status

Three commercial skate species (thornback ray, spotted ray, and cuckoo ray) show increasing trends in relative abundance in fishery-independent trawl surveys. There is evidence of a long-term decline to depleted levels in the distribution and relative abundance of one commercial species (*Dipturus batis* complex). Trends in the relative abundance of two other commercial species (blonde ray, undulate ray) are unclear. Starry ray is an abundant non-commercial species and is almost exclusively discarded, and stock trends are decreasing. Discard survivorship is not known.

The advice is based on the stock status of the main commercial species in the ecoregion, with species-specific advice provided below. Landings of skates and rays in the North Sea have generally declined, and this is associated with changes in species composition and relative abundance.

Table 6.4.24.1 Rays and skates in the North Sea, Skagerrak, Kattegat, and eastern Channel. ICES advice, management, and landings.

Year	Advised percentage change in catch (landings + discards)												
	Thornback ray (IV, VIId, IIIa)	Spotted ray (IV, VIId, IIIa)	Cuckoo ray (IV, VIId, IIIa)	Blonde ray (VIId, e)	Small-eyed ray (IV, VIId, IIa)	Undulate ray (VIId, e)	Common skate complex (IV, VIId, IIIa)	Starry ray IV, VIId, IIIa)	Other species	Total advice	General advice	Agreed TAC [1]	ICES landings
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							0			0	Zero catch	2.7	2.8
2007							0			0	Zero catch	2.2	3.1
2008							0			0	Zero catch	1.6	3.0
2009							0			< 3.1[2]	Av. land. 2002–2006	2.8	3.2[3]
2010							0			< 3.1[2]	No new advice, same advice as for 2009	2.3	3.0
2011							0			< 2.7	Av. land. 2006–2008	2.3	2.7
2012							0			< 2.7	No new advice, same advice as for 2011	2.3	
2013	+20%	+20%	+20%	−20%	−20%	No targeted fishery	0	-36%	−20%	-	No TAC + species-specific measures [4]	2.7	
2014	No new advice, same advice as for 2013										No new advice, same advice as for 2013	2.7	

Weights in thousand tonnes.

[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) Division IIa and Subarea IV, 2) Division IIIa, and 3) Division VIId.

[4] Additional species-specific measures (see main text).

Assessment methodology

The assessment is based on ICES framework for data-limited stocks, where change in survey catch rates is the main indicator. In each case the survey index used was (average of last two years)/(average of previous five years). An average of the previous five years was chosen over the default average of the previous three years. This is to allow time for changes in abundance to become visible, as generation times are longer in these species than in those of many bony fishes.

A recommended change in catch is applied according to change in survey indices, with a ±20% uncertainty cap applied in each case (Category 3.2). Where no suitable survey index was available, a precautionary decrease of 20% was applied (Category 5.2).

ICES does not advise a precautionary decrease in TAC, because it is considered that this would lead to increased regulatory discarding and further reduce the quality of the catch data. ICES does not view the TAC as the main means to manage the fishery, but rather as an upper boundary on the outtake. Therefore, further reductions to the TAC are not considered to be the best approach to allow recovery of depleted species at present.

Biology

Many elasmobranchs are slow growing, have a late age-at-maturity, low reproductive capacity, they are large in size and have an aggregating behaviour. Because of this they are considered to be highly vulnerable to over-exploitation. Skates (Rajidae) are oviparous, and often produce more young than live-bearing species. Some species of demersal elasmobranchs may be locally common and found in discrete areas. Resource competition and species interactions between the various skate species is poorly understood. Historically, common skate have been known to predate on individuals of smaller skate species, and the longer-term decline in the larger skates may have benefited populations of smaller skate species.

The fisheries

Demersal elasmobranchs are caught as a bycatch in the mixed demersal fisheries for roundfish and flatfish. A few inshore vessels target skates and rays with tanglenets and longlines. Landings have declined since their peak in 1982. Most fisheries now take place to the south of the region, in Divisions IVc and VIIe. TACs were introduced in 1999, but only became restrictive in 2004. *Raja clavata* composes 42% of the total ray catch and 62% of the species-specific landings.

Effects of the fisheries on the ecosystem

Some demersal sharks, including lesser-spotted dogfish, may benefit from scavenging on trawl-damaged organisms and discards.

Quality considerations

Species-specific catch data for all the species covered in this advice sheet are of limited extent and there are data quality issues. Age data are not routinely collected. Data limitations and the biological characteristics of elasmobranchs restrict the use of length-based assessment methods. In the absence of formal stock assessments and defined reference points for skate stocks and demersal sharks in this ecoregion, the general status of the major species is evaluated from surveys. Stock trends from fishery-independent trawl surveys are available for many stocks, but it is not possible to quantify whether overfishing takes place.

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of species-specific data are reported. This information covers too short a time period to influence advice at the present time.

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

Management considerations

TACs only regulate the landings, and a low TAC on a low-value bycatch species could induce more discards. Because the elasmobranch species are usually caught as a bycatch in demersal fisheries, they would benefit from a reduction in the overall demersal fishing effort.

In the Dutch commercial fishery the quota for skates and rays was reached halfway through July 2011. Therefore, fishermen were forced to discard any skate and ray catches during the second half of 2011.

Additional considerations

Rays and skates offer a unique opportunity to institute spatial, seasonal, and technical measures that can be used to improve stock status and regulate fishing mortality. This is because they have defined spatially discrete life history stages, and because stock–recruitment relationships are believed to be very strong.

Comparison with previous assessment and advice

The previous advice was given for 2011 and 2012. The basis of this advice was ICES precautionary approach. This year, individual advice is given for each of the main stocks, on the basis of ICES approach to data-limited stocks. An overall TAC advice is also provided using ICES approach to data-limited stocks.

Scientific basis

Assessment type	Survey-based trends.
Input data	IBTS Q1 Survey, including French, UK (Scotland), Norwegian, Swedish, Danish, German, and Dutch surveys. IBTS Q3 Survey, including UK (England), UK (Scotland), Swedish, Danish, and German surveys. UK Beam trawl survey.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

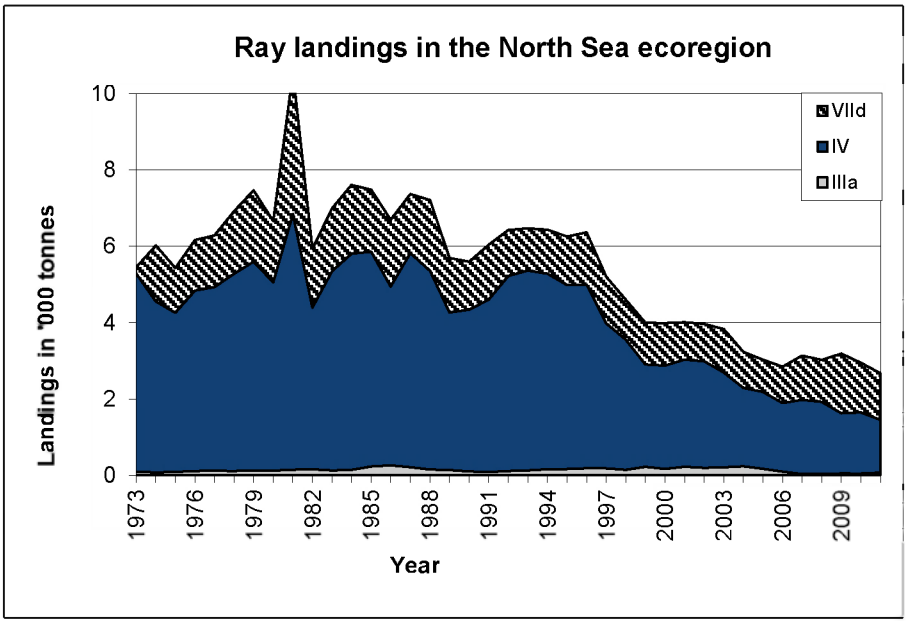


Figure 6.4.24.1 Rays and skates in the North Sea, Skagerrak, Kattegat, and eastern Channel. Landings (in thousand tonnes) of skates and rays per ICES (sub)area.

Table 6.4.24.2 Rays and skates in the North Sea, Skagerrak, Kattegat, and eastern Channel. Total landings of skates (Rajidae) in ICES Division IIIa. "." indicates zero landings, "+" indicates landings < 0.5, and "n.a." indicates not available.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	.	.	.	.	.	.	.	.	.	.	.	.	.
Denmark	11	41	56	22	36	129	65	26	8	5	12	12	44
Germany	.	.	.	.	.	.	.	1	.	.	.	.	+
Iceland	.	.	.	.	.	.	.	.	.	.	.	.	.
Netherlands	.	.	.	.	.	.	.	.	+	.	.	.	.
Norway	208	123	154	159	163	85	94	51	13	23	33	24	25
Sweden	2	2	12	13	9	20	10	18	11	6	2	10	+
UK (E, W_& NI)	.	.	.	.	.	.	.	.	.	.	.	.	.
UK (Scotland)	.	.	.	.	.	.	.	.	.	.	.	.	.
Total of submitted data	221	166	222	194	208	234	169	95	32	34	47	45	69

Table 6.4.24.3 Rays and skates in the North Sea, Skagerrak, Kattegat, and eastern Channel. Total landings of skates (Rajidae) in ICES Subarea IV. Note that "." indicates zero landings, "+" indicates landings < 0.5, and "n.a." indicates not available.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	336	332	370	436	323	276	327	350	272	371	299	294	231
Denmark	45	93	65	34	33	25	23	26	27	23	29	30	38
Faroe Islands	.	.	.	.	.	.	.	.	.	.	.	n.a.	n.a.
France	41	31	61	62	36	37	34	15	56	69	74	89	57
Germany	16	23	11	22	21	17	29	16	17	30	21	32	19
Iceland	.	.	.	.	.	.	.	.	.	.	.	.	n.a.
Ireland	.	.	.	.	.	.	.	.	119	.	.	.	.
Netherlands	515	693	834	805	686	561	680	603	721	564	379	390	212
Norway	152	161	173	83	113	77	87	96	71	97	119	105	56
Poland	.	.	.	.	.	.	.	.	.	.	.	.	n.a.
Sweden	+	+	+	+	+	+	+	+	+	+	+	+	2
UK (E, W_& NI)	618	516	476	500	537	550	434	348	329	392	348	372	413
UK (Scotland)	965	860	822	853	741	512	404	374	331	343	311	289	358
Total of submitted data	2688	2709	2812	2794	2490	2055	2018	1801	1944	1889	1580	1602	1385

Table 6.4.24.4 Rays and skates in the North Sea, Skagerrak, Kattegat, and eastern Channel. Total landings of skates (Rajidae) in ICES Division VIId. "." indicates zero landings, "+" indicates landings < 0.5, and "n.a." indicates not available.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	93	69	79	113	153	96	94	109	164	174	125	111	103
France	558	693	729	725	796	695	602	687	792	710	1270	1043	954
Germany	.	+	.	.	.	.	.	.	.	.	.	.	.
Ireland	.	.	.	.	.	.	.	.	.	.	.	.	.
Netherlands	.	.	.	.	.	.	.	13	21	13	10	11	12
Spain	.	.	.	.	.	.	.	.	.	.	.	.	0
UK (E, W_& NI)	437	355	169	140	186	157	147	139	188	199	152	133	141
UK (Scotland)	.	.	.	.	.	.	.	2	.	6	8	5	6
Total of submitted data	1088	1117	977	978	1135	948	843	948	1165	1102	1564	1303	1217

Table 6.4.24.5 Rays and skates in the North Sea, Skagerrak, Kattegat, and eastern Channel. Total landings of skates (Rajidae) North Sea, Skagerrak, Kattegat, and eastern Channel. "." indicates zero landings, "+" indicates landings < 0.5, and "n.a." indicates not available.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Belgium	429	401	449	548	476	372	422	459	436	545	424	405	334
Denmark	56	134	121	56	69	154	88	52	35	28	41	42	81
Faroe Islands	.	.	.	.	.	.	.	.	.	.	.	n.a.	n.a.
France	599	724	790	725	796	732	636	701	848	779	1344	1132	1011
Germany	16	23	11	22	21	17	29	17	17	30	21	32	19
Iceland	.	.	.	.	.	.	.	.	.	.	.	.	.
Ireland	.	.	.	.	.	.	.	.	119	.	.	.	.
Netherlands	515	693	834	805	686	561	680	615	742	577	389	401	224
Norway	360	284	327	242	276	162	181	120	84	120	152	129	81
Poland	.	.	.	.	.	.	.	.	.	.	.	.	n.a.
Spain	.	.	.	.	.	.	.	.	.	.	.	.	n.a.
Sweden	2	2	12	13	9	20	10	18	11	6	2	10	3
UK (E&W and NI)	1055	871	645	640	723	707	580	487	517	591	500	504	555
UK (Scotland)	965	860	822	853	741	512	404	375	331	349	320	295	365
Total of submitted data	3997	3992	4011	3904	3797	3237	3030	2845	3141	3025	3192	2951	2671

ECOREGION North Sea
STOCK Blonde ray (*Raja brachyuran)* in Divisions IVc and VIId, e (Southern North Sea and English Channel)

Advice for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches should be decreased by at least 20%. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this stock, at present.

Additional measures should be identified that can regulate exploitation of this species. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	
	2009–2011
Qualitative evaluation	? Unknown

The state of the stock is unknown and there is insufficient information to present trends in species-specific landings for this stock. Blonde ray has a patchy occurrence in the North Sea. It is at the edge of its distributional range in this area.

It is captured in coastal waters of this survey area, but generally in low numbers. Catch rates fluctuate as a result of this. Numbers in other surveys are too low to evaluate trends.

Management plans

No specific management objectives are known to ICES.

Biology

This is one of the larger-bodied, moderately long-lived skate species.

The fisheries

This species is usually caught as a bycatch in demersal fisheries.

Effects of the fisheries on the ecosystem

Some demersal sharks, including lesser-spotted dogfish, may benefit from scavenging on trawl-damaged organisms and discards.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data are reported to this level. This information covers too short a time period to influence advice at the present time, and in some instances there are data quality issues (e.g. the proportion of blonde ray and spotted ray). The advice is based on a precautionary reduction of catches because of missing or non-representative data. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	UK Q3 Beam trawl survey.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Blonde ray (*Raja brachyuran)* in Divisions IVc and VIId, e (Southern North Sea and English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

No reliable assessment can be presented for this species. It has a patchy occurrence in the North Sea and is at the edge of its distributional range in this area. Survey trends may not be reliable due to the low numbers captured in certain areas.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation rate is appropriate for the stock.

Following this approach, ICES advises that catches should decrease by 20% in relation to the last three years' average landings. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this stock, at present.

Additional measures should be identified that can regulate exploitation of this stock. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Additional considerations

This species is captured in coastal waters of this survey area, but generally in low numbers. The stock is believed to extend into the Celtic Sea.

Management considerations

TACs only regulate the landings, and a low TAC on a low-value bycatch species could induce more discards. Because this species are usually caught as a bycatch in demersal fisheries, it would benefit from a reduction in the overall demersal fishing effort.

Management measures should aim to regulate fishing mortality and maintain SSB above any candidate reference point. In developing such measures, the linkages between the Channel and the Celtic Sea should be considered.

Uncertainties in the assessment

There are known identification problems between blonde ray and spotted ray (*R. montagui*) in landings and potentially in surveys.

While blonde ray are caught in the UK Q3 Beam-trawl survey, this survey is not considered sufficiently reliable to be used as an abundance index for this stock. Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

Comparison with previous assessment and advice

No species-specific advice has previously been provided for blonde ray in Divisions VIId, e. The advice is based on category 5 of ICES approach to advice provision in data-limited situations.

Sources

Ellis, J. R. 2010. An overview of the demersal elasmobranchs in the eastern English Channel (ICES Division VIId). Working Document for WGEF 2010. WD2010-16.

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

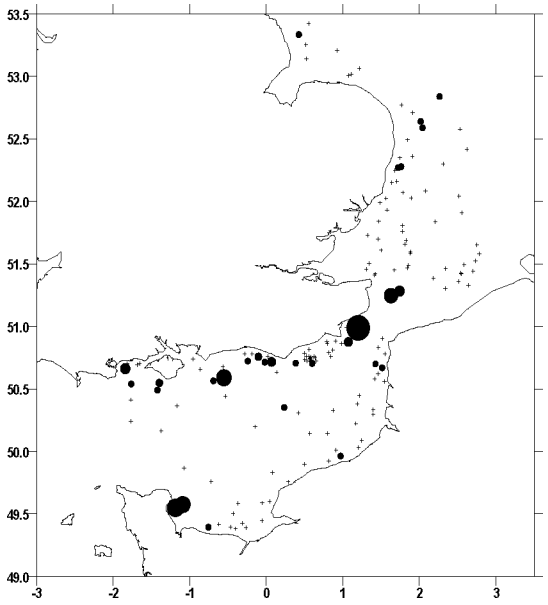


Figure 6.4.24.1.1 Blonde ray (*Raja brachyura*) in Divisions IVc and VIId, e. Distribution and relative abundance of blonde ray in the survey area (from Ellis, 2010).

Table 6.4.24.1.1 Blonde ray (*Raja brachyura*) in Divisions IVc and VIId, e. ICES advice, management, and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2011	No specific advice		168
2012	No specific advice		
2013	No TAC, species-specific measures needed, catch to decrease by at least 20%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea

STOCK Thornback ray (*Raja clavata*) in Subarea IV and in Divisions IIIa and VIId, e (North Sea, Skagerrak, Kattegat, and English Channel)

Advice for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches could be increased by a maximum of 20%. However, ICES does not advise that an individual TAC be set for this species, at present.

Additional measures should be identified that can regulate exploitation of this species. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by managers through stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	
	2005–2011
Qualitative evaluation	Increasing

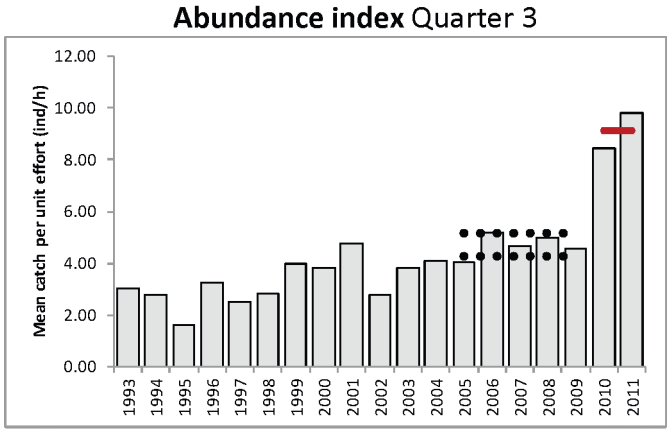


Figure 6.4.24.2.1 Thornback ray in Divisions and Subarea IIIa, IV, and VIId, e. Abundance estimates in Division IVc–VIId (mean survey catch rates, UK Beam-trawl survey Q3). Dashed lines show the mean ±1 std. dev. annual cpue for 2005–2009, the red line shows the mean annual cpue for 2010–2011.

There is insufficient information to present trends in species-specific landings for this stock. Thornback ray in this area are now concentrated in the southwestern part of the ecoregion, where it is the main commercial skate species. The stock has increased, considering the abundance estimate (survey catch rates) in the last two years is 95% above the previous five year average.

Management plans

No specific management objectives are known to ICES.

Biology

Many elasmobranchs are slow growing, having a late age-at-maturity and a low reproductive capacity. Thornback ray are oviparous, and often produce more young than live-bearing species. The large size and aggregating behaviour of elasmobranchs make them susceptible to over-exploitation.

Environmental influence on the stock

Resource competition and species interactions between the various skate species is poorly understood. Historically, common skate have been known to predate on smaller skate individuals, and the longer-term decline in the larger skates may have benefited populations of smaller skate species.

The fisheries

Thornback ray is the most commercially important ray species in this ecoregion. It is mainly caught close to shore. Considerable catches are taken in artisanal coastal fisheries in southeast England.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data have been reported to this level. This information covers too short a time period to influence advice at the present time.

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species. The UK Q3 beam trawl survey is considered to sample the main stock in Divisions IVc and VIId, e more effectively than the IBTS, given that there are more stations in the main stock area, and that the gear is more effective at sampling smaller skates.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Assessment type	Survey-based trends.
Input data	IBTS Q3 Survey, UK Beam trawl survey.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Thornback ray (*Raja clavata)* in Subarea IV and in Divisions IIIa and VIId, e (North Sea, Skagerrak, Kattegat, and English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the five preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by 95% between 2005 and 2009 (average of the five years) and 2010–2011 (average of the two years). This implies an increase of catches of 20% in relation to the last three years' average. Additional measures should be identified that can regulate exploitation of this species. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

A precautionary buffer has not been applied as the abundance increase is significantly large.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Additional considerations

In historical times, this species was distributed across the North Sea. However, it is now mainly confined to the southwestern North Sea. Within this restricted range, it appears to be increasing in abundance.

Given its discrete distribution in the southwestern North Sea, and its being targeted in artisanal and static gear fisheries, this species could be a good candidate for specific spatial, seasonal, and technical measures.

Comparison with previous assessment and advice

The advice is different to that provided in previous years. In 2011 and 2012, *status quo* catch was advised, based on the precautionary approach. The current advice is based on category 3 of ICES approach to advice provision in data-limited stocks.

Sources

Ellis, J. R. 2010. An overview of the demersal elasmobranchs in the eastern English Channel (ICES Division VIId). Working Document for WGEF 2010. WD2010-16.

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

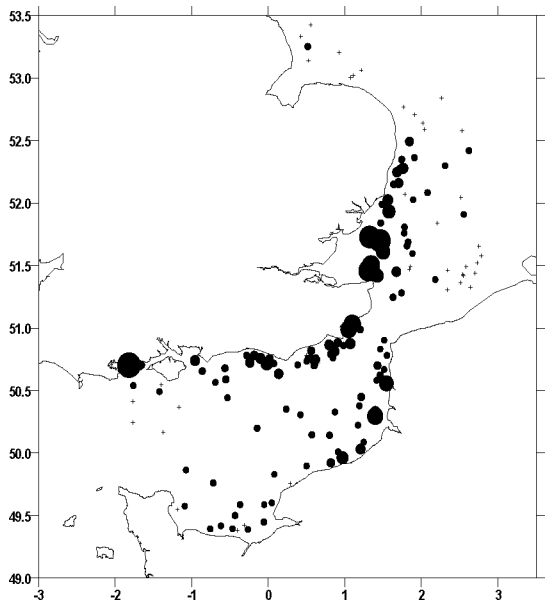


Figure 6.4.24.2.2 Thornback ray (*Raja clavata)* in Divisions and Subarea IIIa, IV, and VIId, e. Distribution and relative abundance of *Raja clavata* in the survey area (from Ellis, 2010).

Table 6.4.24.2.1 Thornback ray (*Raja clavata*) in Divisions and Subarea IIIa, IV, and VIId, e. ICES advice, management, and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2006	Zero catch	0	
2007	Zero catch	0	
2008	No new advice, same as 2007		
2009	*Status quo* catch		
2010	No new advice, same as 2009		
2011	*Status quo* catch		1335
2012	No new advice, same as 2011		
2013	No TAC, species-specific measures needed, catch could increase by max. 20%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea
STOCK Small-eyed ray (*Raja microocellata*) in Divisions VIId, e (English Channel)

Advice for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches should be decreased by at least 20%. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this stock, at present.

Additional measures should be identified that can regulate exploitation of this species. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed through stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	
	2009–2011
Qualitative evaluation	? Unknown

The state of the stock is unknown and there is insufficient information to present trends in species-specific landings for this stock.

Management plans

No specific management objectives are known to ICES.

Biology

This is a medium-bodied skate species of intermediate productivity. Small-eyed ray only occurs in the southern part of this ecoregion (eastern English Channel), as an extension of the western Channel stock.

The fisheries

Only marginal bycatches occur for this species.

Quality considerations

Numbers caught are low and there may be issues of misidentification. Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data have been reported to this level. This information covers too short a time period to influence advice at the present time.

The advice is based on a precautionary reduction of catches because of missing or non-representative data. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Small-eyed ray (*Raja microocellata*) in Divisions VIId, e (English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

No reliable assessment can be presented for this stock. The main cause of this is the limited time-series of species-specific landings data at the present time.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation rate is appropriate.

For this species, ICES advises that catches should decrease by 20%. However, as species-specific landings data are not complete, it is not possible to quantify the current catch at the present time. ICES does not advise that an individual TAC be set for this species, at present.

Additional measures should be identified that can regulate exploitation of this species. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Additional considerations

Management considerations

TACs only regulate the landings, and a low TAC on a low-value bycatch species could induce more discards. Because this species is usually caught as a bycatch in demersal fisheries, it would benefit from a reduction in the overall demersal fishing effort.

Management for this species should be applied across the Channel and the eastern Celtic Sea, as it is likely that this constitutes one stock in these areas.

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

Comparison with previous assessment and advice

ICES has not previously provided species-specific advice for this stock. Advice is based on category 5 of ICES approach to data-limited stocks.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

Table 6.4.24.3.1 Small-eyed ray in the North Sea and English Channel. ICES advice, management, and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2011	No specific advice		18
2012	No specific advice		
2013	No TAC, species-specific measures needed, catch to decrease by at least 20%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea

STOCK Spotted ray (*Raja montagui*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Advice for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches could be increased by a maximum of 20%. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this species, at present.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	
	2005–2011
Qualitative evaluation	Increasing

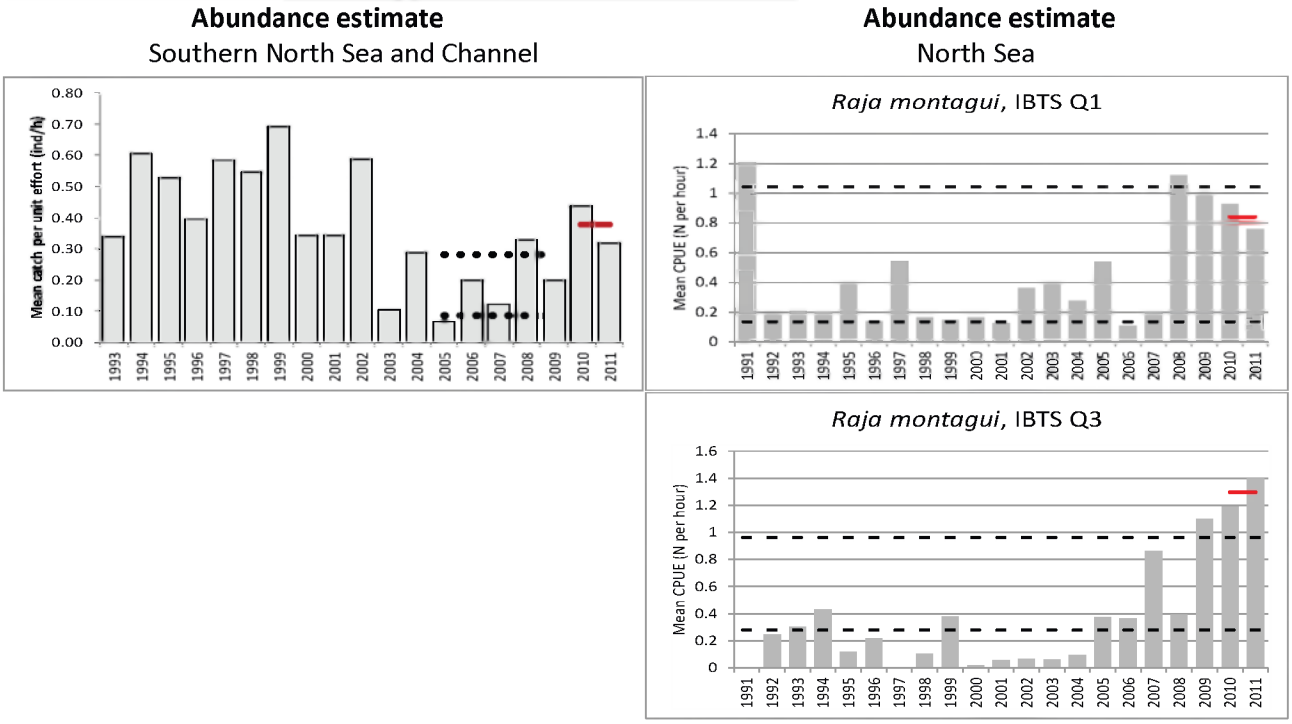


Figure 6.4.24.4.1 Spotted ray (*Raja montagui*) in Divisions and Subarea IIIa, IV, and VIId. Left: Abundance estimate (mean cpue) in Division IVc, UK Beam-trawl survey Q3 IVc,VIId. Right: Abundance estimate in Subarea IV, IBTS trawl survey in quarter 1 (top) and quarter 3 (below). Dashed lines show the mean ±1 std. dev. annual cpue for 2005–2009, the red line shows the mean annual cpue for 2010–2011.

There is insufficient information to present trends in species-specific landings for this species. Abundance is estimated to have increased between the average of the last two years compared to the previous five years by between 43% (southern North Sea) and 109% (in quarter 3 in the North Sea). The quarter 3 survey mainly catches juveniles, and may indicate an increase in recruitment in the past three years.

Management plans

No specific management objectives are known to ICES.

Biology

The stock of spotted ray is concentrated in Divisions IVb, c. However, recent survey data show that this species is wide ranging in the ecoregions and can also be found in Division IVa.

The fisheries

This species is usually caught as a bycatch in demersal fisheries.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data have been reported to this level. This information covers too short a time period to influence advice at the present time, and in some instances there are data quality issues (e.g. there are identification issues between spotted ray and blonde ray (*Raja brachyura*).

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey-based trends.
Input data	UK Beam trawl survey, IBTS Q1 survey, and IBTS Q3 survey.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Spotted ray (*Raja montagui*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the five preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by more than 20% between 2005 and 2009 (average of the five years) and 2010–2011 (average of the two years). These surveys are considered indicative of overall stock abundance. This implies an increase of catches of at most 20% in relation to the last three years' average. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this stock, at present.

A precautionary buffer has not been applied as the abundance increase is significantly large.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Additional considerations

Management considerations

TACs only regulate the landings, and a low TAC on a low-value bycatch species could induce more discards. Because this species is usually caught as a bycatch in demersal fisheries, it would benefit from a reduction in the overall demersal fishing effort.

Comparison with previous assessment and advice

ICES has not previously provided species-specific advice for this stock. Advice is based on category 3 of ICES approach to data-limited stocks.

Sources

Ellis, J. R. 2010. An overview of the demersal elasmobranchs in the eastern English Channel (ICES Division VIId). Working Document for WGEF 2010. WD2010-16.

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

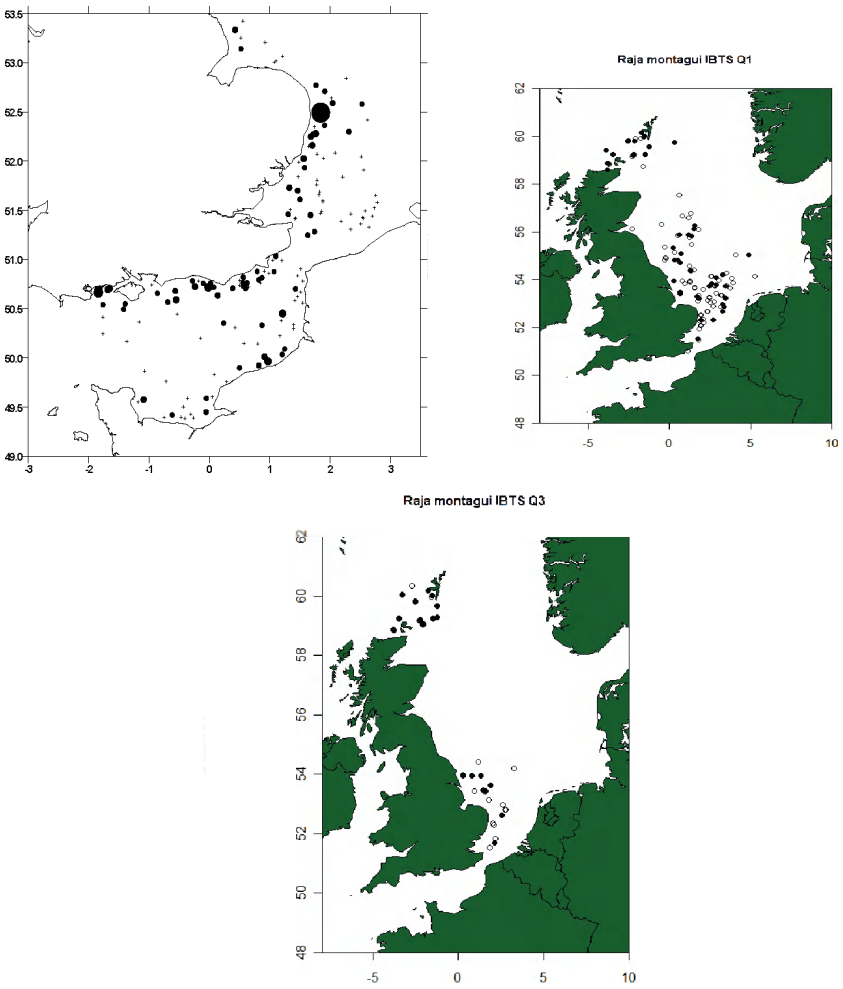


Figure 6.4.24.4.2 Distribution and relative abundance of spotted ray in the survey area (from Ellis, 2010 and IBTS).

Table 6.4.24.4.1 Spotted ray in the North Sea, Skagerrak, Kattegat, and eastern English Channel. ICES advice and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2009	*Status quo* catch	-	
2010	No new advice, same as 2010	-	
2011	*Status quo* catch	-	262
2012	No new advice, same as 2011	-	
2013	No TAC, species-specific measures needed, catch to decrease by at least 20%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea
STOCK Undulate ray (*Raja undulata*) in Divisions VIId, e (English Channel)

Advice for 2013 and 2014

Based on the precautionary approach ICES continues to advise that there be no targeted fishery for undulate ray unless information is provided to show that these are sustainable. Measures should be taken to minimize bycatch.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	
	2009–2011
Qualitative evaluation	? Unknown

There is no new information to alter the perception of the stock, which is uncertain. The species is locally common in discrete areas. Abundance estimates are low and highly variable, but the survey does not cover the main stock area sufficiently.

Management plans

Undulate ray has been on the EU prohibited species list since 2009.

Biology

Raya undulata is considered to be patchily distributed within this ecoregion, mostly in inshore waters of the English Channel. Catches here are comprised mainly of juveniles, in the eastern Channel. This stock extends into the western English Channel, and Division VIIe comprises the main part of the stock.

Undulate ray appears to form a discrete population in the English Channel that is isolated from other stocks of undulate ray. This is one of the larger-bodied rays, and is likely to have a life history that is more conservative than smaller species like spotted ray. In view of its isolated nature, this population is particularly vulnerable.

The fisheries

Undulate ray are one of the main bycaught species in the English Channel.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data have been reported to this level. This information covers too short a time period to influence advice at the present time.

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	UK Beam trawl survey (Q3).
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Undulate ray (*Raja undulata*) in Divisions VIId, e (English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

Precautionary approach

Based on the precautionary approach, ICES advises that there be no targeted fishery for undulate ray unless information is provided to show that these are sustainable. Measures should be taken to minimize bycatch.

Available evidence shows that there may be discrete stocks in the English Channel. In view of the patchy distribution, and following the precautionary approach, ICES recommends that no target fisheries (defined in terms of percentage of total catch) should be permitted unless information is provided to show that these are sustainable. Such information should include information on distribution, stock identity, and abundance trends.

Additional considerations

Uncertainty in the assessment

Survey catch rates (abundance estimates) are low and highly variable (Figure 6.4.24.5.1). Juveniles tend to be caught in coastal areas. Although adults are known to occur in the area (Ellis *et al.*, 2012), the low density of stations to the west of the survey grid means that the main stock area is sampled poorly. Although absent in 2006–2007, the species has been present each year since.

Comparison with previous assessment and advice

The advice and the basis for advice are unchanged.

Sources

Ellis, J. R. 2010. An overview of the demersal elasmobranchs in the eastern English Channel (ICES Division VIId). Working Document for WGEF 2010. WD2010-16.

Ellis, J. R., McCully, S. R., and Brown, M. J. 2012. An overview of the biology and status of undulate ray *Raja undulata*. Journal of Fish Biology, 80: 1057–1074.

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

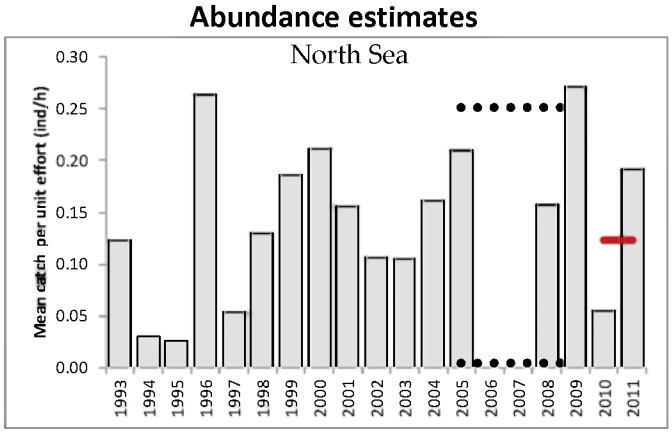


Figure 6.4.24.5.1 Undulate ray (*Raja undulata*) in Divisions VIId and VIIe. Mean cpue of Divisions IVc–VIId undulate ray, UK Beam-trawl survey Q3. Dashed lines show the mean ±1 std. dev. annual cpue for 2005–2009, the red line shows the mean annual cpue for 2010–2011.

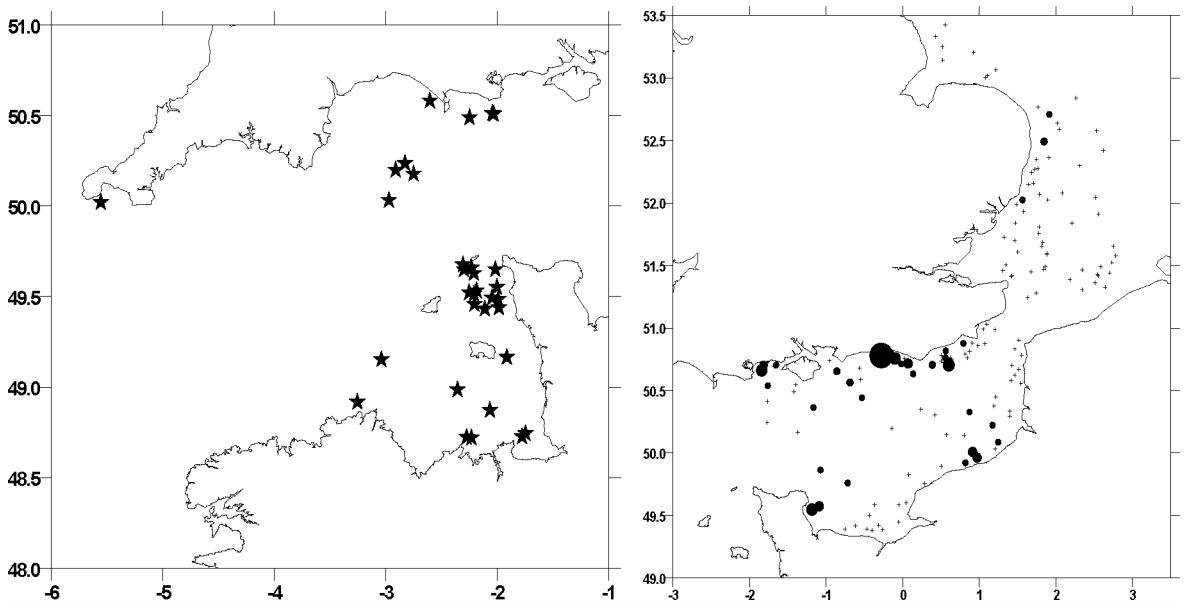


Figure 6.4.24.5.2 Left: Undulate ray in the western English Channel UK beam trawl survey (presence/absence only) 2006–2010 (Ellis, 2010). Right: Undulate ray in the eastern English Channel. Relative abundance. UK beam trawl survey 2003–2011.

Table 6.4.24.5.1 Undulate ray in the English Channel. ICES advice and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2009	No targeted fishery	-	
2010	No new advice, same as 2009		
2011	No targeted fishery	-	3
2012	No new advice, same as 2011		
2013	No targeted fishery, minimize bycatch	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea
STOCK Cuckoo ray (*Leucoraja naevus*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Advice for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches could be increased by a maximum of 20%. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this stock, at present.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed through stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown
SSB (Spawning-Stock Biomass)	
	2005–2011
Qualitative evaluation	↗ Increasing

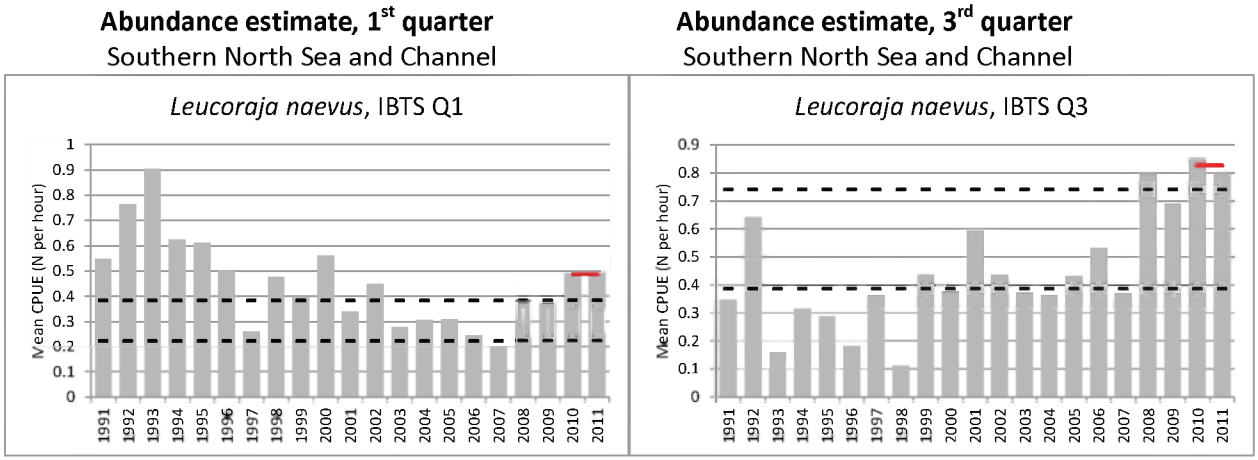


Figure 6.4.24.6.1 Cuckoo ray (*Leucoraja naevus*) in Divisions and Subarea IIIa, IV, and VIId. Mean abundance (catch per unit effort) in Division IV, IBTS trawl survey Q1 (top left) and IBTS Trawl survey Q3 (top right). Dashed lines show the mean ±1 std. dev. annual cpue for 2005–2009, the red line shows the mean annual cpue for 2010–2011.

There is insufficient information to present trends in species-specific landings. Abundance estimates have increased by 61% (Q1) and 47% (Q3), comparing the last two years with the previous five year survey averages.

Management plans

No specific management objectives are known to ICES.

Biology

This is a largely offshore species caught in mixed fisheries in the central and northern North Sea. Cuckoo ray in this ecoregion is primarily found in Divisions IVa and IVb. The stock may extend into Subarea VI.

Environmental influence on the stock

Resource competition and species interactions between the various skate species is poorly understood. Historically, common skate were known to predate on smaller skate individuals, and the longer-term decline in the larger skates may have benefited populations of smaller skate species.

The fisheries

Cuckoo ray is a commercial species. They are a more offshore species than the (inshore) Rajidae and so are normally caught by the beam and otter trawl fleets rather than by gill or tangle nets.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data have been reported to this level. This information covers too short a time period to influence advice at the present time.

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Assessment type	Survey-based trends.
Input data	IBTS Q1 survey, IBTS Q3 survey.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Cuckoo ray (*Leucoraja naevus)* in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the five preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by more than 20% between 2005 and 2009 (average of the five years) and 2010–2011 (average of the two years). This implies an increase of catches of at most 20% in relation to the last three years' average. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for this stock, at present.

A precautionary buffer has not been applied as the abundance increase is significantly large.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

This is the first year ICES is providing quantitative advice for data-limited stocks.

Additional considerations

Comparison with previous assessment and advice

ICES has not previously provided species-specific advice for this stock (Table 6.4.24.6.1). Advice is based on category 3 of ICES approach to data-limited stocks.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

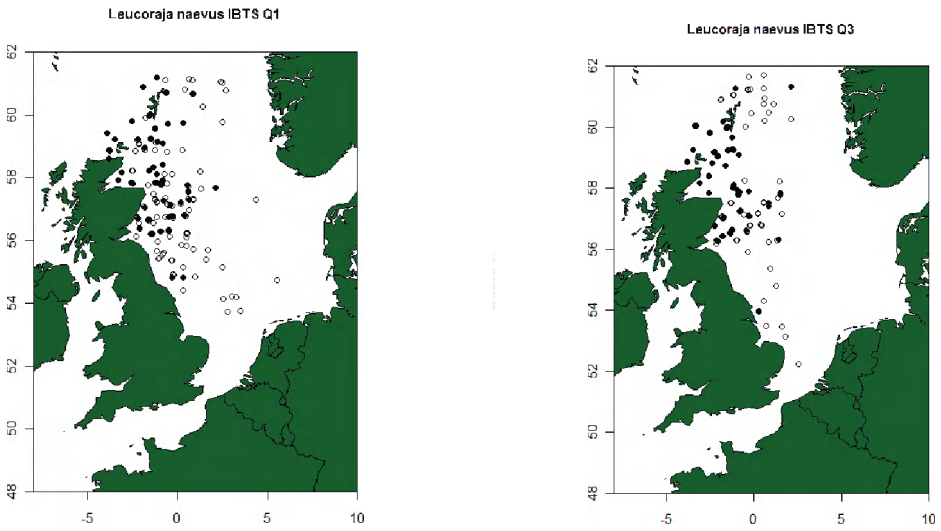


Figure 6.4.24.6.2 Distribution of *Leucoraja naevus* within the surveys. Closed circles show presence for 2010–2011, open circles show presence for 2005–2009.

Table 6.4.24.6.1 Cuckoo ray in the North Sea. ICES advice and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2009	*Status quo* catch	-	
2010	No new advice, same as 2009	-	
2011	*Status quo* catch	-	165
2012	No new advice, same as 2011	-	
2013	No TAC, species-specific measures needed, catch could increase by max. 20%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea
STOCK Common skate (*Dipturus batis*) complex (*Dipturus* cf. *flossada* and *Dipturus* cf. *intermedia*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Advice for 2013 and 2014

Based on the precautionary approach, ICES advises that there should be no targeted fishery for either *Dipturus* cf. *flossada* or *Dipturus* cf. *intermedia*, and measures should be taken to minimize bycatch.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

Stock status

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	2009–2011
Qualitative evaluation	✗ Depleted

The common skate (*Dipturus batis*) complex is now considered to be depleted in the North Sea. Limited information suggests that only *D.* cf. *intermedia* is found in the ecoregion, and only to the north where it likely merges with the neighbouring population in Subareas VI and II.

Management plans

The *Dipturus batis* complex is currently on the EU prohibited species list.

Biology

Common skate has a late age-at-maturity and a low reproductive capacity. They are considered to be particularly vulnerable due to their large size. These are very large, slow-growing species, and as such are highly vulnerable to overfishing. It is now only found in the northern part of the ecoregion.

Environmental influence on the stock

Resource competition and species interactions between the various skate species is poorly understood. Historically, common skate have been known to predate on smaller skate individuals, and the longer-term decline in the larger skates may have benefited populations of smaller skate species.

The fisheries

Commercial fisheries existed for the common skate complex in the past, but declining numbers now means that recent catches have been pure bycatch.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data have been reported to this level. This information covers too short a time period to influence advice at the present time. Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for these species.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	Survey indices, not sufficiently representative for the stock.
Other information	Life history
Working group report	WGEF

ECOREGION North Sea

STOCK Common skate (*Dipturus batis*) complex *(Dipturus* cf. *flossada* and *Dipturus* cf. *intermedia)* in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

Precautionary approach

ICES advises on the basis of the precautionary approach that there should be no targeted fishery for either *Dipturus* cf. *flossada* or *Dipturus* cf. *intermedia*. Measures should be taken to minimize bycatch.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

Additional considerations

Comparison with previous assessment and advice

The advice and the basis of advice are the same as for 2011 and 2012.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

Table 6.4.24.7.1 Common skate (*Dipturus batis*) complex *(Dipturus* cf. *flossada* and *Dipturus* cf. *intermedia)* in Divisions and Subarea IIIa, IV, and VIId. ICES advice and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2006	No targeted fishery		
2007	No targeted fishery		
2008	No new advice, same as 2007		
2009	No targeted fishery	0	
2010	No new advice, same as 2009	0	
2011	No targeted fishery	0	15
2012	No new advice, same as 2011	0	
2013	No targeted fisheries, minimize bycatch.	0	
2014	No new advice, same as 2013	0	

Weights in tonnes.

ECOREGION North Sea

STOCK Starry ray *(Amblyraja radiata)* in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Advice for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches should be reduced by 36%. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise on an individual TAC for this species, which is discarded in most fisheries.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

Stock status

F (Fishing Mortality)	
	2009–2011
Qualitative evaluation	? Unknown
SSB (Spawning-Stock Biomass)	
	2005–2011
Qualitative evaluation	Declining

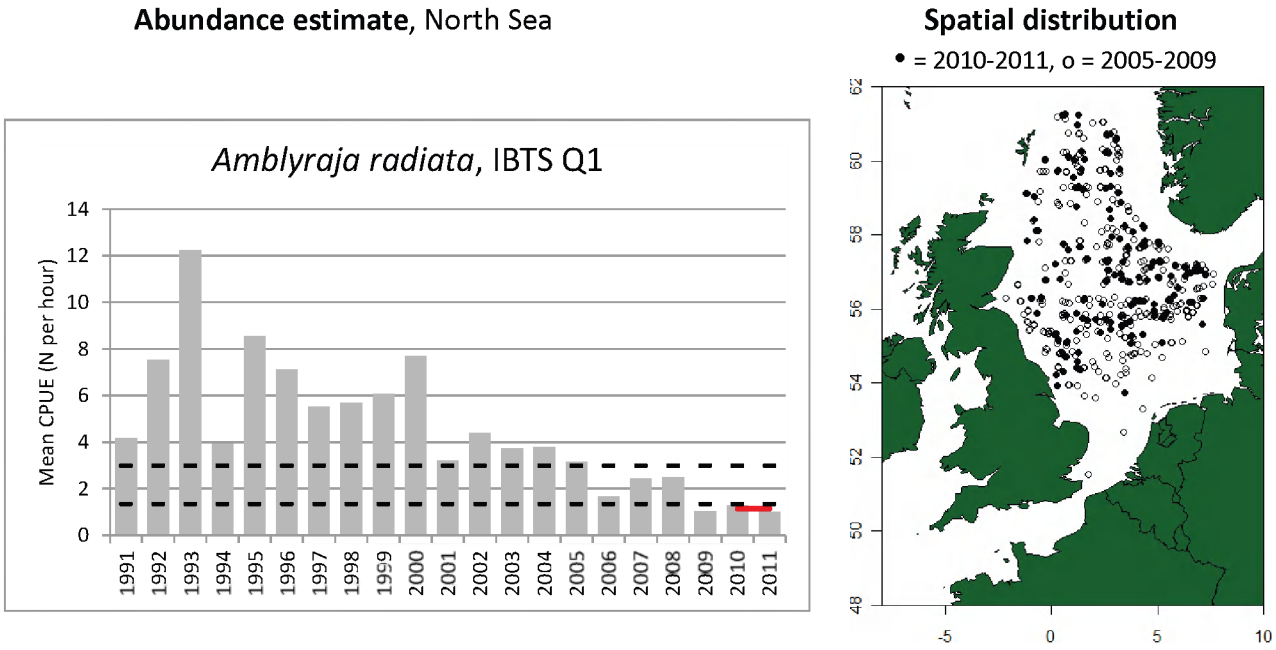


Figure 6.4.24.8.1 Starry ray *(Amblyraja radiata)* in Divisions and Subarea IIIa, IV, and VIId. Left: Abundance estimate (survey catch per unit effort, cpue). Dashed lines show the mean annual cpue ±std. dev. for 2005–2009, the red line shows the mean annual cpue for 2010–2011. Right: Distribution of *Amblyraja radiata*. Closed circles show presence for 2010–2011, open circles show presence for 2005–2009.

There is insufficient information to present trends in species-specific landings for this species. Starry ray is widespread throughout the region, with no evidence of change of distribution. Abundance estimates have been declining over the last decade, with a 47% decrease between the average of the last two years compared to the previous five years.

Management plans

No specific management objectives are known to ICES.

Biology

This is a small-bodied, quite productive ray. Its abundance increased in the 1990s before declining again.

Environmental influence on the stock

This is a cold-water ray that extended its range into the North Sea from boreal waters. Cooler temperatures would be associated with increasing range and abundance of this stock.

The fisheries

Starry ray is a small-bodied ray, of little commercial importance and mainly discarded. Because it is usually caught as a bycatch in demersal fisheries, this species would benefit from a reduction in the overall demersal fishing effort.

Quality considerations

Little information is available on discarding of this species, but it is known to be comparatively high.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey-based trends.
Input data	IBTS Q1 survey.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Starry ray *(Amblyraja radiata)* in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses as harvest control rule an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the five preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have decreased by more than 20% in the main survey, between 2005 and 2009 (average of the five years) and 2010–2011 (average of the two years). This implies a decrease in catches of at most 20% in relation to the last three years' average.

Additionally, the precautionary buffer is applied because of lack of information on exploitation rate, resulting in overall advice for a 36% decrease in catch. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise on an individual TAC for this species that is discarded in most fisheries.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

Additional considerations

Comparison with previous assessment and advice

ICES has not previously provided species-specific advice for this stock. Advice is based on category 3 of ICES approach to data-limited stocks.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

Table 6.4.24.8.1 Starry ray in the North Sea, Skagerrak, Kattegat, and eastern Channel. ICES advice and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2011	No specific advice		< 1
2012	No specific advice		
2013	No TAC, species-specific measures needed, catch to decrease by at least 36%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea
STOCK Other ray and skate species in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Advice for 2013 and 2014

Other species of skates and ray are also found in this ecoregion. These include:

Dipturus linteus, Dipturus nidarosiensis, Dipturus oxyrhinchus, Leucoraja circularis, and *Leucoraja fullonica.*

Based on ICES approach to data-limited stocks, ICES advises that catches should be decreased by at least 20%. However, ICES does not advise that individual TACs be set for these stocks, at present.

Additional measures should be identified that can regulate exploitation of these species. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

Stock status

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Unknown

SSB (Spawning-Stock Biomass)	2009–2011
Qualitative evaluation	? Unknown

There is insufficient survey or abundance data available to assess these species individually. There is insufficient information to present trends in species-specific landings.

Management plans

No specific management objectives are known to ICES.

Biology

There are a variety of species declared in this category. Members of the *Dipturus* family are large-bodied skates.

The fisheries

These species are bycaught in small quantities in different fisheries.

Quality considerations

Since legal obligations to declare most demersal elasmobranchs to species level were introduced, a greater proportion of data are reported to this level. This information covers too short a time period to influence advice at the present time.

Fishery-independent trawl surveys provide the longest time-series of species-specific information, although these surveys do not sample all the size classes and habitats for the various species.

The advice is based on a precautionary reduction of catches because of missing or non-representative data. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea
STOCK Other ray and skate species in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

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

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For these species, ICES advises that catches should decrease by 20% in relation to the last three years' average. However, as species-specific landings data are not complete, it is not possible to quantify the current catch. ICES does not advise that an individual TAC be set for these stocks, at present.

Additional measures should be identified that can regulate exploitation. Such measures may include seasonal and/or area closures, technical measures, and tailored measures for target fisheries. Such measures should be developed by stakeholder consultations, considering the overall mixed fisheries context.

Additional considerations

Comparison with previous assessment and advice

ICES has not previously provided species-specific advice for these species/stocks. Advice is based on category 5 of ICES approach to data-limited stocks.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

Table 6.4.24.9.1 Other ray and skate species in Divisions and Subarea IIIa, IV, and VIId. ICES advice and landings.

Year	ICES advice	Predicted catch corresp. to advice	ICES Species-specific landings:– minimum estimate based on reported landings
2011	No specific advice		905
2012	No specific advice		
2013	No TAC, species-specific measures needed, catch to decrease by at least 20%.	-	
2014	No new advice, same as 2013	-	

Weights in tonnes.

ECOREGION North Sea
STOCK Mixed-fisheries advice

Advice for 2013

This is the first time ICES presents options for mixed fisheries in the North Sea. This advice is based on the single-stock assessments combined with knowledge on the species composition in catches in North Sea fisheries. Five example scenarios of fishing opportunities considering mixed fisheries are presented, taking into account the single stock advice for fisheries catching cod, haddock, whiting, saithe, plaice, sole, and *Nephrops*. Without specific mixed-fisheries management objectives, ICES cannot recommend specific scenario(s). From the scenarios presented here, the most precautionary option would be the 'Minimum' scenario where fishing stops when the first TAC is fished.

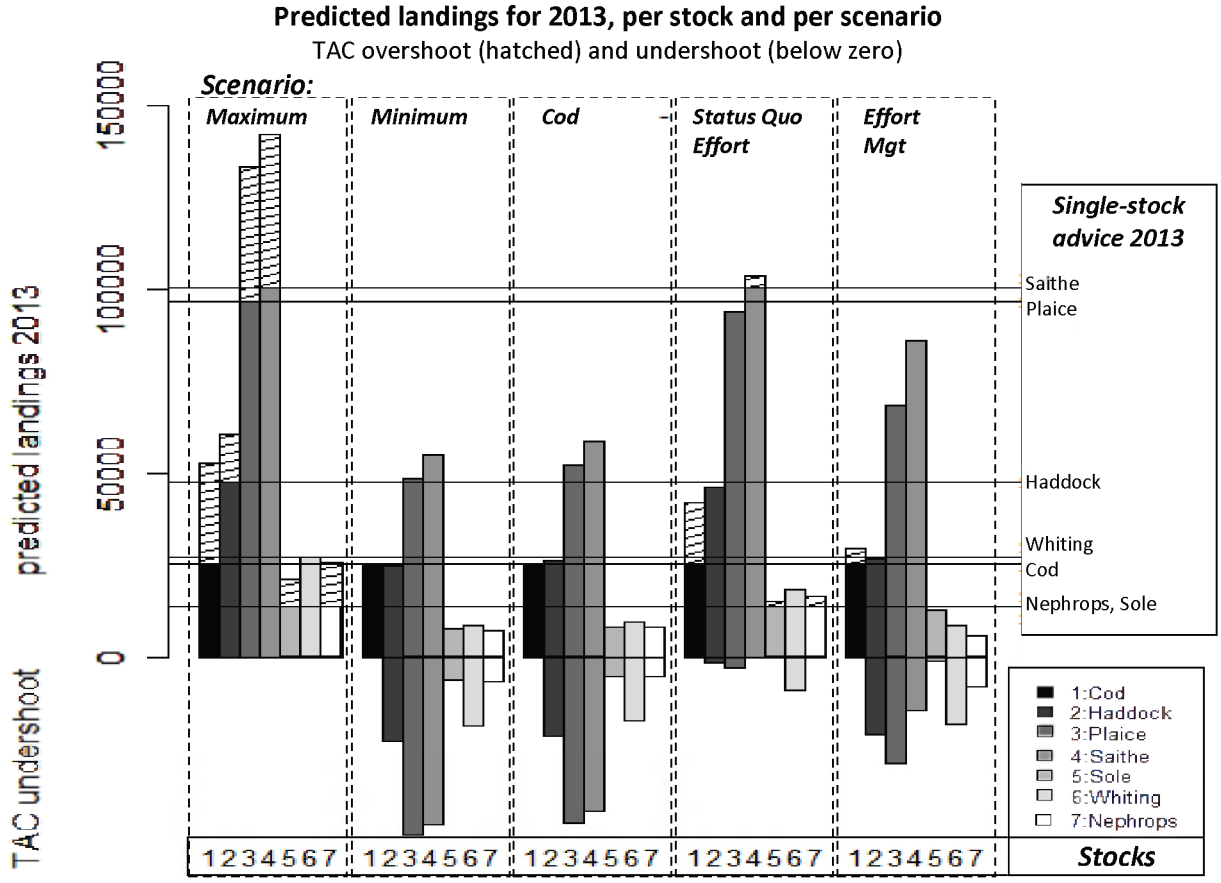


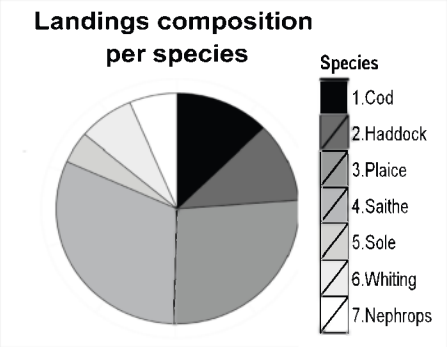
Figure 6.4.25.1 North Sea mixed-fisheries projections. Estimates of potential landings (in tonnes) by stock with scenarios running in 2012 and 2013. Horizontal lines correspond to the single-stock advice for 2013. Bars below the value of zero show the scale of undershoot (compared to single-stock advice) in cases where landings are predicted to be lower when applying the scenario. Hatched columns represent landings in overshoot of the single-stock advice.

	Scenarios
Max	**'Maximum':** Fishing stops when all stocks considered have been caught up to the ICES single-stock advice. This option causes overfishing of the single-stock advice possibilities of most stocks. For 2013, the least limiting stock would be whiting for fleets representing 96% of the effort in 2011.
Min	**'Minimum':** Fishing stops when the catch for any one of the stocks considered meets the single-stock advice. This option causes under-utilization of the single-stock advice possibilities of other stocks. For 2013, the limiting stock would be cod for fleets representing 100% of the effort in 2011.
Cod	**'Cod management plan':** All fleets set their effort corresponding to their cod quota share, regardless of other catches.
Sq_E	**'*Status quo* effort':** The effort is set equal to the effort in the most recently recorded year for which landings and discard data are available.
Ef_Mgt	**'Effort management':** The effort in métiers using gear controlled by the EU effort management regime have their effort adjusted according to this regime (see Table 6.4.25.3).

The fisheries

Fleet and métier categories used in the mixed-fisheries analysis are based on the EU data collection framework (DCF) level 6 categories, but merging over DCF categories has been performed to a) reflect national sampling schemes, and b) aggregate over 'small' métiers (a métier failing to catch 1.0% in 2011 of at least one of the stocks considered). Fleet and métier categories are also consistent with the categories specified in the cod long-term management plan and the EU annual economic report (AER) database.

Catch distribution



Total landings (2011) of all species considered in the mixed-fisheries advice were 249.0 kt, with

- ~ 71% landed by otter trawls and seines
- ~ 21% by beam trawls
- ~ 6% by gill and trammel nets, and
- ~ 2% by other gears.

Total discards were 73.5 kt (21% by weight).

Quality considerations

The quality of data has improved in 2012 because of the joint ICES data call merging data needs and ensuring common data storage for single-stock assessment and mixed-fisheries forecasts. It is expected this process will continue to improve in the future.

Scientific basis

Assessment type	F-Cube (FLR).
Input data	Assessments on the relevant stocks in the North Sea fisheries working group (WGNSSK)
Discards and bycatch	Included as in the single-stock assessments.
Indicators	None.
Other information	This assessment was presented for the first time in 2012. As any scenario results in trade-offs between different fisheries that are informed by more than scientific considerations, no one scenario is presented as advice. The scenarios indicate the stocks that will limit and thus influence the fisheries most.
Working group report	WGMIXFISH

ECOREGION North Sea
STOCK Mixed-fisheries advice

Reference points

The reference points for the various stocks can be found in the single-stock advice sheets (ICES, 2012b).

Outlook for 2013

Mixed-fisheries advice considers the implications of mixed fisheries under current TAC and effort regimes taking into account the fishing pattern and catchability of the various fleets in the North Sea. The outcome of the mixed-fisheries modelling was consistent with the catch proportion by country in 2011.

The ICES single-stock advice for the North Sea demersal stocks in 2013 (ICES, 2012b) is based on existing management plans and the maximum sustainable yield (MSY) framework, the precautionary approach, or the ICES approach to data-limited stocks. The landings for each mixed-fisheries scenario in the following table reflect the application of that scenario in both 2012 and 2013.

Basis: single-stock SSBs at the end of 2011 and assumptions on F in 2012 and SSB at the start of 2013. Fishing patterns and catchability in 2012 and 2013 were assumed to remain as in 2011.

	Single-stock	Landings per mixed-fisheries scenario 2013				
Stock	advice 2013	'Max'	'Min'	'Cod'	'Sq_E'	'Ef_Mgt'
Cod	25.441	49	25	25	42	30
Haddock	47.811 HC	56	25	26	46	27
Plaice	97.070	121	49	52	94	68
Saithe	100.684	131	55	59	104	86
Sole	14.000	19	7.9	8.6	15	13
Whiting	26.000	25	8.8	9.9	19	9.0
Nephrops FU 5	1.000	1.4	0.43	0.50	0.98	0.35
Nephrops FU 6	1.400	2.9	0.92	1.1	2.1	0.84
Nephrops FU 7	10.000	11	3.3	3.9	7.6	2.5
Nephrops FU 8	1.400	2.7	0.84	0.98	1.9	0.72
Nephrops FU 9	0.950	1.9	0.60	0.70	1.4	0.47
Nephrops FU 10	0.050	0.09	0.03	0.03	0.06	0.02
Nephrops FU 32	0.800	0.51	0.16	0.19	0.37	0.13
Nephrops FU 33	1.100	1.5	0.49	0.57	1.1	0.39
Nephrops FU 34	0.600	0.56	0.18	0.21	0.40	0.14
Nephrops other	0.820	1.3	0.42	0.49	0.95	0.34

Weights in thousand tonnes. Advised landings no more than the indicated value.

Mixed-fisheries catch options can take specific management priorities into account. Scenario results show that it is not always possible to achieve all management objectives simultaneously. For instance, if rebuilding of the cod stock is the major objective, this could mean that the TAC for other species in the mixed fisheries cannot be fully utilized. In contrast to single-stock advice there is therefore no single recommendation, but a range of plausible options. ICES single-stock advice provides TACs expected to keep a species above a biomass regarded as safe for the stock, to return a species to a safe biomass within a precautionary timeframe, or to meet some desired fishing mortality. To be consistent with these biological objectives a scenario is necessary that delivers the SSB and/or F objectives of the single-stock advice for all stocks considered simultaneously.

This document presents five example scenarios out of which the 'minimum' scenario meets this outcome. However, the 'minimum' scenario (and to a large extent the 'cod' scenario this year) assumes that fleets would stop fishing when their first quota share is exhausted, regardless of the actual importance of this quota share, thus leading to a distorted perception of plausible fleet behaviour. It is included only to demonstrate the lower bound of potential fleet effort and stock catches.

In addition to the 'minimum' scenario a 'maximum' scenario is included. This is included to demonstrate the upper bound of potential fleet effort and stock catches but, through assuming all fleets continue fishing until all their quotas are exhausted irrespective of the economic viability of such actions, this is also considered a scenario with low plausibility. Currently three intermediate scenarios are included, reflecting basic current management measures and also

the *status quo* option. ICES has not conducted work to assess which of these scenarios may represent the most likely outcome in 2012 and 2013.

Additional considerations

Management considerations

ICES provides five example scenarios. Alternative scenarios taking account of other specific management objectives can be considered in 2013. A scenario requested by Norway and the European Commission based on single-stock advice for the MSY approach was considered but could not be put forward this year, because not all stocks have data and/or reference points to make these calculations possible (whiting and some *Nephrops* stocks).

Scenarios are based on central assumptions that fishing patterns and catchability in 2012 and 2013 are the same as those in 2011 (similar to procedures in single-stock forecasts where growth and selectivity are assumed constant). Options that result in under- or overutilization are useful in identifying the main points of friction between the fishing opportunities of the various stocks. They indicate in which direction fleets may have to adapt to fully utilize these catch opportunities. However, the adaptation mechanisms themselves, which occur largely at the level of the individual vessels (e.g. changes in fishing patterns, catchability, or discarding practices) cannot be easily predicted. Improved mixed-fisheries management should act towards reducing these areas of friction, to limit risks of not achieving the single-stock management objectives.

Spatial and temporal changes in where and when métiers exert their fishing effort have an influence on the species composition of the catch and will change the ability of vessels to target (spatially) the different species. Further investigations are required to be able to include spatial decoupling between species in the scenarios.

The 'cod' scenario reflects the target fishing mortality as set for the cod management plan, and the results present fishing opportunities for other stocks in a mixed-fisheries context. Similar scenarios based on the management plans for the other finfish stocks could be provided by ICES, but the 'cod' scenario is considered because cod has generally been the limiting species since the beginning of mixed-fisheries analysis in 2006.

The 'effort management' scenario presents the expected outcome if the nominal effort reductions stipulated in the effort management plans were translated in full into actual effort cuts and if there existed a 1:1 relationship between fleet effort and mean F. The data used for the mixed-fisheries projections show that effort reductions to date have been less than those stipulated for overall effort by fleet in the fishing opportunities regulations, and studies have indicated linkages between effort and F that change depending on fleet and species. Equally, the projections assume that the relative catchability of different species by fleets and metiers remains constant and cannot take account of changing vessel behaviour in 2012 and 2013 because of, e.g. real-time closures or technical measures.

As for the 'effort management' scenario, the 'cod' scenario presents the expected outcome if the F reductions on cod stipulated in the cod long-term management plan were achieved in full and the relative catchability of different species by fleets and metiers remained constant. A consequence of this approach is that effort reductions in fleets (to achieve new partial Fs) apply equally to fleets where cod is a major component of the catch and those where it represents a small bycatch component. In 2012 the most pronounced example of this effect is for saithe-targeted fisheries where application of the 'cod' scenario leads to small reductions in cod catch, but very large reductions in saithe catches.

To protect the *Nephrops* stocks in their different functional units, management should be implemented at the functional unit level. Catch predictions for *Nephrops* should be distributed over the functional units relative to their share in the general advice.

Species involved

The species considered here as part of the demersal mixed fisheries of the North Sea are cod, haddock, whiting, saithe, plaice, sole, and *Nephrops*. All of these are now subject to multi-annual management plans apart from *Nephrops*. Pelagic stocks (herring, mackerel) are not included as they are taken by fisheries subject to little technical interaction.

Species	**ICES single-stock advice area**	**Mgt area**	**Mgt plan ref(s)**
Cod	Subarea IV, Divisions VIId and IIIa West (Skagerrak)	• EU TAC Skagerrak • EU TAC Division VIId • Subarea IV; EC waters of Division IIa; that part of Division IIIa not covered by the Skagerrak and Kattegat	• EU and Norway management plan • Council Reg (EC) 1342/2008
Haddock	Subarea IV and Division IIIa West (Skagerrak)	• EU TAC Division IIIa, EC waters of Divisions IIIb, IIIc, and IIId • Subarea IV; EC waters of Division IIa	• EU and Norway management plan
Whiting	Subarea IV and Division VIId (advice includes human consumption and industrial landings)	• Subarea IV • EU TAC Subarea VII	• EU and Norway management plan (interim)
Saithe	Subarea IV, Division IIIa West (Skagerrak), and Subarea VI	• Division IIIa and Subarea IV; EC waters of Divisions IIa, IIIb, IIIc, and IIId • Subarea VI; EC waters of Division Vb; EC and international waters of Subareas XII and XIV	• EU and Norway management plan
Plaice	Subarea IV	• Subarea IV; EC waters of Division IIa; that part of Division IIIa not covered by the Skagerrak and the Kattegat	• Council Reg (EC) No 676/2007
Sole	Subarea IV	• EC waters of Subareas II and IV	• Council Reg (EC) No 676/2007
Nephrops	Functional units: 5, 6, 7, 8, 9, 10, 32, 33, 34 other areas outside FUs	• EU: TAC for Subarea IV • Norway: no TAC	• n/a

Data and methods

The projections made use of data requested as part of an ICES data call issued formally under the EU DCF regulations. This has allowed a greater consistency between catch totals supplied to ICES. To allow consideration of fleets defined by length categories, separate data files containing total weight of landings and discards and effort in kW-days by fleet and métier were also requested.

All analyses were conducted using the Fcube method (Ulrich *et al.*, 2011).

Uncertainties in the assessment

This analysis relies on the quality of the single-stock assessments and forecasts. In addition to that there is some uncertainty related to the assumptions on the relationship between effort and fishing mortality. The Norwegian data for 2011 have been provided without any reliable information on mesh size in any gear. Therefore, the Norwegian fleets could not be distinguished according to the specifications given in the data request, there is no distinction between TR1 and TR2, and all data back to 2003 have been mapped to the OTTER category divided in vessel size groups.

The quality of data has improved in 2012 because of the joint ICES data call merging data needs and ensuring common data storage for single-stock assessment and mixed-fisheries forecasts. The new data call has made a more explicit use of the EU data collection framework (DCF)-based national sampling programmes. It is expected this process will continue to improve in the future.

Sources

ICES. 2012a. Report of the Working Group on Mixed Fisheries Advice for the North Sea (WGMIXFISH), 21–25 May 2012. ICES CM 2012/ACOM:22.

ICES. 2012b. ICES Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6.

ICES. 2012c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–3 May 2012. ICES CM 2012/ACOM:13.

Ulrich, C., Reeves, S. A., Vermard, Y., Holmes, S., 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.

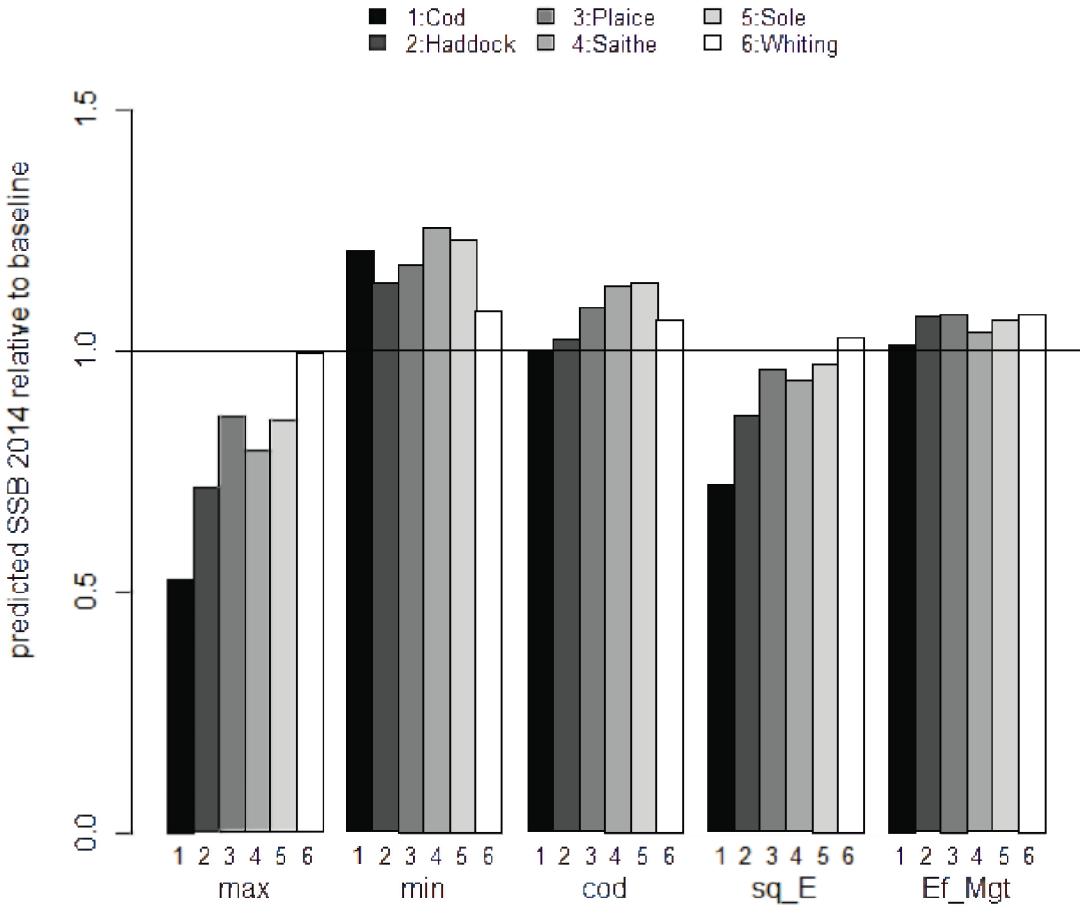


Figure 6.4.25.2 Mixed-fisheries advice in the North Sea. Estimates of potential SSB at the start of 2014 by stock after applying the mixed-fisheries scenarios, expressed as a ratio to the single-stock advice forecast. Horizontal line corresponds to the SSB resulting from the single-stock advice (at the start of 2014). *Nephrops* are not included as abundance is not forecasted from the mixed-fisheries model.

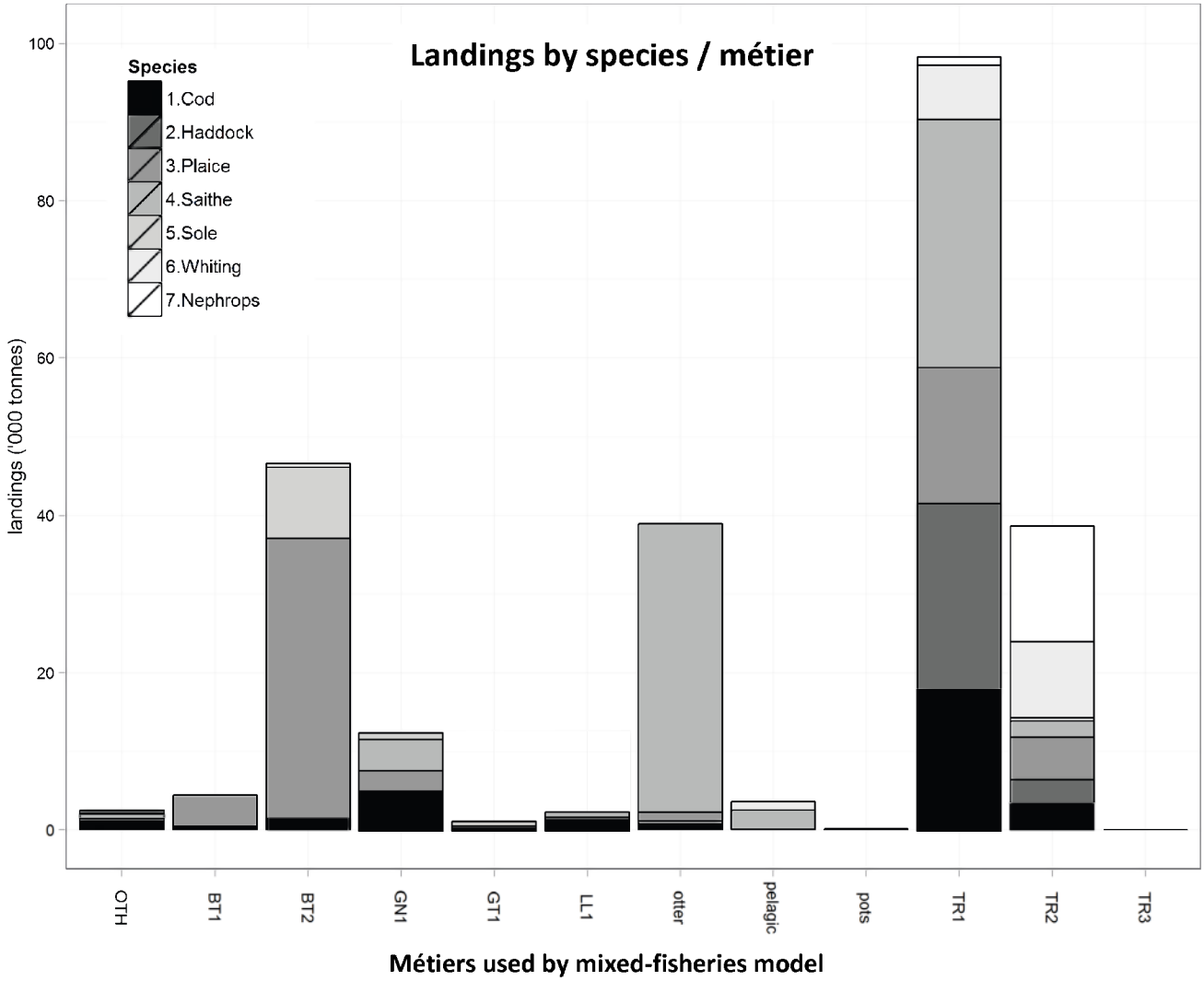


Figure 6.4.25.3 Mixed-fisheries advice in the North Sea. Landings distribution of species by métier in 2011 (list of métiers available in Table 6.4.25.2).

Table 6.4.25.1 Mixed-fisheries advice in the North Sea. SSB results from single-stock advice and different mixed-fisheries scenarios (see Figure 6.4.25.2). *Nephrops* are not included as abundance is not forecasted from the mixed-fisheries model.

	Single-stock Advice	SSB resulting from mixed-fisheries scenario 2014				
Stock	SSB result in 2014	'Max'	'Min'	'Cod'	'SQ_E'	'Eff_mgt'
Cod	103	50	114	95	68	96
Haddock	203	145	231	207	175	217
Plaice	666	575	785	724	639	716
Saithe	252	200	316	286	236	261
Sole	49	42	60	56	47	52
Whiting	346	346	376	370	357	374
legend						
	SSB 2014 > Bpa or MSY Btrigger					
	SSB 2014 > Blim					
	SSB 2014 < Blim					
	No reference points defined					

Weights in thousand tonnes.

Table 6.4.25.2 Mixed-fisheries advice North Sea. Fleet and métier categories used in the mixed-fisheries analysis.

Mixed-fisheries metiers	Gear	Mesh size	Fleet or fleets
TR1	Otter trawl or demersal seine	>= 100 mm	Any group of vessels under one national flag using gear defined as TR1 and catching at least 1% of one of the 'mixfish' species in 2011
TR2	Otter trawl or demersal seine	>= 70 mm and < 100 mm	Any group of vessels under one national flag using gear defined as TR2 and catching at least 1% of one of the 'mixfish' species in 2011
TR3	Otter trawl or demersal seine	>= 16 mm and < 32 mm	Any group of vessels under one national flag using gear defined as TR3 and catching at least 1% of one of the 'mixfish' species in 2011
Pots	Pots	n.a.	Any group of vessels under one national flag using pots and catching at least 1% of one of the 'mixfish' species in 2011
Pelagic	Pelagic trawl or seine		Any group of vessels under one national flag using pelagic trawl gear and catching at least 1% of one of the 'mixfish' species in 2011
Otter	Otter trawl or demersal seine	>= 32 mm and < 70 mm	Any group of vessels under one national flag using otter trawl or demersal seine gear with mesh size unidentified or outside of TR1, TR2 or TR3 mesh ranges, and catching at least 1% of one of the 'mixfish' species in 2011
OTH	Any gear type		Vessels using undefined gear type e.g. dredges; categories with missing information e.g. missing gear; or groups of vessels under one national flag catching < 1% of any 'mixfish' species in 2011
LL1	Long lines	n.a.	Any group of vessels under one national flag using long lines and catching at least 1% of one of the 'mixfish' species in 2011
GT1	Trammel nets	All possible mesh sizes	Any group of vessels under one national flag using trammel nets and catching at least 1% of one of the 'mixfish' species in 2011
GN1	Gill nets	All possible mesh sizes	Any group of vessels under one national flag using gill nets and catching at least 1% of one of the 'mixfish' species in 2011
BT1	Beam trawl	>= 120 mm	Any group of vessels under one national flag using gear defined as BT1 and catching at least 1% of one of the 'mixfish' species in 2011
BT2	Beam trawl	>= 80 mm and < 120 mm	Any group of vessels under one national flag using gear defined as BT2 and catching at least 1% of one of the 'mixfish' species in 2011

Table 6.4.25.3 Mixed-fisheries advice North Sea. Effort reductions in 2012 compared to 2011, and 2013 compared to 2012, by EU-regulated fleet segment (Council regulation (EC). 57/2011 and 43/2012).

Gear Description	Code	% effort reduction in 2012 compared to 2011	% effort reduction in 2013 compared to 2012
Bottom trawls and seines >= 100mm	TR1	18.2%	22.2%
Bottom trawls and seines >= 70mm & < 100mm	TR2	18.2%	22.2%
Bottom trawls and seines >= 16mm & < 32mm	TR3		0%
Beam trawls >= 120mm	BT1		0%
Beam trawls >= 80mm & < 120mm	BT2	Between 0% and 9,85% for some countries	0%
Gill nets and entangling nets, excluding trammel nets	GN1		0%
Trammel nets	TN1		0%
Longlines	LL1		0%
Not regulated gear	None		0%

ECOREGION North Sea
STOCK Turbot in Subarea IV and Division IIIa

Advice for 2012 and 2013

The 2011 advice for this stock is biennial and valid for 2012 and 2013 (see ICES, 2011). ICES advises on the basis of precautionary considerations that catches should not increase.

This is the same advice as last year and the ICES data-limited approach will be implemented in 2013.

Sources

ICES. 2011. Turbot in Subarea IV and Division IIIa. *In* Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.26.

Table 6.4.26.1 Turbot in Subarea IV and Division IIIa. ICES advice, management, and official landings

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1)] turbot and brill	Official landings turbot
2000		-	9	4.2
2001		-	9	4.3
2002		-	6.750	4.0
2003		-	5.738	3.5
2004		-	4.877	3.5
2005		-	4.550	3.3
2006		-	4.323	3.1
2007		-	4.323	3.7
2008		-	5.263	3.1
2009		-	5.263	3.2
2010		-	5.263	2.8
2011		-	4.642	2.9 [2)]
2012	No increase in catches	-	4.642	
2013	No new advice, same as for 2012	-		

Weights in thousand tonnes.
[1)] EU combined TAC for turbot and brill in EU areas of ICES Division IIa and Subarea IV.
[2)] Preliminary.

ECOREGION North Sea
STOCK Brill in Subarea IV and Divisions IIIa and VIId,e

Advice for 2012 and 2013

The 2011 advice for this stock is biennial and valid for 2012 and 2013 (see ICES, 2011). ICES advises on the basis of precautionary considerations that catches should not increase.

This is the same advice as last year and the ICES data-limited approach will be implemented in 2013.

Source

ICES. 2011. Brill in Subarea IV (North Sea). *In* Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.27.

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	2.5
2001		-	9	2.6
2002		-	6.750	2.3
2003		-	5.738	2.4
2004		-	4.877	2.2
2005		-	4.550	2.0
2006		-	4.323	2.1
2007		-	4.323	2.3
2008		-	5.263	1.9
2009		-	5.263	2.0
2010		-	5.263	2.4
2011		-	4.642	2.2 [2)]
2012	No increase in catch	-	4.642	
2013	No new advice, same as for 2012	-		

Weights in thousand tonnes.
[1)] EU combined TAC for turbot and brill in EU areas of ICES Division IIa and Subarea IV.
[2)] Preliminary.

ECOREGION North Sea
STOCK Dab in Subarea IV and Division IIIa

Advice for 2012 and 2013

The 2011 advice for this stock is biennial and valid for 2012 and 2013 (see ICES, 2011). ICES advises on the basis of precautionary considerations that catches should not increase.

This is the same advice as last year and the ICES data-limited approach will be implemented in 2013.

Source

ICES.2011. Dab in Subarea IV and Division IIIa, Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.28.

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 and flounder	Official landings dab
2006		-	17.1	10.0
2007		-	17.1	10.1
2008		-	18.81	8.6
2009		-	18.81	7.1
2010		-	18.81	7.8
2011		-	18.434	7.2 [2)]
2012	No increase in catch	-	18.434	
2013	No new advice, same as for 2012	-		

Weights in thousand tonnes.
[1)] EU combined TAC for dab and flounder in EU areas of ICES Division IIa and Subarea IV.
[2)] Preliminary.

ECOREGION North Sea
STOCK Flounder in Division IIIa and Subarea IV

Advice for 2012 and 2013

The 2011 advice for this stock is biennial and valid for 2012 and 2013 (see ICES, 2011). ICES advises on the basis of precautionary considerations that catches should not increase.

This is the same advice as last year and the ICES data-limited approach will be implemented in 2013.

Source

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.

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 and flounder	Official landings flounder
2006		-	17.1	5.0
2007		-	17.1	4.1
2008		-	18.81	3.2
2009		-	18.81	3.1
2010		-	18.81	3.4
2011		-	18.434	3.1 [2)]
2012	No increase in catch	-	18.434	
2013	No new advice, same as for 2012	-		

Weights in thousand tonnes.
[1)] EU combined TAC for dab and flounder in EU areas of ICES Division IIa and Subarea IV.
[2)] Preliminary.

ECOREGION North Sea
STOCK Lemon sole in Subarea IV and Divisions IIIa and VIId

Advice for 2012 and 2013

The 2011 advice for this stock is biennial and valid for 2012 and 2013 (see ICES, 2011). ICES advises on the basis of precautionary considerations that catches should not increase.

This is the same advice as last year and the ICES data-limited approach will be implemented in 2013.

Source

ICES. 2011. Lemon sole in Subarea IV and Divisions IIIa and VIId. *In* Report of the ICES Advisory Committee, 2011. ICES Advice, 2011. Book 6, Section 6.4.30.

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 and witch	Official landings Lemon sole
2006		-	6.175	4.3
2007		-	6.175	4.5
2008		-	6.793	4.0
2009		-	6.793	3.4
2010		-	6.521	3.2
2011		-	6.391	4.0 [2)]
2012	No increase in catch	-	6.391	
2013	No new advice, same as for 2012	-		

Weights in thousand tonnes.
[1)] EU combined TAC for lemon sole and witch in EU areas of ICES Division IIa and Subarea IV.
[2)] Preliminary.

ECOREGION North Sea
STOCK Witch in Subarea IV and Divisions IIIa and VIId

Advice for 2012 and 2013

The 2011 advice for this stock is biennial and valid for 2012 and 2013 (see ICES, 2011). ICES advises on the basis of precautionary considerations that catches should be reduced.

This is the same advice as last year and the ICES data-limited approach will be implemented in 2013.

Source

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 6.4.31.1 Witch 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 and 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	1.5 [2)]
2012	Reduce catches	-	6.391	
2013	No new advice, same as for 2012	-		

Weights in thousand tonnes.
[1)] EU combined TAC for lemon sole and witch in EU areas of ICES Division IIa and Subarea IV.
[2)] Preliminary.

ECOREGION North Sea
STOCK Pollack in Subarea IV and Division IIIa

Advice for 2013 and 2014

Based on the ICES approach for data limited stocks, ICES advises that in Subarea IV catches should be no more than 1300 tonnes. In Division IIIa, there should be no directed fisheries and bycatch and discards should be minimised.

This is the first year that ICES is providing quantitative advice for data limited stocks (see Quality considerations).

State of the stock

F (Fishing Mortality)	2009-2011	
Qualitative evaluation	?	Insufficient information

SSB (Spawning-Stock Biomass)	2009-2011	
Qualitative evaluation	IV - ?	IV: Insufficient information
	IIIa - ✗	IIIa: Below possible reference points

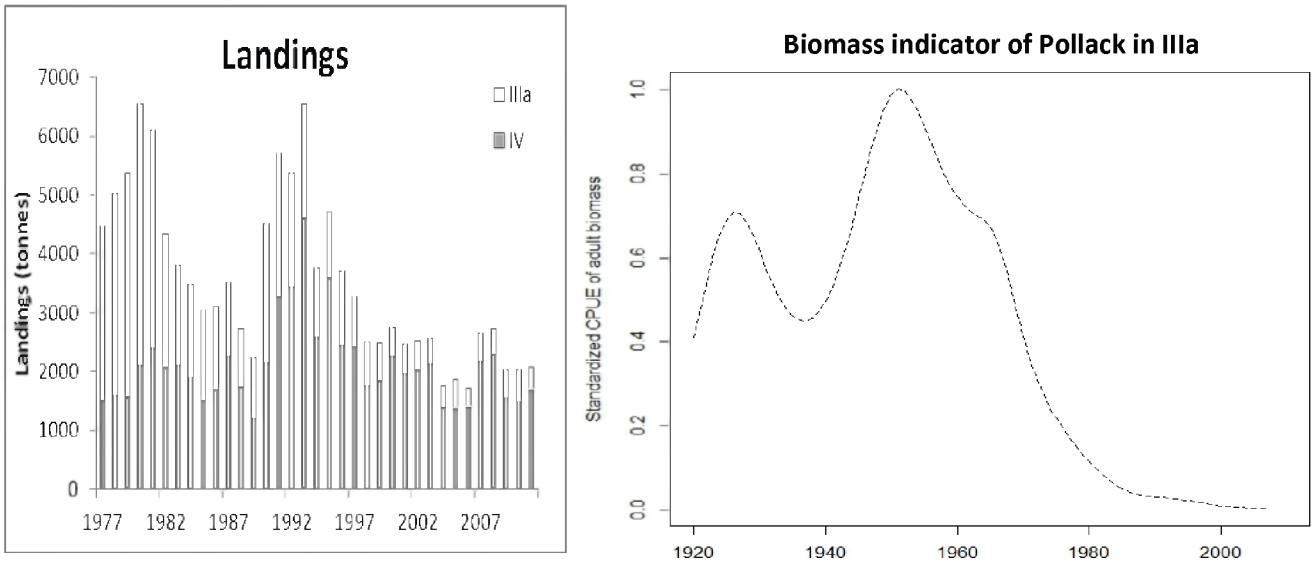


Figure 6.4.32.1 Pollack in Subarea IV and Division IIIa. Left: Official landings (in tonnes, since 1977), right: biomass trend of pollack in Division IIIa since 1920 (modified from Cardinale et al. 2012).

The landings data are insufficient to evaluate stock trends and therefore the state of the stock is unknown, although information available for IIIa suggests that the stock has strongly declined and is currently at a low level in this area.

Management plans

No specific management objectives are known to ICES.

Biology

Pollack (*Pollachius pollachius*) is a benthopelagic species, found mostly close to the shore over hard bottom. It is found down to about 200 m. A maximum size of 130 cm, maximum weight of 18.1 kg and maximum age of 15 years are reported. Growth is fairly rapid, approaching 7 cm per year. Pollack in the 0-group are found in shallow coastal waters, and move to deeper waters as they grow. Maturity has been reported at approximately 3 years and main spawning occurs in March–April.

The fisheries

Pollack is mainly caught as a bycatch in different fisheries. Trawl catches in the open North Sea are mainly taken in the directed saithe fisheries. Gillnets are dominating (2/3 of the total) in Norwegian fisheries where about ¾ of the catches are in coastal areas. Information on catches by recreational fisheries is not available.

Quality considerations

Pollack has a preference for wrecks and rocky bottom, making it difficult to catch with trawls and therefore poorly suited for monitoring by research surveys. Some length frequency data are available for recent years, but area-specific data on life history parameters are missing and should be collected on surveys and through market sampling. Data on growth and maturity, as well as more information from the fisheries are needed.

The advice is based on a standardized cpue abundance index, used as an indicator of stock size. The methods applied to derive quantitative advice for data limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No analytical assessment
Input data	Catch statistics and biomass trends (Cardinale *et. al.* 2012)
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, 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 2013 and 2014

No reliable assessment can be presented in this Ecoregion.

ICES approach to data limited stocks

For data limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current exploitation is appropriate for the stock.

For Pollack in this area two situations occur: for Subarea IV, insufficient information is available on abundance or exploitation. This implies that catches should decrease by 20% in relation to the last three years average catch, corresponding to catches of no more than 1300 t.

For Division IIIa, the abundance is estimated to be at the lowest in the time series. This implies that there should be no directed fisheries and bycatch and discards should be minimised in this Division.

Additional considerations

Stock identity

In the absence of specific information on stock structure, the ICES ecoregions are chosen as a minimum level of disaggregation for the definition of stock units. This is an interim solution until more information is available on stock units.

Quality considerations

Pollack's preference for wrecks and rocky bottom makes it difficult to catch this species with trawls and it is therefore poorly monitored by existing research surveys. Catches during the IBTS surveys in Subarea IV and Division IIIa are usually small. Pollack is mainly distributed over the northeastern North Sea, along the Norwegian Deeps, and into the Skagerrak. Time series of abundance from the IBTS for the years 1977–2011 do not show a clear pattern (Figure 6.4.32.2).

Some length frequency data from landings are available for recent years, but data on life history parameters are missing. Representative data on growth and maturity should be collected. More information from the fisheries is needed. Landings figures are clearly incomplete before 1977 and should not be used as indicator of any trends.

Pollack is an important species for recreational fisheries, but catch statistics are unknown.

Fisheries

An analysis of Norwegian landings data shows that catches peak in March and April, the main spawning time of pollack. The Norwegian fleet predominantly catches pollack in coastal waters (within the 12 miles zone), and mainly by gill net and *Pandalus* trawl. Outside the 12 miles zone the otter trawl is the most important gear. The otter trawl catches are predominantly taken as bycatch in directed saithe fisheries.

Data requirements

There is a requirement for information on stock identity of pollack within the ICES area. Detailed spatial data on the fisheries especially for the earlier years in the time-serie and including landings by gear, length compositions and discards would provide some historical context and indications of the patterns of exploitation. Life history and other

biological parameters derived from surveys and commercial sampling and information on catch and effort in the recreational fisheries would also be useful.

Sources

Cardinale, M., H. Svedäng, V. Bartolino, L. Maiorano, M. Casini and H. Linderholm, 2012. Spatial and temporal depletion of haddock and pollack during the last century in the Kattegat-Skagerrak. J. Appl. Ichthyol. 28(2): 200-208.

ICES. 2012a. Report of the Working Group on the Assessment of New MoU species (WGNEW). 5-9 March 2012. ICES CM 2012/ACOM:20

ICES. 2012b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 27 April - 03 May 2012. ICES CM 2012/ACOM: 13.

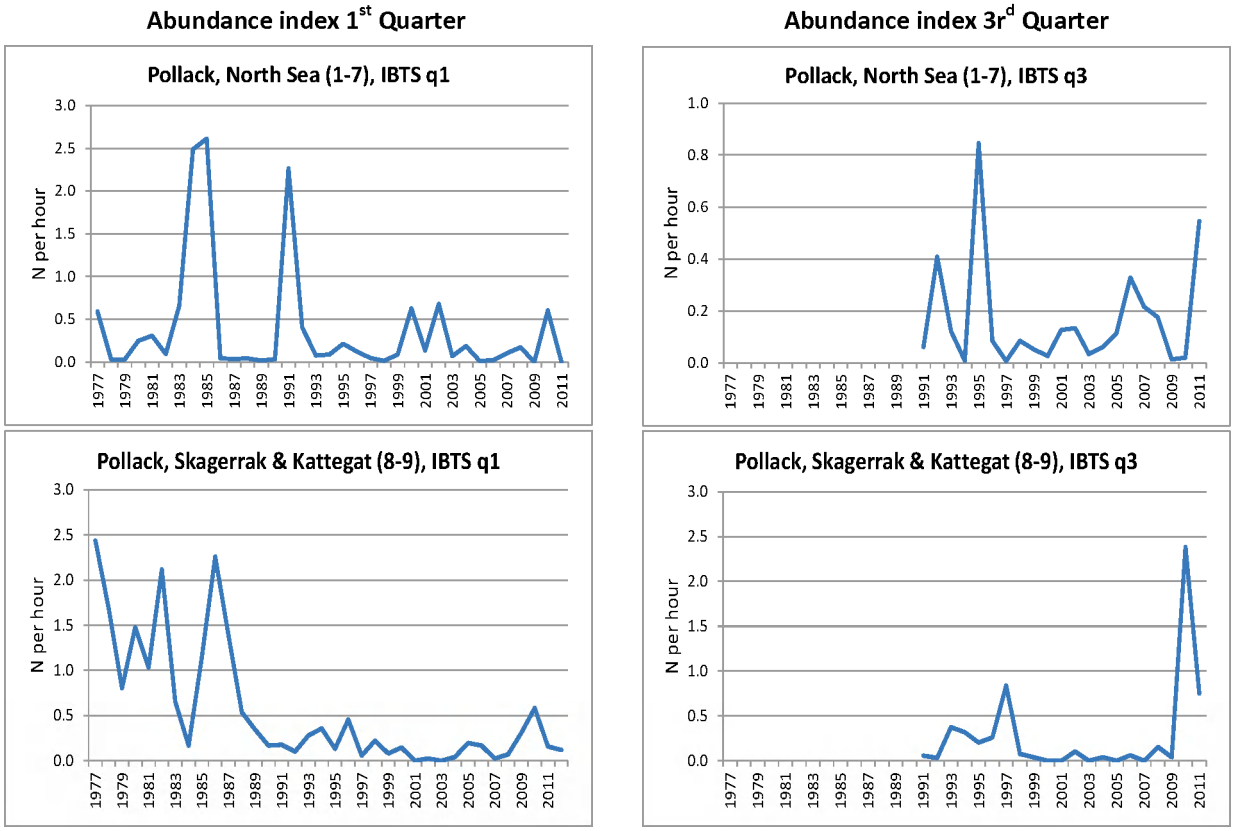


Figure 6.4.32.2 Pollack in Subarea IV and Division IIIa. Time series of abundance of pollack in the IBTS survey in the North Sea (roundfish areas 1-7) and in Skagerrak/Kattegat (roundfish areas 8 and 9), shown as Nos caught per hour with the GOV-trawl.

Table 6.4.32.1 Pollack in Subarea IV and Division IIIa. ICES advice, management and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Total Official landings Subarea IIIa	Total Official landings Division IV	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		-	0.6	1.5	2.0
2011		-	0.4	1.7	2.1
2012	No increase in catches	-			
2013	IV: 20% Reduction in catches (last 3 years average) IIIa: no directed fisheries and reduce bycatch	IV: < 1.3 IIIa: 0			
2014	Same catch advice as in 2013.	IV: < 1.3 IIIa: 0			

Weights in '000 t.

Table 6.4.32.2 Pollack in **Division IIIa**. Official landings by country (tonnes).

	ICES Division IIIa							
	Belgium	Denmark	Germany	Netherl.	Norway	Sweden	UK	Total
1977	10	1764	4	3	449	706		2936
1978	1	2077	4		556	794		3432
1979	13	1898	<0.5		824	1066		3801
1980	13	1860			987	1584	<0.5	4444
1981	5	1661			839	1187	1	3693
1982	1	1272			575	417	<0.5	2265
1983	2	972			438	288		1700
1984	2	930	<0.5		371	276		1579
1985	-	824	<0.5		350	356		1530
1986	4	759	<0.5		374	271		1408
1987	6	665			342	246		1259
1988	4	494			350	136		984
1989	3	554			313	152		1022
1990	8	1842	<0.5		246	253		2349
1991	2	1824			324	281		2431
1992	8	1228			391	320		1947
1993	6	1130	1		364	442		1943
1994	5	645	<0.5		276	238		1164
1995	10	497			322	271		1100
1996		680			309	273		1262
1997		364	<0.5		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	<0.5	471
2010		313	8	1	195	35		552
2011		193	7		168	28		395

Table 6.4.32.3 Pollack in **Subarea IV**. Official landings by country (tonnes).

	ICES Subarea IV										
	Belgium	Denmark	Faeroes	France	Germany	Netherl.	Norway	Poland	Sweden	UK	Total
1977	121	275		75	142	38	419	9	0	442	1521
1978	102	249		98	154	21	492	2	0	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	0	880	2	106	315	1902
1985	14	308		69	23	0	686		51	363	1514
1986	44	550		45	21	0	602		67	362	1691
1987	21	427		988	21	0	471		40	290	2258
1988	32	432		367	30	10	560		20	296	1747
1989	31	273		0	21	4	568		37	269	1203
1990	44	924		0	34	3	651		126	366	2148
1991	31	1464		0	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		0	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	0	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	2	6	50	1	668		32	658	1551
2010	12	163		10	129	0	599		32	540	1485
2011	12	299		NA	73	0	743		63	481	1671

ECOREGION North Sea
STOCK Grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat)

Advice for 2013 and 2014

This is the first time ICES has provided advice for grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat). Based on the ICES approach for data-limited stocks, ICES advises that catches of grey gurnard should not increase from the average catch of the last three years. Because the data for catches of grey gurnard are considered highly unreliable, ICES is not in a position to quantify the result.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Insufficient information

SSB (Spawning-stock Biomass)	2009–2011
Qualitative evaluation	→ Above the long-term average

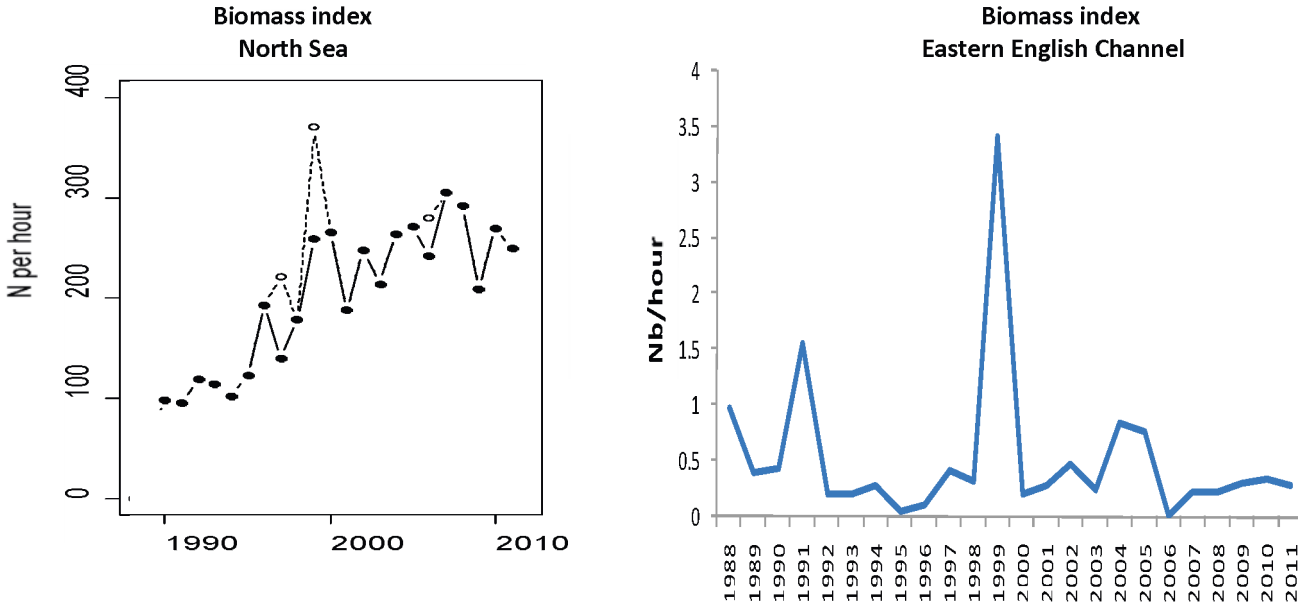


Figure 6.4.33.1 Grey gurnard in Subarea IV and Divisions VIId and IIIa. Left: Biomass indicator in Subarea IV (number per hour for all length classes combined since the survey data are considered relevant for gurnards), based on IBTS-Q1. The plain line excludes the exceptional abundance observed occasionally in a single rectangle by shoal behaviour. Right: biomass index for Division VIId, based on CGFS-Q4.

Abundance indices from Subarea IV show an increase in abundance and has been stable in the last decade. In Division VIId, the abundance has fluctuated without trend since 1988, although the biomass in Division VIId is much lower than in the North Sea. Landings data are not presented for this species because the landings were reported as one generic category of "gurnards" until 2010. Furthermore, landings data are considered only marginally informative because catches are mainly discarded.

Management plans

No specific management objectives are known to ICES. There is no TAC for this species.

Biology

Grey gurnard, *Eutrigla gurnardus*, occurs throughout the Northeast Atlantic. In the North Sea and in Skagerrak/Kattegat, grey gurnard is an abundant demersal species forming dense semi-pelagic aggregations in winter to the northwest of the Dogger Bank: in summer they are more widespread. Spawning takes place in spring and summer. There do not seem to be well-defined nursery areas. Grey gurnard has a large span of ages, up to group 14 at around 40 cm, and above 19–20 cm all individuals can be considered mature.

The fisheries

Currently, grey gurnard is a bycatch species in demersal fisheries mainly by trawlers. Catches are largely discarded.

Quality considerations

In the absence of specific information on stock structure, the ICES ecoregions are chosen as the minimum level of disaggregation for the definition of stock units. This is an interim solution until more information is available on stock units.

Because the species is largely discarded, landings data will not reflect the actual catches. The IBTS survey in Subarea IV can be used as an indicator of abundance of grey gurnard in Subarea IV and Divisions VIId and IIIa. Given the high level of discarding, only observation-at-sea programmes could provide an accurate estimate of catches. Also, focus on specific 'métiers' by self-sampling programmes might be planned.

The advice is based on an abundance index from two surveys, used as an indicator of stock size. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Discards are considered high, but the discard ratio is unknown.
Indicators	IBTS-Q1, CGFS-Q4.
Other information	2011 was the first year ICES advised on grey gurnard. In 2012 the advice was split into ecoregions.
Working group report	WGNEW, WGNSSK

ECOREGION North Sea
STOCK Grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

No assessment can be presented for grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat). Therefore, no catch projections are available.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented, unless there is ancillary information clearly indicating that the current level of exploitation is appropriate for the stock.

For this stock the abundance is estimated to have been stable after an increase, which implies catches could remain at the average catch of the last three years. Because the data for catches of grey gurnard are considered highly unreliable, ICES is not in a position to quantify the result.

Additional considerations

Age determination of grey gurnard during the 2010 IBTS-Q1 has indicated that this species displays a significant number of individuals over a large span of ages (up to group 14). This suggests a low exploitation rate. A maturity length key of grey gurnard sampled by the same survey shows that above 19–20 cm almost all the individuals can be considered mature. Both of these datasets suggest that grey gurnard is early maturing in North Sea and a proportion of fish at age 1 are mature.

Ecosystem considerations

Grey gurnard is considered a predator on a number of commercially important demersal stocks (cod, whiting, haddock, sandeel, and Norway pout) in the North Sea. The steep increase in the abundance of grey gurnard has led to an increase in mortality in recent years, especially of North Sea cod (age 0) and whiting (ages 0 and 1). The multispecies assessment estimates that grey gurnard is currently responsible for over 50% of the predation mortality on 0-group cod and whiting (ICES, 2011).

Stock identity

In the absence of specific information on stock structure, the ICES ecoregions are chosen as the minimum level of disaggregation for the definition of stock units. This is an interim solution until more information is available on stock units.

Data requirements

In the past, gurnards were often landed in one generic category of "gurnards" (Figure 6.4.33.2). Catch statistics are incomplete for several years: some countries reporting no landings at all, other countries reporting exceptionally high landings.

For management purposes, information is required on landings, discards, stock structure, appropriate management units, and basic biological parameters. The majority of the catch is assumed to be discarded. Some data on discards are available although the quality of this data may be questionable, since sampling effort in the observation-at-sea programme is mainly focussed on more valuable species. In addition, in the context of ecosystem considerations (e.g. predation on cod and whiting), it would be useful to obtain more information on age composition of the stock and its diet composition.

Comparison with previous assessment and advice
In 2011, advice for grey gurnard was given for the Northeast Atlantic as a whole. This year, biennial advice is given for three separate ecoregions: Bay of Biscay and Atlantic Iberian waters, North Sea, and Celtic seas.

The advice was based on the precautionary approach last year. This year the advice is based on the ICES approach to data-limited stocks.

Sources

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ICES. 2011. Report of the Working Group on Multispecies Assessment Methods (WGSAM), 10–14 October 2011, Woods Hole, USA. ICES CM 2011/SSGSUE:10. 229 pp.

ICES. 2012a. Report of the Working Group on Assessment of New MoU Species (WGNEW), 5–9 March 2012, ICES Headquarters, Denmark. ICES CM 2012/ACOM:20.

ICES. 2012b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–03 May 2012. ICES CM 2012/ACOM:13.

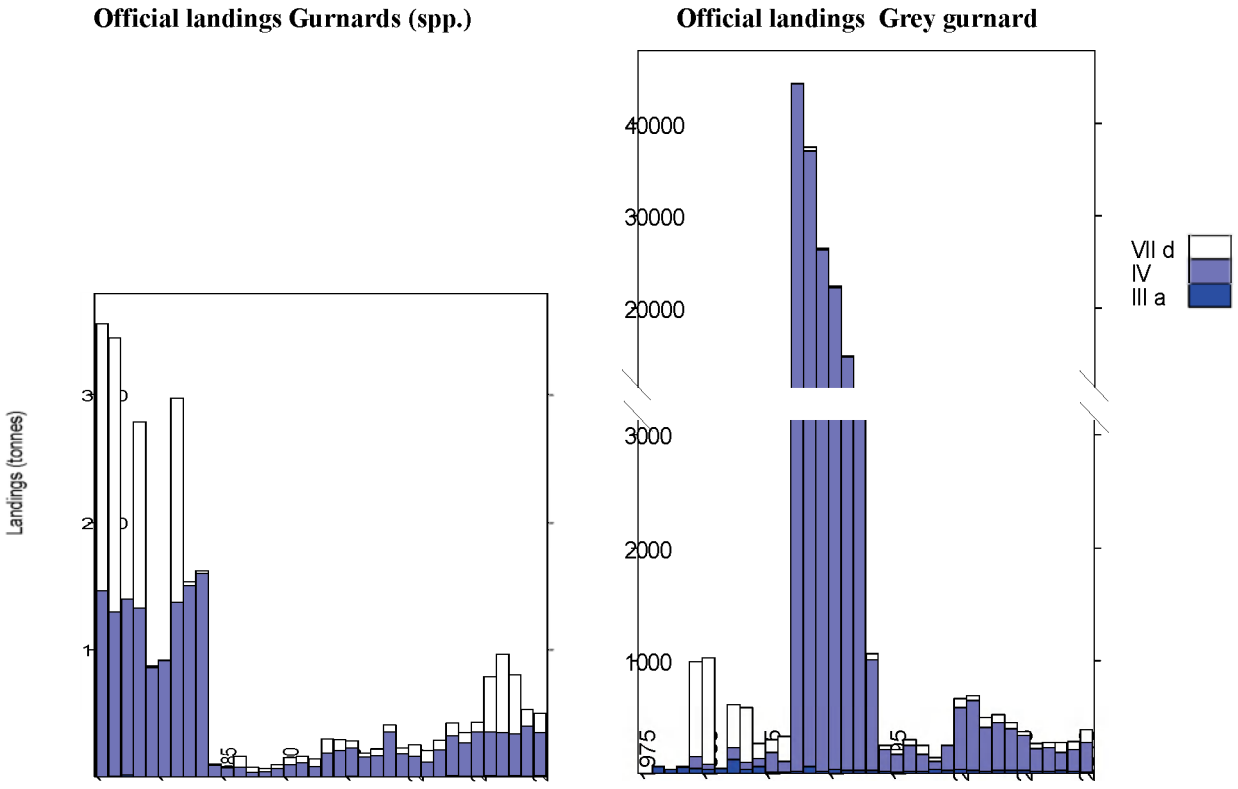


Figure 6.4.33.2 Grey gurnard in Subarea IV and Divisions VIId and IIIa. Official landings (in thousand tonnes) of gurnards (mixed) from the North Sea (left) and grey gurnard (right). Before 1987 most of the landings reported as gurnards probably consisted of grey gurnard. Historical landings statistics are not considered reliable for this species due to problems in species identification.

Table 6.4.33.1 Grey gurnard in Subarea IV and Divisions VIId and IIIa. ICES advice and official landings. Historical landings statistics are not considered reliable for this species due to problems in species identification.

Year	ICES Advice	Predicted catch corresp. to advice	Official landings
2009		-	0.3
2010		-	0.4
2011		-	0.4 [1)]
2012	No increase in catch	-	
2013	No increase in catch	-	
2014	Same catch advice as for 2013	-	

Weights in thousand tonnes.
[1)] Preliminary.

Table 6.4.33.2 Grey gurnard in Subarea IV and Divisions VIId and IIIa. Official landings per country (in tonnes). Omitted years before 1970 indicate zero catches reported by all countries. Historical landings statistics are not considered reliable for this species due to problems in species identification.

	Belgium	**Denmark**	**France**	**Netherlands**	**Norway**	**Sweden**	**UK**	Total
1957	0	0	0	0	0	308	0	308
1958	0	0	0	0	0	387	0	387
.....	0	0	0	0	0	0	0	0
1963	0	0	0	202	0	0	0	202
.....	0	0	0	0	0	0	0	0
1972	0	0	0	0	0	51	0	51
1973	0	0	0	0	0	58	0	58
1974	0	0	0	0	0	64	0	64
1975	0	0	0	0	0	14	0	14
1976	0	0	0	0	0	131	0	131
1977	0	0	0	0	0	74	0	74
1978	0	0	15	0	0	108	0	123
1979	0	0	944	0	0	98	0	1042
1980	0	0	993	0	0	74	0	1067
1981	0	0	0	0	0	92	0	92
1982	0	446	480	0	0	86	0	1012
1983	0	1096	553	0	0	15	0	1664
1984	0	4103	197	0	0	13	0	4313
1985	102	2361	187	0	0	18	0	2668
1986	0	320	283	0	0	20	0	623
1987	77	46611	122	0	0	12	0	46822
1988	86	38296	389	0	0	5	22	38798
1989	82	26758	135	0	0	9	0	26984
1990	91	22110	134	0	0	6	0	22341
1991	75	14564	122	0	0	10	0	14771
1992	104	8158	106	0	0	20	10	8398
1993	113	858	74	0	0	18	24	1087
1994	67	111	54	0	0	24	22	278
1995	50	83	62	0	0	11	21	227
1996	112	88	62	0	0	7	54	323
1997	52	49	103	0	0	10	57	271
1998	34	83	47	0	0	16	0	180
1999	36	109	0	0	0	137	0	282
2000	37	128	72	452	0	10	0	699
2001	28	319	60	277	0	7	33	724
2002	55	82	64	286	0	3	29	519
2003	34	124	47	319	0	8	26	558
2004	35	107	9	299	0	7	23	480
2005	29	94	7	242	0	10	22	404
2006	18	87	4	155	2	4	21	291
2007	14	59	5	166	5	6	50	305
2008	9	72	5	120	5	13	78	302
2009	16	36	3	157	1	7	83	303
2010	20	28	12	259	1	4	77	401
2011	32	11	10	313	1	21	60	449[1)]

[1)] Preliminary.

ECOREGION North Sea
STOCK Striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat)

Advice for 2013 and 2014

This is the first time ICES has provided advice for striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat). Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 1700 tonnes.

This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)	2009–2011
Qualitative evaluation	? Insufficient information

SSB (Spawning-stock Biomass)	2009–2011
Qualitative evaluation	→ Fluctuating without trend

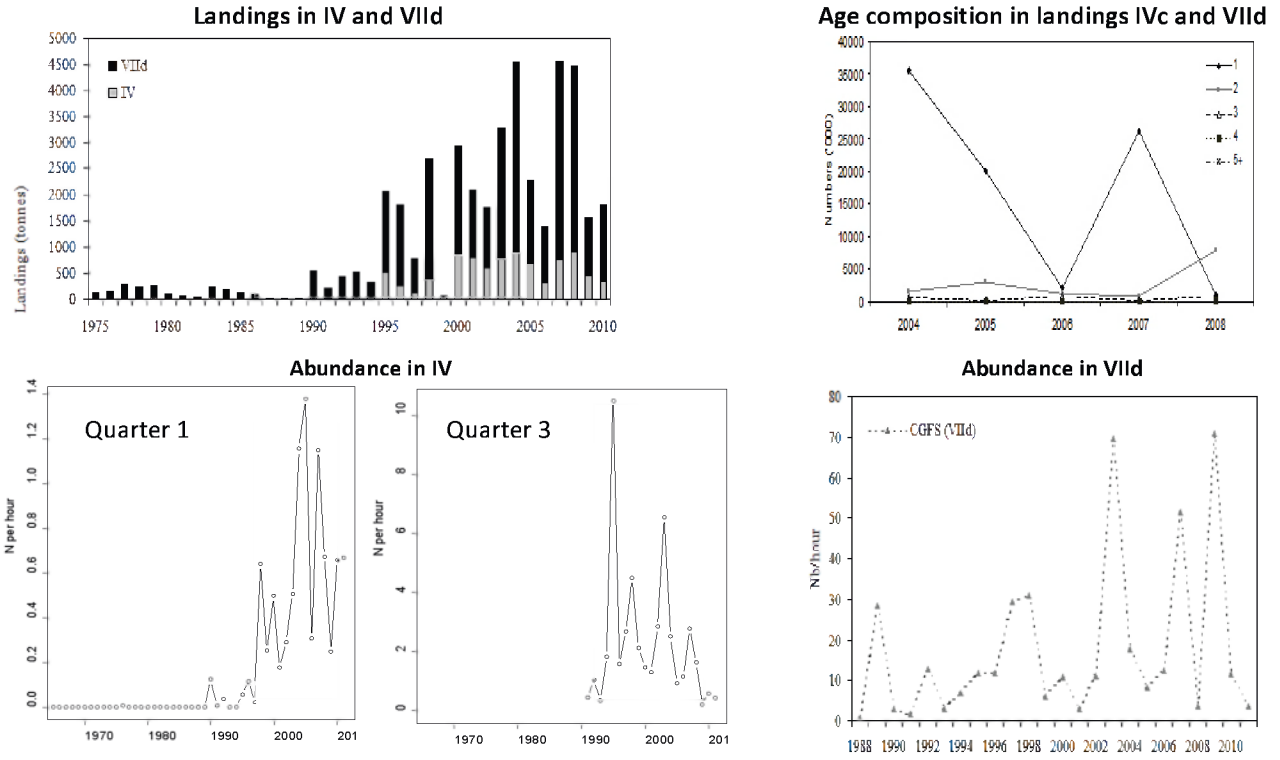


Figure 6.4.34.1 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Total landings by area (tonnes). (Note: No data reported by France in 1999.). Top right panel: Age composition of French landings in Divisions VIId and IVc (Eastern English Channel and Southern North Sea). Bottom panels: three time-series of abundance for striped red mullet in Subarea IV and Division VIId (Q4).

Survey data from the North Sea indicate a considerable increase in the stock size since the 1990s and is now considered fluctuating without trend. The landings follow a similar pattern over this period and do not seem to have been detrimental to the stock. The composition of the landings is largely from age group 1, which limits the possibility to give catch predictions.

Management plans

No specific management objectives are known to ICES. There is no TAC for this species.

Biology

Striped red mullet (*Mullus surmuletus*) is a benthic species. Young fish are distributed in coastal areas, while adults have a more offshore distribution. Recent stock identification studies by otolith and fish shape in European waters show that striped red mullet can be geographically divided into two units: Western Unit (Subareas VI and VIII, and Divisions VIIa–c, VIIe–k, and IXa) and Northern Unit (Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat).

In the English Channel, this species matures at approximately 16 cm.

Environmental influence on the stock

Juveniles are found in waters of low salinity, while adults are found at high salinity. The species is rarely found in transition zones of intermediate salinity. Striped red mullet prefers sandy sediments.

The fisheries

Historically, most catches have been taken by bottom trawls in a targeted fisheries. Since 2009 landings have been shared by two main fisheries, bottom trawlers and flyshooters. Discards are considered negligible.

Effects of the fisheries on the ecosystem

Bottom trawling impacts biomass, production, and species richness.

Quality considerations

Regular sampling of striped red mullet catches is expected to continue under the EU Data Collection Framework. The Channel Ground Fish Survey (CGFS) survey and the IBTS-Q1 and Q3 surveys provide abundance indices-at-age.

The advice is based on combined abundance indices from three surveys, used as an indicator of stock size. The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated.

Scientific basis

Assessment type	No assessment.
Discards and bycatch	Discards are considered negligible.
Indicators	IBTS-Q1&3 and CGFS.
Other information	Landing statistics.
Working group report	WGNEW, WGNSSK

ECOREGION North Sea
STOCK Striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

No reliable assessment can be presented. Therefore, no catch projections are available.

ICES approach to data-limited stocks

For data-limited stocks without information on abundance or exploitation ICES considers that a precautionary reduction of catches should be implemented unless there is reason to assume that the situation is not detrimental to the stock.

For this stock, ICES advises that catches should not increase to the average catch of 2009 and 2010 (2011 is omitted because of incomplete data), corresponding to catches of no more than 1700 t in 2013 and subsequent years.

Additional considerations

Stock identity

A study on otolith shape, used to differentiate stocks, was conducted in six geographic sectors: the North Sea, the Eastern English Channel, the Western English Channel, the Celtic Sea, the Northern Bay of Biscay, and the Southern Bay of Biscay. The results made it possible to separate the populations of striped red mullet in the Western English Channel and in the Eastern English Channel (Benzinou *et al.*, submitted).

The fisheries

Historically, France has taken most of the landings with a targeted fishery for striped red mullet (> 90% of landings). This fishery is conducted by bottom trawlers using a mesh size of 70–99 mm in the eastern English Channel and in the southern North Sea. The eastern English Channel and southern North Sea areas are fished by trawlers of various types. Striped red mullet is a bycatch in all of these fisheries. From 2000 a Dutch targeted fishery, using flyshooters, and a UK fisheries have also developed.

Data requirements

Detailed spatial data on the fisheries, especially for the earlier years in the time-series, and including landings by gear, length compositions, and discards would provide some historical context and indications of the patterns of exploitation. Life history and other biological parameters derived from surveys and commercial sampling would also be useful.

Comparison with previous assessment and advice

This is the first time ICES has provided advice for striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat). In 2011 advice was given for the whole Northeast Atlantic area.

The advice last year was based on precautionary considerations, this year the advice is based on the ICES approach to data-limited stocks.

Sources

Benzinou, A., Carbini, S., Nasreddine, K., Elleboode, R., and Mahé, K. 2012. Discriminating stocks of striped red mullet (*Mullus surmuletus*) in the Northwest European seas using three automatic shape classification methods. Fisheries Research, submitted.

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ICES. 2012b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 27 April–03 May 2012. ICES CM 2012/ACOM:13.

Table 6.4.34.1 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings
2000		-	none	2922
2001		-	none	2102
2002		-	none	1778
2003		-	none	3278
2004		-	none	4535
2005		-	none	2295
2006		-	none	1403
2007		-	none	4555
2008		-	none	4450
2009		-	none	1571
2010		-	none	1819
2011		-	none	1027 [1]
2012	No increase in catch	-		
2013	No increase in catches (average 2009–2010)	< 1700		
2014	Same catch advice as for 2013	< 1700		

Weights in tonnes.
[1] Provisional (no Dutch or UK data).

Table 6.4.34.2 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Official landings by country (tonnes).

.Year	Belgium	Denmark	Denmark	France	Netherlands	UK	total
1975	0	0	0	140	0	0	140
1976	0	0	0	156	3	1	160
1977	0	0	0	279	12	1	292
1978	0	0	0	207	25	3	235
1979	0	0	0	212	32	11	255
1980	0	0	0	86	25	4	115
1981	0	0	0	44	19	1	64
1982	0	2	0	32	18	2	54
1983	0	0	0	232	15	1	248
1984	0	0	0	204	0	3	207
1985	0	1	0	135	0	4	140
1986	0	1	0	84	0	3	88
1987	0	2	1	40	0	3	46
1988	0	1	1	35	0	4	41
1989	0	0	0	37	0	5	42
1990	0	0	0	524	0	13	537
1991	0	0	0	208	0	11	219
1992	0	0	0	431	0	14	445
1993	0	0	0	516	0	18	534
1994	0	0	0	308	0	14	322
1995	0	0	0	2016	0	63	2079
1996	0	1	1	1785	1	36	1824
1997	0	1	1	731	0	48	781
1998	0	1	1	2598	0	97	2697
1999[1)]	0	2	2	0	0	70	74
2000	0	2	2	2590	235	93	2922
2001	0	5	5	1417	533	142	2102
2002	0	12	12	1346	326	82	1778
2003	17	0	0	2750	396	115	3278
2004	22	0	0	3618	804	91	4535
2005	19	0	0	1595	600	81	2295
2006	12	0	0	1029	293	69	1403
2007	13	0	0	3475	906	161	4555
2008	15	0	0	3249	873	313	4450
2009	13	0	0	736	562	260	1571
2010	62	0	0	879	567	311	1819
2011[2)]	0	0	0	1027	0	0	1027

[1)] No data reported by France in 1999.
[2)] Provisional.

Table 6.4.34.3 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Official landings by area (tonnes). Note: Most of the Subarea IV catches are made in Division IVc.

Year	IV	IIIa	VIId	total
1975	0	0	140	140
1976	4	0	156	160
1977	19	0	273	292
1978	30	0	205	235
1979	49	0	206	255
1980	29	0	86	115
1981	20	0	44	64
1982	21	0	33	54
1983	41	0	207	248
1984	22	0	185	207
1985	10	0	130	140
1986	6	0	82	88
1987	7	0	38	45
1988	7	0	33	40
1989	5	0	37	42
1990	33	0	504	537
1991	26	0	193	219
1992	30	0	415	445
1993	63	0	471	534
1994	58	0	264	322
1995	527	0	1552	2079
1996	264	0	1559	1823
1997	139	0	641	780
1998	389	0	2307	2696
1999[1)]	35	0	37	72
2000	882	0	2038	2920
2001	800	0	1297	2097
2002	617	0	1149	1766
2003	809	0	2469	3278
2004	910	0	3625	4535
2005	702	0	1593	2295
2006	320	0	1083	1403
2007	773	0	3782	4555
2008	914	0	3536	4450
2009	454	0	1117	1571
2010	350	0	1469	1819
2011[2)]	1	0	1026	1027

[1)] No data reported by France in 1999.
[2)] Provisional.

ECOREGION North Sea
STOCK Lesser-spotted dogfish (*Scyliorhinus canicula*) in Division IIIa (Skagerrak and Kattegat), Subarea IV (North Sea), and Division VIId (eastern Channel)

Advice for 2013 and 2014

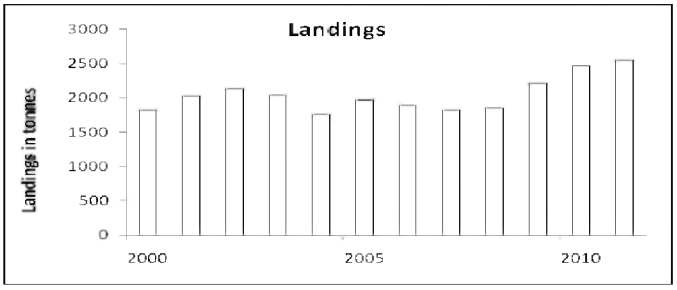
Based on ICES approach to data-limited stocks, ICES advises that catches could be increased by a maximum of 20%. Because the data for catches of lesser-spotted dogfish are not fully documented, ICES is not in a position to quantify the result. ICES does not advise that an individual TAC be set for this stock, at present.

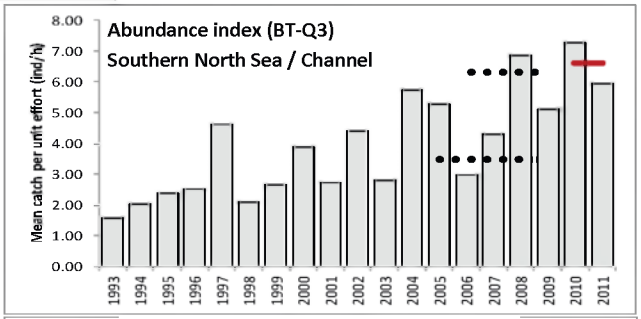
This is the first year ICES is providing quantitative advice for data-limited stocks (see Quality considerations).

Stock status

F (Fishing Mortality)		2009–2011
MSY (F_{MSY})	?	Unknown
Precautionary approach (F_{pa},F_{lim})	?	Unknown
Qualitative evaluation	↘	Decreasing

SSB (Spawning-Stock Biomass)		2005–2011
MSY ($B_{trigger}$)	?	Unknown
Precautionary approach (B_{pa},B_{lim})	?	Unknown
Qualitative evaluation	↗	Increasing





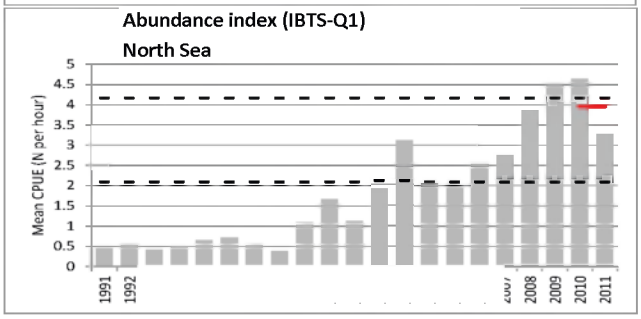


Figure 6.4.35.1 Lesser-spotted dogfish in Subareas and Divisions IIIa, IV, and VIId. Reported landings (tonnes). Right, top: Mean catch per unit effort of BTS-Q3 survey in Divisions IVc–VIId. Right, below: catch per unit effort of IBTS-Q1 in Subarea IV. Dashed lines show the mean (± 1SD) cpue for 2005–2009, the red line shows the mean cpue for 2010–2011.

The stock is estimated to be increasing. Survey catch rates are increasing throughout the ecoregion. The average of beam trawl survey (BTS-Q3), assumed as stock size indicator, in the last two years (2010-2011) is 35% higher than the average of the five previous years (2005-2009). The average of the international bottom trawl surveys in the North Sea (IBTS-Q1), assumed as a stock size indicator, in the last two years (2010-2011) is 26% higher than the average of the

five previous years (2005-2009).Catches are stable or increasing, though data are not complete. Given the increase in abundance, and stable/increasing catches, it can be inferred that exploitation (fishing mortality) is stable or decreasing.

Management plans

There are no known management objectives for this stock.

Biology

Lesser-spotted dogfish is a small, productive, egg-laying shark. It is one of the most common small sharks in this ecoregion. It has a high discard survival rate.

The fisheries

Lesser-spotted dogfish are mainly bycaught in mixed demersal fisheries. They are generally of low commercial value and discard rates are high. Discard survivorship is considered to be high. Fisheries for lesser-spotted dogfish may take place for use as bait in pot fisheries, but this is unquantified.

Effects of the fisheries on the ecosystem

Some demersal sharks, including lesser-spotted dogfish, may benefit from scavenging on trawl-damaged organisms and discards.

Quality considerations

As there is no obligation to report lesser-spotted dogfish at the species level, they are often included in generic categories such as "dogfish and hounds". Therefore, landings data are not considered reliable. High levels of discarding take place.

Fishery-independent trawl surveys provide the longest time-series of species-specific information.

The methods applied to derive quantitative advice for data-limited stocks are expected to evolve as they are further developed and validated. The harvest control rules are expected to stabilize stock size, but they may not be suitable if the stock size is low and/or overfished.

Scientific basis

Assessment type	Survey-based and landings-based trends.
Input data	Two surveys: UK (BTS–Q3; Divisions IVc and VIId) and IBTS–Q1 North Sea.
Discards and bycatch	Data not examined. Improved knowledge of discard rates and discard survival is required.
Indicators	None.
Other information	Life history.
Working group report	WGEF

ECOREGION North Sea

STOCK Lesser-spotted dogfish (*Scyliorhinus canicula*) in Subareas and Divisions IIIa (Skagerrak and Kattegat), Subarea IV (North Sea), and Division VIId (eastern Channel)

Reference points

No reference points have been defined for this stock.

Outlook for 2013 and 2014

Based on ICES approach to data-limited stocks, ICES advises that catches could be increased by a maximum of 20%. Given that landings data are not fully documented, it is not possible to state what the current catch is. ICES does not advise that an individual TAC be set for this stock, at present.

ICES approach to data-limited stocks

For data-limited stocks for which an abundance index is available, ICES uses a harvest control rule on an index-adjusted *status quo* catch. The advice is based on a comparison of the two most recent index values with the five preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For this stock the abundance is estimated to have increased by more than 20% between 2005 and 2009 (average of the five years) and 2010–2011 (average of the two years). This implies an increase of catches of at most by 20% in relation to the last three years average. Because the data for catches of lesser-spotted dogfish are not fully documented, ICES is not in a position to quantify the result.

Considering that current exploitation levels are not thought to be detrimental to these stocks and given that there is a consistent increase over an extended period of time, no additional precautionary buffer is needed.

ICES does not advise that an individual TAC be set for this stock, at present.

Additional considerations

Comparison with previous assessment and advice

The advice is based on Category 3 of the ICES approach to data-limited stocks. The previous advice was based on ICES precautionary considerations (Table 6.4.35.1).

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19.

Table 6.4.35.1 Lesser-spotted dogfish in Subareas and Divisions IIIa, IV, and VIId. ICES advice, management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings	ICES Landings
2007	No advice		No TAC	1.6	1.8
2008	No advice		No TAC	1.9	1.8
2009	*Status quo* catch	1.8	No TAC	2.2	2.2
2010	No new advice, same as for 2009	1.8	No TAC	2.5	2.5
2011	Maintain catch at recent level	1.8	No TAC	2.5	2.5
2012	No new advice, same as for 2011	1.8	No TAC		
2013	Increase catch at most by 20% + no species specific TAC	-			
2014	No new advice, same as for 2013	-			

Weights in thousand tonnes.

Table 6.4.35.2 Lesser-spotted dogfish in Subareas and Divisions IIIa, IV, and VIId. Official species-specific landings by country (in tonnes). "n.a." indicates not available.

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Belgium	186	220	235	244	226	238	265	266	338	313	293	309
France	1633	1811	1899	1777	1472	1614	1492	1459	1406	1751	1999	2013
Netherlands	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	37	42	48
UK (E,W&NI)	n.a.	n.a.	n.a.	13	57	92	118	94	102	116	128	176
UK (Scotland)	.	.	1	5	3	22	6	3 [1)]	2 [1)]	3 [1)]	3 [1)]	.
	1819	2031	2135	2039	1758	1966	1881	1822	1848	2220	2460	2546

[1)] Registered as spotted dogfish.