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Report of the ICES Advisory Committee 2013

Book 6
North Sea

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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

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BOOK 6

6 NORTH SEA

6.1 Ecosystem overview

This Section has not been updated in 2013. 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 State of stocks and fisheries in 2013

ICES provides advice regarding the following stocks in this ecoregion

Stock	Basis for stock status and advice
Brill in Subarea IV and Divisions IIIa and VIId,e	Data limited
Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak)	Analytical
Cod in Division IIIa East (Kattegat)	Data limited
Dab in Subarea IV and Division IIIa	Data limited
Flounder in Division IIIa and Subarea IV	Data limited
Grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat)	Data limited
Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak)	Analytical
Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners)	Analytical
Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)	Analytical
Horse mackerel (*Trachurus trachurus*) in Divisions IIIa, IVb,c, and VIId (North Sea stock)	Data limited
Lemon sole in Subarea IV and Divisions IIIa and VIId	Data limited
Striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat)	Data limited
Nephrops in Division IVa (Noup, FU 10)	Data limited
Nephrops in Division IVa (Norwegian Deeps, FU 32)	Data limited
Nephrops off Horn's Reef (FU 33)	Data limited
Nephrops in Devil's Hole (FU 34)	Data limited
Nephrops in Division IIIa	Analytical
Nephrops in Division IVbc (Botney Gut–Silver Pit, FU 5)	Data limited
Nephrops in Division IVb (Farn Deeps, FU 6)	Analytical
Nephrops in Division IVa (Fladen Ground, FU 7)	Analytical
Nephrops in Division IVb (Firth of Forth, FU 8)	Analytical
Nephrops in Division IVa (Moray Firth, FU 9)	Analytical
Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat) October advice	Analytical
Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat) June advice	Analytical
Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)	Data limited
Northern shrimp (*Pandalus borealis*) in Divisions IIIa and IVa East (Skagerrak and Norwegian Deep)	Analytical
Plaice in Division VIId (Eastern Channel)	Data limited
Plaice in Subarea IV (North Sea)	Analytical
Plaice in Subdivision 20 (Skagerrak)	Data limited
Pollack in Subarea IV and Division IIIa	Data limited
Other ray and skate species in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)	Data limited
Small-eyed ray (*Raja microocellata*) in Divisions VIId, e (English Channel)	Data limited
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)	Data limited
Thornback ray (*Raja clavata*) in Subarea IV and in Divisions IIIa and VIId, e (North Sea, Skagerrak, Kattegat, and English Channel)	Data limited
Blonde ray (*Raja brachyuran*) in Divisions IVc and VIId, e (Southern North Sea and	Data limited

English Channel)	
Spotted ray (*Raja montagui*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)	Data limited
Cuckoo ray (*Leucoraja naevus*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)	Data limited
Starry ray (*Amblyraja radiata*) in Subarea IV and in Divisions IIIa and VIId (North Sea, Skagerrak, Kattegat, and eastern English Channel)	Data limited
Undulate ray (*Raja undulata*) in Divisions VIId, e (English Channel)	Data limited
Saithe in Subarea IV (North Sea), Division IIIa (Skagerrak), and Subarea VI (West of Scotland and Rockall)	Analytical
Sandeel in the Dogger Bank area (SA 1)	Analytical
Sandeel in the South Eastern North Sea (SA 2)	Analytical
Sandeel in the Central Eastern North Sea (SA 3)	Analytical
Sandeel in the Central Western North Sea (SA 4)	Data limited
Sandeel in the Viking and Bergen Bank area (SA 5)	Data limited
Sandeel in Division IIIa East (Kattegat, SA 6)	Data limited
Sandeel in the Shetland area (SA 7)	Data limited
Sole in Division VIId (Eastern Channel)	Analytical
Sole in Division IIIa and Subdivisions 22–24 (Skagerrak, Kattegat, and the Belts	Analytical
Sole in Subarea IV (North Sea)	Analytical
Sprat in Division IIIa (Skagerrak – Kattegat)	Data limited
Sprat in Subarea IV (North Sea)	Analytical
Lesser-spotted dogfish (Scyliorhinus canicula) in Division IIIa (Skagerrak and Kattegat), Subarea IV (North Sea), and Division VIId (eastern Channel)	Data limited
Turbot in Division IIIa	Data limited
Turbot in Subarea IV	Data limited
Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel)	Analytical
Whiting in Division IIIa (Skagerrak – Kattegat)	Data limited
Witch in Subarea IV and Divisions IIIa and VIId	Data limited

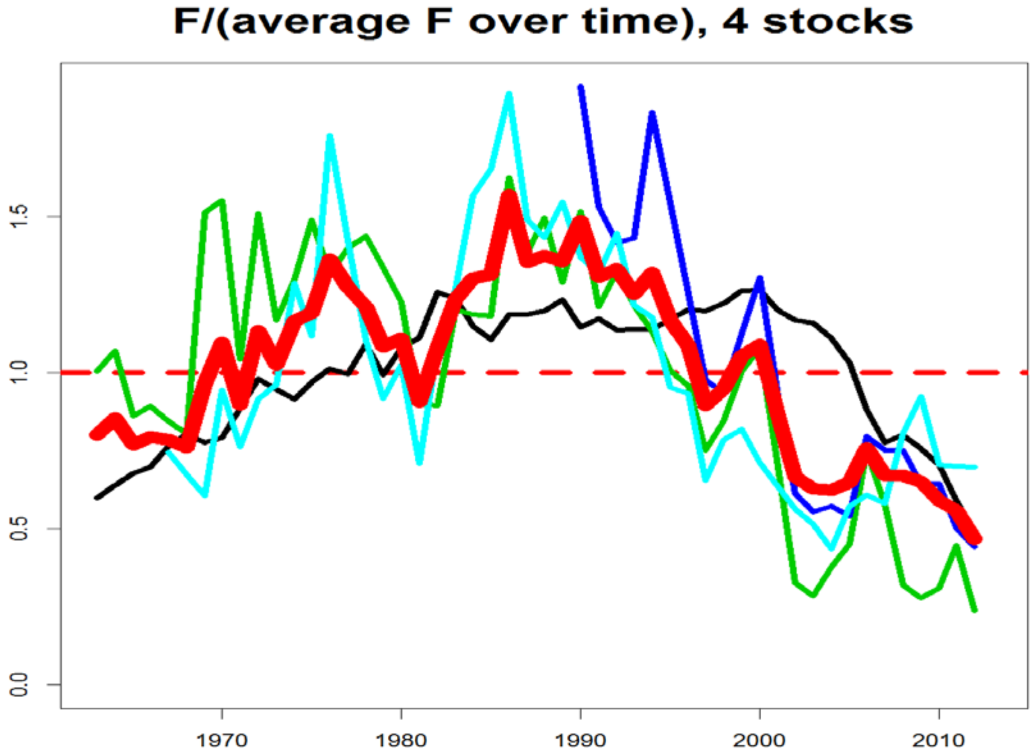
The state and advice of the individual stocks are presented in the stock sections. An overview of the status of the stocks for which information on fishing mortality and spawning stock biomass is available, as assessed for 2012 in 2013, is presented in table 6.2.1.

Table 6.2.1. Status of data rich stocks (n=22) for the North Sea stocks 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 $B_{trigger}$ $SSB_{2013} \geq$ MSY $B_{trigger}$	is below MSY $B_{trigger}$ $SSB_{2013} <$ MSY $B_{trigger}$	is not defined
MSY Approach	**Fishing Mortality**			
	is at or below MSY ($F_{2012} \leq F_{MSY}$)	14% (3)	9% (2)	9% (2)
	is above MSY ($F_{2012} > F_{MSY}$)	18% (4)	18% (4)	-
	is not defined	9% (2)	14% (3)	9% (2)

		is at or above PA $SSB_{2013} \geq B_{pa}$	is at increased risk $B_{pa} > SSB_{2013} > B_{lim}$	is below limit $SSB_{2013} < B_{lim}$	is not defined
Precautionary Approach	**Fishing Mortality**				
	is at or below P ($F_{2012} \leq F_{pa}$)	14% (3)	9%(2)	-	-
	is at increased risk ($F_{lim} > F > F_{pa}$)	5%(1)	-	-	5%(1)
	is above PA ($F_{2012} > F_{pa}$)	-	-	-	-
	is not defined	23 % (5)	14%(3)	5%(1)	27% (6)

Although there is considerable variation between stocks and large year-to-year variation for most stocks, the overall fishing mortality has been decreasing over the last couple of decades. The biomasses have overall in the last few years been increasing (figure 6.2.1-4).



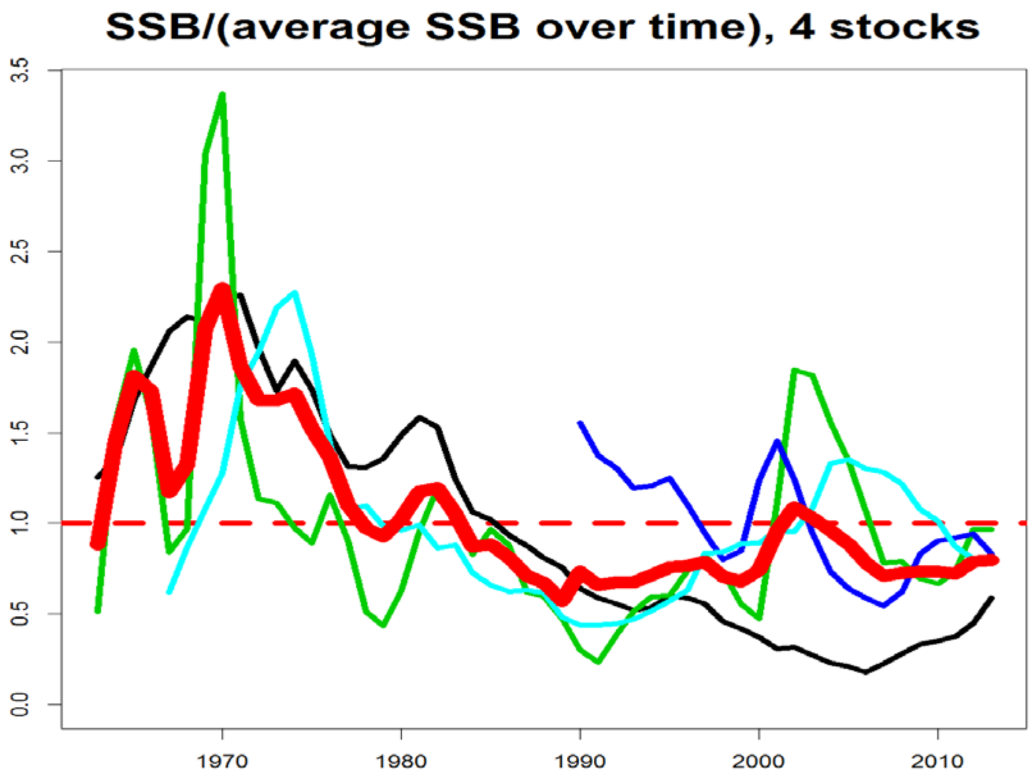
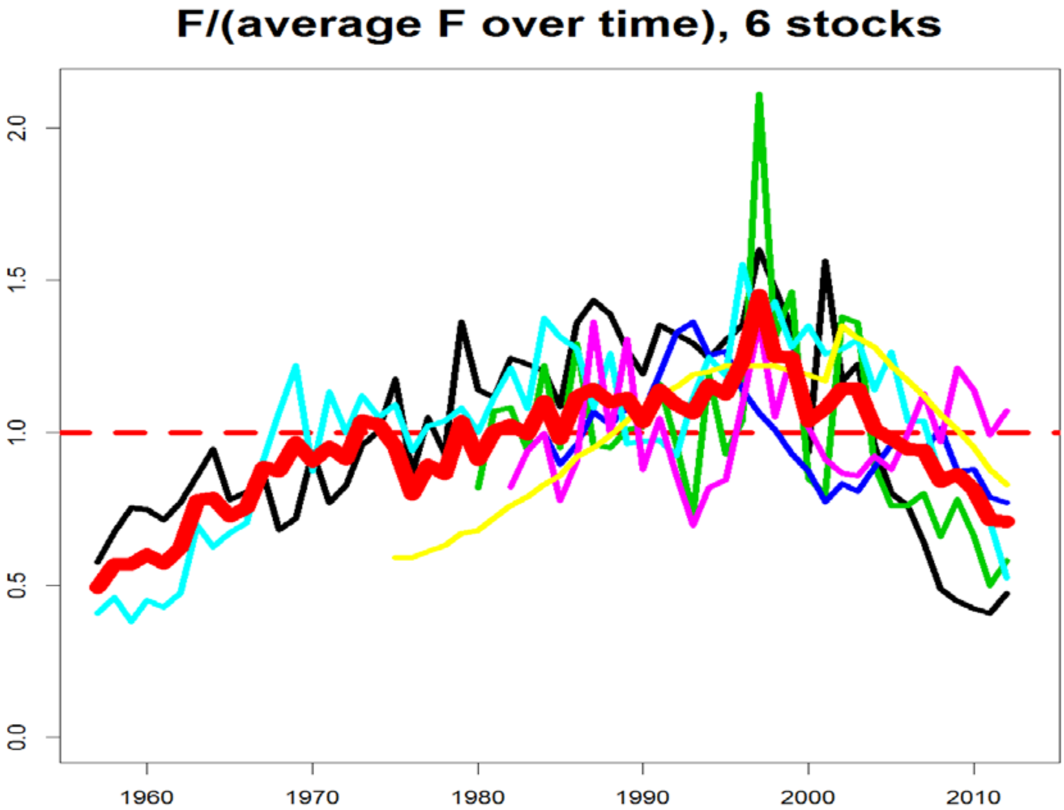


Figure 6.2.1. Trend in fishing mortality and spawning stock biomass relative to the average for each stock of cod, haddock, saithe, and whiting over the time for which data are available. The graphs include data for the stocks for which such estimates are available. The thick (red) line represents the average for all the stocks.



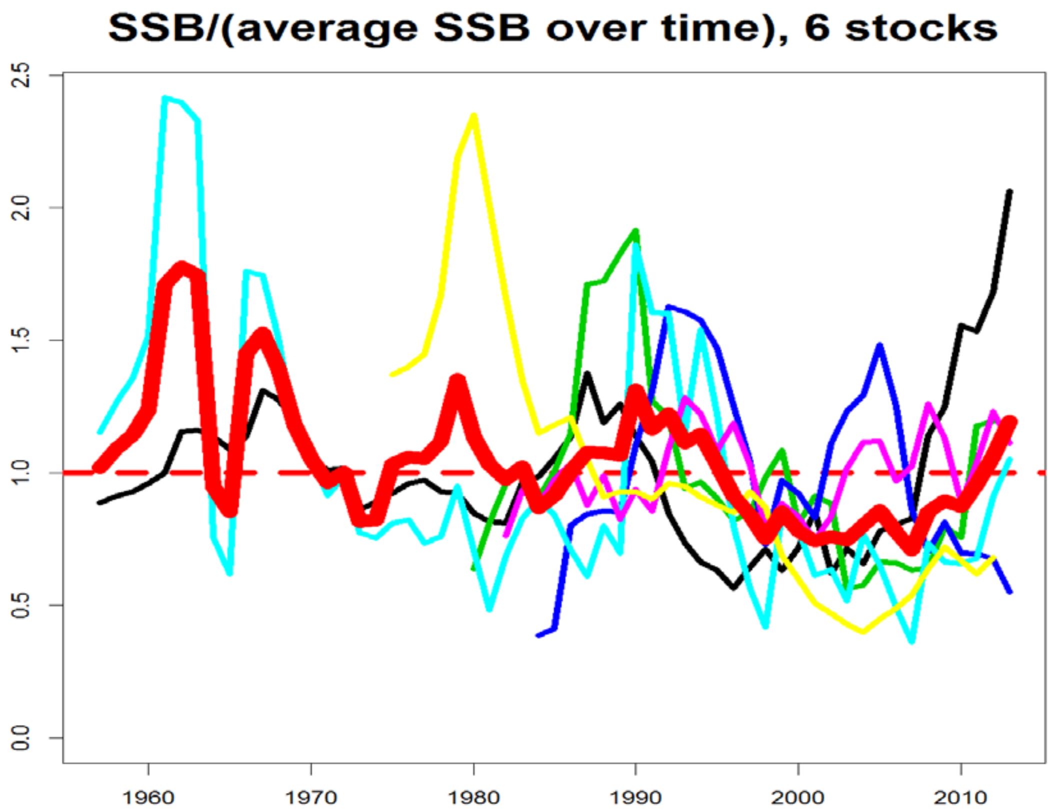


Figure 6.2.2. Trend in fishing mortality and spawning stock biomass relative to the average for each stock of plaice, sole and turbot over the time for which data are available. The graphs include data for the stocks for which such estimates are available. The thick (red) line represents the average for all the stocks.

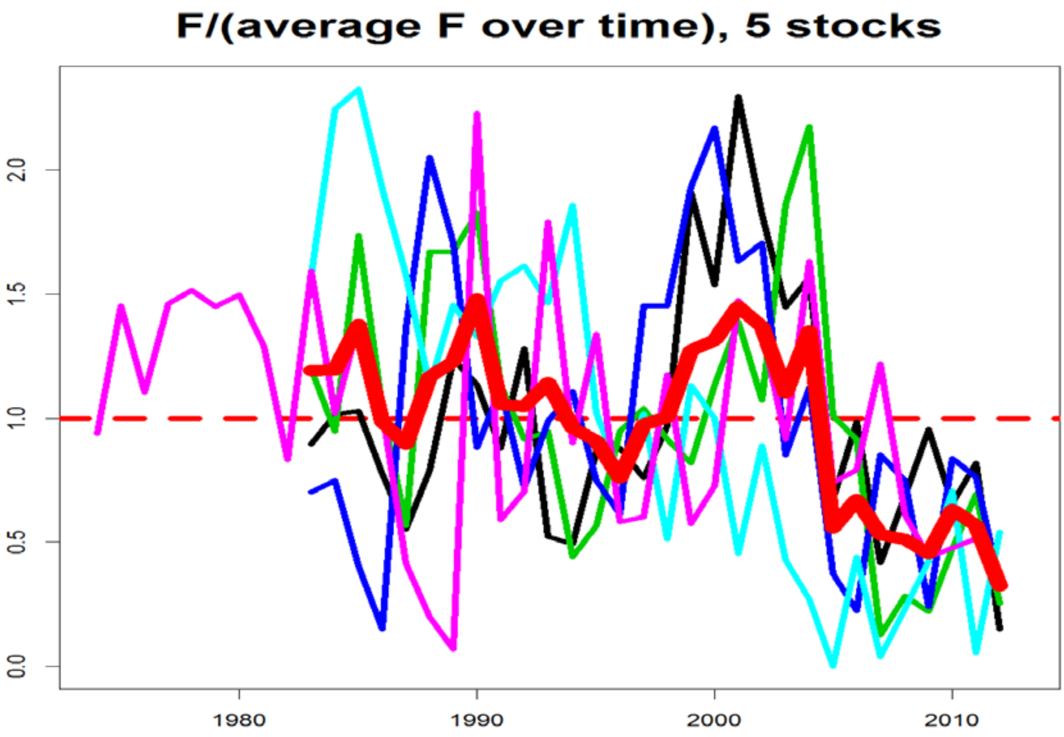


Figure 6.2.3. Trend in fishing mortality and spawning stock biomass relative to the average for each stock of sandeel, sprat and Norway pout over the time for which data are available. The graphs include data for the stocks for which such estimates are available. The thick (red) line represents the average for all the stocks.

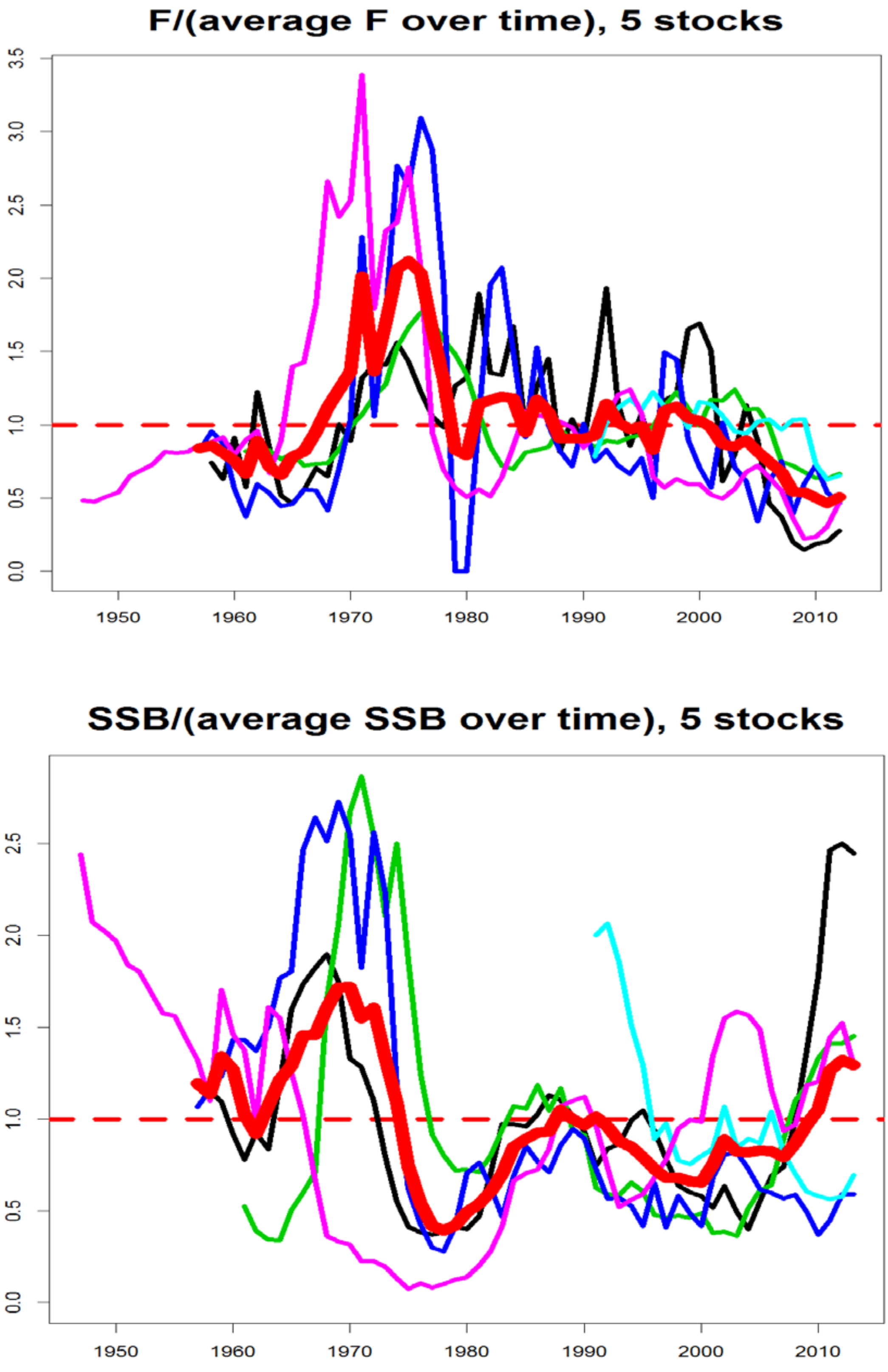


Figure 6.2.4. Trend in fishing mortality and spawning stock biomass relative to the average for each stock of herring including the Celtic Sea over the time for which data are available. The graphs include data for the stocks for which such estimates are available. The thick (red) line represents the average for all the stocks.

Of the stocks for which information exists, fishing mortality are still for many stocks above Fmsy. Of the stocks for which information exist many are now above MSY Btrigger. A few however are still struggling and showing only weak signs of improving towards MSY Btrigger (figures 6.2.5-8).

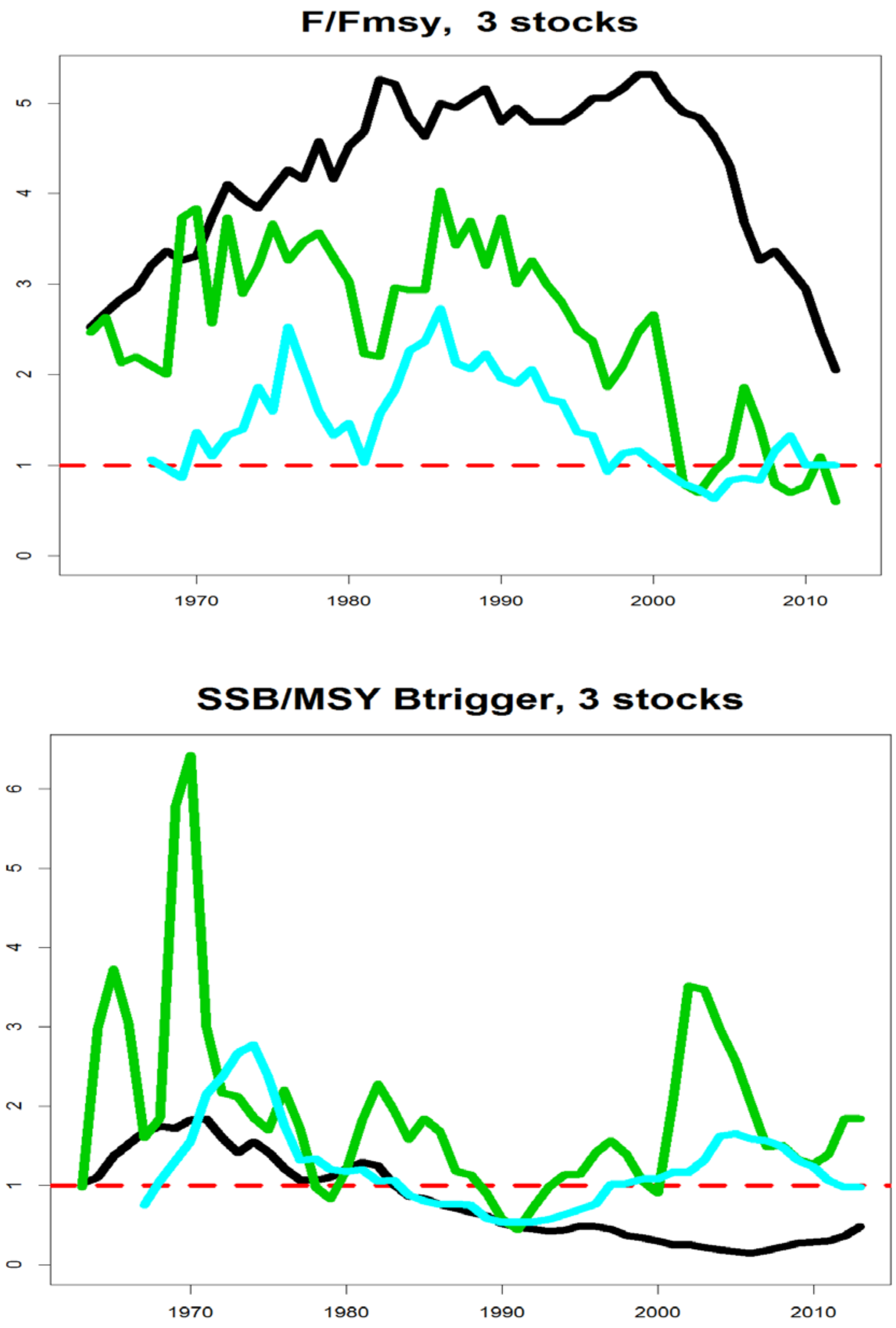
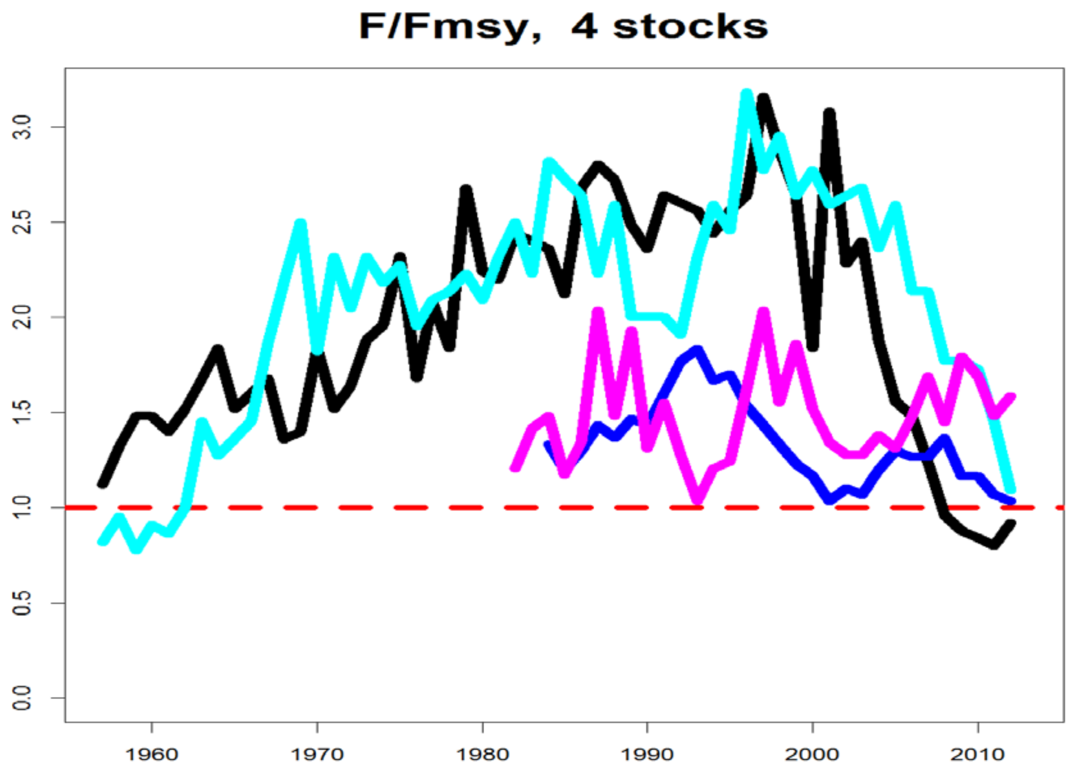


Figure 6.2.5. The status of fish stocks relative to reference points (Fmsy, MSY Btrigger) for those cod, haddock, saithe, and whiting stocks for which this is available. The dotted (red) line represents the ratio 1.



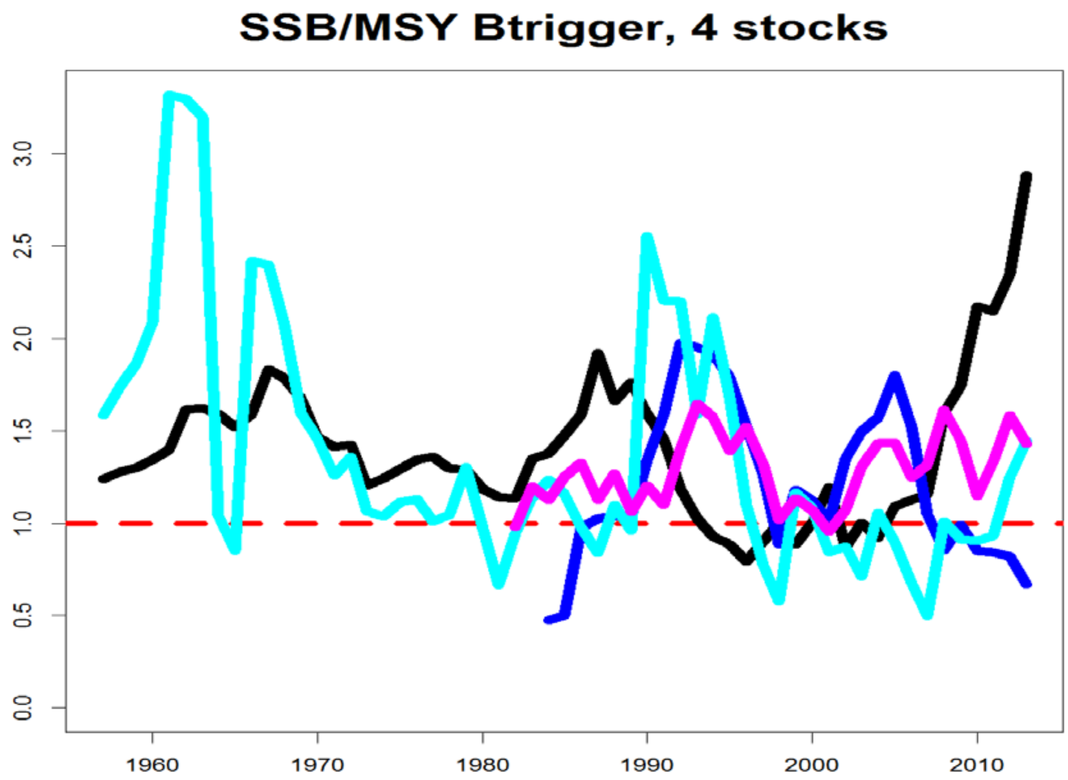
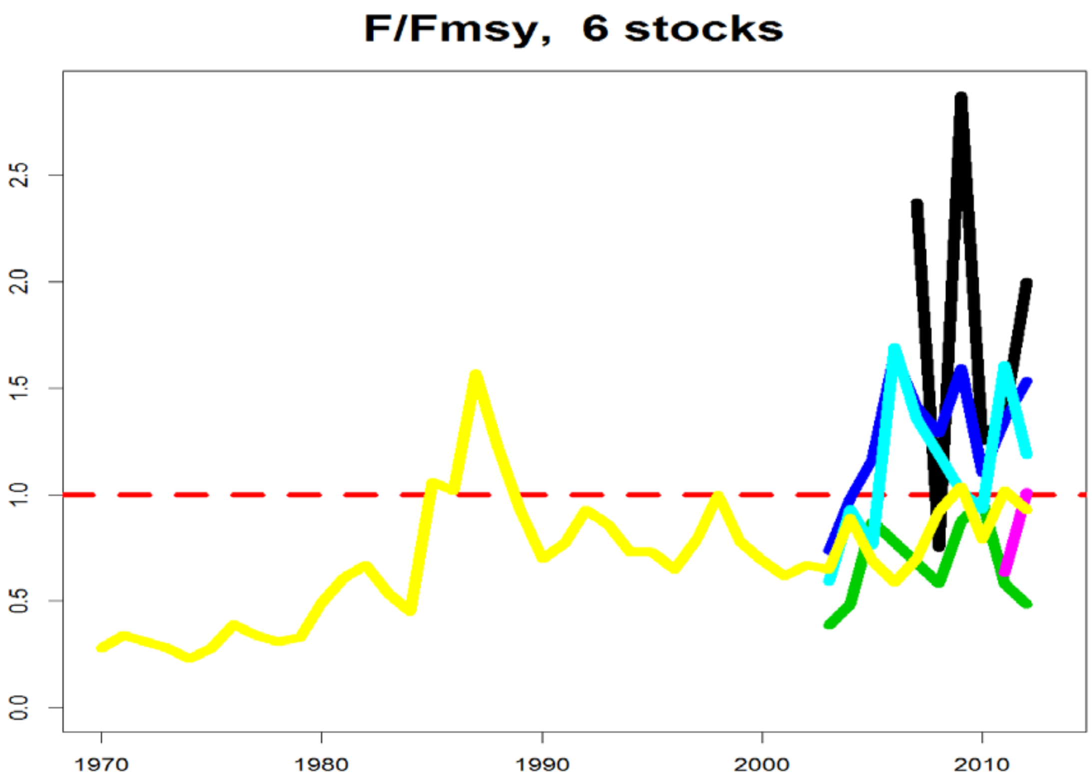


Figure 6.2.6. The status of fish stocks relative to reference points (Fmsy, MSY Btrigger) for those plaice, sole and turbot stocks for which this is available. The dotted (red) line represents the ratio 1.



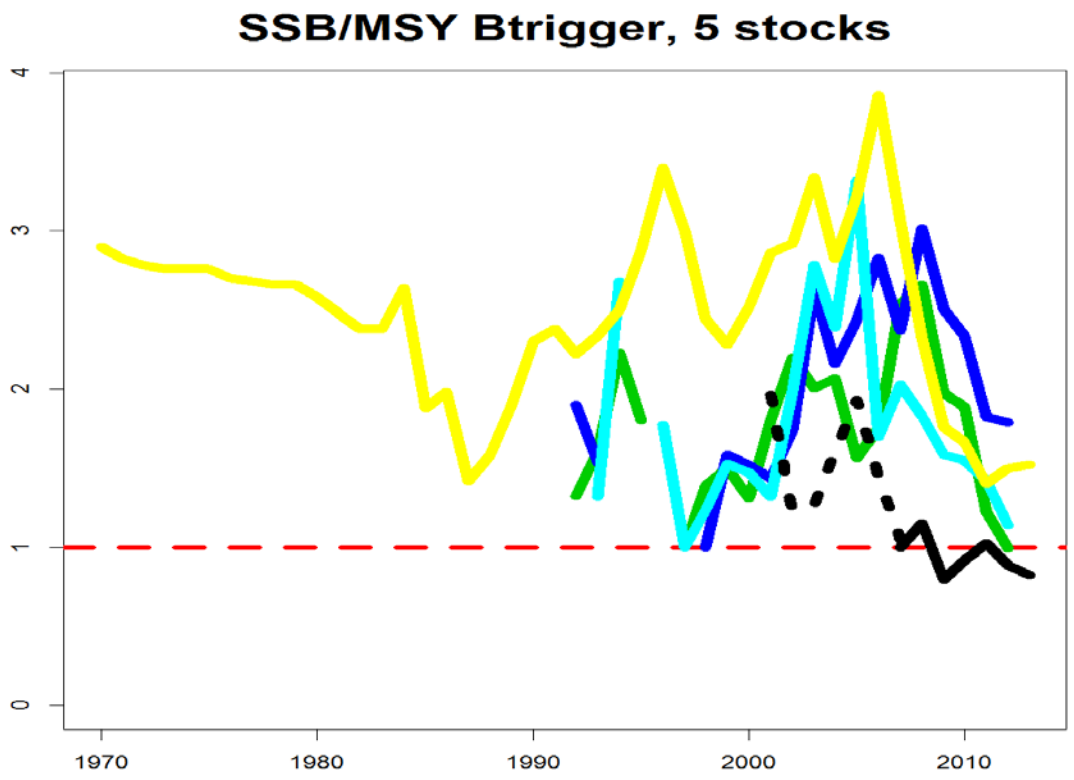
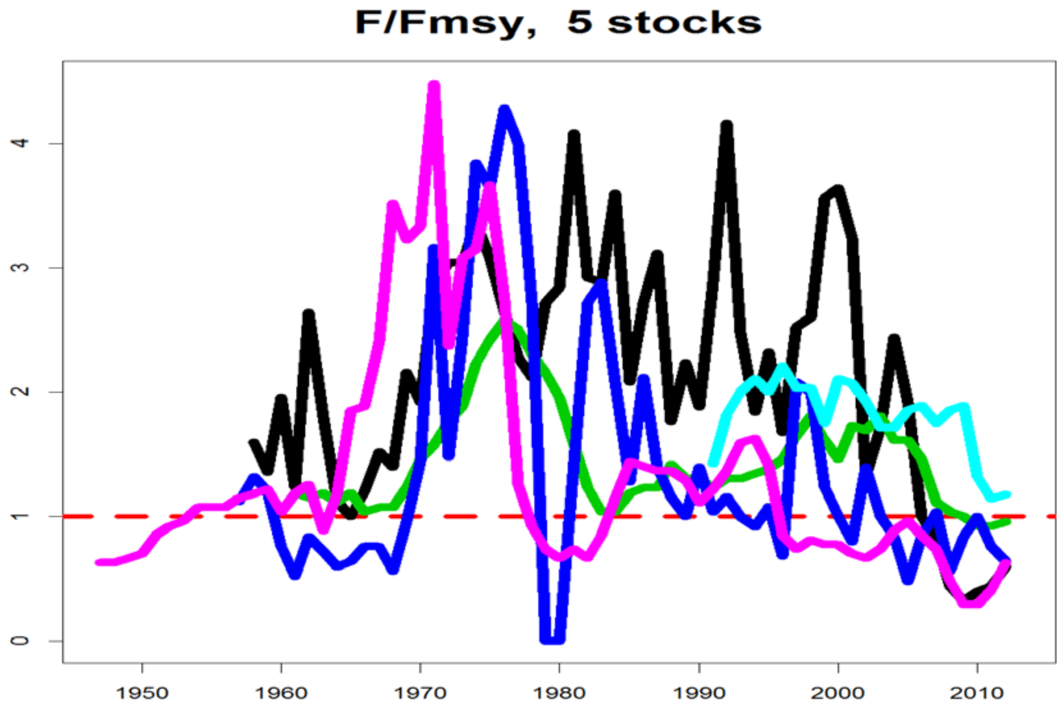


Figure 6.2.7. The status of fish stocks relative to reference points (Fmsy, MSY Btrigger) for those *Nephrops* and *Pandalus* stocks for which this is available. The dotted (red) line represents the ratio 1.



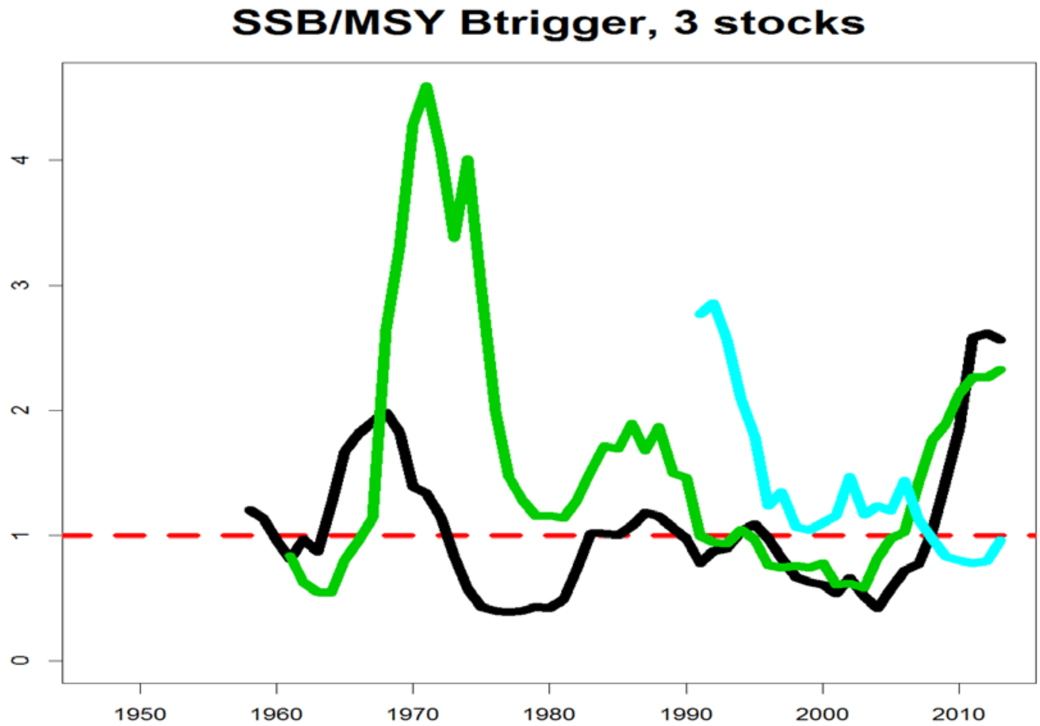


Figure 6.2.8. The status of fish stocks relative to reference points (Fmsy, MSY Btrigger) for those herring stocks including the Celtic Sea for which this is available. The dotted (red) line represents the ratio 1.

Large fish indicators

The amount of large fish (defined here as fish over 49 cm) has varied without a trend over the recent three decades (Figure 6.2.9)

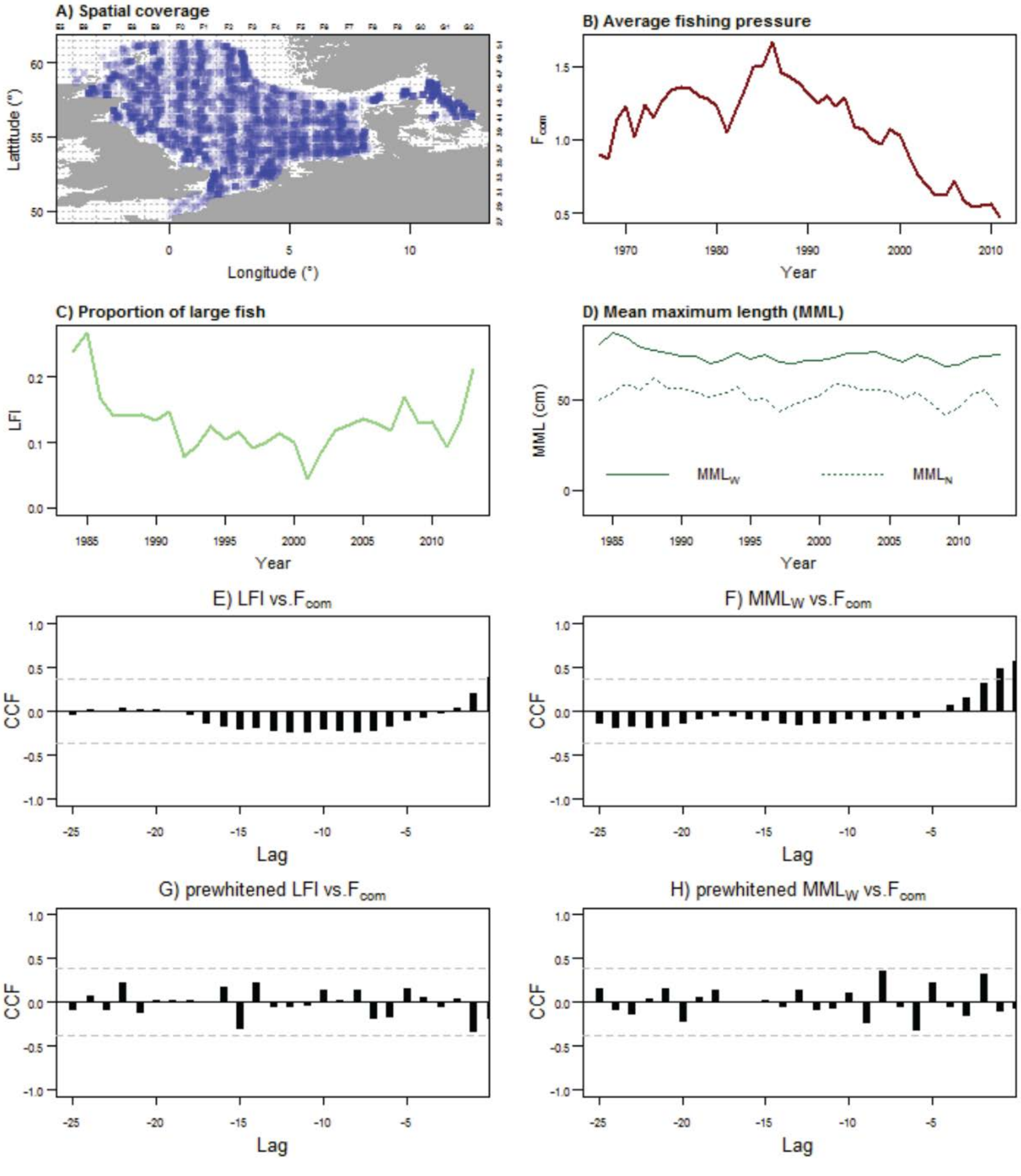


Figure 6.2.9. Community SBI of the North Sea. A) Overlaid haul stations in the survey area. B) Time series of community fishing pressure (Fcom) averaged across the relevant commercial stocks. C) Time series of the large fish indicator (LFI). D) Time series of mean maximum length by weight (MMLW) and numbers (MMLN). E) Cross-correlation function (CCF) of Fcom vs. LFI. F) CCF of Fcom vs. MMLW. G) Prewhitened CCF of Fcom vs. LFI. H) Prewhitened CCF Fcom vs. MMLW. From ICES. 2013. Report of the Workshop on DCF Indicators, 21 - 25 October 2013, ICES Headquarters, Copenhagen, Denmark. ICES CM 2013/ACOM:38. 81 pp

6.3 Assessments and Advice

6.3.1 Advice June 2013

ECOREGION North Sea
STOCK Multispecies considerations for the North Sea stocks

ICES intends to gradually start providing multispecies advice on fisheries for some ecosystems (see Section 1.2) and encourages managers to get familiar with multispecies considerations in the North Sea. The present section may serve as a starting point for a dialogue between ICES and managers, to foster the development of a multispecies management system for the North Sea. Implicit management objectives and risk tolerance that are presented will need to be validated by managers. The selection of preferred options for these parameters would be best made through discussions within an inclusive governance process.

The North Sea has a complex foodweb which leads to more trade-offs in yield between species compared to simpler foodwebs (e.g., Baltic foodweb). If managers decide to adopt a multispecies management approach, a transition period from the present management will be required. This work is meant to be only illustrative, to highlight the most important trade-offs between species and to give a first indication how multispecies MSY reference points might compare to single-species ones. In this work, ICES focuses on the most obvious interactions between most commercially exploited fish stocks in the area and does not attempt to provide a full foodweb model.

ICES used one model to perform a multispecies assessment (SMS). Results are interpreted by ICES qualitatively, to highlight important features of multispecies considerations instead of focusing on absolute values. It should be noted that no value of multispecies F_{MSY} can be considered precautionary until a formal evaluation has been done.

The main results of the present multispecies analysis for the North Sea are that:

Potential target multispecies F_{MSY} depends on the management objectives and SSB constraints used. There is no single maximum sustainable yield solution in a multispecies context, and policy choices will have to be made. ICES multispecies simulations provide the trade-offs of identified scenarios that can be used to inform on the possible consequences of various policy decisions.

Yield of virtually all species is strongly affected by the abundance of cod and saithe, which are the main predator fish species. Changing management target fishing mortality (target F) for cod and saithe therefore influences the yield of other stocks more than the management targets for these other stocks. Indirect predation effects are also important. For example, a lower F on cod increases cod biomass, which leads to a decrease in SSB and yield for whiting and haddock (direct predation effect) but also to an increase in SSB and yield for herring, sandeel, Norway pout, and sprat. The increase in SSB for these prey species is due to the reduction in predation pressure from whiting and haddock, which more than compensates the increase in direct predation from a larger cod stock (indirect effect).

Due to predation, it is unlikely that all stocks can be maintained above precautionary single-species biomass reference points simultaneously. Whiting is the most extreme example of this. Small whiting suffers from high predation pressure by grey gurnard and additionally a recovery of the cod stock deteriorates the situation for whiting in the model. A new approach is needed to define what precautionary means in a multispecies context.

Target fishing mortalities leading to close-to-maximum average yield (F_{MSY}) in a multispecies context are in general higher than the agreed single-species F_{MSY} values. The model simulations show that the predators cod and saithe should be fished at higher F to lower the predation pressure on their prey, and in case of cod also to avoid too much loss in yield due to cannibalism. This highlights the previous point that the target F_{MSY} depends on defining agreed constraints and acceptable risk levels by managers.

Due to a successful reduction in fishing mortality for many stocks, natural mortality is becoming the dominant source of mortality in the North Sea. This means that the stock dynamics are increasingly more influenced by natural processes than by fisheries. At the same time, improving estimates of consumption of fish by top predators, such as seals and cetaceans, is very important, particularly when these predator populations are expected to increase further.

Results should be interpreted qualitatively. The applied simulation model (SMS) focuses on the effect of species interaction (mortality due to predation) and fish catches without considering other factors that can change future stock sizes and yield. Even with such a simplification, a number of assumptions are made to model the complex foodweb. In addition, the conclusions are based on long-term changes due to changes in fishing mortality, while other factors such as effects driven by environmental conditions are assumed constant for a long period. Therefore, the model output should not be used as a quantitative prediction of future yield, but may provide guidance on possible future trade-offs and constraints.

Background

Information on the modelling approach

Extensive multispecies and ecosystem research has been performed in the North Sea in the past 30 years. ICES, together with several institutes around the North Sea, has invested substantially in the research on multispecies interactions, ecosystem functioning, and integrated assessment. Currently, several multispecies and ecosystem models exist for the North Sea (for an overview cf. ICES, 2012a). One of them, the stochastic multispecies model (SMS), was chosen for a more detailed scrutiny in 2012 by ICES in cooperation with the EU STECF (2012) for the Baltic. The North Sea SMS model was updated and reviewed at WGSAM in 2011. Results of simulations presented here have been carried out as part of the EU project MYFISH and were discussed and adopted during WGSAM in 2012. Specific details on model settings are available in ICES WGSAM 2011 and 2012 reports (ICES, 2011, 2012a).

Stomach data are of vital importance for predator-prey multispecies analyses. Stomach data available to parameterize the North Sea SMS model are mainly from the "years of the stomach" in 1981 and 1991. In the last 20 years no internationally coordinated stomach sampling programme has been carried out. This lack of data represents a main difficulty for this work, as conclusions are sensitive to the diet data used. In 2012 a "Study on stomach content of fish to support the assessment of good environmental status of marine foodwebs and the prediction of MSY after stock restoration" was funded to run until November 2014. Sampling has started on IBTS surveys, with the main aim of getting up-to-date information on the importance of grey gurnard, mackerel, and hake in the North Sea foodweb.

The present analysis covers the eight main commercial roundfish stocks in the North Sea:

Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak)
Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak)
Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)
Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)
Sandeel in Division IIIa and Subarea IV
Saithe in Subarea IV (North Sea), Division IIIa (Skagerrak), and Subarea VI (West of Scotland and Rockall)
Sprat in Subarea IV (North Sea)
Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel)

Flatfish stocks are not included, as they do not enter in major direct predation relationships with other fish stocks.

Some other aspects of interactions related to these stocks are presently not included in the SMS model, the most important being: (1) the variation in spatial overlap between stocks, and (2) correlation in recruitment between stocks.

The simulations exploring multispecies reference points applied a sliding harvest control rule, where target F_{MSY} is used for SSB above B_{pa} and with a linear decrease to zero fishing mortality below B_{lim}. Therefore, the so-called multispecies "target F_{MSY}" refers only to the value of F used when SSB is above B_{pa}.

ICES can delimit the space for sustainable exploitation within acceptable good environmental status as proposed by participants of the Stakeholder Workshop on North Sea and Baltic Sea Multispecies Trade-offs (WKM-Trade; ICES, 2012b). However, further input from stakeholders on management objectives, constraints, and risk tolerance is needed to reduce the number of possible options to the most relevant ones.

Overview on the modelled North Sea foodweb (with focus on commercially important fish species)

The North Sea model includes the main species interacting with fish stocks through predation (Figure 6.3.1.1). Top predators form an important part of the foodweb, including numerous charismatic species such as seabirds and marine mammals that eat fish. Within the fish community a number of fish eat other fish, and some of those spend only part of their time in the North Sea. The fish species can be divided into four categories: forage fish, fish that eat small fish, benthic-feeding fish, and fish that eat large fish (top predators). Forage fish feed on plankton in the water column. The majority of forage fish are also targeted directly by the fishery (herring, sandeel, sprat, Norway pout). Together with typical forage fish, juvenile gadoids are also an important food source in the North Sea foodweb. Fish that eat small fish belong to a wide range of species, including some that are targeted by fisheries (e.g. whiting, haddock), some that are only occasionally landed (e.g. grey gurnard, starry ray), and some that enter the North Sea only in specific seasons (e.g. western horse mackerel and mackerel). Benthic-feeding fish include all kinds of flatfish that feed on prey in or near the bottom. The majority of flatfish species only eat a small amount of commercially important fish species and have not been included as a fish predator. Fish that eat large fish are mainly large cod and saithe, which also have almost all other fish in their diet. Elasmobranchs (e.g. spurdog) are also important top predators in the North Sea foodweb, but the abundance of most species is currently at a low level and data on their diet is scarce, so they have not been included in the model.

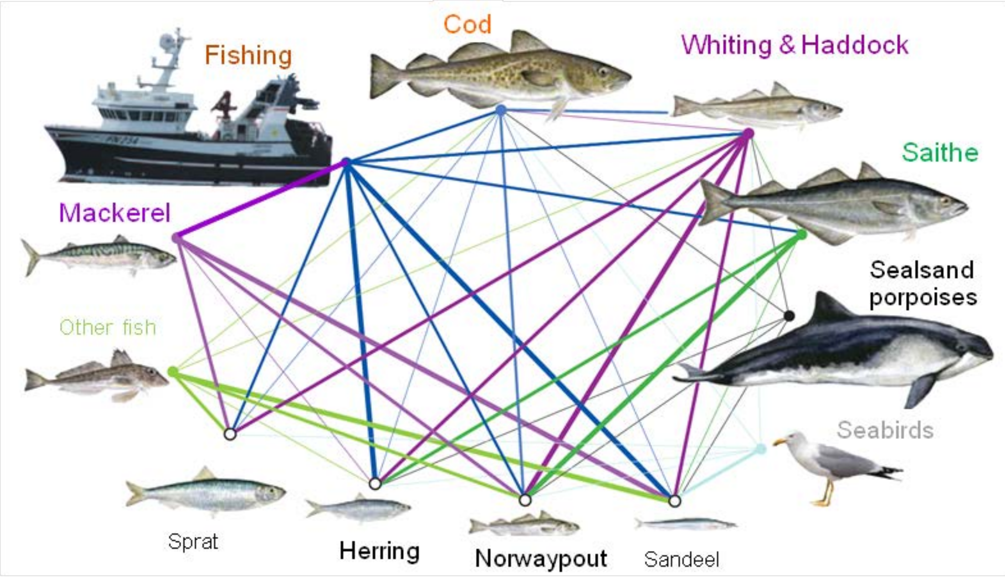


Figure 6.3.1.1 Overview of the important predators and prey in the North Sea SMS model foodweb. Other fish include grey gurnard, North Sea and western horse mackerel, and starry ray. Seabirds include fulmar, gannet, great black-backed gull, guillemot, herring gull, kittiwake, puffin, and razorbill. Seals and porpoises include grey seal and harbour porpoise. An "Other food" pool with constant biomass is included in the model to represent all prey types that are found in the stomachs but that are not modeled explicitly (e.g., crustaceans, mollusks, other prey fish). The colour of the line indicates which predator the species is eaten by, the thickness of the line indicates the biomass removed in this interaction (average from 1963 to 2010).

Results of the SMS model

Important interactions

SMS simulations show that the stock size of the predators cod and saithe has a large influence on both biomass and yield of other species. Hence, the choice of target fishing mortality for cod and saithe affects the yield of all other species considerably (Table 6.3.1.1). Changes in F on haddock influence the yield of sandeel and Norway pout. Fishing for sandeel has relatively strong indirect effects on the three gadoids cod, whiting, and haddock (see Section 6.3.2 for a detailed description). Fishing for sprat and Norway pout has hardly any influence on the yield of other stocks.

Table 6.3.1.1 Effect of changes in fishing mortality (rows) on yield (columns). Dark shading indicates a large impact, light indicates low impact. White diagonal line indicates effects of species F on species yield.

F\YIELD	SAITHE	COD	WHITING	HADDOCK	HERRING	SANDEEL	NORWAY POUT	SPRAT
Saithe								
Cod								
Whiting								
Haddock								
Herring								
Sandeel								
Nor. Pout								
Sprat								

In addition to the predators above, the so-called "other predators" play an important role. The stock dynamics of "other predators" are not modelled explicitly, but their stock sizes are instead given as input to the model. Seabirds, marine mammals, grey gurnard, starry ray, mackerel, and horse mackerel are treated as "other predators". The importance of these "other predators" is clearly shown for cod as prey (Figure 6.3.1.2). Grey gurnard has become the most important predator on 0-group cod, due to a substantial increase in abundance over the 1990s. Similarly, harbour porpoise and seals have become more important predators on cod, due to both an increase in seal abundance and a decrease in the cod stock which has reduced cannibalism. It was assumed that "other predators" would remain at their current abundance levels as it was hard to predict how they would develop in the future (either because there is no assessment or because, in the case of western mackerel and horse mackerel, migration into and out of the North Sea is difficult to quantify and predict). The assumption of constant abundance of "other predators" has, of course, an impact on the results (e.g. it precludes changes in grey gurnard abundance as the cod stock increases).

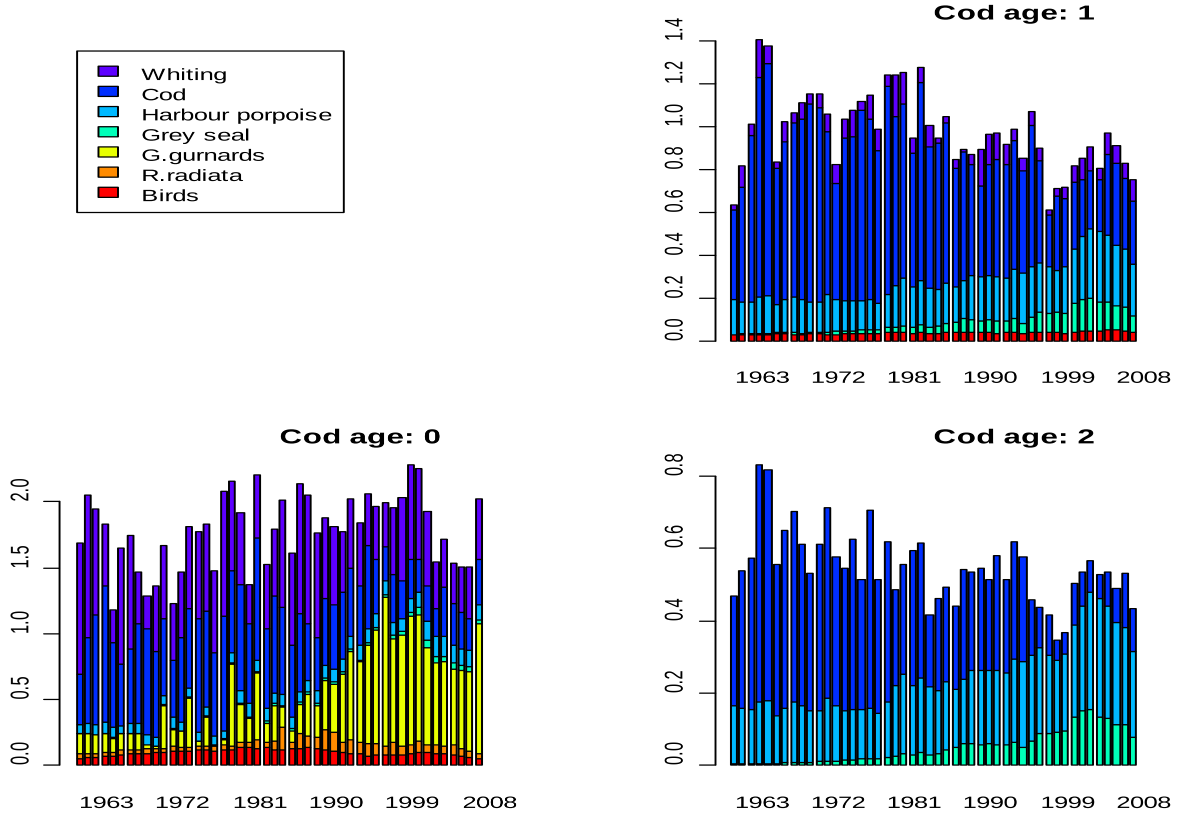


Figure 6.3.1.2 Predation mortality (M2) on cod age 0–2, inflicted by predator species over time.

Main trade-offs

Figures 6.3.1.3 (average long-term yield) and 6.3.1.4 (average long-term SSB) present the main results of the SMS simulations. Each column of small graphs represents the effect of varying target fishing mortality on individual species in turn, on the yield (or SSB) of each species. Target fishing mortalities are on the horizontal axes and yield (or SSB) on the vertical axes.

In each graph, the solid horizontal lines represent the median yield or SSB at the given target fishing mortality, where the median is taken across all combinations of target F on other species. Boxes represent the range of yields and SSB derived when excluding the bottom 25% and the top 25% ranked yields (or SSB). Whiskers (vertical dashed lines) represent the range of yields which are less than 1.5 times the interquartile distance (height of the boxes) away from the upper or lower margin of the boxes. Dots represent observations outside that range. A long box and whiskers implies that the yield or SSB of that species is heavily influenced by fishing pressure on other species than the one depicted on the horizontal axis. In contrast a short range suggests that the yield or SSB is relatively insensitive to variations in fishing pressure on species other than the one on the horizontal axis.

The panels in the diagonal from the top left corner to the bottom right corner show the change in yield or SSB of the specific species that can be obtained by changing the target fishing mortality on that species (similar as represented in single-species advice). Off-diagonal elements represent the effects of species interaction. For example, the change in average SSB of whiting (top row, second plot, Figure 6.3.1.4) shows the effect of the resulting lower cod stock when cod target fishing mortality is increased. A lower cod stock eats less whiting, resulting in higher average SSB of whiting.

The main trade-offs can be found between top predator performance of cod and saithe and their prey species (Figure 6.3.1.3 and 6.3.1.4). The effect of changes in predation on prey SSB is as large as, or larger than the effect of changing target F for these species. The effects of a decrease in target F are similar for cod and saithe. Indirect predation effects seem to be important, which leads to counter-intuitive outcomes. For instance, a decrease in F on cod will give a larger cod stock (top left corner of Figure 6.3.1.4) and more predation on its prey species. For whiting and haddock lower cod F leads to a decrease in SSB (increase in direct predation effect), while SSB of herring, sandeel, Norway pout, and sprat will increase (top row of Figure 6.3.1.4). This increase in SSB for forage fish is due to the loss in whiting and haddock SSB, which induces less predation on the forage fish prey species than the predation from a larger cod stock (indirect predation effect). This contrasts with results from less complex foodwebs (e.g. Baltic), where lower trophic level predators such as whiting and haddock are hardly present and a higher cod SSB has a direct negative effect on forage fish.

Fishing on sandeel leads to direct and indirect effects on predator stocks in the North Sea simulations. An increase in target F on sandeel leads to a smaller sandeel biomass (Figure 6.3.1.4), which induces a higher cannibalism for cod and whiting, leading in turn to a decrease in SSB and yield for those predator species. Due to cascading effects haddock is positively impacted. The fishing on sprat, Norway pout, and herring has less influence on other species.

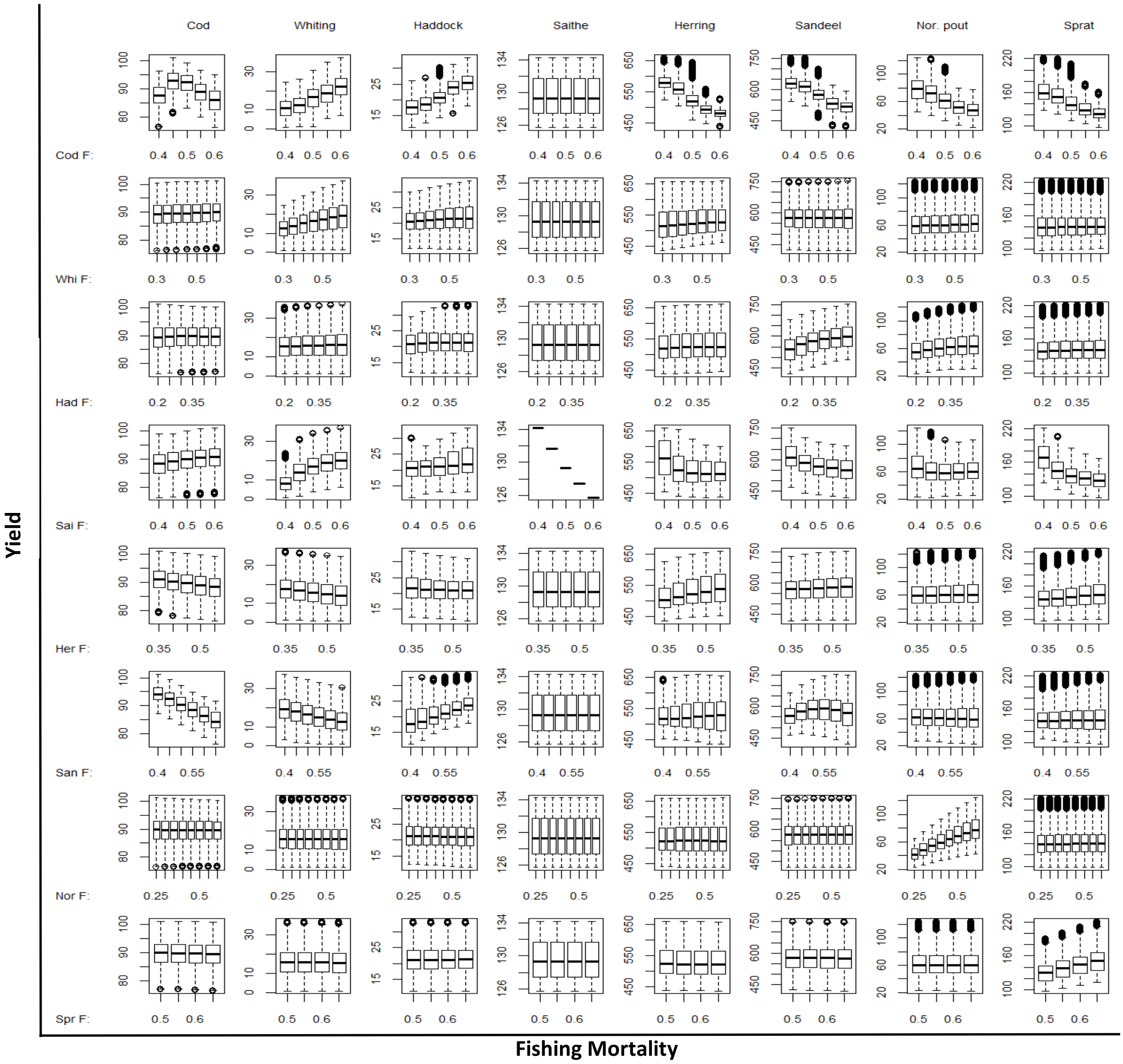


Figure 6.3.1.3 Average yield of cod, whiting, haddock, saithe, herring, sandeel, Norway pout, and sprat (columns from left to right), as a function of target F on the same species (rows from top to bottom). Note that a HCR was used with F = 0 if the stock falls below B_{lim} and a linear increase in F between B_{lim} and a higher MSY $B_{trigger}$ biomass (usually B_{pa}). The F-value on the horizontal axis is the target F for SSB above the specified MSY $B_{trigger}$ biomass. For SSB below the trigger value, the F realized might be considerably lower. The graph by species shows the distribution of yields for any given F shown on the horizontal axis, taking into account the range of Fs for the other species.

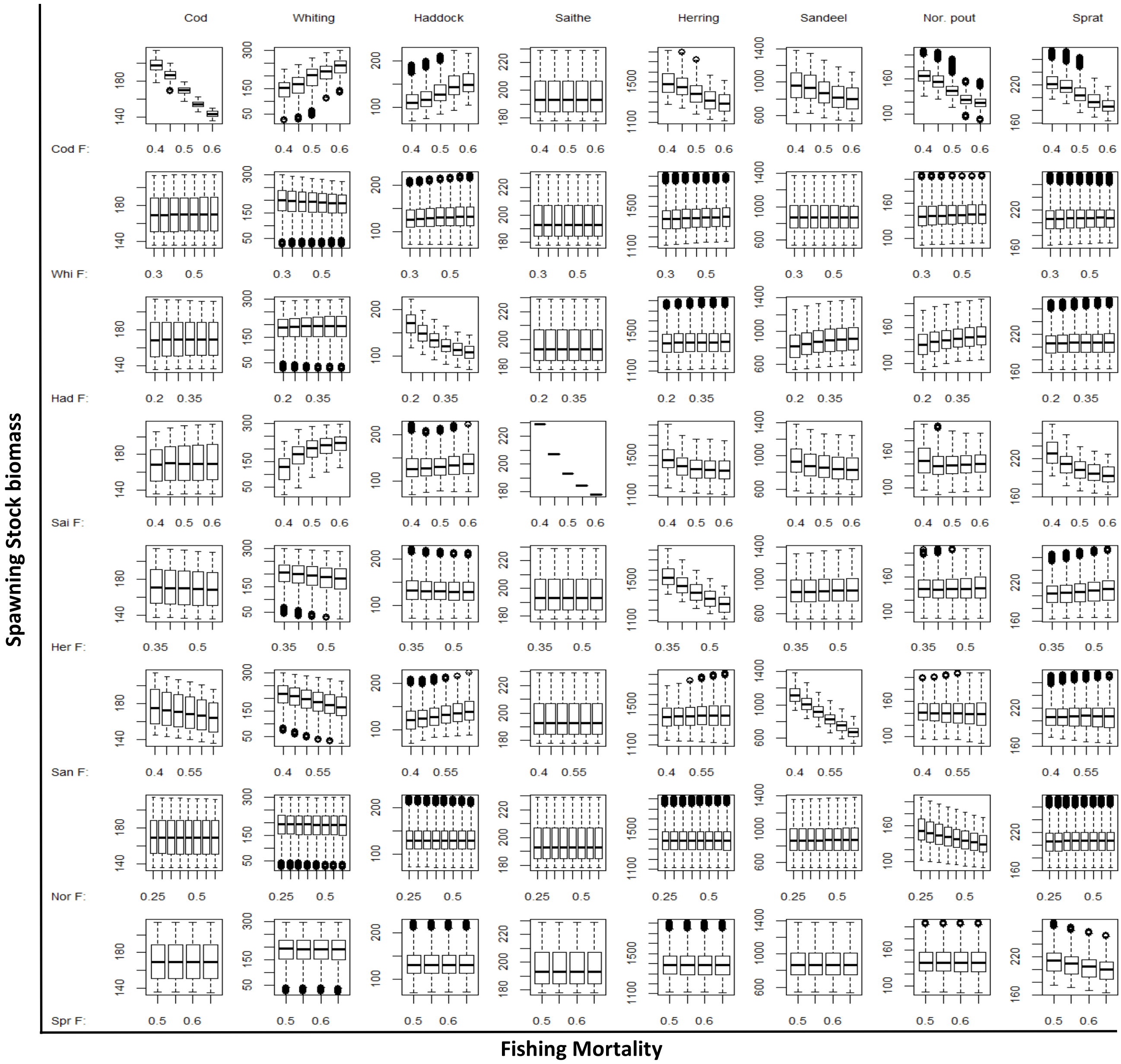


Figure 6.3.1.4 Average SSB of cod, whiting, haddock, saithe, herring, sandeel, Norway pout, and sprat (columns from left to right) as a function of target F on the same species (rows from top to bottom). Note that a HCR was used with F = 0 if the stock falls below B_{lim} and a linear increase in F between B_{lim} and a higher MSY $B_{trigger}$ biomass (usually B_{pa}). The F-value on the horizontal axis is the target F for SSB above the specified MSY $B_{trigger}$ biomass. For SSB below the trigger value, the F realized might be considerably lower. The graph by species shows the distribution of SSB for any given F shown on the horizontal axis, taking into account the range of Fs for the other species.

Single-species F_{MSY} in a multispecies context

Single-species F_{MSY} is currently 0.19 for cod and 0.3 for saithe, but the lowest value presented here is 0.4 for both stocks as this represents the bulk of the dynamics observed. Also, lower values resulted in collapse of several stocks in the simulations. Model results for values of fishing and natural mortality outside the observed historical values are considered less reliable. With F fixed at 0.4 for both cod and saithe (Figure 6.3.1.5), a low F-value ($F \leq 0.25$) for haddock maintains median haddock SSB above B_{pa} (140 000 tonnes), but median whiting SSB is below 80 000 tonnes, and thereby considerably below the 250 000 tonnes used as proxy for B_{pa} here (no official value defined) for combinations of target F for whiting in the range 0.3–0.6. Lower target F values have so far not been evaluated; however, it seems unlikely that such values will provide a SSB three times higher than for whiting F = 0.3.

In conclusion, fishing cod and saithe at target F = 0.4 (when SSB is above B_{pa}) and, therefore, at higher F than the single-species F_{MSY}, resulted in scenario SSB above B_{pa} for all species, except for whiting where SSB is considerably below a possible B_{pa} proxy. However, historically whiting had a rather large stock size concurrently with high stock sizes of cod and saithe during the gadoid outburst in the 1970s. The main difference between the scenario situation and the state of the stocks in the 1970s is the assumption that the present high stock size of grey gurnard is maintained in the scenarios. Grey gurnard was responsible for more than half of the high predation on 0-group whiting in the most recent years, whereas the predation mortality in the period before 1985 was quite low. A higher biomass of larger cod in the future may reduce the biomass of grey gurnard, although few stomach observations exist to quantify this predation. This possible effect has not been included in the simulation scenarios.

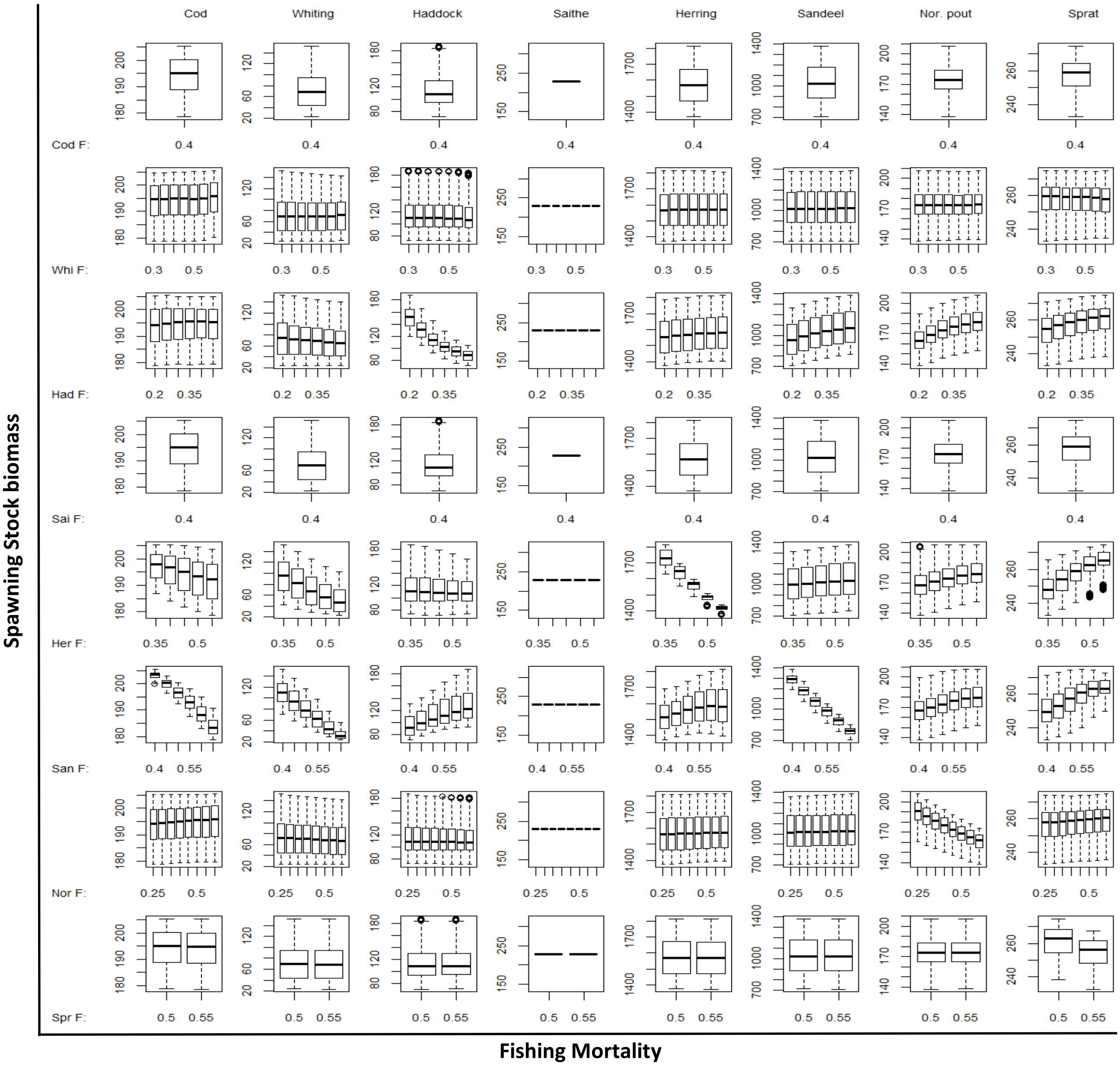


Figure 6.3.1.5 Average SSB of cod, whiting, haddock, saithe, herring, sandeel, Norway pout, and sprat (columns from left to right) as a function of target F on the same species (rows from top to bottom). Note that **target F for cod and saithe was fixed at 0.4**. A HCR was used with F = 0 if the stock falls below B_{lim} and a linear increase in F between B_{lim} and a higher MSY $B_{trigger}$ biomass (usually B_{pa}). The F-value on the horizontal axis is the target F for SSB above the specified MSY $B_{trigger}$ biomass. For SSB below the trigger value, the F realized might be considerably lower. The graph by species shows the distribution of SSB for any given F shown on the horizontal axis, taking into account the range of Fs for the other species.

Close-to-maximum sustainable yield

The results from the previous section suggest that fishing mortality on the predators cod and saithe must be higher than the single-species F_{MSY} to maintain all stocks within precautionary limits as far as possible. Given a fixed target F at 0.5 for cod and 0.45 for saithe, a sequential approach was tried to identify fishing mortalities close-to-maximum sustainable yield for all species. In addition, target F for whiting was fixed at 0.3 (lowest value tested in the simulations) to ensure that the whiting stock as a minimum reaches a biomass close to a potential B_{lim} proxy. The approach is a stepwise exclusion of the scenario F combination that provides the lowest yield relative to the estimated maximum sustainable yield for each particular species. The procedure is applied repeatedly until only one F combination (F value) is left.

As already noted, target F_{MSY} values in the simulations were used for SSB above B_{pa}. For SSB lower than B_{lim} fishing mortality was set to zero, with a linear reduction of F for SSB between B_{lim} and B_{pa}. This ensures that stocks can recover during the long-term simulations. It is also consistent with many management plans currently implemented, where F must be reduced if the stock falls below certain biomass trigger points. The rule presented here does not fully match both the ICES method for estimating F_{MSY} and the harvest control rule used in the MSY approach for single species. This does not affect the qualitative conclusions of the multispecies model.

The target fishing mortalities leading to "close-to-maximum-sustainable-yield" for each species are presented in Table 6.3.1.2. MSY and equilibrium SSB values in the table represent the mean value for the time period 2016–2070. According to the simulations fishing at multispecies F_{MSY} leads to average SSBs above B_{pa} for cod, saithe, herring, sandeel, and sprat. Average SSBs for haddock and Norway pout are between single-species B_{lim} and B_{pa} values. Whiting SSB is below B_{lim} (200 kt is chosen as proxy for B_{lim}).

The mean realized F values are considerably lower than the target multispecies F_{MSY} for whiting, haddock, and Norway pout (Table 6.3.1.2). The discrepancy between multispecies F_{MSY} and realized F shows that SSB was considerably lower than B_{pa} in most of the forecast years and F had to be reduced according to the harvest control rule (HCR) used in the simulations. The discrepancy between target and realized F may also indicate that the currently used SSB trigger values, or the type of HCR, are not appropriate. Further work is needed to come up with precautionary reference points and HCRs in a multispecies framework.

The multispecies F_{MSY} values that lead to a yield close-to-maximum sustainable yield for each species in a multispecies context are higher than the similar single-species (SS) ones (Table 6.3.1.2). The model simulations show that the predators cod (SS $F_{MSY} = 0.19$) and saithe (SS $F_{MSY} = 0.3$) could be fished at higher F in order to lower the predation pressure on their prey and, in the case of cod, also to avoid too much loss in yield due to cannibalism. According to the simulations herring, a typical prey species, could also be fished at considerably higher target F values than the agreed single-species one (0.55 multispecies versus 0.24–0.3 single species). However, the realized F is 0.4, showing that fishing mortality had to be reduced quite often during the forecast because the stock biomass fell below B_{pa}. This highlights that appropriate F_{MSY} values depend on the constraints and risk levels considered acceptable.

Table 6.3.1.2 Estimates of yield and SSB for F_{MSY} with fixed target F = 0.5 for cod, fixed target F = 0.45 for saithe, and fixed target F = 0.30 for whiting. Realized F, MSY, and SSB at F_{MSY} values represent the average value over the time period 2016–2070.

	Single-species	Multispecies					
	F_{MSY}	F_{MSY} (target F above B_{pa})	B_{lim}/Lower trigger biomass (thousand tonnes)	B_{pa}/Higher trigger biomass (thousand tonnes)	Average realized F	Maximum Sustainable Yield (thousand tonnes)	Average SSB at F_{MSY} (thousand tonnes)
Cod	0.19	0.50	70	150	0.45	91	168
Whiting		0.30	(200)	(250)	0.07	8	150
Haddock	0.3	0.35	100	140	0.14	22	128
Saithe	0.3	0.45	106	200	0.40	132	207
Herring	0.24-0.3	0.55	800	1000	0.40	561	1303
Sandeel*		0.55	(787)	(1098)	0.48	616	859
Norway pout*		0.60	(263)	(440)	0.22	82	130
Sprat*		0.55	(157)	(213)	0.43	151	221

* Trigger biomass refers to total stock biomass (TSB). Simulations indicate that an HCR based on TSB performs better than using SSB.
Values in brackets indicate that a single-species reference point does not exist or is not useful in multispecies context.

Additional information

Percentage of total mortality caused by natural sources

In the SMS model, the total mortality (Z) is the sum of fishing mortality (F), predation mortality estimated in the model (M2), and a residual natural mortality assumed known and constant (M1). With the exception of older cod and sprat, natural mortality (M1 + M2) has represented an increasing proportion of the total mortality (Z) in recent years (Figure 6.3.1.6). Due to a successful reduction in fishing mortality for many stocks, natural mortality is becoming the dominant source of mortality.

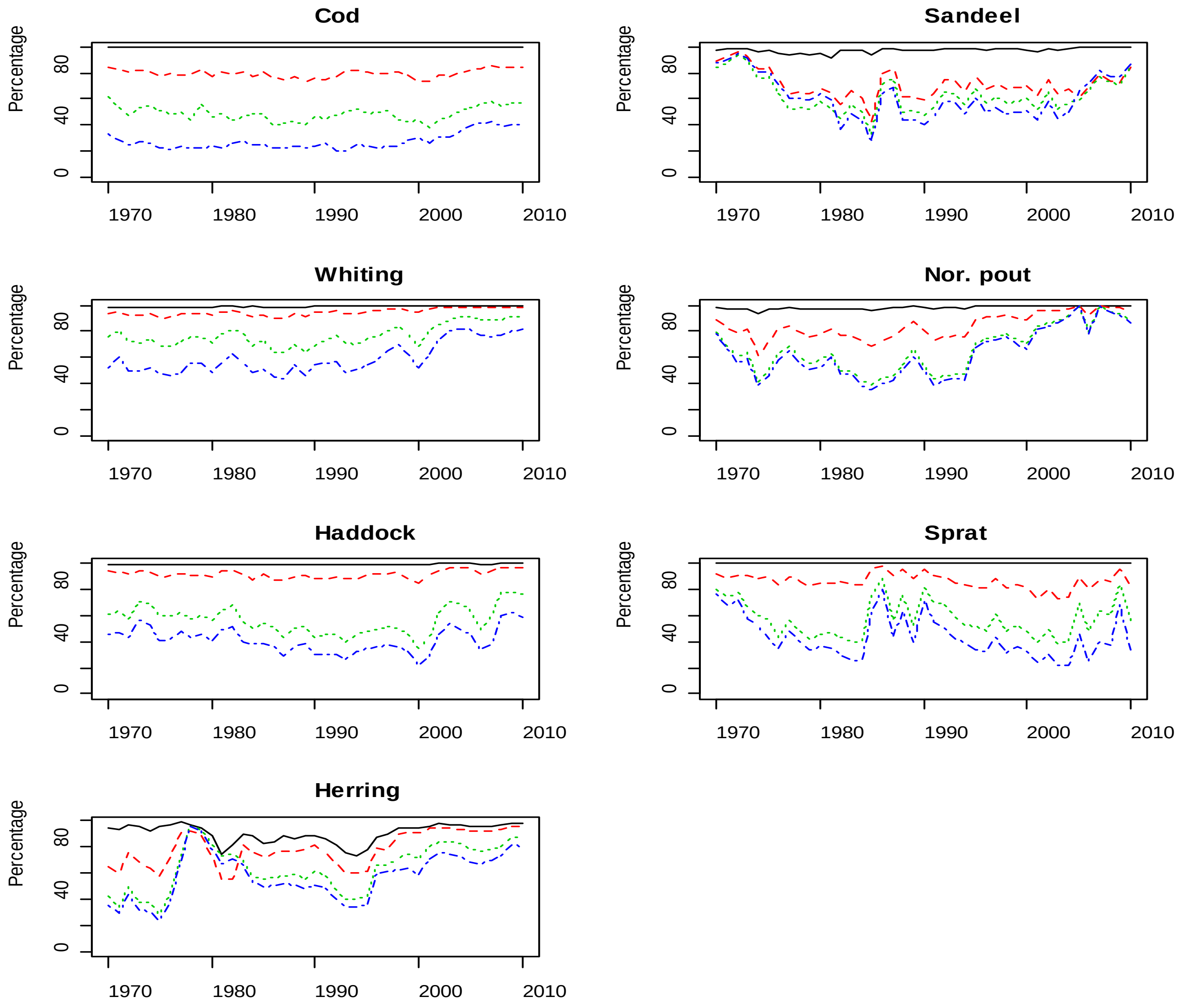


Figure 6.3.1.6 Percentage of total mortality due to natural causes (M1+M2) by species, year, and age. Black line = age 0, red = age 1, green = age 2, and blue = age 3.

Sources

ICES. 2011. Report of the Working Group on Multispecies Assessment Methods (WGSAM), 10–14 October 2011, Woods Hole, MA, USA. ICES CM 2011/SSGSUE:10.

ICES. 2012a. Report of the Working Group on Multispecies Assessment Methods (WGSAM), 22–26 October 2012, Venice, Italy. ICES CM 2012/SSGSUE:10.

ICES. 2012b. Report of the Stakeholder Workshop on North Sea and Baltic Sea Multispecies Trade-offs (WKM-Trade), 9 October 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:71.

STECF. 2012. Scientific, Technical and Economic Committee for Fisheries. Multispecies management plans for the Baltic (STECF-12-06). Edited by John Simmonds and Ernesto Jardim. Luxembourg: Publications Office of the European Union.

ECOREGION North Sea
STOCKMixed-fisheries advice for Subarea IV (North Sea) and Divisions IIIa North (Skagerrak) and VIId (Eastern Channel)

Scenarios for 2014

Mixed-fisheries considerations are based on the single-stock assessments combined with knowledge on the species composition in catches in the North Sea, Skagerrak, and Eastern English Channel 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).

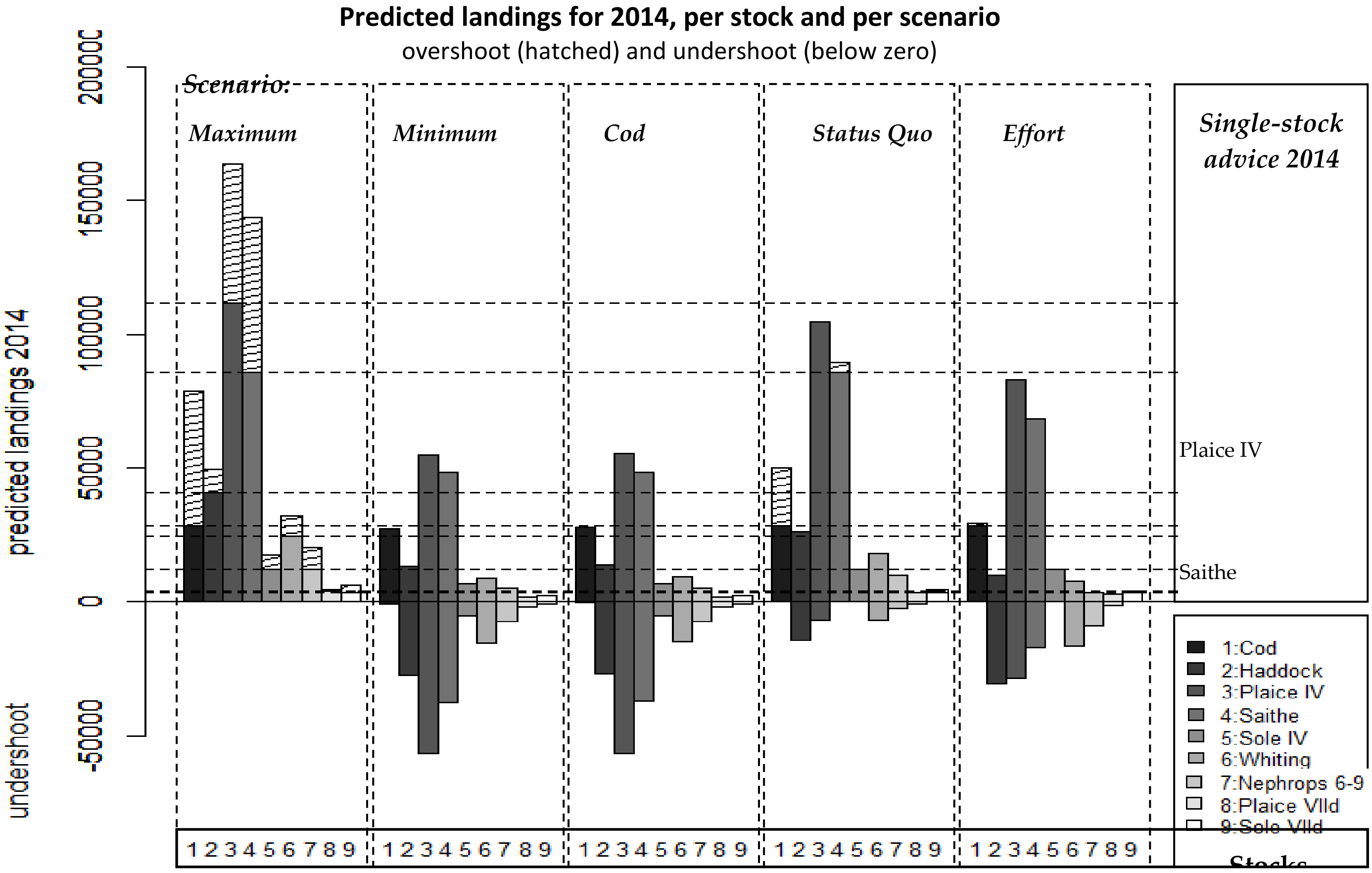


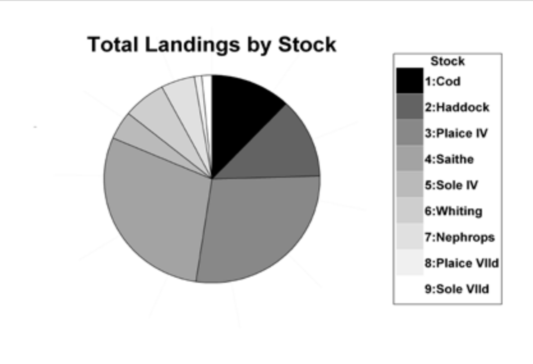
Figure 6.3.2.1 North Sea mixed-fisheries projections. Estimates of potential landings (in tonnes) by stock and by scenario. Horizontal lines correspond to the single-stock landings advice for 2014. Bars below the value of zero show undershoot (compared to single-stock advice) where landings are predicted to be lower when applying the scenario. Hatched columns represent landings in overshoot of the single-stock advice. Details for Division VIId stocks are shown in Figure 6.3.2.2.

	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.
Min	**"Minimum":** Fishing stops when the catch for any one of the stocks considered meets the single-stock advice. This option is the most precautionary option, causing underutilization of the single-stock advice possibilities of other stocks.
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 (EC 1342/2008) have their effort adjusted assuming a 46% reduction for TR1 and TR2 between 2013 and 2014 (see Table 6.3.2.3).

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 at least 1.0% in 2012 of at least one of the stocks considered). Fleet categories are consistent with the EU annual economic report (AER) database and métiers are made consistent with the categories specified in the cod long-term management plan.

Catch distribution



Total landings (2012) of all species considered in the mixed-fisheries advice were 265 000 t, with
~ 60% landed by otter trawls and seines;
~ 21% by beam trawls;
~ 6% by gill- and trammelnets; and
~ 13% by other gears.
Total discards were 81 000 t (23% by weight of total catch).

Quality considerations

Mixed-fisheries projections build on single-stock assessments, most of which are of high quality and precision. Single-stock forecasts are also reproduced independently as part of the mixed-fisheries analyses, allowing additional quality control of both processes.

The quality of data has improved in 2012 and 2013 because of the ICES data call merging data needs and ensuring common data storage for single-stock assessment and mixed-fisheries forecasts. Mixed-fisheries analysis and projections critically rely on data being available on time to allow sufficient quality checking and preparation. Some data were submitted after the start of the meeting, which limited the possibilities for additional data investigations.

Scientific basis

Assessment type	F-Cube (FLR).
Input data	Assessments on the relevant stocks in the North Sea fisheries working group (WGNSSK; ICES, 2013c), catch and effort by fleet and metiers.
Discards and bycatch	Included as in the single-stock assessments.
Indicators	None.
Other information	This assessment was presented for the first time in 2012. In 2013, plaice and sole in the eastern English Channel were added. Exploratory investigations were undertaken for hake in Subarea IV and plaice in Division IIIa. 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 which stocks will limit, and thus influence the fisheries most.
Working group report	WGMIXFISH (ICES, 2013b).

6.3.2 Supporting information June 2013

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, 2013a).

Outlook for 2014

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. The outcome of the mixed-fisheries modelling was consistent with the catch proportion by country in 2012.

In the "Minimum" scenario, the most limiting stocks are cod and *Nephrops* (FU6) for fleets representing 70% and 30% of the effort in 2012 respectively. In the "Maximum" scenario, the least limiting stocks are haddock, *Nephrops* (FU 7), and whiting for fleets representing 68%, 22%, and 10% of the effort in 2012, respectively. It is also noted that the implied F would exceed F_{pa} for cod, saithe, and sole in the Eastern Channel in this scenario, which is therefore not considered precautionary for those species.

The ICES single-stock advice for demersal stocks in 2014 (ICES, 2013a) is based on existing management plans and the maximum sustainable yield (MSY) approach, the precautionary approach, or ICES approach to data-limited stocks.

Basis: single-stock SSBs at the end of 2012 and assumptions on F in 2013 and SSB at the start of 2014. Fishing patterns and catchability in 2013 and 2014 were assumed to remain as in 2012. *Status quo* effort (Sq_E scenario) is assumed to take place in 2013.

Stock	Single-stock landings advice 2014*	Landings per mixed-fisheries scenario 2014				
		"Max"	"Min"	"Cod"	"Sq_E"	"Ef_Mgt"
Cod IIIaN, IV, VIId	28.800	78.729	27.332	27.567 [1]	49.924	29.314
Haddock IIIaN, IV	40.639	49.366	13.390	13.625	26.258	9.746
Plaice IV	111.631	163.655	54.880	55.102	104.520	82.855
Saithe IIIaN, IV, VI	85.581	143.439	48.050	48.359	89.630	68.305
Sole IV	11.900	17.576	6.420	6.424	12.040	11.868
Whiting IV, VIId	24.389	31.983	9.067	9.195	17.758	7.560
Nephrops FU 5	1.000	1.594	0.384	0.393	0.785	0.252
Nephrops FU 6	1.173	4.847	1.190	1.216	2.430	0.842
Nephrops FU 7	8.959	9.223	2.164	2.211	4.417	1.322
Nephrops FU 8	1.417	4.187	1.039	1.062	2.121	0.725
Nephrops FU 9	0.739	1.731	0.425	0.434	0.867	0.266
Nephrops FU 10	0.050	0.080	0.019	0.020	0.039	0.013
Nephrops FU 32	0.715	1.116	0.269	0.275	0.549	0.176
Nephrops FU 33	1.100	1.754	0.423	0.432	0.863	0.277
Nephrops FU 34	0.600	0.957	0.231	0.236	0.471	0.151
Nephrops other IV	0.608	0.969	0.234	0.239	0.477	0.153
Plaice VIId	3.925	4.608	1.697	1.701	3.171	2.605
Sole VIId	3.251	5.858	2.359	2.365	4.266	3.873

Weights in thousand tonnes.
* Advised landings no more than the indicated value.
[1] The cod scenario is intended to match the cod single-species advice exactly. This is not possible because different models are used. The difference is considered small enough not to affect the general conclusions.

Mixed-fisheries catch options can take specific management priorities into account. Scenario results show that it is often not 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 time-frame, 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 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.

Additional considerations

Management considerations

ICES provides five example scenarios. Alternative scenarios taking account of other specific management objectives can be considered. The option to manage all fisheries based on single-species F_{MSY} was studied (ICES, 2012) and, as a proof of concept, preliminary work on MSY-based medium-term projections was performed. As expected, the successive application of the "cod" scenario lead all species to be fished at or below F_{MSY} (cod continues to be the most limiting, or "choke'" species in terms of effort required to catch available quota) by 2015. None of the five scenarios presented are aimed at achieving MSY for all stocks in 2015. Finding the optimal scenario would imply prioritization of management objectives and redesigning of harvest control rules for integrated management at the regional level.

In previous mixed-fisheries projections the assumptions of the example scenarios were applied in both the intermediate and advice years. This year the procedure was changed so that *status quo* effort was applied in the intermediate year and the assumptions of the scenarios only in the advice year. The decision was influenced by the fact that no changes in effort caps were implemented under the cod long-term management plan in 2013. ICES also found that assumptions of *status quo* effort better reflect the assumptions made for the intermediate year in most single-species forecasts of the stocks considered.

Scenarios are based on central assumptions that fishing patterns and catchability in 2013 and 2014 are the same as those in 2012 (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 here because cod has generally been the limiting species since the beginning of mixed-fisheries analysis in 2006.

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 catchability of different species by fleets and metiers remained constant. According to the single-stock advice a reduction of 46% in cod F is required (from 0.39 in 2013 to 0.21 in 2014). In this scenario it is assumed that effort reductions in fleets (to achieve new partial Fs) apply equally to all fleets with any cod catch, including those where it represents a small bycatch component. In 2014 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 for these fisheries, but very large reductions in saithe catches.

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. For 2014, effort reductions are only applied to TR1 and TR2 gear types (based on the EU cod management plan). 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 2013 and 2014 because of e.g. real-time closures or technical measures. Contrary to the effort management regulations in 2013, no reduction in effort was applied between 2012 and 2013. The effort reduction from 2013 to 2014 was assumed to be 46%, which is in line with the required reduction in F based on Council Regulation (EC) 1342/2008, Art. 8.4.b.

Mixed-fisheries results for *Nephrops* are displayed combined for several functional units in plots, but stock status and fishing opportunities differ widely across FUs. In particular, FU6 (Farn Deep) is currently exploited over the MSY target, and this FU acts therefore as a limiting stock for some fleets in the mixed-fisheries advice 2014. Conversely, FU7 (Fladen Ground) is exploited below the MSY target, and acts as a least limiting stock. In order to ensure *Nephrops* stocks are exploited sustainably in the different FUs, management should therefore be implemented at the FU level. Potential undershoot of catch opportunities for FU7 should not be transferred to other FUs.

Newly added to the list of stocks are sole and plaice in the Eastern English Channel. They have low landings compared to other stocks and the results for these stocks are presented in detail in Figure 6.3.2.2. The decrease in the 2014 single-stock advice for sole is likely to be restrictive for the fishery at *status quo* effort. 2014 Landings for plaice are not restricted at the current level of effort ("Sq_E" scenario). Both stocks show an undershoot of the quota in the "cod" scenario, suggesting that the fleets catching sole and plaice are restricted by their cod (by)catches.

Species involved

The species considered here as part of the demersal mixed fisheries are cod, haddock, whiting, saithe, plaice, sole, and *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**	**Management area**	**Management plan ref(s)**
Cod	Subarea IV and 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
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 (FUs) in Subarea IV: 5, 6, 7, 8, 9, 10, 32, 33, 34, and other areas outside FUs	EU: TAC for Subarea IV Norway: no TAC	n/a
Plaice	Division VIId	Divisions VIId and VIIe	n/a
Sole	Division VIId	Division VIId	n/a

Data and methods

The projections made use of data requested as part of an ICES data call issued formally under the EU Data Collection Framework (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, which is generally good for the stocks considered. In addition there is some uncertainty related to the assumptions on the relationship between effort and fishing mortality, and to the *status quo* assumptions in the intermediate year.

The quality of data had improved in 2012 because of the ICES data call, merging data needs and ensuring common data storage for single-stock assessment and mixed-fisheries forecasts. In 2013 additional work was performed that further improved consistency and transparency of data collection and processing. Some issues still remain in reaching full consistency between input data for single-stock and for mixed-fisheries advice, not least for saithe (as illustrated in Figure 6.3.2.4 by the relatively high proportion of landings allocated to the "other" (OTH) category). This category includes some Norwegian landings without corresponding effort, some preliminary French data not fully processed in logbooks at the time of data extraction, and the landings in West of Scotland). But this is not considered to affect the general patterns of the results presented.

Sources

ICES. 2012. Report of the Working Group on Mixed Fisheries Advice for the North Sea (WGMIXFISH), 27–31 August 2012, ICES Headquarters, Copenhagen, Denmark. ICES CM 2012/ACOM:74. 75 pp.
ICES. 2013a. ICES Report of the ICES Advisory Committee, 2013. ICES Advice, 2013, Book 6.
ICES. 2013b. Report of the Working Group on Mixed-Fisheries Advice for the North Sea (WGMIXFISH), 20–24 May 2013. ICES CM 2013/ACOM:22.
ICES. 2013c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/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.

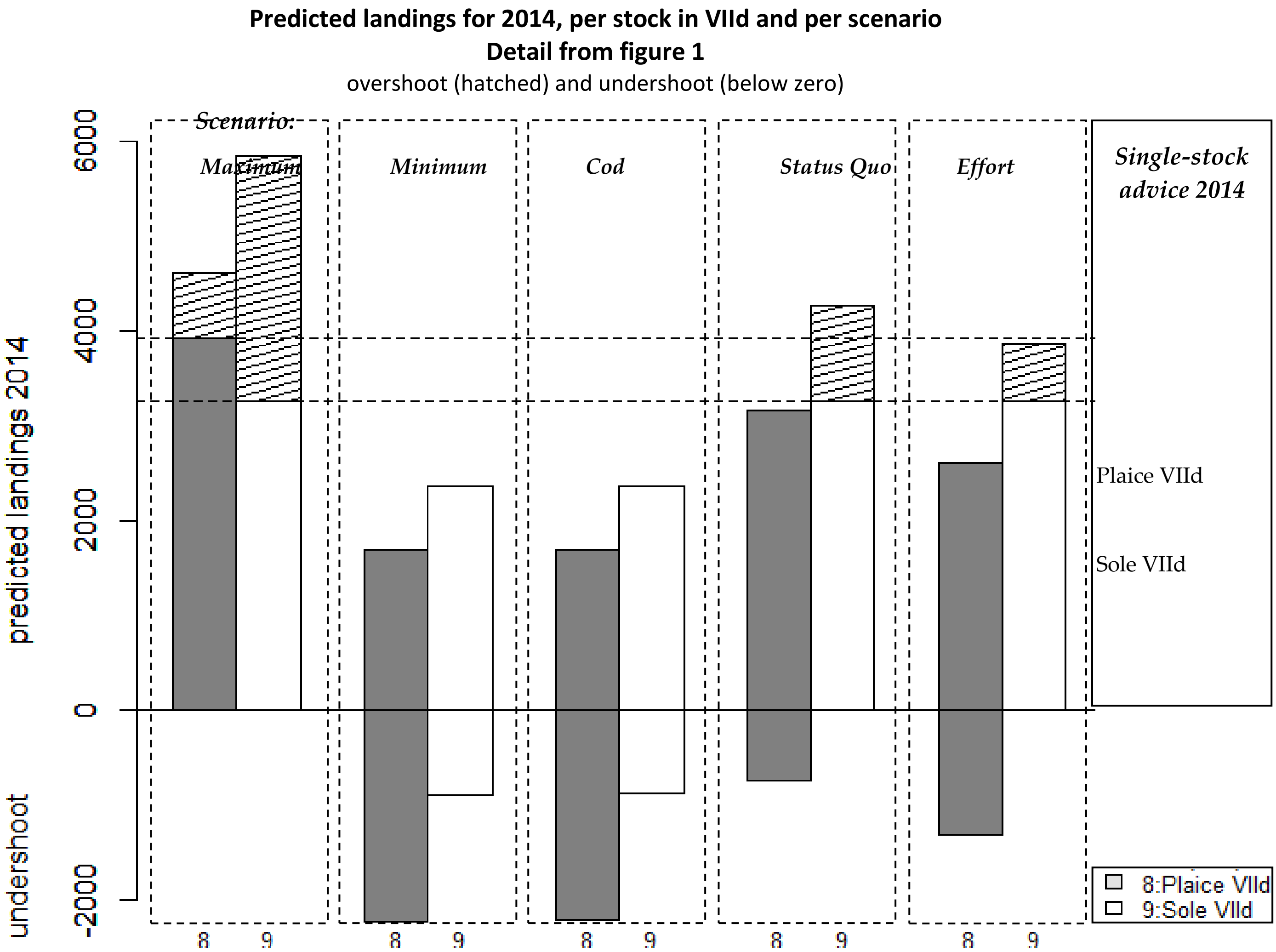


Figure 6.3.2.2 Mixed-fisheries projections for stocks in Division VIId (detail from Figure 6.3.2.1). Estimates of potential landings (in tonnes) by stock and by scenario. Horizontal lines correspond to the single-stock advice for 2014. Bars below the value of zero show the scale of undershoot (compared 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.

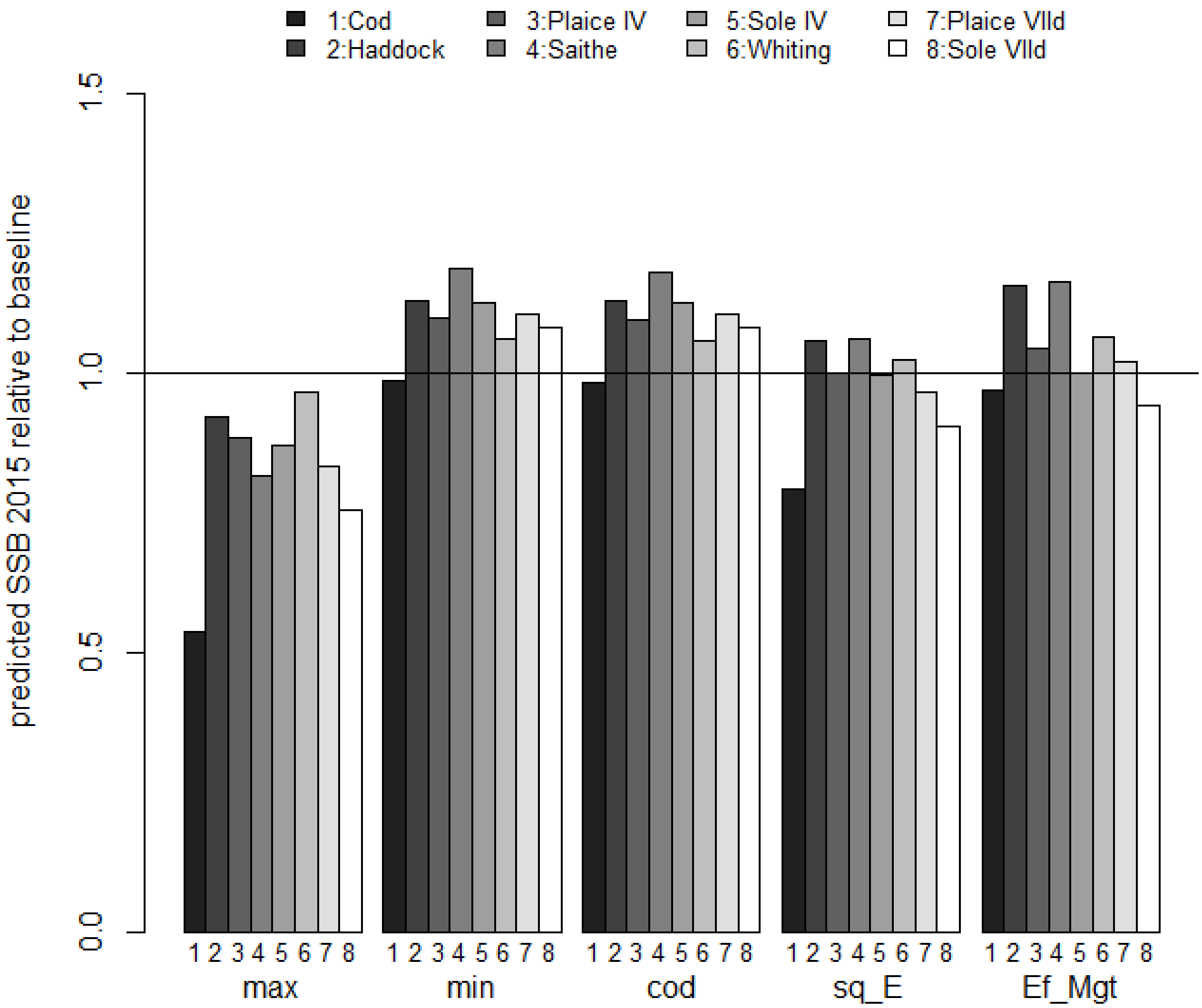


Figure 6.3.2.3 Mixed-fisheries advice in the North Sea. Estimates of potential SSB at the start of 2015 by stock after applying the mixed-fisheries scenarios, expressed as a ratio to the single-stock advice forecast. Horizontal line corresponds to the SSB resulting from the single-stock advice (at the start of 2015). *Nephrops* are not included as abundance is not forecast from the mixed-fisheries model.

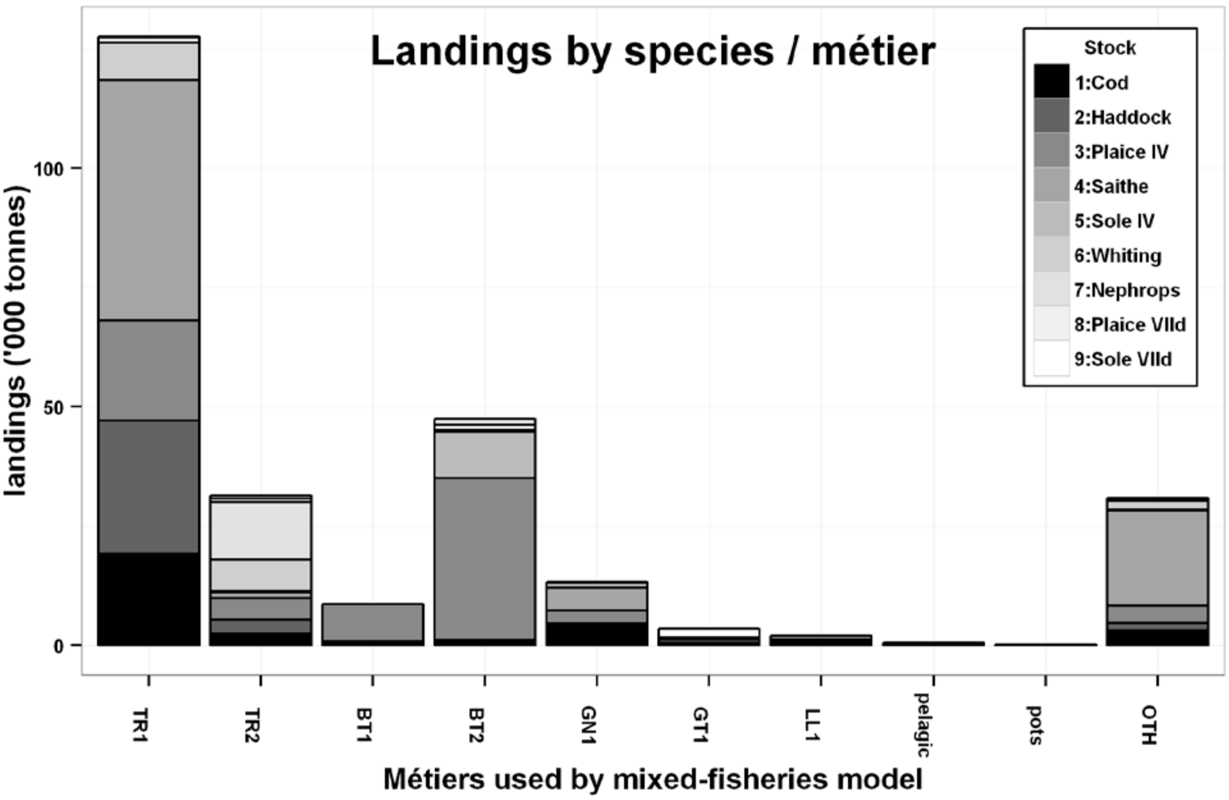


Figure 6.3.2.4 Mixed-fisheries advice in the North Sea. Landings distribution of species by métier with landings consisting of ≥1% of any of the stocks 1–9 (see Figure 6.3.2.1) in 2012 (list of métiers available in Table 6.3.2.2). Note: The "other" (OTH) displayed here is a mixed category consisting of (i) landings without corresponding effort (presented in 2012 as OTH), (ii) landings of any combination of fleet and metier with landings < 1% of any of the stocks 1–9 in 2012, or (iii) remaining unallocated differences between total landings used in single-stock advice and mixed-fisheries advice, such as saithe landings in Subarea VI (not displayed in 2012).

Table 6.3.2.1 Mixed-fisheries advice in the North Sea. SSB results from single-stock advice and different mixed-fisheries scenarios (see Figure 6.3.2.3). *Nephrops* are not included as abundance is not forecasted from the mixed-fisheries model. SSB for plaice in Division VIId is not included because the assessment is relevant for trends only.

	Single-stock advice	SSB resulting from mixed-fisheries scenario 2015				
Stock	SSB result in 2015	"Max"	"Min"	"Cod"	"SQ_E"	"Eff_mgt"
Cod	127 400	65 054	116 680	116 438	93 639	114 641
Haddock	200 000	185 550	227 893	227 615	212 663	232 223
Plaice IV	737 017	650 750	808 471	808 146	736 068	767 586
Saithe	176 100	143 575	221 170	220 911	186 756	204 306
Sole IV	46 070	40 002	51 775	51 772	45 835	46 015
Whiting	311 434	301 300	330 336	330 174	319 332	332 243
Sole VIId	10 951	8 271	11 852	11 845	9 897	10 299
legend						
	SSB 2015 >B_{pa} or MSY $B_{trigger}$					
	SSB 2015 >B_{lim}					
	SSB 2015< B_{lim}					
	No reference points defined					

Weights in thousand tonnes.

Table 6.3.2.2 Mixed-fisheries advice North Sea. Métier categories used in the mixed-fisheries analysis.

Mixed-fisheries metiers	**Gear**	**Mesh size**
TR1	Otter trawl or demersal seine	≥100 mm
TR2	Otter trawl or demersal seine	≥70 mm and < 100 mm
BT1	Beam trawl	≥120 mm
BT2	Beam trawl	≥80 mm and < 120 mm
GN1	Gillnets	All possible mesh sizes
GT1	Trammelnets	All possible mesh sizes
LL1	Longlines	n.a.
Pelagic	Pelagic trawl or seine	
Pots	Pots	n.a.
OTH	Any gear type	

Table 6.3.2.3 Mixed-fisheries advice North Sea. Effort reductions in 2013 compared to 2012, by EU-regulated fleet segment (Council Regulation (EC) Nos. 297/2013 and 43/2012), and the assumed reduction between 2013 and 2014 for the "Effort" scenario.

Gear description	Code	% effort reduction in 2013 compared to 2012	Assumed % effort reduction in 2014 compared to 2013
Bottom trawls and seines ≥100 mm	TR1	0%	46.0%
Bottom trawls and seines ≥70 mm and < 100 mm	TR2	0%	46.0%
Bottom trawls and seines ≥16 mm and < 32 mm	TR3	0%	0%
Beam trawls ≥120 mm	BT1	0%	0%
Beam trawls ≥80 mm and < 120 mm	BT2	0%	0%
Gillnets and entangling nets, excluding trammelnets	GN1	0%	0%
Trammelnets	TN1	0%	0%
Longlines	LL1	0%	0%
Non-regulated gear	None	0%	0%

6.3.3 Assessment and advice regarding protection of biota and habitats

In 2013, ICES has not provided advice regarding protection of biota and habitats for this area.

6.3.4 Assessments and Advice regarding fisheries

6.3.4.1 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

6.3.4.2 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.

6.3.5 Special Requests

6.3.5.1 Special request, Advice June 2013

ECOREGION North Sea
SUBJECT EU request on changing the TAC year for Norway pout in the North Sea

Advice summary

ICES advises that an escapement strategy based on an escapement biomass of 150 kt, modified to include a minimum TAC higher than zero and a ceiling on the TAC, and with a TAC year from 1 November to 31 October, is in accordance with the precautionary approach and leads to sustainable yields, under the following conditions:

The minimum TAC should not exceed 20 kt. The harvest control rule requires a ceiling on F (to be applied when the TAC is set higher than the minimum TAC) in order to be precautionary. If the ceiling for the TAC is set at 200 kt, then the ceiling on F should be no higher than 0.6. If the ceiling for the TAC is set at 100 kt, then the ceiling on F should be no higher than 0.8.

Moving the TAC year to 1 November–31 October, based on annual advice in October, is considered to have limited influence on long-term yield, stock sizes, and probability of low stock biomass.

Request

In 2012, the EU and Norway submitted a request to ICES to evaluate various measures for the management of Norway pout. ICES responded to this request in October 2012.

The first option that ICES evaluated was a management strategy 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).

For this management strategy, ICES evaluated only the option whereby the September assessment is used for the TAC for the next calendar year (with an in-year update in May, but not in September). It was noted that 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.

In the light of this, ICES is asked to again evaluate a management strategy based on the existing ICES escapement strategy, but where the TAC year is changed to 1 November – 31 October rather than 1 January – 31 December. In this case, the TAC for quarter 4 and for quarters 1 to 3 of the following year would be fixed on the basis of the September assessment, with no update in May.

Elaboration on the advice

After discussion with the EC, ICES has interpreted that the request is to evaluate the management strategy based on the existing ICES escapement strategy for the Norway pout stock, including a minimum TAC higher than zero and a ceiling on the TAC. This corresponds to Management Strategy 1 of the ICES advice (ICES, 2012). The present request moves the TAC year from 1 January–31 December to 1 November–31 October. There will be a single annual advice in October.

ICES has evaluated the performance of the harvest control rule (HCR) in relation to its conformity with the precautionary approach. The probability of SSB being below B_{lim} was considered in the short term (for each of the years 2013–2017) and in the long term (for the years 2018–2027). Probability values in the short term are highly influenced by the 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 probabilities of SSB being below B_{lim}. Probability values in the long term 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).

For the HCR to be in accordance with the precautionary approach, the minimum TAC should not exceed 20 kt. A ceiling on the TAC can be set at levels up to around 200 kt. Simulations show that such a high TAC ceiling requires an additional ceiling on F in order to be precautionary. The ceiling on F would apply when the TAC is set above the minimum TAC of 20 kt and should be around 0.6 for an HCR if a TAC ceiling is set at 200 kt, or up to 0.8 if a TAC ceiling at 100 kt is chosen. Median long-term yield is almost the same for the two options.

Avoiding low stock biomass could also be achieved through effort management (instead of a ceiling on F in the HCR). This would require ensuring that standardized fishing effort stays within the range of values observed in the last decade, when fishing mortality has not exceeded 0.6. This is considered a less robust alternative than having a ceiling on F as part of the HCR (for example, concerning issues linked to technological creep).

Basis of the advice

Background

In 2012 ICES evaluated three management strategies with a minimum TAC (ICES, 2012):

Escapement strategy with a minimum TAC >0 and a maximum TAC (with advice in June and October). It was found that a minimum TAC up to 27 kt and a maximum TAC in the range of 100–250 kt would be long-term sustainable.
A fixed initial TAC for the first six months of the year followed by a later update for the second half of the year, such that the TAC for the whole year is set based on a fixed F (with only one yearly advice in June). It was found that an initial TAC between 25 kt and 50 kt and a fixed F = 0.35 (corresponding to a median catch of 60 kt) would be long-term sustainable.
Similar to management strategy 2, but with the within-year assessment and advice (in June) based on the escapement strategy. It was found that this strategy, with an initial TAC of up to 50 kt for the first six months of the year, would be long-term sustainable.

A main constraint required for any of these options to be precautionary was that future fishing mortality should not significantly exceed the range of values observed in the last decade. Values for the ceiling on F larger than 0.6 lead to an increased probability of a low stock biomass for several of the management strategies configurations tested here.

The new request is based on Management Strategy 1 in the 2012 request, shifting the TAC year to 1 November–31 October and having a single annual advice in October.

This request specifies that the TAC should be set in accordance with the ICES escapement strategy, which targets an SSB at spawning time (1 January) above the MSY $B_{escapement}$ after the fishery has taken place. By having a TAC year that does not align to the annual life-cycle of the species, the default ICES escapement strategy cannot be used. ICES considers that the escapement strategy under these conditions should aim at having SSB above MSY $B_{escapement}$ at spawning time (1 January) after the TAC year. To align this with the TAC year, a preliminary assumption in the evaluation is that there are no catches for the period 1 November–31 December immediately after the TAC year. The actual advice for the two months following the TAC year is part of the annual advice given for the following year.

For practical reasons, the actual evaluation done by ICES uses a quarterly-based assessment (1 October–30 September; quarter 4 and quarters 1–3), which does not comply fully with the requested TAC year (1 November–31 October). This is considered sufficient to show that the suggested shift in TAC year has very limited influence on long-term yield, stock biomass, and the probability of the stock biomass being below B_{lim}.

Results

Figures 6.3.5.1.1–6.3.5.1.3 and Figure 6.3.5.1.5 show results for different options for the minimum TAC and the ceilings on the TAC and F. In each figure, two of these quantities are fixed and the figure shows results under different values of the third quantity (horizontal axis of the figure). All figures display the probability that SSB will be below B_{lim} in each of the years 2014–2017 and in the long term (years 2018–2027). Options for which these probabilities are less than 0.05 in all years are considered precautionary, as recommended by ICES (2013).

Given a TAC ceiling at 200 kt and a ceiling on F at 0.6, the performance of the different options is robust to the choice of minimum TAC (Figure 6.3.5.1.1). Considering minimum TACs in the range 0–50 kt, the probability of SSB being below B_{lim} is in the range 0–0.12. For a minimum TAC of around 20 kt, the probability of SSB being below B_{lim} in the long term (2018–2027) is estimated to be approximately 0.05.

Given a minimum TAC at 20 kt and a ceiling on F at 0.6, the actual choice of the TAC ceiling affects the long-term probability of SSB being below B_{lim} very little and is less than 0.05 for the range 50–250 kt TAC ceiling (Figure 6.3.5.1.2). The highest median long-term yield is obtained with a TAC ceiling at around 150 kt. Changing the TAC ceiling to this 150 kt has little influence on the minimum TAC of 20 kt (comparing Figures 6.3.5.1.1 and 6.3.5.1.3).

Figure 6.3.5.1.4 shows the long-term distributions of SSB, yield, and F, under a ceiling on F at 0.6. The left- and right-hand sides of the figure correspond to a ceiling on the TAC of 100 kt and 200 kt, respectively. A higher long-term yield is obtained with a high (200 kt) TAC ceiling compared to yield with a TAC ceiling at 100 kt. The annual F (and effort) is, however, much more variable when a high TAC ceiling is applied. With a TAC ceiling at 100 kt, less than 5% of the simulations are restricted by the F ceiling, while the F ceiling is reached in around 35% of the cases when the 200 kt TAC ceiling is applied. This high percentage emphasizes that the 200 kt option is very sensitive to the assumption of an F ceiling, while the 100 kt TAC ceiling option is robust. Having a TAC ceiling at 200 kt will therefore rely heavily on the assumption on a ceiling in realized F.

Figures 6.3.5.1.1–6.3.5.1.4 all assume that there is insufficient effort to generate an F higher than 0.6, even in the years when the TAC would be set at the minimum of 20 kt. In these figures, the ceiling on F (0.6) is applied to the actual realized F and not as part of the harvest control rule. This means that effort is implicitly assumed not to exceed the level of the last decade, based on the strong relationship observed between effort and F. As a more robust option, the HCR could include a ceiling in both F and the TAC, where the ceiling in F is not applied in the years when the TAC is set at the minimum of 20 kt. With an F ceiling in the HCR, a TAC ceiling at 200 kt results in a probability of SSB being below B_{lim} less than 0.05 if the F ceiling is less than 0.6 (Figure 6.3.5.1.5). With a TAC ceiling at 100 kt, the F ceiling in the HCR should not exceed 0.8 (not shown in the figure).

<u>Methods</u>

A management strategy evaluation (MSE) analysis was conducted to investigate the properties of the proposed management strategy (Vinther and Nielsen, 2013). The analysis was based on settings very similar to the ICES assessment from September 2012, with a quarterly time-step, but was implemented with a different assessment model (SMS) which allows uncertainty in the outputs to be quantified. 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, with inflection point at B_{lim}, fit to the historically observed stock–recruitment values. The stochastic distribution is Normal (in logarithmic scale), constrained to deliver values within 2 standard deviations, to better match the observed recruitments. Assessment errors were included in the MSE loop by generating a perceived population stochastically around the true population. The simulations start in 2013 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 = 0.28 for the quarter 4 of the year and F = 0.32 for quarters 1–3), this value is imposed as an F ceiling and the full TAC is not taken. The situation where a ceiling on F is imposed directly as part of the harvest control rule, instead of on the realized F, was also tested.

The MSE uses quarterly time steps which do not align with the suggested TAC year, 1 November–31 October. It was not possible to change the quarterly time steps used by the software so the implemented TAC year in the simulations was actually 1 October–30 September.

Sources

ICES. 2012. Joint EU–Norway request on management measures for Norway pout. *In* Report of the ICES Advisory Committee, 2012, Section 6.3.3.3. ICES Advice, 2012, Book 6: 19–25.
ICES. 2013. Report of the Workshop on Guidelines for Management Strategy Evaluations (WKGMSE), 21–23 January 2013, ICES HQ, Copenhagen, Denmark. ICES CM 2013/ACOM:39. 127 pp.
Vinther, M., and Nielsen, J. R. 2013. Evaluations of management strategies for Norway pout in the North Sea and Skagerrak. ICES CM 2013/ACOM: 66.

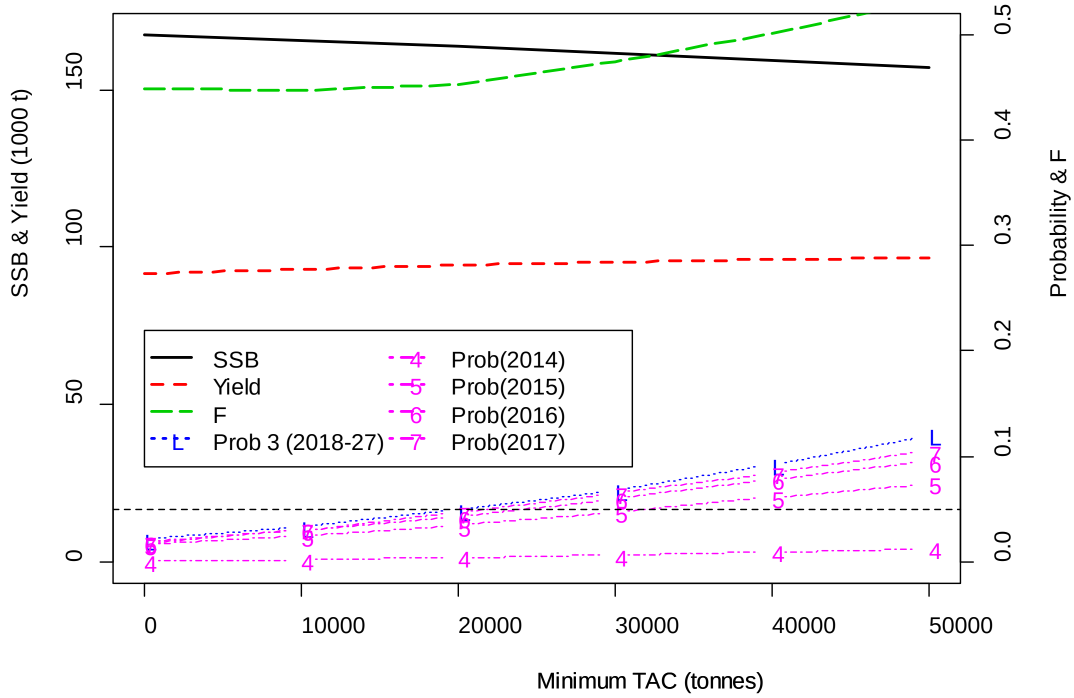


Figure 6.3.5.1.1 Sensitivity to minimum TAC (horizontal axis), assuming the TAC ceiling is fixed to 200 kt, and realised F assumed not to exceed 0.6. The graph shows the median values of SSB, yield, and F in the years 2018–2027 from 10 000 iterations for each value of minimum TAC shown on the horizontal axis. The probabilities (Prob) of SSB being below B_{lim} are shown for individual years and a long-term period.

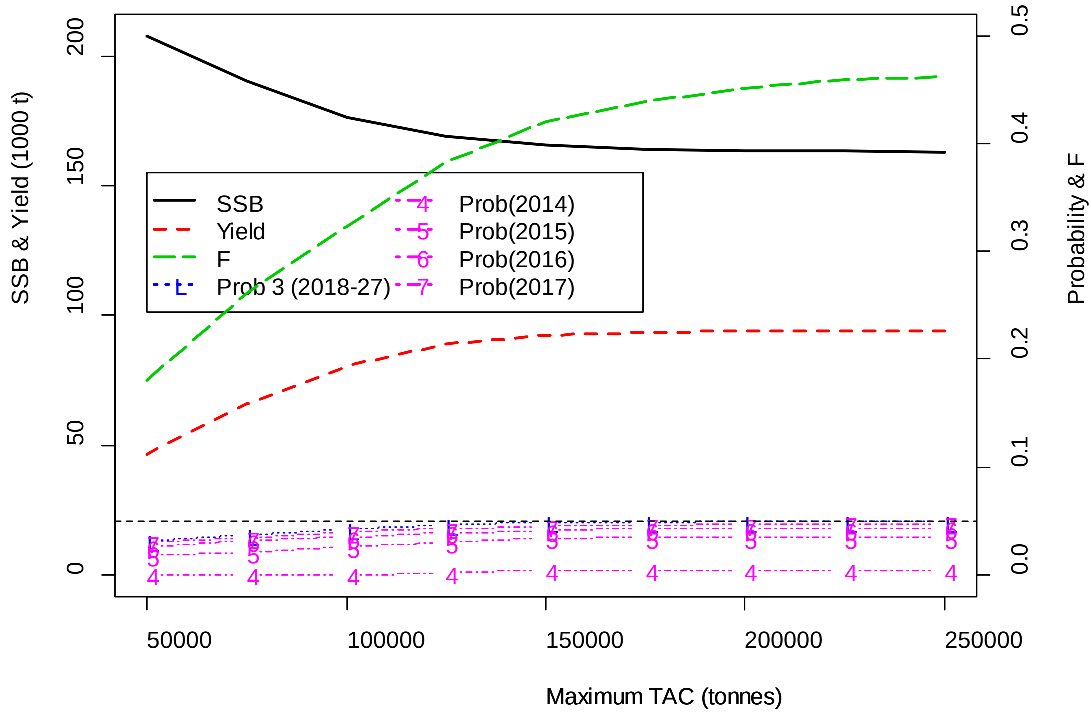


Figure 6.3.5.1.2 Sensitivity to TAC ceiling (horizontal axis), assuming the minimum TAC is fixed at 20 kt, and realised F assumed not to exceed 0.6. The graph shows the median values of SSB, yield, and F in the years 2018–2027 from 10 000 iterations for each value of minimum TAC shown on the horizontal axis. The probabilities (Prob) of SSB being below B_{lim} are shown for individual years and a long-term period.

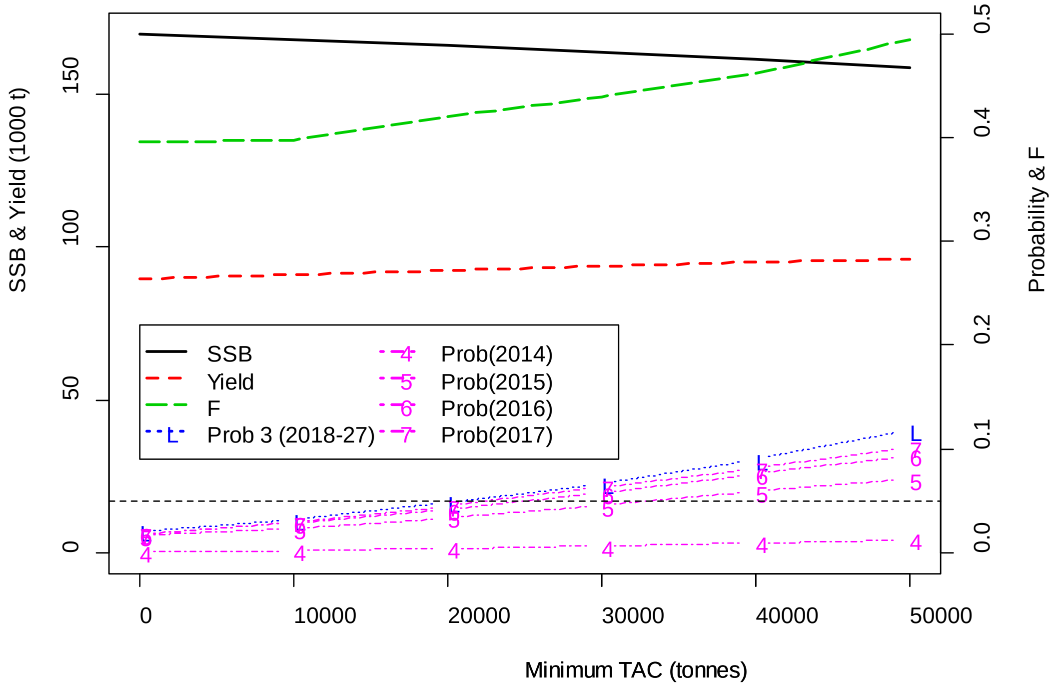


Figure 6.3.5.1.3 Sensitivity to Minimum TAC (horizontal axis), assuming the TAC ceiling is fixed at 150 kt, and realised F assumed not to exceed 0.6. The graph shows the median values of SSB, yield, and F in the years 2018–2027 from 10 000 iterations for each value of minimum TAC shown on the horizontal axis. The probabilities (Prob) of SSB being below B_{lim} are shown for individual years and a long-term period.

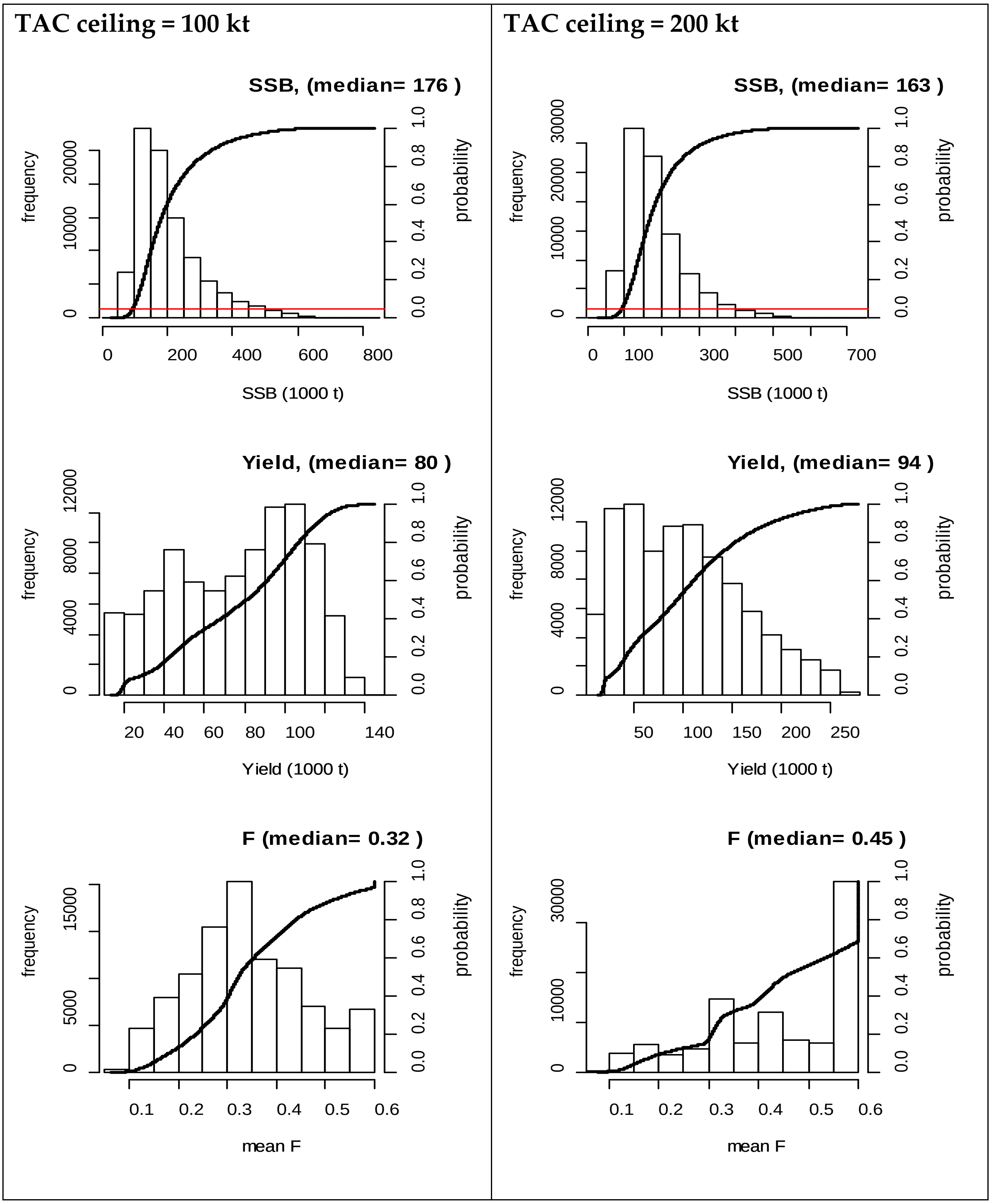


Figure 6.3.5.1.4 Long-term distribution of SSB, yield, and F, including cumulative probabilities of SSB< B_{lim}, for column a) TAC ceiling at 100 kt, and column b) TAC ceiling at 200 kt. Both apply a minimum TAC at 20 kt and realized F is assumed not to exceed 0.6. Yield and F are by calendar year.

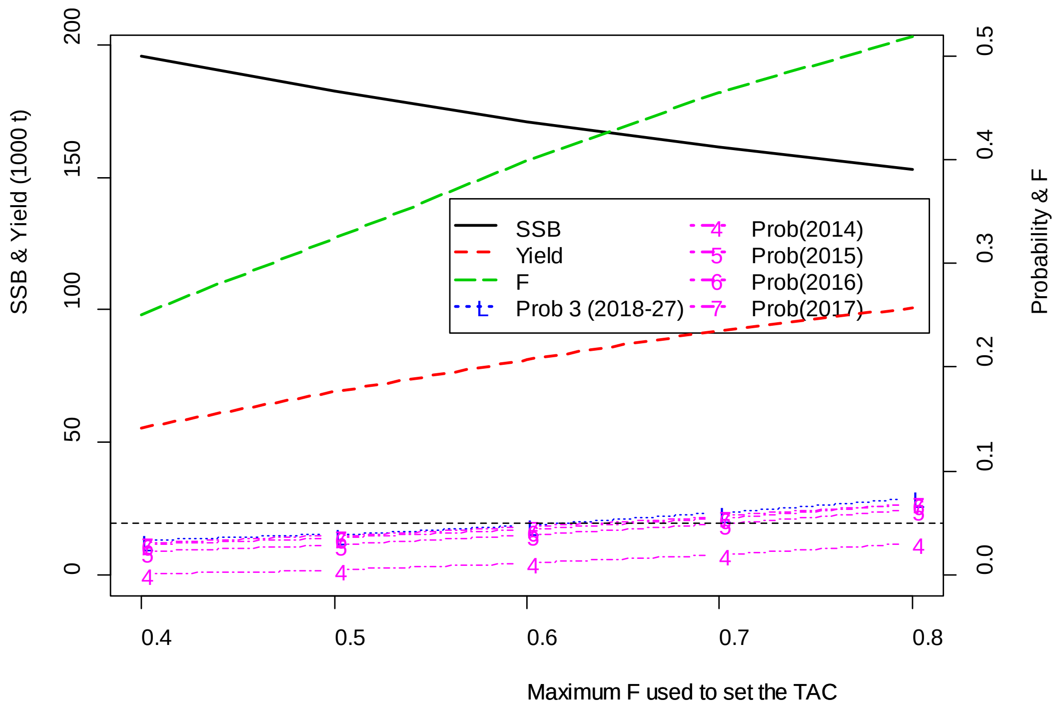


Figure 6.3.5.1.5 Sensitivity to the F ceiling used in the HCR (horizontal axis), assuming the minimum TAC is fixed at 20 kt and the TAC ceiling is fixed at 200 kt. The graph shows the median values of SSB, yield, and F in the years 2018–2027 from 10 000 iterations for each value of F ceiling shown on the horizontal axis. The probabilities (Prob) of SSB being below B_{lim} are shown for individual years and a long-term period.

ECOREGION North Sea
SUBJECT Joint EU–Norway request to evaluate the long-term management plan for whiting in the North Sea

Advice summary

ICES advises that updating the target F from 0.3 to 0.15 within the current management plan is considered precautionary under the assumption that recruitment stays within a medium–low range[1]. A target F of 0.15 is similar to the fishing mortality estimates for 2012 and 2013 and is expected to lead to an average yield in the range of the observed yield in the last decade.

Request

In 2012, the ICES revision of the North Sea whiting natural mortality rate resulted in a rescaling of the assessment estimates of spawning biomass and exploitation rate and resulted in the current joint EU-Norway long-term management plan thresholds and target fishing mortality being unsuitable.

In 2013 ICES is also conducting a benchmark analysis of the stock data and assessment methodology. Consequently, based on the results of 2013 North Sea whiting benchmark, assessment and subsequent scientific advice, ICES is requested to recommend the necessary changes to the joint EU-Norway long-term management plan required to achieve its stated objective of providing sustainable fisheries with high and stable yields in conformity with the precautionary approach.

Elaboration on ICES advice

Until additional information becomes available, it is considered that the lowest observed SSB (SSB in 2007, 184 000 t) can be used as a provisional B_{lim} reference point. On the basis of the 2013 assessment (June 2013 advice; ICES, 2013a), updating the target F from 0.3 to 0.15 within the current management plan leads to around 5% probability of SSB falling below B_{lim}, which is considered precautionary. This is under the assumption that recruitment stays within a medium–low range. A target F of 0.15 is similar to the fishing mortality estimates for 2012 and 2013 and is expected to lead to an average yield in the range of the observed yield in the last decade.

Natural mortality (approximately 0.6) is estimated in a recently updated multispecies assessment (ICES 2011b) and is similar to the highest value of observed fishing mortality in the early 1990s, and much higher than current estimates of fishing mortality. Considering that much of the stock dynamics are driven by natural mortality, future biomass cannot be ascertained from changes in fishing mortality alone. This means that a target F slightly higher than 0.15 might not jeopardize the sustainability of the stock. For example, a target F of 0.2 would lead to around 10% probability of SSB falling below B_{lim}, under the assumption that recruitment stays within a medium–low range.

The basis for the evaluation is a medium–low recruitment scenario, which encompasses most of the observed recruitment range in the time-series, but excludes the highest peaks. Under a more pessimistic recruitment scenario, similar to that observed in 2003–2007, probabilities of SSB falling below B_{lim} would increase substantially and could reach up to around 20% for a target F of 0.15 and 40% for a target F of 0.2. Preliminary information suggests that recruitment in 2013 could be very low.

Given the uncertainty in recruitment trends, and the sensitivity of this evaluation to the multispecies assessment results, a management plan should be reviewed every three to five years.

Suggestions

With the pivotal role played by whiting in the North Sea foodweb, both as a predator and a prey, it is necessary to further develop the integration of whiting advice within an overall multispecies framework. New insights about sources of natural mortality other than those predation processes already included in the multispecies assessment (including predation on pre-recruits), would improve the understanding of the true balance between natural and fishing mortality.

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[1] A medium–low recruitment range encompasses most of the observed recruitment range in the time-series, but excludes the highest peaks.

Development of a more advanced management plan would require a collaborative process with stakeholders. In a previous management plan evaluation (ICES, 2011a), similar probabilities of SSB falling below B_{loss} could be reached with either a low target F with TAC constraint, or a higher target F if the management plan included a sliding scale for F based on recruitment trigger points and a more flexible TAC constraint.

Basis of the advice

Background

In September 2010, a response from ICES to the joint EU–Norway request on the management of whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel) 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). The EU and Norway then agreed on an interim management plan for whiting at this total fishing mortality, conditional on a 15% TAC constraint.

Subsequent simulations performed in 2010 showed that if recruitment remained around the low 2003–2007 values for a protracted period, there would be an increasing risk of the stock declining below the lowest recorded biomass. Another joint EU–Norway request was sent to ICES in 2011, seeking advice on how to quantify poor recruitment and appropriate management responses in this case. ICES (2011a) advised that the target F of 0.3 would need to be reduced at low recruitment in order not to exceed a 5% probability of SSB falling below B_{loss} or, alternatively, that a constant F = 0.27 also resulted in around 5% probability of SSB falling below B_{loss} irrespective of changes in the recruitment regime, but provided that recruitment remained within the range of observed values.

However, this target was never used as the basis for the ICES catch advice, as the later 2011 results of the North Sea multispecies model (ICES, 2011b) updated natural mortality estimates, and this resulted in considerable revisions of historical abundance and fishing mortality estimates for whiting. This invalidated the previous harvest control rule evaluations and the previous target F was no longer considered applicable. As an interim measure, ICES has used a 25% downscaling of the target F in the plan (0.3) as the basis for advice in 2012 and 2013. The scaling factor corresponded to the proportional change in F between the 2011 and 2012 assessments, generating an interim target F of 0.225 (0.75 × 0.3). On the basis of the 2011 multispecies model results, ICES also published for the first time in 2013 some important multispecies considerations for the integrated management of North Sea stocks (ICES, 2013b). These considerations emphasized that whiting was the most sensitive stock in the multispecies assessment model, due to complex direct and indirect predation effects, and that no single management strategy would continuously and simultaneously maintain all stocks above precautionary single-species biomass reference points. A new approach may be needed to define what precautionary means in a multispecies context.

The purpose of the present joint EU–Norway request is to obtain an updated target fishing mortality for the single-species management plan for whiting in the North Sea and Eastern Channel, accounting for the latest knowledge on multispecies considerations.

Results and conclusions

During the historical assessment period (starting in 1990), lower recruitment values have been observed around the years with lower biomass. However, based on the short time-series available it is not possible to evaluate whether these lower values should be considered impaired or not. Until additional information becomes available, it is then considered that the lowest observed SSB (SSB in 2007, 184 000 t) can be used as a provisional B_{lim} reference point, below which the stock dynamics are unknown.

A management plan was agreed in 2011 based on fishing at F_{2-6} = 0.3 and a 15% TAC constraint. This plan was based on a previous assessment (ICES, 2011a) with a considerably lower natural mortality than estimated in the present evaluation; the stock was therefore predicted to be smaller, the fish more long-lived, and the effects of fishing on the stock greater.

The results of the present management strategy evaluation (Darby, 2013) are shown in Figure 6.3.5.2.1 and Table 6.3.5.2.1 (medium–low recruitment scenario) and Figure 6.3.5.2.2 and Table 6.3.5.2.2 (low recruitment scenario). The figures show landings, SSB, F_{2-6}, and recruitment (age 1) with target F = 0.15 and 15% TAC constraint, for the historical assessment period and the forward simulation period. The tables show results with target F at 0.15 or 0.2, and 15% TAC constraint, for the first five years of the simulation period (2014–2018) and the first 20 years of the simulation period (2014–2033).

With a medium–low recruitment scenario, the probability of SSB falling below the provisional B_{lim} (184 000 t) is about 4–5% for target F = 0.15 and about 8–11% for target F = 0.2. Both probabilities increase substantially under a low recruitment scenario. Average landings are a bit higher with target F = 0.2 than with target F = 0.15 and, as expected, they are in both cases lower under a low recruitment scenario.

Methods

The evaluation was based on stochastic simulations identical to those used in evaluations of the management plan from 2011. Recruitment is modelled by randomly alternating different Beverton–Holt recruitment regimes corresponding to low, medium, and high recruitment. Recent recruitment has not been high. Therefore, the current evaluation is based on equal probability of being in the medium or low recruitment regimes, but a more pessimistic scenario of low regime only was also tested.

Different values of target F were investigated within the framework of the current management plan (always including a 15% TAC constraint).

Discards proportions-at-age are assumed constant in the evaluation, and are based on data from recent years. Variable discard rates-at-age depending on the fishing mortality values were not considered in the evaluation. The future EU landing obligation is likely to affect the fishing pattern, but the direction and magnitude of this are unknown and potential changes could, therefore, not be taken into account in the evaluation.

Sources

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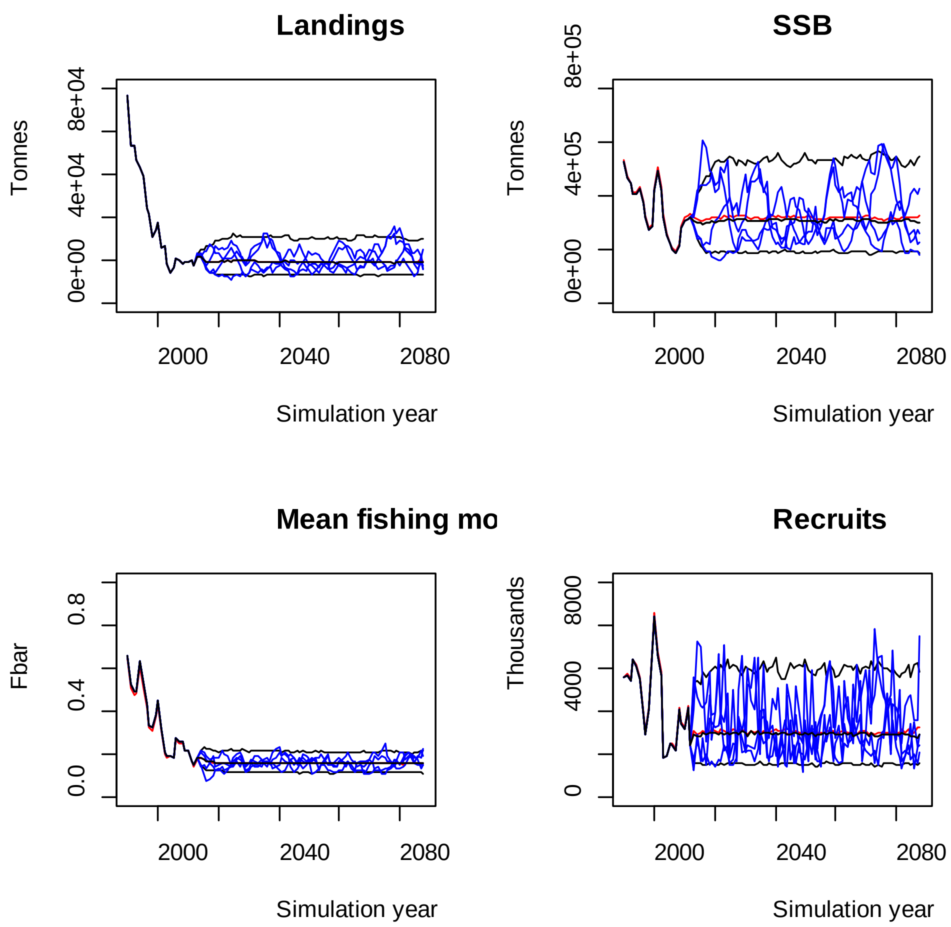

Figure 6.3.5.2.1 Whiting in Subarea IV and Division VIId. A medium–low recruitment scenario with a constant target fishing mortality of 0.15 and 15% TAC constraint. The graphs show the median, 5th, and 95th percentiles (black) of realized landings, spawning-stock biomass, fishing mortality, and recruitment. Management perceptions are shown in red, and four example iterations are in blue.

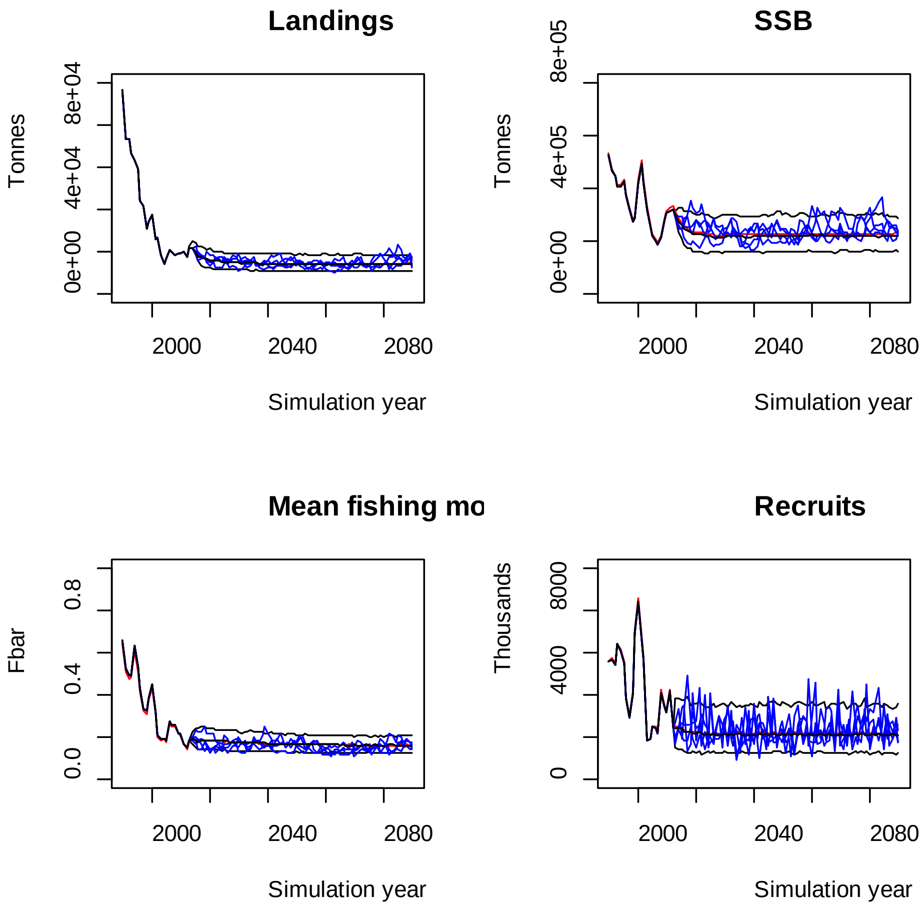

Figure 6.3.5.2.2 Whiting in Subarea IV and Division VIId. A low recruitment scenario with a constant target fishing mortality of 0.15 and 15% TAC constraint. The graphs show the median, 5th, and 95th percentiles (black) of realized landings, spawning-stock biomass, fishing mortality, and recruitment. Management perceptions are shown in red, and four example iterations are in blue.

Table 6.3.5.2.1 Whiting in Subarea IV and Division VIId. A medium–low recruitment scenario with two different values of target F (0.15 and 0.20) and 15% TAC constraint. Probability (maximum percentage of iterations in any year) that spawning-stock biomass is reduced below different thresholds, and associated average realised F, landings, discards, and interannual TAC variability (TAC iav).

F target	**0.15**	
Realised F	0.16	
	Probabilities Maximum P(SSB < Threshold)	
Threshold (tonnes)	years 2014–2018	years 2014–2033
160 000	1%	2%
170 000	1%	3%
180 000	3%	4%
190 000	5%	6%
Landings (tonnes)	20 319	20 328
TAC iav	3%	1%
Discards (tonnes)	10 543	10 491

F target	**0.2**	
Realised F	0.22	
	Probabilities Maximum P(SSB < Threshold)	
Threshold (tonnes)	years 2014–2018	years 2014–2033
160 000	3%	5%
170 000	4%	7%
180 000	6%	10%
190 000	10%	14%
Landings (tonnes)	25 217	24 183
TAC iav	3%	1%
Discards (tonnes)	13 424	13 006

Table 6.3.5.2.2 Whiting in Subarea IV and Division VIId. A low recruitment scenario with two different values of target F (0.15 and 0.20) and 15% TAC constraint. Probability (maximum percentage of iterations in any year) that spawning-stock biomass is reduced below different thresholds, and associated average realised F, landings, discards, and interannual TAC variability.

F target	**0.15**	
Realised F	0.16	
	Probabilities Maximum P(SSB < Threshold)	
Threshold (tonnes)	years 2014–2018	years 2014–2033
160 000	3%	8%
170 000	5%	12%
180 000	10%	19%
190 000	18%	28%
Landings (tonnes)	18 857	16 159
TAC iav (%)	7%	2%
Discards	9 421	8 334

F target	**0.2**	
Realised F	0.22	
	Probabilities Maximum P(SSB < Threshold)	
Threshold (tonnes)	years 2014–2018	years 2014–2033
160 000	8%	20%
170 000	15%	30%
180 000	21%	38%
190 000	27%	49%
Landings (tonnes)	23 285	19 255
TAC iav	7%	3%
Discards (tonnes)	11 978	10 404

ECOREGION North Sea
SUBJECT EU request on interannual quota flexibility for plaice in the North Sea

Advice summary

ICES concludes that the multiannual management plan is robust to inclusion of interannual quota flexibility in terms of the probability of the stock biomass falling below B_{lim}, and without substantial changes in average yield. This conclusion is conditional on the interannual quota flexibility being suspended when the stock is estimated to be outside safe biological limits.

Request

The EU long term management plan for plaice and sole in the North Sea has been in force since 2007 (Regulation (EC) No 676/2007). It was envisaged that this plan would be revised once both stocks had been brought within precautionary limits for two consecutive years, but it was decided to maintain the existing harvest control rules pending consultations with Norway for an agreed EU-Norway management plan for plaice, or for a jointly agreed mixed fisheries plan for the North Sea. As an interim measure, the Commission has nevertheless proposed that fishing effort on sole and plaice can be maintained at its 2012 level.

In order to explore possible options for further changes to the existing plan, ICES is requested to evaluate the impact of an inter-annual quota flexibility of +/-10% (for plaice only) on the performance of the plan with respect to long term yield and risk. For the purpose of this exercise, ICES should assume that the fishing effort ceiling for the sole and plaice fisheries will be maintained at its 2012 level.

Elaboration on the advice

ICES has evaluated the ±10% interannual quota flexibility scheme for plaice in the context of the plaice and sole management plan. ICES simulated some worst case examples of interannual quota flexibility implementation, based on the argument that if the plan is found to be precautionary in worst cases, the overall conclusion is that the multiannual management plan is robust to the inclusion of flexibility.

The different scenarios showed that adding the interannual quota flexibility did not substantially increase the probability of SSB falling below B_{lim}, compared to scenarios without interannual quota flexibility. Average yield did not change substantially either.

A suspension rule where the interannual quota flexibility is not allowed when the stock is estimated to be outside safe biological limits (SBL) is applied. Previous explorations with North Sea herring (ICES, 2012a) suggest that such a suspension rule is essential to the conclusion.

This advice is an addendum to the previous advice on the evaluation of the North Sea flatfish management plan (ICES, 2010) and should be read in this context. Following the evaluation of the Management Plan 2010 ICES advised that "… the proposed management plan is considered precautionary." ICES (2012b) later considered two amendments to the management plan and concluded that the proposed amendments are consistent with the precautionary approach and the principle of maximum sustainable yield.

Basis of the advice

Interannual quota flexibility is an addition to the North Sea Flatfish Multiannual Management Strategy plan (Council Regulation (EC) No. 676/2007). The plan was evaluated by ICES (2010), and STECF also presented an evaluation in Simmonds *et al.* (2010). The simulations forming the basis for the present advice were performed using the same software and model formulation as in the ICES advice in 2012 (details in Coers *et al.* (2012)), and uses the precautionary criterion recommended by ICES (2013). Full details of the present evaluation can be found in Brunel and Miller (2013).

The management plan is set up for both plaice and sole in the North Sea. The impact of interannual quota flexibility for plaice was evaluated for both plaice and sole. Interannual quota flexibility is already in place for sole in the North Sea.

For all scenarios tested, the F-target for plaice is 0.30, the maximal TAC change between consecutive years is 15%, and the maximum allowable effort (MAE) is capped at the 2012 level. For most scenarios the TAC is assumed to be fully utilized (no mixed-fisheries interactions considered). Two additional scenarios were examined to illustrate mixed-fisheries implications: where the fishery stops as soon as one of the TACs for plaice or sole are caught (no over-quota catch), and where fishery continues until both TACs are fished (over-quota catch). None of these scenarios demonstrated a negative effect of interannual quota flexibility on the performance of the management plan.

The use of interannual quota flexibility is based on considerations that are beyond the ICES simulation-testing studies and is largely a socio-economic decision. For this reason, and because the implementation of the regulation is at the Member State level and the decision to use the interannual quota flexibility option in a given year may vary between Member States, it is not possible to assign probabilities of occurrence to the different scenarios that were considered. As noted earlier, the scenarios tested are meant to represent some worst case examples of interannual quota flexibility implementation, where the amount banked or borrowed always reaches 10% of the total stock TAC (i.e. the maximum possible).

ICES has studied the following scenarios:

Scenario 1 ("null"): No banking or borrowing in any year.
Scenario 2 ("banking"): Banking 10% every year (using it in the following year).
Scenario 3 ("borrowing"): Borrowing 10% every year (paying back in the following year).
Scenario 4 ("alternate"): 10% banking and borrowing in alternate years (e.g. bank in year 1; borrow in year 2; bank in year 3; borrow in year 4;...).
Scenario 5 ("worst case"): Following a period of successive poor recruitments, 10% banking in year 1; 10% borrowing in each subsequent year.
Scenario 6 ("yield stability"): Use the interannual quota flexibility scheme to keep the yield as close as possible (within the limits of the banking and borrowing flexibility) to the actual yield in the previous year.

The interannual quota flexibility rules were interpreted as follows:

Interannual quota flexibility

The percentage (maximum 10%) that can be banked or borrowed in year y (to be used or paid back in year y+1), will be **calculated based on the initial quota** for year y, without taking into account modifications of the year y quota arising from banking or borrowing in year y−1.

For example, if in year 2013 a quantity X was banked to or borrowed from 2014, this quantity X can be used or must be paid back in 2014. Subsequent banking or borrowing that is done in 2014 (relating to 2015) will be based on the **initial 2014 quotum** (the country's quotum share of the TAC), without adding or subtracting quantity X.

Implementation error

The evaluation assumes no implementation error will take place (i.e. landings will adhere to the interannual quota flexibility rules, and will not exceed whatever these rules dictate).

Thresholds

The threshold rule to suspend interannual quota flexibility will be the stock being **outside safe biological limits** (SBL) which means that, according to the assessment performed in year y, either $F(y-1) > F_{pa}$ or $SSB(y) < B_{pa}$, or both.

Timing of suspending the interannual quota flexibility

If the stock is outside SBL in year y according to advice for year y+1, flexibility is allowed in year y (banking to/borrowing from y+1), but suspended between y+1 and y+2. Flexibility is reinstated when the stock is in good condition again.

For example, if the 2013 advice for 2014 considers the stock **outside SBL in 2013 (F_{2012}, SSB_{2013}):**

- no interannual quota flexibility will be allowed between **2014 and 2015**;
- interannual quota flexibility will still be allowed to continue in year 2013, and whatever amount is banked or borrowed during year 2013 can be used or must be paid back in year 2014.

Timing of reopening the interannual quota flexibility

If the stock is inside SBL in year y according to advice for year y+1 (after a period of being outside SBL), interannual quota flexibility is allowed from year y+1 onwards (in year y+1 banking to/borrowing from year y+2 is allowed).

For example, if the 2013 advice for 2014 considers the stock **inside SBL in 2013 (F_{2012}, SSB_{2013})** after a period of no interannual quota flexibility:

- interannual quota flexibility will be allowed again between **2014 and 2015**.

Sources

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ECOREGION North Sea
SUBJECT EU request on interannual quota flexibility for saithe in the North Sea

Advice summary

ICES concludes that the evaluated harvest control rules are robust to the inclusion of interannual quota flexibility in terms of the probability of the stock biomass falling below B_{lim}, and without substantial changes in average yield. This conclusion is conditional on the interannual quota flexibility being suspended when the stock is estimated to be outside safe biological limits. ICES repeats its 2012 advice that the management plan should be re-evaluated no later than 2016.

Request

In 2012, the EU and Norway submitted the following request ICES to evaluate a number of options for revising the jointly agreed long term management plan for saithe.

"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:
Applying the current management plan unchanged.
Applying the harvest control rule with no TAC stability mechanism.
Applying the HCR with the following stability mechanisms when the SSB is above Blim:
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.
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.
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.
Applying the HCR with the above mentioned stability mechanisms, but applying them only when the stock is above Bpa.
Allowing an inter-annual quota flexibility of +/- 10%

ICES delivered its response in November 2012, but due to time constraints did not evaluate the impact of an inter-annual quota flexibility of +/- 10%. ICES is therefore requested to complete its evaluations with the inclusion of inter-annual quota flexibility.

Elaboration on the advice

ICES has evaluated the ±10% interannual quota flexibility scheme in the context of the saithe management plan.

The saithe simulations were made based on three of the 12 harvest control rules (HCRs) studied in 2012 (ICES, 2012a – options 1, 3b, and 3c with 15% maximum F deviation). These HCR options were evaluated with some worst case examples of interannual quota flexibility implementation, based on the argument that if the plan is found to be precautionary in worst cases, the overall conclusion is that the HCR is robust to the inclusion of flexibility.

The different scenarios showed that adding interannual quota flexibility did not substantially increase the probability of SSB falling below B_{lim} compared to scenarios without interannual quota flexibility. Average yield did not change substantially either.

A suspension rule where interannual quota flexibility is not allowed when the stock is estimated to be outside safe biological limits (SBL) is applied. Previous explorations with North Sea herring (ICES, 2012b) suggest that such a suspension rule is essential to the conclusion.

The present advice is an addendum to the advice issued in November 2012 (ICES, 2012a) and should be read in that context. The advice then stated "... all HCR options … 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…". The addition of interannual quota flexibility does not change that perception. The management plan should be re-evaluated no later than 2016.

Basis of the advice

Interannual quota flexibility is an addition to the HCRs that were evaluated by ICES (2012a). The simulations forming the basis for the present advice were performed using the same software and model formulation as in the previous ICES advice in 2012, and uses the precautionary criterion recommended by ICES (2013). The evaluation was done for the current regime, based on the time-series since 1988, which has lower recruitment and growth than if the full historical time-series is considered. Full details of the evaluation can be found in De Oliveira (2013).

Based on discussion with clients, ICES has studied the following options:

Option 1: The "Current Plan".
Option 3b: The HCR which sets the TAC (when SSB >B_{lim}) to be the average of the current TAC and the TAC that would result from the application of the HCR for the TAC year.
Option 3c: The HCR which applies a TAC constraint of ±15% (when SSB >B_{lim}), but where the resulting fishing mortality is not allowed to deviate by more than 15% from the target F. The alternatives with 20% or 25% maximum deviation from target F are intermediate options between the 15% deviation and option 1 (the current plan), and have not been evaluated further.

The use of interannual quota flexibility is based on considerations that are beyond the ICES simulation-testing studies and is largely a socio-economic decision. For this reason, and because the implementation of the regulation is at the Member State level and the decision to use the interannual quota flexibility option in a given year may vary between Member States, it is not possible to assign probabilities of occurrence to the different scenarios that were considered. As noted earlier, the scenarios tested are meant to represent some worst case examples of interannual quota flexibility implementation, where the amount banked or borrowed always reaches 10% of the total stock TAC (i.e. the maximum possible).

ICES has studied the following scenarios:

Scenario 1 ("null"): No banking or borrowing in any year.
Scenario 2 ("banking"): Banking 10% every year (using it in the following year).
Scenario 3 ("borrowing"): Borrowing 10% every year (paying back in the following year).
Scenario 4 ("alternate"): 10% banking and borrowing in alternate years (e.g. bank in year 1; borrow in year 2; bank in year 3; borrow in year 4;...).
Scenario 5 ("worst case"): Following a period of successive poor recruitments, 10% banking in year 1; 10% borrowing in each subsequent year.
Scenario 6 ("yield stability"): Use the interannual quota flexibility scheme to keep the yield as close as possible (within the limits of the banking and borrowing flexibility) to the actual yield in the previous year.

The interannual quota flexibility rules have been interpreted as follows:

Interannual quota flexibility

The percentage (maximum 10%) that can be banked or borrowed in year y (to be used or paid back in year y+1), will be **calculated based on the initial quota** for year y, without taking into account modifications of the year y quota arising from banking or borrowing in year y−1.

For example, if in year 2013 a quantity X is banked to or borrowed from 2014, this quantity X can be used or must be paid back in 2014. Subsequent banking or borrowing that is done in 2014 (relating to 2015) will be based on the **initial 2014 quotum** (the country's quotum share of the TAC), without adding or subtracting quantity X.

Implementation error

The evaluation assumes no implementation error will take place (i.e. landings will adhere to the interannual quota flexibility rules, and will not exceed whatever these rules dictate).

Thresholds

The threshold rule to suspend interannual quota flexibility will be applied when the stock is **outside safe biological limits** (SBL) which means that, according to the assessment performed in year y, either F(y−1) >F_{pa} or SSB(y)< B_{pa}, or both.

Timing of suspending interannual quota flexibility

If the stock is outside SBL in year y, according to advice for year y+1, flexibility is <u>allowed in year y</u> (banking to/borrowing from y+1), but <u>suspended between y+1 and y+2</u> – to be reinstated when the stock is in a good condition again.

For example, if the 2013 advice for 2014 considers the stock **outside SBL in 2013 (F_{2012}, SSB_{2013}):**

- no interannual quota flexibility will be allowed between **2014 and 2015**;
- interannual quota flexibility will still be allowed to continue in year 2013, and whatever amount is banked or borrowed during year 2013 can be used or must be paid back in year 2014.

Timing of reopening interannual quota flexibility

If the stock is inside SBL in year y according to advice for year y+1 (after a period of being outside SBL), interannual quota flexibility is <u>allowed from year y+1</u> onwards (in year y+1 banking to/borrowing from year y+2 is allowed).

For example, if the 2013 advice for 2014 considers the stock **inside SBL in 2013 (F_{2012}, SSB_{2013})**, after a period of no interannual quota flexibility:

- interannual quota flexibility will be allowed again between **2014 and 2015**.

Sources

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6.3.5.5 Special request, Advice October 2013

ECOREGION North Sea
SUBJECTJoint EU–Norway request on TAC setting options for cod in the North Sea and Skagerrak

Advice summary

The current management plan is considered precautionary, assuming perfect implementation. The current plan implies further reductions in fishing mortality and catch advice in 2014, which will pose difficulties in a mixed fisheries context. Achieving such a reduction may require that additional effort reductions or equivalent cod avoidance measures are considered. In contrast, the new proposed harvest control rules (HCRs) would result in increased catch advice in 2014, but in lower medium-term catches than the current HCR.

ICES considers the new proposed HCRs not to be precautionary. Specifically, compared to the long-term phase of the current management plan they would delay the recovery of the SSB.

Request

The long-term management plan for cod has failed to achieve the successive reductions in fishing mortality required by the recovery phase of the plan. This has resulted in a growing discrepancy between the target fishing mortality of the plan and the real level of fishing mortality that is observed.

The plan requires that the TAC for 2013 be reduced by 20% compared to that for 2012. This corresponds to a 46% reduction in fishing mortality at a time when the cod stock is increasing and the TACs of the species associated with cod, such as saithe, haddock and whiting, have been substantially increased. Recognising that such a reduction in the cod TAC is likely to increase discard rates rather than decrease total catches, the EU and Norway have stated their intention to revise the cod plan to allow more flexibility in setting the TAC under such circumstances. In order to facilitate the selection of more appropriate TAC levels during the recovery phase of the cod plan, ICES is asked to evaluate the following options for the recovery of the cod stock:

1. Maintaining a target fishing mortality of 0.4 when the SSB is between Blim and Bpa for as long as the resulting stock forecast indicates an increase in SSB, with no inter-annual TAC constraint. Where the stock is forecasted to decrease at a fishing mortality of 0.4, the fishing mortality should be fixed at a level that will maintain the current SSB.

2. Maintaining a constant TAC when the SSB is between Blim and Bpa, provided that the resulting fishing mortality does not exceed 0.4, with the level of the TAC being that corresponding to a fishing mortality of 0.4 in 2014.

For the intermediate year, ICES is asked to assume a fishing mortality consistent with the linear trend of recent years.

ICES is asked to evaluate the consequences of each of the above options for the cod stock in terms of risk, spawning biomass, TAC levels and estimated discards.

Elaboration on ICES advice

Interpretation of the request and harvest control rules tested

Following clarification from the EC, ICES understands that the request was mainly concerned with the "recovery phase" of the cod plan (the phase where 10% annual reductions in F are implemented independently of stock biomass). However, according to the latest ICES assessment (June 2013 advice; ICES, 2013a), ICES now considers the plan to have moved into its "long-term phase", implying that the EU–Norway request may have been superseded by events. Nevertheless, the cod SSB in 2013 is estimated to be only just above B_{lim} (with still close to 50% probability of being less than B_{lim}) and well below B_{pa}. Therefore, the stock cannot be considered to have recovered yet, and ICES has performed the evaluation according to the request.

ICES has evaluated the performance of the harvest control rules (HCRs) proposed in the present request, based on a constant F of 0.4 (termed "F-based", first proposal in this request) and on a constant TAC ("TAC-based", second proposal in this request). Two other HCRs have additionally been evaluated, for comparison: the current HCR in the long-term phase of the cod management plan (as this is the phase of the plan that is relevant now), with or without application of a 20% constraint in interannual TAC changes.

The evaluation focuses on performance of the HCRs during the next ten-year period (2014–2023) and assumes that recruitment shows a limited response to increases in SSB, which leads to a slow increase in recruitment from the present very low values. This is considered an appropriate recruitment scenario for the evaluation because, so far, only little increase in the recruitment has been observed despite the substantial increase in SSB in the last six years.

Advice

The proposed HCRs (F-based and TAC-based) correspond to a probability of SSB being less than B_{lim} (70 000 t) of the order of 20% in the first few years, which then gradually decreases to around 10% towards the end of the evaluated period (Table 6.3.5.5.1 (a)). The current HCR (with or without TAC constraint) performs better in terms of stock biomass, with annual probabilities of SSB being less than B_{lim} that do not exceed 5% in any year (except for a single occasion, when 6% is obtained).

Based on these findings, and assuming perfect implementation, ICES concludes that the current HCR (with or without TAC constraint) is in accordance with the precautionary approach, whereas the new proposed HCRs are not precautionary (since the probability of SSB being below B_{lim} is > 5% in all years evaluated, 2014-2023), and they would delay the recovery of the SSB. Additional analyses have shown that if recruitment increases more rapidly towards the historical average recruitment than assumed in this evaluation, the new proposed HCRs could achieve a probability of SSB being below B_{lim} not exceeding 5% after some initial years.

The evaluated HCRs imply rather different trajectories for F and catch over time (Table 6.3.5.5.1 (c, d)), which may have consequences for implementation in the short term. The new proposed HCRs would result in increased catch advice in 2014, whereas the opposite happens for the current HCR (when compared with the assumed actual catch in 2013, i.e. the catch corresponding to F_{2013} = 0.39). On the other hand, the expected medium-term catches are lower with the new proposed than with the current HCR. Assuming that discard rates-at-age remain as in recent years, trends in landings and discards are similar to those found for catches (Table 6.3.5.5.1 (e, f)).

The clear differences between the effects of the HCRs in 2014 and 2015 should also be considered in a mixed fisheries context. The evaluation assumes that the large reduction in F in 2014 required with the current HCR is implemented. However, the mixed-fisheries analysis performed by ICES in 2013 (ICES, 2013b) shows that the fishing effort needed to catch the advised tonnage (28 809 t landings for cod based on the current management plan) in 2014 is considerably smaller for cod than for other demersal stocks caught in the same fisheries. Achieving such a reduction for F of cod in 2014 may require that effort reductions or equivalent cod avoidance measures are implemented; otherwise, the reduction in F may not occur and increased cod discards may be expected. This is in line with the 2012 ICES response to the EU–Norway request on North Sea cod discard rates (ICES, 2012). It should be noted that the evaluation conducted here does not take into account potential changes in discard practices or selectivity that may arise, for example, as a consequence of the future EU landing obligation.

Basis of the advice

<u>Background</u>

Previous evaluations of the cod management plan concluded that the current plan is considered precautionary, provided that it is adequately implemented. ICES evaluation in 2011 of the EU–Norway long-term management plan (ICES, 2011) concluded that objectives had not been met in terms of reductions of fishing mortality, highlighting a number of weaknesses in the design and implementation of the plan. The implementation did not follow the regulation, mainly because of significant discards and unallocated removals, and difficulties in estimating them accurately, inadequate control instruments, and insufficient coherence in the EU effort regime. In December 2012, ICES concluded that the fishing effort needed to catch the 2013 single-species fishing opportunities for cod was considerably smaller than for other demersal stocks caught in the same fisheries (ICES, 2012), and that reducing the cod TAC by 20% in 2013 would likely result in increased cod discards, unless effort reductions or equivalent reductions in cod catchability were implemented.

<u>Results and conclusions</u>

For the HCRs proposed in this request, the probability that SSB lies below B_{lim} varies between 10% and 23% (Table 6.3.5.5.1 (a)), and the HCRs are therefore not precautionary. In contrast, under the HCR of the current management plan (with or without TAC constraint), this probability does not exceed 5% in any year (except for a single occasion, when 6% is obtained; Table 6.3.5.5.1 (a)), and the HCR is in accordance with the precautionary approach. Additional analyses (De Oliveira, 2013) indicated that if recruitment were to increase more rapidly towards the historical average recruitment than assumed in this evaluation, the new proposed HCRs could achieve a probability of SSB being below B_{lim} not exceeding 5% after some initial years.

In all cases, the probability that SSB is less than B_{pa} (150 000 t) is very high in the first few years, and decreases through time (Table 6.3.5.5.1 (b)). In the final year (2023), the probability that SSB < B_{pa} is less than 50% for all four HCRs, ranging from 39% for the F-based HCR to 2% for the current HCR with TAC constraint.

The evaluated HCRs imply rather different trajectories for F and catch over time. The two new proposed HCRs lead to F_{2014} = 0.41, which is quite close to the assumed F_{2013} (Table 6.3.5.5.1 (c)). After 2014, the F-based rule leads to values of F in the range of 0.33–0.42, whereas the TAC-based rule (aiming to keep a fixed TAC) produces continuously decreasing values of F. The F-based HCR leads to gradual increases in catch, already starting in 2014, whereas with the TAC-based HCR the catch stabilizes at around the 2013 value, after a peak in 2014 (Table 6.3.5.5.1 (d)).

The current HCR (with or without TAC constraint) implies a strong decrease in F in 2014 (F_{2014} = 0.23). After 2014, the current HCR with a 20% TAC constraint leads to further decreasing values of F. If no TAC constraint were applied, it would instead lead to increasing values of F after 2015, coming close to F = 0.4 from 2017 as SSB increases. This contrast is a known effect of TAC constraints in a situation of an increasing stock, as they may prevent catch increasing at the same pace as the stock biomass. The current HCR (with or without TAC constraint) leads to a strong reduction in catch in 2014 (when compared with the assumed actual catch in 2013, i.e. the catch corresponding to F_{2013} = 0.39). After 2014, catch continuously increases, with the catch at the end of the ten-year simulation period very substantially exceeding that in 2013.

In summary, the new proposed HCRs would result in increased catch advice in 2014, but in lower medium-term catches than the current HCR.

The F-based rule relies on forecasting assumptions to a greater extent than the TAC-based rule and the rule in the current management plan, and the uncertainty associated with these assumptions may be playing a role in the higher risks obtained. Under a strongly recovering stock, the TAC-based rule has the potential of leading to low Fs, with associated discarding problems; to a lesser extent the same issue can occur with the current HCR and a 20% TAC constraint.

Methods

A management strategy evaluation (MSE) was carried out to evaluate the HCRs in the request (De Oliveira, 2013). The operating model was conditioned on the 2013 SAM assessment, which is the most recent ICES assessment. A scenario taking into account the present low recruitment was assumed as the most relevant option on which to base the simulation of future recruitment, and a historical average recruitment scenario was included for comparison. The historical average recruitment scenario was modelled using a Ricker S–R relationship fitted to the whole series of data from 1963, and the low recruitment model was constructed by halving the resulting curve. Figure 6.3.5.5.1 shows the two stock–recruitment curves; future recruitment is simulated from a log-normal distribution with median given by the lower stock–recruitment curve and CV = 53%. This approach could potentially underestimate recruitment for biomasses below B_{lim} (lower curve in Figure 6.3.5.5.1 compared to the low recruitment data points from recent years). However, when SSB is above B_{lim} (which is the case in most iterations in the period 2014–2023, considering that median SSB was just above B_{lim} in 2013), such an approach offers a less pessimistic view than using the most recent years for recruitment, as is the case in the June 2013 cod advice (median of re-sampled recruitment 1998–2012 = 174 million). For SSBs in between B_{lim} and B_{pa}, the approach results in recruitment values around the medium-term geometric mean, which included higher historical biomasses (GM 1988–2012 = 288 million). Therefore, the recruitment model used in this evaluation is considered appropriate to capture the actual range of plausible recruitment in the short and medium terms (years 2014–2023), while still assuming a positive response of recruitment to increasing SSB. It should be additionally noted that recruitment is not simulated symmetrically around the stock–recruit curve, because of the assumption that recruitment is log-normally distributed, leading to values being further away above the curve than below. The resulting simulated recruitment can be seen in Figure 6.3.5.5.2.

Four HCRs were tested: the two specified in the request (i.e. the F-based and the TAC-based HCRs) and, for comparison, two HCRs as specified for the long-term phase of the current HCR, one with TAC constraints and one without constraints:

"F-based HCR" (first option in the present EU–Norway request): Apply F = 0.4 to calculate the catch (and corresponding landings) advice, except when the forecast indicates this would lead to a decrease in SSB, in which case the F that keeps the SSB constant should be applied instead. The change in SSB was defined as the difference between the SSB at 1st January after the TAC year and the SSB at 1st January of the intermediate year, i.e. SSB(y+2)−SSB(y). No restriction on interannual TAC changes is applied.

"TAC-based HCR" (second option in the present EU–Norway request): The catch (and corresponding landings) advice for 2014 should correspond to F = 0.4. For later years, the same fixed TAC is applied, except when the forecast indicates this would lead to an F higher than 0.4, in which case F = 0.4 should be applied instead. No restriction on interannual TAC changes is applied.
"Current HCR with TAC constraint": HCR in the long-term phase of the cod management plan, including the 20% constraint on interannual TAC changes.
"Current HCR without TAC constraint": HCR in the long-term phase of the cod management plan, without any restrictions on interannual TAC changes.

The request asks ICES to assume a fishing mortality during the intermediate year consistent with the linear trend of recent years. The evaluation conducted assumes that F in the intermediate year equals the F value estimated for the preceding year, as this is considered the most realistic intermediate year assumption at this stage, in line with that currently implemented for the ICES annual catch advice for this stock.

An XSA approximation to the SAM assessment model was used for the assessment error part of the MSE. The evaluation assumed perfect implementation of the catch advice. The analyses were performed in R, using the library FLR.

Sources

De Oliveira, J.A.A. 2013. North Sea cod evaluations, Summer/Autumn 2013. ICES CM 2013/ACOM:72.
ICES. 2011. Joint EU–Norway request on the evaluation of the long-term management plan for cod. *In* Report of the ICES Advisory Committee, 2011. ICES Advice 2011, Book 6, Section 6.3.3.3.
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ICES. 2013a. Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). *In* Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Book 6, Section 6.4.3.
ICES. 2013b. Mixed-fisheries advice for Subarea IV (North Sea) and Divisions IIIa North (Skagerrak) and VIId (Eastern Channel). *In* Report of the ICES Advisory Committee, 2013. ICES Advice 2013, Book 6, Section 6.3.2.

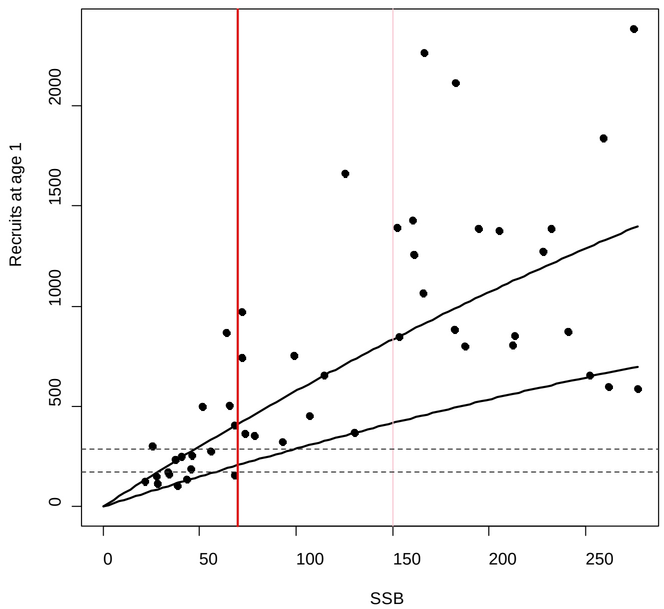

Figure 6.3.5.5.1 Historical stock–recruitment estimates (data points), stock–recruitment curve fit to the whole data set (upper curve), and stock–recruitment curve obtained by halving the upper curve (lower curve). Also shown are B_{lim} (70 kt; red vertical line) and B_{pa} (150 kt; light pink vertical line), along with the recruitment value used for the short-term forecasts in the 2013 WGNSSK North Sea cod assessment (median of re-sampled recruitments from 1998–2012 = 174 million; bottom hashed horizontal line), and the geometric mean recruitment calculated over the period 1988–2012 (= 288 million; top hashed horizontal line). In the evaluation, recruitment is simulated from a log-normal distribution with median equal to the lower stock–recruitment curve, leading to simulated values being further away above the curve than below. Most of the SSB values during the simulation period (2014–2023) are above B_{lim}.

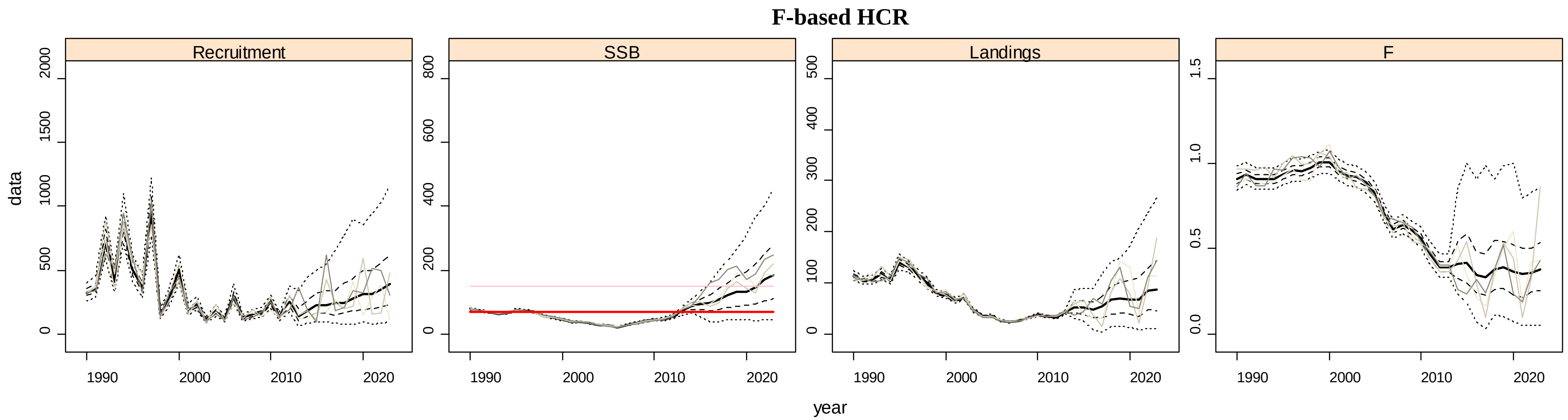

Figure 6.3.5.5.2 (a) Results for F-based HCR. The graphs show the estimated historical period since 1990 and simulated years 2014–2023 (solid line: median; dashed lines: 25 and 75 percentiles; dotted lines: 5 and 95 percentiles; lighter grey lines: examples of individual trajectories). The SSB graph also shows B_{lim} (70 kt, thick red line) and B_{pa} (150 kt, thin pink line).

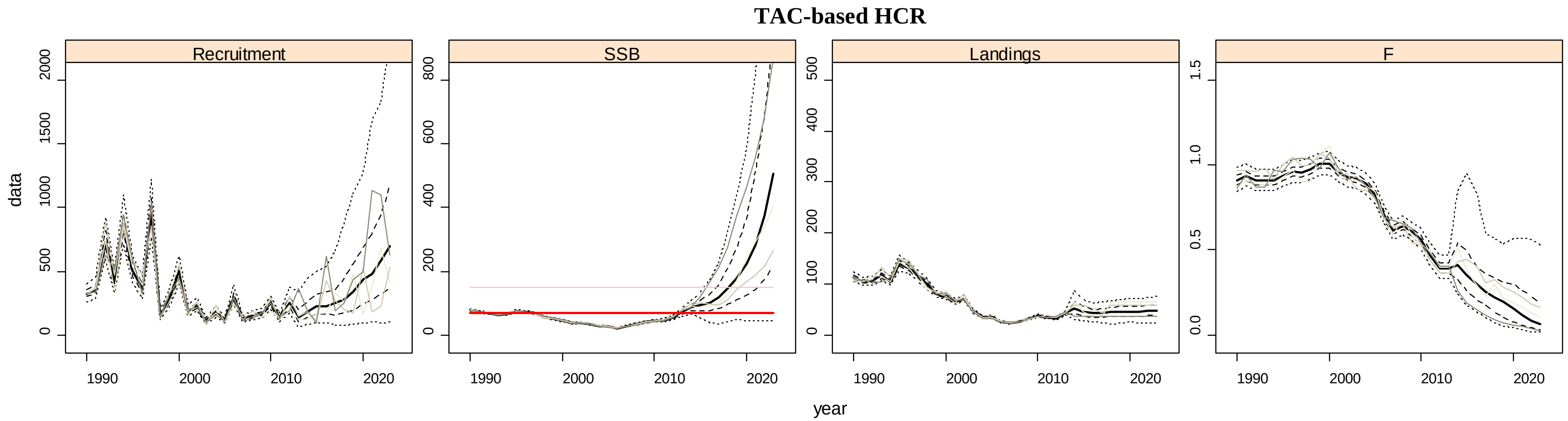

Figure 6.3.5.5.2 (b) Results for TAC-based HCR. The graphs show the estimated historical period since 1990 and simulated years 2014–2023 (solid line: median; dashed lines: 25 and 75 percentiles; dotted lines: 5 and 95 percentiles; lighter grey lines: examples of individual trajectories). The SSB graph also shows B_{lim} (70 kt, thick red line) and B_{pa} (150 kt, thin pink line).

Current HCR (with TAC constraint)

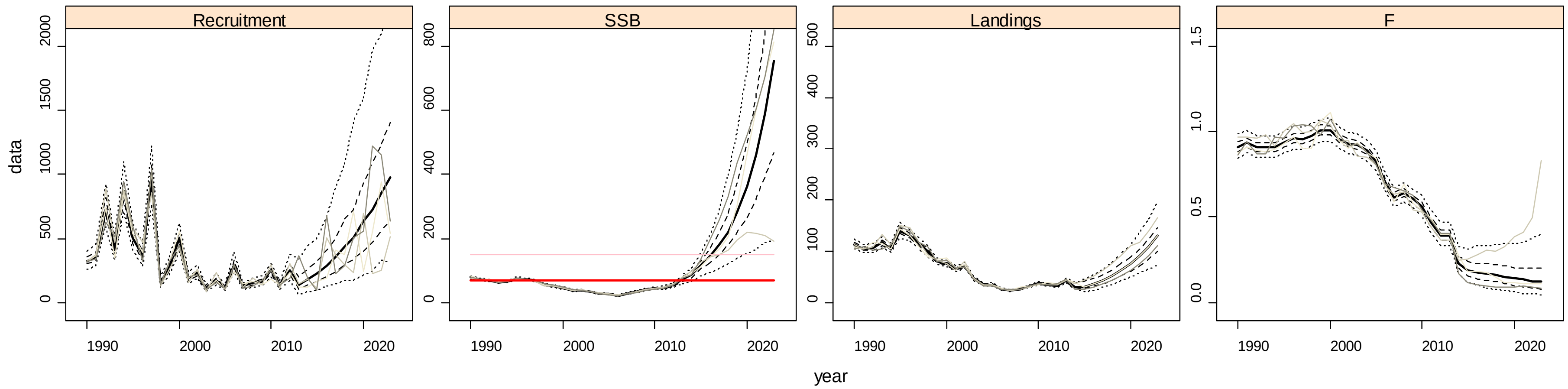

Figure 6.3.5.5.2 (c) Results for current HCR with 20% TAC constraint. The graphs show the estimated historical period since 1990 and simulated years 2014–2023 (solid line: median; dashed lines: 25 and 75 percentiles; dotted lines: 5 and 95 percentiles; lighter grey lines: examples of individual trajectories). The SSB graph also shows B_{lim} (70 kt, thick red line) and B_{pa} (150 kt, thin pink line).

Current HCR (without TAC constraint)

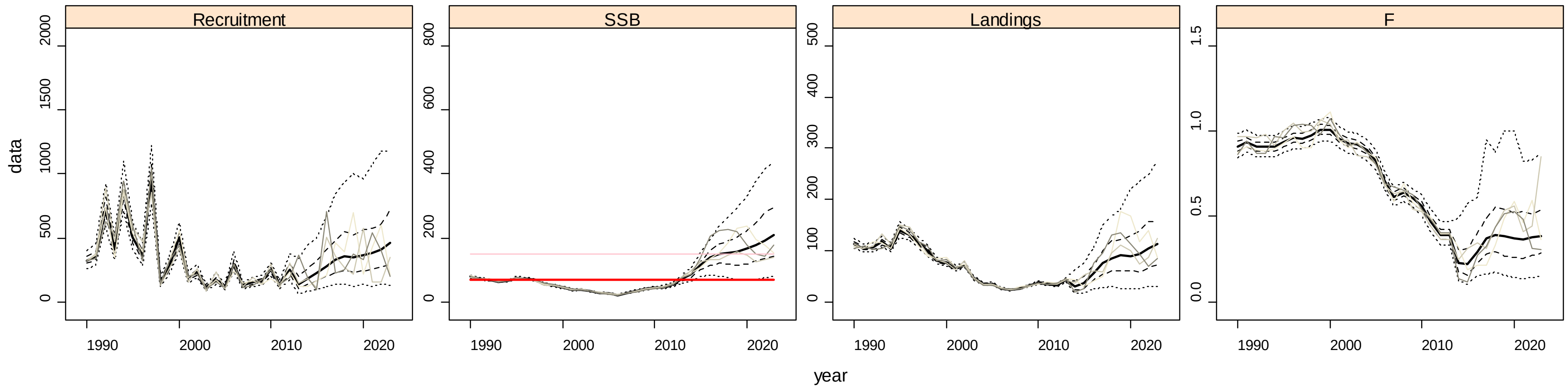

Figure 6.3.5.5.2 (d) Results for current HCR without TAC constraint. The graphs show the estimated historical period since 1990 and simulated years 2014–2023 (solid line: median; dashed lines: 25 and 75 percentiles; dotted lines: 5 and 95 percentiles; lighter grey lines: examples of individual trajectories). The SSB graph also shows B_{lim} (70 kt, thick red line) and B_{pa} (150 kt, thin pink line).

Table 6.3.5.5.1 Summary results of the North Sea cod evaluation. HCR refers to the four different rules evaluated: the two HCRs proposed in this request (F-based and TAC-based) and the current HCR (with or without TAC constraint). A 20% constraint on interannual TAC variability is applied only for the current HCR with TAC constraint, with no TAC constraint applied in the other cases.

(a)		**P(SSB < B_{lim}) (expressed as a percentage)**										
	HCR		**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	F-based HCR		10	18	23	22	17	17	15	14	13	11
	TAC-based HCR		10	18	20	18	14	13	11	10	10	10
	Current HCR with TAC constraint		10	1	0	0	0	0	0	0	0	0
	Current HCR without TAC constraint		10	2	3	4	5	6	5	5	5	5
(b)		**P(SSB < B_{pa}) (expressed as a percentage)**										
	HCR		**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	F-based HCR		100	99	93	82	69	60	59	51	44	39
	TAC-based HCR		100	99	87	70	52	39	31	26	21	19
	Current HCR with TAC constraint		100	92	57	26	15	7	5	3	3	2
	Current HCR without TAC constraint		100	94	64	48	49	45	42	36	32	29
(c)		**median F(ages 2–4)**										
	HCR	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	F-based HCR	0.39	0.41	0.42	0.35	0.33	0.38	0.39	0.37	0.35	0.36	0.38
	TAC-based HCR	0.39	0.41	0.36	0.3	0.25	0.22	0.19	0.15	0.12	0.09	0.07
	Current HCR with TAC constraint	0.39	0.23	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.13	0.12
	Current HCR without TAC constraint	0.39	0.23	0.22	0.3	0.38	0.39	0.39	0.37	0.37	0.38	0.39
(d)		**median Catch (in thousands of tonnes)**										
	HCR	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	F-based HCR	54	64	64	61	66	81	85	84	83	101	107
	TAC-based HCR	54	64	57	53	52	54	55	56	56	56	55
	Current HCR with TAC constraint	54	37	38	45	53	63	75	89	105	124	147
	Current HCR without TAC constraint	54	37	43	66	93	107	113	113	117	130	138
(e)		**median Landings (in thousands of tonnes)**										
	HCR	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	F-based HCR	42	52	52	49	53	67	70	67	67	85	87
	TAC-based HCR	42	52	46	43	43	45	45	46	46	47	47
	Current HCR with TAC constraint	42	31	31	37	44	53	63	76	91	109	130
	Current HCR without TAC constraint	42	31	36	56	76	85	90	90	94	104	112
(f)		**median Discards (in thousands of tonnes)**										
	HCR	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	F-based HCR	11	11	12	11	12	14	15	15	15	17	20
	TAC-based HCR	11	11	11	10	9	9	9	9	9	8	8
	Current HCR with TAC constraint	11	6	6	7	9	10	12	14	15	17	20
	Current HCR without TAC constraint	11	6	7	11	17	21	22	21	22	23	25

6.4 Fish Stock Advice

6.4.1 **Advice June 2013**

ECOREGION North Sea
STOCK Brill in Subarea IV and Divisions IIIa and VIId,e

Advice for 2014 and 2015

ICES advises on the basis of the ICES approach to data limited stocks that catches should be no more than 2727 tonnes. All catches are assumed to be landed.

Stock status

	F (Fishing Mortality)	
	2010–2012	
Qualitative evaluation		Insufficient information
	SSB (Spawning-Stock Biomass)	
	2005–2012	
Qualitative evaluation	/	Stable to increasing

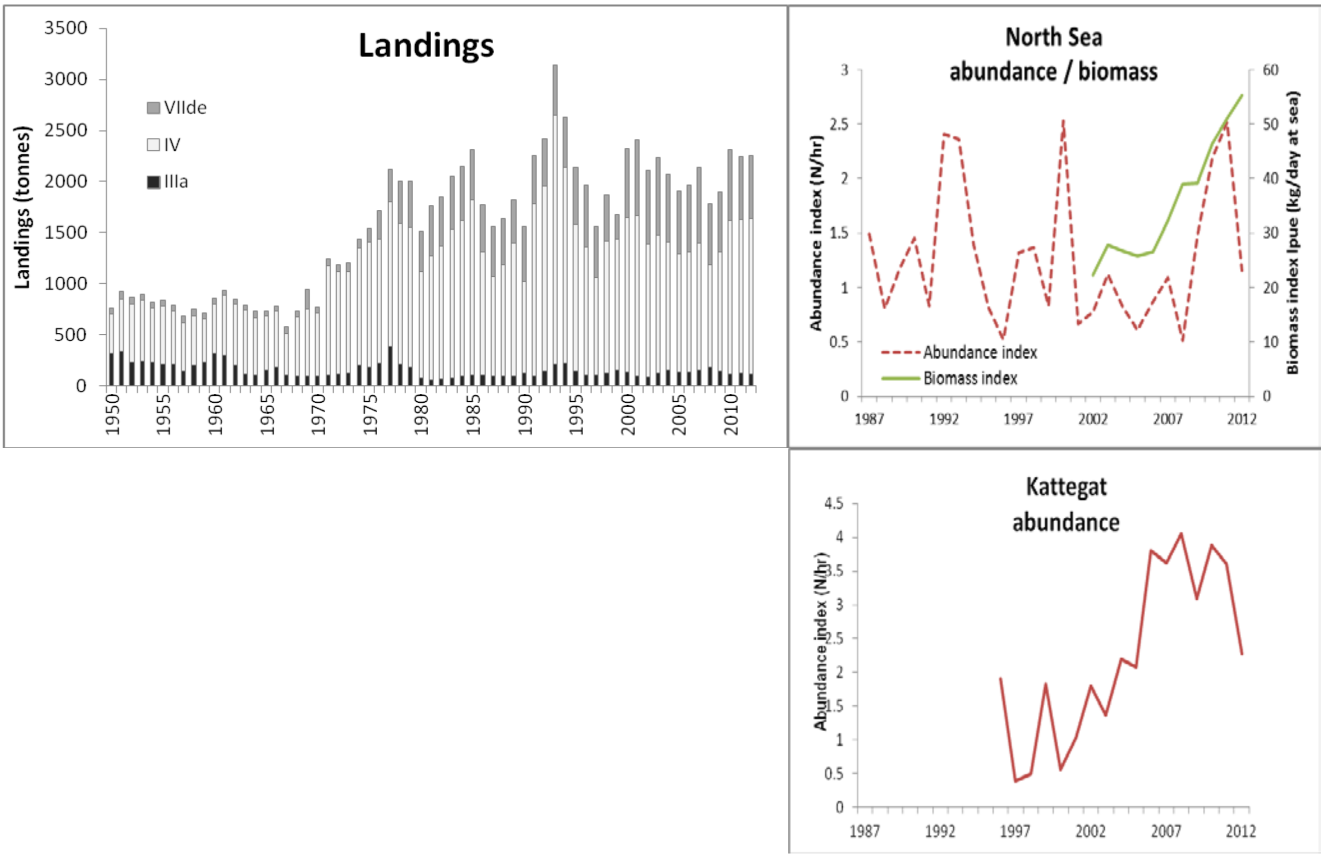

Figure 6.4.1.1 Brill in Subarea IV and Divisions IIIa and VIId,e. Official landings per area (in tonnes). Top right: North Sea abundance index (BTS_ISI_Q3, number/hour) and biomass index (corrected lpue from the Dutch beam trawl fleet > 221kW (kg/day)). Below: Abundance index IIIa South (BITS_HAV_Q1&4, number/hour).

Landings have been relatively stable and above historical values since 1998 and considered a reliable approximation of catches as only little discarding of brill occurs. The stock size indicator (lpue) in the last three years (2010–2012) is 56% higher (North Sea) or 2 % lower (Kattegat) than the average of the five previous years (2005–2009). The survey is noisy and landings and lpue may be also influenced by the turbot uptake of the TAC.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of ICES Division IIa and Subarea IV together with turbot (ICES, 2013a).

Biology

Brill is a shallow-water flatfish found mainly in areas close inshore. It prefers sandy bottoms, but can sometimes also be found on gravel and muddy grounds. Mature brill are rarely observed inshore, whereas immature specimens are often caught near the coast and even in estuaries. Small brill feeds on small benthic fishes and crabs; with increasing length the diet moves to small gadoids. Brill grows faster than flatfish such as sole and plaice, but growth is slower in more Northern waters, where maturation occurs at lower lengths.

The fisheries

Brill is mainly caught as a valuable bycatch species in the beam-trawl fisheries targeting flatfish, and to a lesser extent in the otter trawl and fixed-net fisheries. No official minimum landing size has been set, but Belgian and Dutch producer organisations have adopted voluntary minimum landing sizes between 25–30 cm. A reduction in fishing effort on target flatfish species such as plaice and sole may have influenced the turbot catches.

Catch distribution	Total catch (2012) = 2253 t, where ~ 100% landings (> 95% beam-trawl fisheries, < 5%, others).

Quality considerations

Fishery-independent surveys catch very few old/big brill, creating data gaps for the older ages/greater lengths. Because fishery independent surveys catch relatively few older fish, commercial surveys could be developed to effectively monitor the full size spectrum of this species.

The advice is based on a biomass index used as an indicator of stock size. The uncertainty associated with the index values is not available. 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 based assessment (Data limited stock approach category 3.2.0)
Input data	Commercial catches (international landings), one commercial index (lpue Dutch beam trawl fleet).
Discards and bycatch	Discards are not included and are assumed negligible.
Indicators	Two survey indices (BITS Q1&4 combined, BTS Q3)
Other information	None
Working group report	WGNEW/WGNSSK (ICES, 2013b, 2013c)

ECOREGION North Sea
STOCK Brill in Subarea IV and Divisions IIIa and VIId,e

Reference points

No reference points have been defined.

Outlook for 2014 and 2015

No analytical assessment can be presented. The main cause of this is lack of biological data. Therefore, fishing possibilities cannot be projected.

ICES approach to data-limited stocks

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

The stock size indicator (lpue) in the last three years (2010–2012) is 56% higher (North Sea) or 2% lower (Kattegat) than the average of the five previous years (2005–2009). Given that the North Sea is the main distribution area, and that the Kattegat survey is noisy but, nevertheless, shows a clear increasing trend in the last fifteen years, this implies an increase of catches of at most 20 % in relation to the last three years average catches, corresponding to catches of no more than 2727 t.

The exploitation status is unknown but effort for the main fleet with brill bycatches (beam trawls) in the North Sea and Skagerrak has declined almost 50% between 2002 and 2012. Therefore, no additional precautionary reduction of catches is needed.

All catches are assumed to be landed.

Additional considerations

Brill is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Biology

Genetic analyses show little variation in brill from all over its distribution area. These low levels of variation confirm that brill in IV, IIIa and VIIde can be considered to belong to the same stock, although life-history characteristics change within this assemblage with latitude and the different stock aggregations might be practically separated from each other, which would require a more spatially disaggregated assessment and management. An assessment of brill in the Channel fisheries using the data sampled by France and the UK (Dunn *et al*., 1996) concluded that in the Channel, brill was not heavily overexploited, but that a reduction in fishing effort was required to get an increase of 10% of the observed production. The maximum annual production was found to be around 400 t.

Data

The commercial lpue-series was standardized for engine power and corrected for targeting behavior. The standardization for engine power is relevant as trawlers are likely to have higher catches with higher engine powers, as they can trawl heavier gear or fish at higher speeds. The correction for targeting behavior relies on reducing the effects of spatial shifts in fishing effort.

Data requirements

The collection of survey data needs to be continued in order to get a better understanding of stock identity and the state of brill stocks in the Northeast Atlantic. Because fishery independent surveys catch relatively few older fish, commercial surveys could be developed to effectively monitor the full size spectrum of this species.

Comparison with previous assessment and advice

The assessment in 2011 only considered landings and effort trends. This year, the assessment is based on trends in lpue and effort. The last advice was the same as the previous year and based on precautionary considerations. This year, the basis for the advice is the ICES approach to data limited stocks.

Sources

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ICES. 2013c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/ACOM:13

Table 6.4.1.1 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 turbot & brill	Official landings brill
2000		-	9	6.326	2.3
2001		-	9	6.501	2.4
2002		-	6.750	5.850	2.1
2003		-	5.738	5.575	2.2
2004		-	4.877	5.419	2.1
2005		-	4.550	5.095	1.9
2006		-	4.323	4.877	1.9
2007		-	4.323	5.610	2.1
2008		-	5.263	4.807	1.8
2009		-	5.263	4.991	1.9
2010		-	5.263	4.992	2.3
2011		-	4.642	5.007	2.2
2012	No increase in catch	-	4.642	5.214 [2]	2.3[2]
2013	No new advice, same as for 2012	-	4.642		
2014	No more than 20% increase in recent average catch (2010-2012)	< 2.727			
2015	No new advice, same as for 2014	< 2.727			

Weights in thousand tonnes.
[1] EU combined TAC for turbot and brill in EU areas of ICES Division IIa and Subarea IV.
[2] Preliminary

Table 6.4.1.2 Brill in Subarea IV, Divisions IIIa and VIId,e. Official landings per area (in tonnes).

Year	IIIa	IV	VIIde	TOTAL
1950	319	384	59	762
1951	337	511	78	926
1952	236	565	72	873
1953	246	589	62	897
1954	234	529	60	823
1955	212	571	61	844
1956	213	516	60	789
1957	148	468	70	686
1958	203	480	67	750
1959	233	424	59	716
1960	318	486	52	856
1961	305	581	47	933
1962	207	591	55	853
1963	120	620	51	791
1964	106	565	60	731
1965	155	535	48	738
1966	187	546	53	786
1967	106	409	67	582
1968	100	579	57	736
1969	99	658	190	947
1970	97	618	59	774
1971	104	1073	66	1243
1972	120	994	75	1189
1973	131	989	90	1210
1974	200	1152	81	1433
1975	187	1222	137	1546
1976	224	1208	285	1717
1977	388	1410	323	2121
1978	216	1375	411	2002
1979	184	1366	459	2009
1980	82	1033	402	1517
1981	59	1218	490	1767
1982	74	1294	487	1855
1983	83	1448	526	2057
1984	97	1522	531	2150
1985	109	1709	494	2312
1986	106	1207	456	1769
1987	103	970	493	1566
1988	101	1085	452	1638
1989	97	1302	425	1824

Year	IIIa	IV	VIIde	TOTAL
1990	127	893	543	1563
1991	99	1682	470	2251
1992	146	1810	463	2419
1993	212	2439	490	3141
1994	220	1916	490	2626
1995	150	1434	558	2142
1996	111	1247	608	1966
1997	105	957	501	1563
1998	131	1283	451	1865
1999	156	1280	240	1676
2000	140	1508	678	2326
2001	98	1573	738	2409
2002	89	1302	716	2107
2003	128	1346	759	2233
2004	155	1249	666	2070
2005	133	1160	611	1904
2006	139	1175	649	1963
2007	160	1240	741	2141
2008	182	1004	593	1779
2009	146	1162	591	1899
2010	122	1500	695	2317
2011	131	1495	622	2248
2012	121	1515	617	2253

Table 6.4.1.3 Brill in Subarea IV, Divisions IIIa and VIId,e. Indices of abundance : BTS Q3 (Subarea IV), BITS Q1&4 (Division IIIa) and corrected Dutch commercial lpue.

Year	Abundance index BTS Q3	Abundance index BITS Q1&4	Biomass index commercial lpue
	number/hr	number/hr	kg/day
1987	1.49		
1988	0.81		
1989	1.17		
1990	1.46		
1991	0.83		
1992	2.41		
1993	2.36		
1994	1.39		
1995	0.82		
1996	0.52	1.91	
1997	1.32	0.39	
1998	1.36	0.50	
1999	0.83	1.83	
2000	2.53	0.56	
2001	0.67	1.04	
2002	0.77	1.80	22.3
2003	1.13	1.36	27.8
2004	0.82	2.20	26.8
2005	0.61	2.08	25.8
2006	0.87	3.81	26.5
2007	1.10	3.62	32.2
2008	0.51	4.05	39.1
2009	1.48	3.09	39.2
2010	2.19	3.89	46.4
2011	2.52	3.61	51.1
2012	1.16	2.27	55.3

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

Advice for 2014

New data available for this stock do not change the perception of the stock. Therefore, the advice for this fishery in 2014 is the same as the advice for 2013 (see ICES, 2012): "*ICES advises on the basis of precautionary considerations that there should be no directed fisheries and bycatch and discards should be minimised*".

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.

Scientific basis

Assessment type	Age-based analytical assessment (stochastic state–space model SAM). Data-limited stock approach category 2.1.3.
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling); four bottom trawl survey indices (IBTS-Q1; IBTS-Q3; Havfisken-Q1; Havfisken-Q4); annual maturity data from survey (IBTS Q1); natural mortalities fixed at 0.2.
Discards and bycatch	Discards were included in two of the assessment runs since 2011 (discard data from 1997).
Indicators	None.
Other information	Last benchmarked in 2009 (ICES, 2009).
Working group report	WGBFAS (ICES, 2013).

Additional considerations

Management consideration

In 2013, the cod quota is assumed to be restricted to a bycatch quota. The quota has not been limiting the fisheries in recent years. There are now considerations that the low current quota could be reached before the end of the year and hence increase the discard rate of cod.

Sources

ICES. 2009. Report of the Benchmark and Data Compilation Workshop for Roundfish (WKROUND), 16–23 January 2009, Copenhagen, Denmark. ICES CM 2009/ACOM:32.
ICES. 2012. Cod in Division IIIa East (Kattegat). Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.1.
ICES. 2013. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 10–17 April 2013, ICES Headquarters, Denmark. ICES CM 2013/ACOM:10.

Table 6.4.2.1 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	$F = F_{pa} = 0.6$	4.7	6.2	3.9
2002	No fishery	0	2.8	2.3
2003	No fishery	0	2.3	2
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, minimize bycatches	0	0.190	0.145
2012	No directed fisheries, minimize bycatch and discards	0	0.133	0.093
2013	No directed fisheries, minimize bycatch and discards	0	0.100	
2014	Same advice as 2013.	0		

Weights in thousand tonnes.

ECOREGION North Sea

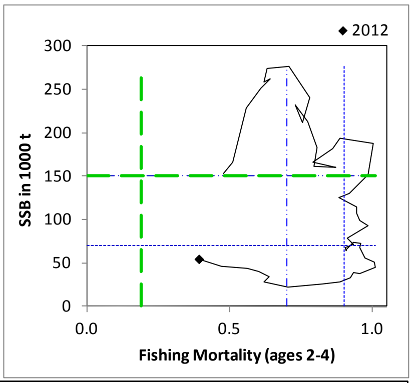
STOCK Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak)

Advice for 2014

ICES advises on the basis of the EU–Norway management plan that landings in 2014 should be no more than 28 809 tonnes. If discards rates do not change from those in 2012, this implies catches of no more than 37 496 tonnes.

Stock status

F (Fishing Mortality)				
	2010	2011	2012	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✗	✗	✓	Below target
SSB (Spawning-Stock Biomass)				
	2011	2012	2013	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	✗	✗	O	Increased risk
Management plan (SSB_{MP})	✗	✗	✗	Below trigger



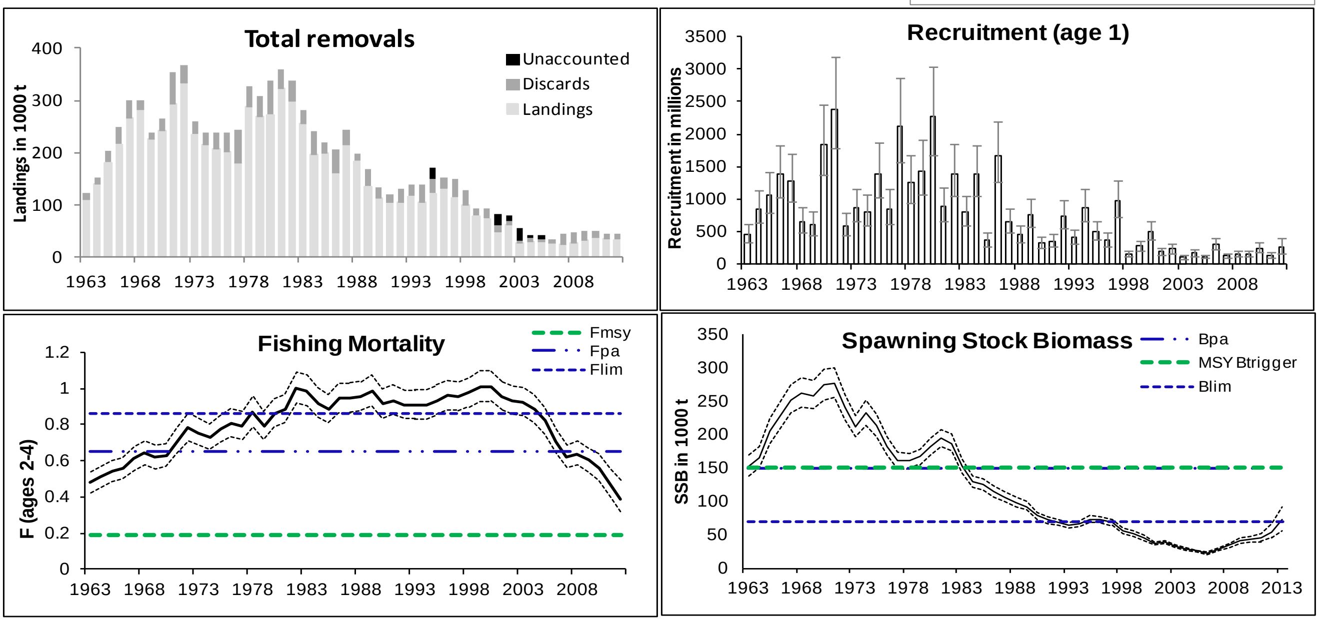


Figure 6.4.3.1 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Summary of stock assessment with point-wise 95% confidence intervals, catch estimated, and adjusted for unaccounted removals (from 1993 to 2005).

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, and is now in the vicinity of B_{lim}. Fishing mortality declined from 2000 and is now estimated to be around 0.4, between F_{pa} and the F_{MSY} proxy. Recruitment since 2000 has been poor.

Management plans

The EU–Norway agreement management plan was updated in December 2008 (Annex 6.4.3). The EU has adopted a long-term plan for this stock with the same aims (Council Regulation [(EC) 1342/2008](); Annex 6.4.3). 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 is a roundfish that lives near the bottom in diverse habitats and can live up to 25–30 years. It feeds on fish, invertebrates, and can be cannibalistic (especially at high densities). Cod are widely distributed throughout the North Sea, but there are indications of subpopulations inhabiting different regions of the North Sea, (e.g. from genetic studies). The inferred limited degree of mixing suggests slow re-colonization in areas where subpopulations are depleted. Subpopulations also show long-term differences in productivity.

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 2007 (after the UK Buyers and Sellers regulation was introduced) to just above the historical average in 2011 and 2012 (from 48% to 24%, weight of cod discarded from the total estimated cod catch).

Catch distribution	ICES estimates total catch (2012) at around 43.6 kt, with 33.2 kt estimated landings (58% demersal trawls and seines >100 mm, 11% gillnets, 9% *Nephrops* trawls 70–99 mm, 6% beam trawls, and 16% other gears) and 10.4 kt estimated discards.

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. Reduced benthic biomass is found in areas of bottom trawl activity compared to unfished areas.

Quality considerations

The overall reporting of catch data provided to ICES has improved since 2006, more recently through fully documented fisheries starting in 2011. Unaccounted removals are no longer estimated for 2006 onwards. The main sources of uncertainty are aspects of the input data (historical landings and discards; discrepancies between stock trends implied by fishery-dependent and -independent sources) and the assumption of fishing mortality in 2013 in the advice forecast.

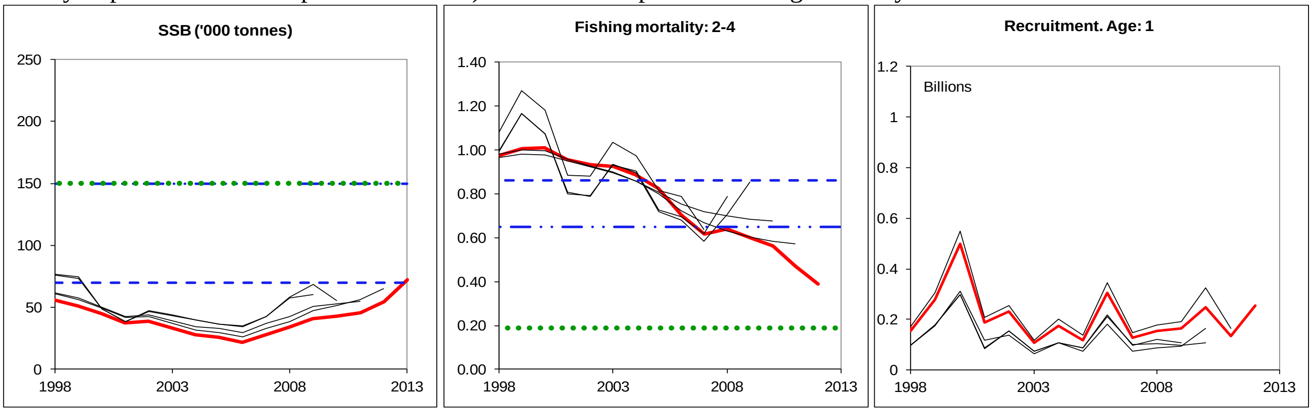


Figure 6.4.3.2 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	A state–space age-structured assessment model (SAM) with estimates of unaccounted removals for the years 1993–2005.
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling by métier), one survey index (IBTS Q1). Maturity data from IBTS (1981–1985); maturity assumed constant over time. Annually varying natural mortalities from multispecies model.
Discards and bycatch	Discards have been included in the assessment since 2004, from samples (in 2012) from all main fleets.
Indicators	None.
Other information	Latest full benchmark was performed in 2009, with an inter-benchmark meeting in 2011.
Working group report	WGNSSK (ICES, 2013a).

ECOREGION **North Sea**

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

Reference points

	Type	***Value***	***Technical basis***
Management Plan	SSB_{MP}	150 000 t.	= 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 2014

Basis: F (2013) = F (2012) = 0.39; Recruitment (2013) re-sampled 1998–2012 = 174 million; SSB (2014) = 87.8; HC landings (2013) = 40.9; Discards (2013) = 14.8.

Rationale	Catch (2014)	Landings (2014)	Discards (2014)	Basis	F_{total} (2014)	F_{land} (2014)	F_{disc} (2014)	SSB (2015)	%SSB[1] Change	%TAC[2] Change
Management plan	37.496	28.809	8.687	Long-term phase	0.21	0.15	0.06	127.392	+45%	−9%
MSY approach	21.014	16.187	4.827	$F_{MSY} \times SSB_{2014}/B_{trigger}$	0.11	0.08	0.03	141.150	+61%	−49%
MSY transition	36.507	28.057	8.450	Transition rule	0.20	0.14	0.06	128.251	+46%	−12%
Precautionary approach	10.064	7.781	2.283	$SSB_{2015} = B_{pa}$	0.05	0.04	0.01	150.000	+71%	−76%
Zero catch	0	0	0	F = 0	0	0	0	158.364	+80%	−100%
Other options	34.672	26.664	8.008	F_{MSY}	0.19	0.13	0.06	129.804	+48%	−16%
	32.988	25.382	7.606	TAC_{2013} − 20%	0.18	0.13	0.05	131.145	+49%	−20%
	41.449	31.801	9.648	Constant TAC	0.23	0.16	0.07	124.147	+41%	0%
	49.722	38.088	11.634	TAC_{2013} + 20%	0.28	0.20	0.08	117.281	+34%	+20%
	65.739	50.227	15.512	F_{2013}	0.39	0.28	0.11	104.192	+19%	+58%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2012).										
Maximum	96.751	78.729	18.022	A	0.75	-	-	65.054	−26%	+247%
Minimum	33.126	27.332	5.794	B	0.20	-	-	116.680	+33%	−14%
Cod MP	33.413	27.567	5.846	C	0.20	-	-	116.438	+33%	−13%
SQ effort	60.828	49.924	10.903	D	0.41	-	-	93.639	+7%	+57%
Effort_Mgt	29.314	29.314	6.229	E	0.22	-	-	114.641	+31%	−8%

Weights in thousand tonnes.

1) SSB 2015 relative to SSB 2014.

2) Landings 2014 relative to TACs 2013 (North Sea 26 475 + Skagerrak 3783 + Eastern English Channel 1543 = 31 801 t).

The Outlook Table assumes no change in fishing mortality in 2013 relative to 2012. This is based on the fact that there is no reduction in effort ceilings for 2013 compared to 2012, leading to an assumed overshoot of the TACs in 2013, higher than the additional 12% added to the North Sea TAC for Fully Documented Fisheries purposes.

Mixed-fisheries assumptions:

A. Maximum scenario: Fleets stop fishing when the last quota is exhausted.
B. Minimum scenario: Fleets stop fishing when the first quota is exhausted.
C. Cod management plan scenario: Fleets stop fishing when the cod quota is 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

The EU–Norway 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 6.4.3).

The EU has adopted a long-term plan for this stock with the same aims (Council Regulation (EC) 1342/2008; Annex 6.4.3). 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}. In 2013, there has been no reduction in effort ceilings compared to the preceding year.

In the recovery phase of 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 2014 equal to 25% of F_{2008} ($F_{2014} = 0.16$). This would lead to a TAC reduction of more than 20%, necessitating the application of the interannual TAC constraint (leading to $F_{2014} = 0.18$).

The long-term phase of the management is reached when the TAC derived from the long-term phase exceeds the TAC derived from the recovery phase. Application of the long-term phase calculates the target F as $0.4-(0.2 \times (B_{pa}-SSB_{2013}) / (B_{pa}-B_{lim}))$ which implies $F_{2014} = 0.21$, and hence leads to a TAC greater than that derived from the recovery phase, implying the management plan now switches to the long-term phase.

Following the management plan long-term phase, landings should be no more than 28 809 t in total for Subarea IV and Divisions IIIa West and VIId in 2014. If discard rates do not change from those in 2012, this implies catches in 2014 of no more than 37 496 t. Because of annual changes in fishing pattern the assumption on discard ratio is based on the most recent estimate.

MSY approach

Following the ICES MSY approach requires fishing mortality to be reduced to 0.11 (lower than F_{MSY} because SSB_{2014}< MSY $B_{trigger}$), resulting in catches of less than 21 014 t in 2014. This is expected to lead to an SSB of 141 150 t in 2015.

To follow the transition scheme towards the ICES MSY framework the fishing mortality must be reduced to $(0.2 \times 0.56) + (0.8 \times 0.11) = 0.20$, which is lower than F_{pa}. This implies catches of less than 36 507 t in 2014, which is expected to lead to an SSB of 128 251 t in 2015. If discards rates do not change from those in 2012, this implies landings in 2014 of no more than 28 057 t.

Precautionary approach

A 87% reduction in F is needed to increase SSB to around B_{pa} in 2015. This corresponds to catches of no more than 10 063 t in 2014. If discard rates do not change from those in 2012, this implies landings in 2014 of no more than 7781 t.

Mixed fisheries

In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings 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 2014. The “minimum” and “cod” scenarios of the mixed-fisheries analyses are both consistent with the single-species advice for cod. It is noted that in the “max” scenario, the implied F would exceed F_{pa} which is not considered precautionary.

Additional considerations

Uncertainty in the assessment

There was a discrepancy between the information coming from commercial catch and the scientific survey used for tuning the assessment, resulting in the estimation of unaccounted mortality and catches for the period 1993–2005. ICES now considers there is no unaccounted mortality from 2006 onwards, the year that catch reporting is believed to have been substantially improved compared to earlier years, partially due to the UK Buyers and Sellers' legislation coming into force in the UK (ICES, 2011b). Removal of the unaccounted mortality from 2006 onwards has reduced the retrospective pattern in F observed in previous assessments.

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 (ICES, 2011b).

The time-series of recruitment estimates was revised downwards in 2011 (with the change in assessment model), and upwards in 2012 (with the update of the natural mortality estimates by predation from multispecies work; ICES, 2011d). The removal of the catch multiplier from 2006 onwards in the 2013 assessment has lead to a slight downward revision of recruitment and SSB. These revisions may influence the stock–recruitment relationship and therefore require re-evaluation of reference points in the benchmark envisaged for 2015.

The main sources of uncertainty in the advice forecast are recruitment assumptions and assumptions about fishing mortality in 2013.

The overall quality of catch data provided to ICES has improved since 2012. International landings and discard rate estimates for 2012 were provided and raised according to the Data Collection Framework (DCF) métier categories.

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

Since the implementation of the management plan, fishing mortality rates have been reduced and the stock has increased since 2006, in spite of continued low recruitment. Fishing mortality in 2012 is estimated below F_{pa} while SSB in 2013 is estimated to be above B_{lim}. The spawning stock does show a low average age which may reduce its reproductive capacity as first-time spawners reproduce less successfully than older fish.

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.

Changes in fishing technology and fishing patterns

The expansion of the closed-circuit TV (CCTV, 27% of landings in 2012) and fully documented fisheries (FDF) programmes in 2010–2013 in Scotland, Denmark, Germany, 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 and German vessels are still permitted to discard undersized cod. In the Netherlands, five vessels have participated in a pilot project during 2012. For these nations, all cod caught are counted against the quota. Some of the fleets in this programme have shown a noticeable increase in smaller fish in the landings, which could imply that less highgrading occurs.

Management plan evaluations

ICES evaluated the EC management plan (EC 1342/2008) and the EU–Norway long-term management plan in March 2009 (Annex 6.4.3) 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 at that time that although there has been a gradual reduction in F and discards in recent years, the plans for North Sea cod had not controlled F as envisaged. Reductions in F observed since 2011 seem to be more pronounced than predicted in this evaluation.

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.

EU introduced effort restrictions 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. However, for 2013, the European Council decided upon a roll-over of the effort level in 2012 into 2013 for both the cod and the sole/plaice management plans.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill/trammel nets, and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, −16% between 2008 and 2012). 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 and in small-mesh beam trawl (80–120 mm, BT2) has shown a pronounced decline (−14%, −45%, and −48%, respectively, between 2004 and 2012). Gill and trammel nets fisheries have remained stable (ICES, 2013b). Effort in large mesh size beam trawl (≥120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline. Nominal effort reported by Norway has increased since 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 at reducing mortality on cod and leading to a reduction in discard numbers. One measure was real-time closures. 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, while there were 173 in 2012. ICES notes that from the initial year of operation (2008) cod discarding rates in Scotland have decreased from 62% in 2008 to 24% (in weights) in 2011 and 2012.

International discard rates in the period where unallocated catch is estimated (1993–2005) are considered not comparable to the later period because of the potential for fish to become undeclared landings instead of discards. There is clear indication, however, that the discard rate for age 2 fish has been increasing since the early 1980s (Figure 6.4.3.5).

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 that tend to use the eastern North Sea region as a nursery area (Knutsen *et al.*, 2004; Svedäng and Svenson, 2006; Svedäng *et al.*, 2007). This picture is supported by genetic evidence of a decoupling of population dynamics between the southern and northern North Sea. Thus, signals normally interpreted as evidence for distributional shifts within the North Sea, may instead reflect fluctuating densities between stock components (ICES, 2013a).

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.
Information from the fishing industry

Comparison between the fishers' North Sea stock survey (Napier, 2012; Figure 6.4.3.6) 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/decrease in these southern areas in 2011–2012.

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.

Comparison with previous assessment and advice

The basis for the assessment has changed from last year in that unaccounted mortality is now no longer estimated from 2006 onwards, given the improved reporting of catches since 2006. This has not changed the overall perception of SSB, F, and recruitment trends, but has led to a downward adjustment in SSB and recruitment, with F estimated to have declined more sharply in recent years. Compared to the assessment in 2012, SSB_{2012} has been revised downwards by 16%, and F_{2011} by 18%.

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

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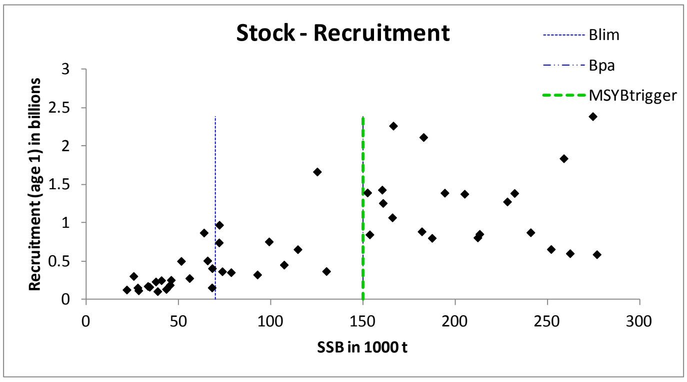


Figure 6.4.3.3 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Stock–recruitment plot.

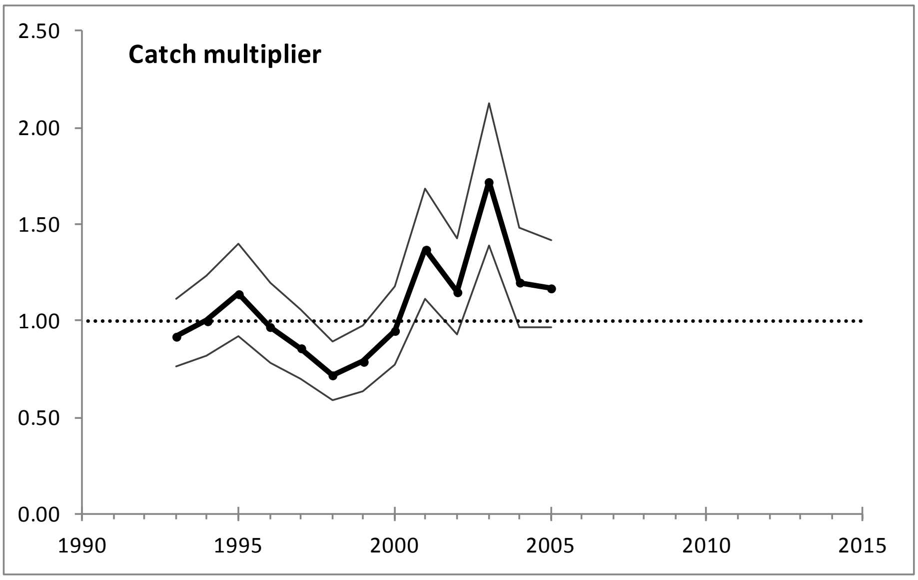


Figure 6.4.3.4 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Estimates of factor for unaccounted removals (catch multiplier).

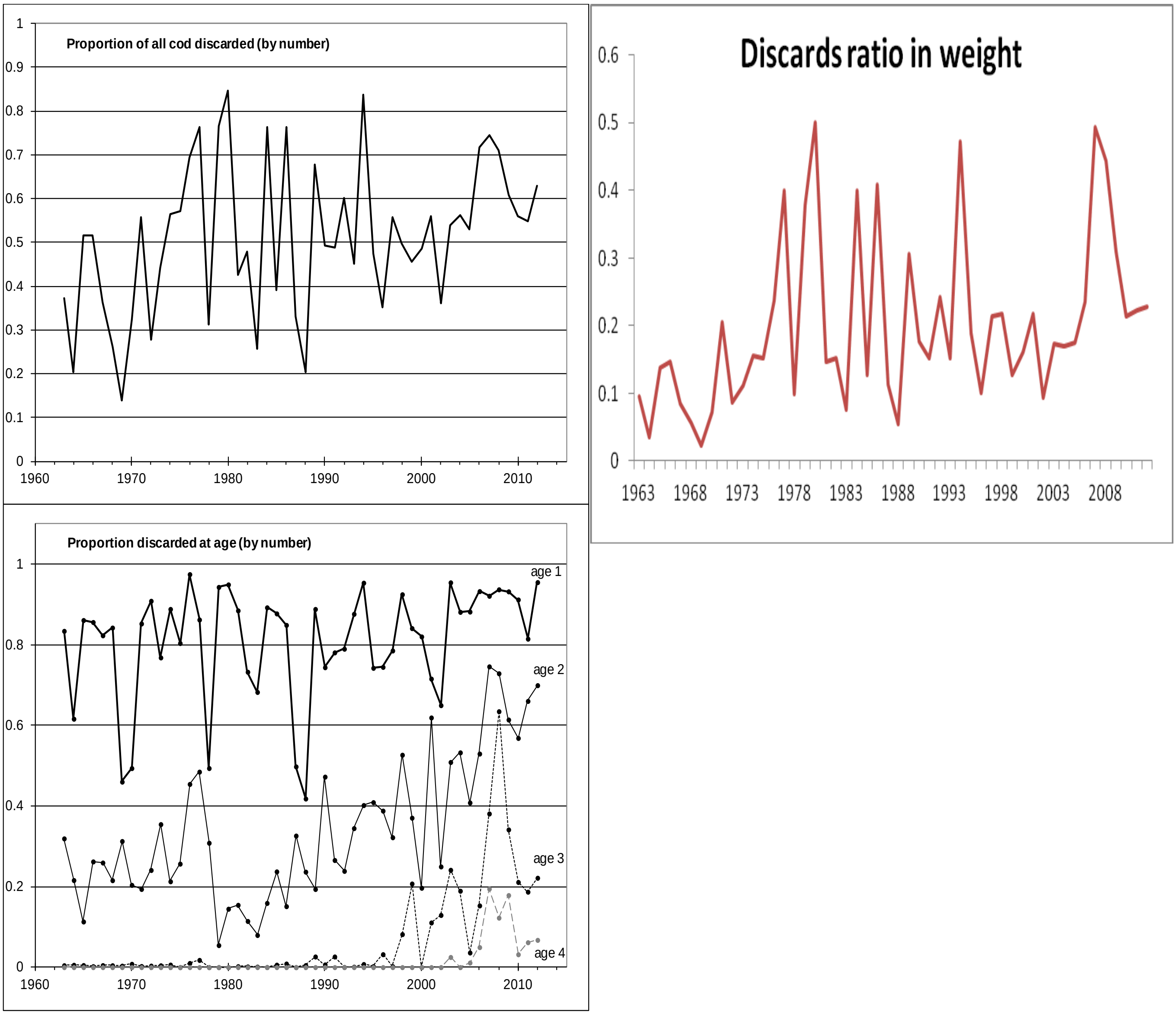


Figure 6.4.3.5 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Proportion of discards, in total, by number (top left) and in total by weight (top right). Plot below shows numbers caught that are discarded by age. In 2012, 96% of 1-year-old, 70% of 2-year-old, 22% of 3-year-old, and 7% of 4-year-old cod were discarded.

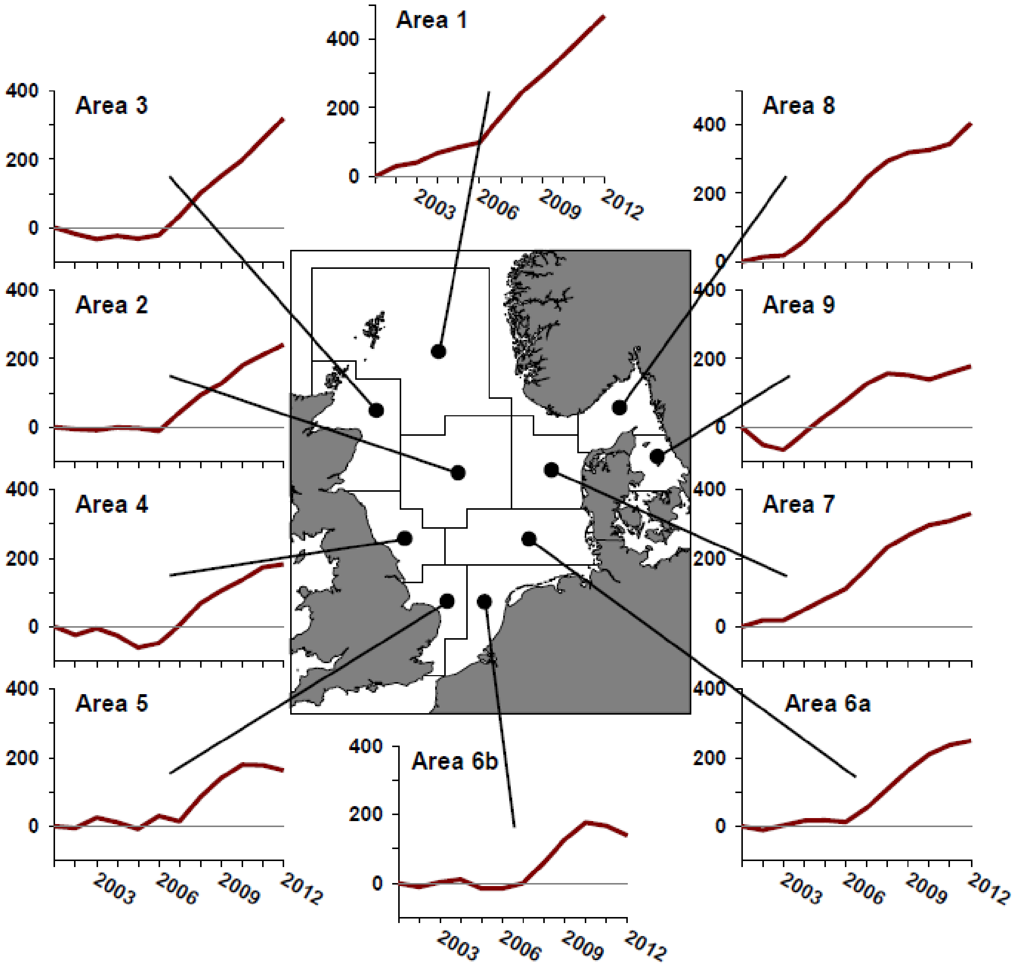


Figure 6.4.3.6 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Results of the North Sea Commission fishers' survey perceptions of abundance by area, (Napier, 2012).

Table 6.4.3.1 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (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 6.4.3.2.

North Sea (Subarea IV)

Year	ICES Advice	Predicted landings 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	27.3	26.7
2013	Management plan (TAC −20%)	< 25.441 [1)]	26.5		
2014	Management plan long-term phase	< 28.809 [1)]			

Weights in thousand tonnes.

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

Table 6.4.3.1 Continued

Skagerrak (Division IIIa West)

Year	ICES Advice	Predicted landings 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	3.8	4.3
2013	Management plan (TAC −20%)	< 25.441 [2)]	3.8		
2014	Management plan long-term phase	< 28.809 [2)]			

Weights in thousand tonnes.
[1)] Norwegian fjords not included.
[2)] For Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak).

Table 6.4.3.1 Continued

Eastern Channel (Division VIId)

Year	ICES Advice	Predicted landings 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 F_{2008})	< 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	1.1	1.1
2013	Management plan (TAC −20%)	< 25.441 [3]	1.5		
2014	Management plan long-term phase	< 28.809 [3]			

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 West (Skagerrak).

Table 6.4.3.2 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	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Belgium	3374	2648	4827	3458	4642	5799	3882	3304	2470	2616
Denmark	19547	19243	24067	23573	21870	23002	19697	14000	8358	9022
Faroe Islands	46	80	219	44	40	102	96	-	9	34
France	1868	1868	3040	1934	3451	2934	.	1222	717	1777
Germany	6800	5974	9457	8344	5179	8045	3386	1740	1810	2018
Greenland	.	.	.	.	.	.	.	.	.	.
Netherlands	10220	6512	11199	9271	11807	14676	9068	5995	3574	4707
Norway	8742	7707	7111	5869	5814	5823	7432	6410	4369	5217
Poland	-	-	-	18	31	25	19	18	18	39
Sweden	646	630	709	617	832	540	625	640	661	463
UK (E/W/NI)	14940	13941	14991	15930	13413	17745	10344	6543	4087	3112
UK (Scotland)	28197	28854	35848	35349	32344	35633	23017	21009	15640	15416
Total Nominal Catch	94380	87457	111468	104407	99423	114324	77566	60881	41713	44421
Unallocated landings	10200	7066	8555	2161	2746	7779	826	-1114	-740	-121
WG estimate of total landings	**104580**	**94523**	**120023**	**106568**	**102169**	**122103**	**78392**	**59767**	**40973**	**44300**
Agreed TAC	**101000**	**102000**	**120000**	**130000**	**115000**	**140000**	**132400**	**81000**	**48600**	**49300**

Division VIId										
Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Belgium	157	228	377	321	310	239	172	110	93	51
Denmark	-	9	-	-	-	-	-	-	-	-
France	1771	2338	3261	2808	6387	7788	.	3084	1677	1361
Netherlands	-	-	-	-	-	19	3	4	17	6
UK (E/W/NI)	530	312	336	414	478	618	454	385	249	145
UK (Scotland)	2	<0.5	<0.5	4	3	1	-	-	-	-
Total Nominal Catch	2460	2887	3974	3547	7178	8665	629	3583	2036	1563
Unallocated landings	-28	-37	-10	-44	-135	-85	6229	-1258	-463	1534
ICES estimate of total landings	**2432**	**2850**	**3964**	**3503**	**7043**	**8580**	**6858**	**2325**	**1573**	**3097**

Division IIIa (Skagerrak)**										
Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Denmark	11994	11921	15888	14573	12159	12339	8682	7656	5870	5511
Germany	530	399	285	259	81	54	54	54	32	83
Norway	1043	850	1039	1046	1323	1293	1146	926	762	645
Sweden	2575	1834	2483	1986	2173	1900	1909	1293	1035	897
Others	88	71	134	-	-	-	-	-	-	-
Norwegian coast *	909	760	846	748	911	976	788	624	846	.
Danish industrial by-catch *	511	666	749	676	205	97	62	99	687	.
Total Nominal Catch	16230	15075	19829	17864	15736	15586	11791	9929	7699	7136
Unallocated landings	-1493	-1814	-7720	-1615	-790	-255	-817	-652	-613	332
ICES estimate of total landings	**14737**	**13261**	**12109**	**16249**	**14946**	**15331**	**10974**	**9277**	**7086**	**7468**
Agreed TAC	**15000**	**15500**	**20000**	**23000**	**16100**	**20000**	**19000**	**11600**	**7000**	**7100**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined										
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total Nominal Catch	113070	105419	135271	125818	122337	138575	89986	74393	51448	53120
Unallocated landings	8679	5215	825	502	1821	7439	6239	-3024	-1816	1745
ICES estimate of total landings	**121749**	**110634**	**136096**	**126320**	**124158**	**146014**	**96225**	**71369**	**49632**	**54865**

** 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	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Norwegian coast *	909	760	846	748	911	976	788	624	846	.
Danish industrial by-catch *	511	666	749	676	205	97	62	99	687	.
Total	**1420**	**1426**	**1595**	**1424**	**1116**	**1073**	**850**	**723**	**1533**	**0**

Table 6.4.3.2 (cont.)

Sub-area IV										
Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	1482	1627	1722	1309	1009	894	946	666	653	846
Denmark	4676	5889	6291	5105	3430	3831	4402	5686	4863	4805
Faroe Islands	36	37	34	3	-	16	45	32	.	.
France	620	294	664	354	659	573	950	781	563	369
Germany	2048	2213	2648	2537	1899	1736	2374	2844	2211	2292
Greenland	.	.	35	23	17	17	11	.	.	.
Netherlands	2305	1726	1660	1585	1523	1896	2649	2657	1928	1951
Norway	4417	3223	2900	2749	3057	4128	4234	4496	4898	4423
Poland	35	-	-	-	1	2	3	.	2	.
Sweden	252	240	319	309	387	439	378	363	315	471
UK (E/W/NI)	2213	1890	1270	1491	1587	1546	2384	2553		
UK (Scotland)	7852	6650	4936	6857	6511	7185	9052	11567		
UK (combined)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12309	12187
Others	.	.	.	786	.	.	.	.	.	.
Norwegian indust by-catch *	.	.	.	48	101	22	4	201	1	.
Danish industrial by-catch *	.	.	.	34	18	46	76	11	0	0
Total Nominal Catch	25936	23789	22479	23108	20080	22263	27428	31645	27742	27344
Unallocated landings	-89	-240	1391	-1012	-336	-68	-1800	-345	-14	-686
ICES estimate of total landings	**25847**	**23549**	**23870**	**22096**	**19744**	**22195**	**25628**	**31300**	**27728**	**26658**
Agreed TAC	**27300**	**27300**	**27300**	**23205**	**19957**	**22152**	**28798**	**33552**	**26842**	**26475**

Division VIId										
Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	54	47	51	80	84	154	73	57	56	38
Denmark	-	-	-	-	.	.	.	.	.	.
France	1730	810	986	1124	1743	1326	1779	1606	1005	885
Netherlands	36	14	9	9	59	30	35	45	51	40
UK (E/W/NI)	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	126	99
Total Nominal Catch	1941	974	1230	1481	2073	1661	2024	1836	1238	1061
Unallocated landings	-707	-167	-197	-353	-331	-307	-777	-44	-20	3
ICES estimate of total landings	**1234**	**807**	**1033**	**1128**	**1742**	**1354**	**1247**	**1792**	**1218**	**1064**
Agreed TAC							**1678**	**1955**	**1564**	**1543**

Division IIIa (Skagerrak)**										
Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	3054	3009	2984	2478	2228	2552	3023	3289	3118	3180
Germany	49	99	86	84	67	52	55	56	60	.
Norway	825	856	759	628	681	779	440	375	421	583
Sweden	510	495	488	372	370	365	459	458	518	.
Others	27	24	21	373	385	13	2	26	.	.
Norwegian coast *	.	720	759	524	494	498	342	369	342	467
Danish industrial by-catch *	.	10	18	9	.	-	1	0	0	0
Total Nominal Catch	4465	4483	4338	3935	3731	3761	3979	4204	4117	3763
Unallocated landings	-674	-696	-533	-569	-784	-463	-101	-116	-192	539
ICES estimate of total landings	**3791**	**3787**	**3805**	**3366**	**2947**	**3298**	**3878**	**4089**	**3925**	**4302**
Agreed TAC	**3900**	**3900**	**3900**	**3315**	**2851**	**3165**	**4114**	**4793**	**3835**	**3783**

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Nominal Catch	32342	29246	28047	28524	25884	27685	33431	37685	33097	32168
Unallocated landings	-1470	-1103	661	-1934	-1451	-838	-2678	-505	-226	-145
ICES estimate of total landings	**30872**	**28143**	**28708**	**26590**	**24433**	**26847**	**30753**	**37180**	**32871**	**32023**

** 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	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Norwegian coast *	.	720	759	524	494	498	342	369	342	467
Norwegian indust by-catch *	.	.	.	48	101	22	4	201	1	.
Danish industrial by-catch *	.	10	18	43	18	46	77	11	0	0

Table 6.4.3.3 Cod in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa West (Skagerrak). Summary of stock assessment (weights in tonnes, recruitment in thousands). Low = lower limit and High = higher limit of 95% confidence interval. 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	Recruits (age 1)	R - Low	R - High	TSB	TSB Low	TSB High	SSB	SSB Low	SSB High	F (2-4)	F-Low	F-High	Landings	Discards	Catch	Catch multiplier	Total Removals
1963	462314	341847	625233	515555	459021	579052	153584	138426	170400	0.478	0.423	0.54	110747	13265	123995		123995
1964	845768	631378	1132955	686252	596874	789013	165877	150710	182570	0.51	0.456	0.57	139246	13001	152207		152207
1965	1067681	801596	1422093	863717	759557	982160	205048	187312	224463	0.541	0.486	0.603	181680	21007	202805		202805
1966	1375049	1031908	1832295	1050734	920787	1199021	228205	209534	248540	0.556	0.501	0.618	216209	31698	247954		247954
1967	1274418	954497	1701567	1137109	1003638	1288331	251954	231929	273707	0.609	0.549	0.675	265402	33624	299240		299240
1968	654744	486708	880795	944112	854044	1043678	262236	241704	284512	0.641	0.578	0.71	280408	21051	301342		301342
1969	600189	447817	804406	802109	719870	893743	258849	238193	281296	0.619	0.558	0.686	226160	11967	237994		237994
1970	1837653	1374637	2456627	1333077	1111666	1598586	274581	252399	298712	0.631	0.571	0.698	241832	23671	265402		265402
1971	2385693	1782808	3192453	1467396	1249208	1723694	276786	255329	300046	0.707	0.642	0.779	292436	61636	353628		353628
1972	587129	438441	786242	980679	877366	1096156	240867	222499	260751	0.782	0.709	0.862	332036	35066	367324		367324
1973	873270	653188	1167506	798109	709441	897859	212140	196331	229221	0.754	0.684	0.831	234920	24588	259367		259367
1974	806130	602595	1078412	753135	672092	843951	232118	213691	252133	0.73	0.663	0.805	214272	24662	238948		238948
1975	1384708	1023665	1873090	861129	738351	1004325	213203	196599	231210	0.772	0.702	0.849	206282	32241	238470		238470
1976	852561	628556	1156397	660664	585848	745033	182773	169032	197631	0.807	0.732	0.889	200988	37571	238709		238709
1977	2113805	1564223	2856478	1012568	836996	1224969	160813	149180	173355	0.794	0.721	0.874	180232	63007	243531		243531
1978	1255444	933877	1687738	1119060	952817	1314310	160332	149265	172219	0.87	0.791	0.956	287506	39935	327420		327420
1979	1428306	1065079	1915406	1000490	871785	1148195	166375	154934	178661	0.792	0.72	0.87	268069	41069	308970		308970
1980	2262543	1679220	3048499	1169398	995619	1373510	181861	169326	195325	0.86	0.785	0.941	272665	66171	339083		339083
1981	885582	660333	1187665	987567	871234	1119434	194269	181306	208160	0.886	0.811	0.968	322546	38025	360411		360411
1982	1388869	1046331	1843543	1011556	872736	1172457	187400	175447	200167	1.003	0.919	1.094	297152	40579	337729		337729
1983	800507	607022	1055663	802109	702407	915964	152360	142415	162999	0.986	0.905	1.075	254740	25413	280127		280127
1984	1391649	1053407	1838499	809361	694435	943306	130092	121766	138988	0.918	0.841	1.002	196222	45707	241832		241832
1985	368060	276675	489627	557936	499806	622827	125116	117015	133779	0.882	0.807	0.964	198392	22049	220356		220356
1986	1664441	1257857	2202448	764517	637800	916411	114577	107311	122335	0.946	0.868	1.031	160653	44623	205253		205253
1987	652783	495875	859340	724328	629659	833231	107152	100212	114571	0.945	0.867	1.029	214915	29378	244263		244263
1988	451802	343190	594788	539825	477829	609864	99012	92658	105803	0.955	0.877	1.039	184241	12702	197008		197008
1989	753889	567559	1001390	528607	453023	616801	92689	86519	99299	0.984	0.903	1.073	135673	32630	168215		168215
1990	323515	245826	425755	369904	328540	416477	78433	73296	83930	0.913	0.835	0.997	112420	21303	133653		133653
1991	353274	268219	465301	338405	298513	383629	71898	67453	76636	0.935	0.858	1.019	104715	14459	119134		119134
1992	741181	562485	976646	487966	411541	578582	68186	63860	72806	0.906	0.831	0.988	105030	26160	131268		131268
1993	405956	308680	533887	397520	350553	450780	63704	59802	67860	0.909	0.834	0.991	126308	25990	152280	0.92	140084
1994	869784	652587	1159269	482145	409686	567419	65644	61628	69921	0.909	0.834	0.991	104513	35280	139814	1.00	140365
1995	505852	384793	664998	513497	446169	590985	73644	68920	78692	0.934	0.857	1.019	122038	27149	149207	1.14	169906
1996	365492	277640	481143	416649	368731	470795	72042	67620	76752	0.959	0.881	1.044	134859	21431	156370	0.97	151146
1997	970921	732750	1286505	576655	478742	694593	68050	63861	72514	0.955	0.879	1.038	132102	42376	174439	0.86	150693
1998	154508	116201	205442	313953	277147	355648	55882	52382	59617	0.975	0.898	1.059	137192	40584	177751	0.72	128669
1999	276786	209592	365521	234920	209045	263998	51380	48136	54842	1.007	0.927	1.095	100493	16869	117341	0.79	93153
2000	499818	379542	658210	313953	266634	369671	45297	42205	48616	1.009	0.929	1.095	78356	20283	98619	0.95	93995
2001	188528	141303	251536	224134	198765	252742	37609	35272	40101	0.957	0.882	1.039	47423	12856	60287	1.37	82372
2002	232118	174972	307928	241349	211259	275725	38561	36101	41189	0.932	0.856	1.014	62381	7533	69844	1.15	80580
2003	106404	80710	140278	136216	123323	150457	33323	31018	35799	0.924	0.85	1.004	27248	5188	32460	1.72	55826
2004	173685	131940	228639	131268	115058	149763	28254	26425	30210	0.885	0.812	0.965	28864	7040	35930	1.20	43002

Year	Recruits (age 1)	R - Low	R - High	TSB	TSB Low	TSB High	SSB	SSB Low	SSB High	F (2-4)	F-Low	F-High	Landings	Discards	Catch	Catch multiplier	Total Removals
2005	117243	89332	153873	124244	110561	139620	25566	23871	27380	0.823	0.752	0.9	29350	5980	35350	1.17	41357
2006	304066	231339	399656	134323	116497	154875	21844	20383	23410	0.703	0.64	0.772	26213	8206	34406		34406
2007	127262	97071	166842	161135	142857	181753	27778	25755	29960	0.618	0.559	0.684	23647	22248	45890		45890
2008	153277	116751	201229	163898	146958	182791	34201	31518	37112	0.638	0.576	0.706	26662	21812	48485		48485
2009	163571	124273	215294	181498	160916	204713	40619	37160	44401	0.603	0.539	0.674	32435	16564	48972		48972
2010	249197	187670	330896	200386	175292	229072	43261	38954	48044	0.562	0.494	0.639	37421	12755	50212		50212
2011	134592	97320	186137	189852	165150	218248	45890	40045	52588	0.47	0.397	0.555	34996	11275	46258		46258
2012	253723	164266	391899	210449	174710	253499	54776	45785	65531	0.391	0.312	0.489	33223	10385	43608		43608
2013							71970	56423	91799								
Average	761915			608508			122511			1			155670	26401	182063		181492

Annex 6.4.3

EU–Norway management plan – Agreed record between EU and Norway, Clonakilty, 18 January 2013.

1. The Parties agree to restrict their fishing on the basis of TACs consistent with a fishing mortality rate that maximises long-term yield and maintains spawning stock biomass above Bpa.

Transitional arrangement:

2. 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

3. 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.

4. 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.
5. When scientific advice indicates that the application of the rules set out in paragraphs 2 to 4 is not appropriate to meet the objectives of the plan, the Parties may, notwithstanding the above mentioned provisions, decide on an altemative TAC level.
6. 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.
7. 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.
8. 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

9. If, due to a lack of sufficiently precise and representative information, it is not possible to implement the provisions in paragraphs 3 to 7, 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 entered into force on 1 January 2013.

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.*

6.4.4 **Advice June 2013**

ECOREGION **North Sea**
STOCK **Dab in Subarea IV and Division IIIa**

Advice for 2014 and 2015

Based on the ICES approach for data limited stocks, ICES advises that landings should be no more than 7795 tonnes. Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Stock status

	F (Fishing Mortality)	
	2010 – 2012	
Qualitative evaluation	?	Insufficient information
	TSB (Total Stock Biomass)	
	2005 – 2012	
Qualitative evaluation	➔	Stable in the main area

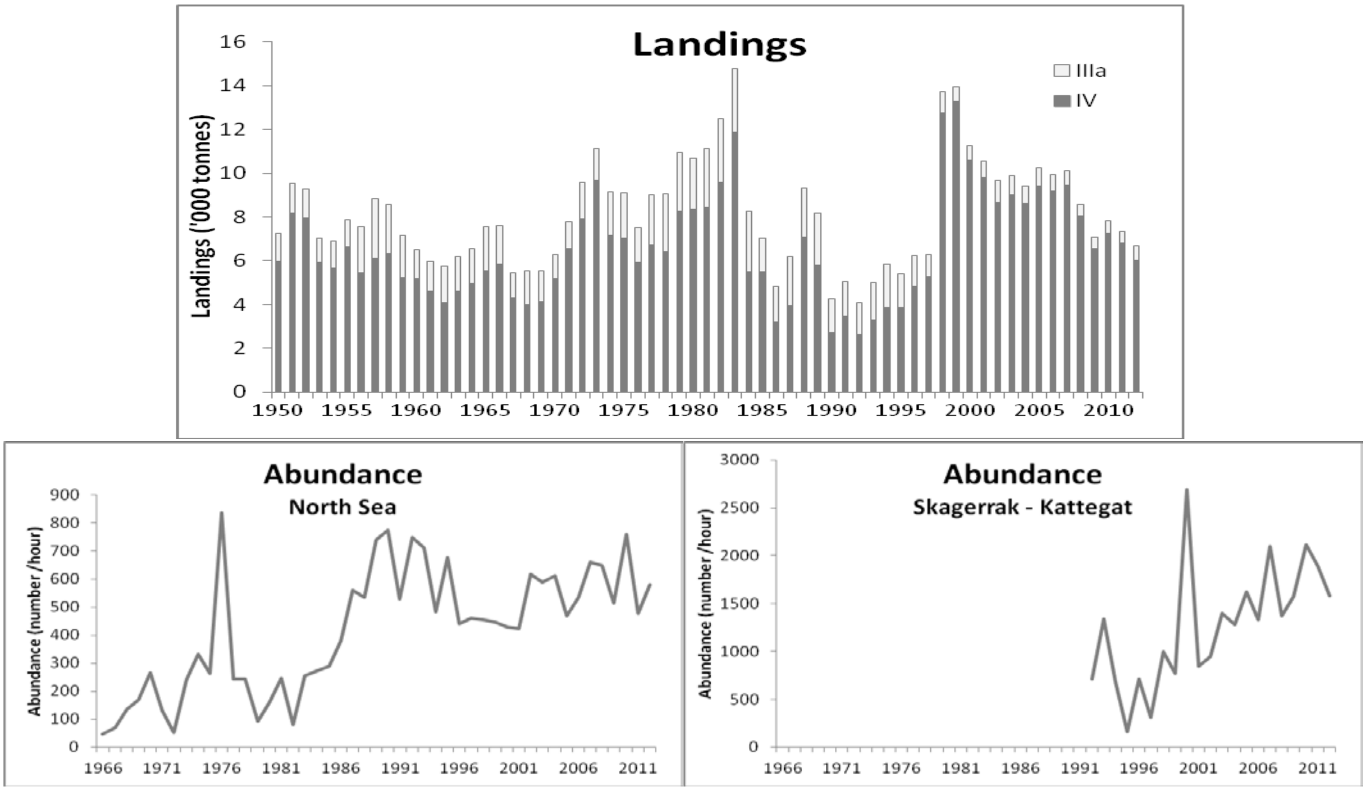


Figure 6.4.4.1 Dab in Subarea IV and Division IIIa. Top: Official landings per area (in thousand tonnes), between 1984 and 1997 Dutch landings wer

Landing data are not complete and are not indicative for catches since discard rates are high. Survey indices show a stable abundance in the last decades in Subarea IV which is the main part of the distribution area and an increasing abundance for Division IIIa. The stock size indicator (number/hour) in the last three years (2010–2012) is 7% higher (North Sea) or 16% higher (Skagerrak–Kattegat) than the average of the five previous years (2005–2009).

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with flounder (ICES, 2013a).

Biology

Dab is a widespread demersal species on the Northeast Atlantic shelf and distributed from the Bay of Biscay to Iceland and Norway; including the Barents Sea and the Baltic. There is no information on the stock identity of this species. Dab is one of the most abundant demersal species in the North Sea with its centre of distribution in the Southern North Sea. Because of its sedentary nature, dab has proved to be a valuable indicator in eco-toxicological studies.

The fisheries

Dab is a bycatch in the fishery for flatfish, shrimp and demersal species, mainly in the beam trawl fisheries. Dab catches are generally discarded based on the availability of target species, and market price. Since 2000 landings decreased in subarea IV and IIIa.

Catch distribution	Total catches (2012) = unknown, landings = 6673 t (50% beam-trawl fisheries, 45% otter trawl, 5% others), discards are high but unquantified.

Quality considerations

Landings data are not complete, and are not indicative of catches. Discards should be estimated and added to the landings. The survey indices need to be available as biomass indicators rather than abundance. The mixed TAC with flounder reduces the accuracy of catch statistics per species.

The advice is based on an abundance index used as an indicator of stock size. The uncertainty associated with the index values is not available. 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 based assessment (Data limited stock approach category 3.2.0)
Input data	Landing statistics, one survey index (IBTS Q1).
Discards and bycatch	Discards are not included in the assessment but are known to be high although data are insufficient to quantify them.
Indicators	Survey index (BITS Q1).
Other information	None.
Working group report	WGNEW/WGNSSK (ICES, 2013b, 2013c)

6.4.4 Supporting Information June 2013

ECOREGION North Sea
STOCK Dab in Subarea IV and Division IIIa

Reference points

No reference points have been defined.

Outlook for 2014 and 2015

No analytical assessment can be presented. The main cause of this is lack of reliable catch data. 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 three most recent index values with the five preceding values, combined with recent landings data. Knowledge about the exploitation status also influences the advised catch.

The stock size indicator (number/hour) in the last three years (2010–2012) is 7 % higher (North Sea) or 16% higher (Skagerrak–Kattegat) than the average of the five previous years (2005–2009). Given that the North Sea is the main distribution area, and that both surveys show an increase, this implies an increase of landings of at most 7% in relation to the last three years average landings, corresponding to landings of no more than 7795 t.

Even though exploitation status is unknown, the effort of the main fleet with dab bycatches (beam trawls) in the North Sea and Skagerrak has declined almost 50% between 2002 and 2012. Therefore, no additional precautionary reduction of catches is needed.

Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Additional considerations

Dab is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

The available sample data on catches and discards need to be more fully utilized. In order to be able to estimate catch, data on discard amounts by different metiers are needed as well as size/age composition of the landings and discards.

Comparison with previous assessment and advice

The assessment in 2011 and now is based on trends in abundance and effort. The last advice was the same as the previous year and based on precautionary considerations. Last year's advice was the same as the previous year and based on precautionary considerations. This year, the basis for the advice is the ICES approach to data limited stocks.

Sources

ICES.2013a. Flounder in Subarea IV and Division IIIa, Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.4.29.
ICES. 2013b. Report of the Working Group on Assessment of New MoU Species (WGNEW) 18–22 March ICES HQ, Denmark, ICES CM 2013/ACOM:21.
ICES. 2013c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/ACOM:13

Table 6.4.4.1 Dab in Subarea IV and Division IIIa. ICES advice, management and official landings

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1)] dab & flounder	Official landings dab & flounder	Official landings dab
2006		-	17.1	14.922	9.915
2007		-	17.1	14.195	10.128
2008		-	18.81	11.792	8.551
2009		-	18.81	10.148	7.059
2010		-	18.81	11.193	7.829
2011		-	18.434	10.544	7.353
2012	No increase in catch	-	18.434	8.978	6.673
2013	No new advice, same as for 2012	-	18.434		
2014	No more than 7% increase in landings	< 7.795			
2015	No new advice, same as for 2014	< 7.795			

Weights in thousand tonnes.

[1)] EU combined TAC for dab and flounder in EU areas IIa and IV.

Table 6.4.4.2 Dab in Subarea IV and Division IIIa. Official landings per country (in tonnes). Note that reporting may be incomplete, particularly missing the Netherlands 1984–1987, 1990–1997; Germany 1995.

Landings IV

Year	BEL	DEU	DNK	FRA	FRO	GBR	NLD	NOR	SWE	Total
1950	254	92	900	139	0	2555	2031	0	0	5971
1951	462	114	1800	90	0	3503	2221	0	0	8190
1952	386	74	1562	227	0	2823	2904	0	0	7976
1953	357	58	1337	189	0	2591	1383	0	0	5915
1954	255	62	1666	177	0	2393	1099	0	0	5652
1955	305	92	2923	161	0	1993	1149	0	0	6623
1956	338	99	1766	138	0	1660	1368	0	99	5468
1957	336	73	1983	154	0	1785	1669	0	127	6127
1958	290	71	2320	175	0	1885	1517	0	84	6342
1959	285	93	1433	146	0	2011	1265	0	6	5239
1960	246	70	1833	154	0	1813	1052	0	0	5168
1961	227	67	1497	161	0	1734	916	0	0	4602
1962	205	54	1357	147	0	1524	795	0	0	4082
1963	306	40	1660	128	0	1481	1000	0	0	4615
1964	424	48	1612	672	0	1177	1049	0	0	4982
1965	432	64	1841	734	0	1099	1349	0	0	5519
1966	507	65	1589	719	0	1215	1767	0	0	5862
1967	384	77	659	716	0	1147	1341	0	0	4324
1968	334	57	861	350	0	877	1516	0	0	3995
1969	302	69	984	448	0	689	1630	0	0	4122
1970	338	71	1476	588	0	752	1958	0	0	5183
1971	409	46	1546	618	0	986	2941	0	0	6546
1972	638	46	1816	727	0	1057	3617	0	0	7901
1973	678	41	1899	873	0	1349	3638	1179	0	9657
1974	281	59	1168	310	0	1227	4101	0	0	7146
1975	600	45	944	418	0	992	4031	0	3	7033
1976	489	52	852	306	0	816	3402	0	0	5917
1977	652	70	743	371	0	907	3959	0	0	6702
1978	520	64	799	513	0	1038	3473	0	0	6407
1979	484	87	1366	630	0	951	4724	0	1	8243
1980	518	24	1376	639	0	777	5023	0	0	8357
1981	542	31	1968	447	0	737	4729	0	0	8454
1982	460	42	2356	594	0	1002	5111	0	0	9565
1983	541	49	4428	495	0	1034	5318	0	0	11865
1984	603	35	3438	486	0	920	0	0	0	5482
1985	509	24	3535	404	0	1030	0	0	0	5502
1986	445	34	1400	289	0	1036	0	0	1	3205
1987	514	36	1574	434	0	1373	0	0	0	3931
1988	697	72	1324	349	0	1221	3404	0	0	7067
1989	443	117	1280	223	0	1232	2521	0	0	5816
1990	416	162	1103	214	0	802	0	0	4	2701
1991	491	290	1160	258	0	1249	0	0	0	3448
1992	464	218	699	217	0	1049	0	0	0	2647
1993	548	493	1016	235	0	1017	0	0	0	3309
1994	397	626	1307	133	0	1398	0	0	0	3861
1995	410	0	1306	155	1	1993	0	0	0	3865
1996	527	718	1484	177	0	1928	0	0	0	4834
1997	507	945	1399	124	0	2284	0	0	0	5259
1998	757	796	1024	126	0	2085	7971	0	0	12759
1999	802	758	1101	0	0	1964	8651	0	0	13276
2000	684	892	785	124	0	1534	6527	49	0	10595
2001	575	878	839	206	0	1368	5886	47	0	9799
2002	516	582	1126	228	0	1224	4951	51	0	8678
2003	396	642	1580	154	0	1204	4955	77	0	9008
2004	382	767	1136	121	0	1158	4989	55	0	8608
2005	372	1105	1128	121	0	1193	5352	131	0	9402
2006	369	1149	949	130	0	1415	5071	107	0	9190
2007	436	526	634	195	0	1212	6313	118	0	9434
2008	371	375	670	161	0	847	5544	61	0	8029
2009	349	262	489	196	0	648	4588	29	0	6561
2010	337	365	523	178	0	724	5097	16	0	7240
2011	243	312	622	149	0	645	4808	29	0	6808
2012	446	252	421	126	0	665	4130	41	0	6019

Table 6.4.4.2 Continued

Landings IIIa

YEAR	BEL	DEU	DNK	FRA	NLD	NOR	SWE	Total
1950	0	34	1253	0	0	0	0	1287
1951	0	17	1315	0	0	0	0	1332
1952	0	21	1273	0	0	0	0	1294
1953	0	9	1114	0	0	0	0	1123
1954	0	4	1233	0	0	0	0	1237
1955	0	3	1254	0	0	0	0	1257
1956	0	5	1462	0	0	0	614	2081
1957	0	5	2025	0	0	0	694	2724
1958	0	4	1578	0	0	0	628	2210
1959	0	2	1307	0	0	0	634	1943
1960	0	1	1313	0	0	0	0	1314
1961	0	0	1367	0	0	0	0	1367
1962	0	2	1681	0	0	0	0	1683
1963	0	0	1565	0	0	0	0	1565
1964	0	1	1574	0	0	0	0	1575
1965	0	1	2051	0	0	0	0	2052
1966	0	0	1755	0	0	0	0	1755
1967	0	0	1115	0	0	0	0	1115
1968	0	0	1535	13	0	0	0	1548
1969	0	0	1430	0	0	0	0	1430
1970	0	0	1079	0	0	0	0	1079
1971	0	0	1242	0	0	0	0	1242
1972	0	0	1669	0	0	0	0	1669
1973	0	0	1449	0	0	0	0	1449
1974	0	0	2003	0	0	0	0	2003
1975	0	0	1959	0	2	0	88	2049
1976	10	0	1493	0	80	0	0	1583
1977	11	0	2105	0	142	0	60	2318
1978	2	0	2515	0	39	0	74	2630
1979	3	0	2616	0	15	0	82	2716
1980	3	0	2218	0	3	0	109	2333
1981	0	0	2574	0	5	0	100	2679
1982	1	0	2823	0	22	0	56	2902
1983	1	0	2759	0	34	0	112	2906
1984	0	0	2695	0	0	0	74	2769
1985	1	0	1486	0	0	0	58	1545
1986	5	0	1551	0	0	0	52	1608
1987	19	0	2182	0	0	0	57	2258
1988	13	0	2150	0	15	0	76	2254
1989	4	0	2302	0	0	0	40	2346
1990	3	0	1535	0	0	0	36	1574
1991	5	1	1556	0	0	0	47	1609
1992	10	0	1412	0	0	0	32	1454
1993	7	0	1656	0	0	0	32	1695
1994	9	0	1917	0	0	0	35	1961
1995	3	0	1482	0	0	0	45	1530
1996	0	0	1387	0	0	0	18	1405
1997	0	0	990	0	0	0	22	1012
1998	0	0	942	0	0	0	19	961
1999	0	0	661	0	0	0	12	673
2000	0	0	647	0	0	1	6	654
2001	0	0	751	0	0	7	7	765
2002	0	0	968	0	0	3	6	977
2003	0	0	674	0	173	14	4	865
2004	0	0	637	0	138	1	3	779
2005	0	0	738	0	95	0	3	836
2006	0	20	566	0	117	18	4	725
2007	0	9	547	0	126	3	9	694
2008	0	12	475	0	26	2	7	522
2009	0	4	478	0	3	1	12	498
2010	0	4	426	0	151	0	8	589
2011	0	10	517	0	0	11	7	545
2012	0	5	633	0	0	10	6	654

Table 6.4.4.3 Dab in Subarea IV and Division IIIa. Abundance indices (number/hour) IBTS Q1 in Subarea IV and BITS Q1 in Division IIIa (Kattegat).

Year	IBTS_q1 IV	BITS_q1 IIIa
1966	45.6	
1967	68.7	
1968	134.6	
1969	168.3	
1970	267.4	
1971	133.3	
1972	52.7	
1973	239.0	
1974	333.1	
1975	262.4	
1976	837.0	
1977	242.2	
1978	242.6	
1979	91.4	
1980	159.7	
1981	247.3	
1982	79.2	
1983	255.4	
1984	272.5	
1985	287.6	
1986	380.0	
1987	559.5	
1988	535.0	
1989	739.7	
1990	773.7	
1991	528.2	
1992	749.1	708.0
1993	712.5	1342.5
1994	482.1	682.0
1995	677.4	157.0
1996	439.6	711.7
1997	458.9	310.2
1998	453.7	994.6
1999	446.3	767.8
2000	429.2	2689.6
2001	421.9	846.5
2002	618.5	949.3
2003	587.9	1393.1
2004	610.7	1283.5
2005	468.2	1621.0
2006	535.7	1329.4
2007	661.0	2098.4
2008	647.5	1374.2
2009	514.9	1576.2
2010	759.3	2112.7
2011	476.1	1890.9
2012	578.8	1584.7

ECOREGION North Sea
STOCK Flounder in Division IIIa and Subarea IV

Advice for 2014 and 2015

Based on the ICES approach for data limited stocks, ICES advises that landings should be no more than 3160 tonnes. Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Stock status

F (Fishing Mortality)		
	2010 - 2012	
Qualitative evaluation	?	Insufficient information
TSB (Total Stock Biomass)		
	2005 – 2012	
Qualitative evaluation	↗	Increase in the main area

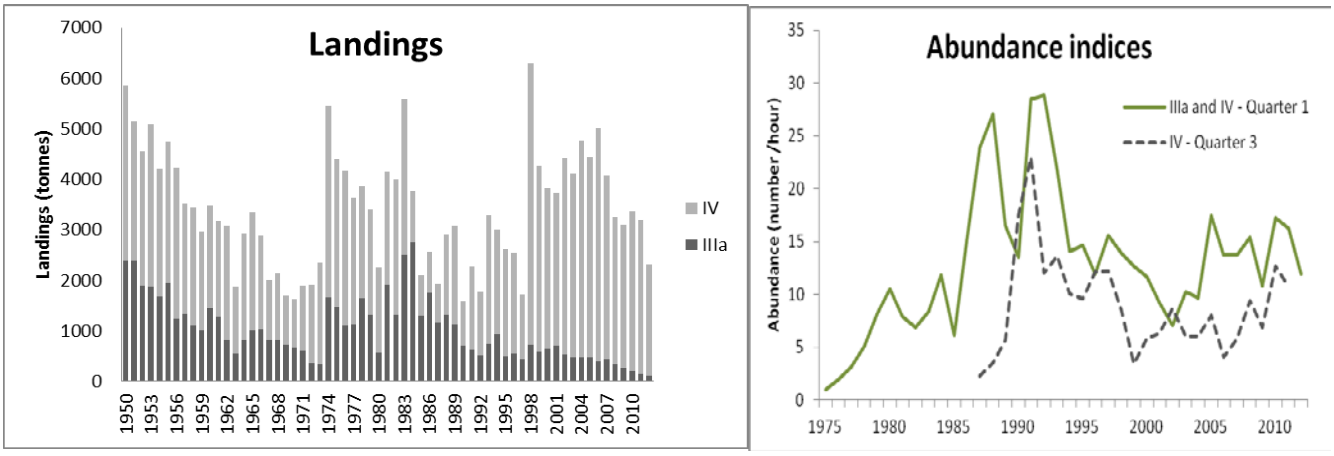


Figure 6.4.5.1 Flounder in Division IIIa and Subarea IV. Left: Official landings by area (in tonnes). Between 1984 and 1997 Dutch landings were not recorded. Right: Abundance indices (number caught per hour) for Division IIIa and Subarea IV,(from IBTS_Q1, excluding roundfish area's 1 and 2) and for Subarea IV (from BTS_Q3).

The available survey information indicates stable stock abundance since the mid nineties. Landings are declining, with the lowest landings for IIIa in 2012. Landing data are not indicative for catches since discard rates are variable. The stock size indicator (number/hour) for the whole area in the last three years (2010–2012) is 7% higher than the average of the five previous years (2005–2009).

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with dab (ICES, 2013a).

Biology

Flounder is a coastal species that spends part of its life cycle in brackish and freshwater habitats. There is no information on the stock identity of this species. They spawn offshore in deeper water of higher salinity, between February and April. After spawning they migrate to inshore and sometimes brackish waters. The shallow coastal zone and in particular the Wadden Sea are important nursery areas. Density in Division IIIa is much higher than Subarea IV. The species feeds on a wide variety of invertebrates and in some areas on fish.

The fisheries

Flounder is a bycatch in the fishery for flatfish and demersal species, mainly in the beam trawl fisheries. Discard rates can vary considerably, depending on the availability of target species and market price.

Quality considerations

Landings data are not complete, and are probably not indicative of catches. Discards should be estimated and added to the landings. The mixed TAC with dab reduces the accuracy of catch statistics per species. International sampling effort for this species is at a very low level as only the Netherlands is collecting data. An increase in sampling intensity should be considered.

The advice is based on an abundance index used as an indicator of stock size. The uncertainty associated with the index values is not available. 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 based assessment (Data limited stock approach category 3.2.0)
Input data	Commercial catches (international landings), one survey index (IBTS Q1,excluding roundfish area's 1 and 2)
Discards and bycatch	Discards are not included in the assessment but considered variable. Some monitoring data available.
Indicators	Survey index (BTS isis Q3)
Other information	2011 was the first year ICES reported on this species in this area
Working group report	WGNEW/WGNSSK (ICES, 2013b, 2013c)

ECOREGION North Sea
STOCK Flounder in Division IIIa and Subarea IV

Reference points

No reference points have been defined.

Outlook for 2014 and 2015

No analytic assessment can be presented. The main cause of this is lack of data (exact catches and biological survey results). Therefore, fishing possibilities cannot be projected.

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 three most recent index values with the five preceding values, combined with recent landings data. Knowledge about the exploitation status also influences the advised catch.

The stock size indicator (number/hour, based on the Q1 survey of the whole area) in the last three years (2010–2012) is 7 % higher than the average of the five previous years (2005–2009). This implies an increase of landings of at most 7 % in relation to the last three years average landings, corresponding to landings of no more than 3160 tonnes.

Even though exploitation status is unknown, the effort of the main fleet with flounder bycatches (beam trawls) in the North Sea and Skagerrak has declined almost 50% between 2002 and 2012. Therefore no additional precautionary reduction of catches is needed.

Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Additional considerations

Flounder is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

For flounder in the North Sea, only the Netherlands collect biological data from the landings and discards. To be able to assess the age composition across the stock, an increase in sampling intensity should be considered. In addition, discard data should be compiled for all relevant countries.

Comparison with previous assessment and advice

Last year’s advice was the same as the previous year and based on precautionary considerations. This year, the basis for the advice is the ICES approach to data limited stocks.

Sources

ICES.2013a. Dab in Division IIIa, and Subarea IV, V and VII, Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.4.28.
ICES. 2013b. Report of the Working Group on Assessment of New MoU Species (WGNEW) 18–22 March ICES HQ, Denmark, ICES CM 2013/ACOM:21.
ICES. 2013c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/ACOM:13

Table 6.4.5.1 Flounder in Division IIIa and Subarea IV. ICES advice, management and official landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1)] dab & flounder	Official landings dab & flounder	Official landings Flounder
2006		-	17.100	14.922	5.007
2007		-	17.100	14.195	4.067
2008		-	18.810	11.792	3.241
2009		-	18.810	10.148	3.089
2010		-	18.810	11.193	3.364
2011		-	18.434	10.544	3.191
2012	No increase in catch	-	18.434	8.978	2.305
2013	No new advice, same as for 2012	-	18.434		
2014	No more than 7% increase in landings	< 3.16			
2015	No new advice, same as for 2014	< 3.16			

Weights in thousand tonnes.

1) EU combined TAC for dab and flounder in EU areas IIIa and IV.

Table 6.4.5.2 Flounder in Division IIIa and Subarea IV. Official landings per area (in tonnes).

year	IIIa	IV		year	IIIa	IV
1950	2381	3467		1982	1311	2689
1951	2395	2748		1983	2512	3069
1952	1892	2656		1984	2746	1030
1953	1876	3220		1985	1305	793
1954	1679	2536		1986	1751	814
1955	1943	2810		1987	1169	754
1956	1235	2999		1988	1313	1598
1957	1343	2178		1989	1129	1951
1958	1111	2322		1990	708	881
1959	1006	1956		1991	624	1659
1960	1451	2026		1992	507	1276
1961	1272	1907		1993	743	2545
1962	815	2268		1994	943	2063
1963	554	1312		1995	498	2125
1964	823	2093		1996	542	2005
1965	1016	2324		1997	437	1290
1966	1027	1853		1998	725	5560
1967	814	1189		1999	588	3672
1968	810	1325		2000	656	3165
1969	721	988		2001	705	3022
1970	667	963		2002	524	3890
1971	612	1285		2003	473	3637
1972	365	1548		2004	478	4294
1973	346	2002		2005	482	3946
1974	1658	3790		2006	393	4614
1975	1467	2939		2007	445	3622
1976	1099	3079		2008	346	2895
1977	1119	2505		2009	273	2816
1978	1648	2211		2010	205	3159
1979	1319	2077		2011	145	3046
1980	561	1698		2012	118	2187
1981	1905	2248				

Table 6.4.5.3 Flounder in Division IIIa and Subarea IV. Average numbers per hour of catches in the European Flounder in IBTS Q1 survey. In area IV the roundfish area's 1 and 2 were excluded.

Year	IBTS Q1 IV & IIIa	IBTS Q1 IV	IBTS Q1IIIa	BTS-isis Q3
1975	0.98	1.06	0.44	NA
1976	1.90	2.09	1.08	NA
1977	3.13	1.09	15.75	NA
1978	5.09	0.73	25.64	NA
1979	8.10	0.33	49.33	NA
1980	10.55	1.56	58.71	NA
1981	7.94	2.53	33.86	NA
1982	6.86	1.39	42.40	NA
1983	8.36	3.67	35.54	NA
1984	11.81	2.06	67.69	NA
1985	6.12	1.79	33.59	NA
1986	15.03	1.78	89.54	NA
1987	23.91	4.34	130.37	2.29
1988	27.08	3.93	162.64	3.53
1989	16.56	5.06	76.91	5.67
1990	13.56	2.55	70.63	17.54
1991	28.47	3.74	152.07	22.94
1992	28.88	4.63	138.00	12.00
1993	21.73	1.77	118.2	13.63
1994	14.11	1.78	74.35	10.06
1995	14.67	2.69	69.88	9.65
1996	11.92	1.76	62.73	12.17
1997	15.58	2.42	77.71	12.26
1998	13.94	2.03	74.21	8.44
1999	12.67	0.68	74.03	3.42
2000	11.63	1.81	63.04	5.89
2001	9.27	1.02	52.96	6.37
2002	7.06	2.36	31.11	8.66
2003	10.27	2.04	53.85	6.04
2004	9.73	0.77	57.18	6.04
2005	17.49	1.83	101.36	8.05
2006	13.68	1.37	78.15	4.06
2007	13.76	2.45	74.95	5.82
2008	15.38	2.28	85.48	9.39
2009	10.82	1.97	58.15	6.93
2010	17.31	1.21	104.43	12.65
2011	16.19	1.25	97.07	10.73
2012	11.96	4.41	52.35	NA

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

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *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.*

Source

ICES. 2012. Grey gurnard in Subarea IV (North Sea) and Divisions VIId (Eastern Channel) and IIIa (Skagerrak–Kattegat). *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.33.

Table 6.4.6.1 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
2012	No increase in catch	-	0.6 [1)]
2013	No increase in catch	-	
2014	Same catch advice as for 2013	-	

Weights in thousand tonnes.
[1)]Preliminary.

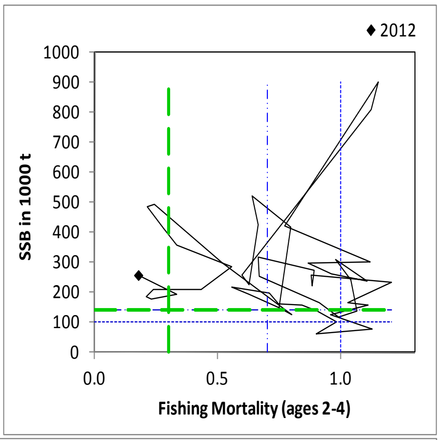
ECOREGION North Sea
STOCK Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak)

Advice for 2014

ICES advises on the basis of the EU–Norway management plan that the TAC (Human Consumption landings) should be no more than 40 639 tonnes in 2014. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010–2012), this implies catches of no more than 45 318 tonnes.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✓	✗	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✗	✓	Below target
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above trigger



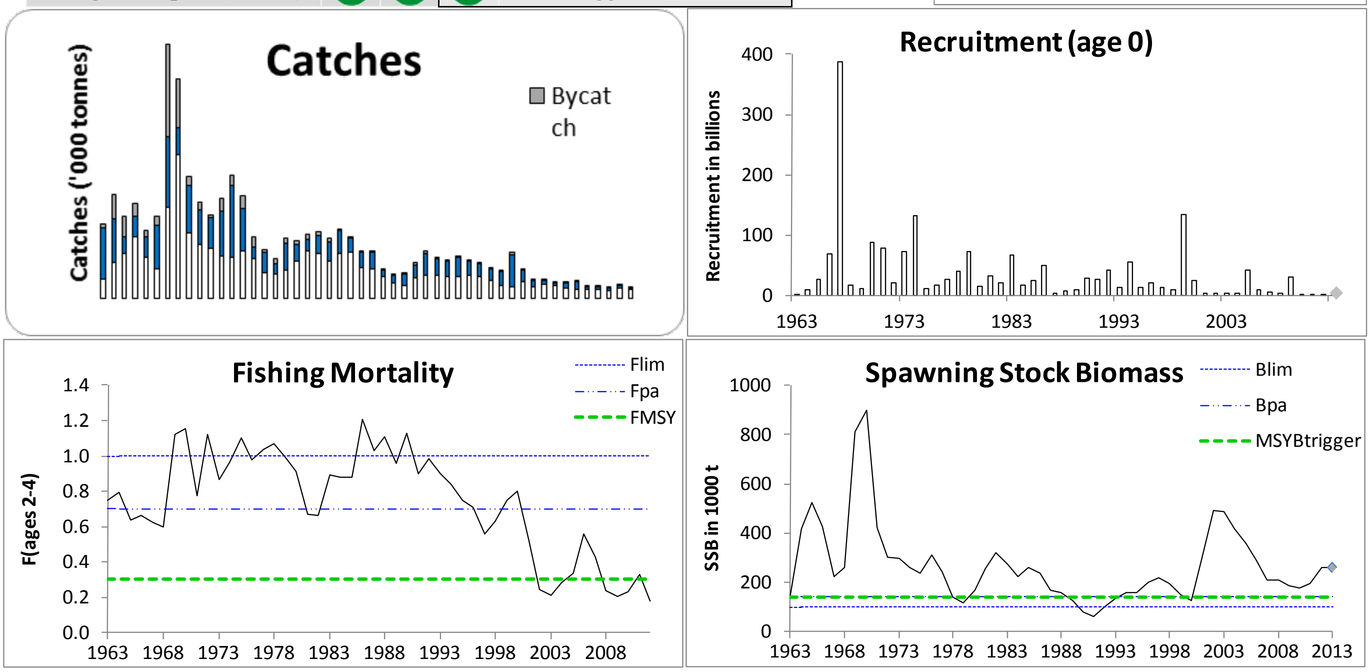


Figure 6.4.7.1 Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak). Summary of stock assessment (weights in thousand tonnes), Estimates are shaded. Top right: SSB and F over the time-series used in the assessment.

Fishing mortality has been below F_{pa} and around the F_{MSY} proxy 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 6.4.7). 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 a lower maximum size (possibly due to faster maturation). There are indications that parental stock size has little effect on subsequent haddock recruitment success, which is principally determined by the environment.

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.

Catch by fleet	Total catch (2012) was 37.4 kt, where 88% were landings (of which 80% demersal trawl and seine >100 mm, 6% trawl 70–99 mm, and 14% others), 12% discards, and <0.5% 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. Reduced benthic biomass is found in areas of bottom trawl activity compared to unfished areas. Since 2001, effort reductions in this fishery have likely led to decreased bycatches.

Quality considerations

The overall reporting (in particular through the fully documented fisheries (FDF) programme) of catch data provided to ICES is likely to have improved in 2012 and 2013. The assessment shows strong consistency across the years.

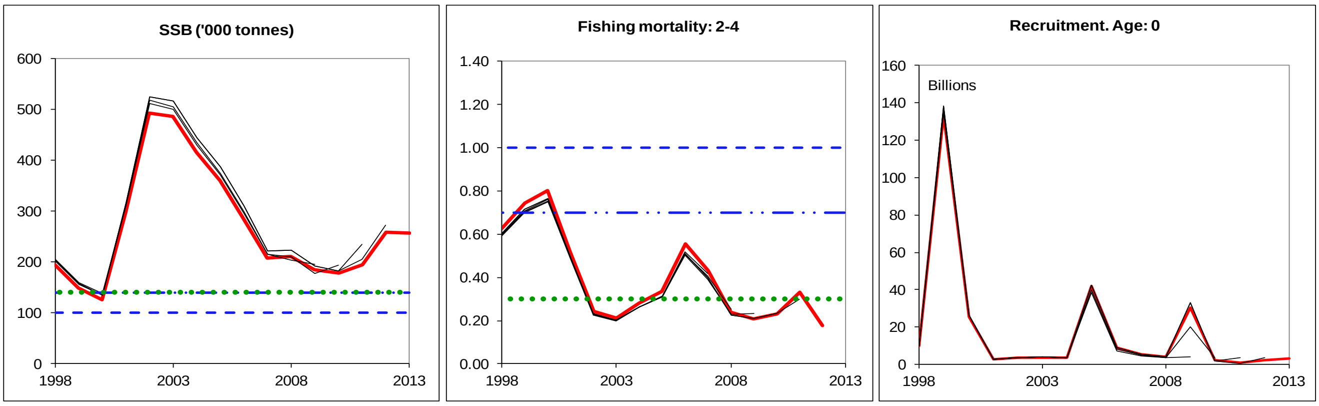


Figure 6.4.7.2 Haddock in Subarea IV (North Sea) and Division IIIa West (Skagerrak). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Commercial catches (international landings, ages from catch sampling), three survey indices: IBTS Q1, ScoGFS Q3, EngGFS Q3. (ScoGFS Q3 and EngGFS Q3 are split into two time-periods). Maturity data and natural mortality assumed fixed over time.
Discards and bycatch	Discards (observations available since 1978) and industrial bycatch are included in the assessment.
Indicators	None.
Other information	Last benchmarked in 2011 (WKBENCH 2011). To be benchmarked (along with Division VIa haddock) in early 2014.
Working group report	WGNSSK (ICES, 2013a)

6.4.7 Supporting information June 2013

ECOREGION **North Sea**

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

Reference points

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

(unchanged since: 2011)

Outlook for 2014

Basis: F (2013) = average (2010–2012), scaled to 2012 = 0.1756; SSB (2014) = 242.848; Human consumption landings (2013) = 38.693; Discards (2013) = 3.037; Industrial bycatch (2013) = 0.068; Recruitment (2013) = trimmed GM = 3103.226 million.

Rationale	**Total catch 2014**	**Human consumption Landings 2014**	**Discards 2014**	**IBC 2014**	**Basis**	**Total F 2014**	**F(landings) 2014**	**F(disc) 2014**	**F(IBC) 2014**	**SSB 2015**	**% SSB change [1)]**	**% TAC change [2)]**
Management plan	45.318	40.639	4.581	0.098	15% TAC decrease (F_{2013}*1.71)	0.332	0.226	0.106	0.0003	200	-22%	-15%
MSY approach	41.418	37.146	4.174	0.098	F_{MSY} (F_{2013}*1.70)	0.300	0.204	0.096	0.0003	204	-21%	-22%
Precautionary approach	95.538	85.775	9.670	0.093	Fpa (F_{2013}*3.98)	0.700	0.476	0.223	0.0003	145	-44%	80%
IBC only	0.102	0.000	0.000	0.102	F = 0	0.000	0.000	0.000	0.0003	249	-3%	-100%
Other options	19.296	17.286	1.910	0.100	0.75 * F_{2013}	0.132	0.090	0.042	0.0003	228	-11%	-64%
	25.315	22.697	2.518	0.100	F_{2013}	0.176	0.119	0.056	0.0003	222	-14%	-53%
	61.263	54.982	6.185	0.096	15% TAC increase	0.446	0.303	0.142	0.0003	182	-29%	15%
	53.281	47.810	5.374	0.097	Rollover TAC (F_{2013}*1.93)	0.386	0.263	0.123	0.0003	191	-26%	0%
	31.148	27.935	3.114	0.099	1.25 * F_{2013}	0.219	0.149	0.070	0.0003	215	-16%	-42%
Mixed-fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b)												
Maximum	54.133	49.366	4.768	-	A	0.42	-	-	-	185.550	-24%	+3%
Minimum	14.634	13.390	1.244	-	B	0.1	-	-	-	227.893	-6%	-72%
Cod MP	14.891	13.625	1.266	-	C	0.1	-	-	-	227.615	-6%	-72%
SQ effort	28.730	26.258	2.472	-	D	0.2	-	-	-	212.663	-12%	-45%
Effort_Mgt	10.648	9.746	0.902	-	E	0.07	-	-	-	232.223	-4%	-80%

Weights in thousand tonnes.
Under the assumption that effort is linearly related to fishing mortality.
[1)] SSB 2015 relative to SSB 2014.
[2)] Human Consumption 2014 relative to TACs 2013 (TAC for IV + IIIa = 47 810 t).
Mixed-fisheries assumptions:
Maximum scenario: Fleets stop fishing when the last quota is exhausted.
Minimum scenario: Fleets stop fishing when the first quota is exhausted.
Cod management plan scenario: Fleets stop fishing when the cod quota is exhausted.
SQ effort scenario: Effort in 2012 and 2013 as in 2011.
Effort management scenario: Effort reductions according to cod and flatfish management plans.

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 agreed management plan implies fishing at the target rate of 0.3, which results in a TAC (Human Consumption landings) reduction of more than 15%. Therefore, the maximum TAC reduction of 15% is applied, resulting in human consumption landings of no more than 40 639 t in 2014. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010–2012), this implies catches of no more than 45 318 t.

This advice implies a reduction in TAC (15%) and increase in F (71%) which is due to the absence of young fish recruiting to the population, and hence a predicted decline in spawning-stock biomass. The possibility of extended periods of low recruitment was accounted for in the 2008 evaluation of the management plan that was deemed to be sustainable.

MSY approach

Following the ICES MSY approach implies fishing mortality to be increased to 0.3, resulting in a TAC (Human Consumption landings) of no more than 37 146 t in 2014. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010–2012), this implies catches of no more than 41 418 t. This is expected to lead to an SSB of 204 000 t in 2015.

Precautionary approach

The fishing mortality in 2014 should be no more than F_{pa}, corresponding to human consumption landings of 85 775 t in 2014. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010–2012), this implies catches of no more than 95 538 t, This is expected to keep SSB just above B_{pa} in 2015.

Mixed fisheries

In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings 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 2014. In all scenarios except the 'max', 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. Discard rates in 2012 are the lowest observed in the time series and appear to be linked to low recruitment.

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 2013.

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 < Blim 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 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. However, for 2013, the European Council decided upon a roll-over of effort level of 2012 into 2013 for both the cod and the sole/plaice management plan.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill/trammel nets and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, -16% between 2008 and 2012). 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 and in small mesh beam trawl (80–120 mm, BT2), has shown a pronounced decline (−14%, −45%, and −48%, respectively, between 2004 and 2012). Gill and trammel nets fisheries have remained stable (ICES, 2013b). Effort in large mesh size beam trawl (>=120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline. Nominal effort reported by Norway has increased since 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 (real-time closures and technical measures). 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, while there were 173 in 2012. The effects of this regulation on the behaviour of the fleet and on the haddock stock have been investigated, but do not show a consistent pattern.

Changes in fishing technology and fishing patterns

The expansion of the closed-circuit TV (CCTV) and fully documented fisheries (FDF) programmes in 2010–2013 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. The uptake of Scottish haddock quota in 2012 was very close to 100%, which contrasts with historical under-utilisation of the quota and supports the hypothesis of increased targeting in combination with a quota that was predicted to be restrictive.

Information from the fishing industry

The 2012 report of the North Sea Stock Survey (Napier, 2012) shows the industry's perception of increasing haddock abundance in all areas of the North Sea in 2012. This does not concur with the stock assessment perception up to 2009. In the last three years both the stock assessment and industry perception 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 (potentially) faster maturation and hence a lower maximum size. Water temperature in the North Sea has increased and Wright et al. (2011) also 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 (Marine Scotland, unpublished) has indicated that haddock recruitment is only weakly linked to spawning-stock biomass, being more obviously determined by ecosystem factors.

Revisions in data and methodologies

The approach used to collate discard data has changed to conform to 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.

Prior to 1977 there were few discard observations, therefore discard estimates used in the assessment come from a statistical model. Since 1978, observed discards are used in the assessment. Discard estimates for 2012 derived from sampling by the main countries fishing 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 suspected to be sensitive to the choice of assessment model. However, the current model generates a consistent time-series on which the management plan is based. The management plan was evaluated in 2008 and 2009 on this basis and was deemed to be sustainable.

Comparison with previous assessment and advice

There is close agreement between the assessments in 2012 and 2013.

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 IIIaW (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

Baudron, A. R., Needle, C. L. and Marshall, C. T. 2011. Implications of a warming North Sea for the growth of haddock *Melanogrammus aeglefinus*. Journal of Fish Biology, 78(7): 1874–1889. doi:10.1111/j.1095-8649.2011.02940.x.

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Napier, I. R. 2012. Fishers' North Sea stock survey 2012. NAFC Marine Centre, Shetland, Scotland.

Wright, P. J., Gibb, F. M., Gibb, I. M., and Millar, C. P. 2011. Reproductive investment in the North Sea haddock: temporal and spatial variation. Marine Ecology Progress Series, 432: 149–160.

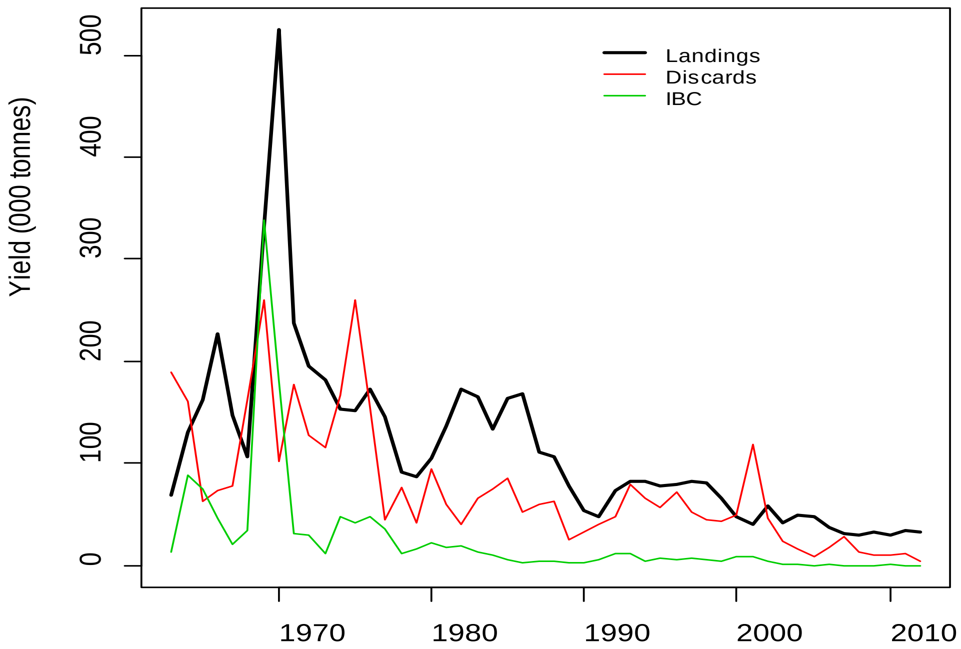
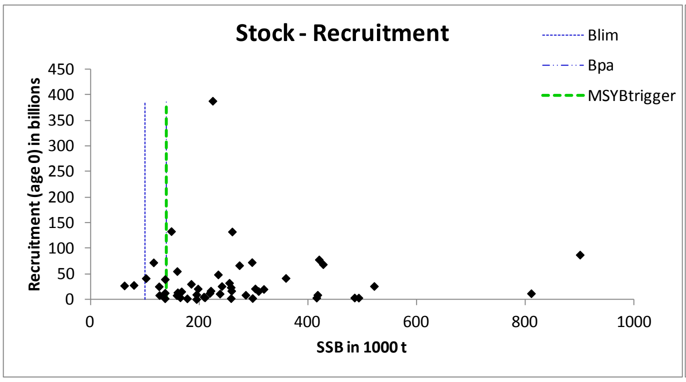


Figure 6.4.7.3 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Catch components (in thousand tonnes) subdivided by landings, discards, and industrial bycatches (IBC).



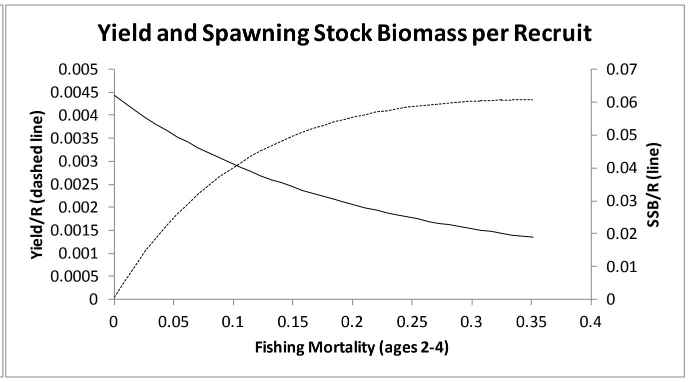


Figure 6.4.7.4 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Stock–recruitment (left) and yield-per-recruit plot (right).

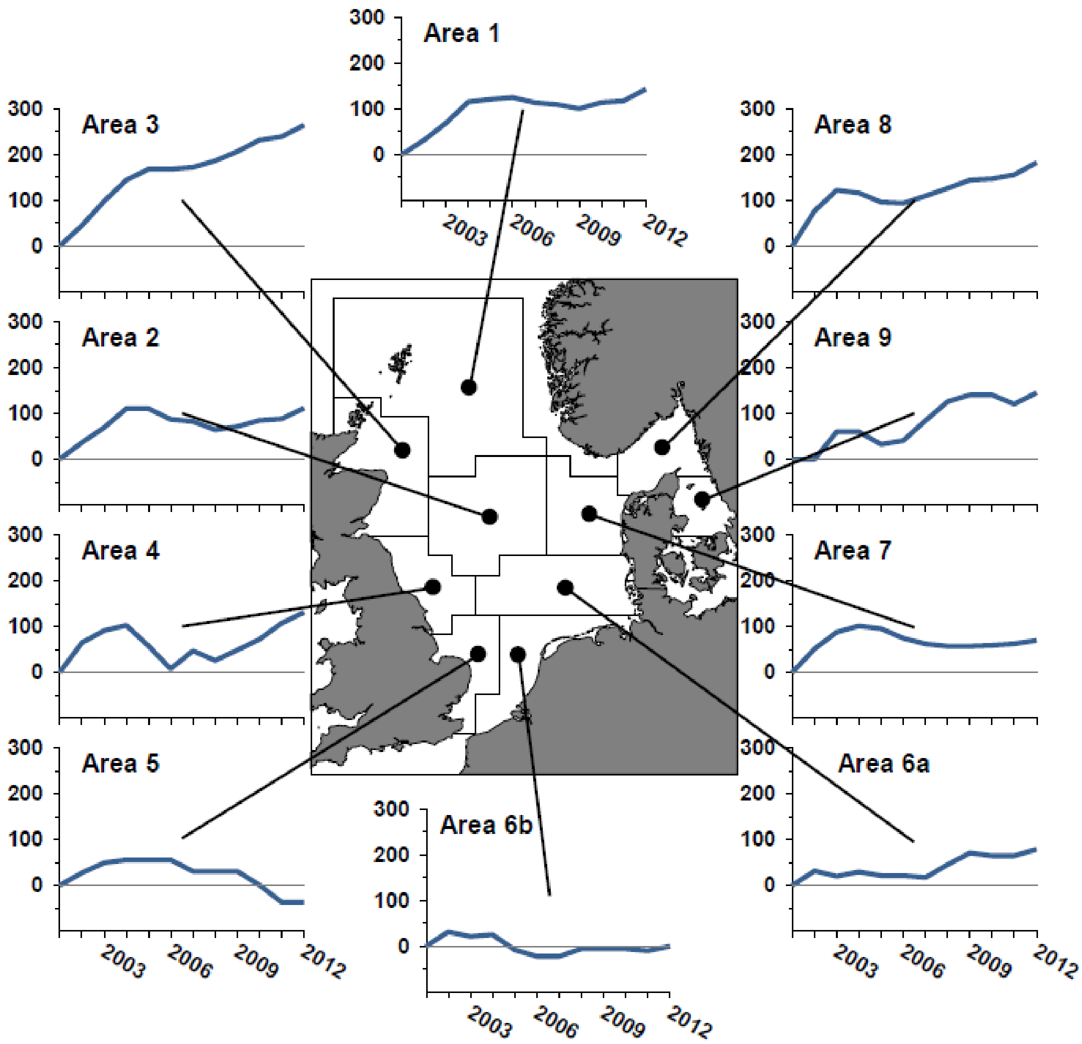


Figure 6.4.7.5 Haddock in Subarea IV and Division IIIa. Results of the 2012 North Sea Stock Survey abundance index (Napier, 2012). Each plot presents a summary of the responses by North Sea roundfish reporting area.

Table 6.4.7.1 Haddock in **Subarea IV (North Sea)**. ICES advice, management, and catch. . The landings in Subarea IV are calculated as 94% of the combined area total.

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	30	30	4	1	35
2013	Apply management plan	47.811 [1-2]	45.041					
2014	Apply management plan	38.201 [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 6.4.7.2 Haddock in **Division IIIaW (Skagerrak)**. ICES advice, management, and landings. The landings in Division IIIa are calculated as 6% of the combined area total.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	Official Landings	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	-	2.095	2.5	2.6	0.7	0	3.3
2013	Apply management plan North Sea	-	2.77					
2014	Apply management plan North Sea	2.438						

Weights in thousand tonnes.
n/a = not available.

Table 6.4.7.3 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	2012
Belgium	III a	0	0	0	0	0	0	0	0	0	0	0
Denmark	III a	3791	1741	1116	615	1001	1054	1052	1263	1139	1648	1916
Germany	III a	239	113	69	69	186	206	87	105	65	102	117
Netherlands	III a	0	6	1	0	0	0	0	0	1	0	0
Norway	III a	149	211	154	93	113	152	170	121	125	125	239
Portugal	III a	0	0	0	0	30	37	0	0	0	0	0
Sweden	III a	393	165	158	180	246	278	276	166	126	198	209
UK -E+W+NI	III a	0	0	0	0	0	0	0	0	0	0	0
UK - Scot	III a	0	0	0	0	0	0	0	0	0	0	0
Official landings	III a	4572	2236	1498	957	1576	1727	1585	1655	1456	1841	2481
ICES landings	III a	4137	1808	1443	764	1537	1515	1374	1515	1287	9850	2620
ICES discards	III a		195	112	217	970	816	646	556	608	1744	730
ICES total catch	III a	4137	2003	1555	981	2507	2332	2020	2072	1896	11595	3350
TAC	III a	6300	3150	4940	4018	3189	3360	2856	2590	2201	2095	2770
Belgium	IV	559	374	373	190	105	179	113	108	78	105	79
Denmark	IV	5123	3035	2075	1274	759	645	501	553	725	698	947
Faeroe Islands	IV	25	12	22	22	4	0	3	32	5	0	0
France	IV	914	1108	552	439	444	498	448	125	277	237	175
Germany	IV	852	1562	1241	733	725	727	393	657	634	575	512
Netherlands	IV	359	187	104	64	33	55	29	24	41	72	191
Norway	IV	2404	2196	2258	2089	1798	1706	1482	1278	1119	1188	1033
Poland	IV	17	16	0	0	8	8	16	0	0	0	0
Portugal	IV	0	0	0	0	76	0	0	0	0	0	0
Sweden	IV	572	477	188	135	100	130	83	141	90	128	103
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	27341
Official landings	IV	54096	42055	47311	30916	36442	30666	30433	31311	27953	25651	30381
ICES landings	IV	54171	40140	47253	47616	36074	29418	28893	31264	27770	26275	30348
ICES discards	IV	45892	23499	15439	8416	16943	27805	12532	9986	9515	10249	3738
ICES IBC	IV	3717	1150	554	168	535	48	199	52	431	23	0.039
ICES total catch	IV	103780	64788	63246	56200	53551	57271	41624	41302	37717	36547	34086
TAC	IV	104000	51735	77000	66000	51850	54640	46444	42110	35794	34057	45040
ICES landings	IV & IIIa	58308	41948	48697	48380	37611	30934	30267	32779	29058	36125	33059
ICES discards	IV & IIIa	45892	23694	15550	8633	17913	28621	13178	10543	10124	11993	4501
ICES IBC	IV & IIIa	3717	1150	554	168	535	48	199	52	431	23	1
ICES total catch	IV & IIIa	107917	66792	64800	57181	56058	59603	43644	43374	39612	48141	37561
TAC	IV & IIIa	110300	54885	81940	70018	55039	58000	49300	44700	37995	36152	41575
ICES quota uptake		53%	76%	59%	69%	68%	53%	61%	73%	76%	100%	80%

Table 6.4.7.4 Haddock in Subarea IV (North Sea) and Division IIIaW (Skagerrak). Summary of stock assessment.

	Recruitment	TSB	SSB	Catch	Landings	Discards	Bycatch	Yield/SSB	Mean F(2-4)
1963	2314960	3412683	137050	271851	68821	189330	13700	0.502	0.745
1964	9155373	1281817	417713	379915	131006	160309	88600	0.314	0.794
1965	26286878	1080997	521738	299343	162418	62325	74600	0.311	0.639
1966	68923101	1480495	427838	346349	226184	73465	46700	0.529	0.662
1967	388349879	5527432	224790	246664	147742	78222	20700	0.657	0.626
1968	17114655	6851991	259396	301821	105811	161810	34200	0.408	0.597
1969	12133703	2477668	810542	930043	331625	260065	338353	0.409	1.121
1970	87603165	2541724	900215	805776	524773	101274	179729	0.583	1.152
1971	78183136	2546129	420392	446824	237502	177776	31546	0.565	0.773
1972	21423632	2181798	302958	353084	195545	127954	29585	0.645	1.119
1973	72899283	4085944	297087	307594	181592	114735	11267	0.611	0.867
1974	132782108	4708422	260633	366992	153057	166429	47505	0.587	0.963
1975	11403696	2383875	238058	453205	151349	260370	41487	0.636	1.104
1976	16381746	1096449	309033	375305	172680	154462	48163	0.559	0.976
1977	26150710	1066970	241589	224516	145118	44376	35022	0.601	1.039
1978	39744556	1134862	137248	179375	91683	76789	10903	0.668	1.066
1979	72494671	1348844	116074	145019	87069	41710	16240	0.75	0.992
1980	15762259	1466405	167440	222127	105041	94614	22472	0.627	0.91
1981	32573237	993166	255403	213240	136132	60067	17041	0.533	0.667
1982	20481167	1088498	318717	233283	173335	40564	19383	0.544	0.664
1983	66907115	2249316	273915	244212	165337	65977	12898	0.604	0.892
1984	17177582	1687290	221318	218946	133568	75298	10080	0.604	0.881
1985	23909178	1185101	258408	255366	164119	85249	5998	0.635	0.877
1986	48938701	1937034	234848	223081	168236	52203	2643	0.716	1.206
1987	4142071	1094118	165079	173852	110299	59143	4410	0.668	1.027
1988	8335950	628563	158854	173124	106973	62148	4002	0.673	1.11
1989	8599596	622238	126905	106526	78439	25677	2410	0.618	0.957
1990	28285263	1578502	79776	88934	53780	32565	2589	0.674	1.125
1991	27405410	1548619	62403	93287	47715	40185	5386	0.765	0.898
1992	41659387	1356841	102106	131650	72790	47934	10927	0.713	0.983
1993	13021649	1011378	137116	172551	82176	79609	10766	0.599	0.902
1994	55427392	1470832	159452	151020	82074	65370	3576	0.515	0.841
1995	13954774	1155066	160348	142524	77458	57371	7695	0.483	0.747
1996	21227007	1041768	197709	156609	79148	72461	5000	0.4	0.71
1997	12600705	959556	219424	141347	82574	52089	6684	0.376	0.557
1998	9874593	776833	195019	131316	81054	45160	5101	0.416	0.627
1999	133501618	3546973	148698	112021	65588	42598	3835	0.441	0.745
2000	25617352	3429716	126118	104457	47553	48770	8134	0.377	0.801
2001	2728460	1185703	298022	166960	40856	118225	7879	0.137	0.517
2002	3585892	849841	493227	107923	58348	45857	3717	0.118	0.241
2003	3749453	738293	485657	66805	41964	23691	1150	0.086	0.212
2004	3608535	735324	415791	64839	48734	15551	554	0.117	0.28
2005	42003728	2787581	359286	57162	48357	8637	168	0.135	0.334
2006	9049360	1393103	285459	56056	37613	17908	535	0.132	0.556
2007	5523197	770942	208556	59643	30939	28657	48	0.148	0.43
2008	4090983	589255	210380	43640	30248	13193	199	0.144	0.239
2009	30449019	1811890	185258	43407	32807	10548	52	0.177	0.207
2010	2173968	610507	177868	39640	29054	10155	431	0.163	0.23
2011	770959	393263	194942	46378	34840	11515	23	0.179	0.331
2012	2506199	438587	258458	37558	33052	4505	1	0.128	0.176
2013	3103226*		257701**						

* Geometric mean of the five lowest recruitment values over the period 1994–2010

** Estimated FLXSA survivors from 2012

Annex 6.4.7 EU and Norway Management plan

"The plan shall consist of the following elements:

Every effort shall be made to maintain a minimum level of Spawning Stock Biomass greater than 100,000 tonnes (Blim). 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).
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.
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.*
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.
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.
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.
No later than 31 December 2013, 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.
This arrangement enters into force on 1 January 2009."

6.4.8 **Advice May 2013**

ECOREGION **North Sea**

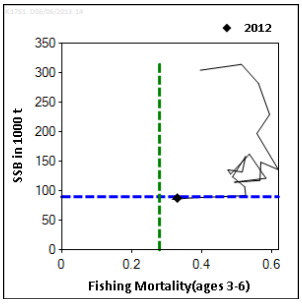
STOCK **Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners)**

Advice for 2014

ICES advises on the basis of the transition to the MSY approach that catches in 2014 should be no more than 41 602 t. All catches are assumed to be landed. This advice applies to catches of western Baltic spring spawners in Divisions IVa east and IIIa, and Subdivisions 22–24.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	✗	✗	O	Increased risk



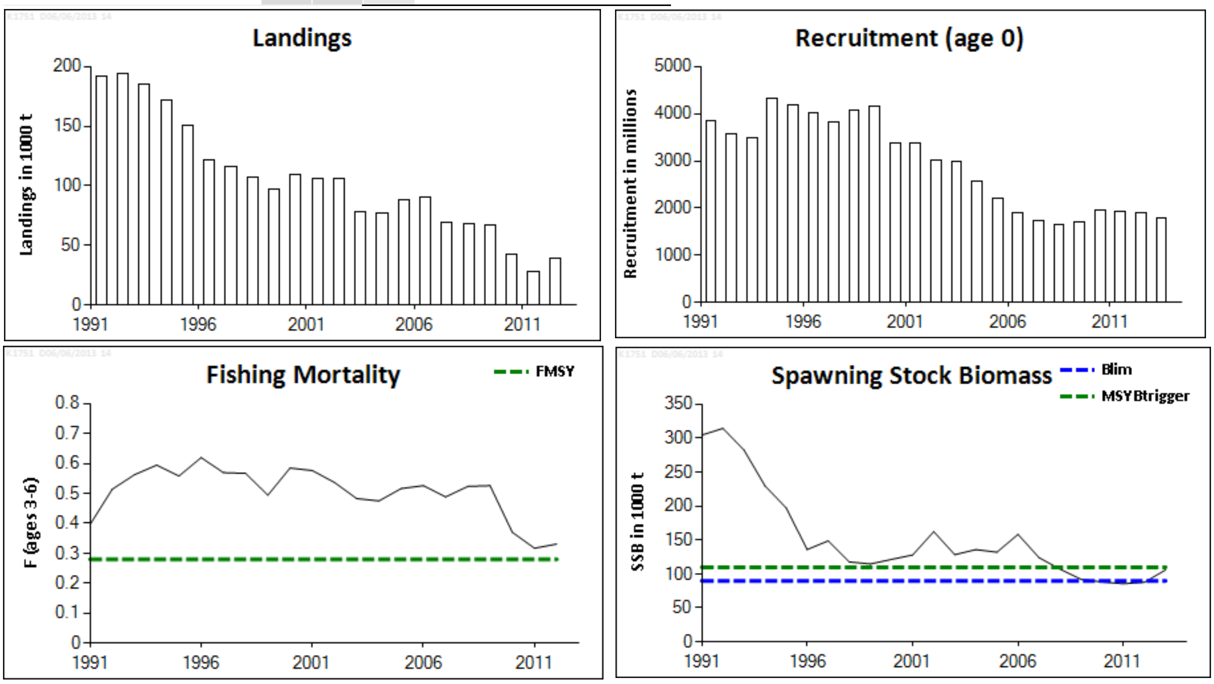


Figure 6.4.8.1 Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners). Summary of stock assessment (predicted values are shown in grey). Top right: SSB and F for the time-series used in the assessment.

SSB has decreased in recent years, reaching the lowest in the time-series in 2011 at between B_{PA} and B_{lim}. Fishing mortality has been at its lowest in the recent years, but it is still above F_{MSY} in 2012. The stock appears to remain in a low production period; however, recruitment is estimated with high uncertainty.

Management plans

No specific management objectives are known to ICES. Following the revision of the reference points, these can now be used for the development of a management plan. ICES recommends to develop such a plan. The previous evaluations were based on a different perception of stock dynamics and need to be revisited.

Biology

In the summer, herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners, WBSS) migrate in search of food from the western Baltic to the more saline waters of Division IIIa and the eastern parts of Division IVa. In these areas they mix with North Sea autumn-spawning (NSAS) herring. In recent years, mixing has also 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 reduced recruitment from 2006 to 2011 are unknown. There are no indications of systematic changes in growth or age-at-maturity, and reduced recruitment is likely due to increased mortality at the egg or larval stage. Specific research efforts are required to identify the causes of poor recruitment .

The fisheries

Misreporting by the C-fleet in Division IIIa is assumed to have stopped since 2009 due to new national regulations. Discards are considered to be low. Of the total catch, 12% are taken with passive gear (mainly gillnets), which is only used in Subdivisions 22–24. The remaining 88% are taken by active gear (mainly pelagic trawl).

Catch distribution

Area where WBSS are being caught	Fleet	Fishery	WBSS 2012 catch	NSAS 2012 catch
Division IIIa	C	Directed herring fisheries with purse-seiners and trawlers.	14 506 t	7 693 t
	D	Bycatches of herring caught in the small-mesh fisheries.	953 t	4 435 t
Subdivisions 22–24	F	All herring fisheries in Subdivisions 22–24.	21 095 t	-
Division IVa East	A	Directed herring fisheries with purse-seiners and trawlers.	2 095 t	-

Quality considerations

The assessment was benchmarked in 2013 and a full statistical assessment model (SAM) was introduced. The perception of the stock changed through this benchmarking process (Figure 6.4.8.4). The assessment is an improvement over previous assessments. Fishing mortality is reliably estimated by the assessment and has been revised upwards. The estimation of SSB over the years 1991–2011 has been revised downwards, and it is expected to be estimated more consistently following the benchmark. Recruitment is estimated with relatively high uncertainty. The inherent uncertainty in the predictions is related to the lack of a firm basis to predict the fraction of NSAS in the catches taken in Division IIIa, due to the natural variation in migration patterns of WBSS and the variation in the distribution of the fishery between years due to the optional transfer of quotas between Divisions IIIa and IV.

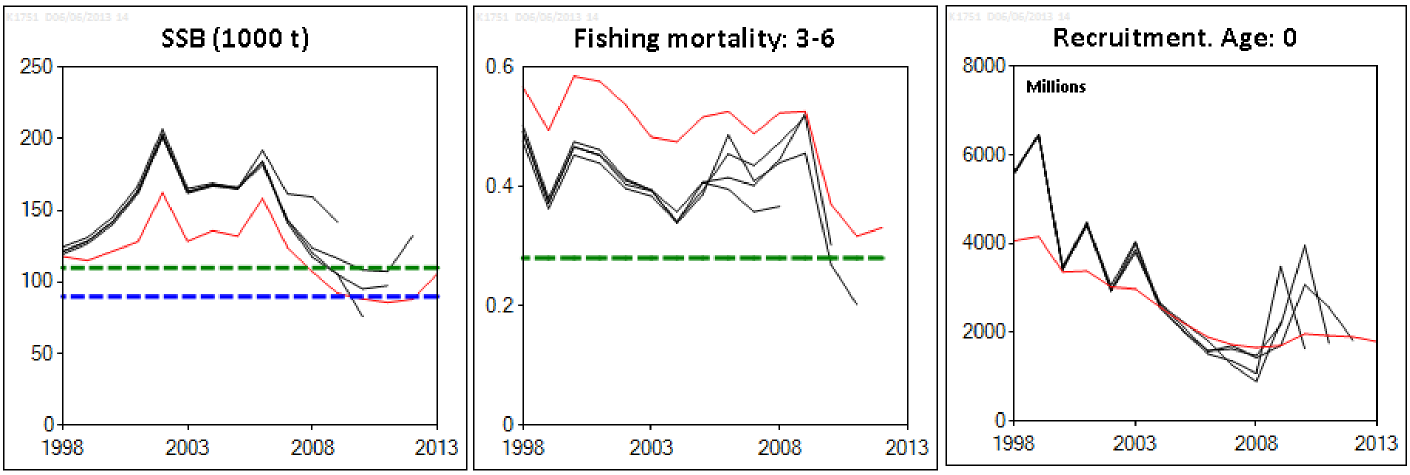


Figure 6.4.8.2 Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners). Historical assessment results (final-year recruitment estimates included). The stock was benchmarked in 2013 (red line).

Scientific Basis

Assessment type	Age-based analytical assessment (SAM).
Stock data category	Category 1
Input data	Commercial catches corrected for historical area misreporting. Otolith microstructure and morphometric methods to calculate the proportion of NSAS in the catches. Two acoustic surveys (HERAS, GERAS), two trawl surveys (IBTS Q1, IBTS Q3), and a larval survey (N20). Maturity ogive constant over time. Natural mortality constant over time. Annual stock weights from catch in Q1.
Discards and bycatch	Discards are not included in the assessment and are considered to be low.
Indicators	None.
Other information	The latest benchmark was conducted in 2013 (WKPELA; ICES, 2013b).
Expert 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.	Tentatively chosen as B_{pa}, equal to the upper 95% confidence limit of B_{lim}. Benchmark (ICES, 2013b).
	F_{MSY}	0.28	Based on randomized YPR analysis using plotMSY software, and a weighted average of F_{MSY} from i) Beverton and Holt and ii) Ricker stock–recruitment relationships. Benchmark (ICES, 2013a).
Precautionary approach	B_{lim}	90 000 t.	Chosen as B_{loss} based on lack of a well-defined recruitment slope at low SSB. Benchmark (ICES, 2013b).
	B_{pa}	110 000 t.	Upper 95% confidence limit of B_{lim} using cv from the final-year SSB estimate in the assessment. Benchmark (ICES, 2013b).
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	

(*Changed in 2013*).

Outlook for 2014

Basis (for Western Baltic spring-spawning herring, WBSS): F(2013) = 0.39 [TAC constraint with optional quota transfer]; R 2012–2014 = GM (2007–2011) = 1789 million; SSB (2013) = 106; catch (2013) = 50[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).

Catch options and results for WBSS herring only in Division IIIa, Subdivisions 22–24, and Division IVaE[1]

Rationale	Catch 2014	Basis	F 2014	22–24 Fleet F	IIIa Fleet C	IIIa Fleet D	IVaE Fleet A[2]	SSB 2014[3]	SSB 2015[3]	% SSB change[4]
MSY approach	39.321	F_{MSY}	0.28	18.614	17.760	0.853	2.095	114.022	129.175	13%
MSY transition	41.602	$0.2\ F_{2010} + 0.8\ F_{MSY}$	0.30	19.754	18.848	0.905	2.095	113.825	127.016	12%
Zero catch	0.000	F = 0	0	0.000	0.000	0.000	0.000	117.082	167.409	43%
Other options	57.632	(SSB[4] change 1%) F2013 × 1.12	0.44	27.769	26.496	1.273	2.095	112.357	113.552	1%
	67.433	(SSB[4] change −5%) F2013 × *1.36	0.53	32.669	31.172	1.497	2.095	111.386	105.400	−5%
	77.233	(SSB[4] change −12%) F2013 × 1.62	0.63	37.569	35.847	1.722	2.095	110.348	97.317	−12%

Catch options for WBSS and NSAS herring in: Division IIIa and Subdivisions 22–24[1]

Rationale	Catch 2014	Basis	22–24 Fleet F	IIIa Fleet C	IIIa Fleet D	% TAC change[5]
MSY approach	49.831	F_{MSY}	18.614	27.424	3.793	-43%
MSY transition	52.883	$0.2\ F_{2010} + 0.8\ F_{MSY}$	19.754	29.104	4.026	−40%
Zero catch	0.000	F = 0	0.000	0.000	0.000	−100%
Other options	74.340	(TAC −15%) F2013 × 1.12	27.769	40.912	5.659	−15%
	87.459	(TAC - no change) F2013 × 1.36	32.669	48.132	6.658	0%
	100.578	(TAC +15%) F2013 × 1.62	37.569	55.352	7.656	15%

Weights in thousand tonnes.

[a] Assuming a utilization in 2013 of the WBSS part of the TAC/bycatch ceiling of 100% (F-fleet), 60% (C-fleet), and 50% (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 as communicated by the EC, and the ratio between the different herring stocks in Division IIIa is based on the 2010–2012 catch proportions. The later proportions cannot be predicted and may therefore deviate significantly from the assumed ratio.

[2] As for 2012 a catch of 2095 t WBSS herring taken in the transfer area in Division IVa East is assumed. The amount of this catch is highly variable since it is dependent on the geographical distribution of the stock components in Division IVa East.

[3] For spring-spawning stocks, the SSB is determined at spawning time and is influenced by fisheries between 1st January and spawning time.

[4] SSB (2015) relative to SSB (2014).

[5] Catches (2014) relative to TAC 2013 (Subdivisions 22–24 + Division IIIa + Division IIIa bycatch ceiling = 25.8 kt + 55 kt + 6.7 kt = 87.5 kt).

To derive the total herring catch for Division IIIa (lower table), predicted catches of NSAS (as advised in Section 6.4.9) 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 6.4.9). Note that the lower of the two tables 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 ICES MSY approach implies a fishing mortality of 0.28 in 2014. This results in catches of no more than 39 321 t in 2014 from the whole distribution area. This is expected to lead to an SSB of 129 kt in 2015. All catches are assumed to be landed.

Fishing mortality in 2013 is predicted to be 0.39, which is above F_{MSY}. Following the transisition to the ICES MSY approach implies a fishing mortality ($0.2 \times F_{2010} + 0.8 \times F_{MSY}$) of 0.30 in 2014. This results in catches of no more than 41 602 t in 2014 from the whole distribution area. This is expected to lead to an SSB of 127 kt in 2015. All catches are assumed to be landed.

Additional considerations

Management measures including optional quota transfer from Division IIIa to be caught in the North Sea have reduced F in 2011 and 2012 to slightly above F_{MSY}. However, even with this transfer F is expected to increase to 0.39, considerably above the target F_{MSY}.

Catches of WBSS herring in Division IVa East increased in 2012.

The proportion of the WBSS catch in Division IVaE relative to the total catch of WBSS in Divisions IIIa and IVaE is variable from year to year and estimated with high uncertainty. If the catches of herring substantially increase in Division IVaE, the risk of overexploitation of adult WBSS increases. WBSS is the stock in most need of protection at the moment, and therefore the proportion of catch from this area should not increase.

Management considerations

In 2011, fisheries regulations allowed 50% of the TAC for Division IIIa to be caught in the North Sea. 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 forecast for 2013 for both WBSS and NSAS herring is based on the assumption that the optional transfer of quotas in 2013 from Division IIIa to the North Sea is 40%. The advice forecast is based on the assumption that the 2014 TAC for Division IIIa will be caught in the area without utilizing the transfer options. Other calculations could be made if such management measures are considered.

In 2009, national regulations and control initiatives stopped the misreporting into Division IIIa of catches taken in the North Sea, which before 2009 amounted to more than 30% of the reported Division IIIa catches. This increased the fishing mortality and subsequently decreased the SSB. Following the reductions in TAC in 2010, however, the landings and fishing mortality have declined and the decreasing trend in SSB has leveled off.

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. The advice takes the natural variation in the mixing of the stocks into account and ICES recommends that when TACs are set for areas where the stocks mix, the status of the weaker stock should be the main concern for the managers. Currently this is the WBSS.

Information from the fishing industry

Area misreporting from the North Sea to the Skagerrak is no longer an issue for the C-fleet. The fishing industry has informed ICES about the estimated 40% utilization of the optimal quota transfer in 2013.

Uncertainties in the assessment and forecast

The main causes for uncertainty in predictions 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 2012 advice assumed a 50% transfer of the C-fleet quota from Division IIIa to the North Sea. With an actual transfer of 49%, forecasts are considered relatively precise; however, ICES does not consider that quota transfer can be predicted more than one year ahead. Inherent uncertainty in predictions could be reduced by eliminating the optional transfer of quotas between Division IIIa and Subarea IV. Estimation of stock identity of herring from the transfer area in Division IVa East should be improved.

Comparison with previous assessment and advice

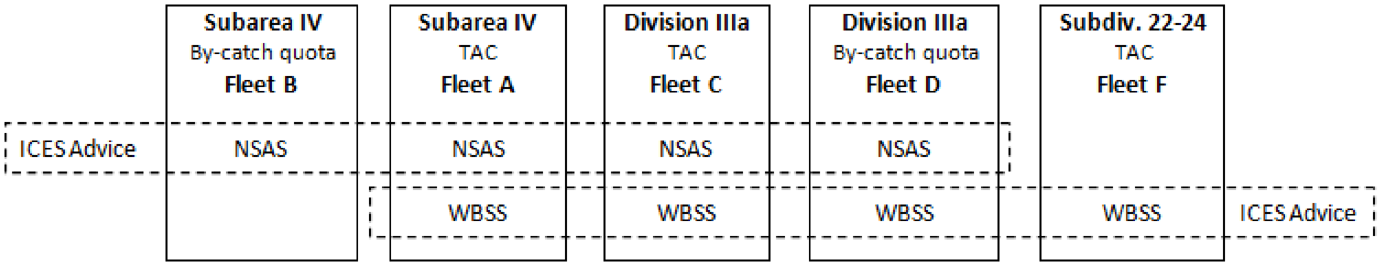
Following the benchmark there has been a change in the perception of the stock. Compared to last year's advice fishing mortality in 2011 has been revised upwards by 57% and the SSB in 2011 downwards by 20%. The 2011 recruitment has been revised downwards by 25%; however, the confidence limits of the SAM model still contains the 2011 recruitment from the ICA (ICES, 2012), highlighting the uncertainty in the estimates of this parameter.

Last year's advice was based on F_{MSY} = 0.25. This year's advice is based on the transition to the MSY approach (with a revised F_{MSY} at 0.28).

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 (2013) catch and the catch options for 2014 are based on:

1. the 2010–2012 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 2012 catch of WBSS taken by the A-fleet in Division IVa East.

For the intermediate year (2013) ICES assumes a transfer of 40% of the Division IIIa quotas to be taken in the North Sea. Short-term predictions are based on an expected catch in 2013 of 49 732 t of the western Baltic spring-spawning stock, including a catch of 2095 t of WBSS in Division IVa East. To make catch options by fleet for 2014 a 50:50 allocation between Division IIIa and Subdivisions 22–24 is applied; in the calculations it is further assumed that each fleet will take its full share of the total area TAC. Catch options are thus set proportional to the utilized part of the area TACs for 2010–2012. The average proportions of WBSS in the 2010-2012 catches were 64% in the C-fleet, 24% in the D-fleet, and 100% in the F-fleet.

Additionally, it is assumed that a catch of 2095 t of WBSS will be caught by the A-fleet in Division IVa East in 2013 and 2014. These catches of WBSS herring are taken under the North Sea TAC in the transfer area in Division IVaE and thus not restricted by the TAC set for WBSS. The proportion of the WBSS catch in Division IVaE relative to the total catch of WBSS in Divisions IIIa and IVaE is variable from year to year and estimated with high uncertainty. If the catches of herring substantially increase in the Division IVaE, the risk of overexploitation of adult WBSS increases. WBSS is the stock in most need of protection at the moment, and therefore the proportion of catch from this area should not increase. Care should be taken that this is avoided, either by reducing the area flexibility or by affording more specific protection through a seasonal closure of the main fishery in quarter 3.

Sources

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ICES. 2011. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 16–24 March 2011, ICES Headquarters. ICES CM 2011/ACOM:06.

ICES. 2012. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 13–22 March 2012. ICES CM 2012/ACOM:06.

ICES. 2013a. Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG), 12–21 March 2013. ICES CM 2013/ACOM:06.

ICES. 2013b. Report of the Benchmark Workshop on Pelagic Stocks (WKPELA 2013), 4–8 February 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:46. 483 pp.

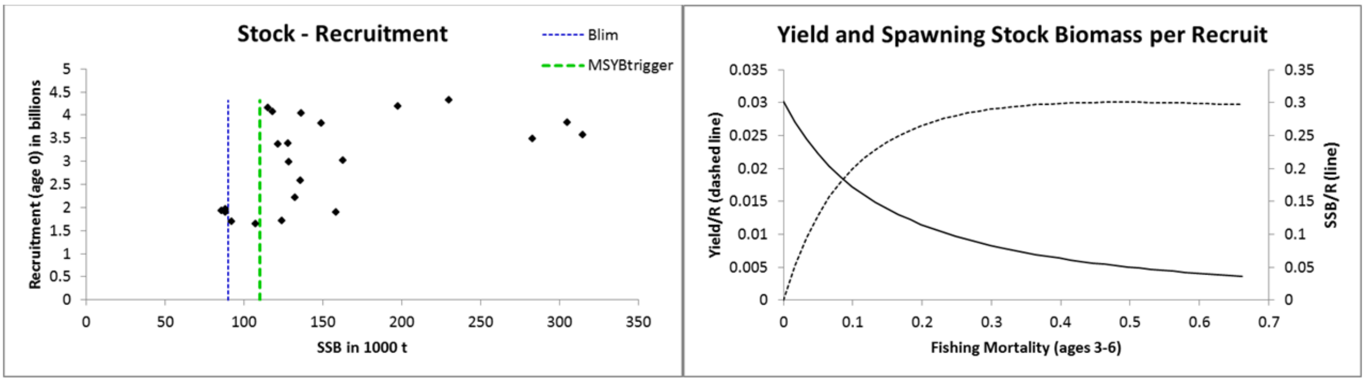


Figure 6.4.8.3 Herring in Division IIIa and Subdivisions 22–24 (Western Baltic spring spawners). Stock–recruitment and Yield- and SSB-per-Recruit plots.

Table 6.4.8.1 Herring in Division IIIa and Subdivisions 22–24 (western Baltic spring spawners). ICES advice, management, and catches.

Year	ICES Advice	Predicted 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	66–85[1]	100	68	55	1	124
	22–24: if required, TAC not exceeding recent catches						
1998	Should be managed in accordance with NSAS	-	97	51	53	8	112
1999	IIIa: managed together with autumn spawners	-	99	50	43	5	98
	22–24: if required, TAC not exceeding recent catches						
2000	IIIa: managed together with autumn spawners	~60 for	101	54	57	7	118
	22–24: if required, TAC not exceeding recent catches	Subdivisions 22–24					
2001	IIIa: managed together with autumn spawners	~50 for	101	64	42	6	112
	22–24: if required, TAC not exceeding recent catches	Subdivisions 22–24					
2002	IIIa: managed together with autumn spawners	~50 for	101	53	47	7	107
	22–24: if required, TAC not exceeding recent catches	Subdivisions 22–24					
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*	21	15	2	39
2013	F_{MSY} = 0.25 and no *optional* transfer of catch options to the North Sea	< 51.9	55[3]/25.8*				
2014	Transition to MSY approach	< 41.602					

Weights in thousand tonnes.

[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 6.4.8.2 Herring in Subdivisions 22–24 and Division IIIa (spring and autumn spawners). ICES catch (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	2012 [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	3.2
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	0.6
Lithuania											0.4		
Norway	9.7							3.5	4.0	3.3	3.3	0.1	0.4
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	16.2
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	20.5
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	6.3
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	0.8
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	7.1
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	4.1
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	11.2
Poland	6.6	9.3		4.4	5.5	6.3	5.5	2.9	5.5	5.2	1.8	1.8	2.4
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	2.7
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	20.4
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	0.04
Sweden	0.1	0.2		0.2	0.3	0.4	0.7		0.3	0.8	0.9	0.5	0.7
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	0.7
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**	**48.8**

[1] Preliminary data.

[2] Revised data for 1998 and 1999.

BOLD = German revised data for 2008 (in ICES, 2010).

[3] 2000 tonnes of Danish landings are missing. See Section 3.1.2 in ICES (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 : 3103 tonnes, see Section 3.2.1 in ICES (2011).

Table 6.4.8.3 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	3 843 908	304 747	191 573	0.3965
1992	3 576 875	314 614	194 411	0.5144
1993	3 485 075	282 658	185 010	0.5629
1994	4 316 692	229 615	172 438	0.5949
1995	4 193 306	197 426	150 831	0.5585
1996	4 032 915	136 116	121 266	0.6201
1997	3 828 563	148 826	115 588	0.5698
1998	4 065 308	117 809	107 032	0.5673
1999	4 159 893	114 886	97 240	0.4944
2000	3 365 207	121 524	109 914	0.5851
2001	3 388 846	127 963	105 803	0.5767
2002	3 020 703	162 427	106 191	0.5370
2003	2 978 707	128 446	78 309	0.4831
2004	2 576 648	135 905	76 815	0.4753
2005	2 206 681	132 129	88 406	0.5165
2006	1 895 513	158 432	90 549	0.5262
2007	1 718 565	123 995	68 997	0.4886
2008	1 652 831	106 982	68 484	0.5237
2009	1 699 764	92 060	67 262	0.5263
2010	1 968 928	88 218	42 214	0.3703
2011	1 928 012	85 681	27 771	0.3171
2012	1 901 208	87 936	38 648	0.3311
2013*	1 789 058	106 053		
Average	2 938 835	152 367	104 761	0.5062

* Recruitment is the geometric mean 2007–2011. SSB is predicted.

** SSB measured at spawning time.

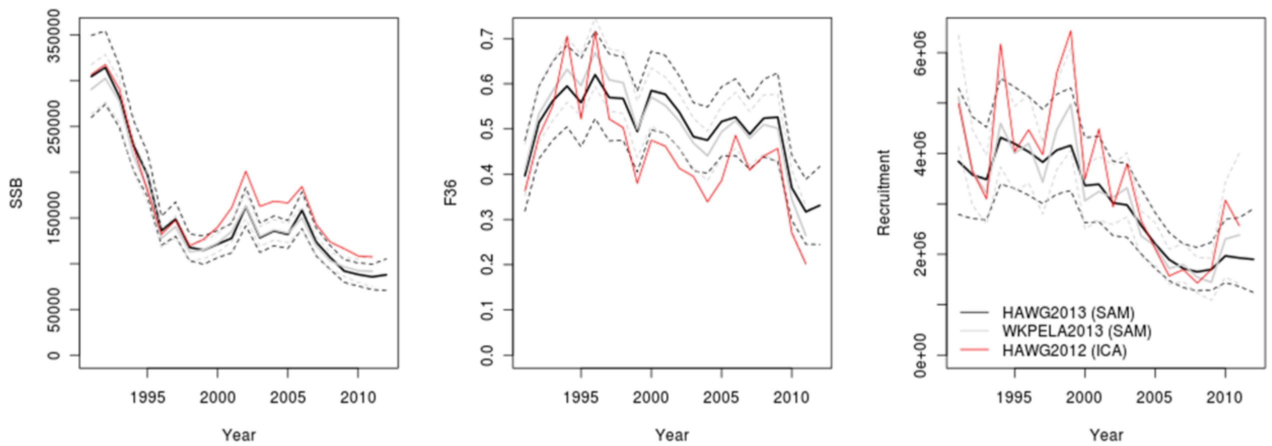


Figure 6.4.8.4 Western Baltic spring-spawning herring. Comparison of SSB, F, and R from ICA (red line) and SAM using the settings proposed in the 2013 benchmark (grey line) and the revised settings adopted after the benchmark for the current assessment (black line). Continuous line is the mean estimate, with the dotted line as 95% CI.

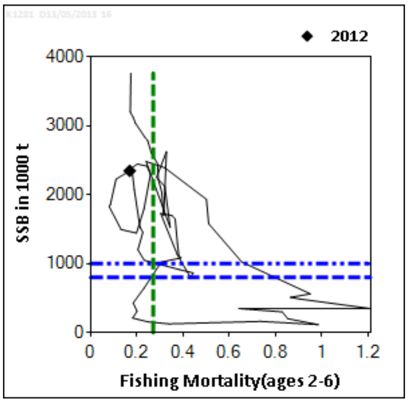
6.4.9		Advice May 2013
ECOREGION	**North Sea**	
STOCK	**Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)**	

Advice for 2013

ICES advises on the basis of the agreed EU–Norway management plan that catches in 2014 should be no more than 482 477 t, including 470 037 t for the A-fleet. All catches are assumed to be landed. ICES advises that activities that have a negative impact on the spawning habitat of herring, such as extraction of marine aggregates and construction on the spawning grounds, should not occur.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa})	?	?	?	Undefined
Management plan (F_{MP})	✓	✓	✓	Below limit
SSB (Spawning-Stock Biomass)*				
* at spawning time in autumn.	2010	2011	2013	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa}, B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above trigger



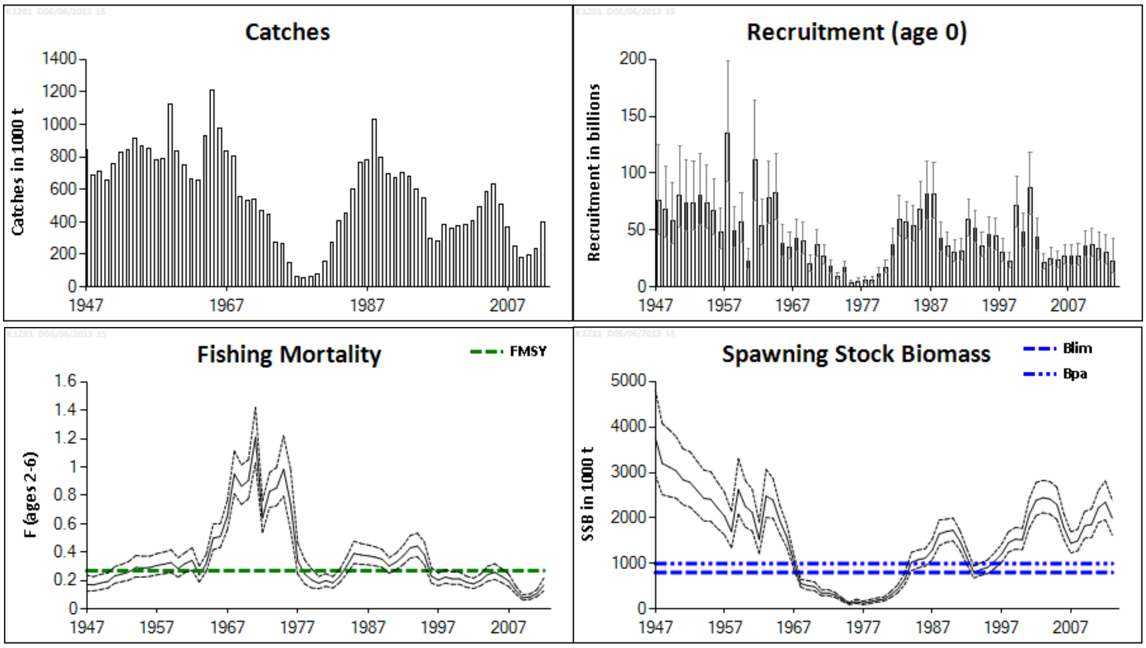


Figure 6.4.9.1 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Summary of stock assessment with 95% confidence intervals, predicted recruitment value is shaded. Top right: SSB and F for the time-series used in the assessment.

Since 2007 SSB has been increasing and it is currently well above B_{pa}. Fishing mortality has been low for the past five years, and while it has increased recently it is still below F_{MSY}. The year classes from 2002 onwards are estimated to be among the weakest since the late 1970s. The recruits per spawner in the last decade are the lowest observed. Thus, 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 6.4.9). ICES has evaluated this management plan and concluded that the plan is consistent with the precautionary approach and the MSY approach. ICES has evaluated the current and new options of the management plan in 2012. ICES concludes that all management plans tested included precautionary options (see ICES Advice 2012, Section 6.3.3.6).

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 can be observed where natural mortality has increased over the period 1963–1978, decreased in 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

Year-class strength has been consistently weak since 2002, something that has never been observed before when SSB was above the B_{lim} (800 000 t). The poor recruitment is attributed to reduced survival during the larval stage. The productivity of the stock (in terms of recruits-per-spawner and larval survival) in the last decade are the lowest on record. 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 (2012) are 405 kt directed NS fisheries – fleet A, 18 kt bycatches – fleet B, 8 kt directed Division IIIa fisheries – fleet C, and 4 kt bycatch in Division IIIa fisheries – fleet D. Most of the catches are taken by pelagic trawl.

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 on human consumption fisheries suggests that discarding of herring is not wide-spread. Interactions between the human consumption North Sea herring fishery with marine mammals, sharks and sea birds are considered to be rare. Juvenile herring are caught as bycatch in industrial fisheries.

Quality considerations

Both the spawning stock biomass and the fishing mortality are reliably estimated by the stock assessment. The consistent underestimation of spawning stock biomass observed over the past years has not been observed this year. There is limited knowledge about the present rate of discarding.

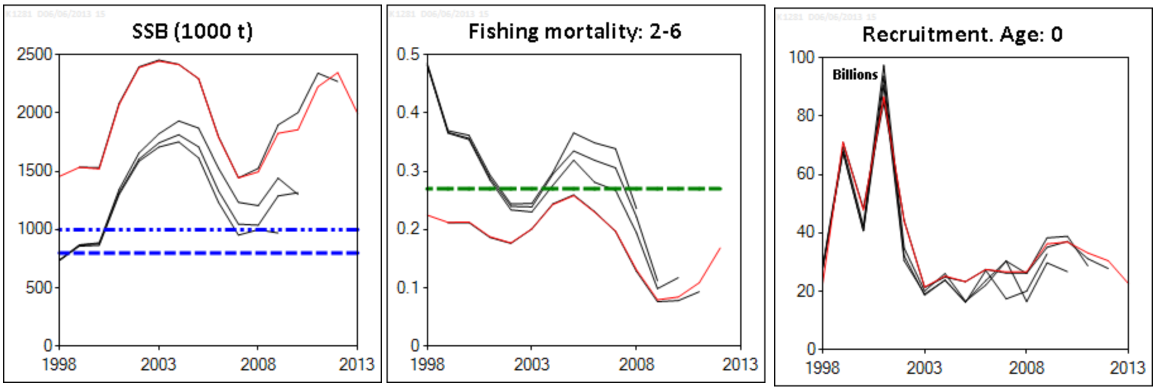


Figure 6.4.16.2 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Historical assessment results (final-year recruitment estimates included). The stock was benchmarked in 2012.

Scientific Basis

Assessment type	Age-based analytical model (SAM).
Stock data category	Category 1
Input data	Commercial catches; One trawl survey (IBTS Q1 1-wr), two larval surveys (SCAI and IBTS0), and an acoustic survey (HERAS); Annual maturity ogives from HERAS; Natural mortality from North Sea multispecies stock assessment (SMS); Annual stock weights from 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

6.4.9 **Supporting information May 2013**

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}	$F_{0-1} = 0.05$ $F_{2-6} = 0.25$	SSB is greater than the SSB_{MP} upper trigger of 1.5 million t (based on simulations).
		$F_{0-1} = 0.05$ $F_{2-6} = 0.25 - (0.15 \times (1\,500\,000 - SSB) / 700\,000)$	SSB is between the SSB_{MP} triggers of 0.8 and 1.5 million t (based on simulations).
		$F_{0-1} = 0.04$ $F_{2-6} = 0.10$	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}	0.27 [0.24 – 0.3]	Stochastic simulations with Beverton & Holt and Ricker stock–recruitment curve.
Precautionary approach	B_{lim}	800 000 t.	< 0.8 million t; poor recruitment has been experienced.
	B_{pa}	1.0 million t.	Based on 5% risk of falling below B_{lim} and the terminal year spawning stock biomass CV from the SAM assessment.
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	

(*Changed in 2013*, WKHELP (ICES, 2012c).

The current management plan is based on the pre-benchmarked perception of the stock.

ICES suggests a range for F_{MSY} between 0.24 and 0.3, based on two different stock–recruitment relationship assumptions. As either stock–recruit relationship assumption is equally likely, the point estimate of F_{MSY} (0.27) can be derived by equally weighting the 0.24 and 0.3 estimates.

Outlook for 2014

Because 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 2014. 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:

1. No fishing.
2. The EU–Norway management plan (which invokes a 15% limit on TAC change).
3. A roll-over TAC from 2013 to 2014 of 478 000 t for the A-fleet.
4. A 15% increase in the A-fleet TAC in 2014
5. A 15% decrease in the A-fleet TAC in 2014.
6. MSY approach (F_{MSY}).

For the intermediate year, no overshoot for the A-fleet was assumed, as the catches corresponded closely to the TAC in 2012. However, an additional 22 000 t was included to account for the Division IIIa TAC transfer agreement.

For the B-fleet (small-meshed EU fleet in the North Sea) the same proportion of the uptake of the bycatch ceiling as observed in 2012 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 (2013) with catch constraint for fleet A, and for fleet B assuming the same proportion of the bycatch ceiling that is taken in 2012. Recruitment (2013) = 22.5 billion.

F fleet A	F fleet B	F fleet C	F fleet D	F_{0-1}	F_{2-6}	Catch fleet A[1]	Catch fleet B	Catch fleet C	Catch fleet D	SSB 2013
0.23	0.02	0.01	0.01	0.04	0.24	497.1	8.6	11.8	2.5	1996

[1] Includes a transfer of 2095 tonnes of the Norwegian quota and 40% of Division IIIa TAC from the C-fleet to the A-fleet.

Scenarios for prediction year (2014)

Basis		F-values by fleet and total						Catches by fleet				Biomass 1)			
		Fleet A	Fleet B	Fleet C	Fleet D	F_{0-1}	F_{2-6}	Fleet A	Fleet B	Fleet C	Fleet D	SSB 2014	SSB 2015 4)	%SSB change 2)	%TAC change fleet A 3)
1	No fishing	0	0	0	0	0	0	0	0	0	0	2101	2183	5%	−100%
2	Management plan	0.25	0.03	0.01	0.01	0.05	0.25	470.0	12.4	11.2	2.4	1780	1508	−11%	−2%
3	No change in TAC	0.25	0.03	0.01	0.01	0.05	0.25	478.0	12.4	11.2	2.4	1774	1498	−11%	0%
4	TAC increase of 15%	0.29	0.03	0.01	0.01	0.05	0.30	549.7	12.4	11.2	2.4	1724	1411	−14%	15%
5	TAC reduction of 15%	0.21	0.03	0.01	0.01	0.05	0.21	406.3	12.4	11.2	2.4	1824	1590	−9%	−15%
6	MSY approach	0.27	0.03	0.01	0.01	0.05	0.27	503.4	12.4	11.2	2.4	1757	1467	−12%	5%

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 (2014) relative to SSB (2013).

3) Calculated landings (2014) relative to TAC 2013 for the A-fleet.

4) Assuming same F in 2015 as in 2014.

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 (F = 0.25) implies a decrease in TAC of 2% which results in a TAC of 470 037 t for the A-fleet in 2014 (Scenario 2), which would lead to an SSB of around 1.8 million tonnes at spawning time in 2014.

The agreed management plan (Annex 6.4.9) 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. ICES has evaluated the current and new options of the management plan in 2012. ICES concludes that all management plans tested included precautionary options (see ICES Advice 2012, Section 6.3.3.6).

MSY approach

As no MSY $B_{trigger}$ has been identified for this stock, the ICES MSY approach has been applied without considering SSB in relation to MSY $B_{trigger}$. Following the ICES MSY approach implies an increase in fishing mortality to 0.27, resulting in catches of less than 503 399 t in 2014 (Scenario 6). This is expected to lead to an SSB of around 1.8 million tonnes in 2014

Precautionary approach

The SSB is expected to remain above B_{pa} in 2013.

Under the revised reference points, F_{pa} is no longer considered an operational reference point for the fisheries management of the North Sea herring stock.

Additional considerations

ICES considers the stock to be in a low productivity phase. The survival ratio between newly hatched larvae and recruits during the most recent decade is much lower than in prior periods (Figure 6.4.9.4). Recruits-per-spawner are the lowest in the time-series (Figure 6.4.9.4). The management plan has proven an effective tool in maintaining sustainable exploitation and conserving the North Sea herring stock during this low-productivity regime. Any deviation from this plan would result in an increased risk of falling below B_{lim}.

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. WKHELP (ICES, 2012c) has re-evaluated the management plan, including a set of new management plan options.

Both SSB and the fishing mortality are reliably estimated by the stock assessment.

Gravel substrate is important fish habitat for herring spawning. Herring spawning and nursery areas are sensitive and vulnerable to anthropogenic influences. Activities that have an impact on the spawning habitat of herring, such as extraction of marine aggregates (e.g. gravel and sand) and construction, can impact 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 scientific information (Groot, 1979; 1996), and ICES advice (ICES, 2003), to support the advice that no gravel extraction should occur in areas with spawning grounds, both within and outside of the spawning time.

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 2014 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 changes over time: in recent years the relative contribution of the spawning components has been stable (Figure 6.4.9.5).

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 6.4.9.5; 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.

Changes in fishing patterns

Apart from a reduction in area misreporting of catch, there have been no major changes to fishing patterns.

Changes in the ecosystem

Temperatures on the spawning grounds have increased in the recent decades (Payne *et al*., 2009). Substantial changes in the plankton community are known to have occurred in the North Sea in the late 1990s (Weijerman *et al*., 2005, Alvarez-Fernandez *et al*., 2012). The contemporary regime consists of a more diversified warmer water community (Beaugrand, 2004; Edwards *et al*., 2007). However, the implications for herring, if any, are unclear.

Herring is considered to have a major impact on the ecosystem as prey for seabirds, marine mammals, and other fish. Young age groups of herring are primarily eaten by cod, saithe, and whiting. The contribution of saithe and cod alone makes up for nearly 90% of the predation mortality from age 4 onwards. It is therefore likely that predation mortality on herring changes with the abundance of saithe and cod as has been observed over the past two decades (ICES, 2011c).

Herring is also an important predator for some species; a large population of herring in the North Sea may repress cod recruitment (Speirs *et al*., 2010).

Information from the fishing industry

Information from the fishing industry shows that discarding occurs in the B fleet as the landing of herring bycatches above a certain limit by area in the industrial fisheries is not permitted. The landing obligation that is forseen in the EU pelagic fishery may change the fleet behavior.

Data and methods

The quality of the recruitment estimates are influenced by the IBTS0 index: in recent years, this survey index has exhibited systematic biases. This is most likely due to increases in recruitment from the Downs component, which is excluded from the calculation of the survey index.

Estimation of stock identity of herring from the transfer area in Division 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

The 2013 assessment is consistent with last year's assessment: SSB in 2011 has been revised slightly downwards by 5% and F in 2011 upwards by 17%.

The basis for the advice is the management plan, which is the same as last year.

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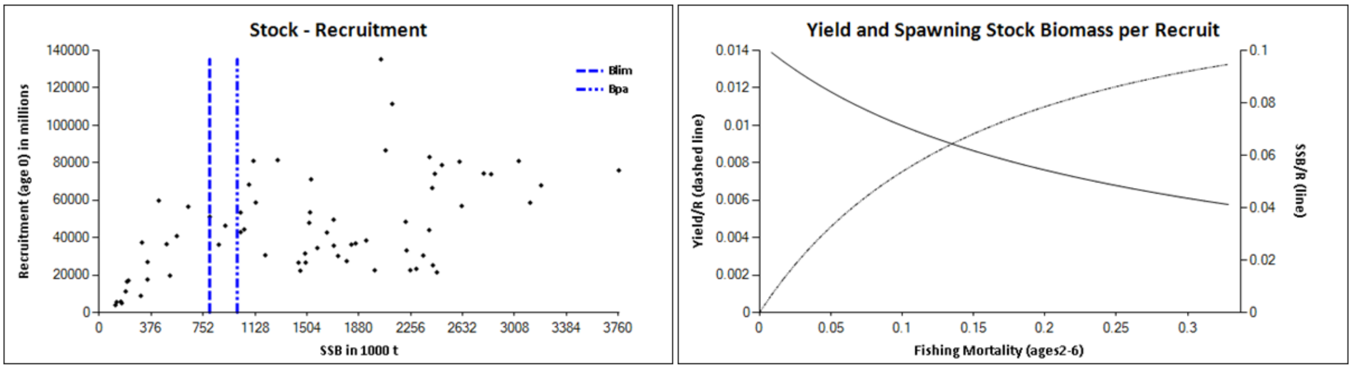

Figure 6.4.9.3 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Stock–recruitment plot and yield-per-recruit analysis.

Table 6.4.9.1 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 Landings[3] IV, VIId	ICES Catch[4] 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 [2]	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	424.287	424.608	434.647
2013	Management plan	See scenarios	478	14.4			
2014	Management plan	See scenarios					

Weights in thousand tonnes.

[1] Catch in directed fishery in Subarea IV and Division VIId.

[2] Revised in June 1996, down from 263.

[3] Landings are provided by the working group and do not in all cases correspond to official statistics.

[4] ICES catch includes unallocated and misreported landings, discards, and slipping.

Table 6.4.9.2 Herring caught in the North Sea (Subarea IV and Division VIId). Catch in tonnes by country, 2003–2012. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	**2003**	**2004**	**2005**	**2006**	**2007**
Belgium	5	8	6	3	1
Denmark [6]	78606	99037	128380	102322	84697
Faroe Islands	627	402	738	1785	2891
France	31544	34521	38829	49475	24909
Germany	43953	41858	46555	40414	14893
Netherlands	81108	96162	81531	76315	66393
Norway [1]	112481	137638	156802	135361	100050
Poland	-	-	458	-	-
Sweden	4781	5692	13464	10529	15448
USSR/Russia	-	-	99	-	-
UK (England)	18639	20855	25311	22198	15993
UK (Scotland)	40292	45331	73227	48428	35115
UK (N.Ireland)	2010	2656	2912	3531	638
Unallocated landings	31875[5]	48898[5]	57788	18764	26641
Total landings	445921	533058	626101	509125	387669
Discards	4125	17059	12824	1492	93
Total catch	**450046**	**550117**	**638925**	**510617**	**387762**
Estimates of the parts of the catches which have been allocated to spring-spawning stocks					
WBSS	2821	7079	7039	10954	1070
Thames estuary [2]	84	62	74	65	2
Others [3]	308	0	0	0	0
Norw. spring spawners [4]	979	452	417	626	685
Country	**2008**	**2009**	**2010**	**2011**	**2012**
Belgium	-	-	-	4	3
Denmark [6]	62864	46238	45869	58726	105707
Faroe Islands	2014	1803	3014	-	-
France	30347	18114	17745	16693	23819
Germany	8095	5368	7670	9427	24515
Netherlands	23122	24552	23872	34708	72344
Norway [1]	59321	50445	46816	60705	119253
Lithuania	-	-	90	-	-
Sweden	13840	5299	4395	8086	14092
Russia	-	-	-	-	-
UK (England)	11717	652	10770	11468	25346
UK (Scotland)	16021	14006	14373	18564	34414
UK (N.Ireland)	331	-	-	17	4794
Unallocated landings	17151	-726	0	0	321
Total landings	244823	165751	174614	218398	424608
Discards	224	91	13	0	0
Total catch	**245047**	**165842**	**174627**	**218398**	**424608**
Estimates of the parts of the catches which have been allocated to spring-spawning stocks					
WBSS	124	3941	774	308	2095
Thames estuary [2]	7	48	85	2	63
Others [3]	0	0	0	0	0
Norw. spring spawners [4]	2721	44560	56900	12178	9619

[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 6.4.9.3 Herring caught in the North Sea. Catch in tonnes in Division IVa West. These figures do not in all cases correspond to the statistics and cannot be used for legal purposes.

Country	2003	2004	2005	2006	2007
Denmark [1]	48 358	48 128	80 990	60 462	45 948
Faroe Islands	95	-		580	1 118
France	11 237	10 941	13 474	18 453	8 570
Germany	25 796	17 559	22 278	18 605	4 985
Netherlands	25 045	43 876	36 619	39 209	42 622
Norway	34 443	36 119	66 232	38 363	40279
Poland	-	-	458	-	-
Sweden	2 647	2 178	8 261	4 957	7 658
Russia	-	-	99	-	-
UK (England)	12 030	13 480	15 523	12 031	11 833
UK (Scotland)	39 970	43 490	71 941	47 368	35 115
UK (N. Ireland)	2 010	2 656	2 912	3 531	638
Unallocated landings	14 115 [2]	28 631 [2]	39 324 [2]	10 981 [2]	22 215
Misreporting from VIa North					
Total Landings	215 746	247 058	358 111	253 048	220 981
Discards	4 125	15 794	10 861	1 492	93
Total catch	**219871**	**262852**	**368972**	**254540**	**221074**
Country	**2008**	**2009**	**2010**	**2011**	**2012**
Denmark [1]	28 426	16 550	25 092	26 523	42 867
Faroe Islands	2	288	1 110	-	-
France	13 068	7 067	6 412	7 885	11 131
Germany	498	-	505	2 642	13 060
Netherlands	11 634	11 017	13 593	15 202	46 654
Norway	40 304	25 926	38 897	45 200	72 581
Lithuania	-	-	90	-	-
Sweden	7 025	1 435	2 310	5 121	6 065
Russia	-	-	-	-	-
UK (England)	8 355	578	7 384	4 555	18 289
UK (Scotland)	14 727	10 249	13 567	17 909	33 352
UK (N. Ireland)	331	-	-	17	4 794
Unallocated landings	14 952	-977	0	0	-3 416
Misreporting from VIa North					
Total Landings	139 322	72 133	108 960	125 054	245 377
Discards	194	91	13	0	0
Total catch	**139 516**	**72 224**	**108 973**	**125 054**	**245 377**

[1] Including any bycatches in the industrial fishery.

[2] May include misreported catch from Division VIaN and discards.

Table 6.4.9.4 Herring caught in the North Sea. Catch in tonnes in Division IVa East. These figures do not in all cases correspond to the off statistics and cannot be used for legal purposes.

Country	2003	2004	2005	2006	2007
Denmark [1]	7 401	16 278	5 761	8 614	2 646
Faroe Islands	359	-	738	975	577
France	-	-	-	-	-
Germany	54	888	-	34	-
Netherlands	-	-	-	-	263
Norway [2]	62 306	100 443	89 925	90 065	54 424
UK (Scotland)	-	-	-	83	-
Sweden	1 529	1 720	3 510	2 857	640
Unallocated landings	9 988				- 96 [3]
Total landings	81 637	119 329	99 934	102 628	58 454
Discards	-	-	-	-	-
Total catch	**83 640**	**119 329**	**99 934**	**102 628**	**58 454**
Norwegian Spring Spawners [4]	979	452	417	626	685
Country	**2008**	**2009**	**2010**	**2011**	**2012**
Denmark [1]	1 587	499	-	1 590	1 822
Faroe Islands	400	700	719	-	-
France	-	-	-	-	-
Germany	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway [2]	17 474	6 981	7 362	12 922	32 714
UK (Scotland)	-	-	-	167	
Sweden	-	1 735	1 505	150	815
Unallocated landings					
Total landings	19 461	9 915	9 586	14 829	35 351
Discards	-	-	-	-	-
Total catch	**19 461**	**9 915**	**9 586**	**14 829**	**35 351**
Norwegian Spring Spawners [4]	2 721	44 560	56 900	12 178	9 619

[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 6.4.9.5 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	**2003**	**2004**	**2005**	**2006**	**2007**
Denmark [1]	22 574	33 857	41 423	32 277	35 990
Faroe Islands	173	402	-	200	1 196
France	7 918	10 592	10 205	17 385	8 421
Germany	12 116	13 823	14 381	14 222	2 205
Netherlands	19 115	23 649	10 038	13 363	8 550
Norway	15 732	1 076	645	6 933	5 347
Sweden	605	1 794	1 694	2 715	7 150
UK (England)	2 632	2 864	3 869	4 924	577
UK (Scotland)	322	1 841	1 286	977	-
Unallocated landings [3]	- 2 401	8 300	10 233	2 364	- 203
Total landings	78 786	98 198	93 774	95 360	69 233
Discards [2]		1 265	1 963		
Total catch	**78 786**	**99 463**	**95 737**	**95 360**	**69 233**

Country	**2008**	**2009**	**2010**	**2011**	**2012**
Denmark [1]	32 230	29 164	19 671	30 498	60 503
Faroe Islands	1 612	815	1 185	-	-
France	9 687	4 316	2 349	1 687	3 898
Germany	2 415	1 061	1 994	1 778	4 187
Netherlands	904	3 164	830	7 314	9 202
Norway	1 543	17 538	557	2 537	13 958
Sweden	6 815	2 129	580	2 815	7 212
UK (England)	833	2	1 577	4 748	3 045
UK (Scotland)	1 293	3 757	805	488	1 062
Unallocated landings [3]	- 904	- 166			411
Total landings	56 428	61 780	29 548	51 865	103 478
Discards [2]	30				
Total catch	**56 458**	**61 780**	**29 548**	**51 865**	**103 478**

[1] Including any bycatches in the industrial fishery.
[2] Discards partly included in unallocated.
[3] Negative unallocated catches due to misreporting into other areas .

Table 6.4.9.6 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	**2003**	**2004**	**2005**	**2006**	**2007**
Belgium	5	8	6	3	1
Denmark	273	774	206	969	113
Faroe Islands				30	-
France	12389	12988	15150	13637	7918
Germany	5987	9588	9896	7553	7703
Netherlands	36948	28637	34874	23743	14958
UK (England)	3977	4511	5919	5243	3583
UK (Scotland)	-	-	-	-	-
Unallocated landings	8170	9963	8231	5419	4725
Total landings	67749	68473	74282	56597	39001
Discards [2]	-	-	-	-	-
Total catch	**67749**	**68473**	**74282**	**56597**	**39001**
Coastal spring spawners included above [1]	84	62	74	65	2
Country	**2008**	**2009**	**2010**	**2011**	**2012**
Belgium	-	-	-	4	3
Denmark [3]	621	25	1106	115	515
France	7592	6731	8984	7121	8790
Germany	5182	4307	5171	5007	7268
Netherlands	10584	10371	9449	12192	16488
Norway	-	-	-	46	-
UK (England)	2529	72	1809	2165	4012
UK (Scotland)	1	-	1	-	-
Unallocated landings	3103	417	0	0	3326
Total landings	29612	21923	26520	26650	40402
Discards [2]	-				
Total catch	**29612**	**21923**	**26520**	**26650**	**40402**
Coastal spring spawners included above [1]	7	48	85	2	63

[1] Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
[2] Discards partly included in unallocated landings.
[3] Including any bycatches in the industrial fishery.

Table 6.4.9.7 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 (2) (tonnes) Mean	Low	High	Landings (tonnes) Mean	Yield / SSB (ratio) Mean	Mean F ages 2-6 Mean	Low	High	Mean F ages 0-1
1947	75905523	46077126	125043571	7088611	5810730	8647521	3764027	2943351	4813528	845768	0.225	0.173	0.126	0.238	0.002
1948	67930793	43276555	106630314	6394827	5245717	7795659	3201084	2513816	4076248	689002	0.215	0.170	0.128	0.228	0.002
1949	58644245	37515217	91673398	6089034	5039803	7356702	3122049	2472064	3942935	714258	0.229	0.183	0.137	0.245	0.002
1950	80922301	52964392	123638136	6119555	5097183	7346991	3038881	2435964	3791024	657368	0.216	0.193	0.147	0.253	0.005
1951	73883494	48982243	111443868	6174880	5174621	7368490	2839107	2289471	3520694	760704	0.268	0.233	0.182	0.299	0.016
1952	74253836	49803270	110708237	6040516	5078588	7184641	2785673	2243433	3458972	828192	0.297	0.246	0.192	0.315	0.029
1953	80599258	55145472	117801881	5944637	5016418	7044609	2610363	2092957	3255680	843234	0.323	0.261	0.204	0.335	0.041
1954	74105477	51428096	106782520	5797863	4905227	6852938	2431454	1937055	3052040	915293	0.376	0.292	0.226	0.377	0.054
1955	66519121	46380942	95401113	5460222	4630066	6439222	2412080	1926636	3019839	866312	0.359	0.289	0.225	0.372	0.084
1956	48447922	33670276	69711371	4891453	4158182	5754033	2219961	1769675	2784819	849158	0.383	0.292	0.230	0.372	0.078
1957	135299311	92181609	198585203	5649062	4705109	6782393	2041101	1626393	2561554	784655	0.384	0.307	0.241	0.391	0.099
1958	49575137	34705794	70815099	5309456	4475546	6298745	1698065	1344068	2145298	790958	0.466	0.316	0.248	0.401	0.084
1959	56911045	39325480	82360524	5487591	4653256	6471524	2626073	2087800	3303123	1129177	0.430	0.328	0.257	0.418	0.106
1960	22567018	15244144	33407601	4448155	3794568	5214317	2253511	1798922	2822975	839029	0.372	0.284	0.224	0.360	0.121
1961	111440347	75859174	163710601	5096171	4285802	6059766	2122277	1715344	2625746	753135	0.355	0.320	0.258	0.398	0.065
1962	53489718	37178589	76956924	4742144	4028247	5582561	1527282	1220458	1911241	663975	0.435	0.343	0.273	0.432	0.055
1963	78766631	56098857	110593735	5405892	4627516	6315195	2483054	2009386	3068380	658026	0.265	0.239	0.190	0.301	0.070
1964	83053871	59037630	116839809	5705836	4981007	6536140	2392860	1996746	2867556	929126	0.388	0.320	0.265	0.386	0.134
1965	38455028	27239993	54287426	5010268	4444175	5648469	1933805	1648315	2268742	1209842	0.626	0.501	0.418	0.599	0.121
1966	34449326	24641387	48161090	3886424	3462981	4361644	1580102	1349824	1849666	976764	0.618	0.510	0.434	0.600	0.111
1967	42926504	30896430	59640701	3169232	2822442	3558633	1024792	879112	1194613	837352	0.817	0.654	0.558	0.767	0.146
1968	40832954	29301017	56903488	2744200	2413770	3119863	561856	483577	652805	802912	1.429	0.951	0.812	1.115	0.153
1969	19697455	13926928	27858960	2141463	1867120	2456117	512471	421784	622657	557936	1.089	0.865	0.737	1.016	0.150
1970	36506468	26523445	50246950	2065742	1802371	2367598	488454	400878	595161	532320	1.090	0.905	0.778	1.051	0.149
1971	26963644	19738966	36832634	1945442	1702904	2222525	350109	290955	421289	540365	1.543	1.211	1.031	1.423	0.280
1972	17592795	12923713	23948724	1681169	1476312	1914452	349759	289816	422100	472598	1.351	0.642	0.539	0.764	0.297
1973	8850637	6419898	12201717	1282087	1133168	1450577	301040	252529	358872	442413	1.470	0.829	0.715	0.961	0.328
1974	16502130	11904007	22876355	946949	832034	1077735	201793	169840	239758	274581	1.361	0.853	0.729	0.999	0.259
1975	3933342	2658401	5819732	775296	661453	908732	117008	95885	142785	263287	2.250	0.985	0.795	1.221	0.302
1976	4945556	3275845	7466326	540365	452170	645763	163244	123980	214942	146239	0.896	0.736	0.552	0.981	0.112
1977	5542743	3616630	8494647	413743	335928	509583	126754	93898	171106	61267	0.483	0.338	0.246	0.464	0.091
1978	5763180	3713152	8945028	464167	375012	574518	156686	119376	205658	52365	0.334	0.247	0.176	0.346	0.097
1979	11228885	7510907	16787300	591845	487207	718956	191186	150613	242688	64991	0.340	0.204	0.148	0.282	0.103
1980	17021708	12180056	23787947	814231	681431	972913	212140	171436	262507	80660	0.380	0.181	0.143	0.229	0.110
1981	37355847	27302215	51111578	1401425	1177716	1667628	309898	251461	381916	159851	0.516	0.200	0.160	0.249	0.288
1982	59769138	44500029	80277473	2126526	1792741	2522456	431490	353455	526754	272120	0.631	0.183	0.147	0.228	0.256
1983	56514059	42494227	75159359	2856192	2440898	3342145	644996	530164	784702	403931	0.626	0.230	0.188	0.283	0.290
1984	53382845	39896645	71427764	3591211	3109954	4146942	1023767	841634	1245316	453613	0.443	0.305	0.251	0.371	0.198
1985	68339603	50261523	92920012	4085685	3565208	4682146	1084902	906856	1297905	604405	0.557	0.391	0.320	0.478	0.198
1986	81003263	59414306	110436848	4713777	4101549	5417390	1116825	941752	1324443	765282	0.685	0.381	0.315	0.462	0.188
1987	81409294	60837954	108936489	4629688	4057646	5282375	1292385	1088415	1534579	785441	0.608	0.375	0.312	0.451	0.246
1988	42712407	31796386	57376008	4538014	4002002	5145817	1649528	1391029	1956065	1031990	0.626	0.365	0.304	0.439	0.299
1989	35676401	26602858	47844695	3809468	3400476	4267651	1699764	1464147	1973298	795718	0.468	0.351	0.293	0.420	0.244
1990	30189357	22265595	40932986	3696881	3311204	4127479	1730637	1498245	1999075	693842	0.401	0.302	0.252	0.362	0.232
1991	31484314	23453024	42265850	3422904	3065059	3822528	1491063	1291970	1720837	672663	0.451	0.331	0.278	0.395	0.206
1992	58761651	45018191	76700808	3426329	3054631	3843256	1133703	974867	1318419	700115	0.618	0.374	0.313	0.447	0.298
1993	51136035	39123145	66837523	3153426	2779637	3577480	800507	679663	942837	682147	0.852	0.431	0.359	0.518	0.328
1994	36215581	27422006	47829043	2819302	2483356	3200695	866312	740101	1014046	600790	0.694	0.444	0.369	0.534	0.202
1995	46362430	34807728	61752808	2733245	2395954	3118018	913465	774035	1078011	546888	0.599	0.385	0.313	0.472	0.207
1996	44366711	32888368	59851102	2913891	2529185	3357114	1050734	890464	1239852	299539	0.285	0.231	0.183	0.291	0.108
1997	30614980	22308091	42015115	3109586	2702367	3578168	1202604	1020210	1417608	284930	0.237	0.204	0.164	0.253	0.033
1998	22297832	16385183	30344080	3305175	2897976	3769590	1457160	1250548	1697908	384616	0.264	0.225	0.182	0.278	0.059
1999	71128595	52268664	96793693	3419483	3010863	3883560	1534937	1314646	1792142	362217	0.236	0.212	0.173	0.260	0.040

2000	47917915	35242045	65153045	4295163	3739093	4933930	1521185	1305976	1771857	372503	0.245	0.213	0.175	0.260	0.044
2001	86616423	63436883	118265659	4842782	4232075	5541618	2074021	1776003	2422048	385386	0.186	0.188	0.153	0.231	0.040
2002	44013194	32289776	59993021	5632140	4912935	6456629	2390469	2053864	2782239	407176	0.170	0.177	0.144	0.217	0.030
2003	21423521	15772669	29098896	5932759	5178596	6796752	2446087	2115366	2828512	494845	0.202	0.201	0.165	0.246	0.039
2004	25191067	18544637	34219588	5045463	4426124	5751465	2416909	2086127	2800141	583034	0.241	0.243	0.196	0.301	0.042
2005	23300841	17232319	31506449	4231216	3725909	4805052	2296737	1969478	2678375	632225	0.275	0.258	0.209	0.319	0.077
2006	27425944	20256851	37132249	3502544	3084463	3977293	1792282	1532558	2096020	504842	0.282	0.230	0.186	0.284	0.046
2007	26615385	19071057	37144178	2996633	2623860	3422367	1444105	1230135	1695291	364033	0.252	0.197	0.159	0.246	0.036
2008	26642014	18899893	37555605	3011654	2619605	3462376	1495543	1277781	1750417	252206	0.169	0.131	0.106	0.161	0.037
2009	36251815	26477662	49634067	3422904	2965567	3950770	1826661	1556729	2143397	183873	0.101	0.079	0.063	0.101	0.026
2010	36873364	26512636	51282904	3929411	3405560	4533841	1857979	1566863	2203184	193687	0.104	0.084	0.067	0.105	0.026
2011	33131664	23058320	47605688	4106165	3559957	4736177	2226630	1900624	2608556	236334	0.106	0.109	0.087	0.136	0.026
2012	30431840	20053848	46180510	4077522	3483873	4772328	2347825	1959619	2812936	401515	0.171	0.168	0.130	0.219	0.035
2013	22544462	12004609	42338136				1996101	1621304	2392041						

(1) Assessment output.
(2) At spawning time

Table 6.4.9.8 ("The Wonderful Table"). Herring caught in the North Sea. Catch in thousand tonnes in Subarea IV and in Divisions VIId and IIIa.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sub-Area IV and Division VIId: TAC (IV and VIId)														
Recommended Divisions IVa, b	265	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-	-	-	
Recommended Divisions IVc, VIId	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]	-	-	-	
Expected catch of spring spawners														
Agreed Divisions IVa,b [1]	240	240	223	340,5	393,9	460,7	404,7	303,5	174,6	147,4	149,0	173,5	360,4	427,7
Agreed Div. IVc, VIId	25	25	42,7	59,5	66,1	74,3	50,0	37,5	26,7	23,6	15,3	26,5	44,6	50,3
Bycatch ceiling in the small mesh fishery	36	36	36	52,0	38,0	50,0	42,5	31,9	18,8	16,0	13,6	16,5	17,9	14,4
CATCH (IV and VIId)														
National landings Divisions IVa,b [2]	261	272	261	354,5	427,7	502,3	439,2	326,8	201,2	145,0	148,1	191,7	387,2	
Unallocated landings Divisions IVa,b	35	2	24	23,7	36,9	49,6	13,3	21,9	14,0	-1,1	0,0	0,0	-3,0	
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	0	
Total catch Divisions IVa,b [4]	296	273	303	382,3	481,6	564,6	454,0	348,8	215,4	143,9	148,1	191,7	384,2	
National landings Divisions IVc, VIId [3]	23	24	43	59,5	56,5	66,1	51,2	34,3	26,5	21,5	26,5	26,7	37,1	
Unallocated landings Divisions IVc,VIId	27	26	7	8,2	12,0	8,2	5,4	4,7	3,1	0,4	0	0	3,3	
Discard/slipping Divisions IVc, VIId [3]	-	-	0	-	-	-	-	-	-	-	-	-	-	
Total catch Divisions IVc, VIId	50	50	50	67,7	68,5	74,3	56,6	39,0	29,6	21,9	26,5	26,7	40,4	
Total catch IV and VIId as used by ICES [4]	**346**	**323**	**353**	**450,0**	**550,1**	**638,9**	**510,62**	**387,8**	**245,0**	**165,8**	**174,6**	**218,4**	**424,6**	
CATCH BY FLEET/STOCK (IV and VIId) [7]														
North Sea autumn spawners directed fisheries (Fleet A)	322	296	323	434,9	529,5	610,0	487,1	379,6	236,3	152,1	164,8	209,2	411,8	
North Sea autumn spawners industrial (Fleet B)	18	20	22	12,3	13,6	21,8	11,9	7,1	8,6	9,8	9,1	8,9	10,6	
North Sea autumn spawners in IV and VIId total	**339**	**317**	**346**	**447,2**	**543,0**	**631,9**	**499,0**	**386,7**	**244,9**	**161,9**	**173,9**	**218,1**	**422,5**	
Baltic-IIIa-type spring spawners in IV	7	6	7	2,8	7,1	7,0	11,0	1,1	0,1	3,9	0,8	0,3	2,1	
Coastal-type spring spawners	0,1	1,2	0,1	0,1	0,1	0,1	0,1	0,0	0,0	0,0	0,1	0,0	0,1	
Norw. Spring Spawners caught under a separate quota in IV [14]	26	7	4	1,0	0,5	0,4	0,6	0,7	2,7	44,6	56,9	12,2	9,6	
Division IIIa: TAC (IIIa)														
Predicted catch of autumn spawners	53	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-	
Recommended spring spawners	-[12]	-[12]	-[12]	-[12]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-[15]	-	
Recommended mixed clupeoids	-	-	-	-	-	-	-	-	-	-	-			
Agreed herring TAC	80	80	80	80,0	70,0	96,0	81,6	69,4	51,7	37,7	33,9	30,0	45,0	55,0
Agreed mixed clupeoid TAC														
Bycatch ceiling in the small mesh fishery	21	21	21	21,0	21,0	24,2	20,5	15,4	11,5	8,4	7,5	6,7	6,7	6,7
CATCH (IIIa)														
National landings	108	90	79	76,0	61,1	90,8	88,9	47,3	38,2	38,8	37,3	20,0	27,7	
Catch as used by ICES	99	82	73	68,1	52,7	69,6	51,2	47,4	38,2	38,8	37,3	20,0	27,7	
CATCH BY FLEET/STOCK (IIIa) [7]														
Autumn spawners human consumption (Fleet C)	36	34	17	24,1	13,4	22,9	11,6	16,4	9,2	5,1	12,0	6,6	7,8	
Autumn spawners mixed clupeoid (Fleet D) [13]	13	12	9	8,4	10,8	9,0	3,4	3,4	3,7	1,5	1,8	1,8	4,4	
Autumn spawners other industrial landings (Fleet E)														
Autumn spawners in IIIa total	**49**	**46**	**26**	**32,5**	**24,2**	**31,9**	**15,0**	**19,8**	**12,9**	**6,5**	**13,8**	**8,4**	**12,2**	
Spring spawners human consumption (Fleet C)	45	33	38	31,6	16,8	32,5	30,2	25,3	23,0	29,4	23,0	10,8	14,5	
Spring spawners mixed clupeoid (Fleet D) [13]	5	3	9	4,0	11,2	5,1	5,9	2,3	2,2	2,9	0,5	0,8	1,0	
Spring spawners other industrial landings (Fleet E)														
Spring spawners in IIIa total	**50**	**36**	**47**	**35,6**	**28,0**	**37,6**	**36,1**	**27,6**	**25,2**	**32,3**	**23,5**	**11,6**	**15,5**	
North Sea autumn spawners Total as used by ICES	**388**	**363**	**372**	**479,7**	**567,2**	**663,8**	**514,6**	**406,5**	**257,9**	**168,4**	**187,6**	**226,5**	**434,6**	

1 IVa,b and EC zone of IIa. 2 Provided by Working Group members. 3 Incomplete, only some countries providing discard information. 4 Includes spring spawners not included in assessment. 5 Based on F=0.3 in directed fishery only; TAC advised for IVc, VIId subtracted. 6 130-180 for spring spawners in all areas. 7 Based on sum-of-products (number x mean weight at age). 8 Status quo F catch for fleet A. 9 The catch should not exceed recent catch levels. 10 During the middle of 1996 revised to 50% of its original agreed TAC. 11 Included in IVa,b. 12 Managed in accordance with autumn spawners. 13 Fleet D and E are merged from 1999 onwards. 14 These catches (including local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area. 15 See catch option tables for different fleets.

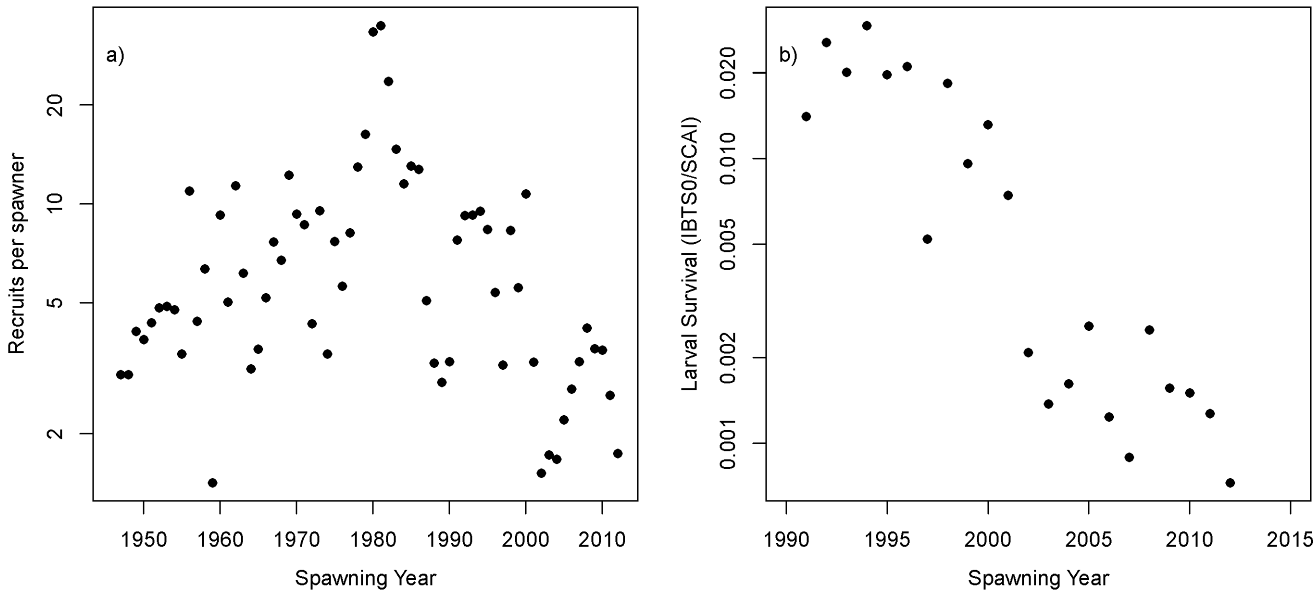

Figure 6.4.9.4 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Time-series of productivity indicators for the stock a) Recruits per spawner from the assessment b) Larval survival ratio (Dickey-Collas *et al.*, 2005; Payne *et al.*, 2009), defined as the ratio of the SCAI index (representing larvae less than 10–11 mm) and the IBTS0 index (representing the late larvae, of approximately 20–30 mm. Note the logarithmic scale on both vertical axes.

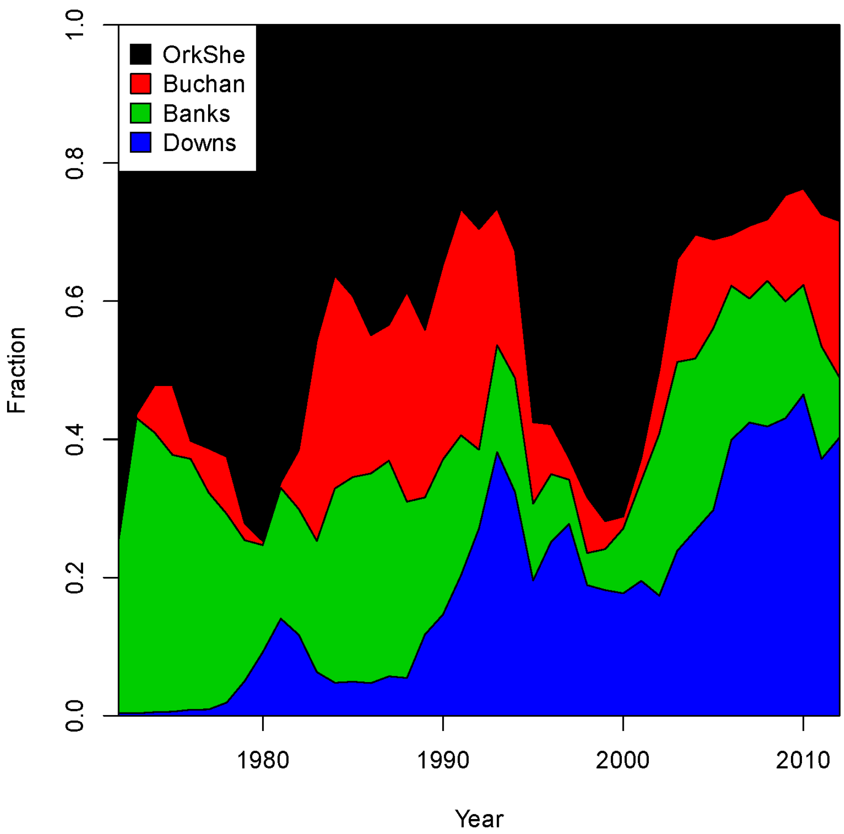

Figure 6.4.9.5 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Time-series of the contribution of each spawning component to the total stock, as estimated from the SCAI index (Payne, 2010). Areas are arranged from top to bottom according to the north-to-south arrangement of the components. Black: Orkney–Shetland component. Red: Buchan component. Green: Banks component. Blue: Downs component.

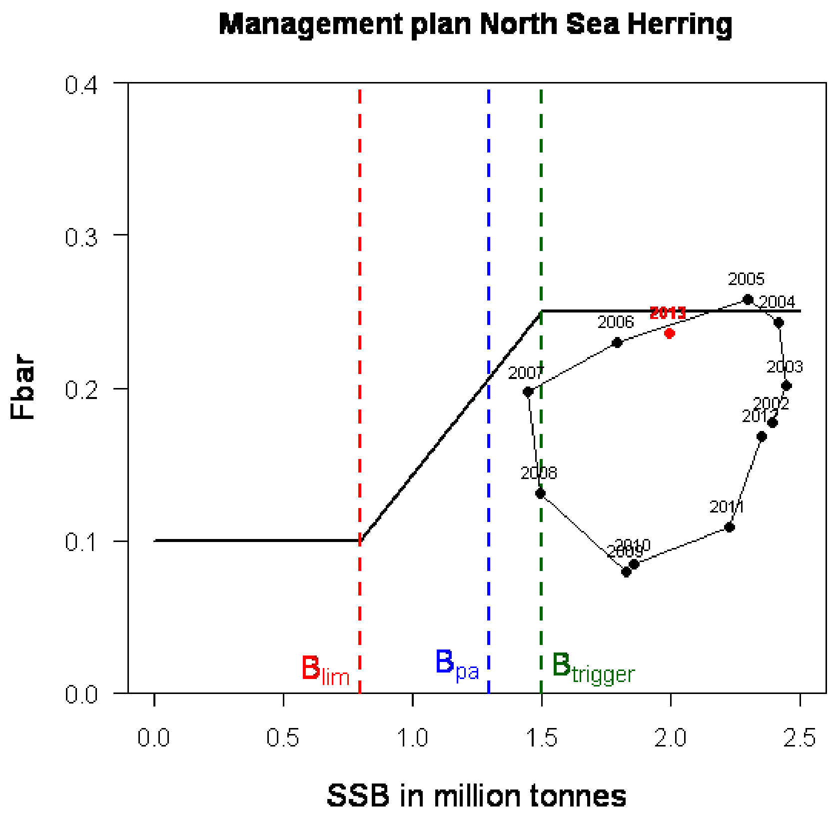

Figure 6.4.9.6 Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners). Current management plan for adult fishery (A-fleet, ages 2–6) including trigger biomass points. Black dots represent realised estimated fishing mortalities from 2002 until 2012. Fishing mortality in 2013 (red dot) is estimated from the short-term prediction, based on the agreed TACS for the A-fleet.

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
STOCK Horse mackerel (*Trachurus trachurus*) in Divisions IIIa, IVb,c, and VIId (North Sea stock)

Advice for 2014

New data on survey indices available for this stock do not change the perception of the stock; therefore, the advice for this fishery in 2014 is the same as the advice for 2013 (see ICES, 2012): Based on the ICES approach to data-limited stocks, ICES advises that landings should be no more than 25 500 t. Discards are known to take place but cannot be quantified; therefore total catches cannot be calculated.

Stock status

F (Fishing Mortality)		
	2010–2012	
Qualitative evaluation	?	Insufficient information

SSB (Spawning-Stock Biomass)		
	2011–2013	
Qualitative evaluation	?	Insufficient information

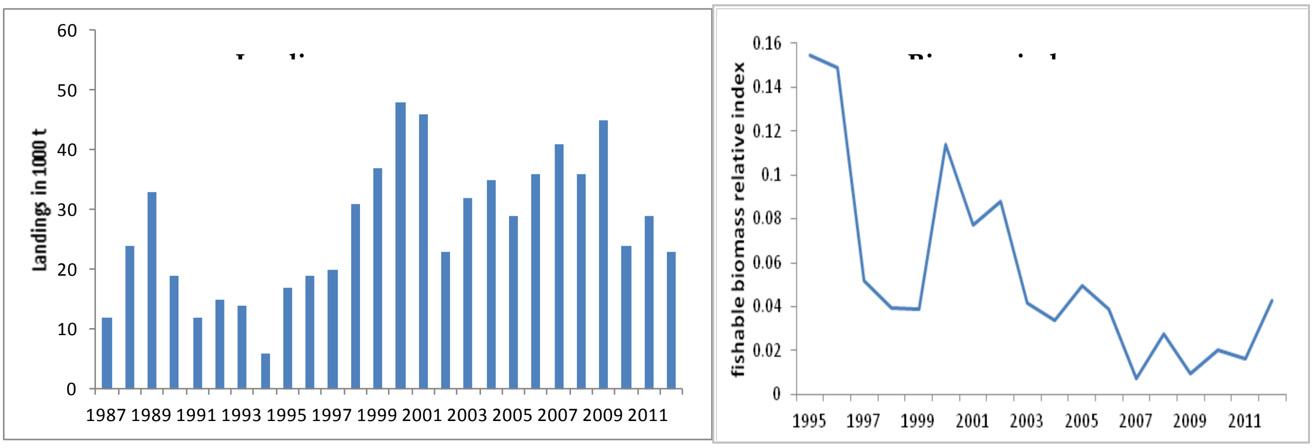

Figure 6.4.10.1 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Left: Landings from Divisions IIIa and IVa (quarters 1 and 2), IVb,c, and VIId (all quarters) (thousand tonnes). Right: Relative biomass index of fish ≥ 20 cm long (quarter 3 IBTS).

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. Landings in recent years (2010–2012) have been around 25 kt.

Management plans

No specific management objectives are known to ICES.

The fisheries

Catches by the Danish industrial fleet for reduction into fishmeal and fish oil formed the majority of North Sea horse mackerel catches throughout the 1970s and 1980s. Catches were taken in the fourth quarter, mainly in Divisions IVb and VIId. The 1990s saw a drop in the value of industrial resources, limited fishing opportunities, and steep increases in fuel costs. In 2001, an individual quota scheme was introduced in Denmark, which resulted in a rapid restructuring of the fleet. Since then the fleet size has been radically reduced and now numbers less than 20% that in the 1980s; additionally, Danish North Sea horse mackerel catches have diminished. Since the 1990s, a larger portion of catches has been taken in a directed horse mackerel fishery for human consumption by the Dutch and German freezer-trawler fleet. Denmark has traded a limited part of its quota with other EU member states for fishing opportunities for other species. However, since only a limited amount of quota is made available to other countries the TAC has been consistently underutilized in recent years (approximately 50% in 2010–2012).

Catch by fleet	Total landings (2012) = 21 426 tonnes (mainly mid-water trawl); discards are only partly quantified.

Quality considerations

The survey index which provides information on the development of the stock and its response to the fishery was available for the first time this year. The survey index has not been used as the basis for advice under the data-limited stocks (DLS) category 3, because the lack of measures of uncertainty limits interpretation of annual changes of this index.

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	Commercial landings (international landings, ages and length frequencies from catch sampling), one survey index (IBTS Q3).
Discards and bycatch	Discards are known to occur. Some discard data available from the Netherlands and Germany.
Indicators	None.
Other information	None.
Working group report	WGWIDE (ICES, 2013).

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 2014

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

ICES approach to data-limited stocks

The survey index, which provides information on the development of the stock and its response to the fishery, was available for the first time this year. The survey index has not been used as the basis for advice under DLS category 3, because the lack of measures of uncertainty limits interpretation of annual changes of this index. This implies that the information available does not significantly alter the perception of the stock from last year, and therefore the advice from 2012 which was to be applied for three years is still relevant.

Advice relates to landings. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

Additional considerations

The new information presented this year in the form of an exploitable biomass index was developed based on a new definition of an index area coinciding with the distribution area of the stock at the time of the IBTS Q3 survey being conducted. Further work on utilization of the developed index in developing an assessment model and TAC setting based on a HCR is planned. Additional data collection to this purpose is planned in cooperation with the industry. The aim is to improve the assessment of this stock to category 1 within 3–5 years.

Comparison with previous assessment and advice

Last year’s advice was based on average catches adjusted by the PA buffer. This year a new biomass index was available, which is considered more reliable than previously available indices. However, this year’s information does not significantly alter the perception of the state of the stock given the uncertainties and therefore last year’s advice still applies.

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.

Source

ICES. 2012. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 21–27 August 2012. ICES CM 2012/ACOM:16.
ICES. 2013. Report of the Working Group on Widely Distributed Stocks (WGWIDE), 27 August–02 September 2013. ICES CM 2013/ACOM:15.

Figure 6.4.10.3 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Age distribution in the catches of North Sea horse mackerel 1995–2011.

Table 6.4.10.1 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]	23
2013	Reduce catches by 20%	< 25.5	38	
2014	Same advice as last year	< 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 6.4.10.2 Horse mackerel in Divisions IIIa, IVb,c, and VIId (North Sea stock). Landings and discards (t) by Division.

Year	IIIa	IVa	IVb,c	Discards	VIId	**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
2012	1	4056	2596		14722	21375

[1]Divisions IIIa and IVb,c combined.

Table 6.4.10.3 North Sea horse mackerel. IBTS index of fishable biomass for fish ≥ 20 cm length.

	Fishable Biomass 20 cm+	Relative Index
1995	12016183.87	0.154327817
1996	11587486.14	0.148821911
1997	4050763.77	0.052025297
1998	3071869.49	0.039453034
1999	3020550.37	0.038793926
2000	8858869.43	0.113777385
2001	6029482.32	0.077438632
2002	6833491.88	0.087764793
2003	3264509.43	0.041927172
2004	2631894.20	0.033802286
2005	3860080.12	0.049576284
2006	3007696.15	0.038628835
2007	564070.50	0.007244544
2008	2155096.97	0.027678622
2009	755114.01	0.009698179
2010	1559471.94	0.020028813
2011	1273166.02	0.016351692
2012	3321629.15	0.04266078
SUM	77861425.74	1

ECOREGION North Sea
STOCK Lemon sole in Subarea IV and Divisions IIIa and VIId

Advice for 2014 and 2015

Based on the ICES approach for data limited stocks, ICES advises that landings should be no more than 4350 tonnes. Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Stock status

	F (Fishing Mortality)	
	2010–2012	
Qualitative evaluation		Insufficient information
	TSB (Total Stock Biomass)	
	2005–2012	
Qualitative evaluation		Increasing

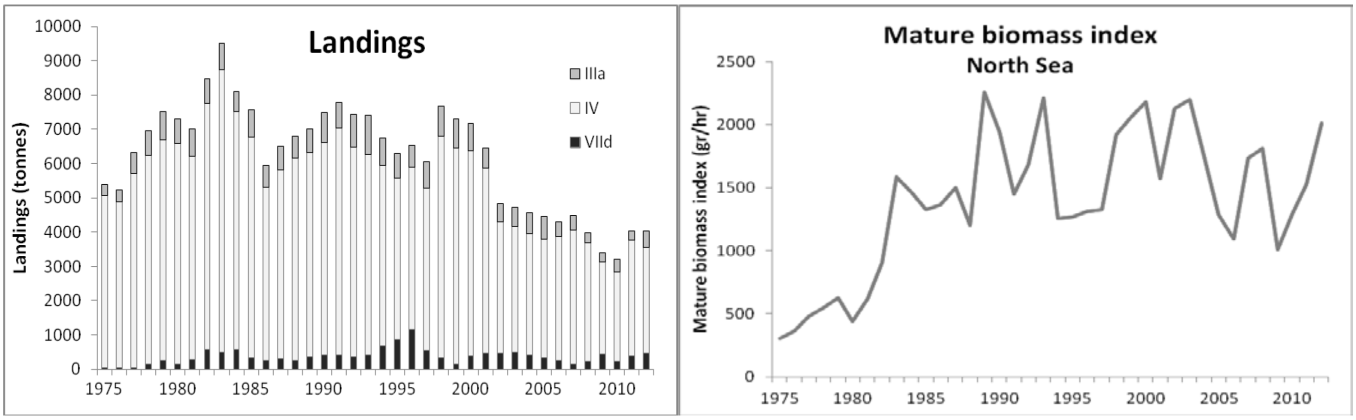

Figure 6.4.11.1 Lemon sole in Subarea IV and Divisions IIIa and VIId. Left: Official landings per area (in tonnes). Right: index for mature biomass for Subarea IV (g/hr from IBTSQ1).

Landing data show a declining long-term trend. The available survey information indicates mature biomass is variable and has been at a high level for the last 20 years. The stock size indicator (gr/hour) in the last three years (2010–2012) is 16% higher than the average of the five previous years (2005–2009).

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of ICES Division IIa and Subarea IV together with witch (ICES, 2013a).

Biology

Lemon sole is a widespread demersal species of shelf waters of the North Atlantic, from the White Sea and Iceland southward to the Bay of Biscay. In the English Channel, investigations of habitat association for plaice, sole, and lemon sole indicated that distribution was restricted to a few sites and that lemon sole appeared to prefer sandy and gravelly substrates, living deeper and at higher salinity and lower temperature than plaice or sole.

Lemon sole spawn in the northwest of the North Sea in April and spawning spreads north and east as the season progresses. There is little information available on lemon sole stock identity.

The fisheries

Lemon sole are generally caught in mixed fisheries by otter trawlers (~ 75%) and beam trawlers (~ 25%). There is no EU minimum landing size for lemon sole. However, individuals less than 25 cm are known to be discarded in some fisheries.

Quality considerations

In general, a great deal of data is already available for lemon sole and needs to be analyzed. Commercial catch samples would be required from all countries involved in the fisheries.

The advice is based on a biomass index used as an indicator of stock size. The uncertainty associated with the index values is not available. 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 based assessment (Data limited stock approach category 3.2.0)
Input data	Commercial catches (international landings), one survey index (IBTS Q1), annual maturity data from surveys
Discards and bycatch	Discards not included in the assessment and only available for some fleets.
Indicators	None.
Other information	None.
Working group report	WGNEW/WGNSSK (ICES, 2013b, 2013c)

ECOREGION **North Sea**
STOCK **Lemon sole in Subarea IV and Divisions IIIa and VIId**

Reference points

No reference points have been defined.

Outlook for 2014 and 2015

No analytic assessment can be presented. The main cause of this is lack of data (e.g. age, effort, and cpue data for countries that take the majority of landings). Therefore, fishing possibilities cannot be projected.

ICES approach to data-limited stocks

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

The stock size indicator (number/hour, based on the Q1 survey of the whole area) in the last three years (2010–2012) is 16% higher than the average of the five previous years (2005–2009). This implies an increase of landings of at most 16% in relation to the last three years average landings, corresponding to landings of no more than 4350 t.

Even though exploitation status is unknown, the effort of the main fleet with lemon sole bycatches (otter trawls) in the North Sea and Skagerrak has declined by 14% (TR1) and 45% (TR2) between 2004 and 2012. Therefore no additional precautionary reduction of catches is needed.

Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Additional considerations

Lemon sole is mainly a bycatch species in mixed fisheries. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

In general, there is a large amount of data already available for lemon sole, however commercial catch samples are needed from all countries involved in the fisheries to enable an analytic assessment. Survey data other than the IBTS should be analysed. Length and age at maturity data should be collated and analysed.

Comparison with previous assessment and advice

Last years advice was the same as the previous year and based on precautionary considerations. This year, the basis for the advice is the ICES approach to data limited stocks.

Sources

ICES. 2013a. Witch in Subarea IV and Divisions IIIa and VIId. *In* Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.4.31.

ICES. 2013b. Report of the Working Group on Assessment of New MoU Species (WGNEW) 18–22 March ICES HQ, Denmark, ICES CM 2013/ACOM:21.

ICES. 2013c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/ACOM:13

Table 6.4.11.1 Lemon sole in Subarea IV and Divisions IIIa and VIId. ICES advice, management, and landings.

Year	ICES Advice	Predicted catch/landings corresp. to advice	Agreed TAC[1)] Lemon sole & witch	Official landings Lemon sole & witch	Official landings Lemon sole
2006		-	6.175	6.593	4.290
2007		-	6.175	6.725	4.488
2008		-	6.793	5.929	3.975
2009		-	6.793	5.212	3.394
2010		-	6.521	4.691	3.201
2011		-	6.391	5.552	4.022
2012	No increase in catch	-	6.391	5.922	4.026
2013	No new advice, same as for 2012	-	6.391		
2014	No more than 16% increase in landings (last 3 years average)	< 4.350			
2015	No new advice, same as for 2014	< 4.350			

Weights in thousand tonnes.
[1)] EU combined TAC for lemon sole and witch in EU areas of ICES Division IIa and Subarea IV.

Table 6.4.11.2 Lemon sole in Subarea IV and Divisions IIIa and VIId. Official landings per area (in tonnes).

year	IIIa	IV	VIId	Total
1975	317	5029	33	5379
1976	361	4830	42	5233
1977	627	5661	36	6324
1978	705	6108	139	6952
1979	833	6428	260	7521
1980	722	6424	152	7298
1981	793	5933	290	7016
1982	735	7168	584	8487
1983	759	8257	491	9507
1984	595	6930	586	8111
1985	793	6435	347	7575
1986	639	5047	251	5937
1987	669	5516	310	6495
1988	642	5898	258	6798
1989	693	5967	364	7024
1990	872	6190	423	7485
1991	734	6618	428	7780
1992	952	6126	364	7442
1993	1152	5839	422	7413
1994	801	5262	695	6758
1995	712	4712	877	6301
1996	634	4737	1151	6522
1997	766	4727	563	6056
1998	865	6466	346	7677
1999	841	6316	140	7297
2000	802	5980	388	7170
2001	583	5389	483	6455
2002	518	3827	474	4819
2003	537	3688	491	4716
2004	602	3543	424	4569
2005	669	3444	350	4463
2006	417	3627	246	4290
2007	432	3892	164	4488
2008	276	3465	234	3975
2009	262	2691	441	3394
2010	351	2627	223	3201
2011	254	3365	403	4022
2012	483	3084	459	4026

Table 6.4.11.3 Lemon sole in Subarea IV and Divisions IIIa and VIId. Index for mature biomass for Subarea IV (g/hr from IBTSQ1).

Year	Mature biomass Index (gram/hour)
1975	304.96
1976	363.93
1977	480.82
1978	551.77
1979	628.39
1980	439.81
1981	618.91
1982	903.75
1983	1585.22
1984	1463.72
1985	1327.96
1986	1365.11
1987	1500.28
1988	1202.44
1989	2260.41
1990	1938.15
1991	1448.78
1992	1684.63
1993	2213.10
1994	1253.49
1995	1270.80
1996	1315.11
1997	1326.13
1998	1920.44
1999	2062.44
2000	2180.82
2001	1573.11
2002	2131.99
2003	2198.79
2004	1744.80
2005	1284.93
2006	1091.58
2007	1733.18
2008	1809.25
2009	1010.43
2010	1289.72
2011	1526.42
2012	2013.71

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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.12.1 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.

ECOREGION North Sea
STOCK Striped red mullet in Subarea IV (North Sea) and Divisions VIId (Eastern English Channel) and IIIa (Skagerrak–Kattegat)

Advice for 2014 and 2015

Based on ICES approach to data-limited stocks, ICES advises that catches should be no more than 460 tonnes. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)		
	2010–2012	
Qualitative evaluation	?	Insufficient information
SSB (Spawning-Stock Biomass)		
	2005–2012	
Qualitative evaluation	↘	Decreasing

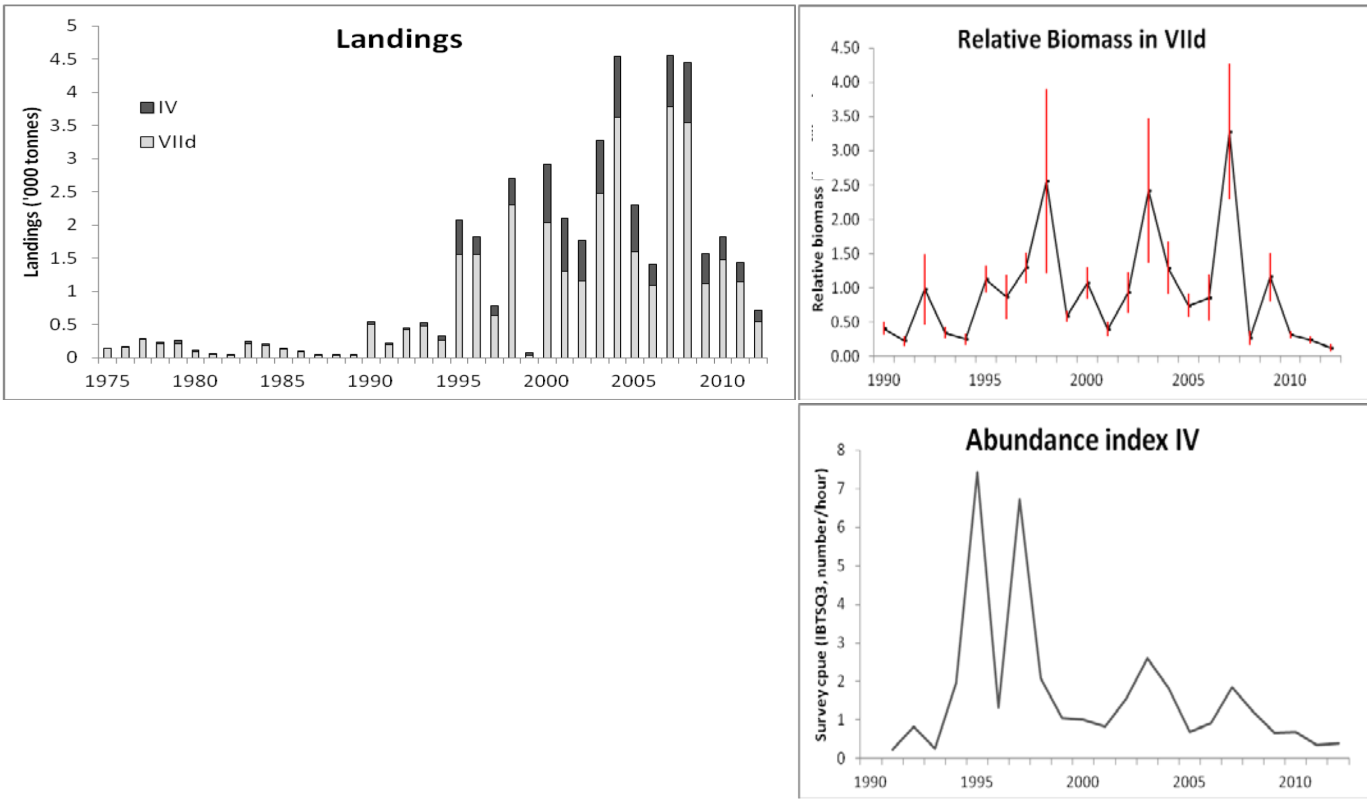

Figure 6.4.13.1 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Total landings by area (tonnes) (Note: no landings in Division IIIa, no data reported by France in 1999, 2012 is an ICES estimate). Top right panel: Relative biomass in Division VIId (Q4). Bottom: abundance in Subarea IV (Q3).

The stock is mainly fished in the eastern English Channel (Division VIId) and southern North Sea. Biomass estimates from Divison VIId show high variability and indicate a considerable decrease in the last three years. Abundance in the North Sea has also been low in recent years. The average of the stock size indicator (relative biomass) in the last two years (2011–2012) is 69% lower than the average of the three previous years (2008–2010). The landings follow a similar pattern over this period and have reduced since 2009.

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. Striped red mullet prefers sandy sediments.

The fisheries

Historically, most catches have been taken by bottom trawls in a targeted fisheries in Division VIId. 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-Q3 surveys provide abundance indices-at-age. No official landings were provided for 2012 because of an omission in the datacall.

The advice is based on a biomass index used as 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. 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 based assessment (Data-limited stock category 3.2.0).
Input data	Commercial catches (international landings), one survey index (CGFS).
Discards and bycatch	Discards are not included and are assumed negligible.
Indicators	Ages and length frequencies from commercial catches, IBTS-Q1.
Other information	IBTS-Q3 abundance index.
Working group report	WGNSSK (ICES, 2013).

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 2014 and 2015

No analytic assessment can be presented. Therefore, no catch projections are available. The advice last year was biennial and meant for 2013 and 2014. The advice is reopened given the very low biomass and abundance indices in the last years, the high decrease of commercial landings in the last years, and because there are directed fisheries.

ICES approach to data-limited stocks

For data-limited stocks for which a biomass/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 biomass is estimated to have decreased by more than 20% between the periods 2007–2009 (average of the three years) and 2010–2011 (average of the two years). This implies an decrease of catches of at most 20% in relation to the catches in the last year (ICES estimates for 2012), corresponding to catches in 2014 of no more than 575 t.

Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results in catches of no more than 460 t in 2014.

All catches are assumed to be landed.

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.*, 2013).

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 second 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 the ICES approach to data-limited stocks and was valid for 2013 and 2014. However, official landings for 2011 were incomplete at the time of the working group meeting. The advice was reopened this year because surveys show low recruitment in the last years.

Sources

Benzinou, A., Carbini, S., Nasreddine, K., Elleboode, R., and Mahé, K. 2013. Discriminating stocks of striped red mullet (*Mullus surmuletus*) in the Northwest European seas using three automatic shape classification methods. Fisheries Research, 143: 153–160.

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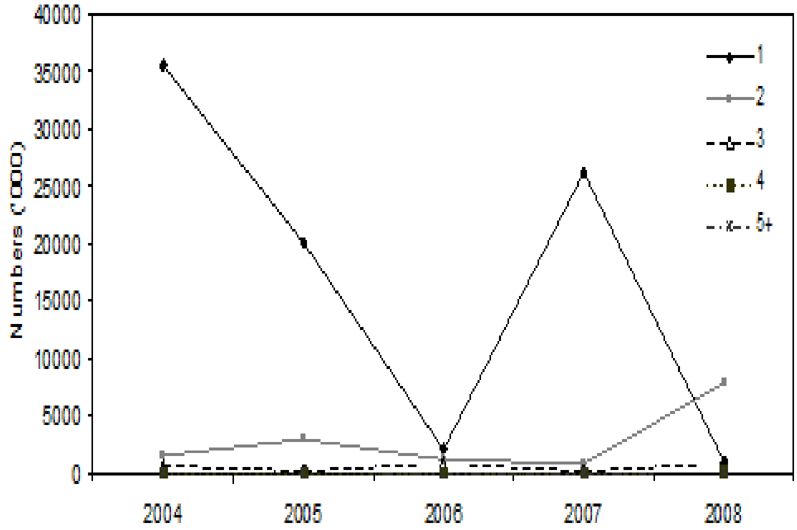

Figure 6.4.13.2 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Age composition of French landings in Divisions VIId and IVc (Eastern English Channel and Southern North Sea).

Table 6.4.13.1 **S**triped 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	1438
2012	No increase in catch	-	none	719 [1]
2013	No increase in catches (average 2009–2010)	< 1700	none	
2014	Reduce catches by 36% compared to 2012	< 460		
2015	Same catch advice as for 2014	< 460		

Weights in tonnes.
[1] ICES estimate.

Table 6.4.13.2 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Official and ICES landings by country (tonnes).

.Year	Belgium	Denmark	France	Netherlands	UK	total
1975	0	0	140	0	0	140
1976	0	0	156	3	1	160
1977	0	0	279	12	1	292
1978	0	0	207	25	3	235
1979	0	0	212	32	11	255
1980	0	0	86	25	4	115
1981	0	0	44	19	1	64
1982	0	0	32	18	2	54
1983	0	0	232	15	1	248
1984	0	0	204	0	3	207
1985	0	0	135	0	4	140
1986	0	0	84	0	3	88
1987	0	1	40	0	3	46
1988	0	1	35	0	4	41
1989	0	0	37	0	5	42
1990	0	0	524	0	13	537
1991	0	0	208	0	11	219
1992	0	0	431	0	14	445
1993	0	0	516	0	18	534
1994	0	0	308	0	14	322
1995	0	0	2016	0	63	2079
1996	0	1	1785	1	36	1824
1997	0	1	731	0	48	781
1998	0	1	2598	0	97	2697
1999[1)]	0	2	0	0	70	74
2000	0	2	2590	235	93	2922
2001	0	5	1417	533	142	2102
2002	0	12	1346	326	82	1778
2003	17	0	2750	396	115	3278
2004	22	0	3618	804	91	4535
2005	19	0	1595	600	81	2295
2006	12	0	1029	293	69	1403
2007	13	0	3475	906	161	4555
2008	15	0	3249	873	313	4450
2009	13	0	736	562	260	1571
2010	62	0	879	567	311	1819
2011	83	0	576	540	239	1438
2012[2)]	40[2)]	0	214[2)]	378[2)]	87[2)]	719[2)]

[1)] No data reported by France in 1999.
[2)] ICES estimates.

Table 6.4.13.3 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	303	0	1135	1438
2012[2)]	179[2)]	-	540[2)]	719[2)]

[1)] No data reported by France in 1999.
[2)] ICES estimates.

Table 6.4.13.4 Striped red mullet in Subarea IV and Divisions VIId and IIIa. Biomass index from GCFS survey Q4, with confidence intervals (high/low).

	Relative biomass	high	low
1990	411895	510540	313250
1991	221058	287222	154894
1992	976611	1489979	463243
1993	348533	426796	270270
1994	246888	333413	160363
1995	1128824	1329364	928285
1996	863418	1183266	543569
1997	1299280	1522173	1076387
1998	2560879	3905279	1216479
1999	588632	665315	511949
2000	1072609	1303495	841722
2001	394453	503306	285601
2002	934764	1231197	638331
2003	2421138	3476441	1365835
2004	1288929	1668664	909194
2005	743895	915624	572166
2006	860384	1205462	515307
2007	3276980	4265361	2288598
2008	271042	380081	162002
2009	1155871	1510042	801700
2010	319230	368025	270436
2011	236305	288785	183824
2012	126177	176826	75529

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Advice 2014

ICES advises on the basis of the MSY approach that landings in 2014 should be no more than 5019 tonnes in 2014. If total discard rates do not change from the average of the last three years (2010–2012), this implies total catches of no more than 8895 tonnes. Note that this figure includes discards expected to survive the discarding process – assumed to be 25% of the total number discarded for this stock.

If a discard ban is implemented, ICES advises on the basis of the MSY approach that catches should be no more than 7578 tonnes.

Stock status

	F (Fishing Mortality)			
	2010	2011	2012	
MSY (F_{MSY})	?	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
	SSB (Spawning-Stock Biomass)			
	2011	2012	2013	
Qualitative evaluation	→	↘	↗	Increasing

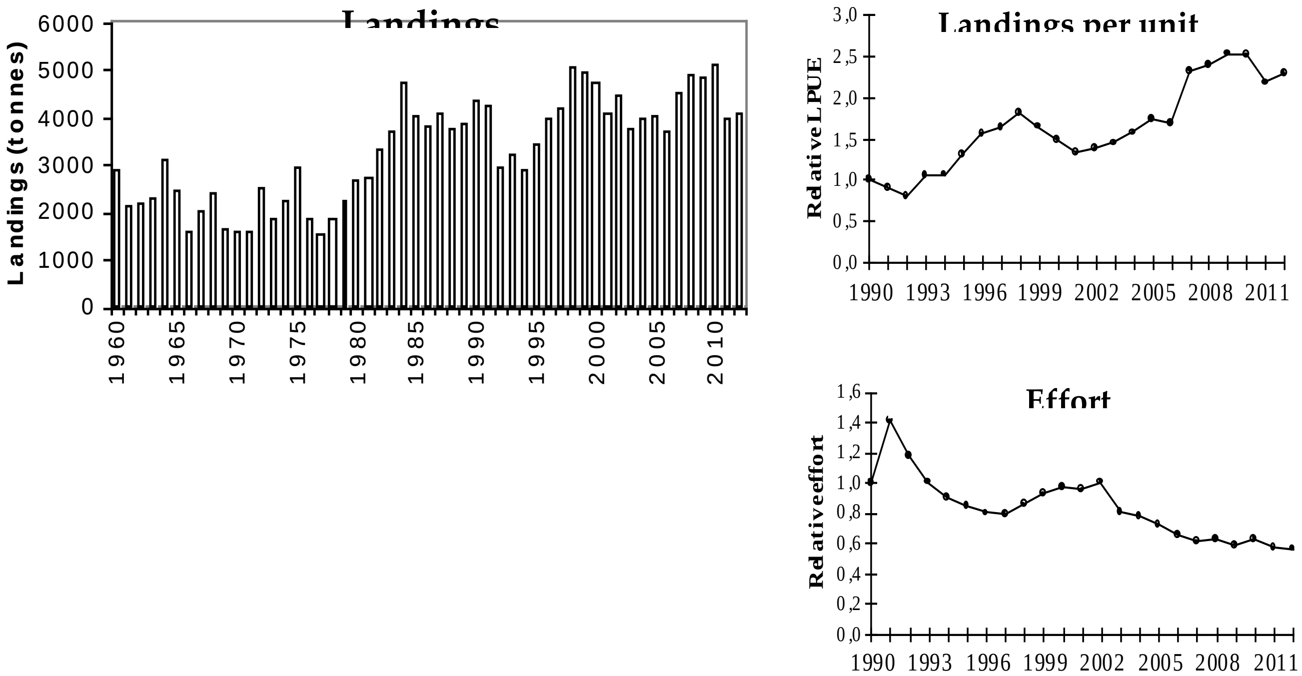

Figure 6.4.14.1 *Nephrops* in Division IIIa. Long-term trends in landings (in tonnes), landings per unit effort (lpue), and effort. Trends are relative to 1990 (= 1.0).

Estimates of absolute abundance, available for 2011 and 2012 from an underwater TV (UWTV) survey for the whole area, showed a 30% decrease. The landings per unit effort suggest an increase in biomass over the full time-series. The estimated harvest ratios of 5.0% (2011) and 8.2% (2012) 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 live in burrows in suitable muddy sediments and are characterized as being omnivorous. They emerge out of their burrows to feed; however, they are also able to sustain themselves by suspension feeding (in the burrows). There are differences between males and females regarding growth rates and behaviour. Males normally dominate the commercial catches due to more frequent emergence from their 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 unusually high catch rates of *Nephrops* were observed. The ability of *Nephrops* to suspension feed may contribute to maintaining a high production rate 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 operate 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 (CL), the proportion of the catch discarded is high. Cod, sole, and plaice are bycatch species in these fisheries in Division IIIa.

Catch distribution	Total catch (2012) = 9.2 kt, where 48% were landings (92% trawling, 8% creels) and total discards 52% (in weight).

Effects of the fisheries on the ecosystem

The high mud content and soft nature of sediments inhabited by *Nephrops* means that trawling severely 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 surveys in 2011 and 2012 were 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	Commercial catches (from logbook data). One survey index (UWTV), length–frequency data, and discard samples. One commercial index (lpue). Length frequencies (landings and discards) from at-sea onboard sampling. Annual maturity data from commercial catch samples. Natural mortalities from literature (Morizur, 1982).
Discards and bycatch	Discard rates from the *Nephrops* directed trawl fishery are available from 1991 and included in the assessment.
Indicators	None.
Other information	None.
Working group report	WGNSSK (ICES, 2013)

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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 2012)

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 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 discard proportions 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 which have a longer time-series, the UWTV survey 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 has only recently been 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 Additional information. All F_{MSY} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

Outlook 2014

$F_{2013} = F_{2012}$ = Harvest rate 8.2%; Bias-corrected survey index (2012) = 2526 million; Mean weight in landings (2010–2012) = 60.8 g; Discard proportion (total discards, in numbers, average 2010–2012) = 65.4 %; Discard survival = 25%; (= 49.1% dead discards in numbers); Survey bias = 1.1.

Basis	Total catches*	Landings	Dead discards**	Surviving discards**	Harvest rate
	L+DD+SD	L	DD	SD	for L+DD
	5629	3176	1918	535	5
	6756	3812	2302	642	6
MSY approach	8895	5019	3031	845	7.9
F_{2013}	9232	5209	3146	877	8.2
	10133	5717	3453	963	9
	11821	6670	4028	1123	10.5

Weights in tonnes.
* Total catches are the landings including dead and surviving discards.
** Total discard rate is assumed to be 65.4% of the catches (by number, average of last three years, 2010–2012), discard survival is assumed to be 25% (WKNEPH; ICES, 2009).

MSY approach

Since MSY $B_{trigger}$ has not been identified for this stock, the ICES MSY approach has been applied without considering SSB in relation to MSY $B_{trigger}$.

Following the ICES MSY approach implies a harvest ratio of 7.9%, resulting in landings of no more than 5019 t in 2014. If discard rates do not change from the average of the last three years (2010–2012, assuming 25% discard survival), this implies total catches in 2014 of no more than 8895 t.

Since the current harvest rate is only marginally above F_{MSY}, there is no need to apply a transition rule.

If a discard ban is implemented, the ICES MSY approach implies that a harvest ratio of 7.9% be applied to all catches (including the discards that have survived up to now), resulting in catches in 2014 of no more than 7578 t.

Additional considerations

The main reason for the high amount of discards (65% in numbers in 2012) is the high minimum landing size (40 mm CL) 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 ICES MSY approach. Because of the way *Nephrops* are assessed, it is not possible to estimate F_{MSY} directly and hence proxies for F_{MSY} are determined. Three candidates for F_{MSY} are $F_{0.1}$, $F_{35\%SPR}$, and F_{max}. Many stocks show a great difference in relative exploitation rate between the sexes. To account for this values for each of the candidates have been determined individually for males, females, and the two sexes combined. The appropriate F_{MSY} candidate has been selected for each functional unit (FU) independently according to the perception of stock resilience, factors affecting recruitment, population density, knowledge of biological parameters, and the nature of the fishery (relative exploitation of the sexes and historical harvest rate *vs.* stock status).

A decision-making framework based on the table below was used in the selection of preliminary stock-specific F_{MSY} proxies (ICES, 2010). These proxies may be modified following further data exploration and analysis. The combined-sex F_{MSY} proxy should be considered appropriate if the resulting percentage of virgin spawner-per-recruit for males or females does not fall below 20%. When this happens a more conservative sex-specific F_{MSY} proxy should be picked instead of the combined proxy.

		Burrow density (average burrows m^{-2})		
		Low < 0.3	Medium 0.3–0.8	High >0.8
Observed harvest rate or landings compared to stock status (historical performance)	$>F_{max}$	$F_{35\%SPR}$	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 2012 was conducted in the six main fishing areas in Division IIIa. To correct for 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 compositions in catches in the 1980s and 1990s. However, the distribution of *Nephrops* is continuous from the 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 EU 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 the increased use of this species-selective device and consequently a decrease in cod bycatch. The Swedish *Nephrops* quota is allocated to different gear categories (30% to creels, 50% to grid trawls, and the remaining 20% 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.

Since 1 February 2013, EU and Norway have agreed on new technical measures. This implies that *Nephrops* trawl fishery in the Skagerrak should use species-selective trawls (35 mm grid and 70 mm square mesh codend, or SELTRA trawls carrying 90 mm diamond mesh codends with large mesh panels). The mixed *Nephrops*/demersal fishery now has a minimum mesh size of 120 mm (diamond mesh).

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 led 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 CL. ICES is in the process of providing advice on the implications of decreasing the minimum landing size for *Nephrops* in the Skagerrak in 2013 as requested by the EU and Norway. Discards of *Nephrops* are known to be very high and any improvement in the size selectivity in 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 live in burrows in suitable muddy sediments and are characterized as being omnivorous. They emerge out of their burrows to feed, however, they are also able to sustain themselves as suspension feeders (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

The historical abundance is not revised from one year to the next because abundances are based on direct observation. Advice for 2014 is based on the MSY approach, similar to the advice for 2013.

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Table 6.4.14.1 *Nephrops* in Division IIIa. ICES advice, management, and landings.

Year	ICES advice	Predicted landings / catch corresp. to advice	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 approach	< 6.0	6.0	4.4
2013	MSY approach1)	< 5.2	5.2	
2014	MSY approach without discard ban (landings)	< 5.019		
	MSY approach with discard ban (catches)	< 7.578		

Weights in thousand tonnes.

1) In 2011, biennial advice was given for both 2012 and 2013. In 2012, new advice was drafted for 2013 because new information was available.

Table 6.4.14.2 *Nephrops* in Division IIIa. Official landings per country, total discards, and total catch (tonnes).

Year	Denmark	Norway	Sweden	Germany	Total landings	Total disc.	Total catch
1991	2824	185	1219		4228	5183	9411
1992	2052	104	749		2905	2523	5428
1993	2250	103	859		3212	8493	11705
1994	2049	62	763		2874	6450	9324
1995	2419	90	918		3427	4464	7891
1996	2844	102	1034		3980	2148	6128
1997	2959	117	1130		4206	3469	7675
1998	3541	184	1319	12	5056	1944	7000
1999	3486	214	1243	6	4949	4108	9057
2000	3325	181	1197	7	4710	5664	10374
2001	2880	138	1037	1	4056	3767	7823
2002	3293	116	1032	7	4448	4311	8760
2003	2757	99	898	13	3767	2208	5975
2004	2955	95	903	12	3965	2532	6497
2005	2901	83	1048	2	4034	3014	7048
2006	2432	91	1143	6	3672	2926	6598
2007	2887	145	1467	13	4512	6524	11036
2008	3174	158	1509	19	4860	4746	9606
2009	3372	128	1331	15	4846	6129	10975
2010	3721	124	1249	29	5123	3548	8671
2011	2937	87	945	17	3986	2847	6833
2012	2970	104	1355	0	4429	4771	9200

Table 6.4.14.3 *Nephrops* in Division IIIa. Assessment data, discard proportion, and mean weight in catches and landings.

Year	TV abundance index (million)	Total discard ratio (number)	Dead discard ratio (number)	Dead discard ratio (weight)	Mean weight Landings (g)	Mean weight Catches (g)	Mean weight Discards (g)	Numbers removed (millions)	Observed harvest rate
2010	*	63.8%	47.8%	29.7%	66.0	40.5	26.0	180	
2011	3577	62.6%	47.0%	31.2%	60.5	38.7	25.8	149	5.0
2012	2526	69.8%	52.3%	38.8%	55.9	35.1	26.1	216	8.2
Average		65.4%	49.1%	33.2%	60.8	37.9	25.9	182	

* TV survey in Division IIIa started with coverage of the whole area in 2011.

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 6.4.15.1). The advice summary for *Nephrops* stocks is given by functional units in Sections 6.4.15.1–9.

Section	FU no.	Name	ICES division	Statistical rectangles
6.4.15.1*	5	Botney Gut – Silver Pit	IVb,c	36–37 F1–F4; 35 F2–F3
6.4.15.2	6	Farn Deeps	IVb	38–40 E8–E9; 37 E9
6.4.15.3	7	Fladen Ground	IVa	44–49 E9–F1; 45–46 E8
6.4.15.4	8	Firth of Forth	IVb	40–41 E7; 41 E6
6.4.15.5	9	Moray Firth	IVa	44–45 E6–E7; 44 E8
6.4.15.6*	10	Noup	IVa	47 E6
6.4.15.7*	32	Norwegian Deep	IVa	44–52 F2–F6; 43 F5–F7
6.4.15.8*	33	Off Horn's Reef	IVb	39–41 F5–F6
6.4.15.9*	34	Devil's Hole	IVb	41–43 F0–F1

* The advice for these stocks is biennial advice for 2013 and 2014.

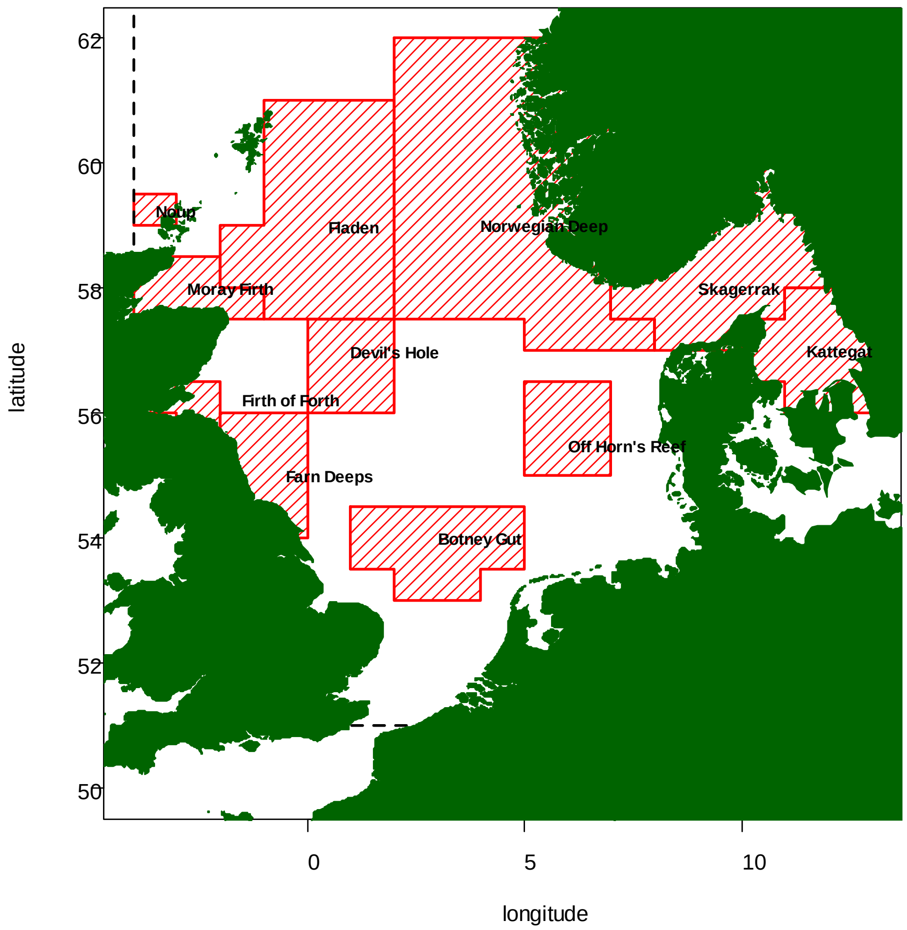

Figure 6.4.15.1 *Nephrops* functional units in the North Sea and Skagerrak/Kattegat region (see Section 6.4.13).

Summary of advice for 2014

A summary of the advice can be found in Table 6.4.15.1. The advice is based on landings but this year ICES states explicitly the total catches (landings + dead and surviving discards) that occur with the landing options in the advice for those FUs where this can be calculated.

In order to ensure the stocks are exploited sustainably in the different FU's, management should be implemented at the functional unit level.

There is no information available on the trends in the stock or exploitation status for the rectangles outside the FUs for which ICES provides advice ('other rectangles'). Advice for the FUs in the North Sea show increases as well as decreases. ICES advises that the catches in the other rectangles should not change from the 2012 landings of 608 tonnes.

Table 6.4.15.1 *Nephrops* in Subarea IV. Summary of ICES advice (landings) 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	9.6
1993	2.4		2.7		4.17		0.87				10.2	12.0	12.6
1994	2.4		5.0		4.17		0.87				12.5	13.0	14.3
1995	2.4		5.0		4.17		0.87				12.5	15.2	14.5
1996	2.4		5.0		4.17		0.87				12.5	15.2	13.5
1997	2.4		5.0		4.17		0.87				12.5	15.2	15.0
1998	2.4		7.0		4.17		1.0				14.6	15.2	13.6
1999	2.4		7.0		4.17		1.0				14.6	15.2	16.4
2000	1.85		9.0		4.17		1.6				16.7	17.2	14.9
2001	1.85		9.0		4.17		1.6				16.7	15.48	15.7
2002	2.0		9.0	1.2	4.17		2.1				18.5	16.623	16.7
2003	2.0		9.0	1.2	4.17		2.1				18.5	16.623	15.8
2004	2.0		12.8	1.5	4.17		2.38				22.9	21.350	18.7
2005	2.0		< 12.8	1.5	4.17		2.38				22.9	21.350	17.6
2006	-		-	NA	-		2.38				-[5]	28.147	24.7
2007	2.4	0.2	< 10.9	NA	3.5	1.5	NA	NA		24.6 [6]	-[5]	26.144	24.7
2008	2.4	0.2	< 10.9	NA	3.5	1.5	NA	NA		9.5 [6]	-[5]	26.144	22.1
2009	< 1.8	< 0.24	< 11.3	[3]	< 3.0	< 2.5	[3]	[3]		< 1.4	-[5]	24.837	24.6
2010	< 1.4	< 0.24	< 16.4	[4]	< 1.2	< 1.6	[4]	[4]		< 1.5	-[5]	24.688	20.9
2011	< 1.3	NA	< 13.3	[7]	< 1.9	< 2.0	[7]	[7]		< 1.9	-[5]	23.454	16.9
2012	< 1.1	[8]	< 14.1	[8]	< 1.4	< 1.7	[8]	[8]		[9]	-[5]	21.929	13.5
2013	< 0.95	< 0.05	< 10	< 0.8	< 1.4	< 1.4	< 1.0	< 1.1	< 0.6	< 0.82	-[5]	17.350	
2014	<0.739	[4]	<8.959	[4]	<1.173	<1.417	[4]	[4]	[4]	<0.608	-[5]		

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-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the main limiting species for the North Sea demersal fisheries in 2014. The 'minimum' and 'cod' scenarios of the mixed-fisheries analyses are both consistent with the single-species advice for cod. The current single-stock *Nephrops* advice for each of the functional units (with the exception of FU 6) 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 6.4.15.2 *Nephrops* in Subarea IV. Landings of *Nephrops* according to single-stock advice and under different mixed-fisheries scenarios (ICES, 2013b).

FU	Moray Firth 9	Noup 10	Fladen Ground 7	Nor-wegian Deeps 32	Farn Deeps 6	Firth of Forth 8	Botney Gut – Silver Pit 5	Off Horn's Reef 33	Devils Hole 34	Other rec-tangles [2)]
*Single-stock Advice**	0.739	0.050	8.959	0.800	1.173	1.417	1.000	1.100	0.600	0.608
Mixed-fisheries scenarios										
Maximum	1.731	0.080	9.223	1.116	4.847	4.187	1.594	1.754	0.957	0.969
Minimum	0.425	0.019	2.164	0.269	1.190	1.039	0.384	0.423	0.231	0.234
Cod MP	0.434	0.020	2.211	0.275	1.216	1.062	0.393	0.432	0.236	0.239
SQ effort	0.867	0.039	4.417	0.549	2.430	2.121	0.785	0.863	0.471	0.477
Effort	0.266	0.013	1.322	0.176	0.842	0.725	0.252	0.277	0.151	0.153

Weights in thousand tonnes. *Advised landings no more than the indicated value

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. Functional Unit TAC management is therefore only one way of managing the fisheries and other approaches may also deliver the required safeguards. 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.

MSY approach

No precautionary reference points have been defined for *Nephrops*. Under the ICES MSY approach, 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 <0.3	Medium 0.3–0.8	High >0.8
Observed harvest rate or landings compared to stock status (historic performance)	> 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, unless the stock has shown signs of stress at higher abundance (in which case a higher value is used).

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 has resulted in reduced predation by cod. 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 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. However, for 2013, the European Council decided upon a roll-over of effort level of 2012 into 2013 for both the cod and the sole/plaice management plan.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill/trammel nets and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, -16% between 2008 and 2012). 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 and in small mesh beam trawl (80–120 mm, BT2), has shown a pronounced decline (−14%, −45%, and −48%, respectively, between 2004 and 2012). Gill and trammel nets fisheries have remained stable (ICES, 2013b). Effort in large mesh size beam trawl (>=120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline. Nominal effort reported by Norway has increased since 2011 due to the generalization of electronic logbooks.

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 was 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%.

At the Nephrops benchmark meeting in February 2013 (ICES, 2013c WKNEPH), stocks in Functional Units 6, 32 and 34 were examined. For FU 6 new maturity estimates were presented along with a more detailed analysis concerning the possibility of sperm limitation in depleted stocks. For FU 32 available data sources were investigated, but the assessment was not changed. For FU34, a detailed analysis of spatial distribution of the fishing grounds was presented leading to an improved methodology for determination of the TV abundance at this FU.

Information from the fishing industry

Trends according to the Fishers' North Sea stock survey (Figure 6.4.15.2) 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 75% of the North Sea *Nephrops* landings in 2012. Landings from outside the FUs accounted for 4.4% of total landings in 2012. 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 for FUs assessed annually and updated where significant change in fishing practice is observed to have occurred.

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 surveys has not changed from last year. The MSY approach and transition are used based on the situation of the stock.

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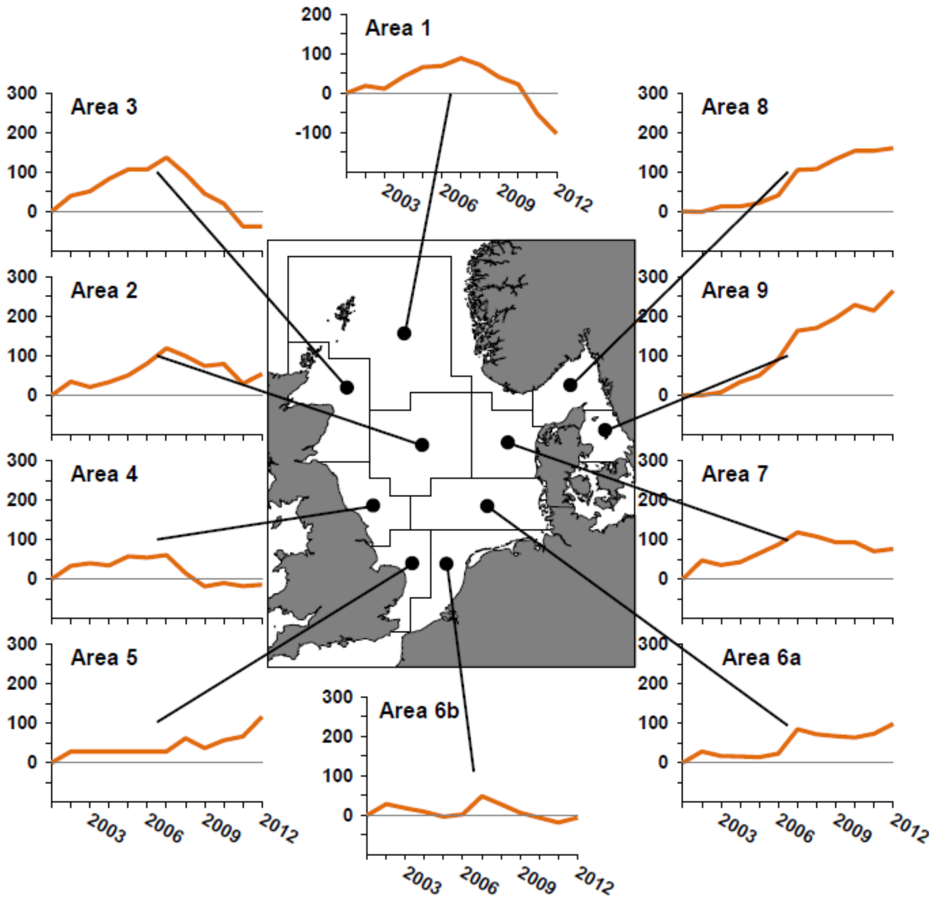


Figure 6.4.15.2 *Nephrops* in Subarea IV. Results of the North Sea Commission fishers' survey perceptions of the abundance 2012 (Napier, 2012).

Table 6.4.15.3 *Nephrops* in Subarea IV. Officially reported landings (tonnes) by functional unit plus other rectangles.

Year	FU 5	FU 6	FU 7	FU 8	FU 9	FU 10	FU 32	FU 33	FU 34	Other **	Total
1981		1073	373	1006	1416	36				76	3980
1982		2524	422	1195	1120	19				157	5437
1983		2078	693	1724	940	15				101	5551
1984		1479	646	2134	1170	111				88	5628
1985		2027	1148	1969	2081	22				139	7386
1986		2015	1543	2263	2143	68				204	8236
1987		2191	1696	1674	1991	44				195	7791
1988		2495	1573	2528	1959	76				364	8995
1989		3098	2299	1886	2576	84				233	10176
1990		2498	2537	1930	2038	217				222	9442
1991	862	2063	4223	1404	1519	196				560	10827
1992	612	1473	3363	1757	1591	188				401	9385
1993	721	3030	3493	2369	1808	376	339	160		434	12730
1994	503	3683	4569	1850	1538	495	755	137		703	14233
1995	869	2569	6440	1763	1297	280	489	164		844	14715
1996	679	2483	5217	1688	1451	344	952	77		808	13699
1997	1149	2189	6171	2194	1446	316	760	276		662	15163
1998	1111	2177	5136	2145	1032	254	836	350		694	13735
1999	1244	2391	6521	2205	1008	279	1119	724		988	16479
2000	1121	2178	5569	1785	1541	275	1084	597		900	15050
2001	1443	2574	5541	1528	1403	177	1190	791		1268	15915
2002	1231	1954	7247	1340	1118	401	1170	861		1383	16705
2003	1144	2245	6294	1126	1079	337	1089	929		1390	15633
2004	1070	2153	8729	1658	1335	228	922	1268		1224	18587
2005	1099	3094	10685	1990	1605	165	1089	1050		1120	21897
2006	974	4903	10791	2458	1803	133	1028	1288		1249	24627
2007	1294	2966	11910	2652	1842	155	755	1467		1637	24678
2008	963	1218	12240	2450	1514	173	675	1444		1673	22350
2009	728	2703	13327	2662	1067	89	477	1163		2367	24583
2010	959	1443	12825	1871	1032	38	407	806	865	709	20955
2011	1053	2070	7558	1888	1391	68	395	1191	432	1166	17212
2012*	1240	2460	4369	2091	860	13	310	1084	597	608	13632

* Provisional.

** Devil's Hole landings only separated from 2011.

ECOREGION North Sea
STOCK ***Nephrops* in Botney Gut–Silver Pit (FU 5)**

Advice for 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 1000 tonnes.*

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Scientific basis

Assessment type	Data-limited method for *Nephrops* (category 4.1.4).
Input data	Commercial catches (international landings and length frequencies from Dutch catch sampling), two survey indices (two UWTV estimates of density per m^2 in 2010 and 2012), Habitat extent from VMS analysis and sediment maps.
Discards and bycatch	Discards are assumed to be similar to those observed in FU6.
Indicators	None.
Other information	None.
Working group report	WGNSSK (ICES, 2013a)

Sources

ICES. 2012. *Nephrops* in Botney Gut–Silver Pit (FU 5). *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.14.1.

Table 6.4.15.1.1 *Nephrops* in Botney Gut–Silver Pit (FU 5). ICES advice and landings.

Year	ICES advice	Predicted landings corresp. to advice	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	-	1.2
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.

ECOREGION **North Sea**
STOCK ***Nephrops* in Farn Deeps (FU 6)**

Advice for 2014

ICES advises on the basis of the MSY transition that landings in 2014 should be no more than 1173 tonnes. If total discard rates do not change from the average of the last 3 years (2010–2012), this implies total catches of no more than 1329 tonnes. Note that this figure includes discards expected to survive the discarding process – assumed to be 15% of the total number discarded for this stock.

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)				
	2010	2011	**2012**	
MSY (F_{MSY})	✗	✗	✗	Above
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)				
	2010	2011	**2012**	
MSY ($B_{trigger}$)	✗	✓	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

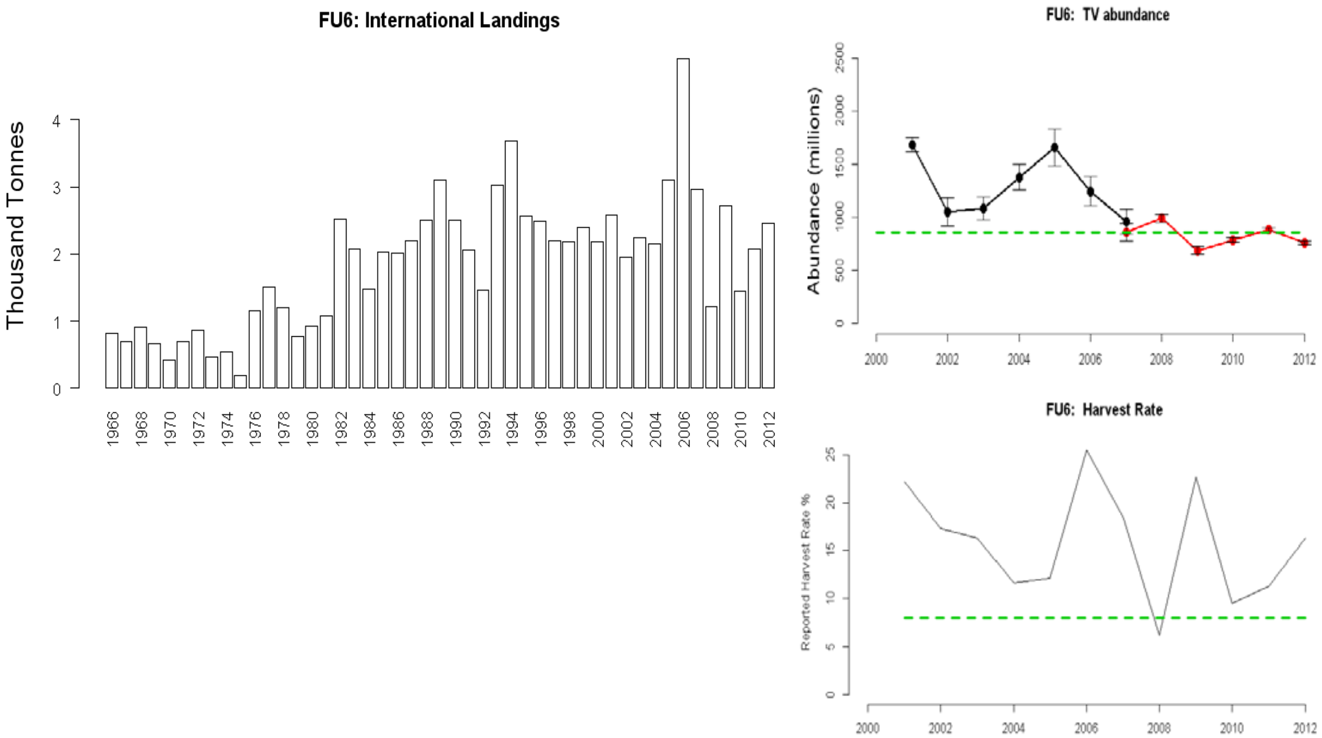


Figure 6.4.15.2.1 *Nephrops* in Farn Deeps (FU 6). Long-term trends in landings, harvest rate, and UWTV abundance (used as F and SSB proxies. Weights in thousand tonnes, UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. For the UWTV abundance calculation a geostatistical method has been determined from 2007 onwards (red line).

The UWTV survey indicates that the stock status has declined since 2005 and has been fluctuating near MSY $B_{trigger}$ since 2007. 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.

Catch distribution	Total catch (2012) = 2805 t, of which 87.7% landings (almost entirely taken in demersal trawl fisheries, either a directed *Nephrops* or a mixed *Nephrops*/demersal fishery), 12.3% discards in weight.

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. The method used to raise the abundances in years prior to 2007 has been found to be statistically flawed and a raising procedure has been developed to avoid these errors. 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.

Revisions in 2013 of UWTV abundances (going back to 2007) have made small (<5%) changes in the series, including the 2007 point used as the MSY Btrigger point, however the general conclusions about stock status remain unchanged.

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. Commercial catches (international landings and length frequencies from English catch sampling), one survey index (FU6 UWTV). Maturity data from (commercial catch sampling), Natural mortalities from Morizur (1982)
Discards and bycatch	Discards included in the assessment since 2000, from English trawls (TR1 & TR2)
Indicators	None.
Other information	Latest benchmark was performed in 2013 (ICES, 2013c)).
Working group report	WGNSSK (ICES, 2013a)

6.4.15.2 Supporting information June 2013

ECOREGION North Sea
STOCK *Nephrops* in Farn Deeps (FU 6)

Reference points

	Type	*Value*	*Technical basis*
MSY	MSY $B_{trigger}$	858 million	UWTV survey index at start of current decline (2007) as measured by a geostatistical method.
Approach	F_{MSY}	Harvest rate 8.1%.	Equivalent to $F_{35\%SPR}$ males in 2011.
Precautionary	$F_{0.1}$	Not agreed.	
Approach	F_{max}	Not agreed.	

(Changed in 2013)

Harvest rate reference points (2013):

	Male	Female	Combined
F_{max}	11.6 %	21.6 %	15.3 %
$F_{0.1}$	7.1%	14.0 %	8.7 %
$F_{35\%SPR}$	8.1 %	15.2 %	11.1 %

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 = 8.1%). New size at maturity data were analyzed at the 2013 benchmark leading to revisions in the harvest rate reference points.

Outlook for 2014

Basis: $F_{2010\text{-}2012}$ = average harvest rate over 2008–2010 = 12.3 %; Bias-corrected survey index (2014=2012) = 758 million; Mean weight in landings (2010–2012) = 25.56 g; Mean weight in discards (2010–2012) = 11.10g,

Basis	Total Catches*	Landings	Dead Discards**	Surviving Discards**	Harvest Rate
	L+DD+SD	L	DD	SD	for L+DD
	348	307	35	6	2%
	697	615	70	12	4%
MSY approach	1234	1091	130	23	7.2%
MSY Transition	1329	1173	133	23	7.6%
F_{MSY}	1414	1248	141	25	8.1%
	1568	1383	157	28	9%
	1915	1690	191	34	11%
	2090	1844	209	37	12%
$F_{2010\text{-}2012}$	2142	1890	214	38	12.3%
	2612	2305	261	46	15%
	3482	3073	348	61	20%

Weights in tonnes.
* Total catches are the landings including dead and surviving discards
** Total discard rate is assumed to be 24.34% of the catches (in number, last 3 years average, 2010–2012), discard survival is assumed 15% (ICES, 2013c).

MSY approach

Following the ICES MSY approach implies a harvest rate of 7.2% (below FMSY because biomass is below MSY Btrigger), resulting in landings of 1091 t in 2014.

Following the transition scheme towards the ICES MSY approach implies fishing mortality to be reduced to ($0.2*F_{2010} + 0.8*(F_{MSY}*(SSB2014/MSYB_{trigger}))$ = 7.6% (biomass is just below MSY $B_{trigger}$, so no additional reductions are considered relevant), corresponding to landings of no more than 1173 t in 2014. If discards rates do not change from the average of the last 3 years (2010–2012, assuming 15% discard survival), this implies total catches of no more than 1329 t.

Additional considerations

In mixed fisheries projections the ‘min’ scenario (where fishing is assumed to stop when the catch for any one of the stocks considered meets the single-stock advice) estimates that the Nephrops stock in FU 6 is one of the main limiting species for 2014, together with cod.

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 2014 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 2012 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 a fair level of consistency between the overall abundance track and the scientific survey. The Fishers’ Stock Survey trajectory (Napier, 2012) for area 4 shows less increase than in other areas, consistent with the scientific perception that the Farn Deeps stock had not experienced the stock increases of other functional units. There is also agreement that the stock in this area has declined in recent years..

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.15.

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 decreased from 879 million to 858 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.

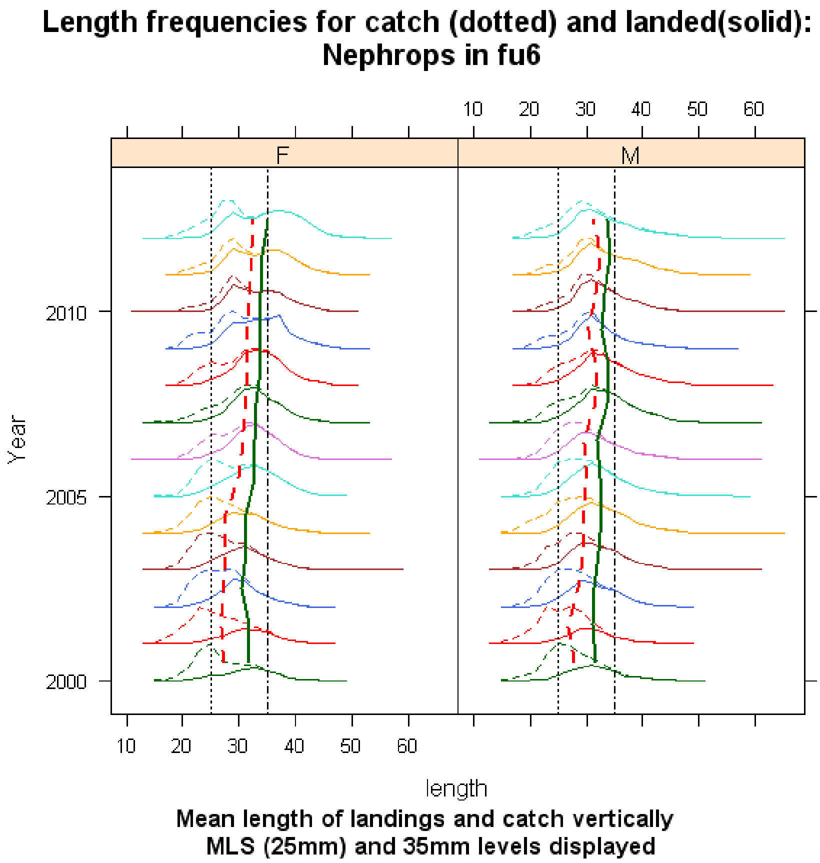


Figure 6.4.15.2.2 *Nephrops* Farn Deeps (FU 6). Length composition of catch (dotted) and landed (solid) of males (right) and females (left) from 1996 (bottom) to 2011 (top). Mean sizes of catch and landings (using same line types) is shown in relation to minimum landing size (MLS).

Table 6.4.15.2.1 *Nephrops* Farn Deeps (FU 6). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice 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]	2.5
2013	MSY transition	< 1.4	-[2]	
2014	MSY transition	<1.173	-[2]	

Weights in thousand tonnes.
[1] Does not include discards.
[2] Advice given at FU level only.

Table 6.4.15.2.2 *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	1220	0	1220
2009	2299	414	2713	0	2713
2010	1258	185	1443	0	1443
2011	1806	250	2056	14	2070
2012*	2177	256	2433	27	2460

* provisional   na = not available

** Other countries includes Ne, Be and Dk

Table 6.4.15.2.3 *Nephrops* Farn Deeps (FU 6). Summary of the assessment.

Year	TV abundance index	Landings (t)	Discard rate (number)	Mean Weight Landings (g)	Mean Weight Discards (g)	Number removed	Observed Harvest Rate
2001	*1685*	2574	66.60%	20.67	9.62	374	*22.2%*
2002	*1048*	1953	46.10%	20.00	9.50	182	*17.3%*
2003	*1085*	2245	42.10%	21.89	9.56	177	*16.3%*
2004	*1377*	2152	41.70%	23.14	9.22	160	*11.6%*
2005	*1657*	3094	34.50%	23.58	10.32	200	*12.1%*
2006	*1244*	4858	31.30%	22.53	10.58	317	*25.5%*
2007	858	2966	25.00%	24.95	10.89	158	18.5%
2008	987	1213	24.90%	26.63	10.97	61	6.2%
2009	682	2711	29.30%	24.45	10.54	155	22.7%
2010	785	1443	23.00%	25.18	11.74	74	9.5%
2011	878	2072	22.60%	27.05	11.02	99	11.3%
2012	758	2457	27.42%	27.30	10.16	123	16.2%

ECOREGION North Sea
STOCK *Nephrops* in Fladen Ground (FU 7)

Advice summary for 2014

ICES advises on the basis of the MSY approach that landings in 2014 should be no more than 8959 tonnes. If total discard rates do not change from the average of the last 3 years (2010–2012), this implies total catches of no more than 9059 tonnes. Note that this figure includes discards expected to survive the discarding process – assumed to be 25% of the total number discarded for this stock.

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level. Should the catch in this FU be lower that advised, the difference should not be transferred to other FUs.

Stock status

F (Fishing Mortality)				
	2010	2011	**2012**	
MSY (F_{MSY})	✓	✓	✓	Below target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)				
	2010	2011	**2012**	
MSY ($B_{trigger}$)	✓	✓	✗	Below trigger
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined

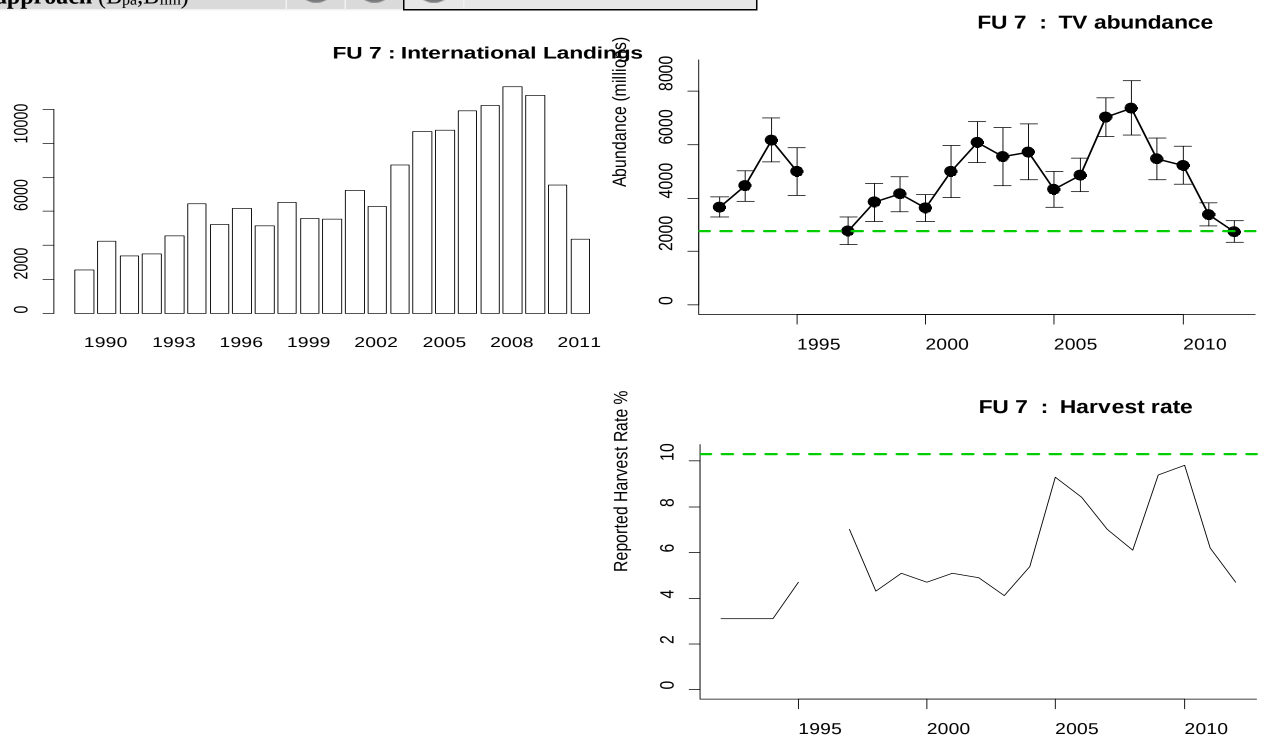


Figure 6.4.15.3.1 *Nephrops* in Fladen Ground (FU 7). Long-term trends in landings, harvest rate, and bias-adjusted UWTV abundance (used as F and SSB proxies. Weights in thousand tonnes, UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock has declined from the highest observed value in 2008 and is now just below the MSY $B_{trigger}$. The harvest rate has fluctuated in recent years, and fell to approximately 4% in 2012 which is below F_{MSY}.

Management plans

No specific management objectives are known to ICES.

Biology

See Section 6.4.15 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 (2012) = 4.4 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 2012.

Quality considerations

See Section 6.4.15 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 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	Commercial catches (international landings, length frequencies from Scottish catch sampling), one survey index (FU 7 UWTV-Scotia-June). Maturity data from commercial catch sampling and natural mortalities from Morizur (1982)
Discards and bycatch	Discards included in the assessment since 2000, from Scottish trawls (TR1 and TR2)
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 (ICES, 2013a)

ECOREGION North Sea
STOCK *Nephrops* in Fladen Ground (FU 7)

Reference points

	Type	*Value*	*Technical basis*
MSY	MSY $B_{trigger}$	2767 million individuals.	Lowest observed UWTV survey estimate of abundance (1992–2011).
Approach	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 with a long term average (1992–2012) of just below 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 in 2011 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 2014

Basis: $F_{2010-2012}$ =average harvest rate of 2010-2012=6.9%; Survey abundance (2012) = 2748 million; Mean weight in landings (2010–2012) = 33.15 g; Discard rate (dead, by number) = 1.7% (average 2010–2012), Mean weight in discards (2010 only as no discards in 2011 and 2012) = 16.4g.

Basis	Total Catches*	Landings	Dead Discards**	Surviving Discards**	Harvest Rate
	L+DD+SD	L	DD	SD	for L+DD
	4530	4479	38	13	5.0%
$F_{2010-2012}$	6250	6181	52	17	6.9%
	6794	6719	56	19	7.5%
MSY approach	9059	8959	75	25	10.0%
F_{MSY}	9330	9227	77	26	10.3%
	11323	11198	94	31	12.5%
	13589	13438	113	38	15.0%
	15853	15678	131	44	17.5%
	18117	17917	150	50	20.0%

Weights in tonnes
* Total catches are the landings including dead and surviving discards
** Total discard rate is assumed to be 2% of the catches (in number, last 3 years average, 2010-2012), discard survival is assumed 25% (ICES, 2009).

MSY approach

Following the ICES MSY approach implies a harvest rate of 10.0%, (lower than the F_{MSY} because SSB is below MSY $B_{trigger}$), resulting in landings of less than 8959 t in 2013. If discards rates do not change from the average of the last 3 years (2010–2012, assuming 25 % discard survival), this implies total catches of no more than 9059 t.

ICES notes that this implies an increase in harvest rate when the stock has shown a steady decline since 2008, and is now below MSY Btrigger. Considering the harvest options for this FU have not been utilised, utilisation of the harvest options from FU 7 elsewhere, may result in overexploitation of other FUs.

Additional considerations

In mixed fisheries projections the maximum scenario (‘max’, where fishing stops when all stocks considered have been caught up to the ICES single-stock advice) the Nephrops stock in FU7 is one of the least limiting stocks. The advice for FU 7 has not been restrictive to landings from the area since 2010. Should the catch in this FU be lower that advised, the difference should not be transferred to other FUs where this would cause local overfishing.

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 is one of the largest known *Nephrops* grounds; 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 and 2012 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 in 2012 shows that perceived abundance increased to 2007 and have subsequently declined to below the level at the start of the series. This is broadly in line with the results of the UWTV survey.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.15.

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 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 advice given in 2013 is based on the MSY approach (as last year).

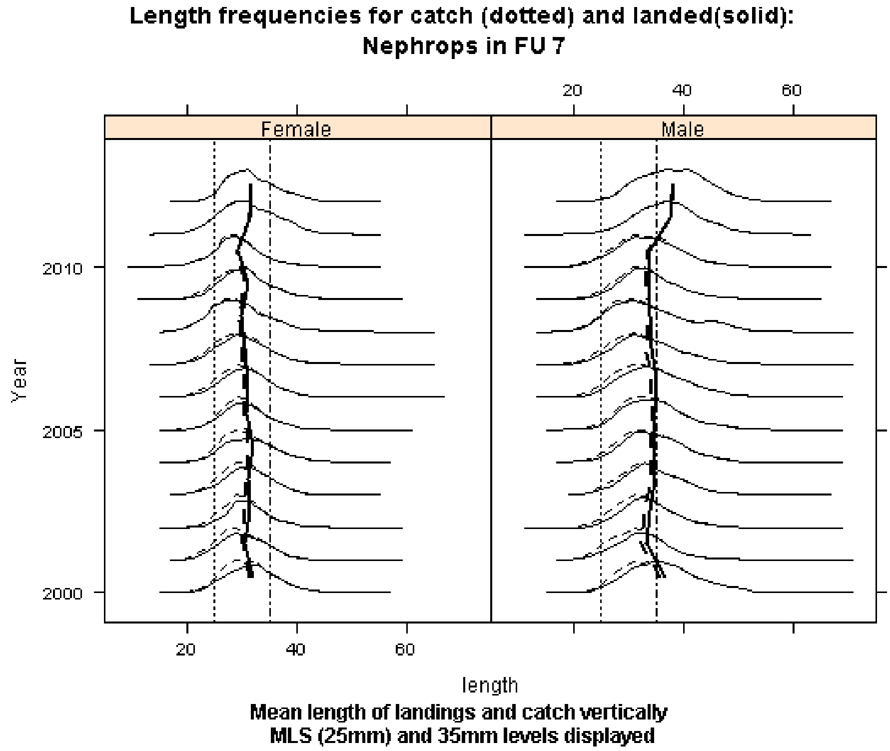


Figure 6.4.15.3.2 *Nephrops*, Fladen (FU 7). Catch length–frequency distribution and mean sizes in the catch and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

Table 6.4.15.3.1 *Nephrops* in Fladen Ground (FU 7). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice 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 approach	< 13.3	7.6
2012	MSY approach	< 14.1	4.4
2013	MSY approach	< 10.	
2014	MSY approach	<8.959	

Weights in thousand tonnes.
[1)] Does not include discards.

Table 6.4.15.3.2 *Nephrops* in Fladen Ground (FU 7). Official landings (tonnes) of *Nephrops*, as reported to ICES.

Year	Denmark	UK Scotland *Nephrops* trawl	UK Scotland Other trawl	UK Scotland Sub-total	Other countries *	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	7372	122	7494	<0.5	7558
2012	75	4225	67	4292	2	4369

na = not available
**Other countries includes Belgium, Norway and UK England

Table 6.4.13.3.3 *Nephrops* in Fladen (FU 7). Results of the 1992–2012 UWTV surveys (abundances and confidence interval).

Year	Stations	Abundance millions	Mean density burrows/m^2	95% confidence interval millions
1992	69	3661	0.13	376
1993	74	4450	0.16	569
1994	59	6170	0.22	814
1995	61	4987	0.18	896
1996		No survey		
1997	56	2767	0.10	510
1998	60	3838	0.13	717
1999	62	4146	0.15	649
2000	68	3628	0.13	491
2001	50	4981	0.17	970
2002	54	6087	0.21	757
2003	55	5547	0.20	1076
2004	52	5725	0.20	1030
2005	72	4325	0.16	662
2006	69	4862	0.17	619
2007	82	7017	0.25	730
2008	74	7360	0.26	1019
2009	59	5457	0.19	772
2010	67	5224	0.19	710
2011	73	3382	0.12	435
2012	70	2748	0.10	392

Table 6.4.13.3.4 *Nephrops* in Fladen (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
2012	2748	4369	0	0	0.047

ECOREGION North Sea
STOCK ***Nephrops* in Firth of Forth (FU 8)**

Advice for 2014

ICES advises on the basis of the transition to the MSY approach that landings in 2013 should be no more than 1417 tonnes. If total discard rates do not change from the average of the last 3 years (2010–2012), this implies total catches of no more than 1646 tonnes. Note that this figure includes discards expected to survive the discarding process – assumed to be 25% of the total number discarded for this stock.

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)				
	2010	2011	**2012**	
MSY (F_{MSY})	✖	✖	✖	Above target
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

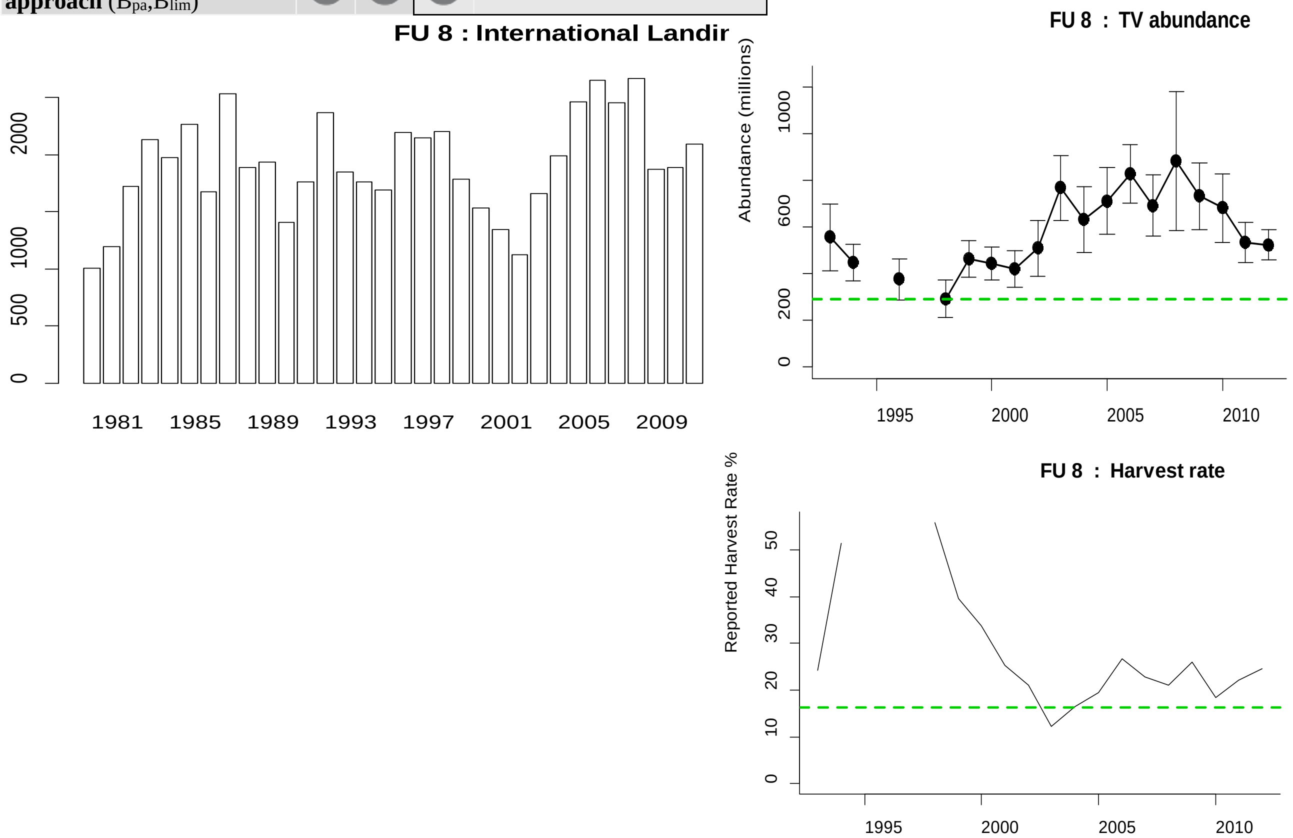


Figure 6.4.15.4.1 *Nephrops* in Firth of Forth (FU 8). Long-term trends in landings, harvest rate, and UWTV biomass (used as F and SSB proxies; weights in thousand tonnes and UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock remains above MSY $B_{trigger}$ but has declined since 2008. 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 higher than in a number of other areas but the rates have declined to 25% by number and 13% by weight (average 2011–2012).

Catch distribution	Total catch (2012) = 2091, where 87% are landings taken in demersal trawl fisheries, either a directed *Nephrops* or a mixed *Nephrops*/demersal fishery, and 13% are discards (in weight).

Quality considerations

See Section 6.4.15 for general comments.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	Commercial catches (international landings, length frequencies from Scottish catch sampling), 1 survey index (FU 8 UWTV). Maturity data from commercial catch sampling, natural mortalities from Morizur (1982)
Discards and bycatch	Discards included in the assessment since 1990, from Scottish trawls (TR1 and TR2)
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 (ICES, 2013a)

6.4.15.4 Supporting information June 2013

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.	Lowest observed UWTV survey estimate of abundance (1993-2010).
	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 2014

Basis: $F_{2010-2012}$ = average harvest rate of 2010–2012 = 21.7%; Survey abundance (2012) = 522 million; Mean weight in landings (2010–2012) = 20.39 g; Mean weight in discards (2010–2012) = 9.70 g Discard rate (dead, by number) = 20.3% (average 2010–2012).

Basis	Total Catches*	Landings	Dead Discards**	Surviving Discards**	Harvest Rate
	L+DD+SD	L	DD	SD	for L+DD
	492	424	51	17	5.0%
	739	636	77	26	7.5%
	985	848	103	34	10.0%
	1232	1060	129	43	12.5%
	1477	1272	154	51	15.0%
F_{MSY}	1605	1381	168	56	16.3%
MSY transition	1646	1417	172	57	16.7%
	1971	1696	206	69	20.0%
$F_{2010-2012}$	2137	1840	223	74	21.7%
	2463	2120	257	86	25.0%

* Total catches are the landings including dead and surviving discards
** Total discard rate is assumed to be 25.3% of the catches (in number, last 3 years average, 2010-2012), discard survival is assumed 25% (ICES, 2009).

MSY approach

To follow the ICES MSY approach the harvest rate should be reduced to 16.3%, corresponding to maximum landings of 1381 t in 2014.

To follow the transition scheme towards the ICES MSY – approach, the harvest rate should be reduced to 16.7% (0.2* F_{2010}+ 0.8* F_{MSY}), corresponding to landings of no more than 1417 t in 2013 (where F_{2010} is the observed harvest rate in

2010 (18.4%)). If discards rates do not change from the ratio in 2012, assuming 25% discard survival), this implies total catches of no more than 1646 t.

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 27% by number in the Firth of Forth in 2012. 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 6.4.15.2) does not include specific information for the Firth of Forth. Area 3 covers the Moray Firth, Firth of Forth and areas of the Devil's Hole. The 2012 report shows a decrease in abundance since 2008 which matches the UWTV survey results.

Uncertainties in assessment and forecast

General comments are found at the beginning of Section 6.4.15.

Comparison with previous assessment and advice

The perception of the state of the stock in earlier years has not changed – assessments are based on direct observations.

The advice given for 2014 is based on the MSY transition scheme (as the advice given for 2013).

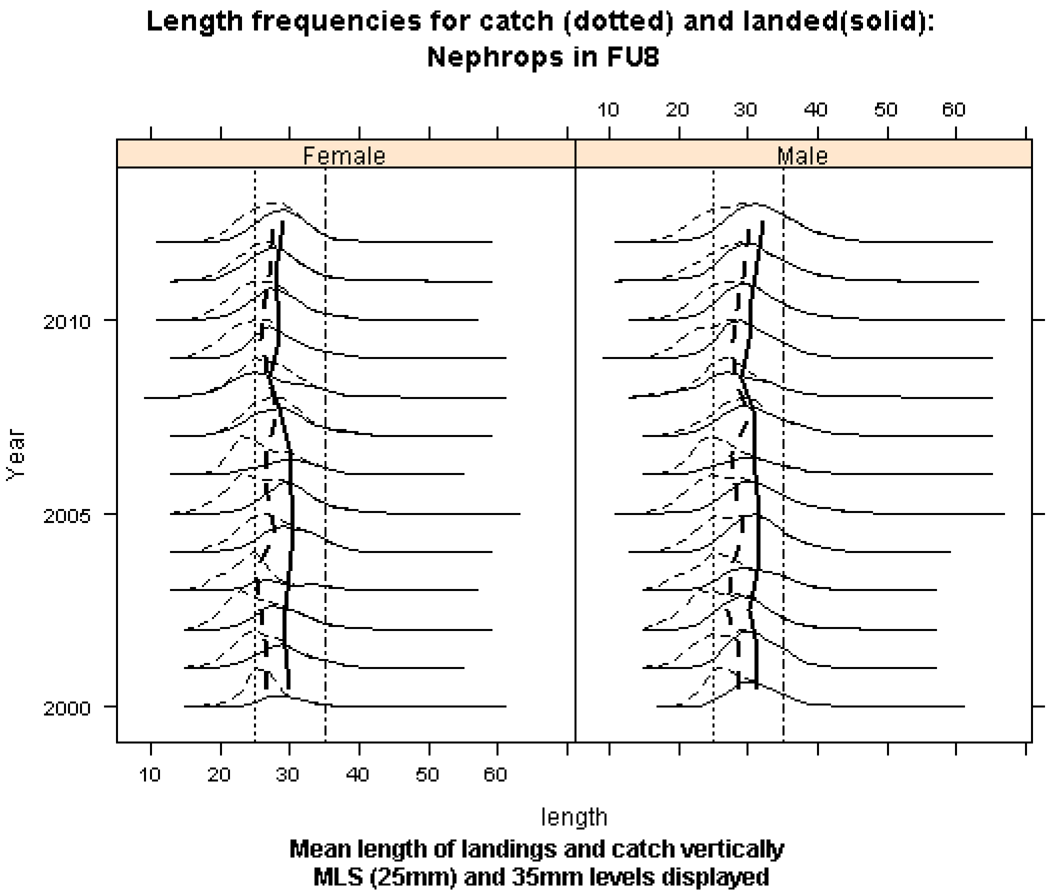


Figure 6.4.15.4.2 *Nephrops* in Firth of Forth (FU 8). Catch length–frequency distribution and mean sizes in the catch and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

Table 6.4.15.4.1 *Nephrops* in Firth of Forth (FU 8). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice 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		2.1
2013	MSY transition	< 1.4		
2014	MSY transition	< 1.417		

Weights in thousand tonnes.
[1)] Does not include discards.
[2)] It is not advised to manage these stocks as a single unit.

Table 6.4.15.4.2 *Nephrops* in Firth of Forth (FU 8). Nominal landings (tonnes) of *Nephrops*, as reported to ICES.

Year	UK Scotland				UK	
	Nephrops trawl	Other trawl	Creel	Sub-total	(E, W & NI)	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	1793	1	89	1883	5	1888
2012*	1918	7	124	2049	42	2091

* provisional na = not available

** There are no landings by other countries from this FU

*** 4 trawl gears in 2011;also includes 5 t other gears

Table 6.4.15.4.3 *Nephrops* in Firth of Forth (FU 8): Results of the TV surveys (abundance and confidence interval).

Year	Stations	Mean Density burrows/m²	Abundance millions	95% conf interval millions
1993	37	0.61	555	142
1994	30	0.49	448	78
1995		no survey		
1996	27	0.41	375	88
1997		no survey		
1998	32	0.32	292	81
1999	49	0.51	463	78
2000	53	0.48	443	70
2001	46	0.46	419	79
2002	41	0.56	508	119
2003	36	0.84	767	138
2004	37	0.69	630	141
2005	54	0.78	710	143
2006	43	0.91	827	125
2007	49	0.76	692	132
2008	38	0.97	881	297
2009	45	0.80	732	142
2010	39	0.75	681	147
2011	45	0.58	533	87
2012	66	0.57	522	64

Table 6.4.15.4.4*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
2012	522	2091	0.27	0.22	0.246

ECOREGION **North Sea**
STOCK ***Nephrops* in Moray Firth (FU 9)**

Advice for 2014

ICES advises on the basis of the MSY approach that landings in 2014 should be no more than 739 tonnes. If total discard rates do not change from the average of the last 3 years (2010–2012), this implies total catches of no more than 796 tonnes. Note that this figure includes discards expected to survive the discarding process – assumed to be 25% of the total number discarded for this stock.

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Stock status

F (Fishing Mortality)				
	2010	2011		**2012**
MSY (F_{MSY})	✔	✖	✖	Above target
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

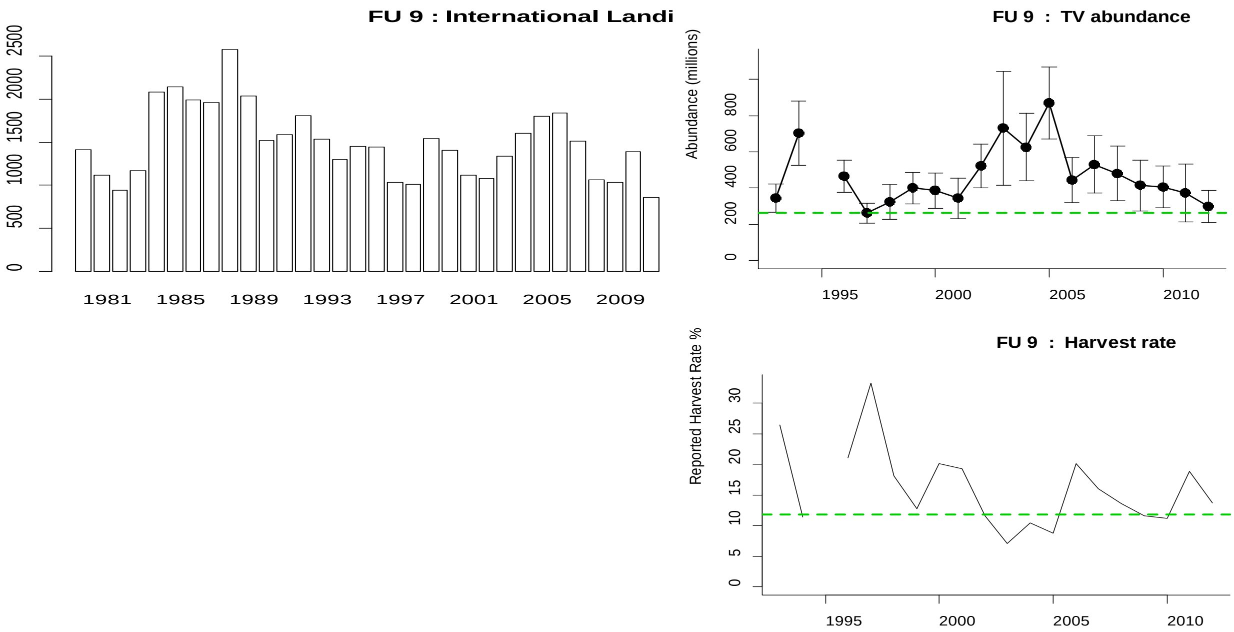


Figure 6.4.15.5.1 *Nephrops* in Moray Firth (FU 9). Long-term trends in landings, harvest rate, and UWTV abundance (used as F and SSB proxies; weights in thousand tonnes and UWTV in millions). Dashed green lines show proxies for F_{MSY} and MSY $B_{trigger}$. Harvest rates before 2007 may be unreliable due to underreporting of landings.

The stock is declining but remains just above MSY $B_{trigger}$. The harvest rate was above F_{MSY} in 2011 and decreased in 2012, although it is still above Fmsy.

Management plans

No specific management objectives are known to ICES.

Biology

See Section 6.4.15 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 (2012) = 860 t, 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 6.4.15 for general comments.

Scientific basis

Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	Commercial catches (international landings, length frequencies from Scottish catch sampling), One survey index (UWTV-Alba na mara-August); Maturity data from (commercial catch surveys), Natural mortalities from Morizur (1982).
Discards and bycatch	Discards included in the assessment since 1990, from Scottish trawls (TR1 and TR2)
Indicators	Size structure information; mean size; lpue.
Other information	Latest benchmark was performed in 2009.
Working group report	WGNSSK (ICES, 2013a)

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 $F_{35\%SPR(combined)}$ 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 2014

Basis: $F_{2010-2012}$=average harvest rate of 2010–2012 = 14.6% (based on average (F_{2010} to F_{2012}); Survey abundance (2012) = 299 million; Mean weight in landings (2010–2012) = 23.91 g; Discard rate (dead, by number) = 12.3% (average 2010–2012); Mean weight in discards (2010–2012) = 9.95 g..

Basis	Total Catches*	Landings	Dead Discards**	Surviving Discards**	Harvest Rate
	L+DD+SD	L	DD	SD	for L+DD
	337	313	18	6	5.0%
	507	470	28	9	7.5%
	676	627	37	12	10.0%
F_{MSY}	796	739	43	14	11.8%
	844	783	46	15	12.5%
$F_{2010-2012}$	987	915	54	18	14.6%
	1013	940	55	18	15.0%
	1350	1253	73	24	20.0%

Weights in tonnes
* Total catches are the landings including dead and surviving discards
** Total discard rate is assumed to be 15.7% of the catches (in number, last 3 years average, 2010-2012), discard survival is assumed 25% (ICES, 2009).

MSY approach

Following the ICES MSY approach implies the harvest rate should be less than 11.8%, resulting in landings of less than 739 t in 2014. If discards rates do not change from the average of the last 3 years (2010–2012, assuming 25% discard survival), this implies total catches of no more than 796 t.

Additional considerations

See Section 6.4.15 for general comments.

Changes in fishing technology and fishing patterns

Discarding rates averaged over the period 2006–2012 for this stock were about 10% by number. This represents a reduction in discarding rate compared to the average for the period 2000–2005. 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 6.4.15.2) does not include specific information for the Moray Firth. Area 3 covers covers the Moray Firth, Firth of Forth and areas of the Devil's Hole. The 2012 report shows a decrease in abundance since 2008 which matches the UWTV survey results.

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 is the same as last year: the MSY approach.

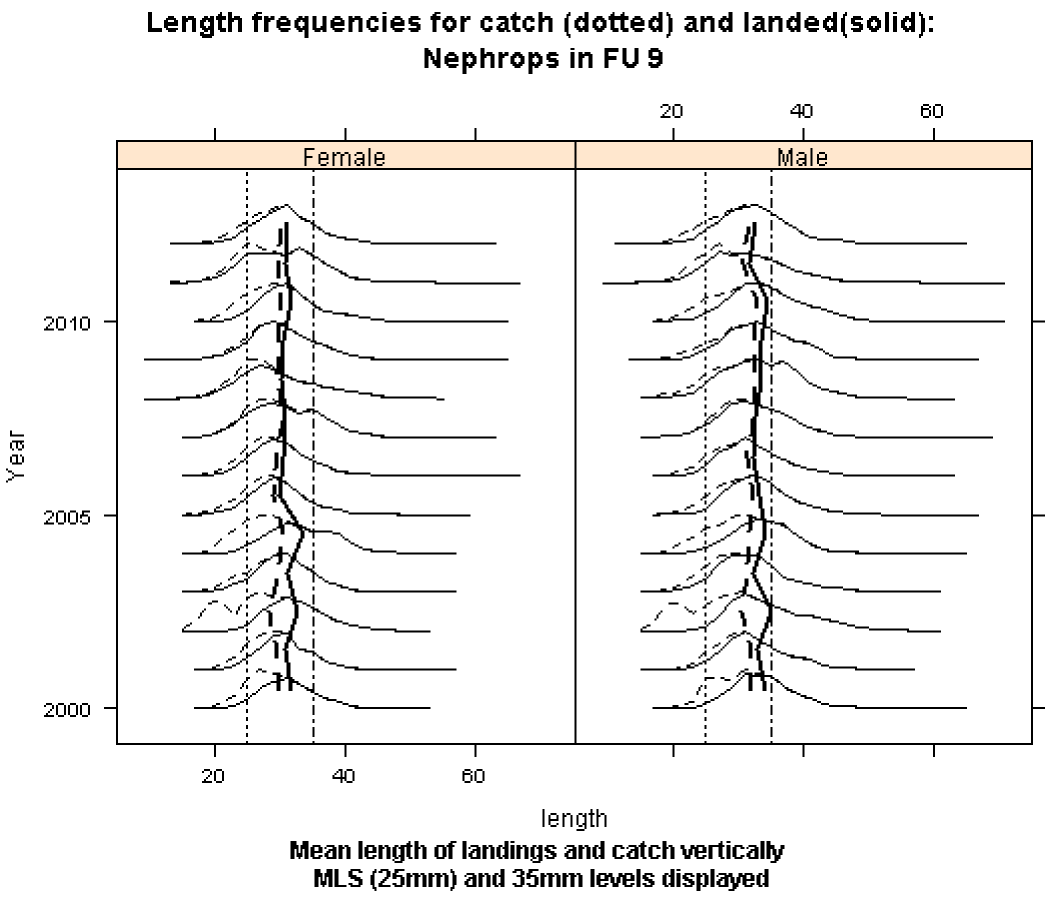


Figure 6.4.15.5.2 *Nephrops* in Moray Firth (FU 9). Catch length–frequency distribution and mean size in catches and landings. Vertical lines are minimum landing size (25 mm) and 35 mm.

Table 6.4.15.5.1 *Nephrops* in Moray Firth (FU 9). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice Moray Firth (FU 9)	Recommended landings FUs 9 and 10	ICES landings FU 9[1)]
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 approach	< 1.1		< 1.0
2013	MSY approach	< 1.0		
2014	MSY approach	< 0.739		

Weights in thousand tonnes.
[1)] Does not include discards.
[2)] It is not advised to manage these stocks as a single unit.

Table 6.4.15.5.2 *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	1363	18	9	1390	1	1391
2012	832	20	8	860	0	860

* No landings by non UK countries from this FU

Table 6.4.15.5.3 *Nephrops* in Moray Firth (FU 9): Results of the 1993–2012 UWTV surveys.

Year	Stations	Mean density	Abundance	95% confidence interval
		burrows/m²	millions	millions
1993	31	0.16	345	78
1994	29	0.32	702	176
1995	no survey			
1996	27	0.21	465	90
1997	34	0.12	262	55
1998	31	0.15	323	95
1999	52	0.18	400	87
2000	44	0.17	386	98
2001	45	0.16	345	112
2002	31	0.24	521	121
2003	32	0.33	730	314
2004	42	0.29	626	186
2005	42	0.40	869	198
2006	50	0.21	445	124
2007	40	0.24	531	156
2008	45	0.21	479	151
2009	50	0.19	415	140
2010	43	0.18	406	116
2011	37	0.17	373	160
2012	44	0.14	298	90

Table 6.4.15.5.4 *Nephrops* in Moray Firth (FU 9): UWTV 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	0.2	0.16	0.11
2011	372	1391	0.14	0.11	0.19
2012	299	860	0.13	0.1	0.137

ECOREGION North Sea
STOCK *Nephrops* in Noup (FU 10)

Advice for 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 50 tonnes.*

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Scientific basis

Assessment type	Data-limited approach for *Nephrops* (category 4.1.4).
Input data	Habitat extent, mean size, occasional UWTV surveys (incomplete time-series 1994, 1999, 2006, 2007). Commercial catches not included in the assessment but available for monitoring (international landings, length frequencies from Scottish catch sampling) One survey index (UWTV survey – limited time series)
Discards and bycatch	No discard information available.
Indicators	Size structure information; lpue.
Other information	Latest benchmark was performed in 2013 (ICES, 2013c)).
Working group report	WGNSSK (ICES, 2013a)

Sources

ICES. 2012. *Nephrops* in Noup (FU 10). *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.14.6.

Table 6.4.15.6.1 *Nephrops* in Noup (FU 10). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice FU 10	Recommended landings FUs 9 and 10	ICES landings [1]
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	-		0.01
2013	20% Reduction in landings (last 3 years' average)	< 0.05		
2014	No new advice, same as 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 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 800 tonnes.*

For the stock in this functional unit (FU), management is implemented at the functional unit level.

Scientific basis

Assessment type	Data-limited approach for *Nephrops* (category 4.1.4).
Input data	Commercial catches (international landings, and length frequencies from catch sampling) One commercial index (Danish lpue)
Discards and bycatch	Discards not included in the assessment but available for monitoring (Danish)
Indicators	Danish commercial lpue.
Other information	Benchmark in 2013 (ICES, 2013c).
Working group report	WGNSSK (ICES, 2013a)

Sources

ICES. 2012. *Nephrops* the Norwegian Deep (FU 32). *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.14.7.

Table 6.4.15.7.1 *Nephrops* in the Norwegian Deep (FU 32). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice	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	0.3
2013	Average landings (last 10 years)	< 0.8	1.0	
2014	No new advice, same as 2013	< 0.8		

Weights in thousand tonnes.
[1] EU TAC for Norwegian zone of Subarea IV.

ECOREGION North Sea
STOCK *Nephrops* off Horn's Reef (FU 33)

Advice for 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 1100 tonnes*

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Scientific basis

Assessment type	Data-limited approach for *Nephrops* (category 4.1.4).
Input data	Commercial catches (international landings, and length frequencies from catch sampling)
Discards and bycatch	Discards not included in the assessment
Indicators	Commercial lpue.
Other information	None.
Working group report	WGNSSK (ICES, 2013a)

Sources

ICES. 2012. *Nephrops* off Horn's Reef (FU 33). *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.14.8.

6.4.15.8.1 *Nephrops* off Horn's Reef (FU 33). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice	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	-	1.1
2013	Average landings (last 10 years)	< 1.1	
2014	No new advice, same as 2013	< 1.1	

Weights in thousand tonnes.
[1)] Does not include discards.
[2)] Includes Farn Deeps (FU 6).

ECOREGION North Sea
STOCK *Nephrops* in Devil's Hole (FU 34)

Advice for 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *Based on the ICES approach for data-limited stocks, ICES advises that landings should be no more than 600 tonnes.*

In order to ensure the stock in this FU is exploited sustainably, management should be implemented at the functional unit level.

Scientific basis

Assessment type	Data-limited method for *Nephrops* (category 4.1.4).
Input data	Commercial catches (international landings, length frequencies from Scottish catch sampling 2006–2011), habitat extent, mean size, occasional UWTV surveys (incomplete time-series 2003, 2005, 2009–2012), one survey index (FU 34 UWTV)
Discards and bycatch	Discards not included in the assessment but available for monitoring (Scottish TR1 and TR2 fleets (2009 and 2010))
Indicators	Size structure information; lpue.
Other information	Latest benchmark was performed in 2013.
Working group report	WGNSSK (ICES, 2013a)

Sources

ICES. 2012. *Nephrops* in Devil's Hole (FU 34). *In* Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.14.9.

Table 6.4.15.9.1 *Nephrops* in Devil's Hole (FU 34). ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice	ICES landings [1)]
2009	No separate advice		1.3
2010	No separate advice		0.76
2011	No separate advice		0.43
2012	No separate advice	-	0.59
2013	Average landings (last 10 yrs)	< 0.6	
2014	No new advice, same as 2013	< 0.6	

Weights in thousand tonnes.
[1)] Provisional international landings, only available from 2009. Does not include discards.

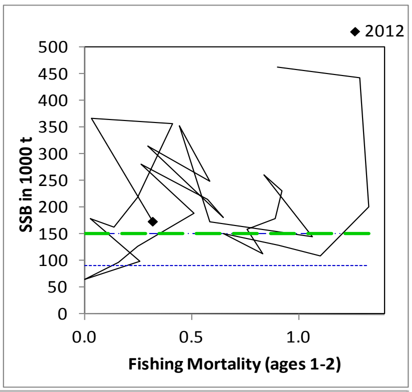
ECOREGION North Sea
STOCK Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)

Advice for 2013

ICES advises on the basis of the MSY approach that catches should be no more than 457 000 tonnes in 2013 according to the escapement strategy. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↘	↗	Below average
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



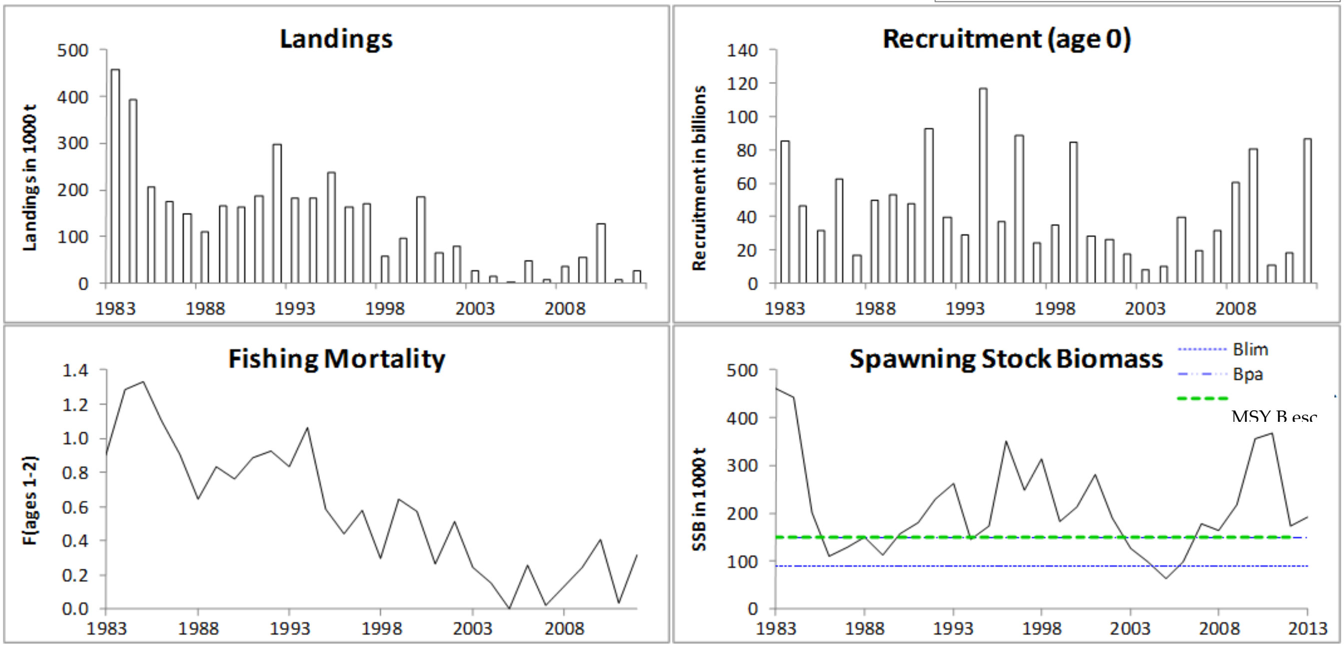


Figure 6.4.16a.1 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F for the time-series used in the assessment.

The stock dynamic is highly variable from year to year, due to recruitment variability and a short life span. Stock size has increased significantly following the very high recruitment in 2012 and is above MSY $B_{escapement}$. 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).

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). EU and Norway requests regarding long term management plans for the stock have been evaluated in 2007, September 2012, and again in April 2013 (see Section 6.3.3.1).

Biology

Norway pout is a short-lived species that most likely only spawn once. 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 the 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. The TAC was not taken in 2008, 2009, 2010 and 2012. 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 (2012) = 27 kt (100% landings and no discards), > 99% taken by the small-meshed trawl fleet. The fishery has a 3 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 values for the natural mortality, maturity-at-age, and weight-at-age used in the assessment were updated in the 2012 benchmark assessment. 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.

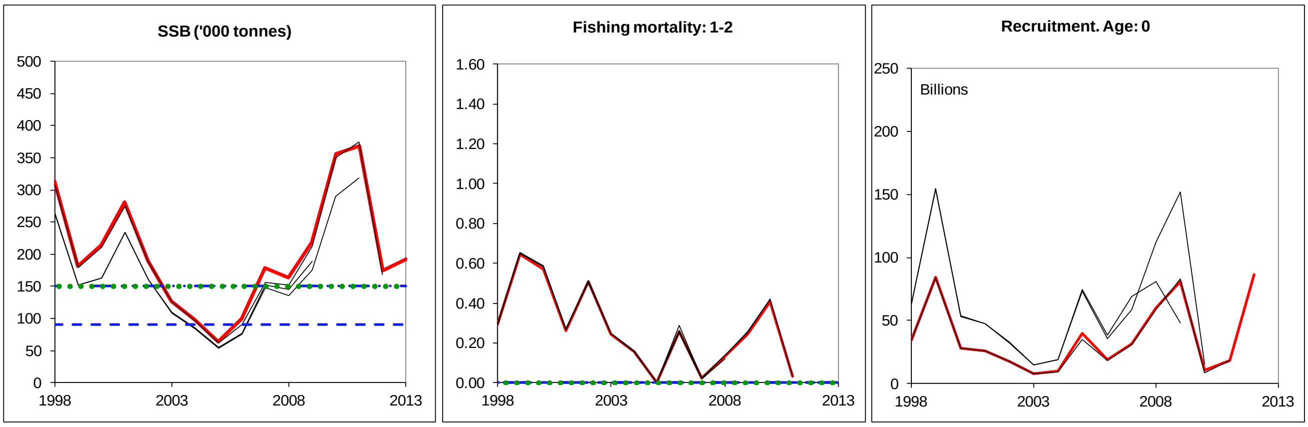


Figure 6.4.16a.2 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Historical assessment results (final-year recruitment estimates included) of the June assessment.

Scientific basis

Assessment type	Age-based analytical (seasonal XSA, SXSA).
Input data	Commercial catches (quarterly catches; ages and mean weight at age from catch sampling of mainly Danish and Norwegian fishery), 4 survey indices (IBTS Q1&3, EngGFS-IBTS-Q3, ScoGFS-IBTS-Q3), 3 commercial indices (cpue indices up to 2006 (CFQ1,Q3,Q4)). Annual maturity data from commercial catch sampling, natural mortality from survey indices (IBTS Q1&3).
Discards and bycatch	Discards not included as there are 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).
Working group report	WGNSSK (ICES, 2013a)

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 2013

Basis: F (2012) = F (1,2) = 0.314; R (2013) = 25% percentile of long-term recruitment (1983–2011) = 25 billion (3rd quarter); SSB (2013) = 192 (assessment); SSB (2013) (forecast model output) = 189; catches (2012) = 27 kt (no discards).

Rationale	**Catches 2013**	**Basis**	**F 2013**	**SSB 2014**	**%SSB change[1)]**
MSY approach	457	MSY $B_{escapement}$	1.77	150	-21
Zero catch	0	No fishery	0.00	448	137
Other options	50	Fixed TAC strategy (2007 LTMSE)	0.12	415	120
	100	F_{2012}*0.79	0.25	381	102
	134	Fixed F strategy (2007 LTMSE)	0.35	358	89
	200	F_{2012}*1.75	0.55	314	66
	216	F_{2012}*1.92	0.60	304	61
	269	F_{2012}*2.54	0.80	269	42
	560	B_{lim}	2.71	90	-52

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.

Management plans

ICES has evaluated and commented on three management strategies in 2007, although no long term management plan has been decided upon.

Based on new joint EU–Norway requests (ICES, 2012a), long term management strategies have been evaluated again in 2012 and 2013 (Vinther and Nielsen, 2012; 2013). Separate advice is provided in relation to those long term management strategies (ICES, 2013b).

MSY approach

With catches up to 457 kt in 2013 the spawning-stock biomass is expected to remain above MSY $B_{escapement}$ by 1st January 2014 according to the escapement strategy. This high catch is possible because the SSB is expected to remain high during 2013 due to the very high 2012 recruitment. All catches are assumed to be landed.

Precautionary approach

With catches up to 457 kt in 2013, the spawning-stock biomass is expected to remain above B_{pa} (= MSY $B_{escapement}$) by 1st January 2014. All catches are assumed to be landed.

Additional considerations

The TAC was not 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). There was only a quota uptake of 27% of the 100 kt TAC in 2012. This is mainly due to the late opening of the fishery at the end of quarter 3 in 2012, but probably also due to high fishing (fuel) costs.

Norway pout is a short-lived species that most likely only spawn once. 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 estimated 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.

An inter-benchmark assessment in spring 2012 (ICES, 2012b) 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, blue 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). Selective devices have been implemented by a significant part of the fleet (larger vessels) since 2010. ICES suggests that these devices (or modified forms of those) be fully implemented.

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 in 2007 – fixed fishing mortality (0.35), fixed TAC (50 000 t), and a variable TAC escapement strategy. The 2007 evaluation showed that all three management strategies were 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 and MSY approaches. It was noticed that 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 objective, then the fixed F (equivalent to fixed effort) strategy will perform better.

In October 2012, ICES evaluated 3 additional management strategies (ICES, 2012a, Vinther and Nielsen, 2012). As a follow up on this, ICES has now evaluated an additional management strategy based on an escapement strategy, with a different TAC year and only one annual advice, in the autumn (ICES, 2013b, Vinther and Nielsen, 2013). This harvest control rule includes a fixed minimum TAC. The evaluation shows that ceilings on both the TAC and F are necessary for it to be precautionary. Options corresponding to all ceilings indicated in the management strategy advice have been included in the Outlook table, but it is noted that the management strategy evaluation was performed on the basis of the September assessment while currently, advice for this stock is given twice a year.

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 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, sorting grids, 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 contributed to reduce 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 assessments.

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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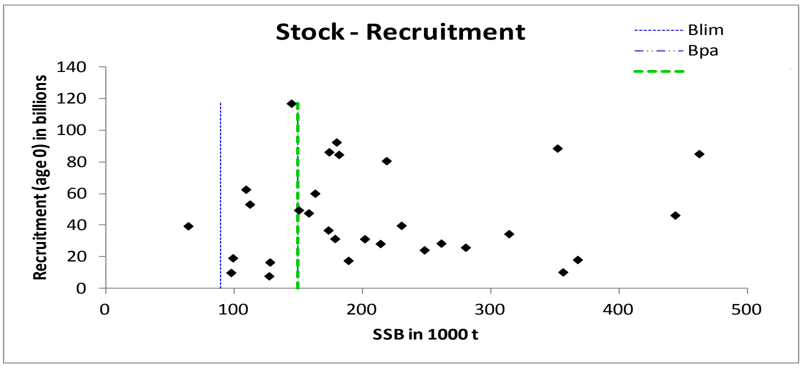


Figure 6.4.16a.3 Norway pout in Subarea IV and Division IIIa. Stock-recruitment relationship.

Table 6.4.16a.1 Norway pout in Subarea IV and Division IIIa**.** ICES advice, management, and catches.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ICES catch
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]	7	7
2012	No fisheries	0	0		
In year[2]	Maintain SSB > MSY $B_{escapement}$	< 101	71 (EU)	30	27
2013	Maintain SSB > MSY $B_{escapement}$	< 457	168 (EU)		
2014	Advice will be given in autumn 2013				

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 6.4.16a.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.

Norway pout ICES area IIIa

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	3.780	4.235	110	-	18	24	156	-	51	2	118 *
Faroe Islands	-	50	45	-	-	-	-	-	-	-	-
Norway	96	30	41	-	2	-	-	209	711	-	-
Sweden	-	-	-	-	-	-	-	-	10	-	-
Germany	-	-	54	-	-	-	4	-	-	-	-
Total	3.876	4.315	250	0	20	24	160	209	772	2	118

*Preliminary.

Norway pout ICES area IVa

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	68.858	12.223	10.762	941***	39.531	59	32.158	19.226	71.032	4.038	24.829 *
Faroe Islands	3.367	2.199	1.085	24	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	22	18	-	-
Germany	-	-	-	-	15	-	-	-	-	-	-
Norway	23.657	11.357	4.953	311	13.618	4.712	6.650	36.961	64.303	3.189	4.528 *
Sweden	-	-	-	-	-	-	10	-	+	1	3 *
UK(Scotland)	-	-	-	-	-	-	-	-	29	-	6 *
Total	95.882	25.779	16.800	1.092	53.164	4.771	38.818	56.209	135.353	7.228	29.360

*Preliminary.

Norway pout ICES area IVb

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	556	191	473	-	394	-	244	595	229	32	611 *
Faroe Islands	12	125	29	-	-	-	-	-	-	-	-
Germany	-	-	-	-	19	-	-	75	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	2	-	-	82	620	21	59 *
Sweden	-	-	88	-	-	-	-	-	-	-	-
UK (E/W/NI)	+	-	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-	-	-
Total	568	316	590	0	415	0	244	752	849	53	670

*Preliminary.

Norway pout ICES area IVc

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	-	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	+	+	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-
UK (E/W/NI)	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0	0	0	0

*Preliminary.

Norway pout Sub-area IV and IIIa (Skagerrak) combined

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	73.194	16.649	11.345	941***	39.943	83	32.558	19.821	71.312	4.072	25.558
Faroe Islands	3.379	2.374	1.159	24	0	0	0	0	0	0	0
Norway	23.753	11.387	4.994	311	13.622	4.712	6.650	37.252	65.634	3.210	4.587
Sweden	0	0	88	0	0	0	10	0	10	1	3
Netherlands	0	0	0	0	0	0	0	22	18	0	0
Germany	0	0	54	0	34	0	4	75	0	0	0
UK	0	0	0	0	0	0	0	0	0	0	0
Total nominal landings	100.326	30.410	17.640	1.252	53.599	4.795	39.222	57.170	136.974	7.283	30.148
By-catch of other species and other	-20.326	-3.310	-4.140	-	-6.973	-	-3.084	-2.670	-11.019	-759	-3.075
WG estimate of total landings (IV+IIIaN)	80.000	27.100	13.500	-	46.626	-	36.138	54.500	125.955	6.524	27.073
Agreed TAC	198.000	198.000	198.000	0****	95.000	0****	114.616 x	116.279 x	162.950 x	4.500 x	70.683 x

* provisional / preliminary
** provisional / preliminary
*** 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
x EU TAC

Table 6.4.16a.3 Norway pout in Subarea IV and Division IIIa**.** ICES estimates of landings (t) by country.

Year	Denmark		Faroes	Norway	Sweden	UK	Others	Total
	North Sea	Skagerrak				(Scotland)		
1961	20.5	-	-	8.1	-	-	-	28.6
1962	121.8	-	-	27.9	-	-	-	149.7
1963	67.4	-	-	70.4	-	-	-	137.8
1964	10.4	-	-	51	-	-	-	61.4
1965	8.2	-	-	35	-	-	-	43.2
1966	35.2	-	-	17.8	-	-	+	53
1967	169.6	-	-	12.9	-	-	+	182.5
1968	410.8	-	-	40.9	-	-	+	451.7
1969	52.5	-	19.6	41.4	-	-	+	113.5
1970	142.1	-	32	63.5	-	0.2	0.2	238
1971	178.5	-	47.2	79.3	-	0.1	0.2	305.3
1972	259.6	-	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	-	51.2	63	2.9	13	0.6	345.9
1974	464.5	-	85	154.2	2.1	26.7	3.3	735.8
1975	251.2	-	63.6	218.9	2.3	22.7	1	559.7
1976	244.9	-	64.6	108.9	+	17.3	1.7	437.4
1977	232.2	-	48.8	98.3	2.9	4.6	1	387.8
1978	163.4	-	18.5	80.8	0.7	5.5	-	268.9
1979	219.9	9	21.9	75.4	-	3	-	329.2
1980	366.2	11.6	34.1	70.2	-	0.6	-	482.7
1981	167.5	2.8	16.4	51.6	-	+	-	238.3
1982	256.3	35.6	12.3	88	-	-	-	392.2
1983	301.1	28.5	30.7	97.3	-	+	-	457.6
1984	251.9	38.1	19.11	83.8	-	0.1	-	393.01
1985	163.7	8.6	9.9	22.8	-	0.1	-	205.1
1986	146.3	4	2.5	21.5	-	-	-	174.3
1987	108.3	2.1	4.8	34.1	-	-	-	149.3
1988	79	7.9	1.3	21.1	-	-	-	109.3
1989	95.7	4.2	0.8	65.3	+	0.1	0.3	166.4
1990	61.5	23.8	0.9	77.1	+	-	-	163.3
1991	85	32	1.3	68.3	+	-	+	186.6
1992	146.9	41.7	2.6	105.5	+	-	0.1	296.8
1993	97.3	6.7	2.4	76.7	-	-	+	183.1
1994	97.9	6.3	3.6	74.2	-	-	+	182
1995	138.1	46.4	8.9	43.1	0.1	+	0.2	236.8
1996	74.3	33.8	7.6	47.8	0.2	0.1	+	163.8
1997	94.2	29.3	7	39.1	+	+	0.1	169.7
1998	39.8	13.2	4.7	22.1	-	-	+	57.7
1999	41	6.8	2.5	44.2	+	-	-	94.5
2000	127	9.3	-	48	0.1	-	+	184.4
2001	40.6	7.5	-	16.8	0.7	+	+	65.6
2002	50.2	2.8	3.4	23.6	-	-	-	80
2003	9.9	3.4	2.4	11.4	-	-	-	27.1
2004	8.1	0.3	-	5	-	-	0.1	13.5
2005	0.9*	-	-	1	-	-	-	1.9
2006	35.1	0.1	-	11.4	-	-	-	46.6
2007	2.0**	-	-	3.7	-	-	-	5.7
2008	30.4	-	-	5.7	+	-	+	36.1
2009	17.5	-	-	37	+	-	+	54.5
2010	64.9	0.2	-	60.9	+	+	+	126
2011	3.3	-	-	3.2	+	+	+	6.5
2012	22.3	0.1	-	4.6	+	+	+	27
* 781 t taken in a trial fishery; 160 t in bycatches in other (small meshed) fisheries.								
** 681 t taken in trial fishery; 1300 t in bycatches in other (small meshed) fisheries.								

Table 6.4.16a.4 Norway pout in Subarea IV and Division IIIa**.** Summary of stock assessment.

Year	Recruitment Age 0 thousands	SSB Tonnes	Landings Tonnes	Mean F Ages 1-2
1983	85133000	462487	457600	0.900
1984	46326000	443803	393010	1.283
1985	31325000	201910	205100	1.329
1986	62620000	109337	174300	1.100
1987	16625000	128054	149300	0.903
1988	49509000	150500	109300	0.646
1989	53226000	112404	166400	0.831
1990	47655000	158264	163300	0.759
1991	92438000	179950	186600	0.888
1992	39803000	230506	296800	0.922
1993	28560000	261517	183100	0.835
1994	116994000	144785	182000	1.062
1995	36827000	173549	236800	0.583
1996	88614000	352088	163800	0.442
1997	24316000	248415	169700	0.581
1998	34541000	314298	57700	0.293
1999	84613000	181818	94500	0.646
2000	28330000	214125	184400	0.572
2001	25978000	280520	65600	0.261
2002	17669000	189156	80000	0.510
2003	7892000	127376	27100	0.245
2004	10041000	97754	13500	0.155
2005	39520000	64377	1900	0.000
2006	19277000	99191	46600	0.256
2007	31479000	178705	5700	0.022
2008	60097000	163227	36100	0.134
2009	80670000	218850	54500	0.246
2010	10383000	356396	126000	0.409
2011	18225000	367804	6500	0.031
2012	86258000	174163	27000	0.314
2013		192067		
Average	45831467	212174	135474	0.572

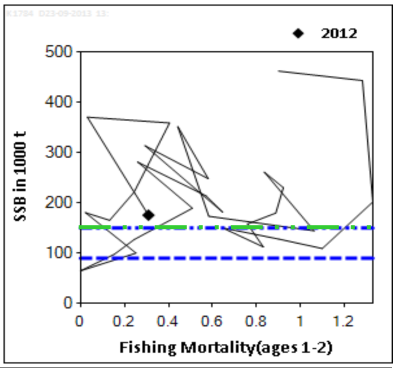
ECOREGION North Sea
STOCK Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat)

Advice for 2014

ICES advises on the basis of the MSY approach according to the escapement strategy that catches in 2014 should not exceed 216 000 t. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)				
	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	↗	↘	↗	Below average
SSB (Spawning-Stock Biomass)				
	2011	2012	2013	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity



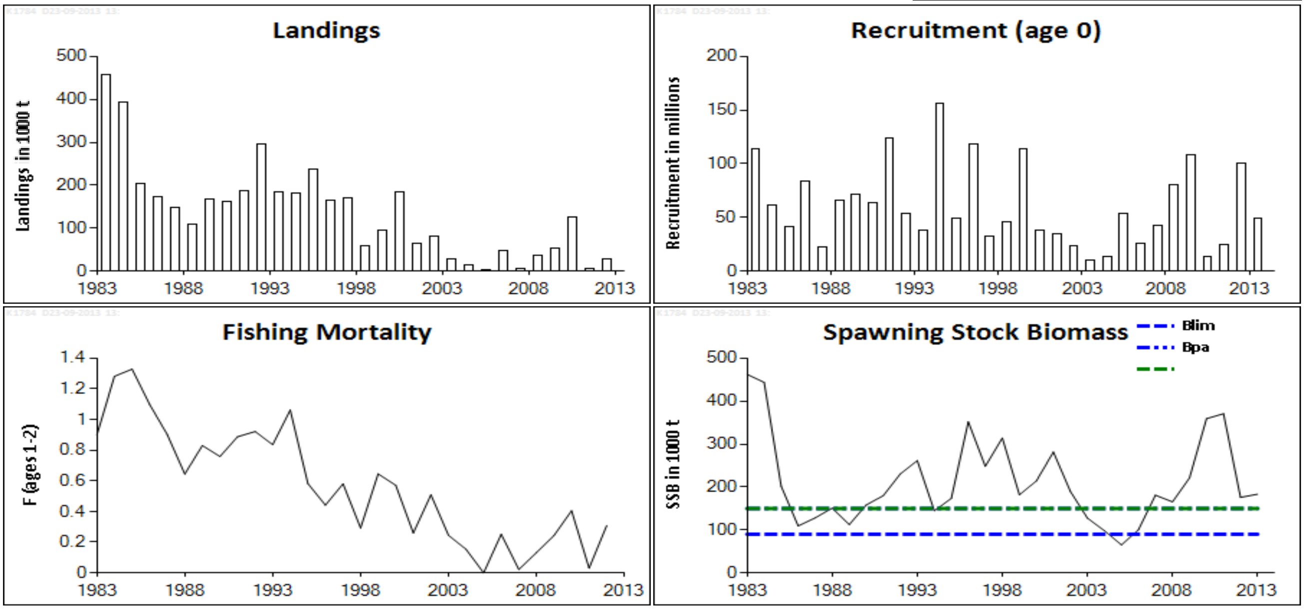


Figure 6.4.16b.1 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F over the time-series used in the assessment.

The stock dynamic is highly variable from year to year, due to recruitment variability and a short life span. Recruitment has been very high in 2012 and about average in 2013. This is expected to maintain SSB above MSY $B_{escapement}$ in 2014. Fishing mortality has been lower than the natural mortality for this stock and has decreased in recent years to below the long-term average F (0.6).

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). EU and Norway requests regarding long-term management plans for the stock have been evaluated by ICES in 2007, 2012, and again in 2013.

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 influences 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. The TAC was not taken in 2008, 2009, 2010, and 2012. Total catch in the first half of 2013 has been 11 000 t. 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 (5–10% in weight).

Catch distribution	Total catch (2012) = 27 kt (100% landings and no discards), > 99% taken by the small-meshed trawl fleet. The fishery has a 3 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 values for the natural mortality, maturity-at-age, and weight-at-age used in the assessment were updated in the 2012 inter-benchmark assessment. These parameters have impact on the predictions and estimates of the SSB because the stock consists of very few year classes. The change in these parameters has resulted in a downward scaling of the time-series of recruitment and some upscaling of SSB. The forecast for 2014 is sensitive to the assumed catches in the second half of 2013. Moving the TAC year to 1 November–31 October (in line with the 2013 advice (ICES, 2013b)) would make the catch forecast less sensitive to the assumption on catches taken in the second half of the year.

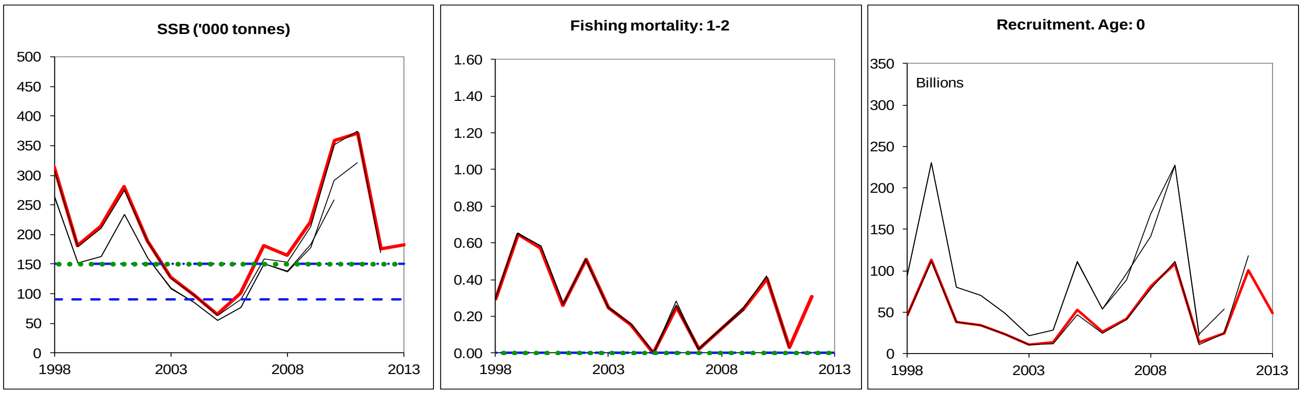


Figure 6.4.16b.2 Norway pout in Subarea IV (North Sea) and Division IIIa (Skagerrak–Kattegat). Historical assessment results (final-year recruitment estimates included) for the October advice.

Scientific basis

Assessment type	Age-based analytical (seasonal XSA).
Input data	Commercial catches (quarterly; ages and mean weight-at-age from catch sampling), four survey indices (IBTS Q1&3, EngGFS-IBTS-Q3, ScoGFS-IBTS-Q3), three commercial indices (cpue up to 2006 (CFQ1,Q3,Q4)). Maturity and natural mortality are assumed constant over years.
Discards and bycatch	Discards were not included as there are 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 and in-year advice. The autumn assessment provides stock status for the current year and advice for the next year. An inter-benchmark assessment was performed in spring 2012.
Working group report	WGNSSK (ICES, 2013a).

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	$= B_{lim}\ e^{0.3\times1.65}$
	F_{lim}	Undefined.	None advised.
	F_{pa}	Undefined.	None advised.

(unchanged since: 2010)

Outlook for 2014

Basis: F (2013) = estimated from assessment (Q1+Q2) = 0.030, and from long-term exploitation pattern (Q3+Q4) scaled by a factor 0.53 in Q3 and Q4 to a total catch (2013) = 150; R(2013) = estimated recruitment (age 0 in 2nd quarter) from in-year assessment = 49 billion; R(2014) = 33 billion (25% percentile of long-term recruitment (1983–2011); SSB (2014) = 312.

Rationale	Catch 2014	Basis	F 2014	SSB 2015	%SSB change[1)]
MSY approach	216	MSY $B_{escapement}$	0.82	150	-52%
Precautionary approach	216	B_{pa}	0.82	150	-52%
Zero catch	0	No fishery	0	280	-10%
Other options	100	TAC ceiling MSE 2013	0.32	217	-30%
	124	~max F last decade	0.41	204	-35%
	171	F ceiling MSE 2013	0.6	176	-44%
	200	TAC ceiling MSE 2013	0.74	159	-49%
	212	F ceiling MSE 2013	0.8	152	-51%
	333	B_{lim}	1.62	90	-71%

Weights in thousand tonnes.
[1)] SSB 2015 relative to SSB 2014.

Management plans

No management plan is agreed at present. ICES evaluated and commented on three management strategies in 2007, none of which have been agreed for management. Based on a new joint EU–Norway and a later EU request, new management strategies were evaluated in September 2012 and June 2013 and considered to be consistent with the precautionary approach under certain constraints (ICES, 2012b, 2013b). This evaluation showed that if a minimum TAC of 20 000 t is permitted and assessment and advice takes place only once per year, ceilings on both F and TAC are needed (simultaneously) for consistency with the precautionary approach. The options for the ceilings on both F and TAC are shown in the outlook table. The June 2013 evaluation showed that if the ceiling on the TAC is set at 200 000 t, then the ceiling on F should be no higher than 0.6, whereas if the ceiling on the TAC is set at 100 000 t, then the ceiling on F should be no higher than 0.8.

MSY approach

To maintain the spawning-stock biomass above MSY $B_{escapement}$ by 1 January 2015, catches in 2014 should not exceed 216 000 t. All catches are assumed to be landed.

The advice for 2014 is sensitive to the actual catches taken in quarters 3 and 4 of 2013. The forecast assumes that the total catch in 2013 is 150 000 t (well below the TAC for EU and Norway, which is 344 500 t). The 2013 catch assumption is based on the low quota uptake by Denmark and Norway (11 000 t taken during the first half of 2013, while preliminary information indicates that the uptake by the third week of September is of the order of 35 000 t) and the fact that the TAC has not been reached in recent years. In the last decade, catches in the 4th quarter have not exceeded 35 000 t. Therefore, 150 000 t is considered as a realistic upper-end estimate of the actual catch that may take place in 2013. If, however, catches in 2013 were substantially above 150 000 t, a catch lower than 216 000 t would be required in 2014 to maintain the stock above MSY $B_{escapement}$ by January 1 2015.

Precautionary approach

The precautionary approach corresponds to maintaining SSB above B_{pa} = MSY $B_{escapement}$ on 1 January 2015. Therefore, it is similar to the MSY approach for this species.

Additional considerations

The TAC was not taken in any of 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). There was only a 27% uptake of the ICES advised TAC of 101 000 t for 2012. This low uptake may be explained by the late opening of the fishery at the end of quarter 3 in 2012. Individual quotas for the Danish fishery may also play a role in the uptake. In the first half of 2013 11 000 t have been landed, whereas the TAC for 2013 is 344 500 t.

Norway pout is a short-lived species that most likely only spawns once. 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 estimated mature (Lambert *et al.*, 2009) and is included in the SSB. Therefore, the recruitment in the year after the assessment year influences the SSB in the following year. Norway pout is also, to a limited extent, exploited from age 0.

An inter-benchmark assessment in spring 2012 (ICES, 2012a) used revised estimates of natural mortality, maturity-at-age, and mean weight-at-age in the assessment. This led to a downward scaling of the recruitment estimates and some upward scaling of the SSB time-series. 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, blue 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 (5–10% by weight). 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 *et al.*, 2012). Selective devices have been implemented by a significant part of the fleet (larger vessels) since 2010. ICES suggests that these devices (or modified forms of them) should be fully implemented.

Management plan evaluations

No management objectives have been set for this stock. With the low fishing mortality in the last decade, 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 in 2007 – fixed fishing mortality (0.35), fixed TAC (50 000 t), and a variable TAC escapement strategy. The 2007 evaluation showed that all three management strategies were 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 and MSY approaches. It was noticed that 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 objective, then the fixed F (equivalent to fixed effort) strategy will perform better.

In October 2012, ICES evaluated three additional management strategies (ICES, 2012b). As a follow up on this, ICES has evaluated an additional management strategy based on an escapement strategy in June 2013 (ICES, 2013b), with a different TAC year and only one annual advice in the autumn. This harvest control rule includes a fixed minimum TAC. The evaluation shows that ceilings on both the TAC and F are necessary for it to be precautionary. Moving the TAC year to 1 November–31 October, based on annual advice in October, is considered to have limited influence on long-term yield, stock sizes, and probability of low stock biomass. Such change in management would make the catch forecast less sensitive to the assumption on catches taken in the second half of the year.

Impacts of fisheries on the ecosystem

Norway pout is an important prey species for a variety of fish species (e.g. saithe, haddock, cod, and mackerel). Natural mortality values by age and season used in the stock assessment are similar to the predation mortality estimates for this stock obtained 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 technical measures such as minimum mesh size in the trawls, sorting grids, fishing area closures (e.g. the Norway pout box in the northwestern part of the North Sea), and bycatch regulations in the fishery to protect other species. Bycatch regulations in force have contributed to reduce 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 June 2013 assessment. The basis for the advice this year is the MSY approach, similar to last year.

Sources

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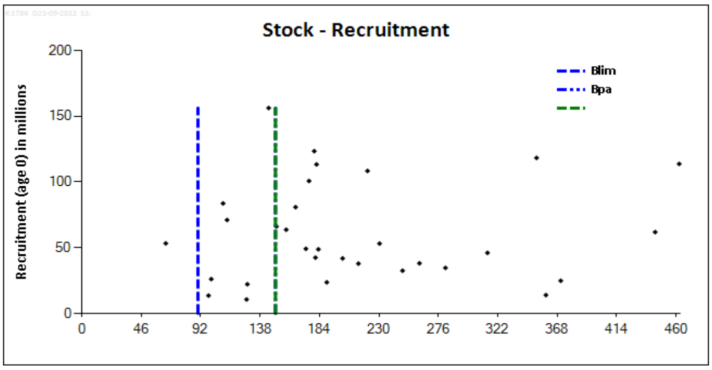

Figure 6.4.16b.3 Norway pout in Subarea IV and Division IIIa. Stock-recruitment relationship.

Table 6.4.16b.1 Norway pout in Subarea IV and Division IIIa**.** ICES advice, management, and catch.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ICES catch
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]	7	7
2012	No fisheries	0	0		
In-year[2]	Maintain SSB > MSY $B_{escapement}$	< 101	71 (EU)	30	27
2013	Maintain SSB > MSY $B_{escapement}$	< 458 ($Catch_{2012}$=0) < 393 ($Catch_{2012}$=101)	344.5 (EU + NO)		
In-year[2]	Maintain SSB > MSY $B_{escapement}$	< 457			
2014	Maintain SSB > MSY $B_{escapement}$	< 216			

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 6.4.16b.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.

Norway pout ICES area IIIa

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	3.780	4.235	110	-	18	24	156	-	51	2	118 *
Faroe Islands	-	50	45	-	-	-	-	-	-	-	-
Norway	96	30	41	-	2	-	-	209	711	-	-
Sweden	-	-	-	-	-	-	-	-	10	-	-
Germany	-	-	54	-	-	-	4	-	-	-	-
Total	3.876	4.315	250	0	20	24	160	209	772	2	118

*Preliminary.

Norway pout ICES area IVa

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	68.858	12.223	10.762	941***	39.531	59	32.158	19.226	71.032	4.038	24.829 *
Faroe Islands	3.367	2.199	1.085	24	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	22	18	-	-
Germany	-	-	-	-	15	-	-	-	-	-	-
Norway	23.657	11.357	4.953	311	13.618	4.712	6.650	36.961	64.303	3.189	4.528 *
Sweden	-	-	-	-	-	-	10	-	+	1	3 *
UK(Scotland)	-	-	-	-	-	-	-	-	29	-	6 *
Total	95.882	25.779	16.800	1.092	53.164	4.771	38.818	56.209	135.353	7.228	29.360

*Preliminary.

Norway pout ICES area IVb

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	556	191	473	-	394	-	244	595	229	32	611 *
Faroe Islands	12	125	29	-	-	-	-	-	-	-	-
Germany	-	-	-	-	19	-	-	75	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	2	-	-	82	620	21	59 *
Sweden	-	-	88	-	-	-	-	-	-	-	-
UK (E/W/NI)	+	-	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-	-	-
Total	568	316	590	0	415	0	244	752	849	53	670

*Preliminary.

Norway pout ICES area IVc

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	-	-	-	-	-	-	-	-	-	-	-
France	-	-	-	-	-	+	+	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-
UK (E/W/NI)	-	-	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0	0	0	0

*Preliminary.

Norway pout Sub-area IV and IIIa (Skagerrak) combined

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	73.194	16.649	11.345	941***	39.943	83	32.558	19.821	71.312	4.072	25.558
Faroe Islands	3.379	2.374	1.159	24	0	0	0	0	0	0	0
Norway	23.753	11.387	4.994	311	13.622	4.712	6.650	37.252	65.634	3.210	4.587
Sweden	0	0	88	0	0	0	10	0	10	1	3
Netherlands	0	0	0	0	0	0	0	22	18	0	0
Germany	0	0	54	0	34	0	4	75	0	0	0
UK	0	0	0	0	0	0	0	0	0	0	0
Total nominal landings	100.326	30.410	17.640	1.252	53.599	4.795	39.222	57.170	136.974	7.283	30.148
By-catch of other species and other	-20.326	-3.310	-4.140	-	-6.973	-	-3.084	-2.670	-11.019	-759	-3.075
WG estimate of total landings (IV+IIIaN)	80.000	27.100	13.500	-	46.626	-	36.138	54.500	125.955	6.524	27.073
Agreed TAC	198.000	198.000	198.000	0****	95.000	0****	114.616 x	116.279 x	162.950 x	4.500 x	70.683 x

* provisional / preliminary
** provisional / preliminary
*** 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
x EU TAC

Table 6.4.16b.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.

Year	Denmark		Faroes	Norway	Sweden	UK (Scotland)	Others	Total
	North Sea	Skagerrak						
1961	20.5	-	-	8.1	-	-	-	28.6
1962	121.8	-	-	27.9	-	-	-	149.7
1963	67.4	-	-	70.4	-	-	-	137.8
1964	10.4	-	-	51	-	-	-	61.4
1965	8.2	-	-	35	-	-	-	43.2
1966	35.2	-	-	17.8	-	-	+	53.0
1967	169.6	-	-	12.9	-	-	+	182.5
1968	410.8	-	-	40.9	-	-	+	451.7
1969	52.5	-	19.6	41.4	-	-	+	113.5
1970	142.1	-	32	63.5	-	0.2	0.2	238.0
1971	178.5	-	47.2	79.3	-	0.1	0.2	305.3
1972	259.6	-	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	-	51.2	63	2.9	13	0.6	345.9
1974	464.5	-	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	-	63.6	218.9	2.3	22.7	1	559.7
1976	244.9	-	64.6	108.9	+	17.3	1.7	437.4
1977	232.2	-	48.8	98.3	2.9	4.6	1	387.8
1978	163.4	-	18.5	80.8	0.7	5.5	-	268.9
1979	219.9	9	21.9	75.4	-	3	-	329.2
1980	366.2	11.6	34.1	70.2	-	0.6	-	482.7
1981	167.5	2.8	16.4	51.6	-	+	-	238.3
1982	256.3	35.6	12.3	88	-	-	-	392.2
1983	301.1	28.5	30.7	97.3	-	+	-	457.6
1984	251.9	38.1	19.11	83.8	-	0.1	-	393.01
1985	163.7	8.6	9.9	22.8	-	0.1	-	205.1
1986	146.3	4	2.5	21.5	-	-	-	174.3
1987	108.3	2.1	4.8	34.1	-	-	-	149.3
1988	79	7.9	1.3	21.1	-	-	-	109.3
1989	95.7	4.2	0.8	65.3	+	0.1	0.3	166.4
1990	61.5	23.8	0.9	77.1	+	-	-	163.3
1991	85	32	1.3	68.3	+	-	+	186.6
1992	146.9	41.7	2.6	105.5	+	-	0.1	296.8
1993	97.3	6.7	2.4	76.7	-	-	+	183.1
1994	97.9	6.3	3.6	74.2	-	-	+	182
1995	138.1	46.4	8.9	43.1	0.1	+	0.2	236.8
1996	74.3	33.8	7.6	47.8	0.2	0.1	+	163.8
1997	94.2	29.3	7.0	39.1	+	+	0.1	169.7
1998	39.8	13.2	4.7	22.1	-	-	+	57.7
1999	41	6.8	2.5	44.2	+	-	-	94.5
2000	127	9.3	-	48	0.1	-	+	184.4
2001	40.6	7.5	-	16.8	0.7	+	+	65.6
2002	50.2	2.8	3.4	23.6	-	-	-	80.0
2003	9.9	3.4	2.4	11.4	-	-	-	27.1
2004	8.1	0.3	-	5	-	-	0.1	13.5
2005	0.9*	-	-	1	-	-	-	1.9
2006	35.1	0.1	-	11.4	-	-	-	46.6
2007	2.0**	-	-	3.7	-	-	-	5.7
2008	30.4	-	-	5.7	+	-	+	36.1
2009	17.5	-	-	37.0	+	-	+	54.5
2010	64.9	0.2	-	60.9	+	+	+	126.0
2011	3.3	-	-	3.2	+	+	+	6.5
2012	22.3	0.1	-	4.6	+	+	+	27.0

* 781 t taken in a trial fishery; 160 t in bycatches in other (small-meshed) fisheries.
** 681 t taken in trial fishery; 1300 t in bycatches in other (small-meshed) fisheries.

Table 6.4.16b.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	113785	462497	458000	0.900
1984	61921	443866	393000	1.282
1985	41881	201973	205000	1.329
1986	83749	109399	174000	1.099
1987	22223	128173	149000	0.902
1988	66171	150729	109000	0.645
1989	71134	112499	166000	0.831
1990	63703	158309	163000	0.759
1991	123512	179978	187000	0.888
1992	53179	230541	297000	0.922
1993	38170	261441	183000	0.836
1994	156338	144711	182000	1.062
1995	49210	173518	237000	0.583
1996	118361	352028	164000	0.442
1997	32508	248326	170000	0.581
1998	46122	314078	58000	0.293
1999	113391	181751	95000	0.646
2000	37924	214224	184000	0.571
2001	34705	281546	66000	0.260
2002	23690	189688	80000	0.509
2003	10670	127543	27000	0.245
2004	13590	98116	14000	0.154
2005	53324	64996	2000	0
2006	26172	100292	47000	0.252
2007	42478	180911	6000	0.022
2008	80883	165493	36000	0.132
2009	108462	221215	55000	0.243
2010	14004	359336	126000	0.405
2011	24879	370802	7000	0.031
2012	100803	175871	27000	0.309
2013	48804	183213		
Average	60508	212486	135567	0.571

ECOREGION North Sea
STOCK Plaice in Subdivision 20 (Skagerrak)

Advice for 2014

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 landings should be no more than 8972 tonnes. In the Eastern Skagerrak, no directed fisheries should occur and bycatch and discards should be minimized. If the discard rate does not change from the rate of the last year (2012), this implies catches of no more than 10 196 tonnes.

If a discard ban is implemented, ICES advises on the basis of the ICES approach for data-limited stocks that catches should be no more than 10 196 tonnes.

Stock status

F (Fishing Mortality)		
	2010–2012	
Qualitative evaluation	?	Insufficient information

SSB (Spawning-Stock Biomass)		
	2008–2013	
Qualitative evaluation	West	West: stable/increasing
	East	East: decreasing and low

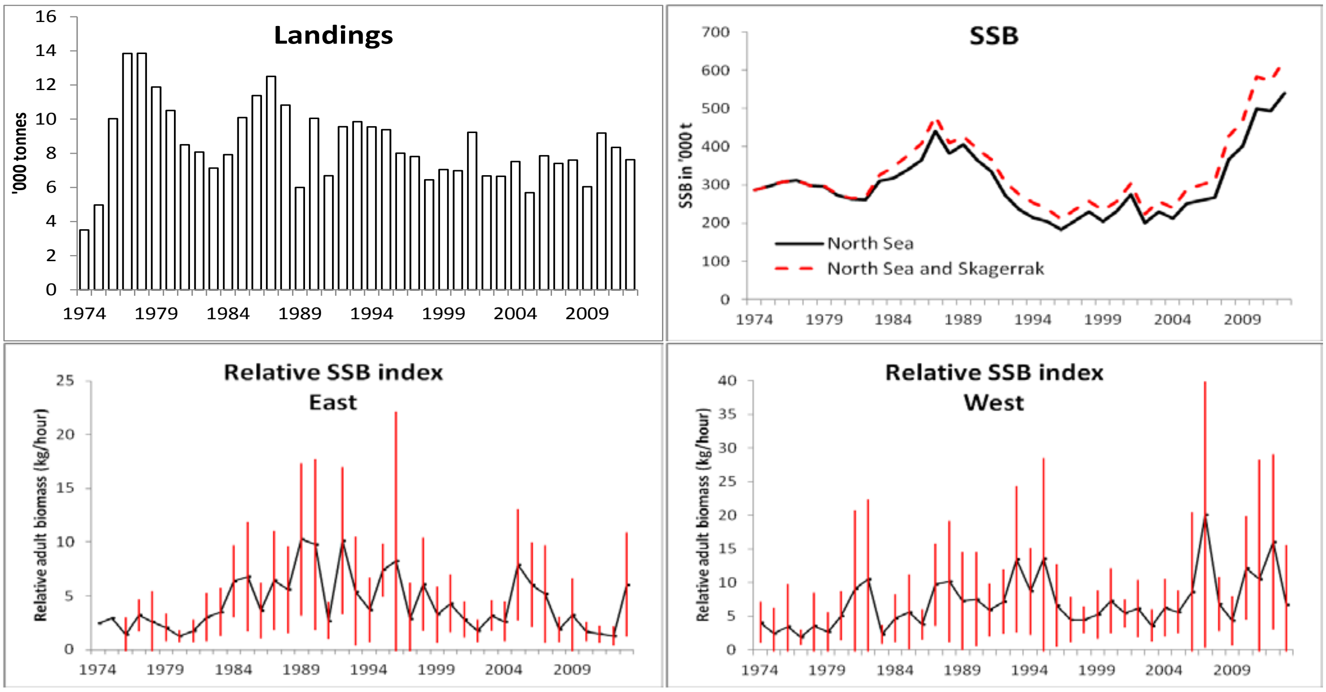

Figure 6.4.17.1 Plaice in Subdivision 20 (Skagerrak). Top: ICES landings (in 'thousand tonnes) in Skagerrak and SSB for the North Sea stock, with and without the Skagerrak landings data included in the assessment. Below: Trends in the adult-stock biomass index (fish above 25 cm, in g/hour) in the Eastern and Western Skagerrak (IBTS).

Plaice in Skagerrak is considered to have two components: Eastern and Western, the latter of which is mixed with the North Sea stock. A combined assessment of the Skagerrak with the North Sea stock shows a consistent upward scaling of the total spawning stock biomass. A biomass index suggests that, in recent years, the Western component is higher than the historical average, and conversely the eastern component is lower (despite the notable increase observed in 2013). Fishing mortality is unknown, but effort has been reduced.

Management plans

No specific management plan is implemented for this stock. ICES evaluated a candidate harvest control rule for an interim management plan in 2012 (See Annex 6.4.17).

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. 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, potentially because of the great diversity of the local hydrographical conditions and/or genetic differentiation.

The fisheries

In Skagerrak, plaice is taken all year round, mainly in a directed fishery by seiners, gillnetters, and small coastal vessels, but also in a mixed trawl fishery together with cod and *Nephrops*.. Nearly all catches are now taken in the Western area, while plaice by-catches in the targeted Nephrops fishery in the Eastern area have dropped to very low levels with the increased adoption of more selective gears.
Plaice discarding is limited in Skagerrak due to the predominance of selective and large-meshed gears for that fishery..

Catch distribution	Total catch (2012) = 8.4 kt, where 88% were landings (49% demersal seine, 33% trawl, 6% gillnets, 6% beam trawl, and 6% others (mainly <10 m vessels)), 12% were discards.

Quality considerations

Uncertainty in the stock distribution boundaries and mixing with the North Sea, as well as insufficient survey spatial coverage make it inappropriate to conduct a separate analytic assessment in this area, but a combined assessment with the North Sea can be performed. The advice is mainly based on a spatially-disaggregated index from the IBTS Q1, with considerations on the protection of local components together with the influence of the North Sea stock on plaice in the Skagerrak. The IBTS survey or other scientific monitoring should be intensified in the Western Skagerrak.

The advice is based on a biomass index from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is available. 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 considerations of trends from local components in Skagerrak, and exploratory XSA Age-based analytical assessment for the North Sea including Skagerrak landings (Data limited stock category 3.2.0)
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling by métier) survey indices (Skagerrak IBTS Q1 indices modified from Cardinale et al. 2011)
Discards and bycatch	Skagerrak discards data not included in the assessment yet, but data available.
Indicators	Landings and effort by gear and ICES rectangle from STECF online database
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). A benchmark is suggested for 2015
Working group report	WGNSSK (ICES, 2013)

ECOREGION North Sea
STOCK Plaice in Subdivision 20 (Skagerrak)

Reference points

No reference points are defined for this stock.

Outlook for 2014

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. This year advice is based on an estimation of the most recent trends in survey index values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch.

For the Western component (where nearly all catches take place) the biomass in the last three years (2011–2013) is 7% higher than the average of the five previous years (2006–2010). This implies an increase of landings of at most 7% in relation to the last three years average landings, corresponding to landings of no more than 8972 t.

Even though exploitation status is unknown, the effort of the main fleets with plaice catches has declined substantially (−41% between 2003 and 2012). For trawling and Danish seines (all mesh sizes) a reduction in 40% effort was recorded. Therefore no additional precautionary reduction of catches is needed.

If discards rates do not change from the rate of the last year (2012), this implies catches of no more than 10 196 t. Discard mortality is assumed to be 100%.

Conversely, in the Eastern component, the biomass is considered depleted. The biomass in the last three years (2011–2013) is 19% lower than the average of the five previous years (2006–2010). Catches in the Eastern area are very low (under 1% of the Skagerrak catches in 2012), but the actual exploitation rate is uncertain due to the reduced stock status. Therefore, no directed fisheries should occur and bycatch and discards should be minimized.

Alternative options for potential interim management plans

In 2013, EU and Norway and the North Sea RAC are considering further options for an interim management plan for plaice in Skagerrak, on the basis of the links between this stock and North Sea Plaice. This work is based on ICES feedback on an EU-Norway request on this topic (ICES, 2012a). ICES concluded that such a strategy could potentially form the basis of an *interim* harvest control rule until the biological knowledge on the stocks structure is consolidated.

In 2012 ICES considered that a pragmatic harvest control rule could be used indexing the Skagerrak TAC to either;

Changes in the North Sea TAC or
Changes in SSB of the combined assessment.

These options could potentially form the basis of an *interim* management plan, with provisions explicitly linked to a monitoring of the dynamics in local components within Skagerrak (ICES, 2012a and Appendix 6.4.17.4).

The SSB estimated from the combined assessment increased by 10% between 2011 and 2012 and is well above MSY Btrigger for the North Sea stock. The West Skagerrak survey index also shows a slightly increasing trend.

A change in the TAC in Skagerrak based on the changes in TAC in the North Sea (+15%) would imply catches in 2014 to be no more than 11 880 t (TAC 2013 = 9142 t landings x 1.15 = 10 513 t landings, with 12% discard ratio to catches = 11 880 tonnes catches).
A change in the TAC in Skagerrak based on the changes in the combined assessment SSB would imply catches in 2014 to be no more than 11 364 t (TAC 2013 = 9142 t landings x 1.1 = 10 056 t landings, with 12% discard rate = 11 364 tonnes catches)

This interim harvest control rule should be reconsidered after the next benchmark of the assessment.

Additional considerations

Management considerations

ICES evaluated the stock identity of plaice in the Skagerrak and Kattegat (ICES, 2012a, 2012b) for which combined advice has been given until 2012. Adjacent waters, such as the North Sea in the Western and the Belts and Sound in the Eastern component are now taken into account due to migration of local components between their spawning and feeding grounds. Although additional work on stock identity is ongoing, the currently available information on biology and fishery of plaice in Division IIIa and adjacent waters could already suggest changes in assessment units as well as in management areas (Ulrich *et al.*, 2013)

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 6.4.17.2, 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 combined 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 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 (Ulrich *et al.*, 2013). 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 (Cardinale *et al.*, 2011). 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 effects of regulations

Previously, plaice TACs were set for Kattegat and Skagerrak separately but with a fixed allocation key between the two areas, based on advice for the entire Division IIIa. Catches in Kattegat have dropped over time, while conversely the TAC in Skagerrak became increasingly restrictive as lpue have increased in the recent years. From 2012 onwards ICES has provided 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 cod stock in North Sea, Skagerrak and Eastern Channel. 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. Plaice in Skagerrak is primarily caught by Danish seines with >120 mm mesh size with limited by-catch of cod; however, this fishery is included in the regulated TR1 category and has been deemed to annual effort ceilings reductions.

Overall nominal effort (kW-days) in the Skagerrak has been substantially reduced (−41% between 2003 and 2012). For trawling and Danish seines (all mesh sizes) a reduction in 40% effort was recorded. A substantial amount of the Danish plaice fishery in Skagerrak is operated under a Fully Documented Fishery scheme (20% in 2012, mainly Danish seiners)

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. Therefore, no analytical assessment can be performed for this area alone.

The survey covers mostly the eastern side of the distribution where limited fishing occurs. The IBTS survey or other scientific monitoring should be intensified in the Western Skagerrak.

Comparison with previous assessment and advice

The stock structure of plaice in the Skagerrak and Kattegat area has been revised in 2012 (ICES, 2012a, Ulrich *et al.*, 2013), where the first assessment was produced for plaice in the Skagerrak. The assessment this year is similar to last year, based on an updated version of Cardinale *et al.* (2011) indices of local adult aggregation during spawning as a monitoring of local abundance, together with an exploratory combined North Sea–Skagerrak assessment.

Last year, the advice was based on the ICES approach to data-limited stocks for Skagerrak separately, using the ratio between the average of the most recent two years and the average of the three preceding years of the local survey index from the Western component. This year, the advice is based on a smoothed recent trend of that same index updated up to 2013.

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.

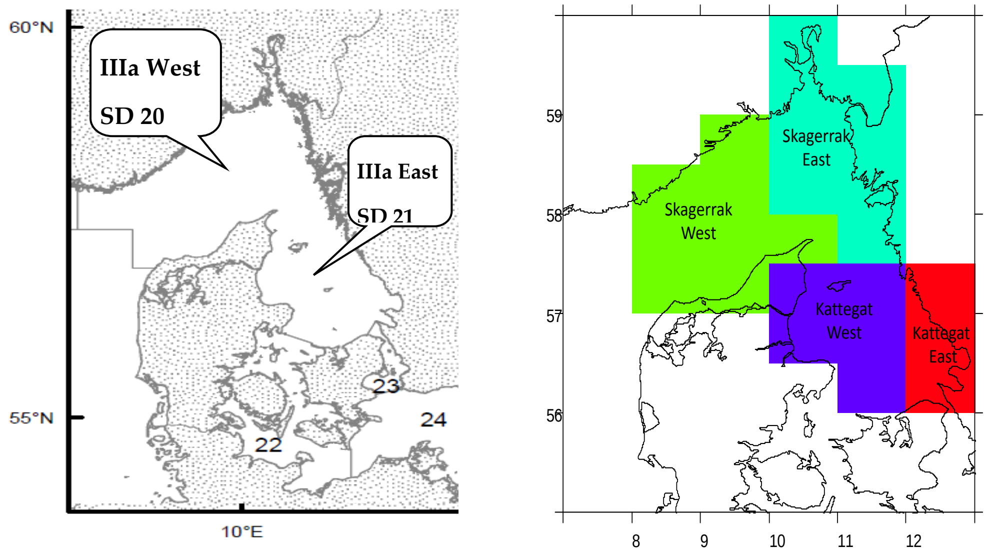

Figure 6.4.17.2 Plaice in the Skagerrak and Kattegat. Left: Subareas in the region. Right: Local components in the area (based on putative spawning subareas) in ICES statistical rectangles. The dark blue and red areas describe the Eastern and Western Kattegat components, the light blue and green areas describe the Eastern and Western Skagerrak components.

Sources

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Ulrich, C., Boje, J., Cardinale, M., Gatti, P., LeBras, Q., Andersen, M., Hemmer-Hansen, J., Hintzen, N.T., Jacobsen, J.B., Jonsson, P., Miller, D.C.M., Nielsen, E.E., Rijnsdorp, A.D., Sköld, M., Svedäng, H., Wennhage, H. 2013. Variability and connectivity of plaice populations from the Eastern North Sea to the Western Baltic Sea, and implications for assessment and management, Journal of Sea Research, 10.1016/j.seares.2013.04.007.

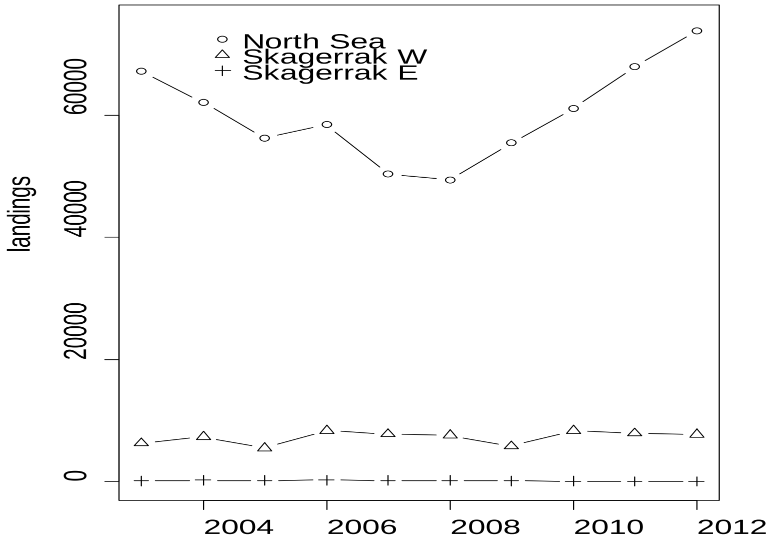


Figure 6.4.17.3 Plaice landings in Skagerrak West, Skagerrak East and North Sea.

Table 6.4.17.1 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/landings corresp. to advice for Skagerrak	Predicted catch corresp. to advice for Skagerrak and Kattegat combined	Agreed TAC Skagerrak	ICES landings	ICES catches
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		-	7.9	7.628	8.353
2013[4)]	Increase catch by 7% – protect Eastern component	< 8.4		9.142		
2014	Increase catch by 7% – protect Eastern component – without discard ban (landings)	< 8.972				
	– with discard ban (catches)	< 10.196				

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

Year	Denmark	Sweden	Germany	Belgium	Norway	Netherlands	Total landings	Discard rate	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		11 200
1993	9 125	287	37	326	79		9 854		11 200
1994	8 783	315	37	325	91		9 551		11 200
1995	8 468	337	48	302	224		9 379		11 200
1996	7 304	260	11		428		8 003		11 200
1997	7 306	244	14		249		7 813		11 200
1998	6 132	208	11		98		6 449		11 200
1999	6 473	233	7		336		7 049		11 200
2000	6 680	230	5		67		6 982		11 200
2001	9 045	125			61		9 231		9 400
2002	6 470	140	3		58		6 671		6 400
2003	4 847	143	8		74	1 584	6 656		1 400
2004	5 717	179			106	1 511	7 513		9 500
2005	4 515	144			116	915	5 690		7 600
2006	6 334	175	14		142	1 190	7 855		7 600
2007	5 467	159	21		100	1 659	7 406		8 500
2008	6 901	219	5		79	403	7 607		9 300
2009	5 617	92	13		60	253	6 035		9 300
2010	7 644	153	10		49	1 332	9 187		9 300
2011	7 744	179	13	185	215	6	8 342		7 900
2012	7 328	155	12		122	10	7 627	12%	7 900
2013									9 142

Table 6.4.17.3 Plaice in Subdivision 20 (Skagerrak). Biomass indices per local component.

West Skagerrak					East Skagerrak			
	Number of observations	average catch/unit effort (g/hour)	Standard deviation			Number of observations	average catch/unit effort (g/hour)	Standard deviation
1974	4	4038	3097		1974	1	2464	NA
1975	4	2428	3782		1975	1	2909	NA
1976	9	3465	6291		1976	2	1418	1597
1977	5	1816	1108		1977	6	3189	1472
1978	6	3579	4951		1978	2	2584	2837
1979	8	2591	2952		1979	4	2055	1300
1980	8	5050	3699		1980	4	1256	559
1981	12	9085	11638		1981	6	1736	1034
1982	6	10455	11913		1982	6	3023	2225
1983	9	2290	1418		1983	10	3521	2232
1984	11	4652	3579		1984	11	6366	3379
1985	8	5605	5569		1985	9	6781	5089
1986	7	3714	2253		1986	13	3622	2573
1987	12	9700	6122		1987	13	6438	4594
1988	7	10129	9012		1988	9	5591	4021
1989	11	7236	7289		1989	10	10243	7094
1990	9	7516	7001		1990	9	9788	7980
1991	11	5905	3950		1991	8	2692	1713
1992	11	7155	4801		1992	9	10123	6841
1993	10	13403	10930		1993	9	5414	5034
1994	10	8661	6426		1994	11	3704	2982
1995	10	13497	15000		1995	12	7376	2458
1996	10	6574	6168		1996	10	8240	13898
1997	10	4402	3359		1997	12	2886	3327
1998	10	4434	2045		1998	10	6078	4323
1999	11	5234	3562		1999	11	3268	2621
2000	11	7287	4838		2000	9	4300	2713
2001	11	5421	2053		2001	9	2814	1679
2002	11	6135	4249		2002	6	1731	1046
2003	8	3585	2458		2003	9	3167	1422
2004	11	6249	4247		2004	11	2621	1865
2005	15	5579	3203		2005	11	7907	5146
2006	11	8573	11857		2006	11	6028	3939
2007	11	20073	19761		2007	11	5193	4547
2008	10	6787	4058		2008	11	1880	1175
2009	11	4312	3658		2009	10	3224	3409
2010	11	12123	7692		2010	9	1709	915
2011	11	10542	17779		2011	7	1448	812
2012	10	16005	13045		2012	9	1268	901
2013	11	6691	8863		2013	10	6025	4844

Annex 6.4.17 Candidate harvest control rule for an interim management plan

Plan as per the joint EU–Norway request on management measures for plaice in the Skagerrak, as evaluated by ICES, (2012a)

Skagerrak plaice TAC setting following the trends in the North Sea and West Skagerrak assessments:

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

North Sea / Skagerrak combined assessment SSB		**West 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.
Letters in cells are used to indicate which option of the plan is being considered.

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

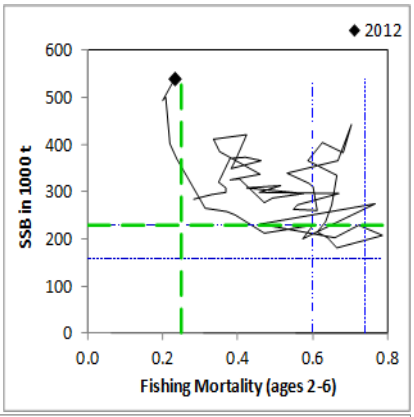
Advice for 2014

ICES advises on the basis of stage one of the EU management plan (Council Regulation No. 676/2007) that landings should be no more than 111 631 tonnes in 2014. If discard rates do not change from the average of the last three years (2010–2012), this implies catches of no more than 159 584 tonnes.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Below target

SSB (Spawning-Stock Biomass)	2011	2012	2013	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity
Management plan (SSB_{MP})	✓	✓	✓	Above target



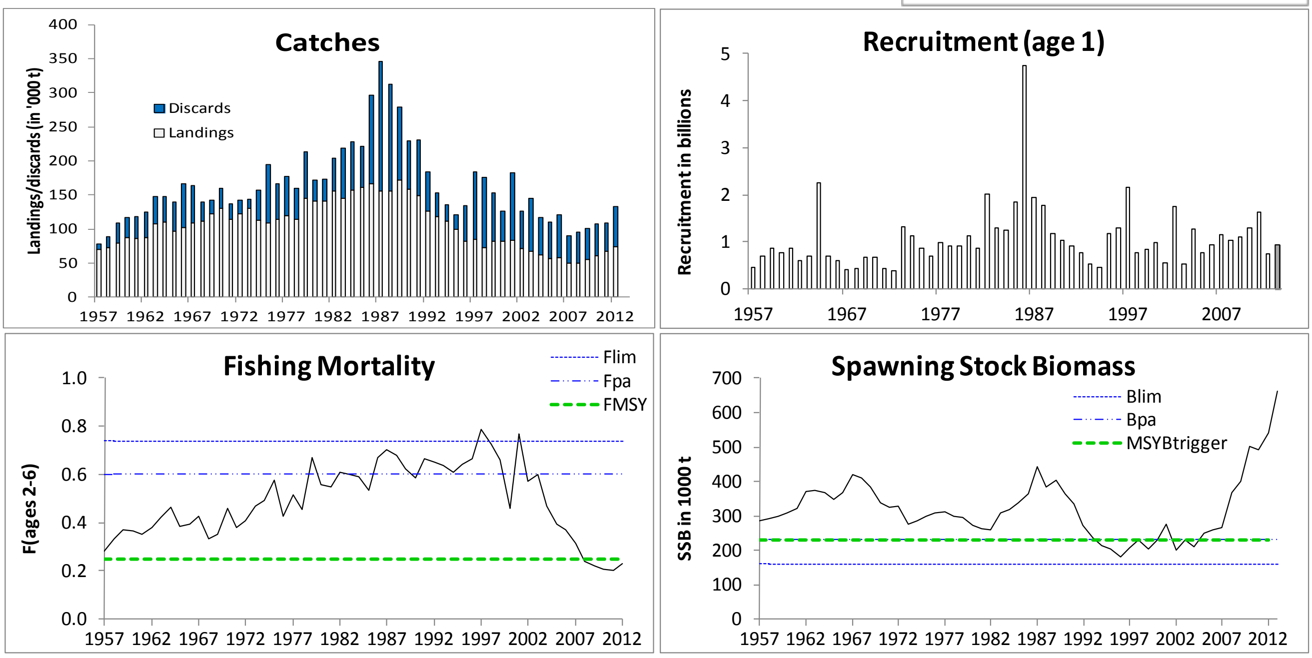


Figure 6.4.18.1 Plaice in Subarea IV (North Sea). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F for the time-series used in the assessment.

The stock is well within precautionary limits, has increased in the past ten years, and has reached a record-high level in 2013. Recruitment has been around the long-term average from 2007 onwards. In recent years, fishing mortality has been estimated below F_{MSY}.

Management plans

There is a two-stage management plan for North Sea sole and plaice (Council Regulation (EC) No. 676/2007, see Annex 6.4.18). An evaluation of the plan (ICES, 2010b) concluded that the management plan is precautionary. The stocks are presently in stage two of the plan; implementation of this second stage (as stipulated in article 5 of the EC regulation) is not yet defined.

Biology
Plaice is a bottom-dwelling species, mainly feeding on annelids and molluscs. In the North Sea they spawn in the first quarter of the year. The major nurseries are situated in the coastal zones and estuaries in the southern North Sea. The growth rate 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
Studies suggest that North Sea plaice has shown a shift northward to deeper waters. Juvenile plaice have been observed to be distributed more offshore in recent years. This distribution shift has been attributed to climate change (Engelhard *et al*., 2011). The distribution shift of plaice increased the bycatch of small plaice further offshore.

The fisheries
Plaice is predominantly targeted by beam trawlers in the central part of the North Sea with a minimum mesh size of 100–120 mm, depending on the area. In addition, plaice is caught in a mixed fishery which targets sole in the southern North Sea with a minimum mesh size of 80 mm. The catches of this latter fishery include plaice under the minimum landing size of 27 cm, which results in high discard rates. The total fleet discard ratio has gradually decreased since 2000 and is at present approximately 45% by weight.

Catch distribution	Total catch (2012) = 132 903 t, where 56% were landings (59% beam trawl, 32% otter trawl, and 9% other gears) and 44% discards.

Effects of the fisheries on the ecosystem
The mixed plaice and sole fishery is dominated by bottom trawls, with bycatch of both commercial and non-commercial species and a physical impact on the seabed. Bottom trawling impacts biomass, production, and species richness. Trawling impact differs among benthic habitats and is likely to be more important in deeper water with silt 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
The assessment was improved by combining two BTS indices, covering different parts of the distribution of plaice, into a single standardized time-series. This has led to a slight upwards revision of the recruitment estimates. Updates of tagging and genetic studies describing the migratory behaviour of plaice between the North Sea and adjacent waters would improve determining stock units.

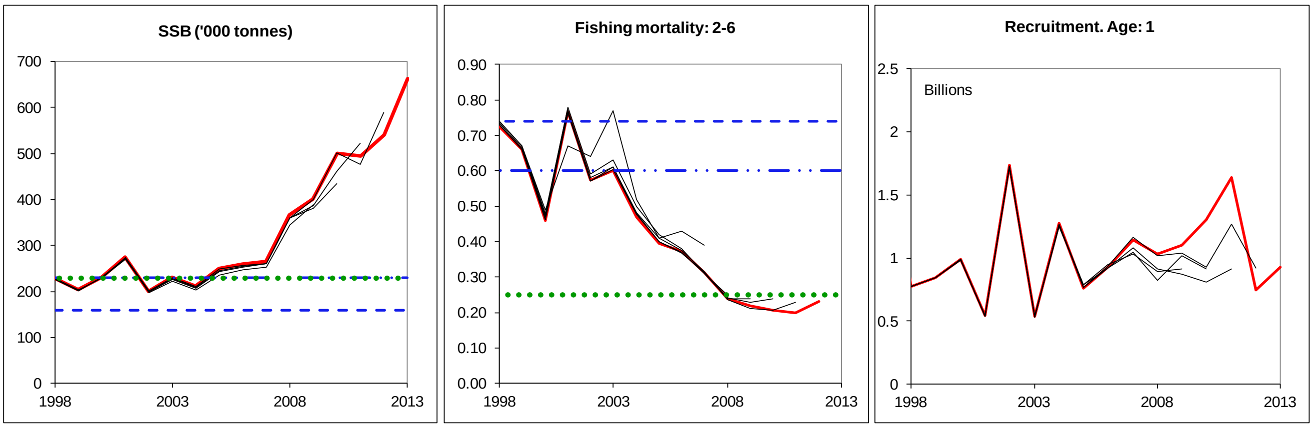


Figure 6.4.18.2 Plaice in Subarea IV (North Sea). Historical assessment results (final-year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Commercial catches from landings, ages and length frequencies from port sampling. Three survey indices (combined BTS (BTS-Tridens and BTS-Isis), BTS-Isis, and the SNS). Maturity-at-age assumed constant; natural mortality-at-age assumed constant at 0.1.
Discards and bycatch	Discards were included in the assessment based on monitoring (NL, UK, GER, DK, since 2000).
Indicators	None.
Other information	This stock was benchmarked in 2009 (WKFLAT) and an inter-benchmark procedure was carried out in 2013 (IBP Plaice 2013).
Working group report	WGNSSK.(ICES, 2013a)

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) that implies $B_{eq} > B_{pa}$[1)] and a 50% probability that $SSB_{MT} \sim B_{pa}$.

(unchanged since: 2011)

Outlook for 2014

Basis: F (2013) = mean(F 2010–2012) scaled to 2012 = 0.23; R (2013) = GM (1957–2010) = 930.070 million; Landings (2013) = 97 688; Discards (2013) = 48 551; SSB (2014) = 735 330.

Rationale	**Catch (2014)**	**Landings (2014)** [3)]	**Basis**	**F(2–6) total (2014)**	**F(2–6) HC (2014)**	**F(2–3) Disc. (2014)**	**Disc. (2014)**	**SSB (2015)**	**%SSB change** [1)]	**%TAC change** [2)]
Management plan	159.584	111.631	TAC + 15%	0.26	0.14	0.23	48.242	737.017	0%	+15%
MSY approach	153.069	106.226	F_{MSY}	0.25	0.13	0.22	46.299	743.656	+1%	+10%
Precautionary approach	317.395	222.529	F_{pa}	0.60	0.31	0.53	94.451	577.047	−22%	+130%
Zero catch	0	0	F = 0	0.00	NA	NA	0	900.243	+22%	−100%
Other options	179.761	125.671	MP_F-target	0.30	0.16	0.26	54.244	716.473	−3%	+29%
	38.666	26.221	$F_{2013} \times 0.25$	0.06	0.03	0.05	11.804	860.586	+17%	−72%
	75.342	51.796	$F_{2013} \times 0.50$	0.12	0.06	0.10	22.935	823.031	+12%	−46%
	130.274	90.229	$F_{2013} \times 0.90$	0.21	0.11	0.18	39.481	766.902	+4%	−6%
	118.269	82.510	TAC −15%	0.19	0.10	0.16	35.879	779.156	+6%	−15%
	139.269	97.070	Stable TAC (= $F_{2013} \times$ 0.967)	0.23	0.12	0.20	42.175	757.726	+3%	0%
	143.165	99.272	F_{2013}	0.23	0.12	0.20	43.34	753.753	+3%	+3%
Mixed-fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b).										
Maximum	233.968	163.655	A	0.41			70.312	650.750	−12%	+69%
Minimum	78.931	54.880	B	0.12			24.051	808.471	+10%	−43%
Cod_ MP	79.249	55.102	C	0.12			24.147	808.146	+10%	−43%
SQ effort	149.936	104.520	D	0.25			45.416	736.068	+0%	+8%
Effort_Mgt	118.995	82.855	E	0.19			36.140	767.586	+4%	−15%

Weights in thousand tonnes.

[1)] SSB2015 relative to SSB 2014.

[2)] Landings 2014 relative to TAC 2013.

[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 (676 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. TAC change restrictions of 15% are applied after subtracting the Division VIId catches.

Mixed-fisheries assumptions:
Maximum scenario: Fleets stop fishing when the last quota is exhausted.
Minimum scenario: Fleets stop fishing when the first quota is exhausted.
Cod management plan scenario: Fleets stop fishing when the cod quota is exhausted.
SQ effort scenario: Effort in 2012 and 2013 as in 2011.
Effort management scenario: Effort reductions according to cod and flatfish management plans.

Management plan

The North Sea plaice and sole stocks have both 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).

Following the EU multiannual plan stage 1 (as rules relating to the setting of F for stage 2 are not yet defined) would imply fishing at the target rate of 0.3, which results in a TAC (landings) increase of more than 15%. Therefore, the maximum TAC increase of 15% is applied, resulting in landings of no more than 111 631 t in 2014. If discard rates do not change from the average of the last three years (2010–2012), this implies catches of no more than 159 584 t. This is expected to lead to an SSB of 737 017 t in 2015.

ICES has evaluated this management plan and considers it to be precautionary (ICES, 2010a).

MSY approach

Following the ICES MSY approach implies an increase in fishing mortality to 0.25, resulting in catches of 153 069 t in 2014. If discard rates do not change from the average of the last three years (2010–2012), this implies landings of no more than 106 226 t. This is expected to lead to an SSB of 743 656 t in 2015.

Given that the current (2012) estimate of fishing mortality is slightly below F_{MSY}, there is no need to follow a transition scheme towards this reference value.

Precautionary approach

The fishing mortality in 2014 should be no more than F_{pa} (0.6), corresponding to catches of no more than 317 395 t in 2014. If discard rates do not change from the average of the last three years (2010–2012), this implies landings of no more than 222 529 t. This is expected to keep SSB above B_{pa} in 2015.

Mixed fisheries

In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the main limiting species for the North Sea demersal fisheries in 2014. In all scenarios except the “Maximum”, the Plaice IV management plan catch options could not be fully utilized.

Additional considerations

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 2013.

Stock identity

ICES evaluated the stock identity of plaice in the Skagerrak and Kattegat (ICES 2012b, 2012c; Ulrich *et al.*, 2013) for which combined advice was given until 2011. Although work on stock identity is still under development, the collected information on the biology and fishery of plaice in Division IIIa and adjacent waters led to decisions upon changes in assessment units as well as in management areas. In 2013, TACs for plaice were established for the Kattegat and the Skagerrak areas separately. Plaice in Skagerrak is now considered to be highly connected to plaice in the North Sea, although these linkages cannot be quantified. The advice for plaice in Skagerrak is therefore linked to the one from the North Sea (ICES, 2013d).

This year – as in 2012 – part of the catches in Division VIId in the first quarter are included in the North Sea plaice assessment as it is assumed that North Sea plaice migrates into that area in the season.

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: a recovery plan during its first stage and a management plan during its second stage. Objectives are defined for these two stages, rebuilding the stocks to within safe biological limits in the first and exploiting the stocks at MSY in the second. 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 an impact assessment and 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. The 2012 and 2013 estimates are well above B_{pa} (43 kt and 39 kt). .Consequently, ICES concludes that the objectives of stage 1 are currently met and provides advice based on the plan's TAC-setting procedure, acknowledging the stock 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 an increase in fishing mortality for plaice as well as a reduction of 10% in effort (following a 10% reduction in F to 0.21 for sole).

In 2012, ICES evaluated a proposal by the Netherlands for an amended management plan, which could serve as the "stage 2" plan (Coers *et al*., 2012). The amendments included changing the target F for sole to 0.25 and to cease reductions of effort. ICES concluded that the plan – subject to those amendments – is consistent with the precautionary approach and the principle of maximum sustainable yield (ICES, 2012a). However, implementation of stage two of the plan is not yet defined. The amendments evaluated do not affect the current TAC advice for plaice as the changes were in relation to (1) the target F for sole, and (2) ceasing reductions in effort limitations.

In 2013, the effects of interannual quota flexibility in the management plan for plaice and sole were evaluated (ICES, 2013c). ICES concluded that the multiannual management plan is robust to inclusion of interannual quota flexibility in terms of the probability of the stock biomass falling below B_{lim}, and average yield. This conclusion is conditional on the interannual quota flexibility being suspended when the stock is estimated to be outside safe biological limits.

Regulations and their effects

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. Bottom otter trawls (OTB) with a mesh size equal to or larger than 100 mm and 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.

The current sole and plaice long-term management plan (Council Regulation (EC) No. 676/2007) also specifically reduces effort as a management measure, affecting BT2 and occasionally trammel nets (GT1) gears since the implementation of the plan. Effort ceilings are updated annually. However, for 2013, the European Council decided upon a roll-over of the effort level in 2012 into 2013 for both the cod and the sole/plaice management plan.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill/trammel nets, and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, −16% between 2008 and 2012). 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 and in small-mesh beam trawl (80–120 mm, BT2), has shown a pronounced decline (−14%, −45%, and −48%, respectively, between 2004 and 2012). Gill- and trammelnet fisheries have remained stable (ICES, 2013b). Effort in large mesh size beam trawl (≥120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline. Nominal effort reported by Norway has increased since 2011 due to the generalization of electronic logbooks.

Technical measures applicable to the mixed flatfish beam-trawl fishery in the southern North Sea, 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. For the overall fleet the discard ratio has been high since 2003 (54%) and has decreased to 44% by weight in 2012. Mesh enlargement would reduce the catch of undersized plaice, but would also result in loss of marketable sole. Furthermore, the size selectivity of the fleet 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). The introduction of the Omega (mesh size) meter in 2010 has led to a slight increase in the effective mesh size in the fishery.

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 latest evaluation reported the Plaice Box as having very little impact on the plaice stock (Beare *et al.*, 2013).

Changes in fishing technology and fishing patterns

In the southern North Sea plaice is caught in a mixed fishery with sole. The combination of days-at-sea regulations, the constrained TAC for plaice, and the relatively stable TAC for sole have lead to a more southern fishing pattern in the North Sea where sole is more abundant. In addition, high oil prices may have contributed to this change in fishing pattern as well, since sole is a substantially more economically valuable fish than plaice. This concentration of fishing effort in the south has resulted in high discarding of juvenile plaice that are mainly distributed in those areas. In recent years, this process is aggravated by a more offshore distribution of juvenile plaice to the fishing grounds, where they are available to the fishery. In 2012 the Dutch beam-trawl fleet shifted towards targeted plaice fisheries in more central parts of the North Sea (e.g. Doggerbank area) because of lower sole and higher plaice prices, in combination with relatively high catch rates for plaice.

The increased use of new gears such as “SumWing” and electric “pulse trawls” will increasingly affect catchability and selectivity of plaice and sole. ICES considered that pulse trawls experienced lower catch rates (kg hr^{-1}) of undersized sole and higher catch rates of marketable sole, compared to standard beam trawls (ICES, 2006). Plaice catch rates decreased for all size classes. In 2011, approximately 30 derogation licenses for pulse trawls were operational in the Netherlands, increasing to 42 in 2012. Debate is ongoing in the EU about extensions of an additional 42 derogation licenses as well as possible amendments to EU regulations that would permanently legalize the use of pulse gears for the whole fleet. The introduction of innovative gears may lead to changes in how the ecosystem is impacted by the plaice and sole targeting fleet. Because of the lighter gear and lower towing speed, pulse vessels generate a lower swept-area per hour and reduced bycatch of benthic organisms. The new gears may change fishing patterns as well.

ICES responded to a request by France on the use of the pulse trawl (ICES, 2012d) and concluded that the introduction of electric pulse systems could significantly reduce fishing mortality of target and non-target species, including benthic organisms, assuming there is no corresponding increase in unaccounted (avoidance) mortality. However, not all items (such as delayed mortality and long-term population effects) have been fully studied and ICES therefore considers that the available data are insufficient to recommend the large-scale use of the electric pulse trawl in fisheries.

Impacts of the fisheries on the ecosystem

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 compared with an un-fished situation (Hiddink *et al.*, 2006; Hinz *et al.*, 2008). Sustained 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). For example, in recent years plaice and sole have become mature at younger ages and at smaller sizes than in the past.

Impacts of the environment on the fish stock

Adult North Sea plaice have an annual migration cycle between spawning and feeding grounds. Feeding grounds are located more northerly than the sole distribution areas. Spawning grounds are located in the (western and eastern) central North Sea, the southern North Sea, and the eastern English Channel, overlapping with the distribution area of sole. Juveniles generally reside in shallow inshore waters and move gradually offshore as they become larger. However, juvenile plaice have been distributed more offshore in recent years (Beare *et al.*, 2013). 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 nursery areas on the eastern side of the North Sea (and possibly inside the Skagerrak area) contribute to much of the total recruitment. Sub-populations have strong homing behaviour to specified spawning grounds.

A shift in distribution has been observed in the relative contribution of the different spawning grounds to overall recruitment from the east to the west of the central North Sea (Hufnagl *et al.*, 2012). This is likely due to positive and negative effects, respectively, in transport success from spawning grounds to inshore nursery areas, caused by changes in both currents and water temperature.

Information from the fishing industry

The Fishers’ North Sea stock survey again took place in 2012 (Napier, 2012; Figure 6.4.18.4). Overall, 66% of the respondents reported that plaice were “more” or ”much more” abundant in 2012 than in 2011. About three-quarters of respondents overall reported catching “all sizes” of plaice in 2012, while of the remainder, twice as many reported “mostly small” plaice as ”mostly large”. This impression coincides with the high discard rates observed in the monitoring programmes, which consisted mostly of age-2 fish. The overall perceptions of the fishing industry reflect the high abundances of plaice estimated by ICES.

Uncertainties in assessment and forecast

The change in distribution of juvenile plaice further offshore resulted in conflicting estimates of abundance between the SNS survey (mainly inshore) and the Tridens and BTS-Isis surveys (offshore) over the years. This issue was resolved in 2013 by combing both indices into a single standardized time-series (ICES, 2013e). The indices were combined applying a gear efficiency correction as recommended by WGBEAM (ICES, 2005).

Although discards form a substantial part of total plaice catches, for which estimates are less certain than for landings, the assessment at present includes 13 years of discard data obtained from sampling programmes in several countries and is considered to be robust and consistent between years. Discard data are now for instance available from Denmark (beam trawls, otter trawls, Scottish and Danish seines, gillnets, and longliners); the United Kingdom (for beam trawls up to 2007); Germany (beam trawls, otter trawls, and gillnets); Belgium (beam trawls); and the Netherlands (beam trawls and otter trawls).The improvement of retrospective patterns observed in the recent years may have benefited from increased coverage of discard estimates from the main fishing nations, through self-sampling and observer programmes.

Since 2009, estimates of discards by the Netherlands are derived from a self-sampling programme by the industry, coordinated by fishery scientists. Mid-2011 the programme was redesigned, to allow for better comparison between self-sampling and observer estimates through paired measurements. From 2011 onwards, Dutch discard estimates are derived exclusively from the self-sampling programme, while observer estimates are used for validation of the self-sampling data only. Preliminary analyses suggest that the self-sampling estimates are as reliable as those from the observer programme. Further analyses will be conducted in 2013 as more data from “matched trips” (self-sampling and observer estimates from the same vessel trip) become available.

Comparison with previous assessment and advice

The 2013 assessment is in close agreement with that of 2012 in terms of SSB and F. The combination of the two BTS-indices, however, has led to a substantial upwards revision of recruitment estimates for recent years.

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

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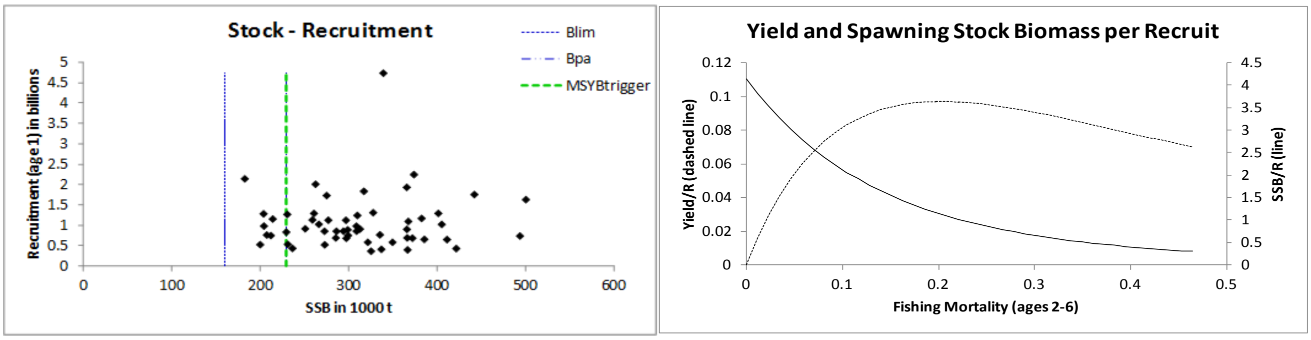

Figure 6.4.18.3 Plaice in Subarea IV (North Sea). Stock–recruitment plot and yield-per-recruit analysis.

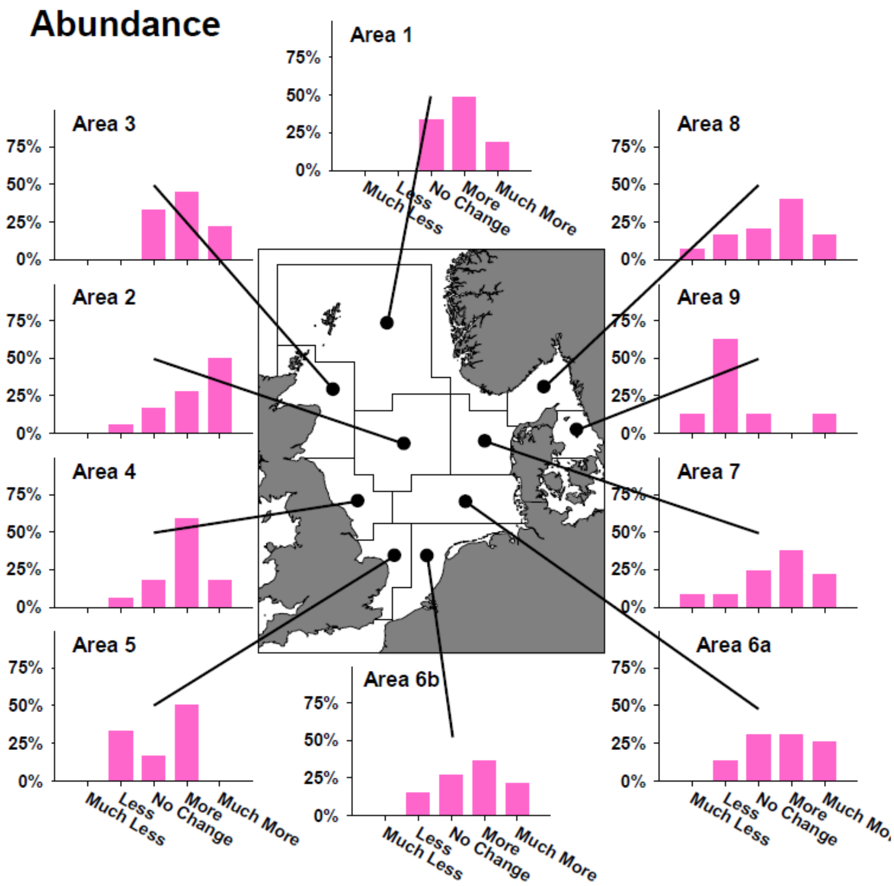

Figure 6.4.18.4 Plaice in Subarea IV (North Sea). Abundance estimates by the North Sea Commission fisher's survey 2012 (Napier, 2012).

Table 6.4.18.1 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 Division VIId (for all years, introduced in 2012).

Year	ICES Advice	Predicted landings 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	73	66	67
2004	Recovery plan	-	61	61	61
2005	Rebuild the SSB above B_{pa} in 2006	35	59	55	56
2006	Rebuild the SSB above B_{pa} in 2007	48	57	56	58
2007	Rebuild the SSB above B_{pa} in 2008	< 32	50	49	50
2008	Rebuild the SSB above B_{pa} in 2009	< 35	49	48	49
2009	Limit total landings to 55 500 t	< 55.5	55.5	NA	55
2010	Limit total landings to 63 825 t	< 63.8	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	71	74
2013	Apply first stage of the management plan	< 97.070	97.1		
2014	Apply first stage of the management plan	< 111.631			

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

Table 6.4.18.2 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	4862	12245	281	3742	32201	1022	5	16888	-	71246	2584	73830	84410

*** Official estimates not available.**

Table 6.4.18.3 Plaice in Subarea IV (North Sea). Summary of stock assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Catches tonnes	Landings tonnes	Discards tonnes	Mean F Ages 2–6
1957	461000	285200	78400	70600	7900	0.283
1958	700000	293800	88200	73400	14800	0.331
1959	865000	299100	109200	79300	29900	0.370
1960	761000	308700	117300	87500	29800	0.368
1961	866000	321400	118500	86000	32500	0.350
1962	594000	371900	125400	87500	37900	0.379
1963	695000	373700	148400	107100	41300	0.422
1964	2255000	366000	147600	110500	37000	0.464
1965	702000	349400	140200	97100	43100	0.383
1966	594000	366400	166600	101800	64700	0.395
1967	407000	421500	163400	108800	54500	0.425
1968	439000	411000	139500	111500	28000	0.335
1969	659000	385400	142800	121700	21200	0.353
1970	664000	336800	160000	130300	29600	0.460
1971	420000	325100	136900	113900	23000	0.379
1972	374000	327500	142500	122800	19600	0.406
1973	1320000	276800	143800	130400	13400	0.470
1974	1135000	286000	157500	112500	44900	0.493
1975	864000	297100	195200	108500	86700	0.577
1976	691000	308600	166900	113700	53200	0.425
1977	989000	312600	176700	119200	57500	0.515
1978	917000	298600	159600	114000	45700	0.457
1979	898000	296700	213300	145300	67900	0.669
1980	1133000	272400	171500	140400	31100	0.560
1981	864000	262300	173600	140600	33000	0.548
1982	2017000	260500	204500	155400	49100	0.611
1983	1301000	309600	219400	144900	74500	0.601
1984	1253000	317000	227800	157000	70800	0.590
1985	1844000	339000	221400	160900	60500	0.533
1986	4743000	365500	296500	166500	130000	0.668
1987	1941000	442000	345600	155100	190500	0.704
1988	1764000	382300	312700	156300	156400	0.681
1989	1179000	405100	279100	171300	107800	0.625
1990	1032000	365700	229000	157800	71200	0.586
1991	911000	335200	230300	149300	80900	0.664
1992	776000	272700	183300	126300	57000	0.650
1993	531000	236200	153000	118000	35000	0.635
1994	443000	213900	135200	111400	23800	0.611
1995	1165000	203500	121100	99200	21800	0.640
1996	1293000	182200	134600	82600	52000	0.665
1997	2151000	207200	184300	84200	100100	0.786
1998	772000	229200	176300	72500	103800	0.724
1999	842000	203900	152700	81700	71000	0.660
2000	991000	230900	126800	82500	44300	0.460
2001	543000	274900	183200	82900	100300	0.767
2002	1739000	199700	125800	71400	54400	0.573
2003	535000	230300	145000	67200	77800	0.602
2004	1277000	211800	116500	62100	54500	0.470
2005	758000	250600	110100	56300	53900	0.394
2006	925000	258800	120300	58500	61800	0.372
2007	1142000	266100	89800	50300	39400	0.314
2008	1034000	367300	95300	49400	45900	0.239
2009	1105000	401200	100700	55400	45200	0.220
2010	1302000	500300	107000	61200	45800	0.207
2011	1640000	493600	108500	68000	40600	0.200
2012	748000	540300	132900	73800	59100	0.232
2013	930000	663200				
Average	1068316	321293	161638	105782	55846	0.491

Annex

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:

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:
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;
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.
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.
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 2014

Based on the ICES approach for data limited stocks, ICES advises that landings of plaice in Division VIId should be no more than 3925 tonnes, and discarding should be reduced. Discards are known to be high but cannot be quantified; therefore total catches cannot be calculated.

Stock status

F (Fishing Mortality)		
	2010-2012	
Qualitative evaluation		Among the lowest in time series
SSB (Spawning-Stock Biomass)		
	2009-2013	
Qualitative evaluation		Increasing

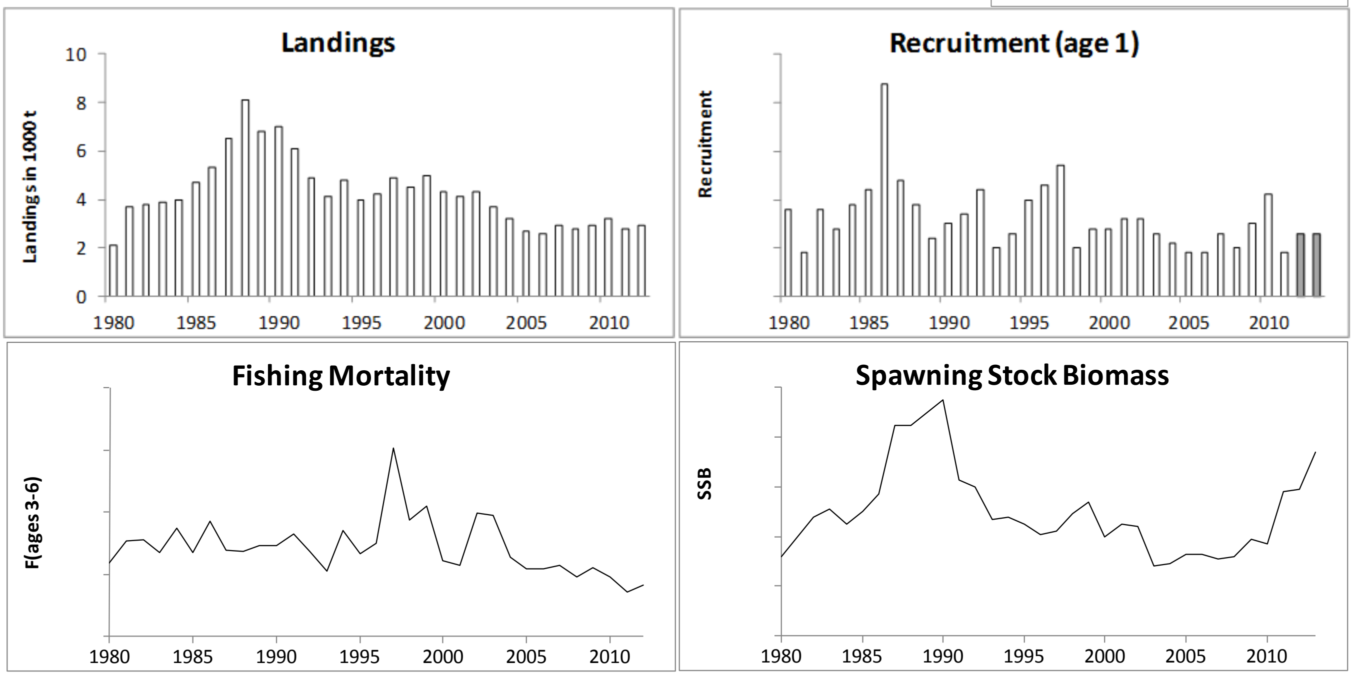

Figure 6.4.19.1 Plaice in Division VIId (Eastern Channel). Summary of stock trends (weights in '000 tonnes, Y-axis starts at 0). Predicted values are shaded. Top right: SSB and F for the time series used in the assessment.

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.

Management plans

No specific management objectives are known to ICES.

Biology

Plaice from Division VIIe and Subarea IV aggregate in this area in the first quarter of the year to spawn. 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. The condition factor for plaice is highest in summer/autumn on the more dispersed feeding grounds.

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 catch unknown, landings of plaice in Division VIId (2012) = 3587 t, including plaice from IV and VIIe in the beginning of the year (42% beam trawl, 30% otter trawl, 17% trammelnets, and 11% other gears). Discards are known to be high but cannot be quantified.

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.

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) (Data limited stock approach category 2.1.1)
Input data	Commercial landings (international landings, ages and length frequencies from catch sampling), three survey indices UK-BTS, FGFS, YFS until 2007, one commercial index (BE-CBT). Natural mortality is assumed to be constant Maturity at age is assumed to be knife edged
Discards and bycatch	Discards not included in the assessment since time series is considered not long enough, but available for monitoring (Belgium and UK(E&W) Beam Trawl, UK(E&W) and French otter trawl and UK(E&W) and French Trammel net fleets)
Indicators	None.
Other information	Last benchmark performed in 2010.
Working group report	WGNSSK (ICES 2013a)

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 2014

Basis: trends based forecast: F(2013) = TAC constraint[1)] = 0.29; R(2012) = GM(2000–2010); Landings(2013) = 3000.

Rationale	Landings plaice in VIId (2014) [2)]	Landings VIId plaice (2014)	Basis	F landings (2014)	%SSB index change 2014-2015
MSY transition	3925	3016	$(F_{2010}*0.2)+(F_{MSY}*0.8)$	0.28	+ 18%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b)					
Maximum	5996	4608	A	0.33	-3%
Minimum	2208	1697	B	0.11	+28%
Cod_ MP	2213	1701	C	0.11	+28%
SQ effort	4127	3171	D	0.21	+12
Effort_Mgt	3390	2605	E	0.17	+18

Weights in tonnes.

1) Based on the recent average proportion of the TAC for VIId,e landed in VIId (72%, last 2 years average).

2) Landings of all plaice in VIId including plaice originating from the North Sea and Western English Channel.

Mixed Fisheries assumptions:
Maximum scenario: Fleets stop fishing when the last quota is exhausted.
Minimum scenario: Fleets stop fishing when the first quota is exhausted.
Cod management plan scenario: Fleets stop fishing when the cod quota is exhausted.
SQ effort scenario: Effort in 2012 and 2013 as in 2011.
Effort management scenario: Effort reductions according to cod and flatfish management plans.

ICES approach to data limited stocks

For data-limited stocks with analytical assessment and forecast that are only treated qualitatively, ICES uses a short-term forecast using the F_{MSY} proxy (or lower, if stock biomass is estimated to be below MSY $B_{trigger}$) as a target to be reached by 2015. A change limit of ±20% is applied to the advice.

For this stock, no MSY Btrigger has been defined, and the method has been applied based on reaching the F_{MSY} proxy in 2015. This implies fishing mortality should be reduced to 0.28, based on $(F_{2010}*0.2)+(F_{MSY}*0.8)$ (= (0.48*0.2)+(0.23*0.8)), resulting in landings of no more than 3925 t in 2014 (including plaice originating from the North Sea and Western English channel). This is expected to lead to an SSB increase of 18% in 2015.

Discards are known to be high but cannot be quantified therefore total catches cannot be calculated.

Mixed fisheries

This is the first year this stock is included in the mixed fisheries assessment for the North Sea. In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined. Cod is the main limiting species for the North Sea and eastern channel demersal fisheries in 2014. In all scenarios except the 'max', the plaice VIId catch option could not be fully utilized.

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.

Fishing effort regulations have not been restrictive so far for the fishery for plaice in this area.

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 the retrospective bias. 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 on the ICES approach to data limited stocks, category 3.2.0 (trends). This year the advice is based on the same basis, but now includes a trends based forecast (category 2.1.0).

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.

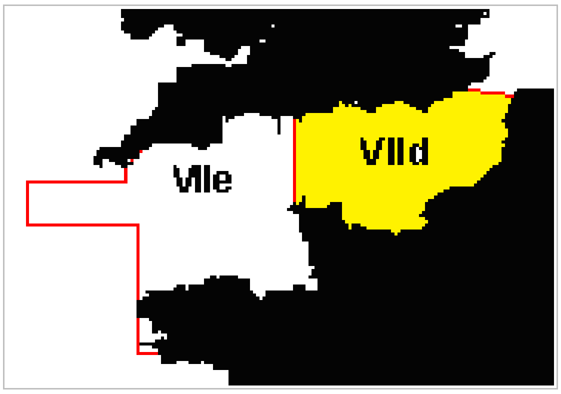

Figure 6.4.19.2 Plaice in Division VIId (Eastern Channel). Assessment in Division VIId and TAC area Divisions VIId,e.

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.

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Table 6.4.19.1 Plaice in Division VIId (Eastern Channel). ICES advice, management, and landings.

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC VIId,e	Official Landings Plaice in VIId[2]	ICES Landings VIId stock[2]
1987	Precautionary TAC for VIId,e	6.8	8.3	7.9	8.4
1988	Precautionary TAC for VIId,e	6.9	9.96	9.1	10.4
1989	No increase in effort for VIId,e	11.7	11.7	6.7[1]	8.8
1990	No increase in F; TAC for VIId,e	10.7	10.7	7.8[1]	9.0
1991	TAC for VIId,e	8.8	10.7	7.4[1]	7.8
1992	*Status quo* F gives mean SSB	7.6[3]	9.6	6.2	6.3
1993	S*tatus quo* F 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 $<F_{pa}$ [3]	<5.4	6.06	4.3	4.0
2005	Fishing at $<F_{\mathbf{pa}}$ [3]	<4.4	5.15	3.7	3.4
2006	No effort increase [3]		5.15	3.5	3.3
2007	Average landings [3]	<4.0	5.08	3.8	3.7
2008	Average landings [3]	<3.5	5.05	3.6	3.5
2009	Average landings (2006–2008) [3]	<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	-	5.062	3.549	3.587
2013	Transition to F_{MSY} proxy for data limited stocks by 2015 and reduce discards	< 4.3	5.342		
2014	Transition to F_{MSY} proxy for data limited stocks by 2015 and reduce discards	< 3.925			

Weights in thousand tonnes.
[1] For France Division VIId landings are estimated by ICES from the combined Divisions VIId,e landings.
[2] Plaice in Division VIId, taking into account fish caught in the first quarter in Division VIId that come from Division VIIe and Subarea IV to spawn.
[3] Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.

Table 6.4.19.2 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	Official landings VIId	Un-allocated VIId	ICES estimated landings Plaice in VIId	Quarter1 Removal* (6)	ICES estimated landings for VIId plaice (6)	ICES estimated landings for plaice in VIIe	Agreed TAC for VIIde (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	1065	4274
2010	1123		2190	517	62	3892	-80	3812	635	3177	1241	4665
2011	1033		2000	460	56	3549	-12	3537	750	2787	1507	4665
2012	995		1962	529	63	3486	-101	3587	672	2915	1520	5062

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 takes into account the ‘Quarter 1 removal' of 65% of the quarter 1 VIId catches of plaice in that originate from VIIe and IV

ECOREGION North Sea
STOCK Pollack in Subarea IV and Division IIIa

Advice for 2013 and 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *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.*

Source

ICES. 2012. Pollack in Subarea IV and Division IIIa. Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.32.

Table 6.4.20.1 Pollack in Subarea IV and Division IIIa. ICES advice, management and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Official landings Subarea IIIa	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	-	0.4	1.1	1.5
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 thousand tonnes.

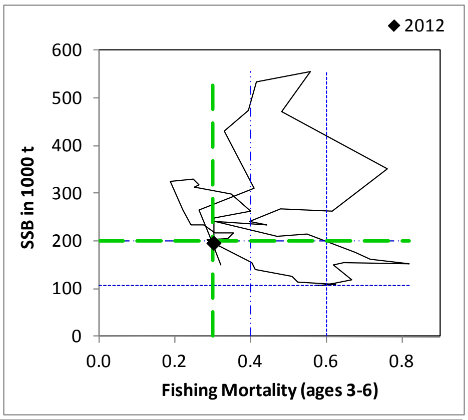
ECOREGION North Sea
STOCK Saithe in Subarea IV (North Sea), Division IIIa (Skagerrak), and Subarea VI (West of Scotland and Rockall)

Advice for 2014

ICES advises on the basis of the EU–Norway management plan that landings in 2014 should be no more than 85 581 tonnes for the whole assessment area. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	At limit
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{trigger}$)	✓	✗	✗	Just below trigger
Precautionary approach (B_{pa},B_{lim})	✓	O	O	Increased risk
Management plan (SSB_{MP})	✓	✗	✗	Just below trigger



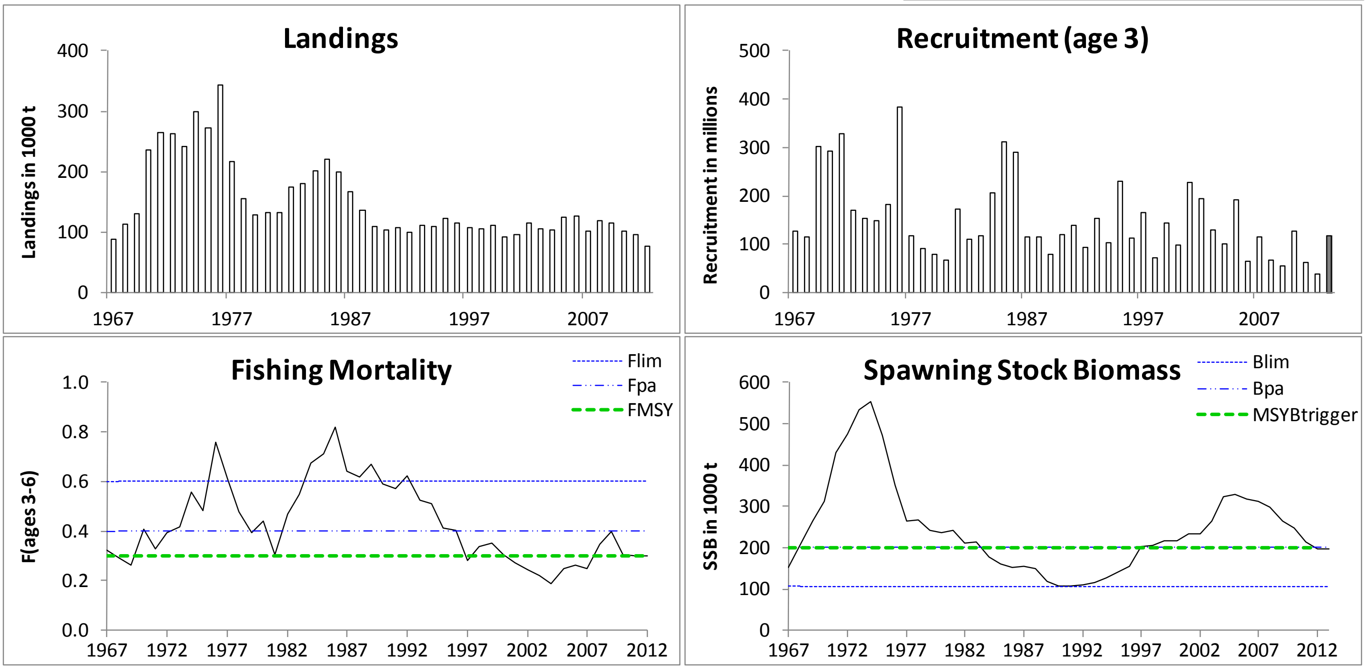


Figure 6.4.21.1 Saithe in Subareas IV and VI, and Division IIIa. Summary of stock assessment in April 2013 (weights in thousand tonnes). Assumed recruitment values are shaded. Top right: SSB and F for the time series used in the assessment.

SSB increased above B_{pa} in 1997, but has declined since 2005. The latest SSB estimate is close to B_{pa}. Fishing mortality has fluctuated around F_{MSY} since 1997. Recruitment has been below average since 2006 and shows a declining trend in recent years.

Management plans

The EU–Norway management plan was reconsidered in February 2013 (Annex 6.4.21), but no modification was implemented. It was previously evaluated by ICES (ICES, 2012) and considered to be consistent with the precautionary approach in the short term (< 4 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 by age 7, all fish can be regarded as being mature. Saithe is one of the top predators in the North Sea ecosystem and saithe abundance influences the yield and abundance of other commercially important species (e.g., whiting, haddock, herring and Norway pout).

Environmental influence on the stock

Low recruitment since 2006 is not linked to low SSB, and may be related to changes in the environment. Current information is not sufficient to identify a relationship between recruitment and specific environmental factors (e.g., temperature, currents, availability of food).

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 French fleet has returned to the northern fishing grounds, but the Norwegian and German fleet still have high effort in the southern area. Fishing on spawning aggregations in the first quarter has declined.

Catch distribution	Landings 2012 = 77.7 kt, of which approximately 91% are taken by bottom trawl, 8% by gillnets, and the remainder by other gears. Discards are not quantified, but considered low in the targeted fisheries, however can be high in the mixed fisheries.

Effects of the fisheries on the ecosystem

Reduced benthic biomass is found in areas of bottom trawl activity compared to unfished areas. North Sea saithe fisheries are known to have less impact on the seafloor than most other bottom trawl fisheries.

Quality considerations

Recent ecruitment estimates are poorly estimated with the current surveys. Additionally, surveys do not cover the areas inhabited by older fish and therefore commercial cpue indices are used for tuning, however there is a concern that use of commercial cpue indices for schooling species may have lead to bias in the assessment. Cpue data from the Norwegian fishing industry lack crucial information on gear specifics and should be improved.

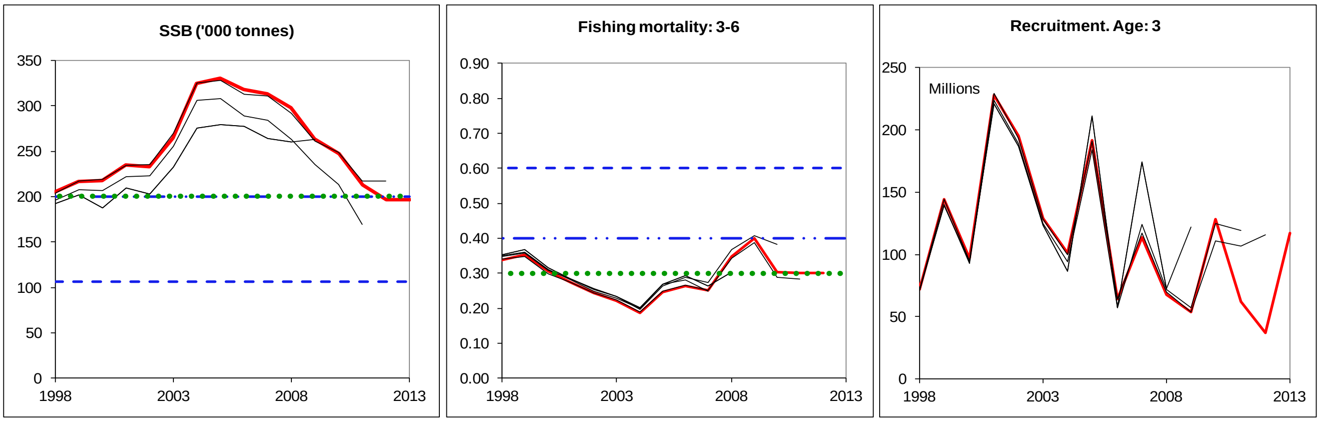


Figure 6.4.21.2 Saithe in Subareas IV and VI, and Division IIIa. Historical assessment results (final-year recruitment estimates included). The 2010 assessment is not included since this was only a forecast based on the 2009 assessment.

Scientific basis

Assessment type	Age-based assessment model (XSA).
Input data	Commercial catches include international landings, and ages and length frequencies from catch sampling., two survey indices (NORACU, IBTS-Q3); Three commercial indices (FRATRB_IV, GER_OTB_IV, NORTR_IV2). Maturity at age and natural mortality are assumed to be constant.
Discards and bycatch	Discards are not included in the assessment, information is available for some fleets.
Indicators	None.
Other information	Benchmarked in January 2011 (revised in October 2011).
Working group report	WGNSSK (ICES, 2013a)

6.4.21 Supporting information June 2013

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

Reference points

	Type	Value	Technical basis
Management Plan	SSB_{MP}	200 000 t	B_{pa}
	F_{MP}	0.3	Or lower depending on SSB in relation to SSB target.
MSY Approach	MSY $B_{trigger}$	200 000 t	Default value B_{pa}
	F_{MSY}	0.3	Stochastic simulation using hockey-stick stock–recruitment.
Precautionary approach	B_{lim}	106 000 t	B_{loss} = 106 000 t (estimated in 1998).
	B_{pa}	200 000 t	Affords a high probability of maintaining SSB above B_{lim}.
	F_{lim}	0.6	F_{loss} the fishing mortality estimated to lead to stock falling below B_{lim} in the long term.
	F_{pa}	0.4	Implies that B_{eq} >B_{pa} and (SSB_{MT} < B_{pa})< 10%.

(unchanged since: 2011)

Outlook for 2014

Basis: F (2013) = 0.37 [TAC constraint]; R (2012–2014) = GM (1988–2010) = 116.945 million; SSB (2014) = 162.125; landings (2013) = 100.684.

Rationale	landings 2014	landings IIIa&IV 2014[1)]	landings VI 2014[1)]	Basis	F 2014	SSB 2015	% SSB change [2)]	% TAC change [3)]
Management plan	85.581	77.536	8.045	15% TAC constraint	0.31	176.056	8.5%	-15%
MSY approach	82.648	74.879	7.769	F_{MSY}* (SSB_{2013}/Btrigger)	0.29	178.386	+10%	-18%
Precautionary approach	56.181	50.900	5.281	B_{pa} (F_{2013}*0.51)	0.19	200.001	+23%	-44%
Zero catch	0	0	0	F = 0	0.0	246.940	+52%	-100%
Other options	84.584	76.633	7.951	F_{MSY}	0.3	176.820	+9%	-16%
	100.869	91.387	9.481	F_{2013}	0.37	163.723	+1%	0%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b)								
Maximum	143.439	129.956	13.483	A	0.54	143.575	-11%	+42%
Minimum	48.050	43.533	4.517	B	0.15	221.170	+36%	-52%
Cod_MP	48.359	43.813	4.546	C	0.15	220.911	+36%	-52%
SQ Effort	89.630	81.205	8.425	D	0.3	186.756	+15%	-11%
Effor_Mgt	68.305	61.884	6.421	E	0.22	204.306	+26%	-32%

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 2015 relative to SSB 2014.
[3)] Landings 2014 relative to TAC 2013.
Mixed-fisheries assumptions:
Maximum scenario: Fleets stop fishing when the last quota is exhausted.
Minimum scenario: Fleets stop fishing when the first quota is exhausted.
Cod management plan scenario: Fleets stop fishing when the cod quota is exhausted.
SQ effort scenario: Effort in 2012 and 2013 as in 2011.
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 (2013).

Since SSB at the beginning of 2013 is below B_{pa}, paragraph 3 of the harvest control rule applies, resulting in a F of 0.29 and a TAC (landings) reduction of more than 15%. Therefore, the maximum TAC reduction of 15% is applied (paragraph 5), resulting in landings of no more than 85 581 t in 2014. This is expected to lead to an SSB of 176 099 t in 2015 which is below B_{pa}. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

MSY approach

Following the ICES MSY framework implies a fishing mortality of 0.29 (below F_{MSY} because SSB is below MSY Btrigger). This would result in landings of no more than 82 600 t in 2014. This is expected to lead to an SSB in 2015 of 178 400 t. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

Precautionary approach

An 49% reduction in F is needed to maintain SSB at B_{pa} in 2015. This corresponds to landings of no more than 56 181 t in 2014. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

Mixed fisheries

In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of plausible scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the main limiting species for the North Sea demersal fisheries in 2014. Following the 'cod' scenario (full implementation of the cod management plan), and also the effort management scenario, the saithe management plan catch options could not be fully utilized. It is also noted that for the 'max' scenario the implied F would exceed F_{pa} which is not considered precautionary.

Additional considerations

Management plan evaluations

In 2012, an EU-Norway request was sent to ICES on options to revise the long-term management plan for saithe (ICES, 2012). ICES advised that all harvest control rule (HCR) options in the request 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 were found between the options in terms of risk or yield, although the stability of yield is slightly more different between options. The EU and Norway agreed to keep the old management plan (Appendix).

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.

In 2013, the effects of interannual quota flexibility in the management plan for saithe were evaluated (ICES, 2013c) . ICES concluded that the harvest control rules evaluated are robust to inclusion of inter-annual quota flexibility in terms of the probability of stock biomass falling below B_{lim}, and average yield. This conclusion is conditional on the inter-annual quota flexibility being suspended when the stock is estimated to be outside safe biological limits and therefore the management plan should be re-evaluated in 2016 at the latest.

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 assumption on the incoming year class for which no information is available. This is likely to lead to greater interannual variability in the advice. The average recruitment assumed in 2013 and 2014 is high relative to recent values, however this does not affect the advice since this is already limited by the 15% maximum TAC change.

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 2013.

The reported landings have been lower than the TACs since 2002, 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.

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. However, for 2013, the European Council decided upon a roll-over of effort level of 2012 into 2013 for both the cod and the sole/plaice management plan.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill/trammel nets and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, -16% between 2008 and 2012). 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 and in small mesh beam trawl (80–120 mm, BT2), has shown a pronounced decline (−14%, −45%, and −48%, respectively, between 2004 and 2012). Gill and trammel nets fisheries have remained stable (ICES, 2013b). Effort in large mesh size beam trawl (>=120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline. Nominal effort reported by Norway has increased since 2011 due to the generalization of electronic logbooks.

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Information from the fishing industry

Saithe has had growing importance for both the Danish and Scottish fleets. The fishers’ survey (Napier, 2012) shows a perception of an increasing stock for the central north and eastern North Sea 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 NSRAC-meeting between scientists and fishers in Hanstholm in April 2012, the industry was worried about the decline in mean weight-at-age after 2000. German industry representatives confirmed changes in fishing pattern due to effort management. French industry representatives noted increased competition over fishing grounds between trawlers and gillnetters in Division VIa, especially in 2009 and 2010. No change in mean age of the catch was observed due to this shift in fishing patterns. 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, must be improved.

Uncertainties in assessment and forecast

The NORASS survey was considered unreliable and did not track cohorts. Since this survey has been discontinued and only had a small influence the assessment, it has been excluded in the 2013 assessment. The NORACU and Norwegian trawl index were updated and revised.

Conflicting signals between the scientific surveys have become more apparent. All scientific surveys on adults have shortcomings in coverage (IBTS-Q3, NORACU). Survey data for young year classes before age 3 are needed. Catches from older age classes in the surveys are not representative and therefore commercial cpue indices are used for tuning.

Commercial catch data from the Norwegian fishing industry lack crucial information on gear specifics and should be improved.

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 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 for ages 3–9 was considered appropriate in the November 2011 update, and also in the 2012 and 2013 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 scientific survey is needed to address this issue.

Comparison with previous assessment and advice

The current assessment estimates SSB in 2013 to be 10% lower than estimated in 2012, and fishing mortality in 2011 is estimated 6% higher than last year. 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.

Sources

ICES. 2008. Norway and EC request on management plan for saithe in the North Sea and West of Scotland. ICES Advice 2008, Book 6, Section 6.3.3.3.

ICES. 2011. Report of the Benchmark Workshop on Roundfish and Pelagic Stocks (WKBENCH 2011), 24–31 January 2011, Lisbon, Portugal. ICES CM 2011/ACOM:38.

ICES. 2012. Joint EU–Norway request to ICES on options to revise the Long-Term Management Plan for saithe in the North Sea. ICES Advice 2012, Book 6, Section 6.3.3.5.

ICES. 2013a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24 - 30 April 2013. ICES CM 2013/ACOM:13.

ICES. 2013b Mixed fisheries advice North Sea. Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.3.2.

ICES. 2013c EU request on inter-annual quota flexibility for saithe in the North Sea. ICES Advice, 2013. Book 6, Section 6.3.5.4.

Napier, I. R. 2012. Fishers' North Sea stock survey 2012. NAFC Marine Centre, Shetland, Scotland.

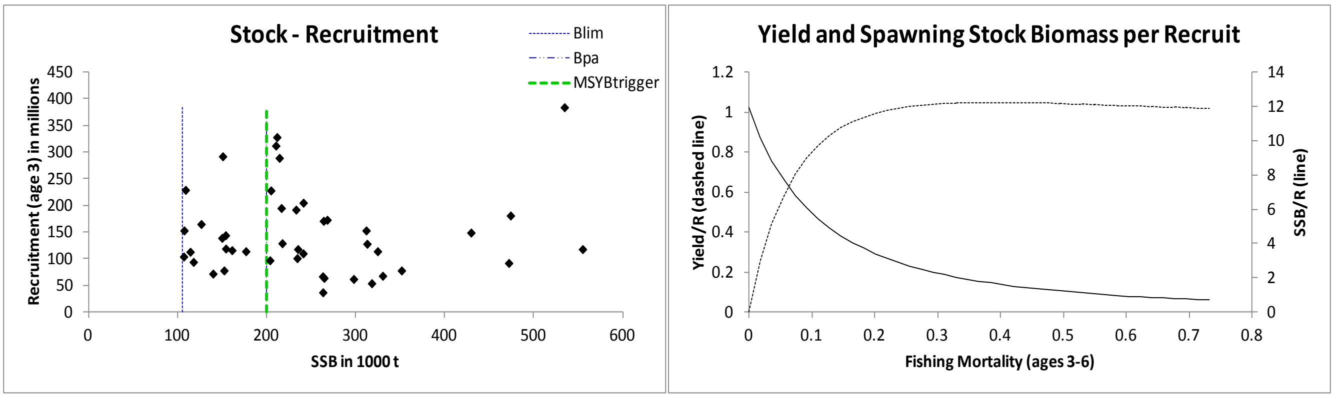


Figure 6.4.21.3 Saithe in Subareas IV and VI and Division IIIa. Stock–recruitment plot and yield-per-recruit analysis.

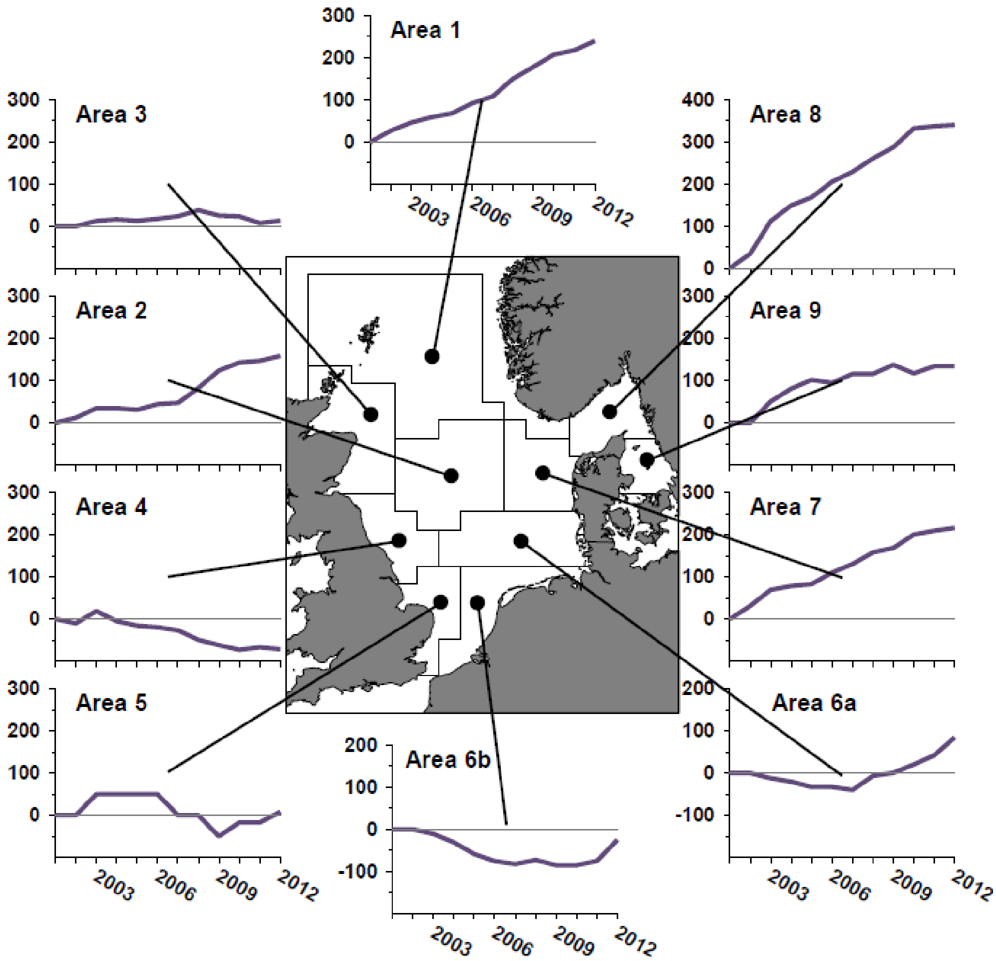


Figure 6.4.21.4 Saithe in Subareas IV and VI and in Division IIIa. Results of the North Sea Commission fishers' survey 2012 on abundance of saithe (Napier, 2012).

Table 6.4.21.1 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	115	116
2003	$F < F_{pa}$	<176	165	107	102
2004	$F < F_{pa}$*	<211	190	104	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	111
2009	F according to man. plan (< F_{pa}) *	<126	126	101	106
2010	F according to man. plan (< F_{pa}) *	<107	107	91	95
2011	See scenarios	-	93	89	90
2012[1]	F according to man. plan (< F_{pa}) *	< 79.320	79	69	70
2013	Management plan (TAC + 15%) *	< 91.219	91.220		
2014	Management plan (TAC - 15%) *	< 77.536			

Weights in thousand tonnes.
* Single-stock boundary and the exploitation of this stock should be conducted in the context of mixed fisheries.
[1] The June advice in 2011 was updated in November 2011.

Table 6.4.21.2 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	7.6	7.2
2013	Management plan (TAC + 15%) *	< 9.464	9.464		
2014	Management plan (TAC - 15%) *	< 8.045			

Weights in thousand tonnes.
[1]*Status quo* catch.
[2] Incomplete data.
[3] The June advice in 2012 was updated in November 2012.
* 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 6.4.21.3 Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Officially reported landings and ICES estimates (in tonnes).

SAITHE IV and IIIa

Country	2002	2003	2004*	2005*	2006	2007*	2008*	2009	2010	2011*	2012*
Belgium	107	45	22	28	16	18	7	27	15	2	1
Denmark	5668	6954	7991	7498	7471	5458	8069	8802	8019	6325	5170
Faroe Isl.	872	495	558	184	62	15	108	-	146	0	8
France	25441	18001	13628	10768	15739	13043	15302	5445*	4582*	13856	14093
Germany	10999	8956	9589	12401	14390	12790	14141	13689	11192	10234	8007
Greenland	62	1616	403	-	-	-	-	-	-	0	-
Ireland	-	-	1	-	0	-	81	81	-	0	0
Netherlands	6	11*	3	40	28	5	3	17	3	24	34
Norway	60013	61735	62783	67365	61268	45395	62055	57708	53031	46778	33028
Poland	752	734*	0	1100	-	-	1407	988	654	584	-
Russia	-	-	-	35	2	5	5	13	-	0	-
Sweden	1863	1876	2249	2114	1695	1380	1639	1363	1545	1331	1305
UK (E/W/NI)	2521	1215	457	1190	9129**	9628**	11701**	12545**	11887**	10148**	7287**
UK (Scotland)	6596	5829	5924	7703							
Total reported	114900	107467	103608	110575	109800	87377	114517	100678	91074	89282	68933
Unallocated	1291	-5809	-3646	968	7312	6241	-3084	4851	4026	422	952
ICES estimate	116191	101658	99962	111543	117112	93618	111433	105529	95100	89704	69885
TAC	135000	165000	190000	145000	123250	135900	135900	125934	107000	93600	79320

*Preliminary, [2]Preliminary data reported in Iva, **Scotland+E/W/NI combined

SAITHE VI

Country	2002	2003	2004*	2005*	2006	2007*	2008*	2009	2010	2011*	2012*
Faroe Islands	-	2	34	21	76	32	23	-	24	5	6
France	3062	3499	3053	3452	5782	3956	2617	2093	2003	2382	2612
Germany	467	54	4	373	532	580	147	298	257	0	9
Ireland	91	170	95	168	243	322	208	208	519	359	341
Netherlands	-	-	-	-	-	-	1	-		0	0
Norway	12	28	16	20	28	377	78	68	249	160	47
Russia	1	6	6	25	7	2	50	4	2	0	-
Spain	4	6	2	3	-	-	-	-		0	-
UK (E/W/NI)	307	263	37	203	2748**	1419**	2887**	3501**	3168**	4399**	4549**
UK (Scotland)	1567	1189	1563	4433							
Total reported	5513	5215	4810	8699	9416	6688	6011	6172	6222	7305	7564
Unallocated	-327	35	-296	-2960	848	98	1223	791	666	95	-357
ICES estimate	5186	5250	4514	5739	8568	6786	7234	6963	6840	7400	7207
TAC	14000	17119	20000	15044	12787	14100	14100	13066	11000	9570	8230

*Preliminary **Scotland+E/W/NI combined

SAITHE IV, IIIa and VI

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ICES estimate	121377	106908	104476	117282	125680	100404	118667	112492	101940	97104	77717
TAC	149000	182119	210000	160044	136037	150000	150000	139000	118000	103170	87550

Table 6.4.21.4 Saithe in Subarea IV, Division IIIa (Skagerrak), and Subarea VI. Summary of stock assessment. (landings for fish age 3–10+)

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	161200	220900	0.714
1986	289000	152300	198600	0.818
1987	114000	154300	167500	0.644
1988	116000	150000	135200	0.619
1989	78000	117900	108900	0.668
1990	119000	107500	103800	0.592
1991	139000	107000	108000	0.570
1992	94000	109000	99700	0.625
1993	153000	114300	111500	0.525
1994	104000	126600	109600	0.509
1995	229000	139900	121800	0.412
1996	113000	154000	115000	0.403
1997	165000	203800	107300	0.283
1998	72000	204900	106100	0.339
1999	144000	216600	110700	0.354
2000	97000	217600	91300	0.307
2001	228000	234400	95000	0.274
2002	195000	233100	115400	0.243
2003	129000	264600	105600	0.222
2004	101000	324700	104200	0.188
2005	192000	330400	124500	0.247
2006	64000	318100	125700	0.263
2007	114000	312900	101200	0.251
2008	68000	297800	119300	0.348
2009	54000	263300	115700	0.399
2010	128000	247500	101900	0.304
2011	62000	212900	96300	0.302
2012	37000	196500	77100	0.301
2013*	116945	196237		
Average	148680	244145	149317	0.432

* Geometric mean recruitment 1988–2010.

Annex 6.4.21 EU–Norway Management plan

In 2013, 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.* The 2008 management plan was extended without changes.

Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 106,000 tonnes (Blim).
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.
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.*
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.
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.
Notwithstanding paragraph 5 the Parties may where considered appropriate reduce the TAC by more than 15 % compared to the TAC of the preceding year.
A review of this arrangement shall take place no later than 31 December 2015.
This arrangement enters into force on 1 January 2009."

6.4.22 Advice February 2013

ECOREGION North Sea
STOCK Sandeel in Division IIIa and Subarea IV

Introduction

Sandeel are largely sedentary after settlement and form 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 6.4.22.1). Generic information is given below, and the advice for sandeel in each of the seven areas is given separately in Sections 6.4.22.1–7.

Section	Sandeel Area (SA)	Name	Rectangles
6.4.22.1	1	Dogger Bank area	31–34 E9–F2; 35 E9–F3; 36 E9–F4; 37 E9–F5; 38–40 F0–F5; 41 F5–F6
6.4.22.2	2	Southeastern North Sea	31–34 F3–F4; 35 F4–F6; 36 F5–F8; 37–40 F6–F8; 41 F7–F8
6.4.22.3	3	Central Eastern North Sea	41 F1–F4; 42–43 F1–F9; 44 F1–G0; 45–46 F1–G1; 47 G0
6.4.22.4	4	Central Western North Sea	38–40 E7–E9; 41–46 E6–F0
6.4.22.5	5	Viking and Bergen Bank areas	47–51 E6 + F0–F5; 52 E6–F5
6.4.22.6	6	Division IIIa East (Kattegat)	41–43 G0–G3; 44 G1
6.4.22.7	7	Shetland area	47–51 E7–E9

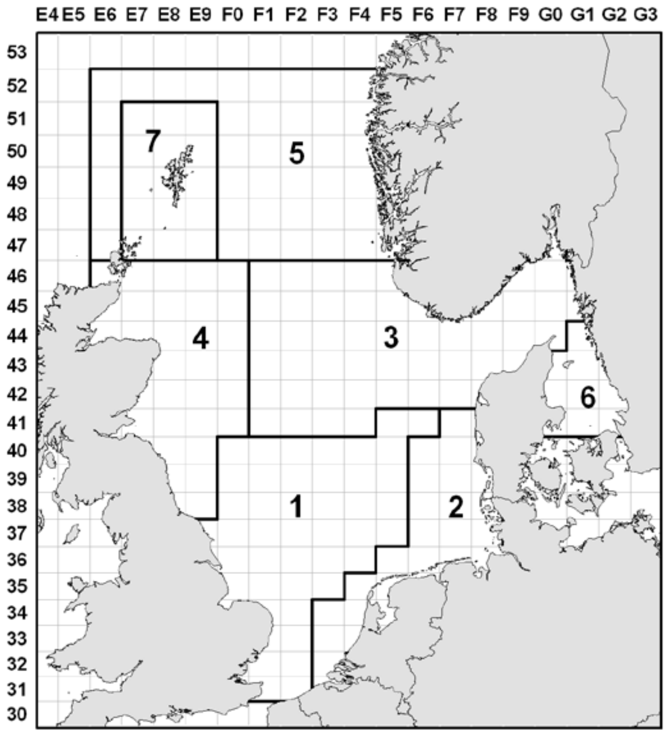


Figure 6.4.22.1 Sandeel in Division IIIa and Subarea IV. Map of sandeel areas (SAs).

Summary of advice for 2013

An overview of the advice by SA can be found in Table 6.4.22.1.

Table 6.4.22.1 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.			354	90	438
2012	< 23	< 5	< 5	< 5	No increase in catches unless there is evidence that this is sustainable.			61	42	101 [3]
2013	< 224.544	< 17.544	< 78.331	< 2.041	0	< 0.219	0	0 [3]	20	

Weights in thousand tonnes.
[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 catch forecast. The advice for SAs 4–7 is based on the ICES approach to data-limited stocks.

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 area. 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 do the details 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 sedentary after settlement and form 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, 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 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.

Fisheries on sandeel 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 2012 surveys confirmed the estimates of the 2011 year classes and indicated a larger recruitment around median value in 2012 for SAs 1–3, and a low recruitment in 2012 for SA 4.

For SAs 1–3 the advice is based on ICES MSY approach to short-lived species as it was last year. For SAs 4–7 the advice this year is based on ICES approach to data-limited stocks, whereas last year the advice was based on precautionary considerations.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.

ICES. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

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.

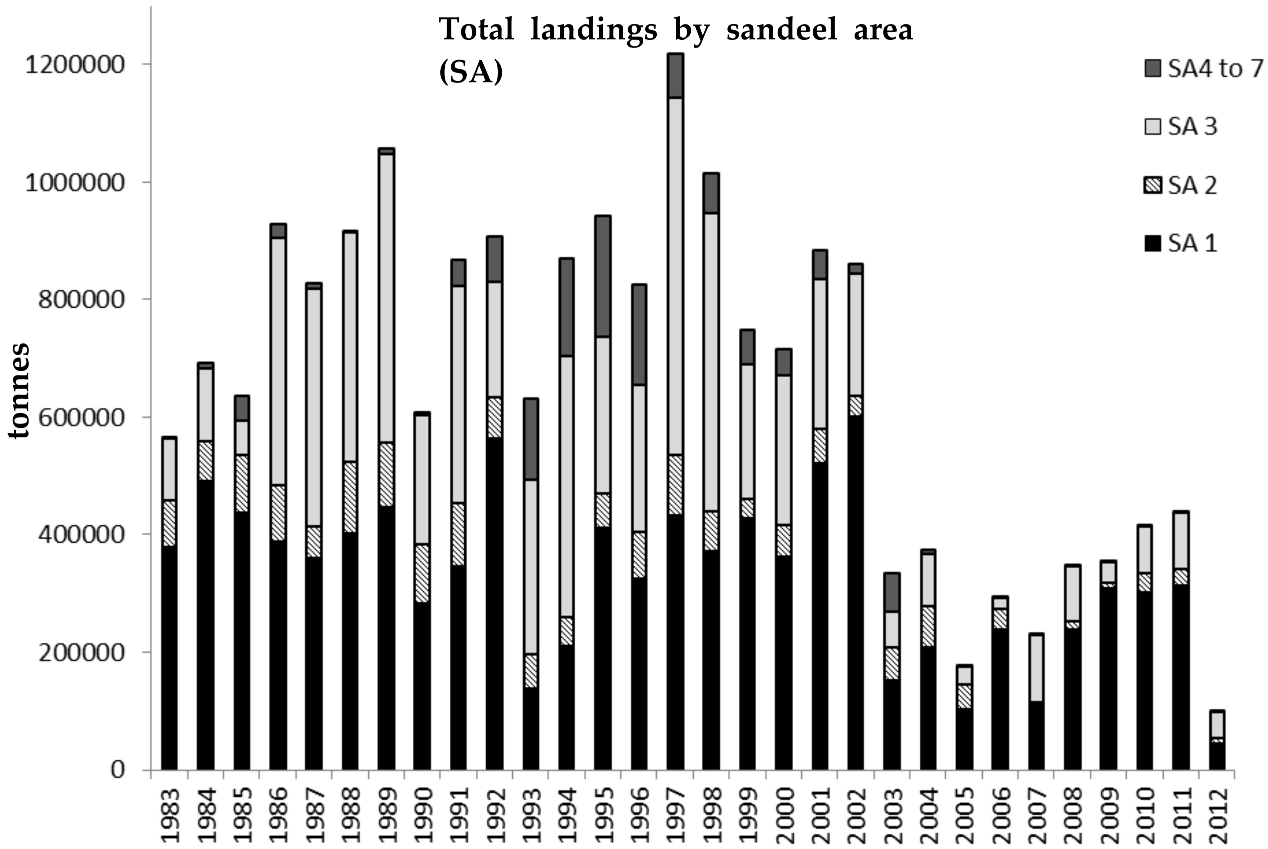


Figure 6.4.22.2 Sandeel in Division IIIa and Subarea IV. Total landings by SA (tonnes).

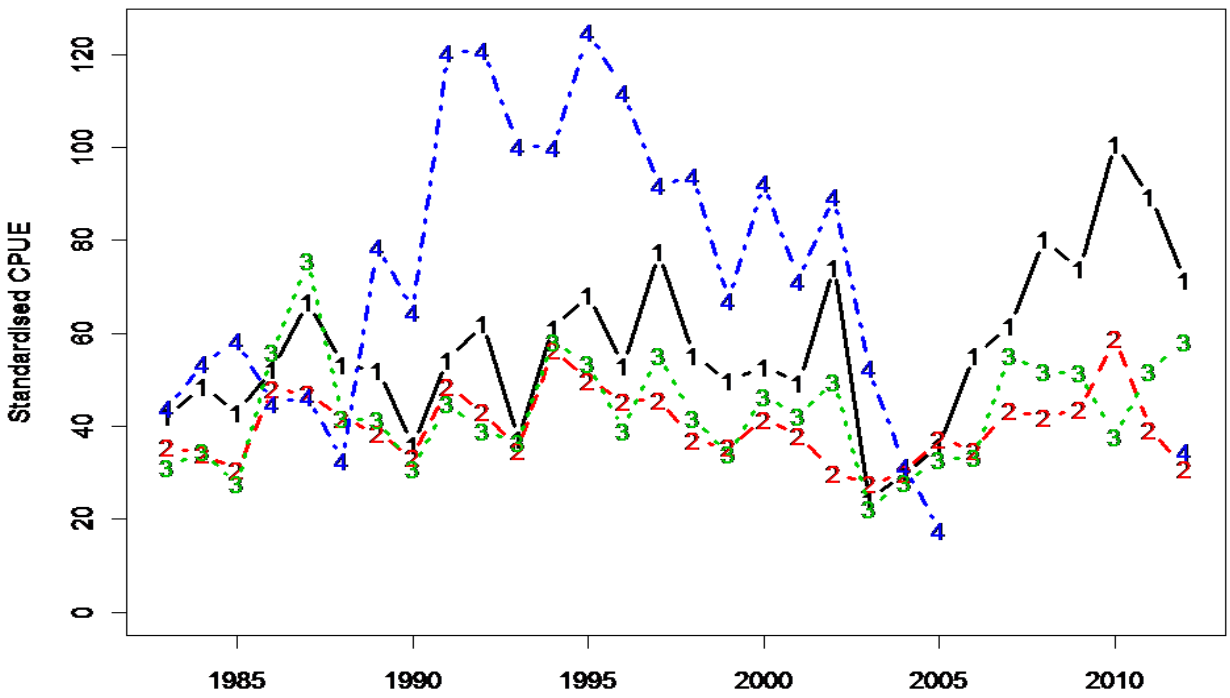


Figure 6.4.22.3 Sandeel in Division IIIa and Subarea IV. Catch (tonnes) per day fishing for a standardized 200 GT vessel in SAs 1–4. Figure labels correspond to SA numbers.

Table 6.4.22.2 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 areas
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	301433	31760	80887	104	0	132	0	414183
2011	312378	29916	94714	272	0	481	0	437761
2012	44713	8048	45734	2551	0	210	0	101256
Average	334185	61046	227251	28579	7047	791	242	659139

Table 6.4.22.3 Sandeel in Division IIIa and Subarea IV. ICES estimates of landings (thousand tonnes) per country.

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
2012	51.4	1.7	-	-	-	42.5	5.7	-	-	101.3

+ = less than half a unit; **- =** no information or no catch.

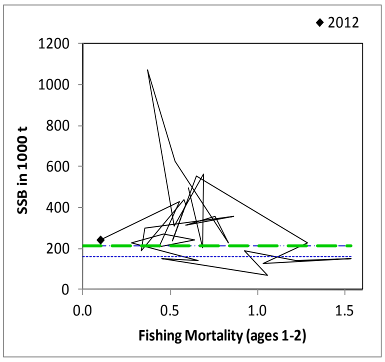
ECOREGION North Sea
STOCK Sandeel in the Dogger Bank area (SA 1)

Advice for 2013

ICES advises on the basis of the MSY approach that the catch in 2013 should be no more than 224 544 t to maintain SSB in 2014 above MSY $B_{escapement}$. All catches are assumed to be landed. The advised catch is mainly driven by the medium recruitment in 2012 (in contrast to the historically low recruitments in 2010 and 2011).

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa}, F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{escapement}$)	✓	✓	✗	Below escapement trigger
Precautionary approach (B_{pa}, B_{lim})	✓	✓	O	Increased risk



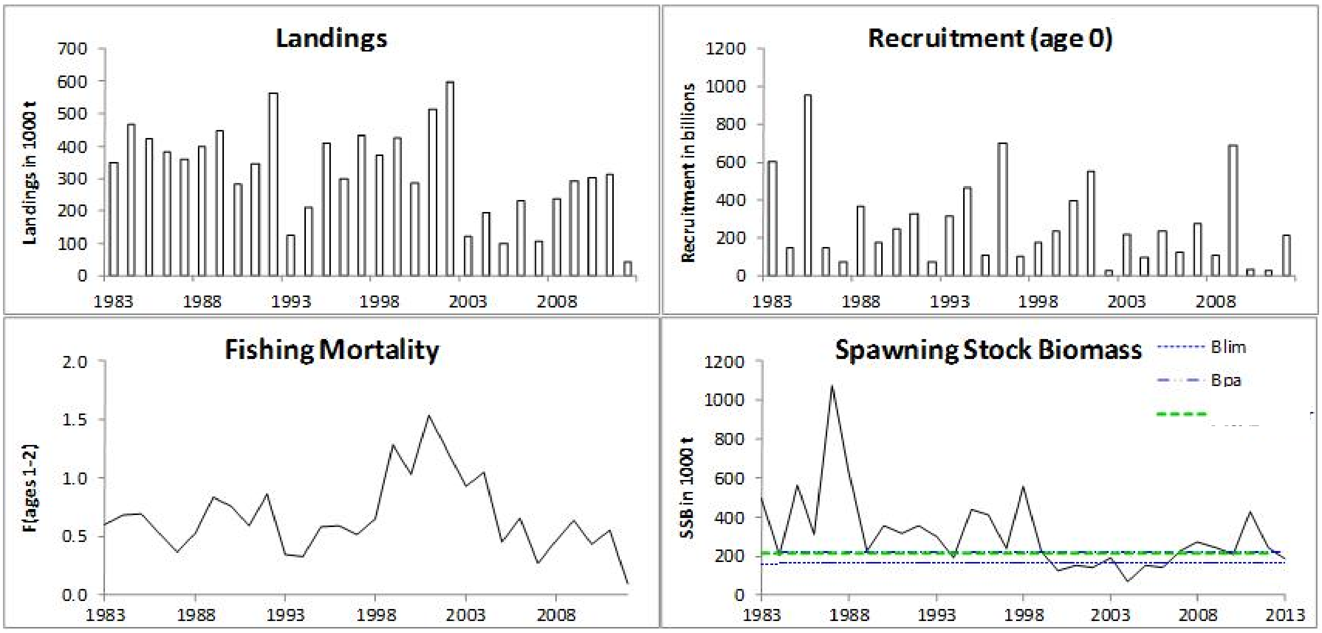


Figure 6.4.22.1.1 Sandeel in the Dogger Bank area (SA 1). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F over the years.

The stock at the start of 2013 is expected to be just above B_{lim}, which is the result of the very low recruitments in both 2010 and 2011. The 2010 and 2011 year classes were the lowest of any two consecutive years in the time-series. It is therefore mainly the amount of young fish, represented as a medium recruitment in 2012, that drives the advised catch for 2013. F has fluctuated around 0.5 since 2005, except in 2012 when F was the lowest observed.

Management plans

No specific management objectives are known to ICES.

Fisheries

Catch distribution	Total landings (2012): 45 kt, where 100% were landings by industrial fisheries.

Quality considerations

The quality of the assessment is considered to be fairly good. 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 (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, and discards are considered to be negligible.
Indicators	None.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	HAWG

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 2013

Basis: F(2012) = sum of half yearly Fs = 0.08; Yield(2012) = 45; Recruitment(2012) = 211 billion; Recruitment(2013) = geometric mean (GM 83–11) = 191 billion; SSB(2013) = 193.

Rationale	**Catches (2013)**	**Basis**	**F (2013)**	**SSB (2014)**	**%SSB change[1]**
MSY approach	224.544	MSY	0.60	215	11%
Zero catch	0	F = 0	0	353	83%
Other options	9.273	F_{2012}*0.25	0.02	348	80%
	18.399	F_{2012}*0.5	0.04	342	77%
	27.381	F_{2012}*0.75	0.06	336	74%
	36.221	F_{2012}*1	0.08	331	71%
	44.922	F_{2012}*1.25	0.10	325	68%
	53.486	F_{2012}*1.5	0.12	320	66%

Weights in thousand tonnes.

[1)] SSB 2014 relative to SSB 2013.

MSY approach

Following the ICES MSY approach to a short-lived species the fishery in 2013 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of no more than 224 544 t in 2013.

Additional considerations

Uncertainties in assessment and forecast

The medium–high survey catch rate of age 0 sandeel in 2012 is largely determined by a single position in ICES square 37F1 (Figure 6.4.22.1). Despite this fact, the survey results are considered reliable enough to provide catch advice for 2013.

Management plans

A management plan needs to be developed. The ICES approach to 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. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

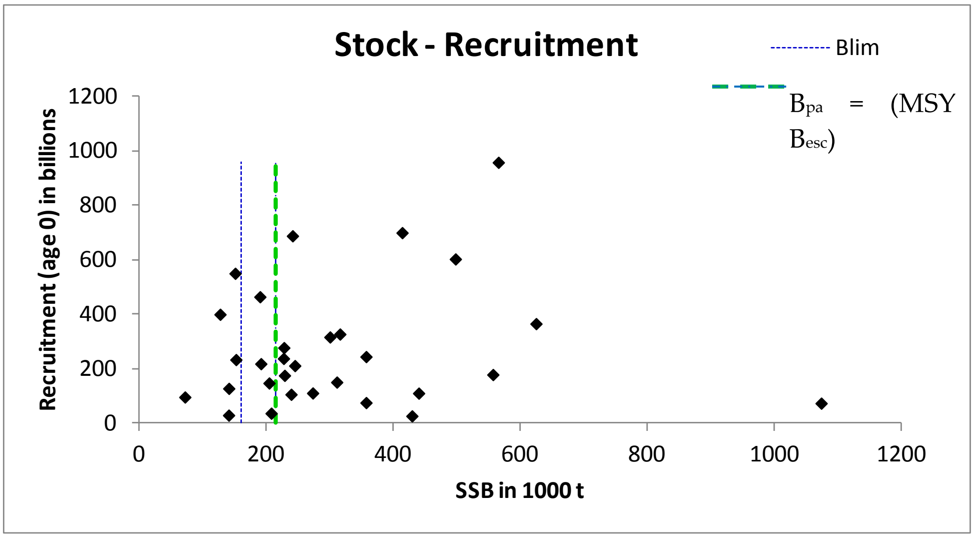


Figure 6.4.22.1.2 Sandeel in the Dogger Bank area (SA 1). Stock–recruitment plot.

Table 6.4.22.1.1 Sandeel in the Dogger Bank area (SA 1). ICES advice, management, and landings.

Year	ICES Advice	Catch corresponding to advice	TAC	ICES landings SA 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	438
2012	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 23	23 [2]	45 [3]	101 [3]
2013	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 224.544			

Weights in thousand tonnes.
[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 6.4.22.1.2 Sandeel in the Dogger Bank area (SA 1). Summary of the assessment.

Year	Recruitment Age 0 (millions)	SSB (tonnes)	Landings (tonnes)	Mean F Ages 1–2
1983	602486	497144	349232	0.60
1984	147000	203620	467609	0.68
1985	957303	564799	424114	0.69
1986	150338	310271	382735	0.52
1987	72948	1073280	357671	0.37
1988	365047	624134	398271	0.53
1989	175015	227983	445695	0.83
1990	243967	356375	283040	0.76
1991	326782	315199	347096	0.59
1992	75106	356380	564298	0.86
1993	316001	299495	124082	0.35
1994	463747	189224	209538	0.33
1995	109805	439279	410513	0.58
1996	699089	413201	298702	0.59
1997	105526	238310	431808	0.51
1998	178080	556191	371117	0.65
1999	237244	226405	427691	1.28
2000	399318	126441	284521	1.03
2001	549783	150147	513068	1.54
2002	29034	139953	596049	1.22
2003	217960	190716	121863	0.97
2004	95590	71012	195274	1.05
2005	233050	151417	100835	0.45
2006	127247	140201	231448	0.66
2007	276914	226964	108600	0.28
2008	110348	272326	237447	0.46
2009	687532	240522	291247	0.64
2010	36157	206943	300954	0.44
2011	26236	428674	311542	0.55
2012	210933	244155	44594	0.10
2013		186297*		
Average**	274186	311841	321022	0.67

* Using mean weight-at-age from 2012.

**Period 1983–2012.

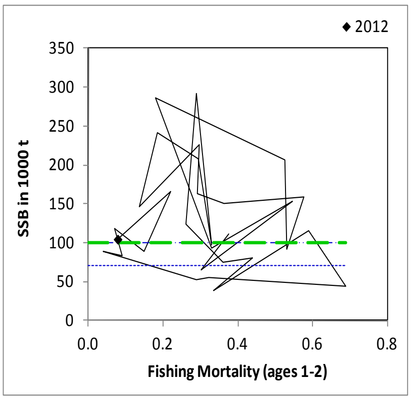
ECOREGION North Sea
STOCK Sandeel in the Southeastern North Sea (SA 2)

Advice for 2013

ICES advises on the basis of the MSY approach that the catch in 2013 should be no more than 17 544 t to maintain SSB in 2014 above MSY $B_{escapement}$. All catches are assumed to be landed. The advised catch is mainly driven by the medium recruitment in 2012 (in contrast to the historically low recruitments in 2010 and 2011).

Stock status

F (Fishing Mortality)	2010	2011	2012
MSY (F_{MSY})	?	?	? Undefined
Precautionary approach (F_{pa}, F_{lim})	?	?	? Undefined
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**
MSY ($B_{escapement}$)	✓	✓	✗ Below escapement trigger
Precautionary approach (B_{pa}, B_{lim})	✓	✓	O Increased risk



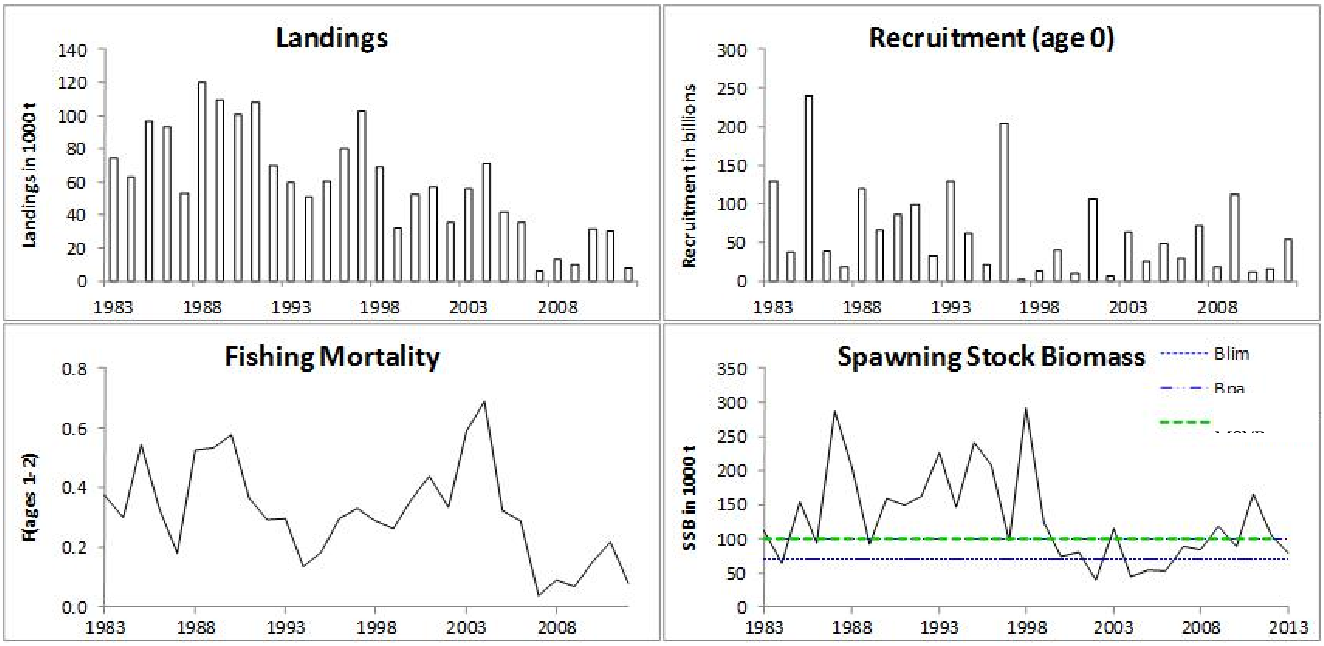


Figure 6.4.22.2.1 Sandeel in the Southeastern North Sea (SA 2). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F over the years.

Despite a very low F in 2012, SSB in 2013 has dropped below B_{pa} due to the very low recruitments in both 2010 and 2011. Recruitment in 2012 is estimated to be medium and this leads to a predicted increase in SSB in 2014.

Management plans

No specific management objectives are known to ICES.

Fisheries

Catch distribution	Total landings (2012): 8 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 2010–2012) exists.

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, and discards are considered to be negligible.
Indicators	None.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	HAWG

ECOREGION North Sea
STOCK Sandeel in the Southeastern 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 $\sigma = 0.23$ estimated from assessment uncertainty in the terminal year (ICES, 2010).
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	

(unchanged since: 2010)

Outlook for 2013

Basis: F(2012) = sum of half yearly Fs = 0.06; Yield(2012) = 8; Recruitment(2012) = 54 billion; Recruitment(2013) = geometric mean (GM 1983–2011) = 41 billion; SSB(2013) = 70.

Rationale	**Catches (2013)**	**Basis**	**F (2013)**	**SSB (2014)**	**%SSB change[1]**
MSY-approach	17.544	MSY	0.12	100	43%
Zero catch	0	F=0	0	110	57%
Other options	2.426	$F_{2012}*0.25$	0.02	108	55%
	4.820	$F_{2012}*0.5$	0.03	107	53%
	7.183	$F_{2012}*0.75$	0.05	106	51%
	9.516	$F_{2012}*1$	0.06	104	50%
	11.819	$F_{2012}*1.25$	0.08	103	48%

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.

MSY approach

Following the ICES MSY approach to a short-lived species, the fishery in 2013 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of no more than 17 544 t in 2013.

Additional considerations

Uncertainties in assessment and forecast

There appears to be a sufficiently robust relationship between the recruitments in SAs 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 medium–high survey catch rate of age 0 sandeel in 2012 (adopted from SA 1) is largely determined by a single position in ICES square 37F1 (Figure 6.4.22.1).

Management plans

A management plan needs to be developed. The ICES approach to 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. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

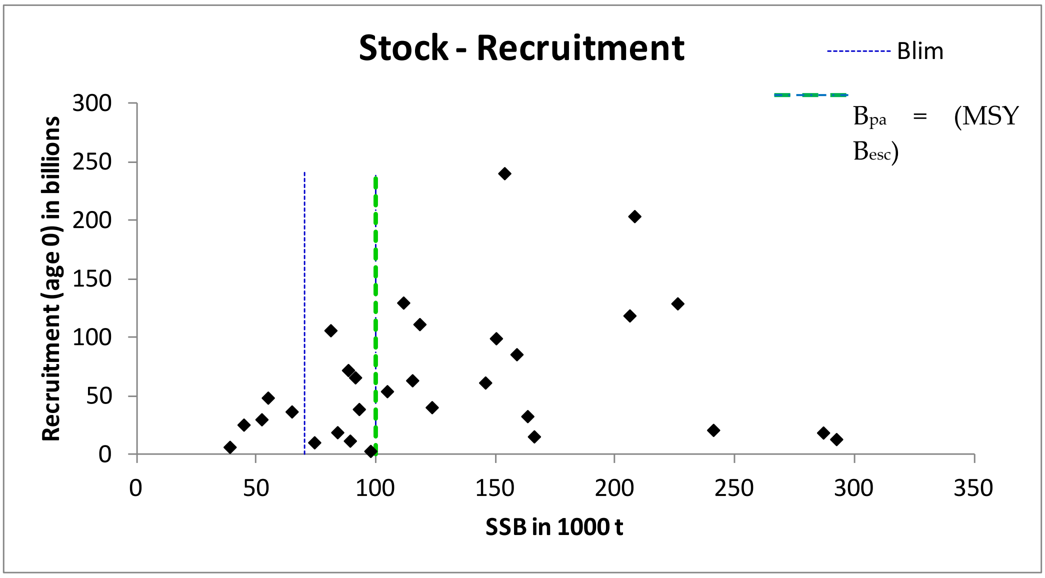


Figure 6.4.22.2.2 Sandeel in the Southeastern North Sea (SA 2). Stock–recruitment plot.

Table 6.4.22.2.1 Sandeel in the Southeastern North Sea (SA 2). ICES advice, management, and landings.

Year	ICES Advice	Catch corresponding to advice	TAC	ICES landings SA 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	438
2012	Catches for monitoring purposes should not exceed 5 000 t.	< 5	0	8 [3]	100 [3]
2013	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 17.544			

Weights in thousand tonnes.
[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 6.4.22.2.2 Sandeel in the Southeastern North Sea (SA 2). Summary of the assessment.

Year	Recruitment Age 0 (millions)	SSB (tonnes)	Landings (tonnes)	Mean F (Ages 1–2)
1983	129796	111401	74481	0.38
1984	36791	64774	63046	0.30
1985	240324	153640	96645	0.55
1986	38893	92871	93146	0.33
1987	18796	286846	53284	0.18
1988	118797	205942	120382	0.53
1989	65930	91293	109703	0.53
1990	85695	158738	100917	0.58
1991	99343	150144	107795	0.36
1992	32826	163266	69825	0.29
1993	129134	225964	59652	0.30
1994	61516	145641	50656	0.14
1995	21057	240903	60138	0.18
1996	203660	207975	80012	0.30
1997	3086	97674	102726	0.33
1998	13222	292317	68953	0.29
1999	40463	123314	32108	0.26
2000	10437	74209	52228	0.36
2001	106166	80997	56934	0.44
2002	6541	38865	35494	0.34
2003	63432	115140	55924	0.59
2004	25561	44684	71413	0.69
2005	48597	54817	41420	0.32
2006	30105	52175	35351	0.29
2007	72165	88332	5911	0.04
2008	19079	83839	13064	0.09
2009	111425	118187	10240	0.07
2010	11861	89110	31747	0.15
2011	15505	166020	29900	0.22
2012	54118	104613	8048	0.08
2013		79269*		
Average**	63811	129128	59705	0.32

*Using mean weight-at-age from 2012.

**Period 1983–2012.

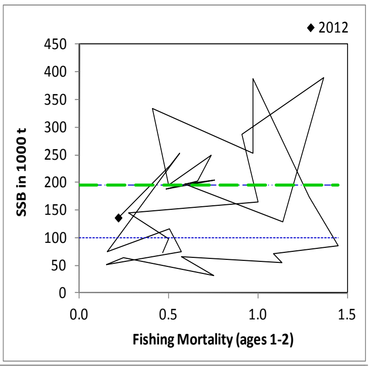
ECOREGION North Sea
STOCK Sandeel in the Central Eastern North Sea (SA 3)

Advice for 2013

ICES advises on the basis of the MSY approach that the catch in 2013 should be no more than 78 331 t to maintain SSB in 2014 above MSY $B_{escapement}$. All catches are assumed to be landed. The advised catch is mainly driven by the medium recruitment in 2012 (in contrast to the historically low recruitments in 2010 and 2011).

Stock status

F (Fishing Mortality)				
	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning Stock Biomass)				
	2011	2012	2013	
MSY ($B_{escapement}$)	✔	✘	✘	Below escapement trigger
Precautionary approach (B_{pa},B_{lim})	✔	O	✘	Below Blim



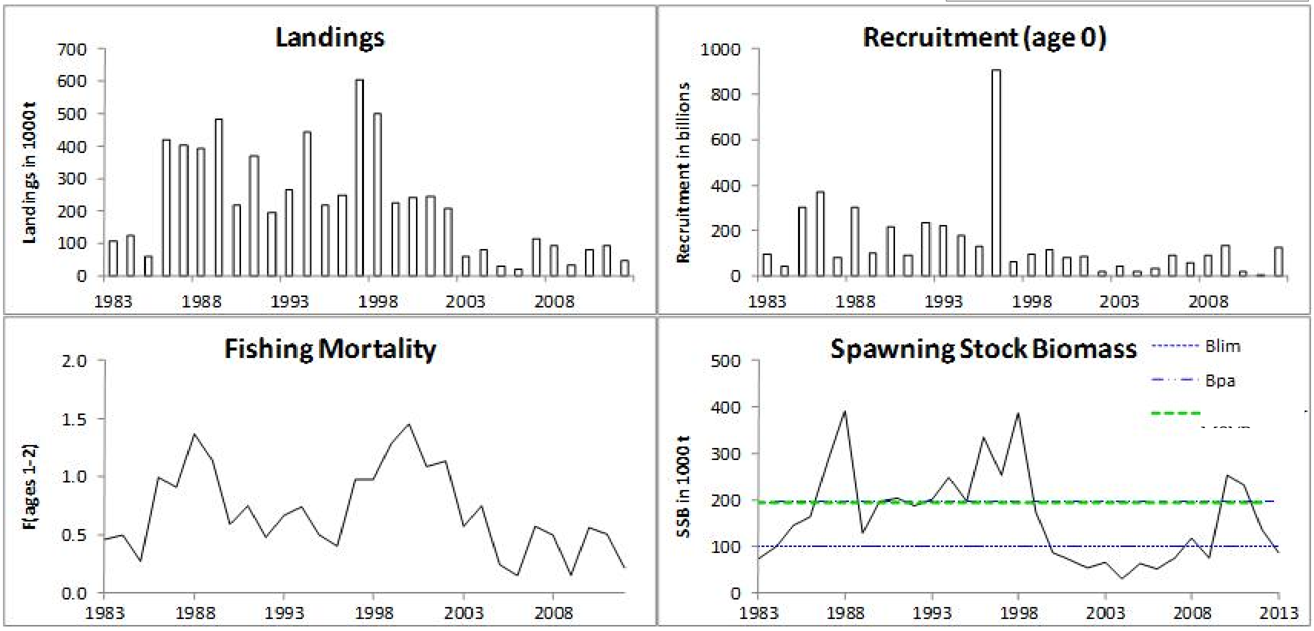


Figure 6.4.22.3.1 Sandeel in the Central Eastern North Sea (SA 3). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F over the years.

Since 2005, F has been variable between years and 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, being below B_{pa} in 2012 and just below B_{lim} in 2013. The low SSB is the result of the historically low recruitments in 2010 and 2011. The advised catch for 2013 is mainly driven by young fish represented by a relatively strong recruitment in 2012.

Management plans

An experimental sandeel management plan has been applied in the Norwegian EEZ since 2010. ICES has not been requested to evaluate this management plan.

The fisheries

Catch distribution	Total landings (2012): 46 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 assessment for SA 1. The dredge survey only covers the southern part of SA 3. There have been substantial differences in management in the past five years between the EU and Norwegian EEZs, potentially changing the selection pattern of the overall fishery (because 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.

It should be noted that the estimated recruitment in 2012 is largely driven by extremely high survey catch rates at a single position in the southwestern corner of SA 3. Despite this fact, the survey results are considered reliable enough to provide catch advice for 2013.

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	HAWG

6.4.22.3 Supporting information February 2013

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 2013

Basis: F(2012) = sum of half yearly Fs = 0.18; Yield(2012) = 46; Recruitment(2012) = 126 billion; Recruitment(2013) = geometric mean (GM 1983–2011) = 87 billion; SSB(2013) = 98.

Rationale	Catches (2013)	Basis	F (2013)	SSB (2014)	%SSB change[1]
MSY approach	78.331	MSY	0.27	195	98%
Zero catch	0	F=0	0	249	153%
Other options	14.281	F_{2012}*0.25	0.04	239	143%
	27.990	F_{2012}*0.5	0.09	230	134%
	41.151	F_{2012}*0.75	0.13	221	124%
	53.788	F_{2012}*1	0.18	212	115%
	65.924	F_{2012}*1.25	0.22	204	107%
	77.579	F_{2012}*1.5	0.26	196	99%

Weights in thousand tonnes.
[1)] SSB 2014 relative to SSB 2013.

MSY approach

Following the ICES MSY approach to a short-lived species, the fishery in 2013 should allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment. This implies a catch of no more than 78 331 t in 2013.

Management plan

Based on the Norwegian national management plan, a TAC for the Norwegian EEZ of SA 3 was set at 20 000 t 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 because 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. In 2011 the survey was extended into the Skagerrak, but a longer time-series is needed before this extension can be included in the assessment.

Norwegian fishing effort data with sufficient resolution are only available for 2011 and 2012, and the estimates of the country effect in cpue are uncertain due to the differences in regulations and the resulting lack of spatial overlap between the Danish and the Norwegian fleets. However, in 2012 the country effect was not statistically significant and no standardization for country effects was performed. Data on fishing effort in 2012 from both Denmark and Norway were included in the assessment. 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.

Management considerations

Sandeel Area 3 comprises both Norwegian and EU EEZ and currently there is no agreement between the parties on management. 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.

The EU fishery has been managed in accordance with the ICES advice, while fisheries in the Norwegian EEZ are managed based on a system of closed areas in combination with acoustic monitoring of the geographical distribution and size of the stock. It is advised that a joint management plan be developed for SA 3 sandeel. In 2012 a TAC at 42 000 tonnes was set for the Norwegian EEZ, which was considerably higher than the ICES advice (< 5000 tonnes for monitoring purposes) for the combined EU and Norwegian EEZ. Given the present combined assessment, overfishing in one EEZ will influence catch options in both EEZs in the following years.

Pre-season estimates of the incoming year class appear less robust for this sandeel 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).

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.
ICES. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

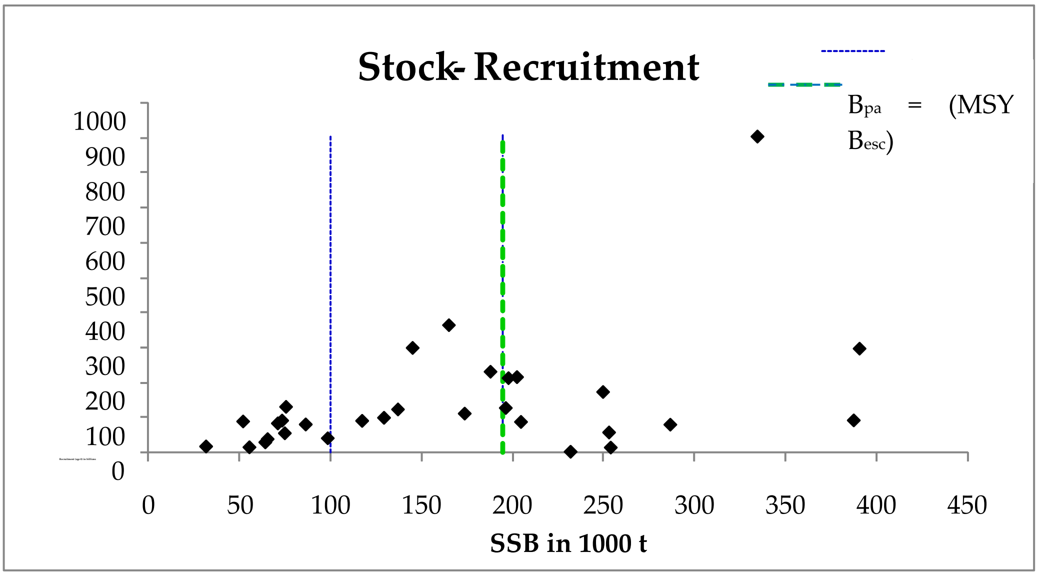


Figure 6.4.22.3.2 Sandeel in the Central Eastern North Sea (SA 3). Stock–recruitment plot.

Table 6.4.22.3.1 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	438
2012	Catches for monitoring purposes should not exceed 5 000 t.	< 5	5	42	46 [4]	101 [4]
2013	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 78.331		20		

Weights in thousand tonnes.
[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 6.4.22.3.2 Sandeel in the Central Eastern North Sea (SA 3). Summary of the assessment.

Year	Recruitment Age 0 (millions)	SSB (tonnes)	Landings (tonnes)	Mean F (Ages 1–2)
1983	93541	72970	105946	0.47
1984	43127	98069	123635	0.50
1985	301553	144725	59083	0.27
1986	366512	164671	420341	0.10
1987	81847	286371	403908	0.91
1988	299345	390381	391081	1.37
1989	101591	129003	481893	1.14
1990	214895	197463	219183	0.59
1991	89705	204302	368105	0.75
1992	233340	187543	195700	0.48
1993	218037	202089	263954	0.66
1994	175473	249410	444119	0.74
1995	129582	195920	218922	0.50
1996	905879	334269	247397	0.41
1997	59564	252688	604159	0.97
1998	94269	387225	499333	0.97
1999	113488	173351	223160	1.29
2000	82514	85968	242732	1.45
2001	85574	70652	245290	1.09
2002	17216	55015	209302	1.14
2003	40604	65058	58942	0.57
2004	19495	31198	79234	0.75
2005	31358	63722	29677	0.25
2006	91037	51576	18863	0.15
2007	57220	74514	113232	0.57
2008	92742	116971	94491	0.50
2009	132851	75172	33350	0.16
2010	16382	253618	80576	0.56
2011	4274	231559	94750	0.51
2012	125675	136655	45732	0.22
2013		87742*		
Average**	143956	163544	220536	0.70

*Using mean weight-at-age from 2012.
**Period 1983–2012.

ECOREGION North Sea
STOCK Sandeel in the Central Western North Sea (SA 4)

Advice for 2013

ICES advises on the basis of the approach to data-limited stocks that catches should not exceed 2041 t.

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

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Unknown
Precautionary approach (F_{pa}, F_{lim})	?	?	?	Unknown
Qualitative evaluation	→	→	→	Very low
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{escapement}$)	?	?	?	Unknown
Precautionary approach (B_{pa}, B_{lim})	?	?	?	Unknown
Qualitative evaluation	↗	→	↘	Declining

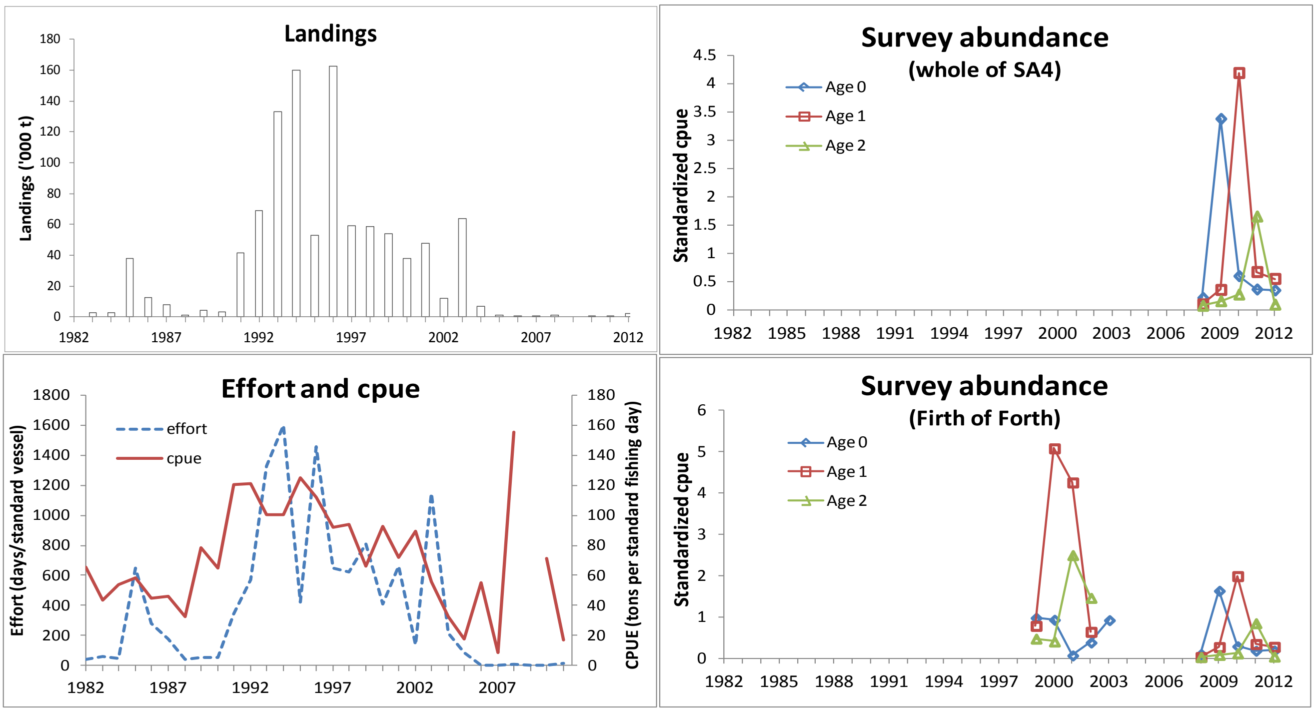


Figure 6.4.22.4.1 Sandeel in the Central Western North Sea (SA 4). Top left: landings, bottom left: effort (days fishing per standard 200 GT vessel) and catch per unit effort (tonnes per standard fishing day). Right: catch indices from the dredge survey (number per hour standardized to mean) in the entire SA 4 (top) and in the Firth of Forth only (bottom).

Survey data indicate that the strong 2009 year class has been followed by lower recruitments in 2010, 2011, and 2012. 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. A limited commercial sandeel fishery (2551 t) occurred in SA 4 in 2012 for monitoring purposes. The fishery ceased before the full TAC (5000 t) was taken.

Catch distribution	Total landings (2012): 2.5 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 information in the commercial catch to be able to provide an analytical assessment similar to those for SAs 1–3.

The advice is based on an abundance index from a survey used as an indicator of stock size. The available survey series is short and difficult to interpret numerically at this time; therefore, this information is used in a qualitative sense. 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	Trends-based assessment (Data-limited stock approach category 3.2.0/5.2.0).
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	HAWG

6.4.22.4 Supporting information February 2013

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 2013

No forecast can be presented for this stock because catch and survey data are insufficient to conduct a traditional age-based assessment.

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. Knowledge about the exploitation status also influences the advised catch.

For this stock, the available survey series is short and difficult to interpret numerically at this time. It shows high recruitment in 2009 followed by much lower recruitment. The recent catches have been very low with some increase in 2012; therefore, catches in 2013 should remain low. Following ICES approach to data-limited stocks, catches in 2013 should decrease by a precautionary buffer of 20% in relation to the 2012 catch, leading to catches of no more than 2041 t.

As this is a short-lived species, the advice will be considered again next year.

Additional considerations

It is important to continue the Scottish dredge survey in this area. The overlap between this survey and the commercial cpue time-series is currently too short to provide an assessment with catch forecast similar to those in SAs 1–3. 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. The advised catch limit of 2041 t will contribute towards providing monitoring information that may be valuable to future assessments.

Sources

ICES. 2010. Report of the Benchmark Workshop on Sandeel (WKSAN), 6–10 September 2010, Copenhagen, Denmark. ICES CM 2010/ACOM:57.
ICES. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

Table 6.4.22.4.1 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]	0.10	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	438
2012	Catches for monitoring purposes should not exceed 5000t.	< 5	0	2.551 [3]	101 [3]
2013	Catch of 2012 reduced by 20% as a precautionary buffer.	< 2.041			

Weights in thousand tonnes.
[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 6.4.22.4.2 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. (Weights are in tonnes per standard fishing day.)

a) Sandeel Area 4				**b) Firth of Forth**		
Year	**Age 0**	**Age 1**	**Age 2**	**Age 0**	**Age 1**	**Age 2**
1999				615	494	301
2000				586	3170	258
2001				48	2656	1561
2002				243	404	916
2003				580		
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
2012	85	135	23	122	178	30

ECOREGION North Sea
STOCK Sandeel in the Viking and Bergen Bank areas (SA 5)

Advice for 2013

ICES advises on the basis of the approach to data-limited stocks that catches should not increase unless there is evidence that this will be sustainable. This corresponds to zero catch.

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

Stock status

F (Fishing Mortality)	
	2010–2012
Qualitative evaluation	Very low
SSB (Spawning-Stock Biomass)	
	2011–2013
Qualitative evaluation	Insufficient information

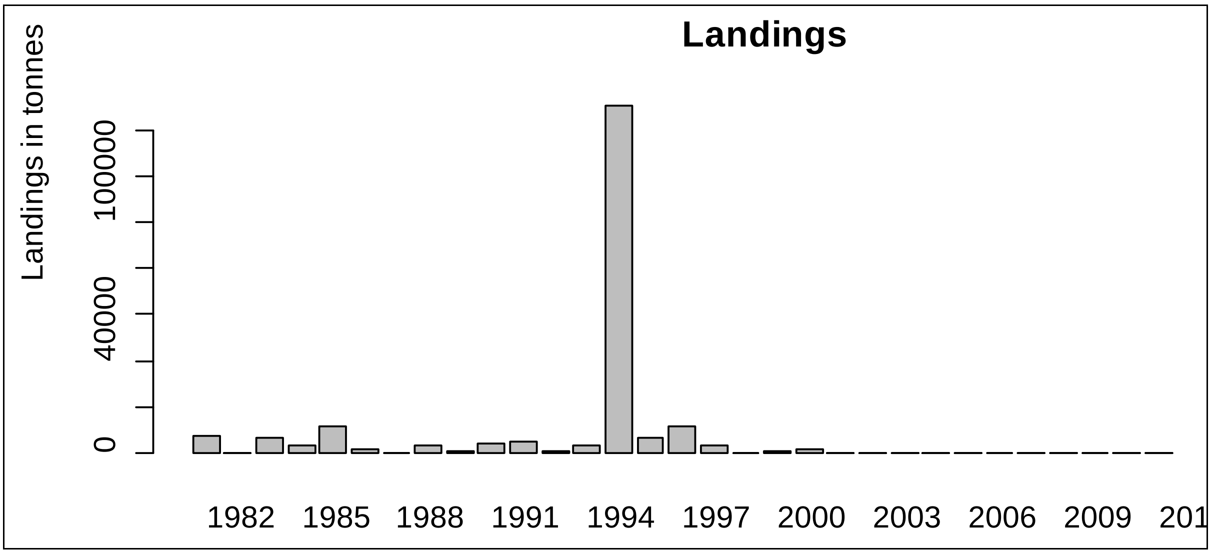


Figure 6.4.22.5.1 Sandeel in the Viking and Bergen Bank area (SA 5). ICES estimates of landings (in thousand tonnes).

Catch statistics 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. ICES has not been requested to evaluate this management plan.

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 (Data-limited stock approach category 6.3.0).
Indicators	Catch statistics.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	HAWG

6.4.22.5 Supporting information February 2013

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 2013

No forecast can be presented for this stock because the available catch and survey data are insufficient to conduct an analytical assessment.

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, current catches are zero. ICES advises that catches in 2013 should remain at zero unless there is evidence that an increase would 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. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

ECOREGION North Sea
STOCK Sandeel in Division IIIa East (Kattegat, SA 6)

Advice for 2013

ICES advises on the basis of the approach to data-limited stocks that catches should be no more than 219 tonnes.

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

Stock status

F (Fishing Mortality)	
	2010–2012
Qualitative evaluation	? Insufficient information

SSB (Spawning-Stock Biomass)	
	2011–2013
Qualitative evaluation	? Insufficient information

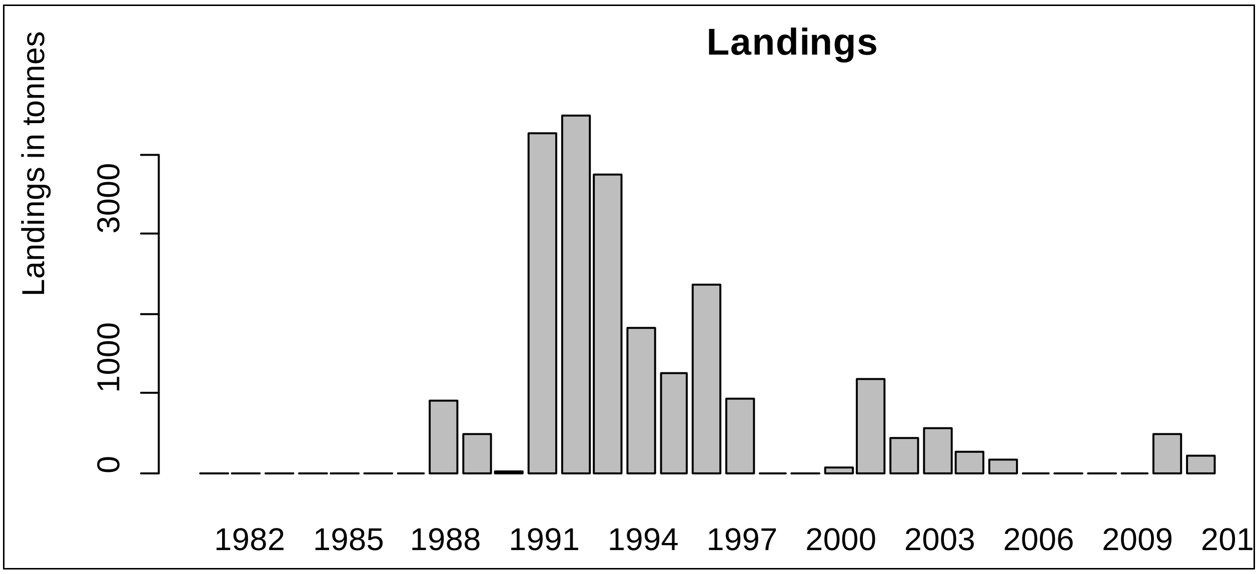


Figure 6.4.22.6.1 Sandeel in Division IIIa East (Kattegat, SA 6). ICES estimates of landings (in tonnes).

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 (2012): 0.21 kt, where 100% were landings by industrial fisheries.

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 (Data-limited stock approach category 5.2.0).
Indicators	Catch statistics.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	HAWG

6.4.22.6 Supporting information February 2013

ECOREGION North Sea
STOCK Sandeel in Division IIIa East (Kattegat, SA 6)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

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, ICES advises that catches should decrease by 20% in relation to the last three years average catch, corresponding to catches of no more than 219 t. This advice is expected to remain unchanged for several years unless information on stock status becomes available.

Source

ICES. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

6.4.22.7 **Advice February 2013**

ECOREGION North Sea
STOCK Sandeel in the Shetland area (SA 7)

Advice for 2013

ICES advises on the basis of the approach to data-limited stocks that no increase in the fisheries should take place unless there is evidence that this will be sustainable. This corresponds to zero catch.

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

Stock status

F (Fishing Mortality)	
	2010–2012
Qualitative evaluation	Very low

SSB (Spawning-Stock Biomass)	
	2010–2013
Qualitative evaluation	Insufficient information

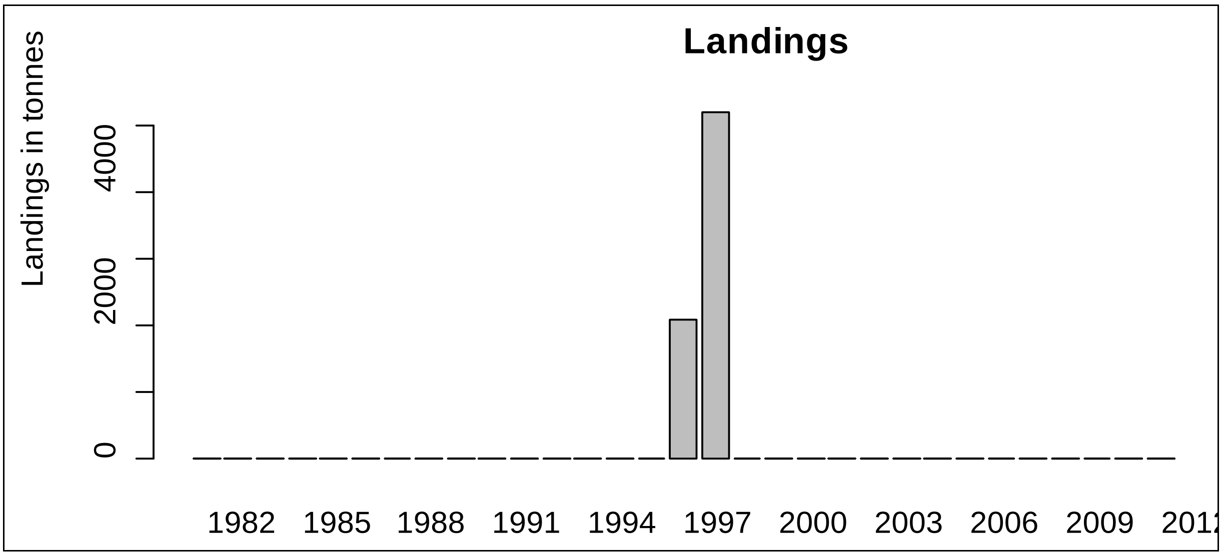


Figure 6.4.22.7.1 Sandeel in the Shetland area (SA 7). ICES estimates of landings (in tonnes).

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. There are no active fisheries for sandeel in this area currently.

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 (Data-limited stock approach category 6.3.0).
Indicators	Catch statistics.
Other information	Last benchmark in 2010 (WKSAN, 2010).
Working group report	HAWG

ECOREGION North Sea
STOCK Sandeel in the Shetland area (SA 7)

Reference points

No reference points are defined for this stock.

Outlook for 2013

No forecast can be presented for this stock because the available data are insufficient to conduct an analytical assessment.

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, because the current catches are zero, ICES advises that catches in 2013 should be remain at zero unless there is evidence that an increase would be sustainable.

Additional considerations

Management plan

A national management plan was in place for this stock 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 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. 2013. Report of the Herring Assessment Working Group (HAWG), 24–26 January 2013. ICES CM 2013/ACOM:06.

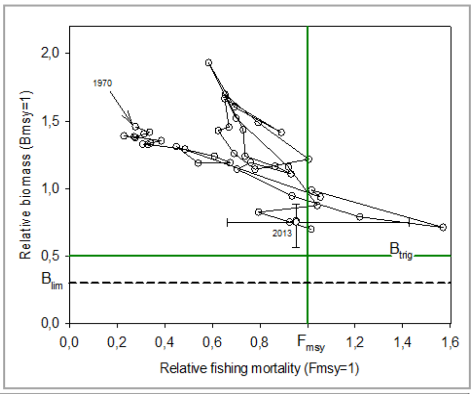
ECOREGION North Sea
STOCK Northern shrimp (*Pandalus borealis*) in Divisions IIIa West and IVa East (Skagerrak and the Norwegian Deep)

Advice for 2014

ICES advises on the basis of MSY considerations that catches should be no more than 6000 t in 2014. If discard rates do not change from the average of the last three years, this implies landings of no more than 5426 t. Additionally, measures should be taken to address highgrading.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✔	✘	✔	At target
Precautionary approach (F_{pa},F_{lim})	?	?	?	Not defined
SSB (Spawning-Stock Biomass)	**2011**	**2012**	**2013**	
MSY ($B_{trigger}$)	✔	✔	✔	Above trigger
Precautionary approach (B_{pa},B_{lim})	✔	✔	✔	Above limit



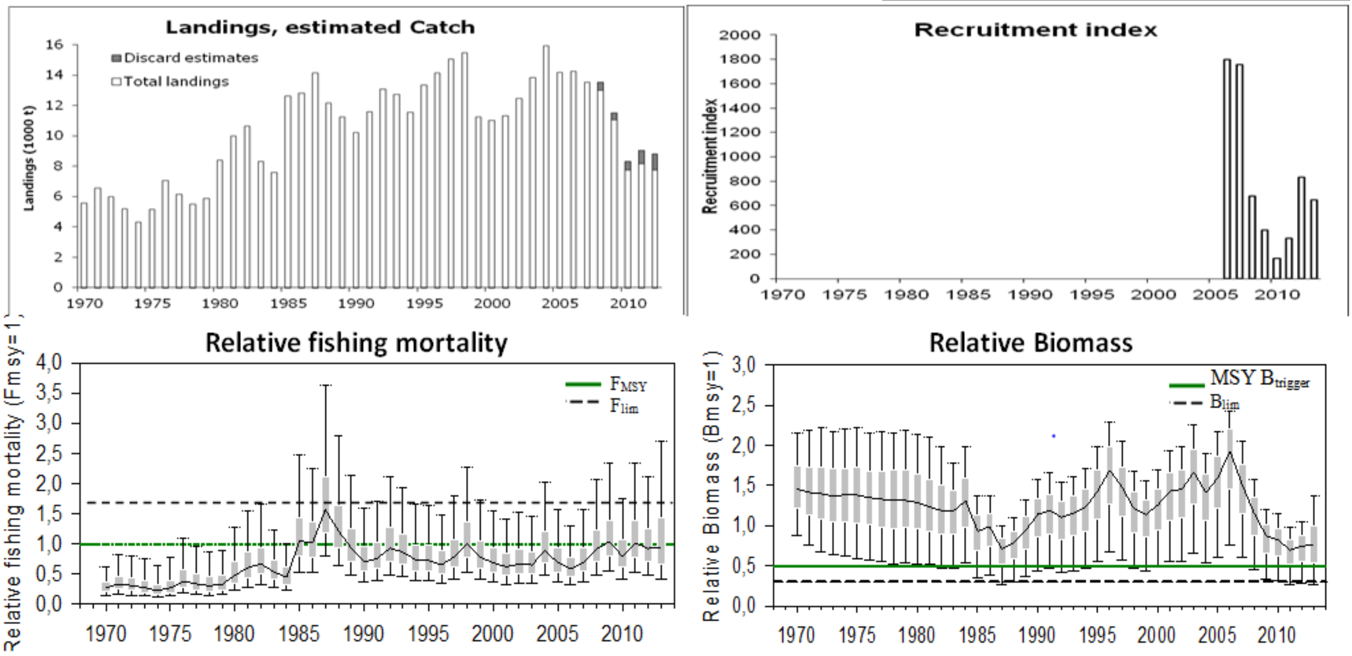


Figure 6.4.23.1 Northern shrimp in Divisions IIIa West and IVa East. Summary of the stock assessment. Landings and estimated catches. Recruitment index: abundance of 1-group shrimp from the Norwegian shrimp survey (2006–2013). Estimates (medians) of relative fishing mortality (F/F_{MSY}) and relative biomass (B/B_{MSY}). Grey boxes are interquartile ranges; the arms of each box are 90% credibility intervals. Top right: Relative biomass and F for the time series used in the assessment.

The assessment is considered indicative of stock trends and provides relative rather than absolute measures of stock status. Since the beginning of the 1990s stock biomass has been above MSY $B_{trigger}$ and fishing mortality below F_{MSY}, although in recent years stock biomass approached MSY $B_{trigger}$ and F has been very close to F_{MSY}. Recruitment indices have increased from a low value in 2010.

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 northern shrimp in Divisions IIIa West and IVa East is probably 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). The targeted northern shrimp fishery in Denmark has declined over the last 20 years, whereas the Norwegian shrimp fleet of vessels < 11 m has expanded. Swedish fishery showed an increase in the use of twin trawls since around 2007. Due to the increasing use of twin trawl in all fisheries (and the accompanying increase in the size of the trawls), the efficiency of the fisheries has increased.

Catch distribution	Total catches (2012) = 8834 kt, where 88% are landings (100% trawl) and 12% 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 requiring a species-selective grid has been implemented in the Skagerrak since 1st February 2013.

Quality considerations

Making the electronic logbooks introduced in the Norwegian fishery in 2011 compulsory for all vessels, instead of only vessels ≥15 m (≥12 m in Skagerrak, since 2013), would result in a considerable increase in the quality of the data available for the assessment.

The assessment model best describes trends in stock development and is not fully sensitive to year-to-year changes. Large and rapid changes in recruitment may therefore not be fully captured in model predictions.

Scientific basis

Assessment type	Bayesian fitting of a surplus-production model.
Stock data category	Category 1
Input data	Commercial landings (until 2007), commercial catches (since 2008), two survey indices (Norwegian shrimp survey 1984–2002 and 2006–2013), and two commercial indices (Danish and Norwegian standardized lpue).
Discards and bycatch	Discards are included in the assessment (Norwegian, Danish, and Swedish fleets since 2008).
Indicators	Swedish standardized lpue.
Other information	A length-based analytical assessment model was adopted at the 2013 benchmark meeting but was not fully operational for providing advice for this year's assessment. A surplus production model was used this year instead.
Working group report	NIPAG (ICES, 2013b).

ECOREGION North Sea
STOCK Northern shrimp (*Pandalus borealis*) in Divisions IIIa West and IVa East (Skagerrak and the Norwegian Deep)

Reference points

	Type	Value	Technical basis
MSY approach	MSY $B_{trigger}$	0.5 of B_{MSY}*	Relative value. B_{MSY} is directly estimated from the assessment surplus production model and changes when the assessment is updated.
	F_{MSY}	*	Relative value. F_{MSY} is directly estimated from the assessment surplus production model and changes when the assessment is updated.
Precautionary approach	B_{lim}	0.3 of B_{MSY}	Relative value.
	B_{pa}	Not defined.	
	F_{lim}	1.7 of F_{MSY}	Relative value (the F that drives the stock to B_{lim}).
	F_{pa}	Not defined.	

(New in 2013)

* Fishing mortality is estimated in relation to F_{MSY} and total stock biomass is estimated in relation to B_{MSY}.

Outlook for 2014

Basis: Catches (2013) = 9 5; median F_{2013}/F_{MSY} = (catch constraint) = 0.95; median B_{2014} > MSY $B_{trigger}$.

Catch options 2014*	6	8	10	12	14
Stock size (B_{2015}/B_{MSY}), median	0.84	0.81	0.78	0.76	0.73
Fishing mortality (F_{2014}/F_{MSY}), median	0.54	0.74	0.97	1.19	1.45
Probability of B_{2015} falling below B_{lim}	6%	6%	6%	7%	7%
Probability of F_{2014} exceeding F_{lim}	5%	10%	19%	29%	39%

*Catches in thousand tonnes.

MSY considerations

The stock biomass is expected to be above MSY $B_{trigger}$ in 2014. Hence, the MSY approach corresponds to fishing at F_{MSY} (or lower) in 2014. Catches of 10 000 t in 2014 correspond to median F_{2014}/F_{MSY} = 0.97. Therefore, catches of up to 10 000 t in 2014 are considered consistent with the MSY approach. With these catches in 2014, the stock biomass is forecast to remain above MSY $B_{trigger}$ in 2015.

However, in the benchmark of this stock, concluded in 2013, two models were considered appropriate for the assessment of this stock; a surplus production model (presented here) and a length-based model. The benchmark group (IBPP and; ICES, 2013a) preferred the length-based model because it incorporates more data (mainly, length information), but concluded that it was not fully operational to provide catch advice this year. Both models show similar stock trends for most of the time-series, but the length-based model indicates a far higher fishing mortality in the last years (Figure 6.4.23.3). ICES advice in the near future will likely be based on the length-based model, and ICES considers that the current advice should take into account the uncertainty due to the different interpretations of recent fishing mortality.

It should be noted that any catch value in the range 6000–10 000 t in 2014 corresponds to a 6% probability of B_{2015} being less than B_{lim}. This indicates that the probability surface is very flat and, therefore, a formal 5% probability criterion would imply a very low catch in 2014, well below any catch value observed in the last three decades, which is considered overly restrictive. At the same time, both assessments show a substantial decrease in stock biomass in recent years (in line with the decreases in the Norwegian survey and commercial lpue indices) and a big increase in F in the case of the length-based assessment. Therefore, a cautious approach to the advice is required this year, until historical stock development and current status in relation to reference points are further evaluated and confirmed by the length-based assessment model selected by the benchmark (IBPPand).

Taking all the above elements into consideration, ICES advises that catches in 2014 should not exceed 6000 t in 2014. If discard rates do not change from the average of the last three years (2010–2012), this corresponds to landings of no more than 5426 t.

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.

A benchmark was finalized for this stock in 2013 (ICES, 2013a) to decide on an appropriate assessment model. The benchmark discussed a length-based model and a surplus production model, which gave generally similar results (except for the last years, when they show more differences) and were both considered capable of forming the basis for the stock assessment. It was concluded that the length-based model is preferred because it made more use of the available data from the surveys and catches, and because it is relatively easy to update and run. It was decided that the surplus production model should be run alongside the length-based model, at least initially, to ensure that assessments from the two models are consistent and that differences are noted and the reasons for them understood. Since the length-based model was not fully operational to provide catch advice this year, the surplus production model is presented as the basis for the advice this year. However, the differences found between the preferred length-based model and the surplus production model also influenced the advice provided.

A joint Nordic–EU project (Interreg. IV, 2011–2013) has investigated the stock structure of northern shrimp using genetics and fisheries data through an extensive collaboration with the industry. The shrimp in Skagerrak and the Norwegian Deep most likely comprise one single stock, which is in agreement with the oceanic current pattern in the area. The benchmark assessment in September 2013 thus concluded that the northern shrimp in the Skagerrak and Norwegian Deep area can be considered to belong to one single stock for assessment purposes.

The estimate of the Danish lpue is based on fishing trips where the landing value of northern shrimp was at least 50% of the landing value of all species. This threshold was selected to ensure the exclusion of trips where northern shrimp is landed as a bycatch rather than as a target species. Uncertainties on discards and highgrading estimates have been 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 fished by all countries. Discarding of small and medium-sized, low-value shrimp may occur in the Swedish fishery, and since around 2011 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.

The management of northern shrimp fisheries 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 2012, estimated discards amounted to 12% of the total catch (1063 t discarded). Sorting grids should be mandatory in all areas to minimize bycatch. Additionally, all vessels, including Norwegian vessels < 15 m (< 12 m in Skagerrak) that are not currently using electronic logbooks, should be required to provide logbooks, as this would result in a considerably increase in the quality of the data available for the assessment.

Changes in fishing technology and fishing patterns

The number of Danish shrimp vessels has decreased from 138 in 1987 to only 10 in 2013. 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 shrimp 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 (≥12 m in Skagerrak) is available from compulsory electronic logbooks introduced in 2011.

Since 2006, 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 sorting grids.

Comparison with previous assessment and advice

The 2012 advice was based on ICES approach to data-limited stocks, taking into account the Norwegian survey biomass index (category 3 of data limited stocks). In 2013 ICES is providing advice on an analytical basis for this stock (category 1), after several years without such an assessment. The advice this year is based on MSY considerations.

Assessment and management area

This assessment is carried out for the stock in the Norwegian Deep and Skagerrak (Figure 6.4.23.2). TACs 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.

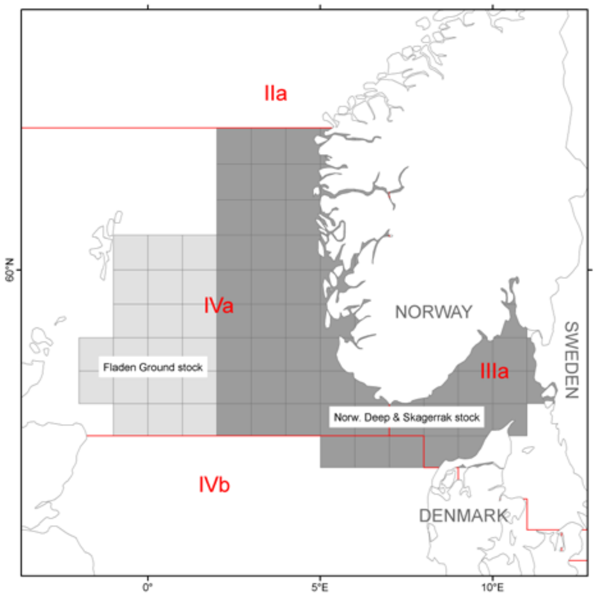


Figure 6.4.23.2 Northern shrimp in Divisions IIIa West and IVa East. Assessment areas in the North Sea and Skagerrak are shown as dark grey. The Fladen Ground stock (light grey) is described in Section 6.4.24.

Sources

ICES. 2013a. Report of the Inter-Benchmark Protocol on *Pandalus* in Skagerrak and the Norwegian Deep (IBPPand), 12–19 September 2013, Dartmouth, NS, Canada. ICES CM 2013/ACOM:71. 379 pp.

ICES. 2013b. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 12–19 September 2013, Halifax, Canada. ICES CM 2013/ACOM:14.

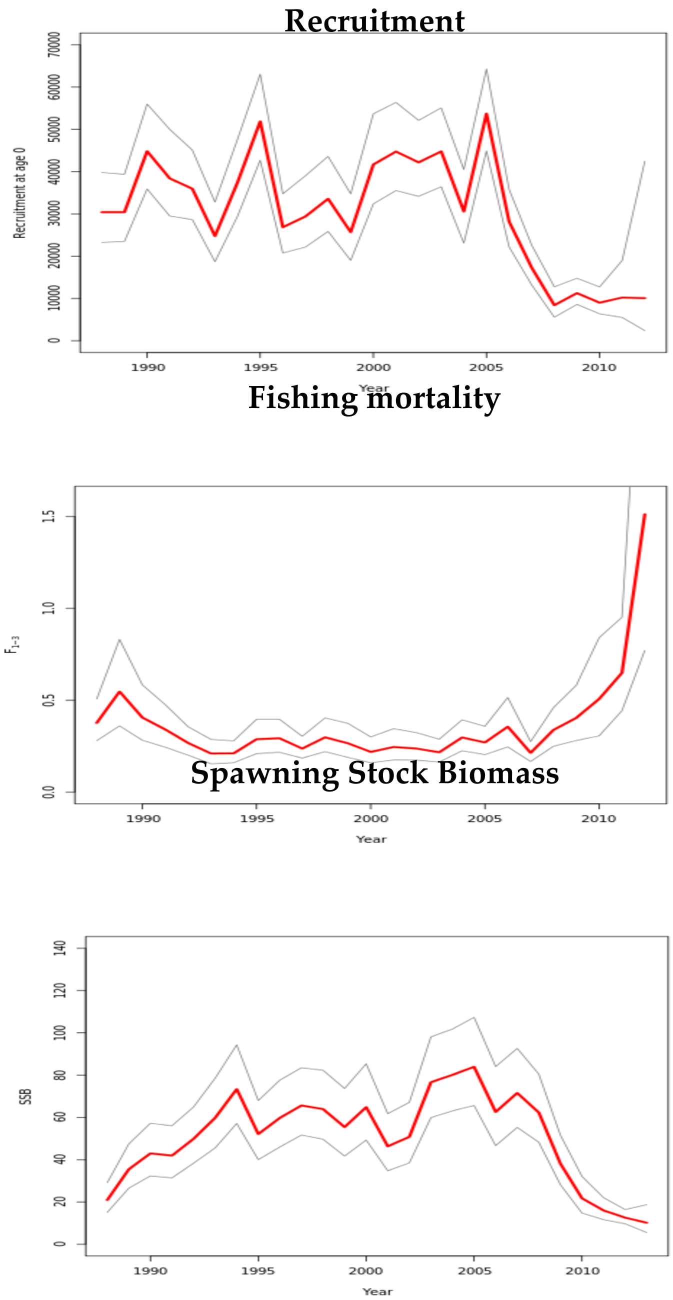


Figure 6.4.23.3 Northern shrimp in Divisions IIIa West and IVa East. Estimates of recruitment, $F_{1\text{-}3}$ and SSB from the length-based model. (red lines with 90% confidence intervals in grey)

Table 6.4.23.1 Northern shrimp in Divisions IIIa West 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	Predicted catch corresp. to advice	TAC Div. IIIa	TAC Norwegian zone Div. IV[1]	Discard estimates	ICES landings	ICES catch (discards and landings)
1987	Not assessed						14.2	
1988	Catches significantly below 1985–1986[3]						12.2	
1989	No advice			3.1 [2]			11.2	
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	4.500		13.1	
1993	Within safe biological limits	13 [3]		10.50	4.500		12.8	
1994	Within safe biological limits	19 [3]		12.60	5.400		11.5	
1995	Within safe biological limits	13 [3]		11.20	4.800		13.4	
1996	No advice	11 [3]		10.50	4.500		14.1	
1997	No advice	13 [3]		10.50	4.500		15.1	
1998	No increase in F; TAC	19 [3]		13.16	5.640		15.5	
1999	Maintain F	19 [3]		13.16	5.640		11.3	
2000	Maintain F	< 11.5 [3]		9.10	3.900		11.0	
2001	Maintain F	13.4		10.15	4.350		11.3	
2002	Long-term average landings	12.6		10.15	4.350		12.5	
2003	Maintain F	14.7		10.15	4.425		13.8	
2004	No increase in F	15.3 [4]		10.71	4.590		16.0	
2005	No increase in catch above recent level	~13 [4]		10.71	4.590		14.2	
2006	No increase in catch above recent level	~13.5 [4]		11.2	4.800		14.3	
2007	No increase in landings above recent level	~14.0 [4]		11.62	4.980		13.6	
2008	No increase in landings above recent level	~15 [4]		11.62	4.980	0.5	13.0	13.6
2009	Same advice as last year	~15 [4]		11.62	4.980	0.5	11.1	11.5
2010	No increase in landings above 2008 level	~13 [4]		9.8	4.200	0.6	7.8	8.3
2011	At least 30% decrease in landings of 2007–2009, reduce discards, mandatory sorting grids	< 8.8		8.3	3.570	0.9	8.2	9.0
2012	Reduce catches and reduce discards	-		7.1	3.035	1.1	7.8	8.8
2013	Reduce landings by 36% and reduce discards	≤ 5.8		6.65	2.850			
2014	MSY considerations, reduce discards	≤ 5.426	≤ 6.0					

Weights in thousand tonnes.
[1] TACs in the Norwegian zone of Division IVa.
[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 West and IVa East. Nominal landings in Division IIIa and Subarea IV; landings, discards, and catches (in tonnes) as estimated by ICES; and the TAC (for Division IIIa and the Norwegian zone of Subarea IV). The ICES landings are used in the assessment.

Year	Denmark *)	Norway *)	Sweden *)	Total landings	Estimated Swedish discards	Estimated Norwegian discards	Estimated Danish discards	TAC	Estimated catch
1970	1102	1729	2742	5573					
1971	1190	2486	2906	6582					
1972	1017	2477	2524	6018					
1973	755	2333	2130	5218					
1974	530	1809	2003	4342					
1975	817	2339	2003	5159					
1976	1204	3348	2529	7081					
1977	1120	3004	2019	6143					
1978	1459	2440	1609	5508					
1979	1062	3040	1787	5889					
1980	1678	4562	2159	8399					
1981	2593	5187	2241	10021					
1982	3766	5422	1450	10638					
1983	1804	5370	1136	8310					
1984	1800	4770	1022	7592					
1985	4498	6550	1571	12619					
1986	4866	6492	1463	12821					
1987	4488	8343	1322	14153					
1988	3240	7659	1278	12177					
1989	3242	6574	1433	11249					
1990	2479	6152	1608	10239					
1991	3583	6104	1908	11595					
1992	3725	7202	2154	13081				15000	
1993	2915	7538	2300	12753				15000	
1994	2134	6814	2601	11549				18000	
1995	2460	8019	2882	13361				16000	
1996	3868	7910	2371	14149				15000	
1997	3909	8568	2597	15074				15000	
1998	3330	9704	2469	15504				18800	
1999	2072	6737	2445	11254				18800	
2000	2371	6442	2225	11038				13000	
2001	1954	7266	2108	11328				14500	
2002	2470	7703	2301	12474				14500	
2003	3270	8177	2389	13836				14575	
2004	3944	9544	2464	15952				15300	
2005	2992	8958	2257	14207				15300	
2006	3111	8669	2488	14268				16000	
2007	2422	8685	2445	13552				16600	
2008	2274	8261	2479	13014	540			16600	13554
2009	2224	6364	2483	11071	337	93	41	16600	11542
2010	1301	4672	1781	7754	386	133	60	14000	8333
2011	1601	4801	1768	8170	504	246	129	11870	9049
2012	1454	4796	1521	7771	683	288	92	10135	8834

*) Swedish (all years), Norwegian (since 2000), and Danish (since 2001) landings have been corrected for loss in weight due to boiling.

Table 6.4.23.3 Northern shrimp in Divisions IIIa West and IVa East. Bycatch in the shrimp fishery in 2012. Combined data from Danish and Swedish logbooks and Norwegian landings (tonnes).

	Division IIIa, no grid		Division IIIa, grid		Division IVa East, no grid	
Species:	Total (t)	% of total catch	Total (t)	% of total catch	Total (t)	% of total catch
Northern shrimp	5481.4	79.3	458.3	95.1	1175.4	77.6
Norway lobster	41.1	0.6	2.8	0.6	8.7	0.6
Anglerfish	80.7	1.2	0.7	0.2	43.6	2.9
Whiting	7.4	0.1	0.0	0.0	1.3	0.1
Haddock	109.3	1.6	1.5	0.3	8.2	0.5
Hake	21.7	0.3	0.4	0.1	24.0	1.6
Ling	45.7	0.7	0.2	0.0	33.5	2.2
Saithe	474.6	6.9	7.3	1.5	112.6	7.4
Witch flounder	72.6	1.1	1.0	0.2	1.5	0.1
Norway pout	2.2	0.0	0.0	0.0	0.0	0.0
Cod	401.2	5.8	3.3	0.7	57.4	3.8
Other market fish	174.7	2.5	6.2	1.3	48.5	3.2

Table 6.4.23.4 Northern shrimp in Divisions IIIa West and IVa East. Summary of the assessment.

	Recruitment index	Biomass lower 90%	Biomass lower interquartile	**Median Biomass**	Biomass higher interquartile	Biomass higher 90%	F lower 90%	F lower interquartile	**Median F**	F higher interquartile	F higher 90%
	Relative index			**Relative to B_{MSY}**					**Relative to F_{MSY}**		
1970	n/a	0.81	1.21	**1.45**	1.73	2.26	0.12	0.21	**0.28**	0.37	0.75
1971	n/a	0.67	1.13	**1.41**	1.73	2.31	0.14	0.25	**0.34**	0.47	1.02
1972	n/a	0.57	1.09	**1.39**	1.72	2.32	0.13	0.23	**0.31**	0.44	1.02
1973	n/a	0.54	1.06	**1.38**	1.72	2.29	0.12	0.20	**0.28**	0.39	0.92
1974	n/a	0.50	1.05	**1.38**	1.73	2.31	0.10	0.17	**0.23**	0.33	0.82
1975	n/a	0.49	1.03	**1.38**	1.73	2.32	0.12	0.20	**0.28**	0.40	0.99
1976	n/a	0.46	1.00	**1.35**	1.69	2.29	0.16	0.28	**0.39**	0.57	1.38
1977	n/a	0.44	0.99	**1.34**	1.69	2.30	0.14	0.24	**0.34**	0.49	1.22
1978	n/a	0.43	0.97	**1.33**	1.70	2.30	0.13	0.22	**0.31**	0.45	1.10
1979	n/a	0.42	0.98	**1.33**	1.69	2.31	0.14	0.24	**0.33**	0.48	1.14
1980	n/a	0.42	0.95	**1.29**	1.64	2.27	0.20	0.35	**0.49**	0.70	1.61
1981	n/a	0.40	0.92	**1.24**	1.58	2.23	0.25	0.44	**0.61**	0.87	1.90
1982	n/a	0.39	0.89	**1.19**	1.51	2.14	0.28	0.49	**0.67**	0.94	2.04
1983	n/a	0.39	0.90	**1.19**	1.44	1.89	0.24	0.41	**0.54**	0.74	1.52
1984	n/a	0.44	0.99	**1.32**	1.59	2.10	0.20	0.33	**0.45**	0.61	1.23
1985	n/a	0.29	0.70	**0.94**	1.13	1.48	0.47	0.79	**1.06**	1.44	2.98
1986	n/a	0.32	0.75	**0.99**	1.16	1.45	0.47	0.77	**1.02**	1.37	2.75
1987	n/a	0.22	0.53	**0.71**	0.84	1.06	0.72	1.18	**1.57**	2.13	4.36
1988	n/a	0.25	0.59	**0.79**	0.92	1.15	0.56	0.93	**1.22**	1.65	3.35
1989	n/a	0.30	0.72	**0.95**	1.12	1.39	0.43	0.71	**0.93**	1.26	2.52
1990	n/a	0.37	0.86	**1.15**	1.34	1.65	0.33	0.54	**0.70**	0.95	1.91
1991	n/a	0.39	0.90	**1.19**	1.40	1.73	0.36	0.58	**0.77**	1.03	2.05
1992	n/a	0.36	0.84	**1.11**	1.31	1.61	0.43	0.70	**0.93**	1.26	2.51
1993	n/a	0.37	0.88	**1.17**	1.37	1.70	0.40	0.66	**0.86**	1.16	2.34
1994	n/a	0.40	0.94	**1.25**	1.46	1.80	0.34	0.56	**0.73**	0.99	2.00
1995	n/a	0.47	1.10	**1.44**	1.69	2.08	0.34	0.56	**0.73**	0.98	1.96
1996	n/a	0.56	1.28	**1.70**	1.99	2.38	0.32	0.50	**0.65**	0.89	1.76
1997	n/a	0.48	1.13	**1.50**	1.74	2.14	0.37	0.61	**0.79**	1.07	2.12
1998	n/a	0.39	0.91	**1.22**	1.42	1.76	0.47	0.77	**1.00**	1.36	2.76
1999	n/a	0.36	0.86	**1.14**	1.33	1.62	0.37	0.60	**0.78**	1.05	2.12
2000	n/a	0.41	0.95	**1.26**	1.46	1.79	0.33	0.53	**0.69**	0.93	1.87
2001	n/a	0.46	1.08	**1.43**	1.67	2.02	0.29	0.48	**0.62**	0.84	1.71
2002	n/a	0.47	1.11	**1.46**	1.70	2.07	0.32	0.52	**0.67**	0.91	1.84
2003	n/a	0.55	1.27	**1.67**	1.95	2.36	0.31	0.50	**0.65**	0.88	1.75
2004	n/a	0.45	1.07	**1.41**	1.65	2.00	0.43	0.68	**0.89**	1.20	2.42
2005	n/a	0.52	1.22	**1.61**	1.87	2.25	0.34	0.53	**0.69**	0.93	1.91
2006	**1800**	0.64	1.47	**1.93**	2.21	2.47	0.29	0.46	**0.59**	0.78	1.55
2007	**1759**	0.49	1.15	**1.53**	1.78	2.16	0.33	0.54	**0.70**	0.94	1.90
2008	**675**	0.38	0.88	**1.16**	1.36	1.66	0.43	0.70	**0.92**	1.24	2.49
2009	**398**	0.28	0.66	**0.88**	1.03	1.26	0.48	0.79	**1.04**	1.40	2.83
2010	**168**	0.26	0.63	**0.83**	0.97	1.19	0.37	0.61	**0.79**	1.07	2.16
2011	**330**	0.22	0.52	**0.70**	0.83	1.02	0.47	0.77	**1.02**	1.39	2.83
2012	**830**	0.24	0.56	**0.75**	0.89	1.10	0.42	0.70	**0.93**	1.26	2.56
2013	**647**	0.21	0.54	**0.76**	1.00	1.51	0.35	0.66	**0.95**	1.42	3.40

6.4.24 **Advice October 2013**

ECOREGION North Sea
STOCK Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground)

Advice for 2014 and 2015

There are no new data available that change the perception of the stock. Therefore, the advice for this fishery in 2014 and 2015 is the same as the advice for 2013 (ICES, 2012a): *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.*

Scientific basis

Assessment type	No assessment (ICES data-limited stock category 6.3.0).
Discards and bycatch	Discards were not included. .
Indicators	Catch statistics.
Other information	None.
Working group report	NIPAG (ICES, 2012b).

Sources

ICES. 2012a. Northern shrimp (*Pandalus borealis*) in Division IVa (Fladen Ground). *In* Report of the ICES Advisory Committee, 2012. ICES Advice 2012. Book 6, Section 6.4.22.
ICES. 2012b. Report of the NAFO/ICES *Pandalus* Assessment Group Meeting, 17–24 October 2012, Tromsø, Norway. ICES CM 2012/ACOM:14. 89 pp.

Table 6.4.24.1 Northern shrimp in Division IVa (Fladen Ground). ICES advice, management, discards, and landings.

Year	ICES advice	Predicted landings corresp. to advice	TAC EC waters in ICES Division IIa and Subarea 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	0
2013	No increase in catch unless there is evidence that this will be sustainable	0	3.058	
2014	No increase in catch unless there is evidence that this will be sustainable	0		
2015	No new advice, same as for 2014	0		

Weights in thousand tonnes.

ECOREGION North Sea
STOCK Rays and skates in Divisions and Subarea IIIa, IV, and VIId, e (Kattegat, Skagerrak, North Sea, and English Channel)

Advice for 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Table 6.4.25.1 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).

ECOREGION North Sea
STOCK Blonde ray (*Raja brachyuran)* in Divisions IVc and VIId, e (Southern North Sea and English Channel)

Advice for 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.1.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.2.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.3.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.4.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.5.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.6.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.7.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.8.1 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 2014

The advice given in 2012 for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012). The advice is summarized in the table below.

Source

ICES. 2012. Report of the Working Group on Elasmobranch Fishes (WGEF), 19–26 June 2012, Lisbon, Portugal. ICES CM 2012/ACOM:19. 547 pp.

Table 6.4.25.9.1 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.

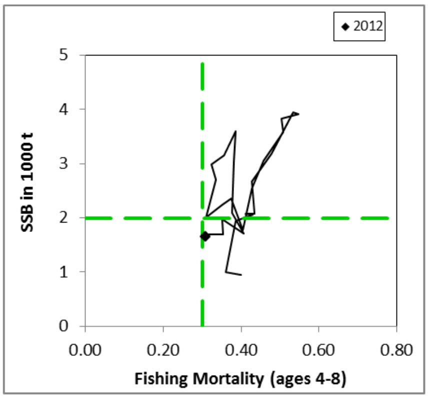
ECOREGION North Sea
STOCK Sole in Division IIIa and Subdivisions 22–24 (Skagerrak, Kattegat, and the Belts)

Advice for 2014

ICES advises on the basis of the transition to the MSY approach that catches in 2014 should be no more than 353 tonnes. Discards are considering low, and therefore all catches are assumed to be landed.

Stock status

	F (Fishing Mortality)			
	2010	2011	2012	
MSY (F_{MSY})	✗	✗	✗	At target
Precautionary approach (F_{pa}, F_{lim})	O	O	O	Increased risk
	SSB (Spawning-Stock Biomass)			
	2011	2012	2013	
MSY ($B_{trigger}$)	✗	✗	✗	Below trigger
Precautionary approach (B_{pa}, B_{lim})	?	?	?	Undefined



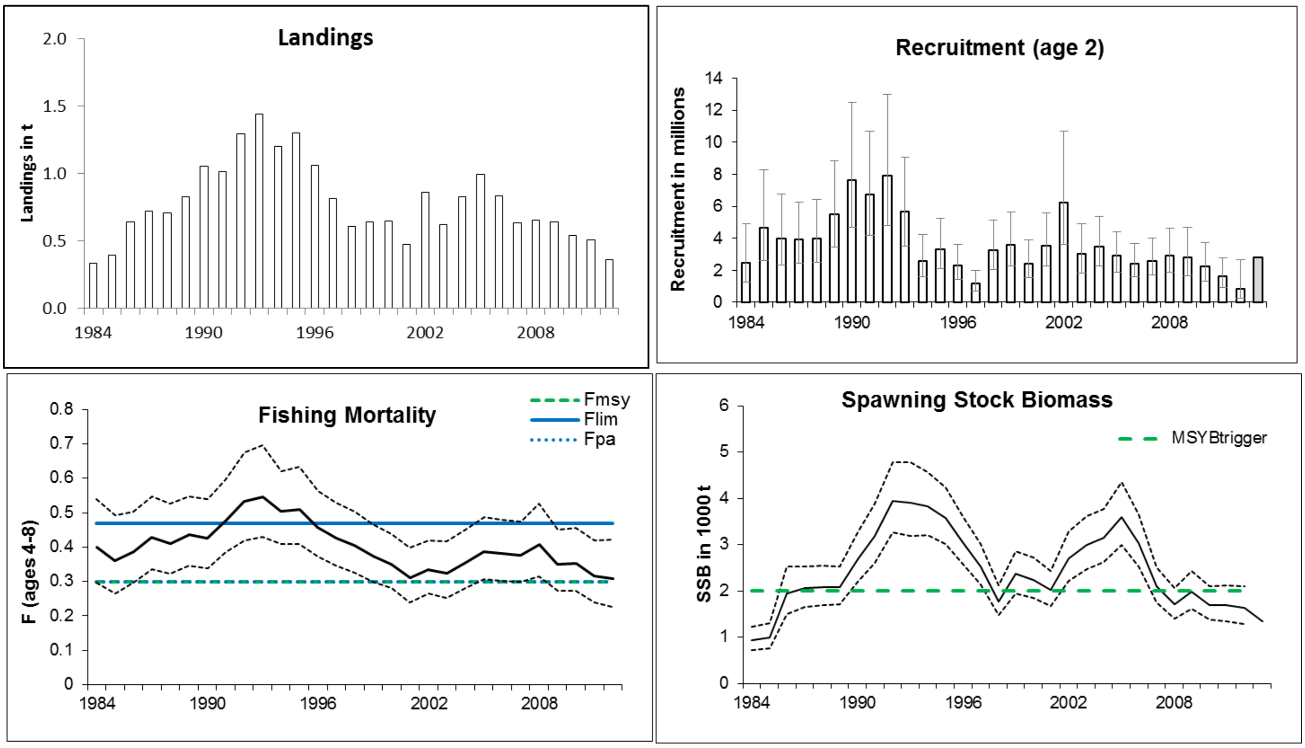


Figure 6.4.26.1 Sole in Division IIIa and Subdivisions 22–24. Summary of stock assessment (weights in thousand tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Predicted values are shaded. Top right: SSB and F over the years.

SSB has decreased since 2006 and has been below MSY $B_{trigger}$ since 2007. Fishing mortality has been around 0.36 since 2005. The last strong year class was the 2000 year class; since then recruitment has decreased to a historical low recruitment in 2012.

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 daytime. Sole is a long lived flatfish species. The main spawning takes place in the second quarter in coastal areas close to the nurseries. The main diet of sole consists of worms and small soft-shelled bivalves. As for many other flatfish species sole has a sexual dimorphism (i.e. females reach older ages and bigger sizes than males).

The fisheries

Sole is taken in a mixed trawl fishery with *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 catches (2012) = 369 t, where 97% were landings (55% trawl, 45% gillnets) and 3% discards.

Quality considerations

Sampling of landings is complicated by the low total landings which are dispersed spatially. This affects the quality of the input data, including the weight-at-age. Historically, the assessment has overestimated SSB and underestimated fishing mortality, but this is not evident for the latest year.

Discard rates in recent years are low and do not impact the quality of the assessment.

The main indicator of recruitment, the survey, ceased in 2011. The absence of the Cooperative Fishermen–DTU Aqua sole survey (Fishermen–DTU Aqua) in 2012 deteriorated the quality of the assessment. The lack of the survey combined with an increase in mesh size in the fishery (selectivity) makes recruitment estimation significantly more uncertain.

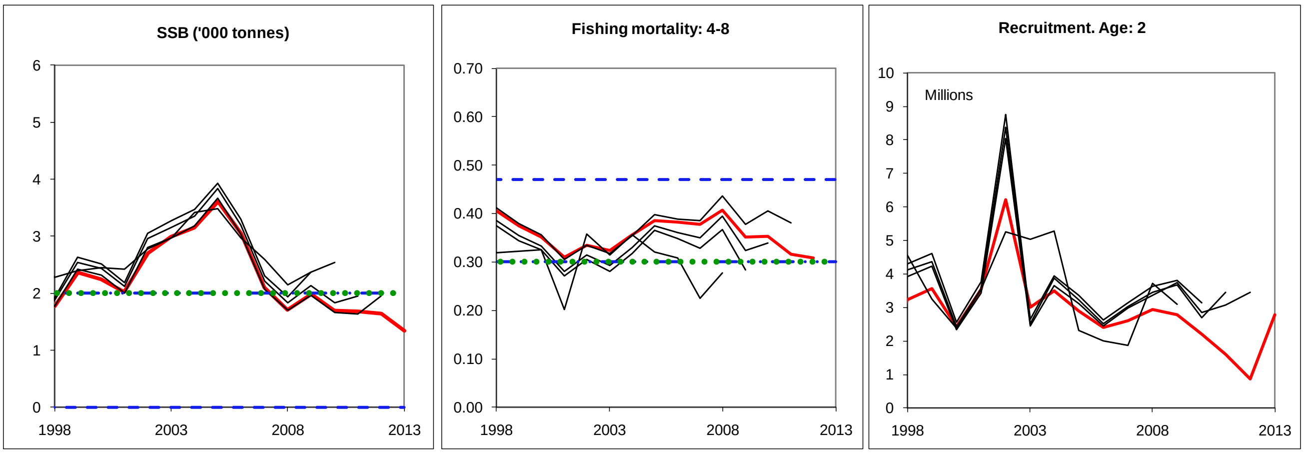


Figure 6.4.26.2 Sole in Division IIIa and Subdivisions 22–24. Historical performance of the assessments. The assessments before 2009 do not include Subdivisions 22–24.

Scientific basis

Assessment type	Age-based analytical stochastic assessment (SAM).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua 2004–2011),three commercial indices (trawlers 12–20 m, 90–104 mm (1994–present), private logbook gillnetters (1994–2007), private logbook trawlers (1987–2008)); fixed maturity; and fixed natural mortality (0.1) for all age groups.
Discards and bycatch	Discards were not included and are considered low.
Indicators	None.
Other information	Last benchmarked in 2010 (WKFLAT 2010; ICES, 2010).
Working group report	WGBFAS (ICES, 2013).

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

Reference points

	Type	*Value*	*Technical basis*
MSY	MSY $B_{trigger}$	2000 t.	lowest observed SSB, excluding low SSBs in 1984–1985 (ICES, 2010).
Approach	F_{MSY}	0.30	Provisional value based on F_{pa}.
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}.

(Changed in 2013).

Outlook for 2014

Basis: F_{2013} = mean F (2010–2012) scaled = 0.31; SSB (2014) = 1540; R (age 2 in 2013) = GM (1995–2010) = 3.1 millions; catches (2013) = 370.

Rationale	**Catches (2014)**	**Basis**	**F (2014)**	**SSB (2015)**	**%SSB change**[1)]	**%TAC change**[2)]
MSY transition	353	$0.2 \times F_{2010}$ + $0.8 \times (F_{MSY} \times SSB_{2014}/MSY\ B_{trigger})$	0.26	1 820	18%	−42%
MSY approach	314	$F_{MSY} \times SSB_{2014}/MSY\ B_{trigger}$	0.23	1 860	21%	−49%
Precautionary approach	396	F_{pa} ($F_{2013} \times 0.97$)	0.30	1 780	16%	−35%
Zero catch	000	F = 0	0.00	2 170	41%	−100%
Other options	170	F~SSB(2015)> MSY $B_{trigger}$	0.12	2 000	30%	−72%
	216	$F_{2013} \times 0.5$	0.15	1 960	27%	−65%
	407	F_{2013}	0.31	1 770	15%	−33%
	517	−15% TAC ($F_{2013} \times 1.32$)	0.41	1 660	8%	−15%
	607	No change in TAC ($F_{2013} \times 1.6$)	0.49	1 570	2%	0%
	702	15% TAC ($F_{2013} \times 1.92$)	0.59	1 470	−4%	+15%

Weights in tonnes.
1) SSB 2015 relative to SSB 2014.
2) Catches 2014 relative to TAC 2013.

MSY approach

Because SSB in the beginning of 2014 is below MSY $B_{trigger}$, the ICES MSY approach implies a fishing mortality of $F_{MSY} \times SSB_{2014}$/MSY $B_{trigger}$ of 0.23. This results in catches of no more than 314 tonnes in 2014. This is expected to lead to an SSB of 1860 t in 2015. All catches are assumed to be landed.

Following the transition to the MSY approach implies a fishing mortality of $0.2 \times F_{2010} + 0.8 \times (F_{MSY} \times SSB_{2014}$/MSY $B_{trigger})$ of 0.26. This results in catches of no more than 353 tonnes in 2014. This is expected to lead to an SSB of 1820 tonnes in 2015. All catches are assumed to be landed.

Precautionary approach

The fishing mortality in 2014 should be no more than F_{pa}, corresponding to landings in 2014 of no more than 396 tonnes. This is expected to lead to an SSB of 1780 tonnes in 2015.

Additional considerations

Between 2010 and 2012 the advice was based on an F_{MSY} of 0.38. This reference point was based on several standard stochastic simulations. Nevertheless, the input data are quite variable and uncertain for this stock, and not least the growth parameters, leading to high F_{MSY} compared to other neighbouring sole stocks. Furthermore, the ICES MSY approach as outlined in Section 1.2 “General context of ICES advice” states that F_{MSY} cannot be higher than F_{pa}. Therefore ICES decided to provisionally apply a F_{MSY} equal to the formerly estimated F_{pa} of 0.30 pending a future revision of reference points.

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.

The cod stock in the Kattegat is depleted and any bycatches of cod in the mixed fishery for sole should be avoided.

Changes in fishing technology and fishing patterns

The SELTRA trawl was introduced in 2011 to protect cod. This trawl is likely less efficient on sole compared to previous trawl types; catch rates of sole are therefore expected to decrease with the SELTRA trawl.

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 of sole.

Spatial and temporal fishing area closures were implemented in the Kattegat in January 2009 to reduce fishing mortality on cod. This closure may influence the effort distribution on sole, and effects of the spatial restrictions on the sole stock are unclear.

Regulations and their effects

The management area includes Division IIIa plus the Belts (Subdivisions 22–24). Danish vessel quota shares cover the whole management area and there is therefore no incentive to misreport sole between Division IIIa and 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. However, only one commercial tuning fleet is available for 2012; the two remaining commercial fleets ceased in 2007 and 2008 and the survey was last conducted in in 2011. The assessment model assumes uncertainty associated to all input data, including the catch-at-age information.

Discard data are not included in the assessment but are low.

Sampling of landings is complicated by the small total landings which are dispersed spatially. This affects the quality of the input data.

Uncertainties in assessment and forecast

The discontinuation of Cooperative Fishermen–DTU Aqua sole survey in 2012 increased the assessment uncertainty especially with regard to recruitment estimations. The survey was the only source for recruitment observations (ages 1 and 2) and after the cease of these measurements only port landings of age 2 constitute recruitment input. Ages 2 in the landings are considered a poor indicator due to changes in selectivity in the fishery.

Comparison with previous assessment and advice

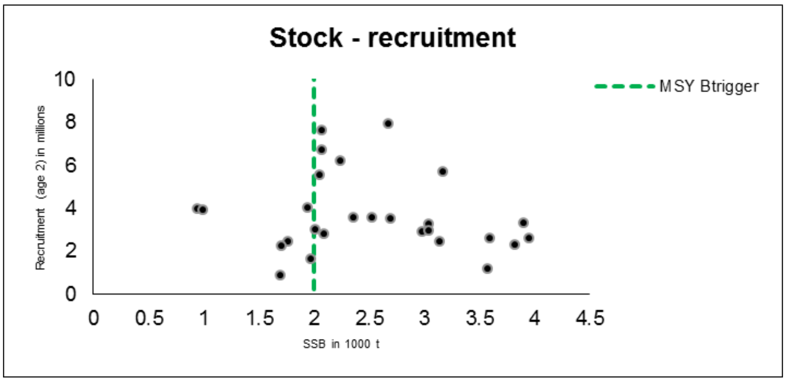
This year's assessment of SSB_{2012} is 16% lower and F_{2011} is estimated to be 19% lower than the assessment results last year.

This year the basis for the advice is the same as last year: the MSY approach, but the F_{MSY} has been changed.

Sources

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. 2013. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 10–17 April 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:10.



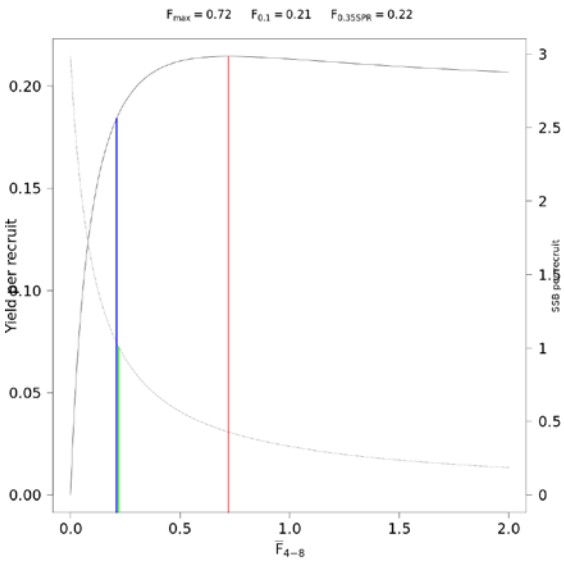


Figure 6.4.26.3 Sole in Division IIIa and Subdivisions 22–24. Stock–recruitment (left) and yield-per-recruit analysis plot (right). The vertical lines represent biological reference points.

Table 6.4.26.1 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]	0.36
2013	MSY framework	0.56	0.59	
2014	MSY approach	0.353		

Weights in thousand tonnes.
[1)] Uncertain.
[2)] TAC applies to Division IIIa and the EC waters of Divisions IIIb and IIIc, d.
[3)] Landings include Division IIIa and Subdivisions 22–24.
[4)] No more than 461 t in Division IIIa.

Table 6.4.26.2 Sole in Division IIIa and Subdivisions 22–24. Official landings (tonnes) and ICES corrections. For Sweden there is no information available between 1962 and 1974.

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Working Group	Total
	Kattegat	Skagerrak	Belts	Skag+Kat	Kat+Belts	Skagerrak	Skagerrak	Corrections	
1952	156			51	59				266
1953	159			48	42				249
1954	177			43	34				254
1955	152			36	35				223
1956	168			30	57				255
1957	265			29	53				347
1958	226			35	56				317
1959	222			30	44				296
1960	294			24	83				401
1961	339			30	61				430
1962	356				58				414
1963	338				27				365
1964	376				45				421
1965	324				50				374
1966	312				20				332
1967	429				26				455
1968	290				16				306
1969	261				7				268
1970	158	25							183
1971	242	32			9				283
1972	327	31			12				370
1973	260	52			13				325
1974	388	39			9				436
1975	381	55		16	16		9	-9	468
1976	367	34		11	21	2	155	-155	435
1977	400	91		13	8	1	276	-276	513
1978	336	141		9	9		141	-141	495
1979	301	57		8	6	1	84	-84	373
1980	228	73		9	12	2	5	-5	324
1981	199	59		7	16	1			282
1982	147	52		4	8	1	1	-1	212
1983	180	70		11	15		31	-31	276
1984	235	76		13	13		54	-54	337
1985	275	102		19	1	+	132	-132	397
1986	456	158		26	1	2	109	-109	643
1987	564	137		19		2	70	-70	722
1988	540	138		24		4			706
1989	578	217		21	7	1			824
1990	464	128		29		2		427	1050
1991 [1]	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 [2]	645
2001 [1]	249	286	21	25				-103 [2]	478
2002 [3]	360	177	18	15	11			281	862
2003 [3]	195	77	17	11	17			301	618
2004 [3]	249	109	40	16	18			392	824
2005 [3]	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
2012	154	140	28	30	0	6	0		358

[1] Considerable non-reporting assumed for the period 1991–1993.

[2]Catches from Skagerrak were reduced by these amounts because of misreporting from the North Sea. The subtracted amount has been added to the North Sea sole catches. Total landings for these years in Division IIIa have been reduced by the amount of misreporting.

[3]Assuming misreporting rates at 50%, 100%, 100%, and 20% in 2002–2005, respectively.

Table 6.4.26.3 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.

Year	Recruits	Low	High	SSB	Low	High	F4–8	Low	High
1984	2481	1255	4908	945	731	1221	0.4	0.296	0.539
1985	4655	2616	8284	1001	763	1314	0.36	0.264	0.492
1986	3967	2327	6761	1950	1507	2524	0.386	0.296	0.503
1987	3899	2428	6262	2053	1663	2534	0.429	0.336	0.548
1988	3999	2501	6396	2078	1692	2551	0.411	0.322	0.525
1989	5518	3442	8847	2074	1706	2520	0.435	0.345	0.547
1990	7627	4659	12485	2676	2191	3268	0.427	0.339	0.538
1991	6704	4202	10695	3179	2600	3886	0.479	0.385	0.596
1992	7915	4821	12994	3953	3264	4788	0.533	0.42	0.675
1993	5661	3528	9082	3907	3189	4785	0.547	0.43	0.696
1994	2583	1571	4247	3826	3211	4560	0.503	0.408	0.62
1995	3299	2081	5230	3577	3017	4242	0.508	0.409	0.632
1996	2272	1427	3616	3050	2577	3608	0.458	0.371	0.564
1997	1167	680	2003	2532	2130	3009	0.427	0.345	0.529

1998	3232	2046	5106	1774	1483	2123	0.405	0.326	0.504
1999	3561	2242	5658	2363	1955	2856	0.374	0.3	0.465
2000	2424	1518	3871	2246	1858	2714	0.351	0.282	0.438
2001	3545	2252	5580	2017	1675	2430	0.31	0.24	0.399
2002	6205	3608	10672	2701	2217	3291	0.334	0.266	0.42
2003	3002	1833	4915	2989	2478	3607	0.324	0.252	0.417
2004	3488	2262	5377	3144	2624	3767	0.356	0.282	0.45
2005	2901	1902	4425	3604	2989	4346	0.386	0.306	0.487
2006	2411	1582	3674	3042	2531	3657	0.382	0.303	0.48
2007	2599	1694	3988	2097	1759	2501	0.377	0.299	0.475
2008	2941	1873	4619	1708	1411	2067	0.407	0.314	0.526
2009	2784	1647	4704	1978	1612	2426	0.351	0.273	0.45
2010	2214	1323	3704	1699	1373	2104	0.353	0.273	0.456
2011	1606	923	2794	1688	1347	2116	0.316	0.239	0.418
2012	862	276	2689	1639	1277	2103	0.309	0.227	0.421
2013	2784			1338					

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

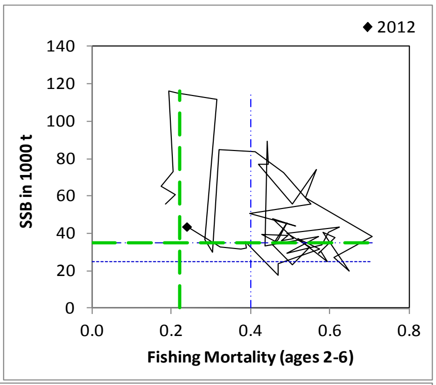
Advice for 2014

ICES advises on the basis of stage one the EU management plan (Council Regulation No. 676/2007) that landings in 2014 should be no more than 11 900 tonnes. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	✓	✓	✓	Harvested sustainably
Management plan (F_{MP})	✓	✓	✓	Appropriate

SSB (Spawning-Stock Biomass)	2011	2012	2013	
MSY ($B_{trigger}$)	✗	✓	✓	Above trigger
Precautionary	○	✓	✓	Full reproductive



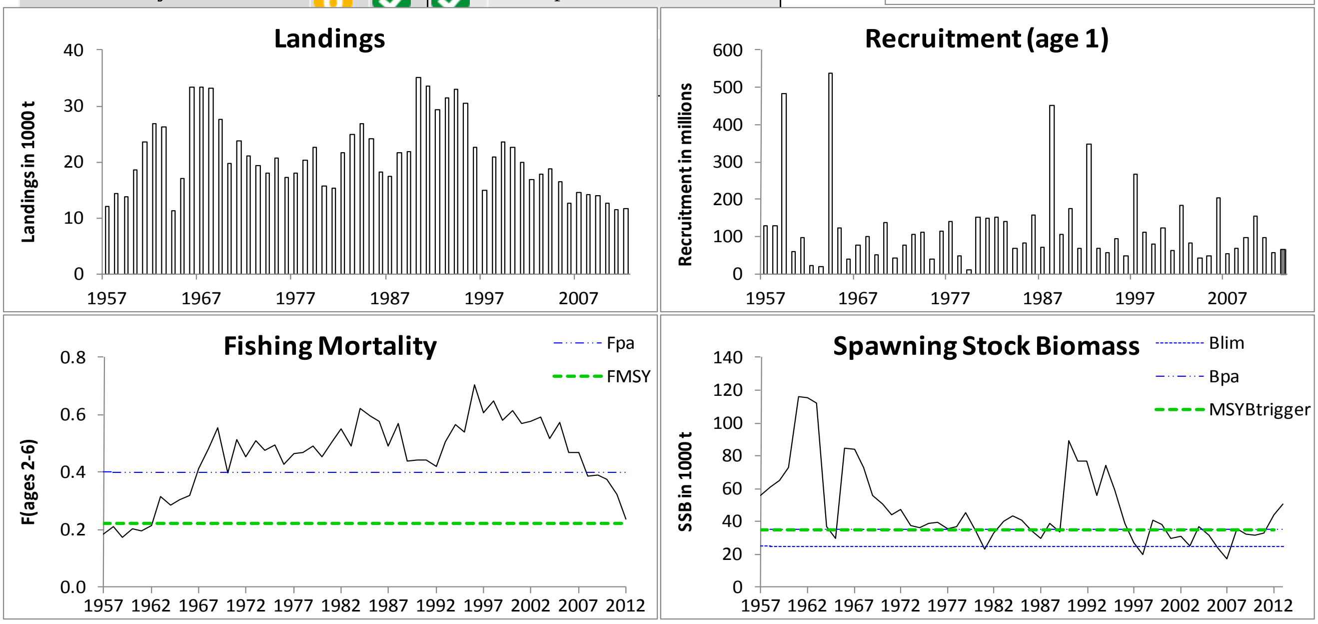


Figure 6.4.27.1 Sole in Subarea IV (North Sea). Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F for the time series used in the assessment.

SSB has fluctuated around the precautionary reference points for the last decade and is estimated to be well above B_{pa} in 2013. Fishing mortality has shown a declining trend since 1995 and is estimated to be close to Fmsy in 2012.

Management plans

There is a two-stage management plan for North Sea sole and plaice (Council Regulation (EC) No. 676/2007, see Annex 6.4.27). An evaluation of the plan (ICES, 2010) concluded that the management plan is precautionary. The stocks are presently in stage two of the plan; implementation of this second stage (as stipulated in article 5 of the EC regulation) is not yet defined.

Biology

Sole is a long lived flatfish species and can reach an age of over 40 years. Sole is a nocturnal predator and therefore more susceptible to capture by fisheries at night than in daylight. The North Sea is the most northern border of the distribution of this species. In cold winters it withdraws to the deeper, warmer waters of the Southern North Sea. The main spawning takes place in the second quarter in coastal areas close to the nurseries. The main diet of sole consists of worms and small soft-shelled bivalves. The large fluctuation in the stock are caused by exceptional strong year classes, which occasionally occur.

Environmental influence on the fish

Large mortality of adult fish has been observed in extremely cold winters (1963) if the water temperature drops below 3 degrees.

The fisheries

Sole is mainly caught by the beam-trawl fleet working with 80 mm mesh mixed with other species. An increasing proportion of the traditional beam trawl fleet is switching to sumwing and/or pulse trawl. Other directed fisheries for sole are carried out with gill nets and otter trawls. Bycatches of sole in other fisheries are small.

Catch distribution	Total catches are unknown. Landings (2012) = 11.6 kt, 83.8% beam trawl, 13.6% gill / trammel nets, 2.2% otter trawl, 0.4% other). Total discards estimates are not available

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. The commercial data used to tune the assessment may be biased due to gradual changes in gear composition, with different catchability, used in this fishery (puls trawl, sum wing). Data on the type of gear used is needed in logbooks. Discard are not included in the assessment as time series are not available yet.

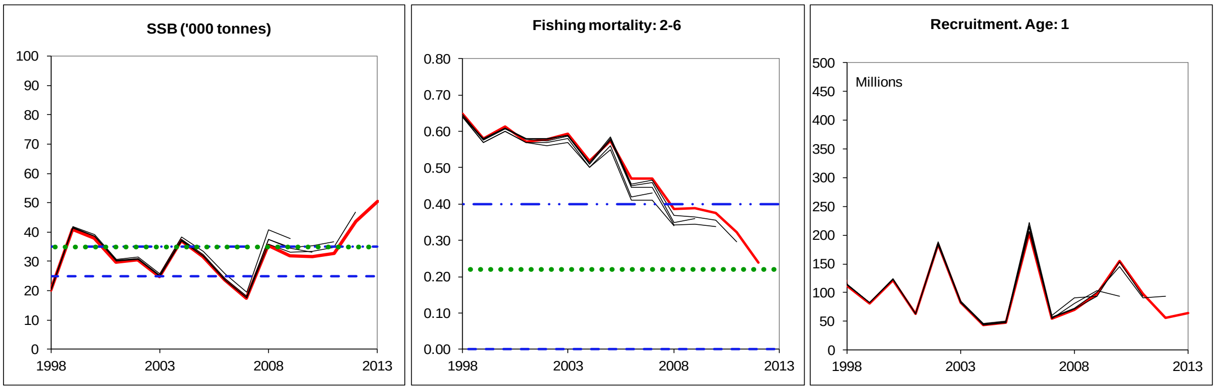


Figure 6.4.27.2 Sole in Subarea IV (North Sea). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (XSA).
Input data	Commercial catches (international landings, age frequencies from catch sampling),

	two survey indices (BTS-ISIS Q3, SNS Q3), one commercial index (NL TBB, all year). Natural mortality is assumed constant. Maturity at age is assumed to be knife edged (at age 3)
Discards and bycatch	Discards not included in the assessment but available for monitoring (TBB, OTB)
Indicators	None.
Other information	Benchmarked February 2010 (WKFLAT). A benchmark is proposed for 2015.
Working group report	WGNSSK (ICES, 2013a)

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 2014

Basis: F (2013) = mean (F2010–2012) scaled to 2012 =0.24; SSB (2014) =48.151; R (2014)= 94.1 million =GM(1957–2010); Landings (2013) =12.757.

Rationale	Landings (2014)	Basis	F landings (2014)	SSB (2015)	%SSB change 1)	%TAC change 2)
Management plan	11.900	15% TAC reduction	0.24	46.070	-4%	-15%
MSY approach	11.190	F_{MSY}	0.22	46.822	-3%	-20%
Precautionary approach	18.533	F_{pa}	0.40	39.087	-19%	+32%
Zero catch	0	F = 0	0.00	58.674	22%	-100%
Other options	10.282	Management F target	0.20	47.782	-1%	-27%
	11.900	TAC-15% (F_{2013})	0.24	46.070	-4%	-15%
	14.000	Stable TAC (F_{2013}*1.2)	0.29	43.847	-9%	0
	16.100	TAC+15% (F_{2013}*1.4)	0.34	41.702	-13%	+15%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b)						
Maximum	17.576	A	0.38	40.002	-17%	+26%
Minimum	6.420	B	0.12	51.775	+8%	-54%
Cod_MP	6.424	C	0.12	51.772	+8%	-54%
SQ effort	12.040	D	0.24	45.835	-5%	-14%
Effort_Mgt	11.869	E	0.24	46.015	-4%	-15%

Weights in thousand tonnes.

1) SSB 2015 relative to SSB 2014.

2) Human Consumption landings 2014 relative to TAC 2013.

Mixed fisheries assumptions

Maximum scenario: Fleets stop fishing when last quota exhausted

Minimum scenario: Fleets stop fishing when first quota exhausted

Cod management plan scenario: Fleets stop fishing when cod quota exhausted

SQ effort scenario: Effort in 2013 and 2014 as in 2012

Effort management scenario: Effort reductions according to cod and flatfish management plans

Management plan

Both the North Sea plaice and sole stocks have been within safe biological limits in the last two years. According to the management plan (Article 3.2), this signals the end of stage one. 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).

Following the EU multiannual plan stage 1 (as rules relating to the setting of F for stage 2 are not yet defined) would imply a 10% reduction of F to 0.21, which results in a TAC (landings) reduction of more than 15%. Therefore, the maximum TAC reduction of 15% is applied, resulting in landings of no more than 11 900 t in 2014. This is expected to lead to an SSB of 46 070 t in 2015. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

ICES has evaluated the plan and considers it to be precautionary (ICES, 2010).

MSY approach

Following the ICES MSY approach implies fishing mortality to be reduced to 0.22 (F_{MSY}, as SSB 2012 > MSY $B_{trigger}$), resulting in landings of 11 194 t in 2014. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated. This is expected to lead to an SSB of 46 916 t in 2015.

Given that the current (2012) estimate of fishing mortality is close to FMSY there is no need to follow a transition scheme towards this reference value.

Precautionary approach

The F_{pa} for North Sea sole is 0.4. This would lead to landings of 18 540 t in 2014 and an SSB of 39 175 t in 2015. Discards are known to take place but cannot be quantified, therefore total catches cannot be calculated.

Mixed fisheries

In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings 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 and eastern channel demersal fisheries in 2014. 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 entered into the SSB in 2012, is above average.

The decline in the fishing mortality starting in the mid-2000s coincides with a reduction of capacity in the beam-trawl fleet. High fuel prices may have contributed to the decrease in effort and, consequently, of fishing mortality.

The assumption of status quo fishing mortality in 2013 in the forecast indicates that the TAC for 2013 will not be taken. The TAC for sole has not been fully utilized in 2010, 2011 and 2012, and in the last 3 years effort limitations have not been restrictive.

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 2013.

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). The impact of fishing since then has probably reduced by considerable reduction in effort and a change to different gears. Continuous 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.

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: a recovery plan during its first stage and a management plan during its second stage. Objectives are defined for these two stages, rebuilding the stocks to within safe biological limits in the first and exploiting the stocks at MSY in the second. 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 an impact assessment and 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. The 2012 and 2013 estimates are well above B_{pa} (43 kt and 39 kt). .Consequently, ICES concludes that the objectives of stage 1 are currently met and provides advice based on the plan's TAC-setting procedure, acknowledging the stock 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 0.21 for sole) as well as an increase in fishing mortality for plaice.

In 2012, ICES evaluated a proposal by the Netherlands for an amended management plan, which could serve as the 'stage 2' plan (Coers *et al*. 2012). The amendments included changing the target F for sole to 0.25 and to cease reductions of effort. ICES concluded that the plan – subject to those amendments –is consistent with the precautionary approach and the principle of maximum sustainable yield (ICES, 2012b). However, implementation of stage two of the plan is not yet defined.

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. 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.

The current sole and plaice long-term management plan (Council Regulation (EC) No. 676/2007) also specifically reduces effort as a management measure, affecting BT2 and occasionally trammelnet (GT1) gears since the implementation of the plan. Effort ceilings are updated annually. However, for 2013, the European Council decided upon a roll-over of effort level of 2012 into 2013 for both the cod and the sole/plaice management plans.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill- and trammelnets, and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel has been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, −16% between 2008 and 2012). Effort by the beam trawl fleet in small mesh size (80–120 mm, BT2) has shown a sharp decline (−45% between 2003 and 2012), while effort in large mesh size (≥120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline.

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 derogation licenses for Pulse trawls were taken into operation, which increased to 42 in 2012. Debate is ongoing in the EU about extensions of an additional 42 derogation licenses as well as possible amendments to EU regulations which would permanently legalize the use of pulse gears. ICES concluded that pulse trawls experienced reduced catch rates (kg/hr) of undersized sole, compared to standard beam trawls (ICES, 2006). Catch rates of sole above the minimum landings size from research vessel trials were higher but the commercial feasibility study suggested lower catch rates. The introduction of innovative gears may lead to changes in how the ecosystem is impacted by the plaice and sole targeting fleet. Because of the lighter gear and lower towing speed, pulse vessels generate a lower swept-area per hour and reduced bycatch of benthic organisms. The new gears may change fishing patterns as well.

ICES responded to a request by France on the use of the Pulse trawl (ICES, 2012a) and concluded that the introduction of electric pulse systems could significantly reduce fishing mortality of target and non-target species, including benthic organisms, assuming there is no corresponding increase in unaccounted (avoidance) mortality. However, not all relevant issues (such as delayed mortality and long-term population effects) have been fully studied and ICES therefore considers that the available data are insufficient to recommend the large-scale use of the electric pulse trawl in fisheries.

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 2012 (Napier, 2012; Figure 6.4.27.4). Overall, about one-third of respondents (35%) reported that sole were ‘more’ abundant in 2012, a higher proportion than 2011 (24%). Most fishermen had the perception that the recruitment was “Moderate” (53%). The overall perceptions of the fishing industry reflect a more positive impression of the trends in the sole stock than estimated by ICES.

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

Uncertainties in the assessment and forecast

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

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

The SNS survey in 2012 was conducted two weeks later and with a different vessel (Tridens) than usual (ISIS), because the ISIS was unavailable due to technical problems. The 2012 SNS datapoint was also the lowest in the timeseries and was not consistent with the BTS survey for all ages. An exploratory analysis was done with additional data from a German survey in the German bight. This survey also showed different trends than the BTS, and was more consistent with the SNS. Therefore it was concluded that the SNS datapoint should be kept in the analysis.

Comparison of previous assessment and advice

The 2013 assessment is in very close agreement with that of 2012. As last year, the advice is based on the EU management plan.

Sources

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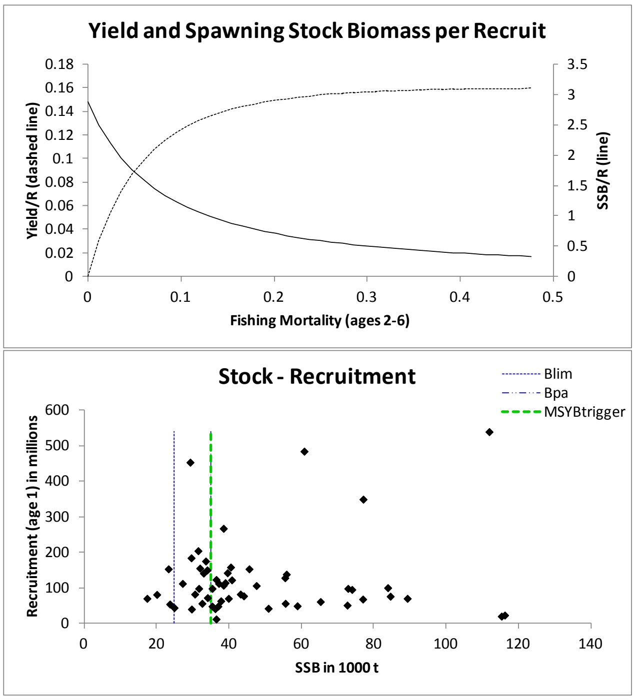


Figure 6.4.27.3 Sole in Subarea IV (North Sea). Stock–recruitment and yield-per-recruit analysis plot.

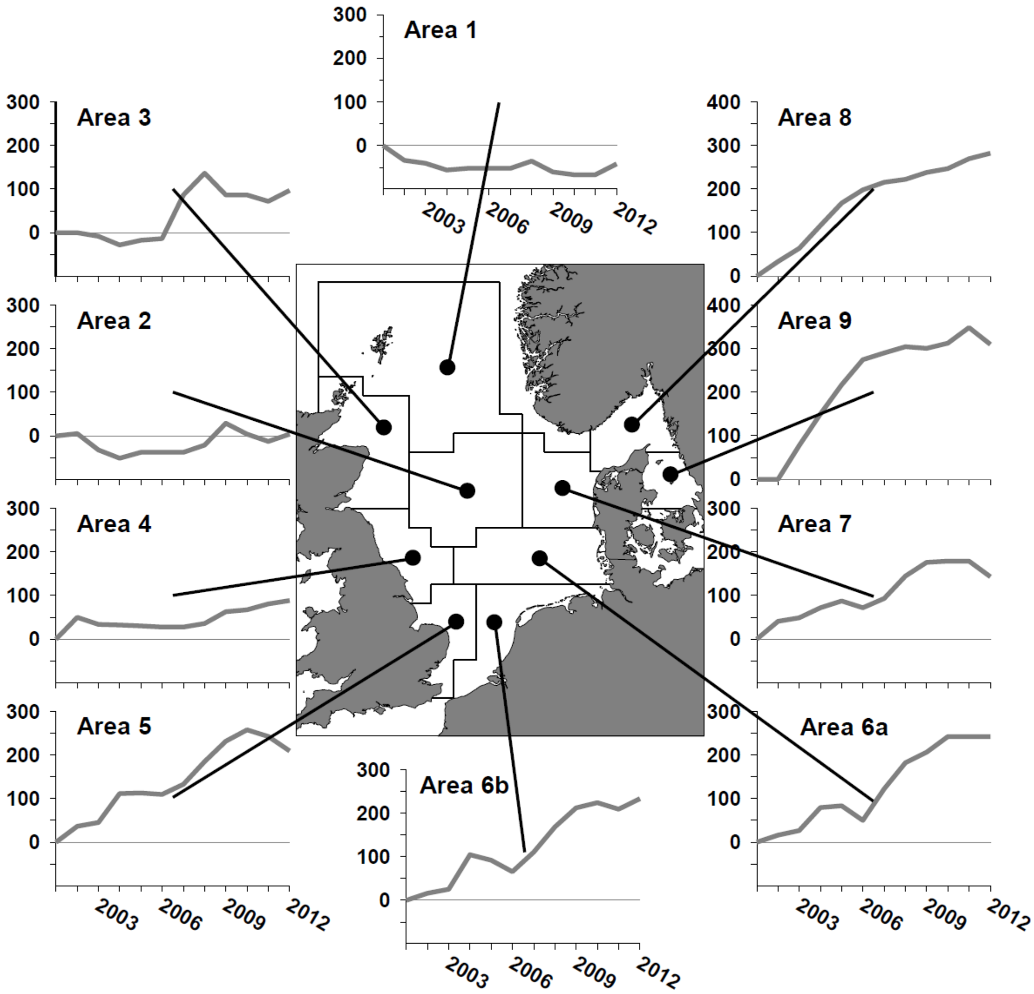


Figure 6.4.27.4 Sole in Subarea IV (North Sea). Results of North Sea Commission fisher's survey 2012 (Napier, 2012).

Table 6.4.27.1 Sole in Subarea IV (North Sea). ICES advice, management, and landings.

Year	ICES Advice	Predicted landings 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;	11.0	14.0	13.4	21.6
1989	Increase SSB towards 50 000 t;	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	26.0	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	33.0
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	15.0
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	22.0	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	16.0	16.9
2003	$F< F_{pa}$	<14.6	15.9	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	17.7	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	<15.7	16.2	11.8	11.6
2013	Apply first stage of the	<14	14.0		
2014	Apply first stage of the management plan	<11.900			

Weights in thousand tonnes.

[1] Catch *status quo* F.

Table 6.4.27.2 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
2012	593	418	633	416	9089	599	3	11752	-142	11610	16200

Table 6.4.27.3 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	128371	55489	12067	0.185
1958	127931	60836	14287	0.209
1959	484247	65349	13832	0.173
1960	60767	72927	18620	0.204
1961	98206	116183	23566	0.194
1962	22509	115319	26877	0.215
1963	20440	111935	26164	0.316
1964	538666	36463	11342	0.284
1965	122937	29722	17043	0.305
1966	40156	84590	33340	0.319
1967	75765	83922	33439	0.412
1968	100019	72685	33179	0.484
1969	51165	55893	27559	0.553
1970	138343	50910	19685	0.397
1971	42367	44054	23652	0.514
1972	76712	47575	21086	0.454
1973	105971	37205	19309	0.509
1974	111571	36236	17989	0.477
1975	41341	38981	20773	0.495
1976	114354	39570	17326	0.427
1977	141807	35367	18003	0.464
1978	47993	36546	20280	0.470
1979	11840	45617	22598	0.491
1980	153486	34000	15807	0.455
1981	149544	23311	15403	0.506
1982	152556	33029	21579	0.550
1983	140856	39890	24927	0.490
1984	70394	43218	26839	0.624
1985	81523	40499	24248	0.596
1986	158271	34059	18201	0.579
1987	71930	29313	17368	0.491
1988	452837	38474	21590	0.571
1989	106703	33614	21805	0.437
1990	174849	89327	35120	0.441
1991	69567	77127	33513	0.443
1992	349071	76985	29341	0.419
1993	68424	55574	31491	0.506
1994	56389	73988	33002	0.566
1995	94962	58877	30467	0.539
1996	48824	38528	22651	0.705
1997	267465	27203	14901	0.609
1998	112053	20091	20868	0.648
1999	80949	40811	23475	0.581
2000	121643	37840	22641	0.613
2001	62656	29550	19944	0.571
2002	183935	30599	16945	0.578
2003	81546	24896	17920	0.593
2004	43974	36999	18757	0.518
2005	48353	31466	16355	0.573
2006	203831	23675	12594	0.470
2007	54421	17398	14635	0.470
2008	69705	35354	14071	0.387
2009	98360	31968	13952	0.389
2010	154732	31729	12603	0.375
2011	97535	32567	11485	0.322
2012	56069	43748	11610	0.238
2013	64976*	50546		
Average	123208	48331	21211	0.455

* RCT3 estimate

Annex 6.4.27

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:

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:
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;
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.
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.
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 2015

ICES advises on the basis of the transition to the MSY approach that catches in 2014 should be no more than 3251 tonnes. All catches are assumed to be landed.

Stock status

	Fishing pressure			
	2010	2011	**2012**	
MSY (F_{MSY})	✗	✗	✗	Above target
Precautionary approach (F_{pa},F_{lim})	O	O	O	Increased risk
	SSB (Spawning-Stock Biomass)			
	2011	2012	**2013**	
MSY ($B_{trigger}$)	✓	✓	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	✓	✓	Full reproductive capacity

Figure 6.4.28.1 Sole in Division VIId (Eastern Channel). Summary of stock assessment (weights in thousand tonnes). Assumed values are shaded.Top right: SSB and F for the time series used in the assessment.

The spawning-stock biomass has fluctutated without trend and is above MSY $B_{trigger}$ since 2002. Fishing mortality has always been above FMSY, and has been above F_{pa} since 2005. Recruitment has been fluctuating without trend.

Management plans

No specific management objectives are known to ICES.

Biology

Sole is a long lived flatfish species and can reach an age of over 40 years. Sole is a nocturnal predator and therefore more susceptible to capture by fisheries at night than in daylight. The main spawning takes place in the second quarter in coastal areas close to the nurseries. The main diet of sole consists of worms and small soft-shelled bivalves, The large fluctuation in the stock are caused by exceptional strong year classes, which occasionally occur.

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 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 (2012) = 4047 t, (30% beam trawls, 49% trammel/gill nets, 18% otter trawls, and 3% other gears). Observations suggest discards are less than 5%.

Effects of the fisheries on the ecosystem

The mixed sole and plaice fishery by beam and otter trawls with a mesh size of 80 mm, has a physical impact on the seabed. Bottom trawling impacts biomass, production, and species richness. Bycatch of both commercial and non-commercial species with this mesh size leads to discarding, especially for small plaice.

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.

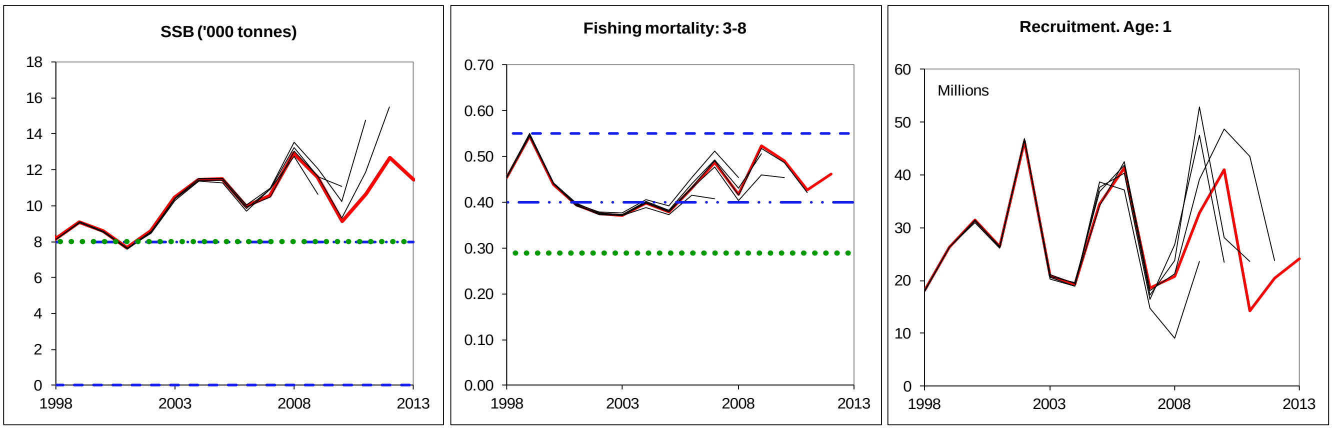


Figure 6.4.28.2 Sole in Division VIId (Eastern Channel). Historical assessment results (final year recruitment estimates included).

Scientific basis

Assessment type	XSA age-based analytical assessment .
Input data	Commercial catches: international landings, ages and length frequencies from catch sampling by metier, 3 survey indices: UK(E&W)-BTS ,UK(E&W)-YFS, and FR-YFS 2 commercial indices: BE-CBT and UK(E&W)-CBT, natural mortality is assumed to be constant, maturity at age is assumed to be knife edged
Discards and bycatch	Discards not included in the assessment, considered negligible but available for monitoring: Belgium beam trawl fleet, UK(E&W) and French otter traw Gill net and Trammel net fleets
Indicators	None.

Other information	This stock was benchmarked in 2009.
Working group report	WGNSSK (ICES, 2013a)

6.4.28 Supporting Information June 2012

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 2014

Basis: F(2013) = mean(F2010–2012) = 0.46; R(2014) = GM(1982–2010) = 24 101; Catches (2013) = 4752 (no discards); SSB(2014) = 10 181.

Rationale	**Catches (2014)**	**Basis**	**F(2014)**	**SSB(2015)**	**%SSB change [1)]**	**%TAC Change [2)]**
MSY transition	3251	(F_{2010}*0.2)+(F_{MSY}*0.8)	0.33	10 951	+8%	-45%
Precautionary approach	3803	F_{pa}	0.40	10 389	+2%	-36%
Zero catch	0	F=0	0.00	14 290	+40%	-100%
Other options	2894	F_{MSY}	0.29	11 319	+11%	-51%
	4264	F_{2013}	0.46	9918	-3%	-28%
	5015	TAC -15% (F_{2013}*1.23)	0.57	9151	-10%	-15%
	5900	Stable TAC (F_{2013}*1.53)	0.71	8249	-19%	0%
	6785	TAC +15% (F_{2013}*1.88)	0.87	7349	-28%	15%
Mixed fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b)						
Maximum	5858	A	0.70	8271	-19%	-1%
Minimum	2359	B	0.23	11 852	+16%	-60%
Cod_ MP	2365	C	0.23	11 845	+16%	-60%
SQ effort	4266	D	0.46	9897	+3%	-28%
Effort_Mgt	3873	E	0.41	10 299	+	-34%

					1%	

Weights in tones.
1) SSB 2015 relative to SSB 2014.
2) Landings 2014 relative to TAC 2013.

Mixed Fisheries assumptions:
Maximum scenario: Fleets stop fishing when the last quota is exhausted.
Minimum scenario: Fleets stop fishing when the first quota is exhausted.
Cod management plan scenario: Fleets stop fishing when the cod quota is exhausted.
SQ effort scenario: Effort in 2012 and 2013 as in 2011.
Effort management scenario: Effort reductions according to cod and flatfish management plans.

MSY approach

Following the ICES MSY approach implies fishing mortality to be reduced to 0.29 resulting in catches of less than 2894 t in 2014. This is expected to lead to an SSB of 11 319 t in 2015.

Following the transition scheme towards the ICES MSY approach implies that (F_{2010}*0.2) + (0.8*F_{MSY}) is 0.32, resulting in catches of less than 3251 t in 2014. This is expected to lead to an SSB of 11 054 t in 2015. Discards are not taken into account, but are considered to be small and all catches are assumed to be landed.

Precautionary approach

The fishing mortality in 2014 should be no more than F_{pa}, corresponding to catches of less than 3803 t in 2014. This is expected to keep SSB well above B_{pa} in 2015. All catches are assumed to be landed.

Mixed fisheries

This is the first year this stock is included in the mixed fisheries assessment for the North Sea. In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the main limiting species for the North Sea and eastern channel demersal fisheries in 2014. Following the ‘cod’ scenario (full implementation of the cod management plan), the sole VIId catch option could not be fully utilized. It is also noted that for the ‘max’, ‘SQeffort’ and ‘Effort_Mgt’ scenario the implied F would exceed F_{pa} which is not considered precautionary.

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).

Fishing effort regulations for cod have so far not been restrictive for the sole fisheries.

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

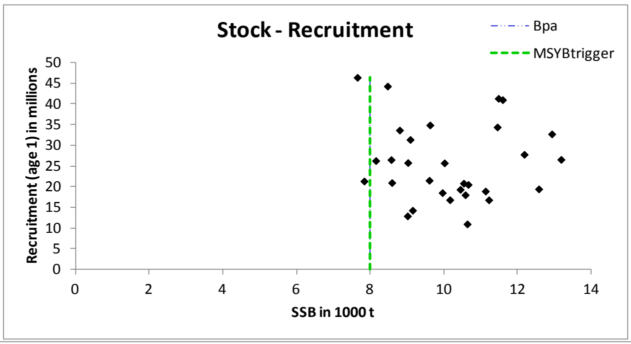
Under-reporting from the inshore fleets and area misreporting into Division VIId by beam trawlers fishing in VIIe was significant, but these are now less of an issue since UK introduced a single area licence scheme at the end of 2008. Historical landings have been adjusted for misreporting between the 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 Young Fish survey showes a much higher uncertainty in the recruitment estimates than prior to 2009 when it was a combined survey over the entire area.

Comparison with previous assessment and advice

The current assessment has revised the value of SSB in 2011 downward by 10%. The estimate of fishing mortality in 2011 was revised upward by 2%. Past recruitment estimates were subject to considerable annual revision. The 2010 year class has been revised downward in this year's assessment by 67% and the assumed mean for the incoming 2011 year class in last year's assessment has now been revised downward by 14%. As last year, the basis for the advice is the transition to the MSY approach.

Source

ICES. 2013a. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 24–30 April 2013. ICES CM 2013/ACOM:13.
ICES. 2013b Mixed fisheries advice North Sea. Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.3.2.



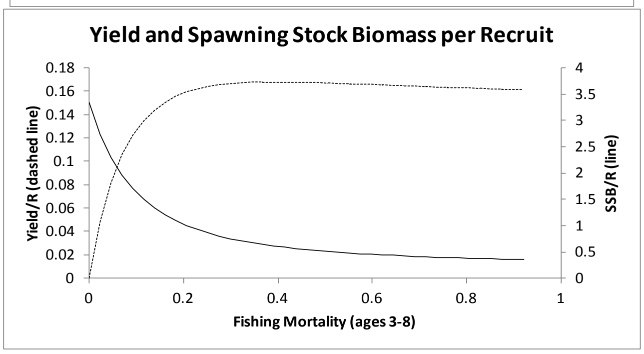


Figure 6.4.28.3 Sole in Division VIId (Eastern Channel). Yield-per-recruit analysis and stock–recruitment plot.

Table 6.4.28.1 Sole in Division VIId (Eastern Channel). ICES advice, management, landings and catches.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ICES Catches
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	4.0	4.0
2013	MSY Transition	<5.90	5.900		
2014	MSY Transition	<3.251			

Weights in thousand tonnes.

Table 6.4.28.2 Sole in Division VIId (Eastern Channel). Landings (tonnes) as officially reported to ICES and ICES estimates (catches and landings are assumed to be the same).

Year	Belgium	France	UK(E+W)	others	Official landings	Unallocated*	ICES Catch	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
2012	920	2475	**	623	0.25	4018	29	4047	5580

* Unallocated mainly due to misreporting
** Preliminary

Table 6.4.28.3 Sole in Division VIId (Eastern Channel). Summary of stock assessment. (catches and landings are assumed to be the same).

Year	Recruitment Age 1 thousands	SSB tonnes	Catches tonnes	Mean F Ages 3-8
1982	12738	7835	3190	0.3542
1983	21346	9603	3458	0.4055
1984	21526	9012	3575	0.4303
1985	12913	10015	3837	0.3353
1986	25726	10634	3932	0.3908
1987	10981	9023	4791	0.5883
1988	25793	10163	3853	0.4286
1989	16817	8471	3805	0.5636
1990	44287	9623	3647	0.3791
1991	34888	8798	4351	0.4519
1992	33658	11220	4072	0.3703
1993	16801	13181	4299	0.3008
1994	26570	12576	4383	0.3534
1995	19442	11129	4420	0.3643
1996	18921	12182	4797	0.4718
1997	27791	10581	4764	0.5884
1998	18019	8152	3363	0.4533
1999	26284	9086	4135	0.5446
2000	31385	8569	3476	0.4387
2001	26516	7651	4025	0.3941
2002	46399	8588	4733	0.3742
2003	20968	10445	5038	0.3707
2004	19324	11451	4826	0.3987
2005	34403	11481	4383	0.3790
2006	41326	9959	4833	0.4313
2007	18538	10537	5166	0.4867
2008	20818	12931	4517	0.4182
2009	32733	11594	5266	0.5232
2010	41005	9150	4409	0.4909
2011	14282	10660	4133	0.4277
2012	10133*	12662	4047	0.4618
2013	24101**	11428		
Average	25213	10262	4243	0.4313

* Replaced by RCT3 estimates 20 512.

** Geometric mean recruitment (1982–2010)

6.4.29 **Advice June 2013**

ECOREGION **North Sea**

STOCK **Sprat in Division IIIa (Skagerrak – Kattegat)**

Advice for 01 July 2013 - 30 June 2014

Based on ICES approach to data-limited stocks, ICES advises that catches of sprat from July 2013 to June 2014 should be no more than 6787 tonnes. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)		
	2010–2012	
Qualitative evaluation	?	Insufficient information
SSB (Spawning Stock Biomass)		
	2011–2013	
Qualitative evaluation	?	Insufficient information

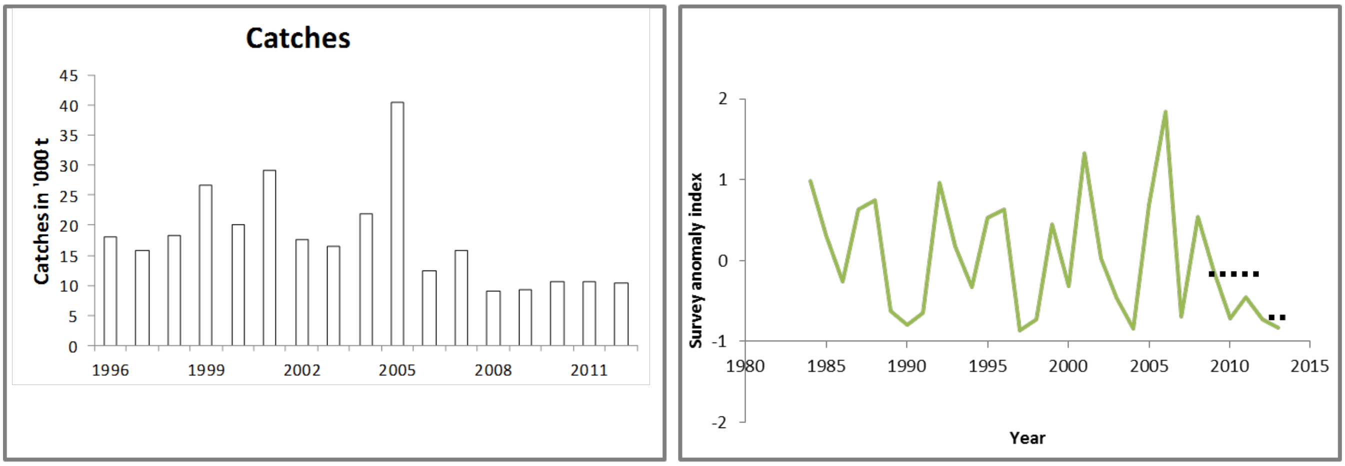


Figure 6.4.29.1 Sprat in Division IIIa (Skagerrak–Kattegat). ICES estimates of catches (in thousand tonnes, left panel). An index of stock trend is derived from the combination of three survey indices: the herring acoustic survey (HERAS) in June–July, the third quarter International Bottom Trawl Survey (IBTS), and the first quarter IBTS in the following year.

The combined survey index indicates lower abundance in the four most recent years. The exploitation status of the stock is unknown.

Management plans

No specific management objectives are known to ICES.

Biology

Sprat is a short-lived species with large annual natural fluctuations in recruitment and stock size.

Environmental influence on the stock

The specific effects of environmental variability on this stock are unknown. Sprat is one of the important prey species in the ecosystem, as prey for fish, marine mammals, and seabirds.

The fisheries

Sprat in Division IIIa is mainly fished together with juvenile herring bycatches and the exploitation of sprat is limited by the herring bycatch restrictions imposed on the fisheries. Two regulations limit the sprat trawl fishery in addition to the sprat TAC, one being the bycatch ceiling for herring and the other the herring bycatch percentage limit in industrial fisheries.

Catch distribution	Landings in 2012 were 10.4 kt: 3.5 kt in Skagerrak (IIIaN) and 6.9 kt in Kattegat (IIIaS).

Effects of the fisheries on the ecosystem

The sprat fishery in Division IIIa is mainly conducted 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

Even though the sampling intensity conforms to the DCF regulation, it does not provide a good enough representation of the fishery catches for use in an analytical assessment. Sampling intensity of commercial catches should be increased.

The advice is based on a combined abundance index from three surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available. Due to the sprat stock being concentrated mostly in some areas of Division IIIa, there are some concerns as to the accuracy of the available abundance indices for this population.

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 assessment.
Stock data category	Category 3.2.0
Input data	Three survey indices (HERAS, IBTS Q3, and IBTS Q1); Commercial landings.
Discards and bycatch	Discards are not included and assumed negligible.
Indicators	None.
Other information	For this short-lived stock, advice is given for the period of July to June of the following year.
Expert Group report	HAWG

ECOREGION North Sea

STOCK Sprat in Division IIIa (Skagerrak – Kattegat)

Reference points

No reference points are defined for this stock.

Outlook for July 2013 to June 2014

No analytical assessment can be presented for this stock; therefore, detailed management options cannot be presented.

ICES approach to data-limited stocks

In cases where an abundance index is available for data-limited stocks, ICES uses as harvest control rule an index-adjusted *status quo* catch. For this stock, the advice is based on a comparison of the most recent index value with the four preceding values, combined with recent catch or landings data. Knowledge about the exploitation status also influences the advised catch. For this stock, ICES compares the index value in the most recent year versus the four preceding years (instead of the more usual procedure of comparing the last two versus the three preceding years) to account for the fact that sprat in Division IIIa is a short-lived species.

For this stock the abundance is estimated to have decreased by 30% between 2009–2012 (average of four years) and 2013. This implies a 20% decrease in catches compared to average landings of the last three years. Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by a further 20% as a precautionary buffer. This results in catches of no more than 6787 tonnes during July 2013 to June 2014.

Additional considerations

Management considerations

Sprat is a short-lived species with a fishery dominated by 1- and 2-year-old fish. The advice, therefore, requires information about incoming 1-year-old fish. In order to meet this requirement and match the natural life cycle of sprat, the advice period has been shifted, relative to the calendar year, to a time-step going from July to June. Therefore, ICES is providing catch advice for the period July to June in the following year. This is also in line with the advice for sprat in the North Sea.

The advice period now used by ICES does not correspond to the TAC year, which is aligned with the calendar year. It is expected that aligning the TAC period to the ICES advice period will facilitate management. In the context of the TAC still applying to the 2013 calendar year, with a potential in-year revision, the following information could facilitate using the advice ICES is currently providing: on average during 2009–2011, 66% of the catch in the period going from July of that year to June of the following year was taken during July to December. Applying this percentage to the catch advised for July 2013–June 2014 (6787 t), it is expected that approximately 4480 t would be taken during July–December 2013.

A TAC of 41 600 t was agreed by the EU and Norway (Skagerrak–Kattegat Agreement) for 2013. This is substantially above the catch advice given by ICES.

Data and methods

The three survey indices identified by WKSPRAT 2013 (ICES, 2013b) for Division IIIa sprat showed the same trend and were combined into one common index. The IBTS Q1 age 1 is used as an indicator of age 1 abundance, whereas IBTS Q1 age 2, IBTSQ3 age 1 in the previous year, and HERAS age 1 in the previous year are used as indicators of age 2 abundance. Together, this provides an index of the sprat which will be age 1 and 2 in the beginning of July. These two age groups make up 77% of the catch biomass on average.

The above combined index for the two cohorts making up the majority of the catch was produced as a weighted average of the cohort-specific indices. The weights used were the average proportion of the weight of the catch which consisted of the particular age group over the past three years. With this method, the weights assigned to the two indices were 0.49 for the 1-winter ring index and 0.51 for the 2-winter ring index (see ICES, 2013b).

Using ICES approach to data-limited stocks, method 3.2.0 was applied to this stock using the combined survey index described above.

Comparison with previous assessment and advice

The advice this year is based on ICES approach to data-limited stocks, using information on stock catches and the combined survey index (ICES, 2013b). Last year, the advice was also based on ICES approach to data-limited stocks, but using only the information on stock catches.

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Table 6.4.29.1 Sprat in Division IIIa (Skagerrak–Kattegat). ICES advice, management, 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	801	80	63	9
1989	Lowest possible level; TAC for "mixed clupeoid" fishery	801	80	62	10
1990	Lowest possible level; TAC for "mixed clupeoid" fishery	601	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	33	27
2000	Limited by restriction on juvenile herring catches	-	50	28	20
2001	Limited by restriction on juvenile herring catches	-	50	43	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	22
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 12	16
2008	Limited by restriction on juvenile herring catches	-	52	12	9
2009	Same advice as last year	-	52	12	9
2010	Same advice as last year	-	52	13	11
2011	No advice [3]	-	52	13	11
2012	20% reduction in catches (last 3 years' average)[3]	< 8.2	52	144	10
2013	Reduce catch by at least 36% compared to the average catch of the last 3 years	< 6.787 [5]	41.600		

Weights in '000 t.

[1] TAC applies to all species in "mixed clupeoid" catches and to the calendar year.

[2] Includes other species in "mixed clupeoid" catches.

[3] Limited by restriction on juvenile herring catches.

[4] To be updated by HAWG in 2014.

[5] Advice for July 1st 2013 to June 30th 2014.

Table 6.4.17.2 Sprat in Division IIIa (Skagerrak–Kattegat). Landings in thousand tonnes by country and calendar year 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
2012	1.7	1.3	0.5	3.5	6.7	0.2	6.9	10.4

* < 50 t

6.4.30 **Advice May 2013**

ECOREGION **North Sea**

STOCK **Sprat in Subarea IV (North Sea)**

Advice for July 2013 - June 2014

ICES advises on the basis of the MSY approach that catches of sprat from July 2013 to June 2014 should be no more than 144 000 t. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
Qualitative evaluation	✔	✔	✔	Below provisional F_{MSY} proxy

SSB (Spawning Stock Biomass)	2011	2012	2013	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	✔	✔	✔	Full reproductive capacity

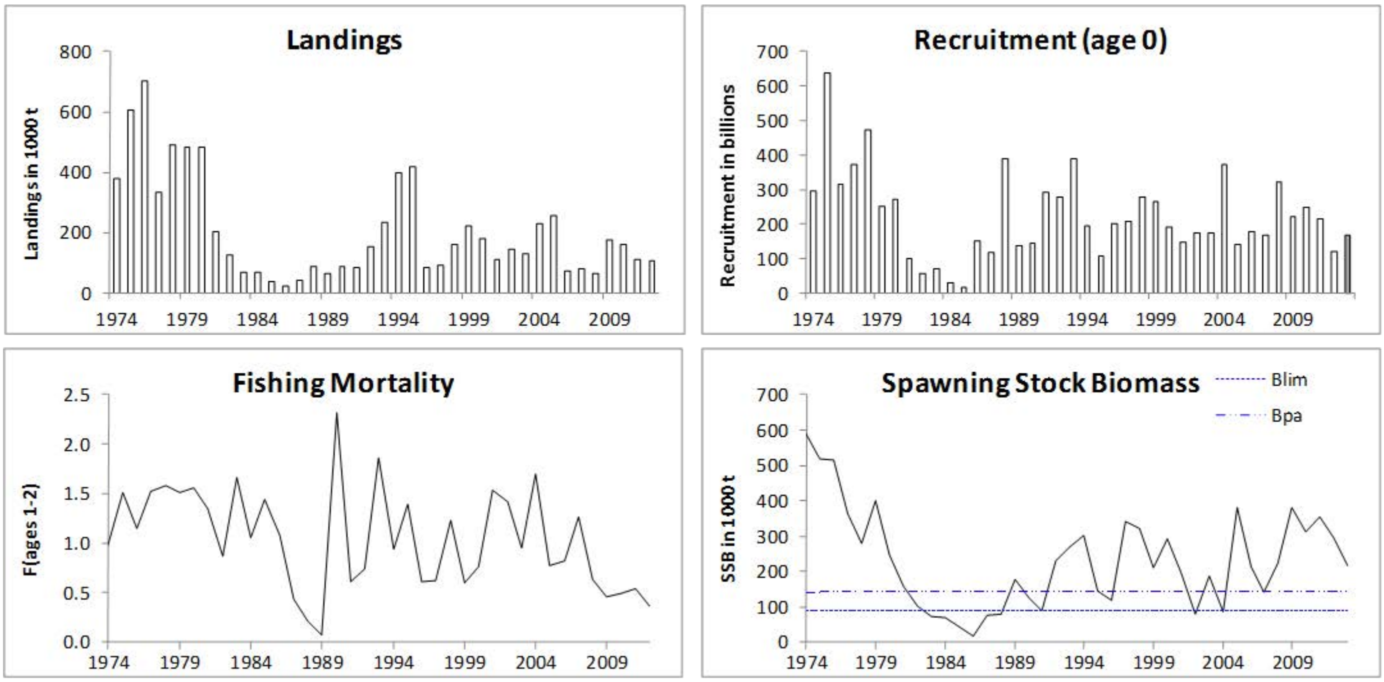

Figure 6.4.30.1 Sprat in the North Sea. Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F over the years. NB: Years on the x-axes refer to the model years (i.e. 2009 corresponds to the period from July 2009 to June 2010). The plot for F does not show the provisional F_{MSY} proxy, because it varies over time.

The spawning stock has been above B_{pa} since 2005, with the exception of 2007, where SSB was approximately at B_{pa}. Fishing mortality shows an overall decreasing trend since 2004. Recruitment appears more stable than is often the case for short-lived species, with recruitment in 2012 estimated to be below average.

Management plans

No specific management objectives are known to ICES.

Biology

Sprat in the North Sea is short-lived with high natural mortality. The age zero year class is not highly available to the fishery and the catch is dominated by fish of ages 1 and 2.

Environmental influence on the stock

The zooplankton community structure that sustains sprat stocks appears to be changing. The implications of the environmental change for sprat are unknown, but no trends in recruitment have been observed in the last years.

The fisheries

Sprat in Subarea IV is mainly fished together with juvenile herring bycatches and the exploitation of sprat is limited by the herring bycatch restrictions imposed on the fisheries. Two regulations limit the sprat trawl fishery in addition to the sprat TAC, one being the bycatch ceiling for herring and the other the herring bycatch percentage limit in industrial fisheries. Given the relatively large North Sea autumn-spawning herring stock, the sprat fishery has been limited by the bycatch limits. The majority of sprat landings are taken in the Danish small-meshed trawl fishery, which has about 10% bycatch of herring. The Norwegian sprat fishery is carried out by purse-seiners and small-meshed trawlers. Norwegian regulations for the North Sea sprat fishery allow for a maximum 10% (by weight) bycatch of herring. The bycatch percentage in this fishery is unknown.

Catch distribution	Total catch (2012): 85.6 kt, where 100% were landed.

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. Concern has been expressed about the preservation of inshore sprat as a food resource for breeding seabirds.

Quality considerations

This is the first time since 2008 that ICES is able to present an analytical assessment for this stock, and it is a marked improvement over previous assessments. The current assessment was proposed during the benchmark in February 2013, introducing a new model (single-species SMS with quarterly time-steps) and the inclusion of the acoustic time-series (HERAS). The acoustic time-series is now long enough to be used in the assessment, and it is considered a reliable index of the abundance of the stock.

To better match the sprat life-cycle, the assessment year has been changed from January–December to July–June, and this improves the performance of the assessment model.

Scientific Basis

Assessment type	Age-based analytical assessment using SMS.
Stock data category	Category 1
Input data	Three survey indices (IBTS Q1&3, HERAS); Commercial catches (international landings, ages and length frequencies from catch sampling); Annual maturity data (from IBTS Q1); Natural mortalities from multispecies model.
Discards and bycatch	Discards are not included in the assessment and considered to be negligible.
Indicators	None.
Other information	Benchmarked in 2013 (ICES, 2013a).
Expert Group report	HAWG

ECOREGION **North Sea**

STOCK **Sprat in Subarea IV (North Sea)**

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Not defined.	
	F_{MSY}	1.3	Provisional F_{MSY} proxy based on M (where M is estimated based on a multispecies assessment and varies over time; 1.3 is the value in 2013).
Precautionary Approach	B_{lim}	90 000 t	B_{lim} was set to ensure that years of very good recruitment mainly occurred when the stock was above B_{lim} and years of very low recruitment only occurred when the stock was below B_{lim} (ICES, 2013).
	B_{pa}	142 000 t	$B_{pa} = B_{lim} \times \exp^{(\sigma \times 1.645)}$, with σ = 0.28 estimated from assessment uncertainty in the terminal year (ICES, 2013).
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	

Outlook for July 2013 to July 2014

Basis: F(2012) = 0.381; Yield(2012) = 107; Recruitment(2012) = 121; Recruitment(2013) = 25 percentile of a log normal approximation of the recruitment (1992-2012) = 166 billion; SSB(2013) = 220. Note that all years (also in the table below) refer to the assessment years.

Rationale	**Catch (July 2013 - June 2014)**	**Basis**	**F (July 2013 - June 2014)**	**SSB (2014)**	**% SSB change** [1]
MSY approach	144	Provisional F_{MSY} proxy	1.3	161	−27%
Zero catch	0	F = 0	0	234	6%
Other options	124	F(2012) × 2.65	1	170	−23%
	134	F(2012) × 3	1.143	165	−25%
	156	F(2012) × 4	1.524	156	−29%
	165	F(2012) × 4.5	1.715	152	−31%
	176	F(2012) × 5.15	2	148	−32%

Weights in thousand tonnes.

[1] SSB 2014 relative to SSB 2013.

MSY approach

The ICES MSY approach for a short-lived species is typically an escapement strategy. Although some preliminary work towards the establishment of an MSY $B_{escapement}$ has been done, the associated uncertainties have not been sufficiently examined to be able to advise according to an escapement strategy at this stage. The value of MSY $B_{escapement}$ should take into account the uncertainties in the final assessment year as well as in the incoming recruitment.

To ensure precautionary exploitation and until an evaluation has been conducted, ICES considers that advice for this stock should be based on a F_{MSY} proxy. For short-lived species, natural mortality is considered as a potential F_{MSY} proxy (ICES, 2013b), although setting an F_{MSY} reference point would also require evaluation. For this sprat stock fishing at F = M = 1.3 (where M has been derived from a multispecies assessment) corresponds to a catch of no more than 144 000 t from July 2013 to June 2014.

Additional considerations

The fishery for this short-lived species is dominated by 1- and 2-year-old fish. This requires information about incoming 1-year-old fish. In order to meet this requirement and to use a model that logically matches the natural life cycle of sprat, the annual period and the quarterly time-steps in the model were shifted relative to the calendar year. The annual time-steps in the assessment model go from 1 July to 30 June, and SSB and recruitment are estimated at July 1st. Hence, 2012 season 1 in the model refers to 2012 quarter 3, 2012 season 3 in the model refers to 2013 quarter 1, and so forth. Figure 6.4.30.5 illustrates how the annual cycle in the assessment model is shifted relative to the calendar year.

In line with the above, ICES is now providing catch advice for the period July to June in the following year. The TAC at present corresponds to the calendar year (January to December). It is expected that aligning the TAC period to the ICES advice period will facilitate management. In the context of the TAC still applying to the 2013 calendar year, with a potential in-year revision, the following information could facilitate using the advice ICES is currently providing: on average during 2009–2011, 85% of the catch in the period going from July of that year to June of the following year was taken during July–December. Applying this percentage to the catch advised for July 2013–June 2014 (144 000 t), it is expected that approximately 122 000 t would be taken during July–December 2013.

Management considerations

The ICES approach for MSY-based management of a short-lived species like sprat is usually an escapement strategy, i.e. to maintain SSB above MSY $B_{escapement}$ after the fishery has taken place. The value of MSY $B_{escapement}$ should take into account the uncertainties in the final assessment year as well as in the projections. After the appropriate reference points have been determined, the long-term consequences for the stock of using the MSY escapement strategy, or another type of MSY strategy, should be evaluated. This evaluation has not yet taken place; therefore, ICES is basing the advice this year on a provisional F_{MSY} proxy. Sprat is an important forage fish, thus also multispecies considerations should be made.

The sprat and herring fisheries are linked; therefore, monitoring bycatch of juvenile herring should continue in the sprat fishery. Management measures that address the bycatch of juvenile herring should be revisited. Sprat catches in recent years have been well below the advised and agreed TAC. Management of this stock should consider management advice given for herring in Subarea IV.

The landing obligation for pelagic fisheries in EU waters is expected to be enacted in the beginning of 2015. This can be expected to have an impact on how the bycatch ceiling is utilized and a change in fishing patterns may occur.

Uncertainties in the assessment and forecast

The assessment estimates high CVs for the commercial catches but lower CVs for surveys, indicating that the model is driven mainly by survey indices. There is some concern that the spatial distribution of the biological samples taken from the fishery do not always follow the catch distribution. This represents a problem if there are spatial differences in growth and age composition and may decrease the consistency between years of the cohort's signal in the catches. This may also partially explain why the CVs on the catches are higher than for the survey indices. To remedy the problem, the existing Danish and Norwegian biological samples were used to produce spatially explicit age compositions and weight-at-age whenever the sampling level allowed. Ideally, this should be coupled with total catches per quarter and statistical rectangle. Inclusion of a properly standardized effort index could potentially also represent part of a solution to the problem of high catch CVs.

The forecast is also sensitive to the choice of maturity ogive, for example whether a 3-year or a 10-year average is used in the forecast. A large proportion of the population contributes to SSB already at one year of age. This means that the estimated value of SSB after the fishery is highly dependent upon the recruitment value used in the forecast. A recruitment index providing indications of the size of the incoming age-0 year class would therefore be important for the forecast.

Comparison with previous assessment and advice

Last year, this stock was considered a data-limited stock and advice was given based only on the development in the survey indices. The stock has since been benchmarked, including a revision of IBTS survey indices, catch-at-age, weight-at-age, and natural mortality. A quarterly assessment model (SMS) is now applied, and advice is provided for the period from July 1st to June 30th in the subsequent year. The advice this year is based on the MSY approach.

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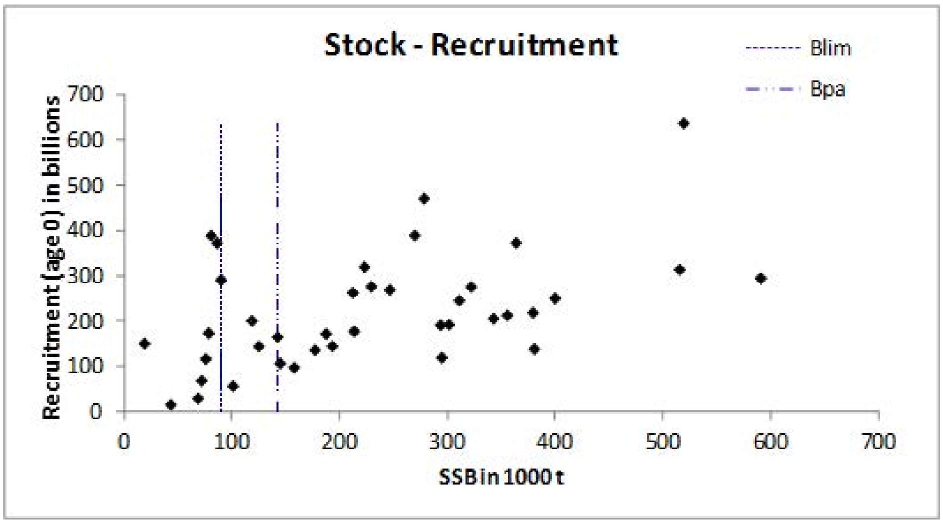

Figure 6.4.30.2 Sprat in Subarea IV (North Sea). Stock–recruitment plot.

Table 6.4.30.1 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	51	73
1991	No advice	-	55	92	112
1992	No advice	-	55	72	124
1993	No advice	-	114	126	200
1994	No advice for sprat; maintain bycatch regulations	-	114	184	320
1995	No advice	-	175	190	357
1996	No advice	-	200	142	137
1997	Enforce bycatch regulations	-	150	123	103
1998	Limited by restrictions on juvenile herring	-	150	175	164
1999	Limited by restrictions on juvenile herring	-	225	182	188
2000	Limited by restrictions on juvenile herring	-	225	207	196
2001	Catch prediction	225	225	184	170
2002	Catch prediction	160	232	167	144
2003	Catch prediction	175	257	201	177
2004	Catch prediction	171	257	208	194
2005	Catch prediction	244	257	242	208
2006	Catch predictions	< 250	175	136	114
2007	Catch prediction	< 195	175	100	84
2008	Catch prediction	< 170	170	77	61
2009	No advice	-	170	141	133
2010	No advice	-	170	157	144
2011	Reduce catches	-	170	145	134
2012	Reduce catches		162	97	86
2012 (In year)	No increase in catches in 2012	< 134			
2013	MSY approach (catch for July 2013–June 2014)	< 144 [2]	161.500		

Weights in thousand tonnes.

[1] TACs are set for January–December where the advice since 2013 is given for July (of the TAC year) to June of the next year.

[2] Advice for July 1st 2013 to June 30th 2014.

Table 6.4.30.2 Sprat in Subarea IV (North Sea). ICES landings by area (in tonnes). 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 are 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 Divisions IVbW and IVE can be found in ICES (2008).

Year	Quarter	Area				Total
		IVaW	IVaE	IVb	IVc	
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			3 747	21 039	24 786
	2			2 067	3	2 070
	3			22 309	451	22 761
	4	8		70 256	13 759	84 023
	Total	8		98 380	35 252	133 640
2012	1			81	1 649	1 730
	2			2 924	0	2 924
	3			26 779	307	27 086
	4			47 765	6 060	53 825
	Total	0	0	77 549	8 016	85 565

* < 0.5 tonnes

Table 6.4.30.3 Sprat in Subarea IV (North Sea). Summary of the assessment.

Year	Recruitment	SSB	Landings	Mean F
	Age 0			Ages 1–2
	millions	tonnes	tonnes	
1974	295931	590355	379883	0.977
1975	637949	518830	607849	1.513
1976	314845	515133	701782	1.151
1977	373635	363312	335306	1.522
1978	471681	277897	489316	1.577
1979	251840	399520	484624	1.511
1980	270293	246161	483279	1.557
1981	98879	157392	201840	1.344
1982	58064	100752	127212	0.866
1983	69990	71625	67486	1.658
1984	31021	68242	68416	1.059
1985	16872	42942	39458	1.446
1986	152040	18513	20659	1.075
1987	117848	75470	42156	0.432
1988	389712	80360	86481	0.208
1989	13762	176813	63698	0.072
1990	145641	124670	89571	2.319
1991	292181	89576	84649	0.616
1992	277499	229060	153649	0.735
1993	390060	269314	234265	1.863
1994	193592	301043	398697	0.938
1995	107915	144308	416538	1.393
1996	201867	118159	83634	0.607
1997	206679	342415	90316	0.626
1998	276951	321635	161433	1.225
1999	264031	211862	220736	0.598
2000	192360	293278	179540	0.758
2001	145915	192745	110442	1.535
2002	174733	78083	144265	1.413
2003	173091	187017	131255	0.952
2004	373211	85722	229197	1.699
2005	139759	380236	257645	0.771
2006	178795	213021	70750	0.825
2007	166239	141970	78730	1.270
2008	320758	222621	65598	0.634
2009	219981	379008	175282	0.459
2010	246921	310601	161814	0.496
2011	214250	355114	111200	0.536
2012	120725	294419	107070	0.365
2013	166000	217169*		
Average**	221934	230159	203993	1.041

*Using mean weights from 2012.

**Period 1974 –2012.

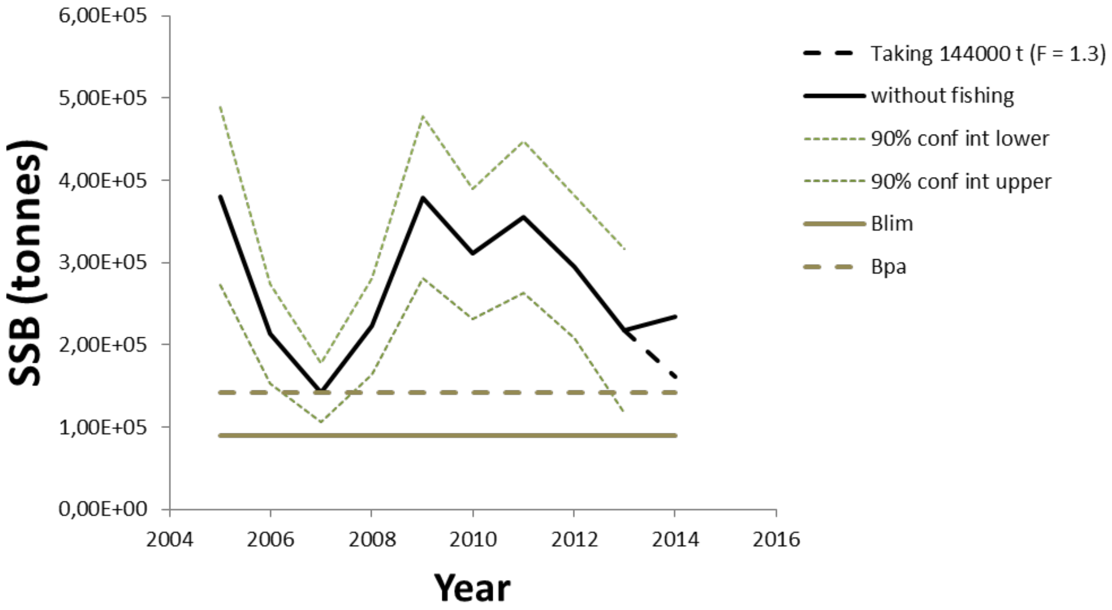

Figure 6.4.30.3 Sprat in Subarea IV (North Sea). Historical SSB estimates (and associated uncertainty) and projected SSB values in 2014 under no fishing, and with catches of 144 kt. The uncertainty associated with the prediction of SSB in 2014 cannot be evaluated without performing stochastic projections, but is considered to be larger than the uncertainty about SSB in 2013. The reason for this is that the main ages contributing to SSB in 2014 are the 2012 and 2013 year classes, which are the most uncertain, as they are the ones for which the least information is available.

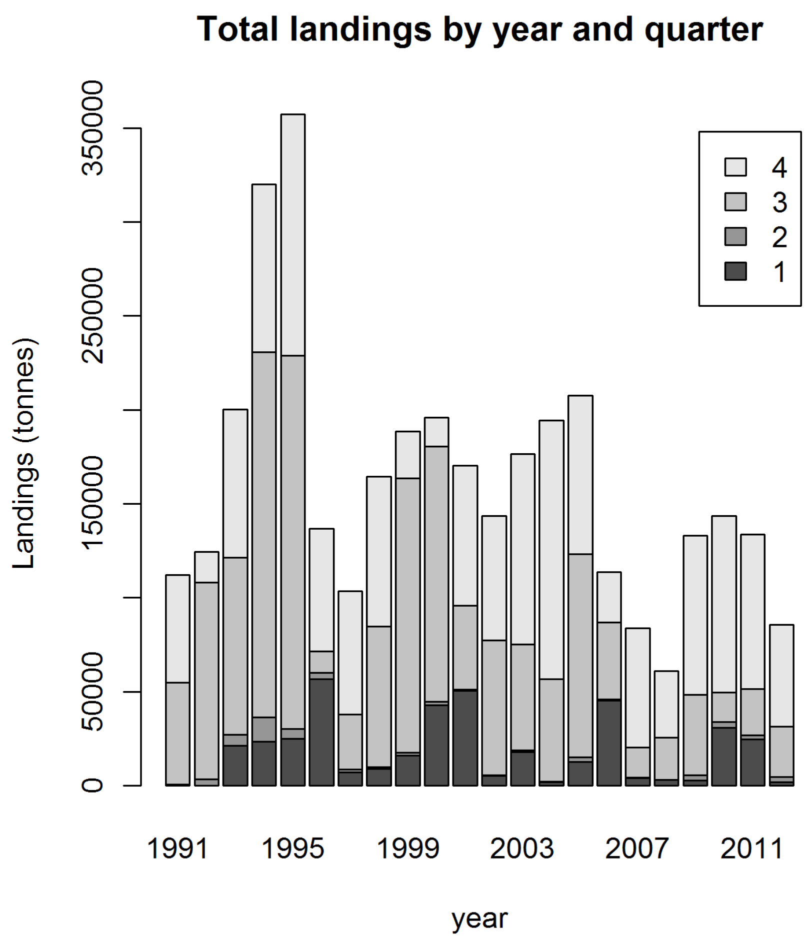

Figure 6.4.30.4 Sprat in Subarea IV (North Sea). ICES landings per quarter (in tonnes).

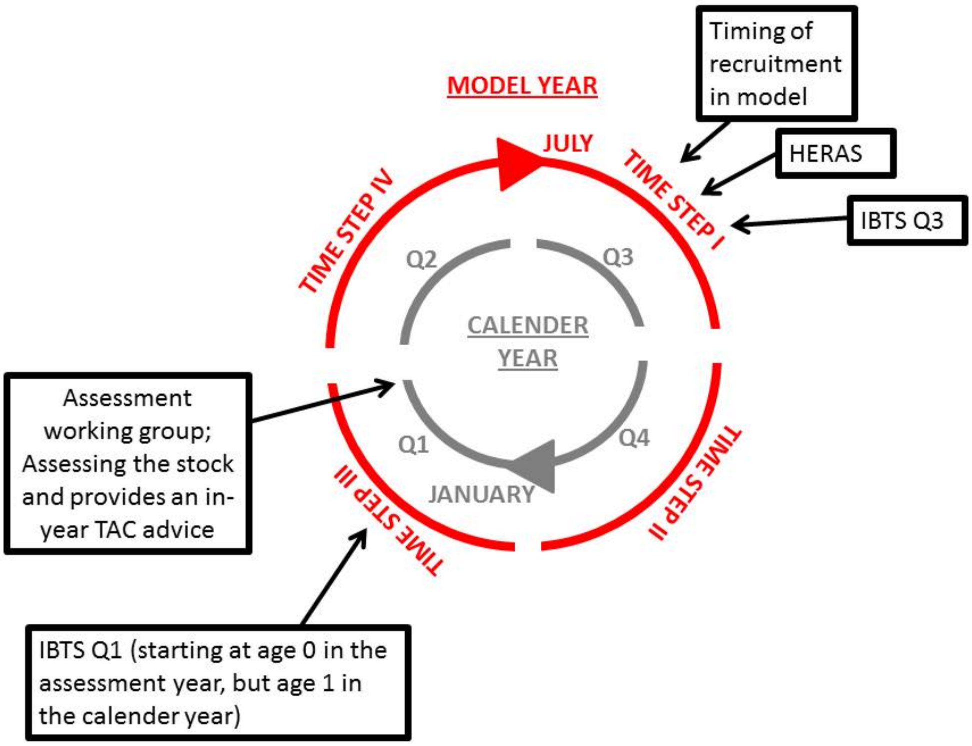

Figure 6.4.30.5 An illustration of how the annual cycle in the assessment model is shifted relative to the calendar year.

ECOREGION North Sea
STOCK Turbot in Division IIIa

Advice for 2014 and 2015

Based on the ICES approach for data-limited stocks, ICES advises that catches should be no more than 102 tonnes in 2014. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)		
	2010-2012	
Qualitative evaluation	?	Insufficient information

SSB (Spawning Stock Biomass)		
	2005-2012	
Qualitative evaluation	→	Stable

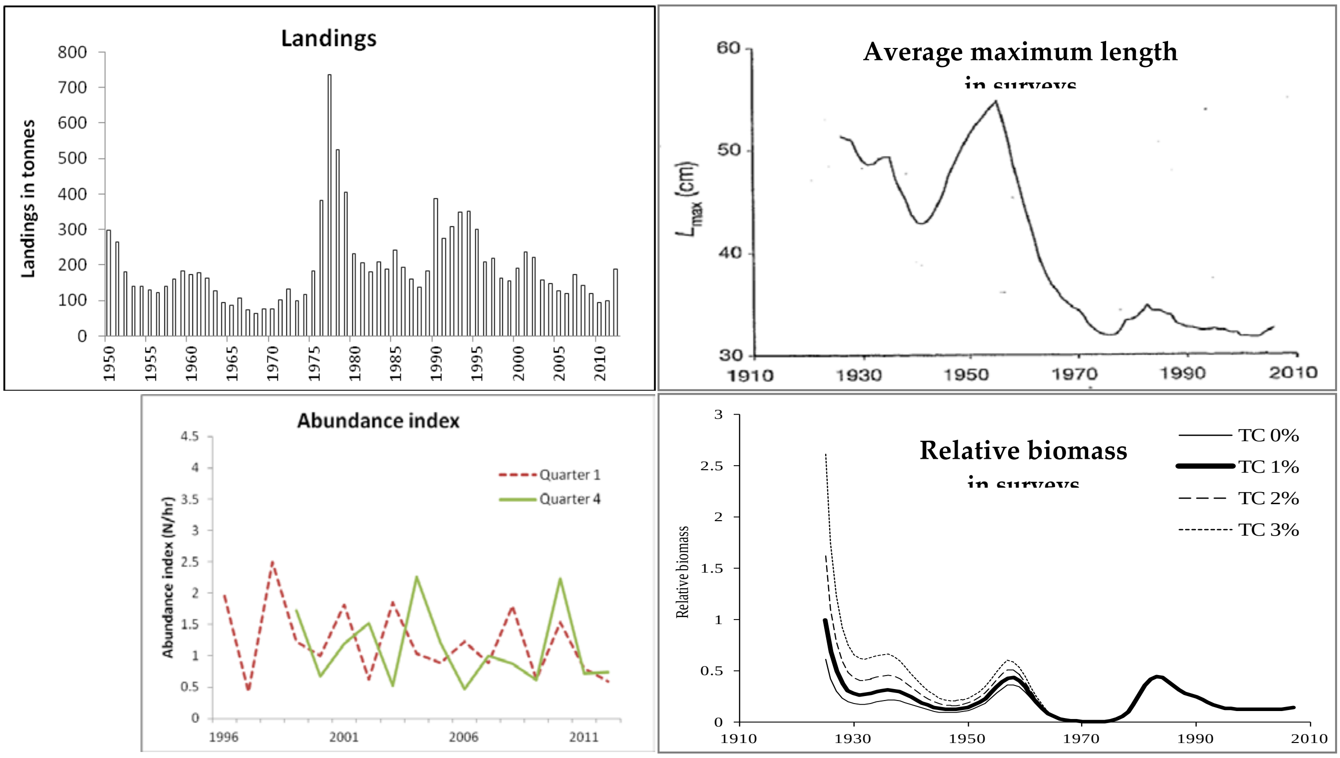

Figure 6.4.31.1 Turbot in Division IIIa (Skagerrak – Kattegat). Top left: Official landings (tonnes). Below left: Abundance indices (Trend in catch per unit effort since 1996 (numbers/hour) from BITS_Q1 and Q4). Top right: Average maximum length in otter trawl survey catches since 1930, Below right, Relative biomass compared to the value estimated in 1925 and assuming different levels of technological creep (TC, both from Cardinale *et al*., 2009).

Landings decreased over the last decade but have increased again in 2012. Survey abundance indices are highly variable without trend over the last decades. Recent analysis has shown that that biomass declined by about 80% since the 20ies and the maximum body size has decreased by about 30%. The stock size indicators (number/hour) show opposing trends comparing the last three years (2010–2012) with the average of the five previous years (2005–2009), either 10% lower (based on the Q1 survey) or 48% higher (Q4 suvery), suggesting no predominant trend in the data.

Management plans

No specific management objectives are known to ICES.

Biology

Turbot is a visual feeder, feeding on bottom-living fishes, small pelagic fish and also on larger crustaceans and bivalves. Turbot is a rather sedentary species, which generally occurs in spatially separated stock units as it spawns at specific localities in shallow areas during summer with low larval dispersal and with restricted movements as adults, and exhibit strong spawning site fidelity. Historical data from the Skagerrak-Kattegat area also indicate spatially separate stock structures, at least in terms of spawning components, which are persistent over time.

The fisheries

In IIIa a target fisheries for turbot probably only occurred before 1960s when the stock was large, while today turbot is only caught as by-catch in the trawl and gillnet fisheries. ICES estimate of landings in 2012 is 189 tonnes which is almost two times higher than the 2011 estimate. Discards are considered negligible.

Quality considerations

Information on stock structure, biological data and catch at age information are needed to be able to perform an assessment of turbot in IIIa. The survey indices are highly variable probably mainly because the survey is not designed for catching turbot and catch per hour is low. The available survey indices have not been explored yet for use as tuning fleet.

The advice is based on a two abundance indices used as an indicator of stock size. The uncertainty associated with the index values is not available. 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 based assessment (Data limited stock approach category 3.2.0).
Input data	Commercial catches (international landings), two survey indices (BITS Q1&4, historic survey indices from otter trawl surveys (Cardinale *et al.*, 2009))
Discards and bycatch	Discards not included and are assumed negligible.
Indicators	None.
Other information	Turbot in the North Sea was benchmarked in 2012 and IBPNEW decided that turbot in Skagerrak/Kattegat should be treated as a separate stock. A benchmark is proposed for 2014.
Working group report	WGNEW/WGNSSK (ICES, 2013a, 2013b)

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

Reference points

No reference points have been defined for this stock.

Outlook for 2014 and 2015

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

The stock size indicator (number/hour) in the last three years (2010–2012) is 10% lower (based on the Q1 survey) and 48% higher (Q4 survey) than the average of the five previous years (2005–2009). This suggests no significant trend in the data and no changes in relation to the last three years average catches, corresponding to catches of no more than 128 t.

Additionally, considering that exploitation is unknown, ICES advises that catches should decrease by 20% as a precautionary buffer. This results in catches of no more than 102 t in 2014.

All catches are assumed to be landed.

Additional considerations

The collection of data needs to be improved in order to get a better understanding of the state of turbot stock in IIIa. Estimates of catch at age and biological parameters of turbot in the Kattegat–Skagerrak should also be initiated.

Biology

Turbot is a typical visual feeder, feeding on bottom-living fishes, small pelagic fish and also on larger crustaceans and bivalves. Turbot is a rather sedentary species, which generally occur in spatially separated stock units as it spawns at specific localities in shallow areas during summer with low larval dispersal (Florin and Franzén, 2010) and with restricted movements as adults (Støttrup *et al.*, 2002), and exhibit strong spawning site fidelity (Florin and Franzén, 2010). Inspection of historical data from the Skagerrak-Kattegat area also indicates spatially separate stock structures, at least in terms of spawning components, which are persistent over time (Cardinale *et al*., 2009).

Comparison with previous assessment and advice

This is the first time that ICES provides advice for this stock. Last year’s advice (for turbot in Subarea IV and Division IIIa) was the same as the previous year and based on precautionary considerations. This year, the basis for the advice is the ICES approach to data limited stocks. From 2013 on turbot in sub area IV is assessed separately.

Sources

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Støtterup, J.G., Sparrevohn, C.R., Modin, J., and Lehmann, K. 2002. The use of releases of reared fish to enhance natural populations- A case study of turbot *Psetta maxima* (Linné, 1758). Fisheries Research. 59: 161–180.

Table 6.4.31.1 Turbot in Division IIIa (Skagerrak – Kattegat). ICES advice and landings. Advice before 2014 applied to turbot in Subarea IV and Division IIIa.

Year	ICES Advice	Predicted catch corresp. to advice	Official landings turbot IIIa
2011	No advice	-	99
2012	No increase in catches	-	189
2013	No new advice, same as for 2012	-	
2014	Reduce recent average catch by 20% (2010-2012)	< 102	
2015	No new advice, same as for 2014	< 102	

Weights in tonnes.
1) EU combined TAC for turbot and brill in EU areas IIa and IV.

Table 6.4.31.2. Turbot in Division IIIa (Skagerrak – Kattegat). Official landings by country in tonnes.

Year	BEL	DEU	DNK	GBR	NLD	NOR	SWE	Total
1950	0	13	212	0	0	1	73	299
1951	0	6	191	0	0	6	62	265
1952	0	6	114	0	0	3	58	181
1953	0	4	80	0	0	4	51	139
1954	0	0	78	0	0	1	61	140
1955	0	4	77	0	0	0	49	130
1956	0	7	75	0	0	0	41	123
1957	0	3	108	0	0	0	30	141
1958	0	7	112	0	0	0	41	160
1959	0	6	132	0	0	3	43	184
1960	0	11	115	0	0	2	46	174
1961	0	4	130	0	0	0	45	179
1962	0	5	157	0	0	0	0	162
1963	0	4	124	0	0	0	0	128
1964	0	5	89	0	0	0	0	94
1965	0	6	79	1	0	0	0	86
1966	0	2	104	0	0	0	0	106
1967	0	4	68	1	0	0	0	73
1968	0	0	64	0	0	0	0	64
1969	0	1	75	0	0	0	0	76
1970	0	1	76	0	0	0	0	77
1971	0	1	100	0	0	0	0	101
1972	0	2	130	0	0	0	0	132
1973	0	2	98	0	0	0	0	100
1974	0	1	116	0	0	0	0	117
1975	0	2	167	0	7	0	7	183
1976	7	2	178	0	190	0	6	383
1977	7	4	331	0	389	0	5	736
1978	2	4	327	0	186	0	6	525
1979	8	0	307	0	87	0	4	406
1980	7	0	205	1	14	0	6	233
1981	2	0	183	2	12	0	8	207
1982	1	0	164	1	9	0	7	182
1983	4	0	171	0	24	0	10	209
1984	0	0	176	0	0	0	12	188
1985	1	0	224	0	0	0	16	241
1986	2	0	180	0	0	0	11	193
1987	5	0	147	0	0	0	9	161
1988	2	0	115	0	11	0	10	138
1989	2	0	173	0	0	0	9	184
1990	5	0	363	0	0	0	18	386
1991	4	0	244	0	0	7	21	276
1992	4	0	278	0	0	8	19	309
1993	3	0	336	0	0	10	0	349
1994	2	0	313	0	0	15	22	352
1995	4	0	268	0	0	17	11	300
1996	0	0	185	0	0	13	11	209
1997	0	0	200	0	0	9	11	220
1998	0	0	148	0	0	7	8	163
1999	0	0	139	0	0	10	6	155
2000	0	0	180	0	0	6	6	192
2001	0	0	227	0	0	8	3	238
2002	0	0	205	0	0	11	5	221
2003	0	0	128	0	13	14	4	159
2004	0	0	119	0	14	7	7	147
2005	0	0	108	0	7	6	6	127
2006	0	1	95	0	8	8	9	121
2007	0	1	138	0	15	7	12	173
2008	0	1	121	0	4	6	11	143
2009	0	1	94	0	2	6	17	120
2010	0	0	72	0	6	4	13	95
2011	0	1	78	0	0	7	13	99
2012	0	0	168	0	0	8	14	189

Table 6.4.31.3. Turbot in Division IIIa (Skagerrak – Kattegat). Average catch per unit effort (cpue, number/hour) estimated from BITS (KASU) surveys for quarter 1 and quarter 4 between 1996 and 2012.

Year	Quarter 1	Quarter 4
1996	1.95	
1997	0.42	
1998	2.50	
1999	1.23	1.73
2000	1.00	0.67
2001	1.82	1.19
2002	0.62	1.52
2003	1.85	0.52
2004	1.03	2.26
2005	0.89	1.20
2006	1.23	0.47
2007	0.89	1.00
2008	1.79	0.87
2009	0.63	0.61
2010	1.53	2.23
2011	0.80	0.71
2012	0.59	0.74

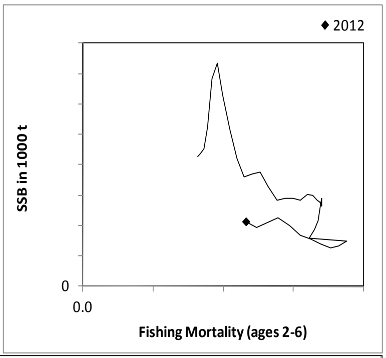
ECOREGION North Sea
STOCK Turbot in Subarea IV (North Sea)

Advice for 2014

Based on ICES approach to data limited stocks, ICES advises that catches of turbot in Subarea IV should be no more than 2978 t. All catches are assumed to be landed.

Stock status

F (Fishing Mortality)				
	2010	2011	2012	
Qualitative evaluation	↘	↘	↘	Declining
SSB (Spawning-Stock Biomass)				
	2010	2011	2012	
Qualitative evaluation	→	→	↗	Increasing from low level



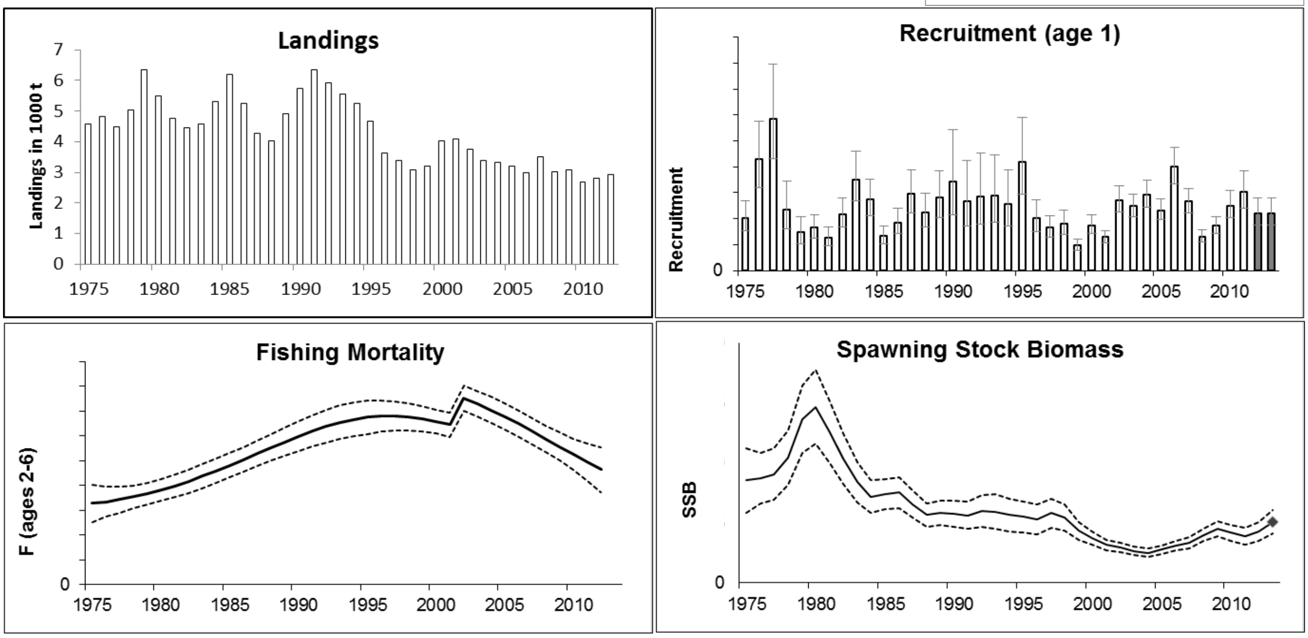


Figure 6.4.32.1 Turbot in Subarea IV. Official landings and summary of stock trends from the assessment. Assumed values are shaded. For F and SSB, the centre line indicates the model best estimate, dashed top and bottom lines indicate 95% confidence limits. Top right: SSB and F for the time-series used in the assessment

A trends-based assessment for turbot in the North Sea is presented for the first time. Landings of turbot have been stable since 1995. Recruitment is variable around the long-term average. The sudden increase in F is because of a reduction of the minimum landing size in 2001. Since then fishing mortality has declined. Spawning-stock biomass is at a low level, but has been gradually increasing in recent years.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of Division IIa and Subarea IV together with brill (ICES, 2013a).

Biology

Turbot is one of the fastest growing flatfish. Turbot is a typical visual feeder and feeds mainly on other bottom-living fish and small pelagic fish and could be regarded as a top predator. In general, turbot is a rather sedentary species, but there are some indications of migratory patterns. For example in the North Sea, migrations from the nursery grounds in the southeastern part to more northerly areas have been recorded. Adult turbot are more tolerant of the colder conditions in the northern areas of the North Sea where temperatures are too low for juveniles to survive.

The fisheries

Turbot is an economically valuable bycatch in the fishery for flatfish and demersal species using beam trawl, otter trawl, and static gear. There is a targeted gillnet fishery that takes less than 10% of the total catch. Discarding in the trawl fisheries for turbot is low. No official minimum landing size has been set, but Belgian and Dutch producer organizations have adopted voluntary minimum landing sizes between 25 and 30 cm. A reduction in fishing effort on target flatfish species such as plaice and sole may have influenced the turbot catches.

Catch distribution	Total catch (2012) = 2.914 kt, where 100% were landings (~90% beam and otter trawls, ~10% gill- and trammelnets).

Quality considerations

Age data only exist for several short periods. The collection of data needs to be continued for the whole area in order to get a better understanding of the state of turbot stocks in the Northeast Atlantic area.

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 statistical age-structured assessment (Data-limited stock category 2.1.1).
Input data	Commercial catches (episodic age frequencies from catch sampling raised to international landings), two survey indices (SNS, BTS-Isis), one commercial index (NL_BT2). Assumed constant annual maturity ogive and natural mortality (ages and years).
Discards and bycatch	Not included and assumed negligible.
Indicators	None
Other information	The stock was benchmarked in 2012 (IBPNES, ICES, 2012), where it was decided to split the advice between Division IIIa and Subarea IV.
Working group report	WGNSSK.(ICES, 2013b)

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

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Undefined.	
	F_{MSY}	0.34	F_{max} as proxy for F_{MSY} (range: 0.31–0.37).
Precautionary approach	Not defined.		

(Changed in 2013)

Outlook for 2014

Basis: trends-based forecast: F (2013) = constant landings = F(2012) × 0.79 = 0.34; R (2013) = Geometric Mean (1957–2012); Landings (2013) = Landings (2012) = 2914.

Rationale	Catches (2014)	Basis	F (2014)	%SSB index change 2014-2015
MSY framework	2978	F_{MSY} proxy (= F_{2013})	0.34	+ 12%

Weights in tonnes.

ICES approach to data-limited stocks

For data-limited stocks with analytical assessment and forecast that are only treated qualitatively, ICES uses a short-term forecast applying the F_{MSY} proxy (or lower, if the stock biomass is estimated to be below MSY $B_{trigger}$) as a target to be reached by 2015. A change limit of ±20% is applied to the advice.

For this stock, no MSY $B_{trigger}$ has been defined, and the method has been applied based on maintaining fishing mortality at the F_{MSY} proxy. This implies fishing mortality should be kept at 0.34, resulting in landings of no more than 2978 t in 2014. This is expected to lead to an increase in SSB of 12% from 2014 to 2015. All catches are assumed to be landed.

Additional considerations

Turbot is mainly a bycatch species in fisheries for plaice and sole. TACs may not be appropriate as a management tool for bycatch species.

Impacts of fisheries on the ecosystems

Currently the mixed flatfish fishery (targeting sole and plaice, but also contributing to the majority of turbot landings) is dominated by beam and otter 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.

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. Bottom otter trawls (OTB) with a mesh size equal to or larger than 100 mm, and 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.

The current sole and plaice long-term management plan (Council Regulation (EC) No. 676/2007) also specifically reduces effort as a management measure, affecting BT2 and occasionally trammelnet (GT1) gears since the implementation of the plan. Effort ceilings are updated annually. However, for 2013, the European Council decided upon a roll-over of effort level of 2012 into 2013 for both the cod and the sole/plaice management plans.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill- and trammelnets, and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel has been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, −16% between 2008 and 2012). Effort by the beam trawl fleet in small mesh size (80–120 mm, BT2) has shown a sharp decline (−45% between 2003 and 2012), while effort in large mesh size (≥120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline.

Changes in fishing technology and fishing patterns

The increased use of “SumWing” and electric “pulse trawls” will likely affect catchability and selectivity of North Sea turbot, though this effect has not yet been quantified. In 2011, approximately 30 licenses for Pulse trawls were taken into operation, increasing to 42 in 2012. Potential future impact either on the turbot stock itself or the stock assessment is unknown.

Uncertainties in the assessment and forecast

An analytic assessment is available for the first time but, because of uncertainties in some of the inputs and model settings, it is treated as indicative of trends in fishing mortality, recruitment, biomass, and future catches, rather than as a full analytical assessment. The assessment estimates, their forecasts, and status relative to reference points are considered to be consistent with each other and can therefore be used to provide management advice. Work is ongoing to make the necessary improvements to the assessment to elevate North Sea turbot to a Category 1 stock under the ICES data-limited stocks classification.

In 2001 the Dutch national minimum landings size for turbot was reduced from 30 to 25 cm. From 2002 onwards all age structure data for landings of this stock are from Dutch samples. This resulted in an increase in landings of age 2 fish, leading to a sudden increase in mean fishing mortality over ages 2 to 6. Prior to 2001, it is unclear if fish at age 2 were discarded or not reported.

Data requirements

The collection of data needs to be continued in order to get a better understanding of the state of turbot stocks in the Northeast Atlantic. Priority should be given to improvement of catch-at-age information available from different countries.

Comparison of previous assessment and advice

This is the first year that an assessment has been presented for turbot in Subarea IV. Previously qualitative advice was given for this stock, including Division IIIa. This year a trends-based assessment is given and the advice is based on ICES approach to data-limited stocks.

Assessment and management area

IBPNEW (ICES, 2012) recommended assessing and managing the North Sea (Subarea IV) turbot stock as a distinct unit. Turbot is managed in Subarea IV and Division IIa in a TAC combined with brill.

Sources

ICES. 2012. Report of the Inter-Benchmark Protocol on New Species (Turbot and Sea bass; IBPNew 2012), 1–5 October 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:45. 239 pp.

ICES. 2013a. Brill in Subarea IV and Divisions IIIa and VIId,e. *In* Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.4.1.

ICES. 2013b. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/ACOM:13.

Table 6.4.32.1 Turbot in Subarea IV. ICES advice, management, and official landings.

Year	ICES Advice	Predicted catch corresp. to advice turbot	Agreed TAC[1] turbot & brill	Official landings turbot & brill	Official landings turbot
2000		-	9	6.326	4.026
2001		-	9	6.501	4.101
2002		-	6.750	5.850	3.750
2003		-	5.738	5.575	3.375
2004		-	4.877	5.419	3.319
2005		-	4.550	5.095	3.195
2006		-	4.323	4.877	2.977
2007		-	4.323	5.610	3.510
2008		-	5.263	4.807	3.007
2009		-	5.263	4.991	3.091
2010		-	5.263	4.992	2.692
2011		-	4.642	5.007	2.807
2012	No increase in catches	-	4.642	5.214 [2]	2.914 [2]
2013	No new advice, same as for 2012	-	4.642		
2014	Apply F_{MSY} proxy for data limited stocks	< 2.978			

Weights in thousand tonnes.

[1] EU combined TAC for turbot and brill in EU waters of Division IIa and Subarea IV.

[2] Preliminary.

Table 6.4.32.2 Turbot in Subarea IV. Official landings per country (in kt).

Year	Netherlands	UK	Denmark	Belgium	France	Germany	Norway	Other[2)]	**IV totals**
1975	3.349	0.503	0.387	0.159	0.021	0.169	0.000	0.001	**4.589**
1976	3.253	0.632	0.588	0.147	0.038	0.157	0.000	0.002	**4.816**
1977	2.973	0.683	0.474	0.146	0.038	0.173	0.000	0.000	**4.486**
1978	3.196	0.752	0.693	0.170	0.051	0.174	0.000	0.000	**5.036**
1979	3.999	0.838	1.164	0.187	0.022	0.152	0.000	0.003	**6.365**
1980	3.241	0.559	1.360	0.163	0.017	0.146	0.000	0.000	**5.486**
1981	3.073	0.404	1.044	0.142	0.006	0.087	0.000	0.000	**4.756**
1982	3.029	0.335	0.880	0.153	0.014	0.043	0.000	0.000	**4.454**
1983	3.163	0.277	0.893	0.174	0.024	0.044	0.000	0.000	**4.576**
1984	3.800 [1)]	0.282	0.886	0.242	0.040	0.046	0.000	0.001	**5.297**
1985	4.600 [1)]	0.312	0.983	0.222	0.037	0.034	0.000	0.000	**6.188**
1986	3.810 [1)]	0.287	0.997	0.134	0.005	0.032	0.000	0.000	**5.264**
1987	2.760 [1)]	0.345	0.988	0.130	0.021	0.028	0.000	0.000	**4.272**
1988	2.660	0.328	0.858	0.129	0.024	0.042	0.000	0.001	**4.042**
1989	3.666	0.333	0.637	0.176	0.030	0.085	0.000	0.000	**4.927**
1990	3.732	0.437	1.046	0.292	0.052	0.185	0.000	0.007	**5.751**
1991	3.780	0.688	1.233	0.350	0.064	0.186	0.030	0.009	**6.340**
1992	3.495	0.902	0.907	0.317	0.081	0.163	0.066	0.003	**5.934**
1993	2.939	1.013	0.818	0.355	0.123	0.252	0.047	0.000	**5.547**
1994	2.724	0.882	0.862	0.330	0.141	0.263	0.042	0.000	**5.244**
1995	2.476	0.703	0.761	0.315	0.108	0.276	0.033	0.000	**4.672**
1996	1.776	0.687	0.618	0.210	0.160	0.157	0.036	0.000	**3.644**
1997	1.854	0.619	0.479	0.169	0.001	0.215	0.045	0.000	**3.382**
1998	1.695	0.582	0.392	0.198	0.022	0.164	0.033	0.001	**3.087**
1999	1.808	0.488	0.411	0.224	0.000	0.224	0.032	0.000	**3.187**
2000	2.280	0.549	0.469	0.302	0.021	0.349	0.055	0.001	**4.026**
2001	2.226	0.642	0.506	0.333	0.017	0.297	0.079	0.001	**4.101**
2002	1.898	0.551	0.677	0.244	0.015	0.280	0.085	0.000	**3.750**
2003	1.893	0.431	0.486	0.193	0.018	0.289	0.065	0.001	**3.375**
2004	1.762	0.463	0.518	0.207	0.015	0.278	0.075	0.001	**3.319**
2005	1.903	0.347	0.429	0.159	0.018	0.274	0.065	0.000	**3.195**
2006	1.828	0.381	0.338	0.146	0.022	0.221	0.040	0.001	**2.977**
2007	2.263	0.485	0.310	0.173	0.033	0.203	0.043	0.000	**3.510**
2008	1.744	0.371	0.457	0.182	0.022	0.199	0.033	0.000	**3.007**
2009	1.698	0.422	0.548	0.172	0.024	0.197	0.030	0.000	**3.091**
2010	1.469	0.385	0.466	0.118	0.037	0.191	0.026	0.000	**2.692**
2011	1.540	0.396	0.548	0.122	0.029	0.144	0.028	0.000	**2.807**
2012	1.739	0.362	0.482	0.145	0.030	0.120	0.036	0.000	**2.914**

Weights in thousand tonnes.

[1)] No official landings for the Netherlands between 1984 and 1987 in the ICES landings database. Values are inserted from the IBPNEW report (ICES, 2012).

[2)] "Other" includes Sweden and, in early years, Ireland and Faroe Islands.

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

Advice for 2013 and 2014

The 2012 advice for this stock is biennial and valid for 2013 and 2014 (see ICES, 2012): *Based on the ICES approach for data limited stocks, ICES advises that catches should be no more than 500 tonnes.*

Quality considerations

Landing statistics do not represent catches as discard rates are high. 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. A better understanding of population structure and population connectivity can be achieved by genetic and otolith chemistry surveys of spawning aggregations in the IIIa, including both fresh samples and historic material.

Source

ICES. 2012. Whiting in Division IIIa (Skagerrak – Kattegat). Report of the ICES Advisory Committee, 2012. ICES Advice, 2012. Book 6, Section 6.4.4.

Table 6.4.33.1 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	-	1.050	0.1	0.4
2013	20% Reduction in catches (last 3 years average)	< 0.5	1.050		
2014	Same catch advice as for 2013	< 0.5			

Weights in thousand tonnes.

[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.

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

Advice for 2014

ICES advises on the basis of precautionary considerations that total catches should be no more than 36 992 tonnes. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010-2012), this implies human consumption landings of no more than 24 389 tonnes (18 514 tonnes in the North Sea and 5875 tonnes in Division VIId). Management for Division VIId should be separated from the rest of Subarea VII.

Stock status

F (Fishing Mortality)				
	2010	2011	2012	
MSY (F_{MSY})	?	?	?	Undefined
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined
SSB (Spawning-Stock Biomass)				
	2011	2012	2013	
MSY ($B_{trigger}$)	?	?	?	Undefined
Precautionary approach (B_{pa},B_{lim})	?	?	?	Undefined
Qualitative evaluation	→	→	→	At recent average

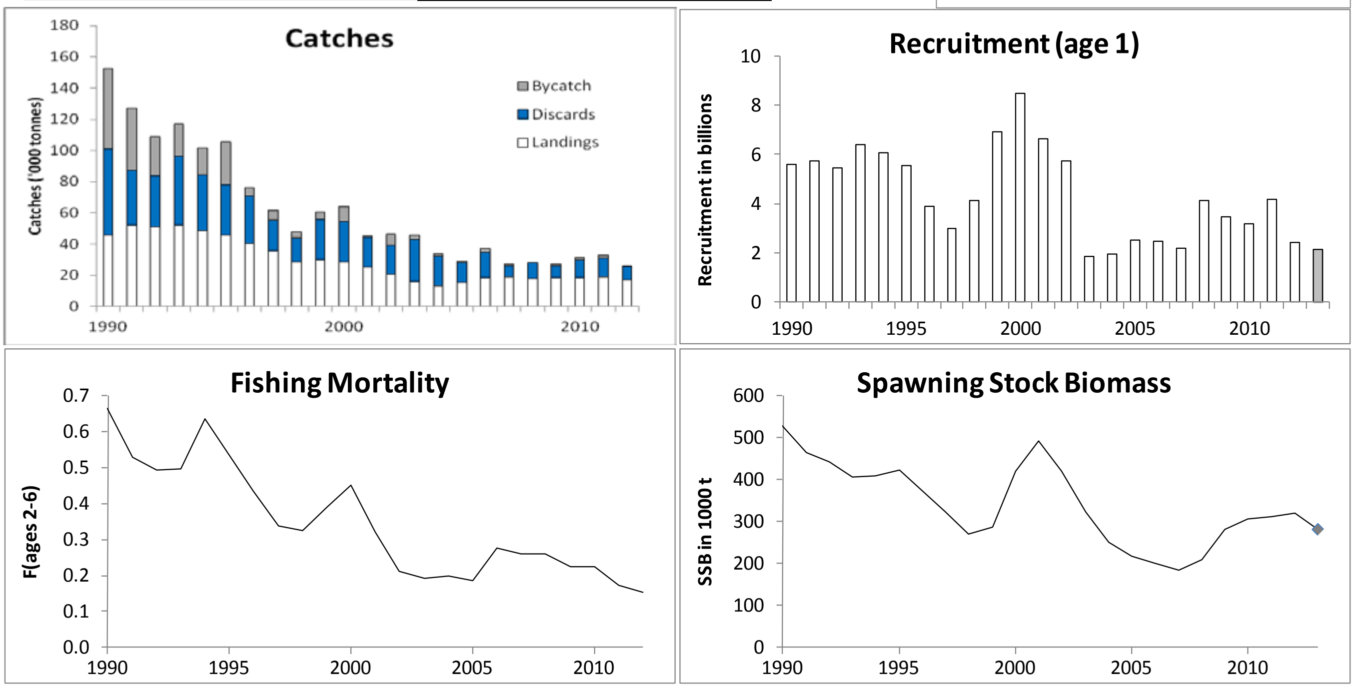


Figure 6.4.34.1 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Summary of stock assessment (weights in thousand tonnes), estimates are shaded. Top right: SSB and F over the time-series used in the assessment.

SSB has been below average since 2002, while fishing mortality has been declining over the whole time series. Recruitment has been well below average since 2003.

Management plans

A management plan was agreed by EU and Norway (see Annex 6.4.34). Based on a considerable revision of the natural mortality rate in 2012, the target F of 0.3 is no longer considered applicable.

Biology

Recent changes in spatial distribution may represent a contraction to a sub-stock structure that coincides with the main spawning areas in the North Sea. Additionally, the stock may also link with whiting in the West of Scotland area. Whiting are a major prey component in the diet of many piscivorous fish and marine mammals, and are also important predators for juvenile fish and lower trophic levels.

The fisheries

Whiting are caught in mixed demersal roundfish fisheries, fisheries targeting flatfish, *Nephrops* fisheries, and as bycatches in the industrial sandeel and Norway pout fisheries Industrial fisheries have reduced considerably since 1995 due to low TACs. The quota for this stock has been restrictive for some fleets for which whiting are commercially very important since 2010. Fleets with lower commercial interest in whiting can have higher discard rates.

Catch distribution	Total catch (2012) = 25485 t, where 17032 t are landings (~48% demersal trawls and seine with mesh >= 120 mm North Sea, 23% demersal trawls mesh size 70–99 mm North Sea, 16% demersal trawls mesh size 70–99 mm Eastern Channel, and 12% other gears), 8376 t discards, and 78 t industrial bycatch.

Quality considerations

The improvement of natural mortality estimates led to a significant revision of the perception of the stock in 2012. While catch rates from local fleets may not represent trends in the overall stock, the catch and survey data appear to indicate consistent stock trends. This is due in part to the improvement in the provision of landing and discard estimates from participating countries in recent years. Stock identity remains an unresolved issue with this assessment.

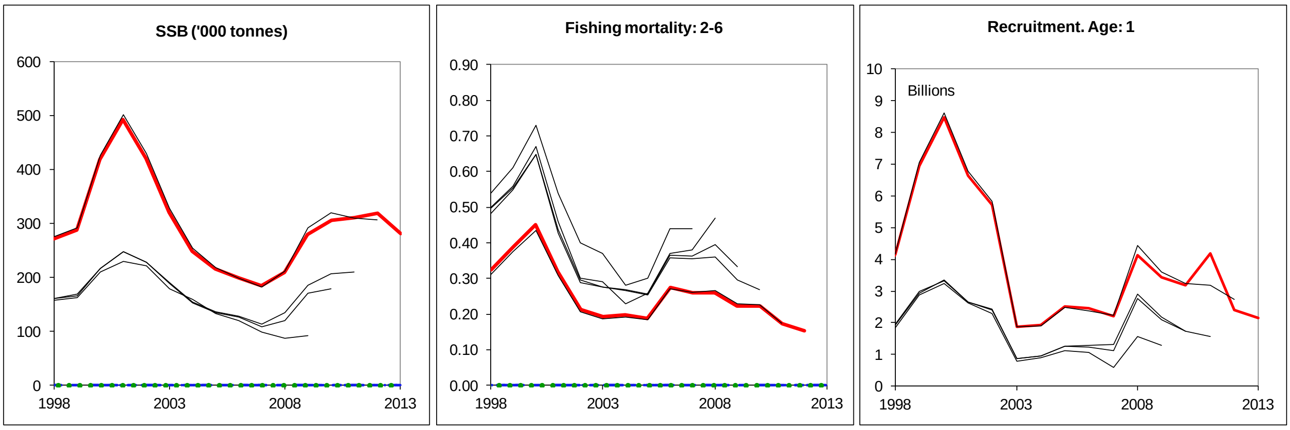


Figure 6.4.34.2 Whiting in Subarea IV (North Sea) and Division VIId (Eastern Channel). Historical assessment results (final-year recruitment estimates included). In 2012, natural mortality estimates changed substantially taking into account additional predation mortality (increase of around 50% for ages 2–8 based on ICES, 2011b).

Scientific basis

Assessment type	Age-based analytical (FLXSA).
Input data	Commercial catches (international landings, ages from catch sampling by métier), two survey indices (IBTS Q1 & Q3 ages 1 to 5). Maturity data assumed fixed through time. Time-varying natural mortalities from the SMS multispecies model.
Discards and bycatch	Discards included in the assessment since 1990, using samples (in 2012) from Denmark, France, Germany, Netherlands, UK (England) and UK(Scotland).
Indicators	None.
Other information	This assessment was benchmarked in 2013 (WKROUND).
Working group report	WGNSSK (ICES, 2013)

6.4.34 **Supporting information June 2013**

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 2014

Basis: F (2013) = average exploitation (2010-2012), scaled to 2012 = 0.153; SSB (2014) = 271.218; TAC IV (2013) = 18.932; Human consumption landings (2013) = 17.466; Discards (2013) = 7.78; Industrial bycatch (2013) = 0.899; Recruitment (2014) = GM1990-2010=4139.101 million.

Rationale	Total Catch 2014	Total Landings IV+VIId 2014	Total Discards 2014	Total IBC 2014	Landings IV 2014	Landings VIId 2014	Basis	Total F 2014	F(landings) 2014	F(disc) 2014	F(IBC) 2014	SSB 2015	% SSB change [1]	% TAC change [2]
Precautionary considerations	36.992	24.389	11.600	1.004	18.514	5.875	MP F rescaled (0.75 x 0.3)	0.225	0.143	0.079	0.004	311.434	+15%	-2%
Management plan	43.391	28.680	13.719	0.992	21.772	6.909	15% TAC increase (IV)	0.269	0.171	0.094	0.004	306.134	+13%	+15%
IBC only	1.068	0.000	0.000	1.068	0.000	0.000	F = 0	0.004	0.000	0.000	0.004	341.495	+26%	-100%
Other options	20.007	12.918	6.055	1.035	9.806	3.112	0.75 * F_{2013}	0.116	0.072	0.040	0.004	325.587	+20%	-48%
	31.742	20.856	9.874	1.013	15.832	5.024	1.25 * F_{2013}	0.190	0.120	0.066	0.004	315.796	+16%	-16%
	32.251	21.199	10.040	1.012	16.092	5.106	15% TAC decrease (IV)	0.194	0.122	0.067	0.004	315.372	+16%	-15%
	25.963	16.953	7.986	1.024	12.869	4.084	F_{2013}	0.153	0.096	0.053	0.004	320.610	+18%	-32%
	37.812	24.939	11.870	1.002	18.932	6.007	Rollover TAC	0.231	0.146	0.081	0.004	310.754	+15%	0%
	47.843	31.655	15.205	0.984	24.030	7.625	MP F target	0.300	0.191	0.105	0.004	302.458	+12%	27%
Mixed-fisheries options – minor differences with calculation above can occur due to different methodology used (ICES, 2013b)														
Maximum	48.212	31.983	16.229	-	24.307	7.676	A	0.31	-	-	-	301.300	+11%	+28%
Minimum	13.540	9.067	4.472	-	6.891	2.176	B	0.08	-	-	-	330.336	+22%	-64%
Cod_MP	13.731	9.195	4.536	-	6.988	2.207	C	0.08	-	-	-	330.174	+22%	-63%
SQ_Effort	26.608	17.758	8.849	-	13.496	4.262	D	0.16	-	-	-	319.332	+18%	-29%
Effort_Mgt	11.283	7.560	3.723	-	5.746	1.814	E	0.07	-	-	-	332.243	+23%	-70%

Weights in thousand tonnes.

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

[1] SSB 2015 relative to SSB 2014.

[2] Human consumption for Subarea IV in 2014 relative to TAC for Subarea IV and Division IIa in 2013 (18932 t).

Mixed-fisheries assumptions (IBC are included in landings in the mixed fisheries projections):
Maximum scenario: Fleets stop fishing when the last quota is exhausted.
Minimum scenario: Fleets stop fishing when the first quota is exhausted.
Cod management plan scenario: Fleets stop fishing when the cod quota is exhausted.
SQ effort scenario: Effort in 2012 and 2013 as in 2011.
Effort management scenario: Effort reductions according to cod and flatfish management plans.

The catch split between Subarea IV and Division VIId in 2013 is assumed to be the same as the proportion as estimated in 2012: 76% landings from Subarea IV and 24% landings from Division VIId. This assumes separate management for Division VIId from Subarea VII.

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 management of whiting at this level of total fishing mortality, conditional on a ±15% TAC constraint.

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 the 2012 assessment, caused by new estimates of natural mortality, the target F is no longer considered applicable and the management target needs re-evaluation.

Following the agreed management plan implies fishing at the target rate of 0.3, which results in a TAC increase for Human Consumption landings in IV of more than 15%. Therefore, the maximum TAC increase of 15% is applied, resulting in human consumption landings for the total area of no more than 28 680 t in 2014. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010-2012), this implies catches of no more than 43 391 t.

Precautionary considerations

As an interim measure, the target F in the plan (0.3) has been scaled 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 2012/2013 assessments, which would generate a target F of 0.225 (0.75 * 0.3).

Following this approach in 2014 with a target fishing mortality of 0.225 would lead to total catches of no more than 36 992 t. If rates of discards and industrial bycatch do not change from the average of the last 3 years (2010-2012), this implies human consumption landings of no more than 24 389 t (18 514 t in the North Sea and 5875 t in Division VIId).

Mixed fisheries

In contrast to single-species advice there is no single recommendation for mixed fisheries (ICES, 2013b), but rather a range of example scenarios, assuming fishing patterns and catchability in 2013 and 2014 are unchanged from those in 2012. Major differences between the outcomes of the various scenarios indicate potential undershoot or overshoot of the advised landings corresponding to the single-species advice. As a result, fleet dynamics may change, but cannot be determined.

Cod is the main limiting species for the North Sea demersal fisheries in 2014.. In all scenarios except the 'max', 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, 2011a). With the revisions in the level of fishing mortality in 2012, this evaluation is invalidated. ICES has been requested to re-evaluate the EU-Norway management plan with the new stock assessment results in 2013.

The whiting bycatch which occurs in the industrial Norway pout and sandeel fisheries has declined due to more selective gears (mandatory since 2012), and a reduced fishery. 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).

Regulations and their effects

The minimum mesh size was increased for demersal whitefish vessels to 120 mm in the northern North Sea in 2002 and this may have contributed to the substantial decrease in catches. Landing compositions from this 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 33% in 2012. Because of the restrictive TACs, discard rates increased in 2010 and 2011, although they are estimated to have decreased again in 2012. More selective gears were introduced in the *Nephrops* (TR2) fleet in 2012 which may also have contributed to a decline in discard rates.

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. However, for 2013, the European Council decided upon a roll-over of effort level of 2012 into 2013 for both the cod and the sole/plaice management plan.

Overall nominal effort (kW-days) by EU demersal trawls, seines, beam trawls, gill/trammel nets and longlines (all mesh sizes included) in the North Sea, Skagerrak, and Eastern Channel had been substantially reduced since the implementation of the two successive effort management plans in 2003 and 2008 (−40% between 2003 and 2012, -16% between 2008 and 2012). 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 and in small mesh beam trawl (80–120 mm, BT2), has shown a pronounced decline (−14%, −45%, and −48%, respectively, between 2004 and 2012). Gill and trammel nets fisheries have remained stable (ICES, 2013b). Effort in large mesh size beam trawl (>=120 mm, BT1) has increased significantly in 2012 after a decade of continuous decline. Nominal effort reported by Norway has increased since 2011 due to the generalization of electronic logbooks.

Uncertainties in the assessment

The use of updated natural mortality estimates from the 2011 key run of the North Sea multispecies model (ICES, 2011b) resulted in 2012 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 changed. Main reason for the increase in absolute natural mortality estimates was the inclusion of harbour porpoise and seals as additional predators in the multi species assessment model. The 2013 benchmark meeting (ICES 2013c, WKROUND) recommended that these natural mortality estimates continue to be used.

Whiting are largely mature from age 2, which means recruitment heavily influences SSB in the following year at low stock sizes. Discards are an important component of the catch. The sensitivity of the assessment outcomes to the raising procedure of discard data has been partially 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.

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. The 2013 benchmark meeting (ICES, 2013c, WKROUND) investigated this inconsistency further, but recommended that this truncation should continue to be used.

Information from the fishing industry

The report of the North Sea fishers' survey (Napier, 2012) shows the industry's perception of increasing whiting abundance across the entire North Sea, which is not 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 generally consistent with differences in local stock abundance observed in scientific surveys.

Comparison with previous assessment and catch options

The 2013 assessment is in close agreement with that of 2012 in terms of SSB and F. In the absence of an updated evaluation of the management plan and reference points, the advice is based on precautionary considerations, as last year.

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, because whiting in the rest of subarea VII is not assessed together with whiting in 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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Napier, I. R. 2012. Fishers' North Sea stock survey 2012. NAFC Marine Centre, Shetland, Scotland.

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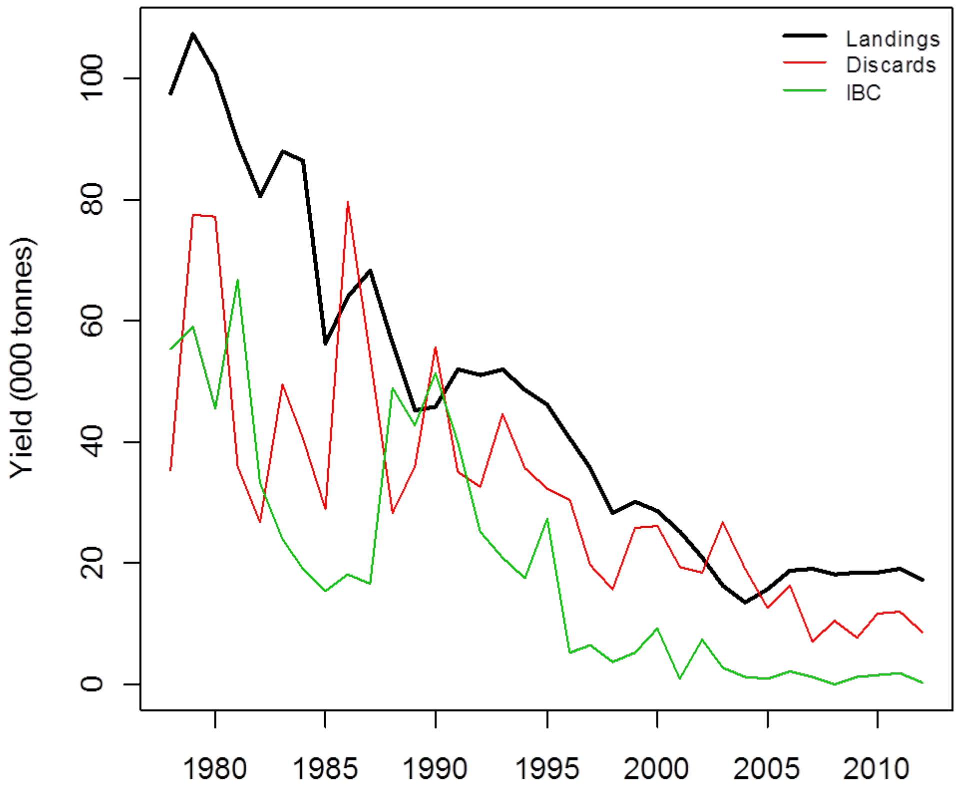

Figure 6.4.34.3 Whiting in Subarea IV and Division VIId. Historical catches, subdivided in landings, discards, and industrial bycatches (in thousand tonnes).

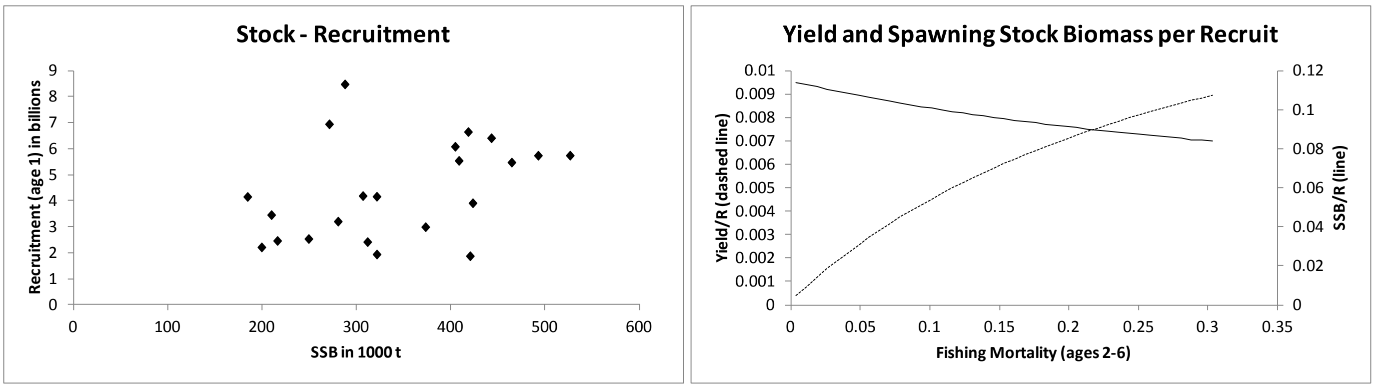

Figure 6.4.34.4 Whiting in Subarea IV and Division VIId. Stock–recruitment and yield-per-recruit plot.

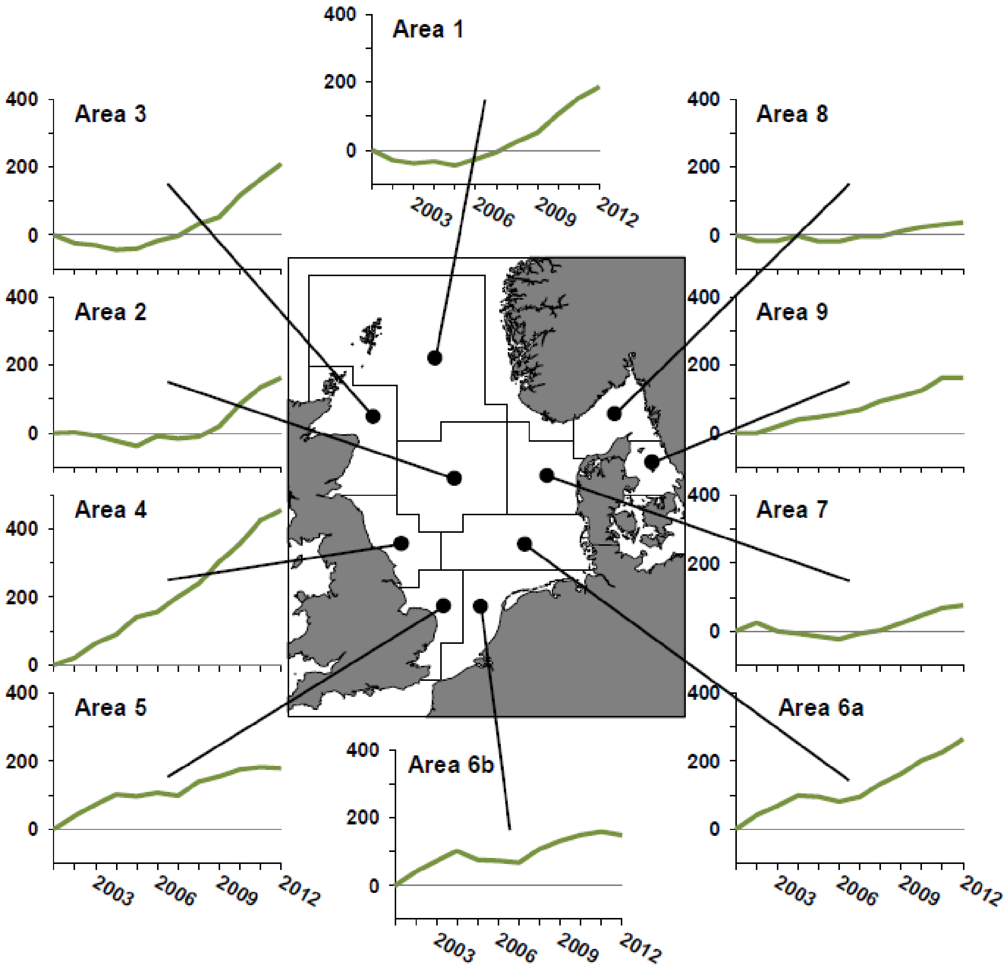

Figure 6.4.34.5 Whiting in Subarea IV and Division VIId. Results of the North Sea Commission fisher's survey 2012 (Napier, 2012).

Table 6.4.34.1 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	$\leq$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	12.547	12.929	0.078	5.929	18.936
2013	Precautionary considerations (F 0.225) and separate management for VIId	< 19	18.932					
2014	Precautionary considerations (F 0.225) and separate management for VIId	< 18.514						

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

Table 6.4.34.2 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 Sea	-	-	5.6	5.4
1996	Reference made to North Sea advice	-	-	5.1	5.0
1997	Reference made to North Sea advice	-	-	4.8	4.6
1998	Reference made to North Sea advice	5.8	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	3.852	4.103
2013	Precautionary considerations (F = 0.225) and separate management for Division VIId	< 7	24.500		
2014	Precautionary considerations (F = 0.225) and separate management for Division VIId	< 5.875			

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 6.4.34.3 Whiting in Subarea IV and Division VIId. Official landings (in tonnes) by country and by area, and ICES estimates of catches.

Subarea IV

year	belgium.iv	denmark.iv	france.iv	germany.iv	netherlands.iv	norway.iv	sweden.iv	england.wales.iv	scotland.iv	uk.iv	total.landings.iv	unallocated.landings.iv	ices.landings.iv	ices.discards.iv	ices.ibc.iv	ices.catch.iv
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	42180	52270	51337	145787
1991	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	46210	30840	39755	116805
1992	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	45210	28470	25045	98725
1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	46610	41400	20723	108733
1994	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	41870	31840	17473	91183
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40550	28940	27379	96869
1996	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	35550	27130	5116	67796
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	30940	16660	6213	53813
1998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	23690	12480	3494	39664
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25700	22110	5038	52848
2000	536	105	2527	424	1884	33	4	1782	17158	NA	24453	173	24280	21931	9160	55371
2001	454	105	3455	402	2478	44	6	1301	10589	NA	18834	-426	19260	16130	940	36330
2002	270	96	3314	354	2425	47	7	1322	7756	NA	15591	721	14870	17144	7270	39284
2003	248	89	2675	334	1442	39	10	680	5734	NA	11251	801	10450	26135	2730	39315
2004	144	62	1721	296	977	23	2	1209	5057	NA	9491	541	8950	18142	1210	28302
2005	105	57	1261	149	805	16	0	2560	3441	NA	8394	-2286	10680	10300	890	21870
2006	93	251	2711	252	702	17	1	3539	8093	NA	15659	562	15097	14018	2190	31305
2007	45	79	3312	76	618	11	1	3048	9063	NA	16253	587	15666	5206	1240	22112
2008	115	42	3051	76	656	92	1	1541	8850	NA	14424	945	13479	8356	0	21835
2009	162	80	2304	125	718	73	4	1397	7456	NA	12319	545	11774	5223	1020	18017
2010	147	158	2631	156	615	118	8	NA	NA	7841	11527	-754	12281	7853	1350	21484
2011	74	135	2546	111	514	28	6	NA	NA	8891	12305	-1000	13305	8180	1750	23235
2012	43	131	1925	18	468	93	3	NA	NA	9862	12547	-382	12929	5929	78	18936
2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 6.4.34.3 Continued

Division VIId

year		belgium.viid	france.viid	netherland.viid	england.wales.viid	total.landings.viid	unallocated.landings.viid	ices.landings.viid	ices.discards.viid	ices.catch.viid
1990		NA	NA	NA	NA	NA	NA	3480	3330	6810
1991		NA	NA	NA	NA	NA	NA	5720	4220	9940
1992		NA	NA	NA	NA	NA	NA	5740	4090	9830
1993		NA	NA	NA	NA	NA	NA	5210	2970	8180
1994		NA	NA	NA	NA	NA	NA	6620	3850	10470
1995		NA	NA	NA	NA	NA	NA	5390	3240	8630
1996		NA	NA	NA	NA	NA	NA	4950	3370	8320
1997		NA	NA	NA	NA	NA	NA	4620	3000	7620
1998		NA	NA	NA	NA	NA	NA	4600	3210	7810
1999		NA	NA	NA	NA	NA	NA	4430	3570	8000
2000		65	5875	14	118	6072	1772	4300	4129	8429
2001		75	6338	67	134	6614	814	5800	3109	8909
2002		58	5172	19	112	5361	-439	5800	1356	7156
2003		67	6654	175	109	7005	1295	5710	604	6314
2004		46	5006	132	99	5283	933	4350	907	5257
2005		45	4638	128	90	4901	111	4790	2219	7009
2006		73	3487	117	53	3730	287	3443	2291	5734
2007		75	3135	118	50	3378	124	3254	1763	5017
2008		69	2875	162	54	3160	-1311	4471	1943	6414
2009		71	6266	112	86	6535	-111	6646	2477	9123
2010		88	5436	270	253	5959	20	5939	3727	9666
2011		78	4438	282	271	5069	5	5064	3538	8602
2012		63	3093	438	258	3852	-251	4103	2446	6549
2013		NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 6.4.34.4 Whiting in Subarea IV and Division VIId. Summary of stock assessment (weights in tonnes).

	Recruitment	TSB	SSB	Catch	Landings	Discards	Bycatch	Yield/SSB	Mean F(2-6)
1990	5589678	970318	526272	152602	45662	55603	51337	0.087	0.664
1991	5728263	1006935	464402	126742	51929	35058	39755	0.112	0.53
1992	5462339	871396	442845	108555	50946	32564	25045	0.115	0.491
1993	6398115	834800	404478	116911	51818	44370	20723	0.128	0.495
1994	6069489	878549	408466	101650	48486	35692	17473	0.119	0.635
1995	5528000	876305	423150	105494	45938	32176	27379	0.109	0.535
1996	3899647	713644	373037	76123	40503	30505	5116	0.109	0.434
1997	2980408	585156	321342	61435	35563	19660	6213	0.111	0.338
1998	4150333	612905	270982	47475	28288	15693	3494	0.104	0.325
1999	6933390	779266	287554	60845	30130	25677	5038	0.105	0.39
2000	8465955	1315334	418301	63806	28583	26063	9160	0.068	0.452
2001	6635602	1114463	492490	45242	25061	19237	944	0.051	0.32
2002	5725704	785231	420322	46450	20675	18501	7275	0.049	0.212
2003	1863855	425258	321403	45640	16161	26745	2734	0.05	0.192
2004	1929401	443322	249125	33557	13295	19048	1214	0.053	0.198
2005	2524939	499515	215977	28883	15471	12525	888	0.072	0.187
2006	2450362	491809	199275	37038	18535	16310	2193	0.093	0.276
2007	2202521	382443	184313	27125	18915	6971	1239	0.103	0.26
2008	4141709	600340	209623	28247	17951	10296	0	0.086	0.26
2009	3444175	577160	280282	27139	18418	7705	1016	0.066	0.223
2010	3193385	567811	306627	31147	18224	11577	1346	0.059	0.223
2011	4175681	714721	311516	32626	18899	11977	1750	0.061	0.174
2012	2406418	517781	319340	25485	17032	8375	78	0.053	0.153
2013	2139711*		281593**						

* RCT3 estimate
** Estimated survivors from 2012

Annex 6.4.34 Long-term management plan for whiting in the North Sea

From the EU–Norway agreement 2013:

The Parties agreed to implement a long-term management plan for the whiting stock in the North Sea, 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. The Parties shall establish a TAC that is 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. A review of this arrangement shall take place no later than 31 December 2014.

4. This arrangement entered into force on 1 January 2012.

ECOREGION North Sea
STOCK Witch in Subarea IV and Divisions IIIa and VIId

Advice for 2014 and 2015

Based on the ICES approach for data limited stocks, ICES advises that landings should be no more than 1574 tonnes. Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Stock status

F (Fishing Mortality)		
	2012	
Qualitative evaluation		Above possible reference points
TSB (Total Stock Biomass)		
	2006 - 2013	
Qualitative evaluation		Increase

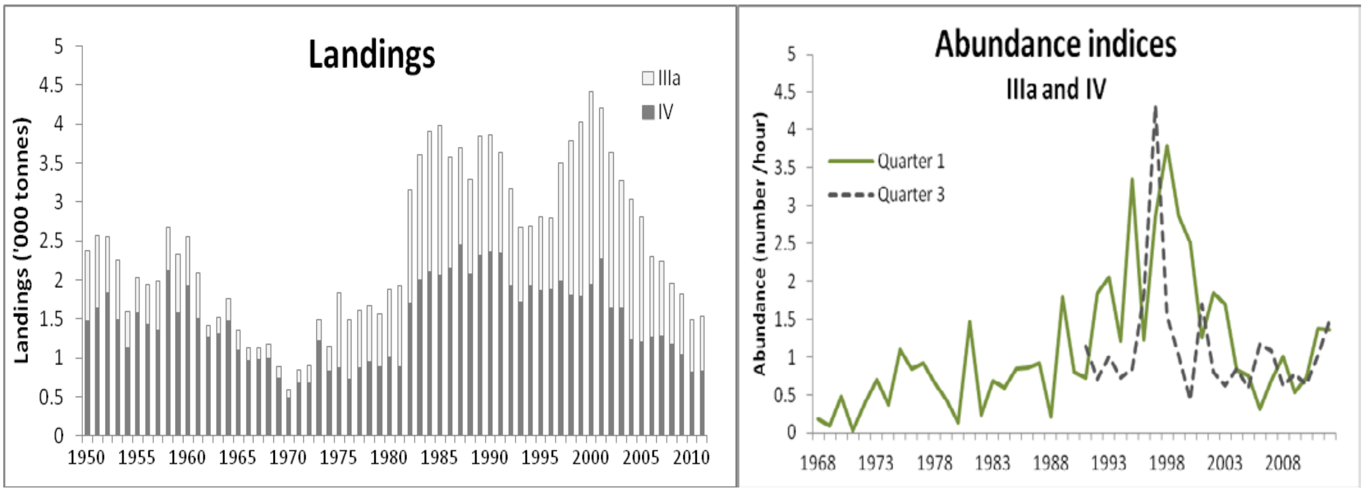

Figure 6.4.35.1 Witch in Subarea IVand Division IIIa and VIId. Left: Official landings by area (in thousand tonnes, landings in Division VIId are negligible). Right: Abundance indices (Trend in cpue (n/h) from the IBTS survey in quarter 1 and 3).

Landings have declined in the last decade, but the 2012 landings in IIIa show an increase. Abundance indices show a declining trend since the peak observed in 2000 and an increase in recent years. The stock size indicator (number/hour) in the last three years (2011–2013) is more than 20% higher than the average of the five previous years (2006–2010) for both surveys. Exploratory estimates suggest that fishing mortality is above potential F_{MSY} proxies.

Management plans

No specific management objectives are known to ICES. An EU TAC is set for EU waters of area IIa and IV together with lemon sole witch (ICES, 2013a).

Biology

Witch (also known as witch flounder) is common in the northern North Sea, west of the British Isles, in Icelandic waters and along the North American east coast. The species is mainly found on soft bottoms, mostly clay or clean sandy bottoms around 100–400 m depth. The main diet consists of crustaceans, worms, brittle stars and fishes. Spawning season may vary among different stock with the Skagerrak as a possible separate spawning stock. Growth rate can vary considerably across the area.

The fisheries

Witch is an important bycatch in some *Nephrops* fisheries. There is an occasional directed fishery in the Skagerrak. There is no Minimum Landing Size (MLS) specified in EU waters. However, on a local level a minimum landing size of 28 cm is enforced in Germany, Denmark, Scotland, Sweden and in some coastal areas of England. Discard rates are unknown but are potentially important to the assessment.

Quality considerations

Information on stock structure, biological data and catch at age information would be needed to be able to perform an analytic assessment. The survey indices are variable probably mainly because the survey is not designed for catching witch and catch per hour is low. Age readings and maturity status evaluation techniques are still uncertain and under development.

The advice is based on abundance indices from two surveys, used as an indicator of stock size. The uncertainty associated with the index values is not available. The F_{MSY} proxy results from a preliminary age based assessment that is mainly based on information from IIIa. Similar information from IV is needed.

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 analysis and XSA exploratory assessment (ICES Data limited stock approach category 3.2.0)
Input data	Commercial catches (international landings, length frequencies distribution and catch at age from catch sampling), two survey indices (IBTS Q1 and IBTS Q3 Survey cpue), annual maturity data from commercial catch sampling),
Discards and bycatch	Not included in the assessment and only available for some fleets.
Indicators	None.
Other information	2011 was the first year ICES reported on this species in this area
Working group report	WGNEW/WGNSSK (ICES, 2013b, 2013c)

ECOREGION North Sea
STOCK Witch in Subarea IV, Division IIIa and VIId

Reference points

	Type	*Value*	*Technical basis*
MSY Approach	MSY $B_{trigger}$	Not defined	
	F_{MSY}	0.18	Provisional proxy based on estimate of $F_{0.1}$
Precautionary Approach	B_{lim}	Not defined	
	B_{pa}	Not defined	
	F_{lim}	Not defined	
	F_{pa}	Not defined	

(Changed in 2013)

Outlook for 2014 and 2015

No analytical assessment can be presented, mainly due to a lack of sufficiently long datasets. Therefore, fishing possibilities cannot be projected

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. Knowledge about the exploitation status also influences the advised catch.

The stock size indicator (number/hour) in the last three years (2011–2013) compared to the average of the five previous years (2006–2010) is 73% and 24% higher for the Quarter 1 and Quarter 3 survey respectively. This implies an increase of landings of at most 20 % in relation to the last three years average landings to 1968 t.

The effort of the main fleet with witch bycatches (otter trawls) in the North Sea and Skagerrak has declined by 14% (TR1) and 45% (TR2) between 2004 and 2012. In the Skagerrak, a similar decrease was seen for TR2 which is the main fleet in this area. At the same time, there is indication from a preliminary assessment that the stock may be overexploited. Concluding, there is uncertainty on the exploitation rate on witch, therefore ICES advises that landings should decrease by 20% as a precautionary buffer. This results in landings of no more than the last three years average landings of 1574 t in 2014.

Discards are known to take place, but the data are insufficient to estimate a discard proportion that could be applied to give catch advice; therefore total catches cannot be calculated.

Additional considerations

Both in IIIa and IV, witch is mainly caught as bycatch species in mixed fisheries. TACs may not be appropriate as a management tool for bycatch species.

Data requirements

The collection of biological data has only recently started (2009) and age reading and maturity staging techniques are still uncertain and under development. In addition, harbour sampling for age and maturity status in Subarea IV is needed from all main fishing countries. A reliable analytical assessment will be possible when a sufficient long data time-series will be available.

Comparison with previous assessment and advice

Last years advice was the same as the previous year and based on precautionary considerations. This year, the basis for the advice is the ICES approach to data limited stocks.

Sources

ICES.2013a. Lemon sole in Subarea IV, Division IIIa and VIId, Report of the ICES Advisory Committee, 2013. ICES Advice, 2013. Book 6, Section 6.4.30.

ICES. 2013b. Report of the Working Group on Assessment of New MoU Species (WGNEW) 18–22 March ICES HQ, Denmark, ICES CM 2013/ACOM:21.

ICES. 2013c. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), 24–30 April 2013. ICES CM 2013/ACOM:13

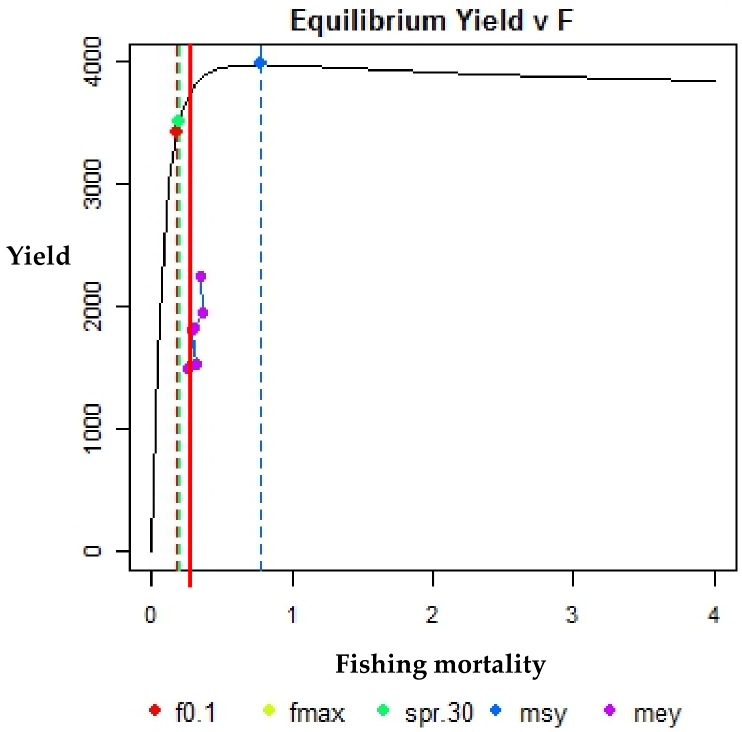

Figure 6.4.35.2. Witch in Subarea IV, Division IIIa and VIId. Yield per fishing mortality plot. Reference points (dots) derived from the XSA explora

Table 6.4.35.1 Witch in Subarea IV, Division IIIa and VIId. ICES advice, management and landings

Year	ICES Advice	Predicted catch/landings corresp. to advice Witch	Agreed TAC[1] Lemon sole & Witch	Official landings Lemon sole & Witch	Official landings Witch
2006		-	6.175	6.593	2.303
2007		-	6.175	6.725	2.237
2008		-	6.793	5.929	1.954
2009		-	6.793	5.212	1.818
2010		-	6.521	4.691	1.490
2011		-	6.391	5.552	1.530
2012	Reduce catches	-	6.391	5.922	1.896
2013	No new advice, same as for 2012	-	6.391		
2014	Decrease landings by 4% (last 3 years average)	< 1.574			
2015	No new advice, same as for 2014	< 1.574			

Weights in thousand tonnes.
[1] EU combined TAC for lemon sole and witch in EU areas IIa and IV.

Table 6.4.35.2 Witch in Subarea IV, Division IIIa. Official landings per area (in tonnes).

Year	IIIa	IV	VIId	Totals
1950	902	1477	0	2379
1951	923	1645	0	2568
1952	713	1841	0	2554
1953	767	1496	0	2263
1954	463	1127	0	1590
1955	450	1577	0	2027
1956	502	1434	0	1936
1957	643	1348	0	1991
1958	559	2119	0	2678
1959	752	1581	0	2333
1960	640	1923	0	2563
1961	594	1499	0	2093
1962	148	1271	0	1419
1963	209	1314	0	1523
1964	288	1472	0	1760
1965	260	1096	0	1356
1966	175	962	0	1137
1967	152	973	0	1125
1968	185	989	0	1174
1969	156	735	0	891
1970	118	479	0	597
1971	162	681	0	843
1972	235	673	0	908
1973	277	1217	0	1494
1974	304	834	0	1138
1975	972	869	0	1841
1976	778	718	0	1496
1977	738	880	0	1618
1978	719	945	0	1664
1979	678	894	0	1572
1980	874	1009	43	1926
1981	1044	889	0	1933
1982	1453	1702	0	3155
1983	1598	2008	0	3606
1984	1796	2107	0	3903
1985	1921	2058	0	3979
1986	1426	2153	0	3579
1987	1252	2448	0	3700
1988	1210	2080	0	3290
1989	1520	2321	0	3841
1990	1498	2364	0	3862
1991	1301	2340	0	3641
1992	1237	1927	0	3164
1993	950	1723	0	2673
1994	771	1925	0	2696
1995	939	1871	0	2810
1996	902	1888	0	2790
1997	1502	1992	0	3494
1998	1986	1800	0	3786
1999	2239	1785	1	4025
2000	2477	1945	0	4422
2001	1939	2267	0	4206
2002	2006	1634	0	3640
2003	1646	1635	0	3281
2004	1788	1241	0	3029
2005	1605	1208	0	2813
2006	1043	1260	0	2303
2007	949	1287	1	2237
2008	783	1170	1	1954
2009	773	1045	0	1818
2010	675	815	0	1490
2011	693	837	0	1530
2012	1107	788	1	1896

Table 6.4.35.3 Witch in Subarea IV, Division IIIa. Average CPUE (n/h) estimated from IBTS surveys for quarter 1 and quarter 3.

Year	Q1	Q3
1968	0.175	
1969	0.095	
1970	0.474	
1971	0.030	
1972	0.407	
1973	0.704	
1974	0.375	
1975	1.096	
1976	0.841	
1977	0.920	
1978	0.656	
1979	0.430	
1980	0.141	
1981	1.469	
1982	0.237	
1983	0.684	
1984	0.594	
1985	0.851	
1986	0.854	
1987	0.919	
1988	0.218	
1989	1.788	
1990	0.800	
1991	0.725	1.140
1992	1.854	0.716
1993	2.050	1.008
1994	1.218	0.731
1995	3.357	0.852
1996	1.221	1.824
1997	2.864	4.320
1998	3.789	1.535
1999	2.860	1.019
2000	2.515	0.427
2001	1.253	1.699
2002	1.848	0.806
2003	1.703	0.619
2004	0.835	0.840
2005	0.755	0.591
2006	0.321	1.176
2007	0.699	1.082
2008	1.006	0.619
2009	0.538	0.767
2010	0.721	0.640
2011	1.371	1.021
2013	1.360	1.484