

ECOREGION **North Sea and Baltic**
SUBJECT **Joint EU-Norway request on long term management for herring in the Western Baltic and the Skagerrak and Kattegat**

Advice Summary

ICES reviewed the available data and models for the assessment of the Western Baltic herring stock (WBSS). Wide scale misreporting of historic catch was acknowledged. Data deficiencies on stock proportions were also found in Division IIIa with some geographical mismatch between catches and sampling, and in the Eastern North Sea the sampling intensity was found insufficient.

An alternative harvest control rule for the TAC setting for herring in Division IIIa and 22–24 is presented, on the basis of a 50:50 split between Division IIIa and Subdivisions 22–24. The 50:50 share of the WBSS TAC between Division IIIa and Subdivisions 22–24 was not specifically evaluated. However, the selection patterns of the C and F fleets were very different and thus choices about the share between Division IIIa and Subdivisions 22–24 are likely to have an impact on the sustainable exploitation of the stock. Additionally, a summer closure of fisheries in the Eastern North Sea should be considered to protect a vulnerable component of the WBSS herring.

Request

Catches of herring in Skagerrak and Kattegat are made up of a mixture of stocks, in particular Western Baltic spring spawners (WBSS) and North Sea autumn spawners (NSAS). A long term management plan for the NSAS has been agreed between the European Union and Norway, and a long term management plan for WBSS is being developed as part of a wider initiative on long term management plans for pelagic stocks in the Baltic. ICES has already advised on possible harvest control rules for this plan.

These plans would be used to fix the overall TACs for the respective stocks, but they do not indicate the appropriate level of the mixed stock TAC in Skagerrak and Kattegat. ICES is therefore requested to:

1. *Collate the available information on the seasonal movements of the WBSS and NSAS stocks.*
2. *Comment on the reliability of the methods currently used to estimate the proportions of WBSS and NSAS in the catches and suggest improvements that could be made to the sampling methodology in order to increase the precision of the estimates.*
3. *In the context of the agreed long term plan for NSAS and the suggested harvest control rules for WBSS, evaluate the compatibility of the following options for setting the mixed TAC in the Skagerrak and Kattegat with the precautionary approach and with the objective of reaching F_{msy} by 2015:*
 - a) *Adjust the TAC for fleet C in the Skagerrak and Kattegat by the average of the percentage adjustments of the NSAS and the WBSS.*
 - b) *Adjust the TAC for fleet C in the Skagerrak and Kattegat by the average of the percentage adjustments of the NSAS and the WBSS, weighted by the proportions of these stocks in the annual catches from the Skagerrak and Kattegat.*
 - c) *Set the TAC for fleet C in Skagerrak and Kattegat corresponding to the largest percentage reduction or smallest percentage increase in the TACs of the two stocks.*
 - d) *Set the TAC for fleet D in Skagerrak and Kattegat corresponding to the largest percentage reduction, the smallest percentage increase in the TACs of the two stocks or somewhere in between.*

For the purposes of these evaluations, it should be assumed that 50% of the TAC for the WBSS will be allocated to Division IIIa and 50% to SD 22-24.

4. *ICES is also invited to suggest other options, including seasonal and spatial limitations on catches in the Skagerrak in order to protect one or other component of the mixture.*
5. *The joint EU-Norway request to ICES on herring in the Skagerrak and Kattegat specified that the evaluations of the options for setting the TAC in the Skagerrak and the Kattegat should be based on the assumption that 50% of the TAC for the Western Baltic spring spawning (WBSS) herring would be allocated to Subdivisions 22-24 in the Baltic and 50% to the Skagerrak.*

ICES is requested to:

- a. Advise on whether the 50:50 split of the TAC between the two areas reflects the actual distribution of the catches.
- b. Suggest and evaluate alternative options for splitting the WBSS TAC, taking into account the seasonal movements of the stock.

ICES Advice

Request 1: Data availability

The existing knowledge on migrations and area distributions for NSAS and WBSS herring was summarised based on literature and recent catch and survey data. The general migration routes are known, allowing an end-to-end spatial lifecycle-closure model to be developed, encompassing active migrations of spawning components and larval drift, describing the connections, interactions and spatial distribution of herring. There are large amounts of empirical data available with which to verify the model, although the paucity of knowledge about specific over-wintering and feeding locations and the processes driving the migrations will challenge its construction. ICES encourages appropriate sampling and further process research to facilitate the construction of a spatial life cycle model for NSAS and WBSS herring.

Request 2: The reliability of the methods currently used to estimate the proportions of WBSS and NSAS in the catches: suggestions for improvements

The sampling for stock proportions in the mixed catches of herring in IIIa and IVa East was reviewed. There was clearly a mismatch between sampling intensity and catch distribution, particularly in relation to the part of the WBSS that migrates into the Eastern North Sea during summer feeding migrations. ICES' recommendations to improve the sampling scheme are presented below.

The methodology currently used to estimate stock proportions at age in the mixed catches of herring was evaluated. Misreporting of catches taken in the North Sea into Division IIIa before 2009 has been substantial and appears to be an important factor influencing the estimated catches by stock although this does not directly influence sampling of stock proportions.

A statistical modelling approach to hind-cast and predict stock proportions in catches was explored and appears promising. Some problems are still unresolved (e.g. uncertainty at the edges of the distribution and differences in observed and estimated proportions of age 2 herring, where most of the mixing occurs), but ICES recommends further refinement and peer-review of the statistical approach with the intention, when possible, to apply the approach in the ICES stock assessment and forecast in 2011.

Request 3 and 5: Setting a mixed TAC in the Skagerrak and Kattegat

ICES evaluated a range of options for setting the mixed TAC as suggested in the request. None of the suggested options was concluded to be optimal to manage the mixed stock in Division IIIa. ICES therefore suggested a different TAC setting procedure, compatible with the precautionary approach and with the objective of reaching F_{MSY} by 2015:

- i) First set the TAC for the WBSS herring according to the MSY (transition) framework for WBSS herring alone;
- ii) A seasonal closure of parts of the Eastern North Sea is suggested (parts of Sub Divisions IVb and IVaE, encompassing but not only restricted to the so-called "transfer area"), but until this is implemented it is recommended that the fraction taken in this area should be subtracted from the total TAC for WBSS before sharing the TAC between Division IIIa and Subdivisions 22–24;
- iii) Subsequently use the best estimates of the proportions of the NSAS and WBSS herring in the catch by fleet to calculate the combined catch options in compliance with the targeted catch for WBSS herring.

ICES notes that if the NSAS herring is greatly impacted by management of the WBSS herring, the rule (i to iii) should be re-evaluated.

Request 4: Suggested alternatives to the TAC measure for the mixed herring stock

ICES recommends a seasonal closure of the herring fishery in parts of the Eastern North Sea, however, until such is implemented, ICES advises that the above approach under ii) should be applied.

Request 5: On the 50:50 split of the TAC between the two areas

The 50:50 share of the WBSS TAC between Division IIIa and Sub Divisions 22–24 was not specifically evaluated. It was viewed as a political choice and thus all evaluations of TAC setting procedures were performed applying a 50:50 share of the TAC between Division IIIa and Sub Divisions 22–24, though using three different approaches as how to include the share taken in the North Sea.

The evaluation showed that the selection patterns of the C and F fleets were very different and thus choices about the share between Division IIIa and Subdivisions 22–24 are likely to have an impact on the sustainable exploitation of the stock.

Basis of advice

Western Baltic Spring Spawning herring (WBSS) and North Sea Autumn Spawning herring (NSAS) are assessed biologically as separate stocks, while the fisheries are managed by herring TACs per area. Since herring from the different stocks migrate between the Western Baltic and the North Sea, herring catches from the mixing areas in Division IIIa and parts of the Eastern North Sea contain herring from both stocks.

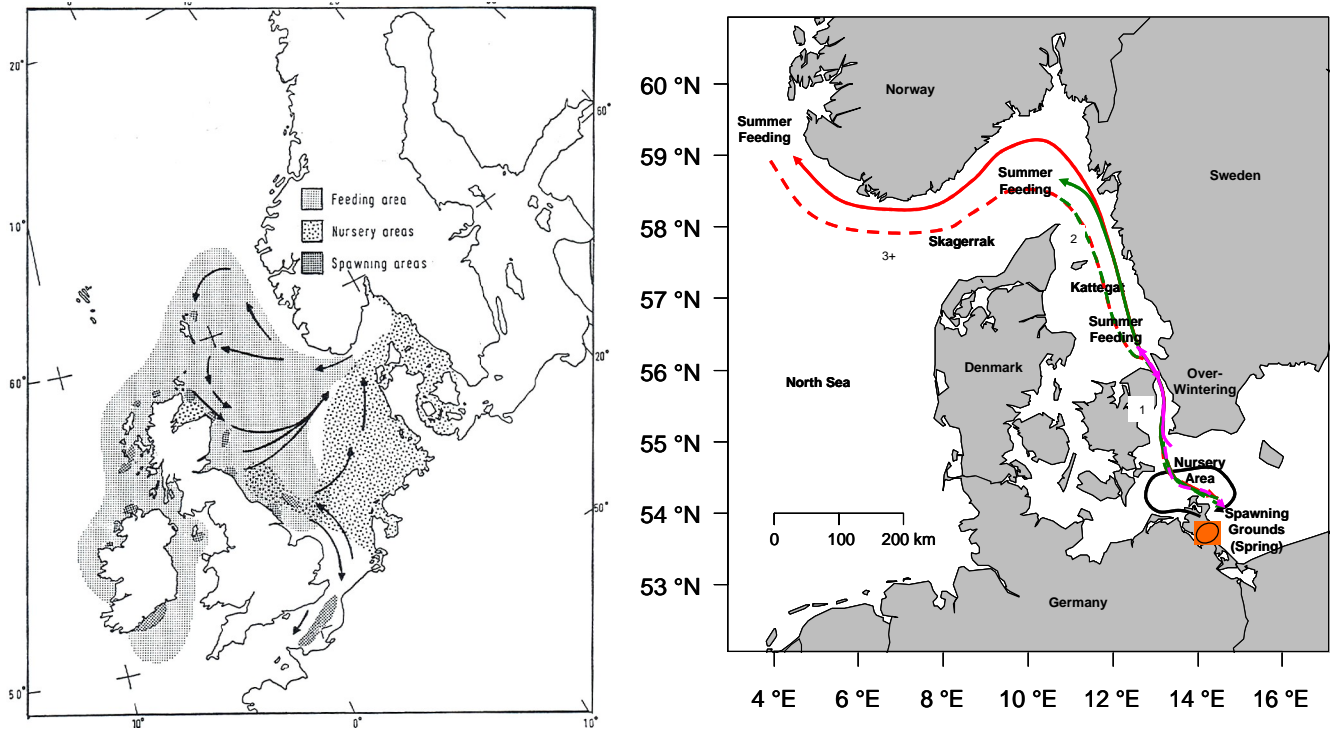


Figure 6.6.5.1 General migration patterns of the NSAS (taken from Burd, 1978) and WBSS (redrawn from M.Payne, the numbers indicates the age at migration into the areas). Left panel (NSAS): The locations of NSAS overwintering change over short and long time scales. Evidence from catch data in the period 2000–2009 suggest that in the last ten years, overwintering of NSAS has been in the north of the North Sea; Right panel (WBSS): The main spawning area of WBSS is considered to be Greifswalter Bodden at Rügen Island (Oerberst *et al.*, 2009).

	Subarea IV	Subarea IV	Division IIIa	Division IIIa	Subdiv. 22-24
	by-catch quota	TAC	TAC	by-catch quota	TAC
	Fleet B	Fleet A	Fleet C	Fleet D	Fleet F
ICES Advice	NSAS	NSAS	NSAS	NSAS	
		WBSS	WBSS	WBSS	WBSS
					ICES Advice

Figure 6.6.5.2 Overview of ICES advice and management areas and methods for NSAS and WBSS herring.

Table 6.6.5.1 Overview of specific fleet abbreviations used in the advice

Area	Fleet	Fishery
Division IVa East	A	Directed herring fisheries with purse-seiners and trawlers.
Division IVa East	B	Bycatches of herring caught in the small-mesh fisheries.
Division IIIa	C	Directed herring fisheries with purse-seiners and trawlers.
	D	Bycatches of herring caught in the small-mesh fisheries.
Sub Division 22-24	F	All herring fisheries in Subdivisions 22–24.

Request 1: Data availability

In the biological advice, the level of mixing between the stocks is measured and used to calculate a total TAC for herring in the separate areas. Improving the reliability in quantifying the levels of different stocks in the catches is important to improve the results of management measures. This applies to both data collected in Division IIIa and to the Eastern North Sea. In the Eastern North Sea sampling intensity of herring is poor and there is very little information on which to base scientific advice.

An end-to-end spatial lifecycle-closure model can be developed, as done for Norwegian Spring Spawning herring, with active migrations of spawning components and larval drift, to investigate the connection, interactions and spatial distribution of herring. It would make sense to construct one such model for both NSAS and WBSS herring.

Request 2: The reliability of the methods currently used to estimate the proportions of WBSS and NSAS in the catches: suggestions for improvements

The current methodology applied for estimation of the WBSS and NSAS proportions in the catches was evaluated. From 2001 and onwards, two different methods have been used in the different management areas: In IIIa, the splitting keys have been constructed solely using the otolith microstructure (OM) method, in IVaE, vertebral series counts (VS) are currently the only method used to split the mixed stock. VS have been used to split the proportions in IIIa before 2001, and the shift from VS to OM method resulted in a large increase in the precision of the stock proportions estimates. The precision for subdivision IVaE is still small and could be improved by combining VS method with an OM calibrated method exploiting meristic characters.

The workshop confirmed widespread misreporting of herring catches into and out of Division IIIa and Subdivisions 22–24 throughout the whole time series. In the most recent years misreporting has reduced, and the data coordinators for some countries have been adjusting the official catches since 2002. Historical misreporting has not directly influenced samples of stock proportions but appears to be a significant factor influencing estimated catches by stock. The corruption of the time series weakens the stock assessment and this uncertainty should be addressed. As for now, the information is based on anecdotal information from the fishing industry and thus the absolute amounts should be quantified or assessment methods applied that account for uncertainty in the catch.

A review of the complete catch-at-age matrix for the entire assessment period (1992 to date) or appropriate stock assessment methods may be required as it appears that historically more than 70% of the catches allocated to the Division IIIa were actually taken in the North Sea.

Additionally, the sampling scheme for biological information needs to be unified following a need for higher resolution in terms of spatial and temporal coverage. The analysis showed that the major source of uncertainty in the estimate of the stock mixing proportions is the variation between samples. This uncertainty could be reduced by adapting the sampling scheme and increasing the number of samples while at the same time reducing the number of individuals in the samples, to increase precision-to-cost ratios for the National laboratories.

The historic mixing of the two stocks was examined in the recently developed statistical “split model”, in order to quantify both the potential fixed seasonal patterns and the inter-annual variability around them and propose robust standard procedures for forecast and projections. The currently applied method for splitting catches between NSAS and WBSS herring in Division IIIa is appropriate, and applying the “split model” to the data for prediction of stock proportions may increase the accuracy, transparency and reproducibility of the splitting methodology.

Request 3 and 5: Setting a mixed TAC in the Skagerrak and Kattegat

Both long term management plans (agreed and proposed LTMPs) for NSAS and WBSS aim at an F_{MSY} of 0.25. Evaluation shows that this goal cannot always be met for both stocks together when setting a mixed TAC as each stock is considered individually and their dynamics may diverge. It is likely not possible to simultaneously manage to 1) protect the weaker stock, 2) keep the inter-annual variability in the catch constraint within the agreed boundaries, 3) reach F_{MSY} and 4) adhere to the assumed 50:50 split of the WBSS TAC between Subdivision 22–24 and Division IIIa.

ICES was asked to evaluate a number of options for setting the mixed TAC in Division IIIa. For the purposes of these evaluations, it was assumed that 50% of the TAC for the WBSS will be allocated to Division IIIa and 50% to SD 22–24. Due to the mixing and the additional NSAS in catches from Division IIIa, the 50:50 split of the catch options of WBSS between the two areas is not expected to reflect the actual distribution of the catches.

The TAC setting options as given in the request were evaluated using a short-term forecast model. Since the A fleet takes WBSS catches in IVaE (Figure 6.6.5.5.2), three scenarios were designed to evaluate different treatments of the WBSS catches by fleet A in each option. None of the TAC setting options from the request was concluded to be optimal

to manage the mixed stock in Division IIIa. A different management rule for setting such a TAC is therefore put forward, which would be compatible with the precautionary approach and with the objective of reaching F_{MSY} by 2015 (see advice). ICES notes that other interpretations of the request are possible. The ICES approach followed the one adopted when providing advice for WBSS herring (ICES, 2010a), based on input from the representative from the EC commission in the workshop.

The advice is supported by examples of short term forecasts, but it is important to underline that these do not replace the advice given from ICES for the WBSS stock (ICES, 2010a). The example forecast table was produced using an entirely different model setup and was used to evaluate request 3 a) to d).

The analysis was based on short-term consequences of the various options to the stock. ICES encourages the development of a simulation framework approach aiming at an evaluation of the long term consequences.

ICES was asked to suggest and evaluate alternative options for splitting the WBSS TAC, taking into account the seasonal movements of the stock. The 50:50 share between Division IIIa and Subdivisions 22–24 was not specifically evaluated however, the choice was viewed as a political one. The analysis shows that the selection patterns of the C and F fleets were very different with a much higher proportion of age 2 herring in fleet C, and thus choices about the share between Division IIIa and Subdivisions 22–24 are likely to have an impact on the sustainable exploitation of the stock. Mechanisms behind the geographical distribution of different age groups in the mixing areas are not clear and whether the recent concentration of age 2 in Division IIIa will continue cannot be predicted. However, the effect of the 50:50 share between IIIa and Subdivisions 22–24 should be investigated, with respect to distribution and selection patterns, especially with regards to its impact on young fish. It was not possible to conclude whether it would be optimal to continue applying a 50:50 split between Division IIIa and Subdivisions 22–24 or to suggest alternatives to this rule, due to insufficient time to perform the extensive modelling required to address this request. The basic assumption for the short term forecasts under the various management options evaluated was the 50:50 split in three alternative methods.

Request 4: Suggested alternatives to the TAC measure for the mixed herring stock

Alternative options other than a mixed stock TAC were discussed that could either replace or supplement the TAC measure and maintain the targets laid down in the management plans for WBSS and NSAS. No direct conclusions could be made on this subject; however some options were discussed as potential ways to protect the most vulnerable component of the mixture based on the seasonal spatial pattern of the mixture of the stocks.

- A closure of parts of the Eastern North Sea during the summer feeding migration period for WBSS herring could protect the stock component, which migrate into this area. This stock component consists of large, fecund and far migrating fish, probably from the Rügen spawning area. Because of the combined North Sea TAC for WBSS and NSAS herring and the fact that the WBSS component is much smaller than the NSAS component, this WBSS component is especially vulnerable to overfishing.

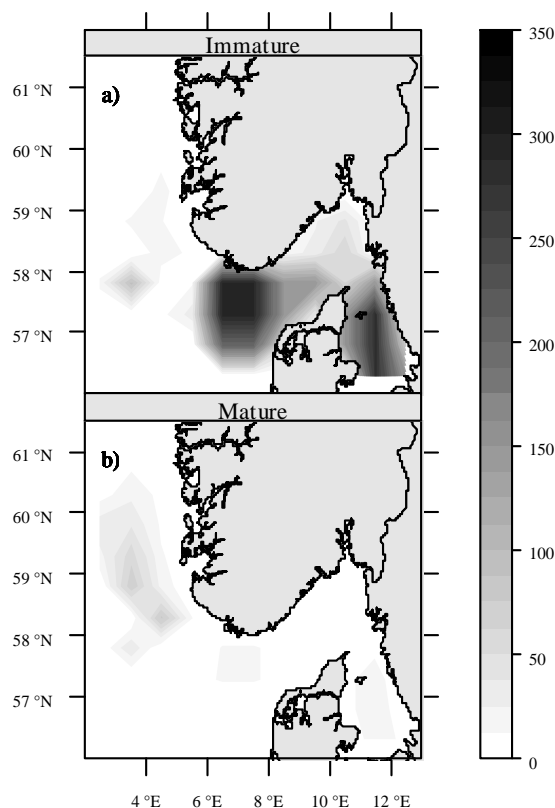


Figure 6.3.3.5.3 Distribution maps of WBSS herring in the Skagerrak, Kattegat, and eastern North Sea from the international HERAS survey in 2005 for (a) immature and (b) mature fish (Payne *et al.*, 2009).

- Alternative shares of the WBSS TAC between IIIa and Subdivisions 22–24 should be investigated, especially with regards to its impact on young fish. A higher share of the WBSS TAC allocated to Subdivisions 22–24 could potentially protect the WBSS stock, however, this should be scientifically examined and validated before any firm recommendations can be put forward concerning this matter.
- In terms of alternative ways to set a precautionary TAC for the mixed stock encompassing both stocks' reference points, other methods than the single stock assessment evaluation are under development and should be considered for future stock assessment of herring in the areas. The preliminary results from a two-stock state-space model shows great potential and this methodology should be investigated further for the NSAS and WBSS assessment.

Sources

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