

EU request on the further development of ICES mixed-fisheries considerations and biological interactions

Advice summary

Request 1: Advice on mixed-fisheries interactions has been produced for the Baltic Sea, Greater North Sea, and Celtic Seas ecoregions and is either included in this advice or in the relevant Fisheries Overview.

Request 2: ICES advises that *Nephrops* stocks, megrim, monkfish, and hake should be integrated in next year's Celtic Sea mixed-fisheries analyses. This would require that release of this mixed-fisheries advice be delayed to the autumn.

Request 3: ICES advises that the degree of mixing of flatfish and roundfish, and of the fleets targeting these stocks in the North Sea, does not warrant the development of separate mixed-fisheries analyses for flatfish and roundfish.

Request 4: ICES concludes that the current information indicates a variable degree of mixing in the Baltic Sea pelagic fisheries. However, the current information may not be sufficiently precise to describe the technical interactions and a plan is therefore proposed to further develop the mixed-fisheries analyses.

Request 5: ICES advises that the data currently available do not allow for development of mixed-fisheries descriptions and advice in the Baltic Sea. A workshop to address this issue will be held early in 2019. The Celtic Seas, North Sea, and Iberian waters mixed-fisheries models and advice are continuously being improved. ICES continues to update the mixed-fisheries considerations, following developments in advice on single stocks. Advice on mixed fisheries in the Bay of Biscay will be issued for the first time in 2019. Biological interactions are reasonably well known for the Baltic and North seas, but further work is required for the Celtic Seas as well as the Bay of Biscay and the Iberian Coast ecoregions.

Request

ICES is requested to further develop advice on mixed fisheries and on biological interactions for the North Sea, Baltic Sea and the Atlantic. This work should include:

1. *A description of the main mixed fisheries technical interactions and biological interactions known in the Baltic Sea, the North Sea and the Atlantic. These can be in either the Fisheries Overviews or the Ecosystem overviews (such as those already developed for the Baltic Sea and the North Sea) or alternatively in the single stock advice. ICES is requested to:*
 - a. *Describe the species caught together in mixed fisheries taking account of spatial, gear, fleet and temporal dimensions as appropriate (e.g. it is known that in the flatfish fishery sole, plaice, witch, lemon sole and turbot are often caught together. It is known that cod, haddock, saithe and whiting are caught together in the North Sea. In the Atlantic it is known that hake, megrim and anglerfish are caught together and that this fishery can have important by-catches of cod and haddock. In the Baltic Sea it is known that sprat and herring are caught together. ICES is asked to confirm these and all other cases of stocks caught together).*
 - b. *ICES is requested to identify if intra-specific density dependence is known to occur for Gulf of Riga herring based on existing, updated scientific evidence.*
2. *Expanding the number of stocks included in the Celtic Sea mixed fisheries considerations. Priority should be given to target species of high economic interest, such as megrims and anglerfish.*
3. *Analyze the existing mixed-fisheries model for the North Sea with a view to develop broken-down [separate] models and scenarios for the flatfish fisheries/fleets and for the roundfish fisheries/fleets*
4. *Developing mixed-fisheries considerations and understanding on biological interactions for stocks in the Baltic Sea. According to the EU multiannual plan for Baltic Sea stocks fishing opportunities may be fixed in accordance with the upper fishing mortality ranges specified in the plan provided that the stock concerned is above the minimum spawning stock biomass reference point.*
 - a. *ICES is requested to describe the mixed sprat and herring fisheries in the Baltic Sea and to develop a mixed fisheries model for these fisheries, which can be used to assess the likely consequences on the stocks and fisheries of different management scenarios.*
 - b. *Developing biological interaction knowledge on Gulf of Riga herring*

5. ICES is also requested to inform the Commission on the tasks and timeline to further develop knowledge necessary to advise on mixed fisheries and biological interactions in the Baltic Sea, the North Sea and the Atlantic.

Elaboration on the advice

Request 1a: A description of the main mixed-fisheries technical interactions and biological interactions known in the Baltic Sea, the North Sea, and the Atlantic

The Fisheries Overview for the Baltic Sea was updated in June 2018 with new text and figures on mixed-fisheries interactions (ICES, 2018a).

In 2017, the Regional Coordination Group for the Baltic (RCG Baltic) established a subgroup to look at designing and implementing a regional sampling programme for small pelagics. This involved generating regional and national overviews of the Baltic fisheries, including spatial and temporal distribution of fishing effort and landings of relevant stocks. Preliminary analysis of this data, on sprat and herring mixing as well as on cod and sprat mixing, was presented at the 2018 Regional Coordination Group (RCG). Maps showing the mixing of sprat and herring, by statistical rectangle and by month, are now available. Similar maps of sprat and cod mixing have been produced (ICES, 2018b).

ICES has also advised a geographical reduction in fishing for sprat in the main range of the eastern Baltic cod stock, to ensure maximum possible food supply for this stock (ICES, 2018c).

The Fisheries Overview for the Greater North Sea (ICES, 2018d) was last updated with new text and figures on mixed-fisheries interactions in 2018. The reply to Request 3 of this advice provides new information on spatial distribution of the landings per species and per gear and their interactions in the North Sea.

The Fisheries Overview for the Celtic Seas (ICES, 2018e) was updated in November 2018 with new text and figures on mixed-fisheries interactions.

Request 1b: Intra-specific density dependence in Gulf of Riga herring

ICES issued the following advice in May 2018 (ICES, 2018f):

“The EC has requested ICES to identify if intra-specific density dependence is known to occur for Gulf of Riga herring based on existing, updated scientific evidence (EC, 2018). In the short term this stock is not expected to increase to biomasses outside the range estimated by the assessment in recent years. Mean weights in the stock have also been stable in recent years suggesting little evidence for declining growth due to intra-species interactions. The stock has been declining in recent years and the direct and indirect effects on other stocks are within the range of what would have occurred in previous years without observing significant detrimental inter-species effects. Therefore ICES does not consider that the evidence is sufficient to justify an application of the upper F_{MSY} range based on the condition; “to avoid serious harm to a stock caused by intra- or inter-species stock dynamics”, set out in the MAP.”

Request 2: Expansion of the number of stocks included in the Celtic Sea mixed-fisheries considerations

ICES has identified ten additional species (21 stocks) that could be included in the Celtic Seas mixed-fisheries analysis in the near future. The feasibility of including stocks was assessed and stocks were prioritized, based on their relative importance to the Celtic Sea landings (in terms of weight and values), the degree of mixing, and the availability of data.

ICES concluded that it should be possible for some of the *Nephrops* stocks, monkfish, hake, and megrim to be added to the mixed-fisheries advice next year. This would require that release of the advice be delayed to the autumn to allow for the inclusion of the *Nephrops* assessments. Other stocks were not considered to have main priority, either because of their lesser importance to the landings or because of the absence of full analytical assessment and short-term forecast.

Request 3: Analysis of the existing mixed-fisheries model for the North Sea: broken-down models and scenarios for the flatfish fisheries/fleets and for the roundfish fisheries/fleets

In terms of overall tonnage, the levels of mixing between flat- and roundfish are low in the majority of the North Sea demersal fisheries. However, most fleets have a degree of mixing, and none of the countries land only one of the two types of fish. The highest degree of mixing occurs in some specific areas (e.g. the central eastern part of the North Sea), in some specific gears (e.g. TR2), and for some countries (e.g. Denmark).

ICES considers that the separation of what would constitute a round- or a flatfish fishery is not clear and distinct enough to justify splitting the current Fcube model. Splitting the model raises difficulties regarding where to draw boundaries, and which gears and fleets to include in each sub-model. The model would also lose the ability to account for the diverse sources of revenue and the recognition of the ability of the fleet to switch target species. Splitting the model would also reverse the efforts made over recent years to increase the number of stocks in the model, including several important bycatch stocks.

Request 4: Mixed-fisheries considerations and understanding of biological interactions for stocks in the Baltic Sea

Current information shows variation in the degree of mixing, in catches from the pelagic as well as from the demersal fisheries in the Baltic Sea. Control data also indicate that species misreporting may occur in pelagic fisheries, which could imply that quotas of bycatch are potentially limiting. Development of a mixed-fisheries model for these fisheries therefore appears to be justified.

Request 4a: The mixed sprat and herring fisheries in the Baltic Sea

ICES cannot currently describe the mixed sprat and herring fisheries in the Baltic Sea with confidence and is therefore not yet able to develop a mixed-fisheries model for these fisheries. It is possible to map the spatial and temporal mixing of the two species; however, catches may not have the same scale of mixing at the level of the individual haul. Moreover, ICES has concerns about the quality of the catch data and will also need to further consider the appropriate tools to be applied in the case of these fisheries.

ICES recommends that a series of steps should be carried out to better investigate (a) the quality of the data available, (b) the extent of the species mixing in the landings, and (c) the variation in the catchability of the different fleets. Data on the degree of mixing per haul is required to identify how mixed the Baltic pelagic fisheries are. The following steps are suggested:

1. Assess the reliability of the catch composition declared in the logbook using data from the European control agency.
2. Based on detailed logbook data and where possible, observer data, describe in detail how the mixed fisheries interactions occur in terms of geographical location, period of the year, and fleets involved. Data collected from acoustic surveys should also be used to inform on the degree of spatial overlap between herring and sprat, and the degree of mixing of the two species at the haul level.
3. Make a mixed fisheries data call to compile landings and effort data for the pelagic fisheries in the Baltic Sea.
4. Using data on catches and effort per fleet, time series of catchabilities for herring and sprat should be calculated for the different fleets.
5. If the above analyses allow it, a mixed fisheries model for these fisheries could then be developed.

Request 4b Biological interactions in the Gulf of Riga herring

A key biological interaction of the Gulf of Riga herring is with their zooplankton prey (the copepod *Eurytemora affinis*). The abundance of zooplankton is in turn influenced by winter weather, with warmer winters leading to higher abundance. The spawning stock biomass (SSB) of the Gulf of Riga herring was relatively stable at around 40 000–50 000 tonnes in the 1970s and 1980s. The SSB started to increase in the late 1980s, reaching the record high level of just under 125 000 tonnes in 1994. This increase was the consequence of a series of mild winters. After mild winters spawning starts earlier and the spawning activity is more evenly distributed over the spawning season, which results in lower mortality of eggs on the spawning grounds. Additionally, after mild winters the zooplankton is more abundant providing better feeding conditions

for herring larvae. In good feeding years the competition for food between older herring and the young-of-the-year decreases and the latter have a greater survival. A strong negative relationship between some successive year-classes was also found. Very strong year-classes were usually followed by poor or below average year-classes. One year old herring does not spawn and starts feeding much earlier in the year than the mature herring, and it is suggested that this affects the amount of food for the young-of-the-year.

Request 5: Tasks and timeline to further develop knowledge necessary to advise on mixed fisheries and biological interactions in the Baltic Sea, the North Sea and the Atlantic

Baltic Sea

The biological interactions within the Baltic Sea stocks are well known. There is a need to develop mixed fisheries models and advise for the Baltic Sea due to spatial and temporal stock mixing in both pelagic and demersal Baltic fisheries. A scoping workshop including both stakeholders and managers is planned in early 2019 to start this process. It is likely that access to data held by the European fisheries control agency will be required to validate existing logbook data.

North Sea

The mixed fisheries model for the North Sea continues to be updated in response to changing stock status. In addition, expert involvement in EU projects with mixed fisheries components has resulted in adaptations to the model structure to allow for a more flexible framework. ICES will continue to take into account changes in stock and management developments.

Atlantic: Celtic Seas

The mixed fisheries model for the Celtic Seas is continually being updated in response to changing stock status. In addition, expert involvement in EU projects with mixed fisheries components has resulted in adaptations in the model structure to allow for a more flexible framework. See also the response to Request 2. Further work is required to understand biological interactions in this ecoregion.

Atlantic: Bay of Biscay and Iberian waters

There is already mixed fisheries advice provided for Iberian waters; models for these waters continue to be updated and further stocks will be included in the model in future. ICES plans to issue its first mixed fisheries advice for the Bay of Biscay in 2019. Further work is required to understand biological interactions in this ecoregion.

Suggestions

In order to determine if a stock is truly limiting in the “min” scenario in mixed fisheries models, ICES suggests that analyses of the effects of quota limitations on the behaviour of fishing fleets is desirable.

Basis of the advice

Request 2: An analysis was conducted to identify candidate species for possible inclusion in Celtic Seas mixed fisheries considerations. Ten species were considered: monkfish *Lophius piscatorius* and *Lophius budegasa*, cod *Gadus morhua*, haddock *Melanogrammus aeglefinus*, hake *Merluccius merluccius*, megrim *Lepidorhombus whiffiagonis* and *L. boscii*, *Nephrops (norvegicus)*, plaice *Pleuronectes platessa*, pollack *Pollachius pollachius*, sole *Solea solea* and whiting *Merlangius merlangus*. The aims of the analysis were to:

- determine the relative contributions of each species to the overall weight and value of landings in the Celtic Seas
- assess the level of mixing among these species within the fisheries executed within the area.
- identify the single species stocks assessments suitable for inclusion in Fcube and prioritise them
- test the inclusion of identified suitable single stock assessment in Fcube.

The analyses prioritized stocks for inclusion in the production of mixed fishery advice and grouped them into tiers.

Tier 1: stocks already included in the current analyses (cod 7ek, haddock 7bk, whiting 7b-c & e-k).

Tier 2: first priority demersal stocks to include (hake 3a46-8abd, megrim 7b-k8abd, white anglerfish 7b-k & 8a-b,k). These stocks have full analytical assessments and forecasts, are widely distributed within the Celtic Sea and caught along with the gadoid stocks already included in the mixed fisheries advice.

Tier 3: stocks that can be directly incorporated in FCube (ICES Category 1 and with short term forecast) but not identified as immediate priority by the analyses (sole 7e and sole 7fg). While these stocks have full analytical assessments and forecasts and therefore could be included in the advice in future, it was felt their more limited spatial distribution and weaker technical interactions with the stocks currently included (sole are most commonly caught by beam trawlers along with plaice and other flatfish) meant they were not a priority at this time. Further work needs to be undertaken to consider how to incorporate stocks with more limited spatial distribution (and its impact on the advice) and this could be best achieved by evaluating interactions and dynamics of the fisheries with plaice and other sole stocks in the region, which are currently categorised as tier 4 stock due to their lack of full analytical assessments.

Tier 4: stocks without full analytical assessment and that will need more work to be implemented in FCube (plaice 7bc, plaice 7e, plaice 7fg, plaice 7hjk, pollack, sole 7bc, sole 7hjk). While some progress has been made in developing methods for including stocks without full analytical assessments across all regions, it was considered these need further work before they could be considered for inclusion in the mixed fisheries advice.

Nephrops stocks: All *Nephrops* stocks in the Celtic Sea have full analytical forecasts with absolute abundance estimates from Underwater TV surveys and as such could be included in the mixed fisheries advice, using the methods developed for the North Sea. However, as a large share of the TAC covering the Functional Units in the Celtic Sea is taken outside of the area (caught in Functional Units 14 and 15, in 7a (the Irish Sea)), the advice will need to fully consider any assumptions made in the model on shares of quotas among areas and its impact on mixed fisheries scenarios.

The inclusion of *Nephrops* stocks and Tier 2 stocks in the Celtic Sea Fcube was tested successfully. However, the results require further consideration before these stocks can be included in the mixed fisheries advice.

Request 3: The patterns show a majority of flatfish landings being derived from the shallower areas of the southern and eastern sections of the North Sea, while roundfish landings are more from the deeper areas to the northwest and along the Norwegian trench. There is nevertheless a degree of overlap, mainly to the northwest of Denmark.

There is seen to be a separation of areas dominated by flatfish and roundfish landings patterns, with most mixing occurring along the Norwegian trench, near the north-eastern boundary of ICES division 4b, and areas near the English Channel.

The patterns in landings derived from the larger mesh-sized TR1 gear show less mixing of roundfish and flatfish landings than the TR2. TR1 is more associated with roundfish landings derived from the more northern areas of North Sea (4a), while TR2 is more associated with mixed roundfish and flatfish landings from shallower depths of the eastern North Sea (4b), English Channel (7d) the Skagerrak (3a20).

Analysis shows that there is not a clear separation between flatfish and roundfish fisheries. While sole is exclusively caught by beam trawlers in subarea 4, plaice is also targeted by Danish fleets that also target roundfish. Plaice is also an abundant bycatch in roundfish fisheries. Roundfish stocks are mainly taken by fleets targeting those stocks, but potentially also with flatfish (e.g. French otter trawl for whiting, Danish fleets for cod). Furthermore, this analysis does not look into details of the stocks representing a smaller percentage of the landings; thus there is probably additional overlap for stocks caught by flatfish and roundfish fisheries.

Request 4: ICES found that at the scale of the Baltic Sea, the majority of the catches are being taken by pelagic trawlers in a directed fishery for either sprat or herring, in which bycatch of the other species may occur. Most of the countries also have fisheries using fixed gears (gillnets or traps) which exclusively catch herring (accounting for up to 20% of the total national herring catches, depending on the country). Part of the catches come from fisheries for industrial purposes using small mesh sizes, where mixed catches are likely and are not sorted by species.

The data show some degree of species mixing but with a lot of variation depending on the areas and countries. The level of aggregation used did not make it possible to clearly assess the degree of mixing. ICES has some concern about the accuracy of the species composition in the catch data.

ICES needs to assess the variability in catchability for herring and sprat for the different Baltic métiers before mixed fisheries models are applied.

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