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Mixed-fisheries advice for Subarea 4, Division 7.d, and Subdivision 3.a.20 (North Sea, eastern English Channel, Skagerrak)

ICES advice

Mixed-fisheries considerations are based on the single-stock assessments, combined with information on the catch composition and fishing effort of the demersal fleets and fisheries in the Greater North Sea catching cod (cod.27.47d20), haddock (had.27.46a20), whiting (whg.27.47d), saithe (pok.27.3a46), plaice (ple.27.420 and ple.27.7d), sole (sol.27.4 and sol.27.7d), and Norway lobster *Nephrops norvegicus* (functional units [FUs] 5–10, 32, 33, 34, and 4outFU). In the absence of specific mixed-fisheries management objectives, ICES does not advise on unique mixed-fisheries catch opportunities for the individual stocks. The mixed-fisheries results shown for Norway lobster are combined for several functional units (FUs) in plots, but stock status and fishing opportunities differ across FUs.

Mixed-fisheries scenarios are based on central assumptions that fleet fishing patterns and catchability in 2018 and 2019 are the same as those in 2017 (similar to procedures in single-stock forecasts where growth and selectivity are assumed constant).

Mixed-fisheries projections are presented in terms of catch. The limiting TAC in 2019 will be the TAC for cod and whiting, and to a lesser extent the Eastern Channel stocks, which are the stocks for which the TACs are almost entirely taken when assuming that fishing fleets stop fishing once they have reached their first quota (scenario "Min" in Figure 1 and Table 2). Otherwise substantial overshoot of TACs may occur ("Max" scenario). The mixed-fisheries results shown for Norway lobster are combined for several functional units (FUs) in plots, but stock status and fishing opportunities differ across FUs.

For those demersal fish stocks for which the F_{MSY} range is available, a "range" scenario is presented (Figure 2) that minimizes the potential for TAC mismatches in 2019 within the F_{MSY} range. This scenario estimates a fishing mortality by stock which, if used for setting single-stock fishing opportunities for 2019, may reduce the gap between the most and the least restrictive TACs, thus reducing the potential for quota over- and undershoot. This "range" scenario suggests that the potential for mixed-fisheries mismatch would be lowered with a 2019 TAC in the lower part of the F_{MSY} range for Eastern English Channel plaice and North Sea saithe, and at the highest possible value for cod in accordance with the MSY approach and the MAP (EU multiannual plan).

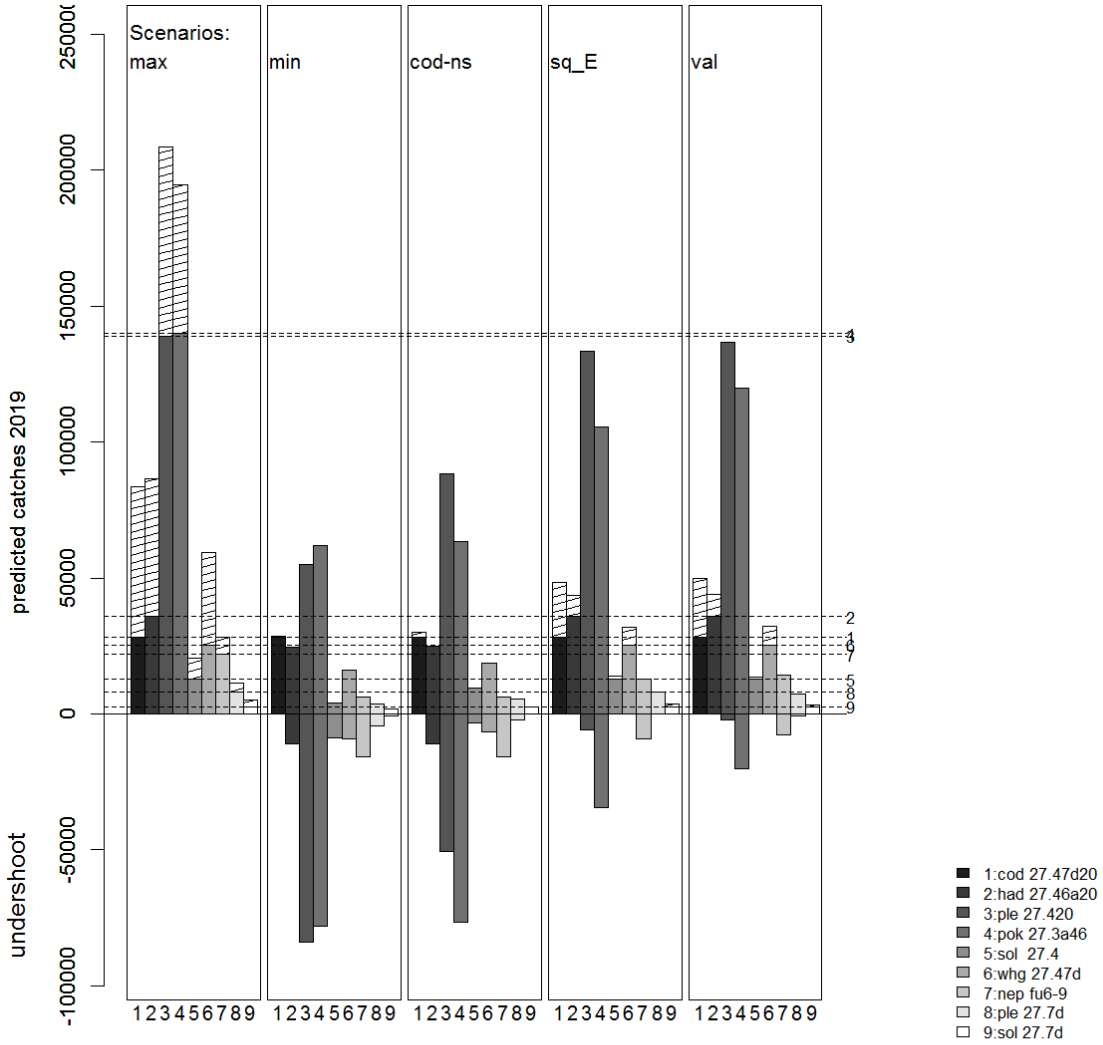

Figure 1 Mixed fisheries for the North Sea. Mixed-fisheries projections. Estimates of potential catches (in tonnes) by stock and by scenario. Horizontal lines correspond to the single-stock catch advice for 2019. Bars below the value of zero show undershoot (compared to single-stock advice) where catches are predicted to be lower when applying the scenario. Hatched columns represent catches that overshoot the single-stock advice. Details for Division 7.d plaice and sole stocks are shown in Figure 7.

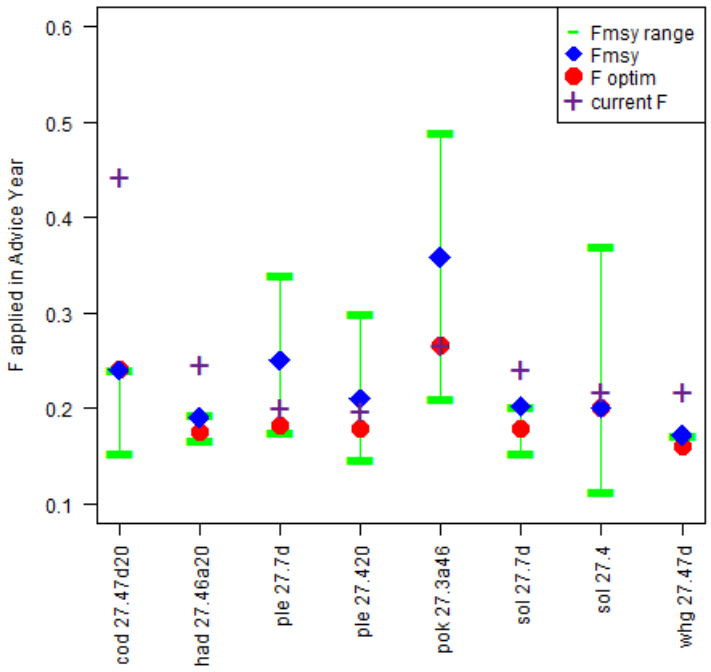

Figure 2 Mixed fisheries for the North Sea. North Sea mixed-fisheries 2019 "range" fishing mortality within the F_{MSY} range, compared with F_{MSY}, current F (F in 2017), and F in the single-stock advice for 2019. The "range" F is the one giving the lowest difference in tonnage between the "Max" and the "Min" scenario across all stocks and fleets. For cod in the North Sea and sole in Division 7.d, F_{MSY} ranges are limited in accordance with the MSY approach and the MAP when below MSY $B_{trigger}$.

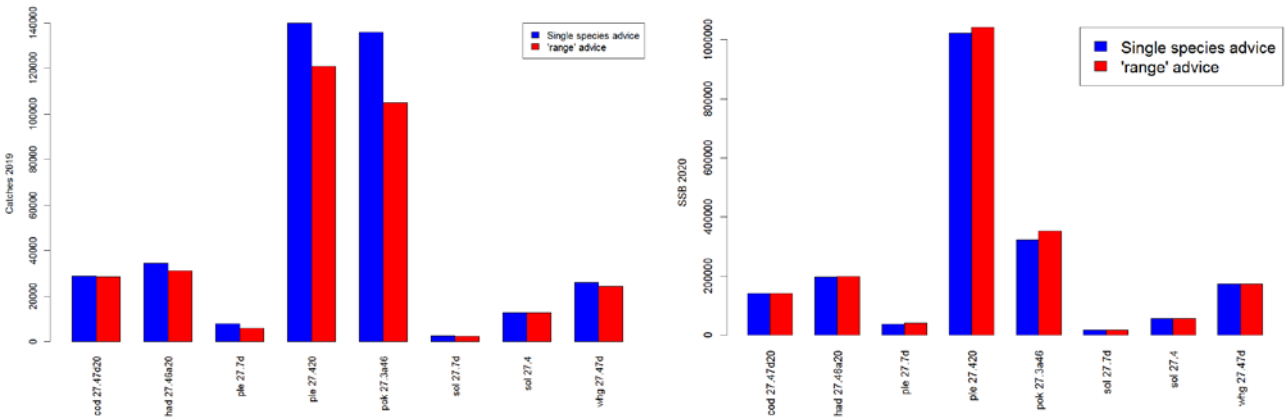

Figure 3 Mixed fisheries for the North Sea. Comparison of the outcomes in terms of total catches in 2019 (left) and SSB in 2020 (right) between the F_{MSY}-based single-stock advice and the F_{range}-based forecast.

Table 1 Mixed fisheries for the North Sea. F_{MSY} ranges used for the "range" scenario.

Stock	$F_{MSY\text{-}lower}$	$F_{MSY\text{-}upper}$
cod.27.47d20	0.154 = MAP $F_{MSY\ lower}$ × SSB (2019)/MSY $B_{trigger}$	0.24 = MAP F_{MSY} × SSB (2019)/MSY $B_{trigger}$
had.27.46a20	0.167	0.194
pok.27.3a46	0.210	0.492
ple.27.420	0.146	0.3
ple.27.7d	0.175	0.344
sol.27.4	0.113	0.367
sol.27.7d	0.154 = MAP $F_{MSY\ lower}$ × SSB (2019)/MSY $B_{trigger}$	0.20 = MAP F_{MSY} × SSB (2019)/MSY $B_{trigger}$
whg.27.47d	0.158	0.172

The potential for quota over- and undershoot linked to the most and the least restrictive single-stock fishing opportunities for 2019 is presented in Figure 1. Six projections are presented, corresponding to different fleet scenarios for 2018 and 2019 (described in Table 2). Norway lobster stocks are not yet included in the "range" scenario.

Table 2 Mixed fisheries for the North Sea. Mixed-fisheries scenarios for the North Sea stocks.

	Scenarios
Max	**"Maximum":** For each fleet, fishing effort in 2019 stops when all stock shares* of that fleet have been caught up. This option causes overfishing of the single-stock advice possibilities of most stocks.
Min	**"Minimum":** For each fleet, fishing effort in 2019 stops when the most limiting of the stock shares of that fleet has been caught up. This option is the most precautionary option, causing underutilization of the single-stock advice possibilities of other stocks. This scenario can highlight some potential "choke species" issues.
Sq_E	**"*Status quo* effort":** The effort of each fleet in 2018 and 2019 is set equal to the effort in the most recently recorded year for which landings and discard data are available (2017).
Val	**"Value":** A simple scenario accounting for the economic importance of each stock for each fleet. The effort by fleet is equal to the average of the efforts required to catch the fleet's stock shares of each of the stocks, weighted by the historical catch value of that stock (see example further below). This option causes overfishing of some stocks and underutilization of others.
COD	**"Cod MSY approach":** All fleets set their effort in 2018 and 2019 corresponding to their cod stock share, regardless of other catches. (There are small differences in the cod catches between this scenario and the single-stock advice because of the slightly different forecast methods used.)
range	**"range":** estimates a fishing mortality by stock (using the F_{MSY} ranges) which, if used for setting single-stock fishing opportunities, may reduce the gap between the most and the least restrictive TACs, thus reducing the potential for quota over- and undershoot. F_{MSY} ranges are limited in accordance with the MSY approach and the MAP for stocks below MSY $B_{trigger}$.

* Throughout this document, the term "fleet's stock share" or "stock share" is used to describe the share of the fishing opportunities of a stock for each particular fleet in 2018, assuming that the proportion of catches by fleet for that stock in 2018 and 2019 is the same as observed in 2017.

Catch scenarios

Mixed-fisheries advice considers the implications of mixed fisheries operating under single-stock TAC regimes, taking into account the fishing patterns of the various fleets in 2017. The scenarios presented here do not assume any quota balancing through changes in targeting behaviour (i.e. changes in catchability and/or in effort distribution) and/or changes in access to quota, although the model used would allow investigating such alternative scenarios in the future.

The ICES single-stock catch advice for demersal stocks in 2019 (ICES, 2017) is based on either the existing management plans, the ICES maximum sustainable yield (MSY) approach, or the ICES precautionary approach. Mixed-fisheries catch scenarios can take specific management priorities into account. Catch scenarios are presented in Table 3 under the scenarios described in Table 2, with the resulting biomass at the beginning of 2019 shown in Table 7 and Figure 8. Scenario results show that it is not possible to achieve all management objectives simultaneously under the current fishing patterns. For instance, if decreasing the fishing mortality for cod is the major objective and fleets would stop fishing after exhaustion of their cod TAC, this could mean that the TAC for other species in the mixed fisheries may not be fully utilized. As a consequence, scenarios that result in under- or overutilization are useful in identifying the main mismatches between the fishing opportunities of the various stocks, where limiting TACs can create potential "choke

species" effects at fleet level. They indicate in which direction fleets may have to adapt to fully utilize these catch opportunities without increasing the risk of unwanted catch.

After years of positive development, North Sea cod is again estimated to be the most limiting stock in the Greater North Sea mixed-fisheries model. For 2019, assuming a strictly implemented landing obligation (corresponding to the "Minimum" scenario), cod is estimated to constrain 18 out of 34 fleet segments. Whiting is the second most limiting stock, constraining twelve fleet segments. Conversely, in the "Maximum" scenario, saithe and both plaice stocks (North Sea and Eastern Channel) would be the least limiting for 15, 6, and 3 fleet segments, respectively. Finally, if Norway lobster were managed by separate TACs, Norway lobster in FU 7 would be the least limiting for six fleet segments. The most and the least limiting species per fleet are shown in Figure 4.

This year, a "range" scenario is presented, as described in Ulrich *et al.* (2017). This scenario searches for the minimum sum of differences between potential catches by stock under the "Min" and the "Max" scenarios within the F_{MSY} ranges. This "range" scenario suggests that the potential for mixed-fisheries mismatch would be lowered with a 2019 TAC in the lower part of the F_{MSY} range for Eastern English Channel plaice and North Sea saithe, and at the highest possible value for cod in accordance with the MSY approach and the MAP (EU multiannual plan). The outcomes of this scenario are largely driven by difference between the current F for cod and the highest possible F used in the adjusted range for cod (see Figure 2), which implies that many mixed fisheries should reduce their effort to avoid over-catching this stock. Other "range" scenarios could be computed in the future, for example scenarios minimizing the potential for discards or maximizing the revenue or profit of fleets.

ICES single-stock advice provides TACs according to the ICES MSY approach or the MAP. To be consistent with these objectives a scenario is necessary that delivers at least the SSB and/or F objectives of the single-stock advice simultaneously for all stocks considered. This is achieved in the "Minimum" scenario, which assumes that fleets would stop fishing when their first stock share is exhausted, regardless of the actual importance of this stock share for the fleet. This scenario reflects the "choke-species" effect that may result from a strictly implemented landing obligation without adaptation of the fleets. Fishing effort in 2019 should be reduced by 49% of its 2017 level to comply with this scenario, consistently with the reductions in fishing mortality advised for cod and whiting.

In contrast to the "Minimum" scenario, the "Maximum" scenario demonstrates the upper bound of potential fleet effort and stock catches. Clearly, the assumption that all fleets continue fishing until all their stock shares are exhausted irrespective of the economic viability of such actions does not make it a highly plausible scenario. Its purpose is mainly to illustrate where the imbalance lies. The different fleets have different opportunities and incentives for 2018 and 2019, depending on their historical catch composition and catchability, and on the differences in productivity across the various stocks that they exploit. In 2019 the fleets catching any amount of Norway lobster, saithe, and plaice would have to increase their effort by more than 50% to achieve their stock shares for these stocks, which would lead to potentially large overshoots of their shares for other stocks. This is an unrealistic outcome for such fleets, especially considering that the TAC for saithe and plaice is already not taken up at present (total catches were around 70% of the catch advice in 2017 for these two stocks).

Two intermediate scenarios reflect alternative mixed-fisheries hypotheses: "SQ_E", "Value".

The *status quo* "SQ_E" scenario sets the effort of each fleet in 2018 and in 2019 equal to the effort in the most recently recorded year for which data are available (2017). This scenario investigates the mixed-fisheries outcomes if the situation remains the same in terms of total effort and effort allocation among métiers. This situation presents potential for 2019 TAC overshoot for cod, haddock, whiting and Eastern Channel sole, and of 2019 TAC undershoot for saithe, North Sea plaice, and a number of Norway lobster stocks. The status quo situation is in better balance for North Sea sole and Eastern Channel plaice.

The "Value" scenario is a simple proxy balancing fishing opportunities by stock with their potential market value, in the absence of a formal economic behaviour model. For example, if a fleet needs 100 days of fishing to catch its share of stock A, and 200 days of fishing to catch its share of stock B, and if the revenue of that fleet (tonnage × mean price in 2016) is 75% from stock A and 25% from stock B, then the resulting effort would be (100 × 0.75) + (200 × 0.25) = 125 days. Historically this scenario has been observed to predict effort levels closer to the realised effort than the "Minimum" and "Maximum" scenarios (Ulrich *et al.*, 2011), and for 2019 again, this scenario estimates results close to the *status quo* scenario.

This year, a “Cod” scenario is again presented. This scenario reflects the fishing mortality corresponding to the single-stock advice for cod (based on the ICES MSY approach), and the results present fishing opportunities for other stocks in a mixed-fisheries context. As not all fleets are limited by cod, the outcomes of that scenario are in between those of the “Minimum” and “SQ_E” scenarios.

Table 3 Mixed fisheries for the North Sea. Catch per mixed-fisheries scenario 2019, in absolute values.

Stock	Single-stock catch advice (2019) *	Catch per mixed-fisheries scenario (2019)					
		Maximum	Minimum	COD	*Status quo* effort	Value	Range
Cod in 4, 7.d, 3.a.20	28204	83577	28517	30109	48217	49743	28671
Haddock in 4, 6.a, 3.a.20	34160	86623	24624	24725	43577	43946	31222
Plaice in 7.d	7864	11218	3479	5466	8062	7209	5881
Plaice in 4	139052	208595	55034	88280	133347	136658	120939
Saithe in 4, 6, 3.a.20	139978	194493	61958	63262	105683	119957	104980
Sole in 7.d	2571	4999	1711	2605	3720	3359	2283
Sole in 4	12801	20353	4093	9491	13758	13398	12725
Whiting in 4, 7.d	25302	59286	16107	18807	32029	32305	24208
Norway lobster FU 5	1637	1438	308.4	318.1	648.6	732.6	
Norway lobster FU 6	1882	4013	919.4	931	1935	1869	
Norway lobster FU 7	16395	15738	3379	3379	6864	7967	
Norway lobster FU 8	2334	5956	1246	1331	2711	3174	
Norway lobster FU 9	1274	2421	488.7	581.5	1179	1322	
Norway lobster FU 10	48	61.59	13.21	13.62	27.78	31.38	
Norway lobster FU 32	397	520.8	111.7	115.2	234.9	265.4	
Norway lobster FU 33	1317	1545	331.3	341.8	696.9	787.2	
Norway lobster FU 34	315	393.6	84.41	87.07	177.5	200.6	
Norway lobster other in 4	525	702.9	150.7	155.5	317.1	358.1	

NA : stocks for which ranges of F_{MSY} are either not available or not yet included in the scenario.

* Advised catches no more than the indicated value.

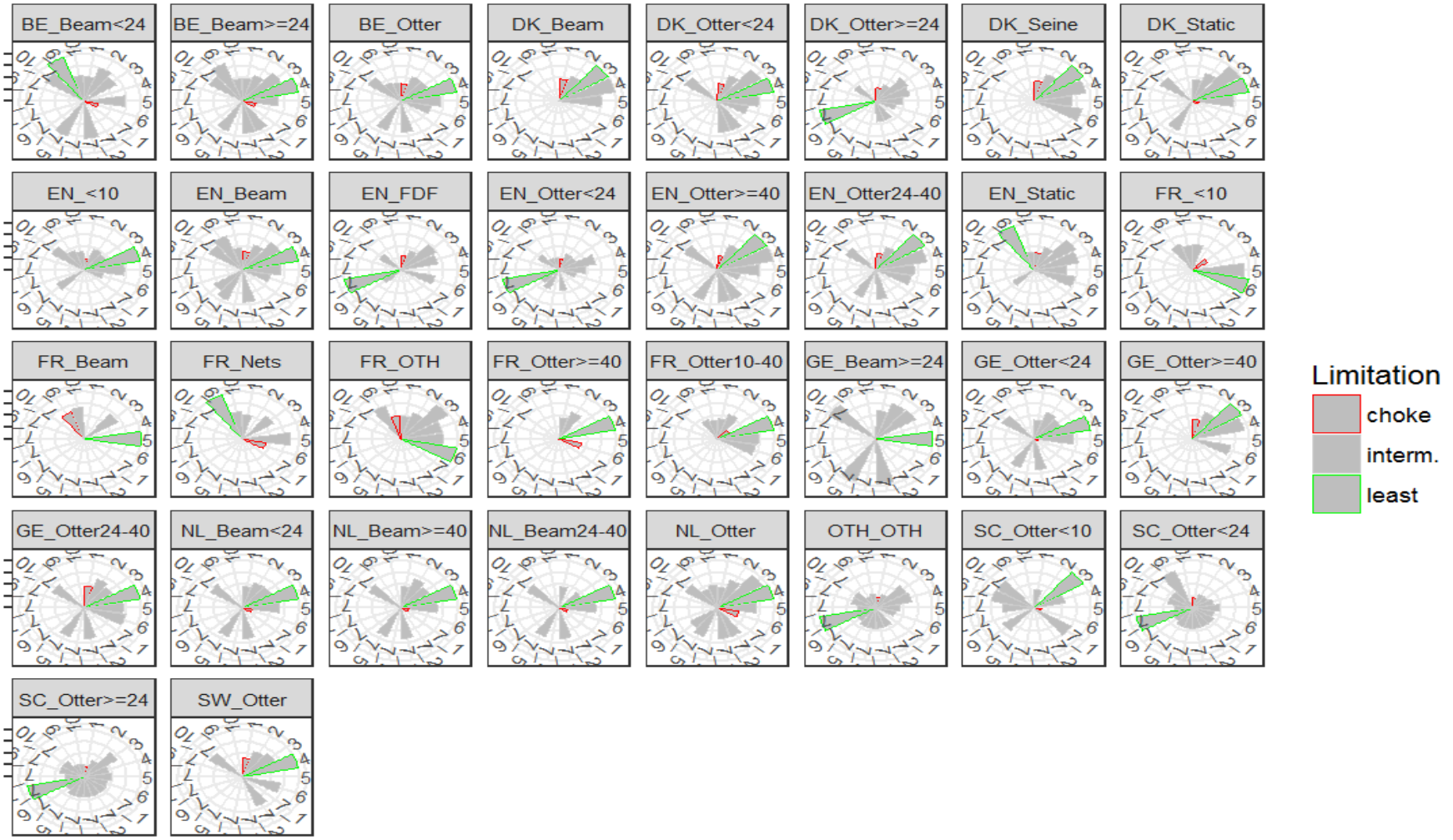

Figure 4 Mixed fisheries for the North Sea. Estimates of effort by fleet needed to reach the single-stock advices. Red triangles highlight the most limiting species for that fleet in 2019 ("choke species"), whereas the green triangles highlight the least limiting species. (1: cod 27.47d20; 2: had 27.46a20; 3: Plaice 27.420; 4: pok 27.3a46; 5: sol 27.a; 6: whg 27.47d; 7_1: NEP10; 7_2: NEP32; 7_3: NEP33; 7_4: NEP34; 7_5: NEP35; 7_6: NEP6; 7_7: NEP7; 7_8: NEP8; 7_9: NEP9; 7_10: NEPOTH; 9: ple 27.7d; 10: sol 27.7d). Fleet names are given by country (BE = Belgium, DK = Denmark, EN = England, FR = France, GE = Germany, IE = Ireland, NI = Northern Ireland, NL = the Netherlands, NO = Norway, SC = Scotland, SW = Sweden, OTH = Others) and by meaningful combinations of main gear and vessel size differing across countries and based on homogeneous average fishing patterns. FDF = Fully Documented Fisheries vessels. Vessels in the various fleet segments can engage in several fisheries (métiers) over the year.

Quality considerations

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

Data on catches and effort are provided disaggregated by métier, and stored in a single database (ICES InterCatch) common for both single-stock assessments and mixed-fisheries forecasts. Complete and consistent estimates of discard ratios and age or length distributions by stock for all fleets and métiers are thus available for the most recent years. In spite of the improvements brought over time, and in particular the issuing of a unique data call, the compilation of the mixed-fisheries dataset remains however a highly demanding process, combining several types of data provided by different people, and covering a large number of countries, stocks and fishing activities. Various changes and updates in the data sources occur every year, and quality control is a major component of the work performed.

Norway has not provided effort information since 2016, making it impossible to estimate catchability estimates. In consequence, Norwegian fleets are now included in the "Others fleets" segment (OTH_OTH).

A key assumption in the projections is that catchability by stock and métier and effort distribution (relative proportion of time spent by each fleet in the various metiers) in 2018 and 2019 remain constant at their 2017 level. In reality fishing patterns may change over time – particularly in response to significant changes in policy, such as the introduction of the landing obligation and the revision of technical rules. In practice, such changes in catchability would affect the outcomes of mixed-fisheries projections. For example, an increase of catchability would imply that a stock can become more limiting in the "Minimum" scenario, as fewer fishing days would be required to fish up the fleets' catch share.

Issues relevant for the advice

This is the second time that ICES has presented a "range" scenario in addition to the standard mixed-fisheries projections. This scenario is intended to illustrate possible mixed-fisheries catch scenarios within the ranges of F_{MSY} provided by ICES. In the absence of explicit mixed-fisheries objectives, the "range" criteria chosen here remains a subjective choice, and other choices including additional ecosystem and/or socio-economic considerations (Rindorf *et al.*, 2017) might be investigated on request from clients.

Norway lobster are managed on the basis of one TAC for the whole North Sea, while ICES advises on the basis of FUs. For example, catches of Norway lobster in FU 7 have long been much lower than advised, while catches in FU 6 have been significantly higher than advised since 2012. The mixed-fisheries analysis is based on the ICES catch advice for the individual FUs. As a consequence, fisheries behaviour between FUs will differ from the modelled runs and this influences the outcomes of the "Maximum" and "Minimum" scenarios.

Since initial and final quotas by fleet are not known, the model builds on the important assumption that 2019 catch opportunities by fleet are computed as a fraction of the 2019 single-stock advice split according to the last year (2017) wanted catch proportion of that fleet over the total wanted catches of the stock. This assumption might not be entirely relevant when a fleet did not catch its 2017 quota of the considered stock. The model could be improved by adding additional considerations on the actual quota by fleet and/or country (final after swaps), provided that such data (from e.g. FIDES database) can be made available in the data call.

Basis for the assessment

Table 4 Mixed fisheries for the North Sea. The basis of the assessment.

Stock data category	Categories 1 and 4 (ICES, 2016)
Assessment type	F_{cube} (FLR)
Input data	Assessments on the relevant stocks in the North Sea fisheries working group (WGNSSK; ICES, 2018), catch and effort by fleet and métiers
Discards and bycatch	Included as in the single-stock assessments
Indicators	None
Other information	This assessment was presented for the first time in 2012. As any scenario will result 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 have the greatest influence on the fisheries.
Working groups	Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK), Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE)

Methods and data

Mixed-fisheries considerations are based on the single-stock assessments combined with knowledge on the species composition in catches in the Greater North Sea fisheries, using the F_{cube} method (Ulrich *et al.*, 2011, 2017; Table 4). Mixed-fisheries scenarios are based on central assumptions that fleets' fishing patterns (quota shares per stock, effort allocation to different métiers) and catchability in 2018 and 2019 are the same as those in 2017.

Table 5 Mixed fisheries for the North Sea. Advice and management areas and management plans for the species considered.

Species	ICES single-stock advice area	Management area	Management plan ref(s)
Cod	Subarea 4, Division 7.d, and Subdivision 3.a.20 (North Sea, eastern English Channel, Skagerrak)	• EU TAC Skagerrak • EU TAC Division 7.d • Subarea 4; EC waters of Division 2.a; the part of Division 3.a that is not covered by the Skagerrak and Kattegat	• EC (2016)^
Haddock *	Subarea 4, Division 6.a, and Subdivision 3.a.20 (North Sea, West of Scotland, Skagerrak)	• EU TAC Division 3.a, EC waters of divisions 3.b, 3.c, and 3.d • Subarea 4; EC waters of Division 2.a • EC and international waters of divisions 5.b and 6.a	• EC (2016)^
Plaice**	Subarea 4 (North Sea) and Subdivision 3.a.20 (Skagerrak)	• Subarea 4; EC waters of Division 2.a; the part of Division 3.a that is not covered by the Skagerrak and the Kattegat • Skagerrak	• EC (2016)^
Saithe	Subareas 4 and 6 and Division 3.a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)	• Division 3.a and Subarea 4; EC waters of divisions 2.a, 3.b, 3.c, and 3.d • Subarea 4; EC waters of Division 5.b; EC and international waters of subareas 12 and 14	• EC (2016)^
Sole	Subarea 4 (North Sea)	• EC waters of subareas 2 and 4	• EC (2016)^
Whiting ***	Subarea 4 and Division 7.d (North Sea and eastern English Channel)	• Subarea 4 • EU TAC Divisions 7.b–k	• EC (2016)^
Norway lobster	Functional units (FUs) in Subarea 4: 5, 6, 7, 8, 9, 10, 32, 33, 34, and other areas outside FUs	• EU TAC Subarea 6 • Norway: no TAC	• EC (2016)^
Plaice	Division 7.d (eastern English Channel)	• Divisions 7.d and 7.e	• EC (2018)
Sole	Division 7.d (eastern English Channel)	• Division 7.d	• EC (2018)

* Prior to 2014 this stock was only assessed for Subarea 4 and Subdivision 3.a.20.
** Prior to 2015 this stock was only assessed for Subarea 4 (North Sea).
*** Advice for this stock includes human consumption and industrial landings.
^ A revised version of the plan is expected to be published during 2018.

The species considered here as part of the demersal mixed fisheries are cod, haddock, whiting, saithe, plaice, sole, and Norway lobster. A large number (12) of the stocks are assessed with analytical assessments. In addition, six Norway lobster stocks without analytical assessments, but for which quantitative advice is provided, are included. All stocks are not managed within the same management area or with the same management rules (MSY approach or MAP). Table 5 summarizes the advice area, management area, and management plan for the main stocks. Figure 5 illustrates the landings by species in the North Sea area per species. Landings by species and aggregated by métiers, as defined in Table 6, are presented in Figure 6. Methods to include stocks without analytical assessments in the mixed-fisheries forecasts are currently being developed in order to account for the potential "choke" species for fleets operating under a landing obligation. Pelagic stocks (herring, mackerel) are not included as they are taken by fisheries subject to fewer technical interactions.

The projections are presented in terms of total catches. Haddock and sole have been under the landing obligation since 2016. Several other stocks are partly under the landing obligation in 2018. All stocks will be under the landing obligation in 2019, and all catches for these species are assumed to count against the fleets' stock shares in that year.

Because of the different forecasting methods used, limited differences between catch forecasts estimated by single-stock and mixed fisheries can occur, but this does not affect the conclusions of the analyses.

Fleet and métier categories used in the mixed-fisheries analysis are based on EU Data Collection Framework (DCF) level 6 categories, which are subsequently translated into the gear groups from the 2008 EU cod management plan (EU, 2008). The "non-allocated" category collects the difference between the total landings used in the single-stock assessments and the sum of the landings allocated to all fleets and métiers. In 2017, this "non-allocated" part became very large as it includes all Norwegian landings for which effort data was not provided and which could therefore not be defined as fleets. The "Other" métier sums up the landings of all "small" métiers (i.e. all métiers failing to land at least 1% in 2017 of at least one of the stocks considered). Both the "Other" and the "non-allocated" métiers are afterwards merged into the "OTH-OTH" fleet in the model.

Total landings (2017) of all species considered in the mixed-fisheries advice were 295 098 t, with:

~ 55% landed by otter trawls and seines;
~ 20% by beam trawls;
~ 3% by gill- and trammelnets;
~ less than 1% by longlines; and
~ 1% by other gears.
21% by non-allocated (including Norwegian landings)

Total discards were 77 562 t (21% by weight of total catch).

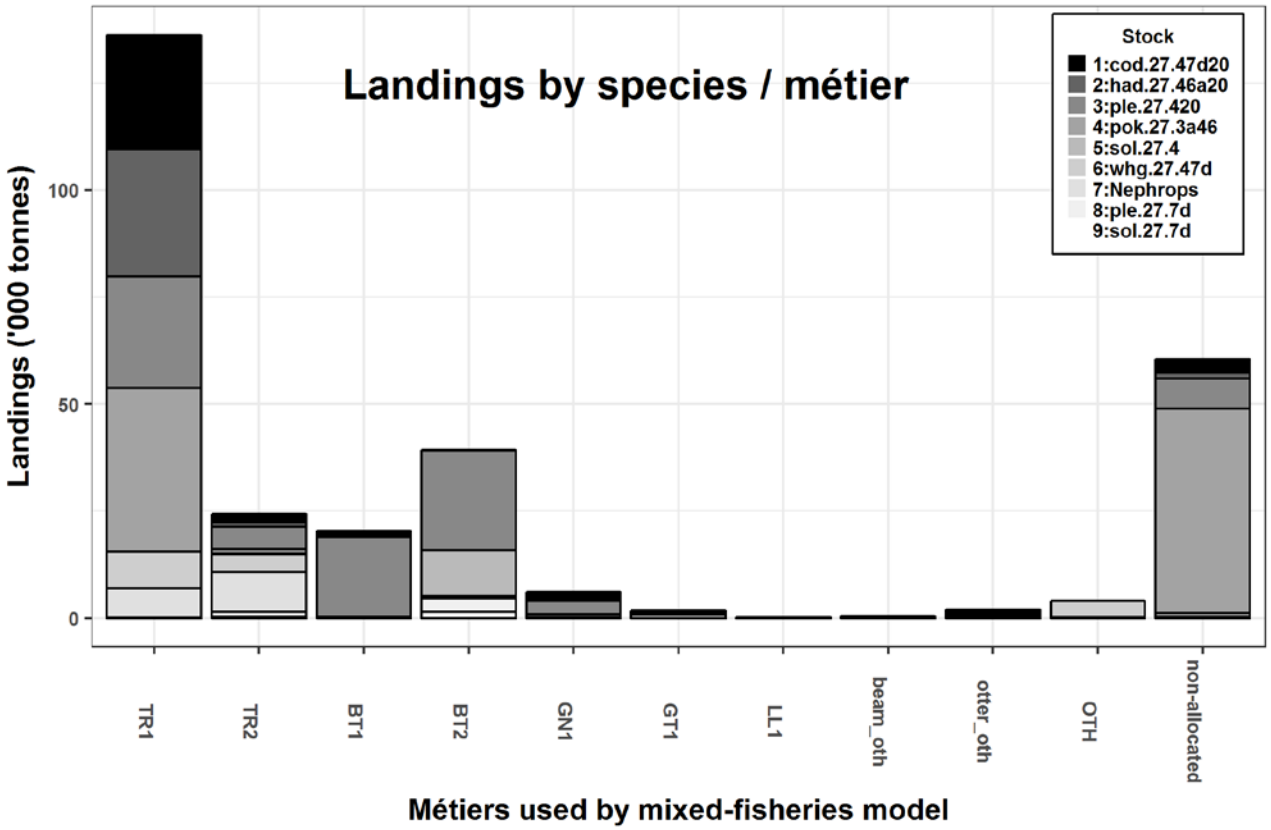

Figure 5 Mixed fisheries for the North Sea. Landings distribution of species by métier, with landings consisting of ≥ 1% of any of the stocks (see Figure 1) in 2016 (list of métiers available in Table 6). Note: The "other" (OTH) displayed here is a mixed category consisting of (i) landings without corresponding effort (Including all Norwegian fleets) and (ii) landings of any combination of fleet and métier with landings < 1% of any of the stocks 1–10 in 2017. The "non-allocated" is the differences between total landings used in single-stock advice and mixed-fisheries advice, such as saithe and haddock landings in Subarea 4 and Division 6.a, respectively.

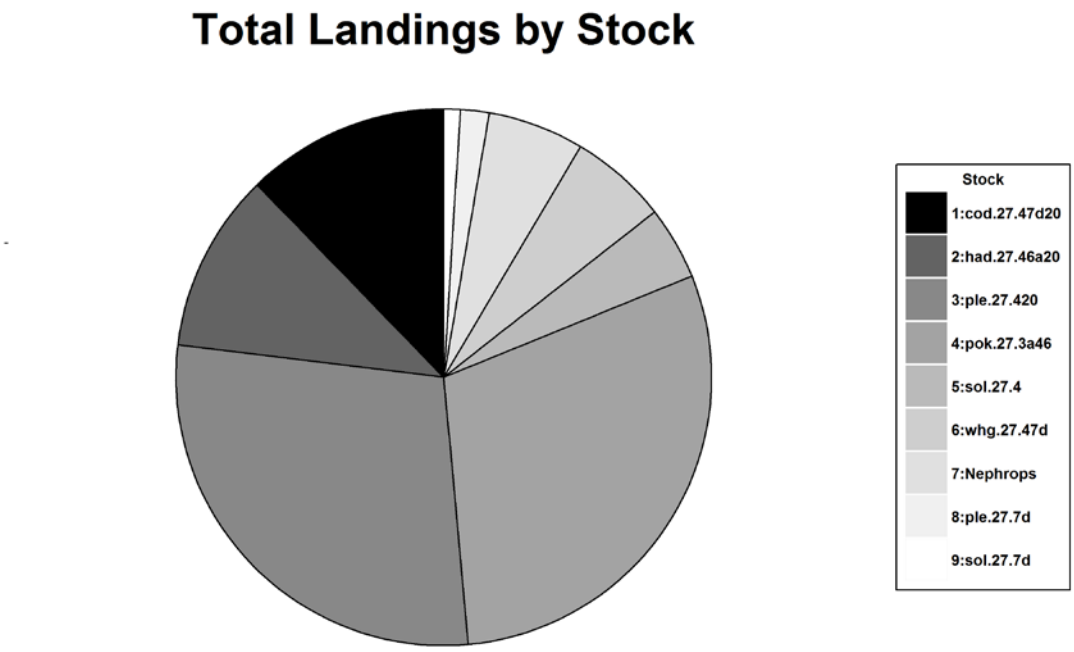

Figure 6 Mixed fisheries for the North Sea. Landings distribution by stock.

Table 6 Mixed fisheries for the 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	NA
Pelagic	Pelagic trawl or seine	
Pots	Pots	NA
OTH	Any gear type	

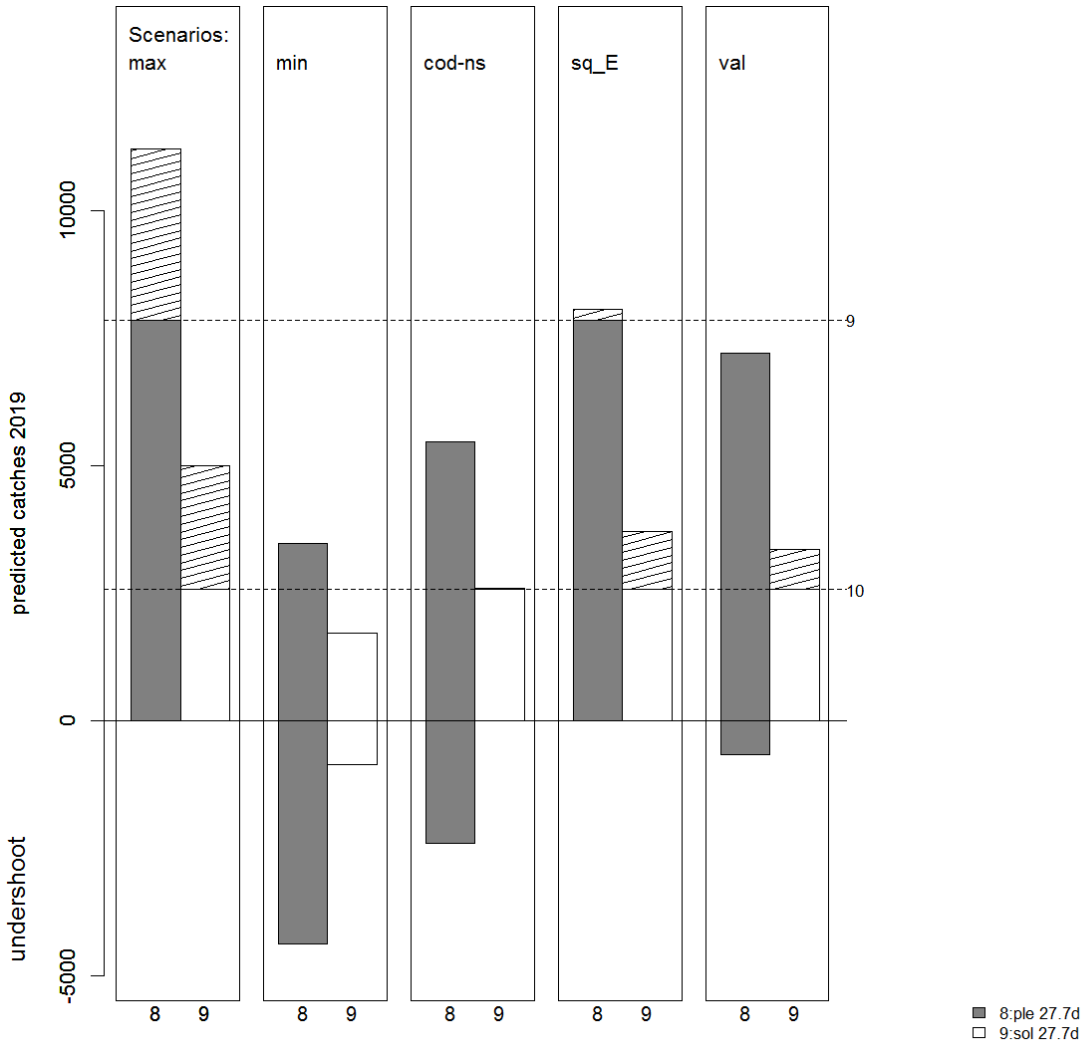

Figure 7 Mixed fisheries for the North Sea. Mixed-fisheries projections for the Eastern Channel flatfish stocks which are subject to lower catches (detail from Figure 1). Estimates of potential catches (in tonnes) by stock and by scenario. Horizontal lines correspond to the single-stock advice for 2019. Bars below the value of zero show the scale of undershoot (compared to single-stock advice) in cases where catches are predicted to be lower when applying the scenario. Hatched columns represent catches that overshoot the single-stock advice.

Summary of the assessment

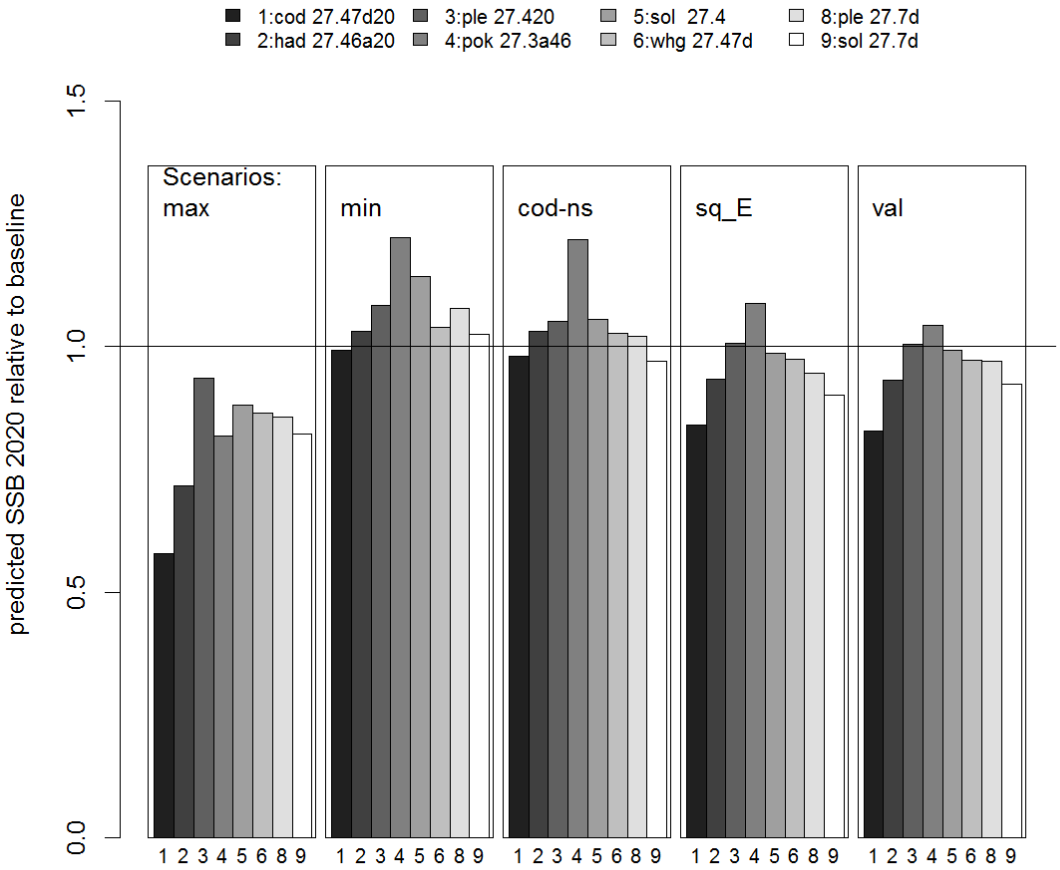

Figure 8 Mixed fisheries for the North Sea. Estimates of potential SSB at the start of 2020 by stock after applying the mixed-fisheries scenarios, expressed as a ratio to the single-stock advice forecast. The horizontal line corresponds to the SSB resulting from the single-stock advice (at the start of 2020). Norway lobster are not included as the abundance was not forecasted in the mixed-fisheries model.

Table 7 Mixed fisheries for the North Sea. SSB results from single-stock advice and different mixed-fisheries scenarios (see Figure 8). Norway lobster are not included as the abundance is not forecasted in the mixed-fisheries model. All weights are in tonnes. Unless otherwise noted, SSB (2020) > B_{pa} or MSY $B_{trigger}$.

Stock	Single-stock advice	SSB (2020) resulting from mixed-fisheries scenario applied in 2019					
	SSB (2020)	Maximum	Minimum	COD	*Status quo* effort	Value	Range
Cod	141896*	82236***	141322*	139585*	119647*	118176*	141436*
Haddock	193817	147325	211830	211737	191693	191399	197826
Plaice in Division 7.d	37200	31338	39477	37356	34617	35522	39142
Plaice in Subarea 4	1022768	954592	1106228	1074245	1029566	1026358	1041674
Saithe	334963	263436	393151	391857	349884	337209	351251
Sole in Division 7.d	16615*	13410***	16709	15810*	14691*	15056*	16911*
Sole in Subarea 4	54818	48365	62668	57909	54154	54497	55041
Whiting	171663	148108*	177921	176054	166802	166733	172176

NA: stocks for which ranges of F_{MSY} are either not available or not yet included in the scenario.
* B_{lim} < SSB (2020) < B_{pa}.
** SSB (2020) < B_{pa}, B_{lim} not defined.
*** SSB (2020) < B_{lim}.

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