

## EU standing request on catch scenarios for zero-TAC stocks; cod (*Gadus morhua*) in divisions 7.e–k (Celtic Sea)

### Service summary

Cod (*Gadus morhua*) in divisions 7.e–k is a target species in the EU multiannual management plan (EU MAP; EU, 2019). The zero-catch advice provided by ICES for this stock is based on precautionary considerations. The mixed-fisheries analysis shows that cod is caught in most mixed fisheries in the Celtic Sea with other species for which non-zero catches are advised. The present technical service provides illustrative catch scenarios consistent with the lower  $F_{MSY}$  range for haddock and the reduced  $F_{MSY}$  advised for whiting as detailed below.

For cod in divisions 7.e–k:

- 2548 tonnes are estimated to be caught when haddock is fished at  $F_{MSY}$ ; this would result in a cod spawning-stock biomass (SSB) of 2410 tonnes in 2022;
- 1856 tonnes are estimated to be caught when haddock is fished at  $F_{MSY\ lower}$ ; this would result in a cod SSB of 3377 tonnes in 2022;
- 2231 tonnes are estimated to be caught when haddock is fished midway between  $F_{MSY}$  and  $F_{MSY\ lower}$ ; this would result in a cod SSB of 2851 tonnes in 2022;
- 1669 tonnes are estimated to be caught when whiting is fished the reduced  $F_{MSY}$  advised (i.e.  $F_{MSY} \times SSB_{2021}/MSY\ B_{trigger}$ ); this would result in a cod SSB of 3642 tonnes in 2022.

Only the haddock  $F_{MSY\ lower}$  and whiting reduced  $F_{MSY}$  scenarios result in an increase in cod SSB relative to 2021 (2943 tonnes). All scenarios result in an SSB below  $B_{lim}$  (4200 tonnes) in 2022.

It is not possible to provide catch scenarios that include changes in the fishing pattern. The above scenarios assume a fixed fishing pattern in 2021. Future changes in the fishing pattern depend on management measures and the response of the fishery, which cannot be predicted by ICES.

Since cod are bycaught in mixed fisheries, a specific monitoring TAC would likely not be required for this stock.

### Request

EU DGMARE has asked ICES to evaluate the following:

*For bycatch and for target stocks where ICES is advising zero TACs but the stock is caught in mixed-fisheries with other species where non-zero catches are advised, where possible ICES will provide the EU with illustrative catch scenarios that are consistent with the advice for the main target species in the fishery.*

*Where the zero TAC advice is given for a target stock subject to a MAP the catch scenarios for the zero TAC stock should include scenarios consistent the  $F_{MSY}$  range in the target stock (e.g.  $F_{MSY}$ ,  $F_{MSY\ Lower}$  and intermediate values) and quantify the corresponding changes in biomass\*. Scenarios should therefore also be produced that give, as a minimum, a stable biomass and increasing biomass if  $F_{MSY}$  ranges do not†. This may involve carrying out mixed fisheries forecast or providing  $F$ -multipliers consistent with the advice for the target stocks or where forecasts are not possible the catch scenario should be based on the best available scientific information. Where possible ICES should provide catch scenarios which include changes in fishing pattern if they considered likely by ICES.*

*For stocks where ICES is advising zero TACs but where a monitoring fishery would be useful to monitor stock development, where possible ICES will provide catch scenarios for a monitoring TAC. This should be the minimum level of catches needed to provide sufficient data for ICES to continue providing scientific advice on the state of this stock.*

\* This is because the safeguards in the MAPs are measured in rebuilding of biomass, not fishing mortality levels.

† E.g. Northern Seabass 2020 catch advice (from June 2019) where both  $F_{MSY}$  and  $F_{MSY\ Lower}$  gave negative biomass for a stock only just above  $B_{lim}$ .

## Basis of the advice

This technical service was completed using ICES data sources and, where available, the results of both single-species and mixed-fisheries forecasts.

In the operational mixed-fisheries model for cod.27.7e–k, the catch of cod in 2021 and SSB in 2022 were explored under different F scenarios for the target stocks taking account of mixed fisheries technical interactions. This model assumes that fishing patterns remain fixed in 2021, and changes in selectivity are not explicitly modelled.

## Results

When considering the mixed-fisheries technical interactions in the Celtic Sea, cod, haddock, and whiting are closely linked in demersal mixed fisheries. Those catch scenarios with haddock as the main target species are considered the most relevant for Celtic Sea cod. The whiting reduced  $F_{MSY}$  scenario is more restrictive than the haddock  $F_{MSY\ Lower}$  scenario since it results in lower cod catches in 2021.

In the 2020 Celtic Seas mixed-fisheries advice, sole is the least limiting stock for the highest number of fleets (6 of the 24 fleets, representing 43% of the effort in 2019). The various Norway lobster functional units (FUs) are collectively the least limiting quota for 14 of the 24 fleets (representing 42% of the effort in 2019) (ICES, 2020). To explore the impact of fishing haddock at  $F_{MSY}$ ,  $F_{MSY\ lower}$ , and an intermediate value, a number of additional mixed-fisheries scenarios are explained in Table 1. The whiting reduced  $F_{MSY}$  is also explained in Table 1. The forecasted projections from these scenarios result in different catch advice for catching cod (cod.27.7e–k), haddock (had.27.7b–k), whiting (whg.27.7b–ce–k), Norway lobster (FUs 16, 17, 19, 20–21, 22, and outside FUs), sole (sol.27.7fg), white anglerfish (*Lophius piscatorius*, mon.27.78abd), and megrim (*Lepidorhombus whiffiagonis*, meg.27.7b–k8abd); these vary to differing degrees from the single-species stock advice (Table 2). The resulting SSB in 2022, for the different species under the different scenarios, is shown in Table 3, and the projected fishing mortality in 2021 is shown in Table 4.

**Table 1** Mixed-fisheries scenarios considered for this request.

Scenarios	Explanation
Haddock $F_{MSY}$	All fleets set their effort corresponding to that which is required to catch their haddock stock share ( $F = 0.353$ ), regardless of other catches.
Haddock $F_{MSY\ lower}$	All fleets set their effort corresponding to that which is required to catch their haddock stock share, where the haddock TAC is set according to the EU MAP $F_{MSY\ lower}$ ( $F = 0.221$ ), regardless of other catches.
Haddock $F_{MSY\ lower} - F_{MSY}$	All fleets set their effort corresponding to that which is required to catch their haddock stock share, where the haddock TAC is set according to the intermediate point ( $F = 0.287$ ) between $F_{MSY\ lower}$ ( $F = 0.221$ ) and $F_{MSY}$ ( $F = 0.353$ ), regardless of other catches.
Whiting reduced $F_{MSY}$	All fleets set their effort corresponding to that required to catch their whiting stock share ( $F = 0.268 = F_{MSY} \times SSB_{2021} / MSY_{B_{trigger}}$ ), regardless of other catches.

**Table 2** Mixed-fisheries advice in the Celtic Sea. Catch (in tonnes) per mixed-fisheries scenario 2020, in absolute values.

Stock	Single-stock catch advice (2021)	Catch per mixed-fisheries scenario (2021)			
		Haddock $F_{MSY}$	Haddock $F_{MSY\ lower}$	Haddock $F_{MSY\ lower} - F_{MSY}$	Whiting $F_{MSY}$
cod.27.7e-k	0	2548	1856	2231	1669
had.27.7b-k	18382	18471	12174	15376	10766
meg.27.7b-k8abd	19184	16952	10944	13995	10355
mon.27.78abd	34579	28702	19489	24175	17808
sol.27.7fg	1413	688	440	566	459
whg.27.7b-ce-k	5261	8678	5875	7333	5273
nep.fu.16	3290	3942	2468	3205	2181
nep.fu.17	508	202	127	165	119
nep.fu.19	595	189	118	154	109
nep.fu.2021	1710	1290	808	1049	795
nep.fu.22	1560	1449	907	1178	827
nep.out.7	150	152	95	124	87

**Table 3** Mixed-fisheries advice in the Celtic Sea. Spawning-stock biomass (in tonnes) per mixed-fisheries scenario 2021, in absolute values.

Stock	Single-stock advice SSB (2022)	Spawning-stock biomass (2022)			
		Haddock $F_{MSY}$	Haddock $F_{MSY\ lower}$	Haddock $F_{MSY\ lower} - F_{MSY}$	Whiting $F_{MSY}$
cod.27.7e-k	6078	2410	3377	2851	3642
had.27.7b-k	70434	70455	77788	73872	78707
meg.27.7b-k8abd	115734	116707	123109	119855	123738
mon.27.78abd	80416	84203	90171	87131	91264
sol.27.7fg	6009	6750	7006	6879	6987
whg.27.7b-ce-k	37494	34620	36969	35747	37535

Legend

	SSB (2022) > $B_{pa}$ or MSY $B_{trigger}$
	SSB (2022) > $B_{lim}$ , no $B_{pa}$ defined
	SSB (2022) > $B_{lim}$
	SSB (2022) < $B_{lim}$

**Table 4** Mixed-fisheries advice in the Celtic Sea. TAC year (2021) fishing mortality per mixed-fisheries scenario 2021, in absolute values.

Stock	Single-stock F advice (2021)	Fishing mortality per mixed-fisheries scenario (2021)			Whiting $F_{MSY}$
		Haddock $F_{MSY}$	Haddock $F_{MSY\ lower}$	Haddock $F_{MSY\ lower} - F_{MSY}$	
cod.27.7e-k	0.000	0.982	0.618	0.80	0.537
had.27.7b-k	0.353	0.353	0.221	0.287	0.194
meg.27.7b-k8abd	0.191	0.168	0.105	0.137	0.099
mon.27.78abd	0.280	0.227	0.149	0.188	0.136
sol.27.7fg	0.251	0.114	0.071	0.093	0.075
whg.27.7b-ce-k	0.268	0.485	0.304	0.394	0.268
nep.fu.16	0.062	0.074	0.047	0.060	0.041
nep.fu.17	0.062	0.026	0.016	0.020	0.015
nep.fu.19	0.069	0.025	0.015	0.020	0.014
nep.fu.2021	0.060	0.049	0.030	0.039	0.030
nep.fu.22	0.097	0.095	0.059	0.077	0.054

Legend

	$F(2021) \leq F_{MSY}$
	$F(2021) > F_{MSY}, < F_{pa}$
	$F(2021) > F_{pa}$
	$F(2021) > F_{lim}$

### Sources and references

EU. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L 83: 1–17. <http://data.europa.eu/eli/reg/2019/472/oj>.

ICES. 2020. Celtic Seas ecoregion – Fisheries overview, including mixed-fisheries considerations. In Report of the ICES Advisory Committee, 2020. ICES Advice 2020, Section 7.2. <https://doi.org/10.17895/ices.advice.7606>.

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