ICES Fisheries Overviews
Celtic Seas ecoregion
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7.2 Celtic Seas ecoregion – Fisheries overview, including mixed-fisheries considerations

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Executive summary

This fisheries overview contains details of mixed-fisheries considerations for the Celtic Sea demersal stocks, and a description of the fisheries and their interactions within the ecoregion. ICES carries out mixed-fisheries forecasts for a number of scenarios including cod (cod.27.6a, cod.27.7e–k), haddock (had.27.6b, had.27.7a, had.27.7b–k), whiting (whg.27.7a, whg.27.7b–ce–k), Norway lobster (nep.fu.11–17, 19, 20–21, 22 and outside FUs), sole (sol.27.7a, sol.27.7e, sol.27.7fg), white anglerfish (mon.27.78abd), and megrim (lez.27.4a6a, lez.27.6b, meg.27.7b–k8abd) caught in mixed demersal fisheries in the Celtic Sea. These scenarios take account of the technical interactions not included in the single-stock forecasts. For 2021, no catch of other stocks is consistent with the cod single-stock advice of zero catch. This is because all demersal fleets operating within the Celtic Sea catch cod to some extent.

The commercial fisheries in the Celtic Sea target a large number of stocks. The pelagic fisheries, which account for the largest catches (by weight) in the region are the mid-water trawl fisheries for blue whiting, mackerel, horse mackerel, herring, boarfish, and sprat. The largest demersal fishery targets hake along the shelf edge using gillnets and longlines. There are also large mixed bottom-trawl fisheries targeting benthic species, *Nephrops*, and gadoids. The species composition of these mixed fisheries tend to vary, depending on the area and the countries involved in the fishery.

The relationship of biomass status or the fishing mortality to reference points is not known for 60% of the 106 stocks that are assessed in the ecoregion. Though only 27% of the stocks are fished below F_{MSY}, these stocks account for nearly 37% of the total landings. There has been a trend of declining fishing mortality since the mid-1990s for the benthic and demersal stocks with known status. The average F/F_{MSY} ratio is below one for assessed benthic stocks and just above for the assessed demersal stocks. The trend for stock size in assessed benthic and demersal stocks has been increasing over the same period. The average F/F_{MSY} ratio is below one for the crustacean stocks and the average biomass has been above one in the past decade. The average F/F_{MSY} ratio for pelagic assessed stocks has been above one in recent years and the average stock size indicator is declining in recent years but remains above MSY $B_{trigger}$.

The technical interactions in demersal mixed fisheries are described for three areas within the ecoregion. *Nephrops* account for the highest landings in the Irish Sea; they are mainly taken in trawl fisheries where they account for more than 90% of the total landings. In the Celtic Sea and west of Ireland hake account for the majority of the landings; they are mainly taken in longline and gillnet fisheries which are also dominated by hake. In the west of Scotland *Nephrops* again account for the highest landings; they are mainly taken using otter trawls, but also in pots.

Introduction

The Celtic Seas ecoregion covers the northwestern shelf seas of the Europe (Figure 1). It includes areas of the deeper eastern Atlantic Ocean and coastal seas that are heavily influenced by oceanic inputs. The ecoregion ranges from north of Shetland to Brittany in the south. Three key areas constitute this ecoregion:

- Northern parts; the Malin shelf, west of Scotland, eastern Rockall Bank, and north of Scotland (parts of Subdivision 2.a.2, divisions 4.a and 6.a, and Subdivision 6.b.2);
- the Celtic Sea and west of Ireland (Division 7.b and Subdivision 7.c.2; parts of divisions 7.e, 7.f, 7.g, 7.h, and subdivisions 7.j.2 and 7.k.2);
- the Irish Sea (Division 7.a).

In the north there are strong linkages with the North Sea, in the southeast a strong linkage with the channel area, and in the south a strong link with the Bay of Biscay. The eastern part of the Rockall Bank is within the geographic scope of the ecoregion although it is separated from the western European shelf by the Rockall Trough.

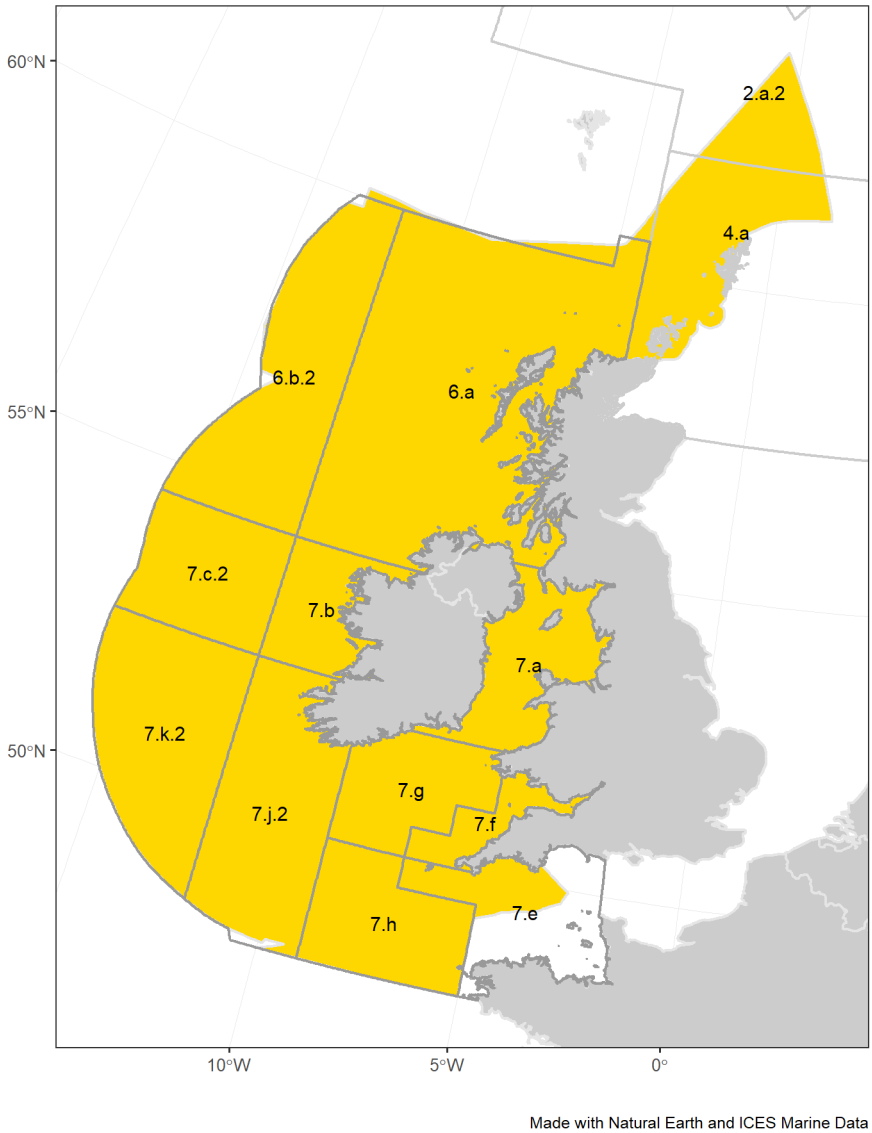


Figure 1 The Celtic Seas ecoregion (highlighted in yellow) and ICES statistical areas.

The overview covers ICES subareas 27.7 (excluding Division 27.7.d) and 27.6, (hereafter, the "27" area prefixes are omitted). Some fisheries statistics do not allow the full differentiation of sections of subareas 4 and 2, and (in earlier years) western sections of subareas 6 and 7 as well as the southeastern section of Division 7.e.

Mixed-fisheries advice for divisions 7.b–c and 7.e–k (Celtic Sea)

Mixed-fisheries considerations combine single-species stock assessments with information on the average catch composition and fishing effort of the fleets catching cod, haddock, whiting, Norway lobster, sole, white anglerfish, and megrim in the Celtic Sea. The mixed-fisheries results shown for Norway lobster are combined over several FUs in plots, but stock status and fishing opportunities differ across FUs. In the absence of specific mixed-fisheries management objectives, ICES does not advise on specific mixed-fisheries catch opportunities for the individual stocks.

Mixed-fisheries scenarios are based on the central assumption that the fishing patterns and catchability of a fleet in 2021 are the same as the average patterns in recent years (2017–2019). A total of seven scenarios are presented, corresponding to different fleet behaviours for 2021 (Table 1). The forecasted scenarios are presented in terms of catch and the potential for quota over- and undershoot, which is driven by the most and the least restrictive single-stock advice (Figure 2).

All fleets in the Celtic Sea catch cod, and cod is the most limiting stock in this area. The 2021 forecast with the cod catch advice at zero implies that catches of the other stocks would also be zero (the "min" scenario). Because the zero catch for cod results in the same outcome as the "min" scenario, the cod scenario is not presented here. To provide a scenario with non-zero catch, a reduced cod F_{MSY} scenario is presented ("cod_F_{AR}MSY"), based on the ICES advice rule, which gives an F value of 0.147 for cod and results in undershoots for all other stocks, as fishing is stopped when the cod quota is reached. The "max" scenario, assumes that all fleets catch all their quotas irrespective of the economic viability of doing so and is intended to represent the maximum potential catch; this scenario leads to an overshoot for all stocks, as individual fleets are least limited by different stocks.

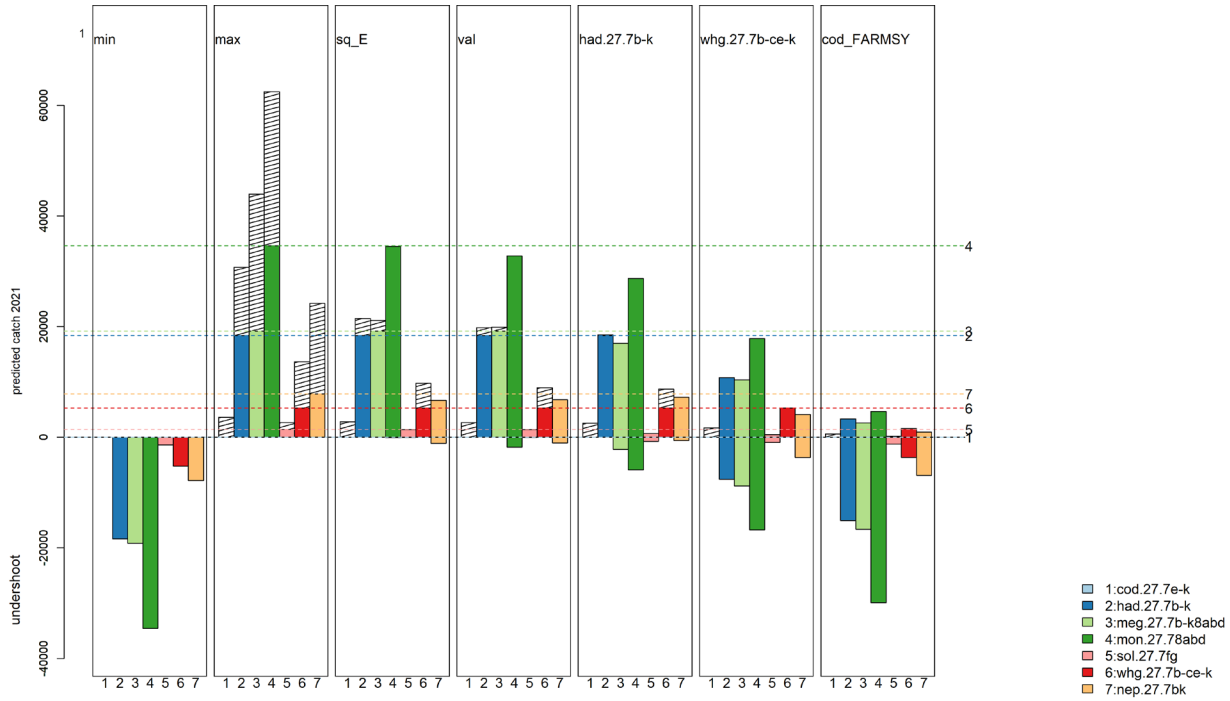


Figure 2 Mixed-fisheries advice for the Celtic Sea. Estimates of potential catches (in tonnes) by stock and by scenario (described in Table 1). The horizontal lines correspond to the single-stock catch advice for 2021. The bars below the value of zero show undershoots (compared to single-stock advice) where catches are predicted to be lower when applying the scenario. Hatched columns represent catches that overshoot the single-stock advice.

An additional "range" scenario minimizes the potential mismatch between the advised fishing mortality in the single-stock advice for 2021 and a fishing mortality which takes into account the technical interactions between stocks in mixed-fisheries by setting target fishing levels within the F_{MSY} ranges. This scenario estimates fishing mortality by stock which, if used for setting single-stock fishing opportunities for 2021, may reduce the gap between the most and least restrictive TACs, thus reducing the potential quota over- and undershoot. This scenario was run using a reduced F_{MSY} range when stock size is below MSY $B_{trigger}$ for cod (F_{MSY} range 0.086–0.208) and whiting (F_{MSY} range 0.222–0.268) and the full range for the other stocks. The scenario results in fishing mortality for cod at the upper end of the F_{MSY} range, with all other stocks being at or close to the lowest bound of their respective F_{MSY} ranges (Figure 3). Norway lobster is not included in this "range" scenario.

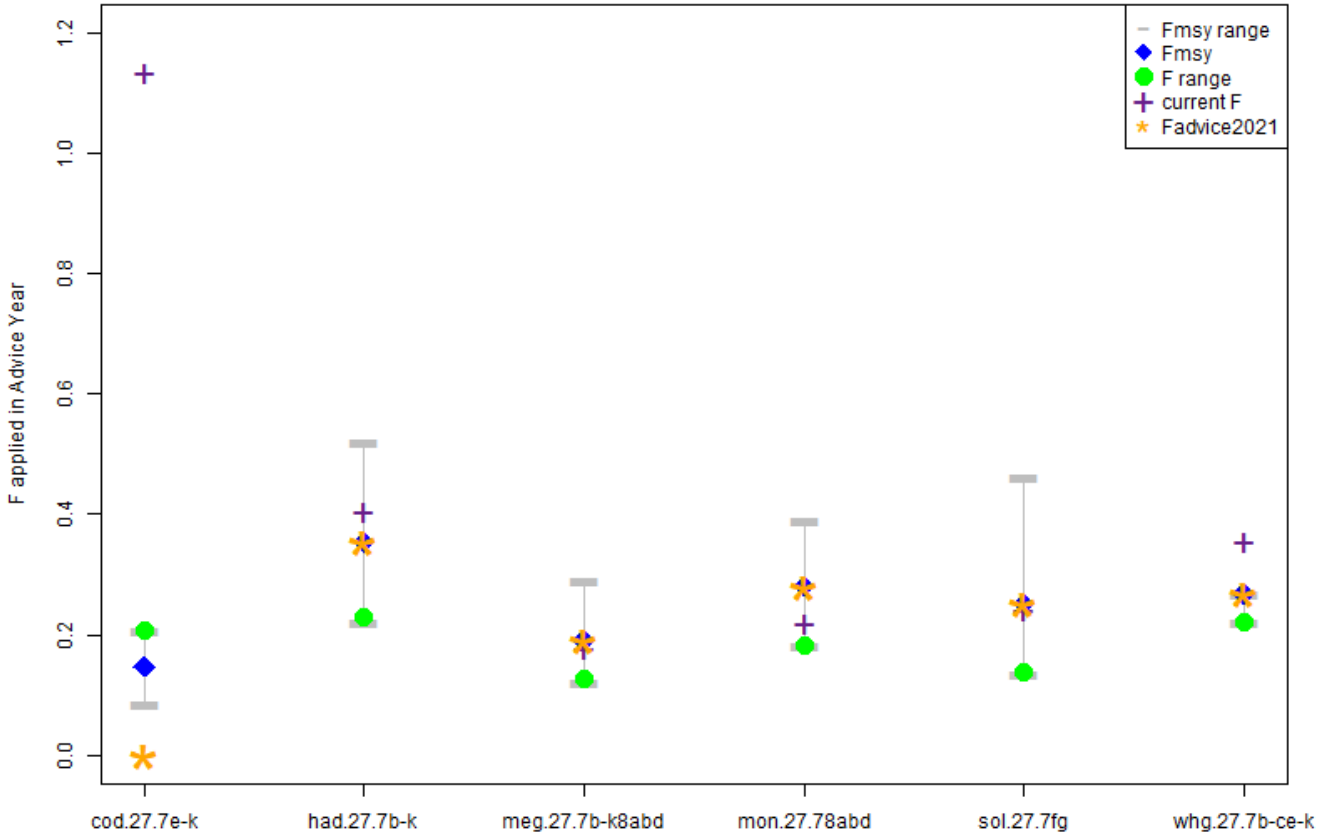


Figure 3 The "range" scenario for divisions 7.b–c and 7.e–k stocks in 2021 using the reduced F_{MSY} range for cod and whiting. The "range" scenario uses fishing mortality rates for each stock that reduce the mismatch between opportunities for the six stocks, along with the current fishing mortality (2019), the fishing mortality corresponding to the single-stock advice, and the F_{MSY} and the F_{MSY} ranges.

Table 1 Mixed-fisheries advice for divisions 7.b–c and 7.e–k. Mixed-fisheries scenarios considered for the Celtic Seas demersal fisheries.

Scenario codes	Scenarios
max	**"Maximum":** For each fleet, fishing stops when all stocks have been caught up to the fleet's stock shares*. This option causes overfishing of the single-stock advice possibilities of all stocks.
min	**"Minimum":** For each fleet, fishing stops when the catch for any one of the stocks meets the fleet's stock share. This option is the most precautionary option, causing underutilization of the single-stock advice possibilities of other stocks.
had.27.7b–k	**"Haddock MSY approach":** All fleets set their effort corresponding to that required to catch their haddock stock share, regardless of other catches.
whg.27.7b–ce–k	**"Whiting MSY approach":** All fleets set their effort corresponding to that required to catch their whiting stock share, regardless of other catches.
sq_E	**"*Status quo* effort":** The effort of each fleet in the TAC year (2021) is set equal to the average effort in the most recent 3 years (2017–2019) for which catch and effort data are available.
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 below). This option causes overfishing of some stocks and underutilization of others.
cod_F_{AR}MSY	**"Reduced Cod F_{MSY}":** All fleets set their effort corresponding to that required to catch their cod stock share, where the cod TAC is set according to reduced F_{MSY} ($F = 0.147 = F_{MSY} \times SSB_{2021}/MSY\ B_{trigger}$), regardless of other catches.
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 bound by the ranges in the single species advice sheet where the F_{MSY} ranges is adjusted using the ICES advice rule when the stock is 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 for each particular fleet, calculated based on the single-stock advice for 2021 and the historical proportion of the stock landings taken by the fleet (2017–2019).

Catch scenarios

Mixed-fisheries scenarios consider the implications of mixed fisheries operating under single-stock TAC regimes, taking into account the fishing patterns of the various fleets in 2017–2019 (i.e. the catchability for the different stocks and effort distribution among métiers as well as access to quota). The scenarios presented here do not assume either any quota balancing in the forecast through changes in targeting behaviour in 2021 or any change in the selection pattern of the fleets. The "min" scenario is consistent with a full implementation of the EU landing obligation given the individual single-stock advice. In 2021, the "min" scenario shows that cod limits all fleets due to the zero catch advice for cod and that all fleets catch cod to a greater or lesser extent. The "max" scenario demonstrates the upper bound of potential fleet effort and stock catches (Table 2, Figure 2), in that it assumes all fleets continue fishing until all their stock shares for all stocks are exhausted, irrespective of the economic viability of such actions. In 2021, the "max" scenario indicated that fleets have different least limiting stocks which results in over-quota catches of all stocks (Figure 4). Sole is the least limiting stock for the highest number of fleets (six of the 24 fleets, representing 43% of the effort in 2019), while the different Norway lobster functional units are collectively the least limiting quota for 14 of the 24 fleets (representing 42% of the effort in 2019).

Scenarios that result in under- or overutilization are useful in identifying imbalance between the fishing opportunities of the various stocks. They indicate the direction in which fleets may have to adapt to fully utilize their catch opportunities without collectively exceeding single-stock fishing opportunities. Under the scenarios presented here, the "max" scenario suggests that if all fleets' stock shares are to be fully utilized, catches of all stocks would be higher than advised in the single-stock advice. This indicates that not all fleets are limited by the same stock. However, as all fleets catch cod to a greater or lesser extent, any fishing effort directed at other stocks is likely to result in catches of cod above the single-stock advice (zero catch) which is considered not precautionary. The "cod_F_{AR}MSY" scenario, where the cod TAC is set at reduced F_{MSY}, results in catches of cod and underutilization of all other single-stock TACs. Under this scenario fleets would be required to reduce their effort by 87%. The *status quo* effort scenario ("sq_E") results in full utilization of most stocks, small overshoots of haddock and megrims, and large overshoots of cod and whiting. In the absence of a full economic behaviour

model, a "val" scenario balances fishing opportunities by stock with their potential market value. For 2021, the "val" scenario gives results that are close to the *status quo* effort scenario.

Mixed-fisheries catch scenarios can take specific management priorities into account, and these results indicate that it is not possible to achieve all single-species management objectives simultaneously. ICES single-stock advice for demersal stocks considered here is based on the EU multiannual plan (MAP) for demersal stocks in the western waters (EU, 2019), except for nep.out.7 (which is based on the precautionary approach). ICES provides zero-catch advice for cod in 2021, based on precautionary considerations. The "max", "sq_E", "val", and "had.27.7b–k" scenarios all result in cod being fished above F_{lim} (1.130) in 2021. All demersal fish stocks are fished above F_{MSY} under the "max" scenario, while all but monkfish and sole are fished above F_{MSY} under the "sq_E" and "val" scenarios (Table 3).

A "range" scenario as described in Ulrich *et al*. (2017) searches for the minimum sum of differences between potential catches by stock under the "min" and the "max" scenarios within the F_{MSY} ranges. The outcomes of this scenario are driven by the restrictive nature of the cod advice this year, with the minimum of the F_{MSY} range advice for all other stocks resulting from the need to reduce cod catches to a minimum. The results are presented as outcomes of single stock forecasts using the identified range of fishing mortalities and do not take account of the technical interactions as for the mixed-fishery scenarios. This implies that the catches forecasted within the "range" scenario could only be achieved with substantial changes in fishing patterns.

Table 2 Mixed-fisheries advice in the Celtic Seas ecoregion. Catch per mixed-fisheries scenario 2021, in absolute values.

Stock	Single-stock catch advice (2021)**	Catch per mixed-fisheries scenario (2021)							range*
		max	min	sq_E	cod_F_{AR}MSY	val	had.27.7b–k	whg.27.7b–ce–k	
cod.27.7e–k	0	3614	0	2787	544	2631	2548	1669	743
had.27.7b–k	18382^	30722	0	21448	3295	19781	18471	10766	12540
meg.27.7b–k8abd	19184^	43915	0	21130	2562	19925	16952	10355	13093
mon.27.78abd	34579^	62462	0	34467	4641	32785	28702	17808	23556
sol.27.7fg	1413^	2620	0	1391	183	1364	688	459	823
whg.27.7b–	5261^	13657	0	9751	1573	8939	8678	5273	4473
nep.fu.16	3290^	15254	0	3193	485	3543	3942	2181	-
nep.fu.17	508^	412	0	225	26	194	202	119	-
nep.fu.19	595^	351	0	212	25	180	189	109	-
nep.fu.2021	1710^	3015	0	1574	193	1383	1290	795	-
nep.fu.22	1560^	4652	0	1345	183	1331	1449	827	-
nep.out.7	150	510	0	141	20	143	152	87	-

* The results of the "range" scenario are bounded by the single-stock MSY ranges (or reduced ranges) and does not directly account for any technical interactions. These catches could only be achieved with substantial changes in fishing patterns.

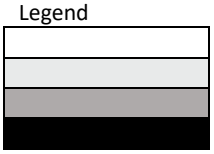
** Advised catches of no more than the indicated value.

^ Single-stock advice based on F ranges (or reduced ranges) in accordance with the MAP for demersal stocks in the western waters (EU, 2019). The value presented here is for catches corresponding to F_{MSY} (or $F_{MSY} \times SSB_{2021}/MSY\ B_{trigger}$).

Table 3 Mixed-fisheries advice for divisions 7.b–c and 7.e–k. TAC year (2021) fishing mortality or harvest ratio (for Norway lobster) forecast by scenario. The F range is averaged across the same ages as those used for the single-stock assessment. The colour gradients of the legend show the forecast fishing mortality under the scenario in relation to reference points detailed in the legend.

Stock	Single-stock F advice (2021)	Fishing mortality per mixed-fisheries scenario (2021)							range **
		max	min	sq_E	cod_F_{AR}MSY	val	had.27.7 b–k	whg.27.7 b–ce–k	
cod.27.7e–k	0.000	1.978	0	1.143	0.147	1.035	0.982	0.537	0.207
had.27.7b–k	0.353	0.667	0	0.423	0.056	0.384	0.353	0.194	0.229
meg.27.7b–k8abd	0.191	0.512	0	0.214	0.024	0.201	0.168	0.099	0.13
mon.27.78abd	0.280	0.570	0	0.279	0.034	0.264	0.227	0.136	0.18
sol.27.7fg	0.251	0.528	0	0.246	0.029	0.240	0.114	0.075	0.138
whg.27.7b–ce–k	0.268	0.886	0	0.559	0.073	0.503	0.485	0.268	0.222
nep.fu.16*	0.062	0.287	0	0.060	0.009	0.067	0.074	0.041	0.062
nep.fu.17*	0.062	0.052	0	0.029	0.003	0.025	0.026	0.015	0.062
nep.fu.19*	0.069	0.046	0	0.028	0.003	0.023	0.025	0.014	0.069
nep.fu.2021*	0.060	0.113	0	0.059	0.007	0.052	0.049	0.030	0.060
nep.fu.22*	0.097	0.305	0	0.088	0.012	0.087	0.095	0.054	0.097

Legend



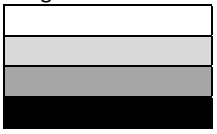
$F_{2021} \leq F_{MSY}$
$F_{2021} > F_{MSY}$, $< F_{pa}$
$F_{2021} > F_{pa}$
$F_{2021} > F_{lim}$

*Norway lobster stocks have no F_{pa} or F_{lim} limits, and so colours relate to above (black) or below (white) F_{MSY} harvest ratios.
**Single-stock advice is based on F ranges in accordance with the EU MAP for demersal stocks in the Western Waters (EU, 2019).

Table 4 Mixed-fisheries advice for divisions 7.b–c and 7.e–k. Spawning-stock biomass (SSB) results in 2022 from single-stock advice and different mixed-fisheries scenarios (see Figure 2). Weights in tonnes. The colour gradients of the legend show the forecast SSB under the scenario in relation to reference points detailed in the legend.

Stock	Single-stock advice	SSB (2022) resulting from mixed-fisheries scenario applied in 2021							range
		max	min	sq_E	cod_F_{AR}MSY	val	had.27.7b–k	whg.27.7b–ce–k	
cod.27.7e–k	6078	995	6076	2082	5272	2296	2410	3642	4981
had.27.7b–k	70434	55493	91521	66073	87799	68059	70455	78707	76584
meg.27.7b–k8abd	115734	88260	134821	112265	132074	113545	116707	123738	120816
mon.27.78abd	80416	62655	102907	80486	99861	81569	84203	91264	87532
sol.27.7fg	6009	4769	7462	6024	7273	6051	6750	6987	6610
whg.27.7b–ce–k	37494	30687	42053	33839	40693	34400	34620	37535	38176

Legend



$SSB_{2022} > B_{pa}$ or MSY $B_{trigger}$
$SSB_{2022} > B_{lim}$, no B_{pa} defined
$SSB_{2022} > B_{lim}$
$SSB_{2022} < B_{lim}$

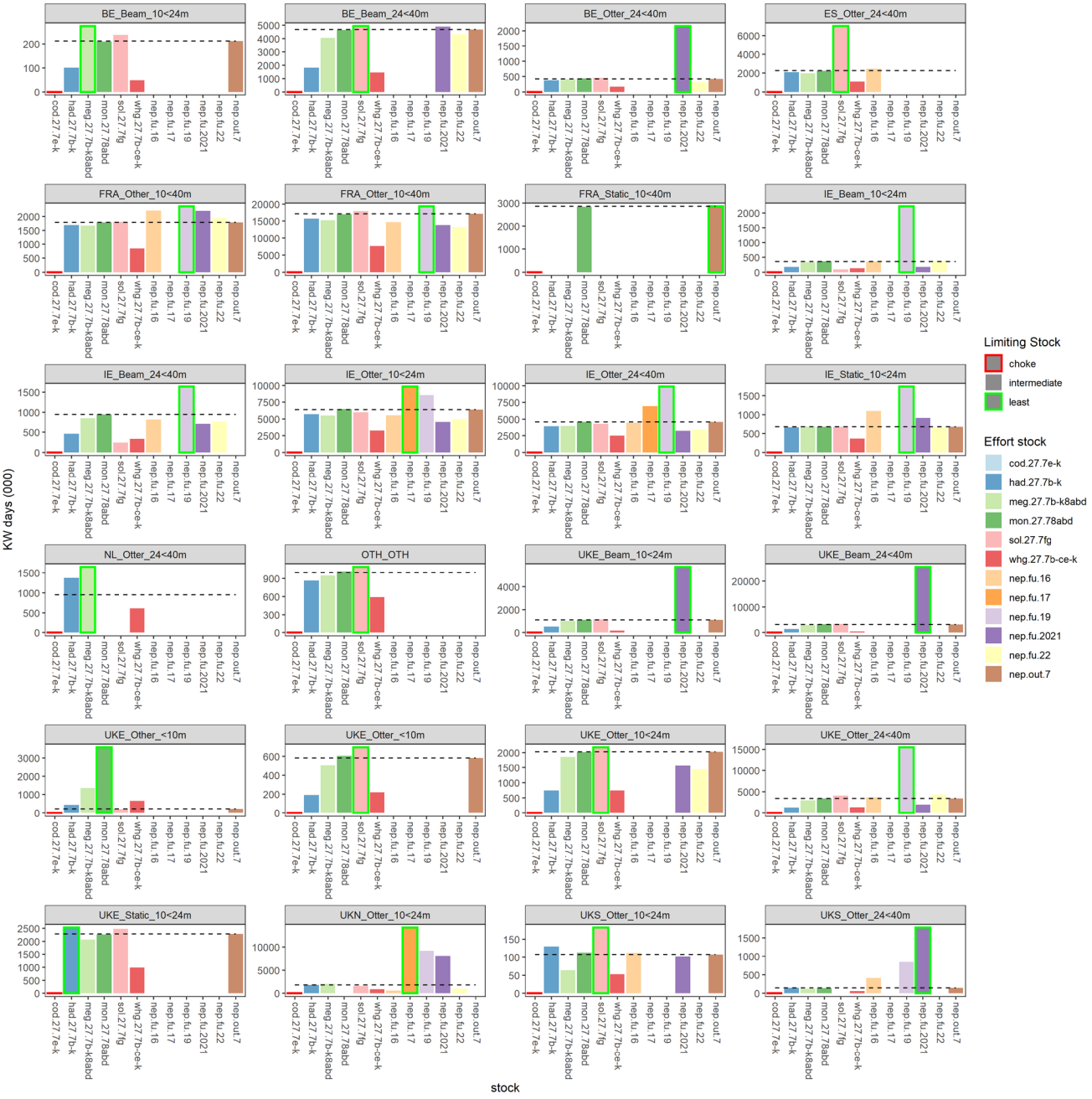


Figure 4 Mixed fisheries for divisions 7.b–c and 7.e–k. Estimates of effort by fleet needed to reach each single-stock advice. The stocks are coded by colour, with the most limiting stock ("choke species") for each fleet in 2021 highlighted with a red border and the least limiting species highlighted with a green border. Fleet names are given by country, main gear, and vessel size (m).

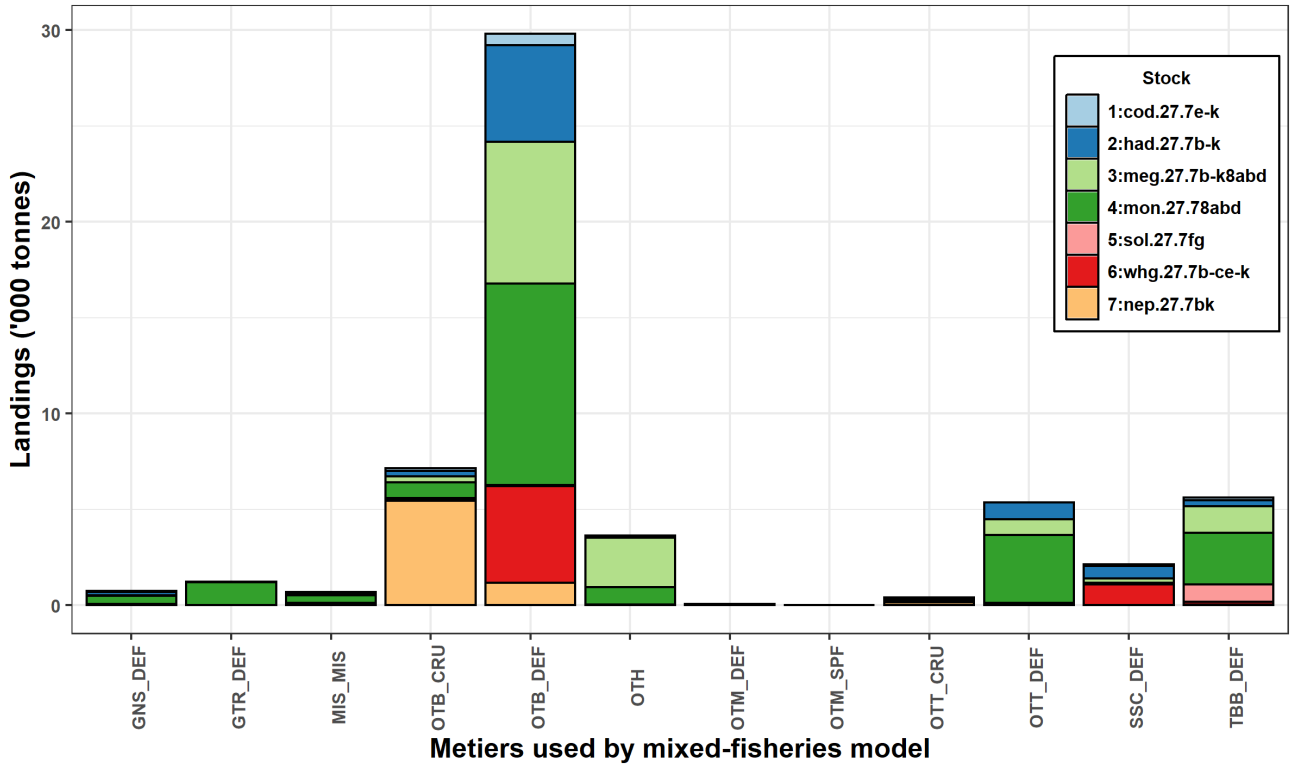


Figure 5 Mixed-fisheries advice for divisions 7.b–c and 7.e–k. Landings distribution of species by métier with landings consisting of ≥ 1% of any of the stocks (see Table 6) in 2019 (list of métiers available in Table 4). Note: The "other" (OTH) displayed here is a mixed category consisting of (i) landings without corresponding effort and (ii) landings of any combination of fleet and métier with landings < 1% of any of the stocks (Table 4) in 2019.

Table 5 Mixed-fisheries advice for divisions 7.b–c and 7.e–k. Métier categories used in the mixed-fisheries analysis.

Mixed-fisheries métiers	Gear	Target species
OTB_DEF	Otter trawls	Demersal fish
OTT_DEF	Twin otter trawls	Demersal fish
OTB_CRU	Otter trawls	Crustaceans
OTT_CRU	Twin otter trawls	Crustaceans
OTM_DEF	Midwater trawls	Demersal fish
OTM_SPF	Midwater trawls	Small pelagic fish
GNS_DEF	Gillnets	Demersal fish
GTR_DEF	Trammelnets	Demersal fish
SSC_DEF	Scottish seines	Demersal fish
TBB_DEF	Beam trawls	Demersal fish
OTH	Other gears	Any
MIS_MIS	Miscellaneous	Any

Quality considerations

The quality of catch data, disaggregated by métier, has improved in recent years. This is due to the single ICES data call, which combines data needs and ensures common data storage in InterCatch and Accessions. In spite of the improvements made over time, and in particular the issuing of a specific data call, the compilation of the mixed-fisheries dataset remains a highly demanding process, combining several types of data provided by different sources and covering a large number of countries, stocks, and fishing activities. Various changes and updates in the data sources occur every year. Quality control is a major component of the work performed and is considered suitable for providing advice.

Mixed-fisheries projections for the Celtic Seas ecoregion are based on full analytical single-stock assessments. Single-stock forecasts are also reproduced independently as part of the mixed-fisheries analyses, allowing additional quality control of both processes. The quality of the individual forecasts of the single-stocks will affect the quality of the mixed-fish scenarios.

For the mixed-fisheries advice, the intermediate year assumption used was the same as that used for the single-stock forecasts. This ensures consistency between the single-stock advice and the stock specific mixed-fisheries advice for that stock (i.e. haddock catches are the same under the haddock scenario as for the single-stock advice). As for the single stock advice the mixed-fisheries scenarios for cod will be very sensitive to the assumptions on catch in 2020 and on the recruitment for 2020 and 2021.

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 métiers) in 2020 and 2021 remain constant at their recent mean level (2017–2019). In reality, fishing patterns may change over time – particularly in response to significant changes in policy, such as the implementation of the landing obligation and revision of technical measures. In practice, such changes could affect the outcomes of mixed-fisheries projections. The year range used as a recent mean (2017–2019) covers the period during which the EU landing obligation has been introduced so the data reflect changes in fishing pattern over this period. It has not been possible to predict further changes in fishing pattern over the projection period.

The current model has been expanded this year to include three additional demersal fish stocks (megrim, anglerfish and sole) in addition to the Norway lobster Functional Units in the Celtic Sea. It has not yet been possible to include hake, which is also important in the mixed fisheries, due to technical difficulties.

Differences in stock distributions mean that spatial decoupling of catches of cod, haddock and whiting from those of megrims, anglerfishes and sole could be achieved (Dolder *et al.,* 2020).

Methods and data

Mixed-fisheries considerations are based on the single-stock assessments combined with knowledge on species composition in catches in the Celtic Seas fisheries (Moore *et al.*, 2020), using the F_{cube} method (Ulrich *et al*., 2011, 2017). Mixed-fisheries scenarios are based on central assumptions that fishing patterns and catchability in the TAC year are the same as those in recent years (2017–2019).

The mixed-fisheries forecasts include full analytical single-stock assessments for the following stocks: cod, haddock, whiting, megrim, anglerfish, and sole; as well as five Norway lobster functional units with underwater TV surveys for absolute estimates of abundance (Table 6).

The TACs for anglerfish and megrims cover two species of each (for anglerfish: *L. piscatorius* and *L. budegassa*; for megrims: *L. whiffiagonis* and *L. boscii*) but only the first of these two species in each case have full analytical assessments and are included in the mixed-fisheries catch advice. For anglerfish this is considered to be 78% of catches in Subarea 7 (ICES, 2020a) and for megrims it is considered to be 95% of catches from each area, so the majority of the TAC derived from these stocks are included. Methods for data-limited stocks are under development which may allow the other species to be considered in future.

For Norway lobster only part of the TAC area (Subarea 7) is covered by the advice. For the mixed-fisheries projections it was assumed that 48% of the landings come from divisions 7.b–k (average proportion from 2000 to 2019).

Table 6 Mixed-fisheries advice for divisions 7.b–c and 7.e–k**.** Advice and management area for the stocks considered (EU, 2019).

Species	ICES single-stock advice area	Management area
Cod	Divisions 7.e–k	EU TAC divisions 7.b–c, 7.e–k and subareas 8–10; EU waters of CECAF 34.1
Haddock	Divisions 7.b–k	EU TAC divisions 7.b–k and subareas 8–10; EU waters of CECAF 34.1.1
Whiting	Divisions 7.b–c and 7.e–k	EU TAC divisions 7.b–k
Megrims	Divisions 7.b–k, 8.a, 8.b, and 8.d	EU TAC divisions 7.b–k and 8.abd
Anglerfishes	Subarea 7 and divisions 8.a, 8.b, and 8.bd	EU TAC divisions 7 and 8abd
Sole	Divisions 7.f and 7.g	EU TAC division 7.fg
Norway lobster	5 FUs and 1 outside FU	EU TAC division 7, and Functional Unit 16

The mixed-fisheries scenarios and forecasts are produced using data requested as part of an ICES data call, issued formally under EU Data Collection Framework (DCF) regulations. This provides consistency in catch and effort totals. Additionally,

separate data files containing total weight of landings and effort in kW-days by fleet and métier are requested. Fleet and métier categories used in the mixed-fisheries analysis are based on DCF level 4 and 5 categories, respectively. Grouping across categories has been performed to aggregate over "small" métiers (defined as métiers with less than 1.0% landed in 2019 for each of the stocks considered).

Total landings (2019) of all species considered in the mixed-fishery advice were 56 804 tonnes, with:

- ~79% landed by otter trawls and seines;
- ~ 10% landed by beam trawls;
- ~ 3% by gill- and trammelnets;
- ~ 8 % by other gears.

Total discards (not shown in the plot) were 9326 tonnes (14% by weight of total catch).

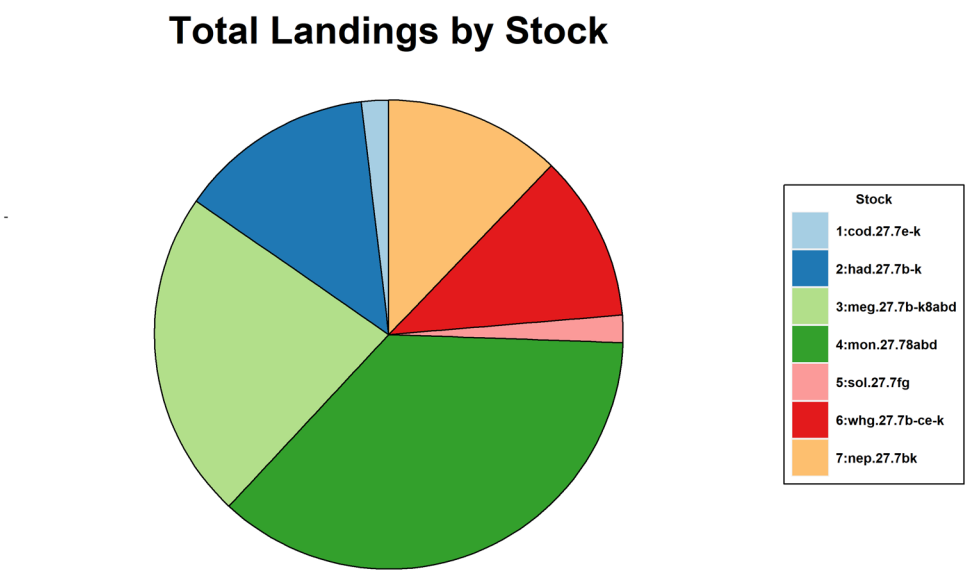


Figure 6 Mixed-fisheries for the Celtic Sea. Landings distribution by species: 1% cod.27.7e–k, 14% had.27.7b–k, 24% meg.27.7b–k8abd, 36% mon.27.78abd, 2% sol.27.7fg, 11% whg.27.7b–ce–k, and 12% nep.27.7bk.

Table 7 Mixed-fisheries advice for divisions 7.b–c and 7.e–k. The basis of the assessment.

ICES stock data category	1 and 5 (ICES, 2019).
Assessment type	F_{cube} (FLR) (Ulrich *et al.*, 2011).
Input data	Assessments on the relevant stocks in the Celtic Seas ecoregion working group (WGCSE) (ICES, 2020b) and Bay of Biscay and Iberian ecoregion working group (WGBIE) (ICES, 2020a); catch and effort by fleet and métiers.
Discards and bycatch	Included as in the single-stock assessments.
Indicators	None.
Other information	None.
Working group report	Working Group for the Celtic Seas Ecoregion (ICES, 2020a), Working Group for the Bay of Biscay and Iberian Waters Ecoregion (ICES, 2020b), and Working Group on Mixed-fisheries Advice (WGMIXFISH-ADVICE) (ICES, 2020f).

Issues relevant for the advice

The model includes two stocks (mon.27.78abd and meg.27.7b–k8abd) that are also included in the mixed-fisheries advice for the Bay of Biscay. Catches of these stocks outside of the Celtic Sea are included in the model as an "OTH" fleet and are subject to the same fleet behaviour assumptions (e.g. "min", "max"). Therefore, the outcomes for mon.27.78abd and meg.27.7b–k8abd can only be considered representative in the context of Celtic Sea stocks. There may be inconsistencies between the catch forecasts in scenarios in the Celtic Sea and Bay of Biscay mixed-fisheries advice; in future years, consideration will be given to splitting the presented catch advice between the respective areas.

Who is fishing

Fourteen nations currently have fisheries targeting the many marine stocks within this diverse and extensive ecoregion. The greatest amount of landings are by Norway, UK, Ireland, the Netherlands, and France. Lesser amounts are landed by Germany, Spain, Belgium, Lithuania, Poland, and Estonia (Figure 7, but note that this figure includes some landings from waters to the west of the ecoregion).

Landings from several of these nations, including Norway, the Netherlands, Germany, Denmark, Lithuania, and Poland, are dominated by pelagic species. Other nations within the UK and EU target a combination of pelagic, demersal (including *Nephrops*), deep-water, and shellfish species. Of these, the UK has the greatest landings, with an almost equal split between pelagic and non-pelagic landings. France has the highest reported effort (Figure 8). Effort levels for most countries show declining trends, with the most pronounced decline seen in Spanish effort.

Belgium

The Belgian fleet consists of about 33 active vessels of which about 21 fish in the Irish Sea. The majority (89%) of the vessels are > 24 m, while the remainder of the vessels are between 18 and 24 m. The Belgian fleet uses beam trawls and otter trawls for rays, plaice, sole, and anglerfish. Since 2016, there has been no targeted fisheries for sole in Division 7.a.

Denmark

Eight Danish vessels fish in this ecoregion, targeting blue whiting with pelagic trawls.

Faroe Islands

Up to ten vessels from the Faroe Islands operate in this ecoregion, targeting blue whiting with pelagic trawls.

France

The French offshore fishery in the Celtic Sea (divisions 7.g and 7.h) is mostly composed of bottom trawlers (18–35 m, around 350 vessels) targeting gadoids, *Nephrops* or anglerfish, megrim, and rays, with less than ten vessels using Danish seine. In the west of Scotland (Division 6.a) around ten bottom trawlers target both saithe and deep-sea fish (at depths less than 800 m) and fewer smaller vessels target hake using longlines or nets. Finally, two large pelagic trawlers target herring and mackerel, and one is also involved in the blue whiting fishery.

Germany

About ten German vessels fish in the ecoregion. This includes vessels that mainly target anglerfish and hake with gillnets and longline, and about three large freezer-trawlers that target mackerel.

Ireland

The Irish fishing fleet is very diverse with around 1500 < 10 m and 500 ≥ 10 m active vessels. Small vessels (< 10 m) operate inshore, typically targeting shellfish with pots or demersal fish with nets. On the shoreline, there is widespread hand gathering of periwinkles. The vessels ≥ 10 m target a wide variety of species using several types of gear. Vessels in the 12–25 m length range target *Nephrops* using trawls on several grounds around Ireland and on the Porcupine Bank. Both inshore

and offshore mixed demersal fisheries use trawls and seine nets to target gadoids and benthic species. Vessels using gillnets target hake offshore and pollack, monkfish, and cod in inshore areas. Ten beam trawlers target benthic species such as megrim, anglerfish, flatfish, and rays. There are dredge fisheries for razor clams and scallops in inshore and offshore areas. About 100 vessels are engaged in aquaculture related activities, including dredging for seed mussels, and mussel and oyster dredging. Twenty large (≥ 30 m) pelagic fishing vessels operate across the whole of the area. Vessels using pelagic trawls target mackerel, horse mackerel, blue whiting, boarfish, and sprat. Pelagic trawling for albacore tuna occurs in the ecoregion.

Lithuania

Two large Lithuanian freezer trawlers target pelagic species in this ecoregion.

Netherlands

Around 10–15 large Dutch pelagic freezer-trawlers operate in this ecoregion, mainly targeting horse mackerel and mackerel.

Norway

About 60 Norwegian vessels operate in this ecoregion. Pelagic trawlers mainly target blue whiting, but also other pelagic species. There is also a demersal longline fishery that mainly targets ling and blue ling.

Spain

The Spanish fleet comprises 67 vessels >24 m that operate mainly in Subarea 7 (the Porcupine and Great Sole banks) and, to a lesser degree, in Subarea 6 (west of Scotland). All of these vessels target demersal species: set longlines targeting hake (44 vessels), bottom otter trawl targeting megrim, anglerfish, and hake (21 vessels), and set gillnet targeting hake (2 vessels).

United Kingdom

Scotland
Most fishing activity by Scottish vessels (754 boats in 2015) occurs in Subarea 6. Around 62 demersal trawlers (mostly > 10 m) fish for mixed gadoids and benthic species such as anglerfish and megrim. A small number of boats target haddock at Rockall. In inshore areas, a fleet of 164 trawlers fish mainly for *Nephrops*–34 of these boats are under 10 m. Pot or creel fishing is carried out by almost 400 vessels. Over 300 of these boats are under 10 m and target either *Nephrops* or lobsters and various crab species. Around 60 larger vessels (> 10 m) fish for crustaceans (mainly brown crab) in more offshore areas to the far north and west of Scotland. Scallop fishing is carried out by around 50 dredgers (mostly > 10 m) and by hand gathering (diving). Limited amounts of inshore longlining and gillnetting are also carried out. About 20 large pelagic trawlers fish in the northern parts of the Celtic Seas ecoregion.

In the Irish Sea, the main Scottish activity is dredging for scallops around the Isle of Man, performed by around 50 boats (mainly > 10 m). Pot fishing occurs along the Solway Firth coast (22 vessels), and about 12 trawlers take part in the Irish Sea *Nephrops* fishery. Trawling for *Nephrops* also occurs at the Porcupine Bank and in the Celtic Sea (divisions 7.c and 7.k). Mixed-fish trawling, longlining, and gillnetting occurs in the Celtic Sea and western English Channel (Division 7.e). Some boats also dredge for scallops in the western English Channel.

Northern Ireland
The Northern Irish fleet consists of around 130 ≥ 10 m and 180 < 10 m vessels. The fleet predominantly operates within divisions 7.a and 6.a. A small number of vessels target *Nephrops* or pelagic species in other parts of the ecoregion. Within the Irish Sea, demersal trawling for *Nephrops* dominates the fishing effort.

Vessels operating inshore typically target shellfish with pots, or by dredging (for king scallops) in divisions 6.a and 7.a. Both trawl nets and dredge gear are used to catch queen scallops in the Irish Sea and north of Rathlin Island in Division 6.a.

A small number of vessels trawl for haddock, hake, and (historically) cod. At present (2018), there is no permitted commercial targeted fishery for cod. A pelagic and gillnet herring fishery operates in late summer–early autumn in the pre- and post-spawning periods. The gillnet fishery occurs on the western Irish Sea coastline whilst two large pelagic trawlers target herring aggregations in the northern English Channel and around the Isle of Man.

England and Wales

The largest sector in terms of vessel numbers are the potting fleets targeting non-quota stocks such as crabs, lobsters (mainly in divisions 7.e, 7.f, and 7.g), and whelks in Division 7.a. The majority of these vessels are under 10 m in length (~600 vessels from a total potting sector of ~700) although more than 50% are polyvalent (vessels using multiple gears).

Vessels employing otter trawls (~300 vessels, around half of which are < 10 m) are mostly found in Division 7.e, with additional activity in divisions 7.a and 7.f; they take a mixture of demersal stocks although some target whitefish and elasmobranchs. The *Nephrops* fleet in Division 7.a comprises around 15 vessels in the 10–15 m sector, with < 10 vessels under 10 m. This sector employs otter trawls that use selective gear to reduce whitefish bycatch. Beam-trawling activity (~60 vessels) is dominated by vessels longer than 15 m (~45 vessels), taking a mixture of flatfish and anglerfish with evidence of an increasing targeted fishery for cuttlefish in Division 7.e. Dredge fisheries, predominantly for king scallops, operate in divisions 7.e and 7.a. Dredging activity occurs across all vessel sizes although there is proportionally less activity by < 15 m vessels in Division 7.a.

Isle of Man

The main fisheries undertaken in the Isle of Man's territorial sea (12 nautical miles) are for king scallop, queen scallop, crab, lobster, and whelk.

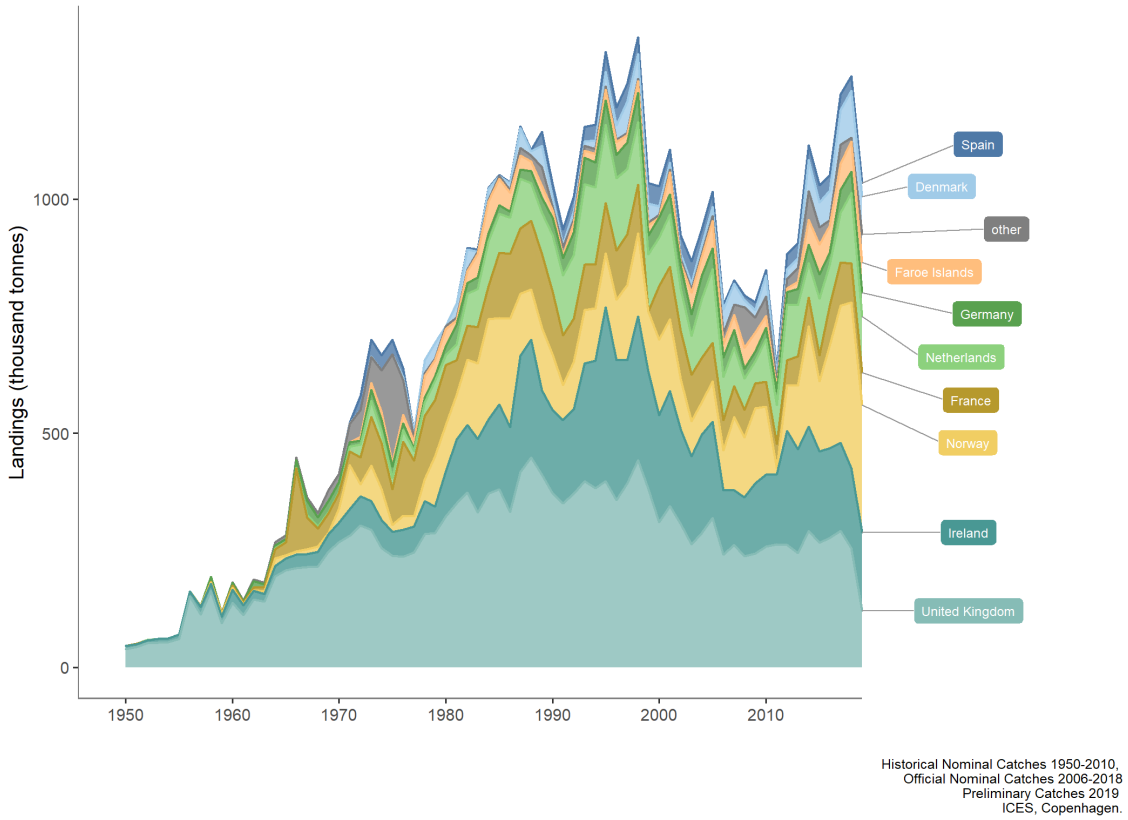


Figure 7 Landings (thousand tonnes) from ICES subareas 6 and 7 (excluding Division 7.d). This approximates to the majority of the Celtic Seas ecoregion in 1950–2019, by (current) country. The nine countries having the highest landings are shown individually and the remaining countries are aggregated and displayed as "other".

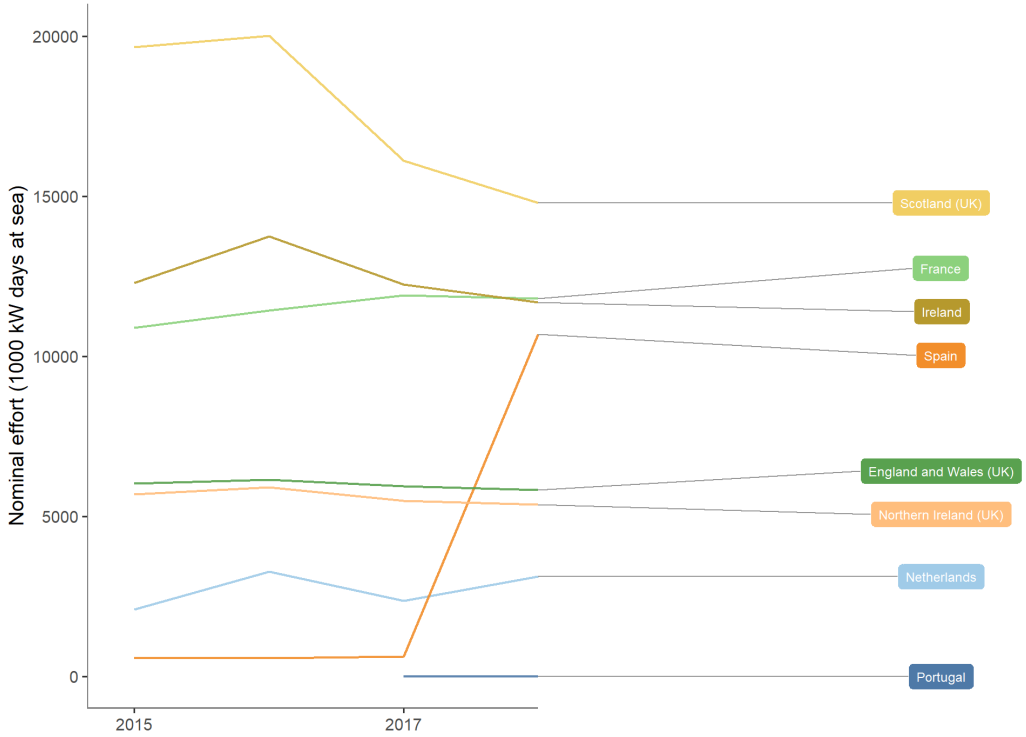


Figure 8 ICES subareas 6 and 7 (excluding Division 7.d). Fishing effort (1000 kW hours at sea) in 2015–2018 for the main countries fishing in the ecoregion. Confidential values have been reported from Ireland, Portugal and France.

Catches over time

Landings of pelagic species within the ecoregion showed an increasing trend from the 1960s until the mid-1990s, with a declining trend thereafter (Figure 9). Blue whiting and mackerel constitute the highest proportions of the catches, with herring and horse mackerel declining in relative importance in the last decade (Figure 10). The demersal fisheries show a generally increasing trend, with some declines in the early 1990s and mid-2000s (Figure 9). Hake, whiting, and haddock account for the highest landings of demersal species (Figure 10). Anglerfish and megrim are also very important, whereas the relative importance of cod, saithe, and ling has declined. Crustacean fisheries have remained relatively stable in the last few decades; *Nephrops* accounts for the highest landings (Figure 10). Other important crustacean species include scallop, crab, and lobster.

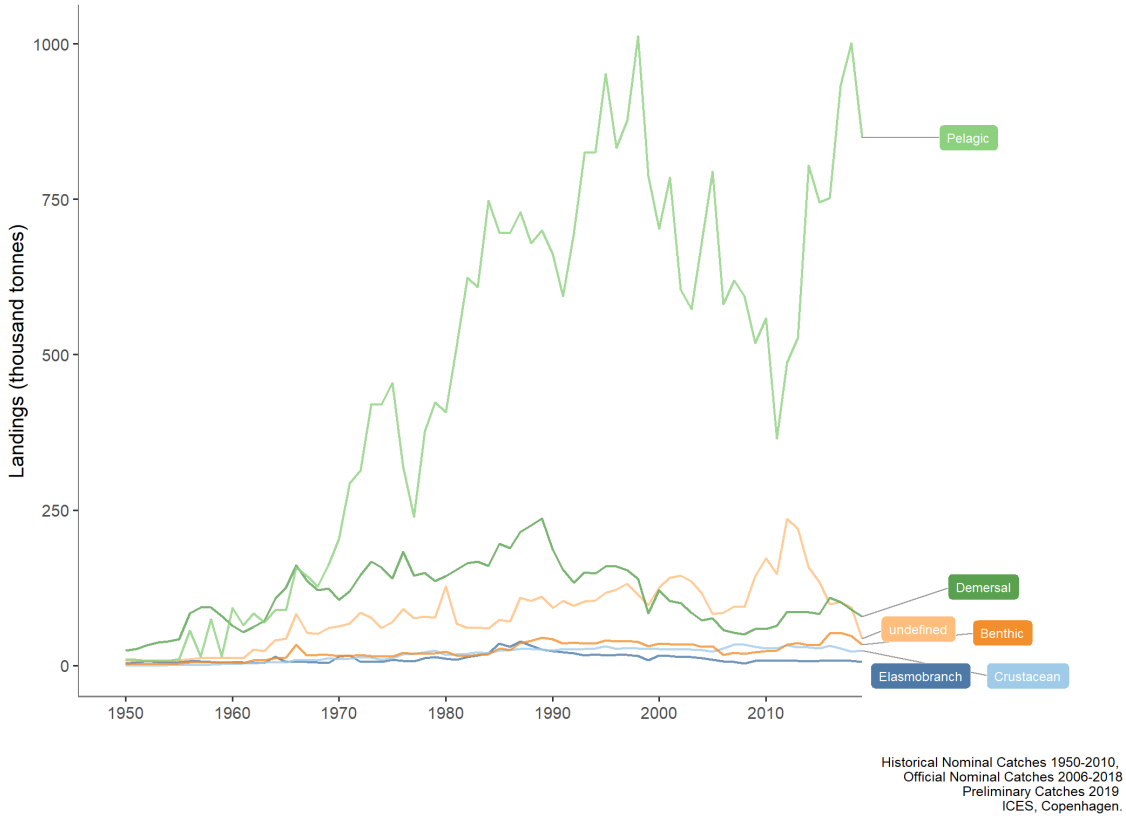


Figure 9 Landings (thousand tonnes) from ICES subareas 6 and 7 (excluding Division 7.d) in 1950–2019, by fish category. Table A1 in the Annex details the species that belong to each fish category.

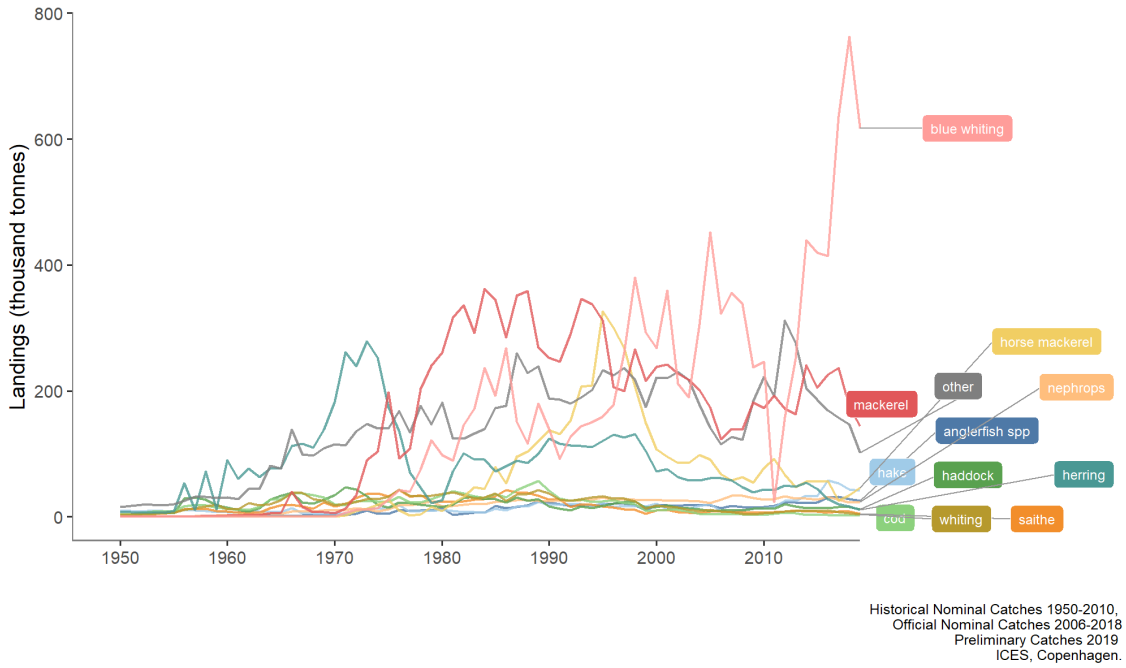


Figure 10 Landings (thousand tonnes) from ICES subareas 6 and 7 (excluding Division 7.d) in 1950–2019, by species. The eleven species having the highest cumulative landings over the entire time-series are displayed separately; the remaining species are aggregated and labelled as “other”.

There are large fluctuations in pelagic landings (Figure 11). Landings by demersal otter trawls, beam trawlers, and pots have been more stable while static (mostly gillnet) landings have been increasing.

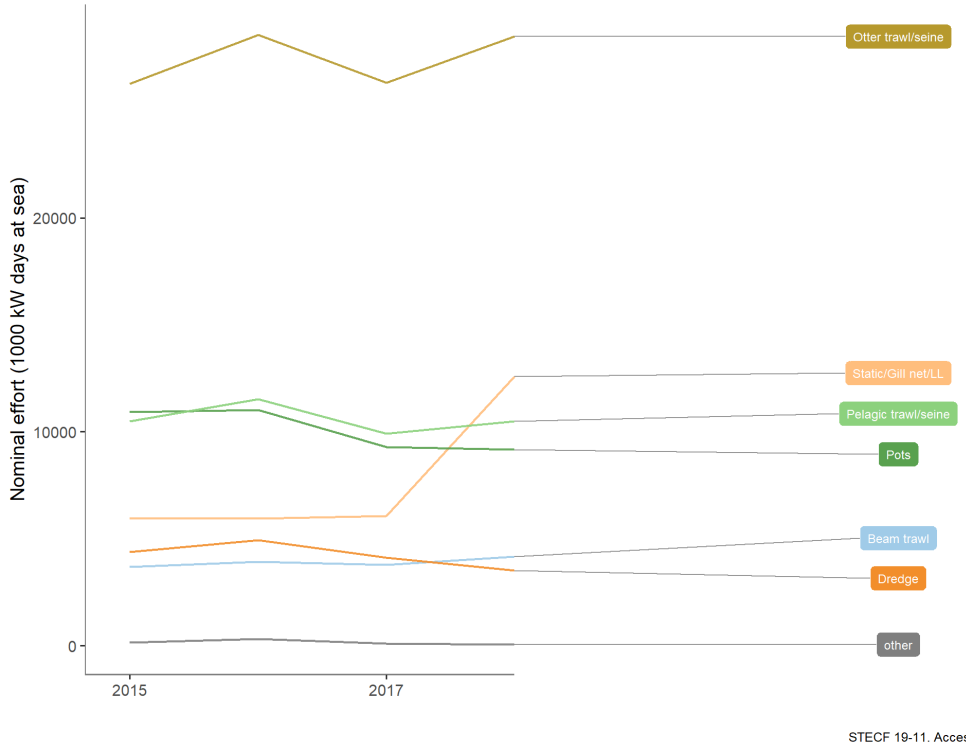


Figure 11 Commercial landings (thousand tonnes) from ICES subareas 6 and 7 (excluding Division 7.d) in 2015–2018, by gear type (LL = longline) for EU Member States. Confidential values have been reported from Ireland, Portugal and France.

Discards

Total discard tonnage (and therefore rate) of pelagic species is estimated to be very low. Discards of demersal, crustacean, and benthic species are estimated to be around 10%. Discard rates for some species are very high in the ecoregion, for example plaice (around 60% of tonnage) and whiting (50–99% of tonnage). The EU's landing obligation for demersal stocks came partially into force in 2016.

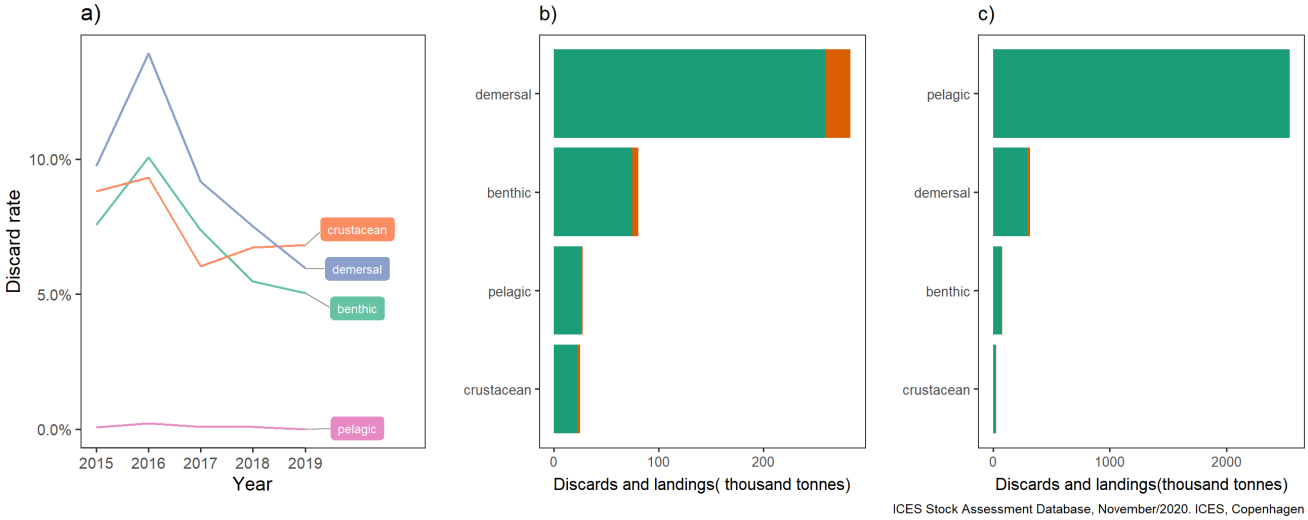


Figure 12 ICES subareas 6 and 7 (excluding Division 7.d). Left panel (a): Discard rates in 2015–2019 by fish category, shown as percentages (%) of the total annual catch in that category. Middle panel (b): Landings (green) and discards (orange) in 2019 by fish category (in thousand tonnes) only of those stocks with recorded discards. Right panel (c): Landings (green) and discards (orange) in 2019 by fish category (in thousand tonnes) of all stocks, including stocks with zero

discards or without discard information. There is uncertainty over the elasmobranch data and thus it is not presented here.[†]

Description of the fisheries

Fisheries that take place within the Celtic Seas ecoregion catch a wide range of different species, including those considered to be demersal, benthic, pelagic, widely distributed, and deep-water.

Otter trawlers and demersal seiners account for the majority of the fishing effort (Figure 13). Otter trawl fishing is highest on the *Nephrops* grounds in the Celtic Sea, and close to the continental shelf edge (Figure 14). Demersal seiners are mainly active in the Celtic Sea. Static gears (longlines and gillnets) account for the next highest levels of effort; these fisheries are also concentrated close to the continental shelf edge, particularly in the southern and northern parts of the ecoregion. Pelagic trawl fisheries occur throughout the ecoregion, but there is generally more effort close to the shelf edge (Figure 14). Beam-trawl effort is concentrated in the Celtic Sea and western English Channel, with some effort in the Irish Sea also. There is little beam trawling in the northern part of the ecoregion. Dredge fisheries are concentrated on scallop grounds around the Isle of Man, western English Channel, southeast of Ireland, and along the Scottish coast (Figure 14).

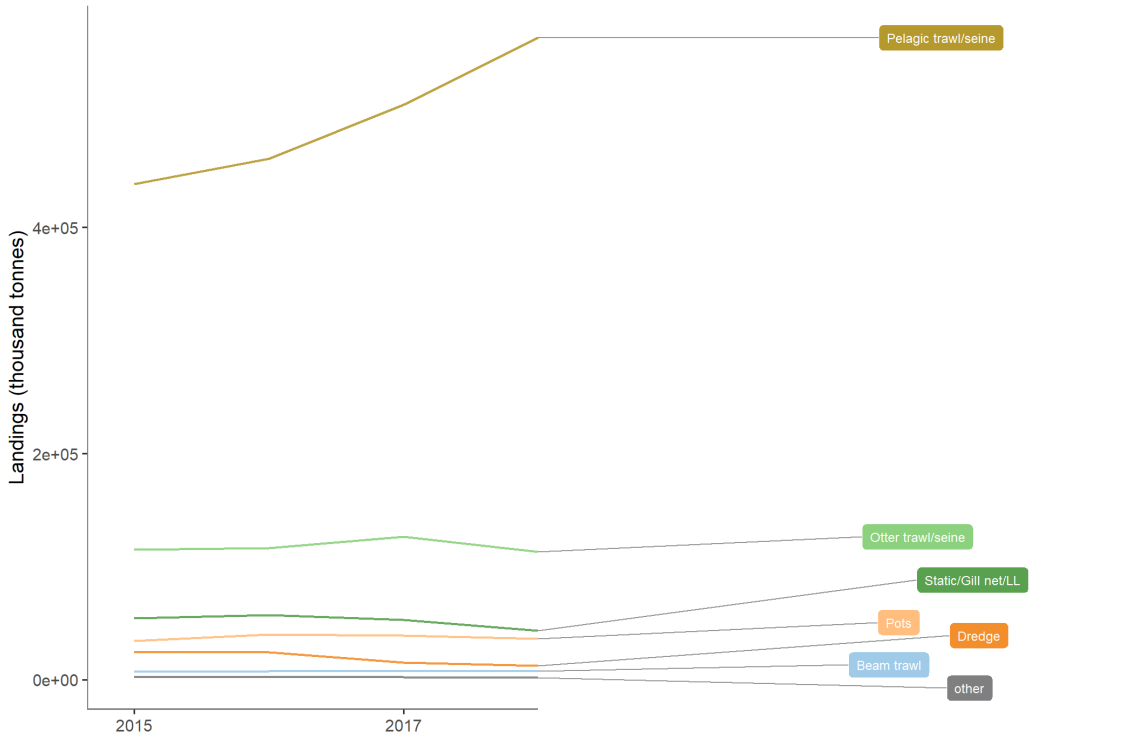


Figure 13 ICES subareas 6 and 7 (excluding Division 7.d). Fishing effort (thousand kW hours at sea) in 2015–2018, by gear type for EU Member States. Confidential values have been reported from Ireland, Portugal and France.

[†] Version 2: Figure and legend updated

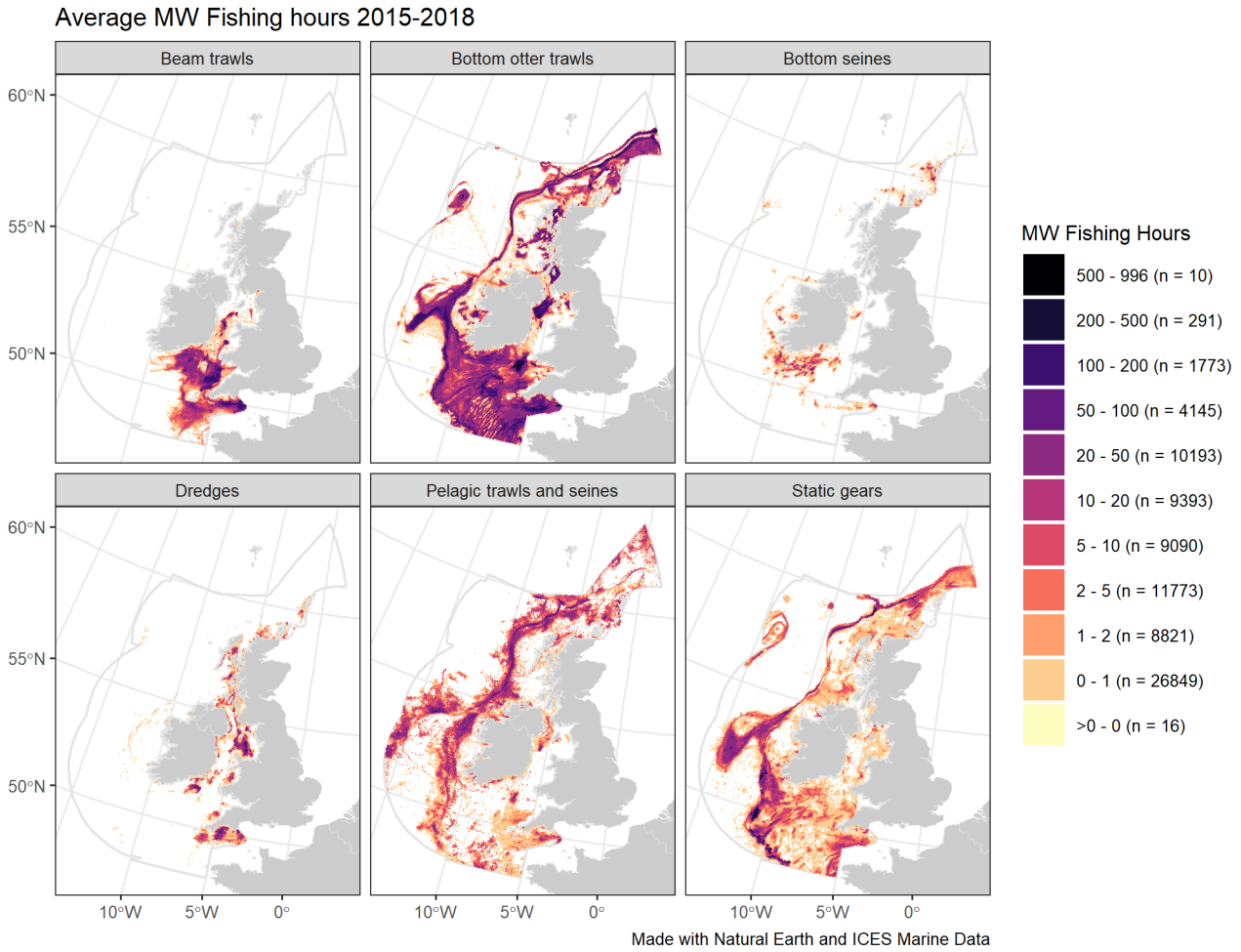


Figure 14 Spatial distribution of average annual fishing effort (MW fishing hours) in the Celtic Seas ecoregion during 2015–2018, by gear type. Fishing effort data are only shown for vessels > 12 m having vessel monitoring systems (VMS), this will bias the distributions, particularly in coastal areas.

The catches of pelagic species varies both spatially and temporally. Mackerel and blue whiting are caught mainly on their southward migrations along the shelf edge to spawning grounds in spring. The highest mackerel catches in recent years have been in the northern part of the ecoregion, whilst the highest catches of blue whiting are around the Porcupine Bank (Figure 11). Horse mackerel are caught throughout the ecoregion and catches are highest west of Ireland in the spring. Herring catches are concentrated in three areas: north of Scotland, in the Celtic Sea, and around the Isle of Man. The highest boarfish catches are in the western Celtic Sea. The albacore tuna fishery occurs in the southwestern part of the ecoregion.

Hake are caught in deeper waters (> 70 m) throughout the ecoregion. Catches are concentrated along the continental shelf edge in the southern and northern parts of the ecoregion where the directed gillnet and longline fisheries occur (Figure 11). Anglerfish are also common throughout the ecoregion, with the highest catches on the shelf in the Celtic Sea and western English Channel. The highest megrim catches are in the western Celtic Sea.

Whiting catches are highest in the Celtic Sea south of Ireland where there are also significant catches of haddock and cod (Figure 15). Saithe are mainly caught in the northern part of the ecoregion. Pollack are mainly caught in inshore areas of Cornwall and along the southern coast of Ireland.

The main *Nephrops* catches are in the western Irish Sea, in the Minches, the Celtic Sea, and on the Porcupine Bank (Figure 11). There are also significant catches of scallops in the Irish Sea (around the Isle of Man) and off southern Cornwall. Brown crab catches mainly occur in coastal areas of Cornwall, northwest of Ireland, and north of Scotland.

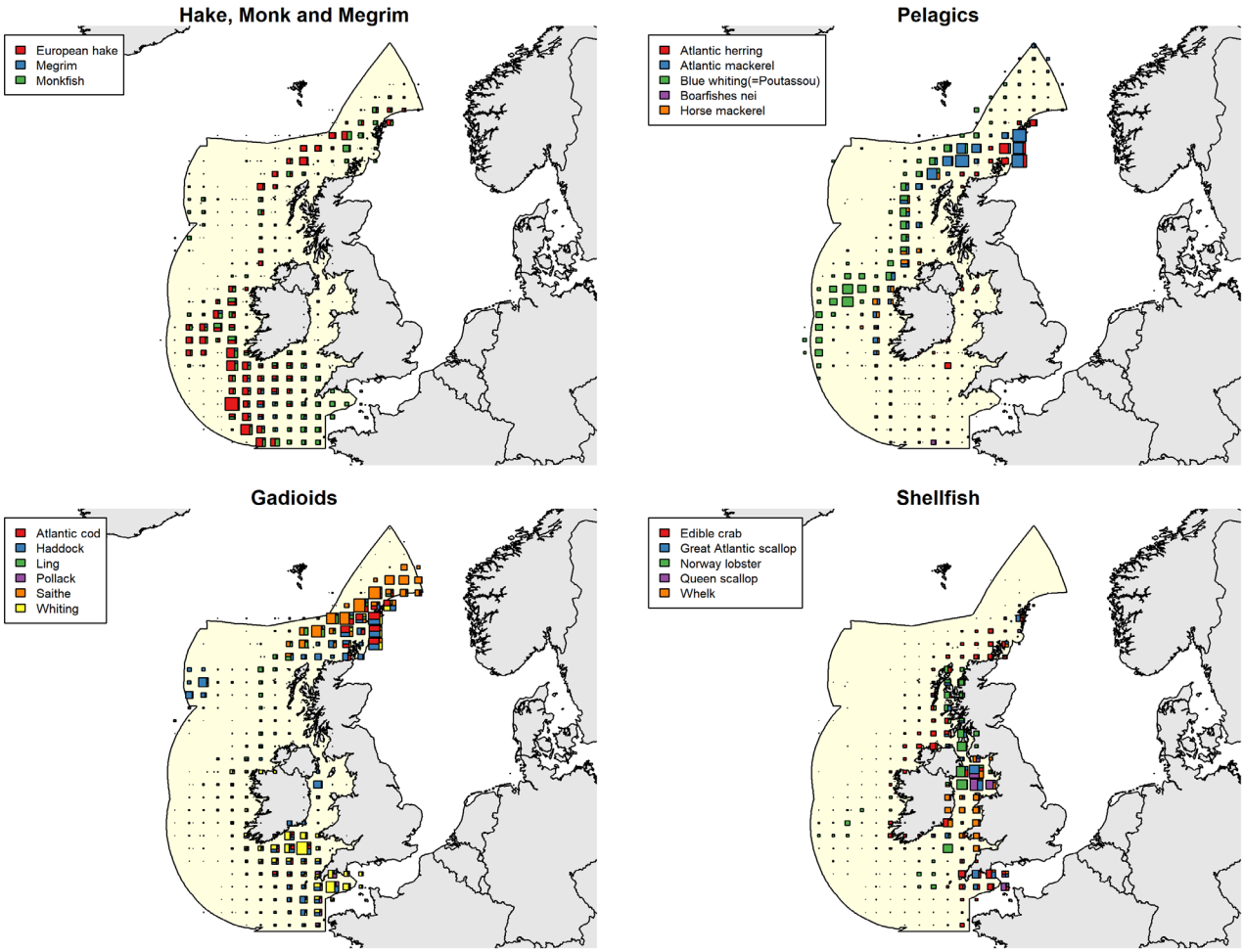


Figure 15 The spatial distribution of the landings for the main pelagic, benthic, gadoid, and shellfish species in the Celtic Seas ecoregion. Landings (tonnes) are represented proportionately within each panel, but not between panels. Based on data for > 10 m EU vessels, 2015–2018. Source: STECF FDI (https://stecf.jrc.ec.europa.eu/dd/effort/graphs-quarter).

Otter trawl

Otter trawl is the main gear by effort used in demersal fisheries in the Celtic Seas ecoregion (Figure 13). The species caught depends on the area, depth-range habitat, and season fished as well as on the cod-end mesh size, but in all cases the catches consist of a mixture of different species.

Nephrops-directed otter trawlers

Nephrops is an important target species on discrete muddy grounds within the ecoregion. Vessels typically, although not exclusively, use twin- or quad-rig trawls with 80 mm cod-ends. A small wanted bycatch of fish species includes cod, haddock, plaice, anglerfish, and to a lesser extent sole. The use of selective gears (grids, square mesh, and separator panels) to reduce unwanted fish bycatch has increased over time, but significant discarding issues still exist on some grounds. Mixed fisheries target both *Nephrops* and finfish in the Celtic Sea using a larger mesh size (100 mm or more).

Finfish-directed otter trawlers and seiners

Fish are targeted with both small (80–99 mm) and larger (> 99 mm) mesh sizes in different parts of the ecoregion, depending on regulation and target assemblage. Smaller mesh otter trawls and seiners are typically used to target a broad mixture of species, including gadoids, flatfish, and other benthic species. These fisheries primarily occur within the Celtic Sea, along the slope west of Ireland and Scotland, and in the western English Channel. Large-mesh otter trawlers (typically 100 mm or 120 mm) tend to target gadoids, anglerfish, or rays.

Deepwater trawl fisheries

Until 2016, deep-water trawl fisheries were conducted in ICES subareas 6 and 7, principally by France, with some Spanish, Irish, and Scottish participation. Trawling deeper than 800 m has been banned since December 2016. This mixed deep-water trawl fishery mainly targeted roundnose grenadier, black scabbardfish, and blue ling, with a bycatch mainly of smoothheads and deep-water sharks on the continental slope and offshore banks of subareas 6 and 7.

Beam-trawl fisheries

Beam trawlers operate on sandy grounds in the Irish and Celtic seas and in the western English Channel. The majority of the vessels use meshes in the range of 80–89 mm, and come from Belgium, the UK, and Ireland. In the Irish Sea, the vessels primarily target plaice and sole (although the sole fishery has declined significantly in the last decade). There is also a fishery for ray species in the southern Irish Sea. In the Celtic Sea, the beam-trawl fishery occurs on grounds where sole, anglerfish, cuttlefish, and megrim are abundant and the seabed is suitable for beam trawling. The fishery has bycatches of anglerfish, cod, haddock, and whiting. In the western English Channel (Division 7.e) beam trawling, using 80–90 mm mesh, mainly targets sole and cuttlefish.

Gillnet fisheries

The main gillnet fishery, (mainly with 120 mm mesh size) in this ecoregion targets hake along the continental slope. Spanish, French, UK, and Irish vessels are involved in the fishery, which typically operates at depths of 150–600 m. In the shallower Celtic Sea, where mesh sizes used are 120–219 mm, target species include anglerfish, flatfish, and gadoids.

A large number of inshore gillnetters (< 12 m) are also active in the Celtic Seas ecoregion. The target species and gears used tend to vary spatially and temporally. In the first quarter, the primary target of inshore gillnetters operating in divisions 7.g and southern 7.a is cod. Fisheries around the Irish coast seasonally target anglerfish, flatfish, pollack, and dogfish.

Prior to 2006, UK, French, German, and Spanish gillnetters operated in deep waters of subareas 6 and 7 targeting hake, monkfish, and deep-water sharks. This fishery stopped or seriously reduced from 2006, following EU regulation of deep-water gillnetting at depths below 600 m.

Longline and line fisheries

Spanish-, French-, and UK-registered longliners target hake along the continental slope with bycatches of ling, blue ling, and other deep-water species. An English hand-line fleet operates inshore around the coast of Cornwall in divisions 7.e–f targeting mackerel, in an area where other fishing methods for this species are not permitted.

Pelagic trawls

The spatial distributions of the main pelagic species are shown in Figure 15.

<u>Blue whiting</u>
The main fisheries target spawning and post-spawning fish west of Ireland and of Scotland. The fishery extends into Faroese and international waters west of the Porcupine Bank. Most of the catch (~90%) is taken in the first half of the year. The multi-national fleet targeting blue whiting mostly consists of large pelagic trawlers. Blue whiting is mainly used for fishmeal.

<u>Mackerel</u>
The Northeast Atlantic mackerel stock ranges over a wide area, part of which includes the Celtic Seas ecoregion. Within the ecoregion the fleet consists of two pelagic trawl components: freezer-trawlers, which are commonly large vessels (up to 150 m) that usually operate a single mid-water pelagic trawl, although smaller vessels may also work as pair trawlers. Non-freezer trawlers vary in size, from 20 to 100 m, and operate both individually and as pairs. The larger of the pelagic trawlers use refrigerated seawater (RSW) tanks for storage.

Horse mackerel
Germany, the Netherlands, and Ireland have trawl fisheries for horse mackerel. The Dutch and German fleets operate mainly west of the English Channel. Irish vessels fish mainly to the west of Ireland. Prior to the 1990s, most of the catches were used for meal and oil; this has changed so most of the catches are now used for human consumption.

Herring
The herring fishery occurs in four main parts of the ecoregion.

- The fishery in Division 6.a North is conducted by single and pair RSW trawlers and by single-trawl freezer trawlers. Prior to 2006, there was a fairly even distribution of effort, both temporally and spatially. The UK and Ireland are the main exploiters, but vessels registered to the Netherlands, Germany, and France also participate in the fishery.
- In divisions 6.a South and 7.b–c, the fishery is conducted entirely by RSW pelagic trawlers and dry-hold vessels, both inshore and offshore on the northwestern Irish coast. In recent years, only Ireland has exploited herring in this area. The fishery is concentrated in quarters one and four.
- The herring Division 7.a North fishery has not changed in recent years. UK pelagic trawlers take the majority of catches in quarters three and four.
- The main herring fishery in divisions 7.a South and 7.g–k takes place on coastal spawning grounds, and on offshore feeding grounds south of Ireland. Ireland, the Netherlands, and Germany exploit this fishery using two types of vessels, larger boats with RSW storage and smaller dry-hold vessels.

Boarfish
The fishery operates from September to March. Catches are generally free from bycatch from September to February. From March onwards a bycatch of mackerel can be found in the catches and the fishery generally ceases at this time. Information on the bycatch of other species in the boarfish fishery is sparse, bycatch numbers are thought to be minimal. The fishery uses pelagic trawl nets with mesh sizes 32–54 mm.

Sprat
Sprat fisheries using pelagic trawls take place in the south Minch and in Irish inshore waters during autumn and winter.

Other fisheries

In addition, a number of small scale coastal fisheries exist throughout the ecoregion for stocks where ICES does not provide routine assessments or advice. For example, dredging for shellfish includes scallops, razor clams, cockles, clams, and oysters. There are also important pot and trap fisheries for crabs, lobsters, and whelks.

Eels migrate through the Celtic Sea, but there is no marine fishery targeting eel in the ecoregion. However, in some transitional waters of the United Kingdom, there are fisheries targeting glass eels (recruits). Similarly, Atlantic salmon also migrate through this ecoregion but commercial fisheries are either prohibited or very restricted.

Recreational fishing

Marine recreational fishing is an important activity in the Celtic Sea with a diverse range of species exploited from a variety of platforms (i.e. shore, boat, charters) using many gears (e.g. rod and line, speargun, nets, pots, traps). The main countries with recreational fisheries are the UK, France, and Ireland, with methods varying between countries. In the UK and Ireland, no license is required and angling from shore and boat is the most popular method, with a number of charter boats offering trips. Angling, nets and spearfishing are popular gears in France. Catches can be significant representing around 5%, 27% and 42% of total removals of cod, sea bass, and Pollack, respectively (Hyder *et al*., 2018; Radford *et al*., 2018). The main targets include: mackerel, pollack, sea bass, saithe, cod, spurdog (*Squalus acanthias*), flatfish (plaice, dab, flounder, sole), sea bream, wrasse, and whiting. There are also be catches of sharks, skates, and rays. In addition, shellfish, crustaceans, and cephalopods are also caught by recreational fishers.

Fisheries management

The Celtic Seas ecoregion includes all or parts of the Exclusive Economic Zones (EEZs) of Ireland, UK, France, and of the Isle of Man. Management within EU waters has been conducted in accordance with the EU Common Fisheries Policy (CFP), and catching opportunities for stocks under EU competency are agreed during meetings of the Council of Ministers. Under the CFP's regionalization policy, proposals on certain issues (for example discard plans) are made by the North western waters Regional Fisheries Group. National authorities manage activities in coastal waters (i.e. within 12 nautical miles). From 2021 the UK will no longer be a member of the EU and new management arrangements will be developed. The fisheries for some stocks are managed based on agreements by the North East Atlantic Fisheries Commission (NEAFC) and by coastal states. Salmon fisheries are managed nationally based on agreements at the North Atlantic Salmon Conservation Organization (NASCO), and fisheries for large pelagic fish are managed based on agreements at the International Commission for the Conservation of Atlantic Tunas (ICCAT). International fisheries advice is provided by the International Council for the Exploration of the Sea (ICES), the European Commission's Scientific Technical and Economic Committee for Fisheries (STECF), the Standing Scientific Committee of ICCAT, and the North Western Waters and Pelagic Advisory Councils.

Total allowable catch (TAC) is the main fishery management tool in the ecoregion. These were introduced for most stocks in 1982, but the TACs (and quotas) were generally not restrictive until the early 1990s. The 2013 reform of the Common Fisheries Policy aimed to eliminate discarding through the introduction of the EU landing obligation (LO). The LO was introduced for pelagic species in 2015 and has been phased in for demersal TAC species since 2016. From 2019, the LO will apply to all TAC species, although there are some exemptions.

A large number of technical measures are in place. These include measures to improve the selectivity of towed gears (partly in order to reduce bycatch), and gear restrictions.

Spatial management also occurs, both for fisheries and for ecosystem reasons. Closed areas/seasons are used to protect e.g. spawning grounds for fish. Protected areas have also been designated for habitats and species listed by EU Nature Directives (Natura 2000). Fishery regulations are in place to restrict certain fisheries that may affect relevant habitats and species, e.g. for cold-water corals.

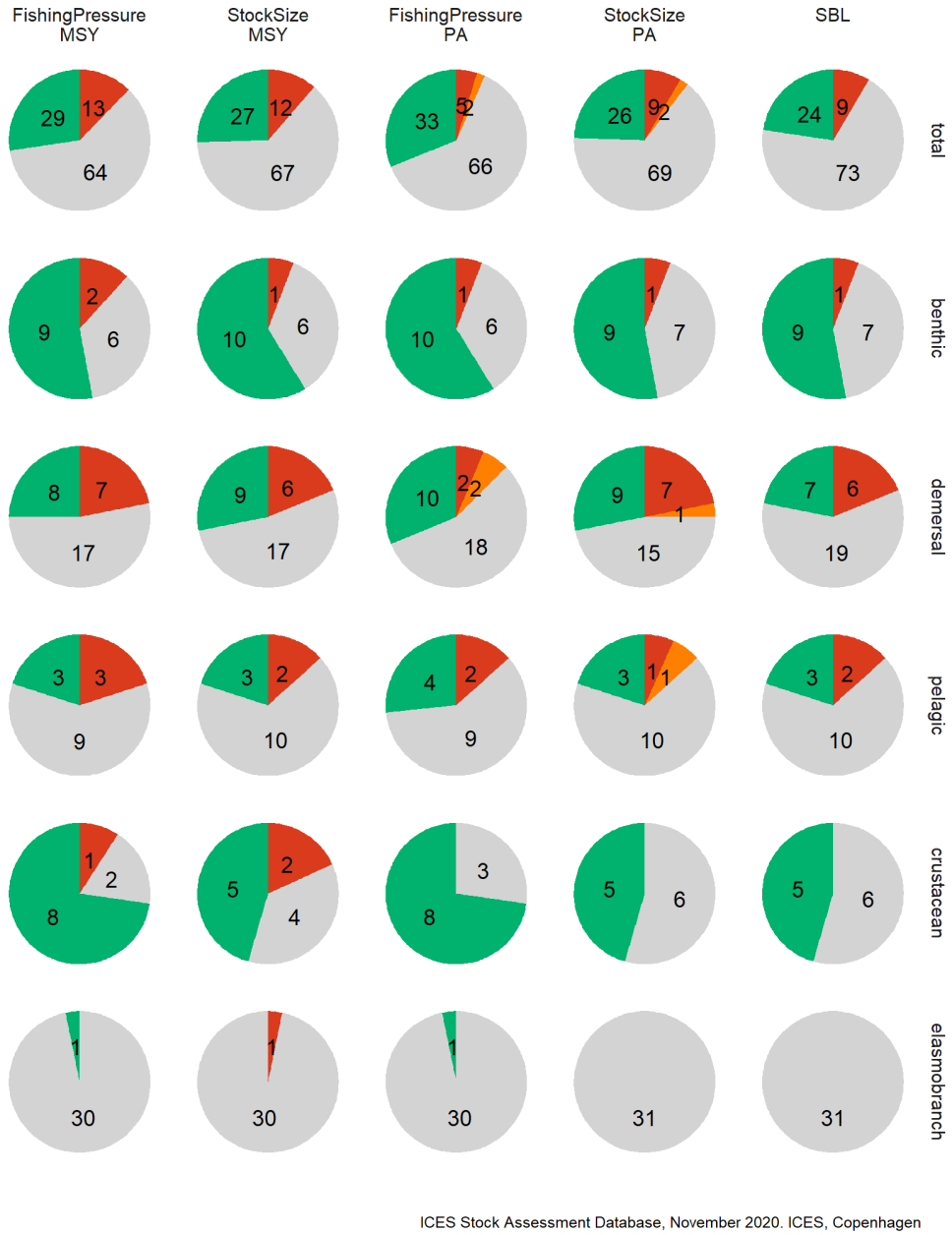
Management plans

Since 2016 the EC has developed multiannual sea basin plans for demersal species caught together in multi species fisheries. These plans are commonly referred to as Multiannual Plans (MAPs). For the ecoregion the Western Waters MAP (2019/472) and the North Sea 2016/0238) MAP are of most relevance. The MAPs set out to achieve the objectives of the CFP, facilitate the implementation of the landing obligation and promote a fair standard of living for those who depend on fishing activities. They were drafted to be coherent with the MSFD (2008/56), and the Birds Directive (2009/147). Unlike previous management plans which laid out a TAC setting rule, the principle of the MAPs is to implement the MSY policy adopted under the CFP, following best scientific advice. This is done whilst having due regard to the fact that many species are caught together, and that some of the species caught by the fisheries are not targeted but bycatches. Implementing the principles has meant: that target species are identified under the plans (species not listed as target are implicitly considered as bycatches); that TACs are set on target species within a range about F_{MSY}, but the upper part of the range can only be used under the conditions set out in the MAPs.

A number of pelagic stocks in the ecoregion have been managed under agreed multi-annual management plans in the past. Currently ICES only provides advice according to the agreed international management plan for blue whiting.

Status of the fishery resources

Fishing mortalities and spawning stock sizes have been evaluated against maximum sustainable yield (MSY) and precautionary approach (PA) reference points, and the status of these stocks has also been assessed relative to safe biological limits, i.e. $F < F_{pa}$ and $SSB > B_{pa}$ (Figure 16). Around 27% of the assessed stocks are fished at or below F_{MSY} target levels. The majority of benthic and crustacean stocks are fished below F_{MSY}, the status of nearly all elasmobranch stocks is unknown, and the status for the majority of the demersal and pelagic stocks is also unknown.



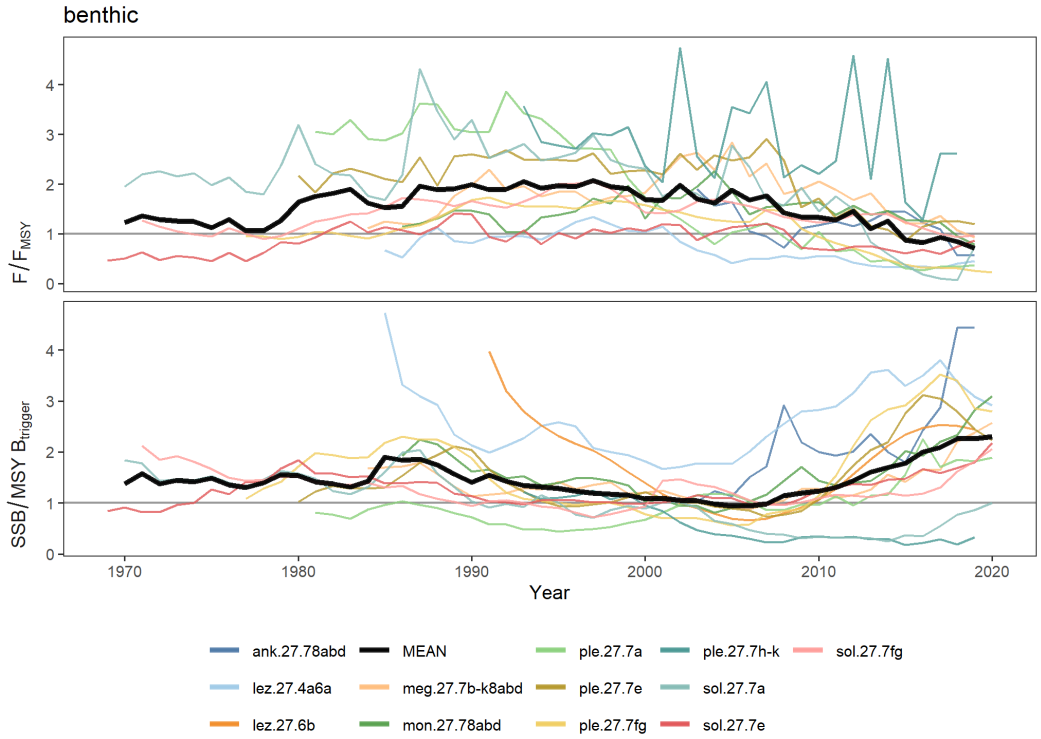
ICES Stock Assessment Database, November 2020. ICES, Copenhagen

Figure 16 Status summary of Celtic Sea stocks in 2020 relative to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA) (excluding European eel, salmon, and sea trout). Grey represents unknown reference points. For the MSY approach: green represents a stock that is either fished below F_{MSY} or the stock size is greater than MSY $B_{trigger}$; red represents a stock status that is either fished above F_{MSY} or the stock size is lower than MSY $B_{trigger}$. For the PA: green represents a stock that is fished at or below F_{pa} while the stock size is equal to or greater than B_{pa}; orange represents a stock that is either fished between F_{pa} and F_{lim} or the stock size is between B_{lim} and B_{pa}; red represents a stock that is fished above F_{lim} or the stock size is less than B_{lim}. Stocks having a fishing mortality below or at F_{pa} and a stock size above B_{pa} are defined as being inside safe biological limits. If this condition is not fulfilled the stock is defined as being outside safe biological limits. For stock-specific information, see Table A1 in the Annex.

Figure 17 Status summary of Celtic Sea stocks in 2020 relative to the EU Marine Strategy Framework Directive (MSFD) assessment criteria of the level of pressure of fishing activity (D3C1) and reproductive capacity of the stock (D3C2). Green represents the proportion of stocks that are either fished below F_{MSY} or the stock size is greater than MSY $B_{trigger}$, for criteria D3C1 and D3C2. Red represents the proportion of stocks that are either fished above F_{MSY} or the stock size is lower than MSY $B_{trigger}$, for criteria D3C1 and D3C2. Grey represents the proportion of stocks without MSY reference points. For stock-specific information, see Table A1 in the Annex.

The Celtic Seas ecoregion has 106 stocks for which ICES provided advice in 2020. These encompass the following categories: 17 benthic, 11 crustacean, 32 demersal, 31 elasmobranch, and 15 pelagic stocks. Of these the pelagic, crustaceans (*Nephrops*), and demersal stocks are the best known, having the highest number of quantitative assessments (ICES data category 1 stocks). Approximately 27% are sustainably fished (i.e. D3C1 where $F < F_{MSY}$); these account for around 37% of the total landings (Figure 17). Other groups, such as the elasmobranchs, have a more limited knowledge base. This limited data means these stocks are placed in ICES categories 3, 5, and 6. While these "data-limited stocks" account for the majority of stocks (60%), they only account for less than 3% of the total landings (Figure 17). Around 25% of the stocks were assessed to be above MSY $B_{trigger}$ (D3C2); these accounted for around 90% of the total biomass caught.

Clear trends show a declining fishing mortality ratio for category 1 benthic and demersal stocks since the mid-1990s (Figure 18). The mean fishing mortality is now below the F_{MSY} target. The SSB ratio shows an increasing trend over the same period and the mean values are now more than twice MSY $B_{trigger}$. Note that though the mean fishing mortality and biomass ratios are in a desirable condition, this does not infer that all stocks are in that condition. The mean fishing mortality ratio is fluctuating less than F_{MSY} and the SSB ratio is fluctuating above one for the crustacean stocks. For pelagic stocks, the mean fishing mortality ratio declined between 2000 and 2012 but has been increasing in recent years to above one. The mean biomass ratio for pelagic species remains above MSY $B_{trigger}$ but has also been declining in recent years.



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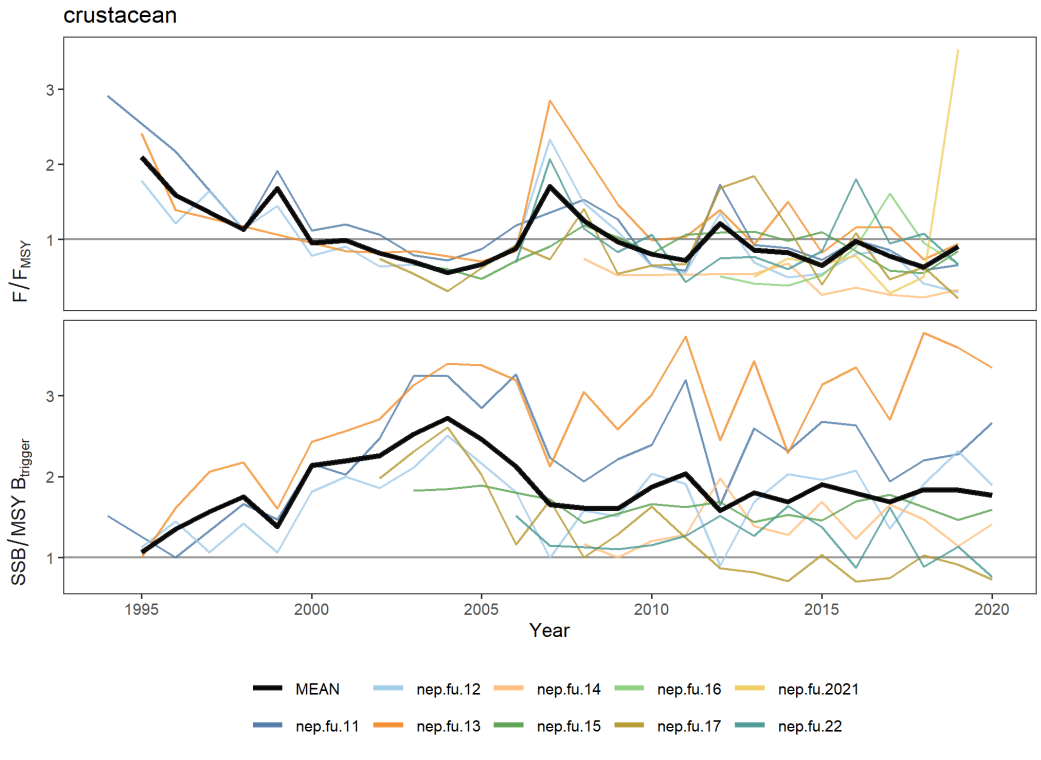

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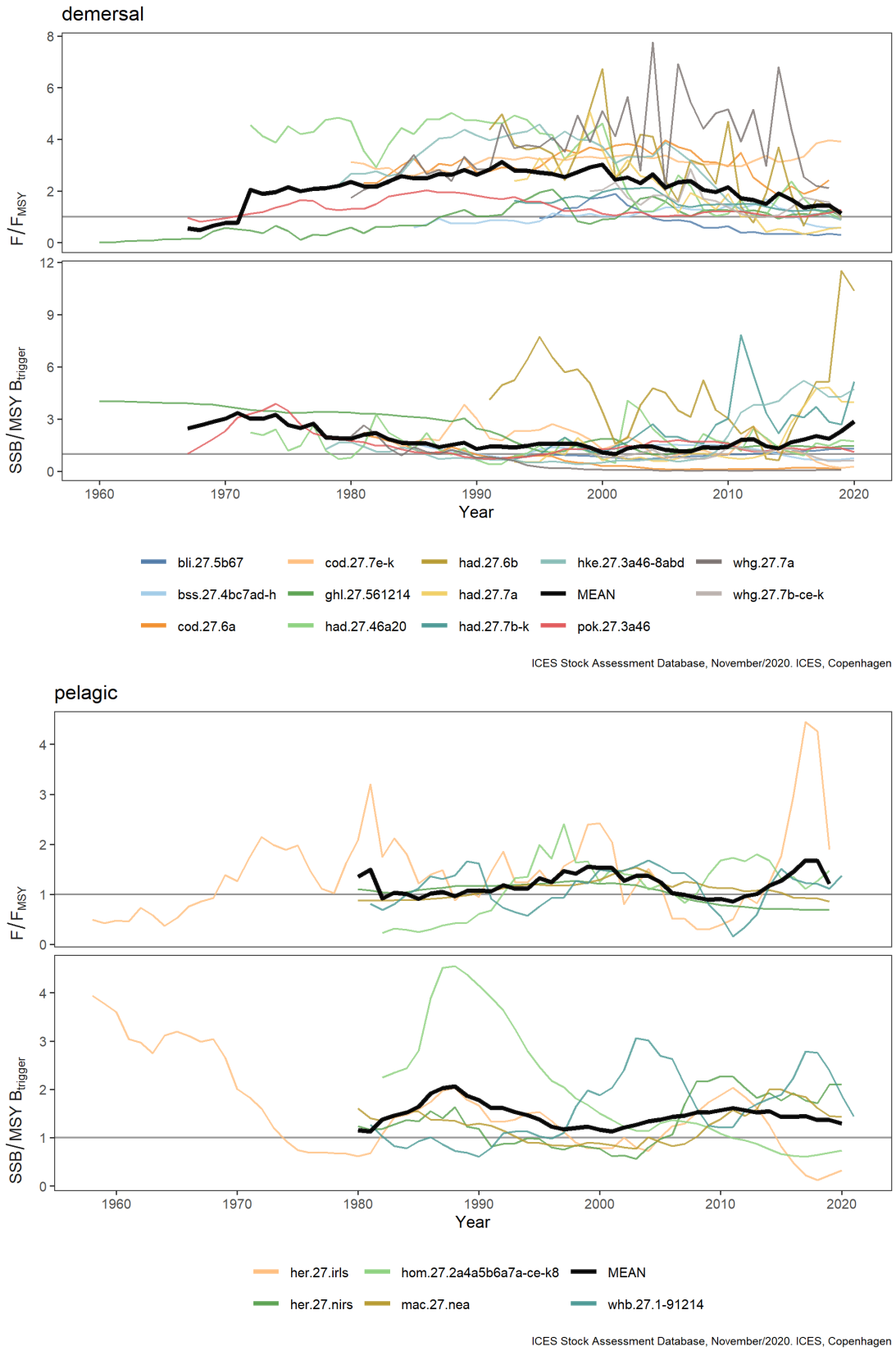
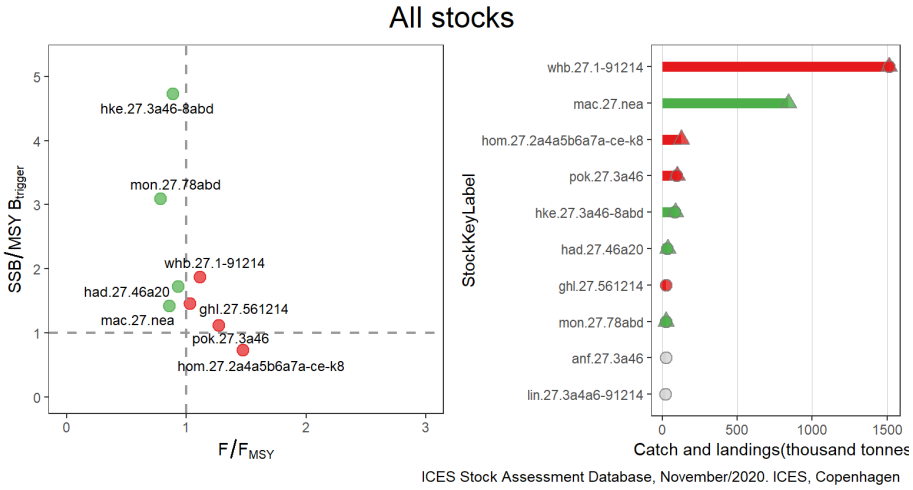
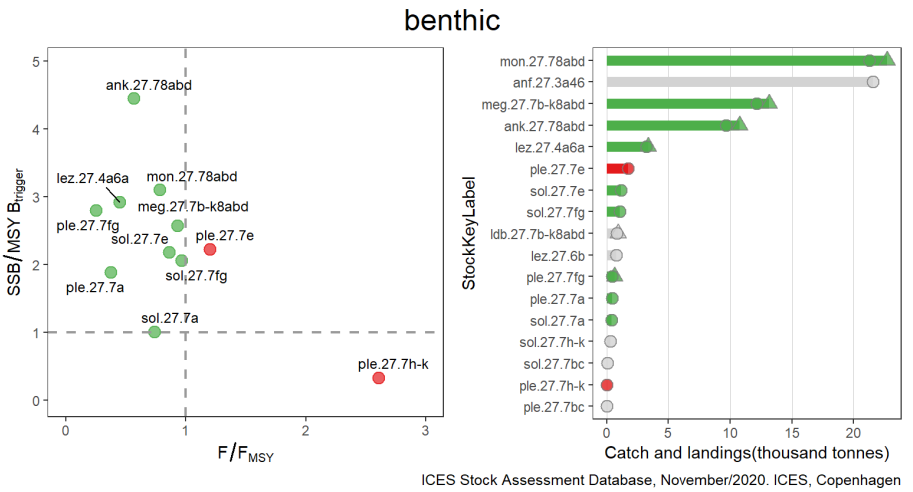
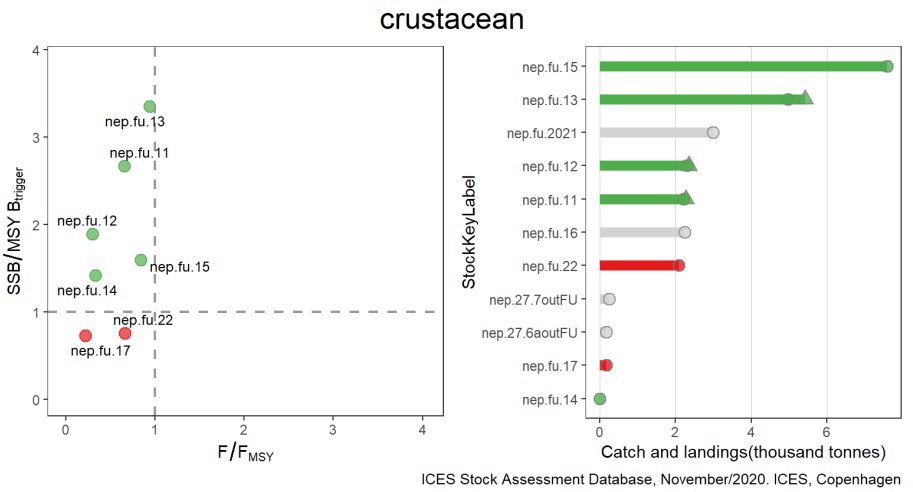


Figure 18 Temporal trends in F/F_{MSY} and SSB/MSY $B_{trigger}$ for Celtic Sea benthic, crustacean, demersal, and pelagic stocks. Only stocks with defined MSY reference points are considered. For full stock names, see Table A1 in the Annex.

The stock status relative to F_{MSY} and MSY $B_{trigger}$ is shown for all stocks and partitioned by stock groups in Figure 19. This shows that the hake stock and Rockall haddock has the best status among all stocks (almost 5 times MSY $B_{trigger}$ and fished below F_{MSY}). Cod in Division 6.a and 7.e–k and whiting in 7.a have the worst stock status, being fished around 2.5 times higher than F_{MSY} and with SSB well below MSY $B_{trigger}$. Blue whiting and mackerel account for the highest landings. Fishing mortality for blue whiting is higher than F_{MSY} while fishing mortality in mackerel is now estimated to be below F_{MSY}. Two demersal, two benthic, and two *Nephrops* stocks in the bottom right quadrant of the stock status plot indicate that they need to be rebuilt and that fishing mortality remains too high. Several stocks are in the bottom left quadrant, indicating that while fishing mortality is lower than F_{MSY}, stock size remains below MSY $B_{trigger}$. In general, the crustacean and benthic stocks have a better stock status than the demersal or pelagic stocks.







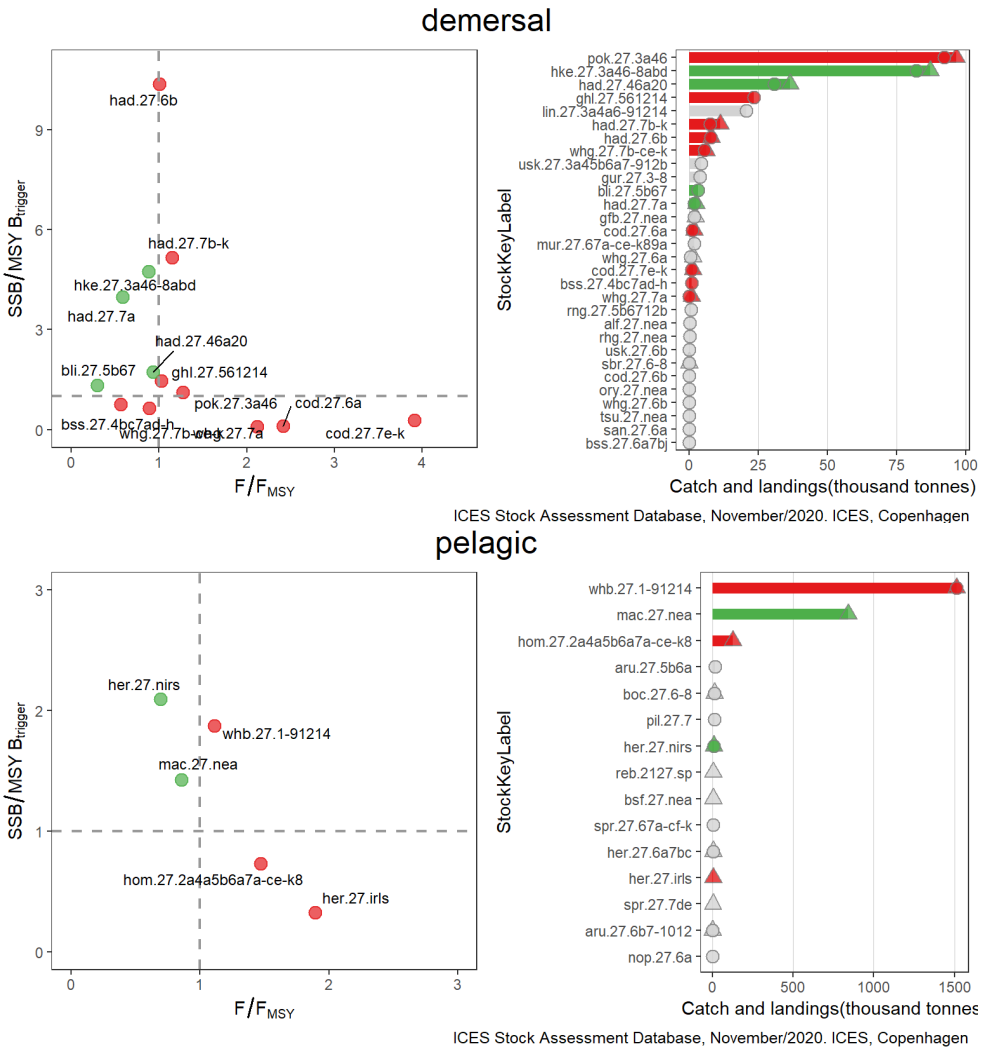


Figure 19 Status of Celtic Sea stocks relative to the joint distribution of exploitation (F/F_{MSY}) and stock size (SSB/ MSY $B_{trigger}$) [left panels, by individual stocks] and catches (triangles) / landings (circles) from these stocks in 2020 [right panels]. The left panels only include stocks for which MSY reference points have been defined (MSY where available). Stocks in green are exploited at or below F_{MSY} while the stock size is also at or above MSY $B_{trigger}$. Stocks in red are either exploited above F_{MSY} or the stock size is below MSY $B_{trigger}$, or both. Stocks in grey have unknown/undefined status in relation to reference points. "All stocks" refers to the ten stocks with highest catch and landings across fisheries guilds in 2019. For full stock names, see Table A1 in the Annex.

European eel cannot be assessed against any PA or MSY reference points. Recruitment of European eel has declined sharply in recent decades due to a range of potential threats.

Mixed fisheries

Fishing operations typically catch more than one species at a time, although some fishing operations are more species selective than others. For example, pelagic trawling tends to catch only one species, whereas demersal trawling normally catches several species simultaneously. These operations are reported to ICES at a level that is aggregated by EU Member States to the following key descriptors of fishing activity (hereafter called "métier"): gear, target assemblage, mesh size range, vessel length, ICES division, and quarter (quarters have been aggregated to year in the analyses below). The catch composition resulting from any fishing activity is described as a technical interaction.

In the absence of fine-scale spatial and temporal information on catches, analysis has been carried out at the EU Member State level. This allows the incorporation of the effects of spatial and temporal variation in fishing patterns and market considerations on technical interactions, but not to distinguish between these factors. In the descriptions below, the term

"landings" is used because the analyses are based on landings reported in logbooks. Elsewhere in ICES advice, the terms "wanted" and "unwanted" catch are used to take account of the EU landing obligation legislation that has been applied to some species since 2016.

In this advice, only the technical interactions occurring within demersal fisheries in the Celtic Seas ecoregion are considered. For this analysis, an average of the 2017, 2018, and 2019 data on métier was used. The Celtic Seas ecoregion was subdivided into three distinct areas: Irish Sea (Division 7.a), Celtic Sea and west of Ireland (divisions 7.b–k, excluding Division 7.d), and west of Scotland (divisions 6.a and 6.b). The technical interactions within each of these areas are described in relation to the main demersal TAC species (cod, megrims, anglerfish, whiting, hake, haddock, *Nephrops*, plaice, sole, pollack, and saithe).

Irish Sea

The nine demersal TAC species that dominate the landings in the Irish Sea (*Nephrops*, haddock, plaice, anglerfish, hake, megrim, cod, whiting, and pollack; Figure 20b) are predominantly landed by three countries (Ireland, United Kingdom, and Belgium) using four main métiers (OTB_CRU, OTB_DEF, TBB_DEF, SCC_DEF – see Table A4 in the Annex for a definition of métiers) (Figure 20a).

Nephrops is the main species landed within the Irish Sea mixed fisheries (mean 6654 tonnes year^{-1}). They are primarily targeted using otter trawls (OTB_CRU). Other species in the *Nephrops* fishery constitute a low proportion of the overall landings (< 10%; Figure 20a). However, there is evidence of significant discarding in these fisheries, including whiting. Haddock account for the second highest landings (2470 tonnes year^{-1}) and are mainly caught in otter trawls targeting demersal fish (UK_OTB_DEF, UK_OTM_DEF and IE_OTB_DEF; Figure 20a). Around 75% of haddock are caught by these three métiers (Figure 20a). Plaice accounts for the third highest landings (495 tonnes year^{-1}) in the Irish Sea, mainly targeted by beam trawls, and have technical interactions with megrim, sole, and some other species (mainly rays; Figure 20b). There is some variation in the landings profiles of each métier at the country level, reflecting different fishing patterns, practice, and quota shares.

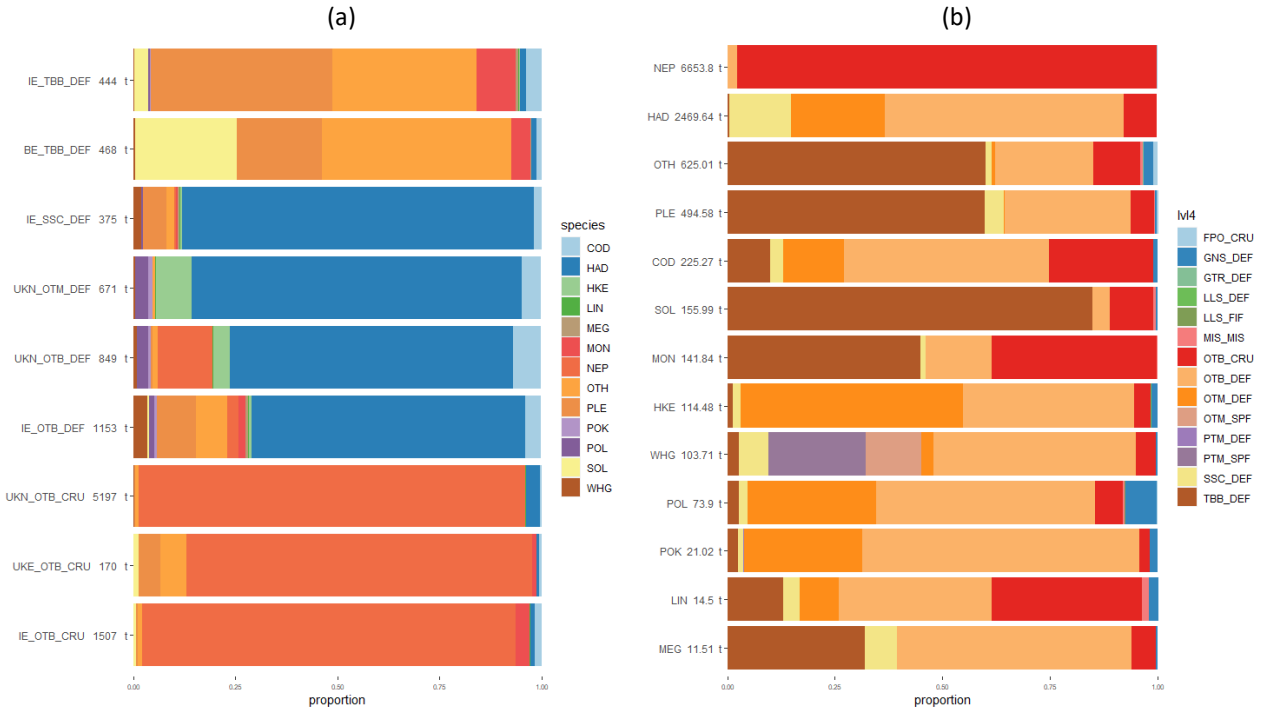


Figure 20 Description of technical interactions of demersal TAC species in the Irish Sea. The left panel (a) shows the species composition of the main demersal métiers (landings > 100 tonnes) operating in the Irish Sea. The label incorporates the country code, métier, and mean annual (2017–2019) landings (tonnes). The right panel (b) shows the proportion of the landings of each species accounted for by the different demersal métiers. The label includes the mean annual landings (2017–2019).

Celtic Sea and west of Ireland

The Celtic Sea and west of Ireland has highly diverse mixed fisheries. Twelve demersal TAC species dominate the landings in the Celtic Sea (hake, anglerfish, megrim, whiting, *Nephrops*, haddock, cod, pollack, sole, ling, saithe, and plaice; Figure 21b). These are landed by six nations (Ireland, France, United Kingdom, Spain, the Netherlands, and Belgium), using twelve main métiers (OTB_DEF, LLS_DEF, GNS_DEF, TBB_DEF, OTB_CRU, OTT_DEF, SCC_DEF, LLS_FIF, OTT_CRU, GTR_DEF, OTM_DEF, and LMH_DEF; Figure 21a). In this area, unlike the Irish Sea, landings profiles by métier vary greatly by EU Member State. For example, demersal otter trawl fisheries carried out by France, Ireland, and United Kingdom yield very different species compositions and therefore result in different technical interactions (Figure 21a).

Hake is the main species landed by demersal mixed fisheries (mean 37 807 tonnes year^{-1}) from the Celtic Sea and west of Ireland. Hake are targeted primarily by longliners (LSS_DEF) and gillnetters (GNS_DEF; Figure 21a). The landings of other species in the hake directed fishery constitutes a low proportion of the overall catch (< 10%; Figure 21a). Hake are caught in the majority of métiers to varying extents. The slope species, anglerfish (22 717 tonnes year^{-1}) and megrims (10 984 tonnes year^{-1}), constitute the next highest landings. Both anglerfish and megrims are primarily targeted by otter trawls (OTB_DEF; Figure 20b) and represent the dominant species of that métier (> 50%; Figure 21a). Most whiting are caught by otter trawls targeting fish; these trawls also catch haddock and varying amounts of other benthic and gadoid species. 80% of *Nephrops* are caught in crustacean trawl fisheries with minor catches of other species.

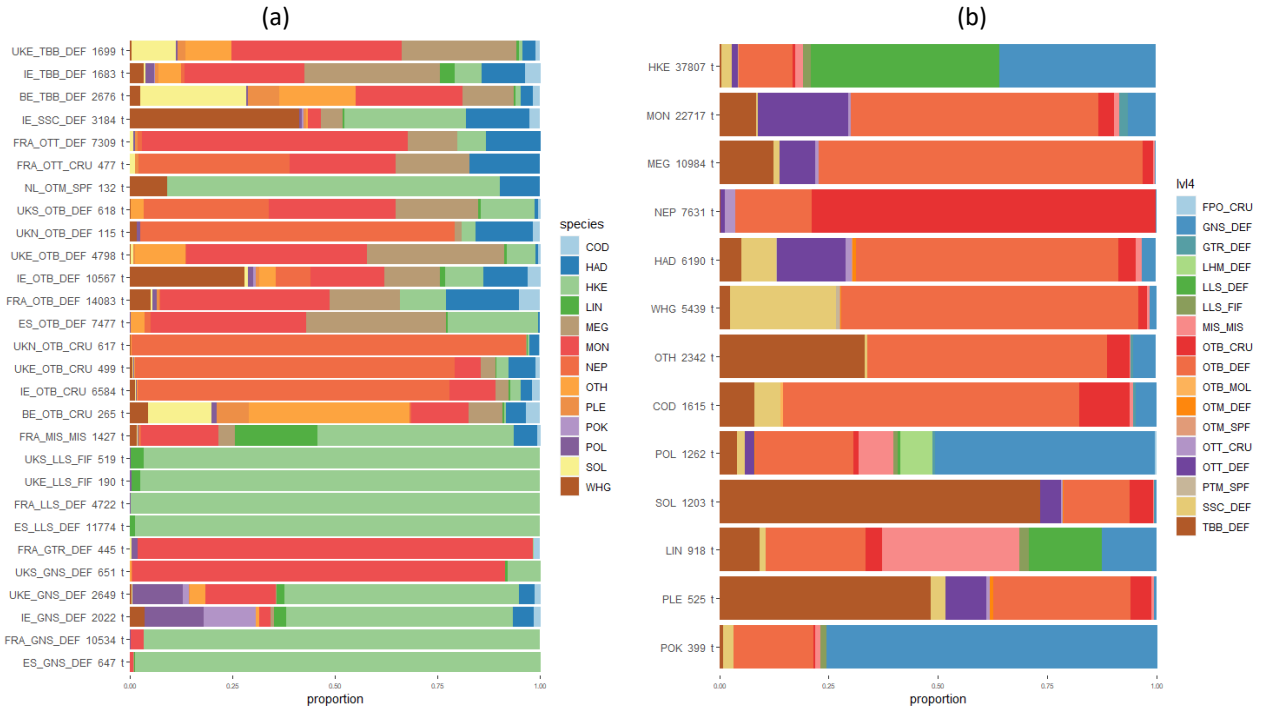


Figure 21 Description of technical interactions of demersal TAC species in the Celtic Sea and west of Ireland. The left panel (a) shows the species composition of the main demersal métiers (landings > 100 tonnes) operating in the Celtic Sea and west of Ireland. The label incorporates the country code, métier, and mean annual (2017–2019) landings (tonnes). The right panel (b) shows the composition of the landings of each species accounted for by the different demersal métiers. The label includes the mean annual landings (2017–2019).

West of Scotland

Ten demersal TAC species dominate the landings from west of Scotland (*Nephrops*, hake, haddock, pollack, anglerfish, ling, megrim, cod, whiting, and plaice; Figure 22b). These are landed by six nations (Ireland, United Kingdom, France, Spain, the Netherlands, and Germany) using ten main métiers (OTB_DEF, OTB_CRU, LLS_DEF, LLS_FIF, FPO_CRU, GNS_DEF, OTT_DEF, SCC_DEF, OTM_DEF, and OTB_DWS; Figure 22a).

Nephrops are the main species in the landings of the demersal fisheries of west of Scotland (average 10 065 tonnes year^{-1}), and are primarily targeted by otter trawls (OTB_CRU) and fishing pots (FPO_CRU). The landings of other species in the

Nephrops fisheries constitutes a low proportion of the overall catch (< 10%; Figure 22a). However, there is evidence of significant discarding in these fisheries. Haddock accounts for the second highest landings (8834 tonnes year^{-1}); it is targeted mainly by otter trawls (OTB_DEF) and has technical interactions with many other species, including hake, ling, pollack, anglerfish, and *Nephrops* (Figure 22b). Hake has the third highest landings (7787 tonnes year^{-1}) in fisheries in this area. It is mainly caught using longliners (LSS_DEF, LSS_FIF; Figure 21b) and represents the dominant species of that métier (> 80%; Figure 22a). As with the Celtic Sea, landings profiles in this area vary greatly depending on the EU Member State. For example, the demersal otter trawl fisheries carried out by France, Ireland, and the United Kingdom have very different species compositions and therefore result in different technical interactions (Figure 22a).

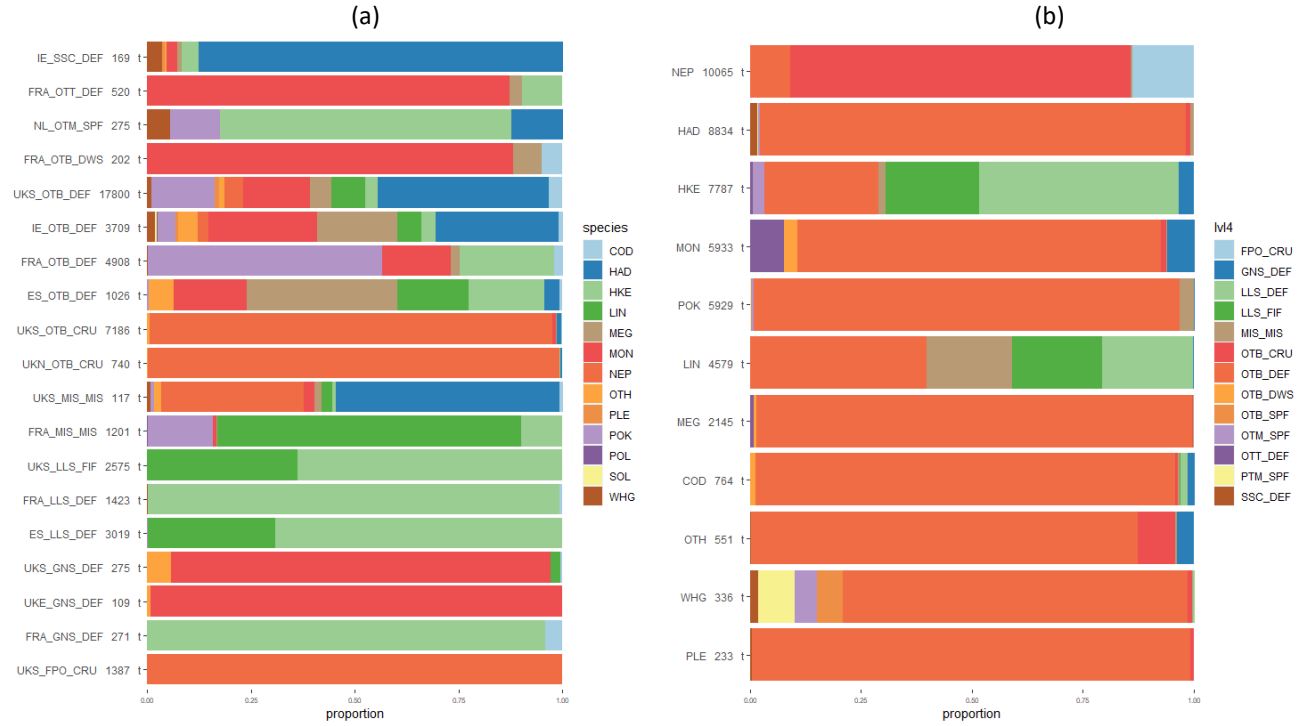


Figure 22 Description of technical interactions of demersal TAC species for the west of Scotland. The left panel (a) shows the species composition of the main demersal métiers (landings > 100 tonnes) operating in these seas. The label incorporates the country code, métier, and mean annual (2017–2019) landings (tonnes). The right panel (b) shows the proportion of the landings of each species accounted for by the different demersal métiers. The label includes the mean annual landings (2017–2019).

The species interactions and relative proportions of catches in mixed fisheries are not likely to change greatly between years. Generally, the interactions between species and the selectivity of fisheries change gradually over time.

Species interaction

Fish species are part of the marine food web and interact in various ways, including through predation and competition. Natural mortality is becoming proportionately more significant in the Celtic Seas ecoregion because fishing mortality has been reduced on many stocks. Predation mortality can occur from other fish, seabirds, and marine mammals. The abundance of some mammal species has been increasing in some parts of the ecoregion.

There is no operational multispecies modelling of the interactions of Celtic Seas species to quantify predation mortality. However, in the North Sea, the modelling indicates that the yields of many stocks are strongly affected by the abundance of cod, saithe, and mackerel, which are the main predator fish species. Changes in fishing mortality on these species influences the abundance and yield of other fish stocks. Indirect predation effects are also important. For example, reduced fisheries exploitation on cod increases cod biomass, which not only leads to reductions in SSB and yields of whiting and haddock (direct predation effect) but also to increases in SSB and yield of herring, sandeel, Norway pout, and sprat. Similar interactions could be expected in the Celtic Seas ecoregion.

Effects of fisheries on the ecosystem

Abrasion of the seabed by mobile bottom-contacting fishing gears has been investigated to describe the extent, magnitude, and effects of fishing on benthic habitats. Mobile bottom-contacting gears are concentrated on the *Nephrops* grounds, along the continental shelf edge, and throughout the Celtic Sea (Figure 23). There is little activity by mobile bottom-contacting gears in much of the area west of Scotland and west of Ireland.

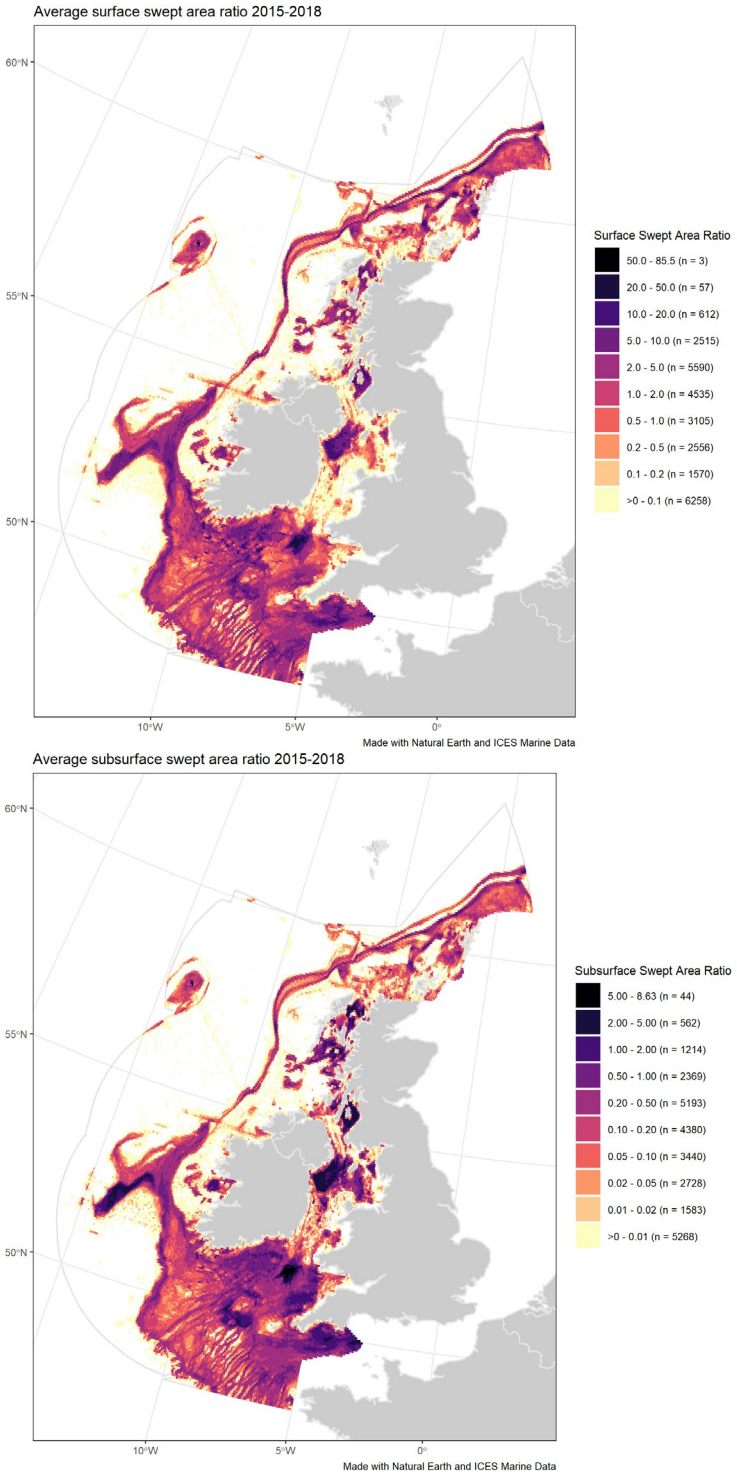


Figure 23 Average annual surface (left) and subsurface (right) disturbance by mobile bottom contacting fishing gear (bottom otter trawls, bottom seines, dredges, beam trawls) in the Celtic Seas ecoregion during 2015–2018, expressed as average swept-area ratios (SAR).

Bycatch of protected, endangered, and threatened species

Bottom-otter trawls and set gillnets pose the highest bycatch risk across species groups for the Celtic Sea, Irish Sea, and Western Ireland areas (FishPi, 2016). In addition, in the Celtic Sea fishing area multi-rig otter trawls and trammel nets, and in the Western Ireland fishing area midwater otter trawls, were also determined to have high bycatch risk factors (FishPi, 2016).

ICES evaluated bycatch mortality across métiers for the common dolphin in the Celtic Seas, in the Bay of Biscay and the Iberian Coast, and in the western English Channel. The at-sea monitoring point estimate of bycatch mortality is just below the potential biological removal while the point estimate from strandings data exceeded it. The estimated mean annual bycatch of the common dolphin in the ecoregion in 2016–2018 across all métiers amounted to 720 (95% CI 278–1345) individuals, with bottom otter trawls and gillnets accounting for the largest bycatch (276 animals 95% CI 151–427, and 192 animals 95% CI 85–299, respectively) (ICES 2020d, 2020e).

For other marine mammal species, the highest bycatch rates are observed in the set net fishery (ICES, 2020d). The bycatch mortality level of the Celtic Sea subpopulation of harbour porpoise exceeded 2% of the population for the area. High bycatch rate in gillnets has also been observed for grey seal (0.25 specimens per monitored days-at-sea) in 2018 in the ecoregion in area Division 7.j.

Set and drift gillnets have the greatest number of documented cases of marine bird bycatch (ICES, 2018). Midwater otter trawls also pose high risk for bycatch for gannets; bottom otter trawls for gannets, shearwaters, cormorants, shags, gulls and guillemots; set nets for all these species as well as ducks and divers; long-lines for fulmar, shearwater species, gannets, cormorants, shags, skua, gulls, terns, and auks, pots; traps for shags. As a quantified evidence, high bycatch rate in nets per monitored days-at-sea in 2018 involved the common murre *Uria aalge*, in the first quarter (1.50 specimens per monitored days-at-sea) in the ICES Division 7.g (ICES, 2020d).

Bycatches of some vulnerable (e.g. spurdog, thorny skate) and near threatened (e.g. thornback ray) species are continuing to be observed (as classified by the International Union for Conservation of Nature [IUCN]), especially in mobile gears in the Celtic Sea

Under EU TAC regulations, it is prohibited to fish for or to land Starry ray, leafscale gulper shark, Portuguese dogfish, birdbeak dogfish, kitefin shark, great lanternshark, tope shark, basking shark, porbeagle, undulate ray in 6, common skate (*Dipturus batis)* complex (*Dipturus* cf. flossada and *Dipturus* cf. *intermedia*), and angel shark. If specimens are caught within the Celtic Seas ecoregion they should be promptly released unharmed.

It is prohibited to catch spurdog (piked dogfish) unless vessels are part of a monitored bycatch avoidance programme.

ICES has previously advised zero catches in this ecoregion for stocks of rare or threatened species such as basking shark, porbeagle, angel shark, the common skate complex, white skates, undulate rays, orange roughy, deep-water sharks (kitefin shark, leafscale gulper shark, Portuguese dogfish), and greater silver smelt. These stocks have been either targeted or by-caught in fisheries in the past and are now considered depleted. Information on these stocks is sparse, but they require special management attention to conserve remaining populations.

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Annex

Supporting data used in the Celtic Seas Fisheries overview is archived at ICES (2020c).

Table A1 Status summary of the Celtic Seas ecosystem stocks in 2020, in regards to the ICES maximum sustainable yield (MSY) approach and precautionary approach (PA) for stocks within the Celtic Seas ecoregion. Grey represents unknown reference points. For the MSY approach: green represents a stock that is either fished below F_{MSY} or the stock size is greater than MSY $B_{trigger}$; red represents a stock that is either fished above F_{MSY} or the stock size is less than MSY $B_{trigger}$. For the PA: green represents a stock that is either fished below F_{pa} or the stock size is greater than B_{pa}; yellow represents a stock that is either fished between F_{pa} and F_{lim} or the stock size is between B_{lim} and B_{pa}; red represents a stock that is either fished above F_{lim} or the stock size is less than B_{lim}. SBL = Safe Biological Limits; MSFD = EU Marine Strategy Framework Directive; D3C1 = MSFD indicator for fishing mortality; D3C2 = MSFD indicator for spawning-stock biomass; GES = good environmental status.

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
ank.27.78abd	Black-bellied anglerfish in Subarea 7 and divisions 8.a–b and 8.d	Benthic	3.2	2020	PA	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
aru.27.5b6a	Greater silver smelt in divisions 5.b and 6.a	Pelagic	3.2	2019	PA	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
bli.27.5b67	Blue ling in subareas 6–7 and Division 5.b	Demersal	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
bss.27.4bc7ad-h	Sea bass in divisions 4.b–c, 7.a, and 7.d–h	Demersal	1.2	2020	MSY	✗	✗	MSY	✓	✗	✓	✗
								PA	✓	o	✓	o
cod.27.6a	Cod in Division 6.a	Demersal	1.2	2020	MSY	✗	✗	MSY	✗	✗	✗	✗
								PA	o	✗	o	✗

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
cod.27.7e-k	Cod in divisions 7.e–k	Demersal	1	2020	MSY	✗	✗	MSY	✗	✗	✗	✗
								PA	✗	✗	✗	✗
dgs.27.nea	Spurdog in Subareas 1–10, 12, and 14	Elasmobranch	1.2	2020	MSY/PA	?	?	MSY	✓	✗	✓	✗
								PA	✓	?	✓	?
ele.2737.nea	European eel throughout its natural range	Demersal	3.14	2020	PA	?	?	MSY	?	✗	?	✗
								PA	?	✗	?	✗
ghl.27.561214	Greenland halibut in subareas 5, 6, 12, and 14	Demersal	1	2020	MSY	?	✗	MSY	✗	✓	✗	✓
								PA	?	✓	?	✓
had.27.46a20	Haddock in Subarea 4, Division 6.a, and Subdivision 20	Demersal	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
had.27.6b	Haddock in Division 6.b	Demersal	1	2020	MSY	✓	✗	MSY	✗	✓	✓	✓
								PA	✓	✓	✓	✓
had.27.7a	Haddock in Division 7.a	Demersal	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
had.27.7b-k	Haddock in Divisions 7.b–k	Demersal	1	2020	MSY	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓
her.27.irls	Herring in divisions 7.a South of 52°30'N, 7.g–h, and 7.j–k	Pelagic	1	2020	MSY	✗	✗	MSY	✗	✗	✗	✗
								PA	✗	✗	✗	✗
her.27.nirs	Herring in Division 7.a North of 52°30'N	Pelagic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
hke.27.3a46-8abd	Hake in subareas 4, 6, and 7, and divisions 3.a, 8.a–b, and 8.d, Northern stock	Demersal	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
hom.27.2a4a5b6a7a-ce-k8	Horse mackerel in Subarea 8 and divisions 2.a, 4.a, 5.b, 6.a, 7.a–c, and 7.e–k	Pelagic	1	2020	MSY	✗	✗	MSY	✗	✗	✗	✗
								PA	✗	o	✗	o

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
lez.27.4a6a	Megrim in divisions 4.a and 6.a	Benthic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
lez.27.6b	Megrim in Division 6.b	Benthic	3.2	2020	PA	?	?	MSY	?	✓	?	✓
								PA	?	?	?	?
lin.27.3a4a6-91214	Ling in subareas 6–9, 12, and 14, and divisions 3.a and 4.a	Demersal	3.2	2019	PA	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
mac.27.nea	Mackerel in subareas 1–8 and 14 and division 9.a	Pelagic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
meg.27.7b-k8abd	Megrim in divisions 7.b–k, 8.a–b, and 8.d	Benthic	1	2020	MP	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
mon.27.78abd	White anglerfish in Subarea 7 and divisions 8.a–b and 8.d	Benthic	1	2020	MP	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
nep.fu.11	Norway lobster in Division 6.a, Functional Unit 11	Crustacean	1	2020	F_{MSY} Ranges	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
nep.fu.12	Norway lobster in Division 6.a, Functional Unit 12	Crustacean	1	2020	F_{MSY} Ranges	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
nep.fu.13	Norway lobster in Division 6.a, Functional Unit 13	Crustacean	1	2020	F_{MSY} Ranges	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
nep.fu.14	Norway lobster in Division 7.a, Functional Unit 14	Crustacean	1	2020	F_{MSY} Ranges	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
nep.fu.15	Norway lobster in Division 7.a, Functional Unit 15	Crustacean	1	2020	F_{MSY} Ranges	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
nep.fu.16	Norway lobster in divisions 7.b–c and 7.j–k, Functional Unit 16	Crustacean	1	2020	F_{MSY} Ranges	?	?	MSY	✓	?	✓	?
								PA	✓	?	✓	?
nep.fu.17	Norway lobster in Division 7.b, Functional Unit 17	Crustacean	1	2020	F_{MSY} Ranges	?	✗	MSY	✓	✗	✓	✗
								PA	✓	?	✓	?
nep.fu.19	Norway lobster in divisions 7.a, 7.g, and 7.j, Functional Unit 19	Crustacean	1	2020	F_{MSY} Ranges	?	✗	MSY	✓	✗	✓	✗
								PA	✓	?	✓	?
nep.fu.2021	Norway lobster in divisions 7.g and 7.h, functional units 20 and 21	Crustacean	1	2020	F_{MSY} Ranges	?	?	MSY	✗	?	✗	?
								PA	?	?	?	?

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
nep.fu.22	Norway lobster in divisions 7.f and 7.g, Functional Unit 22	Crustacean	1	2020	F_{MSY} Ranges	?	✗	MSY	✗	✓	✗	✓
								PA	?	✓	?	✓
ple.27.7a	Plaice in Division 7.a	Benthic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
ple.27.7e	Plaice in Division 7.e	Benthic	3.2	2020	PA	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓
ple.27.7fg	Plaice in divisions 7.f and 7.g	Benthic	3.2	2020	PA	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
ple.27.7h-k	Plaice in divisions 7.h–k	Benthic	3.2	2019	PA	✗	✗	MSY	✗	✗	✗	✗
								PA	✗	✗	✗	✗
pok.27.3a46	Saithe in subareas 4 and 6 and in Division 3.a	Demersal	1	2020	MSY	✓	✗	MSY	✗	✓	✗	✓
								PA	o	✓	o	✓
sol.27.7a	Sole in Division 7.a	Benthic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
sol.27.7e	Sole in Division 7.e	Benthic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
sol.27.7fg	Sole in divisions 7.f and 7.g	Benthic	1	2020	MSY	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓

Stock code	Stock description	Fisheries guild	Data category	Assessment year	Advice category	SBL	GLS	Reference point	Fishing pressure	Stock size	D3C1	D3C2
usk.27.3a45b6a7-912b	Tusk in subareas 4 and 7–9 and in divisions 3.a, 5.b, 6.a, and 12.b	Demersal	3.2	2019	PA	✓	✓	MSY	✓	✓	✓	✓
								PA	✓	✓	✓	✓
whb.27.1-91214	Blue whiting in subareas 1–9, 12, and 14	Pelagic	1	2020	MP	✓	✗	MSY	✗	✓	✗	✓
								PA	✓	✓	✓	✓
whg.27.7a	Whiting in Division 7.a	Demersal	1	2019	MSY	✗	✗	MSY	✗	✗	✗	✗
								PA	✗	✗	✗	✗
whg.27.7b-ce-k	Whiting in divisions 7.b–c and 7.e–k	Demersal	1	2020	MSY	✗	✗	MSY	✓	✗	✓	✗
								PA	✓	✗	✓	✗

Table A2 List of those stocks in the Celtic Seas ecoregion in 2020 that do not have a full set of reference points.

Stock code	Stock name	Fish category	Data category	Year of Assessment	Advice category
agn.27.nea	Angel shark in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
alf.27.nea	Alfonsinos in subareas 1–10, 12, and 14	Demersal	5.2	2020	PA
anf.27.3a46	Anglerfish in Subareas 4 and 6, and Division 3.a	Benthic	3.2	2020	PA
ank.27.78abd	Black-bellied anglerfish in Subarea 7 and in divisions 8.a–b and 8.d	Benthic	3.2	2020	PA
aru.27.6b7-1012	Greater silver smelt in subareas 7–10 and 12, and Division 6.b	Pelagic	3.2	2019	PA
boc.27.6-8	Boarfish in subareas 6–8	Pelagic	3.2	2019	PA
bsf.27.nea	Black scabbardfish in subareas 1, 2, 4– 8, 10, and 14, and divisions 3.a, 9.a, and 12.b	Pelagic	3.2	2020	PA
bsk.27.nea	Basking shark in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
bss.27.6a7bj	Seabass in divisions 6.a, 7.b, and 7.j	Demersal	6.2	2020	PA
cod.27.6b	Cod in Division 6.b	Demersal	6.2	2020	PA
cod.27.7a	Cod in Division 7.a	Demersal	3	2020	PA
cyo.27.nea	Portuguese dogfish in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
gag.27.nea	Tope in subareas 1–10, 12, and 14	Elasmobranch	5.2	2019	PA
gfb.27.nea	Greater forkbeard in subareas 1–10, 12, and 14	Demersal	3.2	2020	PA
guq.27.nea	Leafscale gulper shark in subareas 1 –10, 12, and 14	Elasmobranch	6.3	2019	PA
gur.27.3-8	Red gurnard in subareas 3–8	Demersal	6.2	2019	PA
her.27.6a7bc	Herring in divisions 6.a and 7.b–c	Pelagic	3	2020	PA
ldb.27.7b-k8abd	Four-spot megrim in divisions 7.b–k, 8.a–b, and 8.d	Benthic	5.9	2020	PA/Stock status only
mur.27.67a-ce-k89a	Striped red mullet in subareas 6 and 8, and divisions 7.a–c, 7.e–k, and 9.a	Demersal	5.2	2020	PA
Nep.27.6aoutFU	Norway lobster in Division 6.a, outside the functional units	Crustacean	5.2	2020	PA
Nep.27.7outFU	Norway lobster in Division 7, outside the functional units	Crustacean	5.2	2020	PA
nop.27.6a	Norway pout in Division 6.a	Pelagic	6.3	2018	No advice
ory.27.nea	Orange roughy in subareas 1–10, 12, and 14	Demersal	6.3	2020	PA
ple.27.7bc	Plaice in divisions 7.b–c	Benthic	6.2	2020	PA

Stock code	Stock name	Fish category	Data category	Year of Assessment	Advice category
pol.27.67	Pollack in subareas 6–7	Demersal	4.12	2019	PA
por.27.nea	Porbeagle in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
raj.27.67a-ce-h	Rays and skates in Subarea 6 and divisions 7.a–c and 7.e–h	Elasmobranch	6.9	2020	No advice
reb.2127.sp	Beaked redfish in ICES subareas 5, 12, and 14 and NAFO subareas 1 and 2	Pelagic	3	2019	PA
rja.27.nea	White skate in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
rjb.27.67a-ce-k	Common skate complex and flapper skate in Subarea 6 and divisions 7.a–c and 7.e–k	Elasmobranch	6.3	2020	PA/Stock status only
rjc.27.6	Thornback ray in Subarea 6	Elasmobranch	3.2	2020	PA
rjc.27.7afg	Thornback ray in divisions 7.a and 7.f–g	Elasmobranch	3.2	2020	PA
rjc.27.7e	Thornback ray in Division 7.e	Elasmobranch	5.2	2020	PA
rje.27.7de	Small-eyed ray in divisions 7.d and 7.e	Elasmobranch	5.2	2020	PA
rje.27.7fg	Small-eyed ray in divisions 7.f and 7.g	Elasmobranch	3.2	2020	PA
rjf.27.67	Shagreen ray in subareas 6–7	Elasmobranch	5.2	2020	PA
rjh.27.4a6	Blonde ray in Subarea 6 and Division 4.a	Elasmobranch	5.2	2020	PA
rjh.27.7afg	Blonde ray in divisions 7.a and 7.f–g	Elasmobranch	5.2	2020	PA
rjh.27.7e	Blonde ray in Division 7.e	Elasmobranch	5.2	2020	PA
rji.27.67	Sandy ray in subareas 6–7	Elasmobranch	5.2	2020	PA
rjm.27.67bj	Spotted ray in Subarea 6 and divisions 7.b and 7.j	Elasmobranch	3.2	2020	PA
rjm.27.7ae-h	Spotted ray in divisions 7.a and 7.e–h	Elasmobranch	3.2	2020	PA
rjn.27.678abd	Cuckoo ray in subareas 6–7 and divisions 8.a–b and 8.d	Elasmobranch	3.2	2020	PA
rjr.27.23a4	Starry ray in subareas 2 and 4, and in Division 3.a	Elasmobranch	3.14	2019	PA
rju.27.7bj	Undulate ray in divisions 7.b and 7.j	Elasmobranch	6.3	2020	PA
rju.27.7de	Undulate ray in divisions 7.d and 7.e	Elasmobranch	3.2	2020	PA
rng.27.5b6712b	Roundnose grenadier in subareas 6–7 and divisions 5.b and 12.b	Demersal	5.2	2020	MSY
san.27.6a	Sandeel in Division 6.a	Demersal	6.3	2018	No advice
sbr.27.6-8	Blackspot seabream in subareas 6–8	Demersal	6.3	2020	PA

Stock code	Stock name	Fish category	Data category	Year of Assessment	Advice category
sck.27.nea	Kitefin shark in subareas 1–10, 12, and 14	Elasmobranch	6.3	2019	PA
sdv.27.nea	Smooth-hound in subareas 1–10, 12, and 14	Elasmobranch	3.2	2019	PA
sho.27.67	Black-mouth dogfish in subareas 6 and 7	Elasmobranch	3.9	2019	PA/Stock status only
sol.27.7bc	Sole in divisions 7.b and 7.c	Benthic	6.2	2017	PA
sol.27.7h-k	Sole in divisions 7.h–k	Benthic	3.2	2020	PA
spr.27.67a-cf-k	Sprat in Subarea 6 and divisions 7.a–c and 7.f-k	Pelagic	5.2	2019	PA
spr.27.7de	Sprat in divisions 7.d and 7.e	Pelagic	3.2	2020	PA
syc.27.67a-ce-j	Lesser spotted dogfish in Subarea 6 and divisions 7.a–c and 7.e–j	Elasmobranch	3.9	2019	PA
syt.27.67	Greater-spotted dogfish in subareas 6 and 7	Elasmobranch	3.9	2019	No advice
whg.27.6a	Whiting in Division 6.a	Demersal	3.2	2020	PA
whg.27.6b	Whiting in Division 6.b	Demersal	6.2	2019	PA
usk.27.6b	Tusk in Division 6.b	Demersal	5.2	2020	PA

Table A3 Scientific names of species.

Common name	Scientific name	Common name	Scientific name
Albacore tuna	Thunnus alalunga	Mackerel	*Scomber scombrus*
Angel shark	Squatina squatina	Megrim	*Lepidorhombus whiffiagonis*
Alfonsinos	*Beryx* spp.	Megrims	*Lepidorhombus* spp.
Anglerfish	*Lophius budegassa, Lophius piscatorius*	Norway lobster	*Nephrops norvegicus*
Basking shark	*Cetorhinus maximus*	Norway pout	*Trisopterus esmarkii*
Birdbeak dogfish	*Deania calcea*	Norwegian skate	*Dipturus nidarosiensis*
Black-bellied anglerfish	*Lophius budegassa*	Orange roughy	*Hoplostethus atlanticus*
Black-mouth dogfish	*Galeus melastomus*	Oyster	*Ostrea edulis*
Black scabbardfish	*Aphanopus carbo*	Plaice	*Pleuronectes platessa*
Blackspot seabream	*Pagellus bogaraveo*	Pollack	*Pollachius pollachius*
Blonde ray	*Raja brachyura*	Porbeagle	*Lamna nasus*
Blue ling	*Molva dypterygia*	Portuguese dogfish	*Centroscymnus coelolepis,*
Blue whiting	*Micromesistius poutassouu*	Queen scallop	*Chlamys opercularis*
Boarfish	*Capros aper*	Rays and skates	*Rajidae*
Brown crab	*Cancer pagurus*	Razor clam	*Ensis magnus*
Clam	*Spisula*	Red gurnard	*Chelidonichthys cuculus*
Cockle	*Cerastoderma edule*	Roughhead grenadier	*Macrourus berglax*
Cod	*Gadus morhua*	Roughsnout grenadier	*Trachyrincus scabrus*
Common dolphin (Long-finned)	*Delphis delphinus*	Roundnose grenadier	*Coryphaenoides rupestris*
Common skate	*Dipturus batis*-complex includes flapper skate *Dipturus cf. flossada* and blue skate *Dipturus cf. intermedia*	Saithe	*Pollachius virens*
Cuckoo ray	*Leucoraja naevus*	Salmon	*Salmo salar*
Cuttlefish	*Sepia officinalis*	Sandy ray	*Leucoraja circularis*
European eel	*Anguilla anguilla*	Sardine	*Sardina pilchardus*
Four-spot megrim	*Lepidorhombus boscii*	Sea bass	*Dicentrarchus labrax*
Great lanternshark	*Etmopterus princeps*	Sea trout	*Salmo trutta*
Greater forkbeard	*Phycis blennoides*	Shagreen ray	*Leucoraja fullonica*
Greenland halibut	*Reinhardtius hippoglossoides*	Small-eyed ray	*Raja microocellata*
Greater silver smelt	*Argentina silus*	Smooth-head	*Alepocephalus bairdii*
Greater-spotted dogfish	*Scyliorhinus stellaris*	Smooth-hound	*Mustelus* spp.
Haddock	*Melanogrammus aeglefinus*	Smooth lanternshark	*Etmopterus pusillus*
Harbour porpoise	*Phocoena phocoena*	Sole	*Solea solea*
Herring	*Clupea harengus*	Spotted ray	*Raja montagui*
Hake	*Merluccius merluccius*	Sprat	*Sprattus sprattus*
Horse mackerel	*Trachurus trachurus*	Spurdog (Piked dogfish)	*Squalus acanthias*
Kitefin shark	*Dalatias licha*	Starry ray	*Amblyraja radiata*
Leafscale gulper shark	*Centrophorus squamosus*	Striped red mullet	*Mullus surmuletus*
Lesser-spotted dogfish	*Scyliorhinus canicula*	Thornback ray	*Raja clavata*
Ling	*Molva molva*	Thorny skate	*Amblyraja radiata*
Lobster	*Homarus gammarus*	Thresher sharks	*Alopias* spp.
Tope	*Galeorhinus galeus*		
Tusk	*Brosme brosme*	White skate	*Rostroraja alba*
Undulate ray	*Raja undulata*	Whelk	*Buccinum undatum*
White anglerfish	*Lophius piscatorius*	Whiting	*Merlangius merlangus*

Table A4 Métier definitions.

Area	Gear type	Target assemblage	Métier label
West of Scotland (Division 6.a) and Rockall (Division 6.b)	Pots and traps	Crustaceans	FPO_CRU
	Gillnets	Demersal fish	GNS_DEF
	Longline	Finfish	LLS_FIF
	Otter trawl	Crustaceans	OTB_CRU
		Demersal fish	OTB_DEF
		Deep-water species	OTB_DWS
		Molluscs	OTB_MOL
	Mid-water trawl	Demersal fish	OTM_DEF
		Small pelagic fish	OTM_SPF
	Seines	Small pelagic fish	SSC_SPF
	Others	Miscellaneous	MIS_MIS
Irish Sea (Division 7.a)	Pots and traps	Crustaceans	FPO_CRU
		Molluscs	FPO_MOL
	Gillnets	Demersal fish	GNS_DEF
	Otter trawl	Crustaceans	OTB_CRU
		Demersal fish	OTB_DEF
		Molluscs	OTB_MOL
	Beam trawl	Demersal fish	TBB_DEF
	Others	Miscellaneous	MIS_MIS
West of Ireland (divisions 7.b–c) and Celtic Sea slope (divisions 7.k–j)	Gillnets	Demersal fish	GNS_DEF
		Deep-water species	GNS_DWS
	Otter trawl	Demersal fish	OTB_DEF
		Deep-water species	OTB_DWS
		Molluscs	OTB_MOL
		Small pelagic fish	OTB_SPF
		Crustaceans	OTB_CRU
	Midwater trawl	Small pelagic fish	OTM_SPF
		Demersal fish	OTM_DEF