

Cod (*Gadus morhua*) in Division 6.a (West of Scotland)

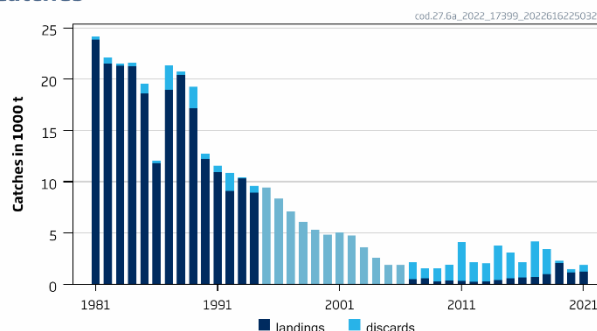
ICES advice on fishing opportunities

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in each of the years 2023 and 2024.

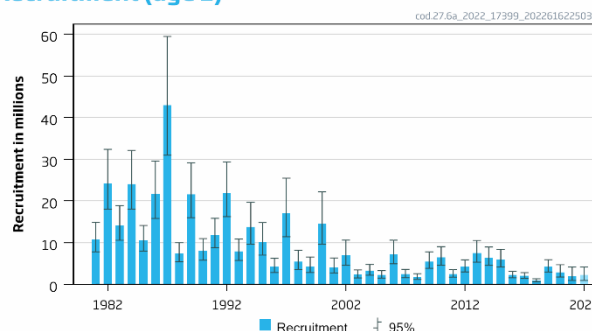
Stock development over time

Fishing pressure on the stock is above F_{MSY} , F_{pa} and F_{lim} ; spawning-stock size is below MSY $B_{trigger}$, B_{pa} , and B_{lim} .

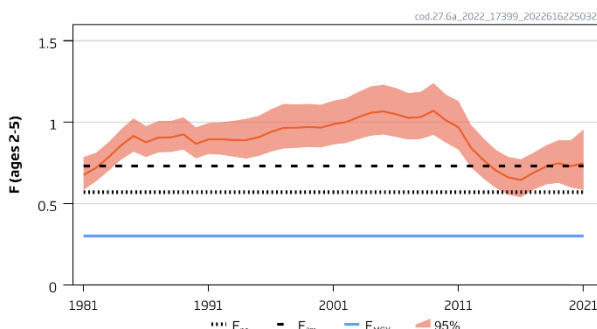
Catches



Recruitment (age 1)



F



SSB

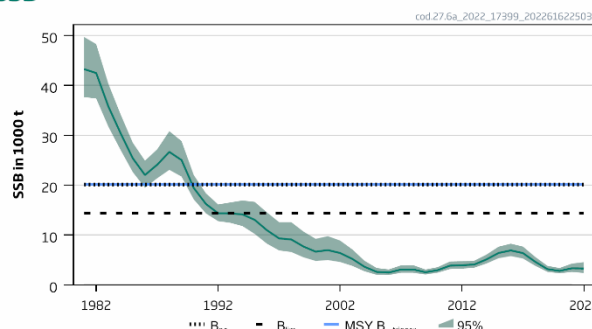


Figure 1 Cod in Division 6.a. Summary of the stock assessment. . Reported landings and estimated discards shown in the upper left panel (catches from 1995–2005 (pale blue) are excluded from the assessment). The assumed recruitment value for 2022 is shaded in a lighter colour.

Catch scenarios

Table 1 Cod in Division 6.a. Assumptions made for the interim year and forecast.

Variable	Value	Notes
$F_{ages\ 2-5}$ (2022)	0.74	$F_{sq} = F_{average}$ (2019–2021)
SSB (2023)	2 923	Short-term forecast; in tonnes
$R_{age\ 1}$ (2022, 2023 and 2024)	2 226	Median recruitment resampled from the years 2016–2021; in thousands
Total catch (2022)	1 873	Short-term forecast; in tonnes
Projected landings (2022)	1 333	Short-term forecast assuming average landing pattern (2019–2021) ^a ; in tonnes
Projected discards (2022)	540	Short-term forecast assuming average discard pattern (2019–2021) ^a ; in tonnes

^a Because of inadequate discard sampling coverage of the fishery in 2021, average landings and discards proportions from 2019–2020 are used for ages 1 and 2.

Table 2 Cod in Division 6.a. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2023)	Projected landings (2023)	Projected discards (2023)	F _{total} (2023)	F _{projected} landings (2023)	F _{projected} discards (2023)	SSB (2024)	% SSB change*	% TAC change^
ICES advice basis									
MSY approach: F = 0	0	0	0	0	0	0	4728	62	-100
Other scenarios									
F _{MSY} × SSB (2023)/MSY B _{trigger}	133	99	34	0.043	0.033	0.01	4569	56	-90
F _{MSY lower} × SSB (2023)/MSY B _{trigger}	80	60	20	0.026	0.02	0.006	4632	58	-94
F _{MSY upper} × SSB (2023)/MSY B _{trigger}	214	159	55	0.071	0.055	0.016	4472	53	-83
F = F _{MSY lower}	514	380	134	0.18	0.139	0.041	4113	41	-60
F = F _{MSY}	809	594	215	0.3	0.23	0.069	3757	29	-37
F = F _{pa}	1359	985	374	0.57	0.44	0.13	3099	6.0	6.3
F = F _{MSY upper}	1210	881	329	0.49	0.38	0.112	3278	12.1	-5.4
F = F ₂₀₂₂	1642	1181	461	0.74	0.57	0.17	2760	-5.6	28
F = F _{lim}	1625	1169	456	0.73	0.56	0.167	2781	-4.9	27
TAC(2022)	1279	929	350	0.53	0.41	0.12	3196	9.3	0.0
TAC(2022) – 25%	959	703	256	0.37	0.28	0.084	3577	22	-25
SSB(2024) = SSB(2023)	1507	1088	419	0.66	0.51	0.15	2923	0.0	17.8
SSB(2024) = 1.2 × SSB(2023)	1017	744	273	0.39	0.3	0.09	3510	20	-20
SSB (2024) = B _{lim} **									
SSB(2024) = B _{pa} = MSY B _{trigger} **									

* SSB 2024 relative to SSB 2023.

** The B_{lim}, B_{pa}, and MSY B_{trigger} options were left blank because none of the three can be achieved in 2024, even with zero catches.

^ Total catch in 2023 relative to the TAC in 2022 (1279 tonnes).

The stock is estimated to be below B_{lim}. There are no catch scenarios that will rebuild the stock above B_{lim} in the short term. ICES continues to advise zero catch.

Basis of the advice

Table 3 Cod in Division 6.a. The basis of the advice.

Advice basis	MSY approach
Management plan	The EU multiannual plan (MAP) for stocks in the Western Waters and adjacent waters (EU, 2019) takes bycatch of this species into account. There is no agreed shared management plan with UK for this stock, and ICES provides advice according to ICES MSY approach and precautionary considerations.

Quality of the assessment

As a result of vessel breakdown, the UK-SCOGFS-Q1 survey was not carried out in 2022. In addition, a lack of discard sampling from the Nephrops trawl fleet (due to COVID-19 disruption) means that total discards were not adequately sampled for ages 1 and 2 in 2021, therefore catch numbers for ages 1 and 2 for 2021 were estimated by the model. Sensitivity analyses indicate that these issues are likely to have minimal impact on the assessment.

Stock structure remains an issue for cod in Division 6.a. The issues of multiple stocks in Division 6.a and connectivity with the North Sea stock remain sources of uncertainty.

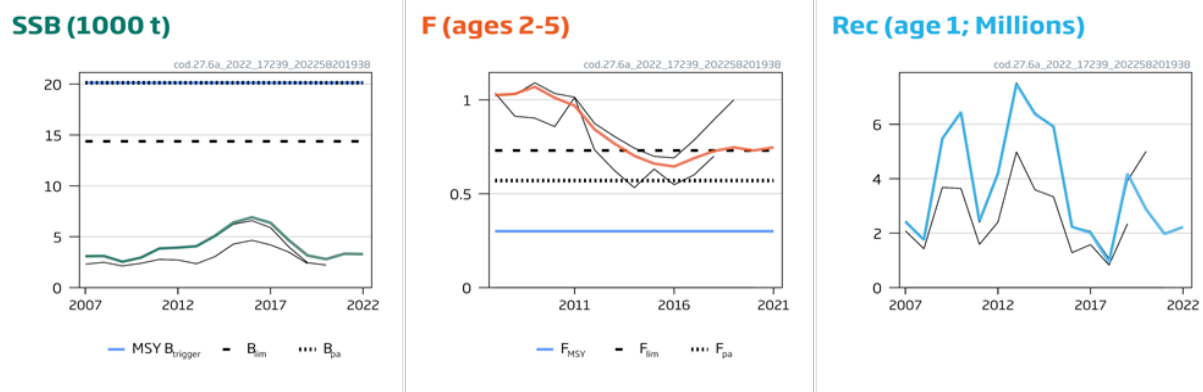


Figure 2 Cod in Division 6.a. Historical assessment results. Final-year recruitment and SSB estimates are included. The assessment was benchmarked in 2020.

Issues relevant for the advice

Management measures taken so far have not resulted in a recovery of the stock. Even though fishing mortality declined between 2009 and 2016, it has remained stable at above F_{lim} since then.

Cod are known to form aggregations; hence, it is still possible to find areas of high cod density at low stock abundance. This can lead to high catches in localized areas, generating high fishing mortality even with low fishing effort. The impact of this could be reduced by temporary spatial measures (e.g. real-time closures).

From 2019, cod is fully under the EU landing obligation in Division 6.a. The below minimum size (BMS) landings of cod reported to ICES are currently negligible, and they are much lower than ICES estimates of catches below the minimum conservation reference size (MCRS).

Cod to the west of Scotland (Division 6.a) are believed to comprise at least two subpopulations and potentially linked to cod in the North Sea (Division 4.a). The current assessment and management does not capture this dynamic as they are treated independently.

Estimated area-misreported landings (catches taken in Division 6.a, but reported elsewhere) have declined from 40% (average percentage 2017–2019) to around 20% (2019–2021) of the total landings.

Grey seal abundance is significant to the west of Scotland, and grey seals are known to feed on cod among other species. Cook *et al.* (2015) suggest that seal predation may be impairing the recovery of this stock.

Reference points

Table 4 Cod in Division 6.a. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	20 126	B_{pa} ; in tonnes	ICES (2020)
	F_{MSY}	0.30	Based on simulation using a segmented regression stock–recruitment relationship (EqSim).	ICES (2020)
	$F_{MSY lower}$	0.18	F at 95% MSY (below F_{MSY}), based on simulation using a segmented regression stock–recruitment relationship (EqSim)	ICES (2020)
	$F_{MSY upper}$	0.49	F at 95 % MSY (above F_{MSY}), based on simulation using a segmented regression stock–recruitment relationship (EqSim)	ICES (2020)
Precautionary approach	B_{lim}	14 376	SSB consistent with high probability of above-average recruitment (SSB in 1992 as estimated by WKDEM); in tonnes	ICES (2020)
	B_{pa}	20 126	$B_{lim} \times 1.4$; in tonnes	ICES (2020)
	F_{lim}	0.73	The F with 50% probability of $SSB < B_{lim}$	ICES (2020)
	F_{pa}	0.57	F_{P05} ; the F that leads to $SSB \geq B_{lim}$ with 95% probability	ICES (2020)
Management plan	SSB_{mgt}	Not applicable		
	F_{mgt}	Not applicable		

Basis of the assessment

Table 5 Cod in Division 6.a. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2022a)
Assessment type	Analytical age-based assessment (SAM) that uses catches in the model and in the forecast (ICES, 2022b)
Input data	Commercial catches (international landings, ages compositions from catch sampling); five survey indexes (ScoGFS-WIBTS-Q1 [G1179]; UK-SCOWCGFS-Q1 [G4748]; ScoGFS-WIBTS-Q4 [G4299]; UK-SCOWCGFS-Q4 [G4815]; IGFS-WIBTS-Q4 [G7212]); maturity data from surveys; time-varying natural mortalities (M) based on a mean weight model (Lorenzen, 1996), using mean weight data from market sampling and discard observations
Discards and bycatch	Because of a lack of discard sampling from the <i>Nephrops</i> fleet in 2021 (due to COVID-19 disruption), total discards were underestimated for 2021. Catch numbers at age 1 and 2 for 2021 were estimated by the assessment model.
Indicators	-
Other information	The stock was last benchmarked in 2020 (WKDEM; ICES, 2020)
Working group	Working Group for the Celtic Seas Ecoregion (WGCSE)

History of the advice, catch, and management

Table 6 Cod in Division 6.a. ICES advice and official landings. All weights are in tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC*	Agreed TAC**	Official landings	ICES estimates of reported landings	Misreporting adjustment	ICES discards^^^	ICES catch
1987	Reduce F towards F_{max}	18000	22000		19199	18970		2388	21358
1988	No increase in F; TAC	16000	18430		19182	20413		368	20781
1989	80% of F (87); TAC	16000	18430		15426	17170		2076	19246
1990	80% of F (88); TAC	15000	16000		11777	12175		571	12746
1991	70% of effort (89)	-	16000		10634	10927		622	11549
1992	70% of effort (89)	-	13500		9017	9086 ^		1779	10865
1993	70% of effort (89)	-	14000		10475	10314 ^		139	10453
1994	30% reduction in effort	-	13000		9131	8927 ^		661	9588
1995	Significant reduction in effort	-	13000		9660	9439 ^		141	9580
1996	Significant reduction in effort	-	13000		9580	9426		63	9489
1997	Significant reduction in effort	-	14000		6992	7034		499	7533
1998	20% reduction in F	9500^^	11000		5671	5714		538	6252
1999	F reduced to below F_{pa}	< 9700^^	11800		4289	4201		69	4270
2000	Recovery plan, 60% reduction in F	< 4200	7480		3064	2977		821	3798
2001	Lowest possible F, recovery plan	-	3700		2439	2347		92	2439
2002	Recovery plan or lowest possible F	-	4600		2231	2242		480	2722
2003	Closure	-	1808		1298	1292		60	1353
2004	Zero catch +	0	848		596	573		78	651
2005	Zero catch +	0	721		420	516		54	570
2006	Zero catch +	0	613		484	470	34	461	965
2007	Zero catch +	0	490		487	485	30	1651	2166
2008	Zero catch +	0	402		445	460	102	1037	1598
2009	Zero catch +	0	302	240	234	231	54	1287	1572
2010	Zero catch +	0		240	249	239	119	1575	1933
2011	Zero catch +	0		182	206	211	130	3867	4208
2012	Zero catch +	0		0**	216	162	65	1914	2141
2013	No directed fisheries, minimize bycatch and discards	0		0**	172	172	93	1870	2136
2014	No directed fisheries, minimize bycatch and discards	0		0**	161	161	234	3369	3764
2015	No directed fisheries, minimize bycatch and discards	0		0**	256	258	270	2498	3026

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC*	Agreed TAC**	Official landings	ICES estimates of reported landings	Misreporting adjustment	ICES discards^^^	ICES catch
2016	MSY approach (minimize all catches)	0		0 ⁺⁺	346	336	272	1499	2108
2017	MSY approach (same advised catch value as provided for 2016)	0		0 ⁺⁺	351	355	320	3519	4195
2018	MSY approach	0		0 ⁺⁺	367	378	613	2429	3419
2019	MSY approach (same advised catch value as provided for 2018)	0		1735 ⁺⁺⁺	1443 ^{##}	1489	571	204	2264
2020	MSY approach	0		1279 ⁺⁺⁺	983 ^{***}	941	332	309	1583
2021	MSY approach	0		1279 ⁺⁺⁺	1209 ^{***}	1215	49	642 [#]	1906 [#]
2022	MSY approach (same advised catch value as provided for 2021)	0		1279 ⁺⁺⁺					
2023	MSY approach	0							
2024	MSY approach (same advised catch value as provided for 2023)	0							

* TAC is for the whole of Subdivision 5.b1 and subareas 6, 12, and 14.

** TAC is for Subdivision 5.b1 and Division 6.a.

*** Preliminary.

^ Including ICES estimates of misreporting.

^^ For Division 6.a only.

^^^ Including BMS landings from 2018 onwards.

+ Single-stock boundaries and the exploitation of this stock should be conducted in the context of mixed fisheries, protecting stocks outside safe biological limits.

++ Bycatch of cod in the area covered by this TAC may be landed, provided this bycatch does not exceed 1.5% of the live weight of the total catch retained on board per fishing trip.

+++ Bycatch TAC.

Underestimate due to lack of discard samples from the *Nephrops* fleet.

Incomplete/missing, as part of the data is unavailable under data confidentiality clauses .

History of the catch and landings

Table 7 Cod in Division 6.a. Catch distribution by fleet in 2021 as estimated by ICES.

Catch	Landings			Discards		
1906 [#] tonnes	Demersal finfish trawl 96%	<i>Nephrops</i> fleet < 1%	Other 4%	Demersal finfish trawl 99%	<i>Nephrops</i> fleet [#] < 1%	Other < 1%
	1264 tonnes			642 [#] tonnes		

Underestimate because of lack of discard samples from *Nephrops* fleet which accounted for 45% of the discards in 2021.

Table 8 Cod in Division 6.a. History of commercial landings; official values are presented by country. All weights are in tonnes.

Year	Belgium	Denmark	Faroe Islands	France	Germany	Greenland	Ireland	Netherlands	Norway	Spain	UK (E, W, N.I.)	UK (Scotland)	UK	Official BMS landings	Total
1985	48	-	-	7411	66	-	2564	-	204	28	260	8032	-		18613
1986	88	-	-	5096	53	-	1704	-	174	-	160	4251	-		11526
1987	33	4	-	5044	12	-	2442	-	77	-	444	11143	-		19199
1988	44	1	11	7669	25	-	2551	-	186	-	230	8465	-		19182
1989	28	3	26	3640	281	-	1642	-	207	85	278	9236	-		15426
1990	-	2	-	2220	586	-	1200	-	150	-	230	7389	-		11777
1991	6	2	-	2503	60	-	761	-	40	-	511	6751	-		10634
1992	-	3	-	1957	5	-	761	-	171	-	577	5543	-		9017
1993	22	2	-	3047	94	-	645	-	72	-	524	6069	-		10475
1994	1	+	-	2488	100	-	825	-	51	-	419	5247	-		9131
1995	2	4	-	2533	18	-	1054	-	61	16	450	5522	-		9660
1996	+	2	-	2253	63	-	1286	-	137	+	457	5382	-		9580
1997	11	-	-	956	5	-	708	2	36	6	779	4489	-		6992
1998	1	-	-	714	6	-	478	1	36	42	474	3919	-		5671
1999	+	+	-	842	8	-	223	-	79	45	381	2711	-		4289
2000	+	-	-	236	6	-	357	-	114	14	280	2057	-		3064
2001	2	-	-	391	4	-	319	-	39	3	138	1544	-		2440
2002	+	-	-	208	+	-	210	-	88	11	195	1519	-		2231
2003	-	-	-	172	+	-	120	-	45	3	79	879	-		1298
2004	-	-	2	91	-	-	34	-	10	-	46	413	-		596
2005	-	-	-	107	-	-	28	-	17	-	25	243	-		420
2006	-	-	1	108	2	-	18	-	30	-	14	318	-		491
2007	-	-	12	92	2	-	70	-	30	-	21	260	-		487
2008	-	-	1	82	1	-	58	-	65	-	6	232	-		445
2009	-	-	-	74	-	-	24	-	18	-	14	104	-		234
2010	-	-	-	60	-	-	49	-	21	-	4	115	-		249
2011	-	-	-	49	-	-	41	-	8	-	3	107	-		208
2012	-	-	-	4	-	-	18	-	2	-	2	135	-		161
2013	-	-	-	3	-	-	14	-	24	-	1	130	-		172
2014	-	-	-	5	-	-	12	-	13	-	9	121	-		160
2015	-	-	-	11	-	-	17	-	59	-	-	-	168		256
2016	-	11	-	86	-	1	28	-	39	-	-	-	183		348
2017	-	1	-	119	-	-	19	-	14	-	-	-	200		352
2018	-	+	+	101	-	-	12	-	37	-	-	-	217		367
2019	-	-	-	142	-	-	^	-	47	31	-	-	1224	+	1443^
2020	-	-	-	139	-	3	65	-	4	32	-	-	738	2	983
2021	-	-	-	162	-	-	98	-	-	27	-	-	923	+	1209

* Preliminary.

+ Landings < 0.5 tonnes.

^Incomplete/missing part of the data being unavailable under data confidentiality clauses.

Summary of the assessment

Table 9 Cod in Division 6.a. Assessment summary. Weights are in tonnes and recruitment in thousands. ‘High’ and ‘Low’ refer to 95% confidence intervals. Total landings and discards from 1995–2006 are not included as input to the assessment.

Year	Recruitment age 1			SSB			Catches ^^	Landings^	Discards ^, *	Fishing mortality ages 2–5		
	Value	High	Low	Value	High	Low				Value	High	Low
1981	10776	14874	7807	43252	49703	37639		23865	303	0.68	0.79	0.58
1982	24158	32385	18021	42471	48273	37367		21511	571	0.72	0.81	0.64
1983	14133	18900	10568	35762	40320	31720		21305	197	0.78	0.88	0.70
1984	24070	32119	18038	30414	34196	27051		21272	329	0.86	0.96	0.77
1985	10610	14131	7966	25388	28505	22611		18607	963	0.92	1.02	0.82
1986	21633	29608	15806	22021	24899	19475		11820	263	0.88	0.98	0.79
1987	42929	59470	30989	24089	27161	21365		18971	2388	0.91	1.01	0.81
1988	7360	9974	5432	26656	30811	23062		20413	368	0.91	1.01	0.82
1989	21585	29143	15987	25011	28826	21701		17169	2076	0.93	1.03	0.83
1990	7974	10959	5803	19427	22020	17139		12175	571	0.87	0.97	0.78
1991	11762	15821	8745	16219	18356	14331		10927	622	0.89	1.00	0.80
1992	21848	29386	16244	14351	16120	12777		9086	1779	0.89	1.00	0.80
1993	7886	10879	5717	14335	16522	12438		10314	139	0.89	1.01	0.79
1994	13771	19640	9656	14118	16916	11784		8928	661	0.89	1.02	0.78
1995	10200	14828	7016	13032	16629	10213	9419		141	0.91	1.04	0.79
1996	4222	6265	2845	10962	14540	8264	8359		63	0.94	1.08	0.82
1997	17062	25460	11434	9311	12567	6899	7087		499	0.97	1.11	0.84
1998	5413	8172	3586	9098	12560	6591	6095		538	0.97	1.11	0.84
1999	4314	6539	2846	7685	10687	5527	5285		69	0.97	1.11	0.85
2000	14621	22205	9627	6650	9228	4792	4822		821	0.97	1.11	0.85
2001	4137	6313	2711	6966	9763	4971	5057		92	0.99	1.13	0.86
2002	6975	10613	4583	6387	8885	4591	4756		480	1.00	1.15	0.87
2003	2303	3466	1531	5208	7115	3811	3649		57	1.03	1.19	0.90
2004	3243	4777	2202	3632	4839	2726	2570		75	1.06	1.22	0.92
2005	2204	3284	1480	2609	3382	2012	1870		41	1.07	1.23	0.92
2006	7212	10572	4920	2476	3095	1981	1856		456	1.05	1.21	0.91
2007	2419	3617	1617	3083	3909	2431		515	1648	1.03	1.18	0.89
2008	1751	2573	1192	3091	3946	2422		561	1037	1.03	1.19	0.90
2009	5474	7799	3843	2534	3080	2084		293	1285	1.07	1.24	0.92
2010	6453	9064	4594	2940	3549	2435		353	1558	1.01	1.17	0.87
2011	2450	3515	1708	3838	4664	3159		344	3805	0.97	1.13	0.83
2012	4188	5873	2986	3931	4759	3248		238	1916	0.84	0.98	0.72
2013	7473	10512	5312	4074	4824	3441		270	1784	0.77	0.90	0.65
2014	6372	8932	4546	5094	6061	4281		397	3367	0.70	0.83	0.60
2015	5925	8356	4201	6395	7652	5343		565	2501	0.66	0.79	0.55
2016	2226	3117	1590	6902	8255	5770		650	1499	0.65	0.77	0.54
2017	2012	2817	1437	6366	7671	5284		687	3500	0.69	0.81	0.59
2018	924	1338	638	4634	5613	3825		994	2426	0.73	0.86	0.62
2019	4183	5902	2964	3158	3820	2611		2077	203	0.75	0.89	0.63
2020	2876	4705	1758	2795	3378	2313		1176	309	0.73	0.89	0.60
2021	1974	4198	928	3326	4255	2600		1241	642#	0.75	0.95	0.58
2022	2226**	4183	924	3288	4558	2376						

* BMS landings are included with discards from 2018 onwards.

** Median resampled recruitment (2016–2020).

^ Calculated using sum of products from the landings and discards numbers-at-age and mean weights-at-age.

^^ Catches estimated by the model.

Underestimate because of lack of discard samples from the *Nephrops* fleet.

Sources and references

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