

Cod (*Gadus morhua*) in subdivisions 22–24, western Baltic stock (western Baltic Sea)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches should be no more than 698 tonnes in 2022. This applies to commercial and recreational catches.

Stock development over time

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

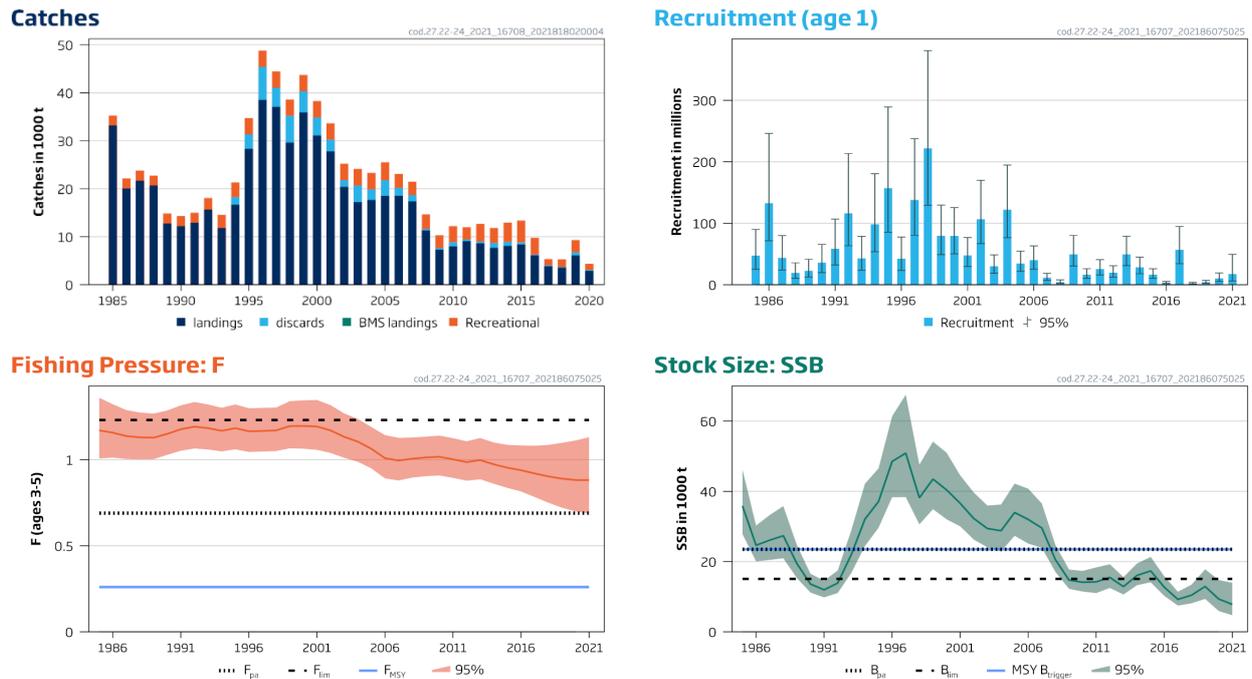


Figure 1 Cod in subdivisions 22–24, western Baltic stock. Summary of the stock assessment. BMS landings (fish below the minimum conservation reference size [MCRS]) have been included since 2017.

Catch scenarios

Table 1 Cod in subdivisions 22–24, western Baltic stock. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
F _{ages 3–5} (2021)	0.80	Based on catch constraint of 4953 tonnes for 2021
SSB (2022)	7879	Short-term forecast; tonnes
R _{age 1} (2021)	17432	From the assessment; thousands
R _{age 1} (2022)	15521	Sampled from the last ten years; thousands*
R _{age 1} (2023)	16028	Sampled from the last ten years; thousands*
Total catch (2021)	4953	Commercial + recreational catches; tonnes
Commercial catches (2021)	3638	Calculated as the 2021 TAC (4000 tonnes), plus an assumed discard rate as in 2020 (5%), and accounting for the proportion of western Baltic cod in commercial catches in subdivisions 22–24 in 2020 (86%); tonnes
Recreational catches (2021)	1315	Same value as in 2020**; tonnes

* Recruitment is randomly resampled from the assessment estimates of the last ten years and the median of these random draws is used. This will vary slightly every time this is carried out.

** Same management measures in 2021 as in 2020 for the recreational fishery (EU, 2020).

Table 2 Cod in subdivisions 22–24, western Baltic stock. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch* (2022)	F _{total} (2022)	SSB (2023)	% SSB change***	% Advice change [^]	% Probability of SSB to be below B _{lim} in 2023
ICES advice basis						
MSY approach: F _{MSY} × SSB (2022) /MSY B _{trigger}	698	0.087	15501	97	-88	47
Other scenarios						
EU MAP**: F _{MSY} × SSB (2022) /MSY B _{trigger}	698	0.087	15501	97	-88	47
EU MAP**: F _{MSY lower} SSB (2022)/ MSY B _{trigger}	463	0.057	15793	100	-92	46
EU MAP**: F _{MSY upper} × SSB (2022)/ MSY B _{trigger}	1161	0.148	14891	89	-80	52
Zero catch	0	0	16260	106	-100	42
F = F _{pa}	4461	0.69	11059	40	-25	79
F = F _{lim}	6712	1.23	8505	7.9	13	91
SSB (2023) = B _{lim}	1049	0.133	15067	91	-82	50
SSB (2023) = B _{pa} [#]	-	-	-	-	-	-
SSB (2023) = MSY B _{trigger} [#]	-	-	-	-	-	-
F _{sq} (F = 2020)	5353	0.88	9999	27	-10	84

* Includes commercial and recreational catch.

** EU Multiannual Plan for the Baltic Sea (EU, 2016).

*** SSB 2023 relative to SSB 2022.

[^] Total catch in 2022 relative to total catch corresponding to the MAP F_{MSY} advice for 2021 (5950 tonnes), including commercial and recreational catch.

[#] The B_{pa}, and MSY B_{trigger} options were left blank because B_{pa}, and MSY B_{trigger} cannot be achieved in 2023 even with zero catch in 2022.

This stock was interbenchmarked in 2021, and this has changed the perception of the stock, which is now estimated to be below B_{lim}. This, in combination with a very low recruitment since 2018, results in a large reduction in advised catch.

Basis of the advice

Table 3 Cod in subdivisions 22–24, western Baltic stock. The basis of the advice.

Advice basis	The EU Baltic multiannual plan could not be used because this plan does not provide guidance on catch scenarios for the present state of the stock. Therefore, the MSY approach was used as basis for the advice.
Management plan	The EU multiannual plan (MAP) in place for stocks in the Baltic Sea includes cod (EU, 2016, 2019). The advice, based on F_{MSY} ranges, is considered precautionary.

Quality of the assessment

The stock went through an interbenchmark in 2021 (ICES, 2021a) due to very large retrospective pattern in F and SSB. The interbenchmark has solved the large retrospective pattern by introducing a number of changes. Natural mortality by age was re-estimated and assumed to be constant over time and maturity-at-age is now assumed to be constant over time. A new survey index is also used in the assessment, which includes the oldest age as a plus group and updates on model configuration with special focus on allowing the selection pattern to be more flexible across ages. Finally, the 2020 catch-at-age data was down-weighted due to increased uncertainty caused by a lower sampling effort due to the COVID-19 pandemic.

In Subdivision 24 catches of cod are a mixture of eastern and western Baltic cod stocks, which is variable temporally and spatially and over size groups. A method to split the catches into the two stocks is applied each year, which is based on data most years but which is also interpolated for years with no observations. This introduces uncertainty in the allocation of catches to the stock. Recreational catches in Subdivision 24 are assumed to be from the western Baltic cod only as fishing is mainly in the shallow coastal waters.

There is also uncertainty of recreational catches in the intermediate year as management regulations such as bag limits and stock size have an effect on the catches.

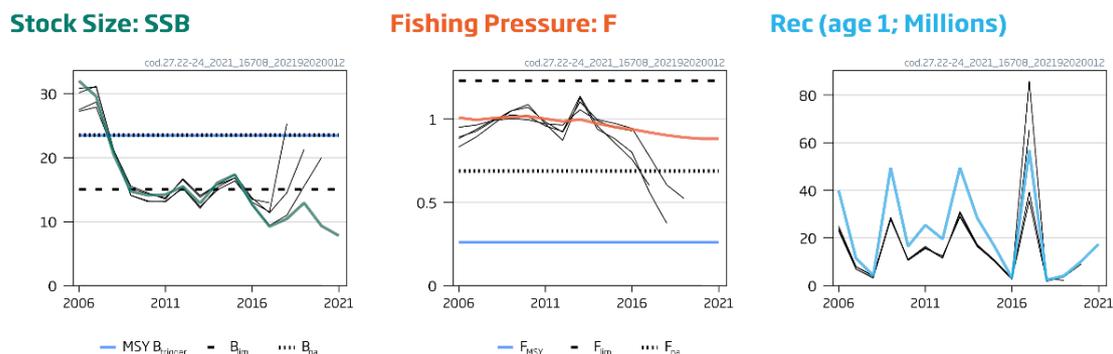


Figure 2 Cod in subdivisions 22–24, western Baltic stock. Historical assessment results (final-year recruitment estimates included). The stock was interbenchmarked in 2021 and only assessment results from the last year should be compared to the reference points indicated.

Issues relevant to the advice

Because the SSB has been below B_{lim} since 2016, ICES has provided the probability of SSB being below B_{lim} in 2023 for each of the scenarios presented in Table 2. Below B_{lim} a stock is considered to have reduced reproductive capacity. Given the advised catch of 698 tonnes, the probability of SSB being below B_{lim} in 2023 is 47%. In comparison, the scenario with zero catches in 2022 has a 42% probability of SSB being below B_{lim} in 2023. ICES advice is normally based on a 50% probability of achieving a particular target.

Cod is exploited by a mixed commercial–recreational fishery. In 2020 the recreational catches included in the stock assessment constituted 30% of the total catches. The current management includes trade-offs between commercial and recreational fisheries. Due to the low advised catches, ICES is not in a position to provide a split between commercial and recreational catches for 2022. Catch and release in the recreational fishery is one potential measure to reduce the

exploitation rate on western Baltic cod. Currently the assessment uses estimates of post-release mortality in the sea-based recreational fishery of 11.2%, while it is considered to be 100% in the land-based recreational fishery.

Reference points

Table 5 Cod in subdivisions 22–24, western Baltic stock. Reference points, values, and their technical basis. Weights in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	23 492	B_{pa}	ICES (2021a)
	F_{MSY}	0.26	Stochastic simulations with segmented regression stock–recruitment relationship	ICES (2021a)
Precautionary approach	B_{lim}	15 067	Average of lowest SSB in years with above average recruitment (1990, 1991, 1993, 2016)	ICES (2021a)
	B_{pa}	23 492	$B_{lim} * \exp(1.645 * 0.27)$	ICES (2021a)
	F_{lim}	1.23	Equilibrium scenarios with stochastic recruitment: F value corresponding to 50% probability of ($SSB < B_{lim}$)	ICES (2021a)
	F_{pa}	0.689	F_{p05} . The F that leads to $SSB \geq B_{lim}$ with 95% probability.	ICES (2021a)
Management plan	MSY $B_{trigger}$	23 492	MSY $B_{trigger}$	ICES (2021a)
	B_{lim}	15 067	B_{lim}	ICES (2021a)
	MAP F_{MSY}	0.26	F_{MSY}	ICES (2021a)
	Target range F_{MSY} to $F_{MSY upper}$	0.26–0.44	Consistent with the ranges resulting in no more than 5% reduction in long-term yield compared with MSY	ICES (2021a)
	Target range $F_{MSY lower}$ to $F_{MSY to}$	0.17–0.26	Consistent with the ranges resulting in no more than 5% reduction in long-term yield compared with MSY	ICES (2021a)

Basis of the assessment

Table 6 Cod in subdivisions 22–24, western Baltic stock. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2021b)
Assessment type	Age-based analytical assessment SAM (ICES, 2021c) that uses catches (landings, discards, and recreational catch) in the model and in the forecast
Input data	Commercial catches (landings, age distributions from catch sampling) and recreational catch (Germany, Sweden, and Denmark). Annual stock separation key (from commercial catches) to split catches in Subdivision 24 into eastern and western Baltic cod, derived from otolith shape analyses combined with genetics (this key is available for 20 of the 35 years in the present time-series). The allocation of catches to stock for the remaining years was performed by interpolation. Three survey indices (FEJUICS, N2828, age 0), BITS-Q1 (G2916, ages 1–4+), and BITS-Q4 (G8863; ages 0–4+); constant maturity data as an average from BITS-Q1 (G2916) surveys for the whole timeperiod. Natural mortalities estimated from life-history parameters, constant for the whole time period.
Discards and bycatch	Included in the assessment since 1994, data series from the main fleets
Indicators	None
Other information	Interbenchmarked in 2021 (ICES, 2021a)
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

History of the advice, catch, and management

Table 7 Cod in subdivisions 22–24, western Baltic stock. ICES advice and official landings. All weights are in tonnes.

Year	ICES advice	Total catch from the stock corresponding to the advice	Commercial catch corresponding to the advice*	Agreed TAC**	ICES estimated total commercial landings subdivisions 22–24 (eastern and western Baltic cod stocks)
1987	TAC		9000		28566
1988	TAC		16000		29159
1989	TAC		14000	220000	18516

Year	ICES advice	Total catch from the stock corresponding to the advice	Commercial catch corresponding to the advice*	Agreed TAC**	ICES estimated total commercial landings subdivisions 22–24 (eastern and western Baltic cod stocks)
1990	TAC		8000	210000	17780
1991	TAC		11000	171000	16693
1992	Substantial reduction in F		-	100000	17996
1993	F at lowest possible level		-	40000	21228
1994	TAC		22000	60000	30695
1995	30% reduction in fishing effort from 1994 level		-	120000	33895
1996	30% reduction in fishing effort from 1994 level		-	165000	50845
1997	Fishing effort should not be allowed to increase above the level of recent years		-	180000	43624
1998	20% reduction in F from 1996		35000	136950	34216
1999	At or below F_{sq} with 50% probability		38000	126000	42155
2000	Reduce F by 20%		44600	105000	38347
2001	Reduce F by 20%		48600	105000	34244
2002	Reduce F to below 1.0		36300	76000	24158
2003	Reduce F to below 1.0		***22600 or 28800	75000	24624
2004	Reduce F to below 1.0		< 29600	29600	20854
2005	Reduce F to below 0.92		< 23400	24700	22045
2006	Management plan		< 28400	28400	22751
2007	Keep SSB at B_{pa}		< 20500	26700	23736
2008	Rebuild SSB to B_{pa}		< 13500	19200	20082
2009	Rebuild SSB to B_{pa}		< 13700	16300	15549
2010	Management plan		< 17700	17700	14120
2011	See scenarios		-	18800	16332
2012	Management plan		21300	21300	17072
2013	Management plan		20800	20000	12968
2014	Management plan		17037	17000	13538
2015	MSY approach		8793	15900	13418
2016	MSY approach (F = 0.23)	≤ 7797		12720	10629
2017	MSY approach (F = 0.15)	≤ 3475	≤ 917	5597	5865^
2018	MAP F ranges: F_{lower} to F_{MSY} adjusted by SSB2018/ MSY $B_{trigger}$ (F = 0.11–0.188)	3130–5295	1376–3541	5597	5850^
2019	MAP range: F_{MSY} F_{lower} to F_{upper} (F = 0.15–0.45)	9094–23992	5867–22238	9515	7701^

Year	ICES advice	Total catch from the stock corresponding to the advice	Commercial catch corresponding to the advice*	Agreed TAC**	ICES estimated total commercial landings subdivisions 22–24 (eastern and western Baltic cod stocks)
2020	MAP range: F_{MSY} F_{lower} to F_{upper} ($F = 0.18–0.43$)	5205–11006	3065–8866	3806	3329 [^]
2021	Management plan	5950 (range 4275–9039)	4635 (range 2960–7724)	4000	
2022	MSY approach	≤ 698			

* Values since 2016 are for the western Baltic cod stock only, whereas in earlier years they are for the area of subdivisions 22–24 and include a fraction of the eastern Baltic cod stock.

** Included in TAC for total Baltic, until and including 2003.

*** Two options based on implementation of the adopted mesh regulation.

[^] Including BMS.

History of the catch and landings

Table 8 Cod in subdivisions 22–24, western Baltic stock. Catch distribution in 2020 as estimated by ICES.

Catch (2020)	Commercial landings		Commercial discards	Recreational catch
4363 t	active gears 63%	passive gears 37%	152 t	1311 t
	2900 t			

Table 9 Cod in subdivisions 22–24, western Baltic management area. History of commercial catch; both the official and ICES estimated values are presented by area. The table includes landings of the western Baltic cod stock as well as of the eastern Baltic cod stock in Subdivision 24. All weights are in tonnes.

Year	Total for management area							
	Human consumption (HC) landings				BMS	Discards	Unalloc.	Total catch
	22	23	24	HC (SDs 22–24)				
1992	9887	2739	5370	17996				17996
1993	7296	1275	7129	15700			5528	21228
1994	8229	1628	13336	23193		2235	7502	32930
1995	16936	3158	13801	33895		3684		37579
1996	21417	4031	23097	48545		7984	2300	58829
1997	21966	2663	18995	43624		4623		48247
1998	15093	3074	16049	34216		6207		40423
1999	20409	3521	18225	42155		4978		47133
2000	18934	3149	16264	38347		4947		43294
2001	14976	2817	16451	34244		2839		37083
2002	11968	2409	9781	24158		1958		26116
2003	9573	1925	13127	24624		4336		28960
2004	9091	2320	9430	20841		2377	13	23231
2005	8729	2621	10686	22036		4994	9	27039
2006	9979	1914	10858	22751		1831		24582
2007	7840	2713	13183	23736		2199		25935
2008	5687	2139	12256	20082		1123		21205
2009	3451	839	11259	15549		815		16364
2010	3925	1179	9016	14120		1371		15491
2011	5493	1198	9641	16332		780		17112
2012	4896	1123	11053	17072		905		17977
2013	4675	960	7333	12968		2250		15218
2014	4316	1361	7862	13538		2135		15673
2015	4994	1232	7193	13419		1361		14780
2016	3193	1123	6313	10629	34	449		11112
2017	2195	941	2697	5833	32	421		6286
2018	2014	870	2942	5826	24	476		6326

Year	Total for management area							
	Human consumption (HC) landings				BMS	Discards	Unalloc.	Total catch
	22	23	24	HC (SDs 22-24)				
2019	3728	1167	2783	7679	22	1292		8993
2020	2147	508	671	3326	3	205		3534

Summary of the assessment

Table 10 Cod in subdivisions 22–24, western Baltic stock. Assessment summary. Weights are in tonnes. Recruitment in thousands. High and low refer to 95% confidence intervals.

Year	Recruitment			Stock Size			Landings	Discards	Recreational catch	Fishing Pressure		
	R (age 1)	High	Low	SSB	High	Low				F (ages 3-5)	High	Low
1985	47467	89920	25056	35868	46221	27834	33188		2075	1.17	1.36	1.01
1986	132591	246203	71406	24638	30270	20053	20088		2078	1.16	1.32	1.01
1987	43740	79866	23955	26098	33274	20470	21692		2081	1.14	1.29	1.00
1988	19283	35559	10456	27372	35798	20930	20672		2082	1.13	1.27	1.00
1989	22706	41478	12430	19433	24694	15292	12795		2083	1.13	1.27	1.00
1990	35930	65709	19646	13596	16534	11180	12237		2085	1.15	1.29	1.03
1991	58557	106867	32086	11956	14597	9793	12931		2087	1.18	1.32	1.05
1992	116304	213378	63393	13878	17454	11035	15672		2420	1.19	1.34	1.06
1993	42966	78732	23447	22006	28932	16739	11815		2752	1.18	1.32	1.06
1994	98355	180633	53555	32073	42149	24406	16642	1614	3088	1.17	1.30	1.05
1995	157031	289026	85317	37112	46537	29595	28310	3016	3417	1.18	1.32	1.06
1996	42418	77567	23197	48518	61426	38323	38505	6868	3419	1.17	1.30	1.04
1997	138041	237551	80216	50887	67523	38350	37077	3981	3420	1.17	1.30	1.05
1998	221804	380747	129213	38165	47625	30585	29634	5575	3410	1.17	1.30	1.05
1999	79637	129568	48948	43488	54172	34911	35934	4378	3416	1.20	1.34	1.07
2000	79382	125416	50245	40421	51014	32028	31132	3738	3432	1.20	1.35	1.06
2001	47823	76836	29765	36590	44572	30037	27781	2449	3427	1.19	1.35	1.06
2002	106614	169818	66933	32267	39668	26247	20410	1395	3437	1.17	1.32	1.04
2003	29996	48538	18537	29414	35950	24066	17205	3473	3448	1.13	1.27	1.01
2004	122102	194717	76567	28790	36249	22865	17686	2189	3445	1.10	1.24	0.99
2005	34584	54713	21861	33974	42217	27341	18493	3265	3771	1.06	1.19	0.95
2006	39948	63266	25225	32000	40767	25119	18503	1686	2923	1.01	1.14	0.89
2007	11453	18481	7097	29563	36546	23914	17384	1325	2782	1.00	1.13	0.88
2008	4206	7793	2270	20523	24742	17024	11302	336	3039	1.01	1.13	0.90
2009	49455	80238	30481	14724	17728	12228	7313	351	2648	1.01	1.13	0.90
2010	16461	26100	10382	14106	17353	11466	8007	838	3367	1.02	1.14	0.91
2011	25415	40699	15870	14226	18349	11030	9107	299	2595	1.00	1.13	0.89
2012	19529	30884	12349	15488	19247	12464	8622	370	3661	0.99	1.11	0.88
2013	49524	78805	31122	12868	15593	10619	7697	1007	3106	1.00	1.13	0.89
2014	28335	44944	17863	16074	19474	13268	8083	837	4044	0.97	1.10	0.86
2015	16396	26048	10321	17339	21344	14085	8390	432	4568	0.95	1.09	0.84
2016	3185	5269	1925	12710	15816	10214	6122	143	3505	0.94	1.08	0.82
2017	56858	94778	34109	9235	11434	7458	3861**	180	1315	0.92	1.08	0.78
2018	2362	3920	1423	10432	13422	8109	3555**	157	1600	0.90	1.09	0.75
2019	4126	6980	2439	12915	17820	9360	6103**	655	2573	0.89	1.10	0.72
2020	10208	19198	5427	9332	14757	5902	2900**	152	1311	0.88	1.11	0.70
2021	17432*	49392*	6039*	7802*	13972*	4711						

*Output from SAM analysis based on survey data.

**Includes BMS.

Sources and references

EU. 2016. Regulation (EU) 2016/1139 of the European Parliament and of the Council of 6 July 2016 establishing a multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea and the fisheries exploiting those stocks, amending Council Regulation (EC) No. 2187/2005 and repealing Council Regulation (EC) No. 1098/2007. Official Journal of the European Union, L 191. 15 pp. <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1139&rid=1>. EU.

2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. <https://eur-lex.europa.eu/legalcontent/EN/TXT/PDF/?uri=CELEX:32019R0472&from=EN>.

ICES. 2021a. Inter-Benchmark Process on Western Baltic cod (IBPWEB). ICES Scientific Reports, 3:87 76 pp. <https://doi.org/10.17895/ices.pub.5257>

ICES. 2021b. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, section 1.1.1. <https://doi.org/10.17895/ices.advice.7720>

ICES. 2021c. Baltic Fisheries Assessment Working Group (WGBFAS). ICES Scientific Reports, 3:53. 717 pp. <http://doi.org/10.17895/ices.pub.8187>

[Download the stock assessment data and figures.](#)

Recommended citation: ICES. 2021. Cod (*Gadus morhua*) in subdivisions 22-24, western Baltic stock (western Baltic Sea). In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, cod.27.22-24, <https://doi.org/10.17895/ices.advice.7744>.