

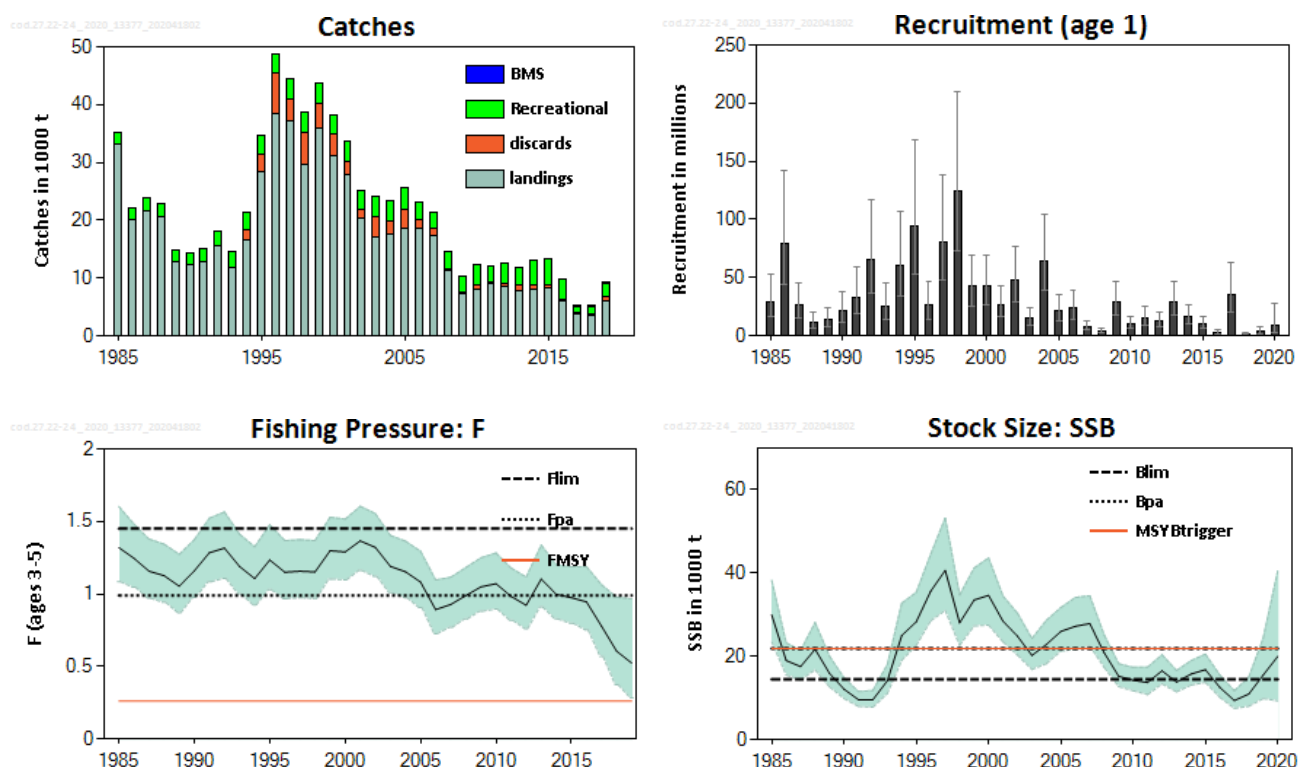
## Cod (*Gadus morhua*) in subdivisions 22–24, western Baltic stock (western Baltic Sea)

### ICES advice on fishing opportunities

ICES advises that when the EU multiannual plan (MAP) for the Baltic Sea is applied, catches in 2021 that correspond to the F ranges in the plan are between 4275 tonnes and 9039 tonnes. According to the MAP, catches higher than 5950 tonnes can only be taken under conditions specified in the MAP, whilst the entire range is considered precautionary when applying the ICES advice rule. Assuming recreational catches at 1315 tonnes, this implies a commercial catch at  $F_{MSY}$  of 4635 tonnes, and a range of 2960–7724 tonnes.

*Note: This advice sheet is abbreviated due to the Covid-19 disruption. The previous advice issued for 2020 is attached as Annex 1.*

### Stock development over time



**Figure 1** Cod in subdivisions 22–24, western Baltic stock. Summary of the stock assessment. Recruitment, F, and SSB show confidence intervals (95%) in the plot. BMS landings (fish below the minimum conservation reference size [MCRS]) have been included since 2017.

### Stock and exploitation status

**Table 1** Cod in subdivisions 22–24, western Baltic stock. State of the stock and the fishery relative to reference points.

		Fishing pressure			Stock size		
		2017	2018	2019	2018	2019	2020
Maximum sustainable yield	$F_{MSY}$	✗	✗	✗	MSY $B_{trigger}$	✗	✗
Precautionary approach	$F_{pa}, F_{lim}$	✓	✓	✓	$B_{pa}, B_{lim}$	✗	✗
Management plan	$F_{MGT}$	✗	✗	✗	SSB $MGT$	✗	✗
				Above			Below trigger
				Harvested sustainably			Increased risk
				Above the range			Below

## Catch scenarios

**Table 2** Cod in subdivisions 22–24, western Baltic stock. Assumptions made for the interim year and in the forecast. Weights are in tonnes. Recruitment is in thousands.

Variable	Value	Notes
$F_{\text{ages 3-5}}$ (2020)	0.235	Based on catch constraint in 2020.
SSB (2021)	24488	Based on catch constraint in 2020.
$R_{\text{age 1}}$ (2020)	9076	From the assessment.
$R_{\text{age 1}}$ (2021)	9535	Sampled from the last ten years*.
$R_{\text{age 1}}$ (2022)	9948	Sampled from the last ten years*.
Total catch (2020)	4488	Commercial + recreational catches.
Commercial catches (2020)	3173	Calculated as the 2020 TAC (3806 tonnes), plus an assumed discard ratio as in 2019 (9.7%), and accounting for the proportion of western Baltic cod in commercial catches in subdivisions 22–24 in 2019 (75.3%).
Recreational catches (2020)	1315	Same value as in 2017**.

\* 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 2020 as in 2017 for the recreational fishery (EU, 2017, 2019).

**Table 3** Cod in subdivisions 22–24, western Baltic stock. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch * (2021)	Recreational catch	Commercial catch	$F_{\text{total}}$ (2021)	$F_{\text{commercial}}$ (2021)	SSB (2022)	% SSB change ***	% Advice change
ICES advice basis								
EU MAP**: $F_{\text{MSY}}$	5950	1315	4635	0.26	0.20	26412	7.9	–18 <sup>^</sup>
$F = F_{\text{MSY lower}}$	4275	1315	2960	0.180	0.125	28429	16	–18 <sup>^^</sup>
$F = F_{\text{MSY upper}}$	9039	1315	7724	0.43	0.37	23080	–5.7	–18 <sup>^^^</sup>
Other scenarios								
$F_{\text{MSY}}$	5950	1315	4635	0.26	0.20	26412	7.9	–18 <sup>^</sup>
Zero commercial catch	1315	1315	0	0.05	0.0	32442	32	–82 <sup>^</sup>
$F = F_{\text{pa}}$	15947	1315	14632	0.99	0.91	14779	–40	120 <sup>^</sup>
$F = F_{\text{lim}}$	19679	1315	18364	1.45	1.35	10603	–57	172 <sup>^</sup>
SSB (2022) = $B_{\text{lim}}$	16229	1315	14914	1.02	0.89	14500	–41	124 <sup>^</sup>
SSB (2022) = $B_{\text{pa}}$	10035	1315	8720	0.49	0.38	21876	–11	39 <sup>^</sup>
SSB (2022) = $\text{MSY } B_{\text{trigger}}$	10035	1315	8720	0.49	0.38	21876	–11	39 <sup>^</sup>
$F_{\text{sq}}$ ( $F = 2019$ )	10479	1315	9164	0.52	0.47	21356	–13	45 <sup>^</sup>

\* Includes commercial and recreational catch.

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

\*\*\* SSB 2022 relative to SSB 2021.

<sup>^</sup> Total catch in 2021 relative to total catch corresponding to the advice for 2020 (7245 tonnes, MAP  $F_{\text{MSY}}$ ), including commercial and recreational catch.

<sup>^^</sup> Total catch in 2021 relative to total catch corresponding to the advice for 2020 for  $F_{\text{MSY lower}}$  (5205 tonnes, MAP  $F_{\text{MSY lower}}$ ), including commercial and recreational catch.

<sup>^^^</sup> Total catch in 2021 relative to total catch corresponding to the advice for 2020 for  $F_{\text{MSY upper}}$  (11 006 tonnes, MAP  $F_{\text{MSY upper}}$ ), including commercial and recreational catch.

## Issues relevant for the advice

**Table 4** Cod in subdivisions 22–24, western Baltic stock. The scenarios illustrate various examples of how to determine an area-based TAC for the western Baltic (WB) management area, under different assumptions for bycatches of the eastern Baltic (EB) cod in Subdivision (SD) 24, and with a recreational catch of 1315 tonnes in 2021. Weights are in tonnes.

Area	Commercial catch WB cod stock			Commercial catch EB cod stock			Commercial catch of cod by management area (TAC)			
	A	B	C	D	E	F	G		H	
	Advice total	SDs 22–23	SD 24	Total	SD 24	SDs 25–32	SDs 22–24	% TAC change (SDs 22–24)*	SDs 25–32	% TAC change (SDs 25–32)**
<b>a. Assuming no catch of EB cod in the western Baltic management area, total TAC is taken in SDs 22–23</b>										
Calculation		$= A \times 1.0$	$= A \times 0.0$		$= C \times 1.27^{^^}$	$= D - E$	$= B + C + E$		$= F$	
EU MAP: $F_{MSY}$	4635	4635	0	0	0	0	4635	22	0	-100
<b>b. Assuming no change in western Baltic historical catch distribution by area, and <i>status quo</i> catch of EB cod</b>										
Calculation		$= A \times 0.74^{\wedge}$	$= A \times 0.26^{\wedge}$		$= C \times 1.27^{^^}$	$= D - E$	$= B + C + E$		$= F$	
EU MAP: $F_{MSY}$	4635	3430	1205	7500	1532	5968	6167	62	5968	-20
<b>c. Assuming EB cod catches in SD 24 limited to 10% of the total EBC <i>status quo</i> catch</b>										
Calculation		$= A - C$	$= E/1.27$		10% of total EBC catch $^{^^^}$	$= D - E$	$= B + C + E$		$= F$	
EU MAP: $F_{MSY}$	4635	4045	590	7500	750	6750	5385	41	6750	-10

\* Compared to the 2020 TAC for subdivisions 22–24 (3806 tonnes).

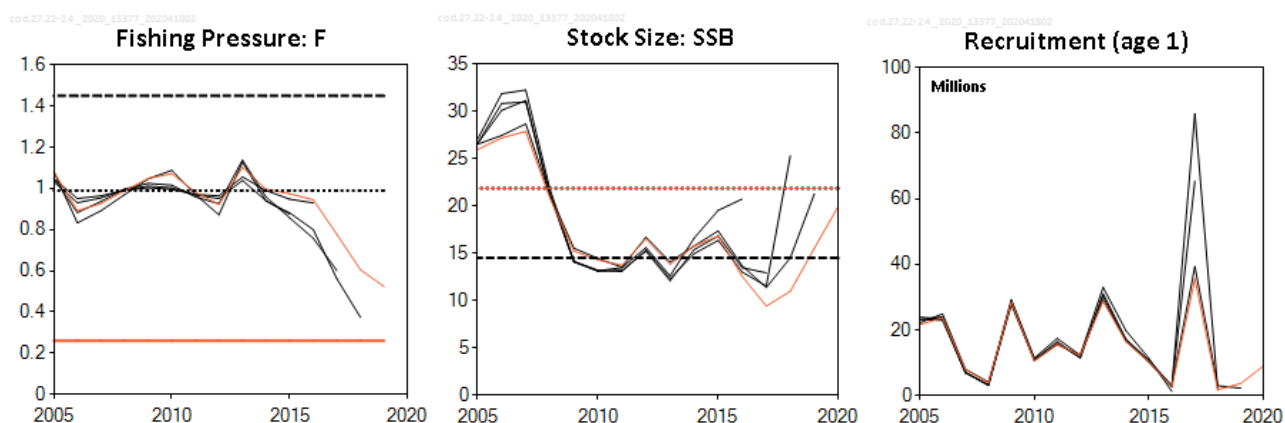
\*\* Compared to the 2020 TAC for subdivisions 25–32 (7500 tonnes, Russia + EU).

$\wedge$  Same proportions of the WB cod stock commercial catch that has been harvested in subdivisions 22–23 and Subdivision 24 in the most recent data year (2019).

$^{^^}$  The EB cod catch / WB cod commercial catch ratio is similar to that observed in Subdivision 24 in the most recent data year (2019).

$^{^^^}$  Same commercial catch ratio between subdivisions 24 and 25–32 as in 2019.

## Quality of the assessment



**Figure 2** Cod in subdivisions 22–24, western Baltic stock. Historical assessment results (final-year recruitment estimates included). The stock was benchmarked in 2019.

## History of the advice, catch, and management

**Table 5** 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
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 ( $F = 0.23$ )	$\leq 7797$		12720	10629
2017	MSY approach ( $F = 0.15$ )	$\leq 3475$	$\leq 917$	5597	5865 <sup>^</sup>
2018	MAP F ranges: $F_{lower}$ to $F_{MSY}$ adjusted by $SSB_{2018}/MSY B_{trigger}$ ( $F = 0.11-0.188$ )	3130–5295	1376–3541	5597	5850 <sup>^</sup>
2019	MAP range: $F_{MSY} F_{lower}$ to $F_{upper}$ ( $F = 0.15-0.45$ )	9094–23992	5867–22238	9515	7701
2020	MAP range: $F_{MSY} F_{lower}$ to $F_{upper}$ ( $F = 0.18-0.43$ )	5205–11006	3065–8866	3806	
2021	Management Plan	5950 (range 4275–9039)	4635 (range 2960–7724)		

\* 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.

<sup>^</sup> Including BMS.

## Summary of the assessment

**Table 6** 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	Fishing pressure			Recreational catch
	R (age 1)	High	Low	SSB	High	Low			F (ages 3–5)	High	Low	
1985	29009	53081	15853	29993	38260	23512	33188		1.32	1.60	1.08	2075
1986	78631	141558	43678	19010	23265	15533	20088		1.25	1.48	1.05	2078
1987	25969	45953	14675	17567	21438	14395	21692		1.16	1.38	0.97	2081
1988	11383	20372	6360	21709	28117	16761	20672		1.13	1.34	0.94	2082
1989	13787	24416	7785	15940	20028	12686	12795		1.05	1.27	0.87	2083
1990	21350	37802	12059	12124	14868	9886	12237		1.16	1.37	0.98	2085
1991	33402	59141	18864	9617	11569	7995	12931		1.28	1.52	1.08	2087
1992	65814	117206	36956	9606	11826	7803	15672		1.32	1.56	1.11	2420
1993	25729	45708	14483	14148	18063	11081	11815		1.19	1.41	1.00	2752
1994	59886	106376	33714	25014	32798	19078	16642	1614	1.11	1.32	0.92	3088
1995	94217	167909	52867	28310	35376	22655	28310	3016	1.23	1.48	1.03	3417
1996	25898	46737	14351	35655	44538	28544	38505	6868	1.15	1.37	0.97	3419
1997	80922	137881	47493	40633	53198	31035	37077	3981	1.16	1.37	0.97	3420
1998	124123	209488	73544	28052	34731	22658	29634	5575	1.15	1.37	0.97	3410
1999	42343	69613	25756	33554	41210	27321	35934	4378	1.30	1.53	1.10	3416
2000	43222	69676	26812	34650	43638	27512	31132	3738	1.29	1.52	1.10	3432
2001	25895	42278	15861	28454	34485	23478	27781	2449	1.37	1.60	1.16	3427
2002	47301	77186	28987	24845	30367	20327	20410	1395	1.32	1.55	1.12	3437
2003	14617	24002	8901	20235	24296	16853	17205	3473	1.19	1.40	1.01	3448
2004	64204	104329	39511	22881	28675	18258	17686	2189	1.15	1.36	0.98	3445
2005	21539	34859	13308	25982	31723	21280	18493	3265	1.08	1.29	0.91	3771
2006	23741	38749	14546	27216	34137	21698	18503	1686	0.89	1.10	0.73	2923
2007	7886	12819	4852	27886	34553	22505	17384	1325	0.93	1.12	0.77	2782
2008	3839	6786	2172	20878	25129	17346	11302	336	0.99	1.18	0.83	3039
2009	28498	47137	17229	15238	18226	12741	7313	351	1.05	1.25	0.88	2648
2010	10530	17041	6507	14293	17353	11773	8007	838	1.07	1.28	0.90	3367
2011	15635	25566	9561	13739	17425	10833	9107	299	0.98	1.18	0.82	2595
2012	12264	19732	7622	16536	20393	13408	8622	370	0.92	1.12	0.76	3661
2013	28818	47027	17660	13813	16619	11481	7697	1007	1.10	1.34	0.91	3106
2014	16354	26600	10054	15760	18961	13100	8083	837	1.00	1.20	0.83	4044
2015	10255	16658	6313	16812	20550	13754	8390	432	0.97	1.19	0.80	4568
2016	2733	4570	1634	12559	15498	10177	6122	143	0.95	1.19	0.75	3505
2017	35586	62977	20108	9410	11766	7525	3861**	180	0.78	1.06	0.57	1315
2018	1777	3250	972	10975	15007	8026	3555**	157	0.61	0.98	0.37	1600
2019	3636	7604	1739	15542	24422	9890	6103**	655	0.52	0.97	0.28	2573
2020	9076*	27316*	2939*	19992*	40481*	9329*						

\*Output from SAM analysis based on survey data.

\*\*Includes BMS.

## Sources and references

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*Recommended citation:* ICES. 2020. Cod (*Gadus morhua*) in subdivisions 22–24, western Baltic stock (western Baltic Sea). In Report of the ICES Advisory Committee, 2020. ICES Advice 2020, cod.27.22-24.  
<https://doi.org/10.17895/ices.advice.5942>.

# Annex 1

ICES Advice on fishing opportunities, catch, and effort  
Baltic Sea ecoregion  
Published 27 September 2019

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

### ICES advice on fishing opportunities

**Please note: The present advice replaces the advice given in May 2019 for catches in 2020.**

ICES advises that when the EU multiannual plan (MAP) is applied, total catches in 2020 that correspond to the F ranges in the plan are between 5205 tonnes and 11006 tonnes. According to the MAP, catches higher than those corresponding to  $F_{MSY}$  (7245 tonnes) can only be taken under conditions specified in the MAP, whilst the entire range is considered precautionary when applying the ICES advice rule. Assuming recreational catches at recent average, this implies commercial catches between 3065 tonnes and 8866 tonnes.

### Stock development over time

The spawning-stock biomass (SSB) has been fluctuating around the limit reference point ( $B_{lim}$ ) since 2009, but has increased in the last two years and is presently above  $B_{lim}$  and close to  $MSY B_{trigger}$ . The fishing mortality (F) is above  $F_{MSY}$ , although a large decrease in F has occurred in later years. Recruitment (R) has been low since 1999; recruitment in 2017 (the 2016 year class) is estimated to be above average in this period. The recruitments in 2018 and 2019 (age 1) are the lowest in the time series.



**Figure 1** Cod in subdivisions 22–24, western Baltic stock. Summary of the stock assessment. Recruitment, F, and SSB have confidence intervals (95%) in the plot. The EU landing obligation entered into force in 2015; therefore, BMS landings (fish below the minimum conservation reference size [MCRS]) have been included since 2017.

### Stock and exploitation status

ICES assesses that fishing pressure on the stock is above  $F_{MSY}$  and below  $F_{pa}$  and  $F_{lim}$ ; while spawning stock size is below  $MSY B_{trigger}$  and between  $B_{pa}$  and  $B_{lim}$ .

**Table 1** Cod in subdivisions 22–24, western Baltic stock. State of the stock and fishery relative to reference points.

		Fishing pressure				Stock size			
		2016	2017	2018		2017	2018	2019	
Maximum sustainable yield	$F_{MSY}$	✗	✗	✗	Above	$MSY B_{trigger}$	✗	✗	✗ Below trigger
Precautionary approach	$F_{pa}, F_{lim}$	✓	✓	✓	Harvested sustainably	$B_{pa}, B_{lim}$	✗	○	○ Increased risk
Management plan	$F_{ranges}$	✗	✓	✓	Within range	$MSY B_{trigger}$	✗	✗	✗ Below trigger

### Catch scenarios

**Table 2** Cod in subdivisions 22–24, western Baltic stock. Assumptions made for the interim year and in the forecast. Weights are in tonnes. Recruitment is in thousands.

Variable	Value	Notes
$F_{ages\ 3-5}$ (2019)	0.33	Based on catch constraint in 2019
SSB (2020)	29613	Based on catch constraint in 2019
$R_{age\ 1}$ (2019)	2226	From the assessment
$R_{age\ 1}$ (2020)	1165	Sampled from the last ten years*
$R_{age\ 1}$ (2021)	1162	Sampled from the last ten years*
Total catch (2019)	7908	Commercial + recreational catches.
Commercial catches (2019)	848	Calculated as the 2019 TAC (9515 tonnes) plus an assumed discard ratio as in 2018 (4.2%), and accounting for the proportion of western Baltic cod in commercial catches in subdivisions 22–24 in 2018 (59%).
Recreational catches (2019)	2140	Average over 3 years (2016–2018)

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

**Table 3** Cod in subdivisions 22–24, western Baltic stock. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch * (2020)	Recreational catch	Commercial catch	$F_{total}$ (2020)	$F_{commercial}$ (2020)	SSB (2021)	% SSB change ***	% Advice change
ICES advice basis								
EU MAP**: $F_{MSY}$	7245	2140	5105	0.26	0.18	32310	10	–52^
$F = \text{Proposed } F_{MSY\ lower}$	5205	2140	3065	0.18	0.11	34657	18	–43^^
$F = \text{Proposed } F_{MSY\ upper}$	11006	2140	8866	0.43	0.35	27251	–7	–54^^^
Other scenarios								
$F_{MSY}$	7245	2140	5105	0.26	0.18	32310	10	–52
Zero commercial catch	2140	2140	0	0.07	0	38560	32	–86
$F = F_{pa}$	19551	2140	17411	0.99	0.88	16350	–44	30
$F = F_{lim}$	23804	2140	21764	1.45	1.32	11054	–62	59
$SSB(2021) = B_{lim}$	20971	2140	18832	1.11	1.00	14500	–51	40
$SSB(2021) = B_{pa}$	15148	2140	13008	0.66	0.57	21876	–25	0.85
$SSB(2021) = MSY B_{trigger}$	15148	2140	13008	0.66	0.57	21876	–25	0.85
$F = F_{2019}$	9089	2140	6949	0.34	0.26	29818	2	–39



\* Includes commercial and recreational catch.

\*\* EU Multi-Annual Plan for the Baltic Sea (EU, 2016a).

\*\*\* SSB 2021 relative to SSB 2020.

^ Total catch in 2020 relative to total catch corresponding to the advice for 2019 (15 021 t, MAP  $F_{MSY}$ ), including commercial and recreational catch.

^^ Total catch in 2020 relative to total catch corresponding to the advice for 2019 for  $F_{MSY\ lower}$  (9094 t, MAP  $F_{MSY\ lower}$ ), including commercial and recreational catch.

^^^ Total catch in 2020 relative to total catch corresponding to the advice for 2019 for  $F_{MSY\ upper}$  (23 992 t, MAP  $F_{MSY\ upper}$ ), including commercial and recreational catch.

Last year's estimation of the large 2016 year class has been revised down by 54%. This year class is the most important year class contributing to the catch and the revised estimate is largely responsible for the 52% decrease in the 2020 catch advice.

## Basis of the advice

**Table 4** Cod in subdivisions 22–24, western Baltic stock. The basis of the advice.

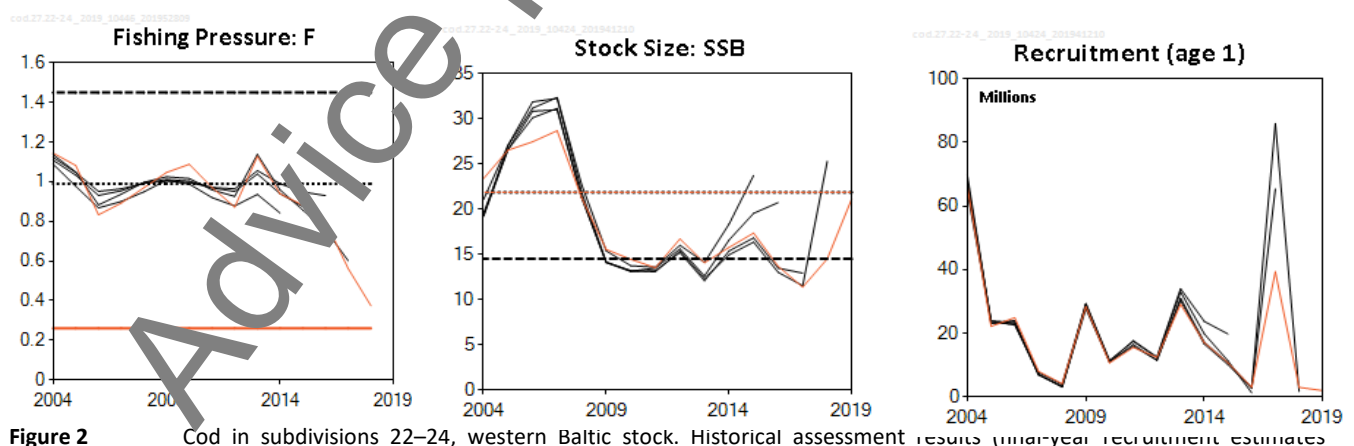
Advice basis	EU Baltic multiannual plan.
Management plan	The EU multiannual plan (MAP) in place for stocks in the Baltic Sea includes cod (EU, 2016a). The advice, based on the $F_{MSY}$ ranges, is considered precautionary.

## Quality of the assessment

The estimate of the abundance of the 2016 year class has been revised significantly downwards in the updated assessment. The SSB development is very dependent on this year class (because the younger and older year classes are very low in abundance). A survey observation of the 2016 year class in 2018 was lower than expected, which explains the downward revision in SSB.

In 2018 the recreational catches included in the stock assessment constituted 30% of the total catches. The uncertainty around recreational catches is considered higher than in commercial catches. In addition, the catches in the recreational fishery are difficult to quantify in the intermediate year. It is also difficult to partition catches between commercial and recreational in the forecast.

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.

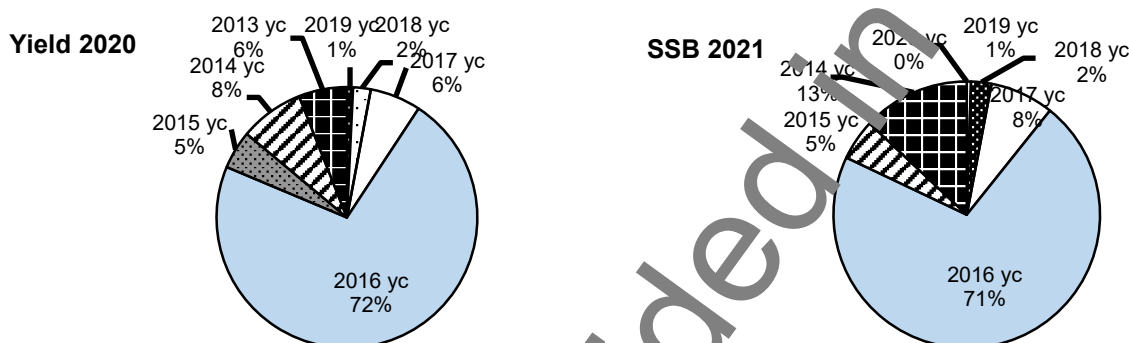


## Issues relevant for the advice

The reference points were re-estimated and changed at the stock benchmark in 2019 (ICES, 2019a).  $B_{lim}$  was revised downwards from 27 400 t to 14 500 t (47%), based on new information on the productivity of the stock at low biomasses.  $F_{MSY}$  and the lower and upper range were also re-estimated and the ranges narrowed. In this case there was no change to  $F_{MSY}$  (0.26), but the  $F_{MSY\ lower}$  is changed from 0.15 to 0.18, and  $F_{MSY\ upper}$  is changed from 0.45 to 0.43.

The increase of SSB in the forecast is mainly due to one strong year class (the 2016 year class). Fishing mortality in 2018 was still above  $F_{MSY}$ . The 2016 year class will account for the majority of the predicted catches in 2020 (72%) and SSB in 2021 (71%) (Figure 3). Additionally, the 2017 and 2018 year classes are historically low. If no stronger year classes occur in the coming years this will lead to a rapid decline of the stock. ICES therefore suggests to use the  $F_{MSY\ lower}$  value in the MAP when setting the TAC.

The SSB in 2020 is predicted to be above  $MSY\ B_{trigger}$ . In this situation, catch scenarios applicable under the MAP correspond to fishing mortalities between  $F_{lower}$  and  $F_{upper}$ . However, according to the MAP, catches corresponding to  $F$  higher than  $F_{MSY}$  can only be taken under conditions specified in the MAP.



**Figure 3** Cod in subdivisions 22–24, western Baltic stock. Relative predicted distribution of year classes in the yield 2020 and spawning-stock biomass 2021.

Landings of fish below the minimum conservation reference size (MCRS, 35 cm) are very low in the management area (24 t below minimum size [BMS] reported in 2018). Discarding still takes place despite the fact that the landing obligation has been in place since 2015. The estimated amount of discards is 157 tonnes in 2018 (approximately 4.2%), based on observer data. ICES understands that this is not in accordance with the current regulations.

A spawning closure was introduced in 2016 (no directed cod fishing in February and March; EU, 2015, 2016b, 2017) and covered the peak spawning time between 2016 and 2018 both a very large and a historically low recruitment were produced with a similar spawning stock size (Eero *et al.*, 2019). The span of years implemented for the closure was too short to evaluate its impact. In 2019 no spawning closure was implemented.

A mixture of eastern (EB) and western Baltic (WB) cod stocks is caught in the western Baltic management area (subdivisions 22–24). The assessment and this advice is for the western Baltic cod stock.

Recreational catches of cod in the western Baltic management area are considered to consist exclusively of WB cod. A bag-limit was introduced for the first time in 2017 (EU, 2016b) due to the poor stock status and this has lead (*inter alia*) to a drop in the recreational catches in 2017 and 2018 (1315 tonnes and 1600 tonnes, respectively). For 2019 the bag limit has been increased from 5 to 7 fish per day per angler. The impact on the recreational catches in 2019 is unknown and the recreational catch value used for the intermediate year (2140 t) is based on a 3-year mean. The recreational catch in 2020 will depend on a management decision on the regulations for the recreational fishery. In the absence of other information the recreational catch assumed in the forecast has been kept constant.

To derive a management area-based total for commercial cod catch for the western and eastern Baltic areas (subdivisions 22–24 and 25–32) in line with ICES advice for the two cod stocks, ICES considers that the following issues should be taken into account:

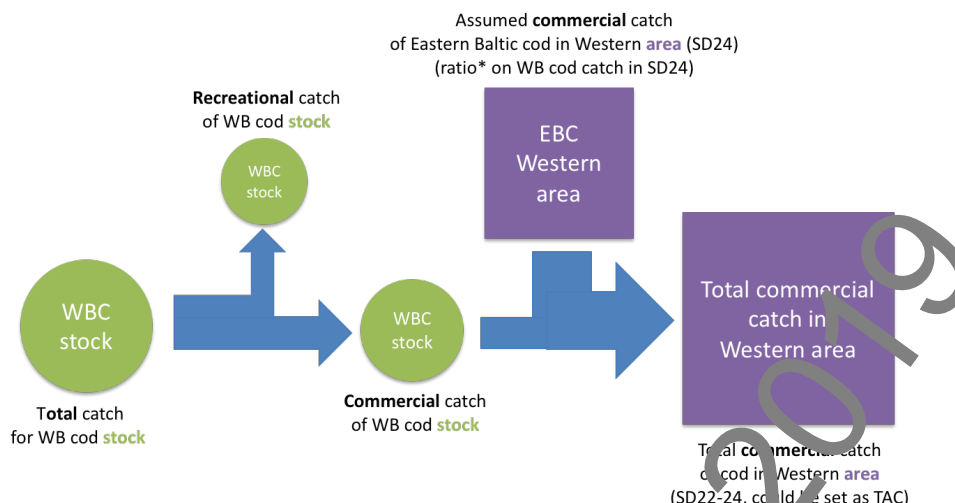
1. The distribution area of the WB cod stock is subdivisions 22–24. The proportions of the WB cod stock commercial catch taken in subdivisions 22–23 and Subdivision 24 have been quite stable since 1994, amounting to 76% and 24%, respectively, on average in the most recent three years (Table 6).
2. The distribution area of the EB cod stock is subdivisions 24 and 25–32.
3. Commercial fishing in subdivisions 22–23 will provide a catch of the WB cod stock only.
4. Commercial fishing in subdivisions 25–32 will provide a catch of the EB cod stock only.
5. Commercial fishing in Subdivision 24 will provide a mixed catch of the EB and WB cod stocks. In the most recent three years, the ratio EB cod / WB cod commercial catch in Subdivision 24 has been 2.90 (Table 6).
6. In an area that includes two stocks of a species, the species TAC should be set such that the risk of overexploitation of the weakest stock is minimized.

The European Commission has requested ICES to provide information on catch opportunities by management area consistent with the stock advice, assuming a *status quo* distribution of the fisheries on subareas and stocks (option A in Table 5). There could be other allocation schemes, but such schemes are not known to ICES.

One example (Option A in Table 5) assumes that the geographical distribution of the commercial catch in 2020 remains as outlined in point 1 above and with average recreational catch in 2020, in which case the distribution of a commercial catch of 5105 t of WB cod will be 3880 t in subdivisions 22–23 and 1225 t in Subdivision 24. However, catches in Subdivision 24 should be zero in order to comply with the zero catch advised for EB cod. With a *status quo* effort in subdivisions 22–23, this would result in a TAC of 3880 t for the western management area which can only be fished in subdivisions 22–23. Alternatively, the implied commercial catch (5105 t) could be taken entirely in subdivisions 22–23. This would represent an increase of effort in this area which is considered the main spawning grounds for WB cod. This may negatively affect the spawning success of WB cod due to disturbance (though the effects on recruitment cannot be quantified). Given this circumstance the reintroduction of a temporal fishery closure during spawning time could be considered.

Option B (Table 5) assumes that the geographical distribution of the commercial catch in 2020 remains as outlined in point 1 above and with average recreational catch in 2020, which means the distribution of a commercial catch of 5105 t of WB cod will be 3880 t in subdivisions 22–23 and 1225 t in Subdivision 24. Under these circumstances the additional amount of EB cod fished in Subdivision 24 is estimated to be 3555 t, assuming the same ratio between EB cod and WB cod as observed on average during 2016–2018 in the commercial catches (i.e. 2.90, see point 5 above). This would result in a TAC of 8660 t for the western management area which could be taken across the entire western Baltic management area. This option is not in line with the catch advice for EB cod.

Figure 4 provides a graphic presentation of how to arrive at area-based TACs from the ICES stock advice.



**Figure 4** Cod in subdivisions 22–24, western Baltic cod. Illustration of calculations to obtain area TACs for western and eastern Baltic cod from ICES stock-based catch advice, taking into account stock mixing in Subdivision 24 and recreational catches for the western stock.

**Table 5** Cod in subdivisions 22–24, western Baltic stock. The scenarios illustrate the implications of zero catch advice for eastern Baltic cod on the commercial catch by management area, assuming a recreational catch of 2140 tonnes in 2020. Weights are in tonnes.

Area	Commercial catch WB cod stock			Commercial catch EB cod stock			Commercial catch of cod by management area (TAC)			
	A	B	C	D	E	F	G		H	
	Advice Total	SDs 22–23	SD 24	Total	SD 24	SDs 25–32	SDs22–24	% TAC change (SDs 22–24)*	SDs 25–32	% TAC change (SDs 25–32)**
<b>a. Status quo distribution, with no catch of EB cod in the Western Baltic management area</b>										
Calculation		$= A \times 0.76^{\wedge}$	$= A \times 0.24^{\wedge}$		$= C \times 2.90^{\wedge\wedge}$	$= D - E$	$= B + C + E$		$= F$	
EU MAP: $F_{MSY}$	5105	3880	0	0	0	0	3880	-59	0	-100
$F=MAP_{FMSY}$ lower	3065	2329	0	0	0	0	2329	-76	0	-100
<b>b. Status quo distribution, with catch of EB cod in the Western Baltic management area</b>										
Calculation		$= A \times 0.76^{\wedge}$	$= A \times 0.24^{\wedge}$		$= C \times 2.90^{\wedge\wedge}$	$= D - E$	$= B + C + E$		$= F$	
EU MAP: $F_{MSY}$	5105	3880	1225		3555	-	8660	-9	-	-
$F=MAP_{FMSY}$ lower	3065	2329	736	-	2134	-	5199	-45	-	-

\* Compared to the 2019 TAC for subdivisions 22–24 (3515 tonnes).

\*\* Compared to the 2019 TAC for subdivisions 25–32 (29 912 tonnes).

$\wedge$  Average proportions of the WB cod stock commercial catch that has been caught in subdivisions 22–23 and Subdivision 24 in the most recent three years (2016–2018; Table 6).

$\wedge\wedge$  The EB cod catch / WB cod commercial catch ratio observed in Subdivision 24 in the most recent three years (2016–2018; Table 6).

**Table 6** Cod in subdivisions 22–24, western Baltic stock. Catches (tonnes) used in the stock assessments of the western (WB) and eastern (EB) Baltic cod stocks in the western Baltic management area.

Year	WB cod stock					EB cod stock			Management area SDs 22–24				EBC/ WBC stock commercial catch in SD 24
	Landings	Discards	Recreational catch	Proportion of discards	Proportion of comm. catch in SD 24	Landings in SD 24	Discards in SD24	% of catch in SD 24	Total landings	Discards	Recreational catch	total catch	
1985	33188		2075		0.29	6971		2.11	40159		2075	42234	0.71
1986	20088		2078		0.36	6604		2.51	26692		2078	28770	0.93
1987	21692		2081		0.37	6874		3.08	28566		2081	30647	0.86
1988	20672		2082		0.47	8487		4.63	29159		2082	31241	0.87
1989	12795		2083		0.49	5721		3.04	18516		2083	20599	0.92
1990	12237		2085		0.49	5543		3.39	17780		2085	19865	0.92
1991	12931		2087		0.32	3762		2.92	16693		2087	18780	0.92
1992	15672		2420		0.19	2324		3.93	17996		2420	20416	0.76
1993	11815		2752		0.27	3885		6.92	15700		2752	18452	1.20
1994	16642	1614	3088	0.09	0.41	6551	622	6.52	23193	2235	3088	28516	0.97
1995	28310	3016	3417	0.10	0.29	5585	568	5.40	33895	3684	3417	40996	0.68
1996	38505	6868	3419	0.15	0.32	10040	1116	8.16	48545	7984	3419	59948	0.77
1997	37077	3981	3420	0.10	0.33	6547	641	7.24	43624	4623	3420	51666	0.53
1998	29634	5575	3410	0.16	0.37	4582	631	6.96	34216	6206	3410	43833	0.40
1999	35934	4378	3416	0.11	0.32	6221	599	8.35	42155	4978	3416	50549	0.52
2000	31132	3738	3432	0.11	0.32	6316	1209	7.32	37448	4947	3432	45827	0.68
2001	27781	2449	3427	0.08	0.36	7794	389	7.99	35574	2838	3427	41840	0.75
2002	20410	1395	3437	0.06	0.31	5060	562	7.51	25470	1957	3437	30864	0.84
2003	17205	3473	3448	0.17	0.34	5729	862	8.44	22934	4336	3448	30718	0.95
2004	17686	2189	3445	0.11	0.27	5309	188	7.30	22995	2377	3445	28817	1.04
2005	18493	3265	3771	0.15	0.44	6064	1729	12.08	24557	4994	3771	33322	0.86
2006	18503	1686	2923	0.08	0.27	6767	144	8.97	25270	1831	2923	30024	1.28
2007	17384	1325	2782	0.07	0.35	8792	875	14.95	26176	2200	2782	31158	1.46
2008	11302	336	3039	0.03	0.31	8811	787	17.27	20112	1123	3039	24274	2.66
2009	7313	351	2648	0.05	0.42	8284	464	14.46	15597	815	2648	19060	2.75
2010	8007	838	3367	0.09	0.36	6049	533	10.90	14055	1371	3367	18793	2.08
2011	9107	299	2595	0.0	0.24	7545	482	12.90	16652	781	2595	20029	3.59
2012	8622	370	3661	0.04	0.31	8469	536	13.43	17091	905	3661	21657	3.28
2013	7697	1007	3106	0.12	0.29	5359	1243	15.36	13056	2250	3106	18413	2.62
2014	8083	837	4044	0.09	0.33	5455	1298	14.91	13538	2135	4044	19716	2.30
2015	8390	432	4568	0.05	0.29	5029	930	11.92	13419	1361	4568	19348	2.35

ICES Advice 2019 – cod.27.22-24 – <https://doi.org/10.17895/ices.advice.5587>

ICES advice, as adopted by its advisory committee (ACOM), is developed upon request by ICES clients (European Union, NASCO, NEAFC, and Norway).

Year	WB cod stock					EB cod stock			Management area SDs 22–24				EBC/ WBC stock commercial catch in SD 24
	Landings	Discards	Recreational catch	Proportion of discards	Proportion of comm. catch in SD 24	Landings in SD 24	Discards in SD24	% of catch in SD 24	Total landings	Discards	Recreational catch	total catch	
2016	6122	143	3505	0.02	0.31	4541	306	12.95	10663	449	3505	14617	2.53
2017	3861	180	1315	0.04	0.20	1994	238	7.21	5355	417	1315	7587	2.79
2018	3555	157	1600	0.04	0.21	2284	311	12.01	5839	469	1600	7907	3.39

## Reference points

**Table 7** 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 $B_{trigger}$	21 876	$B_{pa}$	ICES (2019a)
	$F_{MSY}$	0.26	Stochastic simulations with segmented regression stock–recruitment relationship.	ICES (2019a)
Precautionary approach	$B_{lim}$	14 500	Average of lowest SSB in years with above average recruitment (1991, 1993, 2003, 2016).	ICES (2019a)
	$B_{pa}$	21 876	$1.4 \times B_{lim}$	ICES (2019a)
	$F_{lim}$	1.45	Equilibrium scenarios with stochastic recruitment: F value corresponding to 50% probability of ( $SSB < B_{lim}$ ).	ICES (2019a)
	$F_{pa}$	0.99	$F_{lim} \times e^{-1.645\sigma}$ ; $\sigma = 0.25$	ICES (2019a)
Management plan	MSY $B_{trigger}$	21 876	MSY $B_{trigger}$	ICES (2019a)
	$B_{lim}$	14 500	$B_{lim}$	ICES (2019a)
	MAP $F_{MSY}$	0.26	$F_{MSY}$	ICES (2019a)
	Target range $F_{MSY upper}$ to $F_{MSY}$	0.26–0.43	Consistent with the ranges resulting in no more than 5% reduction in long-term yield compared with MSY.	ICES (2019a)
	Target range $F_{MSY}$ to $F_{MSY lower}$	0.18–0.26	Consistent with the ranges resulting in no more than 5% reduction in long-term yield compared with MSY.	ICES (2019a)

## Basis of the assessment

**Table 8** Cod in subdivisions 22–24, western Baltic stock. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018).
Assessment type	Age-based analytical assessment SAM (ICES, 2019b) 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 19 of the 34 years in the present time-series). The allocation of catches to stock for the remaining years was performed by interpolation. Three survey indices (FEJUCS (age 0), BITS-Q1, and BITS-Q4), annual maturity data from BITS-Q1 surveys. Natural mortalities for age 1 derived from multispecies assessment, unchanged since 1996.
Discards and bycatch	Included in the assessment since 1994, data series from the main fleets.
Indicators	None.
Other information	Benchmarked in 2015 (ICES, 2019a). The basis for the assessment changed in 2015 to being for the western Baltic cod stock, whereas assessments in earlier years were for the area of subdivisions 22–24.
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

## Information from stakeholders

There is no additional available information.

## History of the advice, catch, and management

**Table 9** 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 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
1990	TAC		8000	220000	17780
1991	TAC		11000	171000	16693
1992	Substantial reduction in F		-	100000	17996
1993	F at lowest possible level		-	40000	21228
1994	TAC		2200	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	160000	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 ( $F = 0.13$ )	$\leq 7797$		12720	10629
2017	MSY approach ( $F = 0.15$ )	$\leq 3475$	$\leq 917$	5597	5865^A
2018	MAP F ranges: $F_{lower}$ to $F_{MSY}$ adjusted by $MSY_{2018}/MSY_{B_{trigger}}$ ( $F = 0.11$ – $0.28$ )	3130–5295	1376–3541	5597	5850^A
2019	MAP range: $F_{MSY}$ $F_{lower}$ to $F_{upper}$ ( $F = 0.11$ – $0.45$ )	9094–23992	5867–22238	9515	
2020	MAP range: $F_{MSY}$ $F_{lower}$ to $F_{upper}$ ( $F = 0.18$ – $0.43$ )	5205–11006			

\* 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 10** Cod in subdivisions 22–24, western Baltic stock. Catch distribution in 2018 as estimated by ICES.

Catch (2018)	Commercial landings		Commercial discards	Recreational catch
5312 t	active gears 56%	passive gears 44%	157 t	1600 t
	3555 t			

**Table 11** 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 landings (HC)				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		7334	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	24625		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	2997	5833	32	421		6286
2018	2014	870	294	5826	24	476		6326

**Table 12** Cod in subdivisions 22–24, western Baltic management area. History of commercial landings for human consumption presented by area for each country participating in the fishery. 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	Denmark			Finland	Germany			Estonia		Lithuania	Latvia	Poland	Sweden			Total					
	22	23	22+24		24	Dem.Rep.*	FRG		22	24	24	24	24	22	23	22+24	22	23	24	Unalloc.	Grand total
						22+24	22	22+24													
1965			19457		9705		13350								2182	27867		17007		44874	
1966			20500		8393		11448								2110	27864		14587		42451	
1967			19181		10007		12884								1996	28875		15193		44068	
1968			22593		12360		14815								2113	32911		18970		51881	
1969			20602		7519		12717								1413	29082		13169		42251	
1970			20085		7996		14589								1289	31363		12596		43959	
1971			23715		8007		13482								1419	32119		14504		46623	
1972			25645		9665		12313								1277	32808		16092		48900	
1973			30595		8374		13733								1655	38237		16120		54357	
1974			25782		8459		10393								1937	31326		15245		46571	
1975			23481		6042		12912								1932	31867		12500		44367	
1976		712	29446		4582		12893								1800	33368	712	15353		49433	
1977		1166	27939		3448		11686							550	1516	29510	1716	15079		46305	
1978		1177	19168		7085		10852							600	1730	24232	1777	14603		40612	
1979		2029	23325		7594		9598							700	1800	26027	2729	16290		45046	
1980		2425	23400		5580		6037							1300	2610	22881	3725	15366		41972	
1981		1473	22654		11659		10260							900	5700	26340	2373	24933		53646	
1982		1638	19138		10615		8060							140	7933	20971	1778	24775		47524	
1983		1257	21961		9097		9260							120	6910	24478	1377	22750		48605	
1984		1703	21909		8093		11548							228	6014	27058	1931	20506		49495	
1985		1076	23024		5378		5523							263	4895	22063	1339	16757		40159	
1986		748	16195		2998		2902							227	3622	11975	975	13742		26692	
1987		1503	13460		4896		4256							137	4314	12105	1640	14821		28566	
1988		1121	13185		4632		4217							155	5849	9680	1276	18203		29159	
1989		636	8059		7141		2498							192	4987	5738	828	11950		18516	
1990		722	8584		1629		3054							120	3671	5361	842	11577		17780	
1991		1431	9383				2879							232	2768	7184	1663	7846		16693	
1992		2449	9946				3656							290	1655	9887	2739	5370		17996	
1993		1001	8666				4084							274	1675	7296	1275	7129	5528	21228	
1994		1073	13831				4023							555	3711	8229	1628	13336	7502	30695	
1995		2547	18762	132			9196				15			611	2632	16936	3158	13801		33895	
1996		2999	27946	50			12018		50		32			1032	4418	21417	4031	23097	2300	50845	

Year	Denmark			Finland	Germany			Estonia		Lithuania	Latvia	Poland	Sweden			Total								
	22	23	22+24		24	Dem.Rep.*	FRG		22				24	24	24	24	22	23	22+24	22	23	24	Unalloc.	Grand total
						22+24	22	22+24																
1997		1886	28887	11			9269		6			263	777	2525	21966	2663	18995			43624				
1998		2467	19192	13			9722		8		13	623	607	1571	15093	3074	16049			34216				
1999		2839	23074	116			13224		10		25	660	682	1525	20409	3521	18225			42155				
2000		2451	19876	171			11572		5		84	926	698	2564	18934	3149	16264			38347				
2001		2124	17446	191			10579		40		46	646	693	2479	14976	2817	16451			34244				
2002		2055	11657	191			7322				71	702	354	1727	11968	2409	9781			24158				
2003		1373	13275	59			6775				124	568	551	1899	9573	1925	13127			24624				
2004		1927	11386				4651				121	538	393	1727	9091	2320	9430	13		20854				
2005		1902	9867	2			7002	72	67		476	1093	720	835	8729	2621	10686	9		22045				
2006		1899	9761	242			7516		91		586	801		1855	9979	1914	10858			22751				
2007		2169	8975	220			6802		69		773	2371	534	2322	7840	2713	13183			23736				
2008		1612	8582	159			5489		134		30	1361	525	2189	5687	2139	12256			20082				
2009		567	7871	259			4020		194		23	529	269	1817	3451	839	11259			15549				
2010		689	6849	203			4250			9	159	319	490	1151	3925	1179	9016			14120				
2011		783	7799	149			4521				24	487	414	2153	5493	1198	9641			16332				
2012		733	8381	260			4522		3		11	818	390	1955	4896	1123	11053			17072				
2013		580	6566	50			3237				128	708	380	1317	4675	960	7333			12968				
2014	2206	795	6804	7		2109	3249				39	854	1	565	1231	4316	1361	7862		13538				
2015	2781	738	6623	28		2213	2915				7	755		493	1858	4994	1232	7193		13418				
2016	1576	675	4881	29		1617	2290					657	1	448	1550	3193	1123	6313		10629				
2017 **	1167	506	2352			1029	1281					926		435	352	2196	941	2714		5852				
2018 **	1010	475	2238	0.5		1008	1386					888		395	467	2018	870	2962		5850				

\* Includes landings from October to December 1990 of Federal Republic of Germany.

\*\* Including landings of Below Minimum Conservation Reference size (BMS) from logbooks

## Summary of the assessment

**Table 13** 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 (Age 1)	Recruitment High	Recruitment Low	Stock size: SSB	SSB High	SSB Low	Landings	Discards	Recreational	F (ages 3–5)	F High	F Low
1985	28685	51446	15994	30167	37625	24187	33188		2073	1.33	1.62	1.10
1986	79493	140449	44993	18852	22728	15637	20088		2078	1.25	1.50	1.04
1987	25929	45037	14928	17492	21054	14533	21692		2080	1.24	1.38	0.95
1988	11334	19924	6447	21628	27473	17027	20672		2082	1.12	1.35	0.93
1989	13917	24189	8007	15794	19521	12778	12795		2083	1.01	1.23	0.83
1990	21545	37430	12402	12279	14823	10171	12237		2085	1.15	1.38	0.96
1991	32863	57065	18925	9710	11511	8190	12931		2087	1.30	1.55	1.09
1992	64599	112999	36929	9547	11573	7876	15672		2120	1.34	1.60	1.13
1993	26179	45686	15001	13817	17329	11017	11815		2752	1.18	1.41	0.98
1994	59916	104602	34320	24937	32116	19363	16642	1514	3088	1.07	1.29	0.89
1995	93089	163896	52872	29086	35817	23619	28310	3016	3417	1.28	1.55	1.06
1996	25133	44868	14078	35958	44366	29144	38505	6868	3419	1.14	1.37	0.95
1997	80526	135323	47918	40762	52501	31648	37077	3981	3420	1.15	1.38	0.96
1998	125200	208514	75175	27947	34119	22892	29634	5575	3410	1.12	1.35	0.94
1999	43392	70377	26754	33310	40304	27530	35991	4378	3416	1.33	1.58	1.12
2000	44495	71021	27876	33990	42214	27368	31132	3738	3432	1.28	1.52	1.08
2001	27508	44421	17035	28683	34315	23976	27781	2449	3427	1.38	1.63	1.17
2002	48892	79090	30224	25137	30341	20826	26010	1395	3437	1.33	1.58	1.13
2003	15230	24734	9377	20519	24356	17287	17205	3473	3448	1.16	1.39	0.98
2004	66051	106615	40920	23390	28904	18997	17686	2189	3445	1.15	1.37	0.96
2005	22142	35566	13785	26537	32041	21079	18493	3265	3771	1.08	1.31	0.90
2006	24905	40422	15345	27471	34089	22155	18503	1686	2923	0.83	1.03	0.67
2007	7986	12866	4956	28691	35102	23451	17384	1325	2782	0.89	1.08	0.73
2008	4090	7206	2322	21230	25250	17809	11302	336	3039	0.97	1.17	0.80
2009	28372	46557	17291	15546	18361	13157	7313	351	2648	1.05	1.25	0.87
2010	10620	17061	6610	14459	17418	12073	8007	838	3367	1.09	1.31	0.90
2011	15517	25133	9580	13529	16867	10851	9107	299	2595	0.97	1.18	0.80
2012	12418	19867	7762	16711	20358	13717	8622	370	3661	0.87	1.07	0.71
2013	29082	47030	17984	14076	16715	11853	7697	1007	3106	1.13	1.38	0.92
2014	17003	27514	10507	25705	28818	13224	8083	837	4044	0.94	1.15	0.77
2015	10697	17354	6593	17368	21114	14286	8390	432	4568	0.88	1.11	0.70
2016	2996	5103	1750	13609	17060	10967	6122	143	3505	0.80	1.07	0.60
2017	39319	73594	21007	11374	15296	8458	3861**	180	1315	0.56	0.85	0.37
2018	2946	6266	1385	14509	22544	9338	3555**	157	1600	0.37	0.69	0.20
2019	2226*	7079*	682*	11297	38450	11129						

\*Output from SAM analysis based on survey data.

\*\*Includes BMS

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Advice provided in 2019

*Recommended citation:* ICES. 2019. Cod (*Gadus morhua*) in subdivisions 22-24, western Baltic stock (western Baltic Sea). In Report of the ICES Advisory Committee, 2019, cod.27.22-24, <https://doi.org/10.17895/ices.advice.5587>