

Cod (*Gadus morhua*) in divisions 7.e–k (western English Channel and southern Celtic Seas)

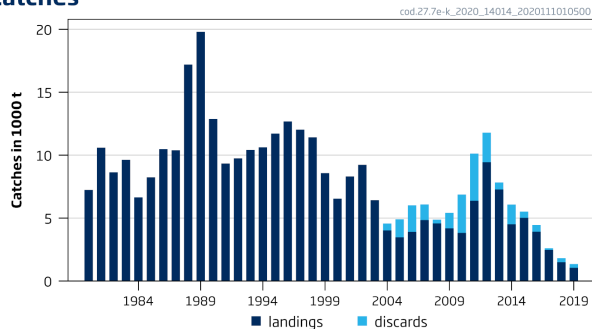
ICES advice on fishing opportunities

ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch in 2021.

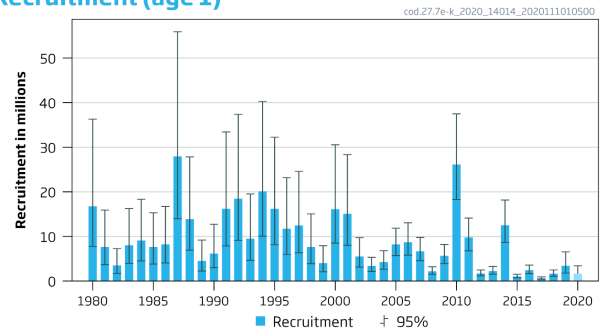
Stock development over time

Spawning-stock biomass (SSB) has been fluctuating around MSY $B_{trigger}$ since 2004, except from 2011 to 2013, and has been below B_{lim} since 2017. Fishing mortality (F) has been above F_{MSY} for the entire time-series, and above F_{lim} in recent years. Recruitment has been highly variable over time. Recent recruitment has been low with the exception of the 2013 year class, which was above average.

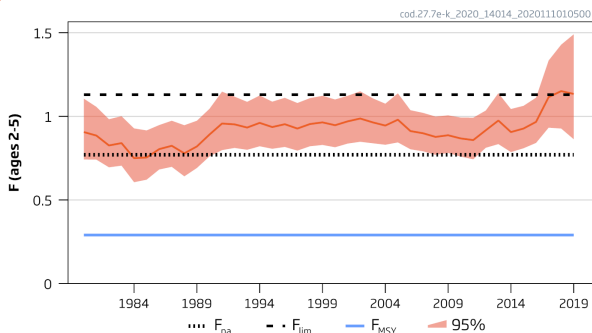
Catches



Recruitment (age 1)



F



SSB

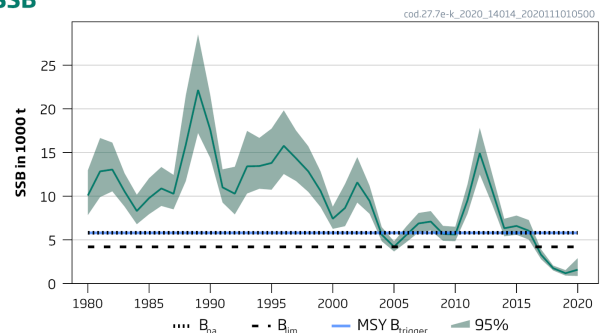


Figure 1 Cod in divisions 7.e–k. Summary of the stock assessment (weights in thousand tonnes). The assumed recruitment value is a paler blue. Discard estimates are available from 2004.

Stock and exploitation status

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

Table 1 Cod in divisions 7.e-k. 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}	✘	✘	✘ Above	$MSY B_{trigger}$	✘	✘ Below trigger
Precautionary approach	F_{pa}, F_{lim}	○	✘	✘ Harvested unsustainably	B_{pa}, B_{lim}	✘	✘ Reduced reproductive capacity
Management plan	F_{MGT}	✘	✘	✘ Above the range	B_{MGT}	✘	✘ Below trigger

Catch scenarios

Table 2 Cod in divisions 7.e-k. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
F ages 2–5 (2020)	0.477	F associated to TAC constraint (TAC in 2020 + average discards from the last three years).
SSB (2021)	2943	Fishing at $F = 0.477$; in tonnes.
Recruitment age 1 (2020–2021)	1640	Median resampled (2015–2019); thousands.
Total catch (2020)	1055	TAC constraint (TAC in 2020 + average discards from the last three years); in tonnes.
Projected landings (2020)	805	TAC (2020); in tonnes.
Projected discards (2020)	250	Average discard amount (2017–2019); in tonnes.

Table 3 Cod in divisions 7.e-k. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2021)	Projected landings (2021)	Projected discards (2021)	F_{total} (2021)	$F_{projected}$ landings (2021)	$F_{projected}$ discards (2021)	SSB (2022)	% SSB change *
ICES advice basis								
MSY and precautionary considerations: $F = 0$	0	0	0	0	0	0	6078	107
Other scenarios								
$F_{MSY} \times SSB_{2021} / MSY B_{trigger}$	544	501	43	0.147	0.142	0.005	5274	79
$F_{MSY lower} \times SSB_{2021} / MSY B_{trigger}$	328	302	26	0.086	0.083	0.003	5594	90
$F_{MSY upper} \times SSB_{2021} / MSY B_{trigger}$	748	689	59	0.208	0.201	0.007	4977	69
$F = F_{MSY}$	1004	924	80	0.29	0.28	0.01	4604	56
$F = 0$	0	0	0	0	0	0	6078	107
$F = F_{pa}$	2175	1986	189	0.77	0.744	0.026	2932	-0.4
$SSB_{2022} = B_{lim}$	1280	1176	104	0.386	0.373	0.013	4208 **	43
$SSB_{2022} = B_{pa} = MSY B_{trigger}$	213	196	17	0.055	0.053	0.002	5807 **	97
$F = F_{2020}$	1522	1396	126	0.477	0.461	0.016	3856	31

* SSB_{2022} relative to SSB_{2021} .

** Numbers presented are approximations of the reference point values.

The advice for 2021 is the same as the advice for 2020, based on the MSY approach and precautionary considerations.

Basis of the advice

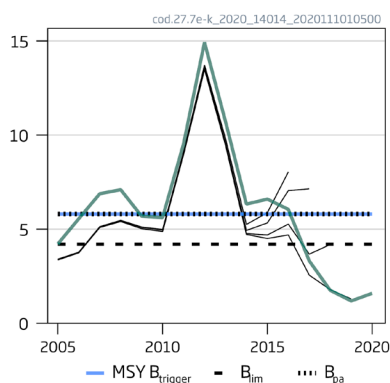
Table 4 Cod in divisions 7.e-k. The basis of the advice.

Advice basis	Management plan
Management plan	The EU multiannual plan (MAP) for stocks in the Western Waters and adjacent waters applies to this stock. The plan specifies conditions for setting fishing opportunities depending on stock status, and for making use of the F_{MSY} range for the stock. Full details of the plan are described in EU (2019).

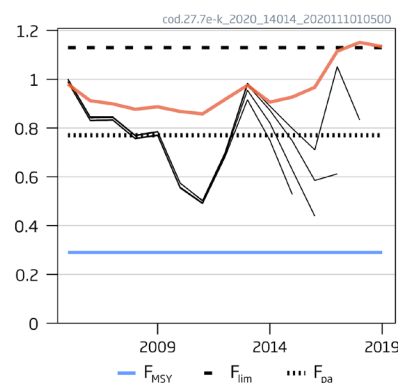
Quality of the assessment

The stock was benchmarked in 2020 (ICES, 2020a). The model was changed to a stochastic state-space assessment model (SAM). Maturity and natural mortality information was updated, discards were included in the assessment, catch (landings and discards) time-series were reviewed and updated from 2004 to 2018, commercial tuning series were reviewed and included as biomass index, and survey indices were updated to a single modelled time-series using a vector-autoregressive spatio-temporal model (VAST). The F-pattern shows less variability across the time-series and higher estimates in most recent years than the previous assessment. Fishing mortality is observed to be sensitive to the addition of an extra year of data.

SSB (1000 t)



F (ages 2-5)



Rec (age 1; Millions)

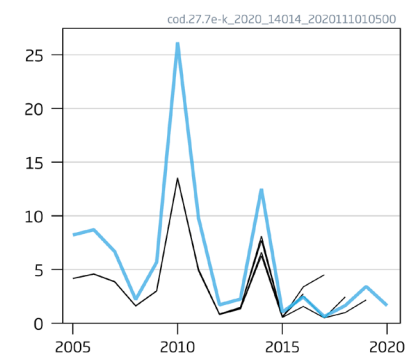


Figure 2 Cod in divisions 7.e-k. Historical assessment results (final-year recruitment assumptions included). The assessment was benchmarked in 2020 (ICES, 2020a). Black lines show the results of the previous assessments of the stock.

Issues relevant for the advice

ICES provides zero-catch advice for this stock in 2021, based on precautionary considerations, because the forecast is very sensitive to the assumptions on catch in 2020 and on the recruitment for 2020 and 2021. The stock is estimated to be well below B_{lim} in 2020. Intermediate year assumptions based on *status quo* F or F scaled were found to produce unrealistically high catches compared to the TAC. At the time when the advice was produced (early November 2020), reported landings were about 740 tonnes of the 805 tonnes TAC. It was therefore assumed that the catches in 2020 would be the sum of landings of 805 tonnes and average discards over the last three years (250 tonnes), i.e. 1055 tonnes. This assumption resulted in a very low F value (0.477) for 2020 compared to the observed time-series and a close to 60% reduction in F from the average of the previous three years. In the ICES advice framework, this would result in advised catches of between 328 tonnes (at $F_{MSY\ lower} \times SSB_{2021}/MSY\ B_{trigger}$) and 544 tonnes (at $F_{MSY} \times SSB_{2021}/MSY\ B_{trigger}$) as the median SSB would be above B_{lim} by 2022. The assumed recruitment in 2020 and 2021 used in the forecast would constitute a significant part of the projected catch in 2021 (39%), and a catch of 544 tonnes in 2021 would have a 26% probability that the stock is below B_{lim} by 2022. Given the uncertainties in the forecast and that the probability of SSB being less than B_{lim} in 2022 is greater than 5%, ICES thus provides advice for zero catch based on precautionary considerations.

Landings are adjusted to include those reported from rectangles 33E2 and 33E3 of Division 7.a, as they are considered part of this stock. This amounts to an average of 18.1% of Division 7.a landings being reallocated over the past five years and

accounts for 1.48% of the official landings in divisions 7.e–k over the past five years. This should be taken into consideration when setting TACs for the two management areas (divisions 7.a and 7.e–k), as a portion of the catch taken under the Division 7.a TAC is considered to be part of the divisions 7.e–k stock.

Mixed-fisheries considerations

Mixed-fisheries advice will be provided in the Celtic Seas fisheries overview later in the year.

Reference points

Table 5 Cod in divisions 7.e–k. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5800	B_{pa} ; in tonnes	ICES (2020a)
	F_{MSY}	0.29	Segmented regression with B_{lim} (EqSim)	ICES (2020a)
Precautionary approach	B_{lim}	4200	B_{loss} , lowest observed SSB from which there has been some recovery (2005) rounded value; in tonnes	ICES (2020a)
	B_{pa}	5800	$B_{lim} \times 1.4$; in tonnes	ICES (2020a)
	F_{lim}	1.13	Segmented regression with B_{lim} (EqSim)	ICES (2020a)
	F_{pa}	0.77	$F_{p0.5}$; the F that leads to SSB $\geq B_{lim}$ with 95% probability	ICES (2020a)
Management plan	MAP MSY $B_{trigger}$	5800	MSY $B_{trigger}$; in tonnes	EU (2019), ICES (2020a)
	MAP B_{lim}	4200	B_{lim} ; in tonnes	EU (2019), ICES (2020a)
	MAP F_{MSY}	0.29	F_{MSY}	EU (2019), ICES (2020a)
	MAP range F_{lower}	0.17	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU (2019), ICES (2020a)
	MAP range F_{upper}	0.41	Consistent with ranges resulting in no more than 5% reduction in long-term yield compared with MSY	EU (2019), ICES (2020a)

Basis of the assessment

Table 6 Cod in divisions 7.e–k. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2019b).
Assessment type	Age-based stochastic analytical assessment (SAM) (ICES, 2020b).
Input data	Commercial landings, ages, and length frequencies from sampling by métier; one combined VAST-modelled survey index (EVHOE-WIBTS-Q4; IGFS-WIBTS-Q4); one commercial index (FR-OTDEF Q2+3+4 trawlers in divisions 7.e–k); fixed maturity ogive derived from UK-WCGFS survey-Q1 data; age-dependent natural mortalities (Lorenzen, 1996).
Discards and bycatch	Included in the assessment. Observer-based estimates from 2004; discards and bycatch prior to that (between 1980 and 2003) are model estimated.
Indicators	None.
Other information	Benchmarked at WKCELTIC 2020 (ICES, 2020a).
Working group	Working Group for the Celtic Seas Ecoregion (WGCSE).

Information from stakeholders

There is no additional available information.

History of the advice, catch, and management

Table 7 Cod in divisions 7.e–k. ICES advice and official landings and ICES catch estimates. All weights are in tonnes.

Year	ICES advice	Landings corresponding to advice	Catch corresponding to advice	Agreed TAC *	ICES landings ^{^^^}	ICES discards
1987	Reduce F	< 6400 **			10390	
1988	No increase in F; TAC	7000 **			17196	
1989	No increase in F; TAC	8600 **			19804	
1990	No increase in F; TAC	9200 **			12878	
1991	TAC; SSB mean	4500 **			9336	
1992	Appropriate to reduce F	-			9747	
1993	20% reduction in F	6500 **		17500	10416	
1994	20% reduction in F	5600 **		17000	10620	
1995	20% reduction in F	4700 ***		17000	11710	
1996	20% reduction in F	4700 ***		20000	12681	
1997	20% reduction in F	7400 ***		20000	12028	
1998	10% reduction in F	8800 ^		20000	11418	
1999	Reduce F below F_{pa}	9200 ^		19000	8580	
2000	Reduce F below F_{pa}	< 7600 ^^		16000	6539	
2001	40% reduction in F	< 4300 ^^		10500	8316	
2002	45% reduction in F	< 5300 ^^		8700	9239	
2003	60% reduction in F	< 3800 ^^		NA	6425	
2004	90% reduction in F or management plan	< 700		NA	4027	543
2005	17% reduction in F	< 5200		6200	3478	1426
2006	No increase in effort (should have been “reduce effort”)	Cannot be estimated		5580	3902	2118
2007	Zero catch	0		4743	4842	1248
2008	Zero catch	0		4316	4577	306
2009	50% reduction in F	< 2600		4023	4187	1229
2010	Substantial catch reduction	-		4023	3831	3040
2011	Catch and effort reduction	-		5379	6376	3749
2012	MSY framework	< 10000		10059	9443	2341
2013	MSY framework	< 10200		10200	7273	562
2014	MSY approach	< 6848		6848	4512	1569
2015	MSY approach	< 4024		5072	5028	483
2016	MSY approach	≤ 3569		4565	3924	525
2017	MSY approach	≤ 1447		2830	2471	134
2018	MSY approach	≤ 3076	≤ 3428	3076	1496	316
2019	MSY approach		0	1610	1051	300
2020	MSY approach		0	805		
2021	MSY approach and precautionary considerations		0			

* TAC covers subareas 7 (except Division 7.a) and 8. From 2009 onwards, the TAC covers divisions 7.b–c and 7.e–k, subareas 8–10, and EU waters of CECAF 34.1.1 (with a separate TAC established for Division 7.d).

** For the divisions 7.f–g stock component.

*** For the divisions 7.f–h stock component.

^ For the divisions 7.e–h stock component.

^^ For the divisions 7.e–k stock component.

^^^ Landings have been adjusted to include landings taken or reported in rectangles 33E2 and 33E3 since 2004.

History of the catch and landings

Table 8 Cod in divisions 7.e-k. Catch distribution by fleet in 2019, as estimated by ICES.

Catch	Landings					Discards				
	Otter trawls	Seine nets	Beam trawls	Mid-water trawls	Other gears	Otter trawls	Seine nets	Beam trawls	Mid-water trawls	Other gears
1351 tonnes	72%	8%	12%	< 1%	8%	53%	32%	15%	< 1%	< 1%
	1051 tonnes					300 tonnes				

Table 9 Cod in divisions 7.e-k. History of official commercial landings, presented by country and ICES discard estimates. All weights are in tonnes.

Year	Belgium	France	Ireland	UK	Others	Total	Discard estimates	Landings taken or reported in rectangles 33E2 and 33E3 *
1971	NA	NA	NA	NA	NA	5782	NA	NA
1972	NA	NA	NA	NA	NA	4737	NA	NA
1973	NA	NA	NA	NA	NA	4015	NA	NA
1974	NA	NA	NA	NA	NA	2898	NA	NA
1975	NA	NA	NA	NA	NA	3993	NA	NA
1976	NA	NA	NA	NA	NA	4818	NA	NA
1977	NA	NA	NA	NA	NA	3059	NA	NA
1978	NA	NA	NA	NA	NA	3647	NA	NA
1979	NA	NA	NA	NA	NA	4650	NA	NA
1980	NA	NA	NA	NA	NA	7243	NA	NA
1981	NA	NA	NA	NA	NA	10597	NA	NA
1982	NA	NA	NA	NA	NA	8766	NA	NA
1983	NA	NA	NA	NA	NA	9641	NA	NA
1984	NA	NA	NA	NA	NA	6631	NA	NA
1985	NA	NA	NA	NA	NA	8317	NA	NA
1986	NA	NA	NA	NA	NA	10475	NA	NA
1987	NA	NA	NA	NA	NA	10228	NA	NA
1988	554	13863	1480	1292	2	17191	NA	NA
1989	910	15801	1860	1223	15	19809	NA	NA
1990	621	9383	1241	1346	158	12749	NA	NA
1991	303	6260	1659	1094	20	9336	NA	NA
1992	195	7120	1212	1207	13	9747	NA	NA
1993	391	8317	766	945	6	10425	NA	NA
1994	398	7692	1616	906	8	10620	NA	NA
1995	400	8321	1946	1034	8	11709	NA	NA
1996	552	8981	1982	1166	0	12681	NA	NA
1997	694	8662	1513	1166	0	12035	NA	NA
1998	528	8096	1718	1089	0	11431	NA	NA
1999	326	5488	1883	897	0	8594	NA	NA
2000	208	4281	1302	744	0	6535	NA	NA
2001	347	6033	1091	838	0	8309	NA	NA
2002	555	7368	694	618	0	9235	NA	NA
2003	136	5222	517	346	0	6221	NA	NA
2004	153	2934	657	281	1	4027	543	108
2005	186	2127	855	309	1	3478	1426	54
2006	101	2431	995	371	3	3902	2118	103
2007	107	3113	1208	411	3	4842	1248	527
2008	65	2994	1222	295	1	4577	306	558
2009	48	3020	847	267	5	4187	1229	193
2010	52	2449	1030	296	3	3831	3040	143
2011	123	4808	1010	427	7	6376	3749	147

Year	Belgium	France	Ireland	UK	Others	Total	Discard estimates	Landings taken or reported in rectangles 33E2 and 33E3 *
2012	290	6900	1539	706	8	9443	2341	85
2013	202	5051	1470	548	3	7273	562	76
2014	141	2715	1189	466	0	4512	1569	24
2015	121	3373	1109	422	3	5028	483	39
2016	97	2579	881	365	1	3924	525	40
2017	82	1578	623	188	0	2471	134	19
2018	49 **	611 **	706 **	130 **	0	1496 **	316	20
2019	43 **	369 **	554 **	84 **	NA	1051 **	300	37

* Included in Ireland landings estimates. Landings in the southern part of Division 7.a (rectangles 33E2 and 33E3) are included in the assessment and are considered to be part of the stock.

** Preliminary.

NA = Not available.

Summary of the assessment

Table 10 Cod in divisions 7.e-k. Assessment summary. Recruitments are in thousands, weights in tonnes.

Year	Recruitment age 1			SSB			Landings	Discards	F ages 2-5		
	Low	Value	High	Low	Value	High			Low	Value	High
1980	7755	16777	36298	7827	10072	12960	7241		0.74	0.91	1.11
1981	3658	7627	15904	9895	12842	16665	10595		0.74	0.89	1.06
1982	1697	3514	7276	10551	13051	16143	8639		0.70	0.83	0.98
1983	3964	8027	16255	8804	10544	12628	9635		0.71	0.84	1.00
1984	4514	9096	18330	6783	8306	10171	6642		0.61	0.75	0.93
1985	3809	7638	15315	7933	9780	12058	8241		0.62	0.75	0.92
1986	4053	8236	16738	8882	10887	13345	10475		0.68	0.80	0.95
1987	13971	27946	55900	8489	10277	12443	10390		0.70	0.82	0.97
1988	6931	13890	27839	11724	15904	21573	17196		0.64	0.78	0.95
1989	2233	4528	9184	17221	22169	28539	19804		0.69	0.82	0.97
1990	2985	6165	12731	14342	17586	21564	12878		0.76	0.89	1.04
1991	7862	16212	33429	9271	11012	13080	9336		0.80	0.96	1.15
1992	9108	18451	37379	7908	10284	13374	9747		0.81	0.95	1.12
1993	4624	9502	19527	10300	13417	17478	10416		0.80	0.93	1.09
1994	10057	20127	40281	10847	13451	16679	10620		0.82	0.96	1.13
1995	8145	16210	32258	10738	13803	17742	11710		0.81	0.94	1.09
1996	5943	11735	23171	12536	15768	19834	12681		0.82	0.95	1.11
1997	6317	12465	24598	11728	14335	17522	12028		0.80	0.93	1.08
1998	3881	7643	15053	10488	12844	15729	11418		0.82	0.95	1.11
1999	2067	4043	7906	8755	10607	12850	8580		0.83	0.96	1.12
2000	8498	16116	30564	6255	7421	8804	6539		0.82	0.95	1.10
2001	8017	15077	28356	6566	8655	11408	8316		0.84	0.97	1.12
2002	3128	5514	9719	9265	11585	14486	9239		0.85	0.99	1.15
2003	2136	3373	5325	7981	9462	11217	6425		0.84	0.96	1.11
2004	2650	4243	6795	4833	5591	6467	4027	543	0.83	0.95	1.08
2005	5688	8211	11854	3670	4212	4834	3478	1426	0.84	0.98	1.14
2006	5809	8709	13055	4721	5552	6531	3902	2118	0.80	0.91	1.04
2007	4549	6669	9776	5853	6878	8082	4842	1248	0.79	0.90	1.02
2008	1519	2206	3203	6068	7095	8297	4577	306	0.77	0.88	1.00
2009	3923	5670	8195	4889	5684	6608	4187	1229	0.78	0.89	1.01
2010	18247	26155	37491	4843	5613	6505	3831	3040	0.76	0.87	0.99
2011	6784	9787	14117	7984	9527	11369	6376	3749	0.74	0.86	0.99
2012	1179	1709	2477	12487	14921	17830	9443	2341	0.81	0.92	1.03
2013	1536	2244	3278	9106	10725	12632	7273	562	0.83	0.98	1.14

Year	Recruitment age 1			SSB			Landings	Discards	F ages 2–5		
	Low	Value	High	Low	Value	High			Low	Value	High
2014	8631	12516	18151	5401	6329	7416	4512	1569	0.79	0.91	1.04
2015	712	1037	1511	5582	6594	7789	5028	483	0.81	0.93	1.06
2016	1665	2436	3564	5030	6049	7273	3924	525	0.84	0.97	1.11
2017	418	625	935	2786	3311	3934	2471	134	0.93	1.12	1.33
2018	1081	1640	2487	1483	1748	2060	1496	316	0.93	1.15	1.43
2019	1791	3422	6536	906	1181	1540	1051	300	0.86	1.13	1.49
2020	625	1640 *	3422	863	1587	2913					

*Median resampled (2015–2019).

Sources and references

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