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Herring (*Clupea harengus*) in subareas 1, 2, and 5, and in divisions 4.a and 14.a, Norwegian spring-spawning herring (the Northeast Atlantic and the Arctic Ocean)

ICES stock advice

Please note: **The present advice replaces the catch advice given for 2017 (in September 2016) and the catch advice given for 2018 (in September 2017).** †

ICES advises that when the long-term management plan agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 is applied, catches in 2017 should be no more than 437 364 tonnes.

ICES advises that when the long-term management plan agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 is applied, catches in 2018 should be no more than 384 197 tonnes.

Stock development over time

Fishing mortality has had an overall declining trend since 2010 and was well below F_{MSY} in 2016. The stock is declining and estimated to be below MSY $B_{trigger}$ since 2014. Since 1998 four large year classes have been produced (1998, 1999, 2002, and 2004). All year classes since 2005 are estimated to be average or small.

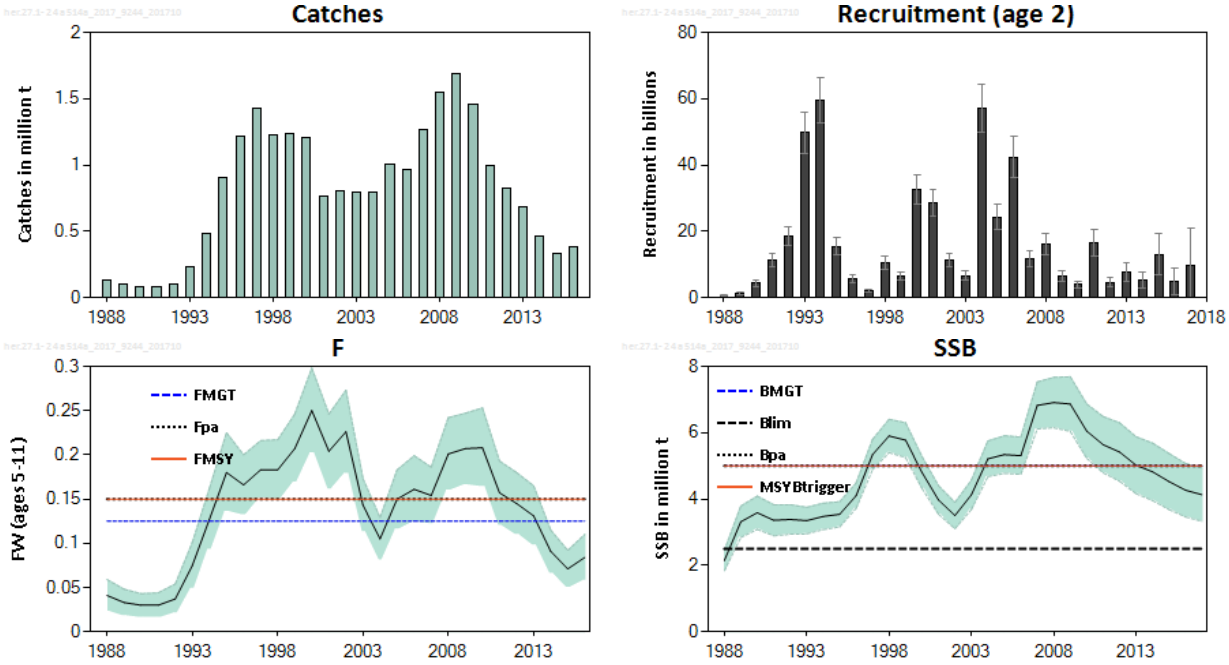

Figure 1‡ Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Summary of the stock assessment. Confidence intervals (95%) are included in the recruitment, fishing mortality, and spawning-stock biomass plots. FW is the fishing mortality weighted by the population numbers.

† Version 2: In October 2017, an error was detected in the conversion of acoustic data from the Norwegian acoustic survey on the spawning grounds survey index ("Fleet 1") for the period 1988 –2008; the error meant that abundance indices from this period had been significantly underestimated. The error affected both the advice for 2017, issued in September 2016, and that for 2018, issued in September 2017. The corrected catch advice for 2017 and 2018 is based on the corrected 2017 assessment. The corrected assessment results in a 14% downwards revision of the SSB value in 2017 and a 15% upwards revision of the F value in 2016 relative to the assessment used for the advice released in September 2017. Applying the long-term management plan results in a 32% downwards revision relative to the previously released catch advice for 2017 and a 30% downwards revision relative to the previously released catch advice for 2018.

‡ Version 2: plots updated to reflect the corrected assessment.

Stock and exploitation status

Table 1 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). State of the stock and fishery relative to reference points.

		Fishing pressure				Stock size			
		2014	2015	2016		2015	2016	2017	
Maximum sustainable yield	F_{MSY}	✓	✓	✓	Below	MSY $B_{trigger}$	✗	✗	✗ Below trigger
Precautionary approach	F_{pa},F_{lim}	✓	✓	✓	Harvested sustainably	B_{pa},B_{lim}	o	o	o Increased risk
Management plan	F_{MGT}	✓	✓	✓	Below	SSB_{MGT}	✗	✗	✗ Below

Catch options for 2018

Table 2[§] Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis for the catch options.

Variable	Value	Source	Notes
F ages 5–11 (2017)	0.191	ICES (2017)	Based on ICES estimated catches 2017.
SSB (2018)	3691000 t	ICES (2017)	
R_{age2} (2017)	9512000 thousand	ICES (2017)	Estimated by XSAM.
R_{age2} (2018)	11069000 thousand	ICES (2017)	Median of stochastic recruitment estimated by XSAM, based on the years 1988–2017.
Catch (2017)	805142 t	ICES (2017)	Sum of declared national quotas.

Table 3[§] Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Annual catch options. All weights are in tonnes.

Basis	Total catch (2018)	FW (2018)*	SSB (2019)	% SSB change **	% Catch change ***
ICES advice basis					
Agreed management plan^	384197	0.086	3629000	-2	-52
Other options					
MSY approach: FMSY × SSB(2018)/MSY Btrigger	489022	0.111	3538000	-4	-39
FMSY	647543	0.150	3399000	-8	-20
F = 0	0	0	3967000	7	-100
Fpa	647543	0.150	3399000	-8	-20
Flim^^	---	---	---	---	---
SSB (2019) = Blim	1690033	0.47	2500000	-32	110
SSB (2019) = Bpa = MSY Btrigger ^^^	---	---	---	---	---
F = F2017	804951	0.191	3262000	-12	0

* F_w = Fishing mortality weighted by population numbers (age groups 5–11).
** SSB 2019 relative to SSB 2018.
*** Catch in 2018 relative to estimated catch in 2017 (805 142 t).
^ According to the harvest control rule in the management plan F(2018) = 0.125 × (SSB(2018)−B_{lim})/(B_{pa}−B_{lim}) + 0.05 × (B_{pa}−SSB(2018))/(B_{pa}−B_{lim}), where B_{pa} = 5, B_{lim} = 2.5 and SSB(2018) = 3.691, expressed in million t.
^^ F_{lim} is presently undefined for this stock.
^^^ Even with zero catch in 2018 the stock is predicted to be below B_{pa} and MSY $B_{trigger}$ in 2019.

[§] Version 2: table values corrected.

Basis of the advice

Table 4 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). The basis of the advice.

Advice basis	Management plan.
Management plan	A long-term management plan was agreed by the EU, Faroe Islands, Iceland, Norway, and Russia in 1999 (see Annex 9.3.11.1 in ICES, 2014). ICES has evaluated the plan and concluded that it is consistent with the precautionary approach (ICES, 2013a).

Quality of the assessment

This year's forecast deals with the intermediate year (2017) in a different way from what was done in 2016. This is because the approach used in 2016 was forecasting substantial change in the selection pattern for the intermediate and forecast years relative to what had been estimated for the final years in the assessment, and it was unclear if such a change was realistic.

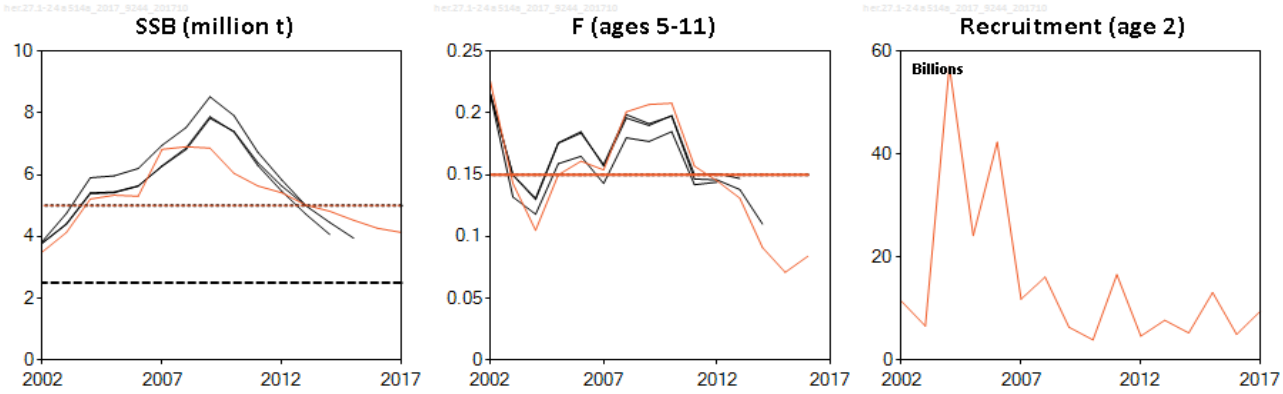

Figure 2[**] Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Historical assessment results. The 2016 assessment is not included in these plots as it has been found to be erroneous. Prior to the 2017 assessment, estimates of F refer to ages 5–14. Recruitment estimates from assessments conducted before 2016 are not shown as they refer to age 0 instead of age 2.

Issues relevant for the advice

An error in the conversion of acoustic data from the Norwegian acoustic survey on the spawning grounds survey index ("Fleet 1") for the period 1988–2008 implied that abundance indices from this period were significantly underestimated in both the 2016 and 2017 assessment. The 2017 assessment has now been corrected and the current advice for 2018 provides a correction of the advice released in September 2017.

Because the error also affected the catch advice for 2017 (issued in September 2016), a correction of the catch advice for 2017 is also included in this document. The correction to this catch advice is based on the corrected 2017 assessment. According to the harvest control rule in the management plan: $F(2017) = 0.125 \times (SSB(2017)-B_{lim})/(B_{pa}-B_{lim}) + 0.05 \times (B_{pa}-SSB(2017))/(B_{pa}-B_{lim})$, where $B_{pa} = 5$, $B_{lim} = 2.5$ and $SSB(2017) = 4.131$, expressed in million tonnes; this results in $F(2017)=0.099$, corresponding to catches of no more than 437 364 tonnes in 2017.

The reductions in the catch advice for 2017 and 2018, relative to the (incorrect) advice originally provided, are due to the fact that the corrected assessment estimates lower SSB for recent years. As a consequence, the estimated SSB is further below B_{pa}, resulting in lower values of F in 2017 and 2018 when the harvest control rule in the management plan is applied.

[**] Version 2: plots corrected.

The F in the management plan and reference points refers to ages 5–14, whereas the F from the current assessment is for ages 5–11. A complete exploration of this issue is still needed. When this is done, taking into account the substantial changes that are estimated to have occured historically on the selection pattern, it will be appropriate to consider whether there are harvest strategies that are more robust to significant changes in the estimated selection in the fisheries (e.g. applying a constant selection pattern in the harvest control rule).

Reference points

Table 5 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	5.0 million t	B_{pa}	
	F_{MSY}	0.15	Stochastic equilibrium analysis using a Beverton–Holt stock–recruitment relationship with data from 1950 to 2009.	ICES (2013b)
Precautionary approach	B_{lim}	2.5 million t	MBAL (accepted in 1998).	ICES (2013b)
	B_{pa}	5.0 million t	$B_{lim} \times \exp(0.4 \times 1.645)$.	ICES (2013b)
	F_{lim}	Not defined.	-	
	F_{pa}	0.15	Based on medium-term simulations.	ICES (2013b)
EU–Faroes–Iceland–Norway–Russia long-term management strategy	SSB_{mgt_lower}	2.5 million t	Medium-term simulations conducted in 2001 and 2014.	ICES (2014)
	SSB_{mgt}	5.0 million t		
	F_{mgt_lower}	0.05		
	F_{mgt}	0.125		

Basis of the assessment

Table 6 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2016a).
Assessment type	Statistical assessment model (XSAM; ICES, 2017) that uses catches in the model and in the forecast and also includes error structures in catches and abundance indices.
Input data	Assessment period 1988–2017: Commercial catches-at-age (stock weight-at-age from surveys and since 2009 from catch sampling). Three survey indices: Norwegian acoustic survey on spawning grounds in February/March (NASF, 1994–2005, 2015–2017); International Ecosystem Survey in the Nordic Seas (IESNS) covering the adult stock in the Nordic seas (1996–2017) and the juvenile stock in the Barents Sea (1991–2017). Maturity ogive variable by year-class strength. Natural mortalities are fixed values from historical analyses (age 2 = 0.9, ages greater than 3 = 0.15).
Discards and bycatch	Not included, considered negligible.
Indicators	None.
Other information	This stock was benchmarked in 2016 (ICES, 2016b). A re-evaluation of reference points and the current management plan is scheduled to take place before WGWIDE 2018.
Working group	Working Group on Widely Distributed Stocks (WGWIDE)

Information from stakeholders

Over the last year the EU pelagic industry has conducted its fishery on the traditional fishing grounds. No changes in distribution have been observed. The fishery in 2016 and 2017 has been characterized by large shoals in both the January fishery and in the autumn season, with higher catch rates than in previous years.

History of the advice, catch, and management

Table 7 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). ICES advice and landings. All weights are in tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Sum of agreed quotas[††]	ICES catch
1987	TAC	150000	115000	127306
1988	TAC	120000–150000	120000	135301
1989	TAC	100000	100000	103830
1990	TAC	80000	80000	86411
1991	No fishing from a biological point of view	0	76000	84683
1992	No fishing from a biological point of view	0	98000	104448
1993	No increase in F	119000	200000	232457
1994	Gradual increase in F towards $F_{0.1}$; TAC suggested	334000	450000	479228
1995	No increase in F	513000	900000*	905501
1996	Keep SSB above 2.5 million t	-	1425000*	1220283
1997	Keep SSB above 2.5 million t	-	1500000	1426507
1998	Do not exceed the harvest control rule	-	1300000	1223131
1999	Do not exceed the harvest control rule	1263000	1300000	1235433
2000	Do not exceed the harvest control rule	Max 1500000	1250000	1207201
2001	Do not exceed the harvest control rule	753000	850000	766136
2002	Do not exceed the harvest control rule	853000	850000	807795
2003	Do not exceed the harvest control rule	710000	711000*	789510
2004	Do not exceed the harvest control rule	825000	825000*	794066
2005	Do not exceed the harvest control rule	890000	1000000*	1003243
2006	Do not exceed the harvest control rule	732000	967000*	968958
2007	Do not exceed the harvest control rule	1280000	1280000	1266993
2008	Do not exceed the harvest control rule	1518000	1518000	1545656
2009	Do not exceed the harvest control rule	1643000	1643000	1687371
2010	Do not exceed the harvest control rule	1483000	1483000	1457015
2011	See scenarios	988000–1170000	988000	992997
2012	Follow the management plan	833000	833000	826000
2013	Follow the management plan	619000	692000*	684743
2014	Follow the management plan	418487	436893*	461306
2015	Follow the management plan	283013	328206*	328740
2016	Follow the management plan	≤ 316876	376612*	383174
2017	Follow the management plan	≤ 437364[‡‡]	805142*	
2018	Follow the management plan	≤ 384197[§§]		

* There was no agreement on the TAC; the number is the sum of autonomous quotas from the individual Parties.

[††] Version 3: title of column changed, previous advice values added to footnotes below.

[‡‡] Version 2: value corrected in October 2017 (previously 646 075 t).

[§§] Version 2: value corrected in October 2017 (previously 546 472 t).

History of the catch and landings

Table 8 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Landings		Discards
383 174 t	49% purse seine	51% pelagic trawl	Discarding is considered to be negligible, but some slippage is known to occur.
	383 174 t		

Table 9 Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). History of commercial landings; ICES estimated values are presented for each country participating in the fishery. All weights are in tonnes.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireland	Netherlands	Greenland	UK (Scotland)	Germany	France	Poland	Sweden	Total
1986	199256	26000	-	-	-	-	-	-	-	-	-	-	-	225256
1987	108417	18889	-	-	-	-	-	-	-	-	-	-	-	127306
1988	115076	20225	-	-	-	-	-	-	-	-	-	-	-	135301
1989	88707	15123	-	-	-	-	-	-	-	-	-	-	-	103830
1990	74604	11807	-	-	-	-	-	-	-	-	-	-	-	86411
1991	73683	11000	-	-	-	-	-	-	-	-	-	-	-	84683
1992	91111	13337	-	-	-	-	-	-	-	-	-	-	-	104448
1993	199771	32645	-	-	-	-	-	-	-	-	-	-	-	232457
1994	380771	74400	-	2911	21146	-	-	-	-	-	-	-	-	479228
1995	529838	101987	30577	57084	174109	-	7969	2500	881	556	-	-	-	905501
1996	699161	119290	60681	52788	164957	19541	19664	-	46131	11978	-	-	22424	1220283
1997	860963	168900	44292	59987	220154	11179	8694	-	25149	6190	1500	-	19499	1426507
1998	743925	124049	35519	68136	197789	2437	12827	-	15971	7003	605	-	14863	1223131
1999	740640	157328	37010	55527	203381	2412	5871	-	19207	-	-	-	14057	1235433
2000	713500	163261	34968	68625	186035	8939	-	-	14096	3298	-	-	14749	1207201
2001	495036	109054	24038	34170	77693	6070	6439	-	12230	1588	-	-	9818	766136
2002	487233	113763	18998	32302	127197	1699	9392	-	3482	3017	-	1226	9486	807795
2003	477573	122846	14144	27943	117910	1400	8678	-	9214	3371	-	-	6431	789510
2004	477076	115876	23111	42771	102787	11	17369	-	1869	4810	400	-	7986	794066
2005	580804	132099	28368	65071	156467	-	21517	-	-	17676	0	561	680	1003243
2006*	567237	120836	18449	63137	157474	4693	11625	-	12523	9958	80	-	2946	968958
2007	779089	162434	22911	64251	173621	6411	29764	4897	13244	6038	0	4333	0	1266993
2008	961603	193119	31128	74261	217602	7903	28155	3810	19737	8338	0	0	0	1545656
2009	101667	210105	32320	85098	265479	10014	24021	3730	25477	14452	0	0	0	1687371
2010	871113	199472	26792	80281	205864	8061	26695	3453	24151	11133	0	0	0	1457015
2011	572641	144428	26740	53271	151074	5727	8348	3426	14045	13296	0	0	0	992997
2012	491005	118595	21754	36190	120956	4813	6237	1490	12310	11945	0	0	705	826000
2013	359458	78521	17160	10503	90729	3815	5626	11788	8342	4244	0	0	23	684743
2014	263253	60292	12513	38529	58828	706	9175	13108	4233	669	0	0	0	461306
2015	176321	45853	9105	33031	42625	1400	5255	12434	55	2660	0	0	0	328740
2016	197501	50455	10384	44727	50418	2048	3519	17508	4031	2582	0	0	0	383174

* In 2006 Scotland and Northern Ireland combined.

Summary of the assessment

Table 10[***] Herring in subareas 1, 2, and 5, and in divisions 4.a and 14.a (Norwegian spring-spawning herring). Assessment summary. Weights are in tonnes.

Year	Recruitment age 2 (thousands)	Rec. 97.5th percentile	Rec. 2.5th percentile	Stock size: SSB (tonnes)	SSB 97.5th percentile	SSB 2.5th percentile	Catches (tonnes)	Fishing pressure F_W (ages 5–11)	F_w 97.5th percentile	F_w 2.5th percentile
1988	641000	934000	348000	2142000	2447000	1836000	135301	0.041	0.059	0.023
1989	1149000	1606000	691000	3315000	3789000	2841000	103830	0.033	0.048	0.018
1990	4284000	5339000	3229000	3587000	4088000	3085000	86411	0.030	0.043	0.016
1991	11337000	13379000	9295000	3360000	3828000	2891000	84683	0.030	0.044	0.016
1992	18535000	21472000	15597000	3384000	3830000	2938000	104448	0.037	0.054	0.021
1993	49666000	55729000	43603000	3350000	3750000	2950000	232457	0.075	0.101	0.049
1994	59516000	66309000	52724000	3476000	3874000	3079000	479228	0.127	0.162	0.093
1995	15486000	18010000	12963000	3539000	3919000	3158000	905501	0.180	0.23	0.136
1996	5666000	6840000	4492000	4101000	4482000	3719000	1220283	0.166	0.20	0.132
1997	2041000	2581000	1501000	5343000	5799000	4888000	1426507	0.183	0.22	0.151
1998	10524000	12375000	8672000	5902000	6404000	5399000	1223131	0.183	0.22	0.149
1999	6370000	7635000	5106000	5776000	6301000	5251000	1235433	0.21	0.25	0.169
2000	32514000	36865000	28164000	4802000	5282000	4322000	1207201	0.25	0.30	0.20
2001	28688000	32711000	24666000	3973000	4402000	3544000	766136	0.20	0.25	0.161
2002	11402000	13451000	9352000	3502000	3899000	3104000	807795	0.23	0.27	0.179
2003	6587000	7939000	5235000	4128000	4570000	3686000	789510	0.143	0.173	0.113
2004	57123000	64280000	49966000	5213000	5751000	4675000	794066	0.105	0.129	0.081
2005	24180000	27994000	20366000	5339000	5906000	4772000	1003243	0.150	0.183	0.116
2006	42338000	48624000	36052000	5307000	5870000	4744000	968958	0.161	0.199	0.124
2007	11809000	14167000	9451000	6824000	7531000	6116000	1266993	0.154	0.186	0.122
2008	16105000	19268000	12943000	6908000	7667000	6148000	1545656	0.20	0.24	0.160
2009	6354000	7932000	4776000	6865000	7690000	6040000	1687373	0.21	0.25	0.166
2010	3888000	5022000	2754000	6048000	6866000	5230000	1457014	0.21	0.25	0.164
2011	16577000	20710000	12445000	5638000	6486000	4789000	992998	0.157	0.193	0.120
2012	4638000	6171000	3106000	5416000	6297000	4535000	825999	0.145	0.180	0.110
2013	7712000	10393000	5031000	5019000	5878000	4160000	684743	0.131	0.165	0.098
2014	5239000	7519000	2960000	4819000	5686000	3953000	461306	0.091	0.115	0.066
2015	13096000	19168000	7023000	4527000	5372000	3682000	328740	0.071	0.092	0.050
2016	4963000	8973000	953000	4266000	5072000	3460000	383174	0.084	0.110	0.058
2017	9512000	20857000	0	4131000	4934000	3328000				

[***] Version 2: table values corrected.

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