

Request from Portugal and Spain for an updated advice for 2021 on catch opportunities for sardine (*Sardina pilchardus*) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters)

ICES advice on fishing opportunities

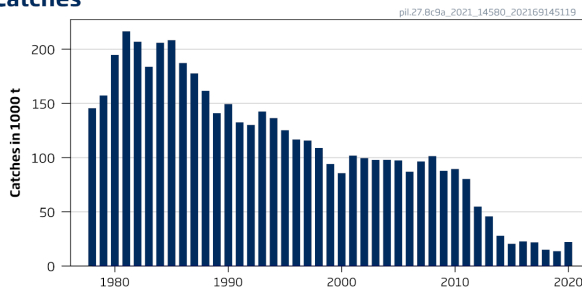
The current advice for 2021 replaces the advice provided in June 2020.

ICES advises that when the MSY approach is applied, catches in 2021 should be no more than 40 434 tonnes.

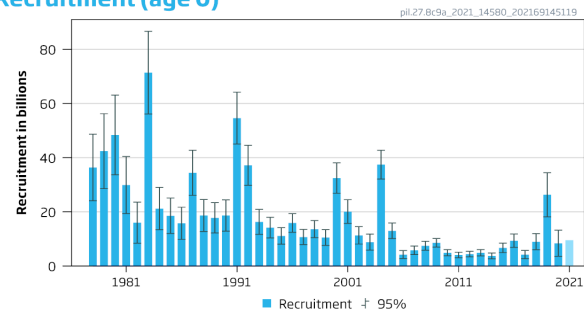
Stock development over time

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

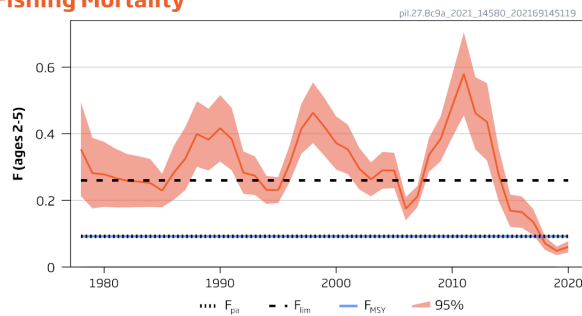
Catches



Recruitment (age 0)



Fishing Mortality



Biomass 1+

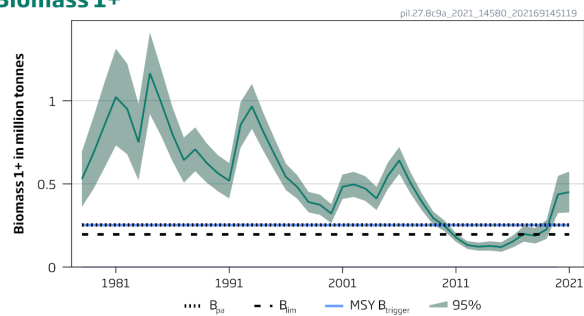


Figure 1 Sardine in divisions 8.c and 9.a. Summary of the stock assessment. The assumed recruitment value for 2021 is shaded in a lighter colour. The current reference points reflect the low productivity regime since 2006. Plots show the relevant confidence intervals.

Catch scenarios

ICES received a special request from Portugal and Spain to update the catch advice for 2021 based on the most recent data available for the stock assessment conducted in May 2021.

Table 2 Sardine in divisions 8.c and 9.a. The basis for the revised catch options for 2021.

Variable	Value	Notes
$F_{\text{ages 2-5}}$ (2020)	0.061	$F_{\text{ages 2-5}}$ estimated in the updated assessment
B1+ (2021)	451 177	Estimated in the updated assessment; tonnes
$R_{\text{age 0}}$ (2020)	8 395 340	Estimated in the updated assessment; thousands
$R_{\text{age 0}}$ (2021)	9 515 637	Geometric mean (GM 2016–2020); thousands
Total catch (2020)	22 143	Official catch; tonnes
Discards (2020)	Negligible	-

Table 3 Sardine in divisions 8.c and 9.a. Annual catch scenarios for the revised catch advice for 2021. All weights are in tonnes.

Basis	Catch (2021)	F (2021)	Biomass 1+ (2022)	% Biomass 1+ change *	% Catch change **	% Advice change ***
ICES advice basis						
MSY approach: F_{MSY}	40 434	0.092	429 076	-5	83	428
Other scenarios						
$F = F_{\text{MSY}} = F_{\text{pa}}$	40 434	0.092	429 076	-5	83	428
$F_{2021} = F_{2020}$	26 928	0.061	438 691	-3	22	179
HCR30 [^]	30 000	0.068	436 502	-3	35	211
HCR35 [^]	35 000	0.079	432 942	-4	58	262
HCR40 [^]	40 000	0.091	429 384	-5	81	314
HCR45 [^]	45 000	0.103	425 831	-6	103	366
HCR50 [^]	50 000	0.115	422 280	-6	126	418
F_{lim}	107 104	0.26	638 980	-15	384	1009
B1+ (2021) = B_{lim} (196334)	378 840	1.32	196 334	-56	1611	3822
B1+ (2021) = $B_{\text{pa}} = \text{MSY } B_{\text{trigger}}$ (252523)	296 600	0.91	252 523	-44	1239	2970

* Biomass 1+ in 2022 relative to biomass 1+ in 2021 (451 177 tonnes).

** Advised catches in 2021 compared to 2020 catches (22 143 tonnes).

*** Advised catches in 2021 compared to advised catches for 2020 (9660 tonnes)

[^] Precautionary harvest control rule (HCR [ICES, 2021a]). The fishing mortality according to the HCR for the estimated B1+ at the beginning of 2021 would be 0.12 but with the value capped by the maximum allowed catches (e.g. the cap for HCR30 is 30 000 tonnes).

The upward revision of the catch advice for 2021 is a consequence of the upward revision of the F_{MSY} reference point and the assessment being updated with the most recent information.

Basis of the advice

Table 4 Sardine in divisions 8.c and 9.a. The basis of the advice.

Advice basis	MSY approach
Management plan	ICES evaluated an HCR that is proposed to be part of a management plan for 2021–2026 and found it be precautionary with maximum allowed catches between 30 000 and 50 000 tonnes (ICES, 2021a). For 2021, the European Commission requested ICES to provide advice based on the MSY approach and include the HCR in other catch scenarios.

Quality of the assessment

The collection of data from the commercial fishery and research surveys during 2020 has been impacted by COVID-19 restrictions to a varying degree across member states (ICES, 2021b). This has had an impact on the quality of the data used in the assessment.

Data from the Spanish (PELACUS) and Portuguese (PELAGO) acoustic surveys inform a joint index in the assessment model. The PELACUS survey in 2020 could not be carried out because of the COVID-19 disruption. As the PELAGO survey represents the majority of the population in numbers (mean = 91%), and a significant correlation exists between sardine abundance of the two surveys, the PELAGO index was adjusted to account for the lack of estimation from the PELACUS survey. Both surveys were fully conducted in 2021. Similarly, the Spanish component of the 2020 DEPM surveys was not undertaken, and the same approach was used to derive the index.

It was not possible to estimate a total discard rate because of the COVID-19 pandemic disrupting on-board sampling. Discards, however, are generally negligible in this area.

The assessment of 2021 shows a poor fit to the 2021 point estimate of the acoustic survey index (ICES, 2020). The model has a tendency to underestimate abundance in years when the survey index is large, such as in 2020 and 2021.

In the previous advice for 2021 issued in June 2020, the assumptions made for 2020 recruitment and 2021 biomass in the interim year were lower than the estimates used in the current advice.

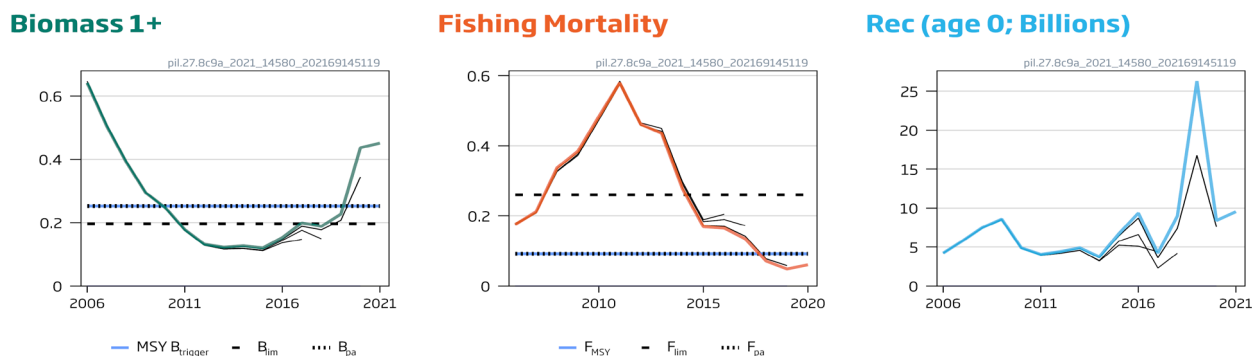


Figure 2 Sardine in divisions 8.c and 9.a. Historical assessment results. For each line in the recruitment plot, the most recent value is an assumption. Biomass 1+ in million tonnes.

Issues relevant for the advice

In 2021 ICES received a request from Portugal and Spain to evaluate a harvest control rule (HCR) that is proposed to be part of a management plan for 2021–2026. ICES found that the HCR was precautionary with maximum allowed catches between 30 000 and 50 000 tonnes (ICES, 2021a).

ICES considers that the stock remains in a low productivity regime. The F_{MSY} corresponding to this regime has been re-estimated in 2021 through an MSE using the most recent information (ICES 2021c). As a result, the F_{MSY} was revised upwards from 0.032 to 0.092 and is the main reason for the large update in the advice.

Reference points

Reference points were revised in 2021 in a management strategy evaluation (MSE) using the most recent information on the stock (ICES, 2021c).

Table 5 Sardine in divisions 8.c and 9.a. Reference points, values, and their technical basis. Weights in tonnes.

Framework	Reference	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	252 523	B_{pa}	ICES (2021c)
	F_{MSY}	0.092	The F that maximizes long-term yield under the constraint that the long-term probability ($SSB < B_{lim}$) \leq 5% when applying ICES MSY advice rule (F_{P05}); calculated by stochastic simulation (MSE)	ICES (2021c)
Precautionary approach	B_{lim}	196 334	Break point of segmented regression fitted to stock–recruitment estimates for 2006–2017	ICES (2021c)
	B_{pa}	252 523	$B_{pa} = B_{lim} \times \exp(1.645 \times \sigma)$, with $\sigma = 0.153$ (coefficient of variation of SSB_{2017} , from the 2018 assessment)	ICES (2021c)
	F_{lim}	0.26	The F that results in long-term probability ($SSB < B_{lim}$) = 50%; calculated by stochastic simulation (MSE)	ICES (2021c)
	F_{pa}	0.092	F_{P05} ; the F that leads to $SSB \geq B_{lim}$ with 95% probability (MSE)	ICES (2021c)
Management plan	SSB_{mgt}	Not defined		
	F_{mgt}	Not defined		

Basis of the assessment

Table 6 Sardine in divisions 8.c and 9.a. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2021d)
Assessment type	Age-based analytical assessment (Stock Synthesis) that uses catches in the model and in the forecast (ICES, 2021b)
Input data	Commercial catches (international landings, ages from catch sampling); annual acoustic spring survey indices (ages from PELAGO and PELACUS [A2548; 1996–2021]), triennial spawning–stock biomass (SSB) indices from the Sardine Daily Eggs Production Method survey (PT-DEPM and SP-DEPM [I9787]; triennial stock weights and maturity data from DEPM (PT-DEPM and SP-DEPM [I9787 (1997–2020), interpolated for other years; natural mortalities based on the Gislason formula (Gislason <i>et al.</i> , 2010).
Discards and bycatch	Discarding and bycatch are considered negligible and are not included in the assessment
Indicators	None
Other information	This stock was benchmarked in 2017 (WKPELA; ICES, 2017). Biological reference points were updated in 2021 (ICES, 2021c).
Working group	Working Group on Southern Horse Mackerel, Anchovy, and Sardine (WGHANSA)

History of the advice, catch, and management

Table 7 Sardine in divisions 8.c and 9.a. ICES advice and official landings. All weights are in tonnes. No official TAC is set for this stock.

Year	ICES advice	Catch corresponding to advice	Official landings	ICES catch*
1987	No increase in F; TAC	140000	n/a	177696
1988	No increase in F; TAC	150000	167000	161531
1989	No increase in F; TAC	212000	146000	140961
1990	Room for increased F	-	150000	149429
1991	Precautionary TAC	176000	135000	132587
1992	No advice	-	139000	130250
1993	Precautionary TAC	135000	153000	142495
1994	No advice	-	147000	136582
1995	No advice; apparently stable stock	-	137000	125280
1996	Lowest possible level	-	134000	116736
1997	Lowest possible level	-	n/a	115814
1998	Significant reduction	-	n/a	108924
1999	Reduce F to 0.2	38000	n/a	94091

Year	ICES advice	Catch corresponding to advice	Official landings	ICES catch*
2000	F below 0.2	< 81000	n/a	85786
2001	F below 0.2	< 88000	n/a	101957
2002	F below 0.25	< 95000	n/a	99673
2003	No increase in F	100000	n/a	97831
2004	No increase in F	128000	n/a	98020
2005	No increase in F	106000	n/a	97345
2006	No increase in F	96000	n/a	87023
2007	No increase in F	114000	n/a	96469
2008	No increase in F	92000	n/a	101464
2009	No increase in F	71000	n/a	87740
2010	No increase in F	75000	n/a	89571
2011	Maintain F at the 2002–2007 level	75000	77000	80403
2012	Reduce F to the 2002–2007 level	36000	52000	54857
2013	Reduce F to the 2002–2007 level	< 55000	46000	45818
2014	Reduce F to the 2002–2007 level, adjusted to low biomass	< 17000	27937	27937
2015	Reduce F to the 2002–2007 level, adjusted to low biomass	< 16000	20595	20595
2016**	Management plan	≤ 12000	22704	22704
2017	Management plan	≤ 23000	21911	21911
2018	MSY approach	0	15062	15062
2019	MSY approach	0	13760	13760
2020***	MSY approach	≤ 9660	22143	22143
2021#	MSY approach	≤ 40434		

n/a = not available.

* Includes only divisions 8.c and 9.a.

** Catch advice for 2016 updated in July 2016.

*** Catch advice for 2020 updated in June 2020.

Catch advice for 2021 updated in June 2021.

History of the catch and landings

Table 8 Sardine in divisions 8.c and 9.a. Catch distribution by fleet in 2020, as estimated by ICES.

Catch (2020)	Landings		Discards
	Purse-seine 99%	Other gear types 1%	
22 143 tonnes	22 143 tonnes		Discarding is considered negligible

Table 9 Sardine in divisions 8.c and 9.a. History of ICES catch; values are presented by area. All weights are in tonnes.

Year	Division 8.c	Division 9.a					Total 9.a	Total catch (divisions 8.c and 9.a)
		North	Central-North	Central-South	South Algarve	South Cadiz		
1940	66816		42132	33275	23724		99131	165947
1941	27801		26599	34423	9391		70413	98214
1942	47208		40969	31957	8739		81665	128873
1943	46348		85692	31362	15871		132925	179273
1944	76147		88643	31135	8450		128228	204375
1945	67998		64313	37289	7426		109028	177026
1946	32280	1231	68787	26430	12237		108685	140965
1947	43459	21855	55407	25003	15667		117932	161391
1948	10945	17320	50288	17060	10674		95342	106287
1949	11519	19504	37868	12077	8952		78401	89920
1950	13201	27121	47388	17025	17963		109497	122698
1951	12713	27959	43906	15056	19269		106190	118903
1952	7765	30485	40938	22687	25331		119441	127206
1953	4969	27569	68145	16969	12051		124734	129703
1954	8836	28816	62467	25736	24084		141103	149939
1955	6851	30804	55618	15191	21150		122763	129614
1956	12074	29614	58128	24069	14475		126286	138360
1957	15624	37170	75896	20231	15010		148307	163931
1958	29743	41143	92790	33937	12554		180424	210167
1959	42005	36055	87845	23754	11680		159334	201339
1960	38244	60713	83331	24384	24062		192490	230734
1961	51212	59570	96105	22872	16528		195075	246287
1962	28891	46381	77701	29643	23528		177253	206144
1963	33796	51979	86859	17595	12397		168830	202626
1964	36390	40897	108065	27636	22035		198633	235023
1965	31732	47036	82354	35003	18797		183190	214922
1966	32196	44154	66929	34153	20855		166091	198287
1967	23480	45595	64210	31576	16635		158016	181496
1968	24690	51828	46215	16671	14993		129707	154397
1969	38254	40732	37782	13852	9350		101716	139970
1970	28934	32306	37608	12989	14257		97160	126094
1971	41691	48637	36728	16917	16534		118816	160507
1972	33800	45275	34889	18007	19200		117371	151171
1973	44768	18523	46984	27688	19570		112765	157533
1974	34536	13894	36339	18717	14244		83194	117730
1975	50260	12236	54819	19295	16714		103064	153324
1976	51901	10140	43435	16548	12538		82661	134562
1977	36149	9782	37064	17496	20745		85087	121236
1978	43522	12915	34246	25974	23333	5619	102087	145609
1979	18271	43876	39651	27532	24111	3800	138970	157241
1980	35787	49593	59290	29433	17579	3120	159015	194802
1981	35550	65330	61150	37054	15048	2384	180967	216517
1982	31756	71889	45865	38082	16912	2442	175190	206946
1983	32374	62843	33163	31163	21607	2688	151463	183837
1984	27970	79606	42798	35032	17280	3319	178035	206005
1985	25907	66491	61755	31535	18418	4333	182532	208439
1986	39195	37960	57360	31737	14354	6757	148168	187363
1987	36377	42234	44806	27795	17613	8870	141319	177696
1988	40944	24005	52779	27420	13393	2990	120587	161531
1989	29856	16179	52585	26783	11723	3835	111105	140961
1990	27500	19253	52212	24723	19238	6503	121929	149429
1991	20735	14383	44379	26150	22106	4834	111852	132587
1992	26160	16579	41681	29968	11666	4196	104090	130250
1993	24486	23905	47284	29995	13160	3664	118009	142495
1994	22181	16151	49136	30390	14942	3782	114401	136582

Year	Division 8.c	Division 9.a						Total catch (divisions 8.c and 9.a)
		North	Central-North	Central-South	South Algarve	South Cadiz	Total 9.a	
1995	19538	13928	41444	27270	19104	3996	105742	125280
1996	14423	11251	34761	31117	19880	5304	102313	116736
1997	15587	12291	34156	25863	21137	6780	100227	115814
1998	16177	3263	32584	29564	20743	6594	92747	108924
1999	11862	2563	31574	21747	18499	7846	82229	94091
2000	11697	2866	23311	23701	19129	5081	74089	85786
2001	16798	8398	32726	25619	13350	5066	85159	101957
2002	15885	4562	33585	22969	10982	11689	83787	99673
2003	16436	6383	33293	24635	8600	8484	81395	97831
2004	18306	8573	29488	24370	8107	9176	79714	98020
2005	19800	11663	25696	24619	7175	8391	77545	97345
2006	15377	10856	30152	19061	5798	5779	71646	87023
2007	13380	12402	41090	19142	4266	6188	83088	96469
2008	13636	9409	45210	20858	4928	7423	87828	101464
2009	11963	7226	36212	20838	4785	6716	75777	87740
2010	13772	7409	40923	17623	5181	4662	75798	89571
2011	8536	5621	37152	13685	6387	9023	71867	80403
2012	13090	4154	19647	9045	2891	6031	41768	54857
2013	5272	2128	15065	9084	4112	10157	40546	45818
2014	4344	1924	6889	6747	2398	5635	23593	27937
2015	1916	1946	7117	4848	1812	2956	18679	20595
2016	2886	2887	7695	4031	1972	3233	19818	22704
2017	2251	2225	5182	6676	2836	2741	19660	21911
2018	2764	856	3579	4759	1400	1704	12298	15062
2019	1608	1076	3520	4290	1986	1280	12152	13760
2020	2822	1950	5049	7560	2807	1955	19321	22143

Summary of the assessment

Table 10 Sardine in divisions 8.c and 9.a. Assessment summary. 97.5% and 2.5% refer to the confidence interval.

Year	Recruitment			Spawning–stock biomass			Total catch	Fishing Mortality		
	Age 0	97.5%	2.5%	Biomass 1+	97.5%	2.5%		Ages 2–5	97.5%	2.5%
	thousands			tonnes						
1978	36382900	48684360	24081440	528196	694822	361570	145609	0.35	0.49	0.21
1979	42399400	56228540	28570260	681938	897247	466629	157241	0.28	0.39	0.176
1980	48386800	63110940	33662660	854555	1111969	597141	194802	0.28	0.38	0.181
1981	29890200	40423400	19357000	1022850	1313740	731960	216517	0.27	0.35	0.179
1982	16009100	23625680	8392520	950519	1223553	677485	206946	0.26	0.34	0.179
1983	71387100	86653860	56120340	750671	981136	520206	183837	0.26	0.33	0.180
1984	21205000	29004960	13405040	1165910	1412045	919775	206005	0.25	0.32	0.180
1985	18550600	25115700	11985500	988419	1189864	786974	208439	0.23	0.28	0.179
1986	15766900	21713060	9820740	797770	960245	635295	187363	0.28	0.36	0.20
1987	34407400	42741900	26072900	642958	778658	507258	177696	0.33	0.42	0.23
1988	18642100	24570380	12713820	708281	840446	576116	161531	0.40	0.50	0.30
1989	17798500	23402340	12194660	626856	745511	508201	140961	0.38	0.48	0.29
1990	18632200	24412200	12852200	564237	673008	455466	149429	0.42	0.52	0.32
1991	54620200	64191180	45049220	518913	625214	412612	132587	0.38	0.48	0.29
1992	37181800	44563980	29799620	854819	991716	717922	130250	0.28	0.35	0.22
1993	16285400	20912080	11658720	966331	1102154	830508	142495	0.27	0.33	0.22
1994	14186100	18002720	10369480	814712	929911	699513	136582	0.23	0.27	0.189
1995	11126800	14169940	8083660	675839	772344	579334	125280	0.23	0.27	0.192
1996	15899500	19356860	12442140	542019	621824	462214	116736	0.31	0.37	0.26
1997	10699600	13517060	7882140	481397	552193	410601	115814	0.42	0.49	0.34
1998	13622700	16784360	10461040	390384	452099	328669	108924	0.46	0.55	0.37
1999	10521300	13434520	7608080	374768	435703	313833	94091	0.42	0.51	0.33
2000	32465500	38087060	26843940	321627	378872	264382	85786	0.37	0.45	0.29
2001	20097500	24491840	15703160	483156	557236	409076	101957	0.35	0.43	0.28
2002	11315000	14533280	8096720	497053	572546	421560	99673	0.29	0.36	0.23
2003	8821960	11772140	5871780	472189	546514	397864	97831	0.26	0.31	0.21
2004	37426200	42750960	32101440	412281	482119	342443	98020	0.29	0.35	0.24
2005	13003500	15874560	10132440	549029	628807	469251	97345	0.29	0.34	0.24
2006	4221700	5708444	2734956	641571	722471	560671	87023	0.175	0.21	0.140
2007	5795130	7364106	4226154	504992	569407	440577	96469	0.21	0.24	0.180
2008	7479270	9131954	5826586	391359	442614	340104	101464	0.34	0.39	0.29
2009	8573310	10164678	6981942	294087	333897	254277	87740	0.38	0.45	0.32
2010	4895460	6054126	3736794	247357	279443	215271	89571	0.48	0.58	0.39
2011	4059110	5078210	3040010	177761	203739	151783	80403	0.58	0.70	0.46
2012	4414100	5443976	3384224	132073	155843	108303	54857	0.46	0.57	0.35
2013	4896510	6078198	3714822	122338	146811	97865	45818	0.44	0.55	0.32
2014	3737170	4819070	2655270	126854	155031	98677	27937	0.28	0.36	0.198
2015	6700910	8470372	4931448	120221	149248	91194	20595	0.169	0.22	0.120
2016	9338230	11797410	6879050	152878	188833	116923	22704	0.165	0.21	0.118
2017	4218480	5752092	2684868	198977	245811	152143	21911	0.134	0.173	0.095
2018	8972500	11935140	6009860	188090	235094	141086	15062	0.071	0.091	0.051
2019	26291600	34430080	18153120	226681	283810	169552	13759	0.049	0.061	0.036
2020	8395340	13238820	3551860	436594	548399	324789	22143	0.061	0.077	0.044
2021	9515637*			451177	573948	328406				

* Geometric mean (2016–2020).

Sources and references

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