Sprat (*Sprattus sprattus*) in subdivisions 22–32 (Baltic Sea)

ICES advice on fishing opportunities

ICES advises that when the EU multiannual plan (MAP) is applied, catches in 2020 that correspond to the F ranges in the plan are between 169 965 tonnes and 233 704 tonnes. According to the MAP, catches higher than those corresponding to F_{MSY} (225 786 tonnes) can only be taken under conditions specified in the MAP, whilst the entire range is considered precautionary when applying the ICES advice rule.

Stock development over time

The spawning-stock biomass (SSB) is well above MSY $B_{trigger}$. The recent increase in SSB is attributable to the strong year class of 2014. The 2015–2018 year classes are estimated at below or close to average. Fishing mortality (F) has declined but has remained above F_{MSY} since 1994.

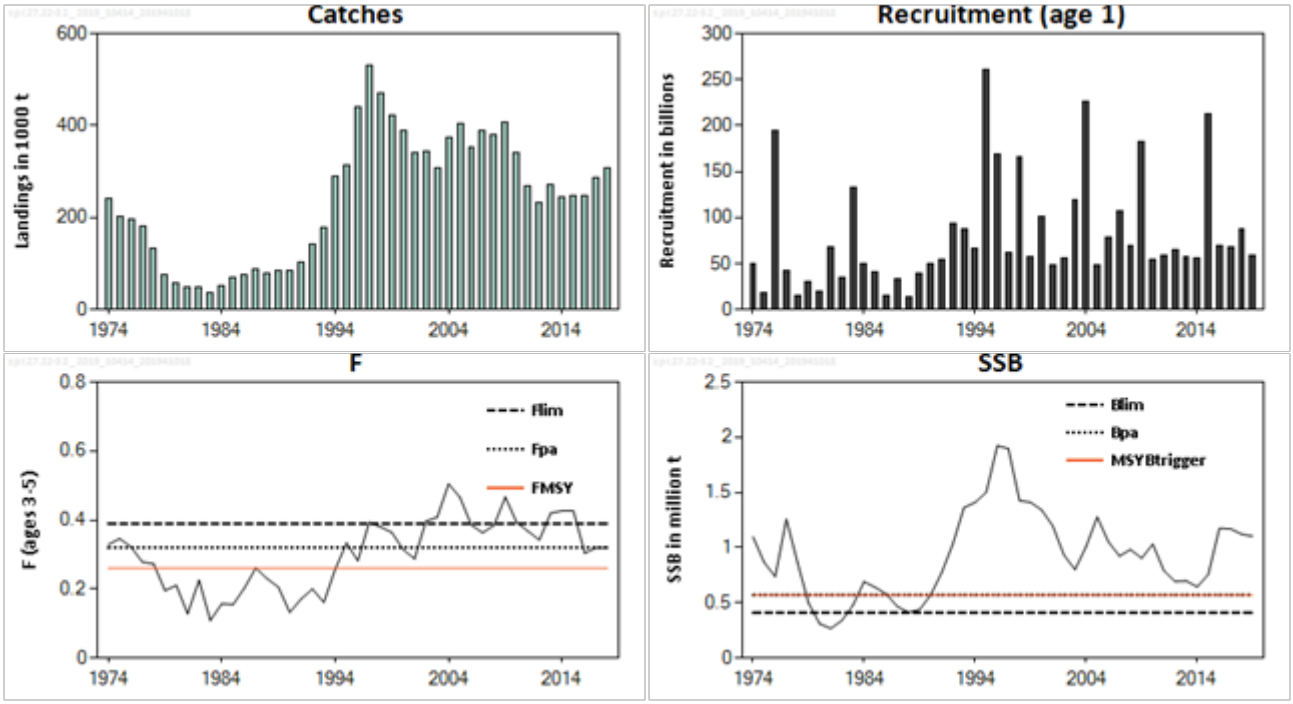

Figure 1 Sprat in subdivisions 22–32. Summary of the stock assessment. SSB at spawning time in 2019 is predicted.

Stock and exploitation status

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

Table 1 Sprat in subdivisions 22–32. 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 $B_{trigger}$	✓	✓	✓	Above trigger
Precautionary approach	F_{pa},F_{lim}	✓	✓	✓	Harvested sustainably	B_{pa},B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MSY} ranges	✗	✗	✗	Above	MSY $B_{trigger}$	✓	✓	✓	Above trigger

Catch scenarios

Table 2 Sprat in subdivisions 22–32. 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)	0.34	F based on catch constraint *
SSB (2019)	1103000	Predicted SSB *
$R_{age\ 1}$ (2019)	59567000	RCT3 estimate
$R_{age\ 1}$ (2020–2021)	86541000	Geometric mean 1991–2018
Total catch (2019)	313000	Catch constraint*

* Catch constraint of 313 100 t in 2019 (EU quota of 270 800 t and Russian quota of 42 300 t).

Table 3 Sprat in subdivisions 22–32. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2020)	F_{total} (2020)	SSB (2020)	SSB (2021)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis							
EU MAP ^^: F_{MSY}	225786	0.26	1016161	1078106	6.1	−28	−25
EU MAP ^^: $F_{MSY\ lower}$	169965	0.19	1039158	1147044	10.4	−46	−25 ^
EU MAP ^^: $F_{MSY\ upper}$	233704	0.27	1012935	1068721	5.5	−25	−25 ^
Other scenarios							
MSY approach = F_{MSY}	225786	0.26 0.26	1016161 1016161	1078106 1078106	6.1 6.1	-28 −28	−25
F = 0	0	0	1106000	1365000	23	−100	−100
F = F_{pa}	271531	0.32	995806	1023563	2.8	−13.3	−9.8
F = F_{lim}	322416	0.39	973660	963848	−1.01	3.0	7.1
20% decrease in TAC	250487	0.29	1005314	1048727	4.3	−20	−17
SSB (2021) = B_{lim}	876813	1.58	668231	410550	−39	180	191
SSB (2021) = B_{pa}	697322	1.08	781959	569558	−27	123	132
SSB (2021) = MSY $B_{trigger}$	697322	1.08	781959	569558	−27	123	132
F = F_{2019}	286927	0.34	989032	1005085	1.62	−8.4	−4.7

* SSB_{2021} relative to SSB_{2020}.
** Catches in 2020 relative to sum of autonomous quotas in 2019 (313 100 tonnes; EU quota of 270 800 tonnes and Russian quota of 42 300 tonnes).
*** Advice value this year relative to advice value last year (301 125 t).
^ Advice value this year relative to the values advised last year for the MAP $F_{MSY\ lower}$ (225 752 t) and MAP $F_{MSY\ upper}$ (311 523 t).
^^ MAP multiannual plan (EU, 2016).

This year lower catches are advised than last year because of the downward revision of SSB in the assessment and because the effect of the very strong 2014 year class will decrease in 2020.

Basis of the advice

Table 4 Sprat in subdivisions 22–32. The basis of the advice.

Advice basis	EU Baltic multiannual plan.
Management plan	This stock is shared between the EU and Russia. An EU multiannual plan (MAP) in place for stocks in the Baltic Sea includes sprat (EU, 2016). The advice, based on the F_{MSY} ranges used in the management plan, is considered precautionary. Russia does not have a management plan for this stock.

Quality of the assessment

The accuracy of the catch data and the quality of the assessment may be affected by species misreporting.

The cause for the upward revision in F is unclear but may be related to several issues, including the impact, as it ages in the population, of the very strong 2014 year class on estimated catch numbers at age.

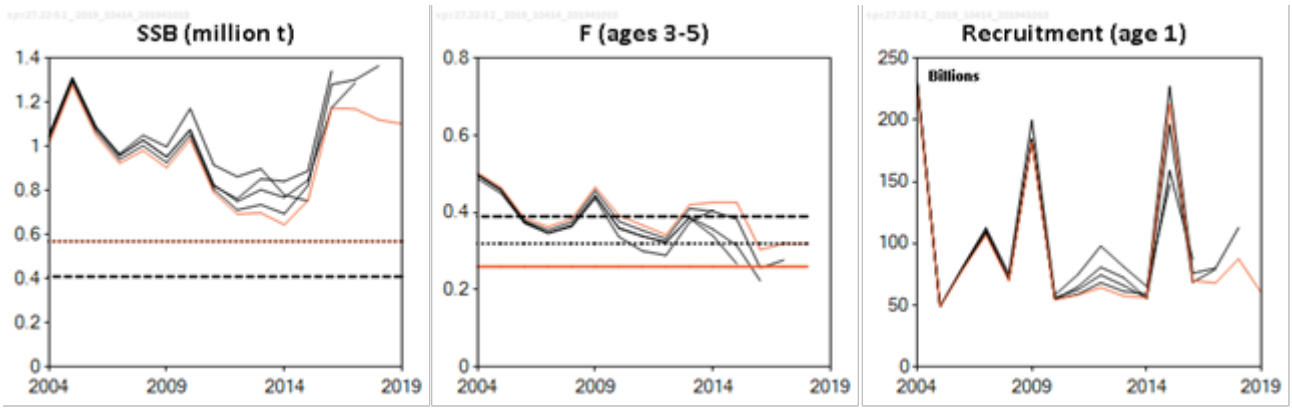

Figure 2 Sprat in subdivisions 22–32. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

ICES recommends that a spatial management plan is considered for the fisheries that catch sprat, with the aim to improve the condition of cod stocks. The abundance of cod in subdivisions 25–26 is high compared to other areas in the Baltic, and the condition of these stocks is considered to be limited by food availability. Sprat and herring are important food items for cod (especially sprat), but the present high biomass of the two prey stocks is to large extent distributed outside the distribution area for cod (Figure 3). Any fishery on the two prey species in the main cod distribution area (subdivisions 25–26) will potentially decrease the local sprat density, which may lead to increased food deprivation for cod (Casini *et al.*, 2016). The relative catch proportion of sprat in the main cod distribution area has since 2010 increased from 37% of the total catch to 56% in 2012–2018. Thus restrictions established on sprat fisheries in the main cod distribution area would result in increased availability of clupeid prey, which could benefit the cod stock; however, several other factors also have impact on the cod stock (see ICES, 2019).

Redistribution of the fishery to the northern areas (subdivisions 27–29 and 32) may also reduce the density-dependent effect, i.e. increase the individual growth for the clupeids in the area (Casini *et al.*, 2006).

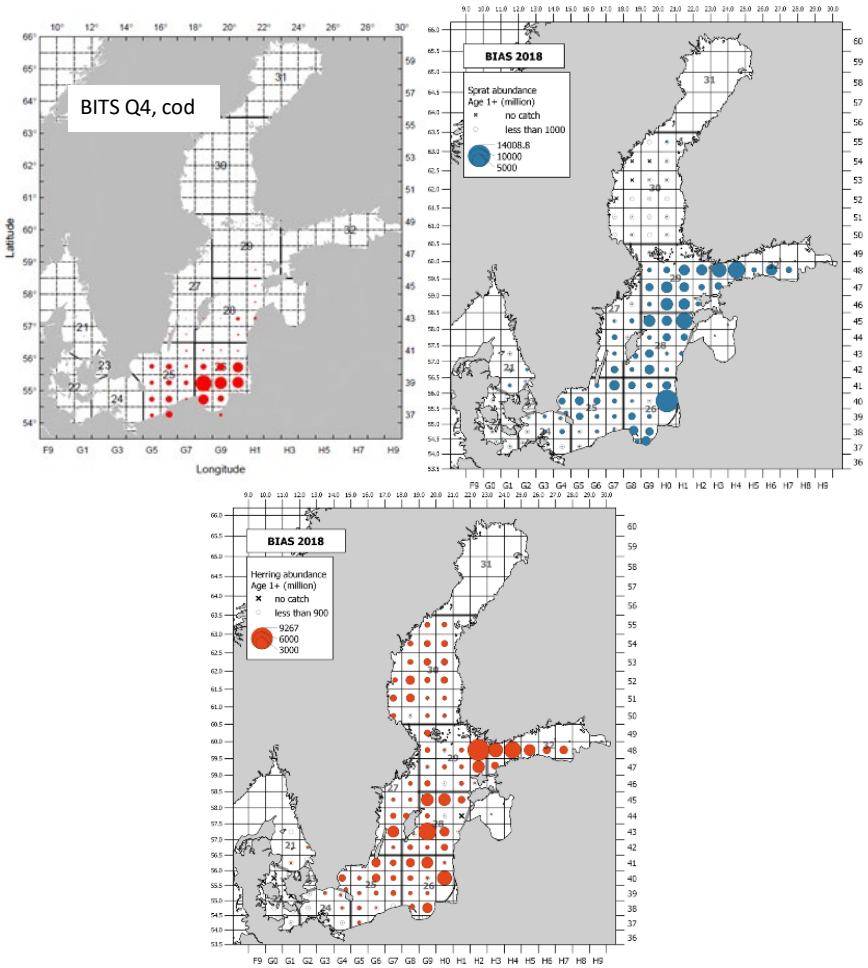

Figure 3 Sprat in subdivisions 22–32. Top left panel: Distribution of eastern Baltic Sea cod from the bottom trawl survey (BITS, in number h^{-1}) in the 4th quarter 2017. Top right panel: Baltic sprat from the acoustic survey (BIAS, numbers) in the 4th quarter 2018. Bottom panel: Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga, from the BIAS survey (BIAS, numbers) in the 4th quarter 2018. The cod panel includes fish ≥ 30 cm, while the herring and sprat panels include ages between 1 and 8. Note that the figures are based on number of individuals and not on biomass.

Reference points

Table 5 Sprat in subdivisions 22–32. Reference points, values, and their technical basis. Weights in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	570 000	Assumed at B_{pa}.	ICES (2015)
	F_{MSY}	0.26	Stochastic simulations with segmented regression and Ricker stock–recruitment curves from the 1992–2013 time-series.	ICES (2015)
Precautionary approach	B_{lim}	410 000	Stock–recruitment relationship (biomass which produces half of the maximal recruitment in a Beverton–Holt model).	ICES (2013)
	B_{pa}	570 000	$B_{lim} \times 1.4$.	ICES (2013)
	F_{lim}	0.39	Consistent with B_{lim}.	ICES (2013)
	F_{pa}	0.32	Consistent with B_{pa}.	ICES (2013)
Management plan	MAP MSY $B_{trigger}$	570 000	MSY $B_{trigger}$	Annex II column A in EU (2016)
	MAP B_{lim}	410 000	B_{lim}	Annex II column B in EU (2016)
	MAP F_{MSY}	0.26	F_{MSY}	Annex I columns A and B in EU (2016)
	MAP target range F_{lower}–F_{MSY}	0.19–0.26	Consistent with the ranges provided by ICES (2015), resulting in no more than 5% reduction in long-term yield compared with MSY.	ICES (2015), and Annex I column A in EU (2016)
	MAP target range F_{MSY}–F_{upper}	0.26–0.27	Consistent with the ranges provided by ICES (2015), resulting in no more than 5% reduction in long-term yield compared with MSY.	ICES (2015), and Annex I column B in EU (2016)

Basis of the assessment

Table 6 Sprat in subdivisions 22–32. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018).
Assessment type	Age-based analytical assessment, XSA (ICES, 2019) that uses catches in the model and in the forecast.
Input data	Commercial catches; two acoustic surveys (BASS; BIAS); natural mortalities from the multispecies model (SMS) and regression of M against eastern Baltic cod SSB.
Discards and bycatch	Not included, considered negligible.
Indicators	None.
Other information	This stock was last benchmarked in 2013 (WKBALT; ICES, 2013).
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

Information from stakeholders

There is no additional information available.

History of the advice, catch, and management

Table 7 Sprat in subdivisions 22–32. ICES advice, the agreed TAC, and ICES estimates of catch. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	ICES catch
1987	Catch could be increased in subdivisions 22, 24, and 25. *Status quo* F for subdivisions 27 and 29–32		117200	88200
1988	Catch could be increased in subdivisions 22–25	-	117200	80300
1989	Catch could be increased for subdivisions 26 and 28. *Status quo* F for subdivisions 27 and 29–32	72000	142000	85800
1990		72000	150000	85600
1991	TAC	150000	163000	103200
1992	Status quo F	143000	290000	142100
1993	Increase in yield by increasing F	-	415000	178100
1994	Increase in yield by increasing F	-	700000	288800
1995	TAC	205000	500000	312600
1996	Little gain in long-term yield at higher F	279000	550000	441000
1997	No advice	-	550000	529400
1998	*Status quo* F	343000	550000	470800
1999	Proposed F_{pa}	304000	467005	422600
2000	Proposed F_{pa}	192000	400000	389100
2001	Proposed F_{pa}	314000	355000	342200
2002	Proposed F_{pa}	369000	380000	343200
2003	Below proposed F_{pa} (TAC should be set on central Baltic herring considerations)	300000	310000	308300
2004	Below proposed F_{pa} (TAC should be set on central Baltic herring considerations)	474000	420000	373700
2005	TAC should be set on central Baltic herring considerations	< 614000	550000	405200
2006	Agreed management plan	439000	468000	352100
2007	< F_{pa}	< 477000	454000*	388900
2008	< F_{pa}	< 432000	454000*	380500
2009	< F_{pa}	< 291000	399000*	407100
2010	< F_{pa}	< 306000	380000*	341500
2011	< F_{pa}	< 242000	322700**	267900
2012	MSY transition scheme	< 242000	255100**	235000
2013	F< F_{MSY}	< 278000	278000**	272400
2014	MSY approach	< 247000	267900**	243800
2015	MSY approach	< 222000	240200**	247200
2016	MSY approach (F = 0.26)	≤ 205000	243000**	246500
2017	MSY approach (F = 0.26)	≤ 314000	303593**	285701
2018	MAP target F ranges: F_{lower} to F_{upper} (F = 0.19–0.27), but F higher than F_{MSY} = 0.26 only under conditions specified in MAP	219152–301722,but catch higher than 291715 only under conditions specified in MAP	304900**	308827
2019	MAP target F ranges: F_{lower} to F_{upper} (F = 0.19–0.27), but F higher than F_{MSY} = 0.26 only under conditions specified in MAP	225752–311523,but catch higher than 301125 only under conditions specified in MAP	313100**	
2020	MAP target F ranges: F_{lower} to F_{upper} (F = 0.19–0.27), but F higher than F_{MSY} = 0.26 only under conditions specified in MAP	169965–233704, but catch higher than 225786 only under conditions specified in MAP		

* EU autonomous quota, not including Russian catches.

** TAC is calculated as EU + Russian autonomous quotas.

History of the catch and landings

Table 8 Sprat in subdivisions 22–32. Catch distribution by fleet in 2018 as estimated by ICES.

Catch (2018)	Landings	Discards
308 827 tonnes	Most of the catch is taken by pelagic trawlers	Discarding is considered to be negligible.
	308 827 tonnes	

Table 9 Sprat in subdivisions 22–32. History of ICES catches presented by area for each country participating in the fishery. All weights are in tonnes.

Year	Denmark	Finland	German Dem. Rep.	Germany Fed. Rep.	Poland	Sweden	USSR	Total		
1977	7200	6700	17200	800	38800	400	109700	180800		
1978	10800	6100	13700	800	24700	800	75500	132400		
1979	5500	7100	4000	700	12400	2200	45100	77100		
1980	4700	6200	100	500	12700	2800	31400	58100		
1981	8400	6000	100	600	8900	1600	23900	49300		
1982	6700	4500	1000	600	14200	2800	18900	48700		
1983	6200	3400	2700	600	7100	3600	13700	37300		
1984	3200	2400	2800	700	9300	8400	25900	52500		
1985	4100	3000	2000	900	18500	7100	34000	69500		
1986	6000	3200	2500	500	23700	3500	36500	75800		
1987	2600	2800	1300	1100	32000	3500	44900	88200		
1988	2000	3000	1200	300	22200	7300	44200	80300		
1989	5200	2800	1200	600	18600	3500	54000	85800		
1990	800	2700	500	800	13300	7500	60000	85600		
1991	10000	1600		700	22500	8700	59700*	103200		
Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1992	24300	4100	1800	600	17400	3300	28300	8100	54200	142100
1993	18400	5800	1700	600	12600	3300	31800	11200	92700	178100
1994	60600	9600	1900	300	20100	2300	41200	17600	135200	288800
1995	64100	13100	5200	200	24400	2900	44200	14800	143700	312600
1996	109100	21100	17400	200	34200	10200	72400	18200	158200	441000
1997	137400	38900	24400	400	49300	4800	99900	22400	151900	529400
1998	91800	32300	25700	4600	44900	4500	55100	20900	191100	470800
1999	90200	33200	18900	200	42800	2300	66300	31500	137300	422600
2000	51500	39400	20200	0	46200	1700	79200	30400	120600	389100
2001	39700	37500	15400	800	42800	3000	85800	32000	85400	342200
2002	42000	41300	17200	1000	47500	2800	81200	32900	77300	343200
2003	32000	29200	9000	18000	41700	2200	84100	28700	63400	308300
2004	44300	30200	16600	28500	52400	1600	96700	25100	78300	373700
2005	46500	49800	17900	29000	64700	8600	71400	29700	87800	405200
2006	42100	46800	19000	30800	54600	7500	54300	28200	68700	352100
2007	37600	51000	24600	30800	60500	20300	58700	24800	80700	388900
2008	45900	48600	24300	30400	57200	18700	53300	21000	81100	380500
2009	59700	47300	23100	26300	49500	18800	81900	25200	75300	407100
2010	43600	47900	24400	17800	45900	9200	56700	25600	70400	341500
2011	31400	35000	15800	11400	33400	9900	55300	19500	56200	267900
2012	11400	27700	9000	11300	30700	11300	62100	25000	46500	235000
2013	25600	29800	11100	10300	33300	10400	79700	22600	49700	272400
2014	26600	28500	11700	10200	30800	9600	56900	23400	46000	243800
2015	22500	24000	12000	10300	30500	11000	62200	30700	44100	247200
2016	19100	23700	16900	10900	28100	11600	59300	34600	42400	246500
2017	27100	25300	16100	13600	35700	12500	68400	38700	48300	285701
2018**	24590	29341	16430	15213	37099	16250	79395	41374	49135	308827

* Sum of landings by Estonia, Latvia, Lithuania, and Russia.
** Preliminary.

Summary of the assessment

Table 10 Sprat in subdivisions 22–32. Assessment summary. Weights are in tonnes. Numbers in thousands.

Year	Recruitment (age 1)	SSB*	Catches	F ages 3–5
1974	50439000	1097000	242000	0.33
1975	18934000	867000	201000	0.35
1976	194499000	738000	195000	0.32
1977	42727000	1257000	181000	0.28
1978	15222000	866000	132000	0.27
1979	30536000	498000	77000	0.196
1980	20035000	311000	58000	0.21
1981	67767000	268000	49000	0.128
1982	35168000	340000	49000	0.23
1983	133305000	478000	37000	0.109
1984	50395000	691000	53000	0.157
1985	40552000	640000	70000	0.155
1986	15184000	581000	76000	0.20
1987	33953000	466000	88000	0.26
1988	13475000	416000	80000	0.23
1989	40039000	439000	86000	0.21
1990	49595000	571000	86000	0.132
1991	54540000	776000	103000	0.171
1992	94261000	1035000	142000	0.20
1993	87190000	1362000	178000	0.161
1994	67033000	1409000	289000	0.26
1995	261404000	1501000	313000	0.33
1996	169134000	1923000	441000	0.28
1997	61556000	1896000	529000	0.39
1998	165573000	1426000	471000	0.38
1999	56918000	1410000	421000	0.36
2000	101688000	1340000	389000	0.31
2001	48810000	1196000	342000	0.29
2002	55164000	933000	343000	0.40
2003	119795000	801000	308000	0.41
2004	226767000	1010000	374000	0.50
2005	48934000	1277000	405000	0.47
2006	78992000	1053000	352000	0.39
2007	106699000	924000	388000	0.36
2008	69733000	982000	381000	0.38
2009	182471000	904000	407000	0.47
2010	54408000	1032000	342000	0.39
2011	58322000	791000	268000	0.37
2012	64280000	694000	231000	0.34
2013	57417000	699000	272000	0.42
2014	55974000	645000	244000	0.43
2015	212928000	756000	247000	0.43
2016	69878000	1174000	247000	0.30
2017	68011000	1171000	286000	0.32
2018	87522000	1121000	308827	0.32
2019	59567000**	1103000***		

* At spawning time.
** Output from survey data (RCT3 analysis).
*** Predicted.

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