Herring (*Clupea harengus*) in subdivisions 25–29 and 32, excluding the Gulf of Riga (central 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 130 546 tonnes and 214 553 tonnes. According to the MAP, catches higher than those corresponding to F_{MSY} (173 975 tonnes) can only be taken under conditions specified in the MAP, whilst the entire range is considered precautionary when applying the ICES advice rule. This advice applies to all catches from the stock, including those taken in Subdivision 28.1.

Stock development over time

Spawning-stock biomass (SSB) has shown an increasing trend since 2001, and has been above MSY $B_{trigger}$ since 2007. Fishing mortality has shown an increasing trend since 2013 and has been above F_{MSY} since 2016. Recruitment in 2015 is estimated to be the highest of the whole time-series. In the last four years recruitment has been below or on average.

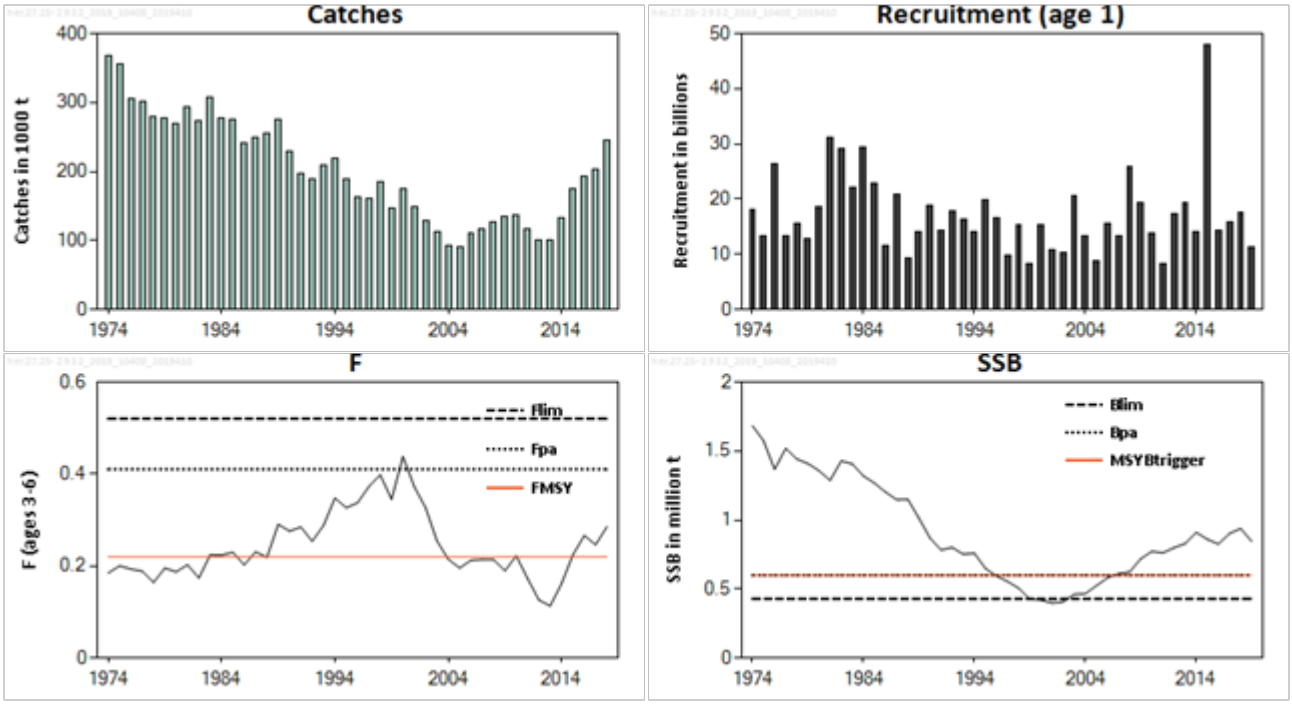

Figure 1 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Summary of the stock assessment. The SSB value for 2019 is predicted.

Stock and exploitation status

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

Table 1 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. 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_{ranges}	✓	✓	✗ Above range	MSY $B_{trigger}$	✓	✓	✓ Above trigger

Catch scenarios

Table 2 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Assumptions made for the interim year and in the forecast. Weights are in tonnes. Recruitment is in thousands.

Variable	Value	Notes
$F_{ages\ 3–6}$ (2019)	0.24	Based on catch constraint.*
SSB (2019)	844663	Projected at spawning time.
$R_{age\ 1}$ (2019)	11437000	RCT3 estimate.
$R_{age\ 1}$ (2020–2021)	14907185	Geometric mean 1988–2017.
Total catch (2019)	204360	Catch constraint.*

* Catch constraint in 2019: EU share 170 360 tonnes + Russian quota 29 900 tonnes + central Baltic herring stock caught in Gulf of Riga 4360 tonnes (mean 2013–2017) − Gulf of Riga herring stock caught in central Baltic Sea 260 tonnes (mean 2013–2017) = 204 360 tonnes.

Table 3 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2020)	F_{total} (2020)	SSB (2020)	SSB (2021)	% SSB change *	% Advice change **
ICES advice basis						
EU MAP ^^: F_{MSY}	173975	0.22	749659	695933	−7%	12%
EU MAP ^^: F_{lower}	130546	0.16	766380	749779	−2%	13%***
EU MAP ^^: F_{upper}	214553	0.28	733412	647049	−12%	11%^
Other scenarios						
ICES MSY approach: F_{MSY}	173975	0.22	749659	695933	−7%	12%
F = 0	0	0	813028	920881	13%	−100%
F = F_{pa}	294109	0.41	699599	555285	−21%	89%
F = F_{lim}	361165	0.52	671119	477488	−29%	133%
SSB (2021) = B_{lim}	399845	0.58	655921	430000	−34%	157%
SSB (2021) = B_{pa}	254759	0.34	716663	600000	−16%	64%
SSB (2021) = MSY $B_{trigger}$	254759	0.34	716663	600000	−16%	64%
F = F_{2019}	186377	0.24	744769	680825	−9%	20%

* SSB 2021 relative to SSB 2020.
** Advice value in 2020 relative to advice value for EU MAP: F_{MSY} 2019 (155 333 tonnes).
*** Advice value for 2020 relative to advice value for EU MAP: F_{lower} 2019 (115 591 tonnes).
^ Advice value for 2020 relative to advice value for EU MAP: F_{upper} 2019 (192 787 tonnes).
^^ MAP multiannual plan (EU, 2016).

The increased catch advice is due to the upward revision of SSB and a downward revision of F in this year's assessment.

Basis of the advice

Table 4 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. 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 herring (EU, 2016). The advice based on the F_{MSY} ranges used in the management plan are considered precautionary.

Quality of the assessment

The revision of SSB and fishing mortality for the recent years is partly due to imprecision in the survey estimate of the large 2014 year class. Species misreporting of herring has occurred in the past (Hentati-Sundberg *et al.*, 2014) and there are again indications of sprat being misreported as herring. This has not been quantified but may affect the quality of the assessment.

Preliminary investigations indicate that the stocks of western Baltic spring-spawning herring (Division 3.a and subdivisions 22–24) and central Baltic herring (subdivisions 25–29 and 32, excluding Gulf of Riga herring) are mixing in subdivisions 24–26 (Gröhsler *et al*., 2013). The level of this mixing is presently unknown and its potential impact on the assessment needs further investigation (ICES, 2018a).

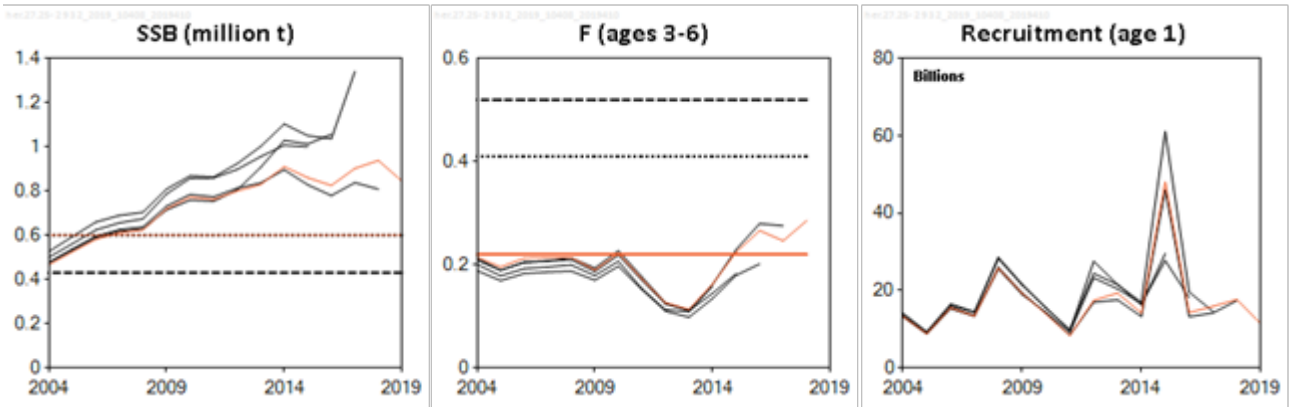

Figure 2 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

It should be noted that the large 2014 year class will be the main contributor to the yields in 2019 and 2020 and to SSB in 2020. For this stock it is uncommon to see such a large contribution of one year class to the SSB. The biomass is expected to decline in the coming years because no substantial year classes have recruited to the stock since the large 2014 year class. This decline has already started to occur in 2019 and 2020.

A mixture of central Baltic herring (subdivisions 25–27, 28.2, 29, and 32) and the Gulf of Riga herring (Subdivision 28.1) is caught in the central Baltic Sea. In the assessment and the advice the central Baltic herring stock is considered to be caught both in and outside the central Baltic Sea. The TAC (sum of the EU and the Russian autonomous quotas) is set for herring caught in the central Baltic management area, which includes also a small amount of Gulf of Riga herring caught in the central Baltic Sea but excludes central Baltic herring caught outside of the central Baltic Sea.

The TAC value proposed for the central Baltic area is based on the advised catch for the central Baltic herring stock, plus the assumed catch of the Gulf of Riga herring taken in the central Baltic, minus the assumed catch of herring from the central Baltic stock taken in the Gulf of Riga. The values of the two latter figures are the average over the last five years.

- Central Baltic herring assumed to be taken in the Gulf of Riga in 2020 (Subdivision 28.1) is 4377 tonnes (average 2014–2018);
- Gulf of Riga herring assumed to be taken in Subdivision 28.2 in 2020 is 314 tonnes (average 2014–2018).

As an example, following the ICES MSY approach (here identical to the MAP F_{MSY}), catches from the central Baltic herring stock in 2020 should be no more than 173 975 tonnes. The corresponding TAC in the central Baltic management area for 2020 would be calculated as 173 975 tonnes + 314 tonnes – 4377 tonnes = 169 912 tonnes.

Reference points

Table 5 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Reference points, values, and their technical basis. Weights in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	600 000	B_{pa}	ICES (2013)
	F_{MSY}	0.22	Stochastic simulations with Beverton, Ricker, and segmented regression stock–recruitment model from the full time-series (1974–2013)	ICES (2015)
Precautionary approach	B_{lim}	430 000	B_{loss}	ICES (2013)
	B_{pa}	600 000	1.4 × B_{lim}	ICES (2013)
	F_{lim}	0.52	Consistent with B_{lim}	ICES (2013)
	F_{pa}	0.41	Consistent with B_{pa}	ICES (2013)
Management plan	MAP MSY $B_{trigger}$	600 000	MSY $B_{trigger}$	EU (2016 – Annex II column A)
	MAP B_{lim}	430 000	B_{lim}	EU (2016 – Annex II column B)
	MAP F_{MSY}	0.22	F_{MSY}	EU (2016 – Annex I columns A and B)
	MAP target range F_{lower}–F_{MSY}	0.16 – 0.22	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 EU (2016 – Annex I column A)
	MAP target range F_{MSY}–F_{upper}	0.22 – 0.28	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 EU (2016 – Annex I column B)

Basis of the assessment

Table 6 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018b).
Assessment type	Age-based analytical assessment, XSA (ICES, 2019) that uses catches in the model and in the forecast.
Input data	Commercial catches (international landings, age distributions from catch sampling); one survey acoustic index (BIAS); natural mortalities from multispecies model (SMS) until 2011, for 2012–2018 natural mortalities are based on regression of M against eastern Baltic cod SSB; fixed maturity ogive.
Discards and bycatch	Discarding is considered negligible.
Indicators	None.
Other information	Last benchmarked in 2013 (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 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. ICES advice, TACs, and catches. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	ICES catch SDs 25–29+32	ICES catch
1988*		204000	399000**	286000	
1989*		176000	399000**	290000	
1990*		112000	399000**	244000	
1991*	TAC for the entire area	293000	402000**	213000	
1992*	F near present level	343000	402000**	210000	
1993*	Increase in yield at higher F	371000	560000**	231000	
1994*	Increase in yield at higher F	317000–463000	560000**	242000	

Year	ICES advice	Catch corresponding to advice	Agreed TAC	ICES catch SDs 25–29+32	ICES catch
1995*	TAC	394000	560000**	221000	
1996*	TAC	394000	560000**	195000	
1997*	No advice	-	560000**	208000	
1998*	No advice	-	560000**	212000	
1999*	Proposed F_{pa} = (0.17)	117000	476000**	178000	
2000*	Proposed F_{pa} = (0.17)	95000	405000**	208000	
2001*	Proposed F_{pa} = (0.17)	60000	300000**	188000	
2002*	$F < F_{pa}$	< 73000	Not agreed**	168000	
2003*	$F < F_{pa}$	< 72000	143000**	154000	
2004	$F < F_{pa}$	< 80000	171000**		93000
2005	$F < F_{pa}$ (single-stock exploitation boundaries)	< 130000	130000***		92000
2006	$F < F_{pa}$ (single-stock exploitation boundaries)	< 120000	128000***		110000
2007	$F < F_{pa}$ (single-stock exploitation boundaries)	< 164000	133000^		116000
2008	$F < F_{pa}$ (single-stock exploitation boundaries)	< 194000	153000^		126154
2009	$F < F_{pa}$ (single-stock exploitation boundaries)	< 147000	143609^		134126
2010	$F < F_{pa}$ (single-stock exploitation boundaries)	< 103000	139776^^		136706
2011	MSY framework (F = 0.19)	< 95000	120020^^		116785
2012	MSY transition (F = F_{pa} = 0.19)	< 92000	93317^^		100893
2013	MSY transition (F = F_{pa} = 0.19)	< 117000	101480^^		100954
2014	MSY approach	< 164000	132225^^		132700
2015	MSY approach (F_{MSY} = 0.26)	< 193000	186351^^		174433
2016	MSY approach (F_{MSY} = 0.22)	≤ 201000	206605^^		192056
2017	MSY approach (F_{MSY} = 0.22)	≤ 216000	220629^^		202517
2018	MAP target F ranges: F_{lower} to F_{upper} (F = 0.16–0.28), but F higher than F_{MSY} = 0.22 only under conditions specified in MAP	200236–331510, but catch higher than 267745 only under conditions specified in MAP	258855^^		244365
2019	MAP target F ranges: F_{lower} to F_{upper} (F = 0.16–0.28), but F higher than F_{MSY} = 0.22 only under conditions specified in MAP	115591–192787, but catch higher than 155333 only under conditions specified in MAP	200360^^		
2020	MAP target F ranges: F_{lower} to F_{upper} (F = 0.16–0.28), but F higher than F_{MSY} = 0.22 only under conditions specified in MAP	130546–214553, but catch higher than 173975 only under conditions specified in MAP			

* 1987–2003 incl. Gulf of Riga herring.
** TAC for subdivisions 22–29S and 32.
*** TAC for subdivisions 25–28(2), 29, and 32.
^ EU TAC for subdivisions 25–28(2), 29, and 32.
^^ TAC is calculated as EU (subdivisions 25–28(2), 29, and 32) + Russian autonomous quotas.

History of the catch and landings

Table 8 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Catch distribution by fleet as estimated by ICES.

Total herring catch in the central Baltic management area (2018)	Total catch of stock (2018)	Landings	Discards
240 157 tonnes	244 365 tonnes	Mainly pelagic trawls. Minor part taken by trapnets, gillnets, and purse-seines	Discarding is negligible
		244 365 tonnes	

Table 9 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. History of commercial catch and landings; both the official and ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes.

Year	Denmark	Finland	Germany	Poland	USSR	Sweden	Total
1977	11900	33 700		57200	112814	48700	264314
1978	13900	38 300	100	61300	113872	55400	282872
1979	19400	40 400		70400	100958	71300	302458
1980	10600	44000		58300	103002	72500	288402
1981	14100	42500	1000	51200	93431	72900	275131
1982	15300	47500	1300	63000	86423	83800	297323
1983	10500	59100	1000	67100	69059	78600	285359
1984	6500	54100		65800	89757	56900	273057
1985	7600	54200		72800	95225	42500	272325
1986	3900	49400		67800	98773	29700	249573
1987	4200	50400		55500	100916	25400	236416
1988	10800	58100		57200	106009	33400	265509
1989	7300	50000		51800	105017	55400	269517
1990	4600	26900		52300	101269	44200	229269

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1991	6800	27036	18100		20709	6500	47100	31900	36500	194645
1992	8100	22264	30000		12533	4600	39200	29500	43000	189197
1993	8900	25420	32300		9576	3000	41100	21600	66400	208296
1994	11300	26345	38200	3700	9797	4900	46100	16700	61600	218641
1995	11400	30681	31400		9328	3600	38700	17000	47200	189309
1996	12148	35943	31502		11569	4243	30712	14626	25909	166652
1997	9397	42585	23749		10140	3324	26229	12526	44078	172028
1998	13876	34005	24777		9972	2368	19344	10520	70997	185860
1999	6185	35437	17850		8292	1312	18121	12676	48866	148739
2000	15786	30135	23330		6718	1070	23066	14814	60161	175080
2001	15786	27425	26103		5217	1639	28358	15797	29832	150156
2002	4557	21010	25724	291	3917	1537	28510	14168	29423	129137
2003	5339	13300	14698	3860	3132	2060	26311	13363	31785	113848
2004	175	10912	14468	4323	2655	1778	22834	6526	29336	93006
2005	3053	10783	6410	3713	1951	748	18476	7007	39426	91600
2006	100	13400	9600	3200	3000	1200	16800	7600	55300	110400
2007	1352	13979	13890	1672	3212	3474	19802	8772	49879	116030
2008	1250	21581	19134	3358	3520	1749	13331	8551	53681	126154
2009	1463	19937	23329	1252	4108	3576	18441	11800	50208	134127
2010	5367	17915	21602	2235	3903	1492	25028	9126	50037	136706
2011	1848	14924	19229	2730	3432	1997	27998	8471	36156	116785
2012	1415	11380	18049	896	2637	1847	25472	13044	26153	101000
2013	3419	12601	18175	1415	3548	1724	20568	10046	29458	100954
2014	2723	15334	27905	1731	4853	2096	27316	15854	34888	132700
2015	332	18782	31571	2917	5657	4694	39024	20889	50568	174433
2016	4040	20097	28852	4340	8362	5184	40990	24179	56011	192056
2017	9342	23320	40692	3594	7912	4037	40102	22327	51191	202517
2018*	11368	24269	45363	3951	11187	6564	49280	25437	66946	244365

* Preliminary.

Table 10 Herring in subdivisions 25–29 and 32 (excluding Gulf of Riga herring). Catches (in tonnes) from the central Baltic management area and of the central Baltic stock.

Year	Catches of herring from the central Baltic area			Central Baltic herring stock catches	
	Central Baltic herring stock	Gulf of Riga herring stock	Total	Central Baltic herring caught in Gulf of Riga	Total catch of central Baltic herring stock
1977	261900	-	261900	2400	264300
1978	276600	-	276600	6300	282900
1979	297800	-	297800	4700	302500
1980	282700	-	282700	5700	288400
1981	269200	-	269200	5900	275100
1982	292600	-	292600	4700	297300
1983	280600	-	280600	4800	285400
1984	269300	-	269300	3800	273100
1985	267700	-	267700	4600	272300
1986	248300	-	248300	1300	249600
1987	231600	-	231600	4800	236400
1988	262500	-	262500	3000	265500
1989	263600	-	263600	5900	269500
1990	223300	-	223300	6000	229300
1991	188500	-	188500	6100	194600
1992	185700	1300	187000	3500	189200
1993	204000	1200	205200	4300	208300
1994	213600	2100	215700	5000	218600
1995	183200	2400	185600	6100	189300
1996	162300	4300	166600	4400	166700
1997	167700	2900	170600	4300	172000
1998	181800	2800	184600	4100	185900
1999	144400	1900	146300	4300	148700
2000	170500	1900	172400	4600	175100
2001	147300	1200	148500	2900	150200
2002	125600	400	126000	3500	129100
2003	109500	400	109900	4300	113800
2004	89700	200	89900	3300	93000
2005	89300	500	89800	2300	91600
2006	107200	400	107600	3200	110400
2007	114500	100	114600	1500	116000
2008	120100	100	120200	6100	126154
2009	129200	100	129300	4900	134126
2010	131500	400	131900	5200	136706
2011	111300	100	111400	5500	116785
2012	97200	200	97400	3800	100893
2013	96900	300	97200	4100	100954
2014	128200	200	128400	4500	132700
2015	169465	316	169781	4968	174433
2016	187741	289	188029	4315	192056
2017	198621	234	198855	3896	202517
2018*	240158	530	240688	4208	244365

* Preliminary.

Summary of the assessment

Table 11 Herring in subdivisions 25–29 and 32, excluding the Gulf of Riga. Assessment summary. Weights are in tonnes. Recruitment in thousands.

Year	Recruitment age 1	SSB*	Catches	F ages 3–6
1974	18111898	1682551	368652	0.185
1975	13327324	1575411	354851	0.20
1976	26353772	1366922	305420	0.194
1977	13396593	1518985	301952	0.189
1978	15696733	1441323	278966	0.164
1979	12849732	1409129	278182	0.195
1980	18705202	1357790	270282	0.187
1981	31173224	1286823	293615	0.20
1982	29071714	1428553	273134	0.174
1983	22104082	1406334	307601	0.22
1984	29412506	1319221	277926	0.22
1985	22842560	1266825	275760	0.23
1986	11497281	1202450	240516	0.20
1987	20957864	1147445	248653	0.23
1988	9359733	1150920	255734	0.22
1989	14142804	1013490	275501	0.29
1990	18926644	870621	228572	0.28
1991	14461978	782481	197676	0.28
1992	17739430	801325	189781	0.25
1993	16371223	752237	209094	0.29
1994	13972566	760267	218260	0.35
1995	19822314	649175	188181	0.33
1996	16596566	593262	162578	0.34
1997	9750989	555004	160002	0.37
1998	15303886	505557	185780	0.40
1999	8346454	427964	145922	0.35
2000	15447064	420361	175646	0.44
2001	10925852	397888	148404	0.37
2002	10401909	406593	129222	0.33
2003	20703902	462156	113584	0.25
2004	13254539	465745	93006	0.21
2005	8823710	524421	91592	0.196
2006	15522767	581137	110372	0.21
2007	13394685	611477	116030	0.21
2008	25786242	623954	126155	0.21
2009	19263358	719152	134127	0.190
2010	13940027	772795	136706	0.22
2011	8309309	762253	116785	0.173
2012	17444682	799912	100893	0.126
2013	19319040	829457	100954	0.113
2014	14138718	910224	132700	0.162
2015	48045440	860498	174433	0.22
2016	14278865	825405	192056	0.27
2017	15893128	902291	202517	0.25
2018	17659964	938281	244365	0.29
2019	11437000**	844663***		

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

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