

ECOREGION Bay of Biscay and Atlantic Iberian waters
STOCK Sardine in Divisions VIIIc and IXa

Advice for 2013

ICES advises on the basis of precautionary considerations that landings in 2013 should be no more than 55 000 tonnes.

Stock status

F (Fishing Mortality)		
2009–2011		
MSY (F_{MSY})	?	Undefined
Precautionary approach (F_{pa}, F_{lim})	?	Undefined
Qualitative evaluation	➔	Stable
SSB (Spawning Stock Biomass)		
2010–2012		
MSY ($B_{trigger}$)	?	Undefined
Precautionary approach (B_{pa}, B_{lim})	?	Undefined
Qualitative evaluation	➔	Stable

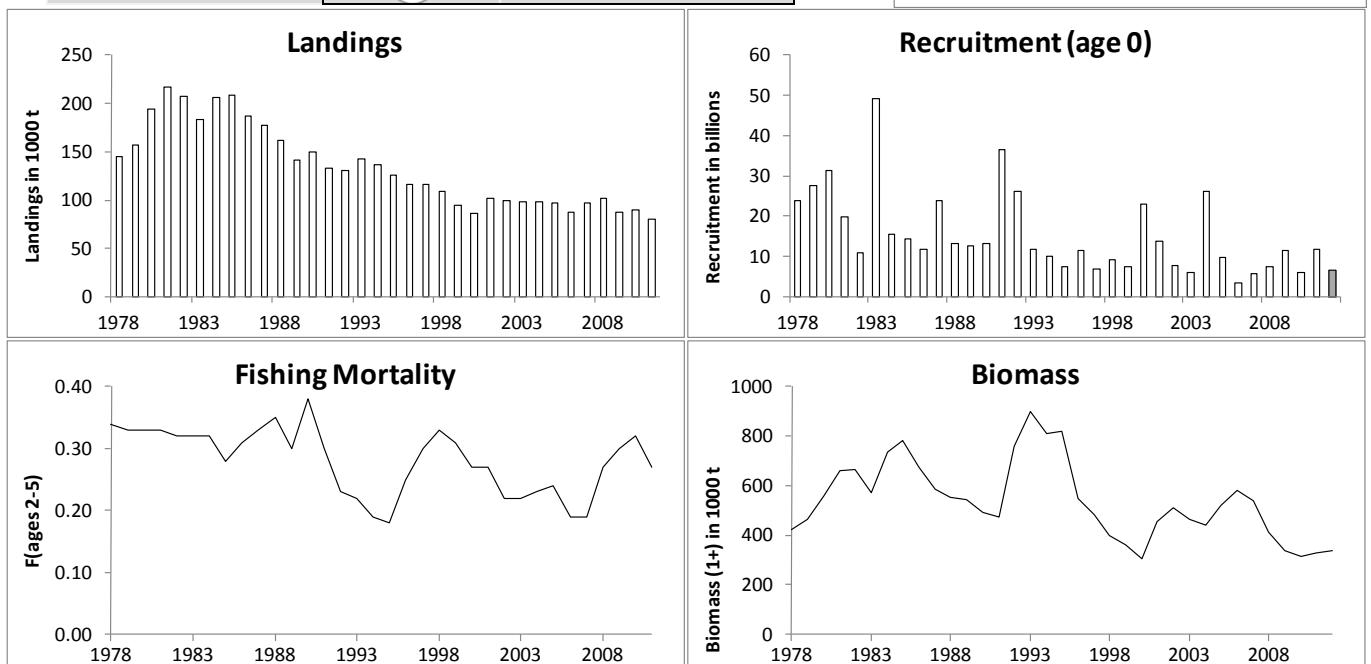
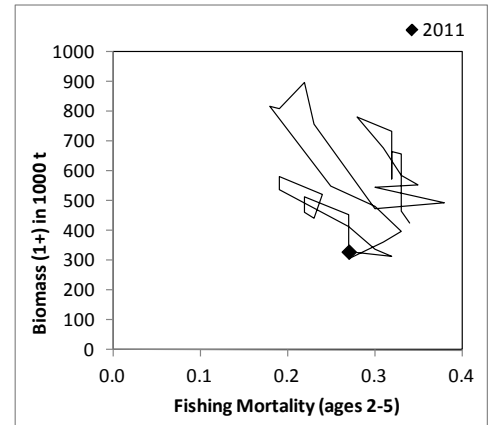


Figure 7.4.7.1 Sardine in Divisions VIIIc and IXa. Summary of stock assessment (weights in '000 tonnes, biomass expressed in weight of age 1 and older fish). Top right: Biomass 1+ and F over the years. Predicted values on recruitment are shaded.

The biomass of age 1 and older fish has been at stable at a historical low since 2009, 37% below the long term average. Recruitment has been below the long term average since 2005. Fishing mortality fluctuated without a clear trend. In 2008-2011 fishing mortality was higher than in preceding years and it currently around the long term average.

Management plans

No specific management objectives are known to ICES.

Biology

Sardine is prey for a range of fish and marine mammal species. Sardine is an omnivorous predator able to feed on both phytoplankton and zooplankton. In addition, sardines have been found to ingest their own eggs (and probably those of other species) and this cannibalism might act as a density control mechanism.

Environmental influence on the stock

Proposed environmental drivers include several global to local scale environmental variables, integrated over the time periods identified as the most critical to ensure egg and larval survival by reducing the transport of eggs and larvae offshore. Indirect effects, e.g. on growth and condition through variations in food supply or water temperature have been given less attention. Results from different studies show that environmental effects, although present, are often weak, and in some cases findings have been contradictory.

The fisheries

Most landings are taken by purse-seiners. Sardine catches are highest in the second semester of the year and catches are concentrated to southern Galician and Cantabrian waters. In Spain, vessels target anchovy, mackerel, sardine, and horse mackerel; in summer, part of the fleet switches to tuna fishing. In Portugal, sardine is the main target species, but chub mackerel, horse mackerel, and anchovy are also landed. Most of the landings are taken off the northern coast. Discards and slippage are uncertain, with slipping estimates only available for the Portuguese fleet but with a limited coverage in time and extent.

Catch distribution Total landings (2011) = 80 kt, where 100% are landings (99% purse seine and 1% other gear types),.

Effects of the fisheries on the ecosystem

Purse seines have low bycatch of non-target species: when targeting sardine, the catches are virtually monospecific. Observer data and interview surveys of fishers also indicate a low impact on megafauna such as cetaceans, seabirds, and turtles. Because purse-seiners operate in open waters, there is little impact on the seabed. The overall effect of the sardine fishery on the pelagic ecosystem of the Atlantic Iberian waters has not been evaluated. The most likely impacts will take place in alterations of prey-predator relationships via modification of sardine abundance, size structure, and behaviour.

Quality considerations

The main uncertainties in the assessment relate to the discrepant signals about the stock trends provided by the daily egg production method (DEPM) and acoustic surveys. Uncertainty continues regarding the extent of sardine movement across the northern stock boundary, on the comparability of Portuguese and Spanish acoustic surveys, on survey and fishery selection patterns and on the weighting of the different data sources in the assessment. The estimate of recruitment in the last year of the assessment (2011) is more uncertain this year due to the lack of the 2012 Portuguese acoustic survey index. Changes in assessment method and input data (e.g. natural mortality) decided during the benchmark lead to a revision in historical SSB, fishing mortality and recruitment.

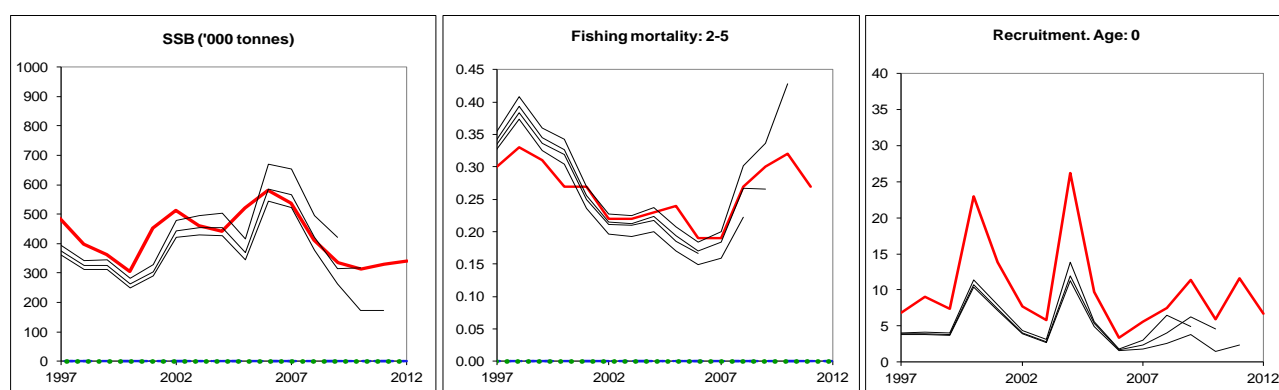


Figure 7.4.7.2 Sardine in Divisions VIIIc and IXa. Historical assessment results (final year recruitment and Biomass estimates included).

Scientific basis

Assessment type	Age-based analytical assessment (SS3).
Input data	One acoustic survey index (joint SP-PELACUS and PT-PELAGO surveys), one SSB survey index (joint SP and PT DEPM surveys), and catch-at-age data
Discards and bycatch	Bycatch, discards, and slippage may occur but are considered to be low. Not taken into account in the assessment
Indicators	None.
Other information	Benchmarked in February 2012 (WKPELA)
Working group report	WGHANSA

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Reference points

No reference points are defined for this stock.

Outlook for 2013

Basis: $F(2012) = \text{average } F(09-11) \text{ unscaled} = 0.29$; $B1+(2013) = 276$; Landings (2012) = 78; $R(2011)$, $R(2012)$ and $R(2013) = GM(2005-2010) = 6720$ million.

Rationale	Landings (2013)	Basis	F (2013)	B1+ (2014)	%B1+ change ¹⁾
Precautionary considerations	55	$F = \text{average } 2002 - 2007$	0.22	278	0%
Zero catch	0	$F=0$	0	318	+15%
Other options	59	$F_{2012} * 0.8$	0.23	275	0%
	65	$F_{2012} * 0.9$	0.26	270	-2%
	72	F_{2012}	0.29	266	-4%
	78	$F_{2012} * 1.1$	0.32	261	-5%
	84	$F_{2012} * 1.2$	0.35	257	-7%

Weights in '000 t.

¹⁾ SSB 2014 relative to SSB 2013.

Precautionary considerations

Fishing mortality has increased and SSB has decreased in the most recent years despite advice not to increase F since 2002. F should be brought back to where it was before the start of this increase, i.e. the 2002–2007 average, which is 0.22. This corresponds to landings of no more than 55 000 t in 2013.

Additional considerations

No management objectives for these fisheries are known to ICES and there is no international TAC. Almost all catches are taken by Spanish and Portuguese purse-seiners in a directed human consumption fishery. The fisheries are managed by Portugal and Spain through minimum landing size, maximum daily catch, days fishing limitations, and closed areas.

Since 2010, annual catch limits are set for the Portuguese fishery by the Portuguese authorities. Catch limits are set for the civil year and allow for an in-year revision following the publication of the ICES Advice. In 2010 and 2011, the catch limit was 55 thousand t and landings were 63 and 57 thousand t, respectively. In 2012 a catch limit of 9 thousand t for January–May and a fishing ban of 45 days during the first quarter of the year were regulated and have been complied. The 2012 initial catch limit was set at 36 thousand t, but may be revised in the middle of the year. Fishing at 0.22 this year given the current stock estimates corresponds to catch of 61 thousand tonnes.

Sardine is distributed in the Iberian region, to the north in Subareas VII and VIII and in the North Sea, and to the south on the Moroccan shelf. The information presented here assumes that sardine in Divisions VIIIc and IXa is a unit stock, based on biological characteristics. However, some movement of fish between Divisions VIIIb and VIIIc is known to occur. The effect of this movement is uncertain but is presently considered to have little influence on the estimation of the stock in the assessed area (Divisions VIIIc and IXa).

The MSY reference points have not been established so far. Candidate reference points have been outlined this year but require further evaluation in light of the recruitment dynamics observed in the stock.

A long-term plan should take into account the spatial distribution of the stock and poor relationship between stock biomass and future recruitment. A long-term management plan would be useful if stability of catches is desired. Such a strategy should be sufficiently flexible with respect to catch limitation to protect the stock under periods of poor recruitment, but also avoid unnecessary fluctuations in the catches when the stock biomass is higher.

The effects of regulations

Different management measures have been enacted by Spain and Portugal since 1997. In Spain, management measures include a maximum allowable catch of 7000 kg per fishing day and a 5-fishing-days week limitation. In Portugal, management measures include an overall limitation in the number of fishing days (180 days per year and a weekend ban). The effects of these fishery regulations are uncertain but may have contributed to the decline in fishing mortality observed between 1998 and 2007.

The environment

Sardine recruitment is considered to be influenced at both the local- and global-scale by environmental variables that may reduce the transportation of eggs and larvae offshore which are critical to ensuring egg and larval survival. Indirect effects, e.g. on growth and condition through variations in food supply or water temperature have been given less attention. Results from such studies show that environmental effects, although present, are often weak and in some cases findings have been contradictory. For example, upwelling intensity has been found to affect recruitment both positively and negatively.

The Iberian sardine is considered a forage fish, i.e. a fish that provides food for predatory fish as well as marine mammals and birds. Sardine is one of the most abundant small pelagic species in western Iberian waters and has been found to be important in the diet of several species of fish and marine mammals. Forage fish such as sardine may exert bottom-up control of their predators or top-down control on their zooplanktonic prey, or they may control both prey and predators (wasp-waist control).

Uncertainties in assessment and forecast

The DEPM and the acoustic survey show discrepant signals in the past but from 2008 to 2011, both surveys agree in a decrease of the stock. The assessment tends to accommodate the signals from the two surveys by providing broadly an average perspective. This year's assessment is affected by the lack of the 2012 Iberian acoustic survey index (the PT survey was not conducted). The DEPM surveys estimates for 2011 are provisional.

Uncertainty regarding the extent of sardine movement across the northern stock boundary, the intercalibration of Portuguese and Spanish acoustic surveys, survey and fishery selection patterns and the weighting of the surveys in the assessment still applies.

Comparison with previous assessment and advice

Compared to last years assessment SSB in 2010 is revised upwards by 71% and F2010 downwards by 26%. This is due to changes in assessment methodology, new values for natural mortality and the new 2011 DEPM survey index.

The basis for the advice is the same as last year.

Sources

ICES. 2012. Report of the Working Group on Anchovy and Sardine (WGANSA), 23–28 June 2012, Horta, Azores Portugal. ICES CM 2012/ACOM:16.

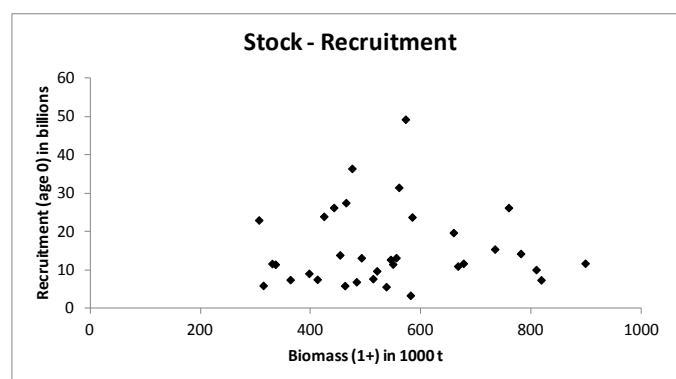


Figure 7.4.7.3 Sardine in Divisions VIIIc and IXa: Stock–recruitment plot.

Table 7.4.7.1 Sardine in Divisions VIIIc and IXa. Single-stock exploitation boundaries (advice), management, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings VIII & IX	ICES landings ²
1987	No increase in F; TAC	140	-		178
1988	No increase in F; TAC	150	-	167	162
1989	No increase in F; TAC	212	-	146	141
1990	Room for increased F	227 ²	-	150	149
1991	Precautionary TAC	176	-	135	133
1992	No advice	-	-	139	130
1993	Precautionary TAC	135	-	153	142
1994	No advice	118 ¹	-	147	137
1995	No advice; apparently stable stock	-	-	137	125
1996	Lowest possible level	-	-	134	117
1997	Lowest possible level	-	-	n/a	116
1998	Significant reduction	-	-	n/a	109
1999	Reduce F to 0.2	38	-	n/a	94
2000	F below 0.2	<81	-	n/a	86
2001	F below 0.2	<88	-	n/a	102
2002	F below 0.25	<95	-	n/a	100
2003	No increase in F	100	-	n/a	98
2004	No increase in F	128	-	10	98
2005	No increase in F	106	-	51	97
2006	No increase in F	96	-	50	87
2007	No increase in F	114	-	120	96
2008	No increase in F	92	-	103	101
2009	No increase in F	71	-	88	88
2010	No increase in F	75	-	90	90
2011	Maintain F at 2002–2007 level	75	-	77	80
2012	Reduce F to the 2002–2007 level	36			
2013	Reduce F to the 2002–2007 level	< 55			

Weights in '000 t.

n/a=not available.

¹Estimated catch at *status quo* F.

²Includes only Divisions VIIIc and IXa.

Table 7.4.7.2 Sardine in Divisions VIIIc and IXa. ICES estimates of landings (tonnes) by subarea and country.

Year	Sub-area						All sub-areas	Div. IXa	Portugal	Spain	
	VIIIc	IXa North	IXa Central North	IXa Central South	IXa South Algarve	IXa South Cadiz				(excl.Cadiz)	(incl.Cadiz)
1940	66816		42132	33275	23724		165947	99131	99131	66816	66816
1941	27801		26599	34423	9391		98214	70413	70413	27801	27801
1942	47208		40969	31957	8739		128873	81665	81665	47208	47208
1943	46348		85692	31362	15871		179273	132925	132925	46348	46348
1944	76147		88643	31135	8450		204375	128228	128228	76147	76147
1945	67998		64313	37289	7426		177026	109028	109028	67998	67998
1946	32280		68787	26430	12237		139734	107454	107454	32280	32280
1947	43459	21855	55407	25003	15667		161391	117932	96077	65314	65314
1948	10945	17320	50288	17060	10674		106287	95342	78022	28265	28265
1949	11519	19504	37868	12077	8952		89920	78401	58897	31023	31023
1950	13201	27121	47388	17025	17963		122698	109497	82376	40322	40322
1951	12713	27959	43906	15056	19269		118903	106190	78231	40672	40672
1952	7765	30485	40938	22687	25331		127206	119441	88956	38250	38250
1953	4969	27569	68145	16969	12051		129703	124734	97165	32538	32538
1954	8836	28816	62467	25736	24084		149939	141103	112287	37652	37652
1955	6851	30804	55618	15191	21150		129614	122763	91959	37655	37655
1956	12074	29614	58128	24069	14475		138360	126286	96672	41688	41688
1957	15624	37170	75896	20231	15010		163931	148307	111137	52794	52794
1958	29743	41143	92790	33937	12554		210167	180424	139281	70886	70886
1959	42005	36055	87845	23754	11680		201339	159334	123279	78060	78060
1960	38244	60713	83331	24384	24062		230734	192490	131777	98957	98957
1961	51212	59570	96105	22872	16528		246287	195075	135505	110782	110782
1962	28891	46381	77701	29643	23528		206144	177253	130872	75272	75272
1963	33796	51979	86859	17595	12397		202626	168830	116851	85775	85775
1964	36390	40897	108065	27636	22035		235023	198633	157736	77287	77287
1965	31732	47036	82354	35003	18797		214922	183190	136154	78768	78768
1966	32196	44154	66929	34153	20855		198287	166091	121937	76350	76350
1967	23480	45595	64210	31576	16635		181496	158016	112421	69075	69075
1968	24690	51828	46215	16671	14993		154397	129707	77879	76518	76518
1969	38254	40732	37782	13852	9350		139970	101716	60984	78986	78986
1970	28934	32306	37608	12989	14257		126094	97160	64854	61240	61240
1971	41691	48637	36728	16917	16534		160507	118816	70179	90328	90328
1972	33800	45275	34889	18007	19200		151171	117371	72096	79075	79075
1973	44768	18523	46984	27688	19570		157533	112765	94242	63291	63291
1974	34536	13894	36339	18717	14244		117730	83194	69300	48430	48430
1975	50260	12236	54819	19295	16714		153324	103064	90828	62496	62496
1976	51901	10140	43435	16548	12538		134562	82661	72521	62041	62041
1977	36149	9782	37064	17496	20745		121236	85087	75305	45931	45931
1978	43522	12915	34246	25974	23333	5619	145609	102087	83553	56437	62056
1979	18271	43876	39651	27532	24111	3800	157241	138970	91294	62147	65947
1980	35787	49593	59290	29433	17579	3120	194802	159015	106302	85380	85380
1981	35550	65330	61150	37054	15048	2384	216517	180967	113253	100880	103264
1982	31756	71889	45865	38082	16912	2442	206946	175190	100859	103645	106087
1983	32374	62843	33163	31163	21607	2688	183837	151463	85932	95217	97905
1984	27970	79606	42798	35032	17280	3319	206005	178035	95110	107576	110895
1985	25907	66491	61755	31535	18418	4333	208439	182532	111709	92398	96731
1986	39195	37960	57360	31737	14354	6757	187363	148168	103451	77155	83912
1987	36377	42234	44806	27795	17613	8870	177696	141319	90214	78611	87481
1988	40944	24005	52779	27420	13393	2990	161531	120587	93591	64949	67939
1989	29856	16179	52585	26783	11723	3835	140961	111105	91091	46035	49870
1990	27500	19253	52212	24723	19238	6503	149429	121929	96173	46753	53256
1991	20735	14383	44379	26150	22106	4834	132587	111852	92635	35118	39952
1992	26160	16579	41681	29968	11666	4196	130250	104090	83315	42739	46935
1993	24486	23905	47284	29995	13160	3664	142495	118009	90440	48391	52055
1994	22181	16151	49136	30390	14942	3782	136582	114401	94468	38332	42114
1995	19538	13928	41444	27270	19104	3996	125280	105742	87818	33466	37462
1996	14423	11251	34761	31117	19880	5304	116736	102313	85758	25674	30978
1997	15587	12291	34156	25863	21137	6780	115814	100227	81156	27878	34658
1998	16177	3263	32584	29564	20743	6594	108924	92747	82890	19440	26034
1999	11862	2563	31574	21747	18499	7846	94091	82229	71820	14425	22271
2000	11697	2866	23311	23701	19129	5081	85786	74089	66141	14563	19644
2001	16798	8398	32726	25619	13350	5066	101957	85159	71695	25196	30262
2002	15885	4562	33585	22969	10982	11689	99673	83787	67536	20448	32136
2003	16436	6383	33293	24635	8600	8484	97831	81395	66528	22819	31303
2004	18306	8573	29488	24370	8107	9176	98020	79714	61965	26879	36055
2005	19800	11663	25696	24619	7175	8391	97345	77545	57490	31464	39855
2006	15377	10856	30152	19061	5798	5779	87023	71646	55011	26233	32012
2007	13380	12402	41090	19142	4266	6188	96469	83088	64499	25782	31970
2008	13636	9409	45210	20858	4928	7423	101464	87828	70997	23045	30468
2009	11963	7226	36212	20838	4785	6716	87740	75777	61835	19189	25905
2010	13772	7409	40923	17623	5181	4662	89571	75798	63727	21181	25843
2011	8536	5621	37152	13685	6387	9023	80403	71867	57223	14157	23180

Div. IXa = IXa North + IXa Central-North + IXa Central-South + IXa South-Algarve + IXa South-Cadiz

Table 7.4.7.3

Sardine in Divisions VIIIc and IXa. Summary of stock assessment.

Year	Recruitment Age 0 thousands	Biomass 1+ Age 1 and older tonnes	Landings tonnes	Mean F Ages 2-5
1978	23921000	424000	145609	0.34
1979	27481000	464000	157241	0.33
1980	31471000	560000	194802	0.33
1981	19690000	659000	216517	0.33
1982	10956000	667000	206946	0.32
1983	49222000	572000	183837	0.32
1984	15381000	734000	206005	0.32
1985	14228000	781000	208439	0.28
1986	11676000	677000	187363	0.31
1987	23745000	584000	177696	0.33
1988	13148000	555000	161531	0.35
1989	12676000	545000	140961	0.30
1990	13119000	492000	149429	0.38
1991	36404000	475000	132587	0.30
1992	26193000	759000	130250	0.23
1993	11694000	898000	142495	0.22
1994	10038000	809000	136582	0.19
1995	7366000	818000	125280	0.18
1996	11478000	549000	116736	0.25
1997	6864000	483000	115814	0.30
1998	9057000	397000	108924	0.33
1999	7427000	363000	94091	0.31
2000	22968000	306000	85786	0.27
2001	13861000	453000	101957	0.27
2002	7685000	513000	99673	0.22
2003	5871000	462000	97831	0.22
2004	26221000	442000	98020	0.23
2005	9707000	520000	97345	0.24
2006	3341000	581000	87023	0.19
2007	5594000	537000	96469	0.19
2008	7511000	412000	101464	0.27
2009	11431000	336000	87740	0.30
2010	5910000	314000	89571	0.32
2011	11627000	330000	80403	0.27
2012	6720000*	340000		
Average	15190914	537457	134189	0.28

*Geometric mean (2005–2010).