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Statistics of the French purse seine fleet targeting tropical tunas in the Indian Ocean (1991-2010)

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Abstract

The French purse seine fleet of the Indian Ocean was composed of 13 large size purse seiners in 2010 that represented a total carrying capacity of more than 12,000 GRT. Total catches were of about 65,000 t in 2010 and composed of 47%, 45%, and 8% of yellowfin, skipjack, and bigeye, respectively. After a period of increase during 2006-2008, the fishing effort of the fleet has been decreasing to reach a minimum of 2,500 searching days in 2010. The decrease in effort was associated with a contraction of the fleet fishing grounds in the recent years and mainly characterized by a strong decrease in the number of sets made on free swimming schools; a total of less than 2,700 fishing sets being made in 2010 compared to more than 4,500 in the mid-2000s. Hence, the percentage of sets made on log-associated schools steadily increased since 2004 to reach 68% in 2010, corresponding to 70% of the total catch in the recent years. No clear trend is apparent in the time series of species-specific catch rates expressed in tonne per searching day for each fishing mode of the fishery. The mean weight in the catch of the 3 tropical tunas has shown a decrease between 15% and 50% in 2009-2010 for both log-associated and free swimming schools.

Keywords: fish aggregating device, *Katsuwonus pelamis*, purse seine fishing, *Thunnus albacares*, *Thunnus obesus*

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1. Introduction

Since 2002, statistical data from the European fleet (France and Spain) have been collected by the Institut de Recherche pour le Développement (IRD) and the Instituto Español de Oceanografia (IEO) within the framework of the EU "Data Collection Regulation" (DCR, Reg. 1543/2000 and 1639/2001), followed in 2008 by the "Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy" (DCF, Reg 199/2008 and 665/2008). The document describes the activities of the French purse seine fleet of the Indian Ocean during 1991-2010 that targets the 3 major tropical tunas, i.e. yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), and bigeye (*Thunnus obesus*). The fleet includes the vessels flying French flags as well as the vessels from the French overseas collectivity of Mayotte that became an overseas department on March 31, 2011. Two major fishing modes are considered for the fishery: log-associated (FAD) and free swimming schools (FSC). The acronym "FAD", which stands for fish aggregating device, will be used here to describe any type of floating object used for fishing tuna. This includes natural objects (e.g. logs, palm branches) and anthropogenic floating objects, such as manmade bamboo rafts equipped with radio-range beacons, satellite transmitters or scanning sonars. All floating objects used in the French purse seine tuna fishery are drifting devices. Fishing sets made on whales were classified as free swimming school sets whereas sets made on whale sharks (*Rhincodon typus*) were classified as FAD sets (Pallarés and Hallier 1997). The fleet activities are described through a suite of fisheries indicators that provide information on fishing effort, catch, catch rates, size structure and mean weights for the major tropical tuna species, with a particular focus on the year 2010.

2. Fishing capacity and effort

2.1. Fishing fleet

The number of vessels of the French purse seine fishing fleet varied around 17 (SD = 1.9) over the period 1991-2010, with a maximum of 20 and a minimum of 13 in 2001 and 2010, respectively (Fig. 1 and Table 1). The size of the vessels progressively increased

in the French purse seine fishery over the last 20 years. The number of small-size vessels (capacity < 600 GRT) decreased throughout the 1990s to become 0 in the early 2000s while medium-size vessels (capacity between 601-800 GRT) disappeared from the fishery in the late 2000s (Fig. 1). From 2009, French purse seiners were all characterized by a capacity larger than 800 GRT.

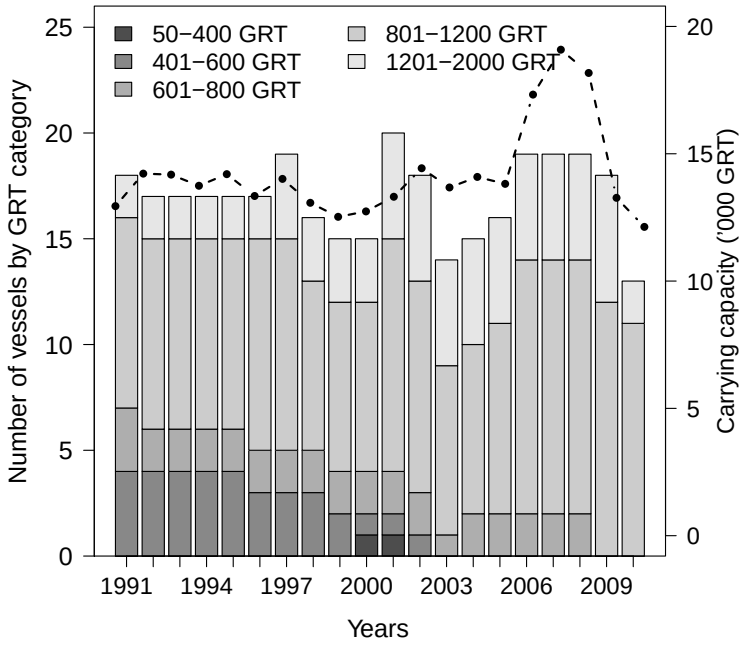

Figure 1: French fishing capacity in the Indian Ocean. Annual changes in the number of vessels by GRT category (barplots) and total carrying capacity (solid line with circles) of the French fishing fleet of the Indian Ocean during 1991-2010. Annual values of capacity were weighted by the proportion of the year at sea (in months). The vessel GRT category was computed as 0.7 times the capacity expressed in m^3

2.2. Carrying capacity

The total carrying capacity expressed in gross tonnage (GRT) increased through time from about 14,000 GRT in the early 1990s to about 20,000 GRT during 2006-2008 (Fig. 1). In the recent years, the fleet capacity strongly decreased to reach about 12,000 GRT in 2010 due to the departure of 10 vessels from the Indian Ocean while 3 new vessels joined the fleet.

2.3. Fishing and searching days

The total number of fishing and searching days showed similar patterns over 1991-2010 with a decrease from 1993 to 2003 followed by a large increase during 2006-2008 (Fig. 2). Fishing effort strongly decreased since then and reached the lowest values during 1991-2010

of about 3,000 and 2,500 fishing and searching days in 2010, respectively.

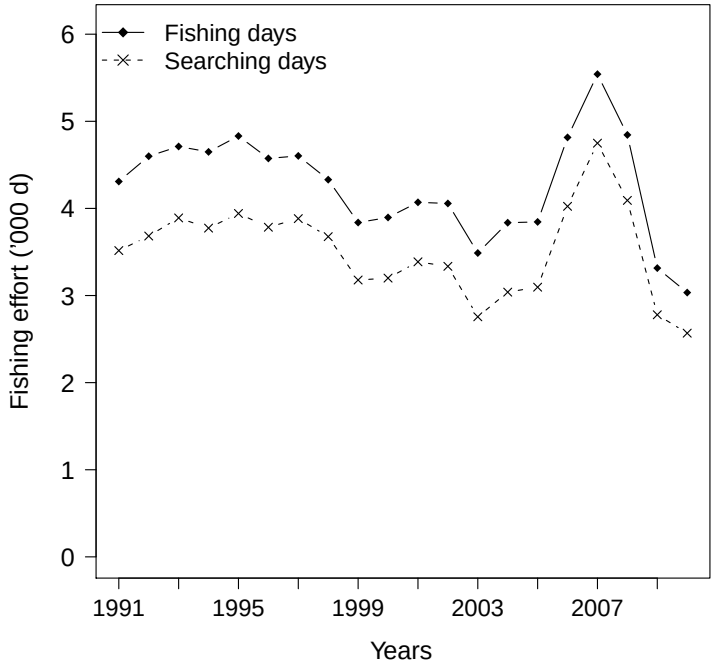

Figure 2: Annual total number of fishing and searching days for the French purse seine fleet in the Indian Ocean during 1991-2010

The effort of the French purse seine fishing fleet in 2010 showed three major fishing grounds located in the North of the Mozambique Channel, West of the Seychelles, and East of the Somali EEZ (Fig. 3). Fishing also took place east of the Seychelles but did not extend far east and very few fishing operations occurred in the British Indian Ocean Territory (BIOT) EEZ (roughly 650,000 km^2) that was implemented as a no-take zone by the United Kingdom on the 1st April 2010, only limited catch by US military personnel being currently permitted.

2.4. Fishing activities

The extent of the purse seine fishing grounds increased to reach a maximum in 1998 at the time of the the strongest warm event observed in the Indian Ocean (Murtuggude 1999, Murtugudde et al. 2000) that led vessels operating in the eastern part of the ocean (Ménard et al. 2007). The fishing ground area then decreased to a minimum level in 2003 before increasing throughout the 2000s (Fig. 4 and Table 3). The number of 1-degree squares with positive catch or minimum effort decreased since 2008 probably due to the decrease in the number of vessels occurring in the Indian Ocean combined with the restricted access to the Somali area due to piracy threat and to the implementation of the Chagos marine

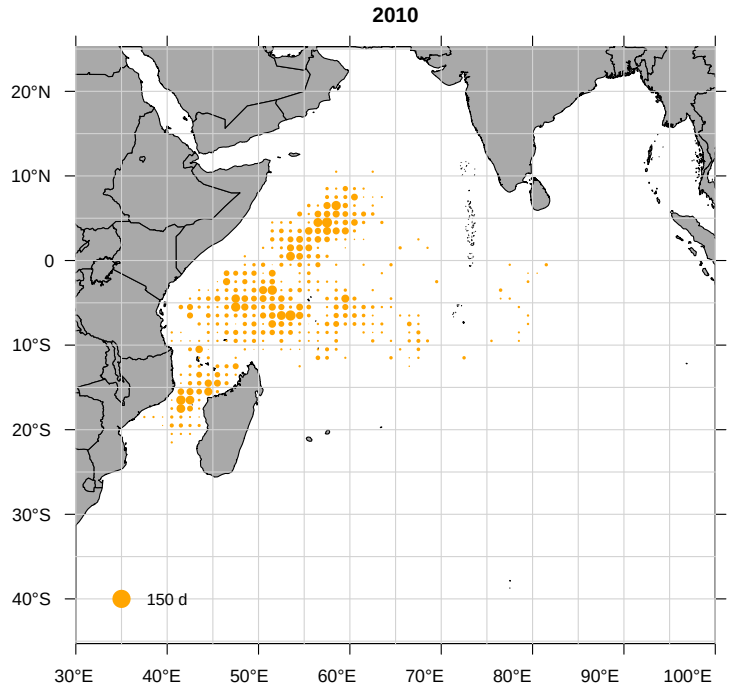

Figure 3: Spatial distribution of fishing effort (in searching days) of the French purse seine fishing fleet in 2010

protected area.

The total annual number of fishing sets made by the French purse seine fleet varied around 3,900 during 1991-2010, showing a general pattern consistent with the annual variations in carrying capacity and in fishing effort of the fleet (Table 4). The fleet showed a strong decrease in the number of sets from more than 4,500 in the mid-2000s to about 2,700 in 2010. The total number of sets showed a pattern very similar to the annual changes in the number of sets made on free swimming schools (Fig. 5). The annual number of sets made on log-schools was more stable through time (around 2,000 y^{-1}) and in an opposite phase than sets made on free swimming schools. The percentage of log-associated over free swimming schools varied around a mean of 50% (SD = 10%) with log-associated fishing predominating from the mid-1990s to the early 2000s while sets made on free swimming schools were more frequent during 2003-2008. The percentage of sets made on log-associated schools steadily increased since 2004 to reach 68% in 2010. Tables 5-7 give the detail of the total number of fishing sets by set size and fishing mode.

The percentage of successful sets (i.e. positive tuna catch) made on log-associated schools (90% ± 2.4%) was higher than for sets made on free swimming schools (52% ± 4.3%) during 1991-2010. The percentage on log-associated sets did not vary much over time although an upward shift seemed to occur in 2000 from an average of 89% in the 1990s to an average of

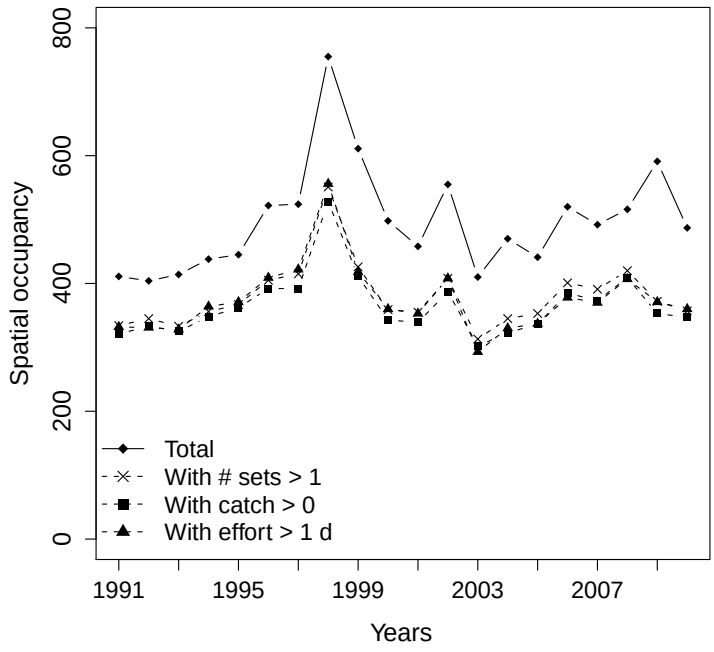

Figure 4: Annual number of 1-degree squares explored by the French purse seine fleet during 1991-2010

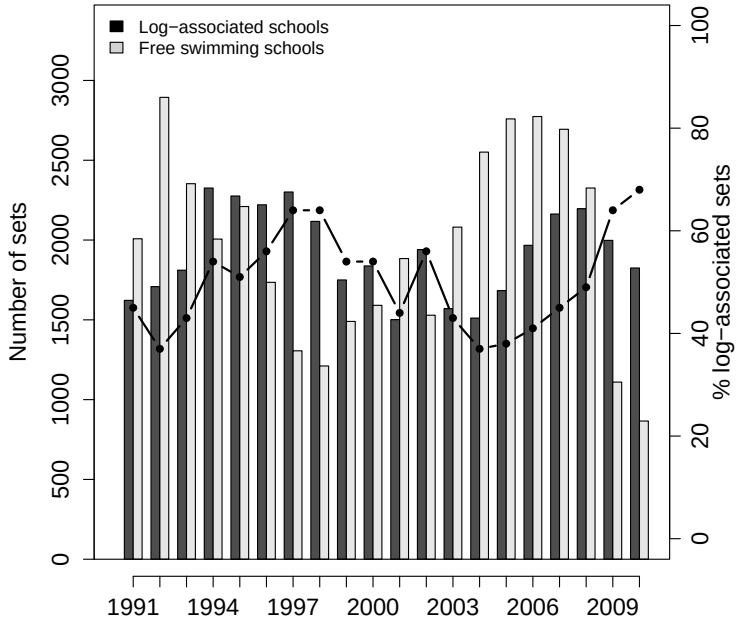

Figure 5: Annual number of fishing sets in the French purse seine fishery on log-associated and free swimming schools during 1991-2010

91% in the 2000s. By contrast, the percentage of successful sets on free swimming schools showed a strong interannual variability during 1991-2010 with an underlying increasing significant trend over time (Pearson's r = 0.5, p-value < 0.05). Overall, the percentage of positive sets for the whole fishery did reach maximum values in 2009-2010 with values of about 80%.

3. Fisheries production

3.1. Catch levels

The French purse seine fishery showed strong interannual variations in the catch over 1991-2010 with a minimum of 60,000 t in 1998 and a maximum of 108,000 t during 2003-2004 (Fig. 6). Catches on log-associated schools represented about 60% of the total catch, increasing from 60% in the early 1990s to about 70% in the late 1990s, and then decreasing to less than 50% during 2003-2005. The percentage has increased since then to reach more than 70% in 2009-2010. Catches on log-associated schools appeared more stable than catches on free swimming schools during 1991-2010 (Fig. 7). They were largely dominated by skipjack that represented about 64% (SD = 6.2%) of all species caught, varying from 50% to about 75% over the period (Fig. 7a). Catches of bigeye mainly derived from the multispecies sampling varied between 5% and 14% of the total of catch on log-associated schools during 1991-2010. Catches of yellowfin on log-associated schools were stable over the

period representing 27% of the catch and an annual average of about 14,380 t (SD = 2,740 t).

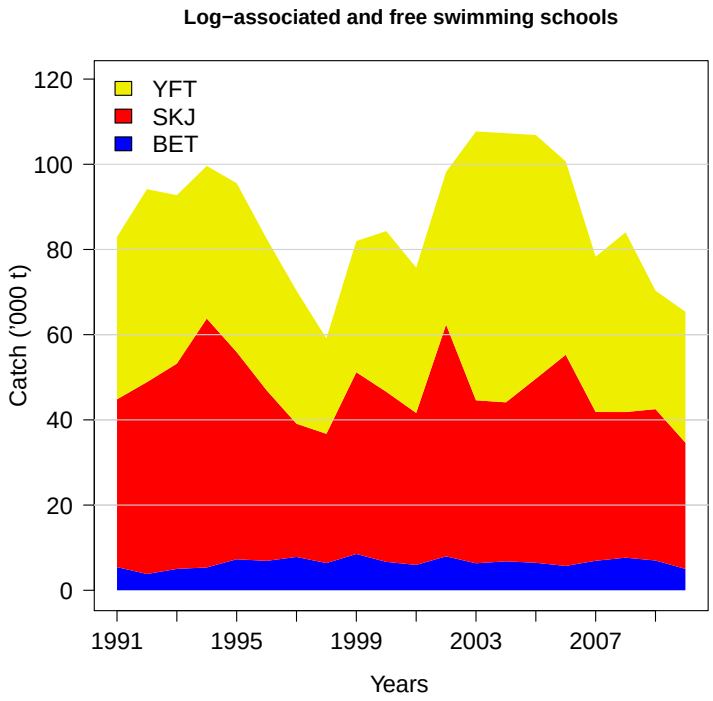

Figure 6: Catch by species of the French purse seine fishing fleet during 1991-2010

Catches made on free swimming schools showed strong internannual variations in the last two decades from less than 20,000 t in the late 1990s to more than 50,000 t during 2003-2005 (Fig. 7b). The changes over time in free swimming schools catches drove the trends in the total catches of the fishery. The catches were largely dominated by yellowfin that represented more than 70% (SD = 9%) of the catch during 1991-2010 and 80% in 2010. However, while catches of YFT on free swimming schools represented more than 70% of the total catch of YFT during 2001-2006, it only represented 50% of the total catch of YFT in 2010. This is mainly due to the strong decrease in the number of sets made on free swimming schools in the recent years, i.e. from more than 2,500 in the mid-2000s to less than 900 in 2010 (Table 4).

3.2. Spatial distribution of the catch

The spatial distribution of the catch in 2010 was dominated by the fishing grounds of the north of the Mozambique Channel and Somali area predominated by skipjack while the catches in the vicinity and east of the Seychelles were dominated by yellowfin (Fig. 8). Indeed, 70% of the French catch was made on log-associated sets in 2010 which drove the spatial pattern of the fishery and was composed of 60%, 33%, and 7% of SKJ, YFT, and

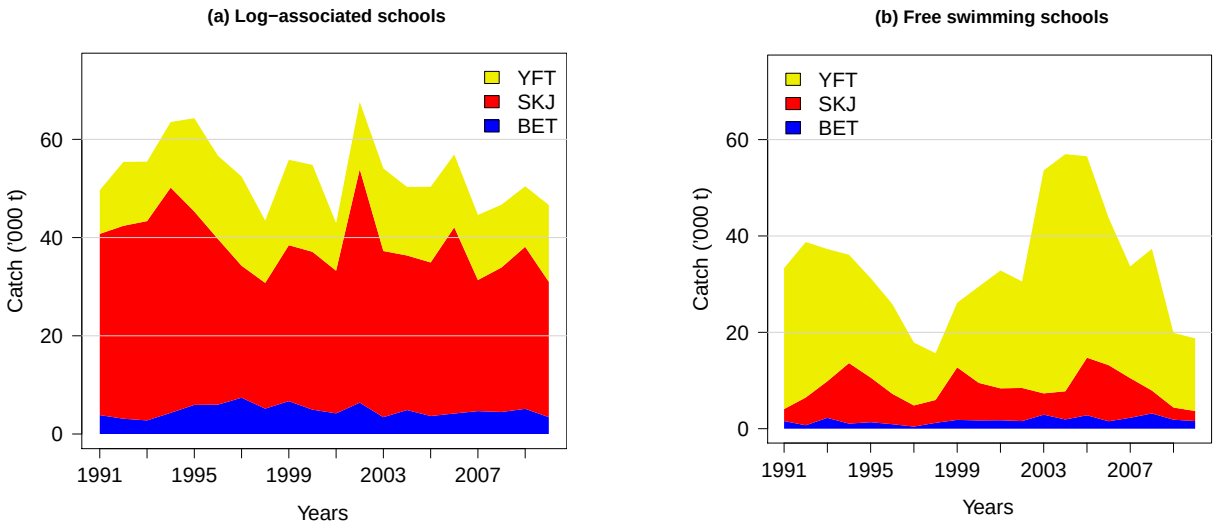

Figure 7: Catch by species of the French purse seine fishing fleet on (a) log-associated and (b) free swimming schools during 1991-2010

BET, respectively (Fig. 10).

Catches on free swimming schools were highly patchy in 2010, mainy predomianted by yellowfin (80% of the total) and mainly centred around the Seychelles islands. Some lower catches on free swimming schools predominated by skipjack were located in the Mozambique Channel where fishing operations generally take place during March-May (Fig. 12).

3.3. Catch rates

Catch rates expressed in tonne per searching day (t d^{-1}) did not show any particular trend over 1991-2010 (Fig. 14). Yellowfin and skipjack catch rates were in the same order of magnitude, i.e. 11.6 t d^{-1} (SD = 4.25 t d^{-1}) and 11.8 t d^{-1} (SD = 2.4 t d^{-1}), respectively. Catch rates of bigeye were stable over time with an average of 1.88 t d^{-1} (SD = 0.4 t d^{-1}).

Skipjack catch rates predominated on log-associated schools and remained quite stable during 1991-2010 at around 10 t searching d^{-1} (Fig. 15a). Yellowfin catch rates varied around 4.2 t d^{-1} (SD = 1.1 t d^{-1}) and showed a steady increase in the recent years, i.e. from 2.8 t d^{-1} in 2007 to 6.1 t d^{-1} in 2010. Yellowfin catch rates predominated for sets made on free swimming schools and showed a high interannual variability, with high values during 2003-2005 > 13.5 t d^{-1} (Fig. 15b). In the recent years, the average catch rates for yellowfin were about 5 t d^{-1} while catch rates for skipjack and bigeye decreased to reach levels of 0.8 and and 0.6 t d^{-1} in 2010, respectively.

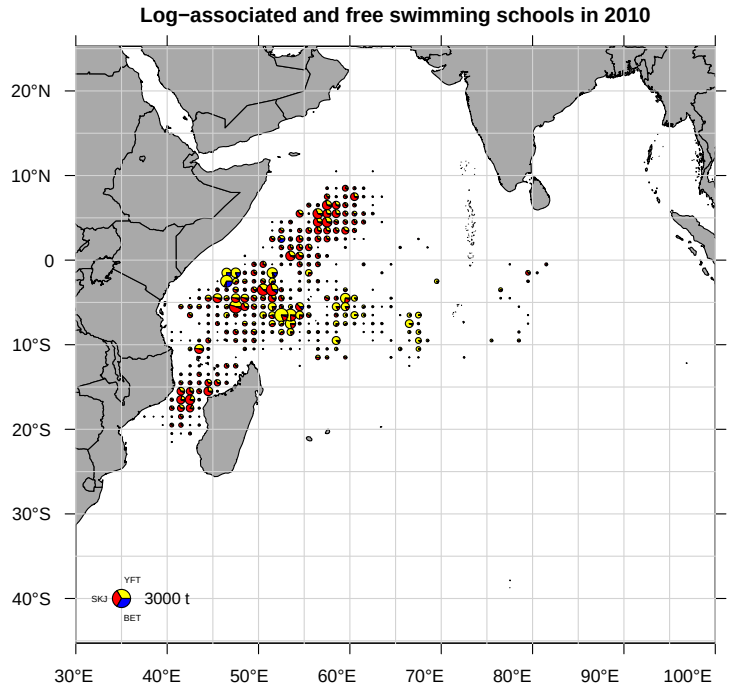

Figure 8: Spatial distribution of tuna catches of the French purse seine fishing fleet in 2010

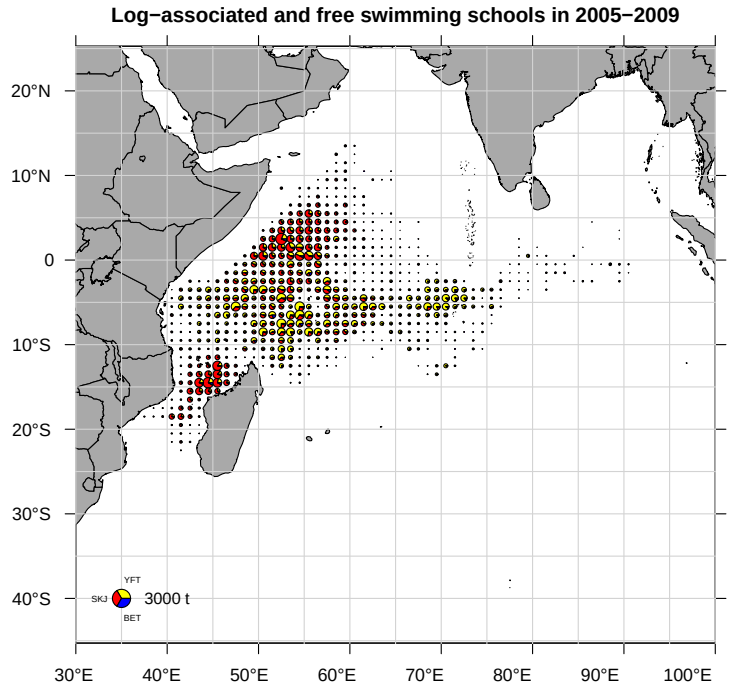

Figure 9: Spatial distribution of tuna catches of the French purse seine fishing fleet in 2005-2009

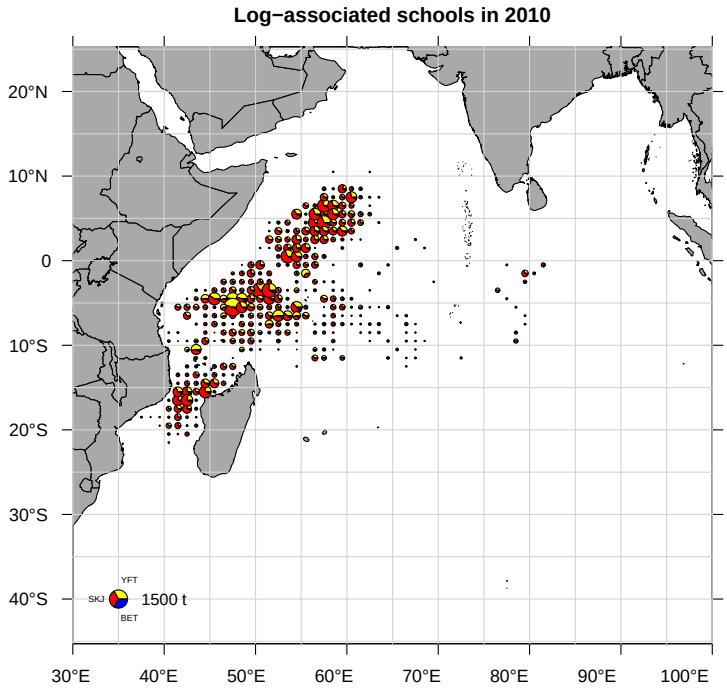

Figure 10: Spatial distribution of tuna catches of the French purse seine fishing fleet made on log-associated schools in 2010

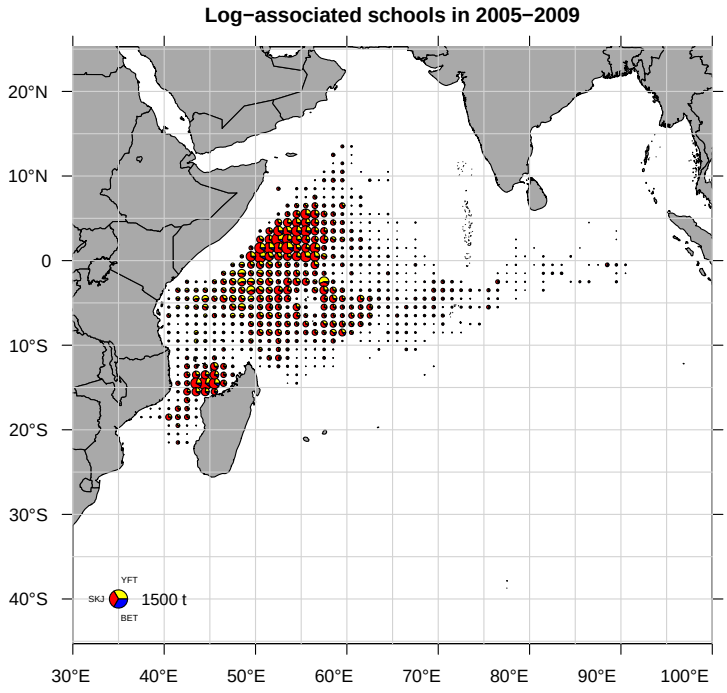

Figure 11: Spatial distribution of tuna catches of the French purse seine fishing fleet made on log-associated schools in 2005-2009

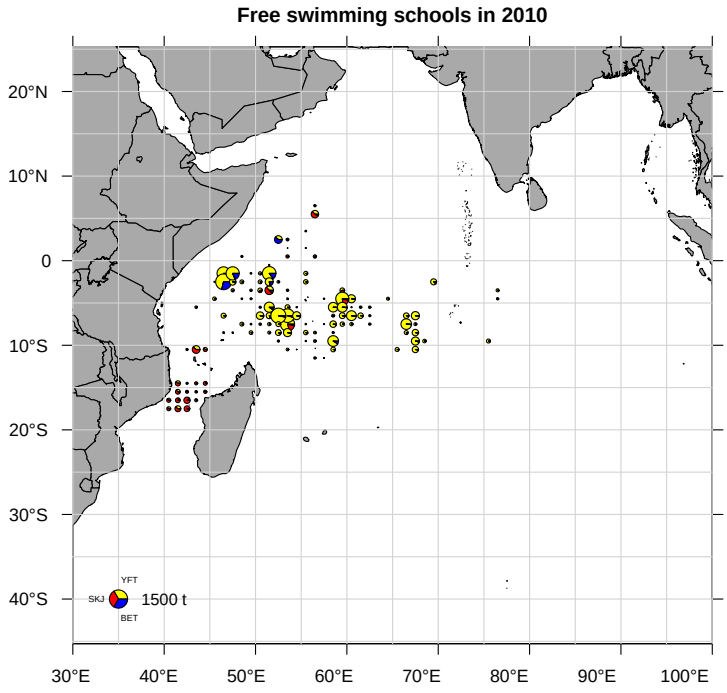

Figure 12: Spatial distribution of tuna catches of the French purse seine fishing fleet made on free swimming schools in 2010

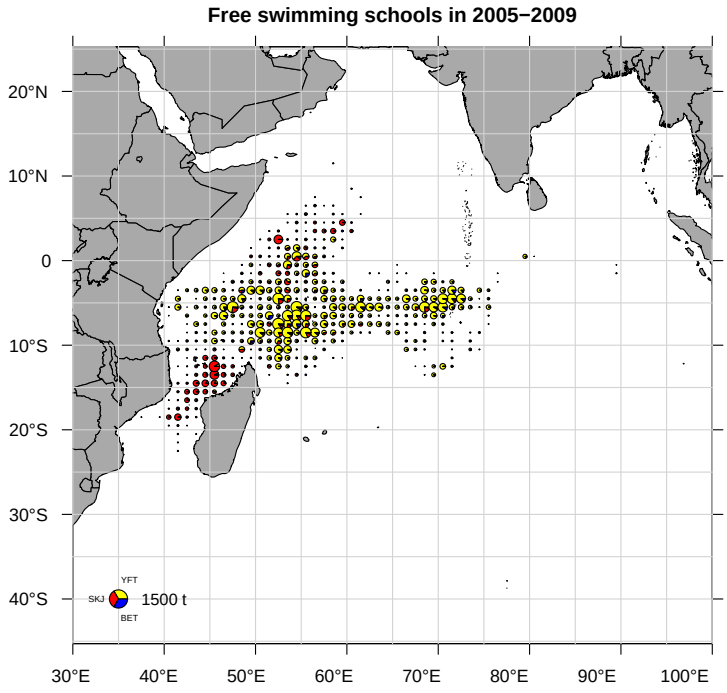

Figure 13: Spatial distribution of tuna catches of the French purse seine fishing fleet made on free swimming schools in 2005-2009

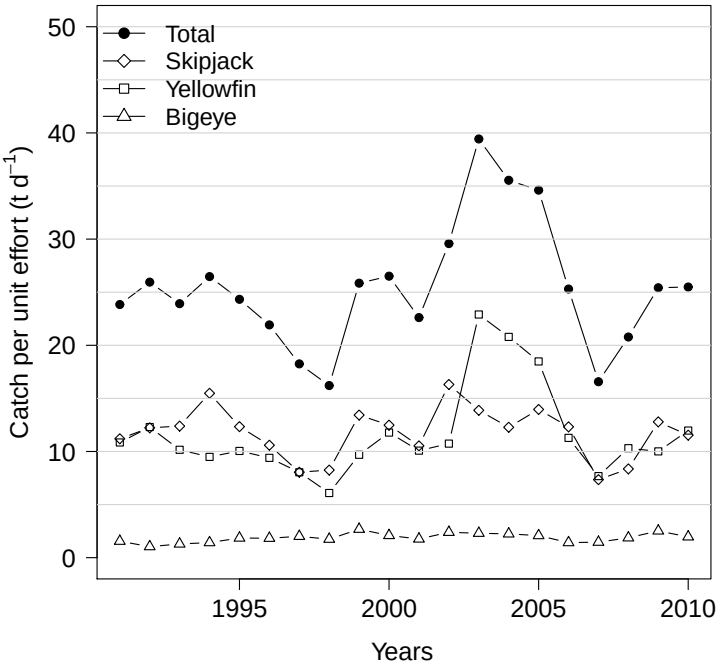

Figure 14: Annual catch rates (in t per searching day) of the French purse seine fleet in the Indian Ocean during 1991-2010

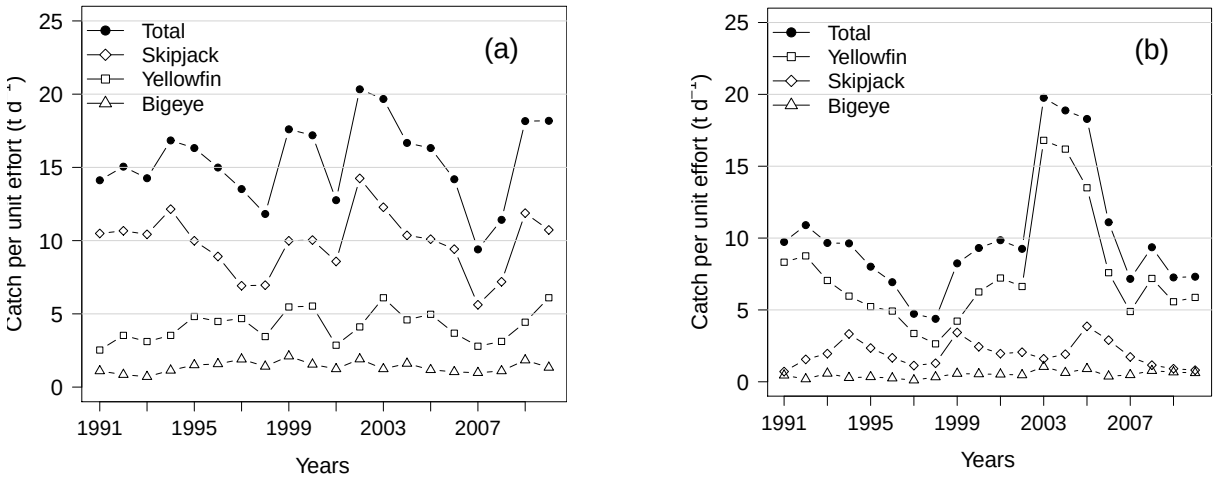

Figure 15: Annual catch rates (in t per searching day) of the French purse seine fleet on (a) log-associated and (b) free swimming schools in the Indian Ocean during 1991-2010

3.4. Size structure of the catch

The total numbers of individuals caught and size structure of the catch on log-associated schools was very similar for the 3 tuna species between 2010 and the average year representing the period 2005-2009 except for skipjack caught on free swimming schools (Fig. 16). The sizes of yellowfin caught on log-associated schools showed a major mode between 40 and 70 cm and a smaller mode around 110-120 cm. Bigeye caught on log schools were only juvenile fishes of median size of 50 cm and the distribution was skewed to the right with a few individuals larger than 80 cm (< 1%). Skipjack showed a unique size mode described by a median of 46 cm (min = 30 cm and max = 70 cm) which was lower than the median size of 48 cm observed during 2005-2009.

The size structure of the catch of yellowfin and skipjack on free swimming schools were similar between 2010 and 2005-2009 although fewer fishes were caught (Fig. 16). By contrast, skipjack caught on free swimming schools in 2010 were smaller (median = 46 cm) than during 2005-2009 (median = 52 cm).

Similarly, the biomass of fish caught by size class showed very similar patterns between 2010 and 2005-2009 except for skipjack caught on free swimming schools (Fig. 17). The biomass of large yellowfin and bigeye (> 100 cm) caught on log-associated and free swimming schools was lower in 2010 than for the average year 2005-2009. The biomass of skipjack 44-50 cm long caught on log-associated schools, which represent the bulk of skipjack catch, was very similar in 2010 than during 2005-2009 while there was a strong decrease in skipjack catch on free swimming schools (Table 8-10).

3.5. Mean weight in the catch

The mean weight in the catch of the major tropical tunas highly differed between fishing modes and showed strong interannual variations during 1991-2010 (Fig. 18). The mean weight of yellowfin caught decreased from more than 37 kg in 1991 to about 15 kg in 1998-1999, before progressively increasing thereafter to reach about 40 kg in 2007-2008. It strongly decreased since then to 28 kg and 25 kg in 2009 and 2010, respectively (Fig. 18a). After an initial decrease from about 10 kg in the early 1990s, the mean weight of yellowfin in the catch made on log-associated schools was stabilised from the mid-1990s to the late 2000s at around 5.8 kg (SD = ± 1.2 kg). Similarly to free swimming schools, the mean weight decreased to reach about 4.3 kg per individual caught during 2009-2010. Over the period 1991-2010, the mean weight of yellowfin on log-associated schools showed a significant linear decrease (Pearson's r = 0.6; p-value < 0.01) characterized by a slope of -0.2 kg per year.

The mean weight of skipjack was more stable than yellowfin during 1991-2010 and varied between a minimum of 2.3 kg in 2002 and a maximum of 3.1 in 2006 for fishes caught on log-associated schools (Fig. 18b). In the recent years, the mean weight of skipjack caught on log-associated schools strongly decreased from more than 3 kg in 2005-2006 to 2.2 kg in 2010. The mean weight of skipjack caught on free swimming schools showed

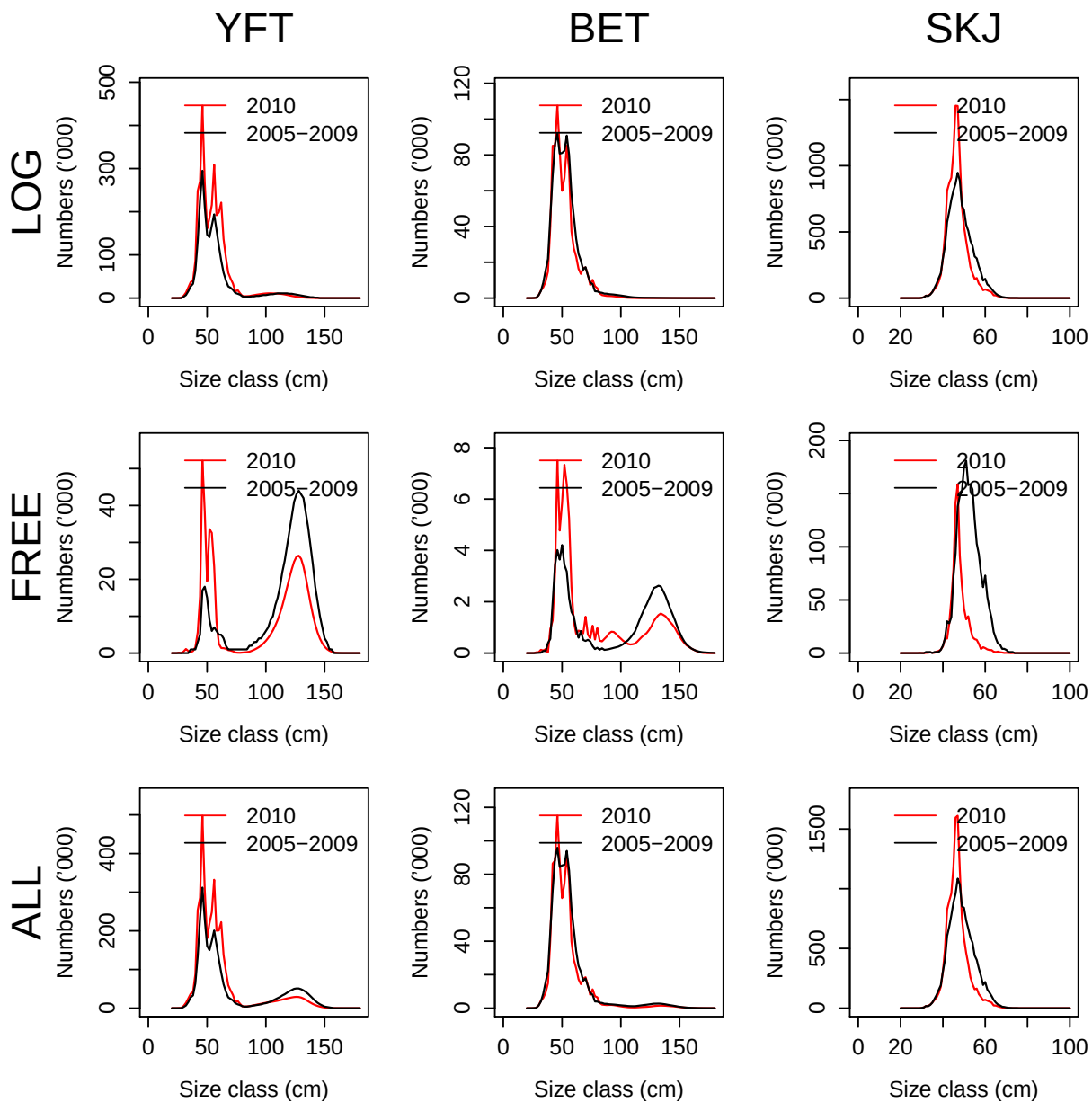

Figure 16: Size distribution (in numbers) of the French purse seine fleet in 2010 and for an average year representing the period 2005-2009

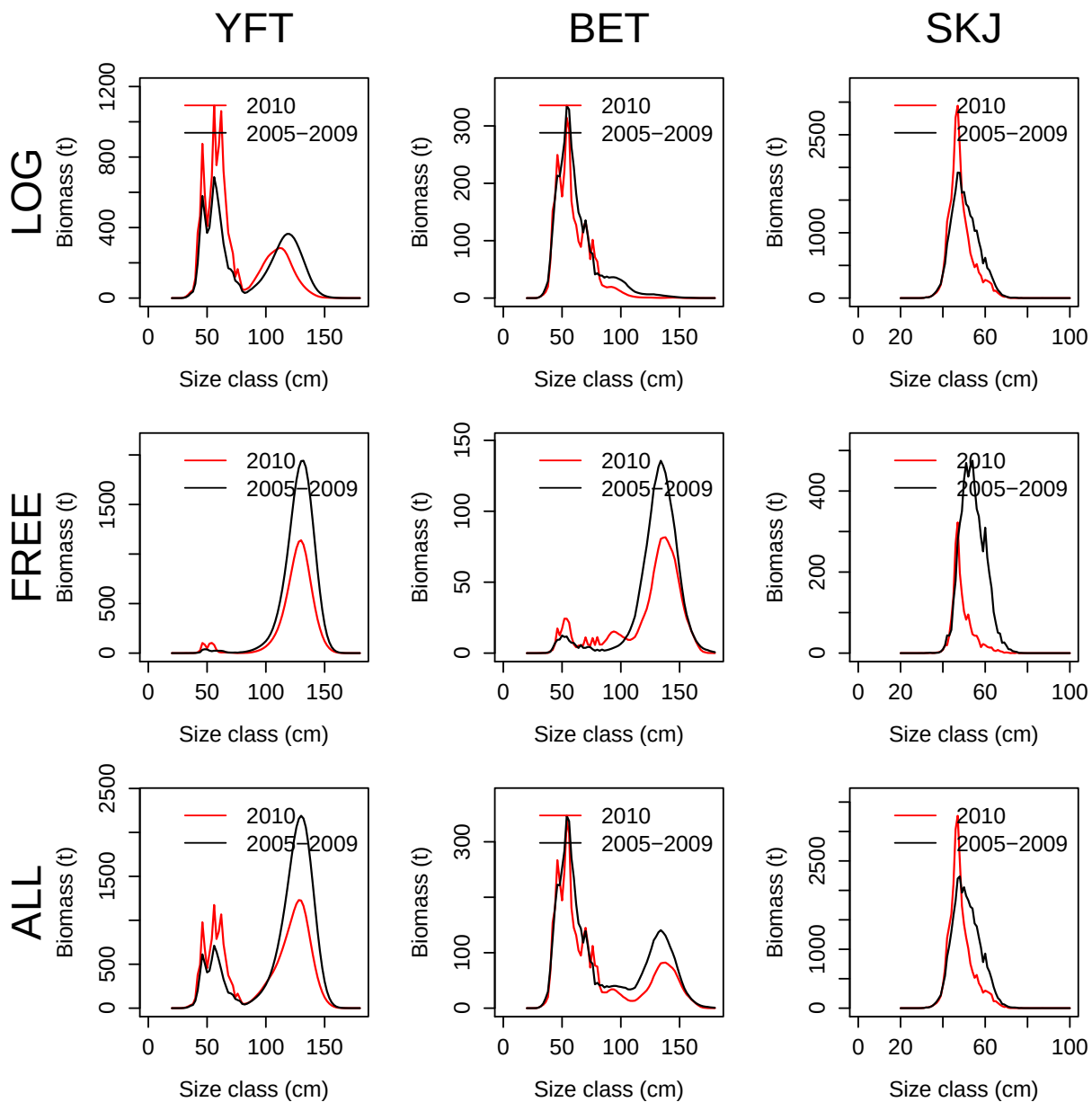

Figure 17: Size distribution (in weight) of the French purse seine fleet in 2010 and for an average year representing the period 2005-2009

more interannual variability with a rather stable value around 3 kg during 1991-1998 before sharply increasing to 4.8 kg in 2001 and then steadily decreasing to reach the lowest value of 2.4 kg in 2010.

The mean weight of bigeye varied around 6 kg (SD ± 1 kg) during 1991-2010 for the whole fishery (Fig. 18c). It showed strong interannual variations for individuals caught on free swimming schools with a pattern very similar to yellowfin tuna (Pearson's r = 0.75; p-value < 0.001). The mean weight of bigeye caught on log-associated schools varied around 4.7 kg during 1991-2007 before decreasing to about 3.7 kg during 2008-2010.

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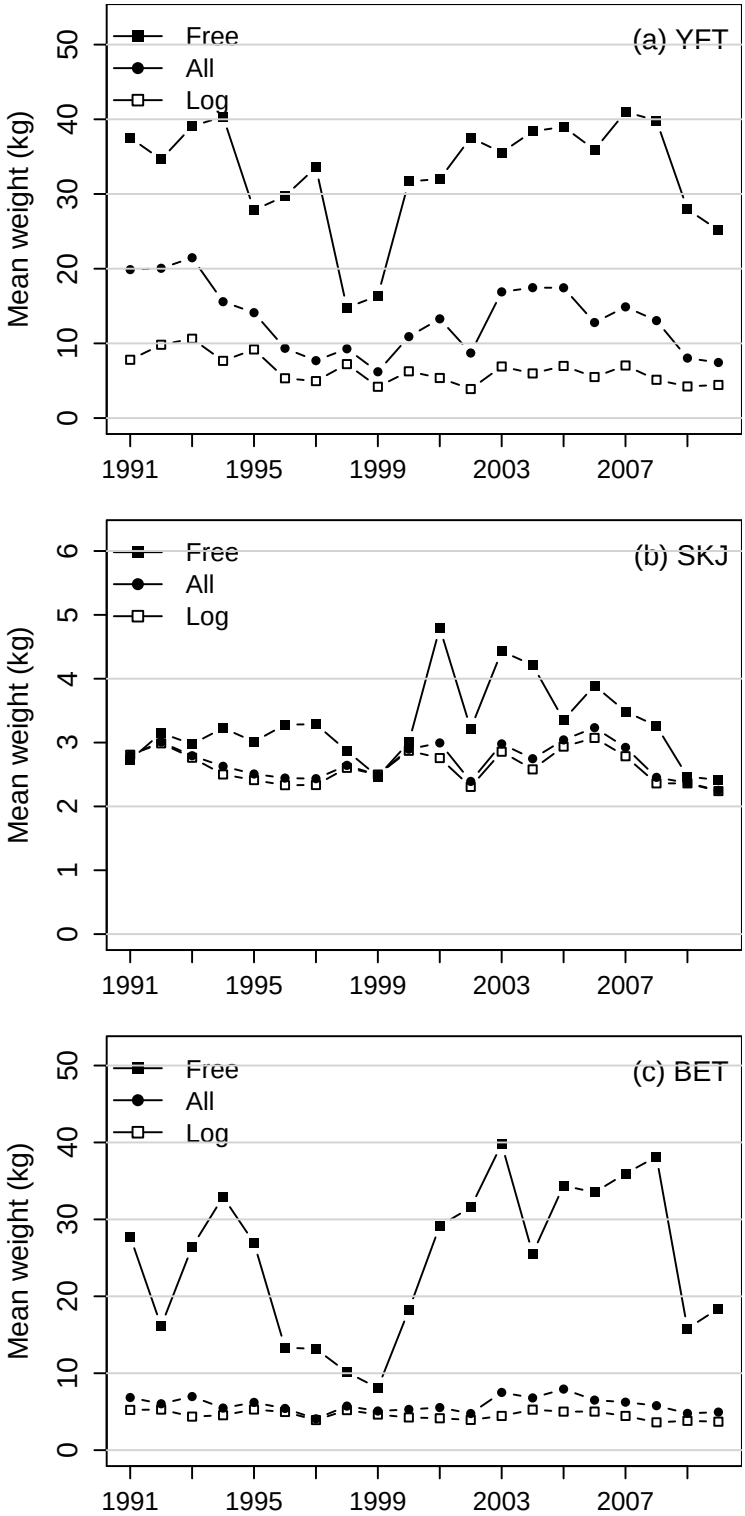

Figure 18: Annual time series of mean weight (kg) for (a) yellowfin, (b) skipjack, and (c) bigeye tuna for each fishing mode during 1991-2010

5. Appendix tables

Table 1: Annual number of purse seiners by GRT category and total carrying capacity (GRT) of the French tropical tuna purse seine fishing fleet of the Indian Ocean during 1991-2010. Total carrying capacity (CC) was weighted by the proportion of the year at sea (in months)

Year	50-400	401-600	601-800	801-1200	>1200	total	CC
1991	0	4	3	9	2	18	12943
1992	0	4	2	9	2	17	14220
1993	0	4	2	9	2	17	14180
1994	0	4	2	9	2	17	13743
1995	0	4	2	9	2	17	14199
1996	0	3	2	10	2	17	13341
1997	0	3	2	10	4	19	14013
1998	0	3	2	8	3	16	13074
1999	0	2	2	8	3	15	12523
2000	1	1	2	8	3	15	12736
2001	1	1	2	11	5	20	13311
2002	0	1	2	10	5	18	14431
2003	0	0	1	8	5	14	13676
2004	0	0	2	8	5	15	14090
2005	0	0	2	9	5	16	13818
2006	0	0	2	12	5	19	17323
2007	0	0	2	12	5	19	19087
2008	0	0	2	12	5	19	18173
2009	0	0	0	12	6	18	13269
2010	0	0	0	11	2	13	12128

Table 2: Annual fishing effort of the French purse seine fishery expressed in fishing and searching days during 1991-2010. Searching days was derived from the total time spent at sea corrected for periods of damage, route towards port, and purse seine operation

Year	Fishing days	Searching days
1991	4309	3516
1992	4599	3683
1993	4711	3891
1994	4649	3774
1995	4831	3942
1996	4574	3784
1997	4603	3883
1998	4330	3676
1999	3838	3178
2000	3896	3200
2001	4070	3387
2002	4057	3335
2003	3488	2756
2004	3836	3039
2005	3845	3096
2006	4815	4024
2007	5541	4749
2008	4844	4092
2009	3315	2779
2010	3034	2568

Table 3: Annual number of 1-degree squares explored by the French purse seine fleet during 1991-2010

Year	TOTAL	#sets	Catch >0	Effort > 1 d	Effort > 5 d
1991	411	334	321	332	203
1992	404	345	333	331	198
1993	414	333	325	328	218
1994	438	356	348	364	231
1995	445	367	362	371	232
1996	522	405	392	409	245
1997	524	415	392	422	258
1998	755	551	528	556	245
1999	611	426	411	418	196
2000	498	359	343	360	201
2001	458	355	339	353	219
2002	555	408	387	408	237
2003	410	313	302	293	186
2004	470	345	323	330	171
2005	441	353	336	337	198
2006	520	401	385	378	220
2007	492	391	373	370	242
2008	516	420	409	407	245
2009	591	372	353	371	189
2010	487	357	347	360	186

Table 4: Number of positive and null sets by fishing mode made by the French purse seine fleet of the Indian ocean during 1991-2010

	ALL			LOG			FREE		
	Total	Positive	Null	Total	Positive	Null	Total	Positive	Null
1991	3630	2448	1182	1622	1538	84	2008	910	1098
1992	4602	2980	1622	1708	1569	139	2894	1411	1483
1993	4164	2764	1400	1811	1612	199	2353	1152	1201
1994	4332	3099	1233	2326	2068	258	2006	1031	975
1995	4486	3066	1420	2276	2052	224	2210	1014	1196
1996	3956	2883	1073	2221	1956	265	1735	927	808
1997	3607	2714	893	2301	2035	266	1306	679	627
1998	3328	2454	874	2117	1828	289	1211	626	585
1999	3240	2371	869	1750	1553	197	1490	818	672
2000	3429	2526	903	1838	1568	270	1591	958	633
2001	3385	2481	904	1501	1378	123	1884	1103	781
2002	3469	2673	796	1940	1835	105	1529	838	691
2003	3651	2464	1187	1570	1405	165	2081	1059	1022
2004	4062	2580	1482	1511	1378	133	2551	1202	1349
2005	4442	3051	1391	1683	1532	151	2759	1519	1240
2006	4741	3233	1508	1967	1814	153	2774	1419	1355
2007	4857	3254	1603	2163	1933	230	2694	1321	1373
2008	4522	3264	1258	2196	1994	202	2326	1270	1056
2009	3108	2488	620	1998	1820	178	1110	668	442
2010	2691	2137	554	1825	1673	152	866	464	402

Table 5: Distribution of the number of sets made on log-associated schools by set size (t) for the French purse seine fishery during 1991-2010

Year	0.1-10	10.1-20	20.1-30	30.1-40	40.1-50	50.1-60	60.1-70	70.1-80	80.1-90	90.1-100	>100
1991	211	428	306	211	125	68	48	26	26	26	63
1992	263	386	293	170	129	82	48	46	28	23	100
1993	264	413	294	167	118	87	60	55	44	27	83
1994	308	595	419	257	168	77	68	47	27	23	78
1995	389	511	369	239	160	104	79	57	45	37	61
1996	407	550	361	229	117	82	49	47	39	18	57
1997	530	570	334	235	121	66	47	42	29	19	42
1998	482	604	309	174	72	49	33	38	18	7	40
1999	312	360	256	165	107	74	60	48	32	26	113
2000	311	381	261	172	110	78	52	46	37	25	95
2001	274	404	233	155	81	47	42	33	24	18	67
2002	309	503	296	179	113	106	70	58	37	30	134
2003	269	344	220	137	99	76	43	49	37	15	116
2004	268	329	226	168	95	67	44	28	25	22	106
2005	315	407	238	152	110	75	71	34	28	16	86
2006	452	468	298	165	108	79	50	41	27	32	94
2007	578	553	314	185	104	74	26	30	17	10	42
2008	547	580	353	208	110	67	44	30	13	11	30
2009	424	503	287	214	120	87	48	40	24	11	61
2010	396	469	276	195	104	51	54	34	24	14	56

Table 6: Distribution of the number of sets made on free swimming schools by set size (t) for the French purse seine fishery during 1991-2010

Year	0.1-10	10.1-20	20.1-30	30.1-40	40.1-50	50.1-60	60.1-70	70.1-80	80.1-90	90.1-100	>100
1991	148	200	156	103	86	47	46	24	24	17	59
1992	283	413	248	159	99	68	47	25	16	14	39
1993	242	286	191	111	95	55	52	21	22	22	54
1994	160	256	180	101	94	64	41	42	17	27	47
1995	175	265	197	115	90	47	35	27	15	17	31
1996	199	256	185	89	58	52	22	19	12	10	25
1997	163	176	128	80	47	29	18	16	4	2	16
1998	162	193	104	47	45	20	21	5	6	7	15
1999	199	196	137	73	66	30	25	18	22	13	39
2000	205	252	170	105	57	50	28	22	16	6	47
2001	282	268	181	99	73	57	43	30	18	7	45
2002	170	190	147	73	67	47	31	20	16	12	65
2003	146	195	150	108	97	78	48	35	33	34	135
2004	161	217	179	146	89	84	54	62	38	36	136
2005	224	363	275	193	120	80	58	61	25	25	95
2006	277	382	242	157	112	76	50	27	24	20	52
2007	325	387	230	126	99	41	37	24	11	9	32
2008	325	317	200	121	89	50	45	30	21	20	52
2009	147	169	111	61	64	35	24	10	11	5	31
2010	76	97	83	52	35	29	18	17	7	14	36

Table 7: Distribution of the total number of sets by set size (t) for the French purse seine fishery during 1991-2010

Year	0.1-10	10.1-20	20.1-30	30.1-40	40.1-50	50.1-60	60.1-70	70.1-80	80.1-90	90.1-100	>100
1991	359	628	462	314	211	115	94	50	50	43	122
1992	546	799	541	329	228	150	95	71	44	37	139
1993	506	699	485	278	213	142	112	76	66	49	137
1994	468	851	599	358	262	141	109	89	44	50	125
1995	564	776	566	354	250	151	114	84	60	54	92
1996	606	806	546	318	175	134	71	66	51	28	82
1997	693	746	462	315	168	95	65	58	33	21	58
1998	644	797	413	221	117	69	54	43	24	14	55
1999	511	556	393	238	173	104	85	66	54	39	152
2000	516	633	431	277	167	128	80	68	53	31	142
2001	556	672	414	254	154	104	85	63	42	25	112
2002	479	693	443	252	180	153	101	78	53	42	199
2003	415	539	370	245	196	154	91	84	70	49	251
2004	429	546	405	314	184	151	98	90	63	58	242
2005	539	770	513	345	230	155	129	95	53	41	181
2006	729	850	540	322	220	155	100	68	51	52	146
2007	903	940	544	311	203	115	63	54	28	19	74
2008	872	897	553	329	199	117	89	60	34	31	82
2009	571	672	398	275	184	122	72	50	35	16	92
2010	472	566	359	247	139	80	72	51	31	28	92

Table 8: Catch by species for the French purse seine fishery of the Indian ocean during 1991-2010

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	38134	39388	5441	875	0	83837
1992	45282	45048	3822	1403	0	95555
1993	39539	48192	5015	310	0	93057
1994	35819	58430	5367	292	0	99908
1995	39636	48652	7280	350	0	95918
1996	35578	40056	6908	391	0	82933
1997	31227	31276	7824	539	0	70866
1998	22382	30340	6389	460	0	59571
1999	30799	42665	8518	154	0	82136
2000	37694	39935	6673	350	172	84825
2001	34127	35673	5956	659	174	76589
2002	35815	54405	7962	264	195	98642
2003	63101	38258	6334	608	368	108670
2004	63174	37323	6798	77	649	108021
2005	57198	43220	6453	86	184	107140
2006	45383	49573	5714	850	290	101809
2007	36455	34918	6928	335	33	78669
2008	42185	34186	7652	981	10	85013
2009	27807	35532	6991	295	3	70628
2010	30722	29639	5020	63	16	65461

Table 9: Catch by species made on log-associated schools for the French purse seine fishery of the Indian ocean during 1991-2010

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	8886	36896	3858	0	0	49639
1992	13014	39286	3112	9	0	55421
1993	12111	40582	2769	5	0	55467
1994	13340	45866	4313	23	0	63543
1995	19002	39380	5933	17	0	64332
1996	16944	33741	5975	70	0	56730
1997	18173	26882	7389	67	0	52511
1998	12680	25599	5173	13	0	43464
1999	17389	31759	6692	103	0	55943
2000	17699	32142	4960	43	172	55017
2001	9678	29045	4206	108	174	43211
2002	13704	47527	6385	0	171	67787
2003	16810	33837	3429	0	134	54209
2004	13959	31473	4882	0	339	50653
2005	15399	31270	3667	0	184	50520
2006	14818	37920	4172	0	214	57124
2007	13254	26695	4662	3	31	44645
2008	12784	29427	4486	2	10	46710
2009	12320	33004	5125	10	3	50462
2010	15652	27549	3438	32	16	46687

Table 10: Catch by species made on free swimming schools for the French purse seine fishery of the Indian ocean during 1991-2010

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	29248	2492	1583	875	0	34198
1992	32268	5762	710	1394	0	40134
1993	27428	7611	2246	305	0	37590
1994	22479	12564	1054	269	0	36365
1995	20634	9272	1348	333	0	31587
1996	18633	6315	933	321	0	26203
1997	13054	4394	434	472	0	18355
1998	9702	4742	1215	448	0	16107
1999	13410	10907	1826	51	0	26193
2000	19995	7793	1713	307	0	29808
2001	24450	6627	1750	551	0	33377
2002	22111	6878	1578	264	24	30855
2003	46291	4422	2906	608	235	54461
2004	49215	5850	1916	77	310	57368
2005	41799	11950	2786	86	0	56620
2006	30564	11653	1542	850	76	44684
2007	23201	8224	2265	332	2	34024
2008	29401	4758	3166	979	0	38303
2009	15487	2527	1866	285	0	20166
2010	15070	2090	1582	31	0	18774

Table 11: Catch per unit of effort (in t per searching day) for the French purse seine fishery of the Indian ocean during 1991-2010

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	10.85	11.20	1.55	0.25	0.00	23.84
1992	12.30	12.23	1.04	0.38	0.00	25.95
1993	10.16	12.39	1.29	0.08	0.00	23.92
1994	9.49	15.48	1.42	0.08	0.00	26.47
1995	10.05	12.34	1.85	0.09	0.00	24.33
1996	9.40	10.59	1.83	0.10	0.00	21.92
1997	8.04	8.05	2.01	0.14	0.00	18.25
1998	6.09	8.25	1.74	0.13	0.00	16.21
1999	9.69	13.43	2.68	0.05	0.00	25.85
2000	11.78	12.48	2.09	0.11	0.05	26.51
2001	10.08	10.53	1.76	0.19	0.05	22.61
2002	10.74	16.31	2.39	0.08	0.06	29.58
2003	22.90	13.88	2.30	0.22	0.13	39.43
2004	20.79	12.28	2.24	0.03	0.21	35.54
2005	18.48	13.96	2.08	0.03	0.06	34.61
2006	11.28	12.32	1.42	0.21	0.07	25.30
2007	7.68	7.35	1.46	0.07	0.01	16.57
2008	10.31	8.36	1.87	0.24	0.00	20.78
2009	10.01	12.79	2.52	0.11	0.00	25.42
2010	11.97	11.54	1.96	0.02	0.01	25.49

Table 12: Catch per unit of effort (in t per searching day) on log-associated schools for the French purse seine fishery of the Indian ocean during 1991-2010

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	2.53	10.49	1.10	0.00	0.00	14.12
1992	3.53	10.67	0.85	0.00	0.00	15.05
1993	3.11	10.43	0.71	0.00	0.00	14.26
1994	3.53	12.15	1.14	0.01	0.00	16.84
1995	4.82	9.99	1.51	0.00	0.00	16.32
1996	4.48	8.92	1.58	0.02	0.00	14.99
1997	4.68	6.92	1.90	0.02	0.00	13.52
1998	3.45	6.96	1.41	0.00	0.00	11.82
1999	5.47	9.99	2.11	0.03	0.00	17.60
2000	5.53	10.04	1.55	0.01	0.05	17.19
2001	2.86	8.58	1.24	0.03	0.05	12.76
2002	4.11	14.25	1.91	0.00	0.05	20.33
2003	6.10	12.28	1.24	0.00	0.05	19.67
2004	4.59	10.36	1.61	0.00	0.11	16.67
2005	4.97	10.10	1.18	0.00	0.06	16.32
2006	3.68	9.42	1.04	0.00	0.05	14.19
2007	2.79	5.62	0.98	0.00	0.01	9.40
2008	3.12	7.19	1.10	0.00	0.00	11.42
2009	4.43	11.88	1.84	0.00	0.00	18.16
2010	6.10	10.73	1.34	0.01	0.01	18.18

Table 13: Catch per unit of effort (in t per searching day) on free swimming schools for the French purse seine fishery of the Indian ocean during 1991-2010

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	8.32	0.71	0.45	0.25	0.00	9.73
1992	8.76	1.56	0.19	0.38	0.00	10.90
1993	7.05	1.96	0.58	0.08	0.00	9.66
1994	5.96	3.33	0.28	0.07	0.00	9.63
1995	5.23	2.35	0.34	0.08	0.00	8.01
1996	4.92	1.67	0.25	0.08	0.00	6.93
1997	3.36	1.13	0.11	0.12	0.00	4.73
1998	2.64	1.29	0.33	0.12	0.00	4.38
1999	4.22	3.43	0.57	0.02	0.00	8.24
2000	6.25	2.44	0.54	0.10	0.00	9.31
2001	7.22	1.96	0.52	0.16	0.00	9.85
2002	6.63	2.06	0.47	0.08	0.01	9.25
2003	16.80	1.60	1.05	0.22	0.09	19.76
2004	16.19	1.92	0.63	0.03	0.10	18.88
2005	13.50	3.86	0.90	0.03	0.00	18.29
2006	7.59	2.90	0.38	0.21	0.02	11.10
2007	4.89	1.73	0.48	0.07	0.00	7.16
2008	7.19	1.16	0.77	0.24	0.00	9.36
2009	5.57	0.91	0.67	0.10	0.00	7.26
2010	5.87	0.81	0.62	0.01	0.00	7.31