

STATISTICS OF THE FRENCH PURSE SEINE FISHING FLEET TARGETING TROPICAL TUNAS IN THE ATLANTIC OCEAN (1991-2012)

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SUMMARY

In 2012, the French purse seine fishing fleet of the Atlantic was composed of 9 vessels of individual carrying capacity >600 t, which all represented a total carrying capacity of 9,000 t. The total cumulated nominal effort was about 2,500 and 2,000 fishing and searching days, respectively. The total number of fishing sets was about 1,900, with nearly 50% realised on schools associated with fish aggregating devices (FAD). Between 2011 and 2012, the capacity and nominal effort of the fleet increased by more than 10% while the total catches decreased by 8%. The decline in catch might be explained by the non access of the fleet to the coastal fishing grounds of Gabon which represented 25% of the fleet catch during 2010-2011 (i.e. 8,000-10,000 t). Overall, the year 2012 was characterized by a decrease in fishing sets and resulting catch on free-swimming schools (FSC) which was partly balanced by increased catches on FADs. Hence, the total catch of skipjack and bigeye remained stable during 2010-2012, i.e. about 12,600 t and 3,300 t, respectively, while the catch of yellowfin decreased by 15% between 2011 and 2012 to reach about 18,000 t. The decrease in yellowfin catch was due to a decrease in the number of sets per searching day on FSC while the catch per positive set remained constant for both fishing modes in 2012, i.e. 20.8 t set⁻¹ and 3.4 t set⁻¹ for FSC and FAD, respectively. For skipjack, catch per positive set in the FAD fishery decreased by 13.5% between 2011 and 2012 but remained at a level of 14 t set⁻¹, similar to the average observed during 2009-2011. By contrast, catch per positive set of skipjack on FSC steadily decreased during 1991-2012 to reach a minimum of 0.56 t set⁻¹ in 2012, in relation with the absence of fishing in the Cap Lopez area where large skipjack are generally caught.

RÉSUMÉ

En 2012, la flottille de senneurs français opérant dans l'Atlantique se composait de neuf navires, chacun ayant une capacité de transport > 600 t, représentant dans leur totalité une capacité de transport de 9.000 t. L'effort nominal cumulé total s'élevait à environ 2.500 et à 2.000 jours de pêche et de recherche, respectivement. Le nombre total d'opérations de pêche s'élevait à environ 1.900, à peu près la moitié étant réalisée sur des bancs associés à des dispositifs de concentration des poissons (DCP). Entre 2011 et 2012, la capacité et l'effort nominal de la flottille ont augmenté de plus de 10%, tandis que les prises totales ont diminué de 8%. La chute des captures pourrait s'expliquer par le fait que la flottille n'avait pas accès aux zones de pêche côtières du Gabon, qui représentaient 25% de la capture de la flottille entre 2010 et 2011 (c.-à-d. 8.000-10.000 t). En règle générale, l'année 2012 a été caractérisée par une diminution des opérations de pêche et des prises résultantes sur bancs libres, ce qui a été en partie compensé par l'augmentation des prises sous DCP. Par conséquent, la prise totale de listao et de thon obèse est demeurée stable entre 2010 et 2012, c.-à-d. à environ 12.600 t et 3.300 t, respectivement, tandis que la prise d'albacore a baissé de 15% entre 2011 et 2012 pour atteindre environ 18.000 t. La baisse des prises d'albacore était due à la diminution du nombre d'opérations par jour de recherche sur bancs libres tandis que la capture par opération positive est demeurée inchangée pour les deux modes de pêche en 2012, c.-à-d. 20,8 t opération⁻¹ pour la pêche en bancs libres et 3,4 t opération⁻¹ pour la pêche sous DCP. Pour le listao, la prise par opération positive dans la pêcherie opérant sous DCP a chuté de 13,5% entre 2011 et 2012, mais elle est demeurée à un niveau de 14 t opération⁻¹ similaire à la moyenne observée entre 2009 et 2011. En revanche, les captures de listao par opération positive en bancs libres ont diminué progressivement entre 1991 et 2012, pour atteindre un minimum de 0,56 t opération⁻¹

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en 2012 en rapport avec l'absence de la pêche dans la zone de Cap Lopez où les gros listaos sont généralement capturés.

RESUMEN

En 2012, la flota de cerco francesa del océano Atlántico estaba compuesta por nueve buques con una capacidad de transporte individual de más de >600 t, lo que supone una capacidad de transporte total de 9.000 t. El esfuerzo nominal total acumulado fue de aproximadamente 2.500 y 2.000 días de pesca y búsqueda, respectivamente. El número total de lances fue de aproximadamente 1.900, y casi el 50% se realizó sobre bancos asociados con dispositivos de concentración de peces (DCP). Entre 2011 y 2012, la capacidad y el esfuerzo nominal de la flota se incrementaron en más de un 10%, mientras que las capturas totales experimentaron un descenso del 8%. El descenso en la captura podría explicarse porque la flota no accedió a los caladeros de la costa de Gabón, donde obtuvo el 25% de su captura en el periodo 2010-2011 (a saber, 8.000-10.000 t) En general, el año 2012 se caracterizó por un descenso de las operaciones de pesca y de la captura resultante en bancos libres (FSC), que se vio equilibrada en parte por un incremento de las capturas en DCP. Por tanto, la captura de listado y patudo se mantuvo estable durante 2010-2012, a saber, aproximadamente 12.600 t y 3.300 t, respectivamente, mientras que la captura de rabil descendió un 15% entre 2011 y 2011, situándose en aproximadamente 18.000 t. El descenso en la captura de rabil se debió a un descenso en el número de lances por día de búsqueda en bancos libres, mientras que la captura por lance positivo se mantuvo constante para los dos tipos de pesca en 2012, a saber, 20,8 t lance⁻¹ y 3,4 t lance⁻¹ para bancos libres y DCP, respectivamente. Para el listado, la captura por lance positivo en la pesquería con DCP experimentó un descenso del 13,5% entre 2011 y 2012, pero se mantuvo en un nivel de 14 t lance⁻¹, similar al promedio observado durante el periodo 2009-2011. Por el contrario, la captura de listado por lance positivo en bancos libres experimentó un marcado descenso en el periodo 1991-2012 llegando a un mínimo de 0,56 t por lance⁻¹ en 2012, relacionado con la ausencia de pesca en la zona de Cabo López, donde se suelen capturar grandes listados.

KEYWORDS

Catch statistics, FAD, Free-swimming school, High seas fisheries, Purse seining

1 Introduction

French purse seiners operating in the Atlantic Ocean target yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), and bigeye tuna (*Thunnus obesus*) through two major fishing modes that result in different species and size composition of the catch: fish aggregating device-associated (FAD) and free-swimming schools (FSC). Statistical data for the French purse seine fishing fleet have been collected by the "Institut de Recherche pour le Développement" (IRD) in collaboration with the Centre de Recherches Océanologiques (CRO) in Ivory Coast, and the Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT), Sénégal since the early 1980s. The fleet activities are described through a suite of fisheries indicators that provide information on fishing capacity, effort, catch, and catch rates for the principal market tropical tunas, with a particular focus on the year 2012.

2 Fishing capacity and effort

In 2012, a total of 9 French purse seiners operated in the eastern Atlantic Ocean (**Figure 1**). The fleet was composed of 2 vessels of carrying capacity (CC) of 600-800 t, 5 vessels of CC 800-1200 t, and 2 vessels of CC >1,200 t (Table 1). The total capacity, weighted by the months of activity for each vessel, increased by 13% between 2011 and 2012 and reached about 13,000 m³, corresponding to 9,000 t of fish hold volume. The increase in CC was due to the arrival of 2 purse seiners from the Indian Ocean while 2 smaller and older vessels (i.e. >30 years) left the fleet in 2011.

The total nominal effort in 2012 was about 2,500 and 2,000 fishing and searching days, respectively (**Figure 2** and **Table 2**). The effort increased by more than 12% between 2011 and 2012 in relation with the increase in fishing capacity. The effort was mainly concentrated between the equator and 10°N, particularly between 10°W-20°W and off the coasts of Ivory Coast (**Figure 3**). Compared to previous years, no fishing occurred in 2012 during the months of May-September in the Cap Lopez area, i.e. within the exclusive economic zone of Gabon, due to the absence of EU Fisheries Partnership Agreement. To face up with the reduction in fishing grounds, the fleet allocated some effort south of 5°S, along the coasts of Angola. Despite the overall increased effort between 2011 and 2012 and fishing activities off Angola, the fleet appeared more concentrated in space in 2012, i.e. a total of 239 1°x1° squares with some effort in 2012 vs. 257 in 2011 (**Table 3**).

While the effort increased by more than 10% between 2011 and 2012, the total number of fishing sets was very similar, i.e. about 2,000 (**Figure 5**). There was however a strong change in the underlying fishing characteristics since the number of FAD sets increased by 40% while the FSC sets decreased by 25% between 2011 and 2012. The reduction in FSC sets might be partly explained by the non access to the Cap Lopez area where fishing on free-swimming schools represented more than 45% of the sets during 2010-2011. The overall increase in FAD sets might also result from an effect of the arrival of the 2 large purse seiners from the Indian Ocean better equipped for FAD-fishing as well as from a more general fishing strategy more oriented toward FAD-fishing in relation with the high sale price for skipjack in 2012. Consequently, the percentage of sets on FAD-associated schools reached nearly 50% in 2012, corresponding to the maximum value observed over the last 2 decades (**Table 4**).

3 Fishery production

In 2012, the total catch of the French component of the EU purse seine fleet of the Atlantic Ocean was 34,000 t, being composed of 54%, 34%, and 10% of yellowfin, skipjack, and bigeye, respectively (**Table 5**). Despite the increase in capacity and effort between 2011 and 2012, the total catch decreased by about 8% (**Figure 6**). The decrease was mainly due to the decrease in catch on FSC by 25% while the catch on FADs increased by 25% in the mean time (**Figure 7**). Overall, the total catch of skipjack and bigeye remained stable during 2010-2012, i.e. about 12,600 t and 3,300 t, respectively, while the catch of yellowfin decreased by 15% between 2011 and 2012 to reach about 18,000 t. The decrease in yellowfin catch was due to a decrease in the number of sets per searching day on FSC in 2012 (**Figure 11b**) while the catch per positive set remained constant for both fishing modes, i.e. 20.8 t set⁻¹ and 3.4 t set⁻¹ for FSC and FAD, respectively (**Figure 11c-d**). The mean catch of yellowfin in the FSC catch increased from about 30 kg in 2010-2012 to nearly 50 kg in 2012 due to the major decrease in the number of small yellowfin caught on free-swimming schools in 2012 (**Figure 15a**).

For skipjack, catch per positive set in the FAD fishery decreased by 13.5% between 2011 and 2012 but remained at a level of 14 t set⁻¹, similar to the average observed during 2009-2011 (**Figure 11c**). By contrast, catch per positive set of skipjack on FSC steadily decreased during 1991-2012 to reach a minimum of 0.56 t set⁻¹ in 2012, in relation with the absence of fishing in the Cap Lopez area where free-swimming skipjack are generally caught (**Figure 11d**). Indeed, the mean weight of skipjack in the catch decreased from 2.5 kg in 2011 to 2.1 kg in 2012 (**Figure 15b**).

While yellowfin were mainly caught on FSC (85% of the catch) and skipjack on FADs (>95%) in 2012, the catch of bigeye in the purse seine fleet resulted from both fishing modes, i.e. 60% and 40% from FAD and FSC, respectively (**Tables 6-7** and **Figure 14**). The decrease in the number of small bigeye on FSC in 2012 resulted in an increase in the mean weight of bigeye in the catch which increased to 31 kg in 2012 (**Figure 15c**). Meanwhile, bigeye caught in association with FADs increased from 3.7 kg to 4.2 kg in 2012 in relation with some medium-sized individuals (about 100 cm fork length) caught on FADs, a feature rarely observed in the purse seine fishery.

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Table 1. Annual number of purse seiners by size category and total carrying capacity of the European tropical tuna purse seine fishing fleet of the Atlantic Ocean during 1991-2012. Total carrying capacity (CC) was weighted by the proportion of the year at sea (in months).

<i>Year</i>	<i>50-400</i>	<i>401-600</i>	<i>601-800</i>	<i>801-1200</i>	<i>1201-2000</i>	<i>>2000</i>	<i>Total</i>	<i>CC</i>
1991	2	9	6	6	0	0	23	11850
1992	1	8	2	6	0	0	17	11457
1993	1	8	3	6	0	0	18	11870
1994	1	8	3	6	0	0	18	12121
1995	0	10	2	5	0	0	17	10863
1996	0	9	2	5	0	0	16	11243
1997	0	10	2	5	2	0	19	11331
1998	0	7	2	6	0	0	15	11071
1999	0	8	2	5	0	0	15	10538
2000	0	7	2	5	0	0	14	10248
2001	0	7	2	7	1	0	17	11314
2002	0	8	3	5	1	0	17	9601
2003	0	8	1	5	0	0	14	9610
2004	0	6	1	5	0	0	12	8345
2005	0	4	0	5	0	0	9	6980
2006	0	4	0	3	0	0	7	4040
2007	0	3	0	2	0	0	5	3581
2008	0	3	2	2	0	0	7	3678
2009	0	1	2	4	3	0	10	6876
2010	0	1	2	4	3	0	10	8846
2011	0	1	2	4	2	0	9	7945
2012	0	0	2	5	2	0	9	8986

Table 2. Annual nominal fishing effort of the French purse seine fishing fleet expressed in fishing and searching days during 1991-2012. Searching days was derived from the total time spent at sea corrected for periods of damage, route towards port, and purse seine operation.

<i>Year</i>	<i>Fishing days</i>	<i>Searching days</i>
1991	4843	4193
1992	4568	4069
1993	4576	3969
1994	4815	4225
1995	4293	3717
1996	4550	3910
1997	4300	3829
1998	4361	3837
1999	3933	3434
2000	3898	3419
2001	4049	3590
2002	3364	2955
2003	3360	2837
2004	2855	2469
2005	2274	1973
2006	1388	1189
2007	1278	1126
2008	1263	1052
2009	2019	1693
2010	2549	2110
2011	2214	1821
2012	2474	2079

Table 3. Annual number of 1-degree squares explored by the French purse seine fishing fleet during 1991-2012. #sets indicates squares where a least 1 fishing set was made.

<i>Year</i>	<i>TOTAL</i>	<i>#sets</i>	<i>Catch >0</i>	<i>Effort > 1 d</i>	<i>Effort > 5 d</i>
1991	389	292	272	313	213
1992	423	293	287	339	215
1993	374	270	260	296	192
1994	420	337	334	358	256
1995	405	307	299	329	200
1996	391	302	291	325	209
1997	464	334	295	373	220
1998	466	355	332	369	214
1999	365	272	260	290	184
2000	368	289	274	299	184
2001	412	283	272	322	195
2002	360	262	249	291	185
2003	358	247	240	267	163
2004	343	254	240	259	149
2005	350	232	216	257	137
2006	264	167	161	182	85
2007	272	166	153	194	84
2008	258	156	146	161	80
2009	332	221	206	228	121
2010	325	256	241	262	142
2011	364	248	235	257	128
2012	345	245	232	239	126

Table 4. Number of positive and null sets by fishing mode made by the French purse seine fishing fleet in the Atlantic ocean during 1991-2012. FAD = Fish Aggregating Device ; FSC = Free-Swimming School.

<i>Year</i>	<i>ALL- Total</i>	<i>ALL- Positive</i>	<i>ALL - Null</i>	<i>FAD- Total</i>	<i>FAD- Positive</i>	<i>FAD- Null</i>	<i>FSC- Total</i>	<i>FSC- Positive</i>	<i>FSC- Null</i>	<i>% Log</i>
1991	3247	2521	726	853	772	81	2394	1749	645	26
1992	2685	2140	545	955	857	98	1730	1283	447	36
1993	3232	2650	582	1172	1116	56	2060	1534	526	36
1994	3135	2581	554	1377	1296	81	1758	1285	473	44
1995	3126	2508	618	1394	1294	100	1732	1214	518	45
1996	3519	2670	849	1347	1212	135	2172	1458	714	38
1997	2598	1908	690	816	725	91	1782	1183	599	31
1998	2889	2162	727	988	913	75	1901	1249	652	34
1999	2745	1995	750	720	653	67	2025	1342	683	26
2000	2616	1971	645	683	622	61	1933	1349	584	26
2001	2500	1904	596	630	560	70	1870	1344	526	25
2002	2209	1678	531	577	545	32	1632	1133	499	26
2003	2838	2263	575	701	662	39	2137	1601	536	25
2004	2075	1657	418	712	669	43	1363	988	375	34
2005	1613	1297	316	459	439	20	1154	858	296	28
2006	1059	828	231	221	214	7	838	614	224	21
2007	819	635	184	171	156	15	648	479	169	21
2008	1018	770	248	188	177	11	830	593	237	18
2009	1595	1253	342	451	400	51	1144	853	291	28
2010	2133	1725	408	872	826	46	1261	899	362	41
2011	1908	1503	405	645	586	59	1263	917	346	34
2012	1913	1556	357	900	813	87	1013	743	270	47

Table 5. Catch by species for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>YFT</i>	<i>SKJ</i>	<i>BET</i>	<i>ALB</i>	<i>OTH</i>	<i>TOTAL</i>
1991	30172	31814	3327	50	554	65917
1992	30778	20383	4985	451	930	57526
1993	33590	31537	10629	565	500	76821
1994	32381	30251	10075	130	1118	73955
1995	27850	22542	6262	83	1099	57836
1996	32179	21370	6778	191	725	61243
1997	29065	13335	4209	39	503	47150
1998	30468	14144	3641	40	927	49221
1999	28833	19457	3383	13	507	52194
2000	29506	16642	3936	23	434	50540
2001	31183	13774	3943	11	275	49186
2002	32982	13806	3597	18	211	50614
2003	32268	17318	3289	63	616	53554
2004	23413	19982	2417	19	264	46094
2005	22073	12606	1913	478	47	37117
2006	18353	5423	2402	347	12	26536
2007	12775	4012	1485	12	98	18382
2008	15929	3661	989	50	37	20666
2009	18545	6602	2043	60	24	27274
2010	19974	13983	3199	109	99	37365
2011	21427	12088	3268	53	152	36990
2012	18243	11749	3574	161	351	34077

Table 6. Catch by species made on FAD-associated schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>YFT</i>	<i>SKJ</i>	<i>BET</i>	<i>ALB</i>	<i>OTH</i>	<i>TOTAL</i>
1991	4476	16465	2501	0	136	23578
1992	6116	16370	3619	0	509	26614
1993	6723	23884	6853	0	432	37892
1994	9124	22273	8372	0	721	40489
1995	5549	18155	5274	4	933	29915
1996	5750	16736	4941	0	559	27985
1997	4371	9076	2945	0	457	16850
1998	4669	8725	2712	0	787	16893
1999	5795	11478	2316	0	289	19877
2000	4335	11207	2696	0	405	18643
2001	3090	8792	2335	0	243	14459
2002	4198	9308	2287	0	164	15957
2003	4332	10937	1833	0	372	17473
2004	3742	14602	1901	0	191	20435
2005	2547	9805	1165	5	47	13569
2006	626	3925	541	0	12	5104
2007	850	3112	489	0	98	4549
2008	557	2103	391	0	37	3088
2009	1089	5531	939	0	24	7583
2010	3001	11297	1530	13	92	15932
2011	1978	9443	1776	12	96	13305
2012	2756	11335	2321	15	312	16739

Table 7. Catch by species made on free-swimming schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>YFT</i>	<i>SKJ</i>	<i>BET</i>	<i>ALB</i>	<i>OTH</i>	<i>TOTAL</i>
1991	25696	15349	826	50	417	42339
1992	24662	4013	1366	451	421	30913
1993	26867	7653	3776	565	68	38929
1994	23257	7979	1703	130	397	33466
1995	22301	4387	988	79	166	27921
1996	26430	4634	1837	191	167	33258
1997	24694	4259	1264	39	46	30301
1998	25799	5419	930	40	140	32328
1999	23038	7980	1067	13	218	32316
2000	25170	5435	1240	23	30	31897
2001	28094	4982	1608	11	33	34727
2002	28784	4498	1310	18	46	34657
2003	27936	6382	1456	63	244	36081
2004	19671	5380	516	19	73	25660
2005	19527	2801	749	472	0	23548
2006	17727	1498	1861	347	0	21433
2007	11925	900	996	12	0	13834
2008	15372	1558	598	50	0	17578
2009	17456	1071	1104	60	0	19691
2010	16973	2687	1668	97	8	21433
2011	19449	2646	1493	41	56	23685
2012	15486	414	1253	146	39	17339

Table 8. Number of sets per searching on FAD-associated (FAD) and free-swimming schools (FSC) for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>ALL</i>	<i>FAD</i>	<i>FSC</i>
1991	0.77	0.2	0.57
1992	0.66	0.23	0.43
1993	0.81	0.3	0.52
1994	0.74	0.33	0.42
1995	0.84	0.38	0.47
1996	0.9	0.34	0.56
1997	0.68	0.21	0.47
1998	0.75	0.26	0.5
1999	0.8	0.21	0.59
2000	0.77	0.2	0.57
2001	0.7	0.18	0.52
2002	0.75	0.2	0.55
2003	1	0.25	0.75
2004	0.84	0.29	0.55
2005	0.82	0.23	0.59
2006	0.89	0.19	0.7
2007	0.73	0.15	0.58
2008	0.97	0.18	0.79
2009	0.94	0.27	0.68
2010	1.01	0.41	0.6
2011	1.05	0.35	0.69
2012	0.92	0.43	0.49

Table 9. Catch per unit of effort (in t per positive set) on FAD-associated schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>YFT</i>	<i>SKJ</i>	<i>BET</i>	<i>ALB</i>	<i>OTH</i>	<i>TOTAL</i>
1991	5.8	21.33	3.24	0	0.18	30.54
1992	7.14	19.1	4.22	0	0.59	31.05
1993	6.02	21.4	6.14	0	0.39	33.95
1994	7.04	17.19	6.46	0	0.56	31.24
1995	4.29	14.03	4.08	0	0.72	23.12
1996	4.74	13.81	4.08	0	0.46	23.09
1997	6.03	12.52	4.06	0	0.63	23.24
1998	5.11	9.56	2.97	0	0.86	18.5
1999	8.87	17.58	3.55	0	0.44	30.44
2000	6.97	18.02	4.33	0	0.65	29.97
2001	5.52	15.7	4.17	0	0.43	25.82
2002	7.7	17.08	4.2	0	0.3	29.28
2003	6.54	16.52	2.77	0	0.56	26.39
2004	5.59	21.83	2.84	0	0.29	30.55
2005	5.8	22.33	2.65	0.01	0.11	30.91
2006	2.93	18.34	2.53	0	0.06	23.85
2007	5.45	19.95	3.13	0	0.63	29.16
2008	3.15	11.88	2.21	0	0.21	17.45
2009	2.72	13.83	2.35	0	0.06	18.96
2010	3.63	13.68	1.85	0.02	0.11	19.29
2011	3.38	16.11	3.03	0.02	0.16	22.7
2012	3.39	13.94	2.85	0.02	0.38	20.59

Table 10. Catch per unit of effort (in t per positive set) on free-swimming schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>YFT</i>	<i>SKJ</i>	<i>BET</i>	<i>ALB</i>	<i>OTH</i>	<i>TOTAL</i>
1991	14.69	8.78	0.47	0.03	0.24	24.21
1992	19.22	3.13	1.06	0.35	0.33	24.09
1993	17.51	4.99	2.46	0.37	0.04	25.38
1994	18.1	6.21	1.33	0.1	0.31	26.04
1995	18.37	3.61	0.81	0.07	0.14	23
1996	18.13	3.18	1.26	0.13	0.11	22.81
1997	20.87	3.6	1.07	0.03	0.04	25.61
1998	20.66	4.34	0.74	0.03	0.11	25.88
1999	17.17	5.95	0.8	0.01	0.16	24.08
2000	18.66	4.03	0.92	0.02	0.02	23.65
2001	20.9	3.71	1.2	0.01	0.02	25.84
2002	25.41	3.97	1.16	0.02	0.04	30.59
2003	17.45	3.99	0.91	0.04	0.15	22.54
2004	19.91	5.45	0.52	0.02	0.07	25.97
2005	22.76	3.26	0.87	0.55	0	27.45
2006	28.87	2.44	3.03	0.57	0	34.91
2007	24.9	1.88	2.08	0.03	0	28.88
2008	25.92	2.63	1.01	0.08	0	29.64
2009	20.46	1.26	1.29	0.07	0	23.08
2010	18.88	2.99	1.86	0.11	0.01	23.84
2011	21.21	2.89	1.63	0.04	0.06	25.83
2012	20.84	0.56	1.69	0.2	0.05	23.34

Table 11. Catch per unit of effort (in t per searching day) on FAD-associated schools for the French purse seine fishery of the Atlantic Ocean during 1991-2012.

Year	YFT	SKJ	BET	ALB	OTH	TOTAL
1991	1.07	3.93	0.6	0	0.03	5.62
1992	1.5	4.02	0.89	0	0.13	6.54
1993	1.69	6.02	1.73	0	0.11	9.55
1994	2.16	5.27	1.98	0	0.17	9.58
1995	1.49	4.88	1.42	0	0.25	8.05
1996	1.47	4.28	1.26	0	0.14	7.16
1997	1.14	2.37	0.77	0	0.12	4.4
1998	1.22	2.27	0.71	0	0.21	4.4
1999	1.69	3.34	0.67	0	0.08	5.79
2000	1.27	3.28	0.79	0	0.12	5.45
2001	0.86	2.45	0.65	0	0.07	4.03
2002	1.42	3.15	0.77	0	0.06	5.4
2003	1.53	3.86	0.65	0	0.13	6.16
2004	1.52	5.91	0.77	0	0.08	8.28
2005	1.29	4.97	0.59	0	0.02	6.88
2006	0.53	3.3	0.45	0	0.01	4.29
2007	0.75	2.76	0.43	0	0.09	4.04
2008	0.53	2	0.37	0	0.04	2.94
2009	0.64	3.27	0.55	0	0.01	4.48
2010	1.42	5.35	0.73	0.01	0.04	7.55
2011	1.09	5.19	0.98	0.01	0.05	7.31
2012	1.33	5.45	1.12	0.01	0.15	8.05

Table 12. Catch per unit of effort (in t per searching day) on free swimming schools for the French purse seine fishery of the Atlantic Ocean during 1991-2012.

<i>Year</i>	<i>YFT</i>	<i>SKJ</i>	<i>BET</i>	<i>ALB</i>	<i>OTH</i>	<i>TOTAL</i>
1991	6.13	3.66	0.2	0.01	0.1	10.1
1992	6.06	0.99	0.34	0.11	0.1	7.6
1993	6.77	1.93	0.95	0.14	0.02	9.81
1994	5.5	1.89	0.4	0.03	0.09	7.92
1995	6	1.18	0.27	0.02	0.04	7.51
1996	6.76	1.19	0.47	0.05	0.04	8.51
1997	6.45	1.11	0.33	0.01	0.01	7.91
1998	6.72	1.41	0.24	0.01	0.04	8.42
1999	6.71	2.32	0.31	0	0.06	9.41
2000	7.36	1.59	0.36	0.01	0.01	9.33
2001	7.82	1.39	0.45	0	0.01	9.67
2002	9.74	1.52	0.44	0.01	0.02	11.73
2003	9.85	2.25	0.51	0.02	0.09	12.72
2004	7.97	2.18	0.21	0.01	0.03	10.39
2005	9.9	1.42	0.38	0.24	0	11.94
2006	14.91	1.26	1.57	0.29	0	18.02
2007	10.59	0.8	0.88	0.01	0	12.28
2008	14.62	1.48	0.57	0.05	0	16.72
2009	10.31	0.63	0.65	0.04	0	11.63
2010	8.04	1.27	0.79	0.05	0	10.16
2011	10.68	1.45	0.82	0.02	0.03	13.01
2012	7.45	0.2	0.6	0.07	0.02	8.34

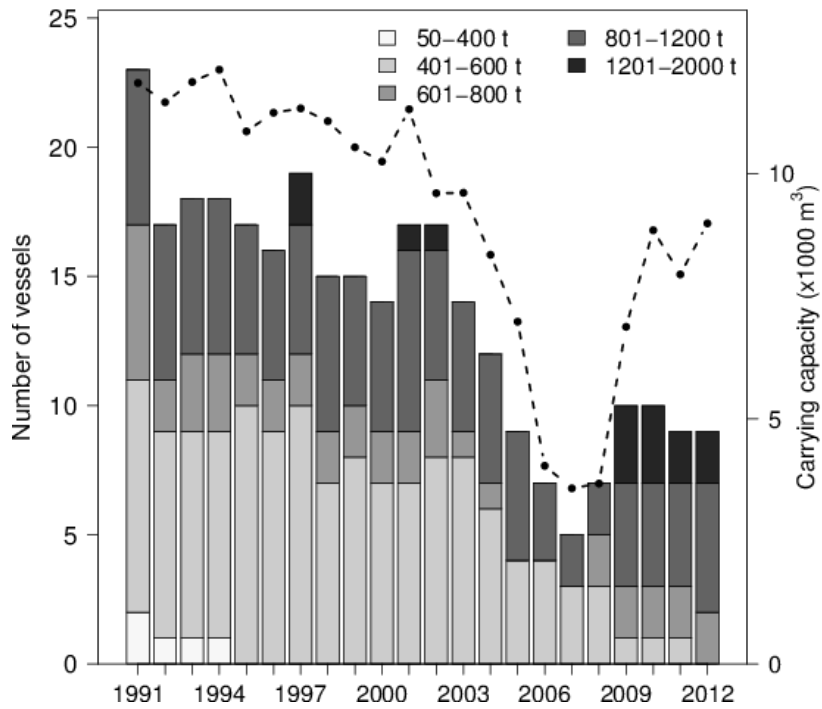


Figure 1. Fishing capacity of the French purse seine fishing fleet in the Atlantic Ocean. Annual changes in the number of purse seiners by size category (barplots) and total carrying capacity (solid line with circles) during 1991-2012. Capacity was weighted by the vessel-specific proportion of the year at sea (in months). The vessel size category (t) was computed as 0.7 times the capacity expressed in m^3 .

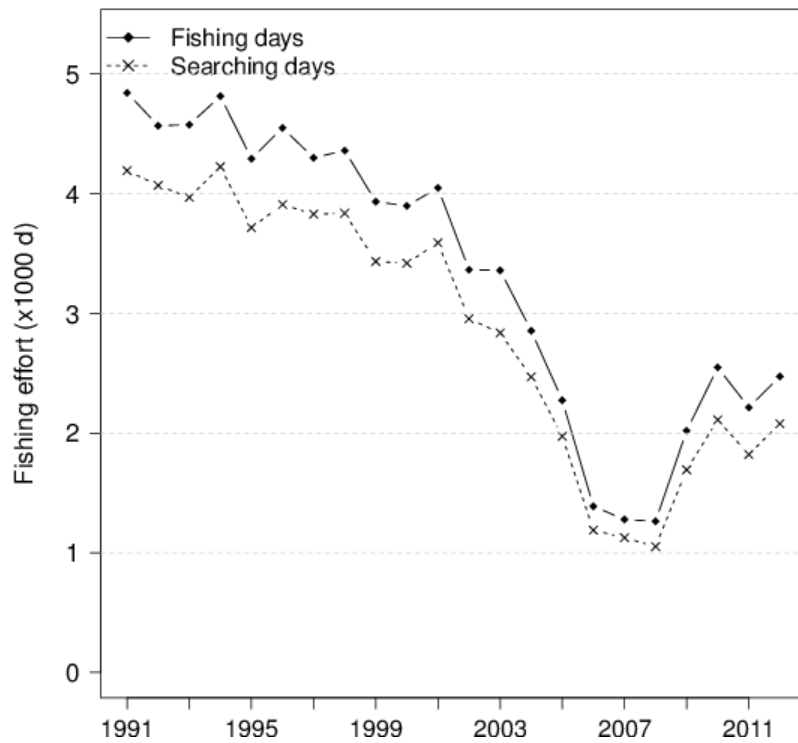


Figure 2. Changes in nominal effort over time. Annual total number of fishing and searching days for the French purse seine fishing fleet in the Atlantic Ocean during 1991-2012.

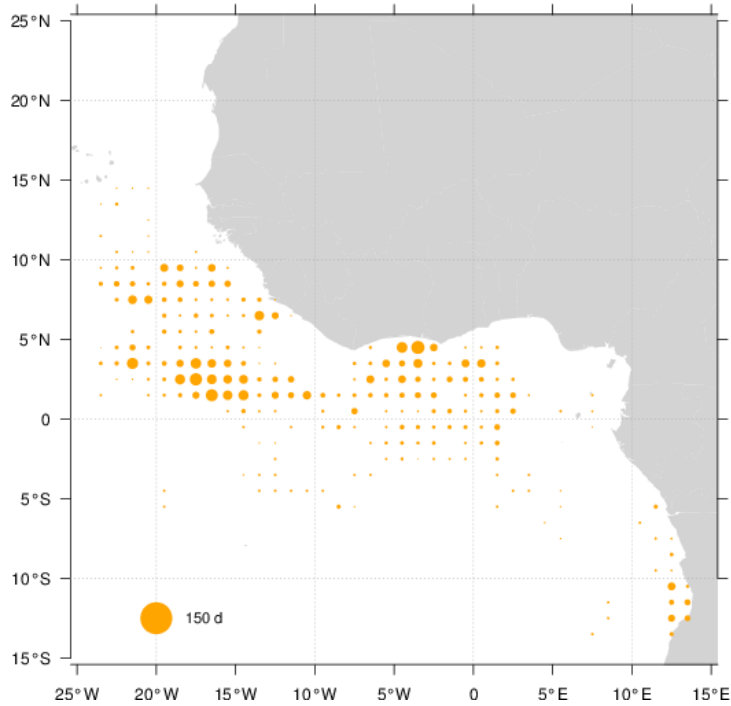


Figure 3. Fishing grounds. Spatial distribution of fishing effort (in searching days) of the French purse seine fishing fleet in 2012.

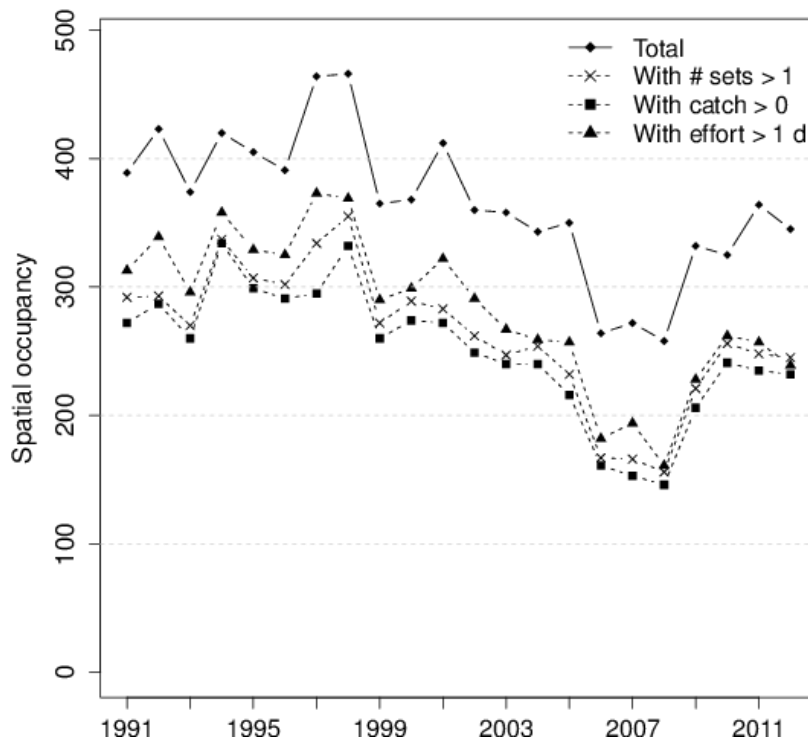


Figure 4. Changes in spatial extent of the fishery over time. Mean annual number of 1-degree squares explored by each vessel of the French purse seine fishing fleet during 1991-2012. Solid line indicates standard deviation. Only vessels in activity during 12 months were selected. A loess function was fitted to the data to illustrate the trend.

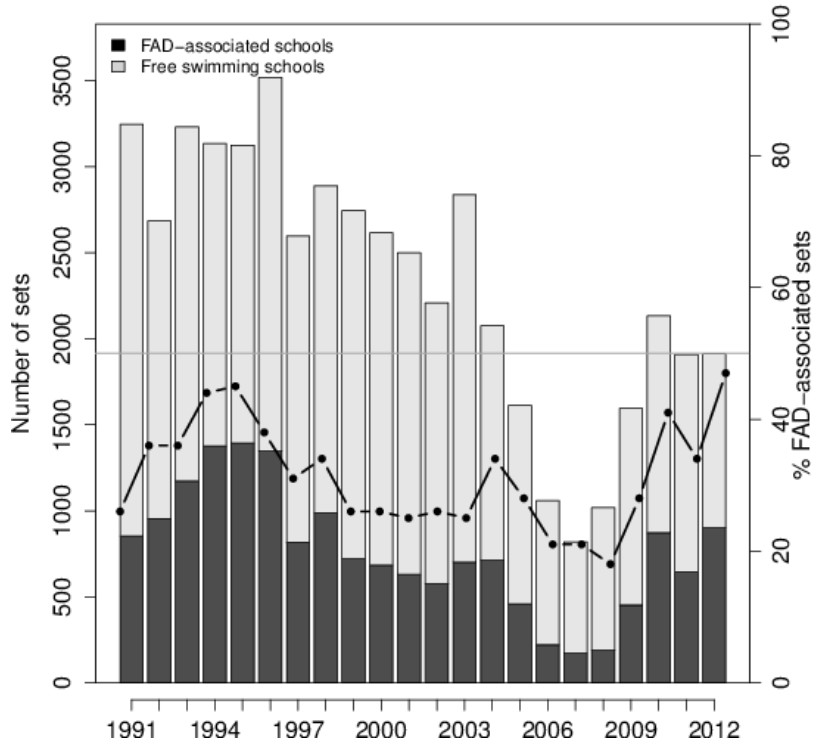


Figure 5. Fishing operations. Annual number of fishing sets in the French purse seine fishery on FAD-associated and free-swimming schools during 1991-2012. Line with solid circles indicates the percentage of sets made on FAD-associated schools over free-swimming schools. Grey solid line indicates the 50% value.

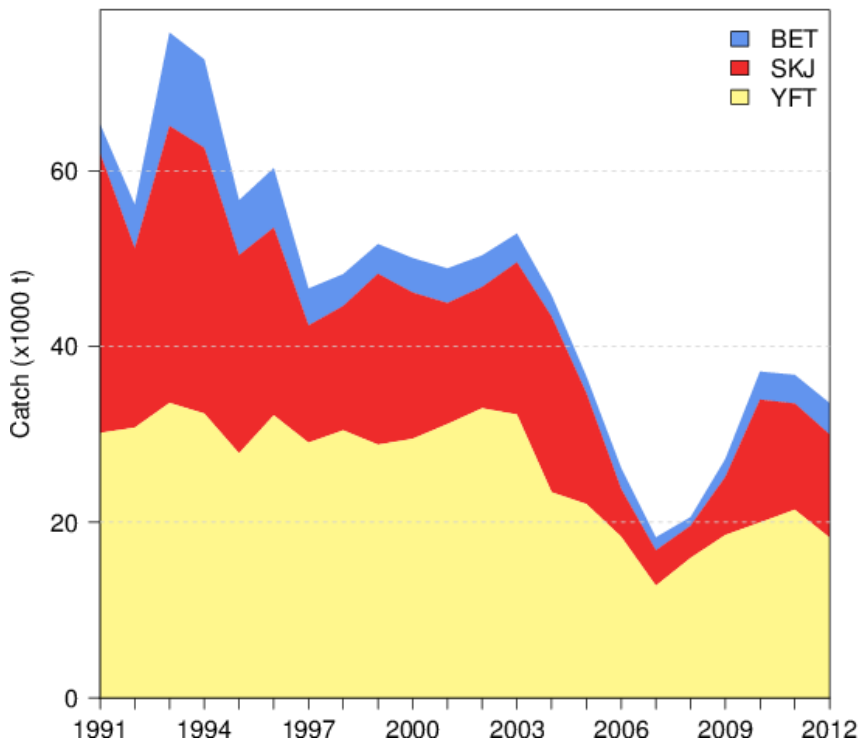


Figure 6. Total fishery production. Catch by species of the French purse seine fishing fleet during 1991-2012.

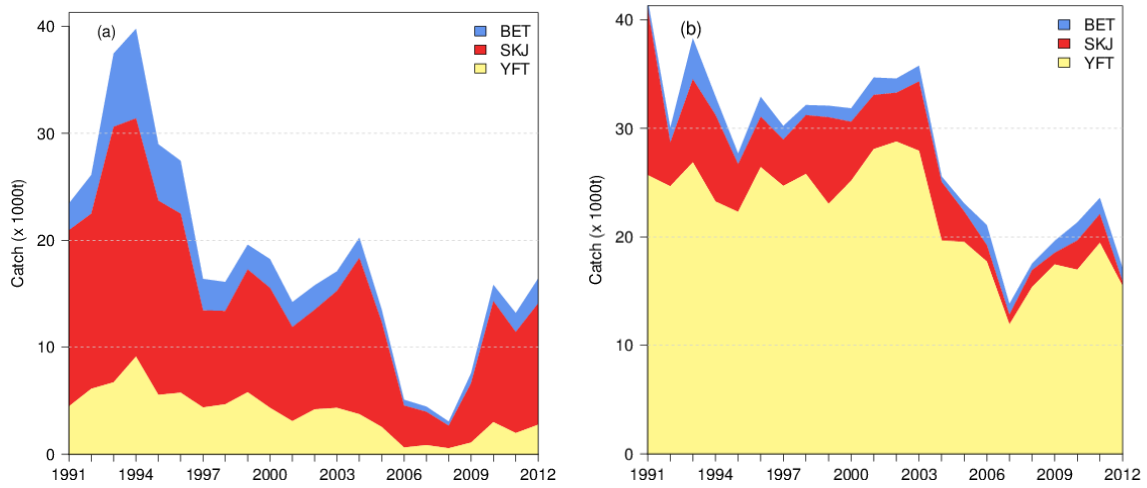


Figure 7. Fishery production by major fishing mode. Catch by species of the French purse seine fishing fleet on (a) FAD-associated and (b) free-swimming schools during 1991-2012.

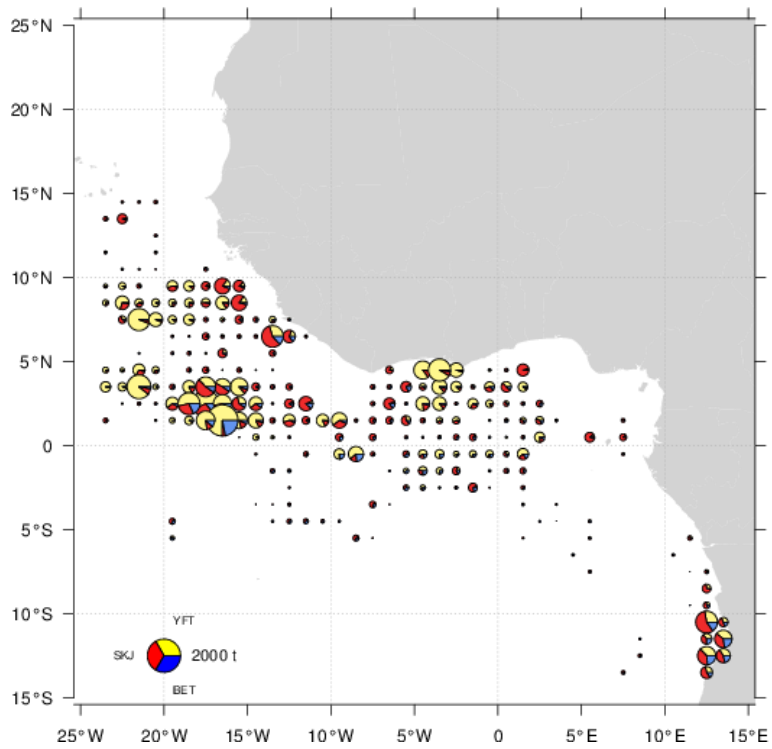


Figure 8. Spatial distribution of tuna catches of the French purse seine fishing fleet in 2012.

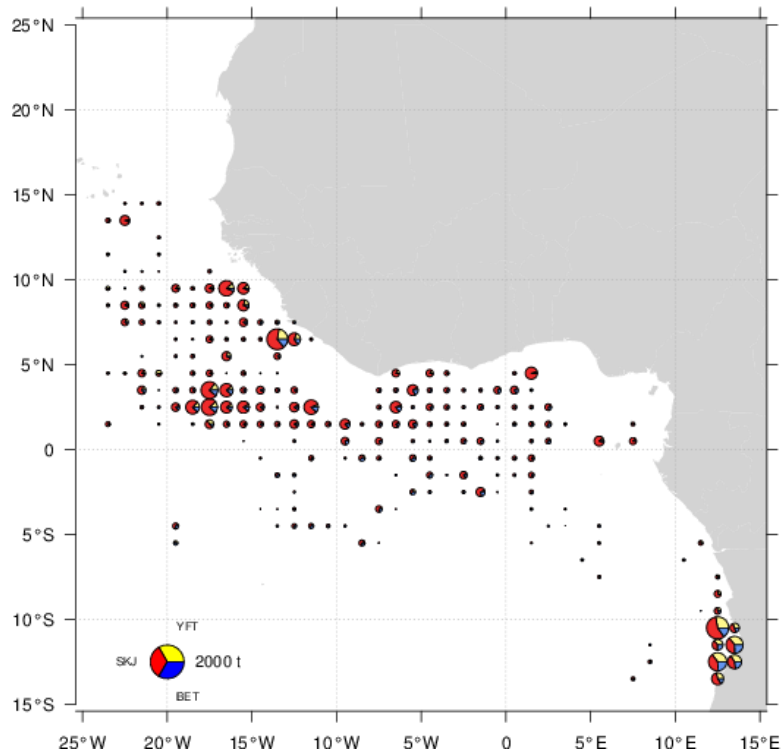


Figure 9. Spatial distribution of tuna catches of the French purse seine fishing fleet made on FAD-associated schools in 2012.

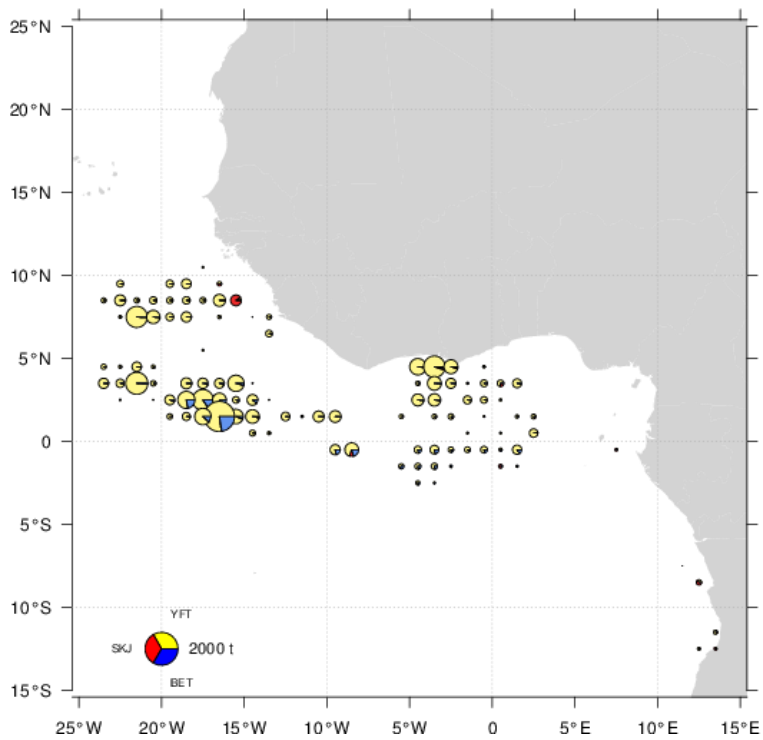


Figure 10. Spatial distribution of tuna catches of the French purse seine fishing fleet made on FSC-associated schools in 2012.

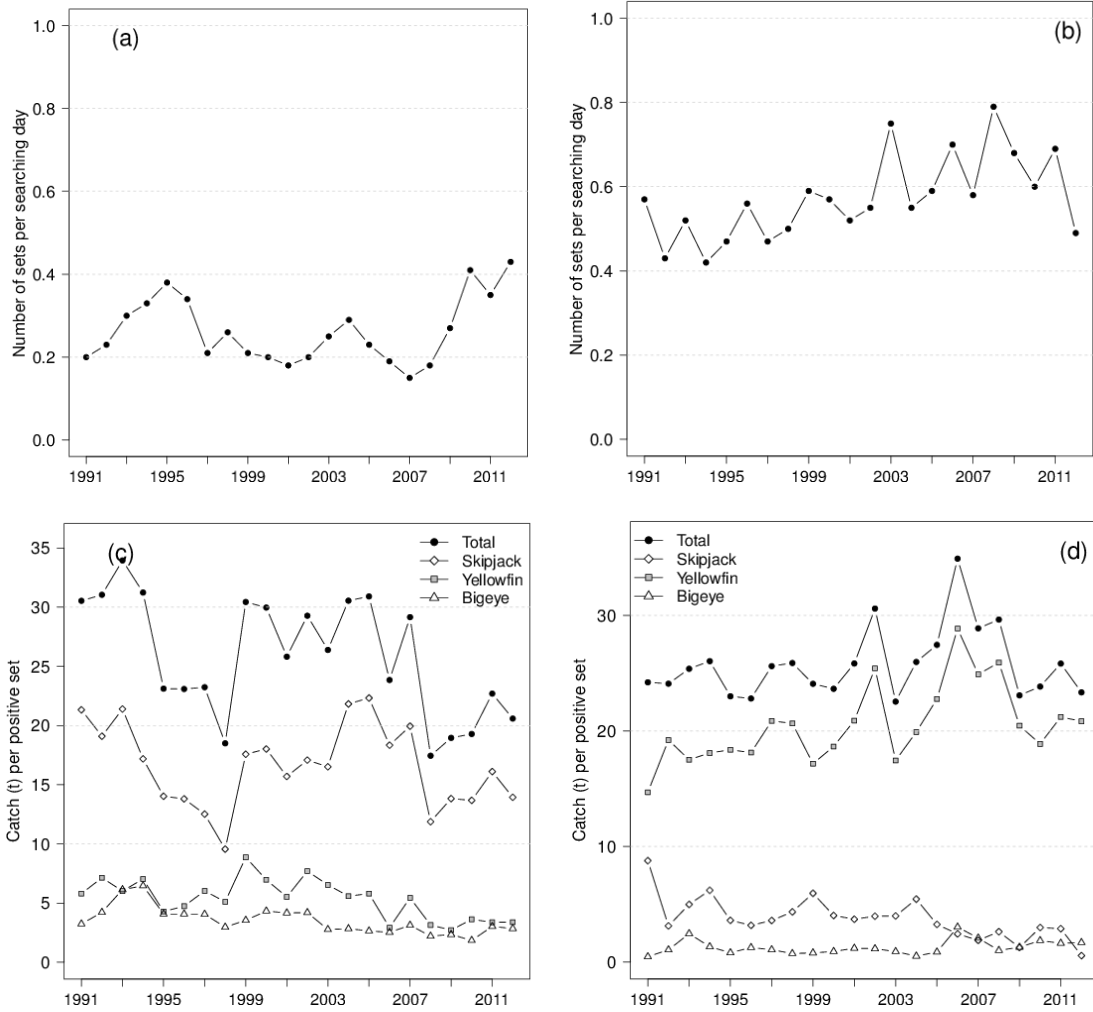


Figure 11. (a-b) Annual number of sets per searching day and (c-d) catch per positive set on (left panel) FAD-associated and (right panel) free-swimming schools for the French purse seine fishing fleet in the Atlantic Ocean during 1991-2012.

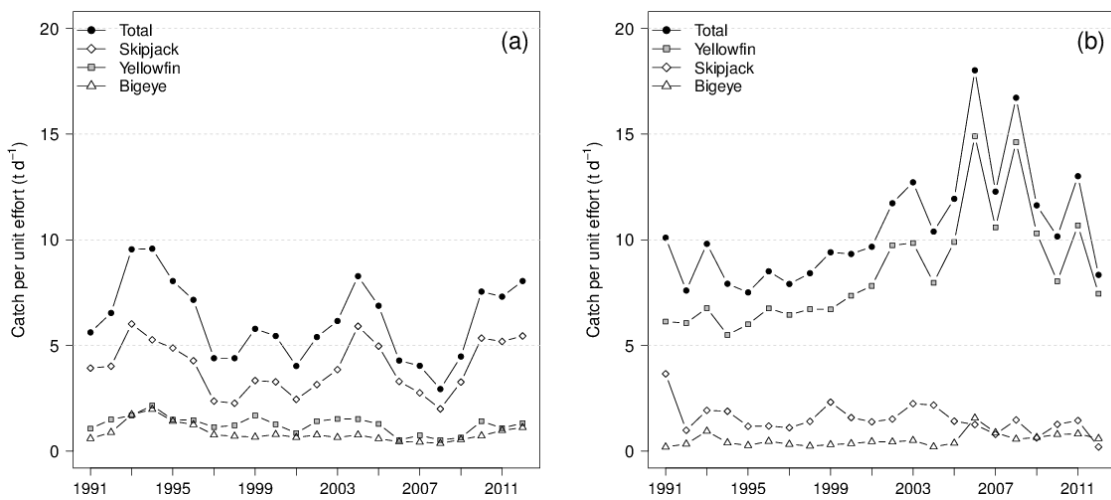


Figure 12. Annual catch rates (in t per searching day) of the French purse seine fishing fleet on (a) FAD-associated and (b) free-swimming schools in the Atlantic Ocean during 1991-2012.

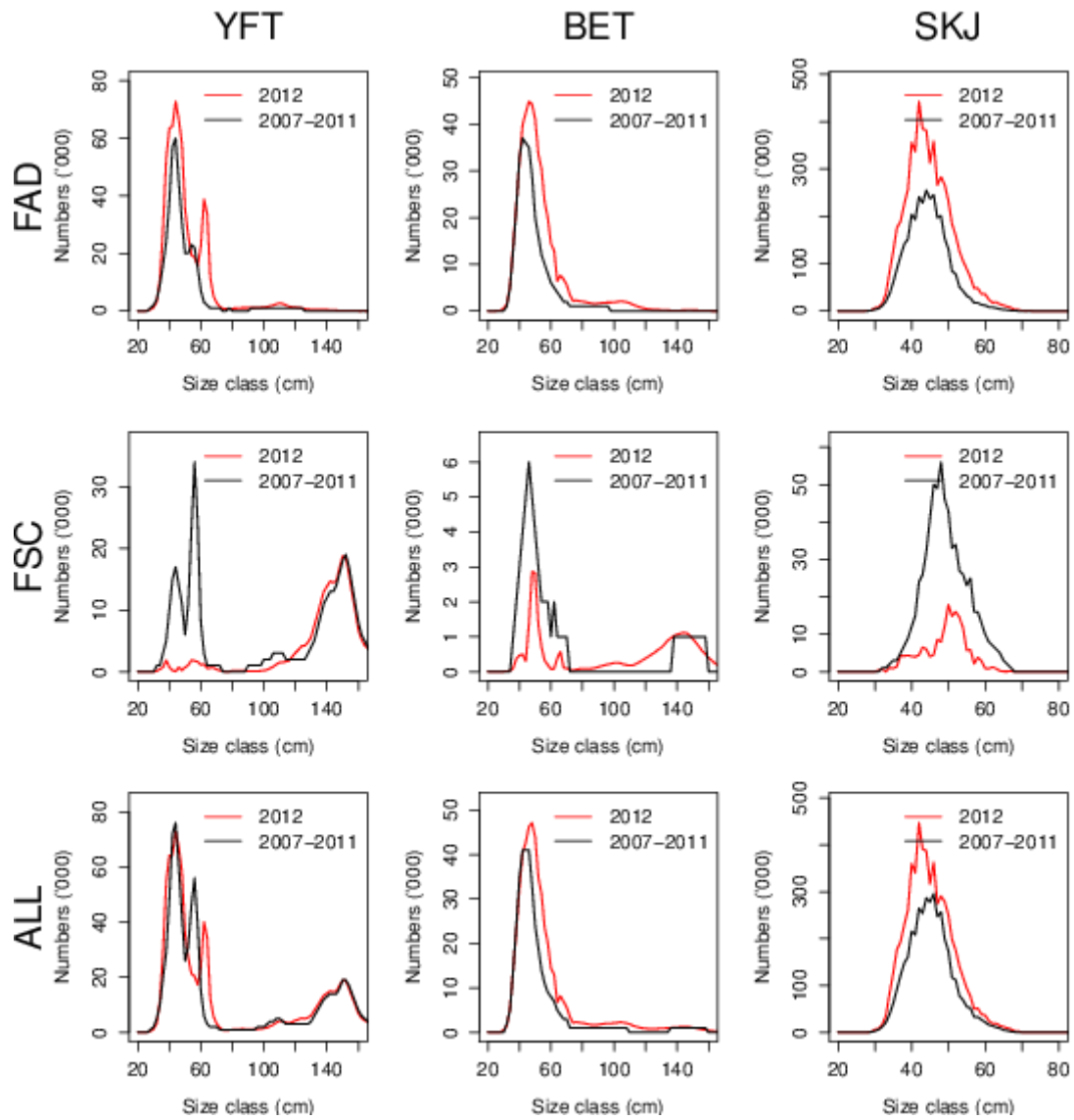


Figure 13. Size distribution of the catch (in numbers) for the French purse seine fleet in 2012 (red line) and for an average year representing the period 2007-2011 (black line).

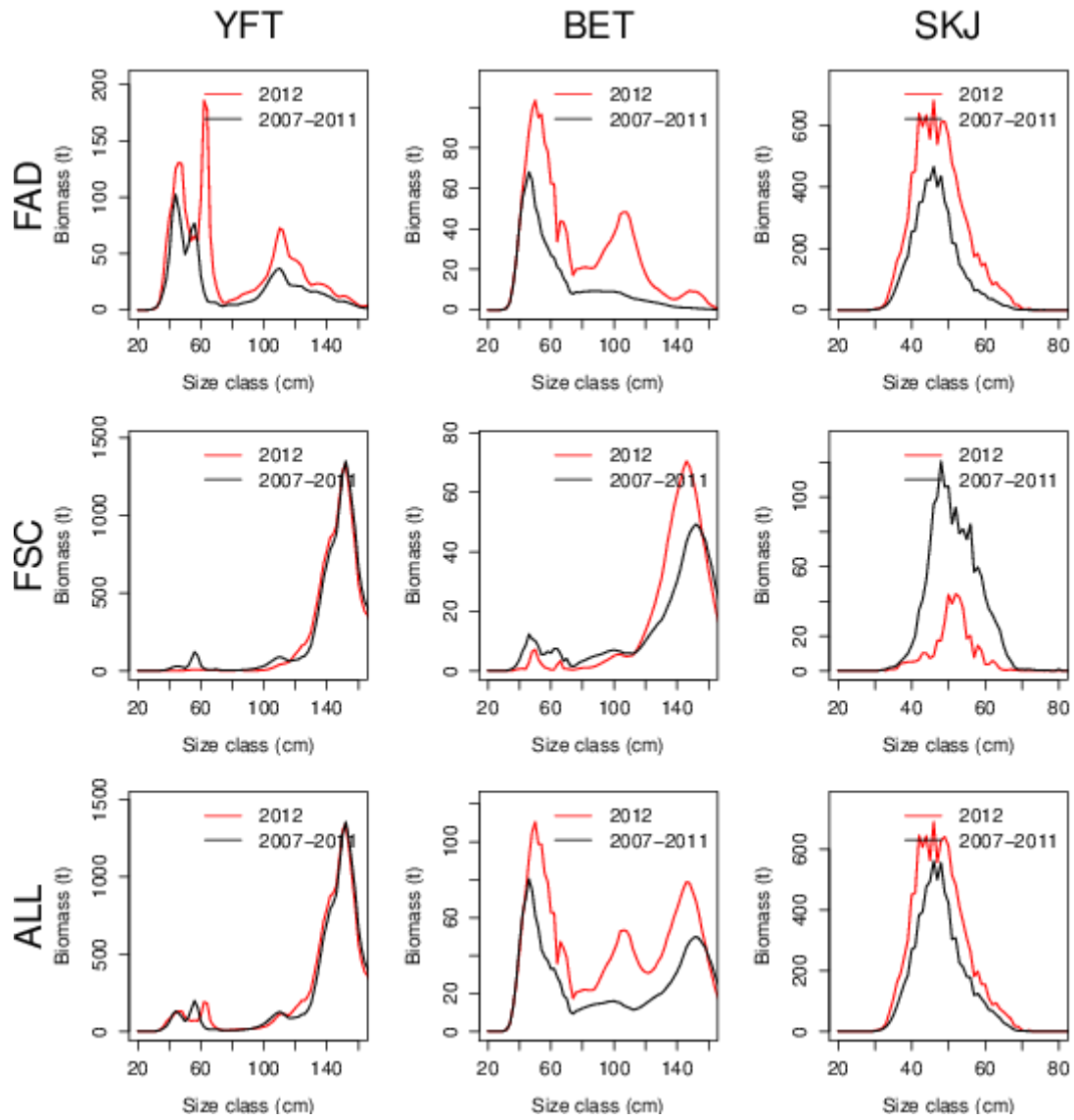


Figure 14. Size distribution (in weight) of the catch for the French purse seine fleet in 2012 (red line) and for an average year representing the period 2007-2011 (black line).

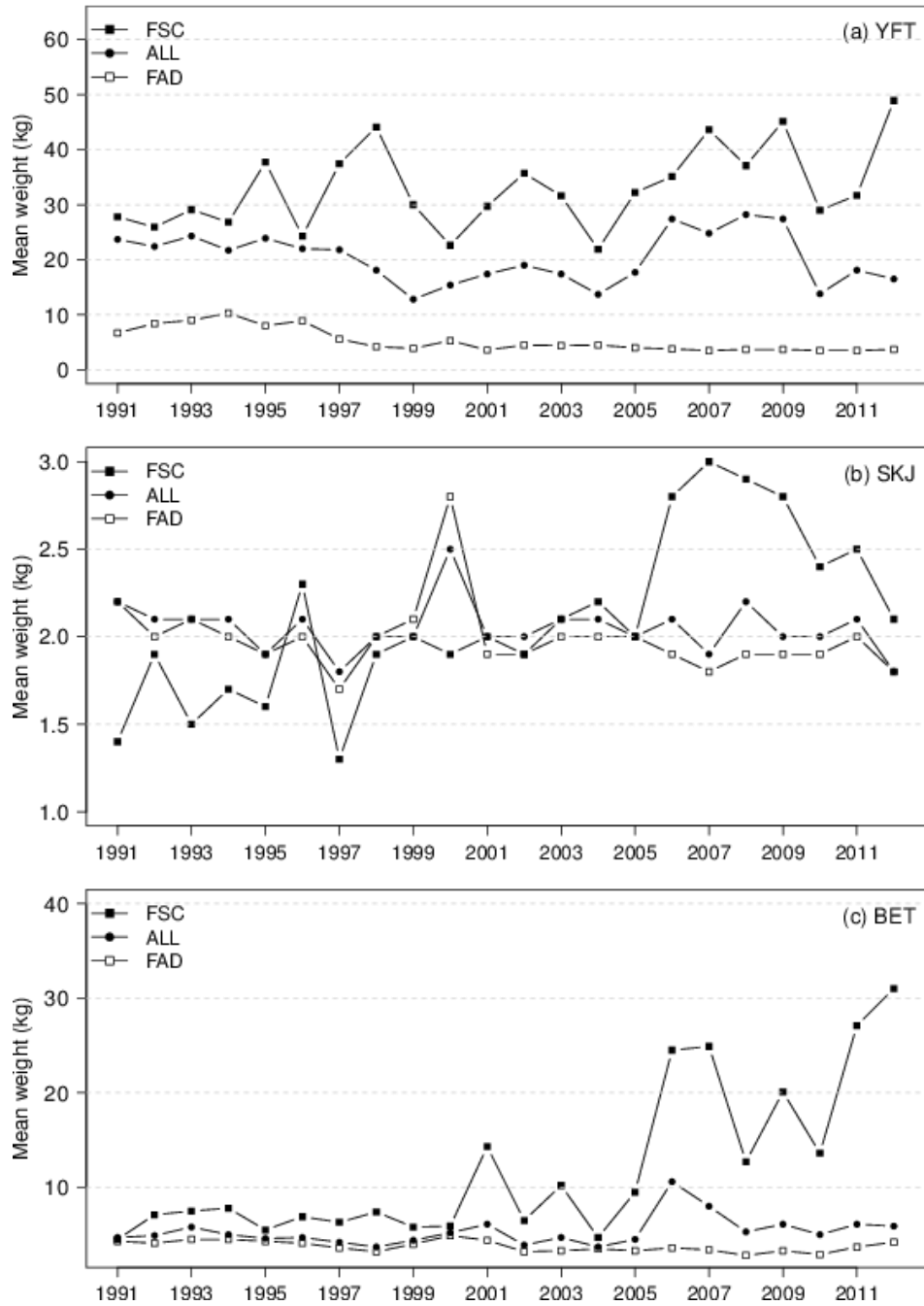


Figure 15. Annual time series of mean weight (kg) for (a) yellowfin, (b) skipjack, and (c) bigeye tuna for each fishing mode during 1991-2012.