STATISTICS OF THE FRENCH PURSE SEINE FISHING FLEET TARGETING TROPICAL TUNAS IN THE ATLANTIC OCEAN (1962-2015)

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SUMMARY

The French purse seine fleet was composed in 2015 of 9 purse seiners of storage capacity >700 t and >60 m length overall, and 1 support vessel of 40 m length overall. The fleet capacity and overall nominal effort have remained stable in the recent years with a total annual number of about 2,000 fishing sets made in 2015, among which 53% on free-swimming schools and 47% on schools associated with drifting floating objects, predominated by artificial fish aggregating devices (FADs). In 2015, each French purse seiner was monitoring on average 70 FADs at sea, resulting in a total of about 730 objects monitored by the French fishing fleet. In 2015, the total landings of the French fleet reached more than 40,000 t and were composed of 46% yellowfin, 48% skipjack, and less than 6% bigeye. Catch rates on FADs have steadily increased since 2008 to exceed 25 t per successful set in 2015 while catch rates on free-swimming schools have remained stable in the recent period.

RÉSUMÉ

En 2015, la flottille de senneurs français était composée de neuf senneurs d'une capacité de stockage > 700 t et d'une longueur hors tout > 60 m et d'un navire de support de 40 m de longueur hors tout. La capacité de la flottille et l'effort nominal global sont restés stables ces dernières années, avec un nombre total annuel d'environ 2.000 opérations de pêche réalisées en 2015, dont 53% sur bancs libres et 47% sur des bancs associés à des objets flottants dérivants, où prédominaient les dispositifs artificiels de concentration de poissons (DCP). En 2015, chaque senneur français a effectué un suivi d'une moyenne de 70 DCP en mer, la flottille de pêche française ayant contrôlé au total environ 730 objets. En 2015, le total des débarquements de la flottille française a atteint plus de 40.000 t et était composé de 46% d'albacore, de 48% de listao et de moins de 6% de thon obèse. Les taux de capture sous DCP augmentent progressivement depuis 2008 pour dépasser 25 t par opération réussie en 2015, tandis que les taux de capture sur bancs libres sont demeurés stables au cours de la période récente.

RESUMEN

La flota francesa de cerco se componía en 2015 de nueve cerqueros con una capacidad de almacenamiento de >700 t y >60 m de eslora total, y de un buque de apoyo de 40 m de eslora total. La capacidad de la flota y el esfuerzo nominal total han permanecido estables en años recientes, con un número total anual de aproximadamente 2.000 lances pesqueros realizados en 2015, entre los cuales el 53% fue sobre bancos libres y el 47% sobre bancos asociados con objetos flotantes a la deriva, principalmente dispositivos de concentración de peces (DCP) artificiales. En 2015, cada cerquero francés realizó un seguimiento de 70 DCP de media en el mar, lo que arroja un total de aproximadamente 730 objetos seguidos por la flota pesquera francesa. En 2015, los desembarques totales de la flota francesa alcanzaron más de 40.000 t y el 46% correspondía a rabil, el 48% a listado y menos del 6% a patudo. Las tasas de captura sobre DCP han aumentado constantemente desde 2008 hasta superar las 25 t por lance con éxito en 2015, mientras que las tasas de capturas sobre bancos libres han permanecido estables en el reciente periodo.

KEYWORDS

Catch statistics, FAD, free-swimming school, high seas fisheries, purse seining

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1. Introduction

French tuna purse seiners have been fishing yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), and bigeye tuna (*Thunnus obesus*) in the eastern Atlantic Ocean since the early 1960s. Tunas are harvested through two major types of school association (or fishing modes) that result in different species and size composition of the catch, i.e. tunas in free-swimming schools (FSC) and tunas associated with drifting floating objects now predominated by artificial fish aggregating devices (FAD). The French purse seine fishery has been monitored by the 'Institut de Recherche pour le Développement' (IRD) since the beginning of the fishery in collaboration with the 'Centre de Recherches Océanologiques' (CRO; Ivory Coast) and the 'Centre de Recherches Océanographiques de Dakar-Thiaroye' (CRODT; Sénégal). Here, we report a synthesis of the fishing activities of the French purse seiners during 1962-2015 based on the collection of logbooks, landing reports, and sampling operations conducted at ports during unloading. No information on bycatch species and discards at-sea collected from observations at-sea is presented in the report.

2. Materials and Methods

2.1 Sources of information

The French purse seine fishery developed in the early 1960s along the West African coasts (Postel 1965, Poinsard 1967). Only landing data are available over the period 1962-1979. Although logbooks were collected from the late 1960s and throughout the 1970s, most historical paper and electronic records have been lost. Landing data include information on the vessel and amount of fish unloaded for each fishing trip by commercial category, i.e. species and weight category. Date of departure or return to the port for unloading is missing for some historical fishing trips, particularly prior to 1967. From the early 1980s, logbooks and landing have been recovered for most fishing trips. Information on the type of school association (i.e. FAD vs. FSC) was not available in the logbooks prior to the early 1990s.

2.2 Fishing capacity

The quantity of tuna stored in brine-freezing wells can vary according to fish size. Fish hold volume (m^3) available for each French purse seiner was converted in metric tons by assuming a constant conversion factor of 0.7 derived from a linear regression model fitted to the relationship between the maximum landing observed for each vessel and storage capacity (m3). The total fleet capacity was computed as the sum of the capacity of each vessel weighted by its proportion of year at sea (in months).

2.3 Fishing effort

Time-at-sea (d) was computed for the time period 1967-2015 to provide an overview of the annual changes in nominal effort on the long-term. Data prior to 1967 were not used as information on landing dates was missing for 10%-50% of the annual landings. For the period 1980-2015, nominal fishing effort was derived from logbooks and expressed in days-at-sea and fishing days considering that purse seiners operate during daylight. Searching time (days), which accounts for the expected time required for setting the purse seine, was also used to describe the nominal purse seine effort over 1991-2015. Information on the number of FADs in use by the French fleet was derived for the period 2010-2015 from (i) the quarterly reports of buoy transmission activity available from satellite communication providers for each individual vessel, (ii) purse seine logbooks that include activities related to FADs and buoys since January 2013 and (iii) GPS location of French buoys that provide information on FAD deployment areas and drifting trajectories (Maufroy et al. 2015).

2.4 Size-frequency samples

In 2015, a total of 271 samples were collected in the ports of Abidjan and Dakar during the unloading of the catch of 64 fishing trips of the 9 French purse seiners. Samples of good quality were used to estimate the size and species composition of the catch following a sampling and processing protocol common with purse seiners flying the flags of Spain, Belize, Cap Vert, Curaçao, El Salvador, Guatemala, Panama, and Sénégal (Pallarés and Petit 1998). Hence, a total of 1,106 samples corresponding to about 470,000 tunas measured were used in the processing of the French purse seine fishery data for 2015.

3. Fishing capacity and effort

3.1 Fleet capacity

The French purse seine fishery developed and expanded from the early 1960s and the number of active purse seiners was >25 in the mid-1970s (**Figure 1**). With the exception of the period 1984-1989 when part of the fleet was reallocated to the western Indian Ocean, the number of French purse seiners has shown a decreasing trend from a maximum of 32 in 1975 to a minimum of 9 in the 2010s (**Figure 1**). Meanwhile, the size and capacity of the vessels have continuously increased and gears and attributes have substantially improved over the last decades (Gaertner and Pallarés 2002). Purse seiners of capacity <600 t progressively vanished from the fleet between 1991 and 2011 while vessels of capacity >1,000 t have become predominant since 2008 (**Figure 2**). In 2015, a total of 9 French purse seiners operated in the eastern Atlantic Ocean. The fleet was composed of 2 vessels of carrying capacity (CC) 600-800 t, 5 vessels of CC 800-1200 t, and 2 vessels of CC >1,200 t (**Figure 2 and Table 1**). The total fish storage capacity of the fleet was about 9,000 t in 2015. In addition, a vessel of 40 m length overall has been operating in the eastern Atlantic Ocean since the second quarter of 2010 in support of French purse seiners. The French support vessel spent a total of 230 days at sea in 2015, contributing to about 10% of the cumulated time-at-sea for the French fishing fleet. The support vessel mostly assists the fleet in detecting tuna schools and managing the network of FADs and buoys used for locating them and estimating the tuna biomass aggregated with floating objects monitored by the French fleet.

3.2 Nominal effort

The nominal purse seine effort strongly decreased over the last decades from more than 6,500 days in the late 1970s to about 2,500 in the recent period. Excluding the support vessel, the total nominal effort in 2015 was about 2,400 and 2,000 fishing and searching days, respectively (**Figure 3 and Table 2**). The overall spatial extent of the fishery was similar to that observed in the recent years, corresponding to about 350 squares of 1° longitude and latitude where some effort was exerted in 2015 (**Figure 4 and Table 3**). Despite the stability in the total number of squares explored in the recent years, the fishery has been showing a contraction in the spatial area where catch is made since 2010 (**Figure 5** and **Table 3**).

The total number of emitting buoys for the French purse seine fleet has slowly increased during 2010-2015. Automatic reports provided by satellite data transmitters indicated that the total number of buoys having emitted in 2015 varied between a minimum of 679 during April-June to a maximum of 847 during October-December (**Figure 6**). This corresponded to a median number of buoys by French purse seiner varying between 34 and 84 on a quarterly basis (**Figure 7**). These figures are conservative (i.e. high estimates) as buoys can be shared between vessels and are then repeated in quarterly reports. Information on FAD activities reported in the logbooks provided complementary information to the buoy activation reports and showed that the area of FAD deployments and buoys transfers overlapped with the whole fishing grounds of the fleet (**Figure 8**). The Cape Lopez appeared as the most active area of buoy transfers and FAD visits during August-October.

The total annual number of fishing sets was rather stable during 2010-2015 at about 2,000 sets y^{-1}, among which about 47% were made on FAD-associated schools and 53% on FSC in 2015 (**Figure 9**). Proportions of successful sets were high in 2015, i.e. about 95% on FAD-associated schools and 78% of free-swimming schools (**Table 3**).

4. Fishery production

Landings of the principal market tunas by the French purse seine fleet operating in the eastern Atlantic Ocean reached a total of 42,000 t in 2015. Total catches of yellowfin and skipjack were at very similar level, i.e. about 20,000 t, while bigeye represented less than 6% of the total catch of the French fishery in 2015, i.e. about 2,500 t (**Figure 10 and Table 5**). Catches on FAD-associated schools represented 55% of the catch in 2015 and were predominated by SKJ (71%), while YFT and BET accounted for 18% and 7% of the FAD catch, respectively (**Figure 11a and Table 6**). Catches on free-swimming schools were predominated by large YFT which represented 80% of the catch (**Figure 11b and Table 7**). The distribution of catch extended all over the Gulf of Guinea, from 25°W to 10°E, and it was restricted to the latitudes between 10°S and 10°N (**Figure 12**). The distribution of catch on free schools overlapped with the catch on floating objects (**Figures 13-14**). The area comprised between 10°W and the equator was however predominated by schools of large yellowfin caught during the spawning season that takes place in the boreal winter, i.e. from December to April (Diaha et al. 2015). A large part of the catch on both types of school association was made along the Gabonese coasts (**Figures 13-14**). The total number of sets per searching day was close to 1 in 2015, similar to what was observed since 2008.

The fleet is progressively targeting more tuna schools associated with FADs. The average number of sets per day on FAD-associated schools has steadily increased since 2007 (**Figure 15a**) while the number of sets per day on FSC has been decreasing in the recent years to reach about 0.5 in 2015 (**Figure 15b**). The catch of skipjack per successful set has increased from a low value of about 12 t in 2008 to more than 18 t in 2015 (**Figure 15c**). Meanwhile, the magnitude of catch of large yellowfin on FSC has remained at around 20 t in the recent years, with 2015 being described by a value of less than 18 t per set^{-1}.

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Table 1. Annual number of purse seiners by size category and total carrying capacity of the French tropical tuna purse seine fishing fleet of the Atlantic Ocean during 1991-2015. *N* = Total number of purse seiners having operated at least 1 day. *Nw* = Total number of purse seiners weighed by the proportion of months of activity. CC = Total carrying capacity (t) weighted by the proportion of months at sea.

Year	*50-400*	*401-600*	*601-800*	*801-1200*	*1201-2000*	*>2000*	*N*	*Nw*	*CC*
1991	2	9	6	6	0	0	23	17.42	11850
1992	1	8	2	6	0	0	17	16.08	11457
1993	1	8	3	6	0	0	18	16.33	11870
1994	1	8	3	6	0	0	18	16.83	12121
1995	0	10	2	5	0	0	17	14.92	10863
1996	0	9	2	5	0	0	16	15.75	11243
1997	0	10	2	5	2	0	19	14.67	11331
1998	0	7	2	6	0	0	15	14.58	11071
1999	0	8	2	5	0	0	15	14	10538
2000	0	7	2	5	0	0	14	13.5	10248
2001	0	7	2	7	1	0	17	14	11314
2002	0	8	3	5	1	0	17	12.25	9601
2003	0	8	1	5	0	0	14	12.42	9610
2004	0	6	1	5	0	0	12	10.08	8345
2005	0	4	0	5	0	0	9	8.25	6980
2006	0	4	0	3	0	0	7	5.42	4040
2007	0	3	0	2	0	0	5	4.67	3581
2008	0	3	2	2	0	0	7	4.67	3678
2009	0	1	2	4	3	0	10	7.33	6876
2010	0	1	2	4	3	0	10	9.08	8846
2011	0	1	2	4	2	0	9	8.17	7945
2012	0	0	2	5	2	0	9	8.67	8986
2013	0	0	2	5	2	0	9	8.42	8715
2014	0	0	2	5	2	0	9	8.58	8908
2015	0	0	2	5	2	0	9	8.75	9118

Table 2. Annual nominal fishing effort of the French purse seine fishing fleet expressed in fishing and searching days during 1991-2015. 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	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
2013	2341	1921
2014	2418	1988
2015	2471	2063

Table 3. Annual number of 1-degree squares explored by the French purse seine fishing fleet in the Atlantic Ocean during 1991-2015. #sets indicates squares where a least 1 fishing set was made.

Year	*TOTAL*	*#sets*	*Catch >0*	*Effort > 1 d*	*Effort > 5 d*
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
2013	369	239	230	245	122
2014	337	230	222	234	126
2015	348	219	212	219	122

Table 4. Number of positive and null sets by fishing mode made by the French purse seine fishing fleet in the Atlantic Ocean during 1991-2015. FAD = Fish Aggregating Device; FSC = Free-Swimming School.

Year	*ALL*			*FAD*			*FSC*			
	Total	*Positive*	*Null*	*Total*	*Positive*	*Null*	*Total*	*Positive*	*Null*	*% Log*
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
2013	2016	1631	385	824	748	76	1192	883	309	41
2014	2033	1734	299	903	857	46	1130	877	253	44
2015	2023	1736	287	960	907	53	1063	829	234	47

Table 5. Catch by species for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015

Year	*YFT*	*SKJ*	*BET*	*ALB*	*OTH*	*TOTAL*
1991	30172	31814	3327	50	24	65917
1992	30778	20383	4985	451	694	57526
1993	33590	31537	10629	565	417	76821
1994	32381	30251	10075	130	978	73955
1995	27850	22542	6262	83	917	57836
1996	32179	21370	6778	191	542	61243
1997	29065	13335	4209	39	346	47150
1998	30468	14144	3641	40	781	49221
1999	28833	19457	3383	13	402	52194
2000	29506	16642	3936	23	340	50540
2001	31183	13774	3943	11	166	49186
2002	32982	13806	3597	18	97	50614
2003	32268	17318	3289	63	458	53554
2004	23413	19982	2417	19	96	46094
2005	22073	12606	1913	478	0	37117
2006	18353	5423	2402	347	2	26536
2007	12775	4012	1485	12	27	18382
2008	15929	3661	989	50	37	20666
2009	18545	6602	2043	60	0	27274
2010	19974	13983	3199	109	0	37365
2011	21427	12088	3268	53	0	36990
2012	18243	11749	3574	161	78	34077
2013	20260	15559	3197	73	187	39533
2014	20763	16637	3475	47	277	41342
2015	19017	19497	2493	59	638	41982

Table 6. Catch by species made on FAD-associated schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015.

Year	*YFT*	*SKJ*	*BET*	*ALB*	*OTH*	*TOTAL*
1991	4476	16465	2501	0	24	23578
1992	6116	16370	3619	0	480	26614
1993	6723	23884	6853	0	360	37892
1994	9124	22273	8372	0	662	40489
1995	5549	18155	5274	4	830	29915
1996	5750	16736	4941	0	386	27985
1997	4371	9076	2945	0	335	16850
1998	4669	8725	2712	0	674	16893
1999	5795	11478	2316	0	214	19877
2000	4335	11207	2696	0	321	18643
2001	3090	8792	2335	0	166	14459
2002	4198	9308	2287	0	54	15957
2003	4332	10937	1833	0	217	17473
2004	3742	14602	1901	0	96	20435
2005	2547	9805	1165	5	0	13569
2006	626	3925	541	0	2	5104
2007	850	3112	489	0	27	4549
2008	557	2103	391	0	37	3088
2009	1089	5531	939	0	0	7583
2010	3001	11297	1530	13	0	15932
2011	1978	9443	1776	12	0	13305
2012	2756	11335	2321	15	62	16739
2013	2476	12317	1972	15	183	17173
2014	4365	14327	1711	19	262	20817
2015	4149	16579	1663	21	538	23193

Table 7. Catch by species made on free-swimming schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015.

Year	*YFT*	*SKJ*	*BET*	*ALB*	*OTH*	*TOTAL*
1991	25696	15349	826	50	0	42339
1992	24662	4013	1366	451	213	30913
1993	26867	7653	3776	565	57	38929
1994	23257	7979	1703	130	316	33466
1995	22301	4387	988	79	87	27921
1996	26430	4634	1837	191	156	33258
1997	24694	4259	1264	39	11	30301
1998	25799	5419	930	40	107	32328
1999	23038	7980	1067	13	188	32316
2000	25170	5435	1240	23	19	31897
2001	28094	4982	1608	11	0	34727
2002	28784	4498	1310	18	43	34657
2003	27936	6382	1456	63	241	36081
2004	19671	5380	516	19	0	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	0	21433
2011	19449	2646	1493	41	0	23685
2012	15486	414	1253	146	16	17339
2013	17784	3242	1224	58	4	22360
2014	16399	2310	1764	27	15	20525
2015	14868	2918	831	38	100	18789

Table 8. Number of sets per searching day on FAD-associated (FAD) and free-swimming schools (FSC) for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015

Year	*ALL*	*FAD*	*FSC*
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
2013	1.05	0.43	0.62
2014	1.02	0.45	0.57
2015	0.98	0.47	0.52

Table 9. Catch per unit of effort (in t per successful set) on FAD-associated schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015

Year	*YFT*	*SKJ*	*BET*	*ALB*	*OTH*	*TOTAL*
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
2013	3.31	16.47	2.64	0.02	0.52	22.96
2014	5.09	16.72	2	0.02	0.46	24.29
2015	4.57	18.28	1.83	0.02	0.86	25.57

Table 10. Catch per unit of effort (in t per successful set) on free-swimming schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015

Year	*YFT*	*SKJ*	*BET*	*ALB*	*OTH*	*TOTAL*
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
2013	20.14	3.67	1.39	0.07	0.06	25.32
2014	18.7	2.63	2.01	0.03	0.03	23.4
2015	17.93	3.52	1	0.05	0.16	22.66

Table 11. Catch per unit of effort (in t per searching day) on FAD-associated schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015

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
2013	1.29	6.41	1.03	0.01	0.2	8.94
2014	2.2	7.21	0.86	0.01	0.2	10.47
2015	2.01	8.03	0.81	0.01	0.38	11.24

Table 12. Catch per unit of effort (in t per searching day) on free swimming schools for the French purse seine fishing fleet of the Atlantic Ocean during 1991-2015.

Year	*YFT*	*SKJ*	*BET*	*ALB*	*OTH*	*TOTAL*
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
2013	9.26	1.69	0.64	0.03	0.03	11.64
2014	8.25	1.16	0.89	0.01	0.01	10.32
2015	7.21	1.14	0.4	0.02	0.06	9.11

Figure 1. Annual number of French purse seiners in operation in the eastern Atlantic Ocean during 1962-2015.

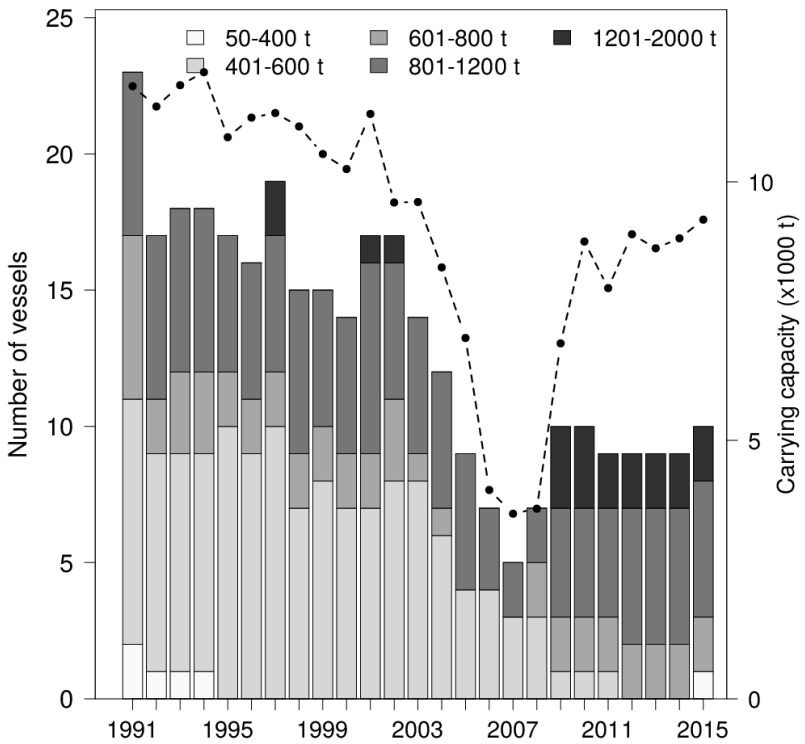

Figure 2. Fishing capacity of the French purse seine fishing fleet in the Atlantic Ocean. Annual changes in the number of purse seiners by size category (barplots) and total carrying capacity (dashed line with circles) during 1991-2015.

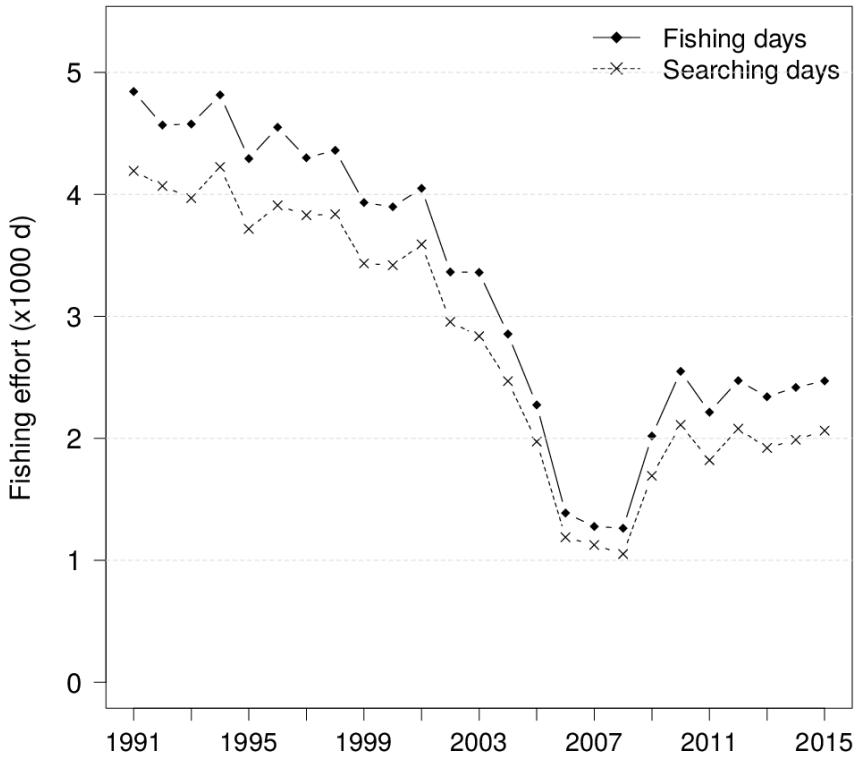

Figure 3. Changes in nominal effort over time. Annual total number of fishing and searching days for the French purse seine fishing fleet in the Atlantic Ocean during 1991-2015.

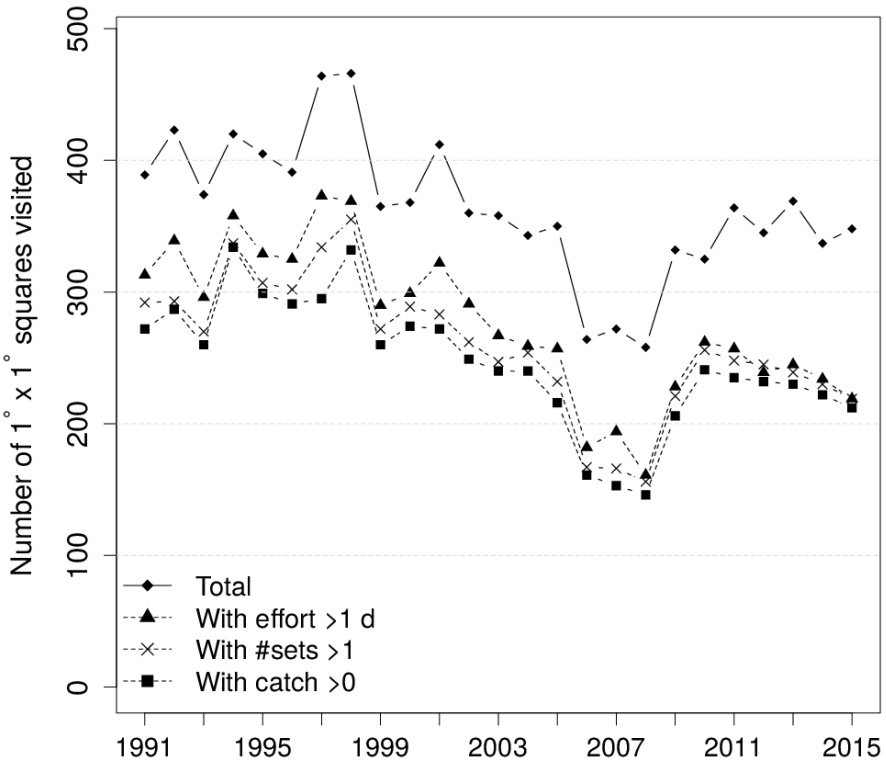

Figure 4. Fishery spatial extent. Annual number of 1-degree squares explored by the French purse seine fleet during 1991-2015.

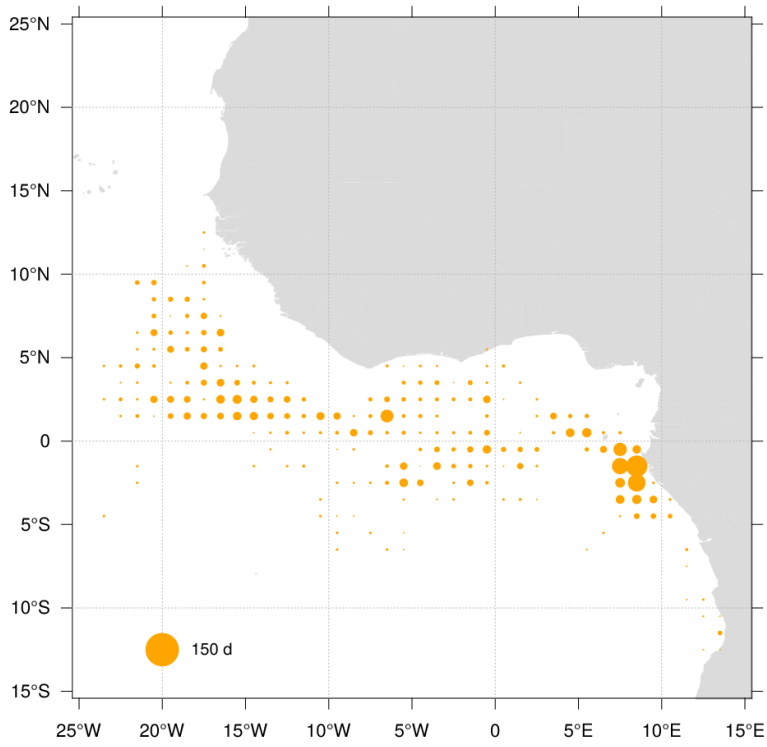

Figure 5. Fishing grounds. Spatial distribution of fishing effort (in searching days) of the French purse seine fishing fleet in 2015.

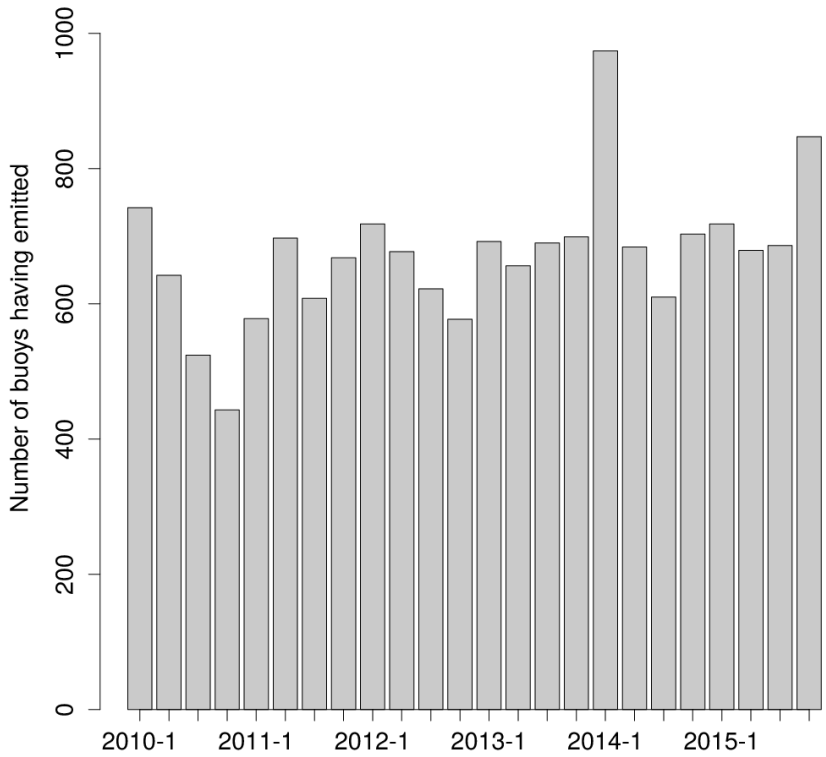

Figure 6. Total quarterly number of buoys of the French purse seine fleet having emitted in the eastern Atlantic Ocean during 2010-2015.

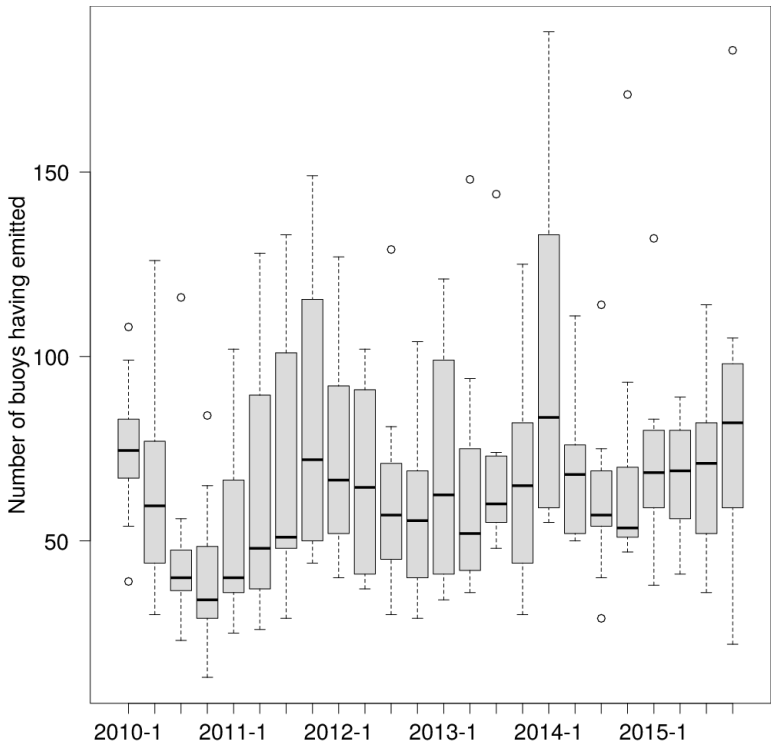

Figure 7. Quarterly number of buoys by French purse seiner and their support vessel having emitted during 2010-2015.

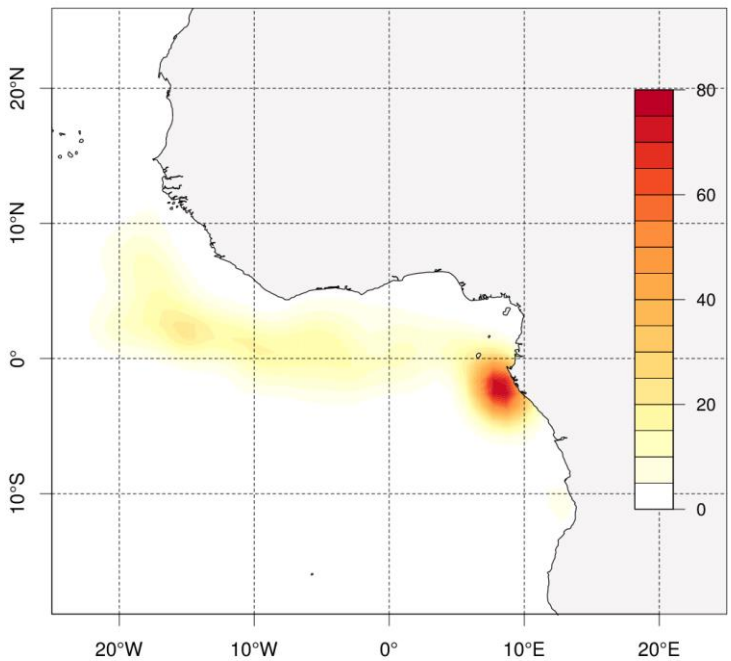

Figure 8. Location of deployments of fish aggregating devices and buoy transfers on existing FADs in the Atlantic Ocean in 2015 as reported in the logbooks.

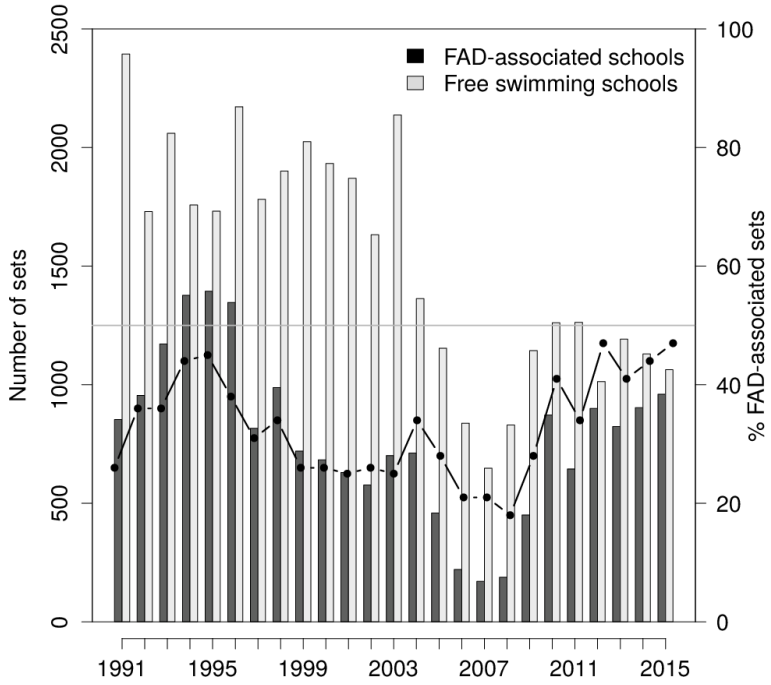

Figure 9. Fishing operations. Annual number of fishing sets in the French purse seine fishery on FAD-associated and free-swimming schools during 1991-2015. Line with solid circles indicates the percentage of sets made on FAD-associated schools over free-swimming schools. Grey solid line indicates the 50% value.

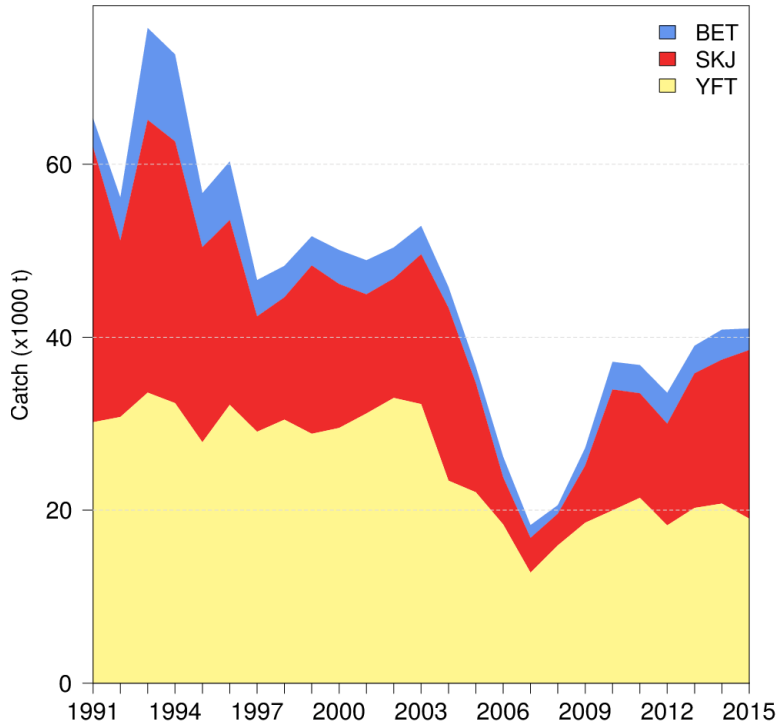

Figure 10. Total fishery production. Catch by species of the French purse seine fishing fleet during 1991-2015.

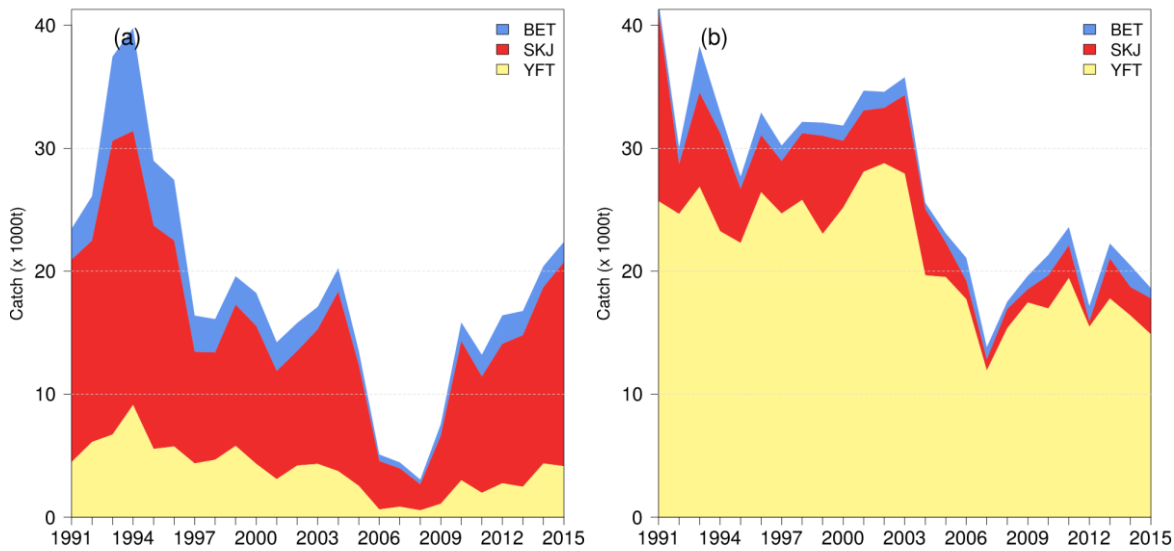

Figure 11. Fishery production by school association type. Catch by species of the French purse seine fishing fleet on (a) FAD-associated and (b) free-swimming schools during 1991-2015.

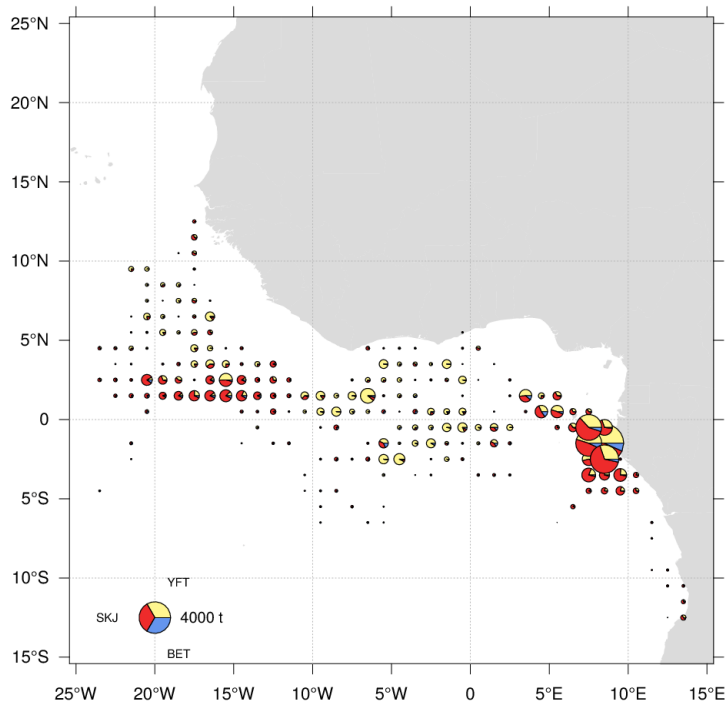

Figure 12. Spatial distribution of tuna catches of the French purse seine fishing fleet in 2015.

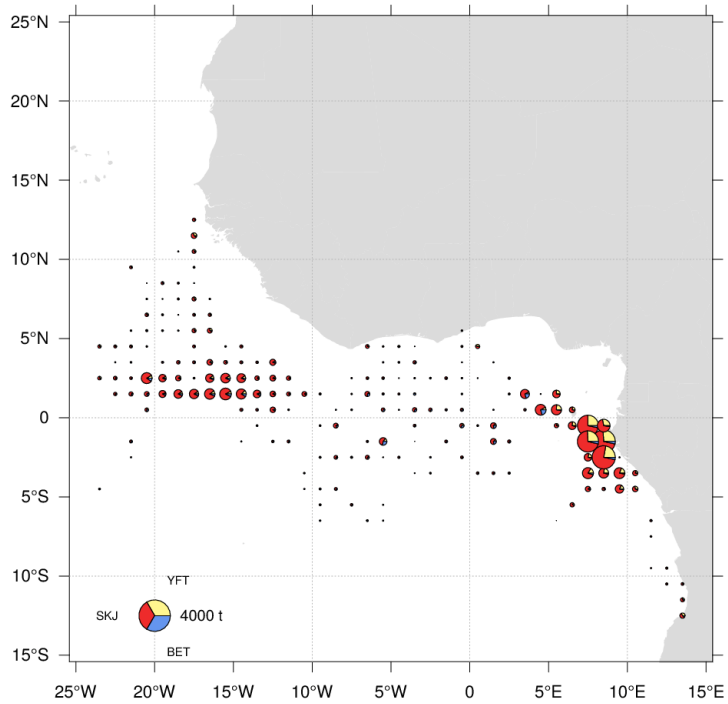

Figure 13. Spatial distribution of tuna catches of the French purse seine fishing fleet made on FAD-associated schools in 2015.

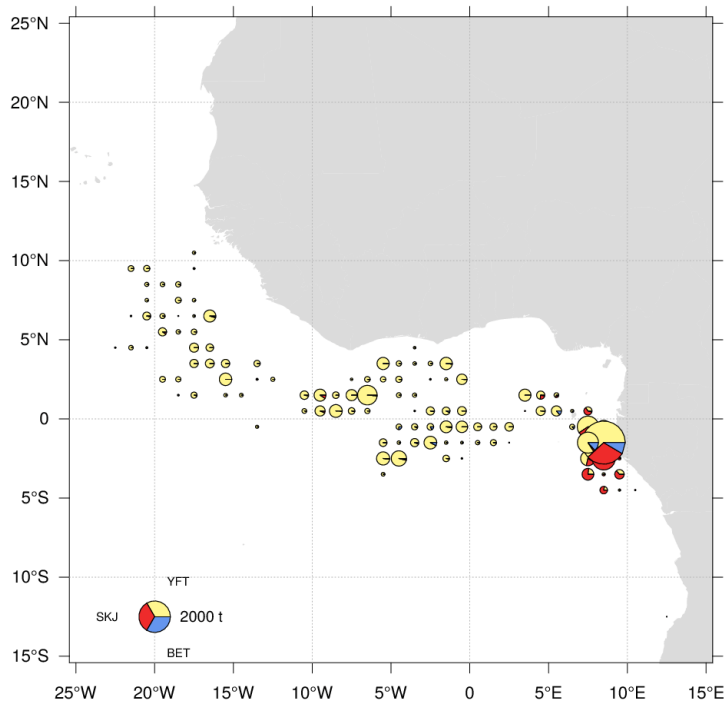

Figure 14. Spatial distribution of tuna catches of the French purse seine fishing fleet made on FSC-associated schools in 2015.

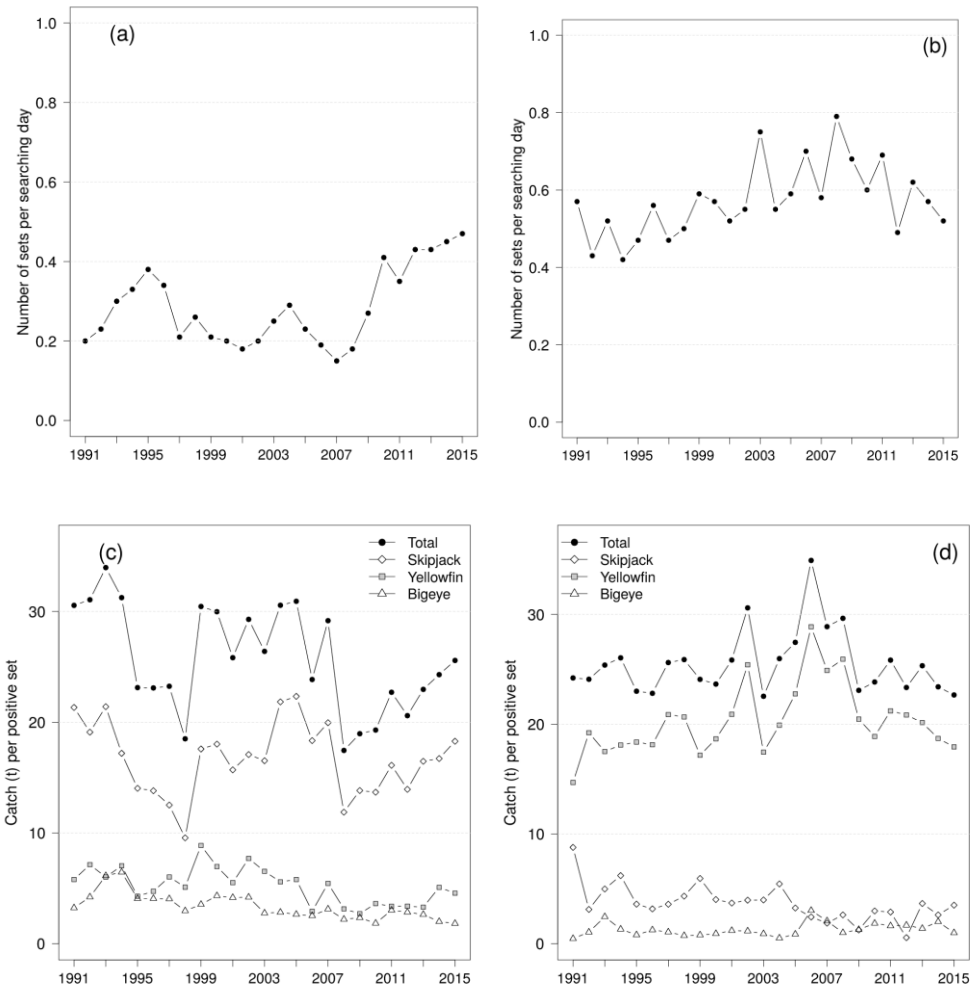

Figure 15 (a-b) Annual number of sets per searching day and (c-d) catch per positive set on (left panel) FAD-associated and (right panel) free-swimming schools for the French purse seine fishing fleet in the Atlantic Ocean during 1991-2015

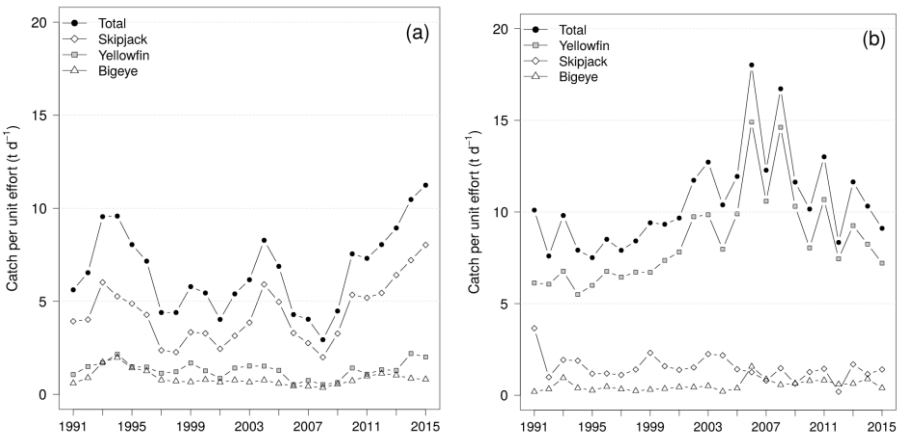

Figure 16. Annual catch rates (in t per searching day) of the French purse seine fishing fleet on (a) FAD-associated and (b) free-swimming schools in the Atlantic Ocean during 1991-2015.