UPDATING THE STATISTICS OF THE EU-SPAIN PURSE SEINE FLEET IN THE INDIAN OCEAN (1990-2017)

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Abstract

This document provides an update of the statistics of the Spanish purse seine fleet fishing in the Indian Ocean for the period 1990 to 2017. Data include catch and effort statistics, as well as some fishery indicators by species and fishing mode. Information about the scheme and coverage of the sampling, together with maps and diagrams illustrating the spatio-temporal fishing patterns of this fleet are also provided. A total of 14 Spanish purse seiners operated in the IOTC area during 2017. Purse seiners' carrying capacity for most of the vessels is higher than 1,200 t. The total estimated catches for the main target species in 2017 were: 54513 t of yellowfin (YFT), 84432 t of skipjack (SKJ), 12345 t of bigeye (BET) and 100 t of albacore (ALB). The total catch in 2017 was 151424 t (including other species), 11 % higher than last year and 12% higher than the average previous 5 years, mainly due to the increase in skipjack catch. Although skipjack has been the main component of the catch in the previous five years (2012-2016), skipjack catches increased by 37% during 2017 in relation to this period. During 2017, YFT catches were 5% lower than the previous five years average (2012-2016). Effort, measured in searching days, has changed in relation to the average of the last five years, thus during 2017 there were 2618 fishing days *vs*. 3274.2 searching days in average for the period 2012-2016. This significant reduction was probably due to the closing of fishing activity on 5th November of 2017 up to the end of the year. During 2017, the length of 73606 tropical tuna fishes from the Spanish fleet was collected, not only from landing at port but also by scientific observers from discards on board: 8409 bigeye, 20207 skipjack, and 44990 yellowfin.

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Introduction

In line with the work undertaken recently on the Spanish fleet (e.g., Soto & Fernández, 2016; Báez et al., 2017), the current paper provides an update on the statistics of the Spanish purse seine fleet fishing in the Indian Ocean for the period 1990 to 2017. Data include catch and effort statistics, as well as some fishery indicators by species and fishing mode. Information about the scheme and coverage of the sampling, together with maps and diagrams illustrating the spatio-temporal patterns of this fleet are also provided.

Material and methods

Since 2013, the Spanish Fishery Office based in Seychelles that supervised the process of sampling and data input *in situ* has not operated due to budget constraints. The current monitoring of the Spanish purse seine landings is made remotely by outsourcing the sampling activities to the Seychelles Fishing Authority (SFA). It is generally acknowledged that species composition records in logbooks are frequently biased due to misidentification (Fonteneau, 1976). Consequently, routine processing corrections (based on a specific sampling design and multispecies size-frequency samples, collected during the landing operation), have been performed since 1980 (Pallarés and Hallier, 1997; Pianet et al., 2000). Thus, data from the Spanish purse seine vessels are collected at port in the Indian Ocean by the SFA, and are shared with those from IRD (Institut de Recherche pour le Développement) and SFA for the adjustment of the nominal catches using the T3 software.

Currently, the collection and management of raw data for the Indian Ocean PS fisheries is based on the AVDTH ('*Acquisition et Validation des Données de Pêche au Thon Tropical*') software that was developed by IRD in the mid-1990s (Lechauve, 1999). AVDTH is a standalone application which connects to an MS Access database. The datasets are composed of (i) daily fishing activities and catches as recorded in logbooks, (ii) landing reports recorded on a trip basis at unloading or transhipment of the principal market tunas by commercial category, and (iii) the size-frequency histograms collected at unloading.

The collection of logbooks and landing reports is done in collaboration with the fishing companies and it typically covers *c.* 95 % of the fishing trips and activities. The current

system of statistics started in the early 1980s, and the same methodology and protocols are followed by Spain, France and Seychelles. Sampling operations are carried out during the unloading of the purse seiners at fishing ports to estimate both size and species composition of the catch.

As explained above, to avoid the systematic bias in the logbook species composition, it is necessary to correct the catch estimates of the logbooks, as well as to provide estimates on the size distribution, by using the samples taken from all the purse seine fleets combined.

Results

Catch data

Catch of the most important species were: 54513 t of yellowfin (YFT), 84432 t of skipjack (SKJ), 12345 t of bigeye (BET) and 100 t of albacore (ALB). The total catch in 2017 (including others species) was 151424 t, 11 % higher than last year and 12% higher than the average previous 5 years, mainly due to the increase in skipjack catch (**Table 1**). Although skipjack has been the main component of catches in the previous five years (2012-2016), skipjack catches during 2017 increased by 37 % in relation to this period. By fishing mode, the catch on FAD sets was 127980 t (**Table 2**), and on free school sets it was 23444 t (**Table 3**). Catches on free schools were slightly higher than in previous years. BET catches (4419 t) have increased 131% in relation to the average of the five previous years (1913.4 t). **Figure 1** shows the total catches by species and the effort in searching days, and **figures 2**, **3** and **4** detail the catches by fishing mode and species. In the **figures 5, 6 and 7** the distribution of the catches by species (all school association types combined) and $1^0 \times 1^0$ squares for 2017 compared to the average over the 2012 – 2016 period is presented. **Tables 4 and 5** show the catches and effort in FAO fishing areas 57 and 51, respectively.

Fishing capacity and effort

A total of 14 Spanish purse seiners operated in the IOTC area during 2017. The Spanish fleet was composed of 10 vessels of carrying capacity (CC), 201-2000 t and 4 vessel of CC >2000 t. The total capacity in 2017 was lower than in 2016 (**Table 6**). **Figure 8** shows the historical carrying capacity and number of boats by category of the Spanish fleet.

Table 7 and **figure 9** show the nominal effort in fishing and searching days. **Table 8** and **figure 10** show the number of $1^0 \times 1^0$ cells explored by the Spanish fleet under different filtering criteria. The fishing area has been maintained since 1996. A similar conclusion is reached from **figure 11**, which compares the distribution of effort by $1^0 \times 1^0$ squares in 2017 with the average of the period 2012 – 2016. **Table 9** shows the total number of sets and the number of sets by fishing mode. The frequency distribution of positive sets by catch size is shown in **Tables 10**, **11** and **12**. **Figures 12**, **13 and 14** show the total number of positives and null sets. Tables 13 to 18 show the catch rates by species and fishing mode.

The effort (fishing days) in 2017 (3512 days) was lower than the average of the previous five years. Effort measured in searching days has changed regarding in relation to the average of the last five years, thus during 2017 there were 2618 fishing days *vs*. 3274.2 searching days in average for the period 2012-2016. This significant reduction was probably due to the closing of fishing activity on November 5, 2017 (according to Order APM/17/2018, BOE 2018).

Mean weight

Mean weight by species and fishing mode is presented in **table 19 and figures 15, 16 and 17**. The mean weight on logs is normally lower than the mean weight on free school catches.

Size distribution

The size distribution of yellowfin, skipjack and bigeye, overall and by fishing mode, for 2017 and averaged over the period 2012-2016, is presented in **figure 18**. The size distribution of yellowfin tuna peaks at around 50 cm on associated sets and 130 cm on free schools, respectively, in 2017. Regarding skipjack tuna, the size distribution peaks at around 45 cm on log sets and around 50 cm and 60 cm on free school sets, respectively,in 2017. In the case of bigeye tuna, a peak is observed around 35 cm on logs and a bimodal pattern is observed on free school sets, with peaks at around 35 and 80 cm.

Conclusions

1. During 2017 there was a significant increase in skipjack catches.

2. Yellowfin tuna catches showed an increasein relation to the previous year, but these catches were below the average of the previous five years.
3. Bigeye tuna catches increased in relation to the previous year. Moreover, these catches were above the catches of the previous five years.
4. The fishing capacity of the Spanish purse seine fleet during the 2017 was lower than in previous years.
5. Nominal fishing effort in fishing days and searching days of the purse seine Spanish fleet during 2017 was lower than the average of the last five years.

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Table 1. Spanish purse seiners total catch by species in the Indian Ocean, 1990-2017. Key: YFT, yellowfin tuna; SKJ, skipjack tuna; BET, bigeye tuna; ALB, albacore; Total, including YFT, SKJ, BET, ALB and other species.

TOTAL CATCH BY SPECIES					
YEAR	YFT	SKJ	BET	ALB	TOTAL
1990	43728	47926	4867	145	96666
1991	44023	41790	6005	1066	92923
1992	37836	46694	3638	1461	89629
1993	47792	51272	5418	904	105385
1994	43128	61608	5924	1773	112433
1995	65143	69587	12233	561	147524
1996	59431	66276	11374	826	139134
1997	60977	62914	15897	1029	141025
1998	38565	58646	11245	269	108725
1999	51875	74285	16034	232	142426
2000	52070	77187	10769	410	140872
2001	47571	68346	7930	339	124389
2002	53205	91462	11096	217	156386
2003	78968	88035	8544	520	176200
2004	80810	64393	8634	76	154106
2005	77519	94312	10290	48	182562
2006	70924	118857	9952	438	200543
2007	37763	65006	9756	246	112848
2008	46051	65096	12490	299	124004
2009	33511	66570	11781	52	111951
2010	45209	75131	10022	130	130519
2011	52256	67247	10702	121	130349
2012	57745	42892	7589	378	108608
2013	68352	64632	13880	117	146982
2014	57892	66597	8988	188	133739
2015	52631	58283	9832	144	120890
2016	51489	75264	9371	22	136174
2017	54513	84432	12345	100	151424

Table 2. Spanish purse seiners catch on FADs by species in the Indian Ocean, 1990-2017.

CATCH ON FADs BY SPECIES					
YEAR	YFT	SKJ	BET	ALB	TOTAL
1990	11789	35320	2375	40	49524
1991	9900	33906	3748	55	47634
1992	13726	37055	3118	6	53906
1993	13932	36839	2753	0	53524
1994	12822	43072	4117	39	60050
1995	36328	56534	10280	29	103171
1996	25996	45944	9396	12	81348
1997	38170	54240	14654	63	107127
1998	22043	49422	8562	18	80046
1999	34689	63459	14301	1	112450
2000	32046	67961	8719	43	109119
2001	18860	56964	6404	4	82415
2002	24710	84063	9566	4	118718
2003	32808	73288	5590	2	111797
2004	20264	56556	7597	0	84610
2005	29367	76328	6775	15	112833
2006	37072	104022	6843	0	148272
2007	18861	54232	7569	1	80711
2008	17647	58032	8220	32	83987
2009	21623	62096	9692	14	93461
2010	34448	70458	8580	9	113523
2011	36854	63709	7822	0	108409
2012	32946	41298	4948	17	79214
2013	55758	61364	12431	17	129570
2014	43478	63454	7558	124	114665
2015	31948	55290	6694	66	93999
2016	38662	72972	8461	10	120133
2017	36583	83426	7926	10	127980

Table 3. Spanish purse seiners catch on free schools by species in the Indian Ocean, 1990-2017.

CATCH ON FREE SCHOOL BY SPECIES					
YEAR	YFT	SKJ	BET	ALB	TOTAL
1990	31939	12606	2492	105	47142
1991	34123	7883	2257	1011	45289
1992	24110	9638	520	1455	35724
1993	33860	14432	2664	904	51861
1994	30306	18536	1807	1734	52383
1995	28815	13054	1953	531	44353
1996	33435	20332	1977	814	57786
1997	22807	8673	1243	966	33898
1998	16522	9224	2683	250	28679
1999	17186	10826	1732	231	29976
2000	20024	9225	2050	367	31753
2001	28712	11382	1526	335	41974
2002	28494	7398	1530	212	37668
2003	46160	14746	2954	517	64403
2004	60546	7837	1036	76	69496
2005	48152	17984	3515	33	69729
2006	33852	14835	3109	438	52271
2007	18902	10774	2187	245	32138
2008	28405	7064	4271	267	40017
2009	11888	4475	2089	39	18490
2010	10761	4672	1442	121	16995
2011	15402	3538	2880	121	21940
2012	24728	1594	2641	361	29394
2013	12595	3268	1449	100	17412
2014	14414	3143	1430	65	19074
2015	20682	2994	3137	78	26891
2016	12827	2291	910	12	16040
2017	17929	1006	4419	90	23444

Table 4. Spanish purse seiners total catch by species in the FAO area 57, 1991-2017.

CATCH AND EFFORT PS DATA AREA: F57							
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**	**FISH. DAYS**	**#SETS+**
1991	0	0	0	0	0	1	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	27	107	23	0	157	21	6
1997	123	147	35	0	305	33	14
1998	5736	4468	2716	6	12926	762	328
1999	59	149	40	0	248	33	11
2000	67	88	13	0	167	30	9
2001	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0
2004	1	4	1	0	5	1	1
2005	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0
2009	464	961	216	0	1641	47	51
2010	12	0	0	0	12	3	1
2011	15	62	16	0	94	1	3
2012	0	0	0	0	0	0	0
2013	29	129	26	0	184	16	9
2014	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0
2017	12	29	5	0	45	4	3

Table 5. Spanish purse seiners total catch by species in the FAO area 51, 1991-2017.

CATCH AND EFFORT PS DATA AREA: F51							
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**	**FISH. DAYS**	**#SETS+**
1991	44023	41790	6005	1066	92923	4324	2402
1992	37836	46694	3638	1461	89629	4296	2594
1993	47792	51272	5418	904	105385	4565	2693
1994	43128	61608	5924	1773	112433	4463	2814
1995	65143	69587	12233	561	147524	5221	3341
1996	59404	66169	11351	826	138977	5771	3818
1997	60855	62767	15862	1029	140720	6374	3886
1998	32829	54179	8529	262	95799	4882	3053
1999	51816	74137	15994	232	142179	5192	3208
2000	52004	77099	10756	410	140705	4496	3160
2001	47571	68346	7930	339	124389	4940	3105
2002	53205	91462	11096	217	156386	4570	3088
2003	78968	88035	8544	520	176200	4468	2926
2004	80809	64389	8633	76	154101	4729	3020
2005	77519	94312	10290	48	182562	5808	4228
2006	70924	118857	9952	438	200543	6462	4688
2007	37763	65006	9756	246	112848	5895	3647
2008	46051	65096	12490	299	124004	4792	3505
2009	33047	65609	11566	52	110311	3737	3296
2010	45197	75131	10022	130	130507	3822	3705
2011	52241	67184	10686	121	130255	3850	3747
2012	57745	42892	7589	378	108608	3991	3415
2013	68323	64503	13854	114	146798	4208	3776
2014	57892	66597	8988	188	133739	4185	3472
2015	52631	58283	9832	144	120890	4157	3584
2016	51489	75264	9371	22	136174	4261	4256
2017	54501	84404	12341	100	151379	3508	3664

Table 6. Number of Spanish Purse seiners by category, carrying capacity in tons and number of supplies vessels used in association with Spanish boat 1990 - 2017.

Class	50-400	401-600	601-800	801-1200	1201-2000	>2000	total	C.Cap.	Supp
1990	-	-	3	8	9	0	20	17908	-
1991	0	0	3	6	8	0	17	16568	-
1992	0	0	1	6	11	0	18	16711	-
1993	0	0	1	6	11	1	19	18953	-
1994	0	0	2	4	11	1	18	18779	-
1995	0	0	2	5	11	1	19	20908	-
1996	0	0	2	6	13	1	22	24090	-
1997	0	0	2	6	14	1	23	26128	-
1998	0	0	2	6	12	0	20	21243	-
1999	0	0	2	6	12	0	20	20260	6
2000	0	0	1	7	9	0	17	19473	7
2001	0	0	1	7	9	0	17	20479	5
2002	0	0	1	6	10	1	18	20490	8
2003	0	0	1	6	9	2	18	21007	8
2004	0	0	1	4	10	5	20	23832	15
2005	0	0	1	4	10	5	20	29052	13
2006	0	0	1	5	11	5	22	31224	13
2007	0	0	1	4	11	5	21	29438	13
2008	0	0	0	3	10	4	17	24212	11
2009	0	0	0	2	9	4	15	20805	11
2010	0	0	0	1	8	4	13	20677	6
2011	0	0	0	1	8	4	13	20458	7
2012	0	0	0	1	9	4	14	21657	6
2013	0	0	0	1	9	4	14	22056	4
2014	0	0	0	2	9	4	15	20761	7
2015	0	0	0	1	11	5	17	23251	10
2016	0	0	0	0	10	4	14	23507	11
2017	0	0	0	0	10	4	14	22811	10

Table 7. Nominal fishing effort in fishing days and searching days of the purse seine Spanish fleet.

YEAR	F.DAYS	S.DAYS
1990	5006	4205
1991	4325	3544
1992	4296	3591
1993	4565	3842
1994	4463	3771
1995	5221	4470
1996	5793	4925
1997	6407	5584
1998	5644	4888
1999	5224	4496
2000	4526	3825
2001	4940	4214
2002	4570	3889
2003	4468	3671
2004	4730	3891
2005	5808	4619
2006	6462	5180
2007	5895	4916
2008	4792	3882
2009	3784	2992
2010	3825	2938
2011	3851	2944
2012	3991	3150
2013	4224	3326
2014	4185	3340
2015	4157	3287
2016	4261	3268
2017	3512	2618

Table 8. Number of 1x1 degree squares explored by the purse seine Spanish fleet. The same, considering different minimum effort limits and number of squares with sets and with catch.

NUMBER OF 1ºX1º SQUARE PROSPECTED BY THE SPANISH FLEET					
YEAR	N. CWP VISITED	N. CWP with SET	N. CWP with CATCH	N. CWP Eff >12hrs	N. CWP Eff >60hrs
1990	395	319	199	301	286
1991	370	290	197	289	277
1992	419	347	223	338	324
1993	415	318	202	317	308
1994	479	380	218	359	348
1995	447	357	210	343	339
1996	574	459	280	446	437
1997	627	490	281	454	437
1998	742	547	263	525	512
1999	584	438	247	459	442
2000	585	428	223	450	430
2001	506	412	262	426	405
2002	534	448	430	436	259
2003	511	421	403	396	252
2004	492	376	359	368	221
2005	514	414	383	391	250
2006	563	473	464	449	275
2007	579	488	466	457	263
2008	577	504	483	476	276
2009	629	524	517	485	239
2010	531	480	464	411	232
2011	522	458	452	405	221
2012	500	416	405	398	224
2013	568	503	493	456	233
2014	460	390	382	352	200
2015	476	430	419	391	200
2016	554	532	524	450	263
2017	541	491	478	409	190

Table 9. Total number of sets, positive sets and null sets. Same statistics by fishing mode.

	ALL			FADs			FREE SCHOOL		
YEAR	**Nº SETS**	**Nº SETS +**	**Nº SETS -**	**Nº SETS**	**Nº SETS +**	**Nº SETS -**	**Nº SETS**	**Nº SETS +**	**Nº SETS -**
1990	4131	2876	1255	1612	1461	151	2519	1415	1104
1991	3291	2402	889	1409	1311	98	1882	1091	791
1992	3422	2594	828	1435	1377	58	1987	1217	770
1993	3756	2693	1063	1425	1372	53	2331	1321	1010
1994	3974	2814	1160	1413	1328	85	2561	1486	1075
1995	4197	3341	856	2287	2151	136	1910	1190	720
1996	4929	3824	1105	2166	2102	64	2763	1722	1041
1997	4592	3900	692	3004	2892	112	1588	1008	580
1998	4339	3381	958	2651	2512	139	1688	869	819
1999	4040	3219	821	2363	2267	96	1677	952	725
2000	3856	3169	687	2331	2236	95	1525	933	592
2001	4050	3105	945	2088	2004	84	1962	1101	861
2002	3681	3088	593	2331	2239	92	1350	849	501
2003	3801	2926	875	1932	1822	110	1869	1104	765
2004	4247	3021	1226	1884	1775	109	2363	1246	1117
2005	5815	4228	1587	2768	2620	148	3047	1608	1439
2006	6244	4688	1556	3333	3100	233	2911	1588	1323
2007	4940	3647	1293	2955	2624	331	1985	1023	962
2008	4495	3505	990	2564	2369	195	1931	1136	795
2009	3824	3347	477	2940	2773	167	884	574	310
2010	4309	3706	603	3442	3219	223	867	487	380
2011	4393	3750	643	3402	3196	206	991	554	437
2012	4135	3415	720	2855	2643	212	1280	772	508
2013	4253	3785	468	3626	3419	207	627	366	261
2014	4040	3472	568	3271	3045	226	769	427	342
2015	4235	3584	651	3109	2932	177	1126	652	474
2016	4809	4256	553	3991	3844	147	818	412	406
2017	4246	3667	579	3354	3197	157	892	470	422

Table 10. Frequency of positive sets by size of catch.

TOTAL SET FREQUENCY BY CATCH.											
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.**
1990	562	648	490	345	235	155	101	87	54	48	150
1991	474	462	374	258	213	145	96	79	58	50	187
1992	518	538	421	316	199	153	124	72	51	54	148
1993	443	518	400	316	217	177	119	107	63	82	251
1994	513	556	419	286	208	171	117	104	89	71	278
1995	469	603	500	391	300	204	166	122	113	84	389
1996	681	865	594	463	292	225	159	118	105	80	242
1997	716	901	614	488	317	218	147	125	70	72	226
1998	672	837	620	417	221	168	103	94	66	30	153
1999	466	621	544	341	264	205	175	125	97	75	305
2000	441	638	502	348	256	216	145	127	96	67	331
2001	534	685	502	366	226	179	125	89	76	63	257
2002	346	594	454	373	281	217	150	117	93	63	398
2003	290	462	404	337	264	201	173	113	97	75	510
2004	325	567	508	346	231	204	151	128	117	49	395
2005	552	924	698	488	354	265	218	160	116	62	391
2006	676	1050	791	539	396	286	187	148	103	103	421
2007	797	972	636	390	251	151	108	100	52	31	159
2008	620	877	603	393	276	190	133	89	64	60	200
2009	623	876	592	368	241	174	111	91	61	33	177
2010	710	936	563	431	266	195	131	91	60	48	225
2011	614	993	704	419	278	197	134	87	62	54	208
2012	791	853	550	381	249	185	101	79	42	45	139
2013	520	941	650	452	307	214	156	109	83	64	289
2014	565	767	604	413	303	167	154	115	84	50	250
2015	728	876	647	366	248	185	128	96	70	43	197
2016	782	1093	795	488	340	234	135	90	69	63	167
2017	533	815	582	462	304	220	152	128	90	70	310

Table 11. Frequency of positive sets in FADs by size of catch.

SET FREQUENCY BY CATCH. FADs.											
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.**
1990	229	336	268	176	137	74	47	55	33	29	77
1991	242	295	201	135	122	81	49	42	37	25	78
1992	223	263	221	191	107	87	77	37	39	32	100
1993	223	287	204	160	117	93	66	52	34	33	103
1994	181	241	204	154	117	88	59	58	46	34	145
1995	252	363	314	266	203	133	116	89	70	64	281
1996	330	476	323	269	160	142	97	71	51	52	131
1997	499	665	451	377	236	164	112	91	58	57	178
1998	499	637	464	311	154	126	75	69	45	20	112
1999	232	397	381	242	205	167	143	101	77	60	262
2000	244	393	359	257	191	159	113	101	85	51	281
2001	300	441	341	247	154	118	81	58	52	42	168
2002	210	424	313	280	203	169	117	92	72	49	309
2003	170	271	246	215	174	125	105	76	62	50	328
2004	175	344	326	209	138	125	94	83	54	27	200
2005	314	579	434	317	227	169	125	109	66	37	243
2006	390	644	492	378	260	202	137	99	79	67	352
2007	582	711	447	277	182	108	77	69	39	16	116
2008	394	626	395	270	187	126	93	60	42	43	133
2009	514	726	496	300	194	141	96	72	55	30	149
2010	621	806	471	379	225	175	118	84	52	42	196
2011	531	872	606	351	226	167	117	69	51	44	162
2012	667	671	420	279	185	141	77	56	28	27	92
2013	468	866	602	409	282	182	141	93	74	55	247
2014	517	680	528	368	265	140	125	95	70	44	213
2015	619	743	543	293	198	150	97	64	51	34	140
2016	692	1013	735	455	307	195	115	81	59	53	139
2017	487	733	498	402	264	189	130	107	75	59	252

Table 12. Frequency of positive sets in free schools by size of catch.

SET FREQUENCY BY CATCH. FREE SCHOOL											
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.**
1990	333	312	222	169	98	81	54	32	21	19	73
1991	232	167	173	123	91	64	47	37	21	25	109
1992	295	275	200	125	92	66	47	35	12	22	48
1993	220	231	196	156	100	84	53	55	29	49	148
1994	332	315	215	132	91	83	58	46	43	37	133
1995	217	240	186	125	97	71	50	33	43	20	108
1996	351	389	271	194	132	83	62	47	54	28	111
1997	217	236	163	111	81	54	35	34	12	15	48
1998	173	200	156	106	67	42	28	25	21	10	41
1999	234	224	163	99	59	38	32	24	20	15	43
2000	197	245	143	91	65	57	32	26	11	16	50
2001	234	244	161	119	72	61	44	31	24	21	89
2002	136	170	141	93	78	48	33	25	21	14	89
2003	120	191	158	122	90	76	68	37	35	25	182
2004	150	223	182	137	93	79	57	45	63	22	195
2005	238	345	264	171	127	96	93	51	50	25	148
2006	286	406	299	161	136	84	50	49	24	24	69
2007	215	261	189	113	69	43	31	31	13	15	43
2008	226	251	208	123	89	64	40	29	22	17	67
2009	109	150	96	68	47	33	15	19	6	3	28
2010	89	130	92	52	41	20	13	7	8	6	29
2011	83	121	98	68	52	30	17	18	11	10	46
2012	124	182	130	102	64	44	24	23	14	18	47
2013	52	75	48	43	25	32	15	16	9	9	42
2014	48	87	76	45	38	27	29	20	14	6	37
2015	109	133	104	73	50	35	31	32	19	9	57
2016	90	80	60	33	33	39	20	9	10	10	28
2017	46	82	84	60	40	31	22	21	15	11	58

Table 13. Catch rate (catch/fishing day) by species and total.

NOMINAL CATCH RATE (F.DAYS) ALL					
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**
1990	8.35	10.65	0.29	0.03	19.32
1991	10.18	9.66	1.39	0.25	21.49
1992	8.81	10.87	0.85	0.34	20.86
1993	10.47	11.23	1.19	0.2	23.09
1994	9.66	13.8	1.33	0.4	25.19
1995	12.48	13.33	2.34	0.11	28.26
1996	10.26	11.44	1.96	0.14	24.02
1997	9.52	9.82	2.48	0.16	22.01
1998	6.83	10.39	1.99	0.05	19.26
1999	9.93	14.22	3.07	0.04	27.26
2000	11.5	17.05	2.38	0.09	31.12
2001	9.63	13.84	1.61	0.07	25.18
2002	11.64	20.01	2.43	0.05	34.22
2003	17.67	19.7	1.91	0.12	39.44
2004	17.08	13.61	1.83	0.02	32.58
2005	13.35	16.24	1.77	0.01	31.44
2006	10.98	18.39	1.54	0.07	31.03
2007	6.41	11.03	1.66	0.04	19.14
2008	9.61	13.59	2.61	0.06	25.88
2009	8.86	17.59	3.11	0.01	29.58
2010	11.82	19.64	2.62	0.03	34.12
2011	13.57	17.46	2.78	0.03	33.85
2012	14.47	10.75	1.9	0.09	27.21
2013	16.18	15.3	3.29	0.03	34.8
2014	13.83	15.91	2.15	0.05	31.96
2015	12.66	14.02	2.36	0.03	29.08
2016	12.08	17.67	2.20	0.01	31.96
2017	15.52	24.04	3.52	0.03	43.12

Table 14. Catch by positive set by species and total.

NOMINAL CATCH RATE (Nº POSITIVE SETS) ALL					
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**
1990	14.53	18.54	0.51	0.05	33.62
1991	18.33	17.4	2.5	0.44	38.69
1992	14.59	18	1.4	0.56	34.55
1993	17.75	19.04	2.01	0.34	39.13
1994	15.33	21.89	2.11	0.63	39.95
1995	19.5	20.83	3.66	0.17	44.16
1996	15.54	17.33	2.97	0.22	36.38
1997	15.64	16.13	4.08	0.26	36.16
1998	11.41	17.35	3.33	0.08	32.16
1999	16.12	23.08	4.98	0.07	44.25
2000	16.43	24.36	3.4	0.13	44.45
2001	15.32	22.01	2.55	0.11	40.06
2002	17.23	29.62	3.59	0.07	50.64
2003	26.99	30.09	2.92	0.18	60.22
2004	26.75	21.32	2.86	0.03	51.01
2005	18.33	22.31	2.43	0.01	43.18
2006	15.13	25.35	2.12	0.09	42.78
2007	10.35	17.82	2.68	0.07	30.95
2008	13.14	18.57	3.56	0.09	35.38
2009	10.01	19.89	3.52	0.02	33.45
2010	12.2	20.27	2.7	0.04	35.22
2011	13.93	17.93	2.85	0.03	34.76
2012	16.91	12.56	2.22	0.11	31.8
2013	18.06	17.08	3.67	0.03	38.83
2014	16.67	19.18	2.59	0.05	38.52
2015	14.68	16.26	2.74	0.04	33.73
2016	12.10	17.68	2.20	0.01	32.00
2017	14.87	23.02	3.37	0.03	41.29

Table 15. Catch rate (catch/fishing day) in FAD by species and total.

NOMINAL CATCH RATE (F.DAYS) FADS					
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**
1990	1.58	8.54	0.14	0.01	10.26
1991	2.29	7.84	0.87	0.01	11.01
1992	3.19	8.62	0.73	0	12.55
1993	3.05	8.07	0.6	0	11.73
1994	2.87	9.65	0.92	0.01	13.46
1995	6.96	10.83	1.97	0.01	19.76
1996	4.49	7.93	1.62	0	14.04
1997	5.96	8.47	2.29	0.01	16.72
1998	3.91	8.76	1.52	0	14.18
1999	6.64	12.15	2.74	0	21.52
2000	7.08	15.02	1.93	0.01	24.11
2001	3.82	11.53	1.3	0	16.68
2002	5.41	18.39	2.09	0	25.98
2003	7.34	16.4	1.25	0	25.02
2004	4.28	11.96	1.61	0	17.89
2005	5.06	13.14	1.17	0	19.43
2006	5.74	16.1	1.06	0	22.94
2007	3.2	9.2	1.28	0	13.69
2008	3.68	12.11	1.72	0.01	17.53
2009	5.71	16.41	2.56	0	24.7
2010	9	18.42	2.24	0	29.26
2011	9.57	16.54	2.03	0	28.15
2012	8.25	10.35	1.24	0	19.85
2013	13.2	14.53	2.94	0	30.68
2014	10.39	15.16	1.81	0.03	27.40
2015	7.68	13.3	1.61	0.02	22.61
2016	9.07	17.13	1.99	0	28.20
2017	10.42	23.75	2.26	0	36.44

Table 16. Catch in FADs by positive set by species and total.

NOMINAL CATCH RATE (Nº POSITIVE SETS) FADS					
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**
1990	5.4	29.27	0.46	0.03	35.16
1991	7.55	25.86	2.86	0.04	36.33
1992	9.97	26.91	2.26	0	39.15
1993	10.15	26.85	2.01	0	39.01
1994	9.66	32.43	3.1	0.03	45.22
1995	16.89	26.28	4.78	0.01	47.96
1996	12.37	21.86	4.47	0.01	38.7
1997	13.2	18.76	5.07	0.02	37.04
1998	8.78	19.67	3.41	0.01	31.87
1999	15.3	27.99	6.31	0	49.6
2000	14.33	30.39	3.9	0.02	48.8
2001	9.41	28.43	3.2	0	41.13
2002	11.04	37.55	4.27	0	53.02
2003	18.01	40.22	3.07	0	61.36
2004	11.42	31.86	4.28	0	47.67
2005	11.21	29.13	2.59	0.01	43.07
2006	11.96	33.56	2.21	0	47.83
2007	7.19	20.67	2.88	0	30.76
2008	7.45	24.5	3.47	0.02	35.45
2009	7.8	22.39	3.5	0	33.7
2010	10.7	21.89	2.67	0	35.27
2011	11.53	19.93	2.45	0	33.92
2012	12.47	15.63	1.87	0.01	29.97
2013	16.31	17.95	3.64	0.01	37.9
2014	14.28	20.84	2.48	0.04	37.66
2015	10.9	18.86	2.28	0.02	32.06
2016	10.06	18.98	2.20	0	31.25
2017	11.44	26.10	2.48	0	40.03

Table 17. Catch rate (catch/fishing day) in free school by species and total.

NOMINAL CATCH RATE (F.DAYS) F.SCHOOL					
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**
1990	6.77	2.11	0.16	0.02	9.05
1991	7.89	1.82	0.52	0.23	10.47
1992	5.61	2.24	0.12	0.34	8.31
1993	7.42	3.16	0.58	0.2	11.36
1994	6.79	4.15	0.4	0.39	11.74
1995	5.52	2.5	0.37	0.1	8.5
1996	5.77	3.51	0.34	0.14	9.98
1997	3.56	1.35	0.19	0.15	5.29
1998	2.93	1.63	0.48	0.04	5.08
1999	3.29	2.07	0.33	0.04	5.74
2000	4.42	2.04	0.45	0.08	7.02
2001	5.81	2.3	0.31	0.07	8.5
2002	6.24	1.62	0.33	0.05	8.24
2003	10.33	3.3	0.66	0.12	14.41
2004	12.8	1.66	0.22	0.02	14.69
2005	8.29	3.1	0.61	0.01	12.01
2006	5.24	2.3	0.48	0.07	8.09
2007	3.21	1.83	0.37	0.04	5.45
2008	5.93	1.47	0.89	0.06	8.35
2009	3.14	1.18	0.55	0.01	4.89
2010	2.81	1.22	0.38	0.03	4.44
2011	4	0.92	0.75	0.03	5.7
2012	6.21	0.4	0.66	0.09	7.36
2013	2.98	0.77	0.34	0.02	4.12
2014	3.44	0.75	0.34	0.02	4.56
2015	4.97	0.72	0.75	0.02	6.47
2016	3.01	0.54	0.21	0	3.76
2017	5.11	0.29	1.26	0.03	6.68

Table 18. Catch in free school by positive set by species and total.

NOMINAL CATCH RATE (Nº POSITIVE SETS) F.SCHOOL					
YEAR	**YFT**	**SKJ**	**BET**	**ALB**	**TOTAL**
1990	23.95	7.45	0.55	0.07	32.03
1991	31.28	7.23	2.07	0.93	41.51
1992	19.81	7.92	0.43	1.2	29.35
1993	25.63	10.93	2.02	0.68	39.26
1994	20.39	12.47	1.22	1.17	35.25
1995	24.21	10.97	1.64	0.45	37.27
1996	19.42	11.81	1.15	0.47	33.56
1997	22.63	8.6	1.23	0.96	33.63
1998	19.01	10.61	3.09	0.29	33
1999	18.05	11.37	1.82	0.24	31.49
2000	21.46	9.89	2.2	0.39	34.03
2001	26.08	10.34	1.39	0.3	38.12
2002	33.56	8.71	1.8	0.25	44.37
2003	41.81	13.36	2.68	0.47	58.34
2004	48.59	6.29	0.83	0.06	55.78
2005	29.95	11.18	2.19	0.02	43.36
2006	21.32	9.34	1.96	0.28	32.92
2007	18.48	10.53	2.14	0.24	31.42
2008	25	6.22	3.76	0.24	35.23
2009	20.71	7.8	3.64	0.07	32.21
2010	22.1	9.59	2.96	0.25	34.9
2011	27.8	6.39	5.2	0.22	39.6
2012	32.12	2.06	3.42	0.47	38.08
2013	34.41	8.93	3.96	0.27	47.57
2014	33.76	7.36	3.35	0.15	44.67
2015	31.72	4.59	4.81	0.12	41.24
2016	31.13	5.56	2.21	0.03	38.93
2017	38.15	2.14	9.40	0.19	49.88

Table 19. Mean weight by species and fishing mode (kg).

	YFT		SKJ		BET	
YEAR	**FAD**	**F.SCHOOL**	**FAD**	**F.SCHOOL**	**FAD**	**F.SCHOOL**
1990	6.1	31.8	2.8	3	4.3	25.2
1991	8	37	2.7	2.7	5.5	20.6
1992	9.9	36.8	3	2.9	5.2	13.5
1993	10.8	40.2	2.7	3.1	4.3	26.7
1994	6.2	39.8	2.5	3.5	4.9	34.4
1995	9.7	27.3	2.4	3	5.3	21.7
1996	5.2	27.8	2.4	3.2	4.7	11.3
1997	4.8	26.6	2.3	2.8	3.7	13
1998	6.9	14.5	2.6	2.5	5.3	9.2
1999	4.6	22.5	2.5	2.5	4.9	8.9
2000	6	23.6	3	3.2	4.9	13.7
2001	4.6	29.7	2.6	3.6	3.6	14.5
2002	3.7	34.8	2.4	3.3	3.7	30.5
2003	5.6	34.6	3.1	3.9	4.4	24.4
2004	4.2	39.7	2.5	3.6	4.8	30.4
2005	5.6	34.5	2.9	3.3	4.8	29.6
2006	4.8	35.2	3	3.8	4.6	34
2007	5.2	36.6	2.4	3	3.5	34.1
2008	3.8	36.1	2	2.7	3.2	30.2
2009	4.2	27.1	2.4	2.4	3.7	15.9
2010	4.5	20.4	2.3	2.3	3.7	14
2011	4.5	22.9	2.3	2.5	3.6	22.8
2012	5	33.3	2.5	2.8	3.5	33.3
2013	4.9	29.6	2.5	3	4.1	21.5
2014	4.9	33.2	2.9	3.6	4	22.8
2015	4.5	47.5	3.1	3.2	3.9	50.9
2016	4.7	38.6	2.7	4.0	3.8	12.8
2017	4.0	39.0	2.9	3.8	3.6	42.4

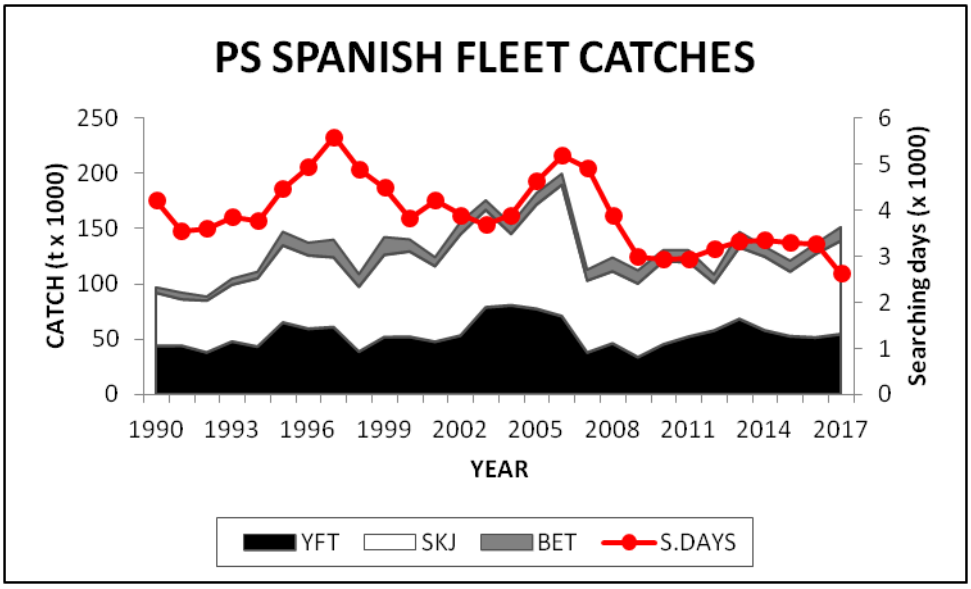

Figure 1. Catch by species and effort in searching days of the purse seine Spanish fleet.

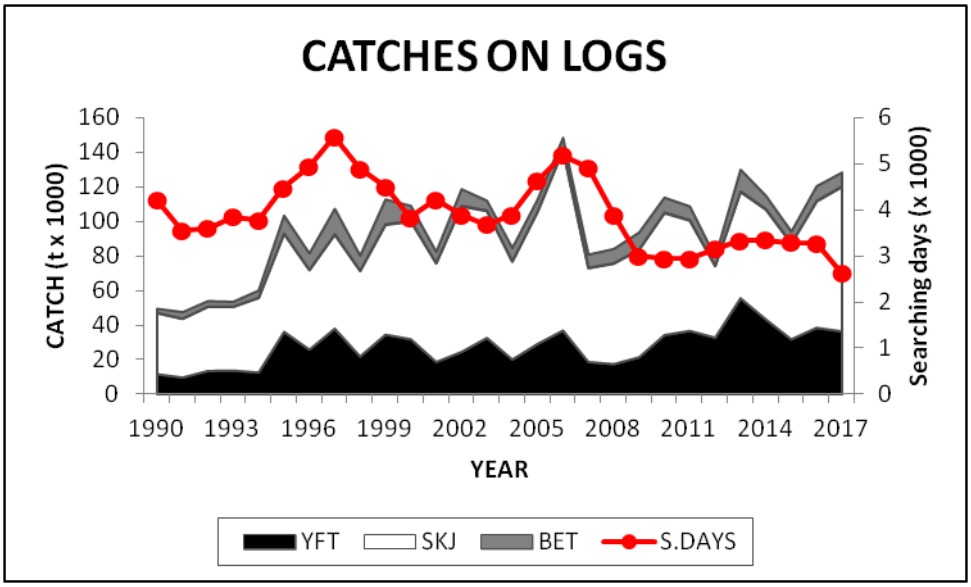

Figure 2. Catch by species on logs and effort in searching days of the purse seine Spanish fleet.

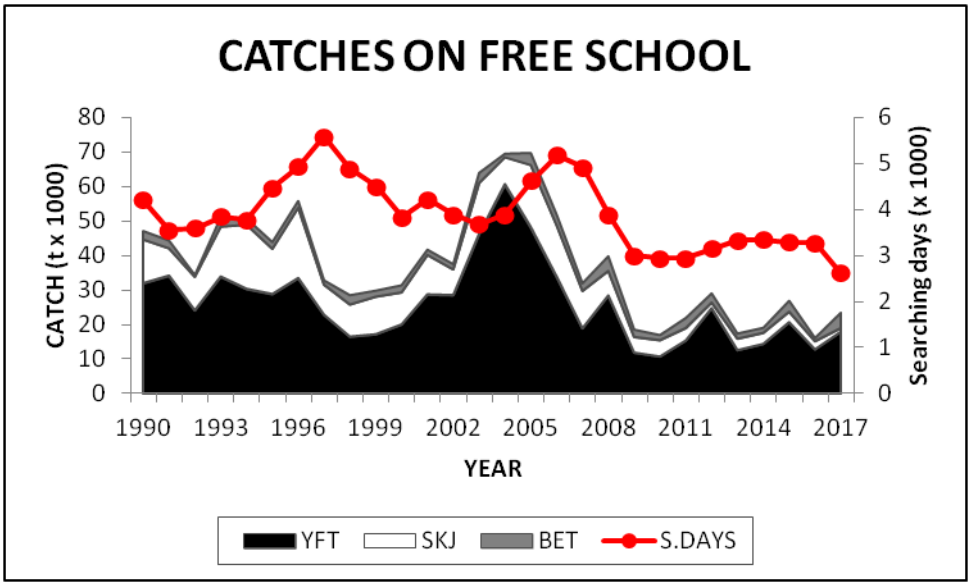

Figure 3. Catch by species on free school and effort in searching days of the purse seine Spanish fleet.

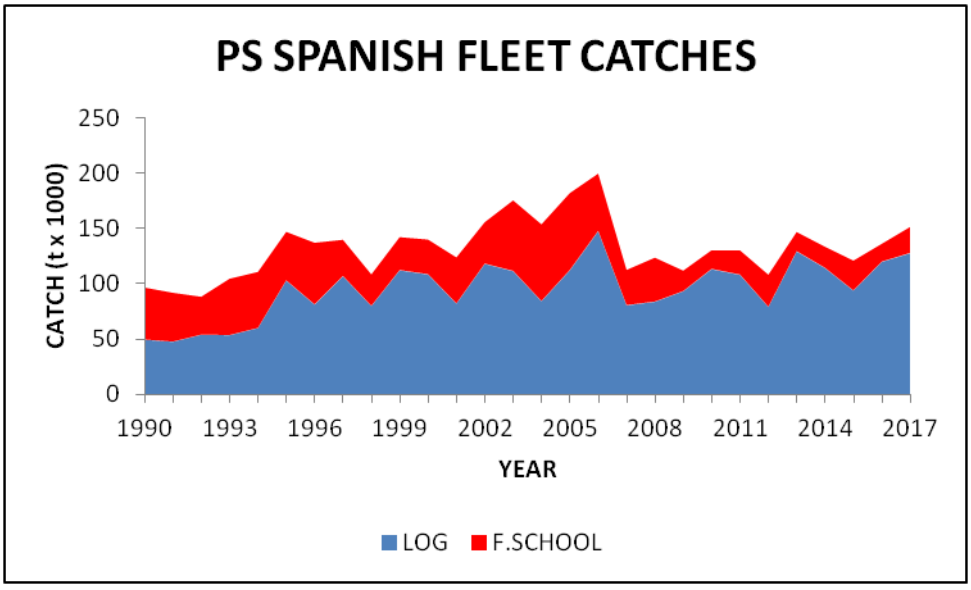

Figure 4. Catch by fishing mode (floating object and free school) of the purse seine Spanish fleet.

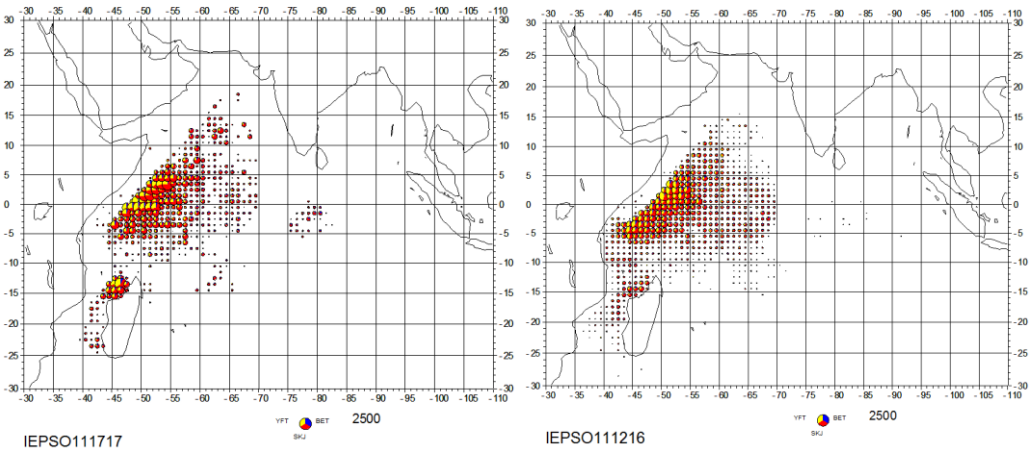

Figure 5. Distribution of the catches by species of de PS Spanish fleet, on log schools in 2017 (left) and on average over the 2012-2016 period (right).

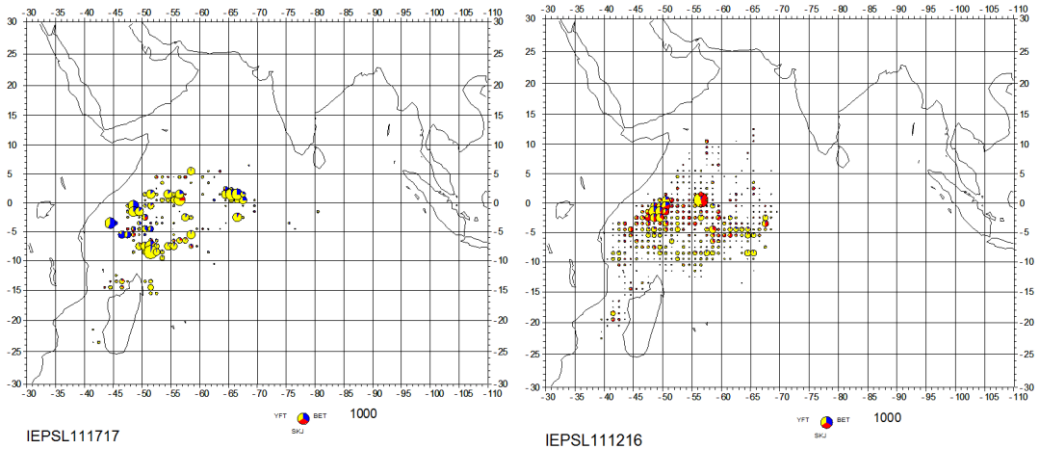

Figure 6. Distribution of the catches by species of de PS Spanish fleet, on free schools in 2017 (left) and on average over the 2012-2016 period (right).

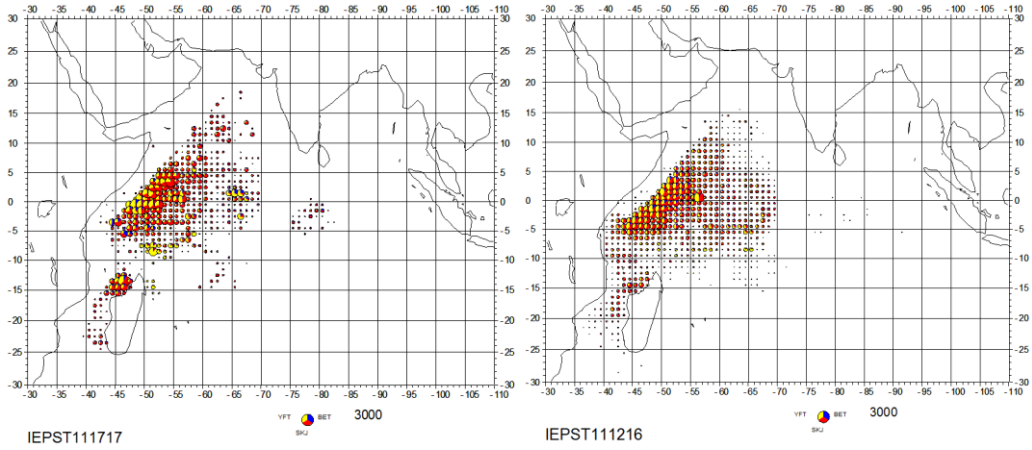

Figure 7. Distribution of the catches by species of de PS Spanish fleet in 2017 (left) and on average over the 2012-2016 period (right).

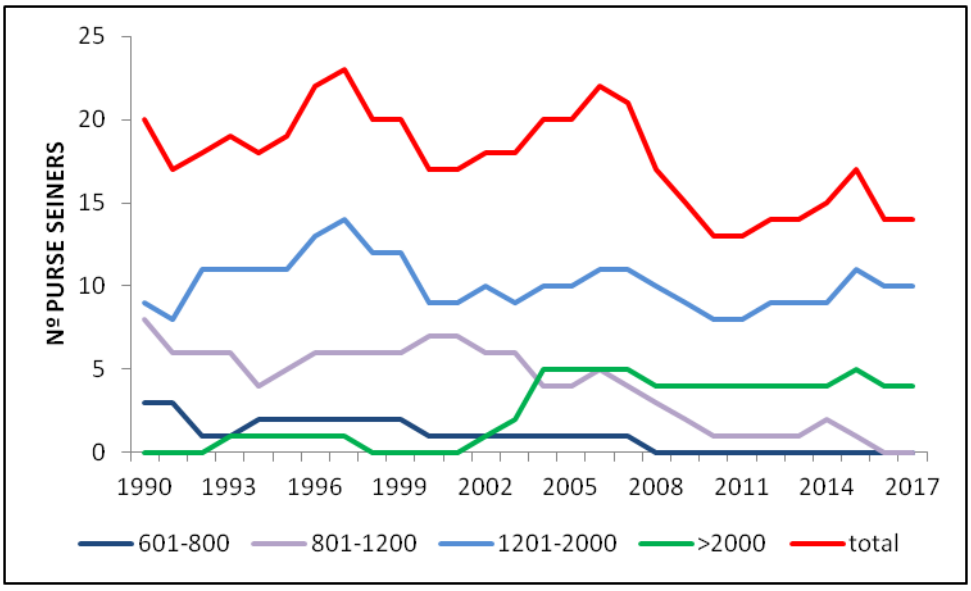

Fig. 8. Spanish purse seiners number by carrying capacity.

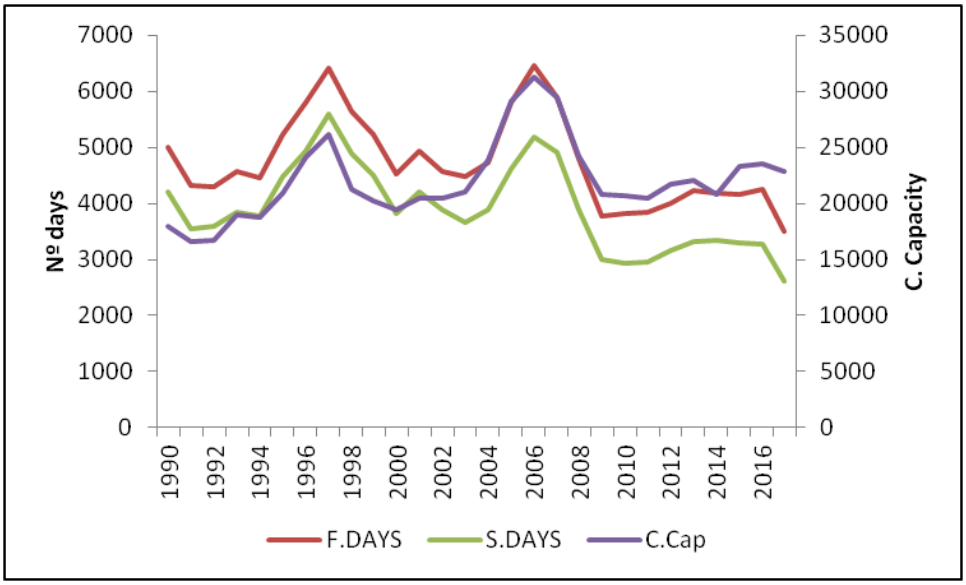

Fig. 9. Fishing and searching days and carrying

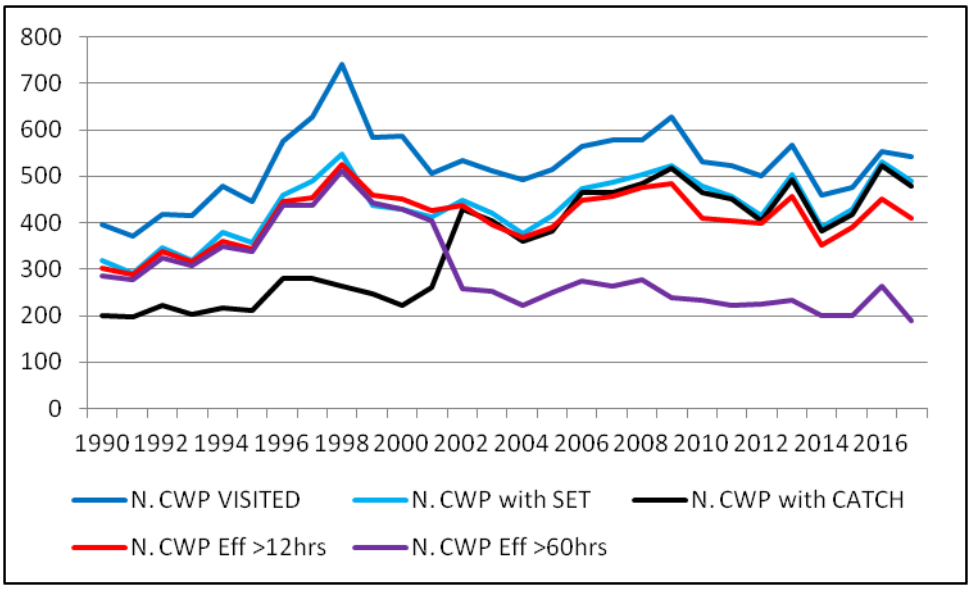

Fig.10. Number of one degree squares visited with different efforts.

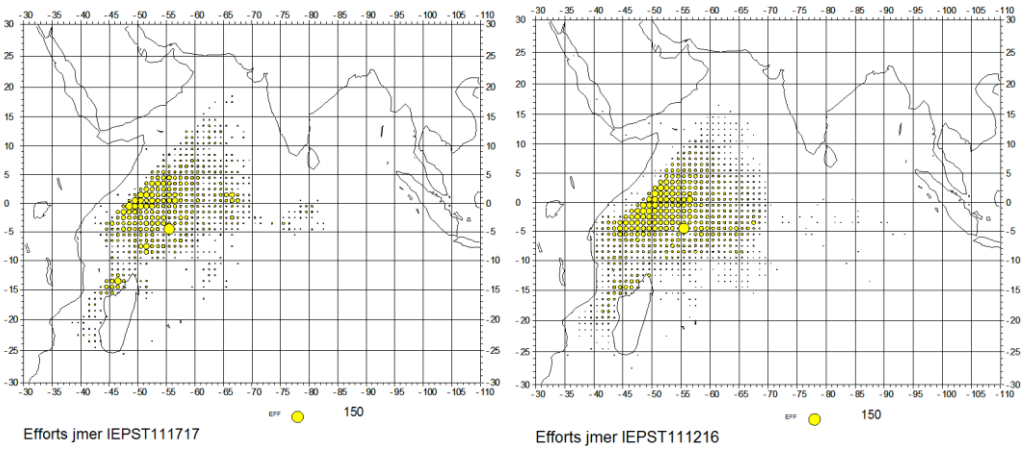

Figure 11. Distribution of the effort (fishing days) by 1ºx1º squares of the purse seine Spanish fleet in 2017 (left) and on average over the 2012-2016 period (right).

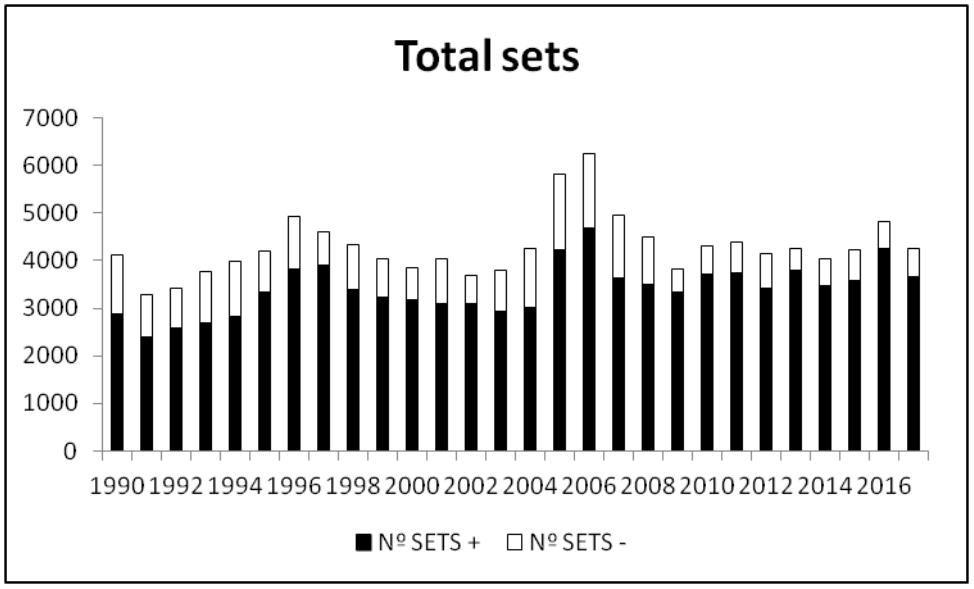

Figure12. Number of positives and nulls sets.

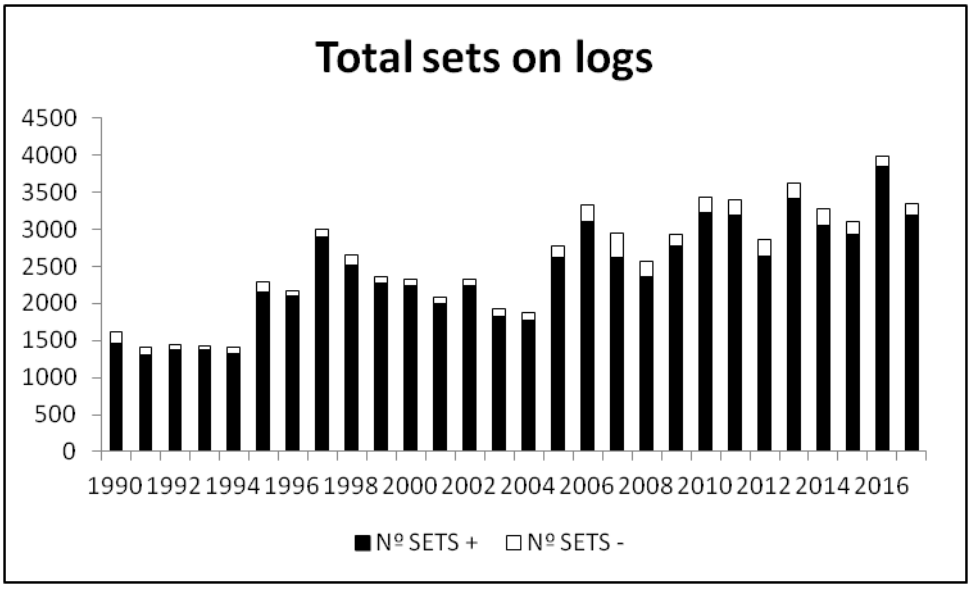

Fig.13. Number of positives and nulls sets on logs.

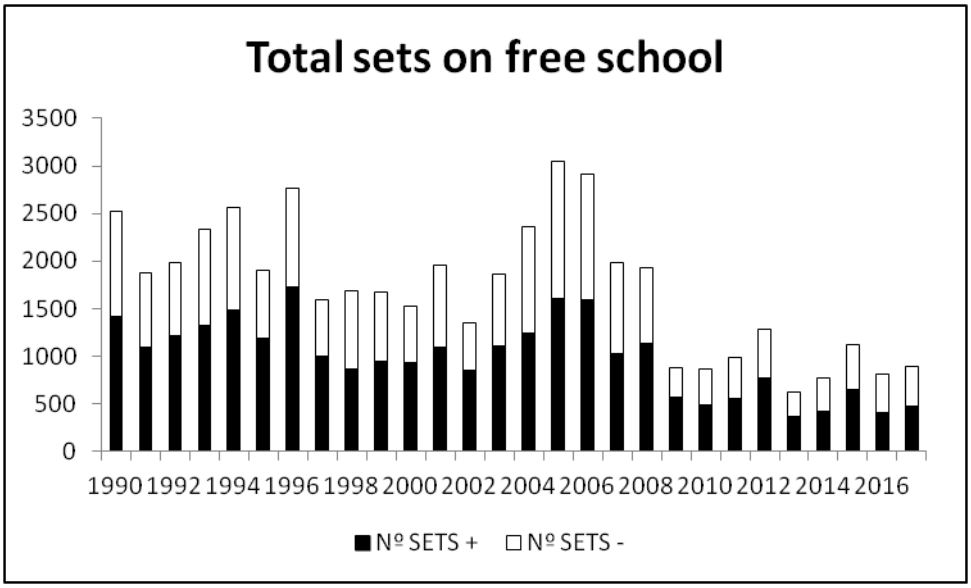

Fig. 14. Number of positives and nulls sets on free school.

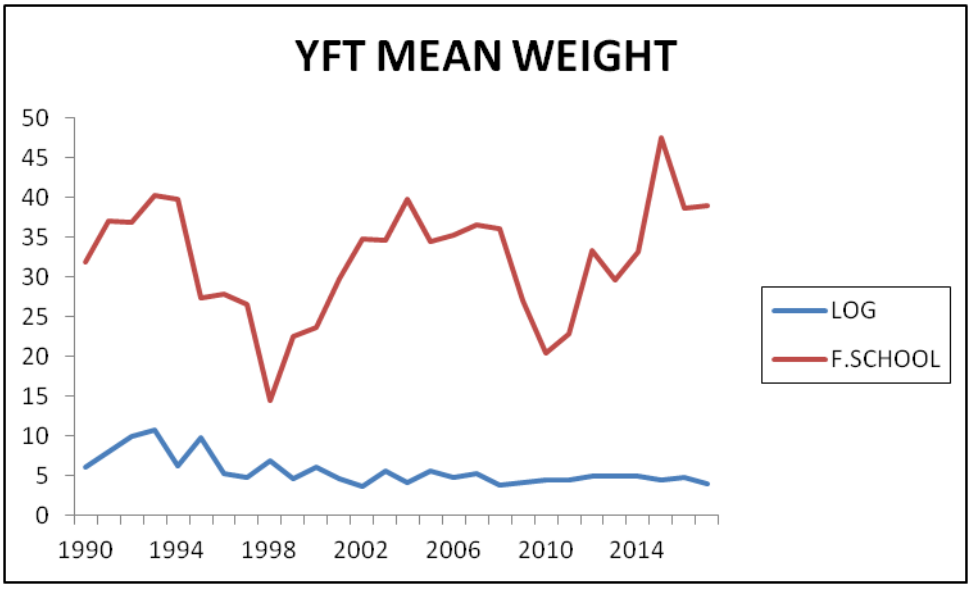

Fig.15 Yellowfin mean weight by fishing mode (log and free school) for the period 1990-2017.

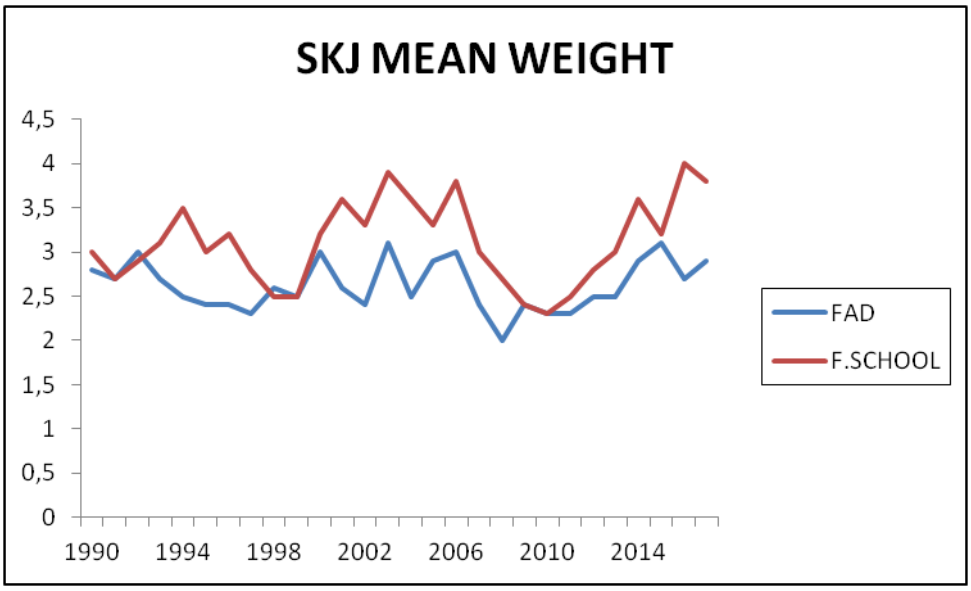

Fig. 16. Skipjack mean weight by fishing mode (log and free school) for the period 1990-2017.

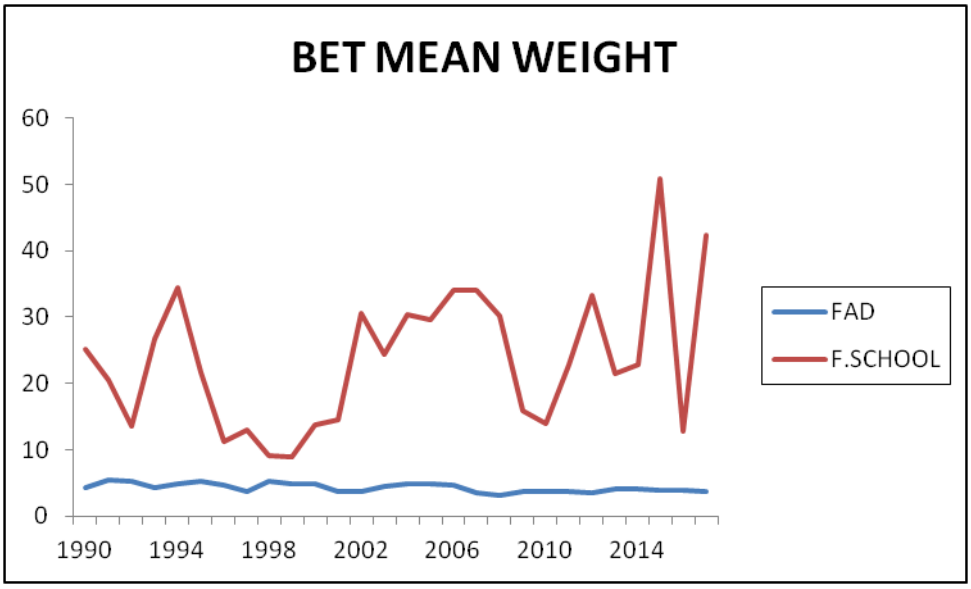

Fig. 17. Bigeye mean weight by fishing mode (log and free school) for the period 1990-2017.

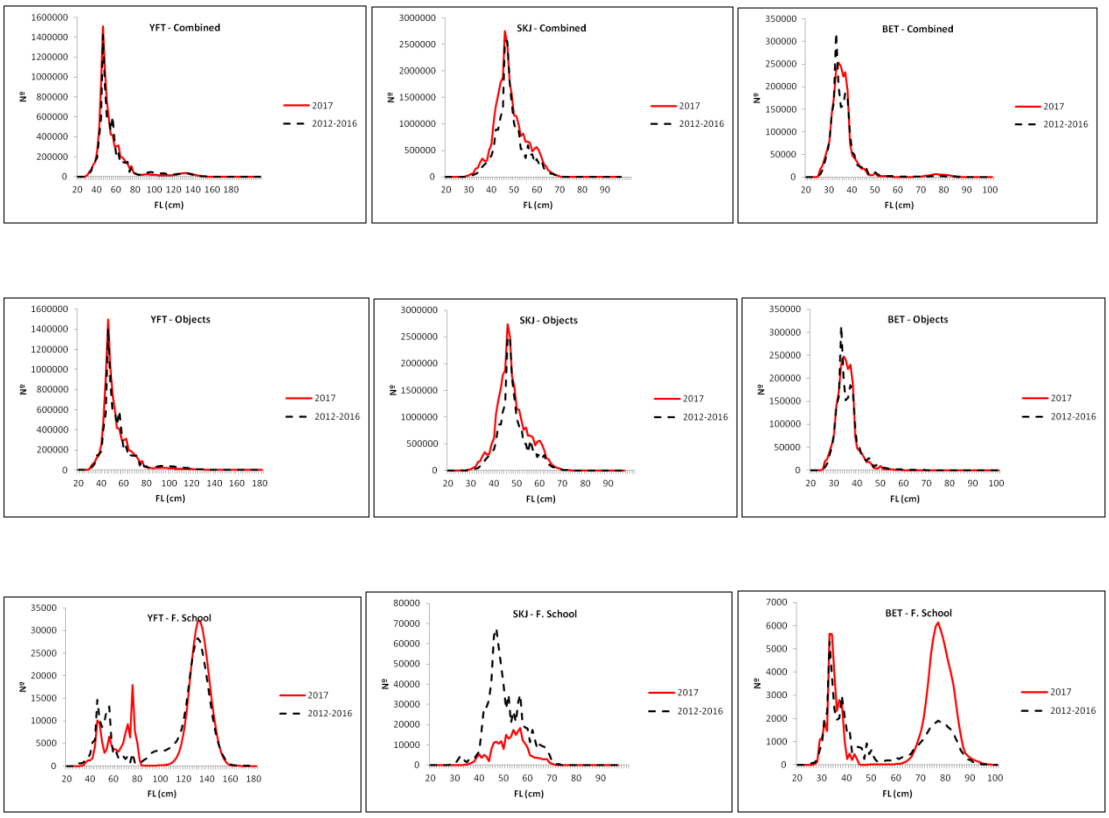

Figure 18. Size distribution of the catches by species (YFT, left; SKJ, middle; BET, right), by fishing mode (combined, top; Logs, middle; Free schools, bottom), in 2017 and on average over 2012 – 2016 period.