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Fishing activities of the French and associated flags purse seiners targeting tropical tunas in the Indian Ocean (1981-2013)

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SUMMARY

In 2013, the French purse seine fishing fleet of the Indian Ocean was composed of 13 vessels of individual capacity >800 t, which all represented a total carrying capacity >13,000 t of tuna. The total cumulated nominal effort exerted during the year was 3,673 and 3,185 fishing and searching days, respectively. The French purse seiners cumulated a total of more than 2,800 fishing sets, with 1 third made on free-swimming schools (FSC) and 2 third realised on schools associated with fish aggregating devices (FADs). The total annual landings of the principal market tunas by the French purse seine fishing fleet has remained very stable during 2010-2013, with a total of 66,000 t landed in 2013. The landings were composed of more than 55%, 33%, and 10% yellowfin, skipjack, and bigeye, respectively. Catch on FADs increased by 36% between 2012 and 2013 to reach more than 46,000 t. The proportion of yellowin in FAD-catch has strongly increased in the recent years and reached 45% in 2012-2013. The total number of sets per searching day on both fishing modes has been decreasing in the recent years and reached a low value <0.9 in 2013. Skipjack catch per positive set on FADs strongly decreased in the recent years concomitantly with an increase in yellowfin catch per set. The catch of large yellowfin per positive set on FSC has shown an increase in the recent years to reach 39 t in 2013. Landings of damaged and small-sized tunas as well as other marine species incidentally caught as bycatch in the French purse seine fishery on the local markets of Madagascar and Seychelles were estimated to be low at about 230 t y^{-1} during 2011-2013. They were predominated by a combination of small tunas and various tuna-like species of length <45 cm. In 2013, the total estimated bycatch discarded at sea, based on a raising ratio of total trips over observed trips, reached 3,850 t, i.e. 5.8% of the 66,000 t of the principal market tunas landings. Some emblematic species were found to be incidentally caught in the fishery and generally released with high levels of survival.

KEYWORDS: fish aggregating device, *Katsuwonus pelamis*, *Thunnus albacares*, *Thunnus obesus*

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1. Introduction

French purse seiners operating in the Indian 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) schools and free-swimming schools (FSC). Statistical data for the French purse seine (PS) fishing fleet have been collected by the "Institut de Recherche pour le Développement" (IRD) in collaboration with the Seychelles Fishing Authority (SFA) since the arrival of the first purse seiners in the Indian Ocean in the early 1980s. In addition, a fisheries observer program has been implemented in the Indian Ocean since 2005 to monitor the bycatch and discards-at sea of the French purse seine fleet. More recently, a data collection system has been developed at Victoria (Seychelles) and Antsiranana (Madagascar) to monitor the landings of the purse seine fleet destined to the local markets. The French PS 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 2013. Information is given on the size and species composition of the bycatch observed at sea and at unloading

2. Materials & Methods

2.1 Data collection

The current data collection system is composed of 3 major components that give an overview of the different fishing activities of the purse seine fleet. First, the collection of all logbooks and landing reports is done in collaboration with the fishing companies. French purse seine logbooks are similar between companies and follow the standards defined by the IOTC. They include information on the position, date, fishing activities (route, fishing set, fishing mode, etc.), and environmental conditions associated with each activity (e.g. sea surface temperature). French purse seiner logbooks have been modified since January 2013 to include information on activities related to the use of GPS buoys and FADs (e.g. deployment, retrieval, etc.). Data related to such activities have been recorded in the IRD information system from October 2013 due to the time required for extending the data collection software 'AVDTH' (Acquisition et Validation des Données de pêche au THon tropical) currently in use (Le Chauve 1999). The collection of FAD and buoy data for the French purse seine fleet is considered to be operational since January 2014 and information collected from this source is presented elsewehere (Chassot et al. 2014a). In addition, landing reports give the detail of the sale of the principal market tunas to the canneries by commercial category and are collected at the scale of the fishing trip.

Second, sampling operations are made during the unloading of the purse seiners at fishing ports to estimate both size and species composition of the catch. The current sampling protocol was established during the European project "Analyse du schéma d'échantillonnage multispécifique des thonidés tropicaux" (Pallarés and Hallier 1997). The sampling protocol is common to all European vessels and associated flags, including Seychelles. It is a simultaneous sampling to estimate both size and species composition of the catch following a given sampling design. The current strata considered to represent homogenous species and size composition were defined during the 'ET' project based on fishing mode (i.e. FAD or FSC), quarter, and large spatial areas (Pallarés and Hallier 1997). FAD is used here to describe any type of floating object used for increasing tuna catchability. This includes natural objects (e.g. logs, palm branches) and anthropogenic floating objects, such as man-made bamboo rafts equipped

with radio-range beacons, satellite transmitters or scanning sonars. Fishing sets made on whales were classified as free-swimming school sets whereas sets made on whale sharks (*Rhincodon typus*) were classified as FAD sets (Pallarés and Hallier 1997). The sampling is made during the unloading of the purse seiners at fishing ports and consists in a 2-step approach: (i) the wells are selected from among those containing homogeneous strata and (ii) fishes are randomly collected, within size category, from the wells and counted and/or measured following a specific protocol. Samples combined with species-specific length-weight relationships are then used to estimate the size and species composition of the catch in each stratum. In 2013, a total of 315 samples was made aboard French and Mayotte purse seiners, corresponding to about 120,000 tunas identified and measured.

Third, two different monitoring systems have been set in place to establish estimates of bycatch quantities for the French PS fleet. Bycatch is made of individuals of principal market tunas with length and/or state not adequate for commercialization and of untargeted species incidentally caught. Bycatch individuals may be commercialized on local market when this market exists or can be discarded at sea, dead or alive. Several purse seine fisheries observer programmes have been implemented in the 1980s and 1990s in the Indian Ocean, with a main focus on the principal market tunas (Karpinski 1988, Montaudoin et al. 1990, Sabadach and Hallier 1993) and the marine species associated with tuna schools (Petit 1994, Coulmance 1995, Stretta et al. 1998). Since 2005, a fisheries observer program has started with the main objective of monitoring bycatch and discards-at sea (Chavance et al. 2012). In addition, a routine port sampling program dedicated to the estimation of landings of bycatch on local markets has started in 2000 and 2011 in the Seychelles and Madagascar, respectively. Sampling is done for each landing by dedicated port samplers using a protocol described by Chavance et al. (2011). Local market in East Africa is not as important as in West Africa but it has some importance in the major landing ports of Antsiranana (Madagascar) and Victoria (Seychelles). Only results for these two ports are presented thereafter.

2.2 Data processing

The current sampling protocol, strata, and algorithms used for the lobgbook data processing were established during the European project "Analyse du schéma d'échantillonnage multispécifique des thonidés tropicaux" (Pallarés and Hallier 1997). Overall, the processing aims to adjust the tropical tuna catch to the landings and estimate the size and species composition of the catch based on large sampling areas, fishing mode, and quarter (Pallarés and Petit 1998). The estimation of the size and species composition relies on the merging of all size samples collected aboard European and associated flags purse seiners. Consequently, the size structure of the catch is given for the whole European fishery in a companion paper (Chassot et al. 2014b). Fishing time (expressed in days) is computed from logbook information and by considering that purse seiners are only fishing during daytime, i.e. 13 hours a day on average in the Indian Ocean. Searching time was computed by subtracting the time spent setting the gear from the fishing time. The time spent setting the gear was estimated by regressions linking duration and size of sets, from at sea measurements made by scientific observers. The spatial distribution of the effort was estimated by evenly allocating the fishing/searching time to the position(s) of fishing sets on a daily basis.

Productions sold on local market are a compilation of quantities estimated and weighed by port samplers during the unloading of each purse seiner or cargo. For species landed in bulk, a visual estimation of the species composition is made through a sub-sampling of the landings intended to be random. The

total weight of the landings is either obtained from weight estimates available through a weighbridge or computed as the product between the number of fish containers (vehicle, bag, scow, etc.) and a standard reference weight by container. Species identification and length measurements are made onboard vessels before unloading for 200 individuals taken randomly within individuals destined to local market. Between 2,000 and 4,000 individuals are measured annually (Fig. 1).

For observations at sea, raising procedures were made based on a selection of fishing trips during which all sets were sampled and the observed to total trip ratio. This method is considered simple and robust enough for 3 main reasons: (i) trips are used as the statistical unit because observers are onboard for a full trip, (ii) observed trips are shared among the whole fleet that is fairly homogeneous in size, and (iii) observed trips are spread over all the quarters (Table 14) (Amandè 2012a). Raising bycatch levels has been shown to be biased for low-occurrence species (Amandè 2012a). Here, the extrapolation followed two computation steps. First, when species annual occurrence was lower than 4%, the species was grouped at the family level. Second, only species or families reaching 4% of annual occurrence were kept as specific categories while the others were gathered in an "Others" category within each species group (Tunas, Other Fishes, Billfishes, Sharks). These groups and their species composition are indicated in Table 15. Statistics relative to catch of emblematic species or species under specific resolution are indicated in numbers of individuals with estimates of survival when released at sea.

3. Fishing capacity and effort

3.1 Fishing fleet

In 2013, the French purse fleet was composed of 13 vessels of capacity >800 t that corresponded to an overall carrying capacity >13,000 t (Fig. 2 and Table 1). The total number of active vessels has shown a decreasing trend over time, from a maximum of 26 (23 when weighted by months-at sea) in 1985 to a minimum of about 13 in the recent years, with a notable increase observed during 2006-2008 (Fig. 3). Meanwhile, the individual purse seiner carrying capacity has increased, which resulted in the overall capacity of the fleet to remain fairly constant during 1984-2013 at a mean of 14,000 t (SD = 1,600 t). The exceptional increase in the number of vessels and associated capacity during 2006-2008 was due to the arrival of several purse seiners from the Atlantic Ocean. This could be mainly explained by the high catch rates observed in the Indian Ocean during 2003-2005 that were twice as observed in the Atlantic. Lower catch rates that became very similar between oceans during 2006-2008 combined with piracy threat may have implied a reallocation of the purse seine effort in the Atlantic Ocean from 2009 (Chassot et al. 2010).

3.2 Fishing effort

The total nominal fishing effort, expressed in fishing and searching days, showed an overall decreasing trend over time during 1984-2013, similar to the number of vessels, with the notable major increase during 2006-2008 (Fig. 4 and Table 2). In the recent years, the effort has shown an increase by more than 20% between 2010 and 2013. In 2013, the total nominal effort was 3,673 and 3,185 fishing and searching days, respectively. The fishery was located in the western part of the Indian Ocean in 2013, ranging from 20°S in the Mozambique Channel to a maximum of about 10°N, at the latitude of the horn of Africa, and from 40°E along the coasts of Mozambique and Tanzania, to 70°E (Fig. 5). While the extent of the

fleet fishing grounds where some effort was exerted has decreased since 2008 from a maximum of about 400 to less than 300 squares of 1° latitude and longitude, it strongly increased in 2013 to reach more than 400 squares (Fig. 6 and Table 3).

3.3 Fishing sets

The total annual number of fishing sets has remained stable during 2009-2013 at about 3,000 (SD = 154), with about 75% of the sets being successful during this period (Fig. 7 and Table 4). In 2013, 2/3 of all sets made by the French purse seine fleet, i.e. 1860, were realised on FAD-associated schools, with a proportion of success close to 88%. While the year 2012 was characterized by a 50-50 balance between fishing modes, the year 2013 appeared similar to 2009-2011 in terms of dominance of FAD-fishing.

4. Fisheries production

4.1 Fishery landings

The total annual landings of the French purse seine fishing fleet for the principal market tunas has remained very stable during 2010-2013 at an average of 67,000 t (SD = 1,850 t) (Fig. 8 and Table 5). In 2013, the landings were composed of more than 55%, 33%, and 10% yellowfin, skipjack, and bigeye, respectively. Albacore represented less than 1% of the catch. Catch on FADs increased by 36% in 2013 to reach more than 46,000 t (Fig. 9a and Table 6). The proportion of YFT in FAD-catch has strongly increased in the recent years, from about 25% in 2009 to 45% during 2012-2013. In 2013, YFT predominated in FAD catch for the first time in the history of the fishery. Catch made on free-swimming schools decreased by more than 40% between 2012 and 2013 and yielded about 20,000 t, with YFT representing 80% of the catch (Fig. 9a and Table 7). Overall, the decrease in FSC catch between 2012 and 2013 was fully compensated by the increase in FAD catch, resulting in a decrease of YFT (-15%), and an increase in SKJ (+28%) and juveniles of BET (+37%).

4.2 Catch rates

The total number of sets per searching day (cumulating both fishing modes) has shown an increasing trend during 1981-2008 (adjusted Pearson's R = 0.67, <0.001, slope = +0.016). Since then, it has been decreasing and reached a low value <0.9 in 2013, i.e. lower than the levels observed during the El Niño event of 1997-1998. The number of sets per searching day on FAD-associated schools showed an increasing shift from an average value of about 0.37 set d^{-1} (SD = 0.09 set d^{-1}) during 1981-1993 to an average value of 0.55 set d^{-1} (SD = 0.05 set d^{-1}) during 1994-2008 (Fig. 13a). The number of sets on FAD per searching day was high during 2009-2011, concomitantly with low values of sets per day on FSC, while it decreased to values <0.6 set d^{-1} in 2012-2013. With the exception of 2012, the number of sets on free-swimming schools per searching day has strongly decreased since 2005 (the maximum value observed of 0.89) to reach a minimum value of 0.3 set d^{-1} in 2013 (Fig. 13b).

The total catch per positive set on FADs decreased from high values (average of more than 36 t set^{-1}) during 1999-2006 to an average of 28 t set^{-1} (SD = 2 t set^{-1}) during 2007-2014 (Fig. 13c). SKJ catch per positive set strongly decreased from maximum values of more than 27 t in 2002 to less than 13 t

in 2012-2013. Meanwhile, YFT catch per positive set showed some strong interannual variations during 1991-2013 with an underlying increasing trend, the period 2011-2013 being described by values >12.6 t set^{-1}. The catch per positive set on FSC has shown an increase in the recent years, from 32.3 t in 2009 to more than 39 t in 2013 (Fig. 13d). Values of YFT catch per positive set averaged around 31.7 t (SD = 3.7 t) during 2010-2013.

4.3 Local markets

A little less than a hundred species or species categories have been encountered during purse seine fishing observer programmes in the Indian Ocean (Table 18). Bycatch landed and commercialized on the local markets of Antsiranana and Victoria fluctuated around 230 t annually between 2011 and 2013 (Fig. 14). While local market landings are growing and are concentrated during the fishing season of the Mozambique Channel (March-June) in Madagascar, landings in Victoria have been evenly spread all over the year and slightly decreased in the recent years. Species composition has been dominated by tuna-like species which represented 74% of the total weight landed during 2011-2013 (Fig. 15). Skipjack and yellowfin sold on local markets are individuals of modal size around 35 cm F_L (Fig. 16). *Auxis* spp. and bigeye tunas have modal size slightly higher, reaching 40-45 cm F_L.

4.4 Discards at sea

Discards at sea in the French purse seine fishery are predominated by small tunas and represent small amounts of catch relative to the fleet landings. The total quantities discards (dead or alive) by the French purse seine fishery are estimated to 3,850 t, representing 5.8% of the landings in 2013 (Table 16). The main species discarded at sea are tunas predominated by skipjack (21%) and yellowfin (16%). Tuna discards mainly occur for size reason with most fishes measuring <50 cm F_L (i.e. ∼2.5 kg) (Fig. 20). Albacore appear to be discarded at bigger sizes, but very seldomly (Table 16). Emblematic species such as cetaceans, turtles and endangered shark species can be caught in the French purse seine fishery but they are generally released alive. Estimates of survival rates after release suggest high rates of survival for turtles and cetacean species and some for shark species (Table 17).

Acknowledgments. We thank ORTHONGEL, TAFF (Terres Australes et Antarctiques Françaises), Oceanic Développement, fishing companies, scientific observers, and all past and current personnel for helpful assistance in data collection and management. Sampling operations in Victoria were conducted in 2013 by J Esparon, A Pascal, A Stephen and R Rose. Data entry was assured by M Adeline and B Jean. Data processing of tuna fisheries data was conducted through close collaboration with SFA and IEO. This work was financed by the European Data Collection Framework (DCF, Reg 199/2008 and 665/2008) and the French "Direction des Pêches Maritimes et de l'Aquaculture" (DPMA). Part of the observer data were collected under the regional observer program OCUP (Observateur Commun, Unique et Permanent) financed by ORTHONGEL and French fishing companies.

5. Figures

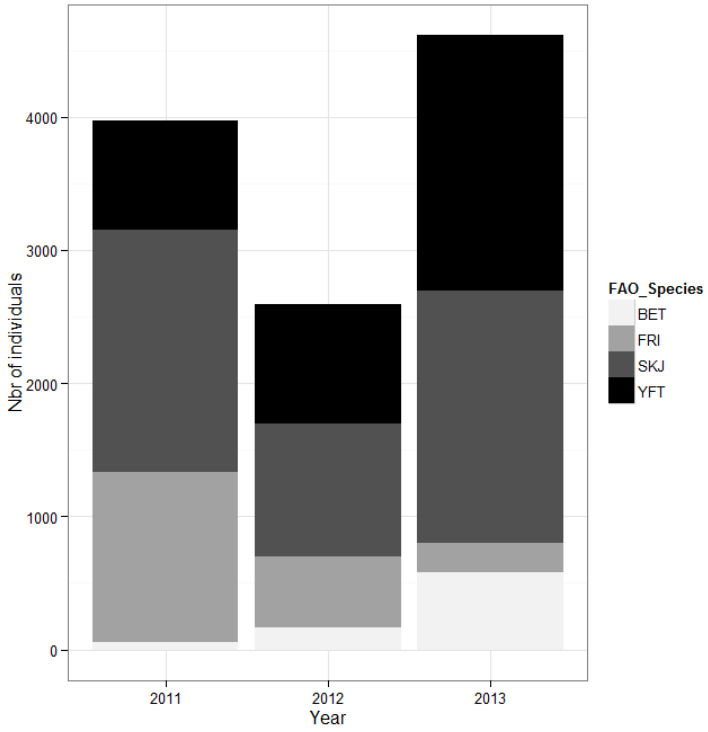

Figure 1: Number of individuals measured by species among the fish landed in Seychelles and Madagascar and commercialized on the local market during 2011-2013

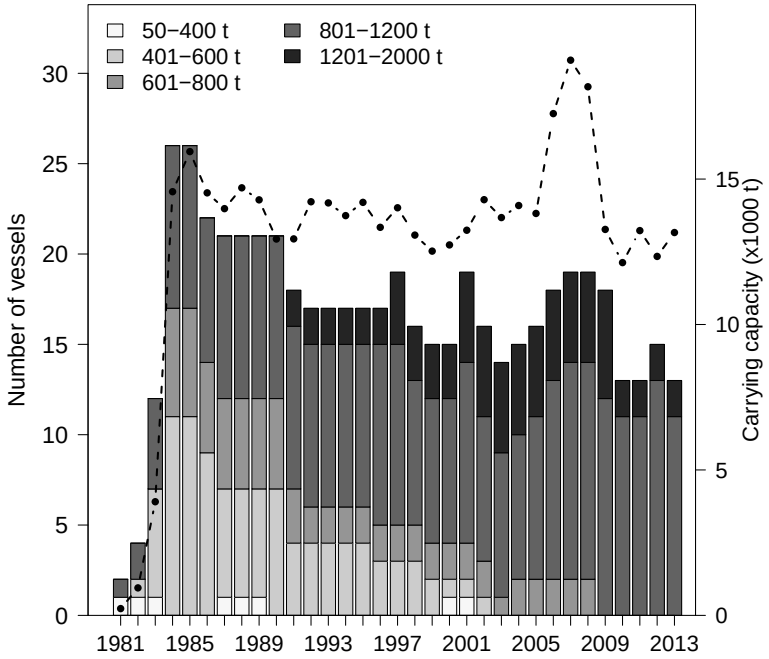

Figure 2: Fishing capacity of the French purse seine fishing fleet in the Indian Ocean. Annual changes in the number of purse seiners by size category (barplots) and total carrying capacity (solid line with circles) during 1981-2013. Capacity was weighted by the vessel-specific proportion of the year at sea (in months). The vessel size category (t) was computed as 0.7 times the capacity expressed in m^3

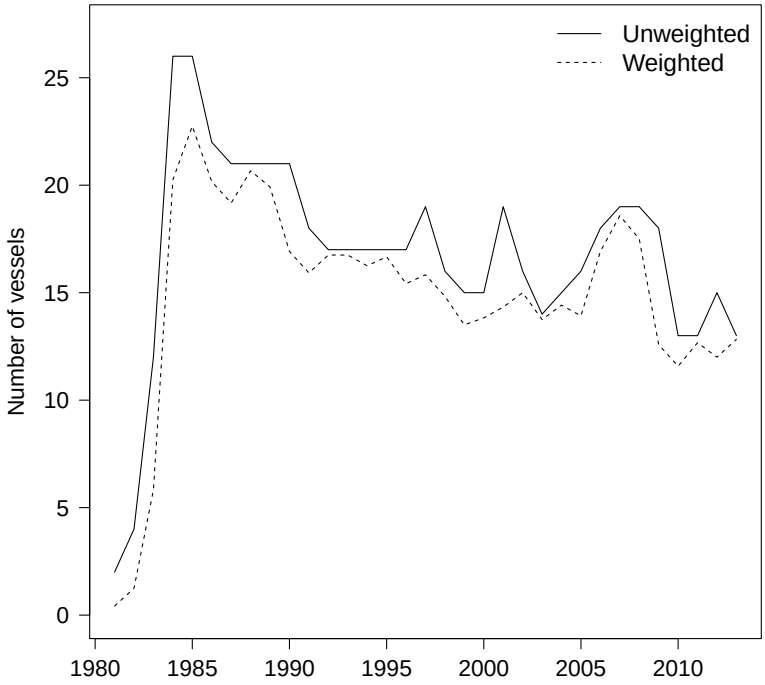

Figure 3: Number of active vessels in the French purse seine fleet. Annual total number of French purse seiners in the Indian Ocean during 1981-2013. Weighted indicates that the number of purse seiners was weighted by the vessel-specific proportion of the year at sea (in months)

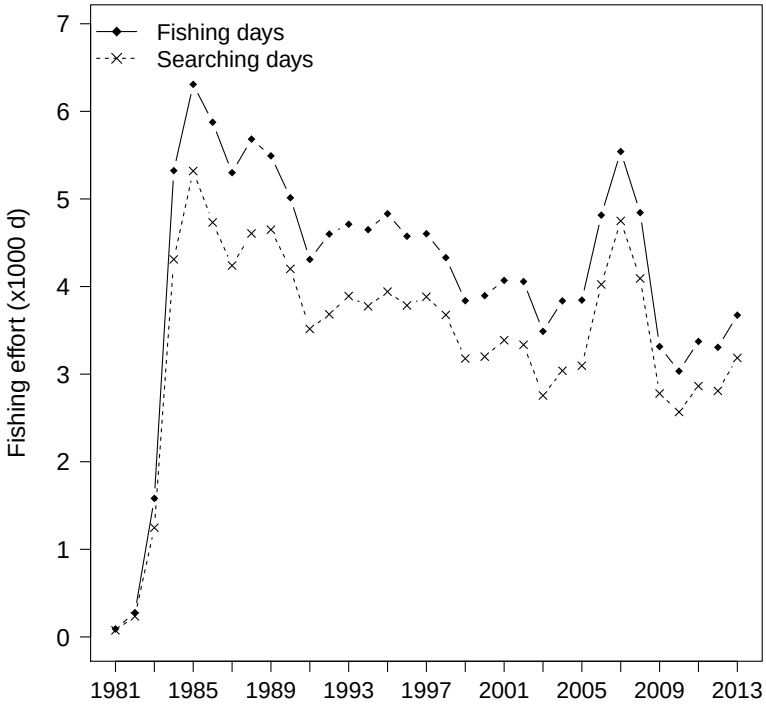

Figure 4: Changes in nominal effort over time. Annual total number of fishing and searching days for the French purse seine fishing fleet in the Indian Ocean during 1981-2013

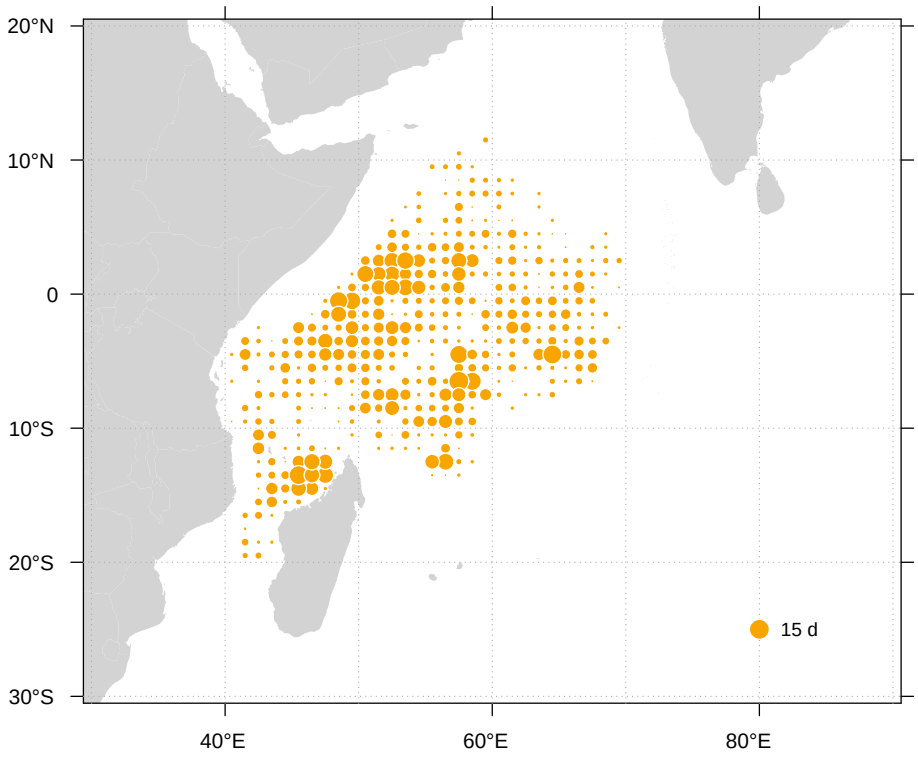

Figure 5: Fishing grounds. Spatial distribution of fishing effort (in searching days) of the French purse seine fishing fleet in 2012

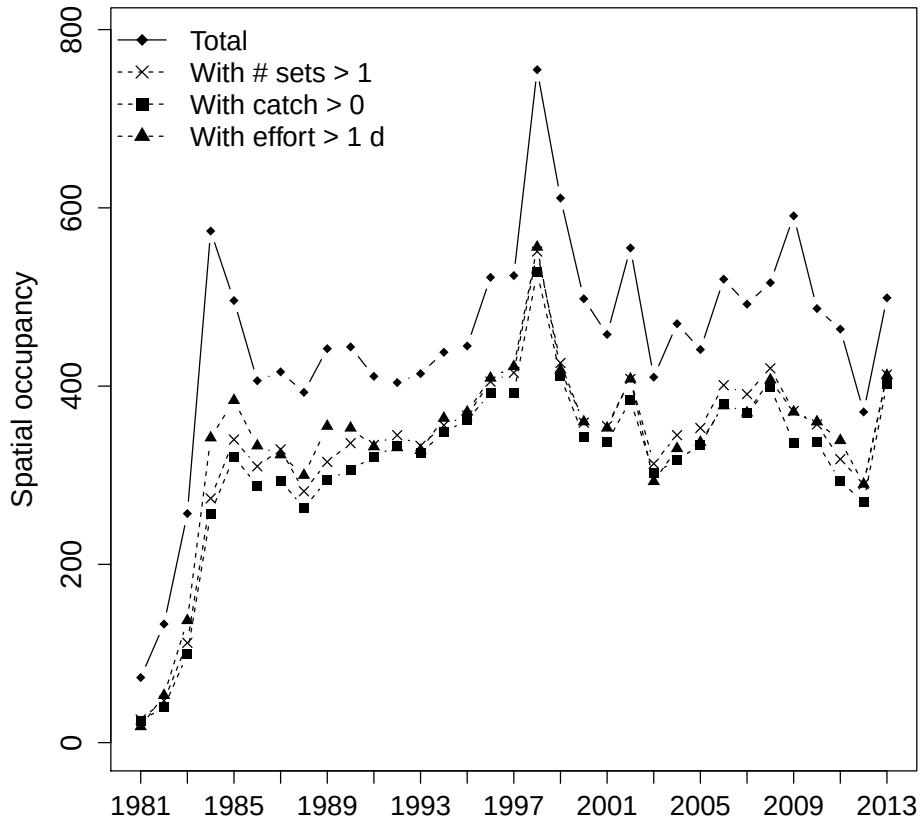

Figure 6: Changes in spatial extent of the fishery over time. Mean annual number of 1-degree squares explored by each vessel of the French purse seine fishing fleet during 1981-2013. Solid line indicates standard deviation. Only vessels in activity during 12 months were selected. A loess function was fitted to the data to illustrate the trend

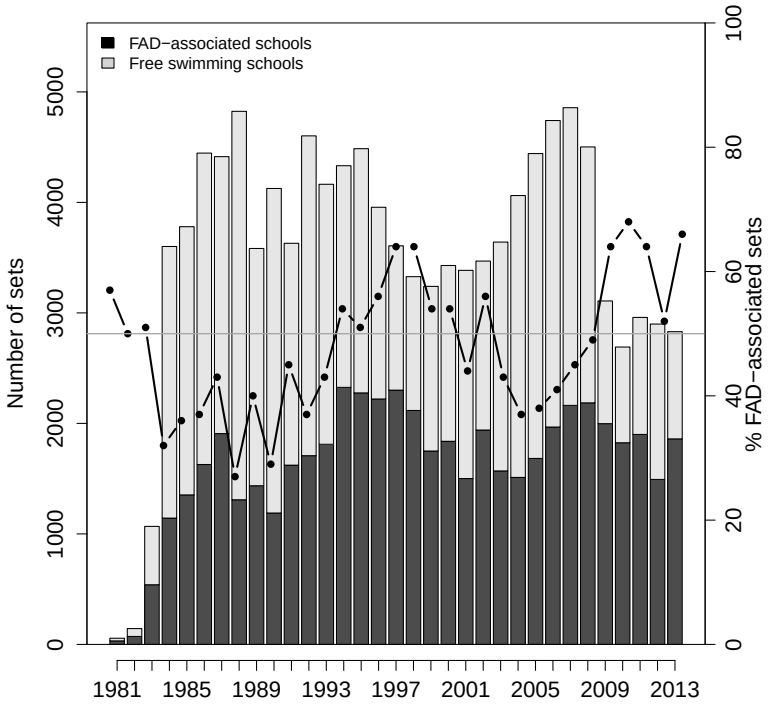

Figure 7: Fishing operations. Annual number of fishing sets in the French purse seine fishery on FAD-associated and free-swimming schools during 1981-2013. Line with solid circles indicates the percentage of sets made on FAD-associated schools over free-swimming schools. Grey solid line indicates the 50% value

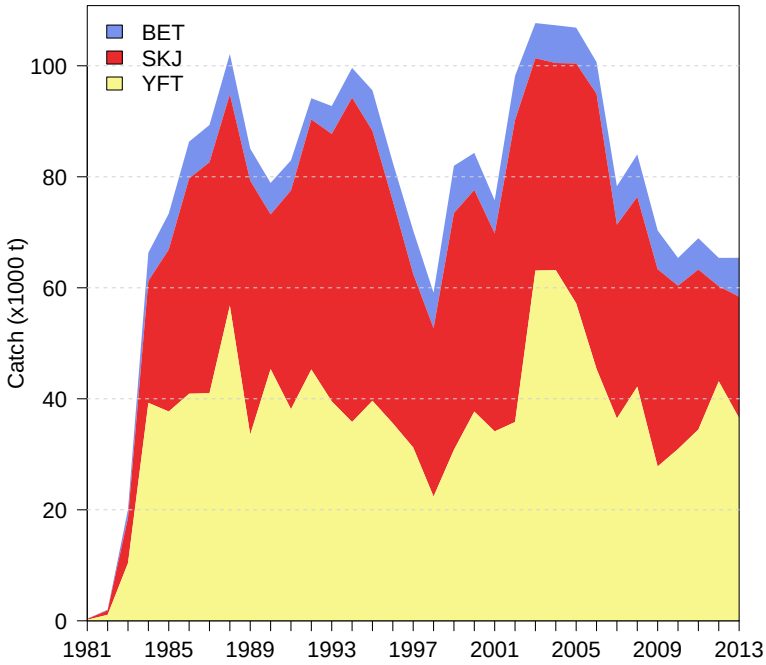

Figure 8: Total fishery production. Catch by species of the French purse seine fishing fleet during 1981-2013

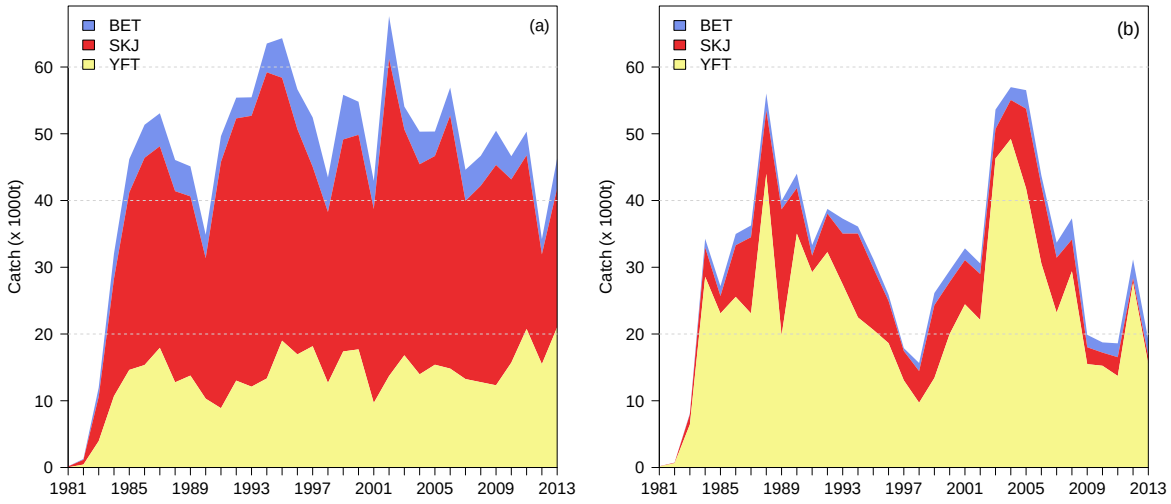

Figure 9: Fishery production by major fishing mode. Catch by species of the French purse seine fishing fleet on (a) FAD-associated and (b) free-swimming schools during 1981-2013

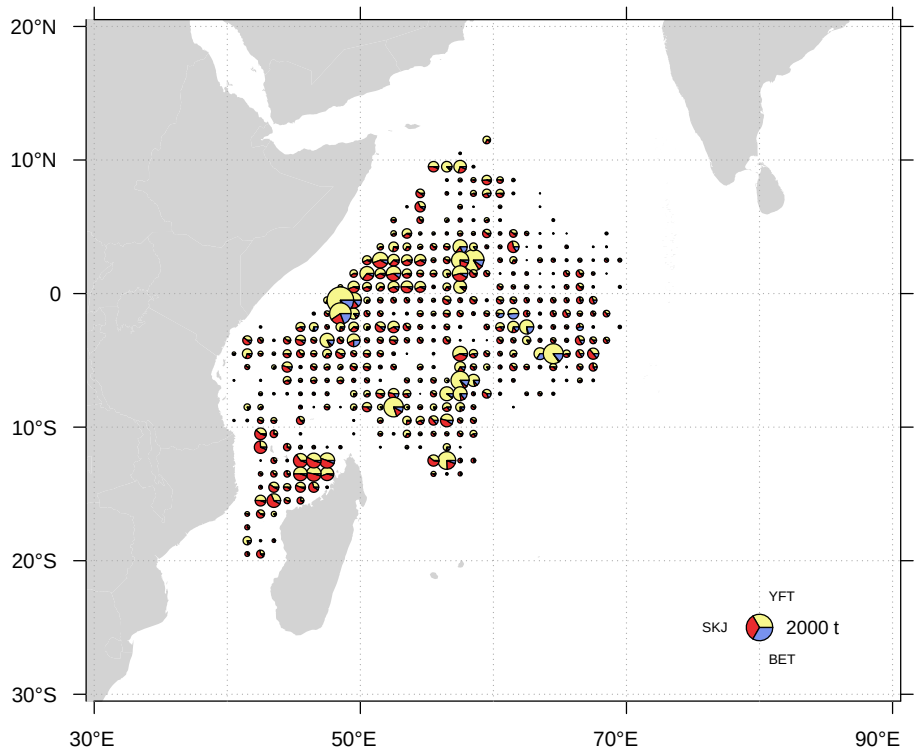

Figure 10: Spatial distribution of tuna catches of the French purse seine fishing fleet in 2012

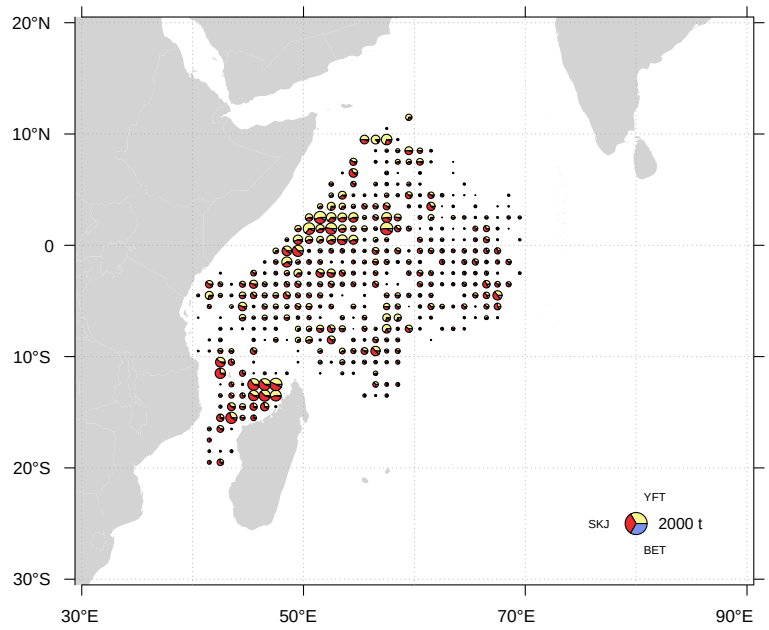

Figure 11: Spatial distribution of tuna catches of the French purse seine fishing fleet made on FAD-associated schools in 2012

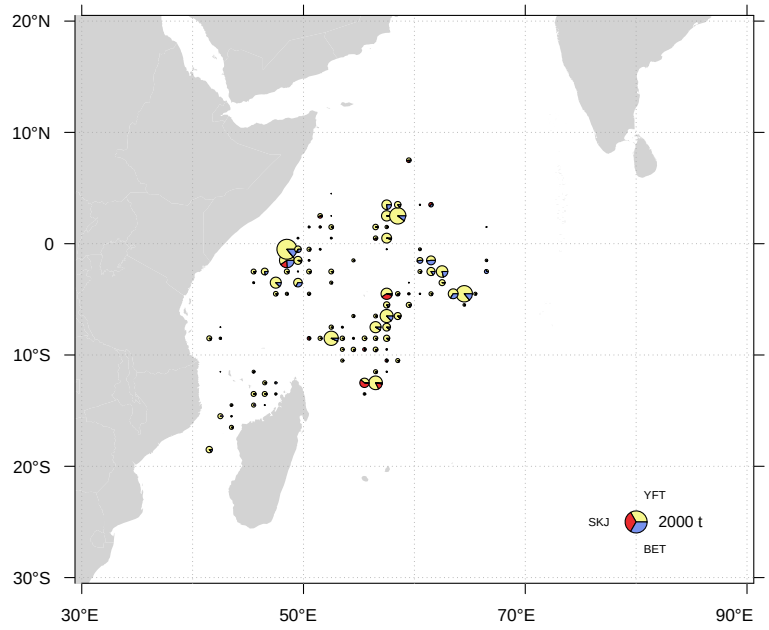

Figure 12: Spatial distribution of tuna catches of the French purse seine fishing fleet made on FSC-associated schools in 2012

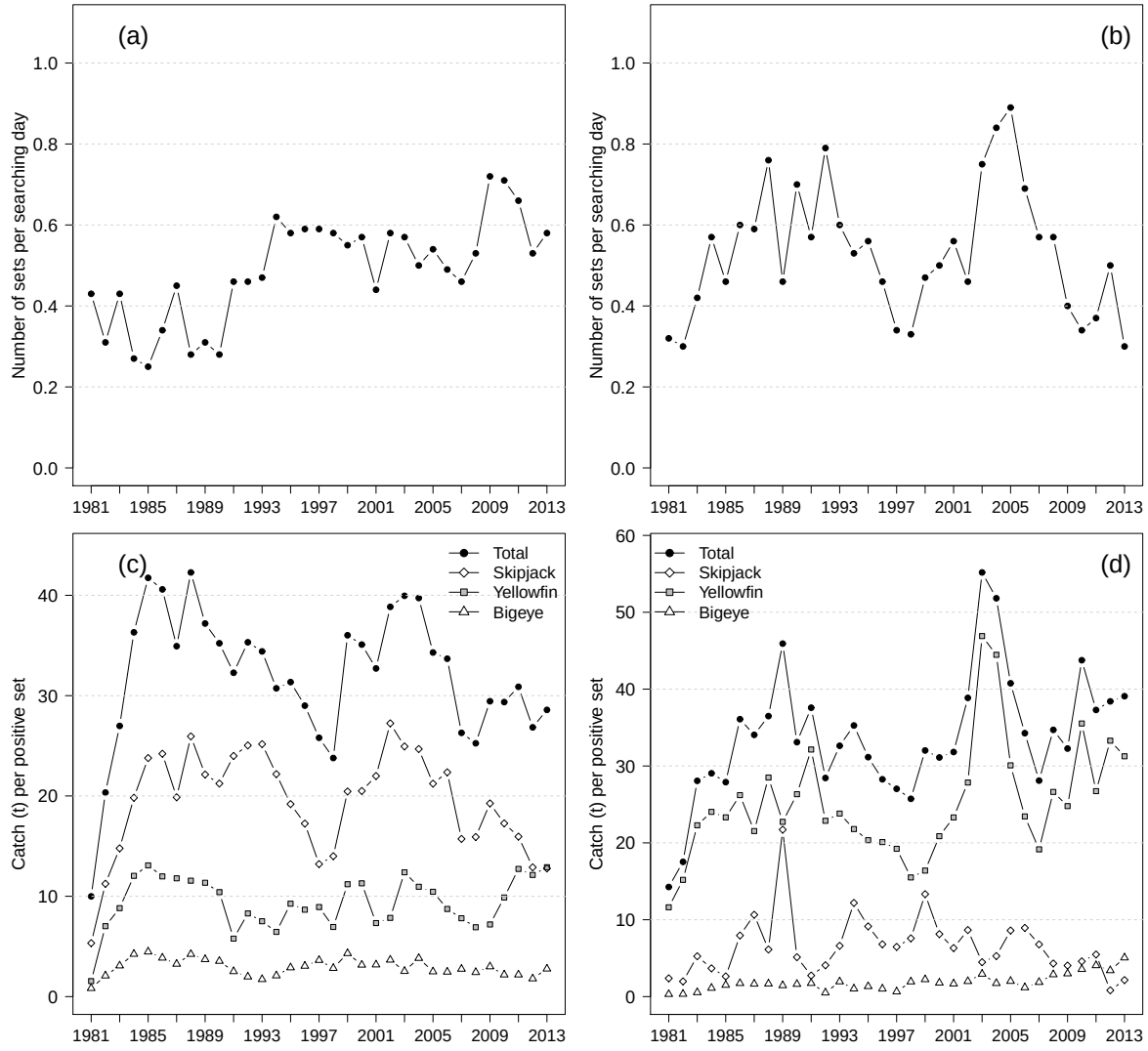

Figure 13: (a-b) Annual number of sets per searching day and (c-d) catch per positive set on (left panel) FAD-associated and (right panel) free-swimming schools for the French purse seine fishing fleet in the Indian Ocean during 1981-2013

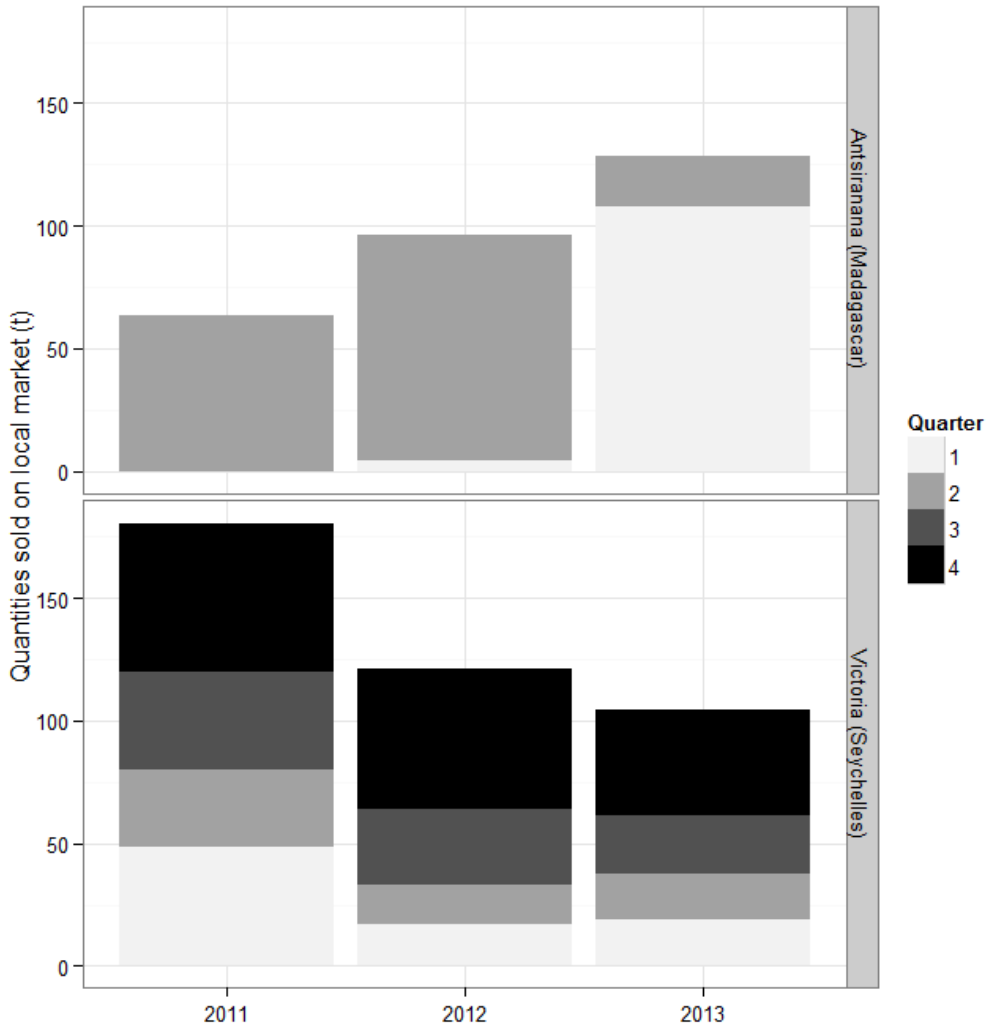

Figure 14: Quarterly estimates of quantities (t) landed by the French PS fleet and commercialized on the local markets of Antsiranana (Madagascar) and Victoria (Seychelles)

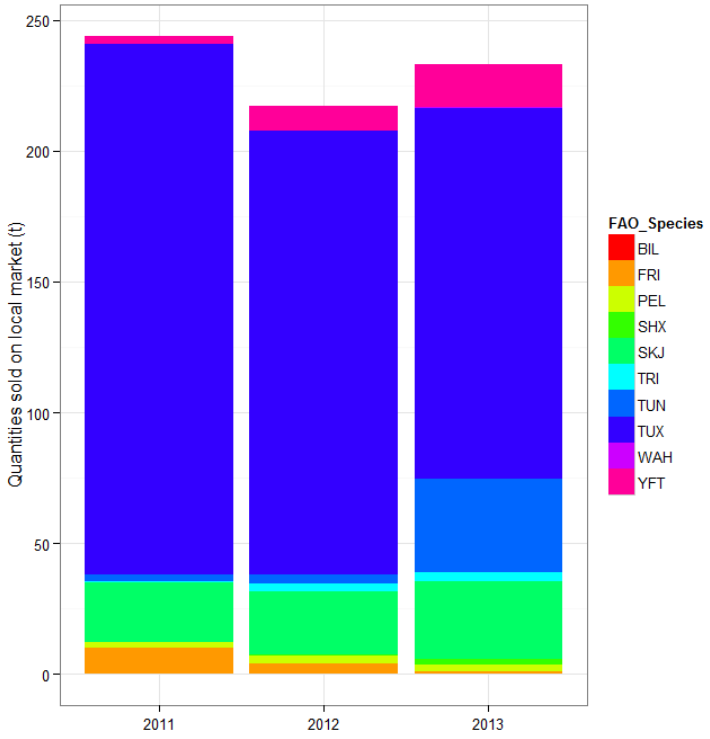

Figure 15: Estimates of total landings (t) by species commercialized on the local markets of Victoria (Seychelles) and Antsiranana (Madagascar) during 2011-2013

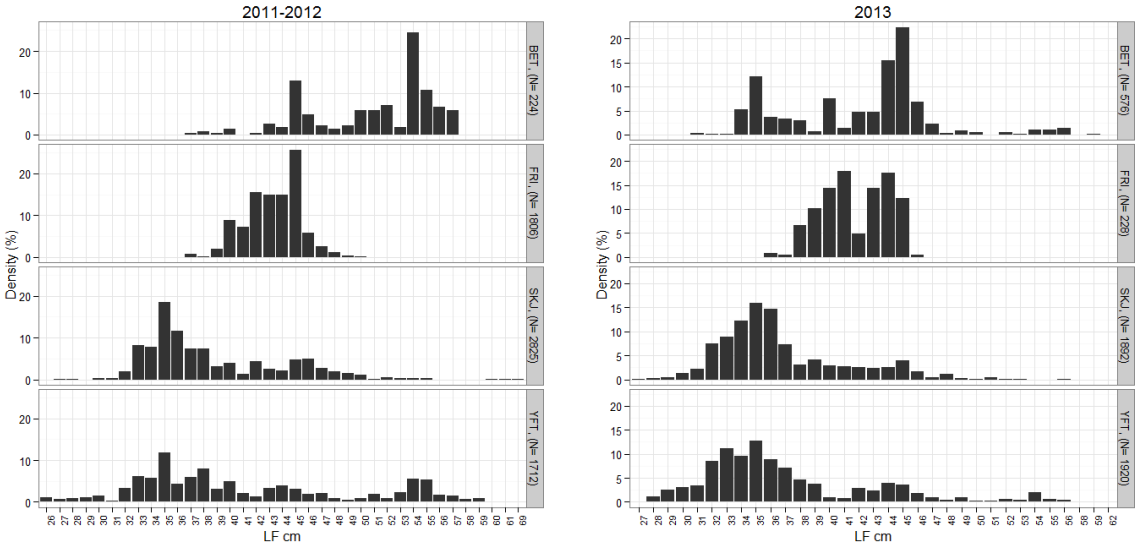

Figure 16: Size-density histograms of the main tuna species landed in Seychelles and Madagascar and commercialized on the local market in 2011-2012 (left panel) and 2013 (right panel). N indicates the number of fish measured

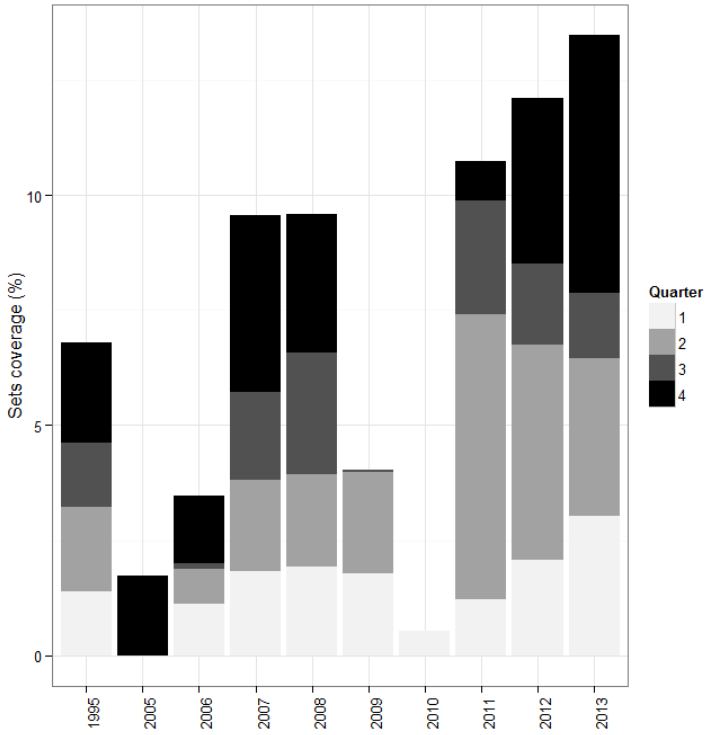

Figure 17: Coverage of the French purse seine observer programme in 1995 and 2005-2013. Percentage of sets observed by quarter and year in the fishery

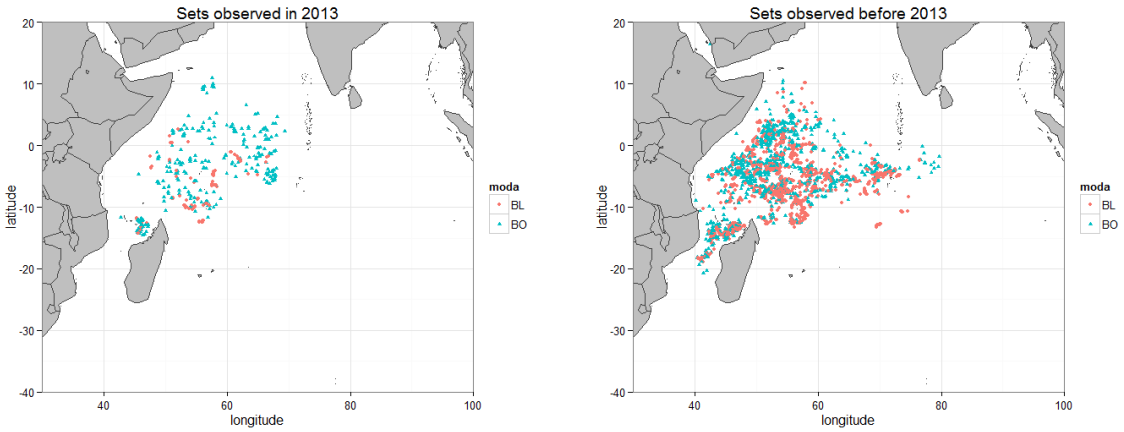

Figure 18: Spatial distribution of French purse seine fishing sets observed in 2013 and before 2013. *BL* = Free-swimming school; *BO* = FAD-associated school

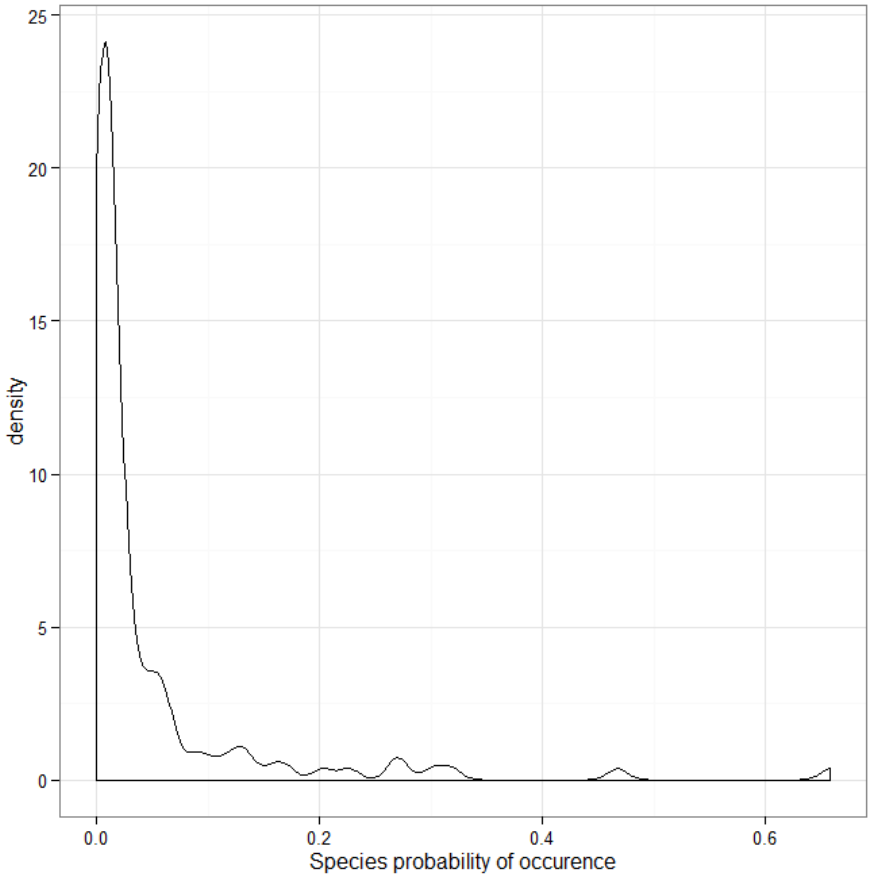

Figure 19: Annual mean probability of occurrence of species in observer programmes and indication of a “rarity threshold near 4%. Source: Observer data 2006-2014 for Indian and Atlantic Oceans

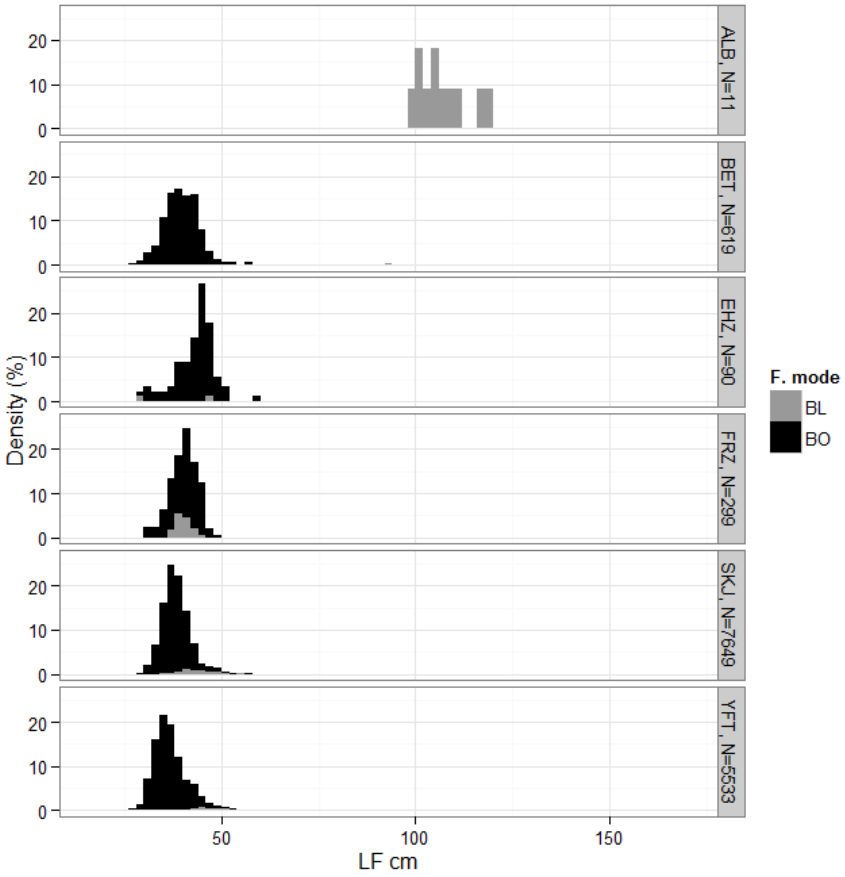

Figure 20: Size-density histograms of tunas discarded-at sea by the French purse seine fleet in 2013 in the Indian Ocean. N indicates the number of fish measured. BL = Free-swimming school; BO = FAD-associated school; LF = Fork length

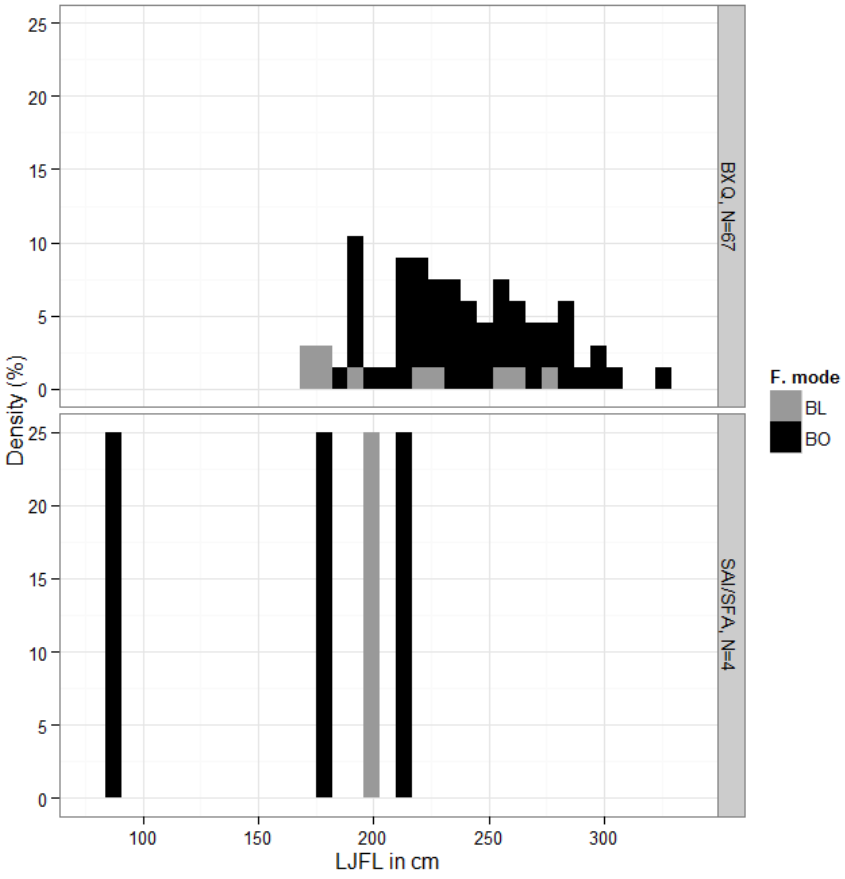

Figure 21: Size-density histograms of billfish discarded-at sea by the French purse seine fleet in 2013 in Indian Ocean. N indicates the number of fish measured. BL = Free-swimming school; BO = FAD-associated school; $LJFL$ = Lower-Jaw-Fork-Length

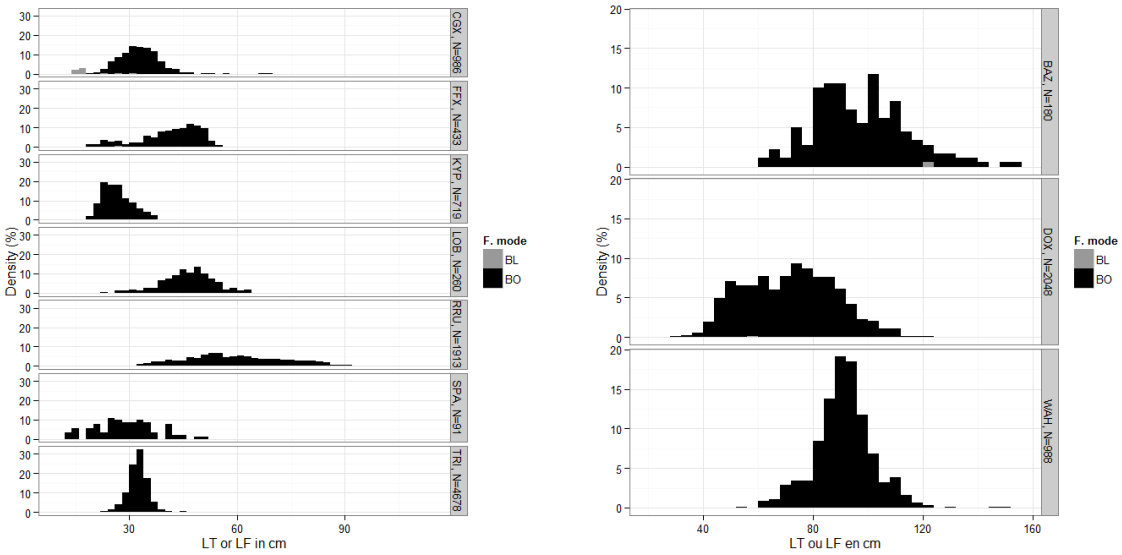

Figure 22: Size-density histograms of other fish species discarded-at sea by the French purse seine fleet in 2013 in the Indian Ocean. (Left panel) Fishes of maximum fork length or total length <1 m (Right panel) Fishes of maximum fork length or total length >1 m. N indicates the number of fish measured; LF = Fork length; LT = Total length

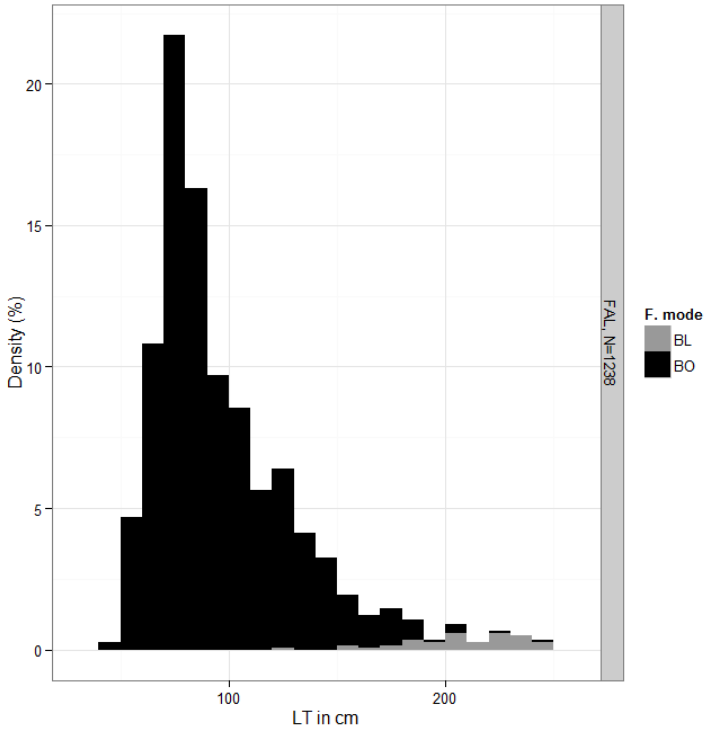

Figure 23: Size-density histograms of silky shark (*Carcharhinus falciformis*) discarded-at sea by the French purse seine fleet in 2013 in the Indian Ocean. N indicates the number of fish measured. LT = Total length

6. Tables

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 Indian Ocean during 1981-2013. N = Total number of purse seiners having operated at least 1 day. N_w = Total number of purse seiners weighted by the proportion of months of activity. CC = Total carrying capacity weighted by the proportion of months at sea

Year	50-400	401-600	601-800	801-1200	1201-2000	>2000	N	Nw	CC
1981	1	0	0	1	0	0	2	0	233
1982	1	1	0	2	0	0	4	1	945
1983	1	6	0	5	0	0	12	6	3907
1984	0	11	6	9	0	0	26	20	14566
1985	0	11	6	9	0	0	26	23	15945
1986	0	9	5	8	0	0	22	20	14526
1987	1	6	5	9	0	0	21	19	13983
1988	1	6	5	9	0	0	21	21	14699
1989	1	6	5	9	0	0	21	20	14285
1990	0	7	5	9	0	0	21	17	12939
1991	0	4	3	9	2	0	18	16	12943
1992	0	4	2	9	2	0	17	17	14220
1993	0	4	2	9	2	0	17	17	14180
1994	0	4	2	9	2	0	17	16	13743
1995	0	4	2	9	2	0	17	17	14199
1996	0	3	2	10	2	0	17	15	13341
1997	0	3	2	10	4	0	19	16	14013
1998	0	3	2	8	3	0	16	15	13074
1999	0	2	2	8	3	0	15	14	12523
2000	1	1	2	8	3	0	15	14	12736
2001	1	1	2	10	5	0	19	14	13241
2002	0	1	2	8	5	0	16	15	14291
2003	0	0	1	8	5	0	14	14	13676
2004	0	0	2	8	5	0	15	14	14090
2005	0	0	2	9	5	0	16	14	13818
2006	0	0	2	11	5	0	18	17	17250
2007	0	0	2	12	5	0	19	19	19087
2008	0	0	2	12	5	0	19	18	18173
2009	0	0	0	12	6	0	18	13	13269
2010	0	0	0	11	2	0	13	12	12128
2011	0	0	0	11	2	0	13	13	13228
2012	0	0	0	13	2	0	15	12	12341
2013	0	0	0	11	2	0	13	13	13162

Table 2: Annual nominal fishing effort of the French purse seine fishing fleet expressed in fishing and searching days during 1981-2013. 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
1981	91	75
1982	277	235
1983	1582	1247
1984	5323	4310
1985	6308	5319
1986	5876	4732
1987	5300	4240
1988	5683	4606
1989	5492	4649
1990	5013	4202
1991	4309	3516
1992	4599	3683
1993	4711	3891
1994	4649	3774
1995	4831	3942
1996	4574	3784
1997	4603	3883
1998	4330	3676
1999	3838	3178
2000	3896	3200
2001	4070	3387
2002	4057	3335
2003	3488	2756
2004	3836	3039
2005	3845	3096
2006	4815	4024
2007	5541	4749
2008	4844	4092
2009	3315	2779
2010	3034	2568
2011	3373	2863
2012	3306	2809
2013	3673	3185

Table 3: Annual number of 1-degree squares explored by the French purse seine fishing fleet during 1981-2013. #sets indicates squares where a least 1 fishing set was made.

Year	TOTAL	#sets	Catch >0	Effort > 1 d	Effort > 5 d
1981	73	26	24	18	
1982	133	47	40	53	10
1983	257	112	99	137	60
1984	574	274	257	342	182
1985	496	340	321	384	267
1986	406	310	288	333	223
1987	416	329	294	323	206
1988	393	282	263	300	210
1989	442	315	295	355	229
1990	444	336	306	353	215
1991	411	334	321	332	203
1992	404	345	333	331	198
1993	414	333	325	328	218
1994	438	356	348	364	231
1995	445	367	362	371	232
1996	522	405	392	409	245
1997	524	415	392	422	258
1998	755	551	528	556	245
1999	611	426	411	418	196
2000	498	359	343	360	201
2001	458	355	337	353	219
2002	555	408	384	408	237
2003	410	313	302	293	186
2004	470	345	317	330	171
2005	441	353	334	337	198
2006	520	401	380	378	220
2007	492	391	370	370	242
2008	516	420	399	407	245
2009	591	372	336	371	189
2010	487	357	337	360	186
2011	464	318	293	339	162
2012	371	290	270	290	184
2013	499	413	402	412	221

Table 4: Number of positive and null sets by fishing mode made by the French purse seine fishing fleet in the Indian ocean during 1981-2013. FAD = Fish Aggregating Device; FSC = Free-Swimming School

	ALL			FAD			FSC		
	Total	Positive	Null	Total	Positive	Null	Total	Positive	Null
1981	56	37	19	32	24	8	24	13	11
1982	143	105	38	72	63	9	71	42	29
1983	1068	738	330	540	449	91	528	289	239
1984	3601	2077	1524	1143	888	255	2458	1189	1269
1985	3780	2108	1672	1353	1118	235	2427	990	1437
1986	4446	2257	2189	1628	1282	346	2818	975	1843
1987	4414	2592	1822	1908	1520	388	2506	1072	1434
1988	4824	2648	2176	1309	1104	205	3515	1544	1971
1989	3583	2083	1500	1436	1213	223	2147	870	1277
1990	4126	2322	1804	1189	991	198	2937	1331	1606
1991	3630	2448	1182	1622	1538	84	2008	910	1098
1992	4602	2980	1622	1708	1569	139	2894	1411	1483
1993	4164	2764	1400	1811	1612	199	2353	1152	1201
1994	4332	3099	1233	2326	2068	258	2006	1031	975
1995	4486	3066	1420	2276	2052	224	2210	1014	1196
1996	3956	2883	1073	2221	1956	265	1735	927	808
1997	3607	2714	893	2301	2035	266	1306	679	627
1998	3328	2454	874	2117	1828	289	1211	626	585
1999	3240	2371	869	1750	1553	197	1490	818	672
2000	3429	2526	903	1838	1568	270	1591	958	633
2001	3385	2370	1015	1501	1321	180	1884	1049	835
2002	3469	2539	930	1940	1745	195	1529	794	735
2003	3641	2344	1297	1570	1357	213	2071	987	1084
2004	4062	2382	1680	1511	1275	236	2551	1107	1444
2005	4442	2862	1580	1683	1473	210	2759	1389	1370
2006	4741	3000	1741	1967	1696	271	2774	1304	1470
2007	4857	2909	1948	2163	1698	465	2694	1211	1483
2008	4502	2954	1548	2186	1850	336	2316	1104	1212
2009	3108	2339	769	1998	1714	284	1110	625	485
2010	2691	2019	672	1825	1590	235	866	429	437
2011	2959	2144	815	1900	1631	269	1059	513	546
2012	2899	2107	792	1493	1276	217	1406	831	575
2013	2830	2125	705	1860	1629	231	970	496	474

Table 5: Catch by species for the French purse seine fishing fleet of the Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	oth	TOTAL
1981	188	158	23	0	56	425
1982	1081	792	145	0	0	2018
1983	10400	8153	1536	0	136	20225
1984	39268	21979	5081	224	228	66781
1985	37706	29183	6477	445	483	74293
1986	40911	38786	6636	200	693	87227
1987	41012	41620	6701	217	43	89593
1988	56766	38094	7251	177	732	103020
1989	33548	45750	5764	6	0	85068
1990	45351	27873	5663	36	31	78954
1991	38134	39388	5441	875	0	83837
1992	45282	45048	3822	1403	0	95555
1993	39539	48192	5015	310	0	93057
1994	35819	58430	5367	292	0	99908
1995	39636	48652	7280	350	0	95918
1996	35578	40056	6908	391	0	82933
1997	31227	31276	7824	539	0	70866
1998	22382	30340	6389	460	0	59571
1999	30799	42665	8518	154	0	82136
2000	37694	39935	6673	350	172	84825
2001	34127	35673	5956	659	174	76589
2002	35815	54405	7962	264	195	98642
2003	63101	38258	6334	608	368	108670
2004	63174	37323	6798	77	649	108021
2005	57198	43220	6453	86	184	107140
2006	45383	49573	5714	850	290	101809
2007	36455	34918	6928	335	33	78669
2008	42185	34186	7652	981	10	85013
2009	27807	35532	6991	295	3	70628
2010	30946	29432	5003	63	16	65460
2011	34468	28826	5635	575	0	69504
2012	43151	17120	5115	771	14	66171
2013	36511	21882	7015	331	204	65943

Table 6: Catch by species made on FAD-associated schools for the French purse seine fishing fleet of the Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	oth	TOTAL
1981	37	128	20	0	56	240
1982	442	709	131	0	0	1282
1983	3959	6637	1381	0	136	12114
1984	10692	17600	3762	0	191	32244
1985	14623	26582	4993	14	459	46671
1986	15353	31040	4953	0	693	52038
1987	17926	30205	4937	0	20	53089
1988	12763	28633	4675	0	602	46673
1989	13769	26850	4499	0	0	45118
1990	10312	21046	3513	0	31	34902
1991	8886	36896	3858	0	0	49639
1992	13014	39286	3112	9	0	55421
1993	12111	40582	2769	5	0	55467
1994	13340	45866	4313	23	0	63543
1995	19002	39380	5933	17	0	64332
1996	16944	33741	5975	70	0	56730
1997	18173	26882	7389	67	0	52511
1998	12680	25599	5173	13	0	43464
1999	17389	31759	6692	103	0	55943
2000	17699	32142	4960	43	172	55017
2001	9678	29045	4206	108	174	43211
2002	13704	47527	6385	0	171	67787
2003	16810	33837	3429	0	134	54209
2004	13959	31473	4882	0	339	50653
2005	15399	31270	3667	0	184	50520
2006	14818	37920	4172	0	214	57124
2007	13254	26695	4662	3	31	44645
2008	12784	29427	4486	2	10	46710
2009	12320	33004	5125	10	3	50462
2010	15704	27461	3474	32	16	46687
2011	20755	26017	3555	45	0	50372
2012	15484	16442	2287	30	10	34253
2013	21008	20814	4506	32	200	46560

Table 7: Catch by species made on free-swimming schools for the French purse seine fishing fleet of the Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	oth	TOTAL
1981	151	31	4	0	0	185
1982	638	83	14	0	0	736
1983	6441	1516	155	0	0	8111
1984	28576	4380	1319	224	37	34537
1985	23083	2601	1484	432	24	27623
1986	25558	7747	1683	200	0	35189
1987	23086	11415	1764	217	23	36505
1988	44003	9461	2575	177	130	56347
1989	19779	18900	1265	6	0	39951
1990	35039	6827	2150	36	0	44052
1991	29248	2492	1583	875	0	34198
1992	32268	5762	710	1394	0	40134
1993	27428	7611	2246	305	0	37590
1994	22479	12564	1054	269	0	36365
1995	20634	9272	1348	333	0	31587
1996	18633	6315	933	321	0	26203
1997	13054	4394	434	472	0	18355
1998	9702	4742	1215	448	0	16107
1999	13410	10907	1826	51	0	26193
2000	19995	7793	1713	307	0	29808
2001	24450	6627	1750	551	0	33377
2002	22111	6878	1578	264	24	30855
2003	46291	4422	2906	608	235	54461
2004	49215	5850	1916	77	310	57368
2005	41799	11950	2786	86	0	56620
2006	30564	11653	1542	850	76	44684
2007	23201	8224	2265	332	2	34024
2008	29401	4758	3166	979	0	38303
2009	15487	2527	1866	285	0	20166
2010	15242	1971	1529	31	0	18774
2011	13713	2809	2080	530	0	19132
2012	27668	678	2828	740	4	31917
2013	15503	1068	2509	299	4	19384

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 Indian ocean during 1981-2013

Year	ALL	FAD	FSC
1981	0.75	0.43	0.32
1982	0.61	0.31	0.30
1983	0.86	0.43	0.42
1984	0.84	0.27	0.57
1985	0.71	0.25	0.46
1986	0.94	0.34	0.60
1987	1.04	0.45	0.59
1988	1.05	0.28	0.76
1989	0.77	0.31	0.46
1990	0.98	0.28	0.70
1991	1.03	0.46	0.57
1992	1.25	0.46	0.79
1993	1.07	0.47	0.60
1994	1.15	0.62	0.53
1995	1.14	0.58	0.56
1996	1.05	0.59	0.46
1997	0.93	0.59	0.34
1998	0.91	0.58	0.33
1999	1.02	0.55	0.47
2000	1.07	0.57	0.50
2001	1.00	0.44	0.56
2002	1.04	0.58	0.46
2003	1.32	0.57	0.75
2004	1.34	0.50	0.84
2005	1.43	0.54	0.89
2006	1.18	0.49	0.69
2007	1.02	0.46	0.57
2008	1.10	0.53	0.57
2009	1.12	0.72	0.40
2010	1.05	0.71	0.34
2011	1.03	0.66	0.37
2012	1.03	0.53	0.50
2013	0.89	0.58	0.30

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 Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	TOTAL
1981	1.54	5.33	0.83	0.00	9.99
1982	7.02	11.25	2.08	0.00	20.34
1983	8.82	14.78	3.08	0.00	26.98
1984	12.04	19.82	4.24	0.00	36.31
1985	13.08	23.78	4.47	0.01	41.74
1986	11.98	24.21	3.86	0.00	40.59
1987	11.79	19.87	3.25	0.00	34.93
1988	11.56	25.94	4.23	0.00	42.28
1989	11.35	22.14	3.71	0.00	37.19
1990	10.41	21.24	3.54	0.00	35.22
1991	5.78	23.99	2.51	0.00	32.28
1992	8.29	25.04	1.98	0.01	35.32
1993	7.51	25.17	1.72	0.00	34.41
1994	6.45	22.18	2.09	0.01	30.73
1995	9.26	19.19	2.89	0.01	31.35
1996	8.66	17.25	3.05	0.04	29.00
1997	8.93	13.21	3.63	0.03	25.80
1998	6.94	14.00	2.83	0.01	23.78
1999	11.20	20.45	4.31	0.07	36.02
2000	11.29	20.50	3.16	0.03	35.09
2001	7.33	21.99	3.18	0.08	32.71
2002	7.85	27.24	3.66	0.00	38.85
2003	12.39	24.94	2.53	0.00	39.95
2004	10.95	24.68	3.83	0.00	39.73
2005	10.45	21.23	2.49	0.00	34.30
2006	8.74	22.36	2.46	0.00	33.68
2007	7.81	15.72	2.75	0.00	26.29
2008	6.91	15.91	2.42	0.00	25.25
2009	7.19	19.26	2.99	0.01	29.44
2010	9.88	17.27	2.18	0.02	29.36
2011	12.73	15.95	2.18	0.03	30.88
2012	12.13	12.89	1.79	0.02	26.84
2013	12.90	12.78	2.77	0.02	28.58

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 Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	TOTAL
1981	11.62	2.38	0.31	0.00	14.26
1982	15.19	1.98	0.33	0.00	17.53
1983	22.29	5.25	0.54	0.00	28.07
1984	24.03	3.68	1.11	0.19	29.05
1985	23.32	2.63	1.50	0.44	27.90
1986	26.21	7.95	1.73	0.21	36.09
1987	21.54	10.65	1.65	0.20	34.05
1988	28.50	6.13	1.67	0.11	36.49
1989	22.73	21.72	1.45	0.01	45.92
1990	26.33	5.13	1.62	0.03	33.10
1991	32.14	2.74	1.74	0.96	37.58
1992	22.87	4.08	0.50	0.99	28.44
1993	23.81	6.61	1.95	0.26	32.63
1994	21.80	12.19	1.02	0.26	35.27
1995	20.35	9.14	1.33	0.33	31.15
1996	20.10	6.81	1.01	0.35	28.27
1997	19.23	6.47	0.64	0.70	27.03
1998	15.50	7.58	1.94	0.72	25.73
1999	16.39	13.33	2.23	0.06	32.02
2000	20.87	8.13	1.79	0.32	31.11
2001	23.31	6.32	1.67	0.53	31.82
2002	27.85	8.66	1.99	0.33	38.86
2003	46.90	4.48	2.94	0.62	55.18
2004	44.46	5.28	1.73	0.07	51.82
2005	30.09	8.60	2.01	0.06	40.76
2006	23.44	8.94	1.18	0.65	34.27
2007	19.16	6.79	1.87	0.27	28.10
2008	26.63	4.31	2.87	0.89	34.70
2009	24.78	4.04	2.99	0.46	32.27
2010	35.53	4.59	3.56	0.07	43.76
2011	26.73	5.48	4.05	1.03	37.29
2012	33.29	0.82	3.40	0.89	38.41
2013	31.26	2.15	5.06	0.60	39.08

Table 11: Catch per unit of effort (in t per searching day) on FAD-associated schools for the French purse seine fishery of the Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	TOTAL
1981	0.49	1.70	0.27	0.00	3.19
1982	1.88	3.02	0.56	0.00	5.46
1983	3.17	5.32	1.11	0.00	9.71
1984	2.48	4.08	0.87	0.00	7.48
1985	2.75	5.00	0.94	0.00	8.77
1986	3.24	6.56	1.05	0.00	11.00
1987	4.23	7.12	1.16	0.00	12.52
1988	2.77	6.22	1.01	0.00	10.13
1989	2.96	5.78	0.97	0.00	9.71
1990	2.45	5.01	0.84	0.00	8.31
1991	2.53	10.49	1.10	0.00	14.12
1992	3.53	10.67	0.85	0.00	15.05
1993	3.11	10.43	0.71	0.00	14.26
1994	3.53	12.15	1.14	0.01	16.84
1995	4.82	9.99	1.51	0.00	16.32
1996	4.48	8.92	1.58	0.02	14.99
1997	4.68	6.92	1.90	0.02	13.52
1998	3.45	6.96	1.41	0.00	11.82
1999	5.47	9.99	2.11	0.03	17.60
2000	5.53	10.04	1.55	0.01	17.19
2001	2.86	8.58	1.24	0.03	12.76
2002	4.11	14.25	1.91	0.00	20.33
2003	6.10	12.28	1.24	0.00	19.67
2004	4.59	10.36	1.61	0.00	16.67
2005	4.97	10.10	1.18	0.00	16.32
2006	3.68	9.42	1.04	0.00	14.19
2007	2.79	5.62	0.98	0.00	9.40
2008	3.12	7.19	1.10	0.00	11.42
2009	4.43	11.88	1.84	0.00	18.16
2010	6.12	10.70	1.35	0.01	18.18
2011	7.25	9.09	1.24	0.02	17.60
2012	5.51	5.85	0.81	0.01	12.19
2013	6.60	6.54	1.41	0.01	14.62

Table 12: Catch per unit of effort (in t per searching day) on free swimming schools for the French purse seine fishery of the Indian ocean during 1981-2013

Year	YFT	SKJ	BET	ALB	TOTAL
1981	2.01	0.41	0.05	0.00	2.47
1982	2.72	0.35	0.06	0.00	3.14
1983	5.16	1.22	0.12	0.00	6.50
1984	6.63	1.02	0.31	0.05	8.01
1985	4.34	0.49	0.28	0.08	5.19
1986	5.40	1.64	0.36	0.04	7.44
1987	5.45	2.69	0.42	0.05	8.61
1988	9.55	2.05	0.56	0.04	12.23
1989	4.25	4.07	0.27	0.00	8.59
1990	8.34	1.62	0.51	0.01	10.48
1991	8.32	0.71	0.45	0.25	9.73
1992	8.76	1.56	0.19	0.38	10.90
1993	7.05	1.96	0.58	0.08	9.66
1994	5.96	3.33	0.28	0.07	9.63
1995	5.23	2.35	0.34	0.08	8.01
1996	4.92	1.67	0.25	0.08	6.93
1997	3.36	1.13	0.11	0.12	4.73
1998	2.64	1.29	0.33	0.12	4.38
1999	4.22	3.43	0.57	0.02	8.24
2000	6.25	2.44	0.54	0.10	9.31
2001	7.22	1.96	0.52	0.16	9.85
2002	6.63	2.06	0.47	0.08	9.25
2003	16.80	1.60	1.05	0.22	19.76
2004	16.19	1.92	0.63	0.03	18.88
2005	13.50	3.86	0.90	0.03	18.29
2006	7.59	2.90	0.38	0.21	11.10
2007	4.89	1.73	0.48	0.07	7.16
2008	7.19	1.16	0.77	0.24	9.36
2009	5.57	0.91	0.67	0.10	7.26
2010	5.94	0.77	0.60	0.01	7.31
2011	4.79	0.98	0.73	0.19	6.68
2012	9.85	0.24	1.01	0.26	11.36
2013	4.87	0.34	0.79	0.09	6.09

Table 13: Quantities (t) landed by species and commercialized on the local markets of Antsiranana (Madagascar) and Victoria (Seychelles). TUX = Tuna-like fishes NEI, TUN = Tunas NEI. See Table eftable:annex 1 for other codes

Year	BIL	FRI	PEL	SHX	SKJ	TRI	TUN	TUX	WAH	YFT	Total
2011	0	10	2	0	23	1	2	203	0	3	244
2012	0	4	3	0	24	3	3	170	0	10	217
2013	0	1	2	2	30	4	36	142	0	16	233
Total	0	15	8	3	77	7	41	515	0	29	694
%	0	2	1	0	11	1	6	74	0	4	100

Table 14: Observer programme coverage by quarter in 1995 and 2005-2013. Numbers in brackets give the percentage relative to the whole French fleet

Year-Quarter	Trips	Sets	Production
1995-1	2(4.3)	76(5.6)	1281(5.4)
1995-2	1(2.4)	97(7.4)	1197.8(5.4)
1995-3	2(4.8)	47(5.5)	1755.2(6.5)
1995-4	1(2.2)	83(8.7)	1748.6(7.5)
2005-4	1(2.1)	84(6.9)	1566.5(5.2)
2006-1	2(3.9)	63(4.5)	1590(5.5)
2006-2	0(0)	41(2.9)	548.5(2.8)
2006-3	1(2)	5(0.5)	49.4(0.2)
2006-4	2(4.7)	59(5.9)	1058.6(4)
2007-1	2(5.1)	101(7.3)	1366(7.4)
2007-2	4(10.3)	101(7.9)	1326.5(8.3)
2007-3	4(10.3)	76(7.6)	1323.8(5.7)
2007-4	4(9.8)	185(15.4)	2562.1(12.3)
2008-1	3(6.4)	119(7.7)	2186.1(8.4)
2008-2	3(7.7)	96(8.1)	2225.3(13.1)
2008-3	5(11.6)	84(10.6)	1726.5(9.2)
2008-4	3(7.1)	116(12)	2812.9(12)
2009-1	3(7.5)	88(7.2)	1653.4(6.4)
2009-2	2(6.5)	61(8.8)	992.4(10.2)
2009-3	1(3)	1(0.2)	25.2(0.1)
2010-1	1(3.6)	15(2.1)	887(5.6)
2011-1	1(3.3)	35(4.9)	1068.6(6.2)
2011-2	6(20)	167(24.7)	3367.5(26.2)
2011-3	2(7.1)	77(9.8)	1485.6(8.7)
2011-4	2(5.3)	27(3.4)	760.5(3.4)
2012-1	2(6.9)	63(8.3)	1695.6(9.4)
2012-2	6(20)	128(18.7)	2025.9(13.7)
2012-3	2(7.4)	42(7)	1400.7(9.7)
2012-4	5(15.2)	123(14.4)	2251.7(11.9)
2013-1	4(12.1)	110(12.2)	2468.1(12.7)
2013-2	6(20.7)	73(13.6)	1317.7(9.6)
2013-3	2(7.7)	37(5.7)	980.2(6.5)
2013-4	5(14.7)	165(22.4)	3541.4(21.2)

Table 15: Species and families encountered most frequently in purse seine fisheries with mean annual occurrence (%) higher than 4%. Source: Observer data collected during 2006-2014 in the Indian and Atlantic Oceans

Species group	FAO code	Scientific name	Occurrence
Tunas	YFT	*Thunnus albacares*	66
Tunas	SKJ	*Katsuwonus pelamis*	47
Other fishes	TRI	*Balistidae*	37
Other fishes	RRU	*Elagatis bipinnulata*	32
Other fishes	DOX	*Coryphaenidae*	31
Other fishes	CGX	*Carangidae*	30
Other fishes	WAH	*Acanthocybium solandri*	27
Sharks	FAL	*Carcharhinus falciformis*	23
Tunas	BET	*Thunnus obesus*	20
Tunas	FRZ	*Auxis spp*	19
Other fishes	LOB	*Lobotes surinamensis*	12
Other fishes	KYP	*Kyphosus spp*	10
Other fishes	BAZ	*Sphyraenidae*	10
Billfishes	BXQ	*Makaira spp*	9
Billfishes	SAI/SFA	*Istiophorus albicans/platypterus*	8
Other fishes	SPA	*Ephippidae*	7
Other fishes	FFX	*Monacanthidae*	6
Tunas	ALB	*Thunnus alalunga*	5
Tunas	EHZ	*Euthynnus spp*	4

Table 16: Estimated quantities (t) of catch discarded at sea (dead or alive) by the French purse seine fishing fleet in 2013 in the Indian Ocean for the species groups the most frequently encountered. Estimates were raised based on trip coverage

Species group	FAO code	Scientific name	Discards
Tunas	SKJ	*Katsuwonus pelamis*	813
Tunas	YFT	*Thunnus albacares*	603
Other fishes	RRU	*Elagatis bipinnulata*	513
Tunas	BET	*Thunnus obesus*	347
Other fishes	KYP	*Kyphosus spp*	322
Sharks	FAL	*Carcharhinus falciformis*	291
Other fishes	TRI	*Balistidae*	280
Other fishes	DOX	*Coryphaenidae*	279
Other fishes	WAH	*Acanthocybium solandri*	123
Other fishes	CGX	*Carangidae*	94
Billfishes	BXQ	*Makaira spp*	50
Sharks	—	*Autres*	39
Other fishes	BAZ	*Sphyraenidae*	23
Tunas	EHZ	*Euthynnus spp*	21
Other fishes	FFX	*Monacanthidae*	18
Tunas	FRZ	*Auxis spp*	12
Other fishes	LOB	*Lobotes surinamensis*	9
Billfishes	—	*Autres*	5
Other fishes	—	*Autres*	3
Tunas	ALB	*Thunnus alalunga*	1
Billfishes	SAI/SFA	*Istiophorus albicans/platypterus*	1
Other fishes	SPA	*Ephippidae*	0

Table 17: Observations of bycatch of species emblematic or under specific resolution in 2013 in the Indian Ocean. Survival rates at release are estimated based on the observations of the state of the individual when released

Species group	FAO code	Scientific name	Number	Released alive	Survival rate
Cetaceans	MYS	*Mysticeti*	11	11	100
Sharks	OCS	*Carcharhinus longimanus*	8	6	75
Sharks	RHN	*Rhincodon typus*	2	2	100
Turtles	LKV	*Lepidochelys olivacea*	2	2	100
Turtles	TTH	*Eretmochelys imbricata*	2	2	100
Turtles	TTL	*Caretta caretta*	1	1	100
Turtles	TTX	*Testitudines*	1	1	100
Turtles	TUG	*Chelonia mydas*	5	5	100

Table 18: List of species and species groups encountered during purse seine observer programmes in the Indian Ocean

Species group	**FAO code**	**Scientific name**	**Group code**	**Group name**
Tunas	ALB	*Thunnus alalunga*	ALB	*Thunnus alalunga*
Tunas	BET	*Thunnus obesus*	BET	*Thunnus obesus*
Tunas	BLT	*Auxis rochei*	FRZ	*Auxis spp*
Tunas	FRI	*Auxis thazard*	FRZ	*Auxis spp*
Tunas	FRZ	*Auxis spp*	FRZ	*Auxis spp*
Tunas	KAW	*Euthynnus affinis*	EHZ	*Euthynnus spp*
Tunas	LTA	*Euthynnus alletteratus*	EHZ	*Euthynnus spp*
Tunas	SKJ	*Katsuwonus pelamis*	SKJ	*Katsuwonus pelamis*
Tunas	YFT	*Thunnus albacares*	YFT	*Thunnus albacares*
Other Fishes	3CUH	*Uraspis helvola*	CGX	*Carangidae*
Other Fishes	3CUX	*Uraspis spp*	CGX	*Carangidae*
Other Fishes	3DEY	*Diodon eydouxii*	DIO	*Diodontidae*
Other Fishes	3MOP	*Molidae*	JHX	*Molidae*
Other Fishes	AJS	*Abalistes stellatus*	TRI	*Balistidae*
Other Fishes	ALM	*Aluterus monoceros*	FFX	*Monacanthidae*
Other Fishes	ALN	*Aluterus scriptus*	FFX	*Monacanthidae*
Other Fishes	BAF	*Ablennes hians*	BEN	*Belonidae*
Other Fishes	BAO	*Platax teira*	SPA	*Ephippidae*
Other Fishes	BAT	*Platax spp*	SPA	*Ephippidae*
Other Fishes	BAZ	*Sphyraenidae*	BAZ	*Sphyraenidae*
Other Fishes	BEN	*Belonidae*	BEN	*Belonidae*
Other Fishes	BON	*Sarda sarda*	MAX	*Scombridae*
Other Fishes	BRZ	*Bramidae*	BRZ	*Bramidae*
Other Fishes	BSX	*Serranidae*	BSX	*Serranidae*
Other Fishes	BTS	*Tylosurus crocodilus*	BEN	*Belonidae*
Other Fishes	CFW	*Coryphaena equiselis*	DOX	*Coryphaenidae*

Table18 – continued from previous page

Species group	FAO code	Scientific name	Group code	Group name
Other Fishes	CGX	*Carangidae*	CGX	*Carangidae*
Other Fishes	CNT	*Canthidermis maculata*	TRI	*Balistidae*
Other Fishes	CXS	*Caranx sexfasciatus*	CGX	*Carangidae*
Other Fishes	DIO	*Diodontidae*	DIO	*Diodontidae*
Other Fishes	DOL	*Coryphaena hippurus*	DOX	*Coryphaenidae*
Other Fishes	DOX	*Coryphaenidae*	DOX	*Coryphaenidae*
Other Fishes	ECN	*Echeneidae*	ECN	*Echeneidae*
Other Fishes	EHN	*Echeneis naucrates*	ECN	*Echeneidae*
Other Fishes	FLY	*Exocoetidae*	FLY	*Exocoetidae*
Other Fishes	GBA	*Sphyraena barracuda*	BAZ	*Sphyraenidae*
Other Fishes	HTL	*Phtheirichthys lineatus*	ECN	*Echeneidae*
Other Fishes	KYC	*Kyphosus cinerascens*	KYP	*Kyphosus spp*
Other Fishes	KYP	*Kyphosus spp*	KYP	*Kyphosus spp*
Other Fishes	KYV	*Kyphosus vaigiensis*	KYP	*Kyphosus spp*
Other Fishes	LAG	*Lampris guttatus*	LAG	*Lampris guttatus*
Other Fishes	LGH	*Lagocephalus lagocephalus*	PUX	*Tetraodontidae*
Other Fishes	LOB	*Lobotes surinamensis*	LOB	*Lobotes surinamensis*
Other Fishes	MAS	*Scomber japonicus*	MAX	*Scombridae*
Other Fishes	MAX	*Scombridae*	MAX	*Scombridae*
Other Fishes	MOX	*Mola mola*	JHX	*Molidae*
Other Fishes	MRW	*Masturus lanceolatus*	JHX	*Molidae*
Other Fishes	MSD	*Decapterus macarellus*	CGX	*Carangidae*
Other Fishes	MZZ	*Osteichthyes*	MZZ	*Osteichthyes*
Other Fishes	NAU	*Naucrates ductor*	CGX	*Carangidae*
Other Fishes	NGT	*Carangoides orthogrammus*	CGX	*Carangidae*
Other Fishes	PUX	*Tetraodontidae*	PUX	*Tetraodontidae*
Other Fishes	REO	*Remora remora*	ECN	*Echeneidae*
Other Fishes	RRL	*Remorina albescens*	ECN	*Echeneidae*

Table18 – continued from previous page

Species group	FAO code	Scientific name	Group code	Group name
Other Fishes	RRU	*Elagatis bipinnulata*	RRU	*Elagatis bipinnulata*
Other Fishes	RUB	*Caranx crysos*	CGX	*Carangidae*
Other Fishes	SDX	*Decapterus spp*	CGX	*Carangidae*
Other Fishes	SPA	*Ephippidae*	SPA	*Ephippidae*
Other Fishes	TRG	*Balistes carolinensis*	TRI	*Balistidae*
Other Fishes	TRI	*Balistidae*	TRI	*Balistidae*
Other Fishes	URU	*Uraspis uraspis*	CGX	*Carangidae*
Other Fishes	USE	*Uraspis secunda*	CGX	*Carangidae*
Other Fishes	WAH	*Acanthocybium solandri*	WAH	*Acanthocybium solandri*
Other Fishes	YTL	*Seriola rivoliana*	CGX	*Carangidae*
Billfishes	1BUM	*Makaira mazara*	BXQ	*Makaira spp*
Billfishes	BIL	*Istiophoridae*	BIL	*Istiophoridae*
Billfishes	BLM	*Makaira indica*	BXQ	*Makaira spp*
Billfishes	BUM	*Makaira nigricans*	BXQ	*Makaira spp*
Billfishes	MLS	*Tetrapturus audax*	BIL	*Istiophoridae*
Billfishes	SFA	*Istiophorus platypterus*	SAI/SFA	*Istiophorus albicans/platypterus*
Billfishes	SSP	*Tetrapturus angustirostris*	BIL	*Istiophoridae*
Billfishes	SWO	*Xiphias gladius*	SWO	*Xiphias gladius*
Sharks	2REX	*Requin non identifié*	SKX	*Elasmobranchii*
Sharks	BSH	*Prionace glauca*	RSK	*Carcharhinidae spp*
Sharks	FAL	*Carcharhinus falciformis*	FAL	*Carcharhinus falciformis*
Sharks	MAK	*Isurus spp*	MAK	*Isurus spp*
Sharks	MAN	*Mobulidae*	MAN	*Mobulidae*
Sharks	MNT	*Manta spp*	MAN	*Mobulidae*
Sharks	OCS	*Carcharhinus longimanus*	RSK	*Carcharhinidae spp*
Sharks	PLS	*Dasyatys (Pteroplatytrygon) violacea*	STT	*Dasyatidae*
Sharks	RHN	*Rhincodon typus*	RHN	*Rhincodon typus*
Sharks	RMA	*Manta alfredi*	MAN	*Mobulidae*

Table18 – continued from previous page

Species group	FAO code	Scientific name	Group code	Group name
Sharks	RMB	*Manta birostris*	MAN	*Mobulidae*
Sharks	RMJ	*Mobula japanica*	MAN	*Mobulidae*
Sharks	RMM	*Mobula mobular*	MAN	*Mobulidae*
Sharks	RMV	*Mobula spp*	MAN	*Mobulidae*
Sharks	RSK	*Carcharhinidae spp*	RSK	*Carcharhinidae spp*
Sharks	SHL	*Etmopterus spp*	SHL	*Etmopterus spp*
Sharks	SMA	*Isurus oxyrinchus*	MAK	*Isurus spp*
Sharks	SPL	*Sphyrna lewini*	SPY	*Sphyrnidae*
Sharks	SPY	*Sphyrnidae*	SPY	*Sphyrnidae*
Sharks	SRX	*Raie non identifiée*	SKX	*Elasmobranchii*
Sharks	STT	*Dasyatidae*	STT	*Dasyatidae*
Sharks	TIG	*Galeocerdo cuvier*	RSK	*Carcharhinidae spp*
Turtles	DKK	*Dermochelys coriacea*	TTX	*Testitudines*
Turtles	LKV	*Lepidochelys olivacea*	TTX	*Testitudines*
Turtles	TTH	*Eretmochelys imbricata*	TTX	*Testitudines*
Turtles	TTL	*Caretta caretta*	TTX	*Testitudines*
Turtles	TTX	*Testitudines*	TTX	*Testitudines*
Turtles	TUG	*Chelonia mydas*	TTX	*Testitudines*
Cetaceans	FAW	*Pseudorca crassidens*	ODN	*Odontoceti*
Cetaceans	FIW	*Balaenoptera physalus*	MYS	*Mysticeti*
Cetaceans	MYS	*Mysticeti*	MYS	*Mysticeti*