

Bycatch and Discards of the French Tuna Purse Seine Fishery during the 2003-2010 Period estimated from Observer data

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Abstract

The observer program for the French tropical tuna purse seine fishery started in december 2005 under the scientific responsibility of the Institut de Recherche pour le Développement. The observer sampling coverage covered 4.3% of the fishing trips during the 2005-2010 period with piracy threat limiting the boarding of observers since mid-2009. Using bycatch ratios with tuna fisheries production as previously estimated for the European purse seine fishery, estimates for the French fleet component are presented and discussed for the 2003-2010 period.

Keywords : observer, bycatch, discards, tuna fishery, purse seine

1. Introduction

Bycatch and discards are of growing concern among managers, scientists and society and form part of the appealed Ecosystem Approach of Fisheries. Generally badly documented in declarative documents like logbooks, this part of the catch has to be accounted for and specific observations must be collected during fishing operations. An observer programme for the French tuna purse seine fishery has started since 2005 with the objective of collecting data on bycatch and discards. This programme is financially supported by the Data Collection Framework of the European Union (Reg. 1543/2000 et 199/2008) and by IRD. IOTC adopted in 2010 a general resolution implementing a regional observer programme with a minimum of 5% coverage. This note intends to elaborate and presents annual bycatch and discards estimates for the French purse seine fishery during years 2003 to 2010.

2. Data and methods

2.1 Terminology

Different terms are used in the literature for the various components of accidental and/or unwanted catch and this may result in confusion and sometimes misunderstanding. Here, the following terms were adapted from FAO (1999) and Kelleher (2005):

- **Total Catch:** the overall biomass that is encircled and retained by the net once closed

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- **Production:** targeted major tuna species, such as yellowfin (*Thunnus albacares*), skipjack (*Katsuwonus pelamis*), bigeye (*Thunnus obesus*), and albacore (*Thunnus alalunga*), which are landed and marketed through canneries
- **Bycatch:** all non-targeted species plus small or damaged target tuna species that are not marketed through canneries

The bycatch may be divided into two components:

- a) **by-products** that are kept for a particular use, i.e. to be consumed on board or sold later on the local African market
- b) **discards** that are rejected at sea, dead or alive

Therefore, we have:

$$\text{Total Catch} = \text{Production} + \text{Bycatch}$$

$$\text{Bycatch} = \text{By-products} + \text{Discards}$$

• **“Faux poisson”** (false fish) is a peculiar term for an important by-product of the purse seine fishery mainly in the Atlantic ocean and particularly in Abidjan (Ivory Coast) but it has also some growing importance in the Western Indian ocean like Antsiranana (Madagascar). This by-product is made up of a mix of damaged or undersized target tunas, minor tuna species, and associated species, like billfish, sharks, and various bony fish, that are sold on the local market (Romagny et al. 2000, Chavance et al., 2010).

Two major fishing modes are considered for the fishery: log-associated (FAD) and free swimming schools (FSC). The acronym “FAD” standing for fish aggregating device, will be used here to describe any type of floating object used for fishing tuna. These include natural objects (e.g. logs, palm branches) and anthropogenic floating objects, such as manmade bamboo rafts equipped with radio-range beacons, satellite transmitters or scanning sonars. All floating objects used in the European purse seine tuna fishery are drifting devices. Fishing sets made on whales were classified as free school sets (FSC), whereas sets made on whale sharks (*Rhincodon typus*) were classified as FAD sets (Pallarés and Petit 1998; Gaertner et al. 2002). Natural and artificial floating objects were assumed to have similar qualitative and quantitative effects on bycatch, based on previous studies in the Eastern Pacific Ocean (Hall et al. 1999) and the absence of specific information in the regions concerned.

2.2 Observer coverage and data collection

The target sampling coverage of the programme is 10% of the fishing effort expressed in trips. In order to reach this target in year N, a sampling scheme is established by IRD at the end of year N-1, indicating the number of trips to be sampled by quarter and ocean. This number is deduced from total number of trips of the fishery year N-1 accounting for potential major changes in the fishery. Selection of vessels is rather opportunistic and does not follow a rigorous statistical procedure because of sharp constraints of room availability on board.

The general methodology, data collection and management methods and tools used within the European observer programme are tightly coordinated between French and Spanish scientists from IRD, IEO, and AZTI and can be found elsewhere (Ariz et al., 2010; Chavance et al., 2011).

2.3 Data analysis

Since the European PS fleet is homogeneous with regards to fishing practices, bycatch estimations were conducted on a common data set collected from the French and Spanish observer programmes to compensate for their respective quite low observer coverage. Using adequate stratification by quarter, area and fishing mode, a similar analysis was made based on a data set covering the 2003-2007 period, including about 2000 sets, and has been presented to the WPEB in 2008 (Amandè et al., 2008) producing bycatch estimates for large species groups using the ratio method on tuna production. These bycatch to tuna production

ratios available by species group and fishing mode were applied here to the annual French production (Chassot et al., 2011). The distinction between by-product and discards was estimated using mean fate proportion evaluated for the French fishery (2005-2010).

3. Results and discussion

The observer program started in 2005 and progressively increased its coverage to reach about 8 % in 2007 and 2008 (**Table 1**). As indicated in **figures 1 and 2**, observations through the whole period cover the overall area where the fishery operates and the two fishing modes. During the year 2009, the program had to be stopped due to piracy events and the lack of security on board tuna vessels. Security forces were rapidly installed on board but the observer program then encountered a problem of room availability, conducting to a rapid decrease of coverage with only 1 trip being observed in 2010. An agreement with the fishing industry has recently been passed to allow the observer program to resume. An 8 % observer coverage is expected in 2011.

Table 2 indicates bycatch ratios by species group and fishing mode estimated by Amandè et al. (2008) using the data for all European tuna surface fishery, i.e. 1958 fishing sets. These ratios, considered as the best available estimates for this fishery, were used to estimate bycatch of the French part of this fishery. Bycatch was split between by-product and discards using the ratio for the French fishery (**Table 3**). Following these ratios, 88 % of tuna bycatch, i.e. minor tunas and small individuals of major tunas, are discarded. Proportions are almost the same for bony fishes while sharks and rays are also predominantly discarded, but in minor proportion. Finally, billfishes are mainly kept onboard for valorization.

Tables 4-6 give estimates of bycatch, by-product, and discards for the main species group and each fishing mode and fishing modes combined, respectively. Total bycatch in 2003 reached almost 4 000 t and declined steadily to 2 600 t in 2010. Over the period, more than 85% of the bycatch was made on log-associated school sets and was composed of tunas species (around 77% on average) followed by bony fishes. **Table 7**, reformatted from Amandè et al. (2008), indicates that very few species (up to a maximum of 4-5) make up more than 90% of bycatch by species groups (accounted in weight).

Figure 2 shows the total French production for the period and corresponding estimated levels of total bycatch by taxonomic group. This figure clearly indicates that although production is declining due in part to a declining effort (Chassot et al, 2011) and efficiency related to piracy context, this has not been followed by the same rate of decline in bycatch. This pattern should be related with the fact that the French fishery is more and more oriented on log-associated schools (68% of sets in 2010) generating a greater proportion of bycatch.

4. Conclusion

Observer programmes generate rich information and allow estimates of bycatch and discards most often unavailable through declarative means. Nevertheless, observer programmes have the general characteristic to have low and fragile coverage levels, with the notable exception of the full coverage of tuna purse seiners in the Eastern and Western Central Pacific Oceans: low, mainly because of associated heavy costs and fragile because the boarding of observer for open-sea fisheries is a permanent challenge as indicated with European experience on purse seine fishery in the Indian Ocean and piracy context.

Analysis and production of estimates at the fishery level should then pay extreme attention on precision and be cautious on the way to raise observer data at the fishery level. Purse seine fishery in the Indian Ocean generates low bycatch level compared to other fisheries and this level has been decreasing since 2003 with decreasing effort. It is however strongly dependent on the fishing mode and current changes in the European purse seine fishery strategy (Pianet et al. 2011) are likely to affect bycatch and discard estimates in 2011.

5. Acknowledgments.

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6. References

- Amande J. M., Ariz J., Chassot E., Chavance P., Delgado de Molina A., Gaertner D., Murua H., Pianet R., Ruiz J., 2008. By-catch and Discards of the European Purse Seine Tuna Fishery in the Indian ocean. Estimation and characteristics for the 2003-2007 period. IOTC-2008-WPEB-12, 26 p.
- Amandè M. J., Ariz J., Chassot E., Delgado de Molina A., Gaertner D., Murua H., Pianet R., Ruiz J. and P. Chavance. 2010. Bycatch of the European purse seine tuna fishery in the Atlantic Ocean for the 2003–2007 period. *Aquatic Living Resources* 23 (4) : 353-362.
- Ariz, J, Chavance P., Delgado de Molina A. and H. Murua, 2010. European Scheme of Observers on Board Purse-Seiners in the Indian Ocean. IOTC/2010/ROS/03, 45 p.
- Cauquil P., Lechauve J. J., Damiano A., Amandé J. M. and P. Chavance, 2009. ObServe: an information system intended to computerize data collection as close as possible to the source and to increase observer program data quality. SCRS/2009/130, 9 p.
- Chassot E., L. Floch, P. Dewals, R. Pianet, P. Chavance, 2011. Statistics of the French purse seine fleet targeting tropical tunas in the Indian Ocean (1991-2010). IOTC-2011-WPTT13, 20, 31p.
- Chavance P., Damiano A., Cauquil P., Relot A., 2011. Le programme national d'observateurs sur les thoniers senneurs tropicaux français dans l'océan Atlantique. ICCAT/SCRS/2011, 124, 10 p.
- Chavance P., J.B. Amon Kothias, P. Dewals, R. Pianet, M.J. Amandè, A. Delgado de Molina and A. Djoh. Statistics on tuna surface fishery's bycatch landed in Abidjan, Côte d'Ivoire, for the 1982-2009 period. SCRS/2010, 140, 8p.
- FAO, 1999, Guidelines for the routine collection of capture fishery data. Prepared at the FAO/DANIDA Expert Consultation. Bangkok, Thailand, 18-30 May 1998. FAO Fisheries Tech. Pap. 382, Rome, 113 p.
- Gaertner D., Ménard F., Develter C., Ariz J., Delgado de Molina A., 2002, By-catch of billfishes by the European tuna purse seine fishery in the Atlantic Ocean. *Fish. Bull.* 100, 683-689.
- Hall M.A., García M., Lennert-Cody C.E., Arenas P., Miller F., 1999, The association of tunas with floating objects and dolphins in the eastern Pacific Ocean: a review of the current purse-seine fishery, in: Scott M.D., Bayliff W.H., Lennert-Cody C.E., Schaefer K.M. (Eds.). *Proc. International Workshop on the Ecology and Fisheries for Tunas Associated with Floating Objects*, February 11-13, Inter-Am. Trop. Tuna Comm. Spec. Rep. 11, 87-194.
- Kelleher K., 2005, Discards in the world's marine fisheries: an update. FAO Fish. Tech. Pap. 470, Rome, 131 p.
- Pallarés P., Petit C., 1998, Tropical tunas: New sampling and data processing strategy for estimating the composition of catches by species and size. *Coll. Vol. Sci. Pap. ICCAT* 48, 230-246.
- Pianet R., Delgado de Molina, A., Dewals, P., Lucas, V., Floch, L., Chassot, E., Ariz, J.. 2011. Statistics of the main purse seine fleets fishing in the Indian Ocean (1981-2010). IOTC-2011-WPTT13, 30p.
- Romagny B., Ménard F., Dewals P., Gaertner D., N'Goran N., 2000. Le "faux-poisson" d'Abidjan et la pêche sous DCP dérivants dans l'Atlantique tropical Est : circuit de commercialisation et rôle socio-économique. In : Cayré P., Le Gall J.Y., Taquet M. (Eds.) *Pêche thonière et dispositifs de concentration de poissons*, Colloque Caraïbe-Martinique, Trois-Îlets, 15-19 octobre 1999. Institut de recherche pour le développement, Institut français de recherche pour l'exploitation de la mer, Ecole nationale supérieure agronomique de Rennes. Editions Quae, 28, 634-652.

7. TABLES AND FIGURES

Table 1: Observer program coverage (% of trips) on french tuna purse seiners (2003-2010)

Year	Observed trips	Total trips	Coverage (%)
2005	1	183	0.55
2006	5	191	2.62
2007	14	159	8.81
2008	14	174	8.05
2009	6	130	4.62
2010	1	111	0.90

Table 2: Bycatch ratios (t/1 000 t of tuna production) by species groups and fishing modes for the European tuna purse seiners estimated by Amandè et al, (2008). FSC = free swimming school, FAD = fish-aggregating device

Species Groups	FSC	FAD	All
Tunas	9.3	26.5	19.2
Bony Fishes	1.5	19.7	12.0
Billfishes	0.4	0.7	0.5
Sharks	0.3	6.0	3.6
Rays	0.2	0.2	0.2
Total	11.7	53.1	35.5

Table 3: Fate of total bycatch to by-product or discards by species group for the French tuna purse seiners (2003-2010)

Species Groups	By-product	Discards
Tunas	12%	88%
Bony Fishes	24%	76%
Billfishes	60%	40%
Sharks and Rays	33%	67%

Table 4 : Estimated total bycatch, by-product and discards of the French purse seine fishery in 2003-2010 when fishing on free swimming schools (FSC)

Total bycatch (FSC)					
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total
2003	566.0	91.3	24.3	30.4	712.0
2004	614.1	99.0	26.4	33.0	772.5
2005	535.6	86.4	23.0	28.8	673.8
2006	493.3	79.6	21.2	26.5	620.6
2007	313.6	50.6	13.5	16.9	394.5
2008	389.1	62.8	16.7	20.9	489.5
2009	199.5	32.2	8.6	10.7	251.0
2010	166.3	26.8	7.2	8.9	209.2

Total by-products (FSC)					
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total
2003	65.5	21.6	14.6	10.2	111.8
2004	71.0	23.4	15.8	11.1	121.3
2005	62.0	20.4	13.8	9.6	105.8
2006	57.1	18.8	12.7	8.9	97.5
2007	36.3	12.0	8.1	5.6	62.0
2008	45.0	14.8	10.0	7.0	76.9
2009	23.1	7.6	5.1	3.6	39.4
2010	19.2	6.3	4.3	3.0	32.9

Total discards (FSC)					
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total
2003	500.5	69.7	9.8	20.2	600.2
2004	543.0	75.6	10.6	22.0	651.2
2005	473.6	66.0	9.3	19.2	568.0
2006	436.2	60.8	8.5	17.6	523.2
2007	277.3	38.6	5.4	11.2	332.6
2008	344.1	47.9	6.7	13.9	412.6
2009	176.4	24.6	3.4	7.1	211.5
2010	147.1	20.5	2.9	5.9	176.4

Table 5: Estimated total bycatch, by-product and discards of french purse seine fishery in 2003-2010 when fishing on fish-aggregating device associated schools

Total bycatch (FAD)						
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total	
2003	1567.0	1164.9	41.4	366.6	3139.9	
2004	1490.6	1108.1	39.4	348.7	2986.9	
2005	1452.5	1079.8	38.4	339.8	2910.5	
2006	1570.2	1167.3	41.5	367.4	3146.4	
2007	1294.7	962.5	34.2	302.9	2594.4	
2008	1373.9	1021.3	36.3	321.4	2753.0	
2009	1490.8	1108.3	39.4	348.8	2987.3	
2010	1236.8	919.4	32.7	289.4	2478.3	

Total by-products (FAD)						
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total	
2003	181.3	275.4	24.8	122.8	604.2	
2004	172.5	262.0	23.6	116.8	574.8	
2005	168.1	255.3	23.0	113.8	560.1	
2006	181.7	275.9	24.8	123.0	605.5	
2007	149.8	227.5	20.5	101.4	499.2	
2008	159.0	241.4	21.7	107.7	529.8	
2009	172.5	262.0	23.6	116.8	574.9	
2010	143.1	217.4	19.5	96.9	476.9	

Total discards (FAD)						
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total	
2003	1385.7	889.5	16.6	243.8	2535.7	
2004	1318.2	846.2	15.8	232.0	2412.1	
2005	1284.4	824.5	15.4	226.0	2350.4	
2006	1388.5	891.3	16.7	244.3	2540.9	
2007	1144.9	735.0	13.7	201.5	2095.1	
2008	1214.9	779.9	14.6	213.8	2223.2	
2009	1318.4	846.3	15.8	232.0	2412.4	
2010	1093.7	702.1	13.1	192.5	2001.4	

Table 6: Estimated total bycatch, by-product and discards of the French purse seine fishery in 2003-2010 for all fishing modes, i.e. free-swimming and C

Total bycatch (All)					
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total
2003	2133.0	1256.2	65.7	397.0	3852.0
2004	2104.7	1207.2	65.8	381.8	3759.4
2005	1988.1	1166.2	61.4	368.6	3584.2
2006	2063.5	1246.9	62.7	393.9	3767.0
2007	1608.3	1013.1	47.7	319.8	2988.9
2008	1763.0	1084.1	53.0	342.4	3242.5
2009	1690.3	1140.5	48.0	359.5	3238.3
2010	1403.1	946.3	39.8	298.3	2687.5

Total by-products (All)					
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total
2003	246.8	297.0	39.3	133.0	716.1
2004	243.5	285.4	39.4	127.9	696.1
2005	230.0	275.7	36.7	123.5	665.9
2006	238.8	294.8	37.5	131.9	702.9
2007	186.1	239.5	28.5	107.1	561.2
2008	204.0	256.3	31.7	114.7	606.6
2009	195.6	269.6	28.7	120.4	614.3
2010	162.3	223.7	23.8	99.9	509.8

Total discards (All)					
Year	Tunas	Bony Fishes	Billfishes	Sharks and Rays	Total
2003	1886.2	959.2	26.4	264.1	3135.9
2004	1861.2	921.8	26.4	253.9	3063.3
2005	1758.0	890.5	24.7	245.2	2918.4
2006	1824.8	952.1	25.2	262.0	3064.0
2007	1422.2	773.6	19.2	212.7	2427.7
2008	1559.0	827.8	21.3	227.7	2635.8
2009	1494.7	870.9	19.3	239.1	2624.0
2010	1240.8	722.6	16.0	198.4	2177.8

Table 7: Species composition of all sets sampled (a total of 2 218 t for the 2003-2007 period) during the observer program on European purse seiners (Amande et al. 2008) in percentage of weight and by fishing mode

Species group	Species	% weight by Fishing mode			
		FSC	FAD	Total	% cum.
Tunas (1263.6 t)	<i>Katsuwonus pelamis</i>	25.7	48.2	45.5	45.5
	<i>Auxis thazard</i>	16.8	25.9	24.8	70.3
	<i>Auxis rochei</i>	36.6	9.2	12.5	82.8
	<i>Thunnus albacares</i>	7.4	8.9	8.8	91.5
	<i>Auxis sp.</i>	0.5	4.0	3.5	95.1
	<i>Thunnus obesus</i>	3.9	2.0	2.2	97.3
	<i>Euthynnus affinis</i>	8.9	1.0	1.9	99.2
	Unk.	0.0	0.8	0.7	100.0
	<i>Thunnus alalunga</i>	0.1	0.0	0.0	100.0
	Total Tunas	100.0	100.0	100.0	
Bony Fishes (730.5 t)	<i>Elagatis bipinnulata</i>	37.1	43.1	42.7	42.7
	Triggerfish	23.8	19.8	20.1	62.8
	<i>Coryphaena spp.</i>	10.2	18.2	17.7	80.5
	Mackerel scad	0.0	7.6	7.0	87.6
	Carangids	20.5	5.0	6.1	93.6
	<i>Acantocybium solandri</i>	6.8	4.2	4.4	98.0
	Others	1.3	1.4	1.4	99.4
	<i>Sphyraena sp.</i>	0.4	0.6	0.6	100.0
	Total Bony Fishes	100.0	100.0	100.0	
Sharks and Rays (183.6 t)	<i>Carcharhinus falciformis</i>	45.1	71.0	69.1	69.1
	<i>Carcharhinus longimanus</i>	6.6	13.6	13.1	82.2
	Requin non identifié	1.1	6.3	5.9	88.1
	<i>Manta birostris</i>	13.5	2.4	3.2	91.3
	Ordre Carcharhiniformes	0.8	1.9	1.8	93.1
	<i>Carcharhinidae sp.</i>	0.2	1.8	1.7	94.8
	<i>Mobula mobular</i>	11.3	0.8	1.6	96.3
	<i>Mobula coilloti</i>	1.1	1.4	1.4	97.7
	<i>Raie non identifiée</i>	10.1	0.2	0.9	98.6
	Others	10.2	0.7	1.4	100.0
		Total Sharks and Rays	100.0	100.0	100.0
Billfishes (41.1 t)	<i>Makaira indica</i>	32.0	27.7	28.7	28.7
	<i>Tetrapturus audax</i>	22.3	29.2	27.6	56.3
	Famille des Istiophoridés	5.0	22.6	18.6	75.0
	<i>Makaira nigricans</i>	10.8	14.6	13.7	88.7
	<i>Istiophorus platypterus</i>	26.3	2.6	7.9	96.6
	<i>Xiphias gladius</i>	1.5	2.1	2.0	98.5
	<i>Tetrapturus angustirostris</i>	2.2	1.3	1.5	100.0
	Total Billfishes	100.0	100.0	100.0	

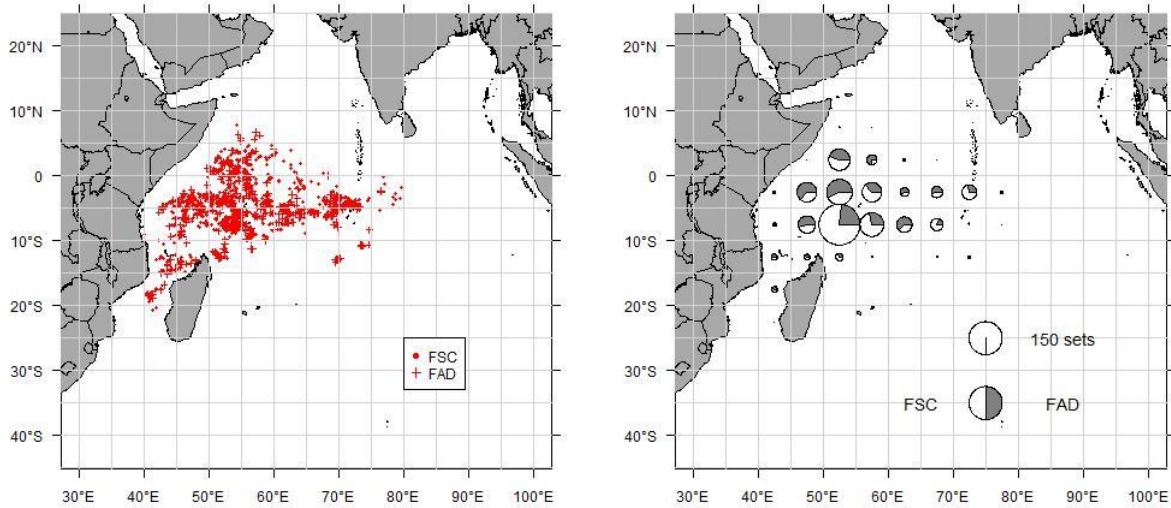


Figure 1: Geographical distribution (left) of observed sets on free swimming schools (FSC) and log-associated schools (FAD) and number of sets (right) observed by 5° statistical square through the French observer program (2005-2010)

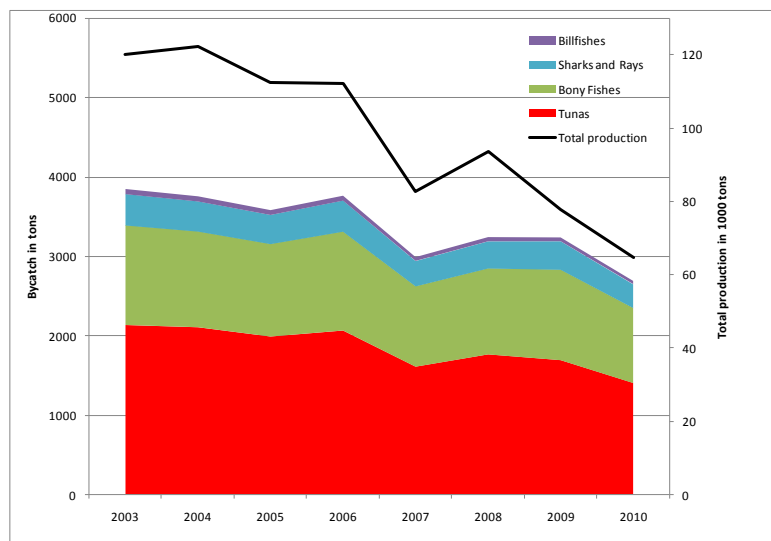


Figure 2: Bycatch by species group and total production for the French purse seine fishery 2003-2010