BY-CATCH AND DISCARDS OF THE EUROPEAN PURSE SEINE TUNA FISHERY IN THE ATLANTIC OCEAN: ESTIMATION AND CHARACTERISTICS FOR 2008 AND 2009

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SUMMARY

An update of by-catch and discards estimations by species groups is presented for the European purse seine tuna fishery operating in the Atlantic Ocean for 2008 and 2009 with 13 and 19 observed trips, respectively. Total by-catch was derived from a stratification based on fishing mode (free school vs. log school), season (quarters) and spatial area. The raising procedure was based on production i.e., landings of major commercial tunas proceeded by canneries. Annual by-catch for 2008 and 2009 was estimated to be about 11,500 t and 11,000 t, respectively, corresponding to a mean annual value of 142 t per 1,000 t and 119 t per 1,000 t of production, respectively. Tuna represents the major part of the by-catch, followed by fin fishes. By-catch fate, main species length distribution for the most common species and silky shark sex ratio are presented.

RÉSUMÉ

Une mise à jour de l'estimation des prises accessoires et des rejets par groupe d'espèces est présentée pour la pêcherie européenne à la senne opérant dans l'océan Atlantique pour les années 2008 et 2009 avec 13 et 19 sorties observées, respectivement. Le total des prises accessoires a été estimé sur la base d'une stratification par mode de pêche (banc libre/banc objet), saison (trimestre) et zone. La production, c'est-à-dire le débarquement de thon commercial qui part à la conserverie, a été utilisée comme facteur d'extrapolation pour le calcul des ratios. Les prises accessoires annuelles pour 2008 et 2009 ont été estimées respectivement à environ 11.500 t et 11.000 t, correspondant respectivement à une moyenne annuelle de 142 t pour 1 000 t et de 119 t pour 1 000 t de la production. Les thonidés représentent la majeure composante de la capture accessoire suivie des autres poissons. Le devenir des prises accessoires, les histogrammes de taille des espèces les plus importantes et le sexe ratio du requin soyeux sont présentés.

RESUMEN

Se presenta una actualización de las estimaciones de captura fortuita y descartes por grupos de especies para la pesquería atunera de cerco europea que operó en el océano Atlántico durante 2008 y 2009, con 13 y 19 mareas observadas, respectivamente. La captura fortuita se obtuvo a partir de una estratificación basada en el modo de pesca (bancos libres frente a bancos con objetos), temporadas (trimestres) y zonas espaciales. La producción, es decir los desembarques de las principales especies comerciales de túnidos destinados a las conserveras, se utilizó como factor de extrapolación para calcular las ratios. Se estimó que la captura fortuita para 2008 y 2009 ascendió a 11.500 y 11.000 t, respectivamente, lo que se corresponde con un valor anual medio de 142 t por 1.000 t y 119 t por 1.000 t de producción, respectivamente. Los túnidos respondieron de la mayor parte de la captura fortuita, seguidos por otros peces. Se presenta información sobre el destino de la captura fortuita, histogramas de talla de las especies más importantes y la ratio de sexos del tiburón jaquetón.

KEYWORDS

Tuna fisheries, purse seining, by-catch, discards, Atlantic Ocean

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1. Introduction

Incidental by-catch and associated discarding are difficult to estimate on the basis of log-book information because they are poorly reported by fishing masters and their importance varies according to several interrelated factors (Rochet and Trenkel, 2005). The issues of discarding are, however, of increasing concern because such practices are responsible for economic loss, juvenile mortality, ecological effects on key species which are relevant to the overall ecosystem structure and functioning (Hall et al. 2000; Kelleher, 2005). In addition, catches of juvenile tunas that are discarded or sold on local fish markets are generally absent from official statistics and, therefore, not included in the available statistics used as inputs of stock assessment models. The purpose of this analysis is to update estimates of total by-catch by species group for European tuna purse seine fishery in the Atlantic Ocean.

2. Data

Spanish and French purse seine fishery data (i.e., logbook, well maps, and landing data) and observer's data collected within the framework of DCF programme for 2008 and 2009 were used to update the estimates of by-catch of the European tuna purse seine fishery in the Atlantic Ocean (Amandé, et al. 2011). Observer data were collected during 13 trips and 19 trips in 2008 and 2009, respectively corresponding to 6.7% and 8.5% of total trips, respectively. Fishing sets were categorized into log associated (FAD) and free swimming schools (FSC) according to direct information reported by observers. **Table 1** shows some details about 2008 and 2009 observer and fishery data.

3. Methods

By computing a ratio between by-catch and tuna catch, by-catch by species group was assumed to be linearly correlated with tuna catch. The observed by-catch for each species group was then raised to the total European purse seine catch derived from fishery data by considering stratification based on fishing mode (FAD and FSC) quarters and areas. More details about the method and associated equations are detailed in Amandè et al. (2010). We used bootstrap approach for bias correction and confidence interval calculation (see Schucany, et al. 2010 for details on bias reduction in estimation).

4. Results

Total tuna production in 2008 was about 80,500 t and the annual by-catch was estimated at about 11,450 t, corresponding to 142 t/1,000 t of landed tunas (12.4% of the total catch). By-catch of tunas represented 77% of the total by-catch corresponding to 109.8 t/1,000 t of unloaded tuna. For the remaining 23% (32 t/1,000 t), bony fishes represented 17% (24 t/1,000 t), billfishes 5% (7 t/1,000 t), sharks and rays 1% (1.1 t/1,000 t) (**Table 2**).

By-catch of tunas was mainly composed of juvenile skipjack mainly discarded. The bulk of these species were small individuals (median of 40 cm and 1.5 kg) that are not of interest for processing by tuna canneries (**Figure 1**). The size structure of skipjack and little tunny by-catch was very similar between 2008 and 2009. However skipjack and little tunny discards did not show significant difference in their size between free swimming (FSC) and log-associated schools (FAD). **Figure 2** shows no difference by sex in terms of number and length distribution of silky sharks caught by purse seiners was female (**Figure 2**).

Total tuna production in 2009 was about 93,000 t and the annual by-catch was estimated at about 11,100 t, corresponding to 120 t/1,000 t of landed tunas (10.7% of the total catch). By-catch of tunas represented 80% of the total by-catch corresponding to 95.2 t/1,000 t of unloaded tuna. For the remaining 20% (24 t/1,000 t), bony fishes represented 14% (17 t/1,000 t), billfishes 3% (3 t/1,000 t), sharks and rays 3.3% (4 t/1,000 t) (**Table 3**).

While the magnitude of by-catch was similar between 2008 and 2009, the spatial and temporal distributions were different. For 2008, the first quarter was 3 times higher than the over ones. In 2009, by-catch was lower during the first half of the year. By-catch was higher on FAD-associated sets than on free school sets, specifically for tunas and other bony fishes (**Figure 3**).

Figure 4 shows that the North-West Piccolo was the area with high by-catch in 2008, when 2009 by-catch spatial distribution indicates that the major areas were the South Equator and North East Equator. Confidence intervals of by-catch estimates by species groups and fishing mode indicate high uncertainty around estimates particularly for tuna's category and for FAD-associated sets (**Figure 5**).

5. Discussion

Estimates of by-catch in 2008-2009 are higher than observed for the period 2003-2007 for the same fishery (Amandè et al. 2010) mainly due to small tunas. This could be explaining by the arriving of boats from Indian Ocean because of pirate reasons. This phenomenon has increased fishing sets particularly log associated ones. The difference could be also the fact of the bias correction on by-catch estimated used in this analysis in contrast to the previous one.

6. Conclusion

The total number of fishing trips of purse seiners in the Atlantic Ocean observed within the European observer programme conducted by the Spanish (IEO and AZTI) and French institutes has increased from about 2.5% to 8.5% since its implementation in 2003. However, the percentage coverage of trips monitored by the observers remains still low compared to the yearly number of trips of the whole fishery and might lead to biases and uncertainties when using ratio estimators (Lennert-Cody). In addition, the fishing vessels associated to the European fleet but flying non European flags such as Panama and Belize are not monitored within the EU DCF observer programme. The update of the results on tuna by-catch in the purse seine tuna fishery of the Atlantic Ocean revealed differences between 2008 and 2009 in terms of spatial and temporal distribution of by-catch.

References

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Table 1. Number of observed sets in the Spanish and French observer program by year and associated percent coverage of the total number of trips. FSC = Free school; FOB = Floating objects.

Year	Fishing mode	Number of sets/quarter				Total observed sets	Sets in the fishery	Number of trips		
		Jan-Mar	Apr-June	Jul-Sept	Oct-Dec			Observed	Total	Coverage (%)
2008	FSC	54	75	62	57	248	1536	13	195	6.7
	FOB	25	54	27	22	128	1827			
2009	FSC	64	42	86	86	278	1875	19	224	8.5
	FOB	29	19	44	45	137	2553			

Table 2. Estimated by-catch by species group for the year 2008.

		FSC		FAD		Total	
		t	t/1000 t	t	t/1000 t	t	t/1000 t
Total catch		41032		50921		91952	
Production		39503		41016		80518	
Total by-catch		1529	38.7	9905	241.5	11434	142.0
	Tuna	1296	32.8	7544	183.9	8840	109.8
	Bony fishes	115	2.9	1834	44.7	1949	24.2
	Billfishes	101	2.6	460	11.2	561	7.0
	Sharks	12	0.3	51	1.2	63	0.8
	Rays	5	0.1	16	0.4	21	0.3

Table 3. Estimated by-catch by the species group for the year 2009.

		FSC		FAD		Total	
		t	t/1000 t	t	t/1000 t	t	t/1000 t
Total catch		53007		51152		104159	
Production		48754		44290		93044	
Total by-catch		4253	87.2	6862	154.9	11115	119.5
	Tuna	3719	76.3	5138	116.0	8857	95.2
	Bony fishes	188	3.9	1418	32.0	1606	17.3
	Billfishes	99	2.0	165	3.7	264	2.8
	Sharks	221	4.5	129	2.9	350	3.8
	Rays	26	0.5	12	0.3	38	0.4

Table 4. By-catch fate (by-products or discards) estimated by the species group.

		By-products		Discards		Total
		%	t	%	t	t
2008	Tunas	21	1821	79	7019	8840
	Bony Fish	53	1031	47	918	1949
	Billfish	99	553	1	8	561
	Sharks	69	44	31	19	63
	Rays	11	2	89	19	21
	Total		3451		7983	11434
2009	Tunas	18	1550	83	7307	8857
	Bony Fish	74	1187	26	419	1606
	Billfish	85	224	15	40	264
	Sharks	55	191	45	159	350
	Rays	10	4	90	34	38
	Total		3156		7959	11115

Table 5. Proportion of by-catch per fishing mode. Values were calculated using observer data.

	By-catch species		2008		2009	
			Percentage		*Percentage*	
	Scientifique name	*Code*	*BL*	*BO*	*BL*	*BO*
Tunas	Thunnus alalunga	ALB			-	100
	Thunnus obesus	BET	-	100		
	Auxis rochei	BLT	94	6	68	32
	Auxis thazard	FRI	45	55	21	79
	Auxis sp.	FRZ	-	100	36	64
	Euthynnus affinis	KAW	-	100		
	Euthynnus alletteratus	LTA	97	3	30	70
	Katsuwonus pelamis	SKJ	31	69	21	79
	Thunnus albacares	YFT	31	69	29	71
	Total		**48**	**52**	**30**	**70**
Bony fishes	Balistes capriscus	BAC	56	44		
	Balistes carolinensis	BAL	0	100	5	95
	Balistes punctatus	BAP	-	100	-	100
	Aluterus monoceros	BAT	2	98	-	100
	Canthidermis maculatus	BCM	1	99	19	81
	Ablennesse hians	BEA			-	100
	Coryphaena equiselis	COE	10	90	16	84
	Coryphaena hippurus	COH	16	84	57	43
	Caranx crysos	CRY	9	91	43	57
	Uraspis helvola	CUH			-	100
	Uraspis secunda	CUS	-	100		
	Uraspis sp.	CUX	-	100		
	Diodon hystrix	DIH				
	Diodon sp.	DIO				
	Elagatis bipinnulata	ELP	4	96	13	87
	Balistidae	FBA			11	89
	Coryphaenidae	FCO	100	-	38	62
	Carangidae	FCR	-	100	79	21
	Exocoetidae	FEX				
	Molidae	FMO				
	Kyphosus sp.	FKY	-	100		
	Kyphosus sectator	KPS	64	36	46	54
	Lobotes surinamensis	LOB	38	62	47	53
	Masturus lanceolatus	MAL	-	100	17	83
	Mola mola	MMO	86	14	60	40
	Remora remora	REM	74	26	50	50
	Ruvettus pretiosus	RUP	100	-	-	100
	Seriola rivoliana	SER	-	100	-	100
	Sphyraena barracuda	SPB	3	97	32	68
	Sphyraenidae	SPH	-	100		
	Acanthocybium solandri	WAH	6	94	36	64
	Total		**3**	**97**	**36**	**64**

Table 6. Proportion of by-catch per fishing mode. Values were calculated using observer data (continuation).

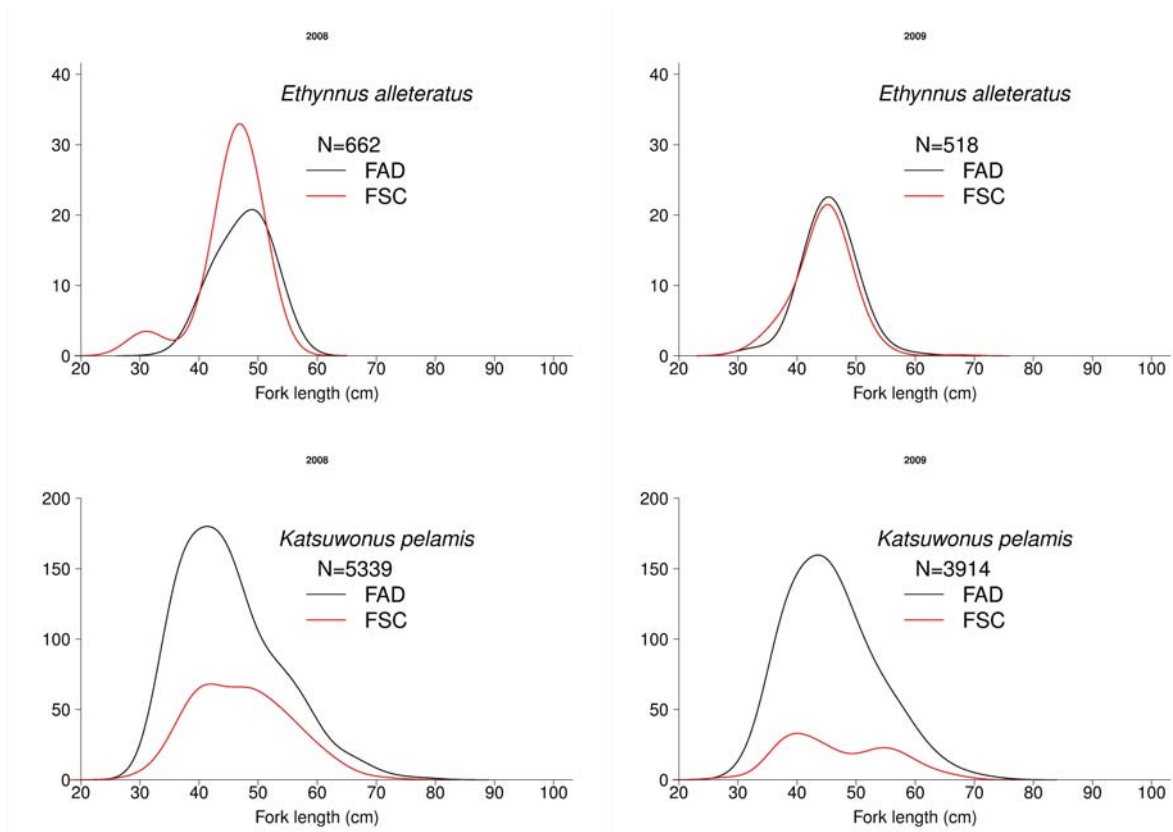|	By-catch species		2008 Percentage		2009 Percentage	
	Scientific name	Code	BL	BO	BL	BO
Billfishes	Makaira indica	BLM	88	12		
	Makaira nigricans	BUM	14	86	38	62
	Istiophoridés	FIS	19	81	53	47
	Istiophorus albicans	SAI	66	34	94	6
	Tetrapterus albidus	WHM			-	100
	Total		**22**	**78**	**49**	**51**
Sharks	Carcharhinus falciformis	CFA	4	96	79	21
	Carcharhinus longimanus	CLO	100	-		
	Carcharhinidae sp.	FCA	47	53	65	35
	Sphyrnidae sp.	FSP			19	81
	Isurus oxyrinchus	IOX	73	27	82	18
	Carcharhiniformes	OCA				
	Prionace glauca	PGL				
	Sphyrna lewini	SLE	100	-	61	39
	Sphyrna zygaena	SZY	20	80	-	100
	Total		**34**	**66**	**74**	**26**
Rays	Dasyatis violacea	DVI	75	25		
	Dasyatidae sp.	FDA				
	Mobula coilloti	MCO			86	14
	Mobula mobula	MOM			50	50
	Mobula rancurelli	MRA	29	71		
	Mobula sp.	RMV	100	-		
	Total		**55**	**45**	**82**	**18**

Figure 1. Length frequency distribution on FAD-associated and free school sets for discarded skipjack, *Katsuwonus pelamis* and little tunny, *Ethynnus alletteratus*. Left and right graphics represent the years 2008 and 2009, respectively.
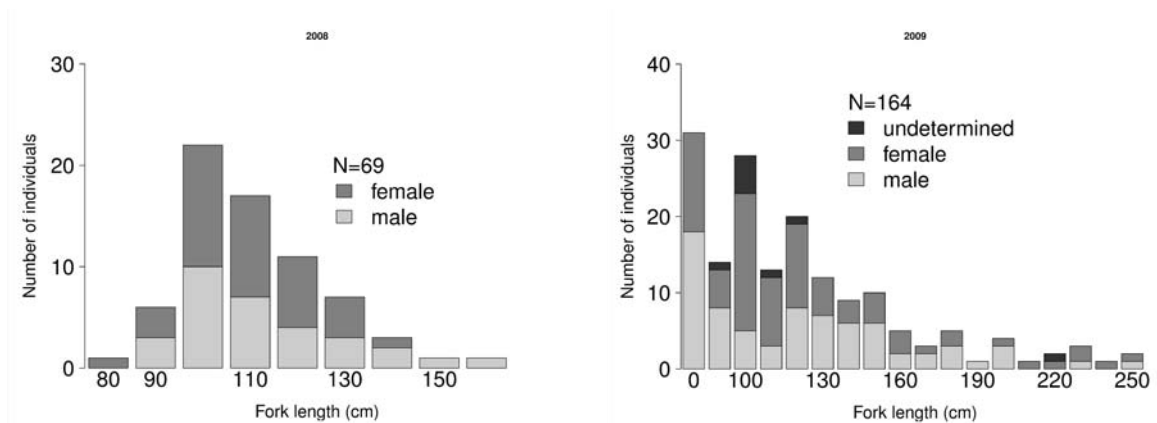

Figure 2. Length frequency distribution of silky shark *Carcharhinus falciformis* by sex. Left and right graphics represent the years 2008 and 2009, respectively.
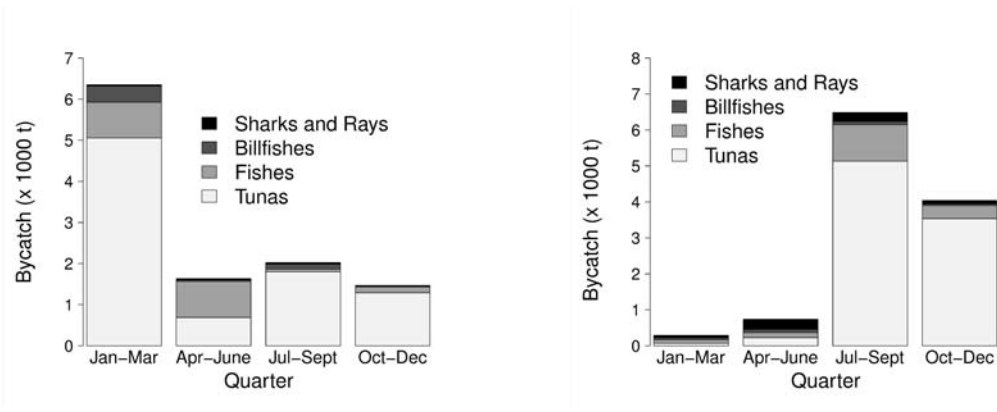
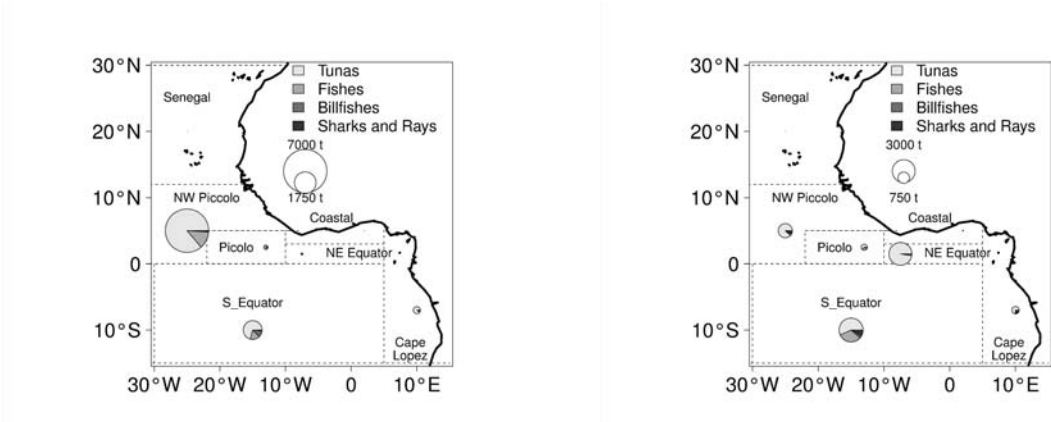**Figure 3**. Total by-catch by quarters. Left and right graphics represent the years 2008 and 2009, respectively.

Figure 4. Estimated by-catch by species group and ET area. Left and right graphics represent the years 2008 and 2009, respectively.
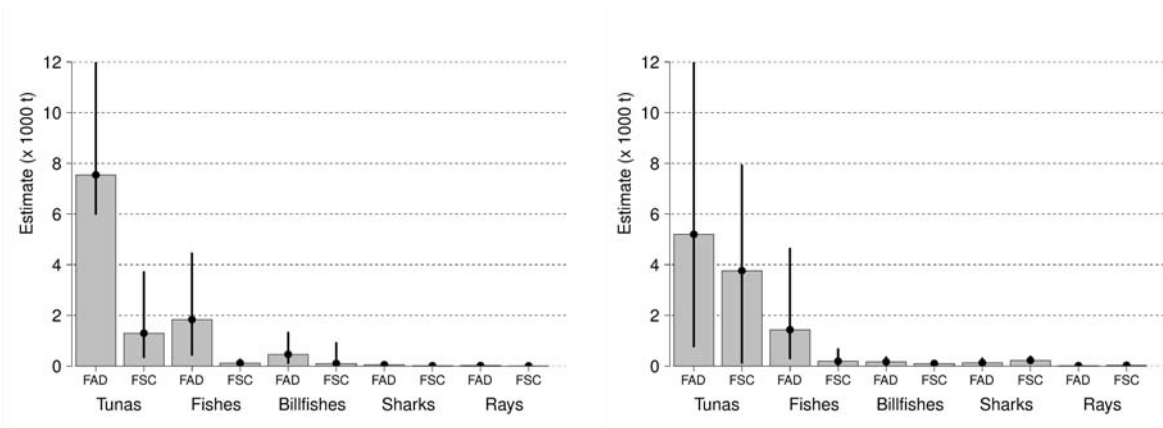

Figure 5. Estimated by-catch by species group and fishing mode. Vertical lines indicate 95% confidence intervals. Left and right graphics represent the years 2008 and 2009, respectively.

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