ICCAT BLUEFIN TUNA AERIAL SURVEY 2013

Final report of surveys carried out in Block A (GBYP sub-area)

Prepared by

Ariadna Purroy Albet MSc.

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INTRODUCTION

One of the scientific initiatives carried out by the ICCAT in the research program GBYP is the aerial survey program, consisting in several campaigns along the Mediterranean Sea during the breeding season of the Bluefin tuna (*Thunnus thynnus*).

The aerial survey is one of the best methodologies to get fishery independent data for those marine species having surfacing behaviors. In the case of Bluefin tuna, the species approaches the sea surface mostly in two periods: in late Spring and early Summer, for spawning, and in late Summer and Autumn for feeding aggregations of juveniles. In the first case, aerial survey could be potentially able to detect trends of the minimum spawning stock biomass, and provide indices for the recruitment. In any case, to get these results, it is necessary that aerial surveys are based on a statistically sound design, set-up by expert specialists, and to carry out the surveys under a precise methodology for several years. The trends obtained by aerial surveys can be used to improve the models. The type of aircraft used for the survey, the quality and expertise of professional spotters and observers and their proper training are other very important elements. The GBYP is focusing its efforts only on spawning aggregations, because the eastern Bluefin tuna stock has a unique spawning area, the Mediterranean Sea.

This report corresponds to the third aerial survey for the seasonal period of 2013 in Block A (see general area in Figure 1). This is westernmost area in the Mediterranean Sea were this program works and contemplates the Balearic Islands and their surroundings. It is limited on the west by the Iberian Peninsula and on the east by Block B.

Due to the main goal of the ICCAT-GBYP is to record tuna sightings and their components, this reports displays specific information on BFT sightings such as number of tones, school components, cue of sightings as for detailed distribution maps, but it also contemplates general information of sightings of other marine species.

During the 2013 campaign the team was composed by: two scientists, Ariadna Purroy and Samantha Bowgen, a professional observer, Lluís Navarro and an aviation pilot, Iñigo Zarate.

The resources employed for the aerial surveys consisted in a Partenavia (aircraft) equipped with bubble windows on each side, a GPS GARMIN aera 500, 2 binoculars 7x50: 113m/1000m, a Camera Nikon D-90 (AF-S NIKKOR 18-200mm. 1:3,5-5.6 G ED) equipped with a polarized lens and 2 clinometers.

The GBYP set up general rules for standardizing the aerial surveys to be conducted: all aircraft shall have upper wings, possibly two engines, should stay at an altitude between 300 to 330 m over the sea level, and shall have a GPS able to continuously record the track and the related data. Each aircraft shall be identified by an ICCAT number in contrasting color with the aircraft, on one lower side of the wings and on one side of the aircraft. Each team on board shall include an expert pilot, a professional tuna spotter and two scientific observers. All sightings shall be properly recorded on a common form in excel, to facilitate the data elaboration, and documented by photos. These standardized conditions were again defined in a meeting in Madrid in June 4th by the ICCAT Secretariat, including a highest speed of 100 knots. These conditions have been maintained except for when the low clouds didn't allow for visibility, in which case the flight below the 300 meters for a few minutes. According to European Union regulations, the flight duration could not exceed 4 hours. In those days were two flights were performed, there was at least a 2 hours break between flights. If all these conditions did not meet, the flight had to be cancelled.

The forms were revised and slightly modified and consisted on an effort form and a sighting form shown in the self-explanatory Tables 1 and 2.

For each survey there was a rotation of position in the aircraft between the scientists and the professional observer. The sightings were spatially located, described and photo-identified when possible by the two scientists; whereas for the tuna sightings, the professional observer estimated the size of the school, the school components in terms of individual size and the weight in terms of total biomass. The *Glare* section was an important determinant for sightings and the *Declination angle* was calculated from the clinometers at the time abeam. In both forms, a *Notes* section was added to record other relevant biological information added to the study.

The study area is shown in Figure 1, and consisted in a Sub-area¹ with two replicas, and an Outside area. Because the time allowed for more surveys, there were extra tracks consisting in three more replicas in the subarea and one more replica in the outside area.



Figure 1. Aerial surveys in Block A

¹ Part of a series of sub-areas identified for conducting the aerial survey on spawning aggregations in 2013, based on the 2008-2009 purse-seine fishing activity.

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Table 1. Effort form template

												Block	
												Survey	
												Transect	
												Bubble windows	
												Date	
												Time sighting	
												Lat initial sighting	
												Lon initial sighting	3
												Time abeam	
												Observer	
												Cue	
												Species	
												Confidency	
-												School size	
-												Estimated weight	
												Height	-
-												Declination angle	
-			_									Lat animals	
-			_									Long animals	
-			_									Break track?	
-			_									Photos taken?	
									-			1st	Ph
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					-				-			School heading	#
-			_						-			% small	
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			_		-				+			% large	
-			_		-		-		+			% giant	mp.
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Table 2. Sighting form template

RESULTS

The aerial surveys in Block A comprising the Balearic Islands and their surroundings waters had an extension of 31 days, starting June 6th and ending July 6th.

Environmental conditions and aircraft maintenance have defined the optimal working days. The sea surface temperature was too low at the beginning of the survey campaign on this part of the Mediterranean, together with strong wind days and bad weather conditions had a relevant presence in many days; thus, the actual days for surveying represented almost the 60% of the campaign with 18 flight days consisting on 9 single flight days and 9 double flight days, comprising a total number of 27 flights (Table 3).

Table 3. Flying days

Flight days		18
No flight down	Bad conditions	10
No flight days	Maintenance	3
Number of flights	27	

The sightings of tuna species have been classified in three groups belonging to the Scombridae Family: Bluefin tuna (BFT), Albacore tuna (ALB) and frigate tuna (OTH). Table 4 shows the number of sightings for each of these group species contemplating the amount of days for these sightings, the amount of sightings within these days and the total weight given in tones (T). These data has been divided for both IN and OFF transect sightings. Considering both types of sightings, and since in certain surveys one day could contemplate both IN and OFF sightings, the total numbers for BFT are 41 schools sighted in 15 days with a total amount of 4681.1 T; for ALB a total number of 8 schools sighted in 2 days summing up 51 T; and for OTH a total number of 10 schools sighted in 6 days. Frigate tuna, locally known as *melva*, is an abundant species found around the Balearic Islands; because of the small size of its individuals and the big schools they constitute, OTH sightings have not allowed to estimate their biomass (See Figure 6 for the spatial distribution of the other Tunnids besides BFT).

Note that in 10 of the sightings for BFT, weight could not be estimated (for more details see Table 6). This could be due to either water transparency conditions (turbidity, clouds...) or that the school dived in.

A considerable amount of sightings corresponded to Accessory species (Table 5 and Figure 7). A total number of 122 marine mammals, comprising both whales and dolphins, were sighted in both IN and OFF transect; 166 turtles, always found individually with many of the sightings distributed along currents and sighted in either side of the aircraft; 11 swordfishes, mostly sighted individually but in a couple occasions travelling in pairs; 20 manta rays both single and group sightings and 3 unidentified species.

School components refer to the size of the sighted individuals and it has been noted as percentages within each sighted school. The ranges are *Small* referring to individuals < 25 Kg, *medium* to individuals between 25 – 150 Kg, *large* to individuals between 150 – 300 Kg and *giant* to individuals > 300 Kg (Table 6 and Figure 5).

		IN				OFF		
		Days	Schools	Tones	Days	Schools	Tones	
	BFT	8	20	1399.1	12	21	3282	
Number of sightings	ALB	1	4	14	2	4	37	
	ОТН	5	6	NA	4	4	NA	

Table 4. Sightings of species from the Family Scombridae

Table 5. Sightings of Accessory species

		IN	OFF
	Marine		
	Mammals	87	35
	Turtles	107	59
Number of sightings	Swordfish	6	5
	Manta rays	7	13
	Und	3	-

The cue for the sightings was classified in travelling, splash, shining, ripples and others. Most of the sightings (28) were sighted when travelling, followed by the shining (13), ripples (6), splash (2) and others (2); some of the sightings resulted from a combination of 2 cues (for more details see Table 7). Also, from the 41 school sightings a total school size of 28164 specimens was recorded.

# of	# of Estimated weight School components					
sighted schools	Date	(T)	% small	% medium	% large	% giant
1	6/6/2013	100	х	х	100	х
2	6/6/2013	60	х	40	60	х
3	6/12/2013	NA	NA	NA	NA	NA
4	6/12/2013	NA	NA	NA	NA	NA
5	6/15/2013	100	х	х	х	100
6	6/15/2013	75	х	70	30	х
7	6/15/2013	350	x	х	50	50
8	6/15/2013	1	100	х	х	х
9	6/16/2013	225	х	х	100	х
10	6/20/2013	150	x	х	х	100
11	6/21/2013	300	х	х	х	100
12	6/21/2013	225	х	50	50	х
13	6/21/2013	NA	NA	NA	NA	NA
14	6/21/2013	264	х	х	80	20
15	6/22/2013	5	100	x	x	х
16	6/25/2013	NA	NA	NA	NA	NA
17	6/28/2013	300	х	100	х	х
18	6/28/2013	500	x	x	80	20
19	6/29/2013	0.6	x	х	100	x
20	6/29/2013	7	100	х	х	х
21	6/30/2013	180	x	х	100	х
22	7/1/2013	NA	NA	NA	NA	NA
23	7/1/2013	NA	NA	NA	NA	NA
24	7/3/2013	100	x	х	100	x
25	7/3/2013	1.5	x	x	100	х
26	7/3/2013	NA	NA	NA	NA	NA
27	7/3/2013	250	х	х	50	50
28	7/3/2013	100	x	80	20	x
29	7/3/2013	500	x	х	50	50
30	7/4/2013	240	x	30	70	х
31	7/4/2013	70	x	65	35	x
32	7/4/2013	150	x	х	100	x
33	7/4/2013	180	x	х	100	x
34	7/6/2013	5	100	x	x	x
35	7/6/2013	1	100	х	x	x
36	7/6/2013	1	100	х	x	x
37	7/6/2013	NA	100	х	х	х

Table 6. Tonnage and school components by size of the Bluefin tuna sightings.

# of		Estimated weight	School components							
sighted schools	Date	(T)	% small	% medium	% large	% giant				
38	7/6/2013	NA	100	х	х	х				
39	7/6/2013	120	х	x	100	х				
40	7/6/2013	NA	NA	NA	NA	NA				
41	7/6/2013	120	х	x	50	50				

OFF transect

Table 7. Cue of the sightings and school size for BFT

Number of sighting	travelling	splash	shining	ripples	other	School size		Number of sighting	travelling	splash	shining	ripples	other	School size
1	х					400		22				х		NA
2	х					200		23	х					NA
3	х					NA		24	х		х			700
4	х					NA		25	х					7
5			х			500		26		х				NA
6			х			900		27			х	х		900
7				x		2000		28	х		х			1200
8					х	NA		29	х					2000
9			х			1500		30			х			1200
10	х	x				500		31	х					700
11	х					1000		32	х		х			1000
12	х					1500		33				х		1200
13	х					NA		34	х					1000
14	х		х			1200		35	х					200
15	х		х			250		36	х					200
16					х	NA		37	х					NA
17	х		х			3500		38	х					4
18	х		х			2500	-	39	х					600
19	х					3		40				х		NA
20	х					NA		41				х		400
21	х		х			900		Total	28	2	13	6	2	28164

3.1. Flight calendar

The following calendars show the distribution of the surveyed period along the months of June and July. From the start of the survey each day contains the number of flights or alternatively, the reason why flying was not allowed. Additionally, there is a distinction between cells with BFT sightings and cells with no BFT sightings; being also distinguished those sightings surveyed off transect (in lines).

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
					1	2
3	4	5	6 Start Survey	7	8	9
			1 FLIGHT	1 FLIGHT	Bad conditions	Bad conditions
10	11	12	13	14	15	16
2 FLIGHTS	Bad conditions	1.FLIGHT	Bad conditions	Bad conditions	1 FLIGHT	1 FLIGHT
17	18	19	20	21	22	23
Bad conditions	Bad conditions	Bad conditions	2 FLIGHTS	2.FLIGHTS	LEUGHT	Bad conditions
24	25	26	27	28	29	30//
Bad conditions	1.FLIGHT	Maintenance	Maintenance	2 FEIGHTS	2/FLIGHTS	1 FLIGHT
	I		I	I		

June 2013

July 2013

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
	2	3	4	5	6 2.FLIGHTS	7
2.FLIGHTS	1 FLIGHT	2 FLIGHTS	2 FLIGHTS	Maintenance	End Survey	
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				



Sightings of Thunnus thynnus IN survey transects

Sightings of Thunnus thynnus OFF survey transects

3.2. Control of flight schedule

Date	Departure	Arrival	Take off	Landing	Dif	Start	Stop	Dif	Observaciones
03/06/13	LERS	LERS	11:40:00	13:05:00	01:25:00	11:10:00	13:10:00	02:00:00	Vuelo de prueba
05/06/13	LERS	LERS	15:10:00	15:35:00	00:25:00	14:50:00	15:45:00	00:55:00	Vuelo de prueba
05/06/13	LERS	LEIB	18:00:00	19:15:00	01:15:00	17:45:00	19:20:00	01:35:00	Relocation
06/06/13	LEIB	LEIB	12:35:00	16:05:00	03:30:00	12:15:00	16:15:00	04:00:00	Survey
07/06/13	LEIB	LEIB	08:35:00	12:00:00	03:25:00	08:20:00	12:10:00	03:50:00	Survey
10/06/13	LEIB	LEMH	07:45:00	11:20:00	03:35:00	07:25:00	11:25:00	04:00:00	Survey
10/06/13	LEMH	LEIB	13:40:00	16:40:00	03:00:00	13:25:00	16:55:00	03:30:00	Survey
12/06/13	LEIB	LEIB	09:30:00	13:05:00	03:35:00	09:20:00	13:20:00	04:00:00	Survey
13/06/13	LEIB	LERS	09:30:00	10:35:00	01:05:00	09:20:00	10:45:00	01:25:00	Ferry
13/06/13	LERS	LEIB	16:10:00	17:35:00	01:25:00	16:00:00	17:45:00	01:45:00	Ferry
15/06/13	LEIB	LEIB	09:05:00	12:20:00	03:15:00	08:55:00	12:30:00	03:35:00	Survey
16/06/13	LEIB	LEIB	09:00:00	11:45:00	02:45:00	08:50:00	11:55:00	03:05:00	Survey
20/06/13	LEIB	LESB	09:10:00	11:25:00	02:15:00	09:00:00	11:40:00	02:40:00	Survey
20/06/13	LESB	LEIB	13:55:00	17:40:00	03:45:00	13:45:00	17:45:00	04:00:00	Survey
21/06/13	LEIB	LEMH	07:35:00	11:15:00	03:40:00	07:25:00	11:25:00	04:00:00	Survey
21/06/13	LEMH	LEIB	13:30:00	17:20:00	03:50:00	13:25:00	17:25:00	04:00:00	Survey
22/06/13	LEIB	LEIB	09:20:00	13:00:00	03:40:00	09:05:00	13:05:00	04:00:00	Survey
25/06/13	LEIB	LEIB	08:55:00	12:25:00	03:30:00	08:50:00	12:35:00	03:45:00	Survey
26/06/13	LEIB	LERS	09:15:00	10:25:00	01:10:00	09:00:00	10:35:00	01:35:00	Ferry
27/06/13	LERS	LEIB	17:30:00	18:35:00	01:05:00	17:15:00	18:45:00	01:30:00	Ferry
28/06/13	LEIB	LEIB	07:55:00	11:30:00	03:35:00	07:40:00	11:40:00	04:00:00	Survey
28/06/13	LEIB	LEIB	14:10:00	17:40:00	03:30:00	14:00:00	17:55:00	03:55:00	Survey
29/06/13	LEIB	LESB	08:10:00	11:40:00	03:30:00	08:00:00	11:50:00	03:50:00	Survey
29/06/13	LESB	LEIB	14:30:00	18:00:00	03:30:00	14:20:00	18:10:00	03:50:00	Survey
30/06/13	LEIB	LEIB	09:45:00	13:15:00	03:30:00	09:35:00	13:25:00	03:50:00	Survey
01/07/13	LEIB	LEMH	08:05:00	11:50:00	03:45:00	07:55:00	11:55:00	04:00:00	Survey
01/07/13	LEMH	LEIB	14:20:00	17:45:00	03:25:00	14:00:00	17:55:00	03:55:00	Survey
02/07/13	LEIB	LEIB	09:45:00	13:25:00	03:40:00	09:35:00	13:35:00	04:00:00	Survey
03/07/13	LEIB	LELC	07:40:00	11:25:00	03:45:00	07:30:00	11:30:00	04:00:00	Survey
03/07/13	LELC	LEIB	14:50:00	18:30:00	03:40:00	14:40:00	18:40:00	04:00:00	Survey
04/07/13	LEIB	LEIB	07:50:00	11:25:00	03:35:00	07:30:00	11:30:00	04:00:00	Survey
04/07/13	LEIB	LEIB	15:10:00	18:55:00	03:45:00	14:55:00	18:55:00	04:00:00	Survey
05/07/13	LEIB	LERS	05:30:00	06:45:00		05:20:00	07:10:00	01:50:00	Ferry
05/07/13	LERS	LEIB	17:50:00	19:10:00		17:35:00	19:25:00	01:50:00	Ferry
06/07/13	LEIB	LEIB	07:45:00	11:20:00		07:30:00	11:30:00	04:00:00	Survey
06/07/13	LEIB	LEIB	13:40:00	17:20:00		13:30:00	17:30:00	04:00:00	Survey
07/07/13	LEIB	LERS	9:10	10:40		9:00	10:50	01:50:00	Ferry
Total hora	as survey:	take off-land	Start-stop						
		94:45:00	120:00:00						

3.3. Surveys

Track 6/6/2013



Track 7/6/2013



Track 10/6/2013 1st flight



Track 10/6/2013 2nd flight



Track 12/6/2013



Track 15/6/2013



Track 16/6/2013



Track 20/6/2013 1st flight



Track 20/6/2013 2nd flight



Track 21/6/2013 1st flight



Track 21/6/2013 2nd flight



Track 22/6/2013



Track 25/6/2013



Track 28/6/2013 1st flight



Track 28/6/2013 2nd flight



Track 29/6/2013 1st flight



Track 29/6/2013 2nd flight



Track 30/6/2013



Track 1/7/2013 1st flight



Track 1/7/2013 2nd flight



Track 2/7/2013



Track 3/7/2013 1st flight



Track 3/7/2013 2nd flight



Track 4/7/2013 1st flight



Track 4/7/2013 2nd flight



Track 6/7/2013 1st flight



Track 6/7/2013 2nd flight



3.4. Spatial distribution

3.4.1. Spatial distribution of Bluefin Tuna

Bluefin Tuna sightings have occurred in a higher percentage in the OFF transect areas; consequently, and despite the nature of this report, both sighting areas have been taken into account and displayed markedly along the following distribution maps. In Figure 2 an overall distribution of BFT sightings is shown.



Figure 2. Spatial distribution of all BFT sightings in both IN transects and OFF transects surveys. In circles: sightings in transect; in squares: sightings off transect

In Figure 3 the distribution of BFT sightings for each surveyed day considering again the IN and OFF transect survey sightings is displayed. Same colors for both IN and OFF transect surveys represent the same days. The maximum amount of schools were observed in July 6th, July 3rd, July 4th, June 15th, June 21st with 8, 6, 4, 4 and 4 sightings. The other days school sightings fluctuated between 1 and 3.



Figure 3. BFT sightings per surveys. In circles: sightings IN transect; in squares: sightings OFF transect

3.4.1.1. Estimated weight (T)

The following distribution map displays the data previously shown in Table 6. The western side the island of Ibiza show a greater biomass. Contrarily, the southeast of Mallorca show the lowest biomass in the different sightings.



Figure 4. Total Biomass of BFT (measured weight in Tones) sighted in the aerial surveys

3.4.1.2. School components

The following distribution map displays the data previously shown in Table 7 referring to the individual composition of the sighted school. Large and small individual sizes are the percentages of school size dominating the observations. Their distribution is consistent with the tonnage, being the western side of Ibiza dominated with large individuals whereas the southeast of Mallorca hold the smaller individuals from the sightings.



Figure 5. Distribution of the School components based on individual size (giant, large, medium and small) from the schools sighted in the aerial surveys.





Figure 6. Spatial distribution of other tunnid species. ALB: Albacore (Thunnus alalunga), OTH: Frigate tuna (Auxis thazard)

3.4.3. Spatial distribution of Accessory species: Marine mammals, turtles, swordfishes and manta rays



Figure 7. Spatial distribution of accessory species. MM: Marine mammal (dolphin & whale), CAR: Turtle (mostly *Caretta caretta*), MOB: Manta ray (*Mobula mobular*), SWO: Swordfish (*Xiphias gladius*)