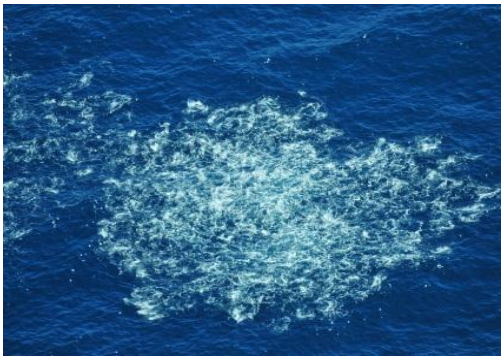
Technical Mission Report

Bluefin Tuna Aerial Survey / GBYP 03/2013 Research Program - Area B - Phase 4

Western Mediterranean Sea (From Minorca to Corso-Sardinian block)



ICCAT CICTA CICAA

ALLARD Rémi

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This work was carried out under the supervision of the ICCAT Atlantic-Wide Research Program for Bluefin Tuna (GBYP), funded by the European Community (grant SI2/542789), Canada, Croatia, Japan, Norway, Turkey, United States, Chinese and the ICCAT Secretariat. The content of this report does not necessarily reflect the point of view of the ICCAT or the other funders which have not responsibility about it. It will not necessarily influence the future decision of the commission in this area.

I. Background and objectives

The comprehensive ICCAT Atlantic Wide Research Program on Bluefin Tuna (GBYP) is required to improve basic data collection, the understanding of biological key and ecological processes, assessment models and management. An important element of this program is to carry out aerial surveys of the spawning population by transects in the Mediterranean Sea where and when shoals are traditionally sighted close to the sea surface to support the development of fishery independent indices. Within this context a Mediterranean-wide extensive survey is carried out in 2013, for a better understanding of the distribution and possible presence of spawners even outside the areas previously monitored in 2010 and 2011. For this purpose, an extensive new design has been developed, dividing the Mediterranean area into 7 sub-areas (Area A: Western Mediterranean/Balearic Sea, Area B: Western Mediterranean/Sardinian Sea, Sub-area C: Tyrrhenian Sea, Area D: Central-southern Adriatic Sea/Northern Ionian Sea, Area E: Strait of Sicily/Central-southern Mediterranean Sea, Area F: Ionian Sea/Eastern Mediterranean Sea/Aegean Sea, Area G: Aegean Sea/Levantine Sea). Areas D, F and B have never been monitored in previous years.

This report will only process the information collected on the area B and will review the effective flights, our target species (Bluefin Tuna or BFT) and the secondary species sighted.

II. Sampling protocole

a) The Aircraft

The aircraft was a Cessna 337 code F-GMBE (fig.1) previously used for professional activities in support of bluefin tuna fishing. “Bubble windows” were applied to improve sightings as foreseen by the ICCAT. Cessna 337’s technical details are available in the 2010 report of Belleney and Ramonet (Bellenet *et al*, 2010).

fig.1: Aircraft Cessna 337 used for aerial survey

As required by the ICCAT, the aircraft had to maintain an approximately altitude of 300 meters and a speed of 100 nm. The flying autonomy is about 5-6 hours.

b) Equipment

The equipment used was a Garmin Map 196 GPS with the statistical survey design uploaded (the same route was sent to the pilot to be transferred in the aircraft GPS as well) and a digital photo camera CANON® EOS 350D with 1600 ISO maximum sensitivity equipped with EF-S 10-22 mm f/3 lens.

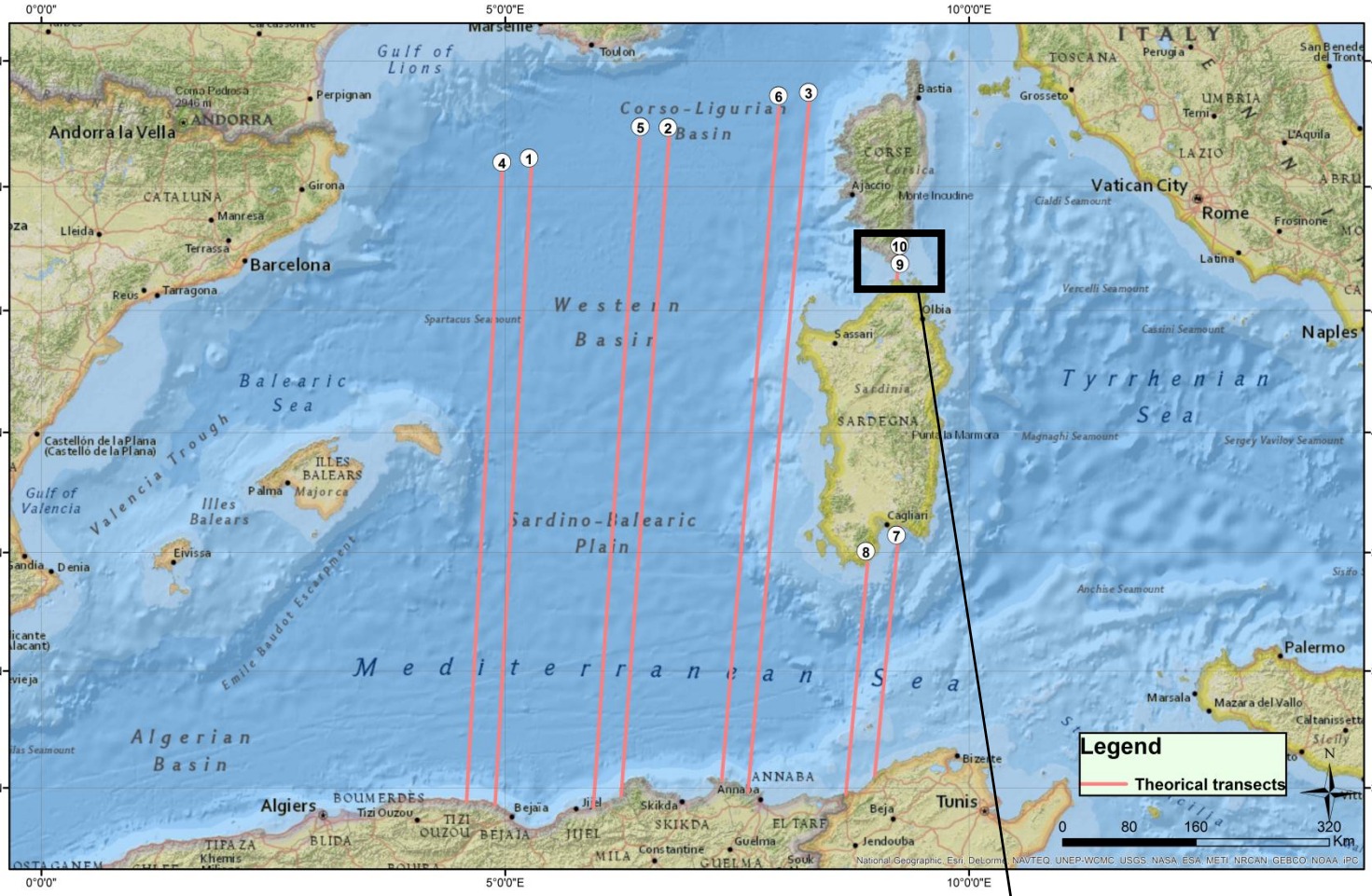
c) Area B

The work area is located in western Mediterranean Sea divided into 10 straight transects oriented north to south (fig.2) forming a working survey. Survey (2, 3…) correspond to replications of this 10 transects. The total transect length is 2231, 8 nm and details are below (fig.3).

Transect	1	2	3	4	5	6	7	8	9	10	**Tot**
Length (nm)	319	331	344	314	334	335	127	118	8,4	1,4	**2231,8**

fig.3: Table of theorical transect

During the survey adverse weather forecast happened during 20% of all days (bad weather conditions mean winds over 3 or 4 on the Beaufort scale, or low clouds at less than 300 m altitude, or heavy rain, which prevents a reliable observation of tuna shoals close to the sea surface).



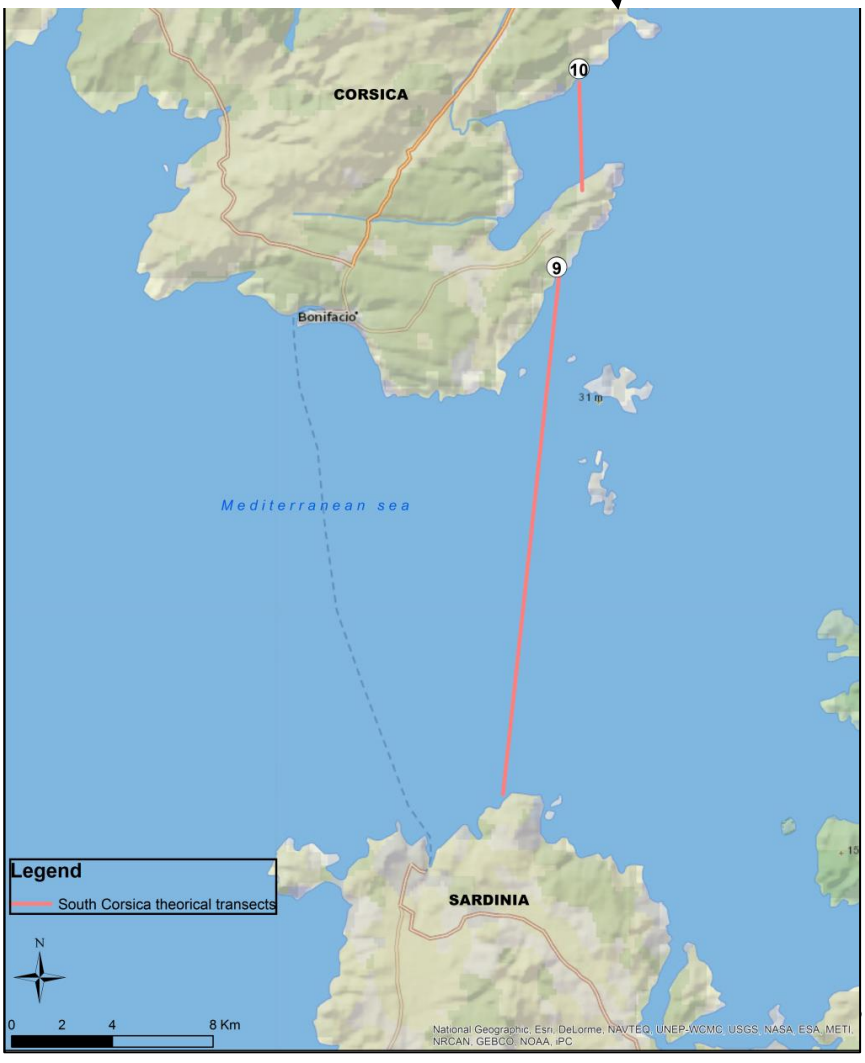


fig.2: Maps of theorical transects *(Arcgis® designed)*

d) The Crew and data collection

The team was made with three members: An airline pilot Olivier MODENE who already practiced the detection of tuna; one professional spotter Philippe Olivier RIGAL seated in front starboard; Khalifa, an additional spotter positioned behind to starboard for the last day. Their role was to spot for fish shoals and guide the pilot around it in case of spotting tunas. They were able to determine mass, size and behavior of the tuna shoals. The only scientist, Remi ALLARD, was sat to port. His role on flight was to take pictures of the shoal as much as possible in case of spotting, and identify other species like marine mammals, chelonians etc. While tuna shoals or other species were observed on track waypoint, it was recorded on the GPS to retrieve the geographic coordinates. When a suspect sighting (BFT) took place outside transect (<6nm) or OFF effort, we headed straight to the sighting and waypoint was also recorded. During the flight, all cartographic informations (sighting waypoints, flight, speed, altitude…) were recorded on a GPSMAP 196 Garmin® (WGS84 referential), and transferred to a computer with the MapSource® software, then exported to the cartographic software Qgis® for an enhanced visibility. As required by the ICCAT the scientist must fill the effort Excel® files (see Annex 2) which includes time of the observation, GPS position, altitude, weather conditions and other details. He also had to fill the sighting Excel® files (see Annex 3) in case of tuna shoal spotting, which included time of spotting, position of the shoal, estimated mass (in tons), size (small, medium, large), and also behavior of species.

III. Results

a) Log Book and flight characteristics

The flights started on june 21 2013 and ended on june 27 2013. 44:02 hours of flights were conducted with 18:38 hours on transect and 25:24 hours off transect (Log book is detailed Appendix 1).

Transects number 1 to 6 were shortened at the Algerian FIR because of a non-authorization. Transect 7 and 8 have been completed thanks to the goodwill of the air traffic controllers who asked us to leave the area quickly, the authorization number was wrong. Transects 9 and 10 could not be made because located in the VFR corridor for airliners flying from eastern to western coast of Corsica.

Two surveys have been done (fig.4 & fig.5). The first survey was completed (FIR Algerian and VFR corridor excluded) and the other one incompleted. Total transects flew were 1961 nm: see details below (fig.6)

Transect Number	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	**Tot (nm)**
Theorical Lenght (nm)	319	331	344	314	334	335	127	118	8	1	**2231,8**
Transect flown during Survey 1(nm)	188	204	213	186	200	220	95,1	94,9	0	0	**1401**
Transect flown during Survey 2(nm)	87	192	0	179	102	0	0	0	0	0	**560**

fig.6: Table of theorical transects and transects flighted

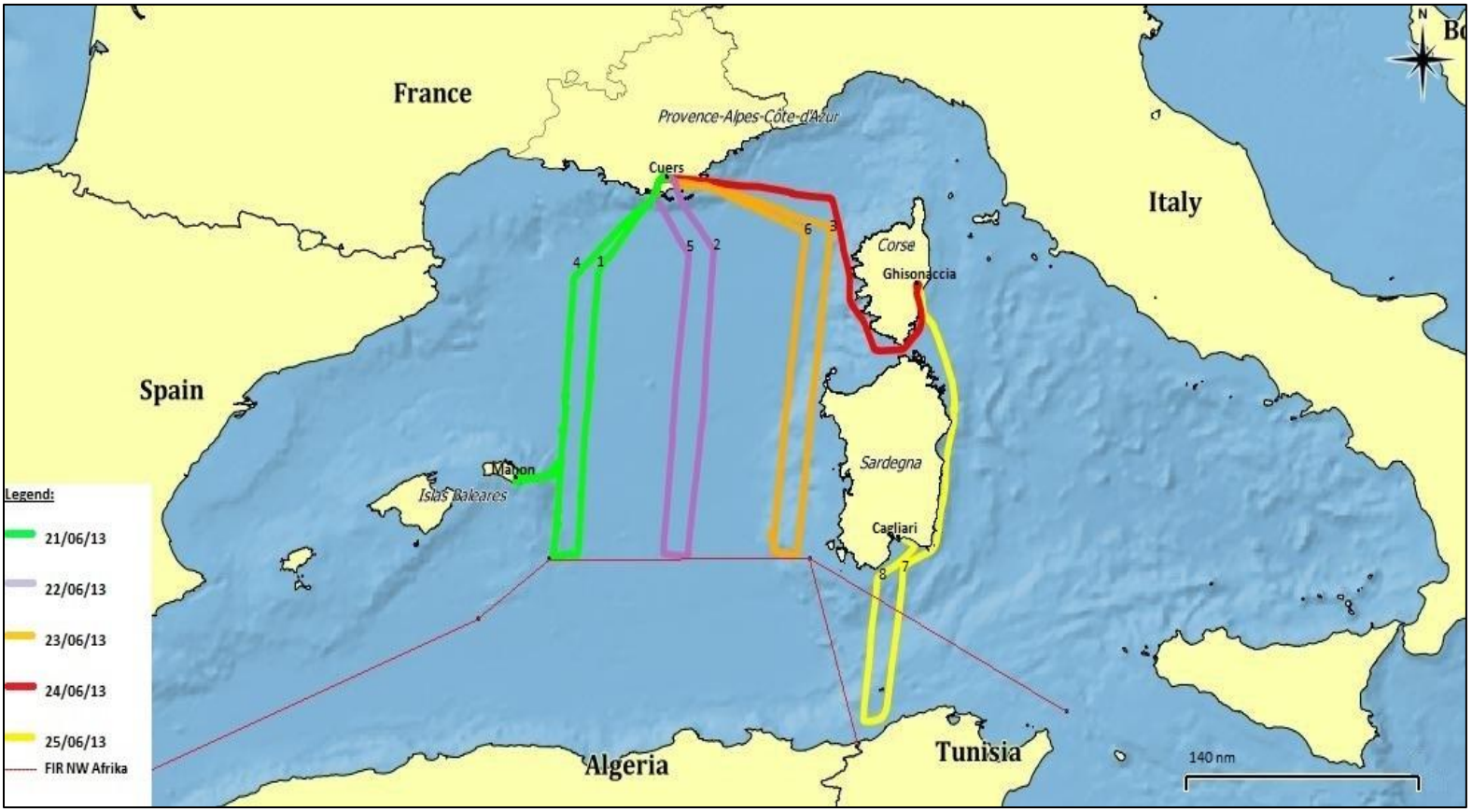


fig.4: Map of survey 1

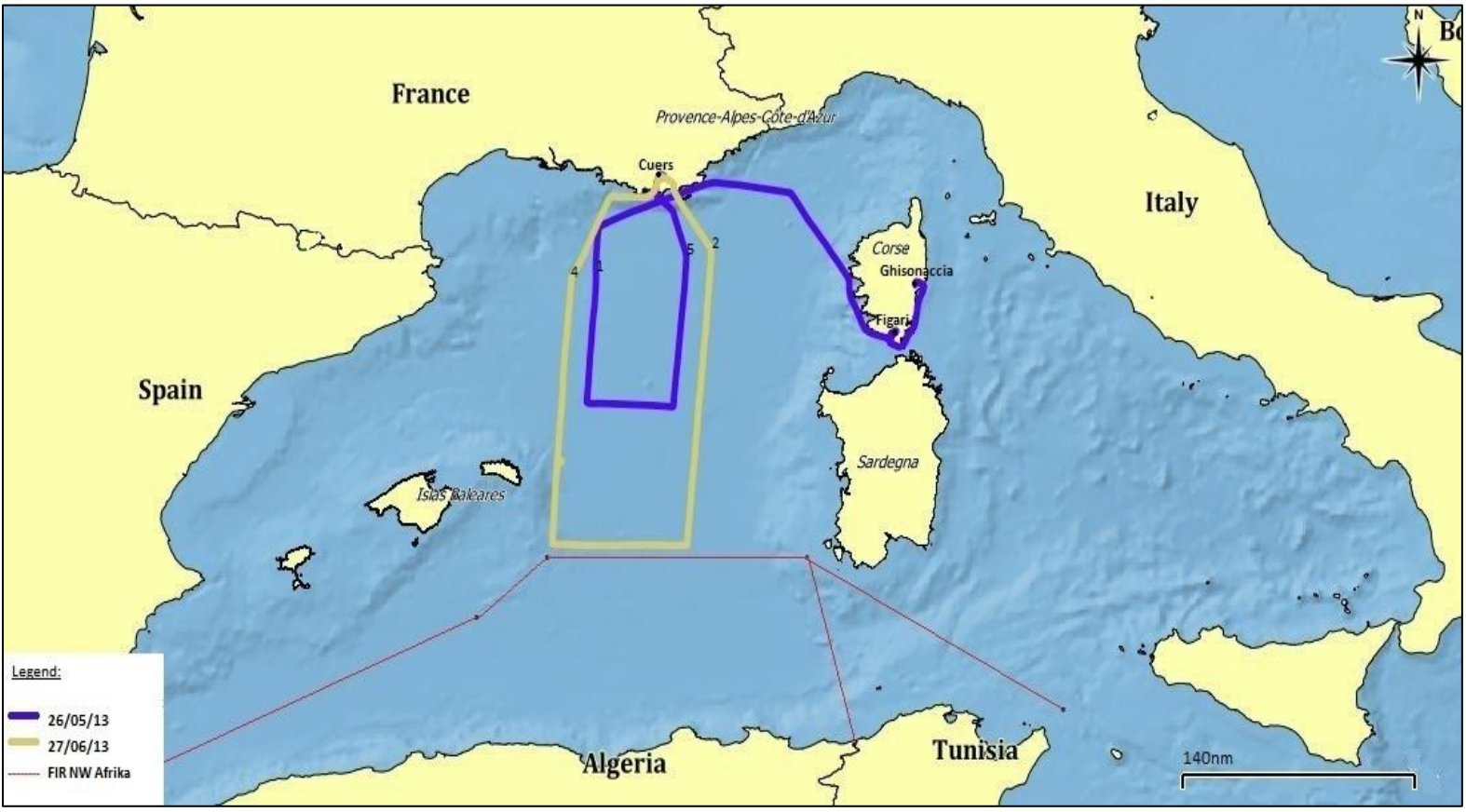


fig.5: Map of survey 2

During these 7 days of flight, viewing conditions were not optimal as can be seen in Appendix 1. The main problem was moderate wind that caused foam on the sea surface. Only two days were very correct in terms of observation conditions. No surveys were conducted on june 24th due to a strong wind.

b) <u>BFT sightings</u>

Unfortunately no Bluefin Tunas were sighted during this aerial survey.

c) <u>Other species and fishing vessels sightings</u>

In this study approximately 797 individuals were reported belonging to seven identified species (*Xiphias gladius, Physeter catodon, Balaenoptera physalus, Delphinus delphis, Tursiops truncatus, mobular mobular, Mola mola*). Some marine mammals UMM could not be identified due to a lack of identification at the last second (recall that the ICCAT instructions about no detour in the case of secondary interest). The reliability of my identification in this study is, in my opinion, about 25% of uncertainty. The most commonly species seen was the common dolphin (40%) followed by the fin whale (23%). The most densely encountered was also the common dolphin which represents 86% of the total number of individuals, followed by the bottlenose dolphin (7%). The only

Scombroidei shoal seemed to be a bonito shoal with around twenty individuals observed along the Var coast during the survey 2. All zoological observations and coordinates are detailed in Annex 3. Excel sighting and their projections are shown below on survey 1 and 2 maps (fig. 6 and fig.7).
Fishing vessels are not shown on the map but estimated at 19, details are presented below (fig. 8)

Date	Fishing vessels	number	transect
21/06/2013	long-liner	1	4
25/06/2013	trawler	11	OFF
25/06/2013	purse-seiner	2	OFF
25/06/2013	trawler	4	1
25/06/2013	purse-seiner	1	1

fig.8: Table of fishing vessels sighted

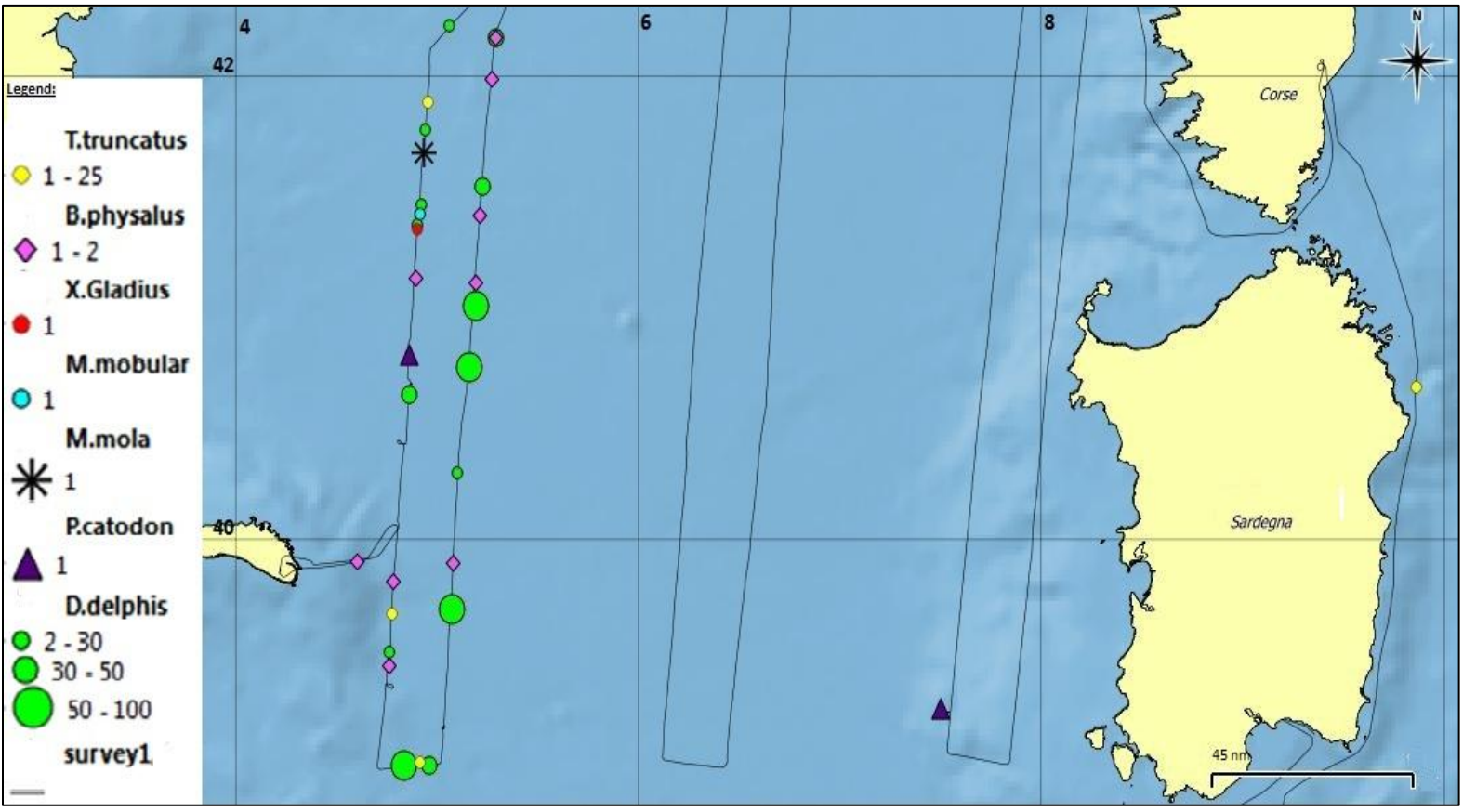


fig.6: Map of species sighted during the survey 1

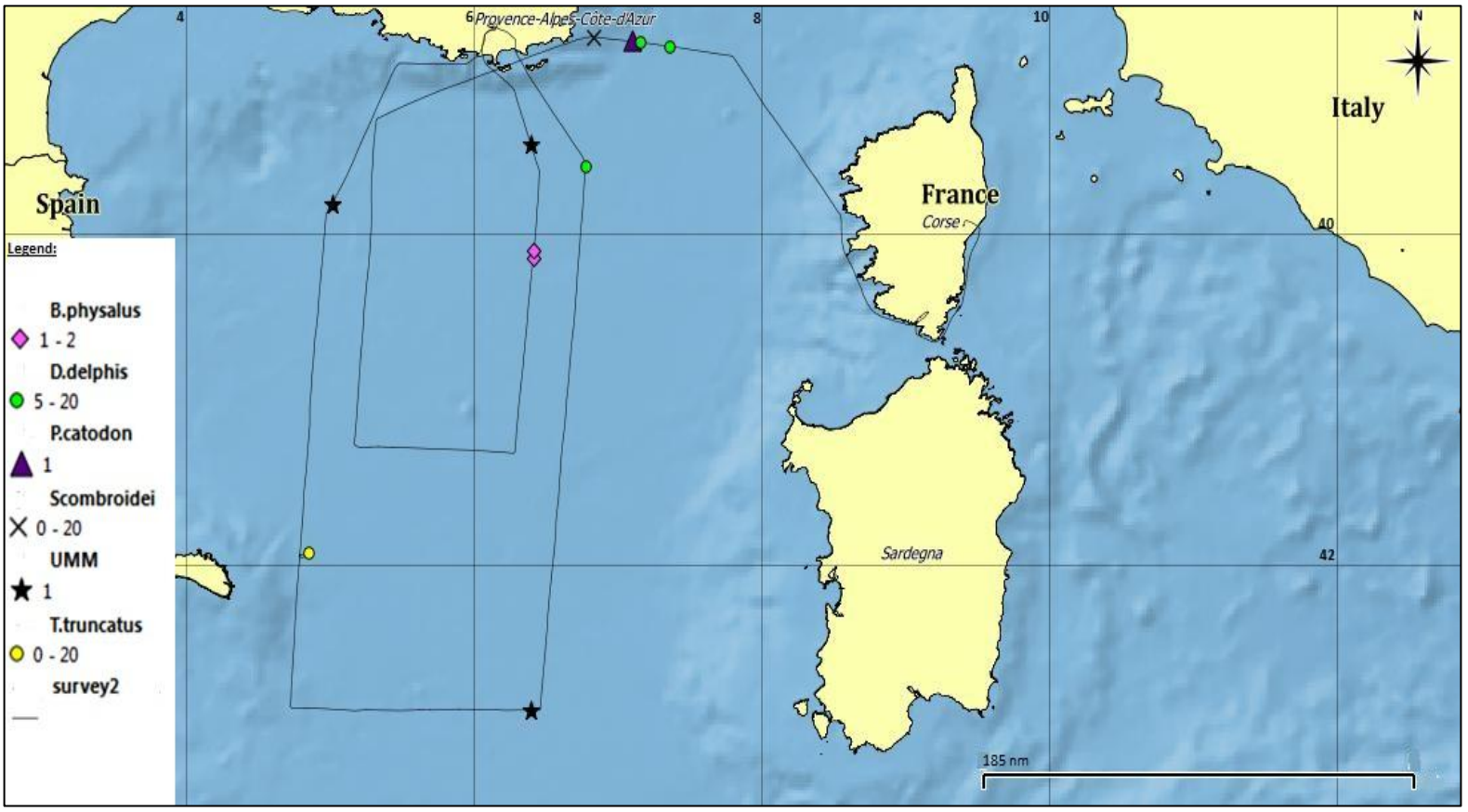


fig.7: Map of species sighted during the survey 2

IV. Discussion-Conclusion

The objective of this mission was to collect as many biological and meteorological data as possible during the observation of Red Tuna shoals (*Thunnus thynnus*), in order to establish mathematical models on spawning population migration, and the presence of young tunas, etc. Today it is generally accepted that bluefin spawning occurs in hot water (> 24 ° C) in specific and restricted areas (around the Balearic Islands, Sicily, Malta, Cyprus and in some areas of the Gulf of Mexico), and once a year in May-June (Karakulak *et al* 2004. Mather *et al* 1995. Nishikawa *et al* 1985, Schaefer 2001). Two suitable areas in the west of the Balearic and Western Sicily seemed geographically close from our transects but this area seemed pretty cool if we refer to the SST recorded last day overview (fig.8)

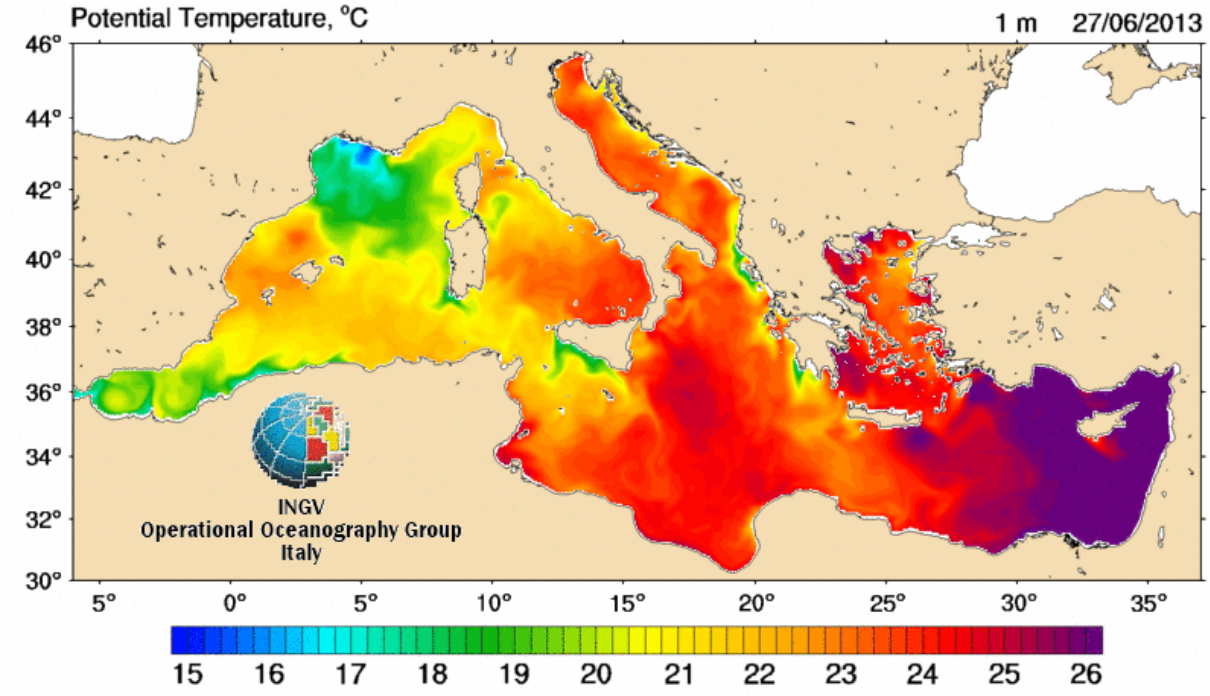


fig.8: Map of Mediterranean SST during the last day of aerial survey

In 2010 during an aerial survey, bluefin tunas were observed during the same period on 21, 22, 23, 25 and 27 of june in the western Balearic Islands. This year the survey area was extended beyond the known hotspots, sweeping wider Mediterranean. A greater effort observation can lead to less result. Furthermore, bluefin tuna spawn in a limited space-time (Fromentin and Fonteneau 2001), it spawn when reaches specific points (Mather *et al* 1995, Rodriguez-Roda 1964). Medina et al. (2002) showed that the time between the onset of migratory fish in the Strait of Gibraltar and spawning in the region of Balearic Islands is short and does not exceed a few weeks. However other nesting sites such as the Ibero-Moroccan Bay and the Black Sea, has been cited in the past (Piccinetti and Manfrin 1993).

The spatial and temporal constraints related to the bluefin tuna's cycle, too cold SST, area transect and sighting conditions were sometimes not suitable, reducing the probability of bluefin tuna sighting during our six days of survey.

Concerning the marine mammals' identification such as dolphins, it should be noted that the angle of view, the speed of 185 km / h to 300 meters, the sighting at the last second and depth had a net effect to identify the cetaceans. Under these conditions, the patterns of identification are size, swimming attitude and color.

V. References

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VI. Table of appendixes

Appendix 1

Date	Start Engine	City	Stop Engine	City	Tot. Times on flight	Times ON effort	Times Off effort	Scient.spotter	Prof. spotter	Notes
21/06/13	07:45	Cuers (Fr)	12:12	Mahon (Sp)	4:27	2:31	1:56	Remi ALLARD	Philippe-O RIGAL	Break for refuelling at Mahon
21/06/13	12:47	Mahon (Sp)	15:57	Cuers (Fr)	3:10	1:12	1:58	Remi ALLARD	Philippe-O RIGAL	
22/06/13	08:00	Cuers	14:04	Cuers (Fr)	5:34	3:47	1:47	Remi ALLARD	Philippe-O RIGAL	
23/06/13	08:00	Cuers (Fr)	14:33	Cuers (Fr)	6:36	4:04	2:32	Remi ALLARD	Philippe-O RIGAL	
24/06/13	09:06	Cuers (Fr)	12:01	Ghisonaccia (Fr)	2:55		2:55	Remi ALLARD	Philippe-O RIGAL	Weather standby. Too much wind and sea foam. Positioning travel at Ghisonaccia for the following flight
25/06/13	05:59	Ghisonaccia (Fr)	08:28	Cagliari (It)	2:29		2:29	Remi ALLARD	Philippe-O RIGAL	Break for refuelling at Cagliari
25/06/13	09:30	Cagliari (It)	14:27	Ghisonaccia (Fr)	4:57	1:47	3:10	Remi ALLARD	Philippe-O RIGAL	
26/06/13	07:45	Ghisonaccia (Fr)	08:39	Figari (Fr)	0:54		0:54	Remi ALLARD	Philippe-O RIGAL	Break for refuelling at Figari
26/06/13	08:58	Figari (Fr)	14:52	Cuers (Fr)	5:54	1:47	4:07	Remi ALLARD	Philippe-O RIGAL	
27/06/13	08:30	Cuers (Fr)	15:36	Cuers (Fr)	7:06	3:30	3:36	Remi ALLARD	Philippe-O RIGAL, Khalifa	
Total					**44:02:00**	**18:38:00**	**25:24:00**			

				Start			Observer			End							Glare			Notes	
Block	Survey	Transect	Date	Time	Lat	Lon	Front	Port	Starboard	Time	Lat	Lon	Altitude	Sea State	Haze	Turbidity	Port	Starboard	Intensity	Fishing vessels	Other
B	1	1	21/06/2013	08:51	42,17	5,28	38	40	38	10:41	39,03	5,02	300	1	0	0	x		2		Good sightings conditions
B	1	4	21/06/2013	10:50	39,01	4,71	38	40	38	11:31	40,04	4,8	300	1	0	0			2	1 LL	
B	1	4	21/06/2013	13:32	40,06	4,8	38	40	38	14:44	42,11	4,97	300	1	0	0	x		2		
B	1	5	22/06/2013	09:08	42,38	6,45	38	40	38	10:51	39,05	6,12	300	3	1	0	x		1		A bit of sea foam during one-third time of the transect could have disturbed sightings
B	1	2	22/06/2013	11:00	39,01	6,42	38	40	38	13:05	42,43	6,77	300	4	2	0			0		No glare because of cloud sky; not sea foam anymore
B	1	6	23/06/2013	08:54	42,11	4,97	38	40	38	10:53	39,08	7,53	300	4	1	0	x		1		A bit of sea foam during two-third time of the transect could have disturbed sightings
B	1	3	23/06/2013	11:00	39,04	7,84	38	40	38	13:05	42,68	8,28	300	4	2	0			0		No glare because of cloud sky; not sea foam anymore
B	1	8	25/06/2013	10:05	38,76	8,87	38	40	38	10:52	37,18	8,7	300	5	1	0	x		2	4 TR; 1LL	A bit of sea foam but didn't disturb sightings
B	1	7	25/06/2013	11:02	37,32	8,99	38	40	38	12:00	38,89	9,21	300	6	2	1			0		Sea foam which disturbed sightings
B	1	1	26/06/2013	11:41	42,16	5,28	38	40	38	12:20	40,74	5,16	300	6	1	0	x		2		Sea foam which disturbed sightings, half-transect flighted
B	1	5	26/06/2013	12:45	40,68	6,27	38	40	38	13:52	42,38	6,45	300	6	1	1	x		2		A bit of sea foam during half time could have disturbed sightings, half-transect flighted
B	1	4	27/06/2013	10:08	42,12	4,97	38	40	38, Khalifa	11:40	39,16	4,72	300	3	1	0	x		2		
B	1	2	27/06/2013	12:28	39,13	6,45	38	40	38, Khalifa	14:26	42,41	6,77	300	3	1	0	x		1		A bit of sea foam during half time could have disturbed sightings

Block	Survey	Transect	Bubble windows	Date	Time sighting	Lat initial sighting	Lon initial sighting	Time abeam	Observer	Cue	Species	Confidency	School size	Estimated weight	Height	Declination angle	Lat animals	Long animals	Break track?	Photos taken?	1st	Last	School heading	% small	% medium	% large	% giant	Notes
B	1	OFF	Bubble window	21/06/2013	08:46	42,17	5,29		38		FIN	Y	2		331													
B	1	OFF	Bubble window	21/06/2013	08:46	42,17	5,29		38		COD	Y	50		332													
B	1	1	Bubble window	21/06/2013	08:57	41,99	5,27		38		FIN	Y	1		342													
B	1	1	Bubble window	21/06/2013	09:12	41,53	5,22		38		COD	Y	50		343													
B	1	1	Bubble window	21/06/2013	09:17	41,4	5,21		38		FIN	Y	2		332													
B	1	1	Bubble window	21/06/2013	09:27	41,11	5,19		38		FIN	Y	2		332													
B	1	1	Bubble window	21/06/2013	09:29	41,03	5,18		38		COD	N	2		331													
B	1	1	Bubble window	21/06/2013	09:33	41,01	5,19		40		COD	Y	100		332													
B	1	1	Bubble window	21/06/2013	09:43	40,75	5,16		38		COD	Y	70		321													
B	1	1	Bubble window	21/06/2013	09:58	40,29	5,1		40		COD	N	5		323													
B	1	1	Bubble window	21/06/2013	10:10	39,9	5,08		40		FIN	Y	1		324													
B	1	1	Bubble window	21/06/2013	10:16	39,7	5,07		38		COD	Y	60		322													
B	1	OFF	Bubble window	21/06/2013	10:43	39,03	4,96		38		COD	Y	50		301													
B	1	OFF	Bubble window	21/06/2013	10:45	39,04	4,91		38		BOT	U	1		313													
B	1	OFF	Bubble window	21/06/2013	10:47	39,03	4,83		38		COD	N	80		334													
B	1	4	Bubble window	21/06/2013	11:11	39,46	4,76		38		FIN	Y	1		349													
B	1	4	Bubble window	21/06/2013	11:13	39,52	4,76		38		COD	Y	30		353													
B	1	4	Bubble window	21/06/2013	11:19	39,68	4,77		40		BOT	N	6		337													
B	1	4	Bubble window	21/06/2013	11:23	39,82	4,78		40		FIN	Y	1		332													
B	1	OFF	Bubble window	21/06/2013	13:24	39,91	4,6		40		FIN	Y	1		326													
B	1	4	Bubble window	21/06/2013	13:52	40,63	4,86		38		COD	Y	50		325													
B	1	4	Bubble window	21/06/2013	13:58	40,8	4,86		38		SPE	Y	2		299													
B	1	4	Bubble window	21/06/2013	14:11	41,13	4,89		38		FIN	Y	2		330													
B	1	4	Bubble window	21/06/2013	14:18	41,34	4,9		38		SWO	Y	1		332													
B	1	4	Bubble window	21/06/2013	14:18	41,36	4,9		40		COD	Y	30		317													
B	1	4	Bubble window	21/06/2013	14:20	41,41	4,91		38		MOB	Y	1		323													
B	1	4	Bubble window	21/06/2013	14:22	41,45	4,92		38		COD	Y	30		336													
B	1	4	Bubble window	21/06/2013	14:29	41,67	4,93		40		UND	Y	1		321													*Mola mola*
B	1	4	Bubble window	21/06/2013	14:32	41,77	4,94		40		COD	Y	30		336													
B	1	4	Bubble window	21/06/2013	14:37	41,89	4,95		38		BOT	Y	10		328													
B	1	OFF	Bubble window	21/06/2013	14:48	42,22	5,06		40		COD	Y	15		324													
B	1	3	Bubble window	23/06/2013	10:46	39,27	7,5		38		SPE	Y	3		370													
B	1	OFF	Bubble window	25/06/2013	13:17	40,66	9,86		38		BOT	Y	25		314													
B	2	OFF	Bubble window	26/06/2013	10:35	43,14	7,35		40		COD	N	5		345													
B	2	OFF	Bubble window	26/06/2013	10:39	43,16	7,15		40		COD	Y	20		345													
B	2	OFF	Bubble window	26/06/2013	10:41	43,17	7,09		40		SPE	Y	1		347													
B	2	OFF	Bubble window	26/06/2013	10:47	43,19	6,83		38		OTH	U	20	300	348					NO				100				Turn around to take photo was impossible because of a military flight-ban but fishes looked like Bonito (*Sarda sarda*) with approximatly 20 black headed gull (*Chroicocephalus ridibundus*)over the school
B	2	OFF-5	Bubble window	26/06/2013	13:33	41,86	6,41		40		FIN	Y	1		340													
B	2	OFF-5	Bubble window	26/06/2013	13:34	41,9	6,41		38		FIN	Y	2		339													
B	2	OFF	Bubble window	26/06/2013	13:58	42,54	6,39		38		UMM	U	1		343													
B	2	OFF	Bubble window	27/06/2013	09:54	42,18	5,01		38		UMM	U	1		350													
B	2	4	Bubble window	27/06/2013	11:11	40,08	4,84		40		BOT	N	20		354													
B	2	OFF	Bubble window	27/06/2013	12:26	39,13	6,39		38		UMM	U	1		330													
B	2	OFF-2	Bubble window	27/06/2013	14:26	42,41	6,77		40		COD	Y	10		297													

Appendix 3