AERIAL SURVEY FOR THE MONITORING OF BLUEFIN TUNA SPAWNING AGGREGATIONS IN THE MEDITERRANEAN SEA CALL FOR TENDERS 04/2024 (ICCAT/GBYP Phase 14) - Circular #G-00262/2024

AREA E

Final Report

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Summary

Within the ICCAT GBYP program, aerial surveys are carried out with the aim of providing fishery-independent indices to improve the knowledge of Bluefin tuna populations in the Mediterranean, particularly for what is concerning the spawners aggregations. After the 2010 and 2011 surveys, which were carried out in four Mediterranean spawning areas, in 2013 and 2015 the survey was extended to the whole Mediterranean Sea. From 2017 the surveys were limited to the 4 initial spawning areas. From 2022, the area G was excluded by the ICCAT survey design. In the 2024 campaign, Unimar was awarded to carry out the survey in the Area E (Sicily Channel) and performed 4 replicas of the eastern part of area E (sub-area "Malta"). The western part of area E (sub-area "Pantelleria) was monitored with 3 replicas, foreseen by the ICCAT sampling protocol as the minimum acceptable. The survey was carried out from June 11th to July 1th, 2024. 14 BFT sightings were performed through 16 total surveys. Including other species, 116 sightings were performed.

1. BACKGROUND AND OBJECTIVES

The improvement of the knowledge of the Atlantic bluefin tuna key biological and ecological processes is essential for developing management policy which can provide long term sustainable exploitation of this resource.

The comprehensive ICCAT Atlantic Wide Research Programme on Bluefin Tuna (GBYP) was initiated with the aim to improve basic data collection, the understanding of key biological and ecological processes, assessment models and management. Among the other activities, aerial surveys were planned to be performed for several years.

In 2010 and 2011, aerial surveys on spawning aggregations were carried on 4 areas in the Mediterranean Sea, which were, identified as spawning areas on the base of biological and traditional knowledge, as well as recent fishery data. In 2013 and 2015, following the GBYP Steering committee recommendation, the area of the survey was extended to the whole Mediterranean basin and therefore more sub-areas than in the previous years were identified.

In 2017, ICCAT decided to restrict the survey to the 4 initial areas and so was done in 2017, 2018 and 2019. From 2022 campaign, ICCAT decided to exclude the Area G and cover only the following three ones:

A – Balearic Sea

C - Southern Tyrrhenian Sea

E - Sicily Channel

This report describes the activities and the results related to the 2024 Unimar-Aerial Banners survey, covering the Area E.

2. MEANS AND METHODS

The activities were carried out following the terms of reference of the ICCAT Call for Tenders and the Technical specifications annexed to the contract. The spawning behaviour of Bluefin tuna was reported in detail by Arena (Arena, P. 1979, 1982 a/b/c/d) for the South Tyrrhenian; the individuals tend to aggregate in bigger schools starting from late April, with maximum aggregation when water temperature exceed 20°C and while a thermocline forms and stabilises at a depth of 15 - 30 m, inducing Bluefin tuna schools to stay in the superficial layers.

Most of the personnel involved in the survey participated to the training course held online on May 30rd, 2024, during which the details of the methodology and operative standards were explained, and previous field experiences were shared.

2.1 Aircrafts and equipment

One aircraft was involved, with upper wings, good forward visibility, bubble windows on both sides and capable of flying at a spotting altitude of 300 m and a speed of 100 nm/h, as foreseen by ICCAT GBYP. The aircraft was a "Partenavia P68" model, already used in the past campaigns.

In details, model was a Partenavia/Vulcanair P68 B (I-GNIT registration number). It has about 4-5 hours flight range.

- Brand: Partenavia/Vulcanair
- Model: P68 B
- Code: I-GNIT

Figure 1 - Aircrafts I-GNIT and the crews

The equipment used by the spotters was the following:
- 2 GPS: *Garmin®* GPSMap 62st and GPSMap 64s, with the statistical survey design uploaded (the same route files were provided to the pilot);
- 2 GPS external antennas, which were applied on the aircraft dashboard under the front window in order to enhance the satellite signal reception
- 2 digital *Nikon®* photo cameras: D3000 and D3200, with 6400 ISO maximum sensitivity, equipped with Sigma® 70-200 zoom lens f/2.8 OS and 62st, polarised filter (77mm gauge) and Nikon 55-200 zoom lens f/5.6 VR, polarised filter (52mm gauge): after some trial, the panning and multiple shot mode was chosen as the best one to have the higher possibilities to capture clear images
- *Silva Sight Master®* clinometers

Onboard the aircraft there were always a pilot, a professional tuna spotter and two scientific spotters. Effort and sightings were recorded on the specific forms and the GPS recording of all the flights and sighting positions were saved. During the flights, the GPS recorded (with a 3 seconds frequency) the exact position of the aircraft as well as all the waypoints entered by the spotters in order to mark the significant events to be transcribed to the forms. After every landing, the information was saved into the laptop and sent to the central office as soon as possible. The altimeter of the spotters GPS device and the aircraft was daily calibrated with the known altitude of the airport. During the survey, the pilot followed the actual altitude that matched with the one measured by the spotters GPS device, that recorded the tracks.

The survey period started on June 11th and ended on July 1th, 2024.

According to the contract terms of reference, weather conditions were considered adverse when they could interfere with a reliable observation of tuna schools (winds over 3 Beaufort scale, clouds lower than 300 m, high or heavy rain).

Esri ArcMap® GIS software was used for data mapping. Garmin BaseCamp® was used for track designing, analysis, saving and editing.

2.2 The Survey design and the Survey area
Aerial surveys were designed using the "DISTANCE" program. In each block, a series of transects were created, based on the dimensions of the area, in a manner to achieve the approximate statistical coverage. Surveys were designed as equal spaced parallel lines since it provides equal coverage probability (Hammond P. et al, 2010). Surveys design was provided by ICCAT GBYP.

Area E is the Central Mediterranean area comprised between Sicily, Tunisia and Libya, included within the Rome and Malta FIR.

The importance of these area for the Bluefin tuna spawning activities is well known (Arena, P. 1978, 1982): for this reason, constant activity of purse seine fishing has been carried out there since the early Seventies (Arena, 1990). The position of the 2024 survey area is shown in Figure 2.
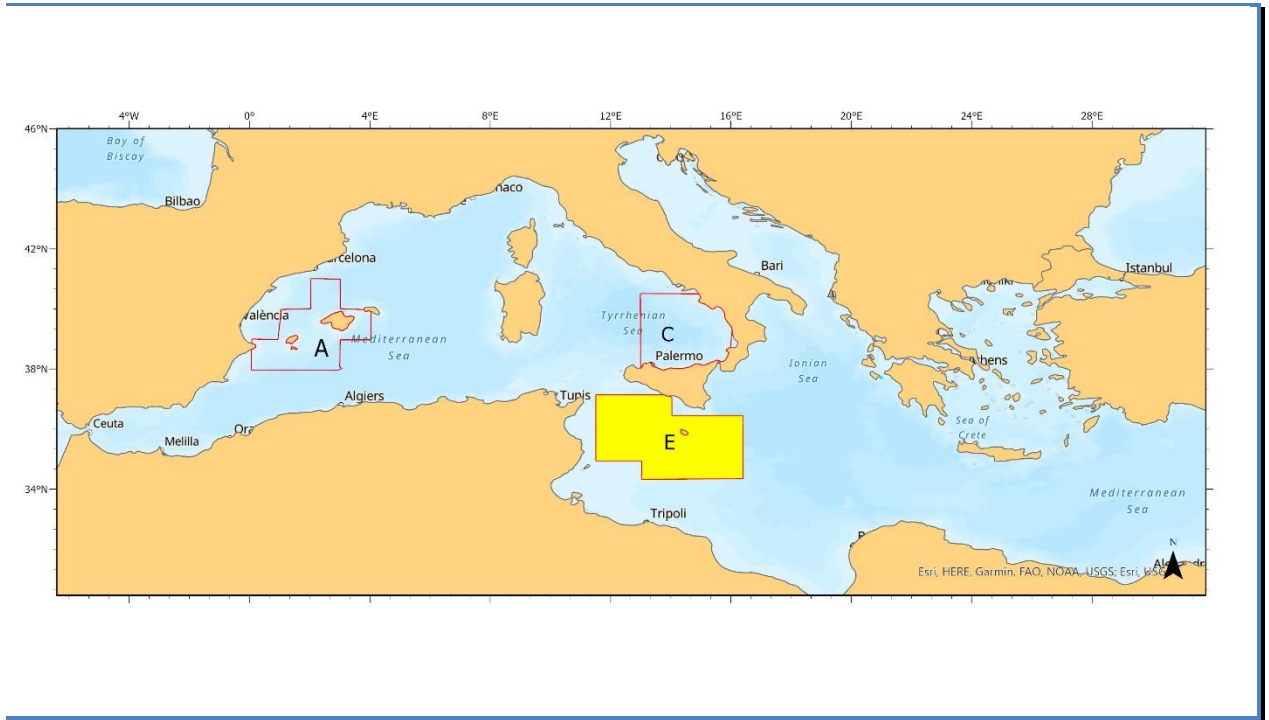

Figure 2 - 2024 Area E in yellow

The features of the survey area are described in Table 1.
The replicas to be performed in each area are shown in Figure 3.

Area	E
Area (km^2)	93,614
Proport. of total area	35.2
Expected proport. Length of Trackline on Effort	11,278
Expected proport. Length of Trackline on Effort (minus 10% for circling)	10,150
% coverage	19.3
Line spacing per replica	41.3
On effort track Replica 1	1,431
On effort track Replica 2	1,410
On effort track Replica 3	1,404
On effort track Replica 4	1,455
Total on effort track	5,700

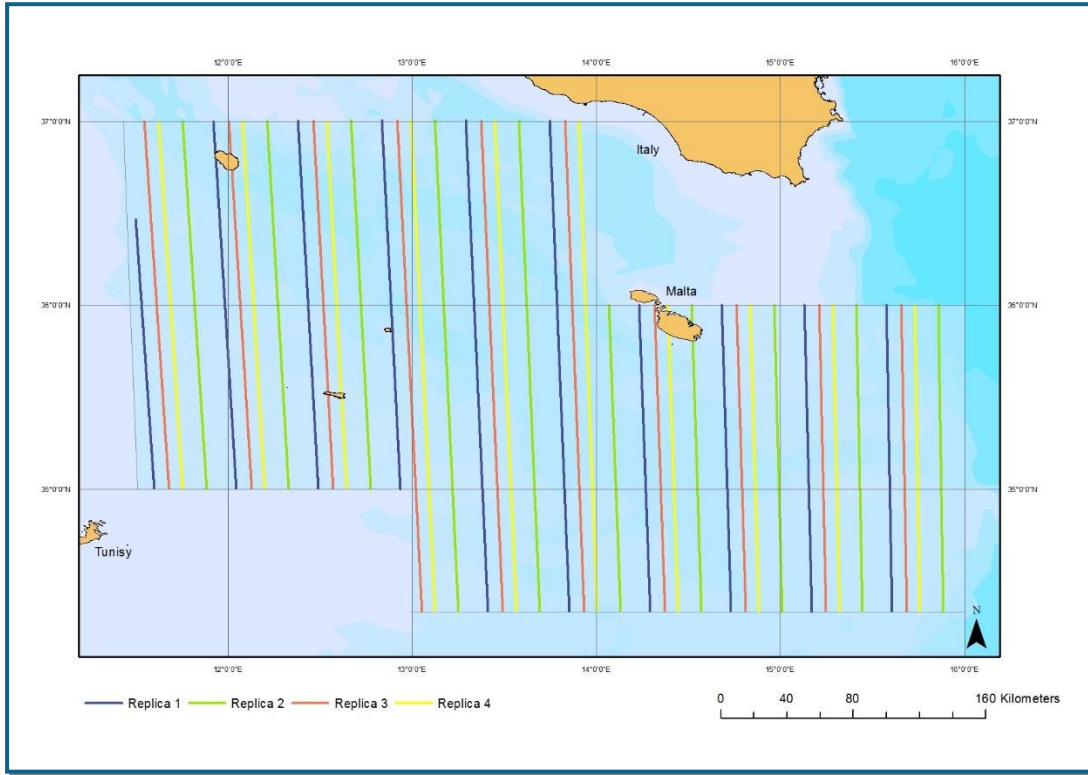| Leftover effort	15.8

Table 1 - Features of Areas E

Figure 3 - Area E sampler routes (Transects-Legs)

3. RESULTS

3.1 Preparatory tasks

First of all, the team was set up. The Unimar coordination staff contacted the spotters and managed the preliminary activities with Aerial Banners, the partner company providing the aircraft and the pilots. The spotters were chosen on the basis of the expertise requested for the aerial survey: years of experience in aerial tuna spotting for the professional spotters, years of experience in tuna fisheries and biology, aerial surveys and/or census of marine populations for the scientific spotters, past participation in aerial tuna spotting or aerial survey campaigns for the pilots. A data analyst with experience in data mapping was involved as well. All scientific observers were already involved in one or more campaigns in the previous years.

Several meetings were organised at Unimar headquarters in order to share the methodology among the scientific spotters and to organise the field activities. Other meetings with the pilots were organised before and during the surveys.

Considering the past difficulties and possible constraints in obtaining the necessary permits in Malta, a new possibility was investigated and found, that is a surface dedicated to take off and landing of small aircrafts in the South of Sicily. This was the base of the survey for the "sub-area Malta".

3.2 Field activity

The base airports were in Pantelleria island and near city of Ragusa (RG). According to ICCAT schedule, the team availability and the meteorological conditions, on the first available day (June 11th, 2024) the first spotters arrived to Pantelleria onboard the I-GNIT aircraft. The survey started in the same day.

The last survey on the Area E was performed on July 1th, 2024. The daily report of the surveys carried out is provided in Table 2. In order to optimize the flight hours and reduce the transfer time, the team was forced to split the area E in two parts: the western one performed from Pantelleria airport, and the eastern one performed from Ragusa airport. Considering the extent of the area and the unstable conditions of the meteorological situation, it was decided to guarantee the coverage of the whole area with the minimum number of foreseen replicas, 3. Once finished the third replica in the eastern part, it was possible to carry out the 4th replica as well for the sub-area. Because of the still unstable meteo conditions and the huge dimensions of some transects of Pantelleria area, the survey was then stopped.

In order to avoid bad wind and sea conditions, the transects order were adapted day by day in order to avoid any risk of exceeding the deadline set by the Protocol. For the same reason, in some case, two short flights per day were performed.

The survey was carried out through 20 survey flights.

The team
Pilot: Francesco Ruggiero
Professional spotters: Salvatore De Martino, Vincenzo Severino
Scientific spotters: Andrea Poggi, Sergio Lombardo, Sergio Bizzarri, Andrea Fusari, Lorenzo De Santis.

Flight	Date	Aircraft	Take off*	Landing*	Area	Transects	Take off airport	Landing airport
1	11/06/2024	I-GNIT	17:11-17:15	19:59-20:01	E	E1L5 (half sup.)-E1L6(half sup.)	Pantelleria	Pantelleria
2	12/06/2024	I-GNIT	12:10-12:15	15:20-15:23	E	E1L7-E1L8	Pantelleria	Pantelleria
3	14/06/2024	I-GNIT	13:33-13:40	16:24-16:26	E	E1L9-E1L10	Pantelleria	Pantelleria
4	15/06/2024	I-GNIT	8:02-8:10	12:01-12:04	E	E1L6 - E1L5	Pantelleria	Pantelleria
5	16/06/2024	I-GNIT	8:29-8:42	11:34-11:36	E	EL10 - EL9	Pantelleria	Pantelleria
6	17/06/2024	I-GNIT	8:30 - 8:40	12:45 - 12:47	E	E2L7 - E2L8	Pantelleria	Pantelleria
7	18/06/2024	I-GNIT	08:41 - 08:57	12:35 - 12:37	E	E2L6	Pantelleria	Pantelleria
8	19/06/2024	I-GNIT	8:58-9:17	12:12-12:14	E	E3L9 - E3L10 - E3L9	Pantelleria	Pantelleria
9	19/06/2024	I-GNIT	13:25-13:32	17:07-17:09	E	E3L7 - E3L8	Pantelleria	Pantelleria
10	20/06/2024	I-GNIT	09:17-09:25	11:52-11:55	E	E3L6 (half sup.) - E3L5 (half sup.)	Ragusa	Ragusa
11	21/06/2024	I-GNIT	08:35-08:40	12:04-12:06	E	E3L6 (half inf.) - E3L5 (half inf.)	Ragusa	Ragusa
12	22/06/2024	I-GNIT	08:29-08:34	11:50-11:51	E	E1L1 - E1L2	Ragusa	Ragusa
13	24/06/2024	I-GNIT	08:13-08:20	11:30-11:31	E	E1L3 - E1L4	Ragusa	Ragusa
14	27/06/2024	I-GNIT	08:40-08:46	12:06-12:07	E	E2L5 - E2L4	Ragusa	Ragusa
15	28/06/2024	I-GNIT	08:02-08:13	11:15-11:16	E	E2L1	Ragusa	Ragusa
16	28/06/2024	I-GNIT	12:05-12:09	15:17-15:18	E	E2L2 - E2L3	Ragusa	Ragusa
17	29/06/2024	I-GNIT	08:52-08:59	12:21-12:22	E	E3L1 - E3L2	Ragusa	Ragusa
18	30/06/2024	I-GNIT	09:01-09:06	12:16-12:17	E	E3L4 - E3L3	Ragusa	Ragusa
19	30/06/2024	I-GNIT	15:00-15:05	18:20-18:21	E	E4L1 - E4L2	Ragusa	Ragusa
20	01/07/2024	I-GNIT	08:45-08:50	11:58-11:59	E	E4L4 - E4L3	Ragusa	Ragusa

Table 2 - Daily report of the surveys

* local time

Although the flights were generally performed at the altitude and speed requested (300 m, 100 nm/h), occasional slight differences and fluctuations due to environmental and technical factors were observed.

For all the performed flights, the tracks were registered by the observers' GPS device (the .gpx files of the tracks and the Excel format tables of the same tracks are sent as Annexes).

The effort and sightings forms can be found in the Annexes, as well.

Maps of recorded GPS tracks

Figure 4 to 7 show the GPS tracks recorded onboard the aircrafts during the survey. Each colour corresponds to a different day.
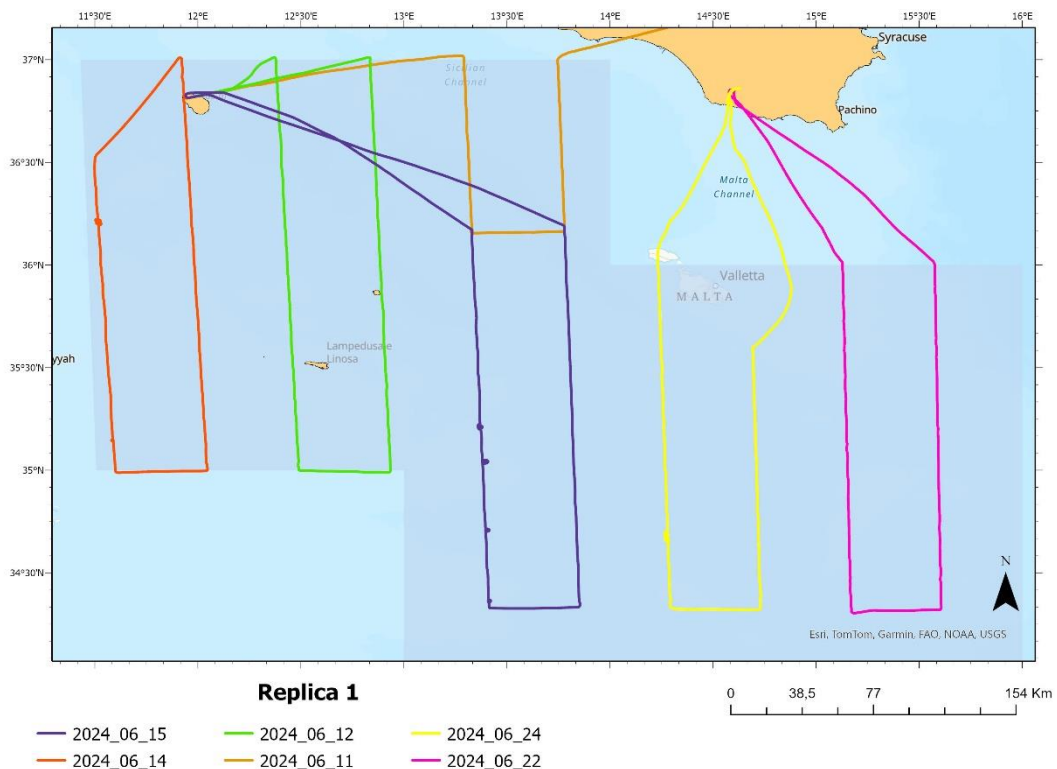
Figure 4 - Recorded GPS tracks: Area E, Replica 1
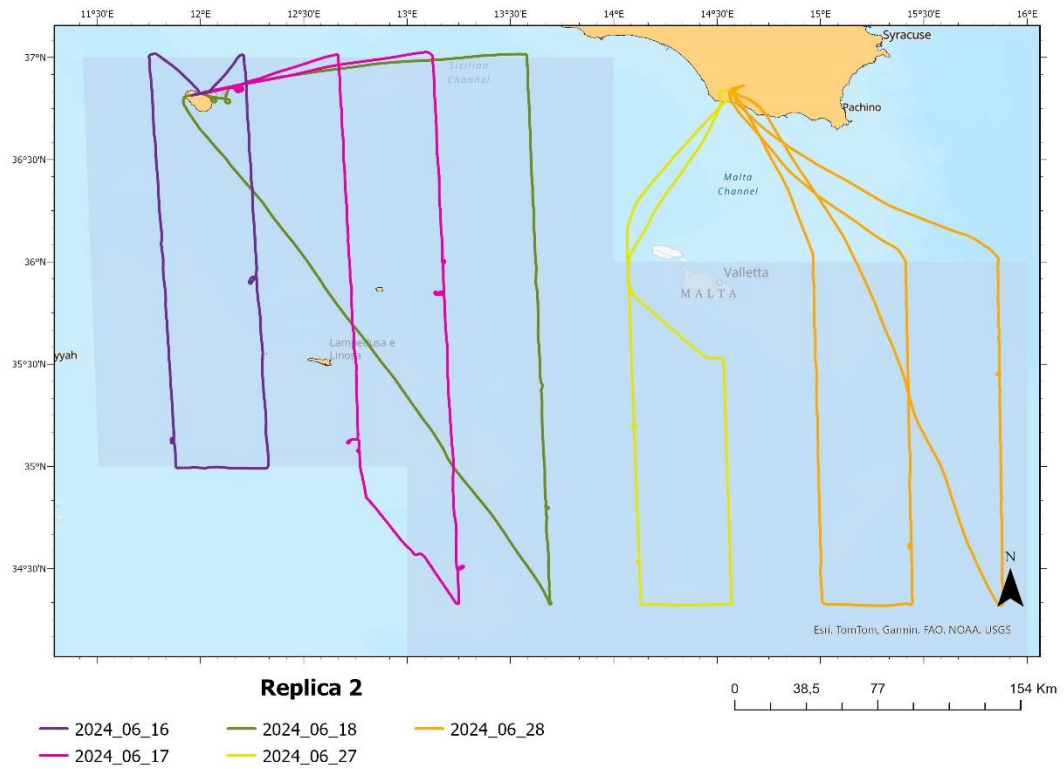
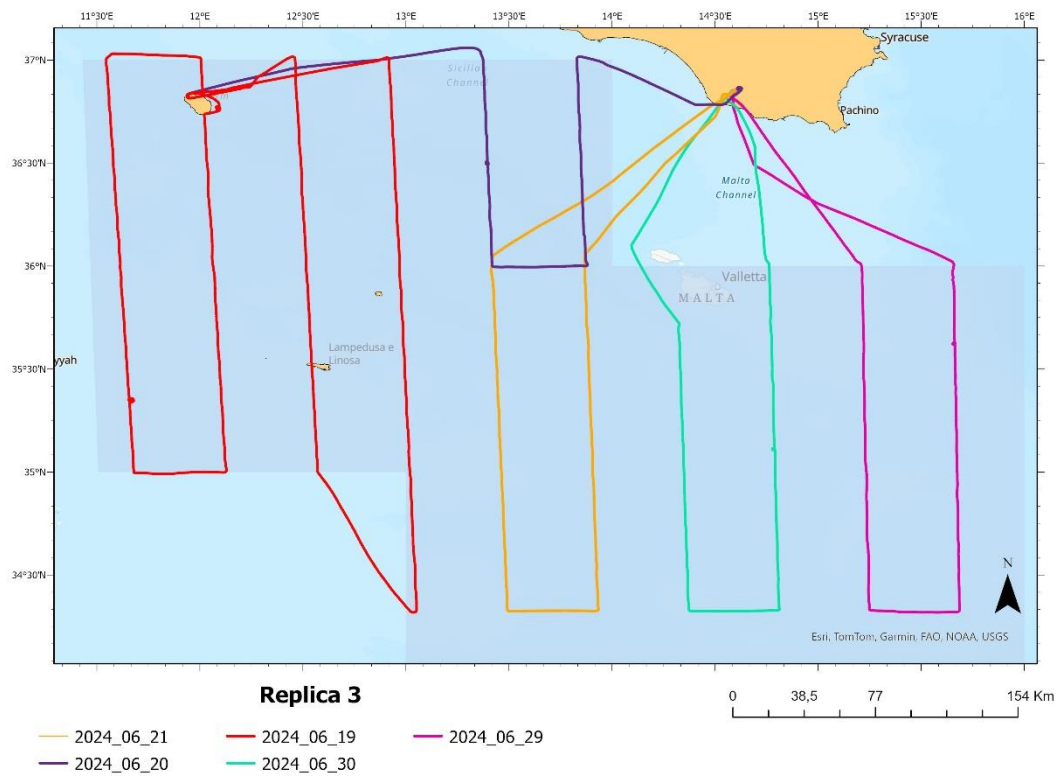Figure 5 - Recorded GPS tracks: Area E, Replica 2

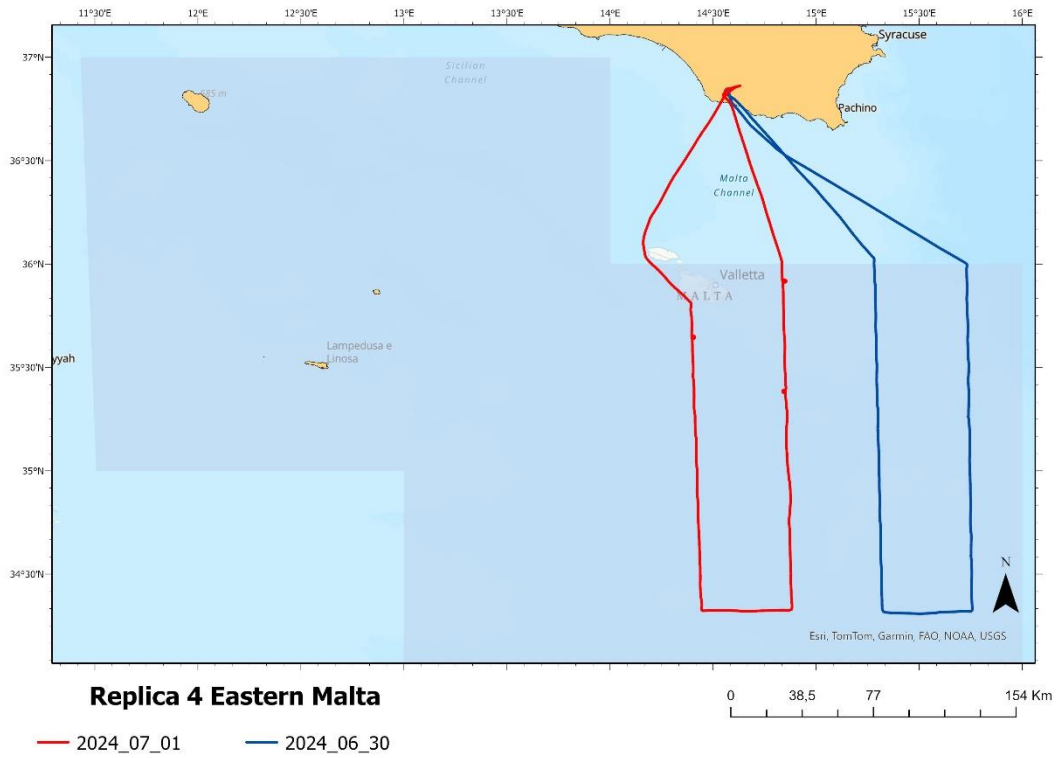Figure 6 - Recorded GPS tracks: Area E, Replica 3

Figure 7- Recorded GPS tracks: Area E, Replica 4

3.3 Sightings overview

Figure 8 shows the positions of the sightings of Bluefin tuna in area E and the related values in terms of number of individuals and weight. All the details are available in table 3 and in the annexed forms. Figure 9 shows the distribution of the sightings of other species.

116 sightings were performed: 14 on BFT, 9 sightings turned out to be "false alarms" and 93 on other species. 6 out of 14 spotted schools were composed by small individuals, and they were in any case in feeding activity. The other 8 were composed both by medium and large fishes. Most of the schools were seen under the surface rather near to the aircraft.

As observed in each campaign, a large number of sea turtles and unspecified dolphins were sighted, as well as 21 swordfish.
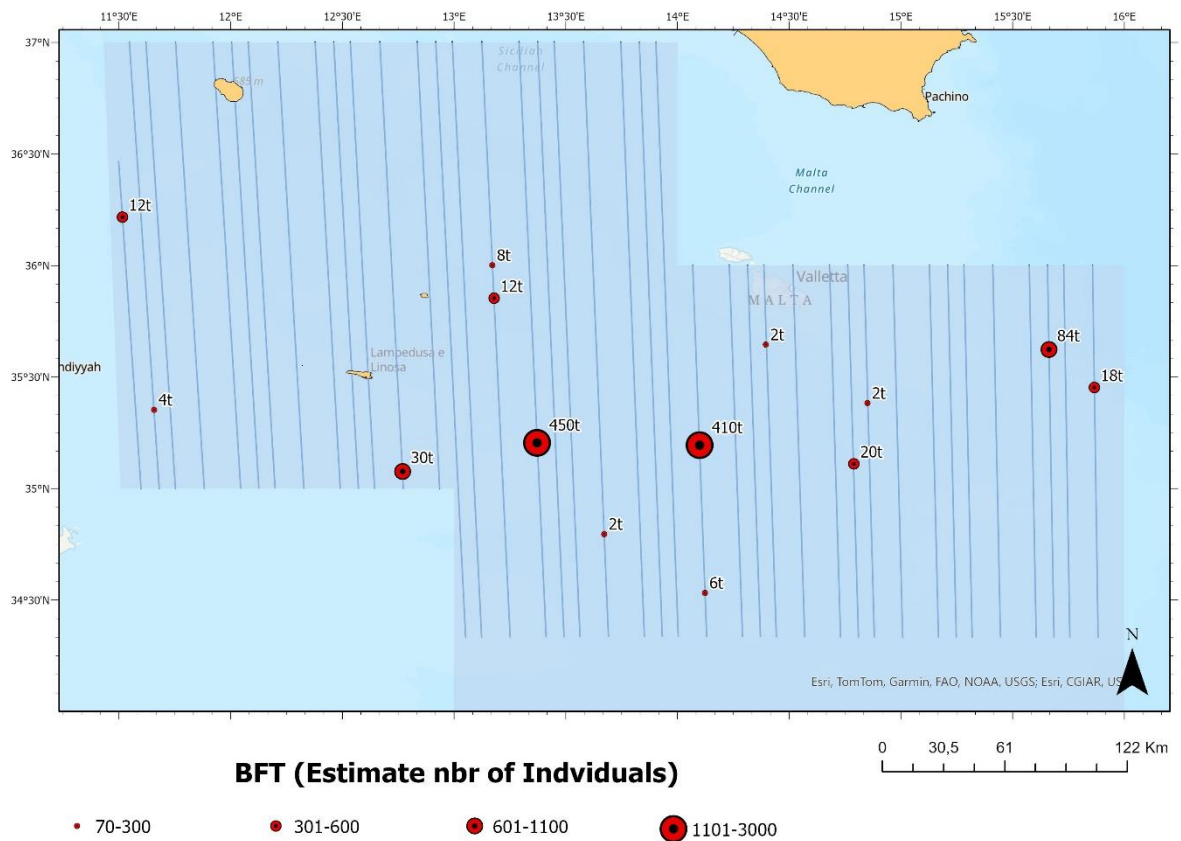

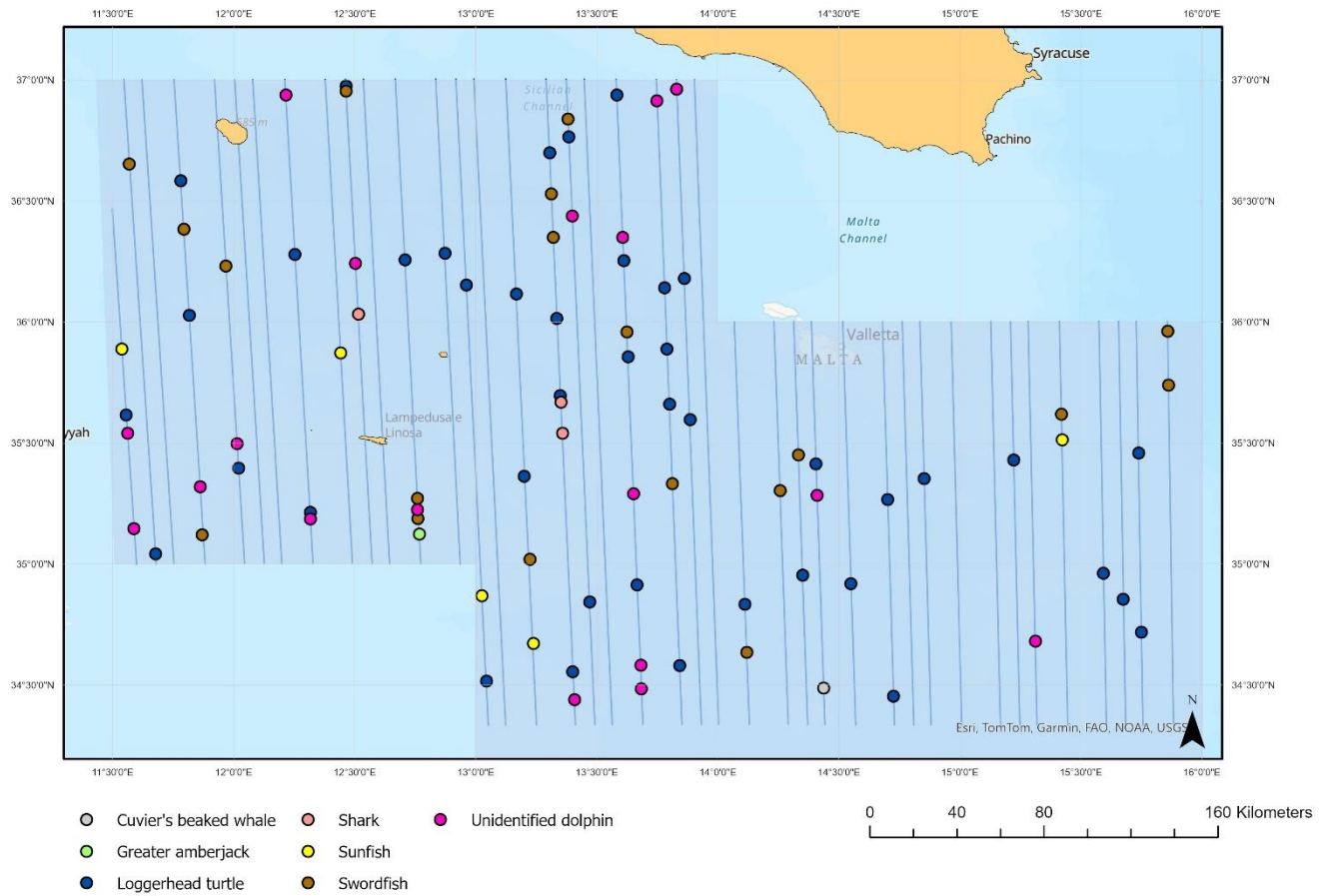Figure 8 - Map of the BFT sightings (number of individuals and weight)

Figure 9 - Map of the other species sightings

Date	Time abeam	Lat abeam	Lon abeam	Angle abeam	School size PS	Weight PS (ton)	% small	% med	% large
14/06/2024	12:20:41	36,21509	11,50797	30	600	12	100	0	0
15/06/2024	07:27:53	35,20570	13,27510	80	2500	450	0	0	100
17/06/2024	07:41:30	35,99745	13,17257	70	300	7,5	100	0	0
17/06/2024	07:48:09	35,84153	13,16814	20	500	12,5	100	0	0
17/06/2024	09:14:09	35,07981	12,76869	80	1000	30	0	100	0
18/06/2024	08:40:28	34,79707	13,68431	25	100	2	100	0	0
19/06/2024	08:41:03	35,34984	11,67859	20	200	4	100	0	0
27/06/2024	07:43:50	35,19325	14,09930	70	3000	410	0	100	0
27/06/2024	08:10:59	34,53291	14,12250	60	150	6	0	100	0
28/06/2024	07:11:13	35,45056	15,85926	60	600	18	0	100	0
29/06/2024	07:51:27	35,62020	15,66222	65	1100	84	0	100	0
30/06/2024	09:13:17	35,11090	14,78721	73	500	20	0	100	0
01/07/2024	07:34:45	35,64357	14,39588	45	70	1,75	100	0	0
01/07/2024	09:09:18	35,88270	14,83827	35	70	2,1	0	100	0

Table 3 - Overview of the BFT sightings

3.4 Methodological remarks and discussion

Regarding the methodological aspects of the sightings, no significant difference from the past campaigns is worthy of notice.

The campaign was carried out without special problems in the Area E: three days stop was necessary due to bad weather conditions.

Regarding the Area E, as in the past campaigns, some difficulties were related to weather conditions, while other difficulties were limited through a careful planning. Bad sea conditions and wind forecasts forced the crew to continuously modify the flight plans in order to avoid strong wind areas, as well as to speed up the surveys performing more than one flight per day in some cases. The worst difficulty was linked to the high variability of the forecasts from a day to another.

It is confirmed that the bubble windows are very useful for vertical and near spotting, but at the same time they create some disturbance for taking photographs because of the strong light reflection and light distortion. Even if the camera was set with the highest shutter speeds, sometimes the photographs were "blurry" or distorted: this seems to be the result of the window interference.

As in the past campaigns, an external antenna was installed and connected to the GPS. We suggest to fix it over the aircraft instrument panel in order to overcome some GPS signal reception problem, already noticed in the former campaigns, especially during circling.

As for the sightings of other species, particularly turtles, since during the survey it was stressed to register them in a systematic way, and it happened to have long periods with only a few sightings followed by strong concentrations of sightings, we suggest to modify the way of registration. It could be much more practical to register them in a separate sheet, where only the position and time of the sighting is requested (it is enough to mark a point in the GPS). Since these species are not the main focus of the survey, it is probably not important to have information about abeam or not and type of cue or to have two different (F and A) waypoints (they are sighted almost always under the aircraft, with the animal swimming at the surface): this modality would permit to sign them without affecting the main target of the survey even in the cases when a big number of sightings occur.

As a further note, we recommend to try to shorten as much as possible the very long transects between Lampedusa and Malta. Toward the south side they arrive to areas very far from eventual emergency landing possibilities, and they also almost touch, or arrive to, Libyan aerial space, that is very often a problematic area.

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Weather forecast websites

Passageweather	www.passageweather.com
Windy	www.windy.com (and smartphone app)
Windfinder	http://it.windfinder.com
Mediterranean Wave Forecast	http://isramar.ocean.org.il
Aeronautica Militare Italiana	http://www.meteoam.it
Consorzio Lamma	http://www.lamma.rete.toscana.it

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5. ANNEXES

1. Complete Effort and Sighting forms
2. GPS tracks (gpx file and Excel track log)
3. Photos
4. Power Point presentation