ICCAT GBYP TAGGING ACTIVITIES IN PHASE 6

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SUMMARY

The ICCAT GBYP tagging activities were launched in Phase 1, by adopting a tagging design and a manual, and then were carried out in all the following Phases. The tagging activity in Phase 6 was limited to electronic tagging in five locations: Morocco, Portugal, Sardinia, Strait of Messina and Levantine Sea. A limited and complimentary conventional tagging activity was carried out in some areas. A general overview of all ICCAT GBYP tagging and tag recovery activities is also provided, updating the previous reports.

RÉSUMÉ

Les activités de marquage de l'ICCAT-GBYP ont été lancées dans la phase 1 en adoptant un schéma et manuel de marquage et ont ensuite été réalisées dans toutes les phases suivantes. L'activité de marquage dans la phase 6 s'est limitée au marquage électronique à cinq endroits : Maroc, UE-Portugal, Sardaigne, détroit de Messine et mer Levantine. Des activités de marquage conventionnel complémentaires et limitées ont été réalisées dans quelques zones. Un aperçu général de toutes les activités de marquage et des activités de récupération des marques de l'ICCAT-GBYP est également fourni, actualisant les précédents rapports.

RESUMEN

Las actividades de marcado del ICCAT GBYP se iniciaron en la Fase 1, mediante la adopción de un manual y un diseño de marcado y posteriormente dichas actividades se llevaron a cabo en las siguientes fases. La actividad de marcado de la Fase 6 se limitó al marcado electrónico en cinco localizaciones. Marruecos, Portugal, Cerdeña, Estrecho de Mesina y mar de Levante. En algunas zonas se desarrolló una actividad de marcado convencional limitada y complementaria. Se proporciona también una visión general de todas las actividades de marcado y de recuperación de marcas del ICCAT GBYP, actualizando los informes previos.

KEYWORDS

Tagging, bluefin tuna, distribution range, electronic tags, tag recovery, awareness

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1. Introduction

According to the general programme, after the adoption of the ICCAT GBYP Tagging Design and the GBYP Tagging Manual in Phase 1, it was planned to begin the tagging activity in GBYP Phase 2 and continue it in the following Phases. The tag awareness and recovery programme was also launched in Phase 2 and continued in the following Phases, including a new tag rewarding policy. The tagging activities in the previous Phases of the ICCAT GBYP are already reported by Di Natale *et al.* (2014a), Di Natale *et al.* (2014b), Di Natale *et al.* (2015), Di Natale (2015), Di Natale *et al.* (2016) and Di Natale *et al.* (In press).

In Phase 6, the ICCAT GBYP Steering Committee decided to proceed with the electronic tagging activities, keeping the conventional tagging only as a complimentary activity. Consequently, 92 electronic tags were deployed in various parts of the Mediterranean Sea and in Eastern Atlantic Ocean. Data of all the tags that popped off at the date have already been processed by the CLS and maximum probable geolocation estimates have been calculated. All PSATs data have been provided in real-time to the Bluefin tuna stock assessment modelling experts and are used for feeding the model. In this Phase 6, additional datasets were recovered from other entities that were deploying electronic tags on Bluefin tuna and they have already been made available for modelling purposes.

Since the beginning of the ICCAT GBYP up to the 21 February 2017, a total of 25,981 tags were implanted on 18,228 bluefin tunas. Most of the tags were implanted in the Bay of Biscay and in the Strait of Gibraltar (**Table 1**).

In this year, ICCAT GBYP continued the tag recovery activities, using the same rewarding policy. In total, 162 tags were recovered during Phase 6. In order to increase the small reporting rates, in this Phase the Steering Committee decided to enhance the tag awareness by producing and disseminating special tag awareness videos. For this purpose, a 5 minutes video and a 40 seconds spot were produced and they are now available on YouTube, while the high-quality files can be downloaded by applying for the simple procedure to gbyp@iccat.int.

2. Electronic tag deployments

For the first part of the tagging activity in 2016, a call for tenders was published in April and the contracts were awarded to a consortium led by COMBIOMA for tagging in the Sardinian traps, a consortium led by INRH for tagging in the Moroccan traps and to the Istanbul University which, in collaboration with UNIMAR, carried out the tagging in the Levantine Sea. In the first part of the tagging activities, a total of 53 electronic pop up tags were implanted on adult bluefin tunas in these areas.

The second part of the tagging activities was intended to be carried out in the Strait of Messina (central Mediterranean Sea), where tagging activities on "resident tunas" have not yet been carried out so far, in the Portuguese traps, where bluefin tuna moving into the Atlantic after spawning can be tagged and in the sea off Ireland, where some tagging activities were carried out in the past. After releasing the call for tenders in June, two contract were provided, to UNIMAR for tagging in the Strait of Messina and to TUNIPEX for tagging in the Portuguese trap, while the contract for tagging off Ireland was suspended by the Steering Committee. A total of 39 tags were deployed in the second part of the year. It is important to stress that 3 of the PSATs deployed in the Strait of Messina were kindly donated by the WWF and the tagging data results will be shared. Another 3 donated tags are to be deployed in the latter phases. The number of tags deployed in each area is showed on **Table 2**.

The fish in traps (Sardinia, Morocco and Portugal) and in purse seine (Levantine Sea) were tagged underwater by well-trained and experienced divers, using a hand pole or specifically modified spearguns (usually calibrated "arbalete" type, but also calibrated oil pneumatic types). The methodology was the one reported by Mariani *et al.* (2014) with the further improvements (Mariani *et al*. 2015), including the size estimates. The tagging in the Strait of Messina was done along the side of the boat by expert taggers. Tagging was done in agreement with the guidelines set in the ICCAT GBYP Tagging Manual (Cort, 2010).

All electronic tags deployed were Wildlife Computers MiniPAT assembled with Domeier dart. Based on the trials and practical experience, we found that the Domeier darts type worked the best for our deployments, especially considering that a large number of them were underwater. The tags were programmed to automatically detach after 365 days. The conditional detachment was also programmed, in case that the tag stayed more than 3 days at the same depth (+/-2.5 m).

3. Electronic tag results

For the purpose of estimating bluefin geolocations and movements from tag data, all available datasets were processed using the best/latest available CLS algorithms. As well all other ICCAT GBYP electronic tag datasets, all available ones from Phase 6 have already been provided to Ph.D. Matt Lauretta (in charge of collecting and analysing all satellite tags data sets on behalf of the SCRS BFT Species Group) and to Tom Carruthers (the modelling expert in charge of developing the technical aspects of both MSE and OM on behalf of the ICCAT GBYP Core Modelling MSE Group).

The results of the tagging activities in Phase 6 show the important number of premature detachments. The reason for this probably lies in the high fishing pressure, the same problem that we faced in Phase 5, as already discussed by Tensek *et al.* (in press). Additionally, this year the PSAT tags supplied by Wildlife Computers, which were used for the ICCAT GBYP tagging, were technically modified in terms of adding the automatic release device situated in the tag tether. As recognized by the manufacturer, a great deal of the premature detachments was due to the broken pin, which was more sensible than it should have been according to the technical specifications. As a matter of fact, out of 92 tags deployed in Phase 6, 25 detached because of the broken pin. A complaint was made and a negotiation process with the producer was initiated. In August the producer recalled and replaced the malfunctioning tags that hadn't been deployed yet and provided more robust ones. Additionally, to compensate for all tags already implanted, those released before their scheduled pop-off date due to this technical failure mode, the producer provided replacement tags free of charge, plus additional complimentary tags that will be used in Phase 7.

Maximum, minimum and mean attachment duration of the tags deployed within Phase 6 by deployment area are given in the **Table 3.** 89 tags have already popped off up to 28/02/2017, while 3 are still attached. The maximum attachment duration in Phase 6 is 118 days, although this number will increase when the remaining tags pop off. The deployments and detachment points of the tags that have already popped off are shown on **Figure 1**.

According to the results, it seems that in the 2016 all tunas tagged in Morocco (**Figure 2**) entered immediately in the Mediterranean Sea for spawning. This is different from the tagging results of previous years, when only a proportion of tagged tunas entered the Mediterranean, while the others stayed in the Atlantic Ocean. The previous results are consistent with the results provided by the GBYP Biological Studies, showing each year different proportion of tunas in Morocco belonging to the eastern and western stock, with high variable mixing rates; therefore, we suspect that all tunas tagged in Morocco in Phase 6 are EBFT.

The tunas tagged in Portugal (**Figure 3**) showed a different pattern, heading towards the North Atlantic. These were expected results, having in mind that these tunas were tagged after the spawning season; it is important to notice that one of the bluefin tuna tagged there showed a different displacement from the others, moving toward the Azores.

The bluefin tunas tagged in Sardinia (**Figure 4**) stayed in the western Mediterranean, which is a behaviour similar to what has already been observed in 2015, when none of the tunas tagged in Sardinia had left the Mediterranean Sea. There is still one tuna tagged in the Sardinian traps with the tag on.

Regarding the bluefin tunas tagged in the Levantine Sea (**Figure 5**), the observed behaviour is the same as the last year. Although the majority of tags detached in a short period of time which didn't let us the chance to record the displacements of these tunas after spawning, it seems that the majority were heading west, and some tunas had reached the western Mediterranean areas before their tag popped off. There is one tuna tagged in the Turkish area with the tag on.

The bluefin tunas tagged in the Strait of Messina (**Figure 6**) mostly stayed in the area of the central Mediterranean, although there is only a part of the tag data that was processed so far and there is still one tuna with the tag attached. Nevertheless, this was expected behaviour having in mind that these tunas were tagged well after the spawning season and therefore included mainly or only Mediterranean "resident" tunas, overwintering in the basin.

4. Tag recovery and reporting

Since the first year of the GBYP and up to 21 February 2017, there have been 565 tags recovered by GBYP (**Table 4** and **Figure 7**). The GBYP recoveries are summarized as follows:

- 352 Conventional "Spaghetti" tags (62.3 % of the total)
- 169 Conventional "Double-barb" (two types) tags (29.9% of the total)
- 25 External Electronic "mini-PATs" tags (4.4 % of the total)
- 12 Internal Electronic "Archivals" tags (2.1 % of the total)
- 3 Acoustic tags (0.5% of the total)
- 4 Commercial "Trade" bluefin tuna tag (0.7% of the total)
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The distribution of tag recovered by area and fishery is showed on **Table 5** and **Table 6**.

In the year 2016, a total of 154 tags were recovered, in spite of the fact that conventional tagging was almost suspended from the 2015 and that in 2014, due to budget constraint, it was poorly done. In the year 2017, up to the 21 February, 17 tags have been recovered. We have to note that, for the first time in ICCAT bluefin tuna tagging activities, the number of tags recovered and reported from the Mediterranean Sea is higher than any other area. Considering that reported tags from the Mediterranean were almost nil before GBYP, this is the clear evidence that GBYP tag awareness campaign is producing positive effects. A total of 162 tags were recovered in Phase 6. The release and recovery locations of conventional tags recovered in Phase 6 are shown on **Figure 8**.

While examining the results of the ICCAT GBYP tag recovery/reporting activities, it is very important to consider that about 90% of the conventionally tagged fish in Phases 2-4 were juveniles (age 0-3); about 70% were surely immature fish (age 0-2) and then it is difficult for these fish to be caught by most of the fisheries, particularly taking into account the ICCAT minimum size regulation and the fact that the baitboat fishery in the Bay of Biscay in the last years was almost nil, because fishermen sold their quota to other fisheries. Furthermore, the institutional GBYP conventional tagging campaign was suspended in Phase 5 and Phase 6.

It is extremely difficult and almost impossible at the moment to define a recovery rate for GBYP conventional tagging activities, taking into account that most of the conventionally tagged tunas were juveniles and they will be possibly available in most of the fisheries within the ICCAT Convention area only in future years. Whenever we consider, as a preliminary exercise, the number of tags recovered so far in comparison with the number of GBYP tags deployed, the provisional recovery rate is now 2.17 %, but this rate is clearly negatively biased by the juvenile ages of about 90% of the tagged fish. At the same time, it is impossible assessing the recovery rate of tags which were not deployed by ICCAT GBYP, because ICCAT does not have the insight in the total number of implanted tags by each tagging entity in the ICCAT area.

Interesting information is slowly coming from the double tagged tunas (**Table 7**): up to 21 February 2017, tags were recovered from 275 double tagged fish and both tags have been recovered from 106 fish (67.72% of the double tagged fish recoveries). 27 fish had only the billfish (double-barb) tag on, while other 36 fish had only the single barb spaghetti on. According to these first data, it seems that both types of tags (single barb and double barb) are more or less equally resistant, with the slight preference for the single barb. The tag recovery rate for all double tagged fish by GBYP is currently 2.14%.

Like in the previous Phases, in Phase 6 the ICCAT GBYP tag reward policy included the following rewards: 50€ or a T-shirt for each spaghetti tag; 1000 € for each electronic tag; annual ICCAT GBYP lottery (September): 1000 € for the first tag drawn and 500 € each for the 2nd and 3rd tag drawn. In addition to these rewards, the GBYP agreed with some Institution which deployed acoustic tags in the past to provide a reward of 100 € for each acoustic tag recovered and reported to GBYP, under a data-sharing agreement.

Tag awareness activity is considered essential for improving the very low tag reporting rate existing so far in the Eastern Atlantic and the Mediterranean Sea. The tag awareness material was produced in 12 languages, considering the major languages in the ICCAT convention area and those of the most important fleets fishing in the area: Arabic, Croatian, English, French, Greek, Italian, Japanese, Mandarin, Portuguese, Russian, Spanish and Turkish. In total, more than 15,750 posters of various sizes (A1, A3 and A4) and more than 18,000 stickers were produced so far; two posters and all stickers were revised in 2014. All posters are also available on the ICCAT-GBYP web page http://www.iccat.int/GBYP/en/AwCamp.asp. A capillary distribution of the tag awareness material was carried out directly by GBYP, sending copies to all stakeholders such as: Government Agencies, scientific institutions, tuna scientists, tuna industries, fishers, sport fishery federations and associations, the

RFMOs and RACs concerned; the coverage was complete in the ICCAT Convention area, including also non-ICCAT countries and entities fishing in the area. The ICCAT-GBYP web page has the full list of contacts http://www.iccat.int/GBYP/images/mapamunditicks.jpg .

Posters are now present in most of the ports where bluefin tuna are usually or potentially landed, in tuna farms, tuna traps, industries, sport fishers clubs, fishers associations, bars where fishers are usually going, local port authorities and on many fishing vessels. Some articles were also promoted and they have been published on newspapers and magazines.

In Phase 6, a call for tenders was released for producing a short video propaganda on ICCAT GBYP tagging activities, specially focusing on its contribution to the scientific knowledge, the sustainability of fisheries and the available rewards. The contract was awarded to the audio-visual producer company MALVALANDA from Spain, for developing a short 5 minutes documentary and a shorter 40 seconds video spot. The videos were translated in 8 languages (Arabic, English, French, Greek, Italian, Portuguese, Spanish and Turkish). They were already presented at the SCRS meeting in September 2016. It is envisaged to develop the ICCAT GBYP bluefin tuna tagging visibility campaign and use these video materials for this purpose, by distributing them to main TV stations and other media in Mediterranean CPCs. All videos are uploaded to YouTube as a full preview and their download in high-quality is available at request, applying to gbyp@iccat.int. The circular letter was sent to CPCs informing them about the purpose and significance of these videos and spots, along with the necessary links.

5. Other activities

It has to be noted that GBYP is only one of the entities regularly providing PSAT data to for the bluefin stock assessment modelling purposes. Although if recently there has been a great progress in a quantity of tagging data that were made available for the same purpose from the other sources, there are still some entities that didn't provide their electronic tags data. GBYP in Phase 6 awarded a contract to Prof. Barbara Block, for recovering the data from Tag-A-Giant research programme of the Stanford University. Datasets of 392 electronic tags were provided in the framework of that contract and were made available to the modelling experts. In addition to these data, Ph.D. Molly Lutcavage also kindly provided many data sets from the electronic tags deployed by her Laboratory.

For the purpose of estimating bluefin geolocations and movements from electronic tag data, all datasets from the beginning of the ICCAT GBYP have been processed by CLS using their latest available algorithm. Since the beginning of the programme, CLS algorithm has been improved, therefore providing results in slightly different format. Datasets up to 2014 were processed using the Ensemble Kalman Filter (ENSKF) model, while from 2014 onwards improved Hidden Markov Model (Grid Filter) has been used. In order to have the all results in the same format and comparable, a contract was given to CLS for reprocessing of the 107 tag datasets with the Grid Filter algorithm, at the end of Phase 6. The newly reprocessed datasets have already been provided to the ICCAT GBYP.

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Table 1. Total number of tags implanted since the beginning of ICCAT GBYP, by area and type.

	TOTAL NUMBER OF TAGS	TAGS IMPLANTED					
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic	% by area
Canada	313	0	308	5	0	0	**1,2%**
Bay of Biscay	11225	7697	3494	21	13	0	**43,2%**
Morocco	515	258	183	66	0	8	**2,0%**
Portugal	388	139	225	24	0	0	**1,5%**
Strait of Gibraltar	8618	5491	3075	27	25	0	**33,2%**
West Med.	2050	1285	732	33	0	0	**7,9%**
Central Med.	2822	1252	1511	47	12	0	**10,9%**
East Med.	50	0	0	50	0	0	**0,2%**
TOTAL	**25981**	**16122**	**9528**	**273**	**50**	**8**	**100,0%**
%	**100%**	**62,1%**	**36,7%**	**1,1%**	**0,2%**	**0,0%**	

Table 2. Number of tags and deployment details by deployment area, of the electronic tags deployed within ICCAT GBYP Phase 6.

Deployment Area	*Deployment site/fishing gear*	*Deployment methodology*	*Deployment period*	*Number of tags implanted*
Messina Strait	hand line	along the side of the boat	25/09/2016-28/11/2016	15
Morocco	trap	underwater	23/05/2016-25/05/2016	14
Portugal	trap	underwater	22/07/2016	24
Sardinia	trap	underwater	05/07/2016	20
Turkey	cage/purse seine	underwater	22/06/2016	19

Table 3. Number of tags popped off (as of 28/02/2017) and maximum, minimum and mean attachment duration, of the electronic tags deployed within ICCAT GBYP Phase 6, by area of deployment

Deployment Area	*Number of tags implanted*	*Number of tags popped off*	*MAX attachment duration*	*MIN attachment duration*	*MEAN attachment duration*
Messina Strait	15	14	111	3	39
Morocco	14	14	26	3	7
Portugal	24	24	29	0	10
Sardinia	20	19	52	3	15
Turkey	19	18	118	2	17
Total	**92**	**89**	**118**	**0**	**16**

Table 4. BFT tags reported by year to GBYP (for comparison purposes tags recovered by ICCAT prior to GBYP are also shown and are in table shaded yellow).

Recovery Year / Tags	Spaghetti Tags	Double BarbTags	External Elec. Tags	Internal Elec. Tags	Acoustic Tags	Commercial Tags	Grand Total	%
2002	1	1		1			3	
2006	1			1			2	
2008	1						1	
2009	1						1	
TOT 2002-2009	4	1	0	2	0	0	7	
2010	3						3	0,53
2011	8		1				9	1,59
2012	36	7	6	1		1	51	9,03
2013	60	28	9	2		1	100	17,70
2014	72	30	1	3		2	108	19,12
2015	68	46	3	3	1		121	21,42
2016	93	54	3	3	1		154	27,26
2017	12	4			1		17	
Undefined (2012 or 2013)			2				2	0,35
Grand Total	352	169	25	12	3	4	565	100

Table 5. Geographical distribution of the areas where the tag recoveries occurred, in numbers and percent, by type of tag (up to 21 February 2017).

Fishing Area / Tags	Spaghetti Tags	Double BarbTags	External Elec. Tags	Internal Elec. Tags	Acoustic Tags	Commercial Tags	Grand Total	%
East Atl	58	32	11	1		1	103	18,23
Med	270	114	10	10	3		407	72,04
North Atl	14	6				2	22	3,89
West Atl	10	17		1		1	29	5,13
Unknown			4				4	0,71
Grand Total	352	169	25	12	3	4	565	100
%ge	62,3%	29,9%	4,4%	2,1%	0,5%	0,7%	100,0%	

Table 6. Details of tag reported to ICCAT GBYP by fishery, in numbers and percent, up to 21 February 2017.

Fishery -Gear / Tags	Spaghetti Tags	Double BarbTags	External Elec. Tags	Internal Elec. Tags	Acoustic Tags	Commercial Tags	Grand Total	%
BB	163	79					242	42,83
FARM	62	18	1	5	3		89	15,75
HAND	21	12	1				34	6,02
LL	34	16		2			52	9,20
LLHB	2	2					4	0,71
NF			13			4	17	3,01
PS	14	6	1	1			22	3,89
RR	14	25		2			41	7,26
SPOR	11	1					12	2,12
TN	1	1					2	0,35
TRAP	4	3		2			9	1,59
TROL	12	4					16	2,83
UNCL	14	2	9				25	4,42
Grand Total	352	169	25	12	3	4	565	100

Table 7. Tag recoveries from double tagged fish by type (up to 21 February 2017).

Release	Spaghetti tag only	Double Barb Tag only	Both	TOTAL FISH	TOTAL TAGS
2011	1	5	5	11	16
2012	10	9	41	60	101
2013	24	12	59	95	154
2016	1	1	1	3	4
Total	36	27	106	169	**275**
%	21,30	15,98	62,72	100	

RcCode: 2conv **both recovered**

	Year of Recovery						
Year of Release	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**TOTAL FISH D/T**
2011	1	3	2	0	0		6
2012	5	15	10	3	6	1	40
2013		6	15	17	19	2	59
2014				1	0		1
2016					1		1
TOTAL	6	24	27	21	26	3	107
%	5,61	22,43	25,23	19,63	24,30	2,80	100,00

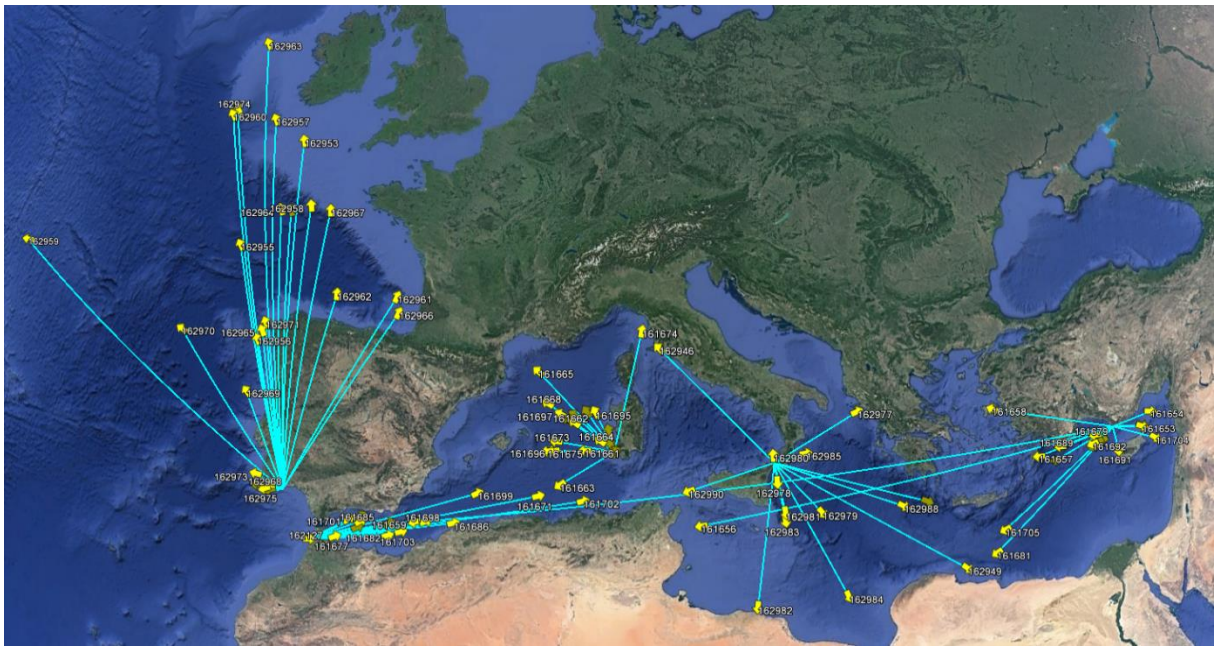

Figure 1. The deployment and pop off coordinates of the tags deployed in Phase 6 that have popped off before 28 February 2017.

Figure 2. Tracks of the electronic tags deployed in Morocco in 2016.

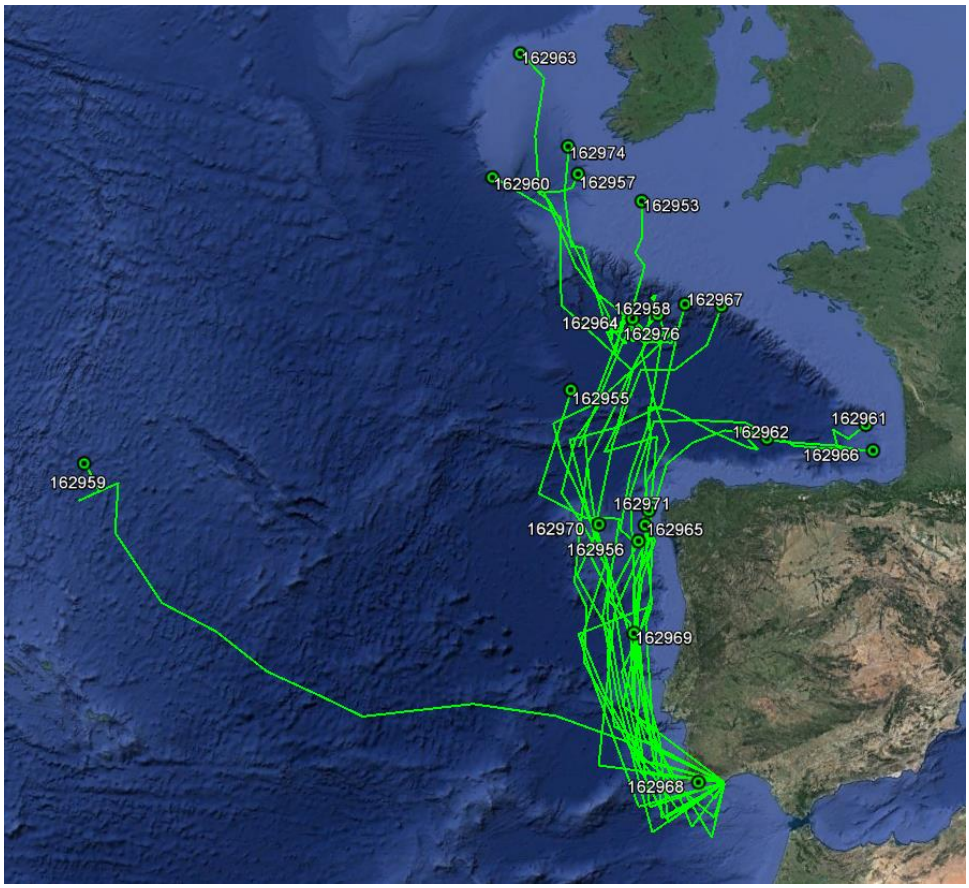

Figure 3. Tracks of the electronic tags deployed in Portugal in 2016.

Figure 4. Tracks of the electronic tags deployed in Sardinia in 2016.

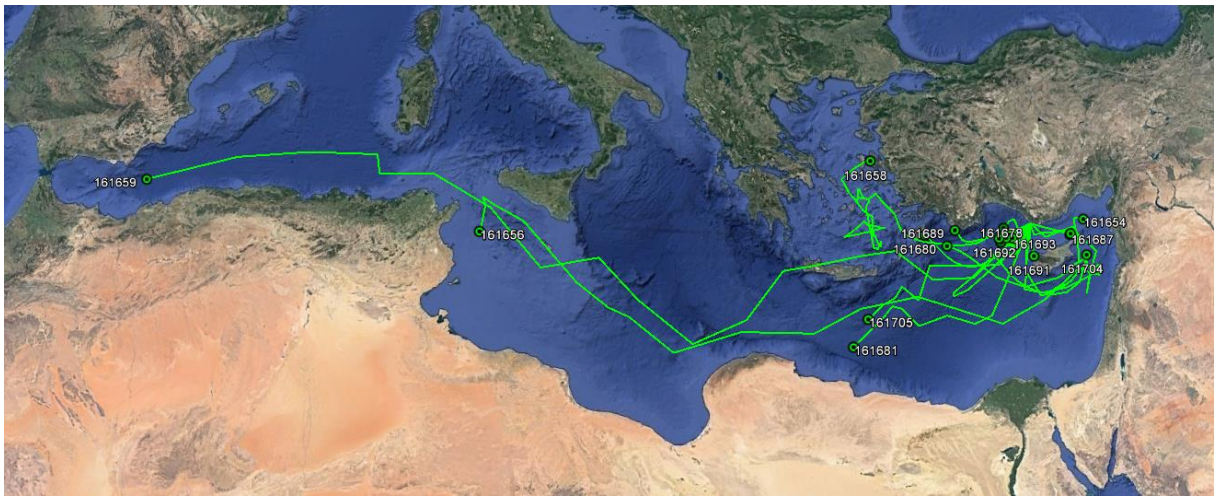

Figure 5. Tracks of the electronic tags deployed in the Levantine Sea in 2016.

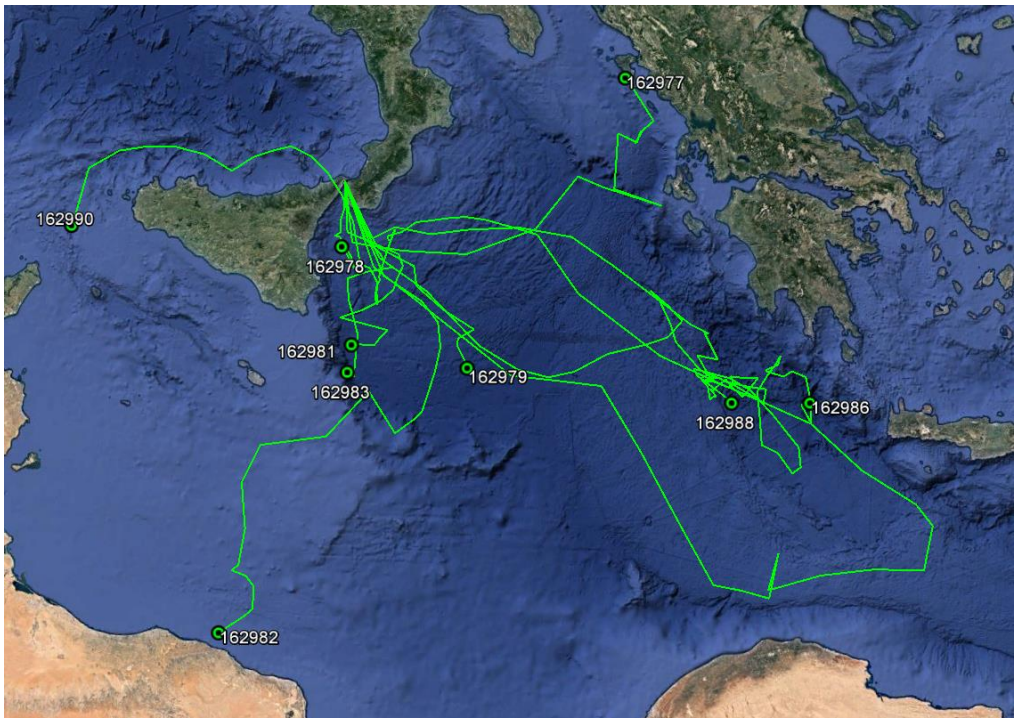

Figure 6. Tracks of the electronic tags deployed in the Strait of Messina in 2016.

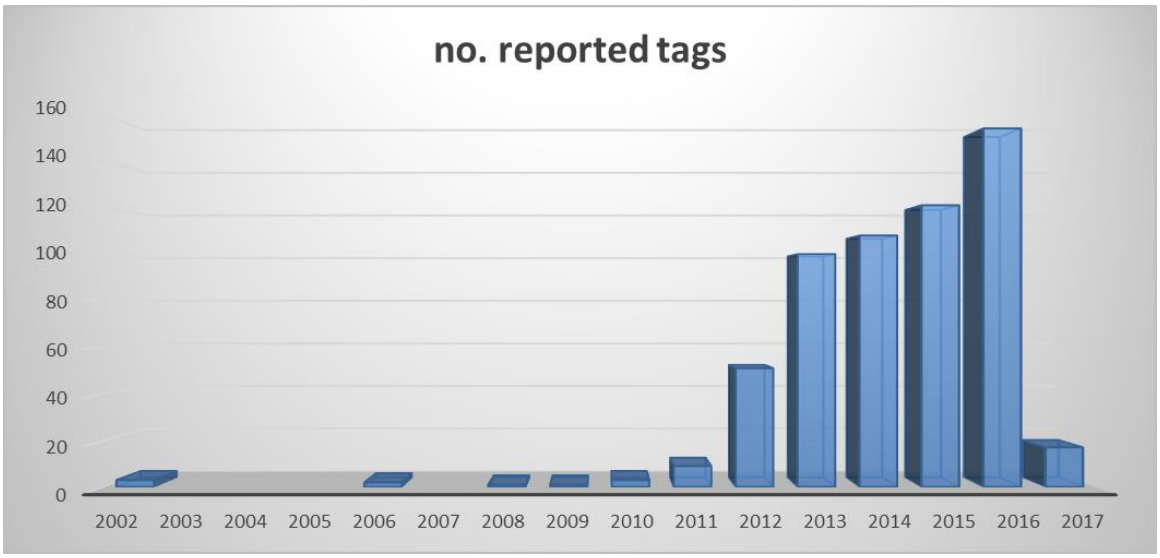

Figure 7. Number of bluefin tuna tags reported to ICCAT by year, up to 21 February 2017 (for comparison purposes, tags recovered by ICCAT prior to GBYP (2002-2009) are also shown.

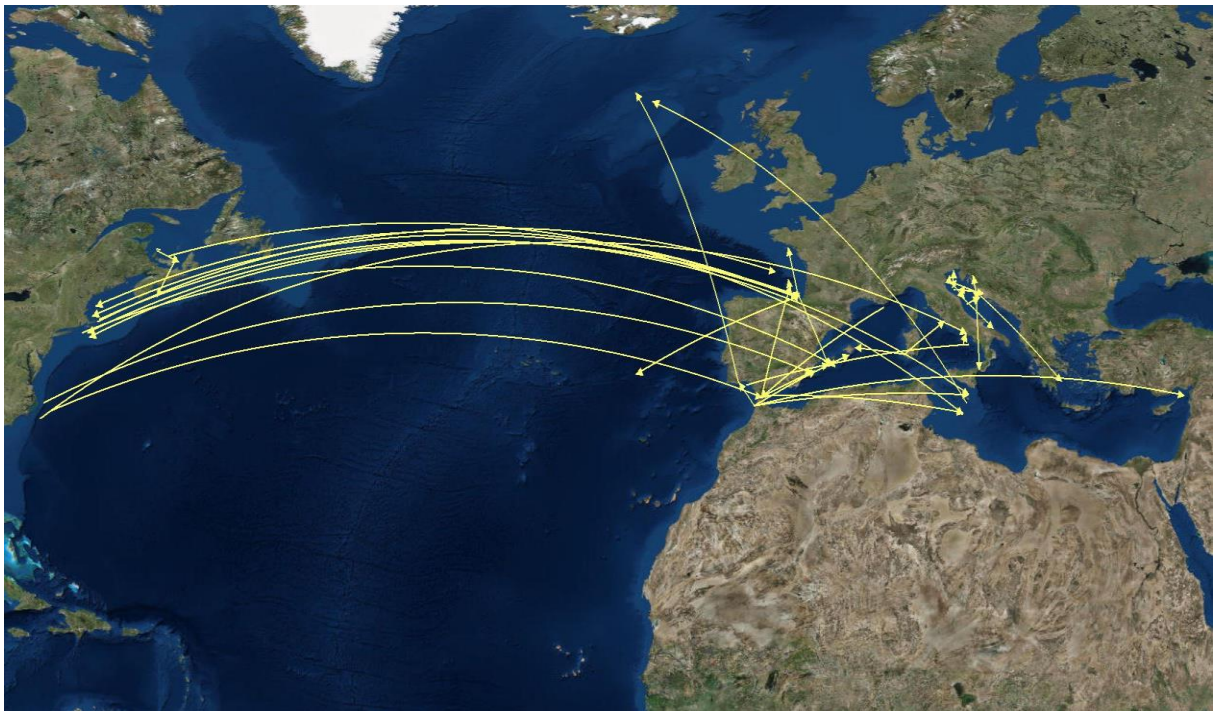

Figure 8. The release and recovery locations of both conventional and electronic tags recovered in ICCAT GBYP Phase 6.