

2012 ICCAT-GBYP POP-UP TAGGING ACTIVITY, IN LARACHE (MOROCCO)

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SUMMARY

The electronic tagging of bluefin tuna carried out in May 2011 on some of the individuals released by one of the traps set along the Atlantic coast of Morocco revealed the need for more MiniPATs (Pop-up tags) to be implanted, with more appropriate protocol and methodology as raised out by the 2011 SCRS Session, then discussed by the 2012 ICCAT GBYP Operational Workshop and authorized by its GBYP Steering Committee. A total of 26 bluefin tuna individuals were tagged using miniPATs: 16 provided by WWF-MedPO and 10 by ICCAT-GBYP, from 14 to 16 May, 2012. Up to September 2012, out of the 17 which have been detached there were 9 pop-offs which brought interesting results in terms of movement patterns of bluefin tuna within a wide area, from the Central Mediterranean to the Atlantic ridge. There are still 8 miniPATs which has not yet detached, while one popped off at the time this paper is under press.

RÉSUMÉ

Le marquage électronique du thon rouge qui avait été opéré en mai 2011 sur quelques individus parmi ceux ayant été relâchés par une des madragues calées le long des côtes atlantiques du Maroc, avait révélé la nécessité que beaucoup plus de marques électroniques MiniPATs (Pop-ups) soient implantées, avec un protocole et une méthodologie plus appropriés, comme il avait été soulevé par le SCRS en 2011, puis débattu début 2012 par l'Atelier opérationnel du GBYP de l'ICCAT et autorisé par son Comité de Direction. Un total de 26 individus a été marqué moyennant des marques électroniques, dont 16 ont été fournies par le Programme WWF-MedPO et 10 par le GBYP, et ce du 14 au 16 mai 2012. Jusqu'en septembre 2012, sur l'ensemble des 17 marques détachées, il y avait neuf marques dont les données fournies montrent d'intéressants résultats en termes de mouvement du thon rouge au sein d'une vaste zone, allant de la Méditerranée centrale jusqu'au niveau de la faille atlantique. A cette date, il y a encore huit marques électroniques qui ne se sont pas encore détachées, alors qu'une marque s'est détachée au moment de la rédaction de ce papier.

RESUMEN

El marcado electrónico de atún rojo llevado a cabo en mayo de 2011 en algunos de los ejemplares liberados por una de las almadrabas caladas en la costa atlántica de Marruecos reveló la necesidad de implantar más miniPAT (marcas pop-up), con un protocolo y una metodología más apropiados tal y como se planteó en el SCRS de 2011 y posteriormente en las Jornadas operativas del ICCAT-GBYP de 2012 y como autorizó el Comité directivo del GBYP. Se marcaron en total 26 atunes rojos utilizando miniPAT: 16 facilitadas por WWF-MedPo y 10 por el ICCAT-GBYP, desde el 14 al 16 de mayo de 2012. Hasta septiembre de 2012, de las 17 que se habían soltado emergieron 9 y arrojaron resultados interesantes en términos de patrones de movimiento del atún rojo en una amplia zona, desde el Mediterráneo central a la cresta atlántica. Continúa habiendo 8 miniPAT que no se han soltado y una que emergió cuando este documento estaba en la imprenta.

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KEYWORDS

Bluefin tuna, ICCAT- GBYP, Atlantic Ocean, Mediterranean Sea, electronic tagging, movement patterns, spawning, traps.

1. Introduction

The comprehensive ICCAT Atlantic-Wide Research Programme for Bluefin Tuna (GBYP) was established to improve basic data collection, understanding of key biological and ecological processes, assessment models and management.

One of the important elements of this programme is to investigate the movement patterns of bluefin tuna within its geographical distribution area: in the Atlantic Ocean, the Mediterranean Sea and their adjacent marine waters as well.

After Phase 1, it was considered the opportunity to tag some bluefin tuna pre-spawners going to the Atlantic Moroccan traps, with the main objective to possibly calibrate the results of the GBYP aerial surveys on spawning aggregations, for evaluating the time at the surface during the spawning period in the Mediterranean sea. The first tentative experience, carried out by several institutions (Instituto Español de Oceanografía, WWF-MedPO, Institut National de Recherche Halieutiques, Association Marocaine de Madragues, Maromadraba sarl., Ricardo Fuentes e Hijos s.a., Madragues du Sud, sarl. and Almadrabas del Norte s.a.) under the coordination and assistance by ICCAT-GBYP and Département de la Pêche Maritime (DPMA-DPM), provided very interesting results in terms of displacements after the tagging (Quílez-Badía *et al.*, in press), but not at all the data originally required for calibrating the aerial surveys. First very preliminary information was provided verbally to the SCRS bluefin tuna Species Group in 2011 by one of us (Sergi Tudela). During the discussion in the BFTSG and following the one in SCRS Plenary (Anon., 2011b, 2012a; Di Natale & Idrissi, in press), GBYP was requested to better balance the electronic tagging between tunas tagged on board and tunas tagged underwater in future trials, for verifying the possible impact of the different techniques on the behaviour after release.

After this first experience that was considered very positively by the SCRS it was decided to continue the tagging activity in Atlantic Morocco, tagging more medium and large size bluefin tuna pre-spawners in traps set along the coast between parallels 34° and 36°N. The electronic tagging activities were included in all GBYP reports (Anon., 2011a, 2011b, 2011c, 2011a, 2011b, 2011c).

2. Material and methods

This programme was initiated in 2011, under the auspices of ICCAT-GBYP, and pursued in 2012, with very positive and fruitful cooperation and collaboration among different partners, namely:

- The Department of Marine Fishery of the Moroccan Ministry of Agriculture and Marine Fishery, through the Direction de la Pêche Maritime et de l'Aquaculture -DPMA-, which provided all the necessary supports in terms of administrative and authorisation supports
- The Company Maromadraba s.a.r.l. and Ricardo Fuentes e Hijos s.a, co-owners of ES-SAHÉL trap, which provided all the logistic support, at both the harbor of Larache and on the trap facilities at sea, all the crew workers and professional divers, necessary to successfully carry out the electronic tagging
- The INRH (Institut National de Recherche Halieutique) of Morocco, through its Regional Research Center of Tangiers, which provided all necessary scientific support at the local level
- The WWF-MedPO (World Wildlife Fund for the Mediterranean) which provided 16 electronic tags (miniPATs), the expert assistance and the tagging staff for tagging
- The ICCAT-GBYP which provided the support framework system, the international assistance and coordination among different partners, the scientific staff, and 10 electronic tags (miniPATs), with double barb dart attachment in plastic provided by the producer, at the opposite of the WWF ones anchored by metallic dart.

As presented by **Table 1**, the 26 miniPATs provided for this 2012 electronic tagging for bluefin tuna were set taking into consideration the recommendations made by SCRS in 2011, and then by the GBYP Operational workshop at its meeting of April, 2012, endorsed by the GBYP Steering a few days later, as follows:

- 14 BFT specimens were tagged on board, with miniPATs and also with conventional tags, and immediately released at sea on the days 14th and 16th of May, 2012.
- 12 BFT specimens were tagged underwater with miniPATs only (7 on the 14th of May and 5 on the 16th of May) and all released together, within a school of more than 250 BFT individuals on the 16th of May, 2012.

The purpose of such two different protocols for implanting the electronic tags, i.e. out or under water is to identify whether or not there would be different behaviours of the bluefin tuna tagged when released, as requested. A dedicated contract was provided to CLS (Collecte – Localisation – Satellites), a specialized French Company operating the ARGOS Systems, to get all the necessary data, both those transmitted by the miniPATs (all provided by Wildlife Computers) when floating at the surface after the pop-off, and those stored at sea and released when the pop-offs occur. This latter information is used to determine the bluefin tuna movement patterns, in terms of:

- The trajectories followed by each bluefin tuna individual, geographically localised by satellites,
- The movements “surface-depth” along the sea water column, occurring for foraging and/or for reproduction needs or for other behaviours.

On each of the 14 bluefin tuna individuals tagged out of the water (i.e. on-board the trap vessel) some length measurements were taken, particularly the total curved fork length in cm (CFL) for all of them while half body circumference (cm) measures were recorded for only 8 individuals. For those tagged under water, it was possible to estimate the weight (kg) for only 5 specimens using the experience of the professional divers of the trap.

Moreover, eleven (11) samples were also collected by WWF scientists for the genetic analyses from tunas handled on board. Under the supervision of WWF-MedPO, a laboratory will be in charge of these tasks, in close coordination with the laboratories of the Consortium already involved in the ICCAT-GBYP programme of biological and genetic analyses.

3. Results

The size of the fish measured and tagged on board ranges from 203 to 298 cm total fork length, and from those with estimated weight (tagged underwater) it ranges from 250 to 300 kg. Two out of the five bluefin tuna specimens tagged the last day on board, using the mini-PATs provided by ICCAT-GBYP, have clear natural marks, circular scars made by the smalltooth cookiecutter shark (*Isistius brasiliensis*) (**Figure 2**). This is not only a very interesting observation made on the bluefin tuna individuals caught by this Moroccan trap but it also provides more questions to be further investigated with regards to the migratory courses followed by some giant or medium bluefin tunas.

Against the expectations, most of the miniPATs tags had unfortunately premature pop-offs, particularly those using only the double barb dart attachment provided by the producer Wildlife Computers. That occurred few days after the tagging operations, since the 21st of May, i.e. barely 5 days later. Based on the up-to-day available information, it is still not clear how many tagged bluefin tuna individuals were fished in a short time, but it seems that at least in four cases the premature detachments were presumably caused by fishing events, considering the presence of some vessels in the pop-off areas; one of these tunas was caught by the last active Moroccan tuna trap after six days at sea. All the necessary efforts were made for recovering some of these 10 tags and particularly for two clearly washed ashore, but without any success.

The summary maps (**Figure 1a** and **Figure 1b**) illustrate the geographical locations where the pop-offs occurred for the tags deployed in Morocco in 2012. In the second figure it is indicated also where the most recent pop-off (# 114007) took place, exactly on the Atlantic ridge, between Ireland and New Foundland.

Based on these very preliminary results, it is confirmed that some potential spawners entered into the Mediterranean Sea, going to well-known spawning areas, such as Balearics, Southern Tyrrhenian Sea, Strait of Sicily and Libyan Sea (**Figure 3**). A total of 5 out of 9 bluefin tuna individuals moved into the Mediterranean; some of them showed very clear spawning behaviours. That was particularly the case of the two individuals which journeyed, from 11 to 21 June, in South-East and South-West of Sardinia; one of them popped-off in the same area while the other returned into the Atlantic Ocean for a long movement northward, directly heading to Ireland and then into the far North Atlantic Ocean, between the Färöer Islands and Norway. The other 3 bluefin tuna individuals had their tags popped-off in the area between Malta and Libya.

On the other side, four (4) individuals went directly to the Atlantic areas, precisely off the Azores and NW Madeira area, without entering into the Mediterranean during this spawning season. One of them even crossed the Atlantic ridge, going towards the western Atlantic (**Figure 4**).

More interesting results are expected to be gained from the remaining 8 miniPATs which are still attached to the bluefin tuna individuals, currently swimming somewhere at the time this document was written.

4. Conclusions and recommendation

Considering the two electronic tagging operations carried out successively during the two last years (2011 and 2012) under the ICCAT-GBYP, it seems that tagging for pre-spawning bluefin tuna individuals proved how many scientific opportunities are provided by these two trials and particularly how interesting results are now available for carrying out deeper investigations in the near future research on bluefin tuna.

The different tagging approach (underwater or on board), according to this first experience, seems slightly affecting the behaviour of fish after tagging. **Table 2**, summarizing the preliminary results, shows that there were as much bluefin tunas entered into the Mediterranean as those headed to the Atlantic Ocean, 8 individuals for each side, with one which after having spent some time during that spawning season in the area between Sicily and Sardinia left back to the Atlantic. However, it seems like those tagged underwater and released within a school tend to prefer entering into the Mediterranean (5 out of 7), while those released individually head into the Atlantic waters (6 out of 9). That is something which will be more studied for the next experiences.

It is interesting to note that Rodríguez Roda (1964) had very similar experience with bluefin tunas tagged off the Moroccan coast: 3 out of 7 tunas went to the Atlantic area between Faro (Portugal) and Isla Cristina (Spain), 3 out of 7 tunas went to the area between Tarifa and Cadiz (Spain), while one tuna went to the Alboran Sea. It seems that bluefin tuna pre-spawners coming to the Moroccan areas may go either to the well-known spawning areas in the Mediterranean Sea or to some Atlantic areas (Azores and Canary Islands), depending on individual choices which have to be better understood. It is also interesting to note that some of the Atlantic areas reached by these tunas during the classical spawning period were hypothesized to be additional or temporary spawning areas by some scientists (Mather *et al.*, 1995), but without any specific evidence. This fact poses additional questions and reveals further need for future investigations.

These preliminary results are of great interest for the scientific community concerned by bluefin tuna, seeking for better knowledge about this enigmatic marine species, and subsequently for a more focused management of the related fisheries.

These are the reasons why it should be recommended:

- to improve even better the electronic tagging in future years, possibly extending the activity to other places where it is possible to tag pre-spawners;
- to improve tagging materials, looking for more resistant implants and anchors for the tags, in order to ensure the stable attachment and to set them for longer periods of time, about one year at least;
- to develop appropriate research for better understanding the courses the bluefin tunas are following before getting into the waters off Morocco;
- to deeply investigate the behaviour of tunas going to some areas outside the Mediterranean Sea during the spawning season, along with a collection of detailed oceanographic data on these areas; larval surveys will be also very useful;

- to maintain such the very fruitful and concrete cooperation agreement set-up in 2011, and even strengthened in 2012, among all the partners which worked together to reach these promising results (**Figure 5**).

5. Bibliography

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Table 1. Detail of the electronic tagging activity carried out in Morocco in 2012.

SUMMARY TABLE OF THE 2012 BLUEFIN TUNA ELECTRONIC TAGGING (Mini-PATs), IN "ES-SAHEL" TRAP, MOROCCO, 14-16 MAY 2012

14/5/2012		Hour (local)	Argos ID #	Pop-up Tag #	PA Conv. Tag #	ICCAT Conv. Tag #	# days set	Size (m)	Half perimeter (m)	#Genetic	Notes
	1	only genetic								M	
	2	11:35	118759	11PO534	PA096	70665		2,68	1,13		Out of water, on board
	3	11:35	118760	11PO535	PA100	70659		2,65	1,15		Out of water, on board
	4	11:40	114009	11PO150	PA025	70672		2,54	1,05	1	Out of water, on board
	5	11:45	114007	11PO134	PA026	70669		2,47	1,08	2	Out of water, on board
	6	11:50	66694	09PO437	PA335	70669		2,51	1,08	3	No ping, Out of water, on board
	7	11:55	118756	11PO531	PA094	70662		2,43	1,07	4	Out of water, on board
	9	12:35	118758	11PO533	PA095	70674		2,26	-	5	Out of water, on board
	10	12:40	118757	11PO532	PA099	70675		2,38	-	6	Out of water, on board
	11	12:45	66697	09PO439	PA424	70664		2,98	-	-	No ping, Out of water, on board
	1	13:30	86238	08A0390	PA097						in water by WWF 2sdorsal lligeramente abajo
	2	13:32	114008	11PO138	PA-cover						in water by trap divers
	3	13:35	114006	11PO133	PA023						in water by trap divers
	4	13:38	86235	08A0386	PA093						in water by trap divers
	5	13:40	118755	11PO530	PA098						in water by WWF 2sdorsal abajo
	6	13:42	111196	11A0601	A042						in water by trap divers Entre 1 y 2º dorsal
	7	13:46	111183	11A0582	PA106						in water by trap divers
15/05/2012	No tagging due to the late delivery of the 10 Mini-PATs by FedEx and strong winds in the afternoon										
16/05/2012		Hour (local)	Argos ID #	Pop-up Tag #	PA Conv. Tag #	ICCAT Conv. Tag #	# days set	Size (m) or weight (kg)	Half perimeter (m)	#Genetic	Notes
	1	9:00	120088	11PO378		70671	250	2,65		7	Out of water, on board w/ natural mark made by the cookiecutter shark
	2	9:07	120081	11PO363		70667	250	2,03		8	Out of water, on board
	3	9:15	120084	11PO372		70657	360	2,38		9	Out of water, on board
	4	9:23	120086	11PO375		70673	250	2,06	0,76	10	Out of water, on board
	5	9:27	120089	11PO381		70652	250	2,41	0,80	11	Out of water, on board w/ natural mark made by the cookiecutter shark
	1	10:45	120087	11PO377			250	260 kg (estimated)			in water by trap divers
	2	10:47	120082	11PO364			250	364 kg (estimated)			in water by trap divers
	3	10:49	120080	11PO362			300	230 kg (estimated)			in water by trap divers
	4	10:51	120085	11PO373			250	190 kg (estimated)			in water by trap divers
	5	10:55	120083	11PO365			250	130 kg (estimated)			in water by trap divers
Trap "Es-Sahel" geographical position: 35°18'10"N - 06°11'40"W ; ICCAT LIST #: AT002MAR00011 ; Company: "Soci�t� Maromadra" - Morocco											

Table 2. Preliminary summary table of bluefin tuna displacement after tagging in Morocco. Tagging underwater versus tagging on board; pop-offs distribution and areas where they occurred.

	<i>Entered into the Mediterranean and popped-off there</i>	<i>Headed to the Atlantic Ocean and popped-off there</i>	<i>Entered first into the Mediterranean then left toward the Atlantic Ocean</i>	<i>Number of bluefin tunas individuals without pop-offs; up to September 2012</i>
From a total of 12 bluefin tuna tagged underwater	5	2	1	4 (except one, popped-off on 19/09/12)
From a total of 14 bluefin tuna Tagged on board the trap vessel	3	6	0	5
Total and percentage (%) to overall 26 mini-PATs implanted	8 (30,8%)	8 (30,8%)	1 (3,8%)	9 (34,6%)

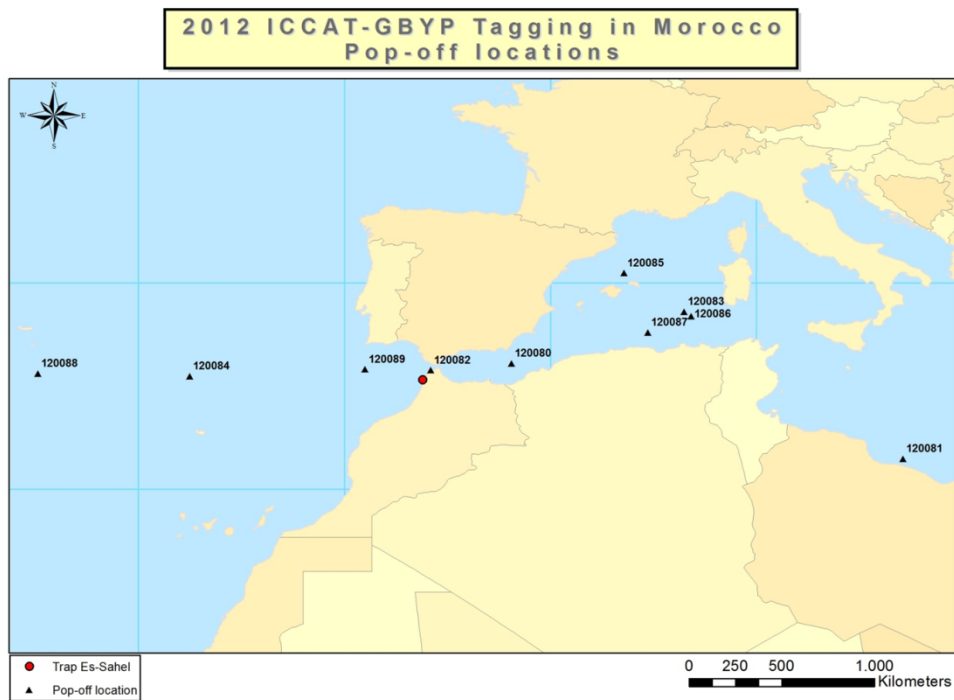


Figure 1a. Pop-off locations of the miniPATs deployed by ICCAT-GBYP team in Larache (Morocco) on May 16, 2012.

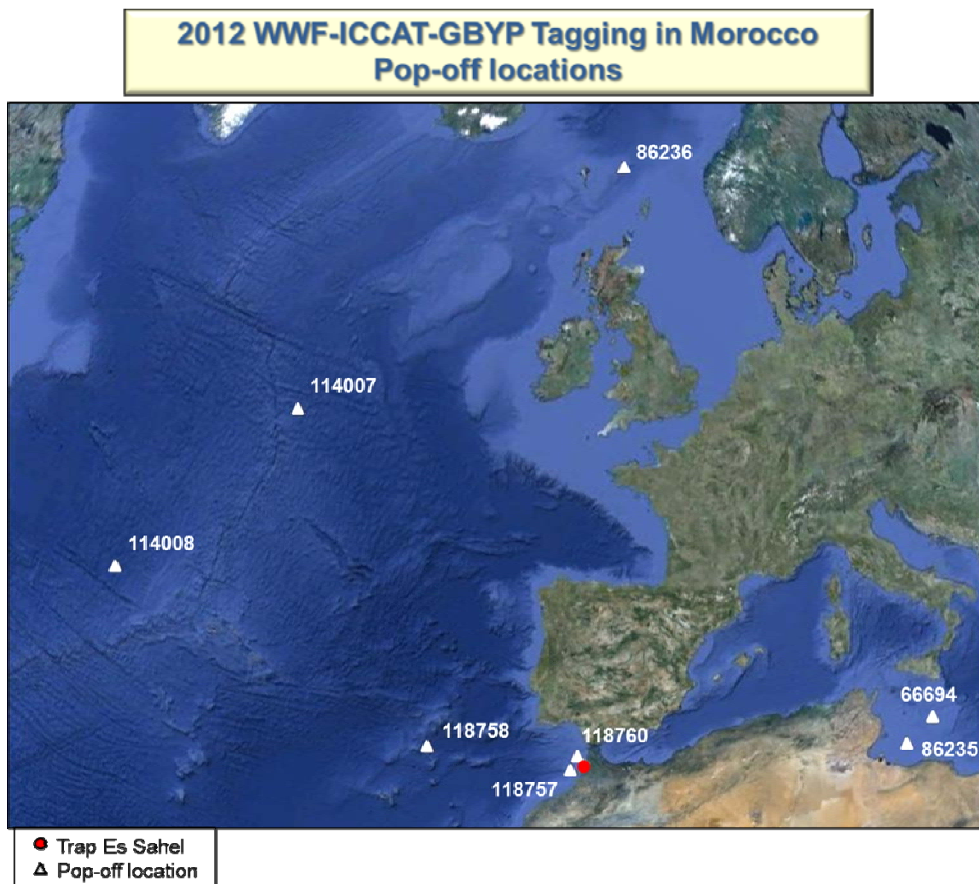


Figure 1b. Pop-off locations of the miniPATs deployed by WWF-MedPO team in Larache (Morocco) on May 14, 2012.

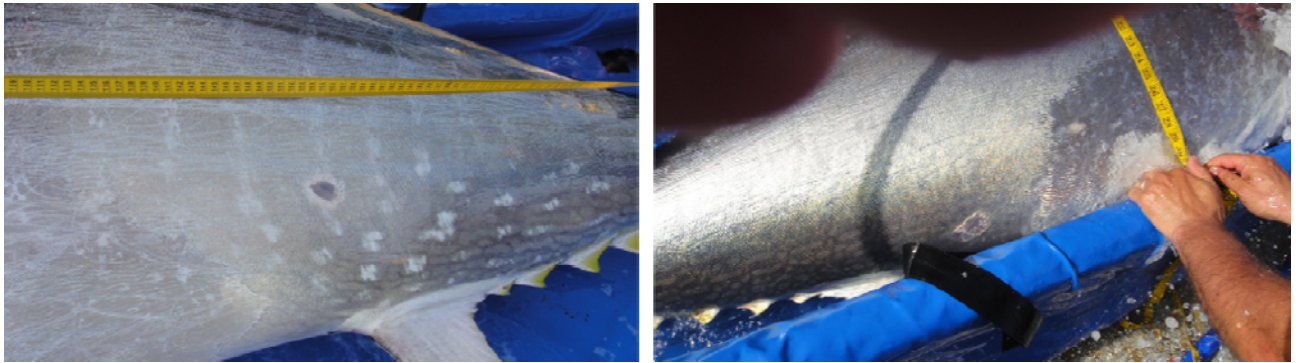


Figure 2. Two BFT specimens with natural marks, circular scars caused by the smalltooth cookiecutter shark (*Isistius brasiliensis*), observed on the 16th of May 2012.

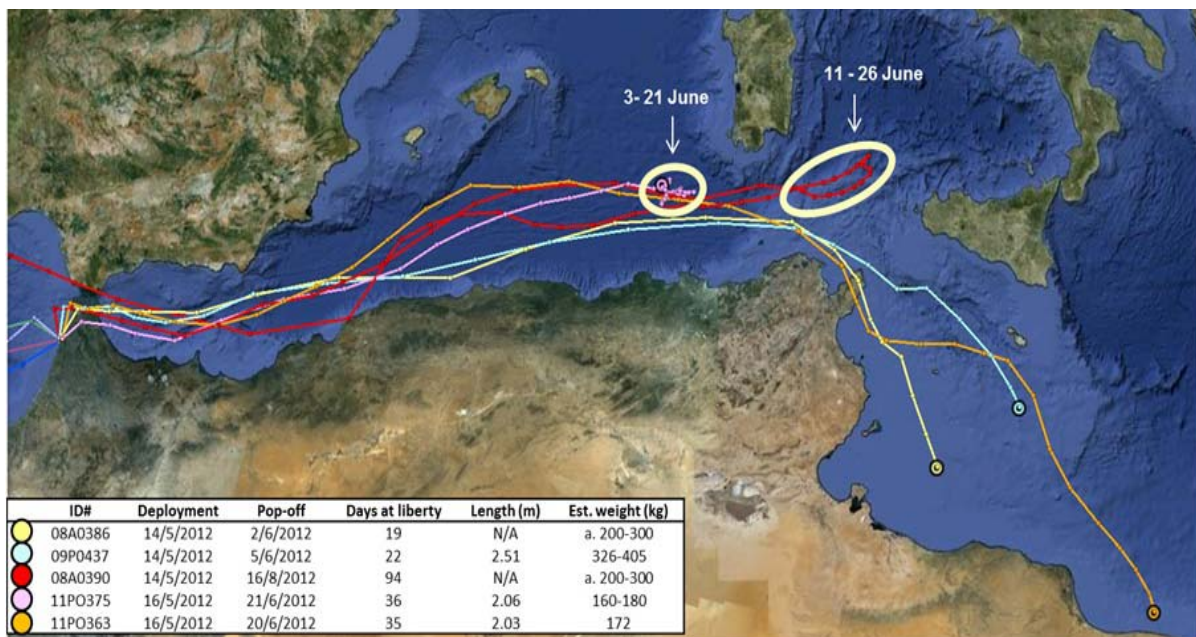


Figure 3. 2012 Bluefin tuna pop-up tracks in the Mediterranean Sea only (zoom).

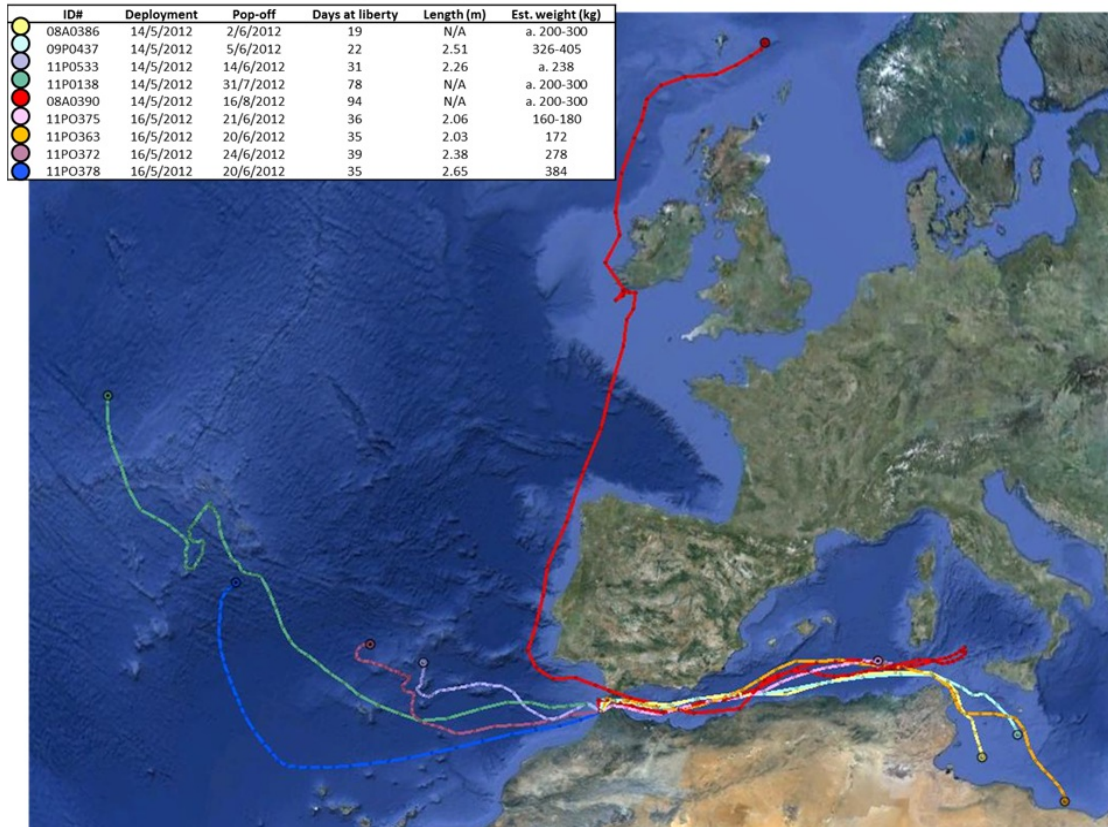


Figure 4. 2012 Bluefin tuna pop-up tracks in both the Mediterranean Sea and in the Atlantic Ocean (overview).



Figure 5. Patchwork of images illustrating several aspects of the electronic tagging carried out in Es-Sahel Trap in Larache (Morocco) in May 2012, under the ICCAT-GBYP cooperation agreement.