

## Final report on the activities led in the framework of the ICCAT/GBYP Phase 4 Tagging Program – Objective A

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### Executive summary

The tagging activities corresponding to the Objective A of the ICCAT/GBYP Phase 4 Program were led onboard three baitboats, one operating in the Bay of Biscay and two in the Strait of Gibraltar (with a complementary tagging activity of recreational vessels in the Balearic Sea) from July 4<sup>th</sup> to October 18<sup>th</sup> 2013. A total of **5740** juvenile bluefin tunas could be tagged during this period, i.e. **105.9%** of the initial objective which was 5418 individuals. The activity was particularly successful in the Strait of Gibraltar, where 2670 (vs 2418 planned) tunas could be tagged in a total of 79 days (vs 93 planned), thanks to a particularly high – although temporally irregular – local abundance of age-3 fish in that area.

This report presents the tagging methodology used, the work carried out in each region, the maps of the areas prospected by each of the three baitboats, the detailed tables with the number of tagged specimens by vessel, area, size-group and type of tag (single barb, small double-barb, miniPAT), and the data input worksheets from the ICCAT tagging database.

The percentage of conventional double-tagged individuals was 53.2% in the Bay of Biscay and 52.7% in the Strait of Gibraltar, which correspond to a global percentage of **52.9%** of double-tagged fish for both areas.

13 of these 5738 tunas were tagged with miniPAT satellite archival tags, which corresponds to 100% of the objective for this type of tags. However their attachment time seems relatively low, as 5 out of the 7 miniPAT tags implanted in the Bay of Biscay popped off within a few weeks. The attachment time seems higher for the individuals tagged in the Strait of Gibraltar, perhaps due to the larger size of pop-up tagged individuals in this area compared to the ones tagged in the Bay of Biscay.

Some suggestions for adjusting the tagging strategy for further conventional tagging in GBYP program are also given.

### 1. Tagging coordinator

As defined in the final offer, the tagging coordinator for the ICCAT/GBYP Phase 4 Tagging – Objective A was Nicolas Goñi (AZTI-Tecnalia, Pasaia).

### 2. Protocols for tagging and sampling

#### 2.1. Tagging protocols

The tagging teams being essentially the same as in Phase 3 activities, no common workshop was held again. Instead, each local coordinator (José Miguel de la Serna for Gibraltar Strait and Nicolas Goñi for the Bay of Biscay) gave a briefing to the respective tagging teams operating in each region. The resulting updated protocol (in Spanish) for conventional and pop-up tagging is given in **Annex 1**.

#### 2.2. Data recording

As in Phase 3 activities, all taggers use submersible paper and pencils, which is the most robust way to record data during tagging.

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Forms to be filled during tagging are printed on submersible paper. Each form will correspond to a given series of 50 tags, or to two series in the case of double tagging (figure 1). In addition, a form for the general activities of the vessel will be filled in the deck. Both forms are in **Annex 2a** and **Annex 2b** respectively.

The format of the data to be transmitted to the coordinator will be the one detailed in the final offer.

### 2.3. Settings for miniPAT tags

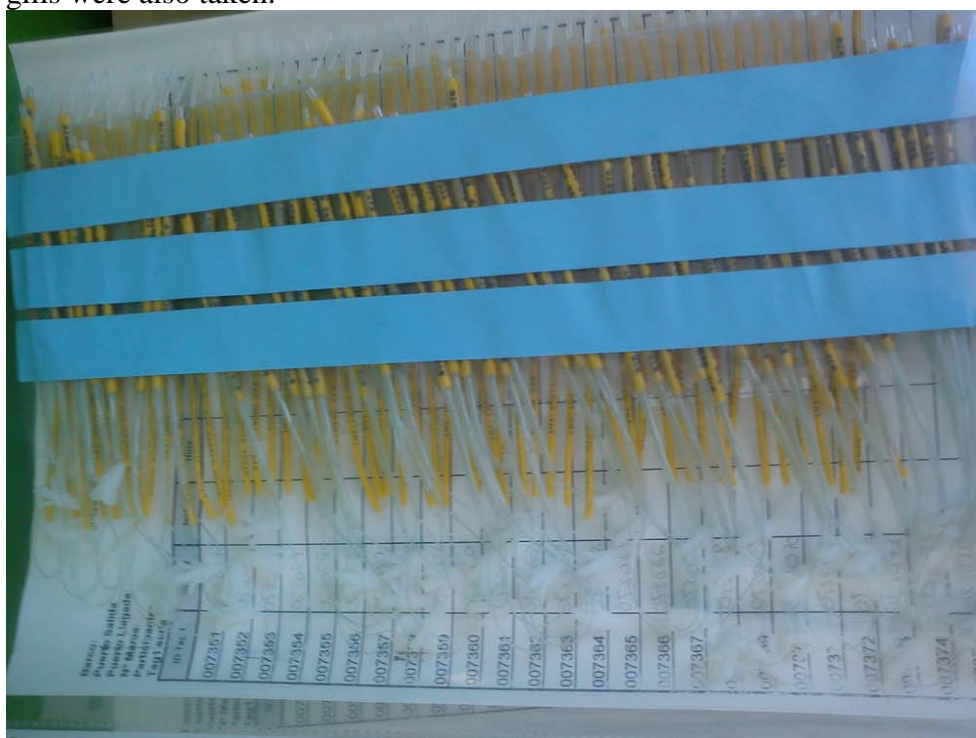
As specified by ICCAT/GBYP, the miniPAT tags will be set for the maximal possible recording time (taking into account the need to record appropriate data to filter the raw geolocations), i.e. 360 days. The template we will use is given in **Annex 3**.

### 2.4. Sampling

As specified in the offer, the sampling objective was 60 individuals of the “medium” (25 to 100 kg) size-class. The corresponding catches were documented and communicated to ICCAT through the RMA forms.

In the Bay of Biscay, individuals over 25kg were very scarce. Age-1, age-2 and age-3 individuals were sampled instead, so that the objective was reached in terms of numbers, although not corresponding to the targeted size-group. The details will be given in the ICCAT/GBYP Phase 4 Biosampling and Analyses report.

In the Strait of Gibraltar, 60 individuals over 25 kg were sampled. In addition to otoliths, spine and muscle required for the biological sampling program, gonads, stomach, liver, heart and gills were also taken.



The F/V *Fernandez y Moreno* and *Nuevo Adrian* participated in the tagging activities in the Strait of Gibraltar. The use of these boats corresponds to the tasks of Bernardo Jiménez S.L. and Embarcación Nuevo Adrian S.L. (consortium members), respectively. The tagging activity in this region started on August 24<sup>th</sup>.

#### 4. Summary of tagging activities in the Bay of Biscay (AZTI-Tecnalia)

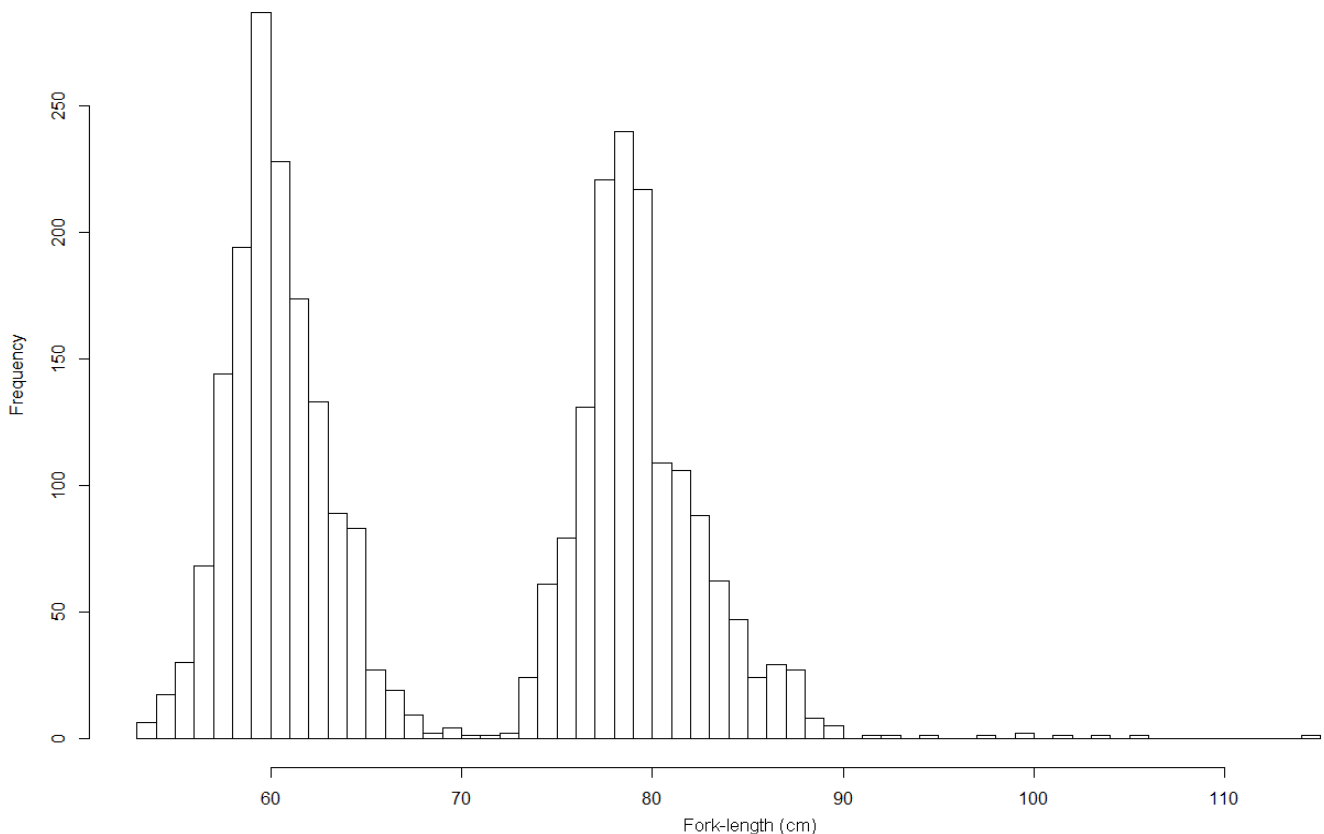
The activities onboard the F/V *Attalaya Berria* started on July 4<sup>th</sup> and ended on August 28<sup>th</sup>. Complementary tagging was done onboard the recreational vessel *Sai Sai* in order to reach the objective of 3000 tagged tunas.

On October 20<sup>th</sup>, a total of **3009** juvenile bluefin tunas has been reached (tables 1 and 2), of which 7 age-3 fish, 1466 age-2 fish and 1533 age-1 fish (figure 2). Most of the activity occurred near the Canyon of Capbreton (figures 3a and 3b).

The objective for age-2 individuals (the age-group with most regular presence in this region) was completed relatively quickly, their local abundance being high in July. On the other hand, age-1 bluefin tunas were scarcer than in normal years, and did not appear more abundant in August as they frequently do. For this reason, and in order to secure the fulfillment of the numerical objective we decided – after agreement with the *Attalaya Berria* crew – to replace a part of the objective for age-1 individuals by age-2 individuals that were available and reactive to the live-bait.

The tagging activity was globally more successful during July. Many days without tagging or with daily catches inferior to 10 individuals occurred in August.

A total of 2981 individuals tagged on the F/V *Attalaya Berria* were reached on August 28<sup>th</sup>. On August 29<sup>th</sup> and September 2<sup>nd</sup>, respectively 12 and 2 age-1 individuals were tagged onboard the recreational vessel *Sai Sai*. 5 other individuals were tagged on September 17<sup>th</sup> on the same vessel (table 2). Six additional individuals were tagged between September 21<sup>st</sup> and 26<sup>th</sup>. And three last ones were tagged onboard the recreational vessel *Kabus Bat* on October 20<sup>th</sup>. The percentage of double-tagged fish in the Bay of Biscay is 53.2%.



**Figure 2:** size-distribution of the 3009 individuals tagged in the Bay of Biscay in 2013. We can notice the age-classes 1 and 2 with modal fork-lengths around 60 and 78 cm respectively.



**Figure 3a:** displacements of the F/V Attalaya Berria during July 2013 in the Southeastern Bay of Biscay



**Figure 3b:** displacements of the F/V Attalaya Berria during August 2013 in the Southeastern Bay of Biscay

**Table 1:** repartition by day, age-class and type of tagging of the bluefin tunas tagged by AZTI-Tecnalia from July 4<sup>th</sup> to August 28<sup>th</sup> 2013 onboard the FV *Attalaya Berria*:

Date	Age-1, spagh. tag only	Age-1, spaghetti and small billfish tag	Age-2, spagh. tag only	Age-2, spaghetti and small billfish tag	Age-3, spagh. tag only	Age-3, spaghetti and pop- up tags	Fish tagged by day (subtotal)	Spaghetti tags used by day (subtotal)	Billfish tags used by day (subtotal)
July 4 <sup>th</sup>	0	0	0	0			0	0	0
July 5 <sup>th</sup>	18	22	85	78			203	203	100
July 6 <sup>th</sup>	19	17	80	81			197	197	98
July 7 <sup>th</sup>	31	5	160	45			241	241	50
July 8 <sup>th</sup>	0	0	0	0			0	0	0
July 9 <sup>th</sup>	4	27	4	173			208	208	200
July 12 <sup>th</sup>	11	32	0	50			93	93	82
July 14 <sup>th</sup>	0	0	0	0			0	0	0
July 15 <sup>th</sup>	27	43	0	0			70	70	43
July 17 <sup>th</sup>	0	4	0	0			4	4	4
July 18 <sup>th</sup>	0	5	0	0			5	5	5
July 21 <sup>st</sup>	12	10	100	158			280	280	168
July 22 <sup>nd</sup>	0	0	0	0			0	0	0
July 23 <sup>rd</sup>	0	1	0	0			1	1	1
July 24 <sup>th</sup>	188	331	0	0			519	519	331
July 25 <sup>th</sup>	68	42	0	0			110	110	42
July 26 <sup>th</sup>	5	0	0	0		7	12	12	0
July 29 <sup>th</sup>	11	1	59	71			142	142	72
July 30 <sup>th</sup>	1	0	0	0			1	1	0
July 31 <sup>st</sup>	4	0	0	0			4	4	0
Aug. 1 <sup>st</sup>	1	0	0	0			1	1	0
Aug. 3 <sup>rd</sup>	8	0	0	0			8	8	0
Aug. 5 <sup>th</sup>	0	0	0	0			0	0	0
Aug. 6 <sup>th</sup>	165	175	17	0			357	357	175
Aug. 7 <sup>th</sup>	7	0	0	0			7	7	0
Aug. 8 <sup>th</sup>	0	0	0	0			0	0	0
Aug. 10 <sup>th</sup>	8	0	9	0	1		18	18	0
Aug. 11 <sup>th</sup>	4	3	0	0			7	7	3
Aug. 12 <sup>th</sup>	6	0	0	0			6	6	0
Aug. 15 <sup>th</sup>	1	0	0	0			1	1	0
Aug. 16 <sup>th</sup>	1	0	0	0			1	1	0
Aug. 17 <sup>th</sup>	37	55	0	0			92	92	55
Aug. 18 <sup>th</sup>	0	0	0	0			0	0	0
Aug. 22 <sup>nd</sup>	0	0	0	0			0	0	0
Aug. 23 <sup>nd</sup>	1	30	0	19			50	50	49
Aug. 26 <sup>th</sup>	7	4	0	0			11	11	4
Aug. 27 <sup>th</sup>	87	59	70	0			216	216	59
Aug. 28 <sup>th</sup>	35	24	23	34			116	116	58
Total by category	767	890	607	709	1	7	<b>2981</b>	2981	1599

**Table 2:** age-1 bluefin tunas tagged onboard the recreational vessel *Sai Sai* in the Bay of Biscay between August 29<sup>th</sup> and September 16<sup>th</sup> and onboard the recreational vessel *Kabus Bat* on October 20<sup>th</sup>

Date	Age-1, spaghetti tag	Fish tagged by day (subtotal)	Spaghetti tags used by day (subtotal)	Billfish tags used by day (subtotal)
August 29 <sup>th</sup>	12	12	12	0
September 2 <sup>nd</sup>	2	2	2	0
September 17 <sup>th</sup>	5	5	5	0
September 21 <sup>st</sup>	1	1	1	0
September 23 <sup>rd</sup>	1	1	1	0
September 26 <sup>th</sup>	4	4	4	0
October 20 <sup>th</sup>	3	3	3	0
Total	28	<b>28</b>	28	0

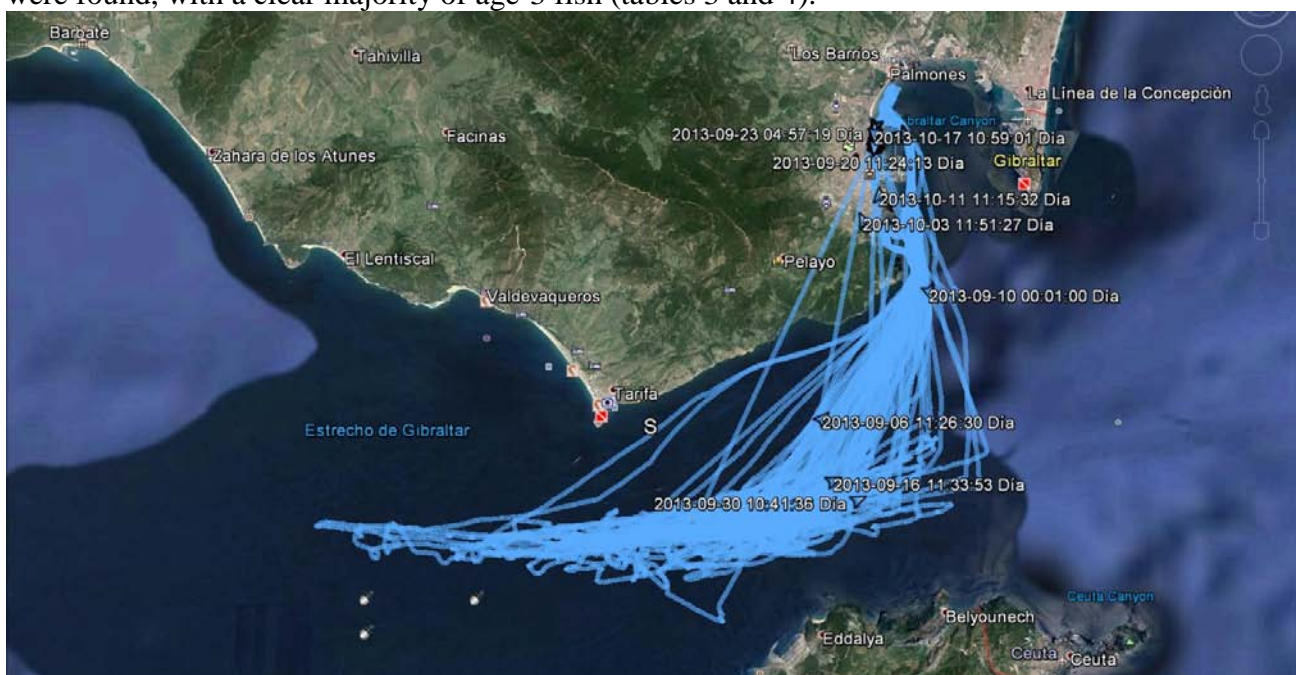
## 5. Summary of tagging activities in the Strait of Gibraltar

The activities in the Strait of Gibraltar started on August 24<sup>th</sup> onboard the F/V *Nuevo Adrian* and on August 26<sup>th</sup> onboard the F/V *Fernández y Moreno*. A report on the local activity led in this region is available as Annex 4, and a detailed logbook of the activity onboard the F/V *Fernández y Moreno* is available as Annex 5. Most of the activity occurred in the central part of the Strait, as shown on the daily GPS tracks (Figures 4a and 4b and Annex 6)

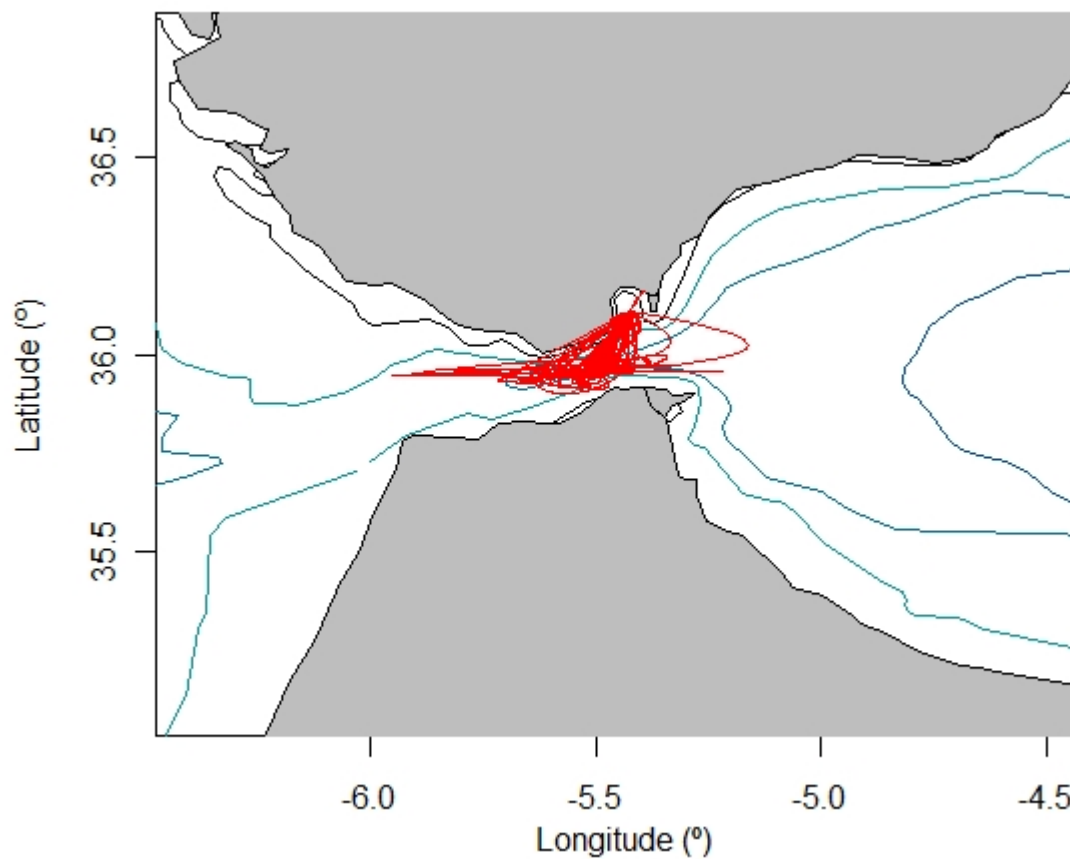
A total of **2670** juvenile bluefin tunas has been tagged (tables 3 and 4) by 18<sup>th</sup> October, of which 1204 in the F/V *Fernández y Moreno* and 1466 in the F/V *Nuevo Adrián*. Two of these individuals were recaptured and tagged a second time. This corresponds to 110% of the objective for this area, in respectively 42 and 37 days at sea for the two boats. The number of fish double-tagged was 1409, i.e. 52.8%.

The tuna catches were very irregular. In addition, several with low or null catches occurred in the second half of September. On the other hand, very good catches could be done in the first half of September and in the first half of October.

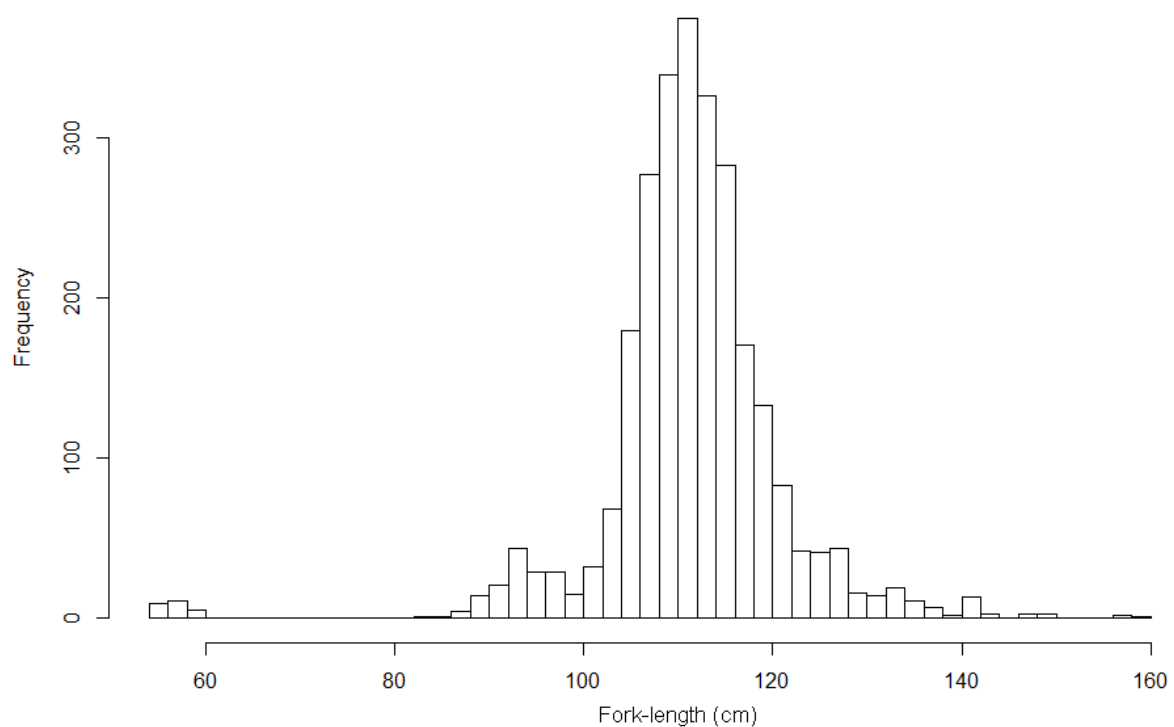
Most of the tagged fish were age-3 (figure 5), with fewer individuals of classes age-1 and age-2 and age-4+. Age-1 individuals were found only one day. Mostly groups of tunas of mixed ages 2 - 4+ were found, with a clear majority of age-3 fish (tables 3 and 4).



**Figure 4a:** tracks of the F/V *Fernández y Moreno* between September 5<sup>th</sup> and October 18<sup>th</sup> in the Strait of Gibraltar. The tracks appearing on land are due to interpolations between two consecutive positions recorded with an important time-lag due to battery exhaustion.



**Figure 4b:** tracks of the F/V Nuevo Adrián between August 24<sup>th</sup> and October 14<sup>th</sup> in the Strait of Gibraltar. The tracks appearing on land are due to interpolations between two consecutive positions recorded with an important time-lag.



**Figure 5:** size-distribution of the 2672 individuals tagged in the Strait of Gibraltar in 2013. We can notice the importance of the age-class 3 with a modal fork-length around 110 cm.

**Table 3:** repartition by day, age-class and type of tagging of the bluefin tunas tagged by UPV, IEO and INRH from August 26<sup>th</sup> to October 18<sup>th</sup> 2013 onboard the FV *Fernandez y Moreno*. The days not appearing on this table are days on which the boat stayed at port due to bad weather conditions. 1204 tunas were tagged, of which one was tagged a second time (after a recapture) on October 18<sup>th</sup>, which corresponds to 1205 releases.

Date	Age-1 tunas		Age-2 tunas		Age-3 tunas				Age-4+ tunas				total
	spag. only	spag+ billfish	spag. only	spag+ billfish	spag. only	spag+ billfish	billfish only	spag.+ miniPAT	spag. only	spag+ billfish	billfish only	spag.+ miniPAT	
26/08/2013	16	9			1	16	1			1			44
27/08/2013				1		43				8			52
28/08/2013						2				1			3
29/08/2013						4				1			5
30/08/2013						7				19			26
05/09/2013					27	39			3	21			90
06/09/2013					24	31	1		5	4	1		66
07/09/2013						26				9			35
08/09/2013				1		19				8			28
09/09/2013				1	31	27			15	6			80
10/09/2013													0
14/09/2013						3			3				6
15/09/2013			1	1	5	9			7	6			29
16/09/2013				1	18	6			7	2			34
17/09/2013													0
18/09/2013													0
20/09/2013													0
21/09/2013													0
23/09/2013													0
24/09/2013			1		14			2	9			1	27
25/09/2013													0
26/09/2013			1	2	24	34			8	12			81
27/09/2013				1	12	8			3	1			25
28/09/2013					1								1
29/09/2013													0
30/09/2013			1		22	7			5	4			39
01/10/2013				1	13	33			7	7			61
02/10/2013													0
03/10/2013					2				4				6
04/10/2013					1								1
05/10/2013				2	33	23			7	6			71
06/10/2013				1	5	21	1		2	5			35
07/10/2013			1	4	74	25			17	6			127
10/10/2013			1		28				8				37
11/10/2013			1	1	39	13			8				62
12/10/2013									2				2
13/10/2013			1		6				4				11
14/10/2013			3		45				2				50
15/10/2013			4		33				8				45
16/10/2013			3		16				3				22
17/10/2013									1				1
18/10/2013							1		2				3
Total by category	16	9	18	17	474	396	4	2	140	127	1	1	<b>1205</b>

**Table 4:** repartition by day, age-class and type of tagging of the bluefin tunas tagged by IEO, UPV and INRH from August 24<sup>th</sup> to October 14<sup>th</sup> 2013 onboard the FV *Nuevo Adrián*. The days not appearing on this table are days on which the boat stayed at port due to bad weather conditions, mechanical problems or lack of live bait. 1466 tunas were tagged, of which one was tagged a second time (after a recapture) on October 14<sup>th</sup>, which corresponds to 1467 releases.

Date	Age-2 tunas		Age-3 tunas				Age-4+ tunas			unknown FL tuna	total
	spag. only	spag. + billfish	spag. only	spag. + billfish	billfish only	spag. + miniPAT	spag. only	spag. + billfish	spag. + miniPAT	billfish only	
24/08/2013		2	2	1							5
25/08/2013		2	8	31				5			46
26/08/2013				27				7			34
27/08/2013			2	70				7			79
28/08/2013				1							1
29/08/2013				33				18			51
30/08/2013				1				5			6
05/09/2013			10	57	1		8	24			100
06/09/2013				22				7			29
07/09/2013		2		103	1			10			116
08/09/2013				5				2			7
09/09/2013		3	22	88			6	17			136
10/09/2013											0
14/09/2013		1	49	59			5	5			119
15/09/2013			21				4				25
16/09/2013			1				9				10
17/09/2013											0
18/09/2013											0
20/09/2013											0
24/09/2013			29				21				50
25/09/2013											0
26/09/2013	1		23				7				31
27/09/2013	1		7				2				10
28/09/2013			2								2
29/09/2013											0
30/09/2013	1		72			1	12	1			87
01/10/2013			8				5				13
02/10/2013											0
03/10/2013											0
04/10/2013	1	25	46	56			7	5	1	1	142
05/10/2013	4	4	43	35			6	4			96
06/10/2013				6				4			10
07/10/2013		3	1	74				17			95
11/10/2013	25		74				5	1			105
12/10/2013	3		6								9
13/10/2013	1		5						1		7
14/10/2013	15		25				6				46
Total by category	52	42	456	669	2	1	103	139	2	1	<b>1467</b>

**Table 5:** Subtotals and types of tags used by the FV *Nuevo Adrián* and the F/V *Fernández y Moreno* from August 24<sup>th</sup> to October 18<sup>th</sup> 2013 in the Strait of Gibraltar

date	Nuevo Adrián				Fernández y Moreno				totals		
	spag. only	spag. + billfish	billfish only	spag. + miniPAT	spag. only	spag. + billfish	billfish only	spag. + miniPAT	Tunas tagged	spaghettis used	billfish used
24/08/2013	2	3			(at port)				5	5	3
25/08/2013	8	38			(at port)				46	46	38
26/08/2013	0	34			17	26	1		78	77	61
27/08/2013	2	77			0	52			131	131	129
28/08/2013	0	1			0	3			4	4	4
29/08/2013	0	51			0	5			56	56	56
30/08/2013	0	6			0	26			32	32	32
05/09/2013	18	81	1		30	60			190	189	142
06/09/2013	0	29			29	35	2		95	93	66
07/09/2013	0	115	1		0	35			151	150	151
08/09/2013	0	7			0	28			35	35	35
09/09/2013	28	108			46	34			216	216	142
10/09/2013	0	0			0	0			0	0	0
14/09/2013	54	65			3	3			125	125	63
15/09/2013	25	0			13	16			54	54	16
16/09/2013	10	0			25	9			44	44	9
17/09/2013	0	0			0	0			0	0	0
18/09/2013	0	0			0	0			0	0	0
20/09/2013	0	0			0	0			0	0	0
21/09/2013	(at port)				0	0			0	0	0
23/09/2013	(at port)				0	0			0	0	0
24/09/2013	50	0			24	0		3	77	77	0
25/09/2013	0	0			0	0			0	0	0
26/09/2013	31	0			33	48			112	112	48
27/09/2013	10	0			15	10			35	35	10
28/09/2013	2	0			1	0			3	3	0
29/09/2013	0	0			0	0			0	0	0
30/09/2013	85	1		1	28	11			126	125	12
01/10/2013	13	0			20	41			74	74	54
02/10/2013	0	0			0	0			0	0	0
03/10/2013	0	0			6	0			6	6	0
04/10/2013	54	86		1	1	0			143	142	87
05/10/2013	53	43			40	31			167	167	74
06/10/2013	0	10			7	27	1		45	44	38
07/10/2013	1	94			92	35			222	222	129
10/10/2013	(at port)				37	0			37	37	0
11/10/2013	104	1			48	14			167	167	15
12/10/2013	9	0			2	0			11	11	0
13/10/2013	6	0		1	11	0			18	17	0
14/10/2013	46	0			50	0			96	96	0
15/10/2013	(at port)				45	0			45	45	0
16/10/2013	(at port)				22	0			22	22	0
17/10/2013	(at port)				1	0			1	1	0
18/10/2013	(at port)				2	0	1		3	2	1
Total by category	611	850	3	3	648	549	5	3	2672	2664	1407

## 6. Summary of tagging activities in the Balearic Sea

The data corresponding to 61 tagged tunas have been transmitted by Oriol Ribalta (CEPRR).

The repartition by age-groups shows a higher proportion of large fish and an absence of juveniles in late July and August.

**Table 6:** repartition by day and age-class of part of the bluefin tunas single-tagged by the collaborating CEPRR recreative fishermen in the Balearic Sea

date	Age 0, spaghetti tag	Age 1, spaghetti tag	Age 2, spaghetti tag	Age 3, spaghetti tag	Age 4+, spaghetti tag	total
27/05/2013				4		4
06/07/2013		2	3	2		7
07/07/2013		4				4
14/07/2013			1			1
17/07/2013					1	1
21/07/2013			3		2	5
23/07/2013					1	1
25/07/2013					1	1
28/07/2013					3	3
03/08/2013					2	2
08/08/2013					5	5
11/08/2013					1	1
17/08/2013					1	1
20/08/2013					2	2
06/09/2013				1		1
14/09/2013			2	2		4
22/09/2013					1	1
23/09/2013				4		4
25/09/2013			1			1
11/10/2013	12					12
total	12	6	10	13	20	<b>61</b>

## 7. Tag recoveries and pop-offs

We had 11 recoveries of BYP tags in the Bay of Biscay (Table 7) of which one implanted in the Strait of Gibraltar; 13 recoveries of BYP tags in the Strait of Gibraltar (Table 8) of which one implanted in the Gulf of Lions ; 5 pop-offs of miniPAT tags in the Bay of Biscay, displaying northwestwards movements and an important association with the northern shelf-break (Celtic Sea to Capbreton) of the Bay of Biscay (figures 6 to 10).

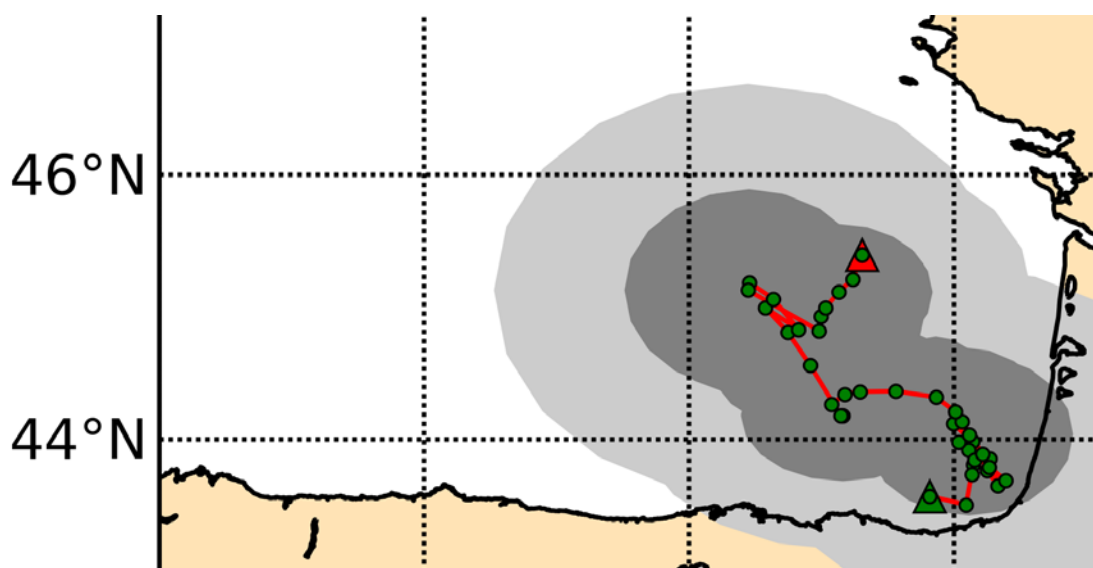
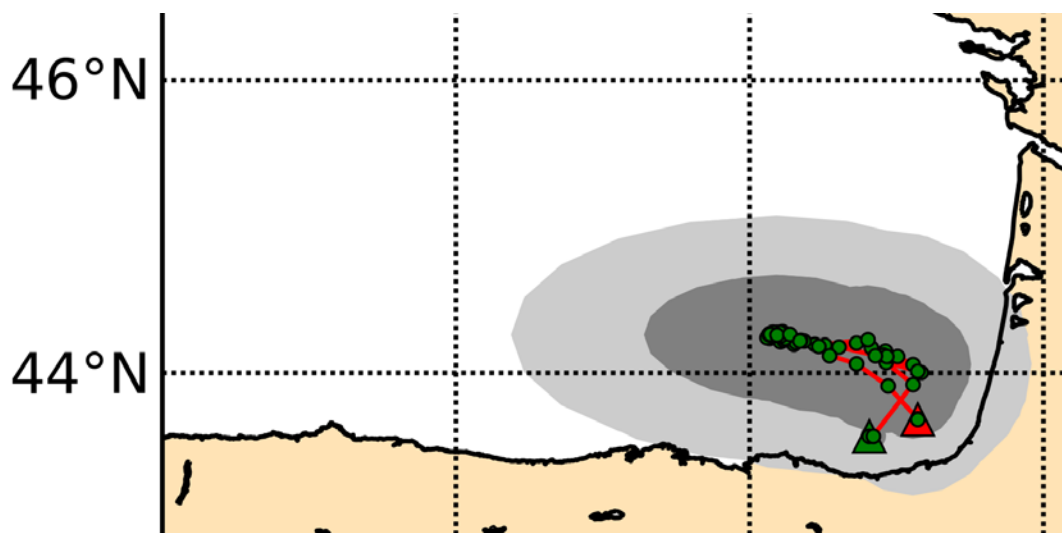
Recaptures of conventional tags implanted during Phase 4 activities are mentioned in the database.

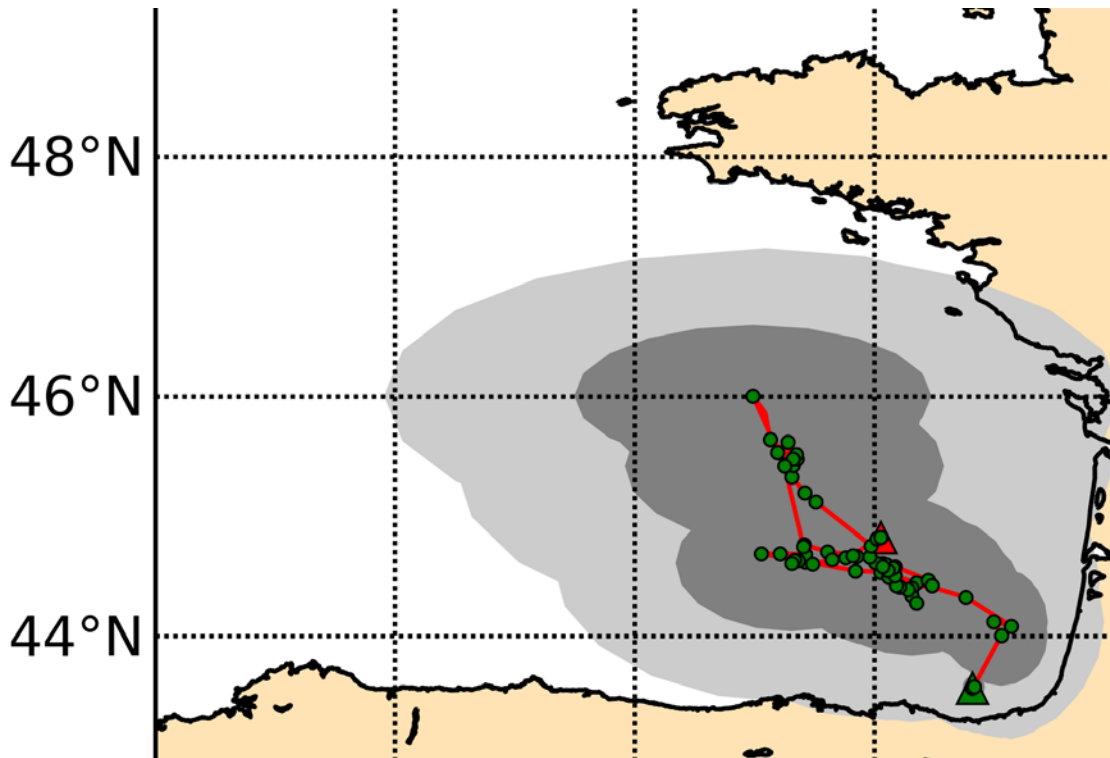
**Table 7:** Bluefin tunas with BYP tags recaptured in the Bay of Biscay in 2013

Spaghetti tag number	Tagging date	Fork-length at tagging	Recapture date	Fork length at recapture	Region of tagging
BYP006446	18/11/2012	70cm (estimated)	22/06/2013	78cm	Gibraltar Strait
BYP007498	18/07/2012	60cm	04/07/2013	77cm	Bay of Biscay
BYP008318	30/07/2012	63cm	06/07/2013	77,5cm	Bay of Biscay
BYP008354	03/08/2012	62cm	06/07/2013	73,5cm	Bay of Biscay
BYP010011	17/07/2012	65cm	07/07/2013	81cm	Bay of Biscay
BYP017032	09/07/2013	74cm	21/07/2013	74cm	Bay of Biscay
BYP009656	19/07/2012	63cm	29/07/2013	78,3cm	Bay of Biscay
BYP017707	05/07/2013	77cm	29/07/2013	78,5cm	Bay of Biscay
BYP017840	06/07/2013	82cm	29/07/2013	84cm	Bay of Biscay
BYP008102	03/08/2012	64cm	22/08/2013	86cm	Bay of Biscay
BYP009582	22/07/2012	61cm	22/08/2013	82cm	Bay of Biscay
BYP016909	09/07/2013	75cm	13/11/2013	90cm CFL	Bay of Biscay
BYP007890	08/07/2012	61cm	06/11/2013	89cm CFL	Bay of Biscay

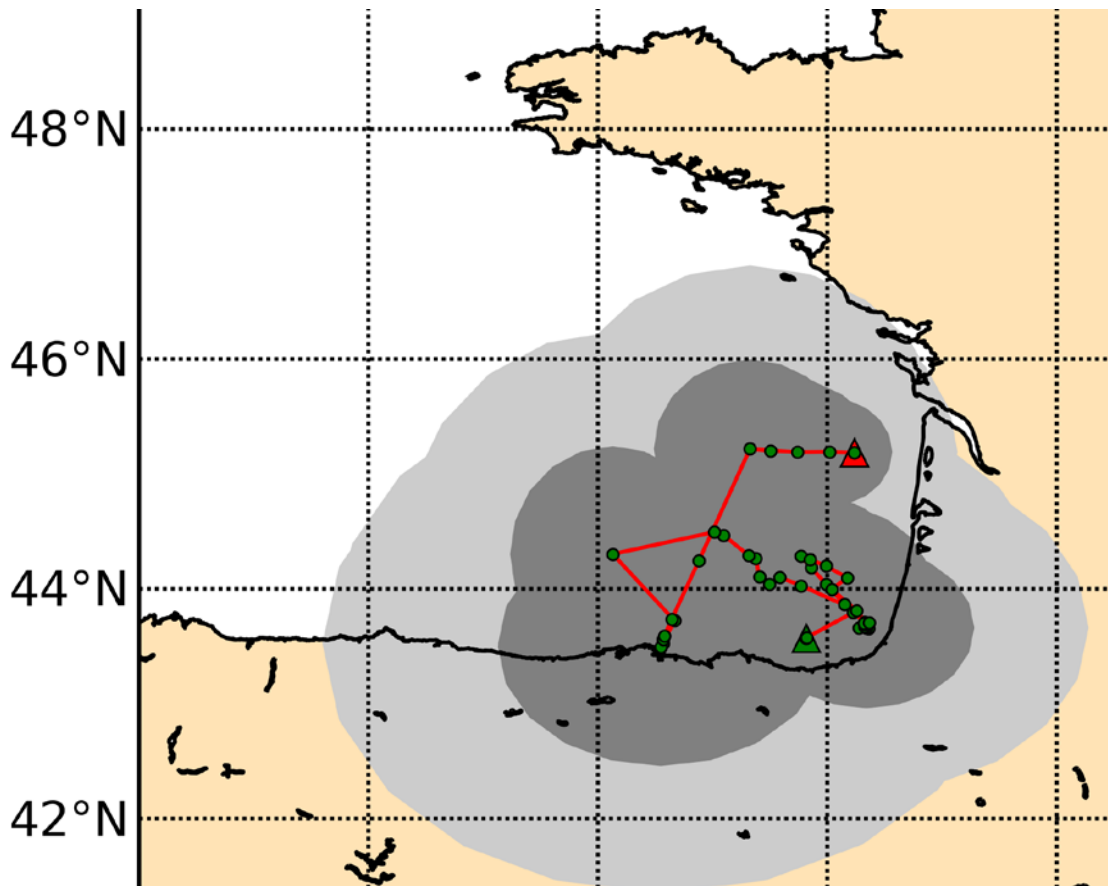
**Table 8:** Bluefin tunas with BYP tags recaptured in the Strait of Gibraltar in 2013

Spaghetti tag number	Tagging date	FL at tagging	Recapture date	FL at recapture	Region of tagging	Tags implanted at 2 <sup>nd</sup> release	
BYP004232	09/12/2011	109 cm	30/08/2013	128 cm	Gibraltar Strait	BYP010535	BYP055531
BYP004972	01/02/2012	93 cm	05/09/2013	119 cm	Gibraltar Strait	BYP010877	BYP054619
BYP001882	16/09/2011	82 cm	14/09/2013	109 cm	Gulf of Lion	BYP011604	BYP055667
BYP014077	10/10/2012	106 cm	14/09/2013	117 cm	Gibraltar Strait	BYP011658	BYP011659
BYP004122	08/12/2011	94 cm	01/10/2013	120 cm	Gibraltar Strait	BYP013356	
BYP003863	07/12/2011	92 cm	06/10/2013	106 cm	Gibraltar Strait		BYP051952
BYP014044	06/10/2012	103 cm	07/10/2013	117 cm	Gibraltar Strait	BYP013609	
BYP010945	06/09/2013	106 cm	13/10/2013	107 cm	Gibraltar Strait		
BYP011815	15/09/2013	106 cm	14/10/2013	106 cm	Gibraltar Strait	BYP014809	
BYP011174	10/11/2012	92 cm	14/10/2013	112 cm	Gibraltar Strait	BYP013748	
BYP015011	10/10/2012	106 cm	15/10/2013	114 cm	Gibraltar Strait	BYP013791	
BYP003941	08/12/2011	93 cm	15/10/2013	112 cm	Gibraltar Strait	BYP013783	
BYP013228	26/09/2013	117 cm	18/10/2013	117 cm	Gibraltar Strait		BYP055974

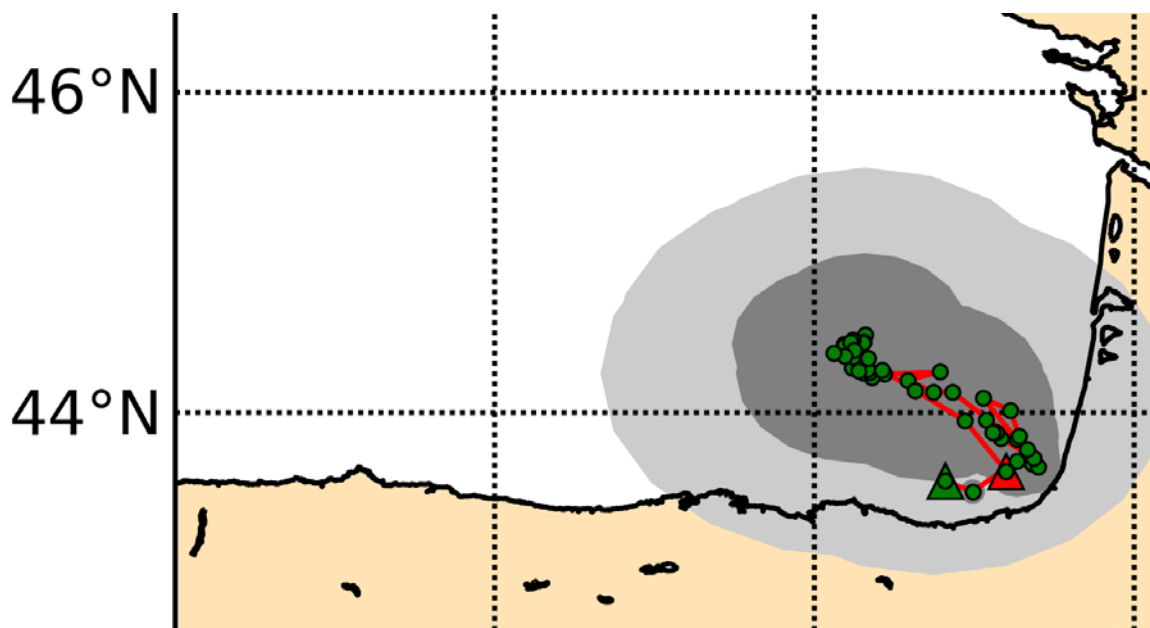
**Figure 6:** track of the bluefin tuna tagged with the miniPAT 12PO221 on July 26<sup>th</sup> 2013 (tagging location indicated by green triangle)**Figure 7:** track of the bluefin tuna tagged with the miniPAT 12PO222 on July 26<sup>th</sup> 2013 (tagging location indicated by green triangle)



**Figure 8:** track of the bluefin tuna tagged with the miniPAT 12PO223 on July 26<sup>th</sup> 2013 (tagging location indicated by green triangle)



**Figure 9:** track of the bluefin tuna tagged with the miniPAT 12PO217 on July 26<sup>th</sup> 2013 (tagging location indicated by green triangle)



**Figure 10:** track of the bluefin tuna tagged with the miniPAT 12PO224 on July 26<sup>th</sup> 2013 (tagging location indicated by green triangle)

### 8. Preliminary analysis of survival rates, from capture-recapture data

One of the aims of the tagging program from the GBYP is the estimation of age specific survival probability for bluefin tunas. At present methods used to estimate survival rates from capture-recapture data in the wild must account for the recapture probability of tagged animals. This implies that a minimum of three capture-recapture occasions are needed before estimates of survival can be obtained without being biased by the joint probability of survival and recapture events (see Lebreton et al 1999). The aim of these preliminary analyses is to obtain a first approximation to the estimation of survival parameters and information about recapture probability.

We used the tagging data of juvenile bluefin tuna during the GBYP phases 2 and 3 in the Mediterranean and Bay of Biscay and the recapture data during GBYP phases 3 and 4. We considered only tuna up to three years old when first tagged. Tunas that were older were not included in the dataset. A total of 9283 tunas were included in the analyses. For the analyses we considered three age groups: one year old tuna (*age 1*), two year old tunas (*age 2*) and three year or older tuna (*age 3+*). The tagging was done during two months (July-August in the Bay of Biscay and western Mediterranean, and November in the Gibraltar Strait in 2011; July –August in 2012 and 2013 in the Bay of Biscay; February, September-November in the Mediterranean and Gibraltar strait in 2012, and mid-August-mid October in 2013 in Gibraltar Strait). For simplicity we did consider the data set with three tagging/recapture sessions (one per year). Thus, tuna tagged in 2011 was considered as recapture if captured in 2012 or 2013, independently of the month of recapture.

Data analyses were done using live recapture models based on the Cormack-Jolly-Seber model modified to consider age-specific survival rates (e.g. Lebreton et al 1999). Analyses were done using software MARK 6.1 (<http://www.cnr.colostate.edu/~gwhite/mark/mark.htm>). Our starting model considered three ages for survival (*age 1*, *age 2* and *age 3+*) and time dependent recapture rates. Different models were considered which included, only two age categories instead of three (*age 1* and *age 2+*), no age effects on survival, and no time dependent recapture probabilities. Model selection was done using the Akaike Information Criteria (AIC). The best model was the one with the lowest AIC value. We used this model to estimate parameters using the Markov chain Monte Carlo procedure implemented in software MARK.

### Results

A total of 29 tuna were recaptured out of 9283 tagged (see Table 8). A total of 7 tuna were recapture but were not release again (dead tuna; this need to be reviewed). Therefore we coded this information in the data set to avoid a bias in this sense. Models fitted to the data are in Table 9. The best model that fitted the data included three age classes and constant recapture probability. There were other models with similar fit to the data as the best model.

We used the best model to use a MCMC procedure to obtain parameter estimates. The results are in Table 10.

It is worth noting that the estimates have large standard error, i.e. low precision. In theory we used mainly the data obtained in the tagging campaigns. Therefore live recapture models are suitable for the analyses instead of dead recovery models. However, the relative large number of dead recoveries (20% of the 2recaptures were indeed dead recoveries) suggest that the use of models One potential solution is the use of combined information from dead recoveries and live recaptures. This approach will have the advantage of estimating directly fishing and natural mortalities (e.g. Pollock *et al.* 2004). On the other hand we have not used the information obtained from electronic tagging (miniPATs). This two considerations may improve the estimation of survival parameters in future approaches to estimate natural survival probability of Bluefin tuna.

It is also worth noting that recapture probability is below the mean recovery rate estimated by Belda et al (2012) in the tagging design ( $0.03 \pm 0.07$ ). The recovery rate estimated in the tagging design for the period 2007-2009 was  $0.002 \pm 0.0017$  (Belda et al 2012). Thus the present recapture rate is better than in the last years previous to the starting of the GBYP tagging program but the awareness campaign need further effort in order to improve recapture and recovery rates

**Table 8.** Number of releases by age and year of bluefin tuna in the eastern Atlantinc during the GBYP tagging program included in the analyses of survival. Recapt means number of blufin tuna first recaptured in each year.

<b>Tuna tagged at age 1</b>				
Year	Releases	Recapt. 2012	Recapt. 2013	Total recaptures
2011	1181	2	0	4
2012	3171		8	8
<b>Tuna tagged at age 3</b>				
Year	Releases	Recapt. 2012	Recapt. 2013	Total recaptures
2011	2011	2	4	6
2012	3171		2	2
<b>Tuna tagged at age 1</b>				
Year	Releases	Recapt. 2012	Recapt. 2013	Total recaptures
2011	2011	3	1	4
2012	3171		5	5

**Table 9.** Model selection to estimate survival and recapture probabilities for juvenile Bluefin tuna. Age 3+ : three ages considered, age1, age 2 and age3+ tunas; Age2+. Two ages considered age 1 and age2+;  $t$  : time dependent model;  $S$ : survival probability;  $p$ : recapture probability.  $AIC$ : Akaike Information Criteria;  $\Delta AIC$ : difference in AIC with model with lowest AIC.

Model	AIC	Delta AIC	AIC Weights	Model Likelihood	Num. Par	Deviance
{S (age 3+) p( )}	412.7785	0	0.38683	1	4	91.1499
{S (age 2+) p( )}	413.9766	1.1981	0.2125	0.5493	3	94.3497
{S(.) p(.)}	414.2376	1.4591	0.1865	0.4821	2	96.6121
{S (age 3+) p(t)}	414.7702	1.9917	0.1429	0.3694	5	91.1395
{S (t) p(t)}	416.1615	3.383	0.07127	0.1842	3	96.5347

**Table 10.** Age specific survival probabilities and recapture probability obtained using MCMC procedure.

Parameter	Mean	Standard Dev.	Median	Mode	95 HDP Credibility Intervals
Survival age 1	0.33	0.16	0.29	0.25	0.05 – 0.65
Survival age 2	0.34	0.17	0.31	0.24	0.07 – 0.68
Survival age 3+	0.66	0.20	0.68	0.70	0.30 – 0.99
Recapture probability	0.008	0.005	0.007	0.006	0.002 – 0.017

#### References

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- Pollock, K.H., Jiang, H. and Hightower, J.E. (2004). Combining telemetry and fisheries tagging models to estimate fishing and natural mortality rates. *Transactions of the American Fisheries Society* **133**, 639–648.

## 9. Recommendations for adjusting the tagging strategy for further conventional tagging in GBYP program

The tagging activities were successful and we did not identify any precise element of the tagging design that resulted problematic. We therefore mainly underline the elements that, in our opinion, contributed to a good activity:

- Number of boats: we consider that using one boat in the Bay of Biscay and two (due to their smaller size) in the Strait of Gibraltar is a suitable option. The use of two boats in Gibraltar also allows sharing real-time information between both, which compensates the absence of commercial fishery during the tagging period.
- Payment by fish: the payment by fish motivates an efficient tagging and we consider this payment mode is suitable, together with the involvement of local fishermen for tagging activities. In the case of Gibraltar Strait, we could add a special reward for the vessels completing the activity in a particularly short time-frame.

- Timing of the survey: the timing of the activities in the Strait of Gibraltar was more adequate this year compared to Phase 3 activities. We recommend starting the activities in August in this area for further tagging surveys.
- Biological sampling: when designing the program we omitted to define the financial conditions of the fish to be sampled by the boats taking part into the tagging activities. This point should be properly defined between the tagging teams and the crew members, in agreement with the GBYP coordination.
- Age-groups focused: we recommend not focusing on age-1 fish in the Strait of Gibraltar, as this age-group appeared very scarce in that area in the previous tagging surveys. Age-2 and mostly age-3 fish appear to me more resident in the area. In the Bay of Biscay, on the contrary, age-3 fish appear more sporadically, so focusing on younger age-groups is more suitable.