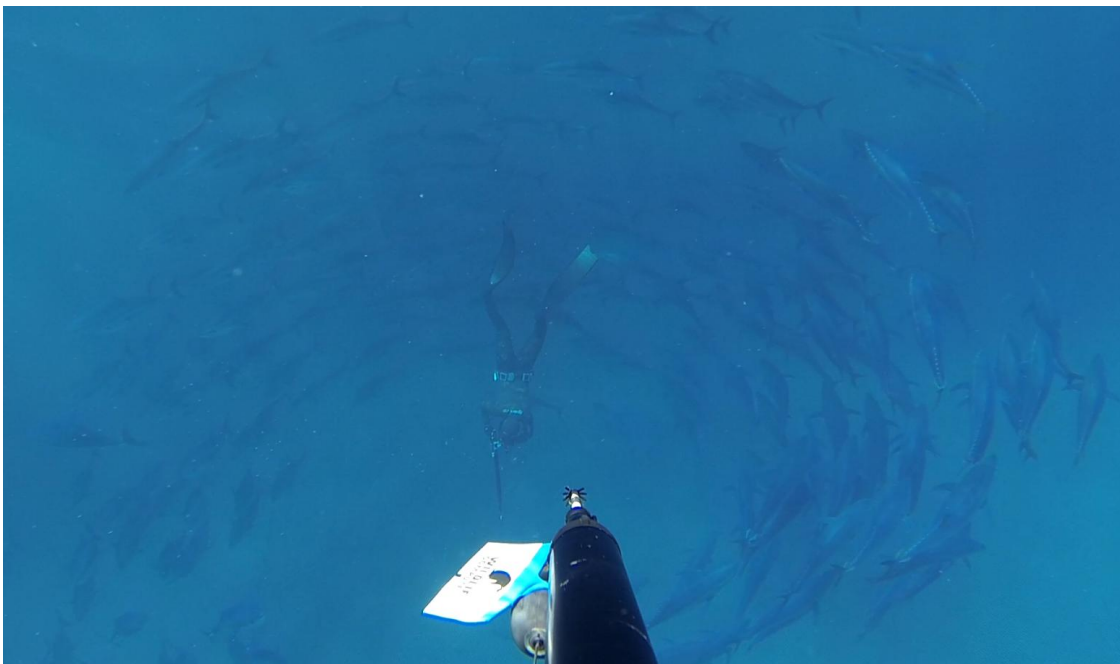


**TAGGING PROGRAMME 2016 ATLANTIC-WIDE RESEARCH
PROGRAMME ON BLUEFIN TUNA (ICCAT/GBYP 03/2016)**

Task C:

**Electronic tagging of adult bluefin tunas in traps in the Mediterranean Sea,
Sardinian waters**



FINAL REPORT

01 August 2016

Consortium partners:



Centro di Competenza sulla Biodiversità Marina Soc. Cons. a r.l. (COM.BIO.MA.)

Società Consortile a Responsabilità Limitata

Legal address: Via ing. Tommaso Fiorelli n.1, Cagliari (09126), Italy

Phone (39) 0706758050 - (39) 0706758051 – Fax (39) 0706758022



CARLOFORTE TONNARE P.I.A.M. – Srl

Carloforte Tonnare P.I.A.M. (Promozioni Industriali Agroturistiche mercantili) S.R.L.

Legal Address: Via Arezzo – 09126 Cagliari - Italy

VAT Number: 01929800926

Phone (39) 0781 855163 – Fax (39) 0781 850039

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CONTACTS

Prof. Angelo Cau (Administrator) +39 070 675 8050 E-mail: cau@unica.it

Co.Bio.Ma. – Centro di Competenza sulla Biodiversità Marina

c/o Department of Life Science and Environment, University of Cagliari Via Fiorelli
1, 09126 Cagliari, Italy

Tel. +39 070 675 8000 – Fax +39 070 675 8022 – Adm. +39 070 675 8040

Tagging Coordinator

Dr. Piero Addis (University of Cagliari - Com. Bio. Ma.)

E-mail: addisp@unica.it

Via Fiorelli 1 - 09126 Cagliari, ITALY

Phone: (39) 070 675 8082, Fax: (39) 070 675 8022

Tagging Staff

Dr Marco Secci ma.secci7@studenti.unica.it	Scientist – Tagging staff PhD – University of Cagliari
Dr Andrea Sabatini asabati@unica.it	Senior researcher – Tagging staff University of Cagliari - Com.Bio.Ma.
Dr Francesco Palmas fpalmas@unica.it	Scientist – Tagging staff PhD – University of Cagliari – Com.Bio.Ma.
Mrs Elisabetta Mereu - combioma_scri@legalmail.it	Administrative officer Com.Bio.Ma.

ICCAT/GBYP 03/2016
“TAGGING PROGRAMME 2016”

FOREWORD

The proposal for the “ICCAT-GBYP Tagging programme 2016 - TASK C: Electronic tagging of adult bluefin tunas in traps in the Mediterranean Sea, Sardinian waters” was awarded on May 17, 2016 by the consortium composed by the Centro di Competenza sulla Biodiversità Marina (Com.Bio.Ma.) and the Carloforte Tonnare PIAM (CTPIAM).

The general aim of the project was to improve the information on the stock distribution and habitat utilization of bluefin tuna to better understand the occurrence (or not) of stock units and their mixing rate between ocean basins.

The issue specified by Task C: Electronic tagging of adult bluefin tunas in traps in the Mediterranean Sea, Sardinian waters, is particularly remarkable for the Mediterranean area since the hypothesis of stock separation “Mediterranean residents Vs. Atlantic migrants” has not been already tested. Previous electronic tagging (and conventional tagging) carried out in Sardinian traps in the period 2013-2015 highlighted a “residency” behaviour of small/medium size BFT, i.e. these tagged fish haven’t left the Mediterranean during the tagging time. The current proposal was aimed to tag mature BFT of small/medium size (n=10) and largest size (n=10) to understand the spatial-temporal behaviour of these size classes assuming that small/medium size individuals being “Mediterranean residency” and largest sizes being “Atlantic migrants”. This hypothesis reconsiders the historical assumption of the so called “golfitani tunas” when fishermen observed small/medium size fish along the Mediterranean coasts all year long, while largest sizes were observed only during the genetic migration in late spring-summer.

The Com.Bio.Ma. is a non-profit scientific institution formally recognized by the Italian Ministry of University which joins the two main Sardinian universities (the University of Cagliari and the University of Sassari). The Com.Bio.Ma. which is located at the University of Cagliari (Sardinia, Italy), owns a documented multi-year experience in bluefin tuna research and from 2013 has been involved in the ICCAT/GBYP programmes.

The partnership between the Com.Bio.Ma. and the Carloforte Tonnare PIAM is a consolidated collaboration that lasts twenty-years, both for biological studies and applied research on bluefin tuna and the trap fisheries. The present report summarizes the tagging activities carried out by July 20, 2016 in Sardinian waters.

SARDINIAN TRAPS: GENERAL FEATURES

In Sardinia currently are settled three traditional traps (tonnara): the Isola Piana trap, Capo Altano trap and Porto Paglia trap. These are the last active traps remaining in the Mediterranean and they are settled in the same area since the 17th century when bluefin tuna fishing contributed to the economic support to the coastal villages of Carloforte and Portoscuso (namely "the tuna district"). The current project involved the Isola Piana trap located in the Island of San Pietro. It is the westernmost trap of the area representing the last trap along the local tuna pathway.

The Isola Piana trap is deployed in the northern part of the island of San Pietro in the location known as "Tacche Bianche". It is the second oldest trap in Sardinia and nowadays the most productive one. It consists of a 1050 meters long tail and five chambers settled on a sandy bottom at 42 m depth. The trap of Isola Piana is managed by the Carloforte Tonnare PIAM srl. The trap crew includes 25 fishermen (tonnarotti).

Table 1 - General features of the Isola Piana Trap.

Iccat number	Reporting Flag	Trap	Reg. Number	Owner	Address	Operator
ATEU2ITA00003	EU.Italy	Tonnara Isola Piana	ITA02/FIS/2010	Soc. Carloforte Tonnare P.I.A.M. s.r.l.	Via Arezzo n.2, 09125 Cagliari (CA)	Soc. Carloforte Tonnare P.I.A.M. s.r.l.

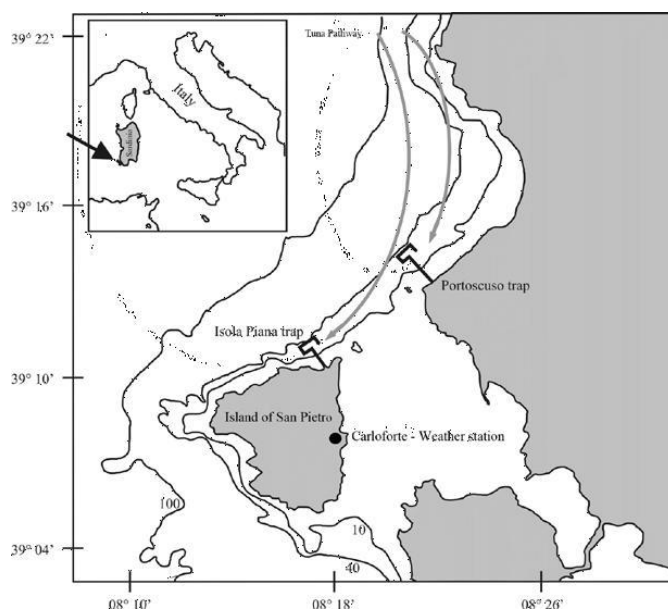


Fig. 1 - Location of the trap fishery in Sardinia.

FISHING SEASON 2016

The trap fishing season in Sardinia started in early February when the equipment (nets, ropes, buoys and anchors) is submitted to the regular maintenance, before being deployed. The Isola Piana trap utilizes about 120 anchors (~200Kgs each), kilometres of steel cables and chains, hundreds buoys and kilometres of nets of different mesh size. This trap needs about 20 working days to be settled, providing favourable weather conditions.

Since mid-April 2016 the trap of Isola Piana has been fully operative and the first observation of entrapped bluefin occurred on late April.

The capturing system is currently used for the entrapping and caging fish to be moved in Malta for tuna farming. Thus, from 2011 the traditional system of harvesting by “mattanzas on-site” ceased, and only one/two mattanzas are planned by year.

The quota provided to the Italian trap fishery by the Ministry for Agriculture, Food and Forestry Policies in 2016 is 232,8 tons (for three traps).

The quota for the Isola Piana trap has been completed in the third week of June. On the basis of the operative plan agreed with the trap company the tagging operations started on June 23, but become effective later due to bad weather conditions which affected the presence/absence of bluefin tuna inside the trap.

TAGGING PROTOCOL

The tagging protocol applied in the current project was similar to the one described in the document SCRS/2014/189 (Mariani et al., 2014), the SCRS/2015/181 (Marian et al., 2015) and the SCRS/2015/193 (Addis et al., 2015). Some modifications were made in order to accomplish the tagging procedure by diver and pneumatic spearguns.

TRAINING COURSE FOR DIVERS AND SCIENTIFIC TEAM

Operational activities were properly planned during three technical meetings at the trap company's headquarter and at the University of Cagliari. The tagging coordinator presented the tagging team (Fig. 2), the tagging protocol, details on the methodology to be applied and the equipment for electronic tagging and these were discussed during the meetings with the trap manager and the trap chief (Rais) and the crew (Fig. 3). Two testing day were useful for testing the effectiveness of the equipment and adjustments mainly needed for tagging adult bluefin tuna. Specifically, due to the hard skin of large bluefin tuna it was decided to use large size of spearguns (97 cm) to better accomplish the tagging of fish equal and larger of 100 kgs.



Fig. 2 - The tagging team from the University of Cagliari – Com.Bio.Ma. in 2016.



Fig. 3 – The “tonnarotti” crew of the Isola Piana Trap (Carloforte Tonnare company).

TECHNICAL FEATURES OF THE TRAP OF ISOLA PIANA

The trap system used in Sardinia is classified as 'tonnara di corsa' (arrival trap) because bluefin tunas are captured along their pre-spawning migration route and with ripening gonads. According to the historical documentation, this location entrapped tuna from the north and north-west pathways.

The gear (Fig. 4) consists of nylon nets arranged in a tail and five chambers: the "Grande" (120 m x 45 m), the "Bordonaro" (45 m x 45 m), the "Bastardo" (45 m x 40 m), the "Camera di ponente" (45 m x 40 m) and the "Camera della morte" (the "death chamber") (45 m x 30 m). Only the death chamber has a moving mesh 'floor' (horizontal), used for pulling up the tuna and for carrying out the "mattanza". There are some differences in size of the tail and the chambers between the two traps due to the diverse features of the sea bottom and the trap orientation.

Following the technical meeting with the trap manager (Mr Giuliano Greco), the tagging coordinator (Piero Addis), and the fishermen chief (*Rais* Luigi Biggio), it was decided to proceed as follows:

- A) to start tagging operation after the tuna transfer into the transportation cage (for avoiding any interference between the death chamber and the cage);
- B) to carry out electronic tagging inside the "death chamber", following positive experience of previous electronic tagging (2015 and 2016).

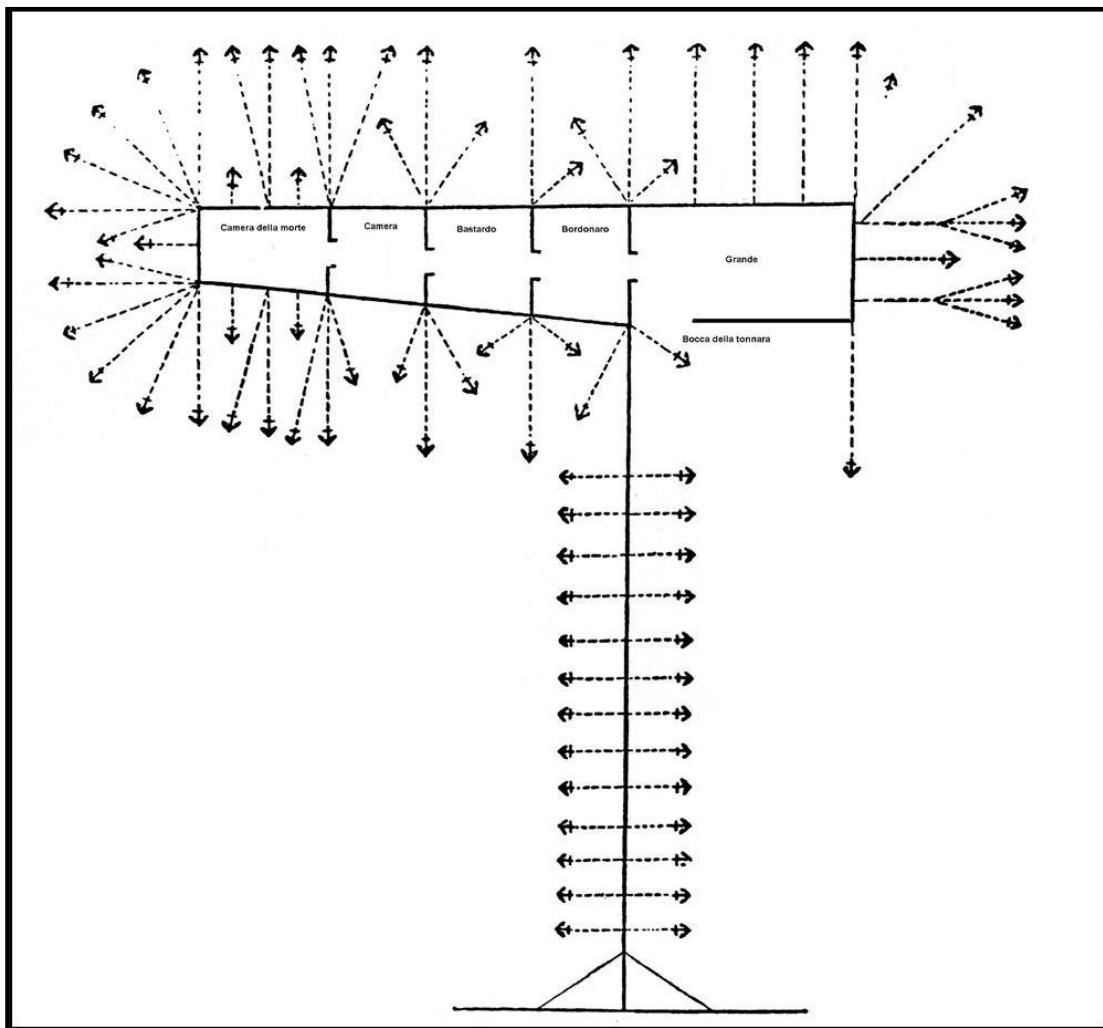


Fig. 4 - Scheme of the traditional trap of Isola Piana (Sardinia) with five chambers.

TAGGING EQUIPMENT

Tagging equipment used for the tagging in the trap fishery of Isola Piana is summarized in Table 2.

Table 2 - Equipment used for the electronic tagging.

Equipment	
Tag applicator	Customized
Speargun	Oleo pneumatic: MARES Cyrano 85 cm; 97 cm
Underwater camera	GoPro® HERO System
Software for image editing and analysis	TPSDig2; GoPro CineForm Studio
Underwater Laser pointer	APINEX BALP-LG05-B150 - green
Anchor	Domeier L

APPLICATOR

The tag applicator have been provided by Com.Bio.Ma. and it was composed by a stainless steel tip (3mm \varnothing) inserted into the shaft properly drilled (Fig. 5).



Fig. 5 – Details of the applicator for electronic tagging (shaft was drilled \varnothing 3 mm).

SPEARGUN

We adopted the MARES mod. Cyrano speargun. This speargun combines the power characteristics of a pneumatic gun with manageability and extreme shaft speed. It is equipped by highly sensitive release mechanism, ergonomic handle with a soft insert and with power adjusting system. For tagging activities we used the 85, 97 cm, which are equipped with a 7 mm Tahitian race shaft. Operating pressure was 20 BAR.



Fig. 6 - Set of spearguns, model Mares Cyrano, adopted for tagging: sizes 97 and 85 cm were used for electronic tagging.

CAMERA TYPE

The GoPro Hero3 Black (Fig. 7) and a waterproof housing (Fig. 8) was used to record tagging actions. The GoPro is a digital camera capable of capturing ultra-wide videos and 12MP photos at a rate of 30 photos per second. The optics are Ultra sharp $f/2.8$ 6-element aspherical glass lens and Ultra wide angle / reduced distortion. It is powered by a 1050 mAh rechargeable lithium-ion battery chargeable via USB, with an estimated time duration ranging from 1:05-1:20 hours, depending on the resolution, frame rate and the usage of the LCD screen. Features of the camera are reported in Table 3.



Fig. 7 - The GoPro Hero3 Black edition was successively adopted for tagging.



Fig. 8 - Waterproof housing for the GoPro Hero3 Black edition.

Table 3 - Key features of GoPro hero 3 black edition.

Video Resolution	NTSC fp s	PAL fps	STD Mode	Protune Mode	Field of View (FOV)	Screen Resolution
720p	120, 60 fps	100, 50 fps	YES	YES	Ultra Wide, Narrow*	1280x720 16:9
1080p	60, 48, 30, 24 fps	50, 48, 25, 24 fps	YES	YES	Ultra Wide, Medium, Narrow	1920x1080 16:9

LASER POINTERS

We used waterproof green laser (Fig. 9) pointers by Apinex with the following features:

- Laser Class: IIIa
- Output Power: <5mW
- Wavelength: 532nm
- Batteries: 2 x AA (included)
- Body material: Aluminium
- Range : >3000 meters (outside the water)
- Dimensions: L:190mm x D:25mm
- Waterproof to: up to 300 feet

Pointers were coupled with a customized system (Fig. 10) which allows a fast junction on the speargun and provided by screws for adjustments.



Fig. 9 - The single green-laser pointer used during electronic tagging.



Fig. 10 - Coupled laser used on the speargun for scaling length of bluefin tuna.

LENGTH ESTIMATION

Laser inter-distance validation

The inter-distance of the coupled lasers on each speargun was set on 17.8 cm, as a length reference. Before the tagging activities the inter-distance of each coupled lasers was tested at different distances (1, 3, and 5 meters) fixing lasers on a ruler. Possible laser deviations were corrected with the adjustment screws.

Length estimation

Fork length (FL) of bluefin tuna was estimated by photo referencing technique. Photos were obtained from frames of the video recordings by the GoPro. High resolution pictures have been analysed by Tpsdig2 (Rohlf, 2009: *TpsDig. Version 2.14*). The inter-distance lasers marks (17.8 cm) on the body of bluefin tuna were used as a length reference.

It must be pointed out that an exact angle between the body of the tuna and the laser beams cannot be detected by the frame analyses. The best frame with an angle closer to 90° (orthogonal beam) was chosen for length calculation.

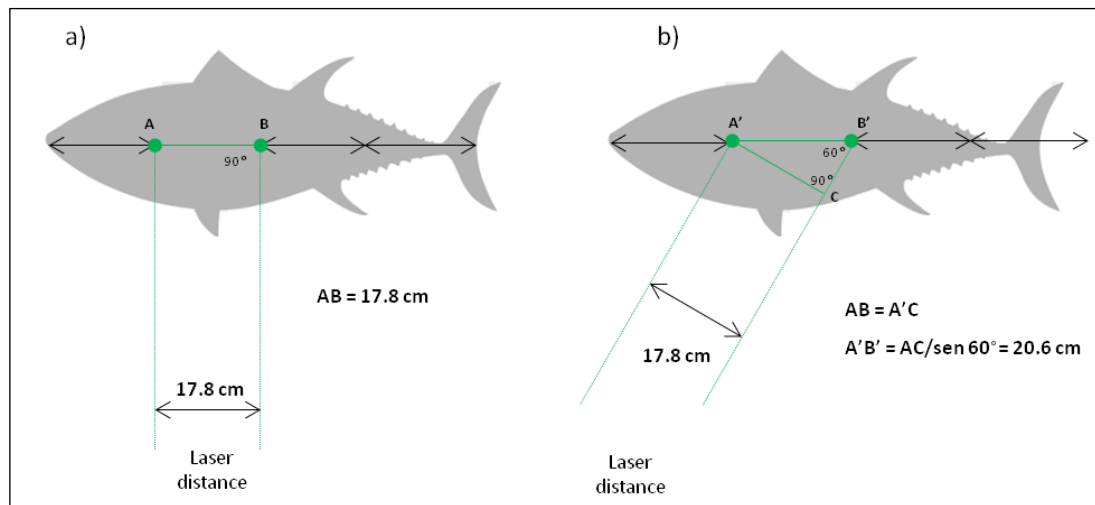
Exercise for size estimate

Fig. 11 - Scheme of the exercise for size estimates conducted in previous tagging programme (2015) **a)** Laser landmarks with 90° angle; **b)** Laser landmarks with 60° angle (laser inter-distance on the specimens corresponds the hypotenuse of a right triangle whose cathetus is the known distance of 17.8 cm).

Weight estimation

Weight of bluefin tuna was also calculated considering the length/weight relationships calculated for bluefin tuna captured in Sardinian traps in previous years ($n = 12800$; period 1994-2007): $W = FL^{2.8171} * 0.000044300$.



Fig. 12 – Speargun equipped by MiniPAT ready for tagging.



Fig.13 – School of bluefin tuna before the tagging in the trap of Isola Piana.

LABELING PROCEDURE AND CODES

The serial number of each electronic tag was registered by digital camera by the scientist on board and by the diver before each tagging action.



Fig.14 – Mini-PAT mounted on the shaft.

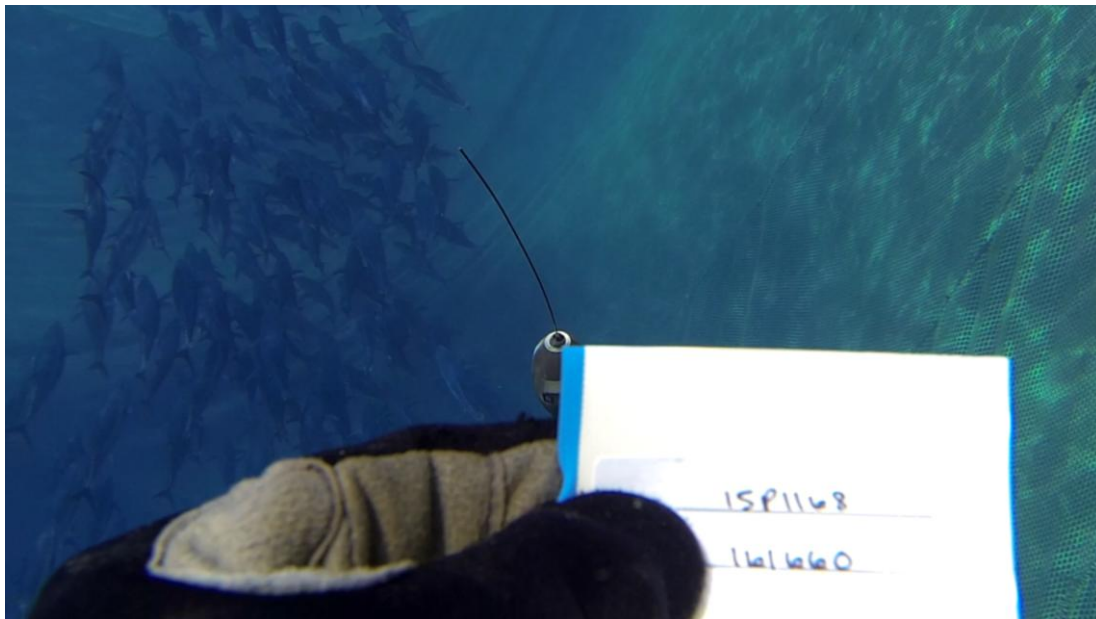


Fig. 15- Serial number and PTT ARGOS identification before tagging.



Fig. 16 - The trap crew of Isola Piana preparing the *death chamber* for tagging in July 2016.



Fig. 17 – Tagger preparing the speargun.

AUTHORIZATION

An official communication on tagging activities was delivered by email to the Coast Guard of Portoscuso and Carloforte on May 30, 2016 and successively on July 01 just before the tagging day. The Coast Guard of Carloforte monitored the whole tagging process in the Isola Piana trap, until the release of the tagged tunas. A proper communication was delivered to the Ministero delle Politiche Agricole, Alimentari e Forestali - Direzione Generale Della Pesca Marittima e dell'acquacoltura - Reparto Pesca Marittima delle Corpo delle Capitanerie di Porto.

A proper communication and a video on the release of bft was sent to previous authorities at the end of tagging activities.

TAG AWARENESS CAMPAIGN ACTIVITIES

A contribution to ICCAT GBYP Tag Awareness Campaign was made, by informing the public on the tagging programme and activities. Poster "Trova la marca" with info on tags recovery and reward has been distributed in the following localities:

- Portoscuso
- Carloforte
- Teulada
- Buggerru
- Oristano
- Sant'Antioco
- Calasetta

A communication by the social network Facebook, the website of the University of Cagliari, the local television (TG3 and Videolina) was publicized during the tagging period.

Tagging was also presented during the broadcast "Linea Blu" on the main Italian channel RAI1.

TAGGING ACCOMPLISHED

A total of 20 bluefin tuna were tagged on July 05, 2016 (Table 4). Information on bluefin tuna tagged in Sardinian trap were properly recorded on the forms provided by ICCAT and sent by email to GBYP coordinator on July 20.

Table 4 - Length estimates made by photo referencing/visual estimation for bluefin tuna tagged in 2016 considering the validation exercise carried out in 2015 (SCRS/2015/193).

ID	S/N tag	PTT	Days	Date	Time	Tag	mean FL (cm)	Weight (kg)	note
1	15P1168	161660	365	05/07/2016	11.27	Yes	112	26	Photo referencing
2	15P1169	161661	365	05/07/2016	11.27	Yes	116	29	Photo referencing
3	15P1170	161662	365	05/07/2016	11.35	Yes	106	22	Photo referencing
4	15P1171	161694	365	05/07/2016	11.41	Yes	121	32	Photo referencing
5	15P1172	161695	365	05/07/2016	12.15	Yes	104	21	Photo referencing
6	15P1173	161663	365	05/07/2016	11.43	Yes	125	36	Photo referencing
7	15P1207	161664	365	05/07/2016	11.51	Yes	140	49	Photo referencing
8	15P1209	161696	365	05/07/2016	12.32	Yes	118	30	Visual estimation
9	15P1210	161665	365	05/07/2016	12.17	Yes	123	34	Photo referencing
10	15P1218	161666	365	05/07/2016	11.56	Yes	100	19	Photo referencing
11	15P1219	161667	365	05/07/2016	11.52	Yes	155	66	Photo referencing
12	15P1227	161668	365	05/07/2016	12.53	Yes	113	27	Photo referencing
13	15P1228	161697	365	05/07/2016	12.31	Yes	146	55	Photo referencing
14	15P1229	161669	365	05/07/2016	11.46	Yes	113	27	Photo referencing
15	15P1231	161670	365	05/07/2016	12.36	Yes	118	30	Photo referencing
16	15P1233	161672	365	05/07/2016	14.14	Yes	141	50	Visual estimation
17	15P1235	161673	365	05/07/2016	11.57	Yes	110	25	Visual estimation
18	15P1236	161674	365	05/07/2016	11.38	Yes	95	17	Photo referencing
19	15P1237	161675	365	05/07/2016	12.08	Yes	109	24	Photo referencing
20	15P1238	161676	365	05/07/2016	12.09	Yes	110	25	Photo referencing

Table 5 - Summary of tag deployment and pop-off.

Argos ID decimal	Argos ID Hexadecimal	Tag Serial No	Pop-off date	Pop-off latitude	Pop-off longitude
161660	F39E8C7	15P1168	08/07/2016	39,19107	8,2903
161661	F39E8D4	15P1169	09/07/2016	39,26634	6,88242
161662	F39E8E1	15P1170	15/07/2016	40,29841	6,46995
161663	F39E8F2	15P1173	16/07/2016	38,03447	5,68082
161664	F3A6F00	15P1207	19/07/2016	39,60793	7,63583
161665	F3A6F13	15P1210			
161666	F3A6F26	15P1218	30/07/2016	40,57253	6,45737
161667	F3A6F35	15P1219	18/07/2016	39,46312	8,11453
161668	F3A6F4C	15P1227	18/07/2016	41,00687	5,22158
161669	F3A6F5F	15P1229			
161670	F3A6F6A	15P1231	14/07/2016	40,4016	6,15971
161672	F3A6F8B	15P1233	08/07/2016	39,19741	8,28175
161673	F3A6F98	15P1235	25/07/2016	39,62745	5,56313
161674	F3A6FAD	15P1236	26/07/2016	43,44868	9,95491
161675	F3A6FBE	15P1237	22/07/2016	39,27268	5,14858
161676	F3A6FC7	15P1238	12/07/2016	39,97385	8,07041
161694	F3A9AE1	15P1171	13/07/2016	40,67647	7,06986
161695	F3A9AF2	15P1172	31/07/2016	40,6519	7,4818
161696	F3B7000	15P1209	23/07/2016	39,28781	5,42351
161697	F3B7013	15P1228	23/07/2016	40,61229	5,82361

TECHNICAL PROBLEMS

Target size of BFT

In order to accomplish the working hypothesis (i.e. small/medium size residency vs. large size migrants”) the targeted size for tagging would have been 10 small/medium size individuals and 10 large size BFT (> 170 cm LF). The working programme considers to begin the tagging activities after reaching the trap quota. The trap quota was reached on June 22 and thereafter we started the underwater visual inspection for the target BFT. First survey confirmed the presence of a flock of BFT of large and medium size which were suitable for tagging. On the time window June 25 – July 1 the bad weather conditions (Mistral) has affected the presence of large BFT which escaped from the trap. In a second survey, later the windy days, the divers estimated about 100 fish of small-medium size (from 25 to 50 kgs), but none large size individuals. Following the agreement of the GBYP steering committee we have proceeded to tag these specimens.

Surfaced TAG

All entrapped fish were observed for health conditions at least 1h inside the death chamber. None anomaly was observed in tagged fish before to be released.

The early popping off recorded for PTT 161660, 161672 and 161676 can be caused by the death of the individual, or the detach of the anchor by the tuna body or by fishing activities. Currently (July 31) the tag PTT 161660 has not been recovered but we are proceeding for surveys in the last transmitting waypoint on the San Pietro Island.

BIOLOGICAL SAMPLINGS

A total of 30 samples (muscle, spines) were collected in the trap of Porto Paglia. Samples were collected from specimens during a mattanza carried out on June 18, 2016. The ICCAT GBYP protocol for sampling, labeling and storing samples of genetic tissue, otoliths, spines was duly followed and the samples will be provided to the Consortium in charge of the GBYP Biological studies in 2016.



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