ICCAT/GBYP 07/2017

TAGGING PROGRAMME 2017

ATLANTIC WIDE RESEARCH PROGRAMME ON BLUEFIN TUNA (ICCAT GBYP – PHASE 7)

Electronic tagging of adult bluefin tunas in Portuguese traps in the eastern Atlantic Ocean

DELIVERABLES 4:

Final Report

Prepared by:

Pedro G. Lino, Rui Coelho, Maria Nunes, Alfredo Poço, Rubén Muñoz-Lechuga & Morikawa Hirofumi

Contractor: Tunipex – Empresa de Pesca de Tunídeos

Sub-contractor (scientific): IPMA – Instituto Português do Mar e da Atmosfera

19 October 2017

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1. Executive summary

One of the major research tasks of the ICCAT Atlantic wide Research Programme on Bluefin Tuna (GBYP) is to carry out a large, wide and intensive scientific tagging programme. In 2017, following a similar call released in 2016, ICCAT/GBYP made a particular call for carrying out field tagging activities in the Portuguese tuna traps, where bluefin tuna moving into the Atlantic after spawning can be tagged. After this call, a proposal was made by Tunipex (contractor) and IPMA (scientific sub-contractor), which was accepted by ICCAT to fulfill the required work.

The Tunipex tuna trap, where the tagging operations took place, is located about two and a half nautical miles from the coast of the Algarve, between about 20-60m depth. The central location of the trap is at: Lat=37.0194 (North); Long= -7.7056 (West). The tags used were Wildlife Computers miniPATs with an intra-muscular tag applicator, and were pre-programmed by ICCAT/GBYP. The bluefin tunas were tagged by experienced divers directly underwater using a long pole. During the tagging operations, each tagging pole also had a fixed underwater camera. Opportunistic conventional tagging and biological sampling was carried out on other bluefin tuna from the same school.

The tagging took place on the 11th of July 2017, and it was possible to successfully deploy 40 miniPAT tags. All tagged bluefin tuna were adults, with estimated round weights (RWT) between 50 kg and 340 kg (average RDW = 128.8kg, SD = 57.8). After conversion, the estimated stretched fork length (SFL) ranged between 141 and 267 cm (average SFL = 189.0 cm, SD = 26.7). Additionally, a total of 6 conventional tags were deployed on other 6 bluefin tuna from the same school. The estimated RWT of the conventionally tagged specimens ranged between 50 kg and 100 kg (average RWT = 68.3kg, SD = 19.4). After conversion, the estimated SFL of the conventionally tagged specimens ranged between 141 and 178 cm (average SFL = 155.4 cm, SD = 14.4). All tagging data were recorded and transmitted to ICCAT in the appropriate ICCAT tagging forms. Tissue samples (muscle) for genetic analysis were collected from 4 additional specimens and will be sent to the GBYP biological sampling coordinator.

In conclusion, the tag deployment process was carried out successfully according to the ICCAT call and the contractor proposal. After the tagging was completed, we also provide some additional recommendations, specifically in terms of underwater tagging operations, individual specimen weight estimations, and conventional tags used, that may be considered for adjusting the tagging strategy on future phases of the ICCAT/GBYP tagging project.

2. Background

One of the major research tasks under the ICCAT Atlantic wide Research Programme on Bluefin Tuna (GBYP) is to carry out a large, wide and intensive scientific tagging programme to address several important biological and ecological topics regarding Atlantic bluefin tuna as well as to possibly provide independent estimates of abundance and/or fishing mortality rates. In 2017, ICCAT/GBYP made a particular call for carrying out the second part of the field tagging activities in 2017. Following the recommendation by the GBYP Steering Committee, the call was limited to electronic tagging focusing the attention on particular areas. One of the priority areas requested was the Portuguese traps, where bluefin tuna moving into the Atlantic after spawning can be tagged (Part B of the planned tagging activities).

Given the importance of the bluefin tuna as a marine resource (Fromentin & Powers, 2005) and captures in the Algarve tuna traps, particularly in the Tunipex tuna trap, catches and biological data have been recorded since 1998 in a strait collaboration between IPMA and Tunipex. Between 2010 and 2017, seven papers were presented to the ICCAT SCRS describing the bluefin catches on this trap in terms of number, weight, size frequency distribution and CPUEs, including the estimation of standardized CPUE series to be considered as relative abundance levels in stock assessments (Lino et al., 2016, 2017a, 2017b; Santos & Coelho, 2011; Santos et al., 2011, 2014, 2015).

Following the call made in GBYP - Phase 7 - Tagging Programme 2017, a proposal was presented and accepted by Tunipex (contractor) and IPMA (scientific sub-contractor) to fulfill the required work tagging adult bluefin tunas in Portuguese traps in the eastern Atlantic Ocean.

3. Objectives

The objective of this document is to provide **<u>Deliverables 4</u>** (Final Report) of the Project ICCAT/GBYP - Phase 7 - Tagging Programme 2017 for Item b) Electronic tagging of adult bluefin tunas in Portuguese traps in the eastern Atlantic Ocean. The details included in this Report, as requested in the call for tender and in the detailed proposal submitted, include the following:

I. Scientific report (this report) containing:

a) Full description of the work carried out for the tagging activities in the various areas, with the total number of tagged tunas and specification of any double tagged tuna;

b) Detailed description of the methodology and protocols;

c) Maps of the areas in which the tagging was carried out;

d) Detailed tables with the definitive number of tagged specimens by area, size composition and type of tag (miniPATs or conventional spaghetti tag);

e) Copy of the data input worksheets from the ICCAT tagging database;

f) Possible recommendations for adjusting the tagging strategy for conventional tagging in future Phases of ICCAT GBYP;

g) Executive Summary.

II. A PowerPoint presentation of the main results.

III: Copy of the databases in the ICCAT format, specifically:

a) TG01-CnvEleTSurv: Summary of tagging activities (campaigns & others) [Form-A]; contained in file: "TG01-CnvEleTSurv_PRT_GBYP7_FINAL.XLSX".

b) TG02-CnvTReRc: Conventional Tag release-recovery data (Version: v11). Contained in file: "TG02-CnvTReRc_PRT_GBYP7_FINAL.XLSX".

c) TG03-EleTReRc: Electronic Tagging Release - Recovery Information (Version: v11). Contained in file: "TG03-EleTReRc_PRT_GBYP7_FINAL.XLSX".

4. Detailed description of the methodology

4.1. Description, mapping and scheme of the tuna trap for the tagging operations

Traditional tuna traps are composed by a complex net system that leads the individuals through a maze so they may be trapped and captured (Costa 2000; Leite et al., 1986). Those nets are a fixed and passive fishing gear that stays at sea during a certain period of the year, during the migratory route of the bluefin tunas.

The bluefin tuna were tagged in a Portuguese trap in the eastern Atlantic Ocean, specifically in the Tunipex tuna trap operating in the Algarve region, Southern Portugal (**Fig. 1**). The tuna trap is located about two and a half nautical miles away from the coast line of the Algarve, and between about 20-60m depth. The central location of the trap is at: Lat=37.0194 (North); Long= -7.7056 (West).

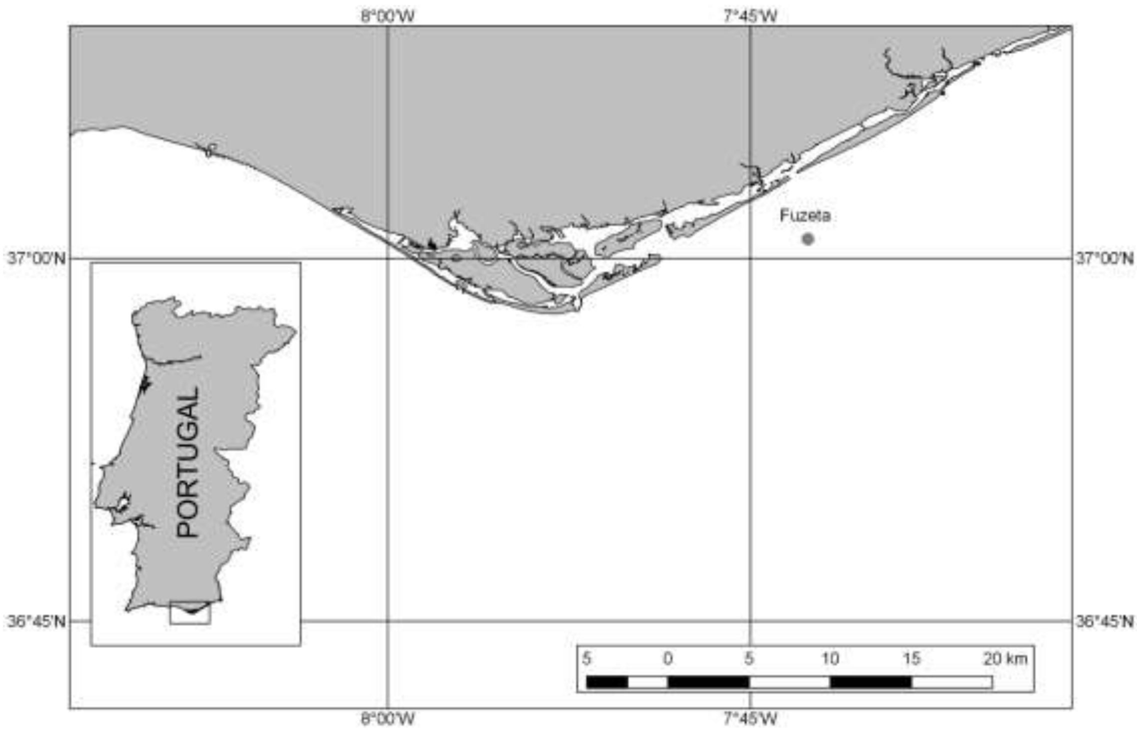

Fig. 1. Location of the Tunipex tuna trap in the Algarve, Southern Portugal (NE Atlantic).

In terms of operational scheme, the Tunipex set net consists of 2 leading nets, a playground net, an ascending slope net, a box net and two crawl nets (**Fig. 2**). When the tunas encounter the leading nets they move along those nets and end up entering the set net. The area where the tuna first enter the set net is called the playground net, which is a large space surrounded by nets. This is a large space that allows the fish to swim in a calmer and less stressful manner for some time. On the opposite side of the playground area there is a device called the ascending slope net which has the role of preventing the fish from escaping the set net. This is an open channel, that is not completely closed and allows the fish to swim freely between the playground area, but without exiting the set net. The next and final stage is to move the fish into the box net, where the tunas are captured. To catch the fish in the box net, the fishermen hoist the box net up. If necessary, some fish are moved to the crawl nets temporally, due to operational adjustments (**Fig. 2**).

The contractor, Tunipex, was available to perform all tagging operations as described above. The time frame for the activities was set up to a maximum of 2 weeks immediately after the quota closure of the tuna trap fisheries in Portugal. After the quota was reached, the tuna trap remained operational for the extra time until a bluefin tuna school of sufficient size entered the trap. This allowed for the tagging of bluefin tunas that spent relatively little time (few days) in the trap.

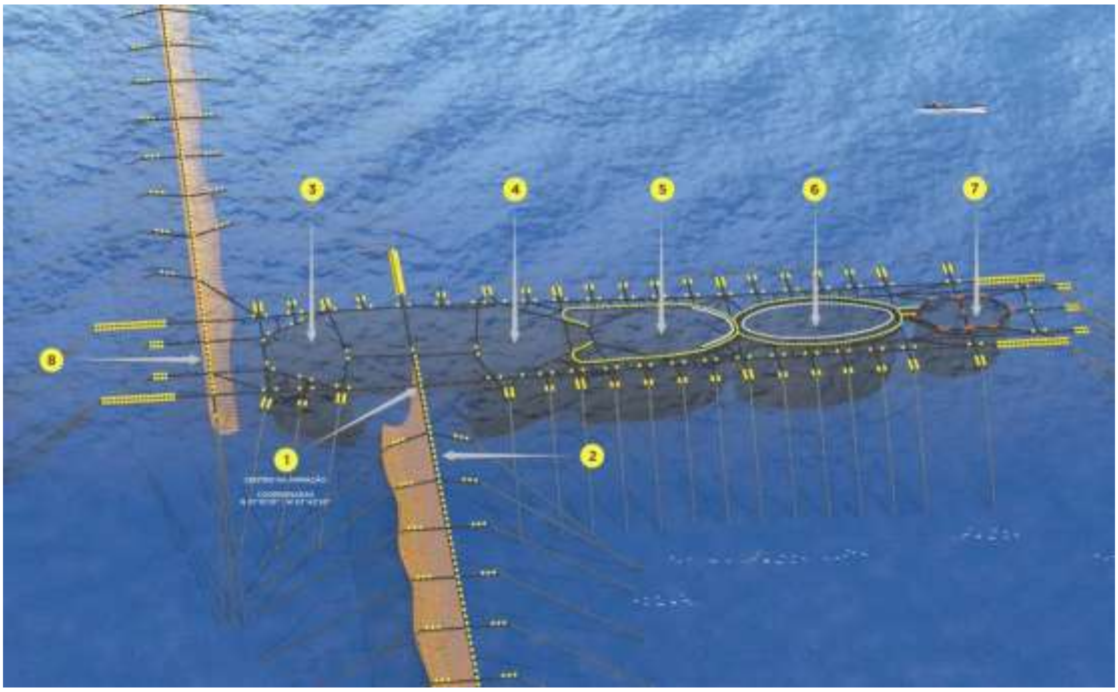

Fig. 2. Scheme of the Tunipex tuna trap in the Algarve, Southern Portugal (NE Atlantic), with details of the entrance and center of the trap (1), leading nets (2 and 8), playground net (3), ascending slope net (4), box net (5) and crawls (6 and 7).

4.2. Satellite tagging operations and logistics

As specified in the detailed proposal that was submitted, the tagging coordinator for the project was Mr. Alfredo Poço (Tunipex). Mr. Alfredo Poço has more than 20 years' experience on the daily handling operations of tuna traps and performing regular dives in the traps, and has also considerable experience tagging bluefin tuna, as well as other species like sharks, in the tuna traps.

The tagging protocol adopted for deploying the satellite tags was the preferred option as specified in the call for tenders and in the detailed proposal. In general, the methodology for tagging followed Mariani et al (2015) with, as much as possible, the improvements reported by Mariani et al. (2016).

The tags were Wildlife Computers miniPATs with an intra-muscular tag applicator that were provided already rigged by ICCAT/GBYP. The detailed instructions on the program to be used in the tags (deployment duration, data types to be collected and transmitted, periodicity of data collection and transmission, as well as all other tag programming specifications), were also programmed by ICCAT/GBYP.

For the tagging logistics and operations, the contractor Tunipex used its 2 main boats (length 22m, 800hp) and the 2 smaller boats (length 7m, 160hp). Those are the boats used in the regular tuna trap operations, and were used to provide assistance during the tagging operations to the trap operators, divers and the IPMA (sub-contractor) personnel that were present.

With the tagging option adopted, the tunas were tagged by divers directly underwater using a long pole. All divers were hired personnel by the tuna trap that have substantial work experience in the regular work (including underwater) of the tuna trap operations. Several additional divers were underwater at all times to record images and perform assistance during the operations (**Fig. 3**). For collecting underwater imaging during the tagging operations, both tagging poles used (two) were equipped with fixed underwater cameras (**Fig. 4**).

Fig. 3. Divers (taggers, assistants and video operators) preparing for the underwater tagging operations. This operation was taking place in the box net, where around 107 tunas (from a unique school) were available for tagging.

Fig. 4. The tagging coordinator, Mr. Alfredo Poço, preparing a satellite tag in one of the underwater tagging poles. The 2nd pole is returned for reloading.

4.3. Conventional tagging

Opportunistic tagging was carried out on other fish from the same school as the satellite tagged fish, but not on the same fish in order to avoid additional stress on the satellite tagged tuna. Single tagging with single barb tags was planned and carried out, with the use of a single barb tag on each tagged specimen. All tags and applicators were provided by ICCAT/GBYP.

Tagging with conventional tags used the same protocol as the satellite tagging, with the tags rigged at the extreme of long tagging poles and the tagging taking place underwater by experienced divers.

4.4. Biological sampling

Biological sampling was carried out during the tagging activities, in fish from the same school but not on the same fish in order to avoid additional stress in the satellite tagged fish.

The samples collected were muscle for genetic analysis. The biological sampling was conducted according to the protocols adopted by the contractor in charge of the biological and genetic sampling and analyses. Specifically, a piece of muscle tissue was collected and stored in non-denatured Ethanol 96%, in 5ml tubes, that were labeled according to the labeling codes used in GBYP. The samples are currently stored in cold at IPMA and will be shipped later to the laboratory in charge, or possibly hand delivered to researchers from that Institute.

4.5. Data recording and reporting

While tagging, the divers estimated the specimen weights that were properly recorded. As mentioned before, the divers are extremely experienced personnel that have substantial work experience in the regular trap operation work, and are used to underwater estimate weights of the fish in the tuna traps with good accuracy. Additionally, the images from each of the cameras rigged in each of the tagging poles were analyzed to further revise the estimated specimen weights (RDW - round weight) of the tagged bluefin tuna. The specimen sizes (SFL - strait fork length) were then converted from RDW using the Rodriguez-Marin (2015) equations, in this case specifically for eastern bluefin tuna for the month of July, that are included in the ICCAT manual Appendix 4-III (ICCAT, 2006-2016).

All data, including the serial and PTT numbers of each tag, the size/weight estimate of each specimen, the condition/injuries of the specimens, and other notes (e.g., sea surface temperature, cloud coverage, wind speed, etc) were properly recorded. All data were recorded in the appropriate ICCAT tagging forms. Specifically, the survey summary data were reported in file template "TG01-CnvEleTSurv.xlsx", the electronic/satellite tagging were reported using file template "TG03-EleTReRc.xlsx" and the additional conventional tags deployed were reported using file template "TG02-CnvTReRc.xlsx".

5. Full description of the work carried out

5.1. Satellite tagging

A total of 40 satellite pop-up tags (miniPATS from Wildlife Computers) were sent by ICCAT to the sub-contractor (IPMA) for deployment in adult bluefin tuna (> 30 kg).

The bluefin tuna traps quota in Portugal closed in early-July, and after that period the Tunipex prepared the tuna trap for the tagging operations, which took several days while in stand-by for the tagging activities.

A large school with an estimated size of 107 specimens entered the trap on the 10 of July, remaining in the box net for posterior tagging. The tagging coordinator contacted the IPMA staff in order to carry out tagging on the following day, July 11th. Tagging was carried out by the Tunipex divers that had instructions to randomly select fish covering the whole range of sizes present. The complete operation was covered by digital cameras placed on the tagging poles (**Fig. 5**).

All 40 miniPATS were successfully deployed in bluefin tuna (**Fig 6**). All tagged bluefin tuna were adults, with estimated round weights ranging between 50 kg and 340 kg (average RDW = 128.8kg, SD = 57.8). After conversion the individual weights to sizes (RDW-SFL) with the Rodriguez-Marin (2015) equation (eastern bluefin tuna for July), the estimated SFL ranged between 141 and 267 cm (average SFL = 189.0 cm, SD = 26.7). The summarized information on the tagged specimens is presented in **Table 1** (section 5.4) of this report. The detailed information is provided in the ICCAT electronic tagging reporting forms.

Fig. 5. The tagging coordinator, Mr. Alfredo Poço, supervising the tagging operations, and preparing a tagging pole with a fixed digital camera for satellite tag deployments.

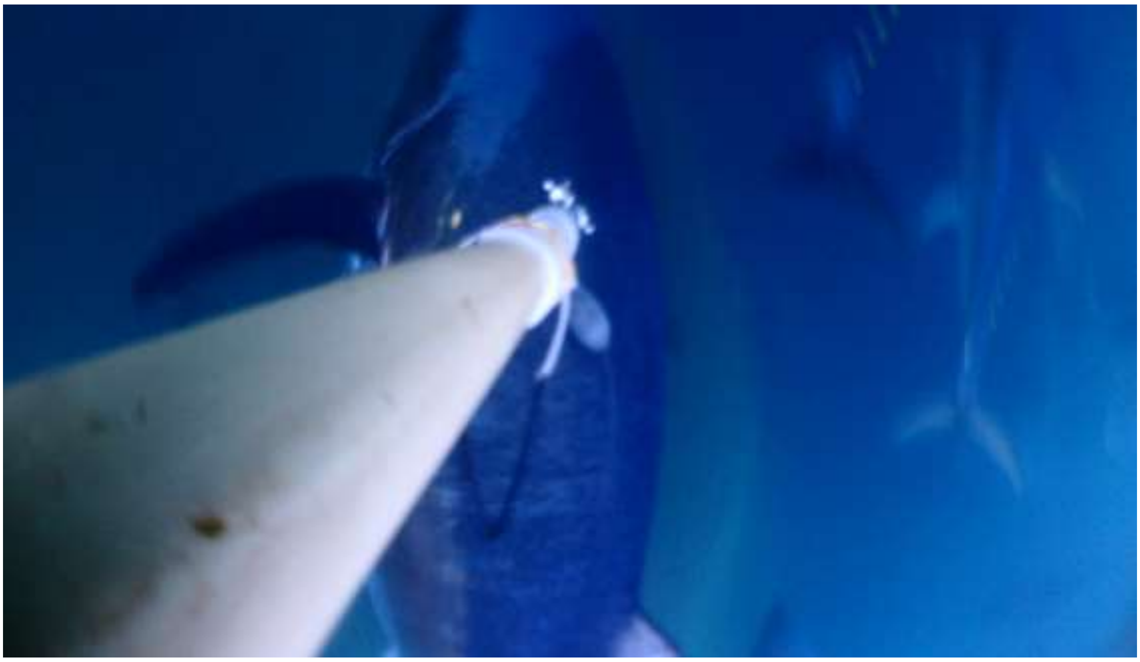

Fig. 6. Tagging a bluefin tuna. Image captured from one of the cameras rigged in each of the tagging poles.

5.2. Conventional tagging

A total of 6 conventional tags (single tagging) were opportunistically deployed on 6 additional bluefin tuna specimens (**Fig. 7**). As explained previously, those specimens tagged with conventional tags were specimens from the same school as the satellite tagged fish, but not the same fish in order to avoid additional stress on the satellite tagged tuna.

In contrast to previous years, single tagging with single barbel tags was carried out. Following previous experiments tagging with the double barbel tags is more time consuming because the applicator tends to break very easily. Specimen sizes were estimated underwater by the divers and are reported in detail in the respective ICCAT conventional tag reporting forms. In summary, the estimated total weight (RWT) of the specimens tagged with conventional tags ranged between 50 kg and 100 kg (average RWT = 68.3kg, SD = 19.4). After conversion of the individual weights to sizes (RDW-SFL) with the Rodriguez-Marin (2015) equation (eastern bluefin tuna for July), the estimated SFL of the conventional tagged specimens ranged between 141 and 178 cm (average SFL = 155.4 cm, SD = 14.4). The summarized information on the tagged specimens is presented in **Table 1** (section 5.4) of this report. The detailed information is provided in the ICCAT conventional tagging reporting forms.

Fig. 7. Tagging additional bluefin tuna with conventional tags (single tagging with a single barb tag).

5.3. Biological sampling

Tissue samples (muscle) for genetic analysis were opportunistically collected from 4 additional specimens. All data were recorded and will be sent to the GBYP biological sampling contractor. The samples are currently stored in cold at IPMA in non-denatured Ethanol 96%, and will be shipped or hand delivered to the Institute (AZTI) in charge of the GBYP biological sampling.

After tagging (satellite and conventional) and biological sampling, all tagged tunas were released together with the entire school.

5.4. Detailed tables with the definitive number of tagged specimens by area, size composition and type of tag

The summarized information of the definitive numbers of tagged specimens by tag type and size class is shown bellow in **Table 1** and **Fig 8**.

Table 1: Detailed table with the definitive number of tagged specimens by size composition (10 cm SFL size classes) and type of tag. All specimens were tagged in the Tunipex tuna trap in Southern Portugal, NE Atlantic (Lat: 37.0194 North, Long: 7.7056 West).

Size class (10cm FL)	Sattelite (miniPAT)	Conventional (single barbel)	Total
140	2	1	3
150	1	1	2
160	6		6
170	8	2	10
180	9	2	11
190	2		2
200	3		3
210	4		4
220	2		2
230	1		1
240	1		1
260	1		1
Total	**40**	**6**	**46**

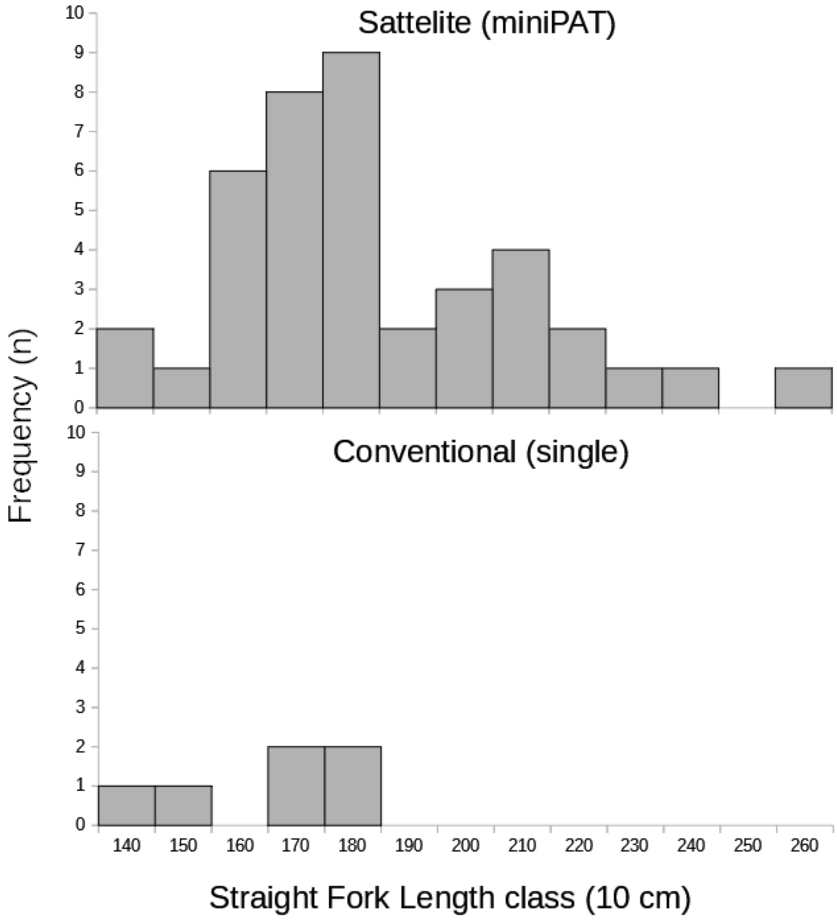

Fig. 8: Size distribution of the definitive number of BFT specimens tagged, by size composition (10 cm SFL size classes) and type of tag. All specimens were tagged in the Tunipex tuna trap in Southern Portugal, NE Atlantic (Lat: 37.0194 North, Long: 7.7056 West).

6. Data input worksheets from the ICCAT tagging database

As specified in the detailed description of the methods, all data was recorded during the field mission and was already reported to ICCAT in the appropriate ICCAT tagging forms. Specifically, the following files were provided to the ICCAT Secretary:

- TG01-CnvEleTSurv_PRT_GBYP6_FINAL.xlsx: Summary of tagging activities (campaigns & others) [Form-A].

- TG02-CnvTReRc_PRT_GBYP6_FINAL.xlsx: Conventional Tag release-recovery data (Version: v11).

- TG03-EleTReRc_PRT_GBYP6_FINAL.xlsx: Electronic Tagging Release - Recovery Information (Version: v11).

7. Recommendations for adjusting the tagging strategy for future phases of ICCAT GBYP

7.1. Satellite tagging

- <u>Underwater *vs* onboard tagging</u>: All BFT were tagged underwater during this project. In the project proposal, there was also the option of tagging onboard, as an alternative method. We believe that the method used (underwater tagging) is in principle appropriate, as it allows for an efficient and fast tagging process, with low stress for the tagged specimens and in this case producing no mortality events. However, it is also important to note that the release of premature tags seem to be relatively high in underwater tagged specimens. Therefore, the alternative option to tag onboard should be revisited in the future, noting however that this will be more time consuming in terms of operations and might result in some blue fin tuna mortality during the catch and tagging process. As such, in the future we **recommend** to keep the two options open (underwater and onboard tagging) and discuss with the ICCAT Secretariat and GBYP Steering Committee on the preferred tagging method, considering both the advantages and disadvantages of each one.

- Specimen weight estimations: The individual specimen weights were estimated with a combination of underwater visual estimations from the divers while tagging and a posterior verification with the video recordings, from the digital cameras rigged in the tagging poles. We **recommend** keeping this combination of various weight estimation methods during the tagging process, as it provides additional information for verification of the estimated individual specimen weights. Additionally, if in the future the option for onboard tagging is preferred, direct size measurements will be possible to take during the tagging process.

7.2. Conventional tagging

- Efficiency of tagging: Although in previous years double barbel tags seemed to be more reliable (when double tagging), in our experience the double barbel applicator breaks off easily when doing tagging with the long pole. Therefore we preferred to use single tagging with single barbel tags which is more time efficient. Still, the double tagging as was carried out in the past might be useful to continue to do in the future. As such, we **recommend** further investigation into either double tagging with single barbel tags, and/or to carry out improvements in the double barbel applicator.

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