ICCAT ATLANTIC-WIDE RESEARCH PROGRAMME FOR BLUEFIN TUNA (GBYP) ACTIVITY REPORT FOR THE LAST PART OF PHASE 4 AND THE FIRST PART OF PHASE 5 (2014-2015)

Antonio Di Natale[1] and Stasa Tensek[1]

SUMMARY

The Atlantic-wide research programme on bluefin tuna (GBYP) began in October 2009. The 4th Phase began in March 2013 and was extended up to 21 February 2015, while the 5th Phase began on 22 February 2015 and will be active until 21 February 2016. Activities included (a) continuation of data mining, recovery and elaboration, (b) biological studies, (c) tagging, including awareness and rewarding campaign, (d) aerial survey on bluefin spawning aggregations and (e) further steps of the modelling approaches. A very impressive amount of data was recovered, covering a period from 1512 to 2009. Tag reporting is improving, even if the recovery rate is still low. The miniPATs provided very interesting results, which strongly contributed to our knowledge, changing several previous hypotheses. The aerial survey, carried out in an extended area (about 60% of the Mediterranean), provided updated estimates. The biological studies indicate that the western and eastern stocks have micro-chemical and genetic differentiations, but mixing among all areas is evident except for the two main spawning areas. The Modelling efforts are orientated to the development of a MSE.

RÉSUMÉ

Le Programme de recherche sur le thon rouge englobant tout l'Atlantique (GBYP) a commencé ses activités en octobre 2009. La quatrième phase a débuté au mois de mars 2013 et a été prolongée jusqu'au 21 février 2015, tandis que la cinquième phase a commencé le 22 février 2015 et sera active jusqu'au 21 février 2016. Les activités comprenaient (a) la poursuite de l'exploration, récupération et élaboration des données ; (b) les études biologiques ; (c) le marquage, y compris les campagnes de sensibilisation et de récompense ; (d) les prospections aériennes des concentrations de reproducteurs de thon rouge et (e) les étapes ultérieures des approches de modélisation. Un volume très impressionnant de données a été récupéré, couvrant une période s'étalant de 1512 à 2009. La déclaration des marques est en voie d'amélioration, même si le taux de récupération est encore faible. Les mini PAT ont fourni des résultats très intéressants, qui ont fortement contribué à accroître nos connaissances, modifiant plusieurs hypothèses antérieures. La prospection aérienne, réalisée sur une vaste zone (environ 60% de la Méditerranée), a fourni des estimations actualisées. Les études biologiques indiquent que les stocks de l'Ouest et de l'Est font apparaître des différences micro-chimiques et génétiques, mais les échanges entre toutes les zones sont manifestes, exception faite des deux principales zones de ponte. Les efforts de modélisation sont orientés vers le développement d'une MSE.

RESUMEN

El Programa de investigación sobre atún rojo para todo el Atlántico (GBYP) comenzó oficialmente en octubre de 2009. La cuarta fase se inició en marzo de 2013 y se amplió hasta el 21 de febrero de 2015, mientras que la quinta fase se inició el 22 de febrero de 2015 y estará en activo hasta el 21 de febrero de 2016. Las actividades incluían: a) una continuación de la minería, recuperación y elaboración de datos; b) estudios biológicos; c) marcado, lo que incluye una campaña de concienciación y recompensas, d) prospección aérea de concentraciones de reproductores de atún rojo y e) más pasos en los enfoques de modelación. Se recuperó una cantidad impresionante de datos, cubriendo el periodo desde 1512 hasta 2009. Está mejorando la comunicación de marcas recuperadas, aunque la tasa de recuperación sigue siendo baja. Las miniPAT proporcionaron resultados muy interesantes, que han contribuido

[1] ICCAT, GBYP – Calle Corazón de Maria 8, 6ª – 28002 Madrid (Spain).

enormemente a nuestros conocimientos, cambiando varias hipótesis anteriores. La prospección aérea, llevada a cabo en una amplia zona (aproximadamente el 60% del Mediterráneo) proporcionó estimaciones actualizadas. Los estudios biológicos indican que los stocks oriental y occidental tienen diferencias microquímicas y genéticas, pero que la mezcla entre todas las zonas es evidente excepto en las dos principales zonas de desove. Los esfuerzos en cuanto a modelación están orientados hacia el desarrollo de una MSE.

KEYWORDS

Bluefin tuna, ICCAT, historical data, sampling, biological analyses, tagging, genetics, microchemistry, aerial survey, modelling, Mediterranean Sea, Atlantic Ocean.

1. Introduction

The Atlantic-wide Research Programme for Bluefin Tuna was officially adopted by SCRS and the ICCAT Commission in 2008, and it started officially at the end of 2009, with the objective to:

a) Improve basic data collection, including fishery independent data;
b) Improve understanding of key biological and ecological processes;
c) Improve assessment models and provision of scientific advice on stock status.

The total budget of the programme was estimated at about 19 million Euros in six years, with the engagement of the European Union and some other Contracting Parties to contribute to this programme in 2009 and in the following years; the budget officially approved by the ICCAT Commission in 2008 was 19,075,000 Euro for 6 years. The initial year had costs for 653,874 Euro (against the original approved figure of 890,000 Euro), the second phase had costs for 2,318,849 Euro (against the original figure of 3,390,000 Euros), while the third phase had costs for 1,769,262 Euro (against the original approved figure of 5,845,000 Euro). The fourth phase had a total budget of 2,875,000 Euros (against the original approved figure of 5,195,000 Euros) and final costs for 2,819,557 Euro. The fifth phase has a total budget of 2,115,000 Euro (against the original approved figure of 3,345,000 Euro). The overall GBYP operating budget for the first five phases, covering 6 years (a total of 9,676,542 Euro) is about 50.73% of what was supposed to be (19,075,000 Euro), as it was approved by the Commission. Several private or public entities2 provided few additional funds or in kind support. These budget reductions had an impact on all activities carried out so far.

Taking into account the above reported figure, in 2014 the GBYP Steering Committee (ICCAT GBYP Steering Committee, 2015) and the SCRS recommended extending the GBYP activities up to 2021 and this proposal was endorsed by the Commission during its meeting on November 2014.

Phase 1 and Phase 2 activities were jointly committed by the European Community (80%), Canada, Croatia, Japan, Libya, Morocco, Norway, Turkey, United States of America, Chinese Taipei and the ICCAT Secretariat. Other CPCs (Algeria, Egypt, Iceland and Korea) joined the first funders in Phase 3, 4 and 5, but some of CPCs did not paid their contribution, further limiting the use of available funds, because the EU has a maximum percentage of contribution of 80% under the firm condition to duly obtain the remaining 20%.

The third phase (7 months) officially initiated on June 20, 2012, after the signature of the Grant Agreement for co-financing the GBYP Phase 3 (SI2.625691) by the European Commission. Phase 3 officially expired on January 19, 2013, but closing the administrative issues took more time than scheduled, due to a delay of one contractor in providing the necessary documents. The GBYP activities up to the first part of Phase 3 were presented to the SCRS and the ICCAT Commission in 2012 and they have been approved, while the last part was present to the SCRS and the Commission in 2013 and therefore approved.

[2] Additional financial contributions to GBYP were provided by Asociación de Pesca, Comercio y Consumo Responsable de Atún Rojo (SP) and by Grupo Ricardo Fuentes e Hijos s.a. (SP). In kind contributions were provided by Aquastudio Research Institute (IT), Balfegó Grup (SP), Carloforte Tonnare PIAMM (IT), Federcoopesca (IT), Ph.D. Jean Marc Fromentin (France), IEO–Fuengirola (SP); INRH –Tangier (MO), Maromadraba SARL and Es Sahel (Fuentes Group) (MO), Oceanis srl (IT), Mr. Roberto Mielgo Bregazzi (SP), the Stanford University (USA), the University of Cagliari (IT), the WWF Mediterranean Programme and the GBYP Coordinator.

The fourth phase of GBYP officially initiated on March 6, 2013, after the signature of the Grant agreement for co-financing the GBYP Phase 4 (SI2.643831) by the European Commission and then it was extended for a total of about 23 months, ending on 23 February 2015. The partial results were presented to SCRS and the Commission in 2013 and 2014 (documents SCRS/2013/144 and Di Natale, 2015e) and they have been approved.

The fifth phase of GBYP officially initiated on February 24, 2015 after the signature of the Grant agreement for co-financing the GBYP Phase 4 (SI2.702514) by the European Commission and will end on 23 February 2016.

The ICCAT Commission, in its meeting in Genova (Italy) on November 2014 approved the extension of the GBYP up to 2021, following the recommendations of the GBYP Steering Committee and the SCRS. A new plan for the GBYP activities to be done during these additional years was approved along with the extension.

The GBYP activity is being supported by a twin programme carried out by NOAA-NMFS, which will focuses its research activities on the western Atlantic Ocean.

2. Coordination activities

In the first part of the Programme, the staff was composed by the GBYP Coordinator, the Coordinator assistant (from March 2011 to March 2014) and one contracted technician for data management (from October 2011 to December 2013). In the second part of Phase 4 the staff was reduced to the Coordinator only, while the previous staff level was resumed from May 2015. The ICCAT Secretariat provided always the necessary support for the GBYP activities.

A total of 45 reports were produced in the framework of ICCAT GBYP in Phase 4. Several additional documents and reports have been also provided by GBYP for the needs of the Steering Committee for its meetings. A total of 58 scientific papers have been produced in Phase 4 (list in **Annex Ia**), while others will be published later on. A total of 24 reports have been produced in the first part of Phase 5, along with 26 scientific papers (**Annex 1b**).

A total of 9 Calls for Tenders were issued in Phase 4 and a total of 25 contracts have been released to various entities in Phase 4 (**Annex IIa**). Additional 6 calls for tenders were released so far in the first part of Phase 5 and a total of 15 contracts have been released so far to various entities in Phase 5 (**Annex IIb**).

In total, the number of contracts provided by GBYP up to the first part of Phase 5 is 88, including 83 entities, localised in 23 different countries; many hundreds of researchers and technicians have been working so far in the various GBYP activities; this large and open participation to ICCAT GBYP activities is considered to be one of the best results of this research programme. The coordination staff participated in 22 meetings in various countries in Phase 4 (17 were reported in the previous GBYP report), and to 5 meetings in the first part of Phase 5, up to September 2015 (**Annex III**).

As usual, the administrative and desk work behind all these duties was huge and heavy and it was carried out in continuous and constructive contact with the ICCAT Secretariat and the Administrative Department, which had to face an important additional workload caused by GBYP activities since the beginning of this programme.

A particular coordination effort was necessary for assisting the contractors engaged in the aerial survey activities and for assisting them for the many permits required, getting directly in touch with the relevant Authorities of the various CPCs concerned. A continuous assistance, 7/7 days 24/24h, was necessary for solving various problems, emergencies and operational difficulties for the aerial survey. Additional coordination efforts were required by the various contractors engaged in the field tagging activities, assisting them for many needs and problems.

Furthermore, the GBYP coordination is providing scientific support to all the national initiatives which are potentially able to increase the effectiveness of the GBYP and its objectives. For this reason, since 2010 the Coordinator joined the Steering Committee for the bluefin tuna programmes of the NOAA, together with some members of the GBYP Steering Committee; in this function he participated to the evaluation session of the US domestic research programmes for bluefin tuna also in 2013, 2014 and 2015.

In conformity with the Atlantic-Wide Bluefin Research Programme (GBYP) adopted by the SCRS and the Commission for Phase 4 and 5, the following research initiatives have been conducted, completed or initiated (see also Annex II).

3. Data mining and data recovery (final part of Phase 4 and first part of Phase 5)

3.1 Objectives of the data recovery and data mining

The objective of data recovery and data mining activities is to fill the many gaps existing in several data series currently present in the ICCAT data base, concerning both recent and historical data, which causes a large amount of substitutions in the assessment process, increasing uncertainties. At the same time, data mining activities should provide reliable data series, longer that those previously available, recovering data from many sources, including archives having difficulties for the access. The data mining activity can include also the recovery of old genetic and biological data. This activity will allow for a better understanding of the long-time catch series by gear, improving the data available for the assessment and possibly for replacing substitutions used for data gaps; old data will allow also for improving our knowledge about Atlantic bluefin tuna.

The total budget for data mining and data recovery was 600,000 euro for activities in 3 years; so far, the total expenditures have been 395,462.06 euro for 6 years of activities (65.91 % of the original budget), recovering much more data that it was set at the beginning and carrying out additional activities (a Symposium, various workshops and meetings). The data recovered so fare in all ICCAT GBYP Phases are included in **Table 1** and **Table 2**, except those there are still under check. So far, the GBYP objectives set for data recovery and data mining in these first Phases have been largely accomplished.

3.2 Data recovery in the last part of Phase 4

Just after the adoption of the previous partial report concerning most of the activities in Phase 4, the SCRS had not et-up any specific expert group for further examining the part of trade, auction and marked data which were initially validated by an external expert contracted by GBYP (SCRS/2014/042). Therefore, as agreed by the SCRS, these data sets are officially considered validated and shall be incorporated in the ICCAT data bases. The format of these data (excel files with many information not in any ICCAT official language) requires additional work for the incorporation in a new specific section of ICCAT Task II data base and this work will be possibly initiated in the last part of Phase 5, after setting a format in agreement with the ICCAT Statistical Department.

The only data mining activity which was carried out in the last part of Phase 4 was not originally included in the plan for this Phase. As a matter of fact, GBYP was already aware of a huge data base on historical tuna trap that was used for a Ph.D. Thesis by Christelle Ravier-Mailly in 2003 and that was used also for several papers coordinated by Ph.D. Jean-Marc Fromentin. These data were provided on an excel file, having 10 spreadsheets and 6384 records (**Table 3**). The data cover the period 1525-1997 (**Table 4**), including about 50[3] traps from five countries. This huge data base was kindly provided by Dr. Fromentin to GBYP, as a donation in kind, in the last part of Phase 4. It was initially examined by GBYP and the ICCAT Statistical Department and it was clear that several data and traps were already present in the ICCAT GBYP data base. Therefore, it was necessary to plan a long and huge work for checking all these data.

During the first four months of work it was clear that the system used for obtaining the total catch when this quantity was not available was based on a mean size by country. This method was not fitting the methodology used by the ICCAT Secretariat and therefore it was necessary to examine again the file and reconvert the number of fish to kg using the weight of the various size categories, when this information was available. The ICCAT Statistical Department decided to propose the comparison between the two methods to the SCRS Sub-group of Statistics and to the SCRS BFT Species Group, for adopting the most suitable method; five data series (related to five traps, one in each country: Sant'Elia-IT, Principe-MO, Torre del Barra-PT, Barbate-SP and Ras el Ahmar-TN) were proposed to the groups. The detailed results of this work are presented in Pagá Garcia *et al*., 2015 (*in press*).

[3] The total number of traps is uncertain, because some traps were reported with different names in different historical times, while they were exactly in the same location, just changing the name over the years.

When this decision will be adopted, then it will be necessary cross-check the last data from these files against the data already existing in the ICCAT GBYP historical trap data base, examining and solving any possible data conflict according to the best available knowledge, for eliminating duplicated data and for finally incorporating any missing data into the ICCAT GBYP data base, according to the format used by the Statistical Department at the Secretariat. All data for periods previous to 1950 will be directly incorporated, while data sets after 1950 will be checked also by national scientists and agreed before incorporating them.

3.3 Genetic Data mining in the first part of Phase 5

Following the first activity carried out in Phase 4, which provided a preliminary overview of the effective opportunities for recovering historical samples of Bluefin tuna bones over a long period of time (from the 2nd century B.C. to 1927), and particularly for those discovered in Istanbul (Turkey) and recovered in GBYP Phase 4, which covers a long period from the 4th to the 15th century A.C.

The GBYP Steering Committee recommended extending the previous contract and therefore a new short-time contract was provide to the same team who carried out the first set of genetic analyses, with the objective of extending and completing these important genetic analyses on historical Bluefin tuna samples.

A preliminary report was provided on August 6, 2015. The report shows the first results of the SNP genotyping analyses on a first set of 86 samples analysed to date (**Figure 1**), concerning samples from the II century B.C. to 2012. The total number of samples to be analysed, for a period from the IV century B.C. to 2011 (**Table 5**) is 525. The final report shall be provided by January 2016.

4. Aerial Survey on Bluefin Tuna Spawning Aggregations

4.1 Objectives of the Aerial Survey for bluefin tuna spawning aggregations

ICCAT GBYP Aerial Survey on bluefin spawning aggregations was initially identified by the Commission as one of the three main research objectives of this programme, in order to provide fishery-independent trends and estimates on the minimum SSB. The original programme included a total of three surveys over a maximum of three areas, but this was later modified by the Steering Committee and a first power analyses revealed that under the best possible conditions a minimum of six surveys will be necessary for detecting a trend. The total original budget, set for 3 surveys in 3 areas, was 1,200,000 euro; the costs for carrying out 4 surveys in much more areas (up to 4 main “internal” areas and 7 “external” areas) are about 1,619,624 euro (134.97% of the original budget, but with much more than the double of the activities). So far, the GBYP objectives initially set for the aerial survey on spawning aggregations in these first Phases have been largely accomplished.

Two surveys on selected areas have been carried out in GBYP Phase 1 (2010) and Phase 2 (2011). The first one covered entirely 3 areas and partly 3 additional areas (it was carried out without bubble windows and declinometers), while the second one was limited to 3 areas, due to security and permits problems. The aerial survey activity was suspended in Phase 3 (2012), following the recommendation by the GBYP Steering Committee, because it was requested an extended survey all over the potential Mediterranean spawning areas, which covers about 90% of the Mediterranean Sea surface, including those were flights were banned for security reasons, and because sufficient funds were not made available.

Di Natale *et al*., 2015c (*in press*), among other biological contents concerning bluefin tuna, presented a summary of the available scientific knowledge also on the spawning areas in the Mediterranean Sea, including a map, which was used by GBYP. At the end of Phase 3, under the GBYP Modelling budget item, it was possible to have a study for assessing the feasibility of a large-scale aerial survey on bluefin tuna spawning aggregations in the Mediterranean Sea (a power analysis) for obtaining useful data for operating model purposes, following the views of the GBYP Steering Committee and including various operative choices (see: http://www.iccat.int/GBYP/Documents/MODELLING/PHASE%203/Aerial_Survey_Feasibility_Study_Phase3.pdf) and this document was used as the base for developing a first extended aerial survey in Phase 4, which was carried out in .

The extended survey was conducted in 2013 and the results were presented to the SCRS and the Commission. This was the first extended aerial survey conducted in more than 60% of the Mediterranean Sea, under very difficult situations, and using a budget that was not proportionally increased; therefore, the replicates in the main areas (defined as "inside") were less, while they were reduced to the minimum in the additional areas (identified as "outside"). Even in this survey, security and permit problems have been serious constraints.

Due to severe budget constraints, it was impossible to carry out any aerial survey in 2014, during the extension period of Phase 4.

The GBYP Steering Committee, in September 2014, included again an extended aerial survey within the activities of Phase 5; this survey included 11 areas, for more than 60% of the total Mediterranean surface. In the very last part of Phase 4, after the meeting of the GBYP Steering Committee in February 2015, a further analyses of the previous data was requested, for better assessing any variance possibly induced by the use of bubble windows since 2011 and the various types of aircrafts (**Annex 1a**, document no. 19). The possible use of a calibration exercise was discussed at the same meeting and a first document on a SWOT analyses was presented by the GBYP coordination (SCRS/2015/143). This preliminary document was therefore discussed with some well-known experts in aerial survey, who shared the contents, and therefore revised and presented to SCRS. The main results of the SWOT analysis indicates that a calibration for an aerial survey which uses so many pilots and spotters of different nationalities is not feasible, also taking into account the many legal constraints. Furthermore, a calibration limited to the rotation of spotters (when feasible) will concerns only one of the many variance factors which can bias an aerial survey.

The GBYP Steering Committee, after many discussions, finally confirmed the agreement to include again the aerial survey in the activities of Phase 5, according to a map of possible areas to be surveyed (**Figure 2**).

4.2 The ICCAT-GBYP Revision of the Aerial Survey Design for Phase 5

Following the recommendation of the GBYP Steering Committee and taking into account the new map, it was agreed to extend the contract for the aerial survey design to the same entity who made it in previous years. The design was revised always following the DISTANCE methodology, according to the approach which was recommended by the Steering Committee, trying to balance the limited budget with the relevant research needs of an extended survey. The study provided a design for the 4 most documented spawning areas ("inside") already surveyed in previous years, having a more dense number of transects, and a less dense design for the 7 other areas ("outside"). The design was made with additional tracks, in order to provide opportunities when necessary (**Figure 4)**. At the same time, the team in charge of the design was ready to provide modified tracks in case of any problem or need.

The design was provided with the maximum urgency (**Annex 1b**, document no. 18) and, after the agreement of the Steering Committee, it was attached to the Call for tenders[4] (**Figure 3**).

4.3 The ICCAT-GBYP Aerial Survey for Bluefin Tuna Spawning Aggregations in Phase 5

This year, for the first time, the Call for tenders for the aerial survey (IICAT GBYP 03/2015, ICCAT Circular 1796 on 8 April 2015) was set for two different activities, as requested by the Steering Committee: activity A for providing aircrafts, pilots and a scientific spotter for each aircraft, and activity B for providing only professional and scientific spotters to be rotated among the areas. Some tenders provided offers for both components, because of the legal problems existing for taking on board crew members from other companies and for all the complex procedures linked to the flight permits. Therefore, after consultation with the Steering Committee, three companies were awarded the contracts for various areas.

A training course for pilots, professional spotters and scientific observers was organised at the ICCAT Secretariat in Madrid, on 26 May 2015, attended by 21 fellows, trained by two external experts (Dr. A. Cañadas and Dr. J.A. Vasquez) and by the GBYP Coordinator (**Annex 1b**, document no. 5). The new GBYP Protocol for Aerial Survey for Bluefin Tuna Spawning Aggregation (**Annex 1b**, document no. 6), provided by the two expert, was reviewed by GBYP and officially circulated among all the contractors.

[4] The initial draft for the aerial survey, which was ready at the beginning of Phase 5 (February 2015) according to the plan set in September 2014 by the SC, was delayed for taking into account all the discussion from February to April of the SC.

Once awarded the contracts (on May 14,2015), the ICCAT Secretariat immediately informed all concerned CPCs and assisted all contractors in all procedures for getting the necessary permits, because the field activities should start on June 1, 2015. This work needed a continuous assistance by the GBYP Coordination, because of the many delicate aspects concerned and many daily difficulties encountered for various reasons. Tunisia, after several letters and besides of the many interventions of the ICCAT Executive Secretary, the GBYP staff and the efforts made by the Companies, provided a letter of availability which arrived too late, on 3 July 2015, just two days before the final date for finalising the survey.

The major difficulties have been the permits for documenting the sightings with photos, because these permits are under the control of various different authorities. These permits, in some cases, caused a delayed beginning of the survey activities in some areas. It was necessary to partly readapt the survey design of areas C, E and G, taking into account the lack of permit from the Tunisian authorities and the need to cut few coastal areas in the Turkish FIR, according to specific requests of the Turkish authorities. A Turkish observer was available for surveying the Turkish FIR.

Additional problems were registered in 2015, due to the few number of airports having the right type of fuel for some aircrafts, the unexpected limitation of fuel quantities in Malta (which created serious limitation to the autonomy of the aircrafts), the impossibility to go outside a FIR when the take-off was done from a non-international airport, the need to provide well in advance the list of crew for each aircraft for clearance reasons, the limitation for carrying on board cameras when high security circumstances suddenly occurred (Pantelleria). All these constraints caused a strong impact on the logistics in various areas and the need for a continuous assistance at any time of the day, including week-ends, by the GBYP coordinator.

Several times, the aircrafts operating in various areas for ICCAT GBYP were approached and checked by military aircrafts belonging to various countries.

The survey was carried out using a total of 6 aircrafts, 4 Partenavia P68 of various types and 2 Cessna F377 G. Other four aircraft were kept in stand-by in case of need, as reserve. Each aircraft had a specific ICCAT identification number. The surface to be surveyed was about 1,284,858 km^2 (312,490 km^2 of "inside" areas and 972,368 km^2 for "outside" areas), representing about 54.35% of the whole surface of the Mediterranean Sea, a surface never covered by any other scientific survey in the Mediterranean. The total length of transects to be covered on regular tracks was about 38,308 km[5] and it is reasonable that this length was almost doubled due to the many logistic needs.

Strong winds, scarce visibility, bluefin tunas travelling well below the surface (many purse-seiners got most of the catches fishing with sonar in 2015) due to abnormal extreme oceanographic conditions[6] and military activities have been operative and environmental problems that caused troubles for the survey in some areas. The provisional tracks and sightings are showed on **Figure 4**.

It is important to note again that this very extended aerial survey, even considering the various limitations and problems, was possible only thanks to the remarkable help of various national officers in the many CPCs concerned and the extreme good-will and availability of all the three Companies and crew contracted by ICCAT GBYP and the team in charge of the survey design.

4.4 Elaboration of Aerial Survey Data

At the end of the survey, each Company provided a report, with details for each area, including the excel forms with the detailed data and the GPS tracks (**Annex 1b**, documents 7, 8, 9, 10, 11 and 12). A contract for elaborating the 2013 aerial survey data was provided to the same team which carried out the same analysis in previous years, after inviting three different team of experts (one never responded, while another one decided not to submit a bid). The GBYP staff carried out a quality check of each report, while the detailed data were checked directly by the external experts, cross-validating them with a continuous direct contact with the observers, whenever this was necessary. Some files had various problems. The first provisional report was presented on 14 September 2015 (**Annex 1b**, document 13 and Di Natale *et al*., 2015a (*in press*)), while the final report, including a power analyses, will be available in February 2016.

[5] The effective amount of km on trasects is to be further checked, due to some problems in the GPS files, which were only partly checked before the first part of the analyses.

6 See Di Natale *et al*., 2015b (*in press*), and consider that July 2015 was the hottest one registered in the Mediterranean Sea.

The survey revealed that most of the sightings were concentrated in the areas initially selected by GBYP for conducting the surveys in 2010 and 2011 (which were also the "inside" areas of the extended survey (**Figure 4**), confirming the full validity of the initial choice based on scientific knowledge and recent fishery data obtained by a VMS analyses of the purse-seiners activities at the end of 2009. Only very few sightings were made in other areas where spawners usually travel not so close to the surface. One exception, in 2015, was in the area between East Algeria, North Tunisia, western Sicily and SW Sardinia, where some huge schools of spawners we spotted at the surface and this was confirmed also by a bluefin tuna electronically tagged by GBYP in Morocco. This area is not usually one of the main spawning areas, because of the Mediterranean water circulation, but this year the conditions were favourable for some days and we had the opportunity to document this fact.

The logistic of such an extended survey was extremely complex and the long transfers had a very serious impact on the effective available effort on transects. As a matter of fact, the total number of flight hours was about 381 but only a part was on transects; anyway, the survey allowed for the more than 52% of the total Mediterranean surface. **Tables 6, 7** and **8** show the very preliminary results of the aerial survey in both "inside" and "outside" areas and in total.

A tentative analyses on overlapping "inside" areas over the four surveys (**Figure 5**) was included in the preliminary report, because we suppose that looking at the same areas over the differ years may possibly provide a more homogenous comparison, even if further standardisation might be necessary, because the number of replicates or coverage was different in the various surveys. The first results are shown on **Table 9**. Even in this case, the final analyses will be provided before the end of Phase 5.

As noted before, the quantities registered by the survey were negatively biased by the particular oceanographic situation in 2015. On the opposite, large schools were noticed at the surface in outside areas where they were not usually seen. A delay of about three weeks in spawning aggregations was noticed in several areas and this was totally unpredictable when the survey was launched. Fishery patterns confirms this abnomalous situation.

Clearly, these are the "normal" variance factors when carrying out an extended survey in a fixed period (which was set according to the peak of bluefin tuna spawning in June, as it is known since a couple of centuries, Piccinetti *et al*., 2013). This effect shold be smoothed in a sufficiently long series of surveys if oceanographic conditions will be close to the usual average over most of these years.

In 2015, for the first time, it was checked the possibility to include into the analyses also the additional variance induced by the percentage time at the surface of the bluefin tuna in the Mediterranean spawing areas during the spawning season. Some priliminary tests were done on the data obtained by several electronic tags deployed in the most recent years and a first paper (Quilez Badia *et al*., 2015 (*in press*)) proposing a methodological approach was submitted to the SCRS.The detailed report for the aerial survey activity in 2015, based also on the provisional results of the preliminary analyses, is provided in Di Natale *et al*., 2015a (*in press*).

The main recommendations related to the aerial survey are the followings:

a) The methodology for the survey design applied in 2010, 2011, 2013 and 2015 (i.e. equally spaced parallel lines and DISTANCE approach) has proven to be feasible and successful and it is recommended to design future surveys in the same way.
b) Concentrate the survey effort to only the known spawning areas ('inside' sub-areas), for more densely survey these areas with more replicates, in order to decrease the bias. The 2013 survey and, even more, the 2015 survey proved that surveying in "outside" areas add many logistic problems.
c) It would be useful, though, to repeat a whole-basin wide survey from time to time (i.e.: every three/five surveys) to assess possible variability over the time; if surveys are going to be done annually or bi-annually, the recommendation is to concentrate all efforts on the known and previously surveyed main spawning areas. When an extended survey is included, then the budget should be increased accordingly, in order to avoid a lower number of replicates in the main areas.
d) Concentrate the survey effort in a defined time period (i.e.: only June), the same all years, to allow a more realistic comparison of the results and avoid a potential temporal (seasonal) variability and biases. Oceanographic features should become part of the necessary data, in order to further improve the understanding of any additional parameter.

e) Any calibration trial will be useful, but under the condition to be feasible and clearly meaningful. Its cost shall not affect the survey, in order not to lose the necessary number of replicates.

f) Implant more electronic tags on fish presumably moving to spawning areas, with a maximum 3-months setting, in order to have much more detailed data about the surfacing behaviour of these fish during the aerial survey and use these data for better assessing any additional variance.

g) Allocate more effort to future surveys, allowing for more passages and for the CV reduction.

h) Possibly carry out the annual surveys continuously (without holes between years), in order to improve the technical capacity of the crews and take advantage of the problems rising each year for finding solutions. This approach will allow for an increasing quality of the results and for getting more reliable trends.

5. Tagging activity

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

5.1 Objectives

The specific objectives of the GBYP tagging activity on the medium term were set as follows:

a) Validation of the current stock status definitions for populations of bluefin tuna in the Atlantic and Mediterranean Sea. If the hypothesis of two stock units (eastern and western stocks) holds, the tags should provide estimates of mixing rates between stock units by area and time strata (ICCAT main area definitions and quarter at least). It is also important to consider possible sub-stock units and their mixing or population biomass exchange, particularly in the Mediterranean Sea[7] (this point included both conventional and electronic tagging).

b) Estimate the natural mortality rates (M) of bluefin tuna populations by age or age-groups and/or total mortality (Z) (this point was related to conventional tagging).

c) Estimate tagging reporting rates for conventional tags, by major fishery and area, also using the observer programs currently deployed in the Mediterranean fisheries (ICCAT ROP-BFT).

d) Evaluate habitat utilization and large-scale movement patterns (spatio-temporal) of both the juveniles and the spawners (this point was mostly related to electronic tagging but not only).

e) Estimate the retention rate of various tag types, due to contrasting experiences in various oceans.

Electronic Pop-up tags should provide data over a short time frame, while conventional tags and internal archival tags should provide data over a longer period of time, always depending on the reporting rate.

The initial, short-term GBYP objective was to implant 30,000 conventional tags and 300 electronic tags in three years in the eastern Atlantic and Mediterranean, with a total budget of 9,765,000 euro; the absolutely necessary the tagging design study and protocol, as well as the tag awareness and rewarding campaigns, were not included. So far, with only 37.65% of the funds (a total of 3,767,593 euro, including the budget amount set for Phase 5, equal to 431,758 euro), GBYP deployed 81.07% of the conventional tags (24,560) and 81.87% of the electronic tags (238; 180 mini PATs, 50 internal archival tags and 8 acoustic tags); furthermore, the tagging design and protocols, the awareness and rewarding campaigns were included in the activity carried out so far. It is very clear that the general objectives sets for the tagging activities in these first Phases were largely accomplished so far, taking into account the proportion of the available budget.

The final reports of all electronic tagging activities in Phase 5 are already available (see **Annex 1b**) and they are summarised in Di Natale *et al*., 2015c (*in press*).

[7] Additional elements will be provided by the GBYP biological and genetic sampling and analyses.

5.2 Tags and correlate equipment

At first, ICCAT GBYP acquired a considerable amount of tags during these first Phases of the programme, allowing both the tag delivery to all stakeholders who have a bluefin tagging activity (either opportunistic or institutional) and to the GBYP contractors. The details of the materials and tags acquired so far by ICCAT GBYP or donated by various institutions are in Di Natale *et al*., 2015c (*in press*).

5.3 Tagging activities

The final overview of the tagging activities done in Phase 4 is showed on **Table 10** and this table complete and replaces the table provided along with the GBYP report in 2014 to the SCRS.

The Steering Committee, in September 2014, adopted a different tagging strategy for Phase 5, and initially recommended continuing the conventional tagging by baitboats in the Bay of Biscay and in the Strait of Gibraltar, continuing the electronic tagging in Moroccan traps, and extending it to the western Mediterranean (Italian traps, Sardinia) and in the eastern Mediterranean Sea (Turkish purse seiners). The budget for Phase 5 was set and approved accordingly. The draft call for tenders was ready at the beginning of Phase 5 (February 2015).

In February 2015, the Steering Committee, taking into account the clear difficulties for assessing the recovery rate by fishery and that the tag reporting rate for conventional tags was still too low, recommended revising the plan for Phase 5, cancelling the conventional tagging, and addressing all activities only to the electronic tagging in the three areas previously identified, increasing the number of tags as much as possible, according to the availability of tags by Wildlife Computers and the budget possibilities.

After several discussions, a revised Call for tender was agreed by the Steering Committee and it was issued on 22 April 2015. After selecting the bids, the contracts were provided to an international consortium headed by INRH with the participation of Maromadraba and WWF MedPO for the Moroccan traps, to an Italian consortium headed by COMBIOMA for the Sardinian traps, and to a joint team made by the University of Istanbul and UNIMAR for tagging in the eastern Mediterranean. Further tagging activities were carried out on a complimentary base by INRH (conventional tagging in Moroccan tuna traps) and by Federcoopesca and others (electronic and conventional tagging in southern Tyrrhenian Sea, taking advantage of some tunas to be released from a cage).

The updated situation of the tagging activities in Phase 5 is showed on **Table 11**. In total, up to September 1, 2015, the total number of bluefin tunas tagged so far in all GBYP Phases are 16883, and a total of 24560 tags of various types have been implanted (**Table 12**). 46.67% of the tagged fish were double tagged.

Figure 6a shows the progression of the ICCAT GBYP tagging activities in the various years, clearly showing the yearly improvements up to 2014 and the remarkable reduction in Phase 5, due to the cancellation of the conventional tagging. **Figure 6b** shows the percentage distribution of tags implanted in the various geographical areas, up to September 1, 2015.

The ICCAT GBYP electronic tagging with mini-PATs in Phase 5 were carried out on adult fish in all areas, as planned.

It is important to note that several premature detachments[8] were noticed for mini-PATs since the beginning of its use; this problem was discussed with various specialists and with the manufacturer Company. Different anchors were supplied by Wildlife Computers in Phase 4 and used by GBYP contractors and the situation improved. In Phase 5 it was decided to use the type of anchor which was unanimously considered the best by the most experienced colleagues, the "Domeier large" type. One of the experts hired by ICCAT GBYP carried out some tests, trying to detach the dart from a dead bluefin tuna that was used for this purpose. The trial revealed that the dart was holding very well (independently from the angle of insertion) and it was impossible to extract it by strongly polling. This test confirms the reliability of the choice made with this type of dart. At the same time, the wound made by the dart is not minimal and, even using the best disinfectants and local antibiotics as set by the protocol, we cannot exclude that the friction made by the wire could create a later infection in the wound, which

[8] In some cases it is not clear if the premature detachment was a real one or due to a fishing activity.

might result is weakening the skin itself around the wound in few weeks. It is to be noted that most of the "premature detachments" happened in areas and times where several fishing vessels were operating and that some analyses of the tag data seems confirming a fishery motivation.

The preliminary maps of the mini-PATs deployed by GBYP in Phase 5 in the various areas and which popped-off up to September 16, 2015, are on **Figures 7** to **11**. The most recent data concerning tag popped-off in Phase 5 which have been not processed up to September 16, 2015, will be included in the final report of Phase 5.

The most important preliminary result of the tagging activity in Phase 5 is concerning the evidence that all previous hypotheses about the lack of interchanges between the tunas in the eastern Mediterranean and the other Mediterranean and Atlantic areas, which was showed by all previous tagging activities, does not hold anymore. As a matter of fact, in 2015 we had 3 fish tagged in Turkey which moved into the central Mediterranean, one fish tagged in Turkey which moved to the NE Atlantic in 53 days, another one moved up to Faroe Islands in 82 days, one tuna tagged in the Strait of Gibraltar in 2013 with a conventional tag that was reported in Turkey and one tuna double tagged in Croatia in 2013 that was recovered also in Turkey. This absolutely new evidence now supports the results of the genetic analyses made in Phase 4, which reported mixing among all areas in the Mediterranean (**Figure 12**), without allowing for any specific subpopulation discrimination.

As it was discussed in 2014, this year it was possible to have a preliminary overview of the behaviour of the bluefin tuna adult tagged in Moroccan traps in 2011, 2012, 2013 and 2015. As discussed in Di Natale *et al*., 2015c (*in press*), now it seems that a possible explanation might be that some of these fish had a western origin and therefore these "western" fish going to the Moroccan traps had no reason for going into the Mediterranean during the spawning period. On the opposite, if we trust the full separation of the spawning areas for those fish born in a given area, they had good reasons for going back to the western Atlantic areas. This variable presence of western-origin Bluefin tuna in the Moroccan traps (**Figure 13**) was fully unknown when all the discussions about the possible impact of the tagging technique took place at the SCRS BFT Species Group in 2012 and 2013, and its interannual variability can further support the different percentages of tunas entering into the Mediterranean after being tagged. Therefore, now it seems that the behaviour of these fish was mostly subject to other factors than the tagging technique and that the different behaviour most possibly informs us about a different natal origin, even if other side reasons cannot be fully excluded. Of course, any further observation of these data should take into account that we are still missing all details about those bluefin tuna distributed in the central-southern Atlantic.

5.4 Tag awareness campaign

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

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

5.5 Tag reward policy

Following the recommendations made by SCRS and the GBYP Steering Committee, the ICCAT GBYP tag reward policy was considerably improved since the beginning, with the purpose of increasing the tag recovery rate which was extremely and unacceptably low. The new strategy includes the following rewards: spaghetti tag

50€/ or a T-shirt; electronic tag 1000 €; annual ICCAT GBYP lottery (September): 1000 € for the first tag drawn and 500 € each for the 2nd and 3rd tag drawn. According to the results in the first Phases, this policy (along with the strong tag awareness activity) was very useful for considerably improving the tag reporting compared to years previous to GBYP.

5.6 Tag recovery and tag reporting

This activity is the final result of the activities listed in points 5.3, 5.4 and 5.5. For further improving the results, meetings with ICCAT ROPs were organised during their annual training, further informing them about the ICCAT GBYP tag recovery activity and asking them to pay the maximum attention to tags (and to natural marks) when observing harvesting in cages or any fishing activity at sea. Special information forms have been provided to ICCAT ROPs.

Updated data are provided by Di Natale *et al.*, 2015c (*in press*). While examining the results of the ICCAT GBYP tag recovery/reporting activities, it is very important to consider that about 90% of the conventionally tagged fish in Phases 2-4 were juveniles (age 0-3); about 70% were surely immature fish (age 0-2) and then it is difficult for these fish to be caught by most of the fisheries, particularly taking into account the ICCAT minimum size regulation and the fact that the baitboat fishery in the Bay of Biscay in the last years was almost cancelled, because fishermen sold their quota to other fisheries. Since the first year of the GBYP and up to September 4, 2015, there have been 341 tags recovered by GBYP. The GBYP recoveries are summarized as follow:

- 217 Conventional "Spaghetti" tags (63.6% of the total)
- 94 Conventional "Double-barb" (two types) tags (27.6% of the total)
- 19 External Electronic "mini-PATs" tags (5.6% of the total)
- 7 Internal Electronic "Archivals" tags (2.1% of the total)
- 4 Commercial "Trade" bluefin tuna tag (1.2% of the total)

The distribution of tag recovered by area and fishery[9] is showed in **Table 13** and **Table 14**.

The important tag reporting improvement registered after the beginning of the tagging and tag awareness activities by ICCAT-GBYP is impressive: the average ICCAT recovery for the period 2002-2009 was only 0.77 tags per year, while during GBYP tag recovery activities the average was 60.14 tags per year[10], with 7,810% increase. The year 2014, after that tagging activities were carried out in many areas and the tag awareness activities were already settled, GBYP recovered a total of 108 tags, about 31.8% of the total over the whole period. Even considering that conventional tagging was almost suspended in 2015 and only very poorly done in 2014 (due to the lack of budget), it is possible that 2015 recoveries will be close to a similar level at the end of the year. We have to note that, for the first time in ICCAT bluefin tuna tagging activities, the number of tags recovered and reported from the Mediterranean Sea is higher than from any other area. Considering that reported tags from the Mediterranean were almost nil before GBYP, this is the clear evidence that GBYP tag awareness campaign is producing positive effects.

It is extremely difficult and almost impossible at the moment to define a recovery rate for GBYP conventional tagging activities, taking into account that most of the conventionally tagged tunas were juveniles and they will be possibly available in most of the fisheries within the ICCAT Convention area only in future years. Whenever we consider, as a preliminary exercise, the number of tags recovered so far in comparison with the number of GBYP tags deployed, the provisional recovery rate is only 0.9%, but this rate is clearly negatively biased by the juvenile ages of more than 90% of the tagged fish. At the same time, it is impossible assessing the recovery rate of tags which were not deployed by ICCAT GBYP, because ICCAT does not have the complete number of implanted tags by each tagging entity.

The number of tags reported by two important commercial activities in the Eastern Atlantic and in the Mediterranean Sea (purse-seiners/cages and tuna traps) is surprisingly very low. The purse-seine fishery is historically the most productive in the last decades, reaching over 70% of the total catch in some years; since

[9] For comparison purposes, but also because the data were not previously reported, we included in the table also the tags recovered by ICCAT between 2002 and 2009, before GBYP. These tags were only 7 (4 spaghetti, 1 double barb spaghetti and 2 internal archival).

[10] Without considering that GBYP initiated its activities in March 2010 and the tag recovery considers only tags reported before 10 August 2015. The first year was considered as full year.

1999, almost all catches are moved to cages and then to fattening farms and these activities are strictly monitored by ICCAT observers (ROPs). Consequently, the GBYP was supposed to have a high tag recovery and reporting rate from purse-seiners/farms, but the data are showing a different reality: so far, only two Spanish farms (Balfegó and Fuentes), two Maltese farms (ADJ Tuna Ltd and Fish & Fish Ltd) and one Greek farm (Bluefin Tuna Hellas SA) had recovered 36 tags, of various types (28 single-barb spaghetti, 6 double-barb spaghetti, 2 archival). Even considering that most of the recent tagging activities were targeting juveniles, the recovery and reporting rate is unrealistically too low (10.6% of the total reported tags). The same considerations can be done for the traps, because only one Spanish tuna trap (Tarifa) and 1 Italian trap (Carloforte) had reported 6 tags to ICCAT within the period taken into account (3 single-barb spaghetti, 1 double-barb spaghetti, 2 internal archival). Even in this case, the recovery and reporting rate (1.76% of the total recovered tags) is unrealistically too low. A similar consideration is applicable even to the long-line fishery; including both the bluefin tuna targeted fishery and the many long-liners targeting other pelagic species having the bluefin tuna as a by-catch (32 tags in total, 19 single-barb spaghetti, 11 double-barb spaghetti and 2 archival, equal to 9.38% of the total). The possible reasons for the low report rates from these fisheries are detailed in Di Natale *et al*., 2014a.

Interesting information is slowly coming from the tunas double tagged (**Table 15**): Up to September 3, 2015, tags were recovered from 90 double tagged fish and both tags have been recovered from 74 fish (82.2% of the double tagged fish recoveries). 9 fish had only the billfish (double-barb) tag on, while 7 fish had only the single barb spaghetti on. According to these first data, it seems that both types of tags are quite resistant, with a slight prevalence (92.2%) of the double barb against the single barb ones (90%). The tag recovery rate for all double tagged fish by GBYP is currently 1.14%.

Reiterating what it was said in the first part of the ICCAT GBYP, the extreme importance of having all tag release data related to all tagging activities carried out on bluefin tuna (but also on all other species under the management of ICCAT) concentrated in the ICCAT tag data base is something that should be mandatory. That is essential because recoveries can be logically reported to ICCAT at any time and it is not always easy, rather time/effort consuming finding the entity which implanted the tags if data are not properly stored. As usual, the GBYP staff had experienced a lot of difficulties in recovering the tag release data in several cases, with an important additional workload. At the moment this tag release communication is not mandatory, but it should be, because it has a general interest, including for the various entities and institutions carrying out this activity. The SCRS BFT Data Preparatory Meeting in May 2014 recommended the following: “Given the substantial number of tags that have been deployed on Atlantic Bluefin tuna, much of which has not been made available through ICCAT, the Group recommended that all electronic tagging data be submitted to ICCAT in the format approved by the Ad Hoc SCRS working group on tagging to be made available for analyses by April, 2015. In this regard, the Group supports the previous recommendation from the Biological Parameters Meeting (2013, Tenerife)”.

6. Biological studies

The initial, short-term ICCAT GBYP objective approved by the Commission in 2008 was to collect samples from 12,000 fish (including western Atlantic and the Japanese catches and markets) and carry out ageing and genetic studies, and micro-constituent analyses in three years in the eastern Atlantic and Mediterranean, with a total budget of 4,350,000 Euros. So far, with only 34.04% of funding (a total of 1,480,787 Euros, including the budget amount set for Phase 5, equal to 342,496 Euros), the ICCAT GBYP collected samples from 9,723 fish (81.03% of the target) and carried out ageing, genetic and micro-constituent analyses; furthermore, the sampling design and protocols, and the otolith shape analyses were included in the activity carried out so far. It is very clear that the general objectives sets for the biological studies in these first Phases were largely accomplished so far, taking into account the proportion of the available budget.

The GBYP biological sampling design was the one provided by the Institut National de Recherche Haulieutique (INRH - Morocco) on March 2011. The final approved version is available on the ICCAT-GBYP web site: http://www.iccat.int/GBYP/Documents/BIOLOGICAL%20STUDIES/PHASE%202/Rapport%20final%20design%20echantillonnage%20biologique%20ICCAT-GBYP.pdf

All the activities carried out in previous Phases concerning the biological sampling and analyses have been already preliminary presented to SCRS and the Commission in 2012, while the activities for Phase 3 and the first part of Phase 4 were presented by Die *et al*., 2014, SCRS/2013/089 and SCRS/2014/151. This report includes the results of Phase 4 activities and the preliminary activities in Phase 5.

6.1 Objectives

The main objective of this task was to improve understanding of key biological and ecological processes through broad scale biological sampling of live fish to be tagged and dead fish landed (e.g. gonads, muscles, otoliths, spines, etc.), histological analyses to determine bluefin tuna reproductive state and potential, and biological and genetics analyses to investigate mixing and population structure. In particular, Phase 4 objective was pursuing the work to better define the population structure of Atlantic Bluefin Tuna (*Thunnus thynnus*), with a particular attention to the age structure and any possible sub-populations identification.

6.2 Activities

The activities in previous GBYP Phases have been clearly able to accomplish their objectives (**Table 16**). Of course, the activities in following Phases of GBYP are set for completing and improving the preliminary results and for better defining some issues, such as mixing between the two current stocks and any sub-population hypothesis.

The biological activities for **Phase 4**, carried out by an international Consortium headed by AZTI including 13 institutions and 8 subcontractors was reported in detail in the various contractual deliverables[11] and was officially reported to SCRS in September 2014, within the GBYP report (see final report on: http://www.iccat.int/GBYP/Documents/BIOLOGICAL%20STUDIES/PHASE%204/_GBYP_Biological_studies_Final_Report_2014.pdf). Other two contracts were released at the end of 2014 (Mediterranean Spain and Sicily) for collecting additional YOY samples; originally it was supposed to release other 4 contract (Bay of Biscay, Ligurian Sea, Malta and Turkey), but YOY were not there in most of the places at that time, while the contract in Malta was not released due to the refusal of permit for the YOY sampling to the local contractor by the Maltese Fishery authorities. Additional 89 bluefin tuna YOY were sampled under these two contracts; the sampling included both otoliths and tissue for genetic analyses and they are included on **Table 16**, under the total number of samples in the GBYP tissue bank kept by AZTI.

As requested by the Bluefin tuna Species Group, the SCRS and the GBYP Steering Committee, an SCRS meeting was organized in May 2013 in Tenerife for reviewing the bluefin tuna biological parameters and the report is available on http://www.iccat.int/Documents/Meetings/Docs/2013-BFT_BIO_ENG.pdf. The results are also on documents Di Natale *et al*., 2014b, Rodriguez-Marin *et al*., 2014, SCRS/2013/089, USA Scientists, 2014, all presented at the Tenerife meeting. Other documents were preliminary presented at the SCRS BFT Data Preparatory meeting in May 2014.

The total number of samples reported by the Consortium was much higher than the target: +43.22% for the specimens to be sampled and +17.08% for the number of samples; this achievement was made possible thanks to the ICCAT Rec.11-06, which allowed collecting samples even outside the fishing season. The Libyan samples mentioned in the previous report (Die *et al*., 2014) were made available in Phase 4, as planned, though the Maltese colleagues working within the Consortium. Additional technical and logistic problems were noticed by the Consortium, particularly for collecting YOY samples in Malta and exporting samples from Turkey.

6.2.1 Micro-chemical analyses

After the preliminary discrimination between WBFT and EBFT carried out in Phase 2 and 3, and after defining a new baseline, the **micro-chemical analyses** of the otoliths in Phase 4 were concentrated mostly on Atlantic areas, trying to better define the mixing between the two main stocks.

The analyses on $\delta^{13}C$ and $\delta^{18}O$, carried out on 327 otoliths, show a large majority (94%) of western origin tunas in the NW Atlantic areas, a 100% presence of eastern origin fish in North Atlantic in samples collected in 2011 and 83% in those collected in 2012, while the situation in the Ibero-Moroccan area shows a certain variability between years and areas (Canary and Moroccan traps), but with a clear majority of eastern Atlantic fish. This information, when adding the results from the analyses concerning the Moroccan samples in the previous Phase, shows a clear and marked interannual variability of the components, and therefore a variable mixing rate that should be further followed and investigated, particularly for management purposes and for developing MSE

[11] Preliminary reports, due to scientific confidentiality issues, are not available on the ICCAT GBYP web page, while final reports are available there after their final approval.

approaches. The situation in the Mediterranean Sea and in the Straits of Gibraltar appears more stable, with almost 100% of eastern Atlantic fish (only in 2011 there was a very minor percentage of western Atlantic components, <1%, maybe due only to analytical procedures). Even if the previous GBYP report discusses in a deeper way this part, in general the micro-chemical analyses carried out so far provide various elements for improving our understanding of the Atlantic bluefin tuna components, but more samples, in different years and from more areas should be necessary for having more solid results, possibly assisted by a parallel genetic analyses, particularly taking into account the marked interannual variability of the components (**Figure 12**).

Further micro-chemical analyses were carried out on trace elements in the otoliths edge, which are able to further determine the bluefin tuna movements. In this case, after analysing 154 samples from various areas and ages, the difference between the western Atlantic and the eastern Atlantic was clear, even if less if compared to the results mentioned in the previous paragraph, while several differences were noticed within the Mediterranean and even some Atlantic components were found in samples from southern Sicily (see the final report provided by AZTI).

A further type of micro-chemical analyses concerned the elemental composition in otoliths of young-of-the-year (YOY) bluefin tunas within the Mediterranean, having the objective to possibly have additional elements for discriminating the natal origin of the young fish. According to the elements taken into account in the preliminary analyses, which was carried out on a total of 60 samples (20 per area), it seems possible discriminating the natal origin among the three areas (western, central and eastern Mediterranean Sea), with some overlapping data (**Figure 13**); of course these first results do not necessarily imply different subpopulations.

Additional micro-chemical analyses were carried out on $\delta^{13}C$ and $\delta^{18}O$ along the otoliths transect, trying to understand the bluefin tuna movements between the Mediterranean Sea and the western North Atlantic. The preliminary test carried out on 10 fish caught in 2009 in the Bay of Biscay and in 2010 in Spanish traps, showed in some cases promising data, which are potentially able to describe their migration between the two areas in different years.

6.2.2 Genetic analyses

The **genetic analyses** carried out in Phase 4 (also thank to the study carried out under the data mining item, which included historical samples) are clearly showing the genetic characteristics and difference between the specimens from the Western Atlantic and the Eastern Atlantic. After the studies carried out in 2011, the additional results obtained in 2012 and in 2013 and therefore, with the most advanced techniques, in Phase 4 on 165 samples, confirm a clear difference between the western stock and the eastern stock. At the same time, there are minor differences within the eastern stock, with a considerable mixing. The DNA analyses were conducted only on larvae and YOY by RAD sequences and by DAPC (**Figure 14**).

Further genetic analyses were carried out on ancient adult specimens, collected partly under the data mining item and partly thanks to additional very ancient vertebras provided by Spanish colleagues. The results are showing some differences within the Mediterranean Sea (**Figure 15**) under different assumptions of ancestral populations, while a marked difference is evident between the western Atlantic bluefin tuna and the eastern Atlantic and Mediterranean samples (**Figure 16**). These first results should be further investigated, because a mixing within the Mediterranean is also clear and, as a consequence, any possible sub-populations hypothesis in various Mediterranean areas will need a much solid confirmation.

Even if further analyses are necessary for confirming or not any sub-population, it is clear that the availability of information from many different sources (tagging, aerial survey, environmental data, genetics, microchemistry, etc.) possibly contribute all together in increasing our understanding of the results of sophisticated analyses.

6.2.3 Otolith shape analysis

Along this line, the biological studies in Phase 4 were reinforced with a new research item, the otolith shape analyses, quite innovative and which was considered as a further tool for discriminating the various population components. The first trial was carried out on 422 otoliths and preliminary results are showing that at least one of the parameters (the circularity) varies significantly between regions (see the final report of the Consortium on the ICCAT GBYP pages), but the first samples were not including any from northern or western Atlantic or from Atlantic Morocco or Canary Islands and this integration will result very useful in future additional work for a better understanding of the results. Taking into account that this innovative technique used for bluefin tuna

seems promising, the research team is proposing a much higher sampling of both juveniles and spawners in the various areas with the objective to have a broader overview; therefore, it should be very useful to compare the results of the otolith shape analysis with the genetic and the microchemical ones.

6.2.4 Ageing calibration

Following the recommendations of both the SCRS and the GBYP Steering Committee, an ageing calibration exercise was carried out in 2014, incorporating this first trial in the same research contract of the other biological studies. A reference set of images of both sliced otoliths and spines, with confidential references, were prepared and made available to all participants. A Call for cooperation was launched on April 28, 2014 and 16 different institutions (32 scientists from 11 countries) subscribed this first trial, coordinated by Dr. Enrique Rodriguez Marin (IEO). Finally, 13 institutions from 9 countries were able to provide their readings on time for the elaboration and the results are quite promising. The first results showed a good agreement in ageing otoliths from medium fish between expert and non-expert[12] readers, while ageing the juvenile or young adult specimens showed some differences. Differences were more marked in ageing the spines, while discrepancies were noticed depending on the type of light used for age readings (**Figure 17** and **18**). According to this first and important international cooperative experience, it seems very relevant to further developing refinements and apply them in future years. The results were made available to SCRS (SCRS/2014/150).

6.2.5 Other biological studies

The GBYP coordination carried out a comprehensive and critical review of all prediction models (for spawners, juveniles and even larvae) currently available for the bluefin tuna. The result of this study, having no impact on the budget, was presented to the SCRS in 2014 (Di Natale, 2015d).

Another activity, which was not included in the official list of Phase 4 at the beginning, concerns the recovery of many old ICCAT BYP tissue samples, that were finally detected at the University of Girona (SP) and at the National Ocean Service in Charleston (USA). The number of samples is quite important and these might improve all the analyses carried out by GBYP in future years. The idea to move all samples to the same sample bank used for GBYP samples and then made them available to all SCRS scientists was not possible and therefore these old ICCAT BFT samples were now moved to the NOAA SWFC in Panama City, under the condition to make them available for SCRS and GBYP studies. NOAA will develop a simple procedure for using them.

6.2.6 Biological studies in Phase 5

Following the recommendations of the Steering Committee and the SCRS, the GBYP plan for **Phase 5** was set as a continuation of Phase 4, going on with all activities and repeating the ageing calibration. Furthermore, it was planned to have a recompilation of previous analytical data according to well-established areas that shall be constant over the years. The GBYP coordination, working together with the Steering Committee, revisited the list of strata and areas for the sampling, according to the improvements that were not available at the moment of the sampling design. This table now is the reference table for all ICCAT GBYP biological studies, because its details allow for any type of aggregation when elaborating the data. As such, it was made mandatory attaching it to the Call for tenders (no. 02341/2015) that was released on 29 April 2015. Unfortunately, ICCAT the three bids received by ICCAT were not considered adequate. Therefore, and after few modifications of the ToRs, ICCAT released a new Call for tenders (no. 03587/2015) on June 6, 2015. After the selection of the four bids received, two bids were awarded. The first was to a large Consortium headed by AZTI, including 14 entities and 7 subcontractors, belonging to 8 different countries, while the second, limited to sampling in two areas, was awarded to Necton. Unfortunately, it was not possible to contract a new ageing calibration in Phase 5, because the bid was not satisfactory.

Three first reports were provided to GBYP so far, confirming that the activities are going on and showing the results of the sampling carried out so far. **Table 17** shows the last updated results. Due to the late release of the contracts, all the analyses will be carried out in the following months and the results would be available before the end of Phase 5.

[12] Non-expert readers were anyway scientists having a good experience in ageing determinations, but not for bluefin tuna.

7. Modelling approaches

The initial, short-term ICCAT GBYP objective which was approved by the Commission in 2008 was to carry out operating modelling studies from year 4, with a total budget of 600,000 Euros. So far, with only 62.98% of the funds (a total of 377,895 Euros, including the budget amount set for Phase 5, equal to 194,670 Euros), the ICCAT GBYP carried out many modelling activities from Phase 2, following the recommendations of the Steering Committee and the SCRS. It is very clear that the general objectives set for the modelling studies in these first Phases were largely accomplished so far, taking into account the proportion of the available budget. Furthermore, the modelling plan was fully revised and now it has been extended up to 2021, as it was endorsed by the Commission.

In Phase 4, two meetings were held on modeling: a first one in May 2013 in Tenerife (EU-ESP) for preparing a first discussion draft document, which was very useful for the following meeting (see: http://www.iccat.int/GBYP/Documents/MODELLING/PHASE%204/tenerife_Modelling.pdf, and http://www.iccat.int/GBYP/Documents/MODELLING/PHASE%204/Tenerife_gbyp-modelling_draft_proposal.pdf) and a second meeting was held in July in Gloucester (USA), where a detailed planning of bluefin tuna modeling activities have been agreed for the submission to SCRS (http://iccat.int/Documents/Meetings/Docs/2013_BFT_METHODS_REP_ENG.pdf). Therefore, the modelling plan was submitted to SCRS, which endorsed it. Another meeting of the Modelling group was held in Phase 5, during the SCRS bluefin tuna data preparatory meeting in March 2015 (http://iccat.int/Documents/Meetings/Docs/BFT_DATA_PREP_2015_eng.pdf).

A modeling coordinator and a modeling technical assistant were contracted in Phase 4, following two Calls for Tenders, according to the decision taken by the bluefin tuna species group, the ICCAT GBYP Steering Committee and the SCRS. An ICCAT GBYP Modelling Steering Group was also established. The modelling coordinator was replaced in Phase 5, based on a recommendation of the Steering Committee, while the modelling technical assistant got a renewed contract up to the end of Phase 5.

The ICCAT-GBYP Modelling activities in Phase 4 strictly followed those recommended by the GBYP Steering Committee, endorsed by ICCAT SCRS and approved by the ICCAT Commission.

Four contracts were awarded in Phase 4 under the Modelling Programme in support of BFT Stock Assessment: i.e. I) Quantitative Risk Assessment, II) Statistically based stock assessment methods, III) Support to BFT Stock Assessment (Modelling Coordinator) and IV) Support to BFT Stock Assessment (MSE Technical Assistant). No bids were submitted for the Call for tenders concerning the Development of biological hypotheses for the use of MSE (Management Strategy Evaluation). The final reports for each modelling activity is available on http://www.iccat.int/GBYP/en/modelling.htm, while the summary of these activities were included in the ICCAT GBYP report presented to the SCRS and the Commission in 2014 (Di Natale, 2015e).

There were institutional replacements in the membership of the ICCAT GBYP Modelling-MSE Steering Group in Phase 5, taking into account the new GBYP Modelling MSE Coordinator, the new SCRS Chair and the new WBFT rapporteur. The work necessary for developing new modeling approaches will take anyway several years.

The GBYP Modelling MSE Coordinator presented a first report in 2015 and this will be discussed at the SCRS Bluefin tuna Species Group in 2015. The dates for the GBYP Modelling MSE meeting, which is planned for Phase 5, will be decided during the SCRS meeting in 2015.

8. Mid-term review

A full mid-term review of ICCAT-GBYP was carried out in Phase 4, as requested by the Commission and the SCRS, with the following TORs:

- For each of the scientific components, review the progress to date relative to the basic objectives for that component taking into account the available resources.

- For each of the scientific components, review the appropriateness and adequacy of the design, implementation and results to date and suggest possible modifications or additions that would may improve the accuracy, precision, robustness and/or cost-efficiency of the work being conducted taking into account logistical, feasibility and administrative considerations.
- For each of the scientific components and taking into account the results to date, provide guidance on the timeframe and resources required (and the trade-off between these).
- Provide an overview of the interrelationships, priority and reasonable timeframes for the various components in terms of their contribution to the improvement of the stock assessments, the provision of management advice and the general scientific knowledge of bluefin tuna, taking into account the current resources.
- Provide suggestions for improvements in the logistical and administrative arrangements for future activities taking into account constraints under which the program must operate.
- Provide a general review of the current chain of decisions (BFT Species Group, Steering Committee, SCRS and Commission), underlying the objective to provide suggestions for improvements and independence, taking into account the respective roles and components and the institutional prerogatives of the two statutory bodies (SCRS and Commission).

The review, carried out by PhD Alain Fonteneau, PhD Andrew L. Payne and PhD Ziro Suzuki, after the Call for tenders 05/2013 issued on 30 April 2013, was concluded in September 2013 and the full report was distributed to SCRS, the GBYP Steering Committee and the Commission. The reviewers recognized the important improvements in scientific knowledge obtained by GBYP in the first parts of the programme. Specifically, the reviewers recognized that "on the whole, the GBYP did yield an impressive increase in scientific investigations into Atlantic BFT, delivering much of the background scientific evidence crucial to conducting and improving stock assessments and ultimately management advice" and that "the investment in coordination of the programme through ICCAT is another shining example of good practice". The reviewers, in their report, provided also an extensive range of proposals for improving the research in the following years.

Most of the points raised by the reviewers, concerning individual current or future activities of GBYP were answered by the GBYP Steering Committee in its report of September 2013 (http://www.iccat.int/GBYP/en/scommittee.htm).

9. Legal framework

The enforcement of the ICCAT Rec. 11-06, which allows for a "research mortality allowance" of 20 tons for GBYP and for the use of any fishing gear in any month of the year in the ICCAT Convention area for GBYP research purposes, finally helped GBYP in carrying out both tagging and biological sampling activities. As in 2012, the ICCAT Secretariat issued the circular #2279/2013 on 28 May 2013, detailing the procedures and the list of authorized entities for the use of the ICCAT GBYP Research Mortality Allowance.

A total of 172 ICCAT GBYP RMA certificates have been issued from 2012 to 2015, using 10,539.89 kg of bluefin tuna (equal to 1070 fish), while only 5 RMA certificates have been issues so far in 2015, using a total of 219.86 kg corresponding to 33 fish (provisional data), but the sampling activities are still going on. RMA used quantities in previous years (5,039.40 kg in 2012, 4,392.76 kg in 2013 and 887.78 kg in 2014) were officially communicated to ICCAT Statistical Department for the inclusion in the official ICCAT BFT catch table (see Di Natale *et al*., 2015f).

10. Cooperation with the ROP

The GBYP coordination, together with the ICCAT Secretariat, is maintaining and improving the contacts with the ICCAT ROP observers, for strengthening the cooperation and providing opportunities. The ICCAT ROP observers are engaged for directly checking bluefin tuna at the harvesting for improving the tag recovery and reporting and for noticing any natural mark. Special forms were provided to ROP for reporting natural marks. The GBYP Coordinator is regularly participating to the ICCAT ROP observers training courses, specifically training them for the tag recovery and reporting. ICCAT GBYP tag awareness material is regularly provided to ICCAT ROPs.

11. Steering Committee Meetings

The GBYP Steering Committee is currently composed by the Chair of SCRS, Ph.D. David Die (who replaced Ph.D. Josu Santiago from December 2014), the BFT-W Rapporteur, Ph.D. Youkio Takeuchi (who replaced Ph.D. Clay Porch from December 2014), the BFT-E Rapporteur, Ph.D. Sylvain Bonhommeau (who replaced Ph.D. Jean-Marc Fromentin from December 2013), the ICCAT Executive Secretary, Mr. Driss Meski, and the external expert, Ph.D. Tom Polacheck, who was contracted for this duty.

The Steering Committee members have been constantly informed by the GBYP about all the initiatives, even with monthly reports, and consulted by e-mail on many issues.

The activity of the Steering Committee included continuous and constant e-mail contacts with the GBYP coordination, which provided the necessary information. In Phase 4 the Steering Committee held three meetings meetings (September 28-29, 2013, September 22-26, 2014 and February 10-12, 2015), discussing various aspects of the programme, providing guidance and opinions. All finalised reports of the GBYP Steering Committee meetings are available on http://www.iccat.int/GBYP/en/scommittee.htm. The next meeting is planned after the SCRS Bluefin Tuna Species Group (26 September 2015) with the objective, among others, to propose a plan for Phase 6.

12. Funding, donations and agreements.

The Atlantic-wide Research Programme for Bluefin Tuna, according to the Commission decision in 2009, is voluntary funded by several ICCAT CPCs. The annual budgets are on http://www.iccat.int/GBYP/en/Budget.htm

So far, up to the first three Phases, GBYP received and used only 50.73% of the funds originally approved for the same time period.

In Phase 5, the budget is supposed to have the following donors (in order of committed or requested contribution); the amounts received so far are in brackets:

European Union (grant agreement)	Euro	1,700,000.00	(1,190,000.00)
United States of America (donation)	Euro	0	(40,365.00)
Kingdom of Morocco (donation)	Euro	66,268.25	(50,000.00)
Japan (donation)	Euro	59,000.00	(59,000.00)
Tunisia (donation according to quota, 2014)	Euro	55,133.49	(55,163.46)
Libya (donation according to quota)	Euro	51,117.22	-
Turkey (donation according to quota)	Euro	31,244.39	(31,244.39)
Canada (service agreement)*	Euro	21,000.00	(10,389.97)
Norway (donation)	Euro	18,000.00	(18,000.00)
Algeria (donation according to quota)	Euro	11,919.81	(11,919.81)
Chinese Taipei (donation)	Euro	5,000.00	(5,000.00)
Egypt (donation according to quota)	Euro	4,205.80	(622.51)
Korea (donation according to quota)	Euro	4,200.49	-
Popular Republic of China (donation according to quota)	Euro	1,992.01	(767.54)
Albania (donation according to quota)	Euro	1,751.68	-
Syria (donation according to quota)	Euro	1,751.68	-
Iceland (donation according to quota)	Euro	1,615.61	(1,615.65)

*the amount was in Canadian $ (30,000) but the amount in Euro is depending on the date of the bank transfer to ICCAT.

Further amounts were residuals of previous GBYP Phases and they were used for better balancing the EU contribution and for covering costs not covered by the EU funding in Phase 4. Contributions for previous GBYP Phases are still pending for Korea, Libya and Tunisia.

The lack of a stable and reliable multi-year funding system is one of the major problems for GBYP, because this fact prevents a proper planning of all activities and contracts at the beginning of each Phase. The GBYP Steering Committee and the SCRS several times recommended the adoption of a more stable funding system, but all proposals submitted so far by the ICCAT Secretariat or some CPCs to the Commission (i.e.: scientific quota, contribution proportional to quota, etc.) were discussed but never approved so far.

The Atlantic-wide Research Programme for Bluefin Tuna is a very complex programme and its activities concern all stakeholders; when it was approved by the Commission, the reason was that it was necessary to improve the scientific knowledge about this species and this is the difficult work that GBYP is carrying on, following the strategy recommended yearly by the Steering Committee and the SCRS, but also by the Commission. As a consequence, the GBYP needs the cooperation of all stakeholders and all countries to fulfil its duties in the best possible way. This need was perfectly identified by SCRS and the Commission during the preliminary evaluation of the Programme. Therefore, GBYP is managing to work with all stakeholders, making them aware of the programme and its activities and getting them directly involved when necessary.

A formal agreement of collaboration for research activities to be developed under the GBYP and particularly on tagging was established with the WWF Mediterranean Programme (WWF-MedPO) on 28 April 2011. A formal agreement of collaboration for research activities to be developed under the GBYP and particularly on acoustic tagging was established with the Hopkins Marine Station of the Stanford University on 15 May 2013.

GBYP, in these first four phases, continued to work constantly on this diffused network. This activity helped the Programme to get donations and practical supports, which sometimes was destined for a precise activity. Here following is the list, in alphabetic order:

- ✓ Asociación de Pesca, Comercio y Consumo Responsable de Atún Rojo (SP): Euro 6,000.00 (for GBYP in Phase 1).
- ✓ Association Marocaine de Madragues, donation in kinds of a social dinner in Tangier; estimated value not defined (for the Symposium on Trap Fishery).
- ✓ Departement de la Pêche Maritime, DPMA/DPRH, Rabat (MO), essential administrative and logistic support for tagging in Moroccan traps in Phase 2, 3 and 4.
- ✓ Grup Balfegó (SP), donation in kinds of tuna heads prepared for sampling otoliths; estimated value: Euro 300,00 (for the GBYP Operational Meeting on Biological Sampling in Phase 2).
- ✓ Grupo Ricardo Fuentes e Hijos S.A. (SP): Euro 10,000.00 (for the Symposium on Trap Fishery in Phase 2) and the practical support for tagging in Moroccan traps in Phase 2, 3 and 4.
- ✓ Institute National de Recherche Haulieutique, Tangier (MO), donation in kinds of logistic support and staff assistance for tagging in Morocco: estimated value to be defined (for GBYP Tagging in Phase 2, 3 and 2014).
- ✓ Instituto Español de Oceanografia, Fuengirola, donation in kinds of staff assistance for tagging in Morocco: estimated value not defined (for GBYP Tagging in Phase 2).
- ✓ Maromadraba SARL and Es Sahel (Fuentes Group), donation in kind of divers working time, vessels support and sailors, for tagging in Morocco; estimated value: Euro 6,000.00 (for GBYP Tagging in Phase 2, 3 and in 2014).
- ✓ Mielgo Bregazzi Roberto (SP), donation in kinds of many thousands of individual tuna data from auctions, estimated value: 50,000.00 Euros (for GBYP Data Recovery in Phase 2) and 300,000 Euros (for GBYP Data Recovery in Phase 3).
- ✓ National Research Institute for Far Seas Fisheries, Shimizu (JP), donation of many hundreds bluefin tuna samples from the central Atlantic fishery: estimated value not defined (for GBYP biological and genetic analyses in Phase 2, 3, 4 and 5).
- ✓ WWF Mediterranean Programme (WWF MedPO), donation in kinds of 24 miniPATs, analysis and logistics in Morocco; estimated value: Euro 80,400.00 (for GBYP Tagging in Phase 2 and 3).

- ✓ Hopkins Marine Station of the Stanford University, donation in kind of 7 acoustic tags and 8 miniPATs analysis and logistics in Morocco; estimated value not defined (Phase 4, 2013 and 2014).
- ✓ Jean-Marc Fromentin, Ph.D., IFREMER: a collection of tuna trap data from 1525 to 2000, estimated value not defined (for Data Recovery and Data Mining, Phase 4).
- ✓ Aquastudio Research Institute, donation in kind of 1 miniPAT, estimated value 3,000 euro (2014).
- ✓ Federcoopesca, Roma, donation in kind, providing 5 extra days of a purse-seiner time for tagging; estimated value not defined (Phase 4, 2013) and donation in kind of the electronic and conventional tagging activity in Phase 5.
- ✓ Carloforte Tonnare PIAMM, donation in kind of several tunas for biological sampling and tagging; estimated value not defined (Phase 4).
- ✓ COMBIOMA, University of Cagliari, donation in kind for tagging underwater and logistics in Sardinian traps; estimated value not defined (Phase 4).
- ✓ Oceanis srl, donation in kind for tagging underwater and logistics in Maltese cages and Sardinian traps; estimated value not defined (Phase 4).
- ✓ GBYP Coordinator, donation of many thousands of old catch data; estimated value not defined (Phases 3 and 4).

13. GBYP web page

The ICCAT-GBYP web page, which was created in the last part of Phase 1, is usually regularly updated with all documents produced by GBYP; in some cases, due to the huge workload, some set of documents are posted all together. Documents are posted only after their revision and final approval. The texts were revised, improved and updated on August 2013. Documents are regularly updated.

14. Recommendations

The GBYP Steering Committee and the various GBYP meetings provided a list of recommendations on various issues; several of them are essential for fulfilling the duties. The SCRS in 2014 will provide the updated recommendations for Phase 5, to be discussed at the Commission meeting.

In addition, based on the outcomes of the first part of Phase 5, GBYP considers essential better defining the following points:

a) Evolution of the Atlantic-Wide Research Programme for Bluefin Tuna: according to the current situation, which demonstrated the impossibility to reach the funding level approved by the ICCAT Commission for the various years of the GBYP and, as a consequence, the impossibility to carry out the various activities as originally planned, considering the need of having a sufficient number of years for obtaining the necessary results, a programme revision is now necessary, finding the right balance among funding possibilities, research needs and duration. The GBYP funding system shall be better defined, stabilised and improved, in order to ensure the regular development of the activities.

b) Data bases: after a meeting with the ICCAT Statistical Department, following the discussions at the SCRS Bluefin tuna Species Group, several new specific data bases must be set-up. After completing the work for the ancient traps data sets, which is necessary before the next data preparatory meeting in 2016, it will be necessary to define the structure and the formats of various new data bases, currently not existing in ICCAT: data base for market, auction and commercial data, data base for RMA data, data base for electronic tagging data; data base for biological data and studies (ageing, genetics, micro-chemistry, otoliths shape analysis), data base for aerial survey. All these data bases should take into account all different original file types, finding the way for making these data usable for the SCRS. For this reason, a considerable amount of work should be allocated to this basic task.

c) Data recovery and data mining: Task II data will be finally included in the ICCAT BFT data base; several data conflicts were resolved, but some others must be revised as soon as possible by the concerned CPCs and national scientists. Market and auction data, after the implicit validation of the two first data set by the SCRS and made available to scientists as soon as possible. If reliable additional data about LL BFT fisheries in the

Mediterranean in the last decade, not already included in official task 2 data, will be detected, then these data should be recovered and used for improving our understanding of these fisheries, which are poorly documented.

d) Aerial survey: GBYP considers essential continuing the survey on spawning aggregations in selected areas, for providing a trend to be used in advanced models; a minimum of 6/7 years of survey is needed, but after the experience in 2015 abnormal years in terms of detecting possibilities should be useful for the general knowledge but possibly excluded from the years necessary for assessing the trend; data should be tested for standardisation; the prediction model using the SST data should be further developed and improved. If any calibration requested by the Steering Committee will become feasible, this exercise should be done.

e) Tagging: electronic tagging should be strongly improved, while conventional tagging should be evaluated again by the Steering Committee, taking advantage of the awareness activities carried out so far that are slowly working. The awareness activity shall be firmly continued, improving the media communication.

f) Biological and genetic sampling and analyses: sampling should be continued, covering the less sampled areas; the analyses of the available samples should be improved; age analyses should be cross checked for validation and further calibrated. The recovery of old ICCAT BYP samples should be defined.

g) Modelling: new additional efforts should be devoted for finding the best approaches for using fishery independent data and innovative approaches for better quantify uncertainties. The proposed plan should be adopted and enforced as soon as possible.

h) Other fishery independent data: Searching for any additional method for obtaining fishery independent data should continue, always balancing realist possibilities, budget availability and without affecting other current activities.

Additional recommendations will be provided by the GBYP Steering Committee and the SCRS in 2015.

Table 1. Total data recovered by GBYP in Phase 1, Phase 2, Phase 3 and the first part of Phase 4. The additional trap data provided in Phase 4 are still to be checked and were not included.

TOTAL PHASES 1 to 4	origin	1st Total	Total data
# Records	OG	87,761	509,620
	TP	30,923	
	TAMD	311,415	
	FARM	49,354	
	GEN	172	
	DTBV	29,995	
BFT (no.)	OG	34,753	26,377,340
	TP	23,247,666	
	TAMD	825,485	
	FARM	49,354	
	GEN	172	
	DTBV	2,219,910	
BFT (t)	OG	114,596	1,191,312
	TP	744,227	
	TAMD	80,408	
	FARM	474	
	DTBV	251,607	
#Fish sampled	OG	94,932	3,197,443
	TP	7,610	
	TAMD	825,485	
	FARM	49,354	
	GEN	152	
	DTBV	2,219,910	
Legenda: OG = Other Gears; TP = Trap; TAMD = Trade, Auction nd Market Data; FARM = Farmed tunas; GEN= Genetic; DTBV = Data To Be Validated			
Note: TAMD data include 29,995 records, 2,219,910 bft (no.) and 251,607 t to be further checked and validated.			

Table 2. Total data recovered by GBYP in Phase 1, Phase 2, Phase 3 and the first part of Phase 4 by century (<1500-1900) and by decade (1900 onwards) (TP = Traps; OG = Other gears; TAMD* = Trade, Auction and Market data, provisional; FARM = data provided by farms; GEN = Historical genetic samples; DTBV = trade, auction and marked data to be further validated).

	year	<1500	1500	1600	1700	1800	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	TBA	DTBV
# Records	OG						9	10	87	11.509	15.616	29.992	17.946	6.201	1.781	1.174	3.210	236		
	TP		252	171	211	6.100	3.005	4.353	6.705	2.301	1.021	1.040	2.032	184	777	1.221	1.548		3	3
	TAMD*																		311.415	
	FARM															851	18.492	30.021		
	HGEN	20						60	60		2				30					
	DTBV																			28.170
BFT (no.)	OG													107	70	9.937	21.559	3.080		
	TP		3.978.087	1.292.782	425.335	4.472.749	1.613.889	1.883.967	2.971.129	2.013.583	1.787.209	1.566.956	614.611	51.510	178.743	204.806	186.199		6.111	6.111
	TAMD*																		825.485	
	FARM															851	18.492	30.021		
	HGEN	20						60	60		2				30					
	DTBV																			2.219.910
BFT (t)	OG						44	163	601	2.497	6.057	29.059	14.842	24.461	17.880	17.086	1.704	203		
	TP					141.907	40.327	70.723	75.579	83.592	86.204	111.417	71.842	11.981	8.755	19.568	15.306	711		
	TAMD*																		80.408	
	FARM															207	268			
	DTBV																			251.607
#Fish sampled	OG											18.614	18.548	9.053	804	18.569	28.000	1.344		
	TP							153	170							2.225	5.062			
	TAMD*																		825.485	
	FARM															851	18.492	30.021		
	HGEN	20						60	60		2				10					
	DTBV																			2.219.910

Table 3. Additional data recovered in the last part of Phase 4, which are still under check. The table on the left shows the years covered by the data for each country.

Records	6.384
BFT (n)	17.441.811
BFT (t)	2.791.528

Table 4. Range of years covered by the trap data recovered in the last part of Phase 4 for each country.

Country	1st year	Last year
Italy	1595	1997
Morocco	1916	1973
Portugal	1797	1933
Spain	1525	1980
Tunisia	1863	1997

Table 5. Data recovery activities. Samples to be genotyped using a high performance 96 SNP panel containing loci associated with population structuring and selective traits (from UNIBO Preliminary Report, August 2015).

Geographic region	Modern samples	1911-1926 (Massimo Sella Archive)	1755 (Cadiz, Spain)	4th-15th century AD (Istanbul, Turkey)	1st century AD (Cadiz, Spain)	2nd century BC (Tavira, Portugal)	4th-2nd century BC (Portugal + Spain)	**TOTAL**
Adriatic Sea	**40** (2011)	**50** (Istrian traps)						**90**
Tyrrhenian Sea	**40** (2011)	**50** (Traps of Pizzo and Messina-Cialona)						**90**
NW Ionian Sea	**40** (2011)	**50** (Trap of Sliten)						**90**
Gibraltar + Portugal	**26** (2011) + **40** (2011)		**2**		**10**	**10**	**35**	**123**
Levantine Sea	**40** (2007 + 2011)	**2** (Istanbul)		**50**				**92**
Bay of Biscay	**40** (2011)							**40**
Total	**266**	**152**	**2**	**50**	**10**	**10**	**35**	**525**

Table 6. Provisional 2015 survey data for mean school size, density and total weight and abundance of bluefin tuna for each "inside" area (without taking into account the areas that became not available during the survey).

		Areas				
		A	**C**	**E**	**G**	**TOTAL**
Survey area (km^2)		62,150	64,610	117,718	68,013	**312,491**
Number of transects		15	7	12	10	**44**
Transect length (km) (L)		4,143	3,237	3,620	1,291	**12,291**
Effective strip width x2 (km)		3.2	3.2	3.2	3.2	**3.2**
Area searched (km^2)		13,435	10,496	11,739	4,187	39,857
% coverage		21.6	16.2	10.0	6.2	12.8
Number of sightings (n)		7	3	4	2	**16**
Encounter rate of schools	**n/L**	0.0017	0.0009	0.0011	0.0015	0.0013
	CV (%)	37.9	60.5	48.3	69.5	30.5
Density of schools (km^2)	**Density of schools**	0.521	0.286	0.341	0.478	0.395
	CV (%)	40.2	61.9	50.1	70.8	30.0
Weight (tonnes)	**Mean weight**	160.7	190.0	200.0	9.0	106.0
	CV (%)	11.7	19.9	77.1	66.7	22.5
School size (animals)	**Mean school size**	708	1,533	1,005	600	**818**
	CV (%)	19.8	19.0	60.6	66.7	19.1
Density of animals (per km^2)	**Density of animals**	0.369	0.438	0.343	0.287	**0.355**
	CV (%)	44.8	64.8	78.7	97.2	40.9
Total weight (tonnes)	**Total weight**	**5,419**	**3,654**	**8,354**	**304**	**17,731**
	CV (%)	40.4	65.2	92.0	97.3	
	Lower 95% CL	2,449	1,099	1,235	34	
	Upper 95% CL	11,991	12,150	56,520	2,718	
Total abundance (animals)	**Total abundance**	**22,912**	**28,317**	**40,324**	**19,491**	**111,044**
	CV (%)	44.8	64.8	78.7	97.2	40.9
	Lower 95% CL	9,814	8,569	8,231	2,181	
	Upper 95% CL	53,491	93,569	197,530	174,170	

Table 7. Provisional 2015 survey data for mean school size, density and total weight and abundance of bluefin tuna for each "outside" area (without taking into account the areas that became not available during the survey).

		Areas							
		A	**B**	**C**	**D**	**E**	**F**	**G**	**TOTAL**
Survey area		123,351	87,334	149,607	147,666	92,378	130,585	241,447	**972,368**
Number of transects		8	6	6	6	2	11	8	**47**
Transect length (km) (L)		1,508	888	1,866	2,122	213	1,171	2,068	**9,835**
Effective strip width x2 (km)		3.2	3.2	3.2	3.2	3.2	3.2	3.2	**3.2**
Area searched (km2)		4,889	2,880	6,051	6,881	690	3,797	6,705	31,892
% coverage		4.0	3.3	4.0	4.7	0.7	2.9	2.8	3.3
Number of sightings (n)		3	3	1	0	0	1	1	9
Encounter rate of schools	**n/L**	0.0020	0.0034	0.0005			0.0009	0.0005	0.0009
	CV (%)	59.4	62.7	105.2			105.0	104.0	44.8
Density of schools (per sq km)	**Density of schools**	0.614	1.042	0.165			0.263	0.149	0.269
	CV (%)	60.9	64.1	106.0			105.9	104.9	39.0
Weight (tonnes)	**Mean weight**	213.3	1250.0	300.0			2.0	20.0	130.0
	CV (%)	34.8	70.8						49.3
School size (animals)	**Mean school size**	1,200	1,700	2,500				1,333	**1,154**
	CV (%)	33.3	41.2						23.3
Density of animals (per sq km)	**Density of animals**	0.736	1.771	0.413			0.053	0.199	**0.372**
	CV (%)	69.4	76.2	106.0			105.9	104.9	51.9
Total weight (tonnes)	**Total weight**	**16,813**	**118,410**	**7,723**			**72**	**750**	**143,768**
	CV (%)	70.3	95.6	106.1			105.9	105.0	
	Lower 95% CL	4,571	16,019	1,296			12	130	
	Upper 95% CL	61,849	875,320	46,032			431	4,320	
Total abundance (animals)	**Total abundance**	**90,827**	**154,660**	**61,811**			**6,876**	**48,002**	**362,176**
	CV (%)	69.4	76.2	106.0			105.9	104.9	51.9
	Lower 95% CL	25,126	33,690	10,376			1,142	8,337	
	Upper 95% CL	328,330	710,040	368,210			41,379	276,370	

Table 8. Provisional data about mean school size, density and total weight and abundance of bluefin tuna for the total "inside" and "outside" areas in 2015, showing a comparison of both effort and sightings.

Total areas	2015 'inside'	2015 'outside'	TOTAL
Survey area (km^2)	312,491	972,368	**1,284,859**
Number of transects	44	47	**91**
Transect length (km)	12,291	9,835	**22,126**
Effective strip width x2 (km)	3.2	3.2	**3.2**
Area searched (km2)	39,857	31,892	**71,749**
% Coverage	12.8	3.3	**5.6**
Number of schools	16	9	**25**
Encounter rate of schools	0.0013	0.0009	0.0011
%CV encounter rate	30.5	44.8	25,2
Density of schools (1000 km^{-2})	0.395	0.269	0.265
%CV density of schools	30.0	39.0	30.3
Mean weight (t)	106.0	130.0	107.5
%CV mean weight	22.5	49.3	12.8
Mean cluster size (animals)	**818**	**1,154**	**807**
%CV mean cluster size	19.1	23.3	16.9
Density of animals	**0.355**	**0.372**	**0.368**
%CV density of animals	40.9	51.9	38.2
Total weight (t)	**17,731**	**143,768**	**161,499**
%CV total weight			71.4
Total abundance (animals)	**111,044**	**362,176**	**473,220**
%CV total abundance	40.9	51.9	38.2

Table 9. Results for the re-analysis of the data for all overlapping areas (A+C+E+G) for the various years. Area G was not surveyed in 2011.

All sub-areas				
Year	**2010**	**2011**	**2013**	**2015**
Survey area (km^2)	265,627	209,416	265,627	265,627
Transect length (km)	29,967	26,247	14,862	10,032
Effective strip width x2 (km)	2.96	1.36	3.00	3.03
Area searched (km^2)	88,803	35,697	44,539	30,443
% coverage	33.4	17.0	16.8	11.5
Number of schools ON effort	76	65	52	15
Abundance of schools	328	420	397	147
%CV abundance of schools	23.3	20.6	22.0	33.0
Encounter rate of schools	0.0025	0.0025	0.0035	0.0015
%CV encounter rate				
Density of schools (1000 km^{-2})	1.236	2.004	1.494	0.553
%CV density of schools	23.3	20.6	22.0	33.0
Mean weight (t)	87.9	101.1	52.5	136.2
%CV weight	1.7	2.8	1.8	5.9
Mean cluster size (fish)		1,275	582	888
%CV abundance		37.3	18.5	40.8
Density of animals (km^{-2})		**2.8363**	**0.789**	**0.504**
%CV density of animals		30.0	30.4	41.7
Total weight (t)	**26,882**	**45,639**	**17,818**	**19,298**
%CV total weight	25.6	28.7	30.1	50.9
L 95% CI total weight	14,243	26,133	9,902	6,484
U 95% CI total weight	38,347	79,703	32,061	57,435
Total abundance (no. fish)		**593,968**	**209,486**	**133,788**
%CV total abundance		30.0	30.4	41.7
L 95% CI total abundance		332,640	116,000	5,886
U 95% CI total abundance		1,060,600	378,330	306,570

Table 10. Details of tags implanted by ICCAT GBYP in Phase 4.

Phase 4

	ALL FISH TAGGED	FISH SINGLE TAGGED					FISH DOUBLE TAGGED						
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic	Double Tags - Conventional	Mini-PATS + Conv.	Mini-PATS + 2Conv.	MiniPAT+ Acoustic+ Conv.	Archivals + Conv.	Archivals + 2Conv.	Acoustic + Conv.
Canada	6	0	1	0	0	0	0	5	0	0	0	0	0
Bay of Biscay	3009	1403	0	0	0	0	1599	7	0	0	0	0	0
Morocco*	273	129	0	7	0	0	121	8	0	7	0	0	1
Portugal	116	17	11	0	0	0	88	0	0	0	0	0	0
Strait of Gibraltar***	2681	1251	6	0	0	0	1418	6	0	0	0	0	0
West Med. **	420	70	343	0	0	0	7	0	0	0	0	0	0
Central Med. ****	1308	675	135	0	0	0	479	7	0	0	12	0	0
		3545	**496**	**7**	**0**	**0**	**3712**	**33**	**0**	**7**	**12**	**0**	**1**
GRAND TOTAL	**7813**	**SUBTOTAL = 4048**					**SUBTOTAL = 3765**						

	TOTAL NUMBER OF TAGS	TAGS IMPLANTED				
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic
Canada	11	0	6	5	0	0
Bay of Biscay	4615	3009	1599	7	0	0
Morocco*	417	258	129	22	0	8
Portugal	204	139	65	0	0	0
Strait of Gibraltar	4105	2669	1430	6	0	0
West Med. **	427	77	350	0	0	0
Central Med.	1806	1154	633	7	12	0
	11585	**7306**	**4212**	**47**	**12**	**8**

Table 11. Details of tags implanted by ICCAT GBYP in Phase 5, up to September 1, 2015.

Phase 5 (up to 1 September 2015)

	ALL FISH TAGGED	FISH SINGLE TAGGED					FISH DOUBLE TAGGED						
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic	Double Tags - Conventional	Mini-PATS + Conv.	Mini-PATS + 2Conv.	MiniPAT+ Acoustic+ Conv.	Archivals + Conv.	Archivals + 2Conv.	Acoustic + Conv.
Canada	0												
Bay of Biscay	0												
Morocco*	44		24	20									
Portugal	0												
Strait of Gibraltar***	0												
West Med. **	29	1		28									
Central Med. ****	62	1	56	5									
East Med.	30			30									
		2	**80**	**83**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
GRAND TOTAL	**165**	**SUBTOTAL = 165**					**SUBTOTAL = 0**						

	TOTAL NUMBER OF TAGS	TAGS IMPLANTED				
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic
Canada	0					
Bay of Biscay	0					
Morocco*	44		24	20		
Portugal	0					
Strait of Gibraltar	0					
West Med. **	29	1		28		
Central Med.	62	1	56	5		
East Med.	30			30		
	165	**2**	**80**	**83**	**0**	**0**

Table 12. Details of all tags implanted so far by ICCAT GBYP from Phase 2 to Phase 5 (up to September 1, 2015).

All GBYP Phases (2, 3, 4 & 5) (up to 1 September 2015)

	ALL FISH TAGGED	FISH SINGLE TAGGED					FISH DOUBLE TAGGED							
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic	Double Tags - Conventional	Mini-PATS + Conv.	Mini-PATS + 2Conv.	MiniPAT+ Acoustic+ Conv.	Archivals + Conv.	Archivals + 2Conv.	Acoustic + Conv.	% by area
Canada	6	0	1	0	0	0	0	5	0	0	0	0	0	**0,0%**
Bay of Biscay	7701	4173	1	3	0	0	3493	18	0	0	13	0	0	**45,6%**
Morocco*	327	129	24	32	0	0	121	13	0	7	0	0	1	**1,9%**
Portugal	116	17	11	0	0	0	88	0	0	0	0	0	0	**0,7%**
Strait of Gibraltar***	5561	2254	43	0	0	0	3212	22	5	0	23	2	0	**32,9%**
West Med. **	1675	932	358	28	0	0	352	5	0	0	0	0	0	**9,9%**
Central Med.	1467	773	191	5	0	0	479	7	0	0	12	0	0	**8,7%**
East Med.	30	0	0	30	0	0	0	0	0	0	0	0	0	**0,2%**
		8278	**629**	**98**	**0**	**0**	**7745**	**70**	**5**	**7**	**48**	**2**	**1**	
GRAND TOTAL	**16883**	**SUBTOTAL = 9005**					**SUBTOTAL = 7878**							**100,0%**

	TOTAL NUMBER OF TAGS	TAGS IMPLANTED					
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Archivals	Acoustic	% by area
Canada	11	0	6	5	0	0	**0,0%**
Bay of Biscay	11225	7697	3494	21	13	0	**45,7%**
Morocco*	476	258	158	52	0	8	**1,9%**
Portugal	204	139	65	0	0	0	**0,8%**
Strait of Gibraltar***	8618	5491	3075	27	25	0	**35,1%**
West Med. **	2031	1285	713	33	0	0	**8,3%**
Central Med.	1965	1252	689	12	12	0	**8,0%**
East Med.	30	0	0	30	0	0	**0,1%**
TOTAL	**24560**	**16122**	**8200**	**180**	**50**	**8**	**100,0%**
%	**100%**	**65,6%**	**33,4%**	**0,7%**	**0,2%**	**0,0%**	

(*)7 miniPATs (GBYP) + 7 miniPATs (WWF) + 8 Acoustic (SU)
(**) 11 fish were tagged in the Balearic Sea; all tags were single barb (FT-1-94)
(***) 10 fish had a second tagging and release, 1 with double tagging - not included in the table
West Med = Gulf of Lions, Balearic Sea, Ligurian Sea and Sardinia.
Central Med = Tyrrhenian Sea, Adriatic Sea, Malta.

Table 13. Details of tag recovery by area (first table), fishery, in numbers and percent (updated on 4 September 2015).

Fishing Area / Tags	Spaghetti Tags	Double BarbTags	External Elec. Tags	Internal Elec. Tags	Commercial Tags	Grand Total	%
East Atl	53	27	9	1	1	91	26,69
Med	159	65	6	5		235	68,91
North Atl	3	1			2	6	1,76
West Atl	2	1		1	1	5	1,47
Unknown			4			4	1,17
Grand Total	217	94	19	7	4	341	100
%ge	63,6%	27,6%	5,6%	2,1%	1,2%	100,0%	

Table 14. Details of tag recovery by fishery, in numbers and percent.

Fishery -Gear / Tags	Spaghetti Tags	Double BarbTags	External Elec. Tags	Internal Elec. Tags	Commercial Tags	Grand Total	%
BB	112	58				170	49,85
FARM	28	6		2		36	10,56
HAND	7	7	1			15	4,40
LL	17	9		2		28	8,21
LLHB	2	2				4	1,17
NF			13		4	17	4,99
PS	13	5	1	1		20	5,87
RR	3	2				5	1,47
SPOR	11	1				12	3,52
TN	1	1				2	0,59
TRAP	3	1		2		6	1,76
TROL	7	2				9	2,64
UNCL	13		4			17	4,99
Grand Total	217	94	19	7	4	341	100

Table 15. Detail of the recoveries from double tagged bluefin tunas (GBYP only) (updated on 4 September 2015).

Release	Spaghetti tag only	Double Barb Tag only	Both	TOTAL FISH	TOTAL TAGS
2011	0	2	5	7	12
2012	3	4	34	41	75
2013	4	3	35	42	77
Total	7	9	74	90	**173**
%	7,78	10,00	82,22	100	

RcCode: 2conv	both recovered				
	Year of Recovery				
Year of Release	**2012**	**2013**	**2014**	**2015**	**TOTAL FISH D/T**
2011	1	3	2	0	6
2012	5	15	10	3	33
2013		6	15	14	35
TOTAL	6	24	27	17	74
%	8,11	32,43	36,49	22,97	100

Table 16. Samples collected and analyses carried out by the Consortium headed by AZTI in GBYP Phase 4, with the target and percentage of achievement. The last column shows the number of samples in the tissue bank from all ICCAT GBYP Phases, including the YOY collected in the last part of Phase 4 even by other contractors (updated on 13 March 2015).

item	***Target no.***	***Achievement no.***	***% of achievement***	***samples in the tissue bank***
Bluefin tuna individuals sampled (1)	1210	1733	143.22	7256
Biological & Genetic Sampling (2):				
Genetic samples (muscle/fin)	1110	1712	154.23	6990
Otoliths	910	1052	115.60	4558
Spines	1160	959	82.67	3611
Total biological and genetic samples	*3180*	*3723*	*117.08*	*15159*
Biological & Genetic Analyses (3):				
Genetic analyses (SNP validation)	192	188	97.92	
Genetic analyses (new genotypes)	576	165	28.65	
Genetic analyses (RAD-seq)	60	165	275	
Microchemical analyses (stable hisotopes)	190	324	170.5	
Microchemical analyses (trace elements)	210	154	73.33	
Microchemical analyses (YOY addit. sets)	100	60	60	
Otolith shape	300	422	140.67	
Age readings (intercalibration)(3 x each)	100	100	100	
Total biological and genetic analyses	*1728*	*1578*	*91.32*	

Table 17. List of planned sampling and analyses for ICCAT GBYP Phase 5, for the two contractors. The table shows the number of samples collected up to 16 September 2015.

GBYP PHASE 5: CONSORTIUM HEADED BY AZTI + NECTON				
item	**PLANNED**		**TOTAL**	**ACHIEVED**
Sampling	**CONS.AZTI**	**NECTON**		
BFT individuals sampled	665	300	965	834
Genetic samples (muscle/fin)	665	300	965	
Otoliths	665	300	965	
Spines	565	300	865	
Biological & Genetic Analyses				
Task 1 - Otolith microchemistry - stable isotope analyses - determining nursery areas	200		200	
Task 2 - Otolith microchemistry - individual assignments on available stable isotope data - individual origin assignment	1000		1000	
Task 3 - Otolith microchemistry - trace element analyses - tracking habitat usage trough different life stages	120		120	
Task 4 - Otolith microchemistry - stable isotope and trace element analyses - discrimination of nursery areas within Med	160+100		260	
Genetics - Task 1 - Population structure - SNPs derived from RAD-seq	(160+)75		235	
Genetics - Task 2 - Restricted market panel for individual assignment, SPN from RAD-seq	192		192	
Genetics - Task 3 - Genotyping new reference samples with validated markers, final SNP panel	192		192	
Otolith shape - Stock discrimination	100		100	
Ageing	300		300	
Ageing calibration	cancelled			

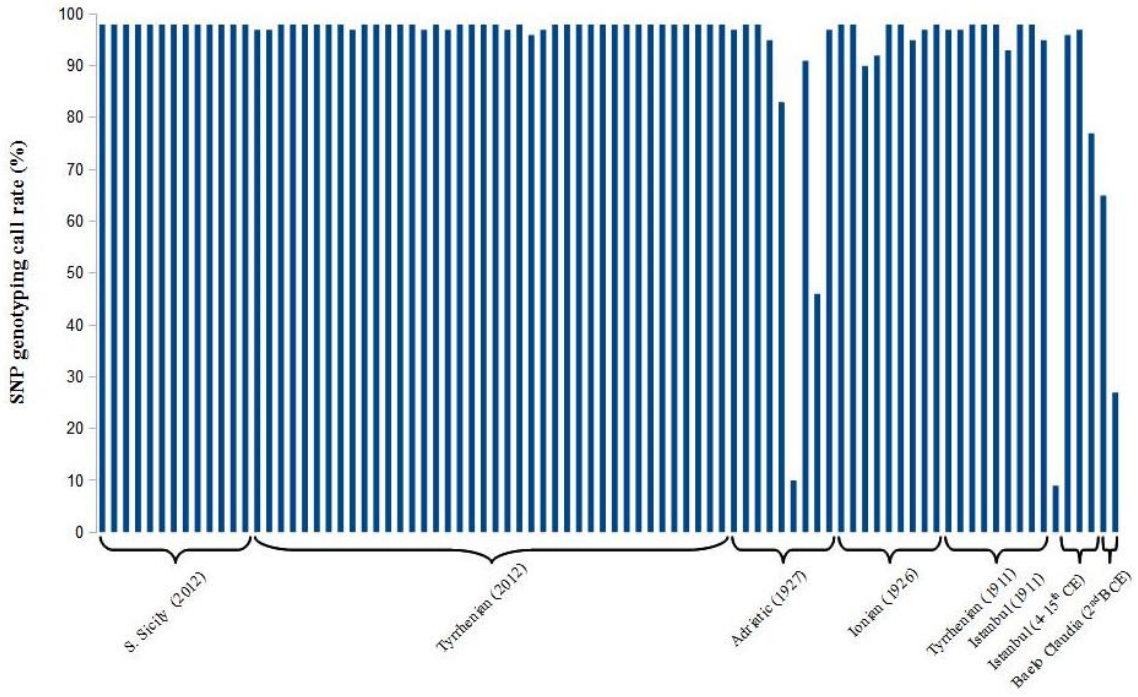

Figure 1. Data recovery. SNP genotyping call rate for all 86 samples analyzed to date (from UNIBO Report).

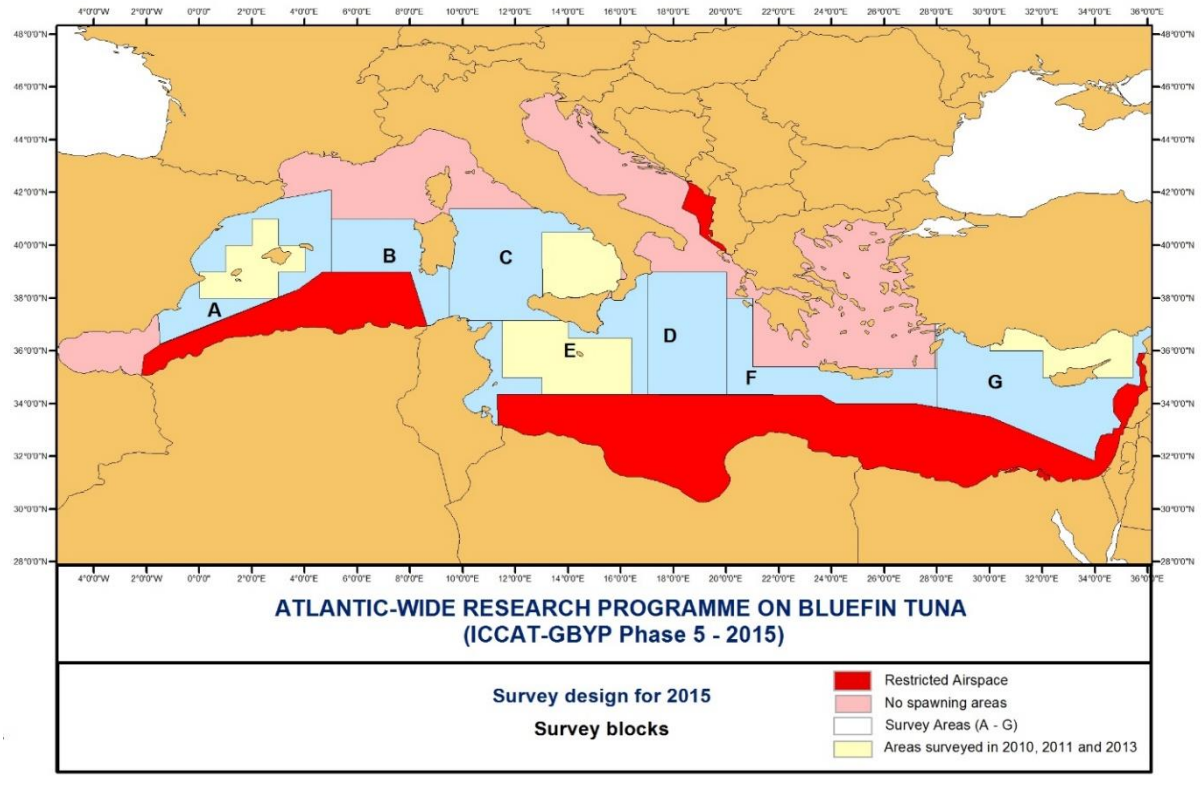

Figure 2. Map used for elaborating the aerial survey design in 2015, as agreed by the GBYP Steering Committee. The letters in bold identify the various areas used by GBYP.

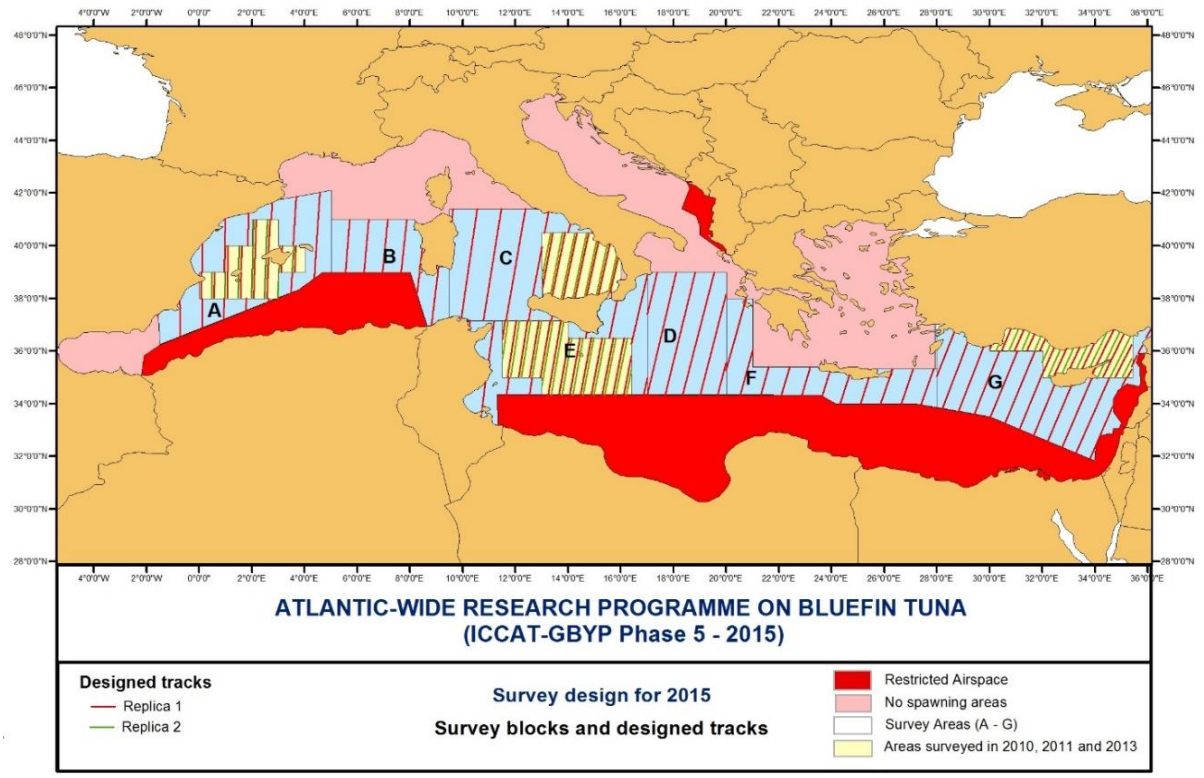

Figure 3. ICCAT GBYP aerial survey design in 2015. Additional tracks are not included.

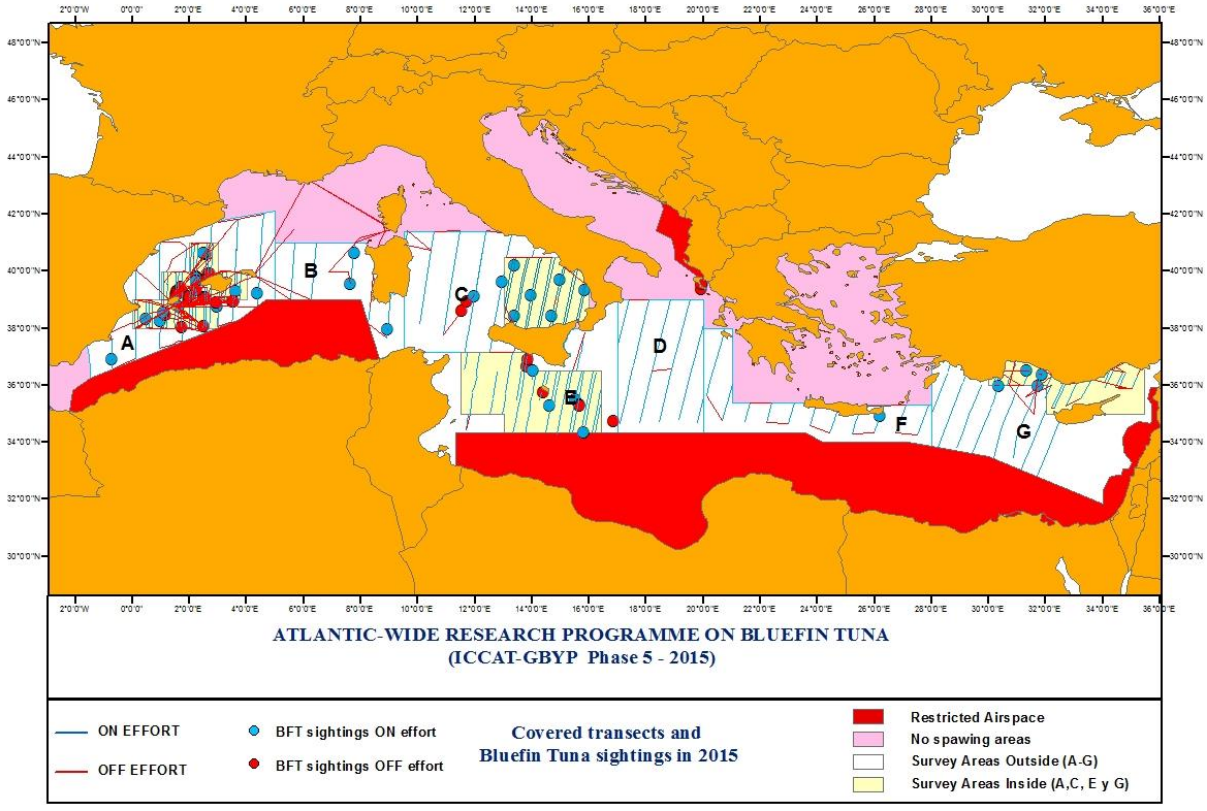

Figure 4. Provisional overview of transects and sightings of bluefin tuna (on and off effort) during the 2015 GBYP aerial survey on spawning aggregations.

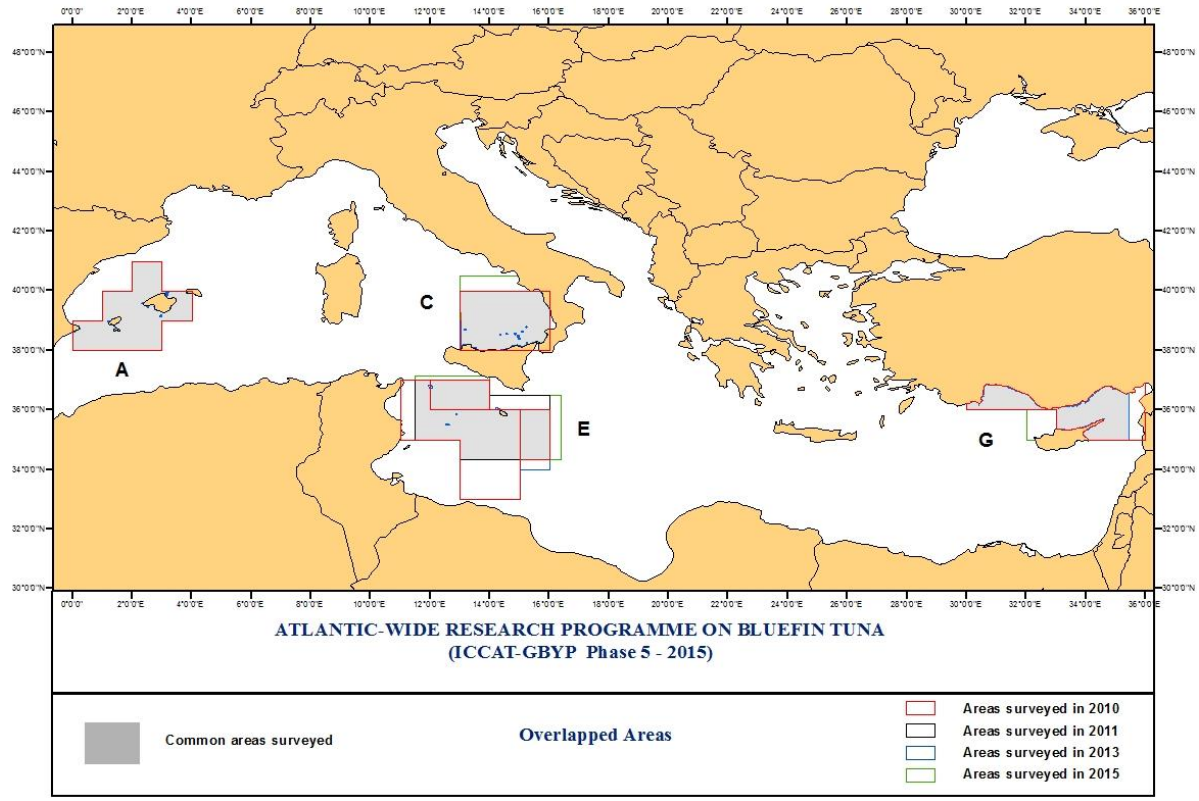

Figure 5. Overlapping survey blocks used for the tentative analyses of multi-year GBYP survey data.

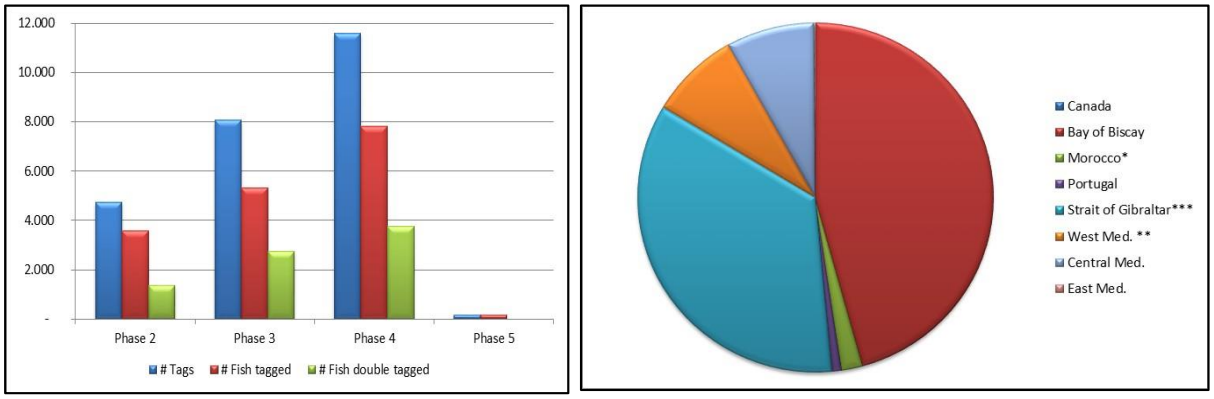

Figure 6a (left). Progression of the ICCAT GBYP tagging activities in the various Phases. **Figure 6b (right)**. Percentage distribution of tags implanted in the various geographical areas by GBYP, up to September 1, 2015.

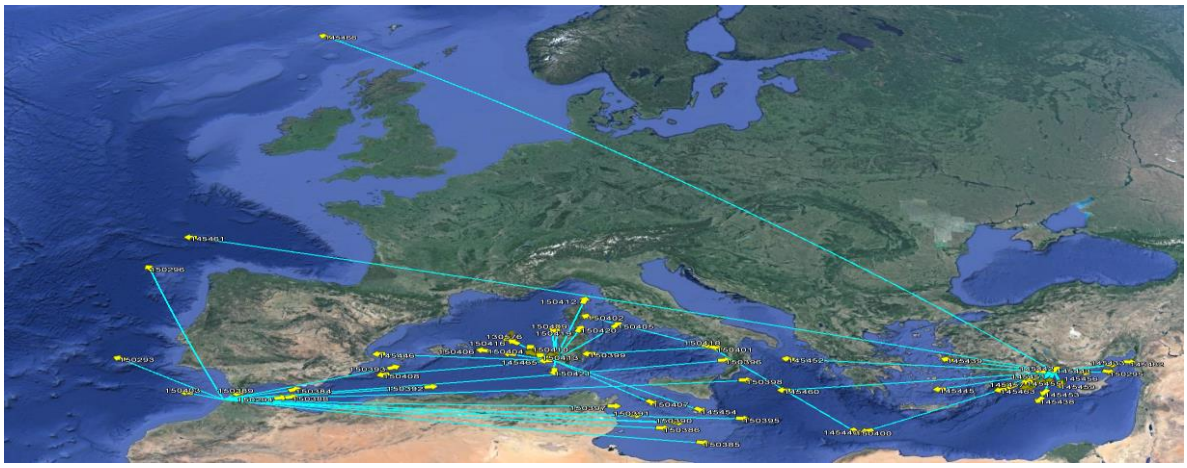

Figure 7. Tag release-tag pop-up vectors of adult bluefin tunas tagged with miniPATs in the Moroccan and Sardinian traps, in Turkish purse-seine and in an Italian cage in GBYP Phase 5 (2015) (up to September 7, 2015).

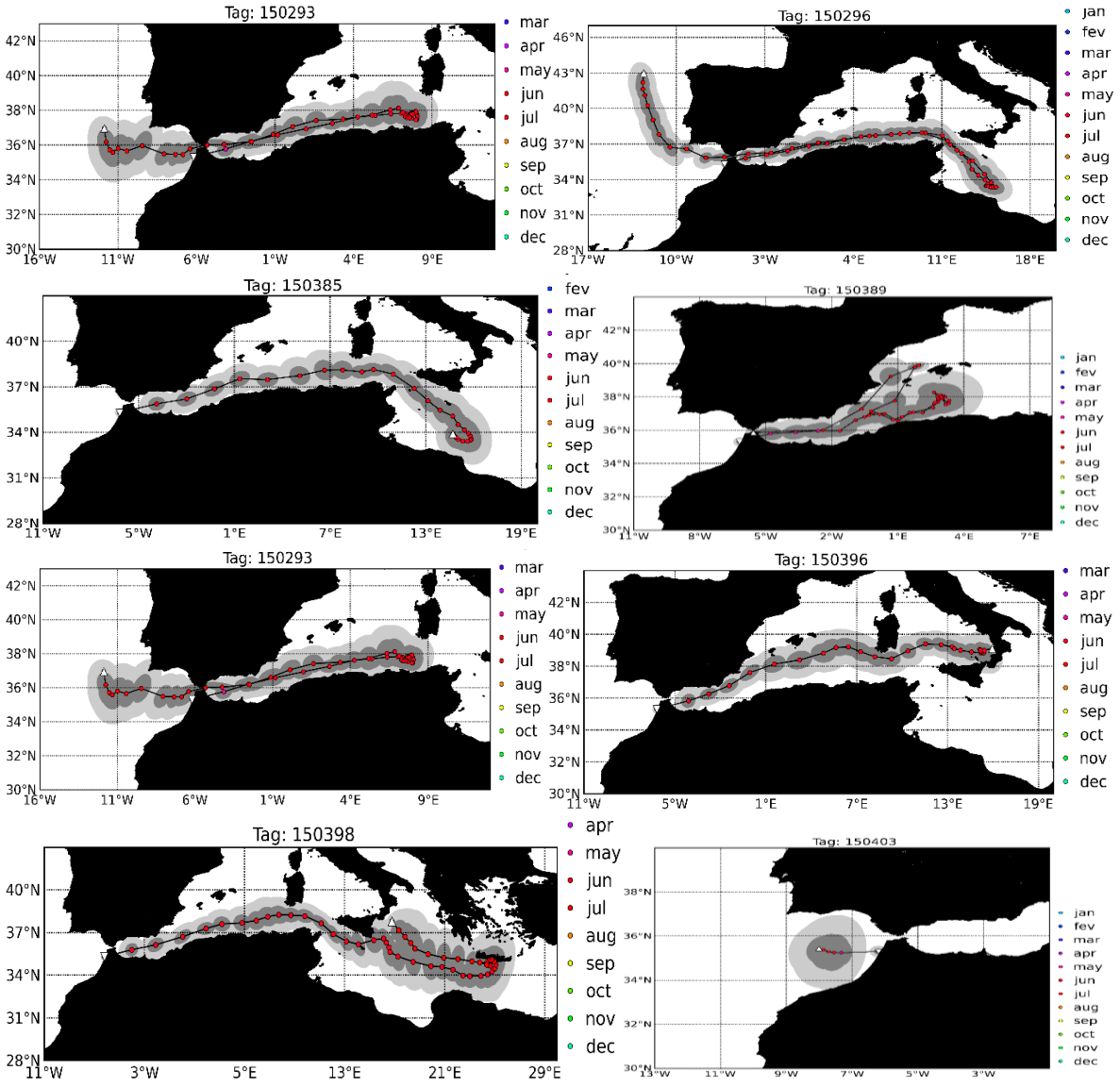

Figure 8. Selected tracks of 8 miniPATs deployed in Morocco in 2015, showing very different behaviours.

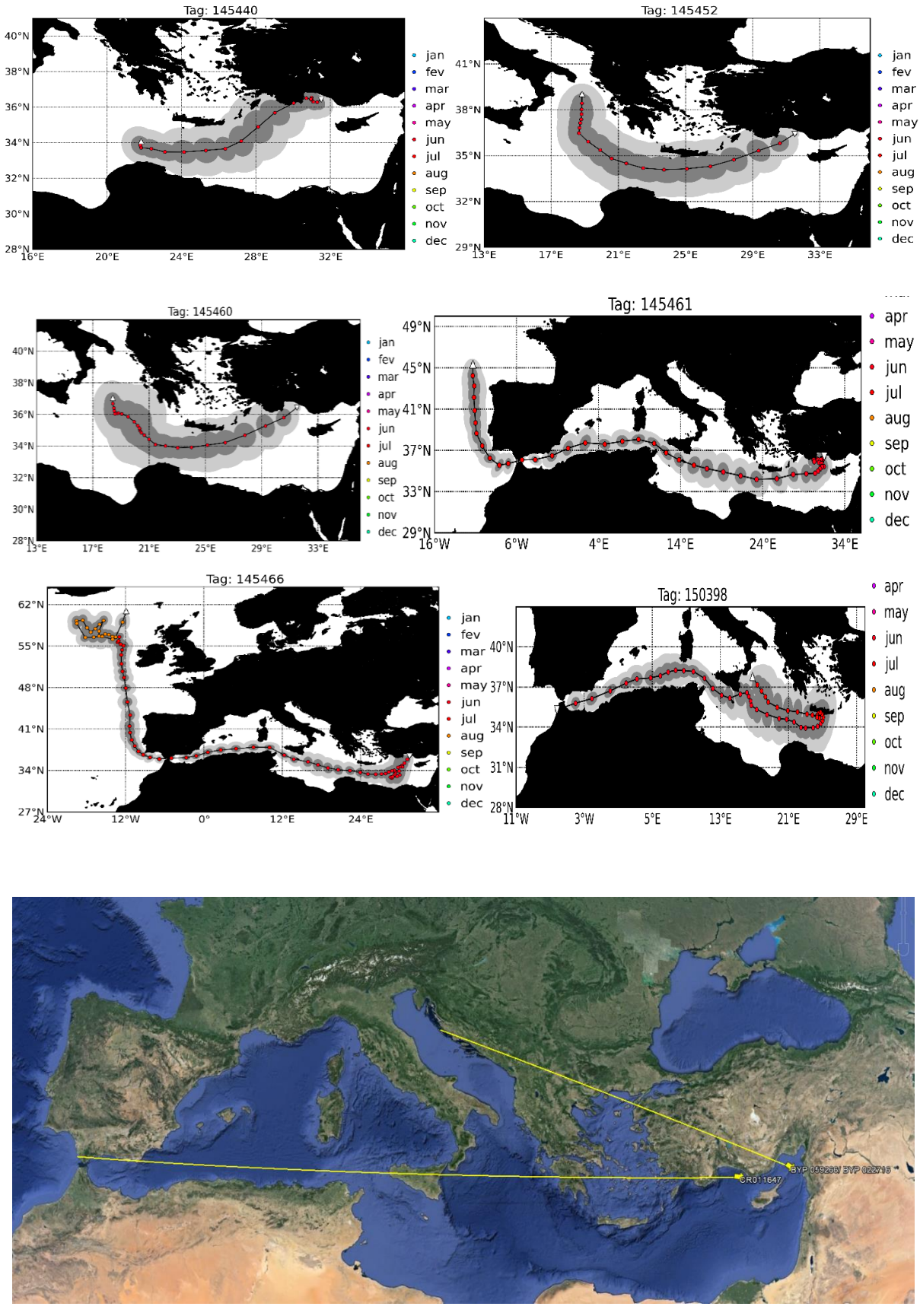

Figure 9. Tracks of 5 miniPATs deployed in Turkey in 2015, moving westwards from the eastern Mediterranean of one tag deployed in a Moroccan trap in 2015 which reached the eastern Mediterranean, and trajectories of two Bluefin tunas conventionally tagged in 2011 and 2013, moving into the eastern Mediterranean Sea.

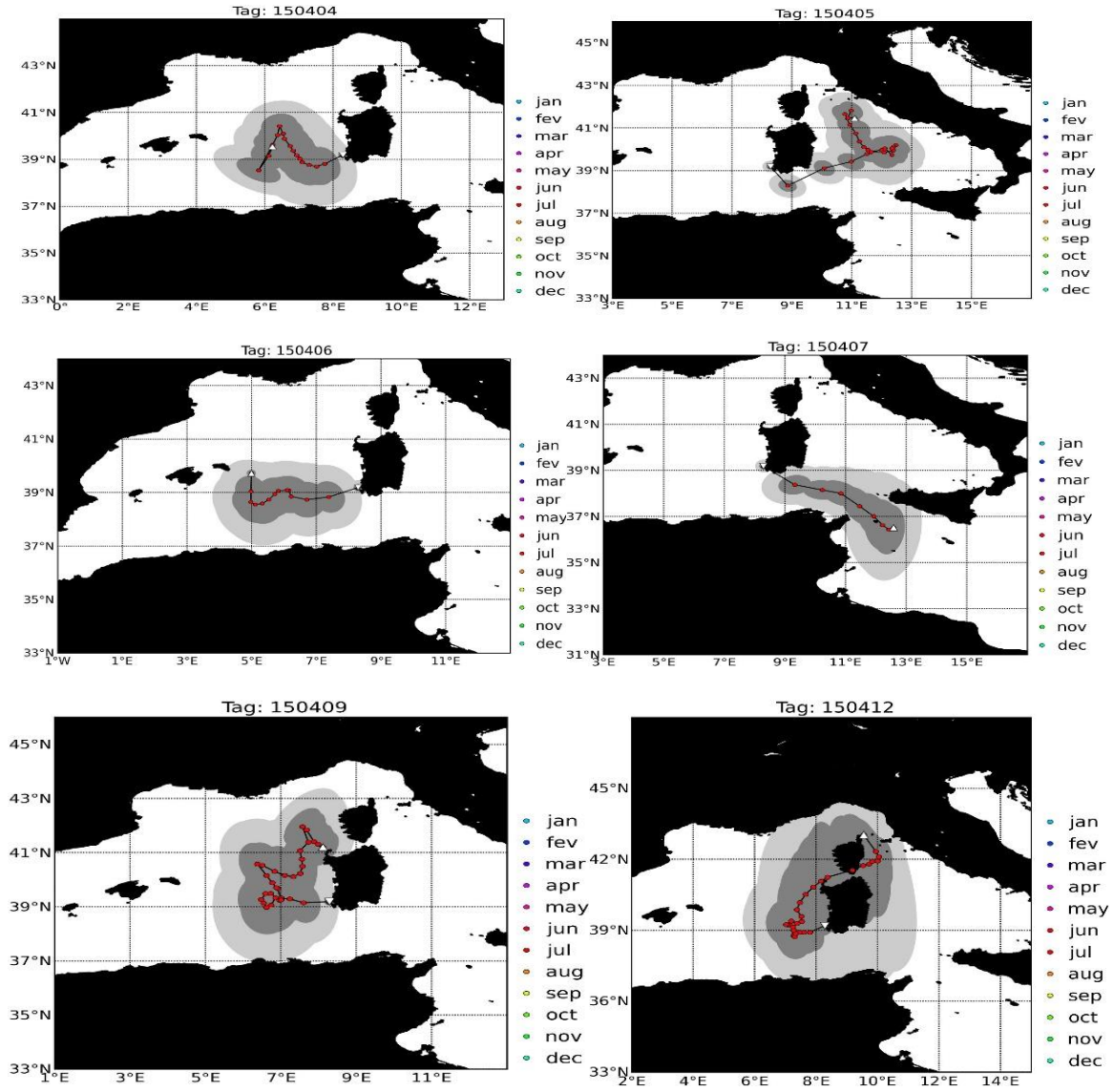

Figure 10. Selected tracks of 6 Bluefin tunas tagged with miniPatS in Sardinia in 2015, showing different behaviors.

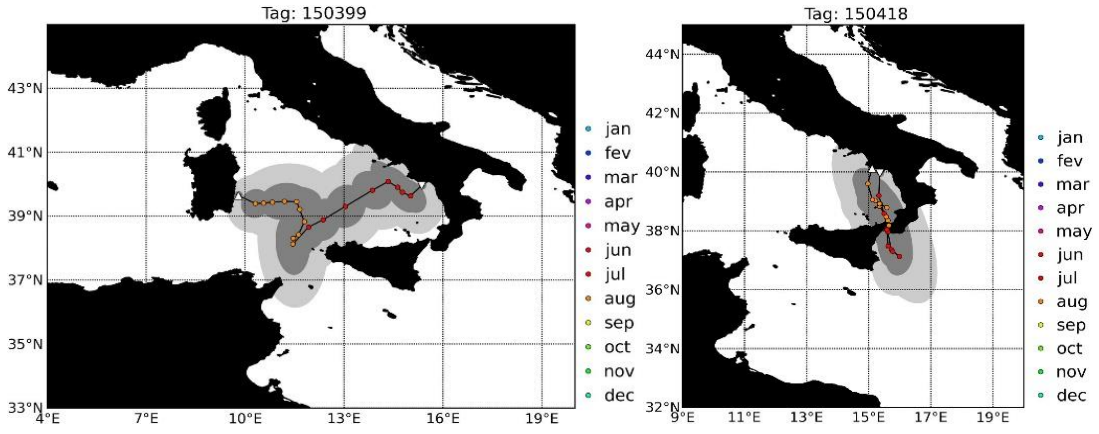

Figure 11. Selected tracks of 2 bluefin tunas tagged with miniPatS in Tyrrhenian Sea in 2015, showing different behaviors (the track for the tag which went to Libya is not available at the date).

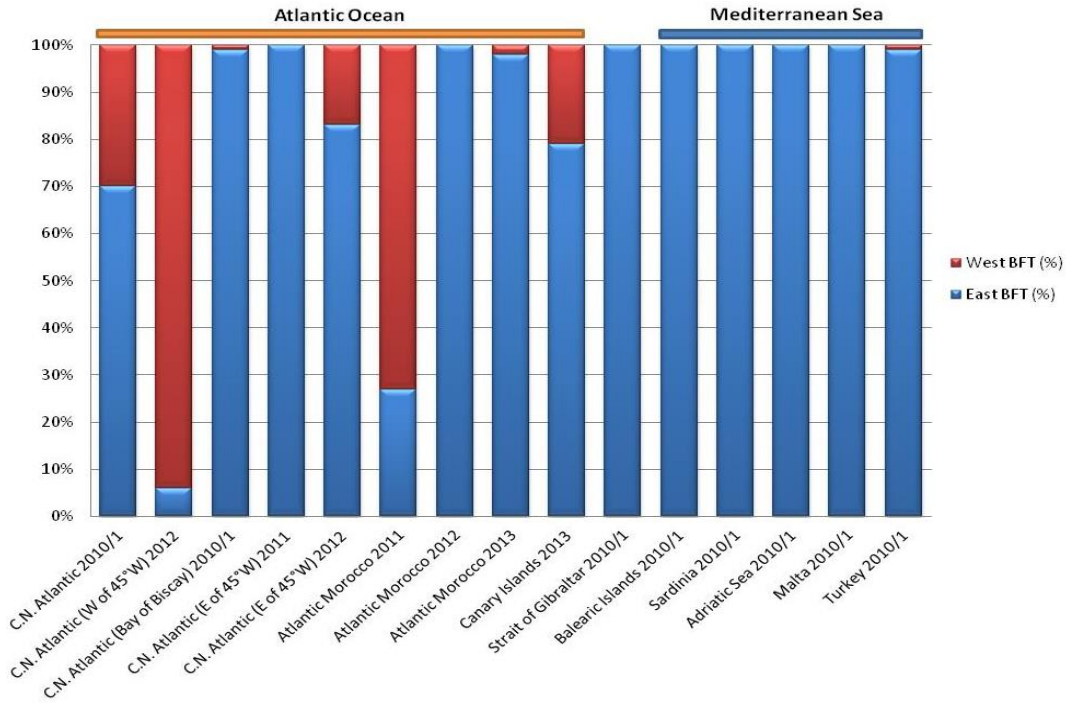

Figure 12. Graphic presentation of maximum likehood prediction of the origin of bluefin tuna collected from various areas and analyzed in Phase 3 and Phase 4. Estimates are given by percentages and mixed-stock analyses (HISEA program) was run under bootstrap mode with 1000 runs to obtain standard deviations (~error) around estimated percentages (from the final reports of Phase 3 and 4 provided by the Consortium headed by AZTI).

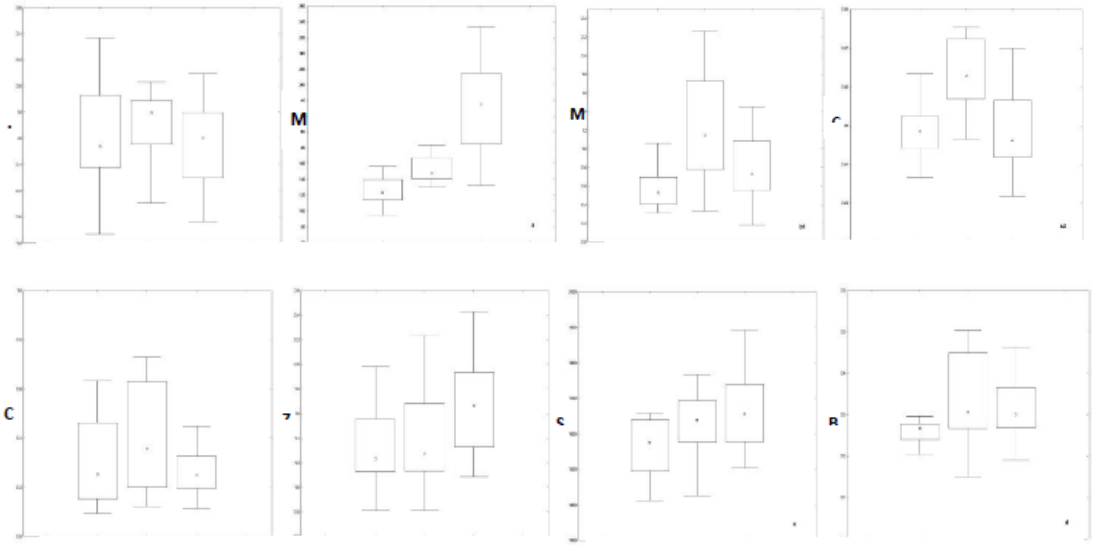

Figure 13. Box-plots comparing element: Ca distribution in otoliths of YOY bluefin tuna from western, central and eastern Mediterranean Sea. 1st line left: eastern Mediterranean significantly different from central and western Mediterranean ($p<0.05$). 1st line right: central Mediterranean significantly different from western and eastern Mediterranean ($p<0.05$). 2nd line left: eastern Mediterranean significantly different from western Mediterranean ($p<0.05$). 2nd line right: western Mediterranean significantly different from central Mediterranean ($p<0.05$).

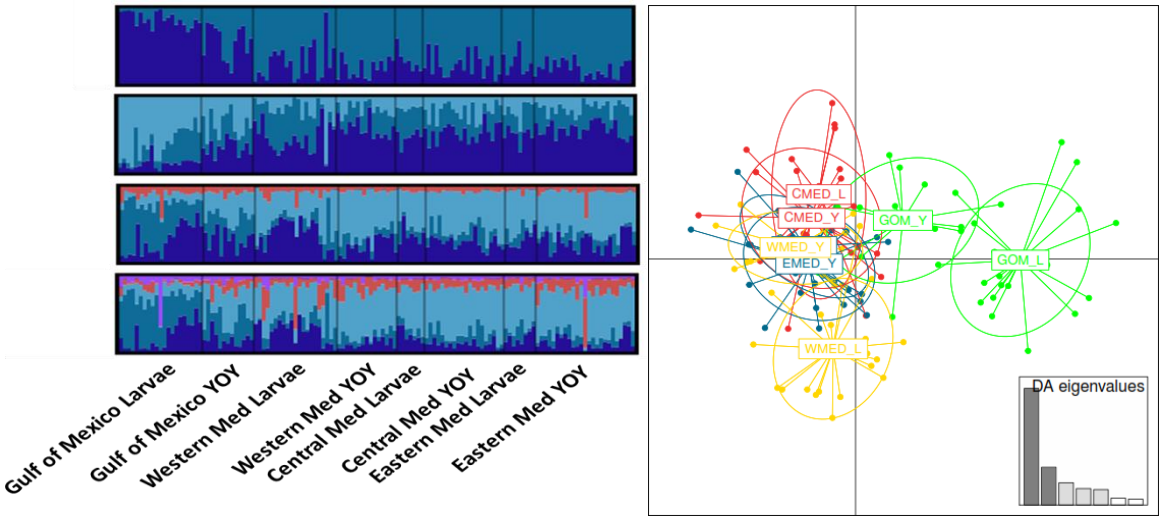

Figure 14 left. Graphic representation of individual ancestry using Structure software. Each bar represents one individual and each color, its degree of belonging to each inferred group. K varies from 2 to 5 from top to down. **Figure 14 right**. DAPC analysis of 130 samples assuming 8 distinct groups.

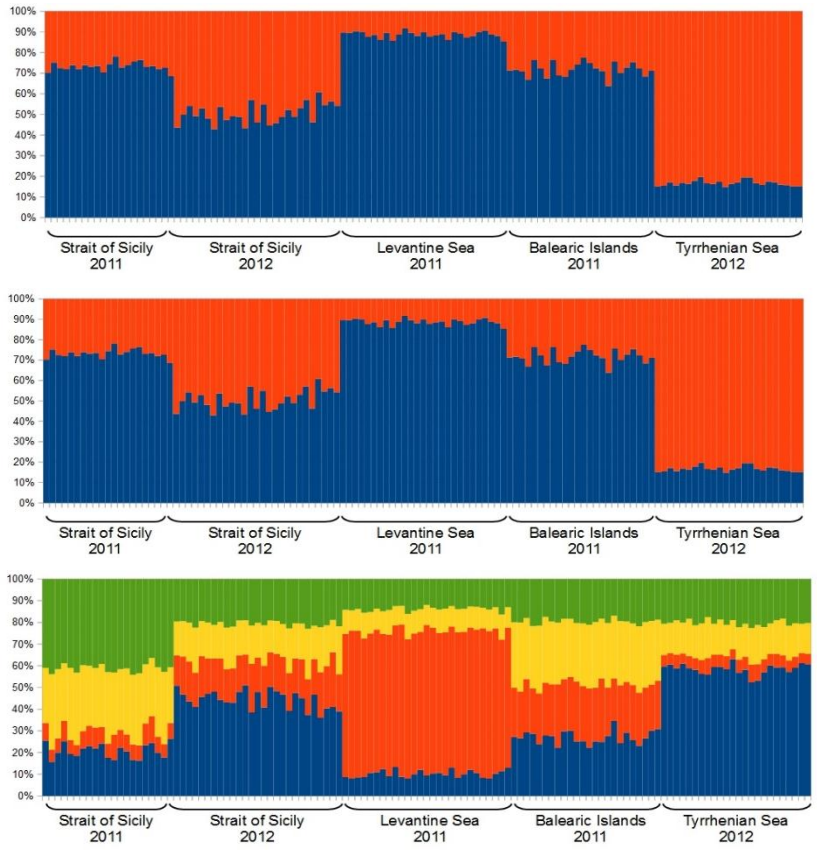

Figure 15. STRUCTURE analysis of 123 BFT collected from the Mediterranean Sea using a subset of 48 SNPs from the validated 96 SNP panel developed by the BGSA Genetics Consortium. **Top**: The model used assumes 2 ancestral populations. **Middle**: the model assumes 3 populations. **Bottom**: the model assumes 4 populations.

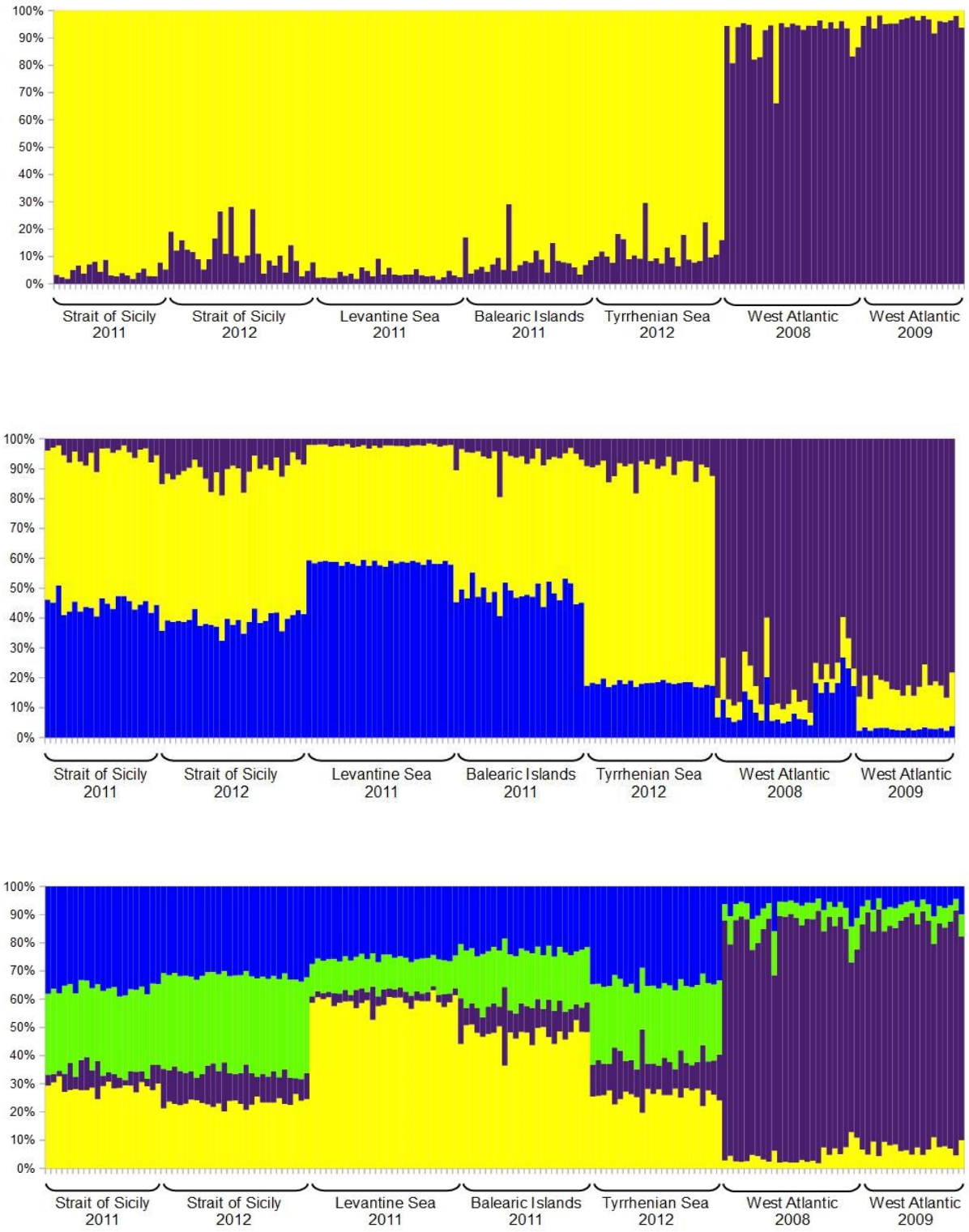

Figure 16. STRUCTURE analysis of 123 BFT collected from the Mediterranean Sea using a subset of 48 SNPs from the validated 96 SNP panel developed by the BGSA Genetics Consortium. **Top**: The model used assumes 2 ancestral populations. **Middle**: the model assumes 3 populations. **Bottom**: the model assumes 4 populations.

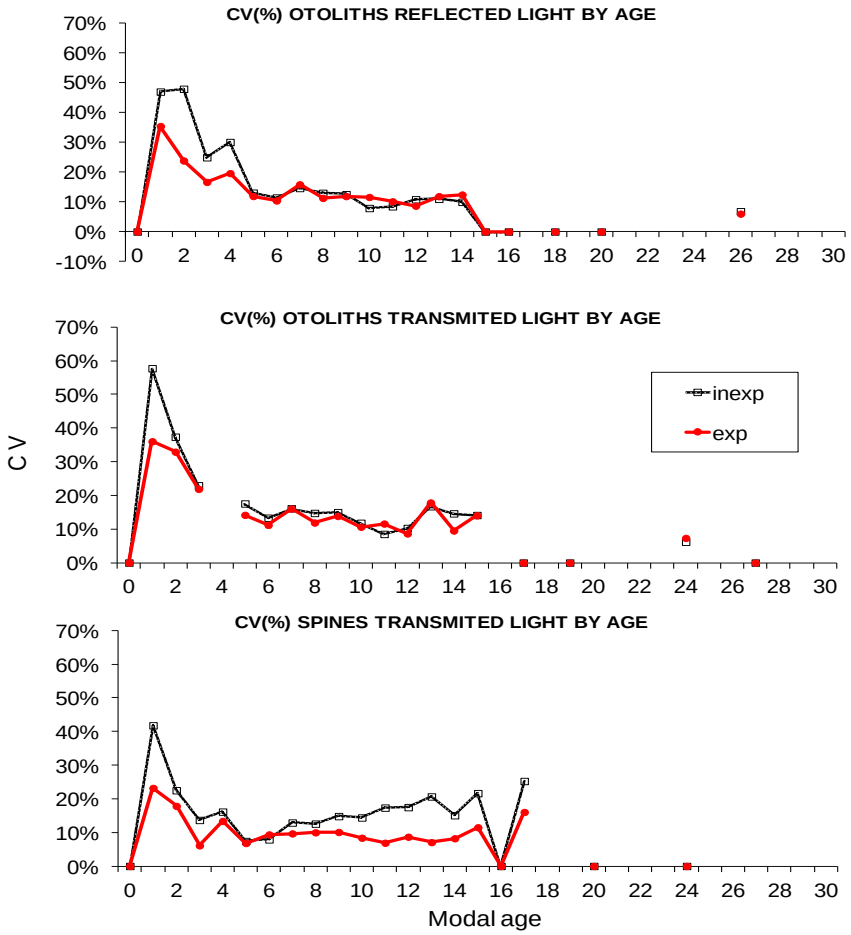

Figure 17. CV (%) trend by age and by calcified structure/type of light and reader experience (exp= experienced readers; inexp= inexperienced).

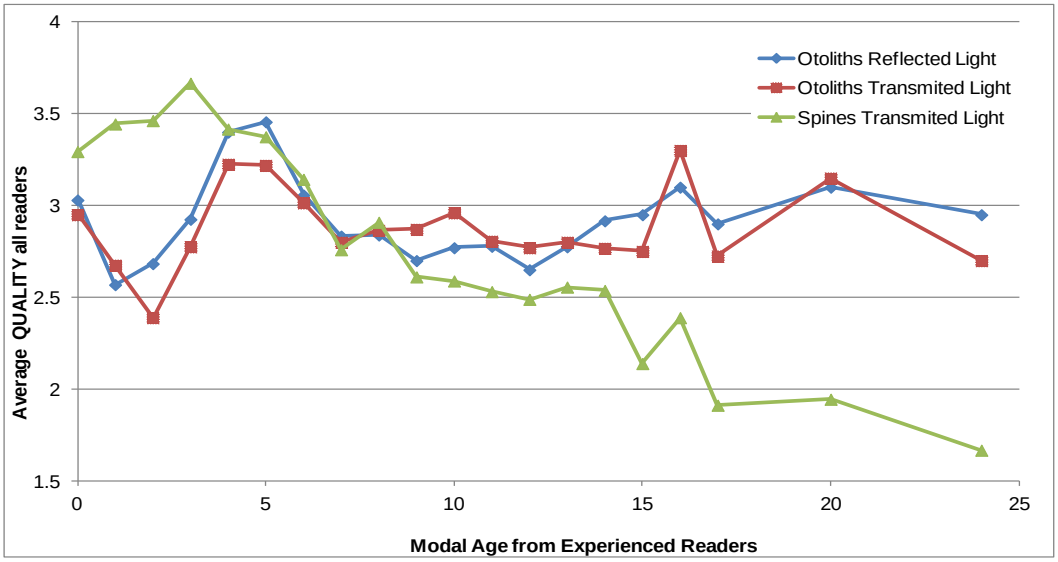

Figure 18. Average quality by CS/light type versus experienced reader modal age. Readability Code: 1=Pattern present-no meaning, 2=Pattern present-unsure with age estimate, 3=Good pattern present-slightly unsure in some areas, 4=Good pattern-confident with age estimate.

Annex Ia. List of reports and scientific papers in GBYP Phase 4

List of deliverables produced within the framework of GBYP contracts and activities in Phase 4 (mid-term reports will not be included in the final copies when the final report is available; interim reports cannot be published):

1. Coordination: Mid-term Review – Final report: Mid-term review of the ICCAT Atlantic-wide research Programme on Bluefin Tuna. Fonteneau A., Suzuki Z., Payne A.I.L.: 24 p.
2. Coordination: Steering Committee – ICCAT GBYP Steering Committee Report, Madrid, 28-29 September 2013: 17 p.
3. Coordination: Steering Committee – ICCAT GBYP Steering Committee Report, Madrid, 24 September 2014: 4 p.
4. Data recovery, data mining and data analyses - Report no. 1, 16/12/2013: Historical genetic samples collected in old times in the Eastern Mediterranean Sea, in the Marmara Sea or in the Black Sea, including the genetic analyses of these samples. University of Bologna, 2 p.
5. Data recovery, data mining and data analyses - Report no. 2, 13/05/2014: Historical genetic samples collected in old times in the Eastern Mediterranean Sea, in the Marmara Sea or in the Black Sea, including the genetic analyses of these samples. University of Bologna, 8 p.
6. Data recovery, data mining and data analyses – Extra Report no. 1, 14/07/2014: Successful extraction of high quality tuna DNA from ancient remains: An assessment of quality and quantity using qPCR techniques and Sanger sequencing. University of Bologna, 9 p.
7. Data recovery, data mining and data analyses – Extra Report no. 2, 06/08/2014: Report about the discovery of ancient tuna bones and the mission to Istanbul. University of Bologna, 3 p.
8. Data recovery, data mining and data analyses – Final Report, 27/01/2015: Historical genetic samples collected in old times in the Eastern Mediterranean Sea, in the Marmara Sea or in the Black Sea, including the genetic analyses of these samples. University of Bologna, 22 p.
9. Data recovery, data mining and data analyses - Trade, Auction and market data: Report, 24/04/2014: Weight/Size structure of Atlantic Bluefin Tuna fished and/or ranched in the Mediterranean and Northeast Atlantic during the period 1995 to 2014 as revealed by trade, market & corporate biometric data. Mielgo-Bregazzi R., 42 p. + various annexes.
10. Aerial survey on spawning aggregations – Report, 19/04/2013: Short-term contract for the aerial survey design of the Atlantic-wide Research Programme for Bluefin Tuna (ICCAT-GBYP Phase 4 - 2013). Alnilam S.A., Madrid, 21+26+20p.
11. Aerial survey on spawning aggregations – Report, July 2013: ICCAT Bluefin tuna aerial survey 2013, Final report of surveys carried out in Block A (GBYP sub-area). Grup Air Med (Spain), 34 p. + various annexes.
12. Aerial survey on spawning aggregations – Report, July 2013: Bluefin tuna aerial survey GBYP 03/2013 Research Programme, Area B. Air Périgord and Action Communication (France), 15 p.
13. Aerial survey on spawning aggregations – Report, 2 August 2013: Aerial survey on spawning aggregations, Atlantic-wide Research Programme for Bluefin Tuna. Final report, sub-areas C, D and F. UNIMAR (Italy), 36 p. + various annexes.
14. Aerial survey on spawning aggregations – Report, 12 July 2013: GBYP 2013 Atlantic-wide Research Programme for Bluefin Tuna, Area E, Italian FIR only. Final Report. Air Périgord and Action Communication (France), 15 p. + various annexes.
15. Aerial survey on spawning aggregations – Report, August 2013: Atlantic-wide Research Programme for Bluefin Tuna. Final report Area E. Périgord Travail Aérienne (France), 22 p. + various annexes.
16. Aerial survey on spawning aggregations – Report, 2 August 2013: Atlantic-wide Research Programme for Bluefin Tuna. Prospeccion aérienne de concentration de *Thunnus thynnus*. Rapport final de mission, zone G. Périgord Travail Aérienne (France), 52 p. + various annexes.
17. Aerial survey on spawning aggregations – Report, 13 September 2013: Elaboration of 2013 data from the aerial survey on spawning aggregations. Final report. Alnilam S.A. (Spain), 33 p. + various annexes.
18. Aerial survey on spawning aggregations – Tentative SWOT analysis for the calibration of ICCAT GBYP aerial survey. Presented to the GBYP Steering Committee. A. Di Natale, 10 February 2015: 1-11.

19. Aerial survey on spawning aggregations – Further elaboration of the data From the aerial survey on spawning aggregations of the Atlantic-wide Research Programme on Bluefin Tuna (ICCAT GBYP – Phase 4), requested by the GBYP Steering Committee. Alnilam Investigaciones S.A., February 20, 2014, 8 p.
20. Biological Studies: Meetings – Report of the 2013 Bluefin tuna meeting on biological parameters. Tenerife, Spain, May 7 to 13, 2013: 75 p.
21. Biological Studies – 30 April 2014: Short-term contract for the biological and genetic sampling and analyses (ICCAT GBYP 02/2013) within the GBYP (Phase 4). Updated preliminary report. AZTI on behalf of the Consortium, 42 p.
22. Biological Studies – 15 September 2014: Rodríguez-Marín E., Di Natale A., Quelle P., Ruiz M., Allman R., Bellodi A., Busawon D., Farley J., Garibaldi F., Ishihara T., Koob E., Lanteri L., Luque P.L., Marcone A., Megalofonou P., Milatou N., Pacicco A., Russo E., Sardenne F., Stagioni M., Tserpes G., Vittori S., Report on the age calibration exchange within the Atlantic-wide Research Programme for Bluefin Tuna (ICCAT GBYP): 19 p.
23. Biological Studies – 15 September 2014: Short-term contract for the biological and genetic sampling and analyses (ICCAT GBYP 02/2013) within the GBYP (Phase 4). Final Report. Coord. H. Arrizabalaga, AZTI on behalf of the Consortium, 86 p.
24. Biological Studies – 9 September 2014: Short-time contract for the biological sampling: Collection of BFT YOY samples within the framework of the Atlantic-wide research programme for bluefin tuna (ICCAT GBYP – Phase 4 – 03b/2014). Final Report, Dr. Massimiliano Valastro: 9 p.
25. Biological Studies – 4 December 2014: Short-time contract for the biological sampling: Collection of BFT YOY samples within the framework of the Atlantic-wide research programme for bluefin tuna (ICCAT GBYP – Phase 4 – 03a/2014). Final Report, AZTI: 8 p.
26. Tagging programme – Report, 30 July 2013: Marquage conventionnel et marquage électronique de thons rouges adultes dans des madragues situées dans l'océan Atlantique Est, dans les eaux marocaines. Rapport Final Révisée. INRH, Maromadraba (Morocco), WWF-MedPO, 32 p. + various annexes.
27. Tagging programme – Report, 19 July 2013: Task E, Conventional tagging of adult bluefin tunas in traps in the Mediterranean Seas, Sardinian waters, Final report. COMBIOMA, Compagnia Tonnare Sardegna, Carloforte Tonnare PIAM (Italy), 39 p. + various annexes.
28. Tagging programme – Report, December 2013: Conventional tagging of juvenile and/or adult bluefin tunas by purse-seiners in the Tyrrhenian Sea, Final report. UNIMAR on behalf of the Consortium (Italy), 33 p. + various annexes.
29. Tagging programme – Report, 5 February 2014: Tagging Programme 2013, Objective C, TAGAT, Tagging of Adriatic Tunas, Final Report. KALITUNA D.o.o. (Croatia), 32 p. + various annexes.
30. Tagging programme – Report, 10 February 2014: final report on the activities led in the framework of the ICCAT/GBYP Phase 4 Tagging Program – Objective A. AZTI on behalf of the Consortium (Spain), 17 p. + various annexes.
31. Tagging programme (complimentary activities) – Report, 16 April 2014: Tagging experimental activity of bluefin tuna individuals using the original applicator (SMAT) and biometric tracking through a synchronized underwater video recording system in Malta. Final report. Oceanis srl (Italy) and Fish and Fish Ltd (Malta), 24 p. + various annexes.
32. Tag awareness programme – Interim progress report, 15 July 2014: ICCAT GBYP 01/2014, Field tag awareness activities. COFREPECHE on behalf of the Consortium: 9 p.
33. Tag awareness programme – Final report, 15 September 2014: ICCAT GBYP 01/2014, Field tag awareness activities. COFREPECHE on behalf of the Consortium: 124 p.
34. Modelling approaches – Report of the 2013 Meeting on bluefin tuna stock assessment methods. Glouchester, MA, USA, July 20 to 22, 2013: 11 p.
35. Modelling approaches – Final report, 15 January 2014: Report for ICCAT GBYP 04/2013. Etienne M.P., Carruthers T., McAllister M. (France, Canada), 36 p.
36. Modelling approaches – Final report, Specifying and weighting scenarios for MSE robustness trials. Levontin P., Leach A.W., Holt J., Mumford J.D. (UK), 22 p.
37. Modelling approaches – Interim report, 6 June 2014: BFT MSE Program Review. Davies C. (Australia), 3 p.

38. Modelling approaches – Interim report, 1 July 2014: Notes from ABT MSE Initial Planning Meeting. Davies C. (Australia), 2 p.
39. Modelling approaches – Interim report, 22 July 2014: BFT MSE Core Modelling Group. Davies C. (Australia), 2 p.
40. Modelling approaches – Interim report, 31 July 2014: Summary Work Programme. Davies C. (Australia), 2 p.
41. Modelling approaches – Evaluating management strategies for Atlantic bluefin tuna. PPT. December 5, 2014. Tom Carruthers, 33 p.
42. Modelling approaches – Final report, 05/02/2015. Report of the first GBYP Core Modelling Group. Davies C. (including the deliverable from Tom Carruthers).
43. SCI-APP.5-2013 – Anonymous, ICCAT Atlantic-wide research programme for bluefin tuna (GBYP), Activity Report for 2013 (extension of Phase 3 and first part of Phase 4). 5 p.
44. SCI-APP.5-2014 – Anonymous, ICCAT Atlantic-wide research programme for bluefin tuna (GBYP), Activity Report for the first part of Phase 4 (2013-2014). 11 p.
45. GBYP Scientific and Technical Final Report for Phase 4. EC Grant Agreement S12.646831. April 10, 2015. 75 pag + annexes.

List of Scientific Papers – Phase 4

1. Anon. 2014. Report of the 2013 Bluefin tuna meeting on biological parameters. Tenerife, Spain, May 7 to 13, 2013. Col. Vol. Sci. Pap ICCAT: 70(1): 1-159.
2. Anon. 2014. Report of the Bluefin tuna stock assessment methods meeting. Gloucester, USA, July 20 to 22, 2013. Col. Vol. Sci. Pap ICCAT: 70(1): 160-189.
3. Di Natale A., Idrissi M., Justel Rubio A. 2014a. Bluefin catch and size historical data recovered under the Atlantic-wide research programme for bluefin tuna (ICCAT-GBYP phases 1 - 3). Col. Vol. Sci. Pap. ICCAT, 70(1): 241-248.
4. Di Natale A., Idrissi M., Justel Rubio A. 2014b. ICCAT-GBYP activities for improving knowledge on bluefin tuna biological and behavioural aspects. Col. Vol. Sci. Pap. ICCAT, 70(1): 249-270.
5. Fonteneau A. 2014. On the potential use of size measurements by observers in the farm for the estimation of Mediterranean BFT Catch at size. Col. Vol. Sci. Pap. ICCAT, 70(1): 284-288.
6. Justel-Rubio A., Ortiz M., Parrilla A., Idrissi M., Di Natale A. 2014. Preliminary review of ICCAT bluefin tuna conventional tagging database. Col. Vol. Sci. Pap. ICCAT, 70(2): 299-320.
7. Rodriguez-Marin E. *et al*. *Withdrawn*. SCRS/2013/079. Biometric relationships and condition of Atlantic bluefin tuna (*Thunnus thynnus*) from the North-East Atlantic and Mediterranean Sea.
8. Rodriguez-Marin E., Luque P.L., Quelle P., Ruiz M., Perez B., Macias D., Karakulak S. 2014. Age determination analyses of Atlantic bluefin tuna (*Thunnus thynnus*) within the Biological and Genetic Sampling and Analysis Contract (GBYP). Col. Vol. Sci. Pap. ICCAT, 70(2): 221-231.
9. Rodriguez-Marin E. *et al*. *Withdrawn*. SCRS/2013/081. An attempt of validation of the Atlantic bluefin tuna age using dorsal fin spines.
10. Ortiz M., Justel Rubio A., Gallego J.L. 2014. Review and preliminary analyses of farm harvested size frequency samples of eastern bluefin tuna (*Thunnus thynnus*). Col. Vol. Sci. Pap. ICCAT, 70(2): 338-356.
11. Rooker J., Fraile I., Arrizabalaga H., Kimoto A., Sakai O., Abid N., Neves M., Karakulak S., Macías D., Addis P., Deguara S., Tinti F. *Withdrawn*. SCRS/2013/089. Origin of Atlantic bluefin tuna in the Atlantic Ocean and Mediterranean Sea using d13C and d18O in otoliths.
12. Macías D., Murua H., Gómez-Vives M.J., Saber S., Fraile I., Addis P., Medina A., Rodríguez-Marín E., Arrizabalaga H. *Withdrawn*. SCRS/2013/090. First Results on reproduction of East Atlantic bluefin tuna out of GBYP-MUBI phase 3 Project.
13. Mariani A., Dell'Aquila M., Scardi M., Costa C. 2014. Feasibility study to assess the utilization of stereo-video systems during transfer of Atlantic bluefin tunas (*Thunnus thynnus*) to evaluate their number and size. Col. Vol. Sci. Pap. ICCAT, 70(2): 401-421.

14. Di Natale A. 2014. Iconography of tuna traps: the discovery of the possible oldest printed image of a tuna trap. Col. Vol. Sci. Pap. ICCAT, 70(6): 2820-2827.

15. Di Natale A. 2014. The ancient distribution of tuna fishery: how coins can improve our knowledge. Col. Vol. Sci. Pap. ICCAT, 70(6): 2828-2844.

16. Örenc A.F., Ünver M., Düzcü L., Di Natale A. 2014. Tentative bluefin tuna data recovery from the Ottoman Archives, the Maritime Museum Archives and the Archives of the Istanbul Municipality. Col. Vol. Sci. Pap. ICCAT, 70(2): 447-458.

17. Di Natale A., Idrissi M., Justel Rubio A. 2014. ICCAT Atlantic-wide Research Programme for Bluefin Tuna 2013. (GBYP). Activity report for 2013 (extension of Phase 3 and first part of Phase 4). Col. Vol. Sci. Pap. ICCAT, 70(2): 459-498.

18. Justel-Rubio A., Ortiz M., Palma C., Gallego J.L., Di Natale A., Idrissi M. 2014. Preliminary Evaluation of the Total Catch Removals Eastern Bluefin tuna. A comparison of the GBYP and ICCAT Task I databases. SCRS/2013/169, Collect. Vol. Sci. Pap. ICCAT, 70(2): 518-536.

19. de la Serna J.M., Godoy D., Belda E., Sanchez R., Majuelos E. 2014, Análisis de los resultados de la campaña de marcado de atún rojo (*Thunnus thynnus*) del "Tagging GBYP-ICCAT 4ª Fase" realizada en el Estrecho de Gibraltar durante 2012. Col. Vol. Sci. Pap. ICCAT, 70(2): 537-542.

20. Di Natale A., Idrissi M., Justel Rubio A. 2014. ICCAT-GBYP Tag Recovery Activities (up to September 2013). Col. Vol. Sci. Pap. ICCAT, 70(2): 299-320.

21. Fonteneau A., Suzuki Z., Payne A.I.L. 2014. Mid-term review of the ICCAT Atlantic-wide research Programme on Bluefin Tuna. Col. Vol. Sci. Pap. ICCAT, 70(2): 565-584.

22. Addis P., Secci M., Sabatini A., Palmas F., Culurgioni J., Pasquini V., Cau A. 2014. Conventional tagging of bluefin tunas in the trap fishery of Sardinia (W-Mediterranean): a critical review. Col. Vol. Sci. Pap. ICCAT, 70(2): 585-591.

23. Abid N., Talbaoui M., Benchoucha S., El Arraf S., El Fanichi C., Quílez-Badia G., Tudela S., Rodríguez López N.A., Cermeño P., Shillinger G., Benmoussa K., Benbari S. 2014. Tagging of Bluefin tuna in the Moroccan Atlantic trap "Essahel" in 2013: Methodology and preliminary results. Col. Vol. Sci. Pap. ICCAT, 70(2): 663-672.

24. Kell L.T. 2015. Identification of the major sensitivities in the East Atlantic and Mediterranean bluefin assessment. Col. Vol. Sci. Pap. ICCAT, 71(2): 946-959.

25. Kell L.T., Fromentin J.M. and Szuwalski C.S. 2015. Which Came First? The Chicken, The Egg or The Tortilla? Col. Vol. Sci. Pap. ICCAT, 71(3): 1297-1307.

26. Kell L.T., Hillary R., Fromentin J.M., Bonhommeau. 2015. Evaluation Of Model Free Harvest Control Rules. An Example North Atlantic Bluefin Tuna Management Strategy. Col. Vol. Sci. Pap. ICCAT, 71(6): 2790-2797.

27. Busawon D.S., Rodriguez-Marin E., Lastra Luque P., Allman R., Gahagan B., Golet W., Koob E., Siskey M., Ruiz Sobrón M., Quelle P., Neilson J., Secor D.H. 2015. Evaluation of an Atlantic bluefin tuna otoliths reference collection. Col. Vol. Sci. Pap. ICCAT, 71(2): 960-982.

28. Ortiz M., Justel-Rubio A., Gallego J.L. 2015. Review and analyses of farm harvested size frequencies frequency samples of eastern bluefin tuna (*Thunnus thunnus*). Col. Vol. Sci. Pap. ICCAT, 71(2): 1018-1035.

29. Mielgo-Bregazzi R. *Withdrawn*. SCRS/2014/042. Weight/Size structure of Atlantic Bluefin Tuna fished and/or ranched in the Mediterranean and Northeast Atlantic during the period 1995 to 2014 as revealed by trade, market & corporate biometric data.

30. Di Natale A. 2015. Review of the historical and biological evidences about a population of bluefin tuna (*Thunnus thynnus* L.) in the eastern Mediterranean and the Black Sea. Col. Vol. Sci. Pap. ICCAT, 71(3): 1098-1124.

31. Di Natale A., Idrissi M. 2015. Review of the GBYP tagging activities. Col. Vol. Sci. Pap. ICCAT, 71(3): 1125-1143.

32. Di Natale A. 2015. An unknown bluefin tuna fishery and industry in Tenerife (Canary Islands, Spain) in the early XX century: the Florio's enterprise. Col. Vol. Sci. Pap. ICCAT, 71(3): 1152-1173.

33. Di Natale A. 2015e. ICCAT Atlantic-wide Research Programme for Bluefin Tuna (GBYP), Activity Report for the first part of Phase 4 (2013-2014). Col. Vol. Sci. Pap. ICCAT, 71(3): 1174-1214.

34. Cort J.L., Artetxe I. and Santiago J. 2015. Review of bluefin tuna, *Thunnus thynnus* (L.), catches made by the Spanish baitboat fleet in the Bay of Biscay during the 20th century. 2015. Col. Vol. Sci. Pap. ICCAT, 71(3): 1215-1222.

35. Rodríguez-Marín E., Ortiz de Urbina J.M., Abid N., Alot E., Andrushchenko I., Deguara S., Di Natale A., Gatt M., Golet W., Karakulak S., Kimoto A., Macias D., Quelle P., Saber S., Nieves dos Santos M., Walter J., Zarrad R. *Withdrawn*. SCRS/2014/053. Length and weight relationships for Atlantic Bluefin tuna (*Thunnus thynnus*).

36. Levontin P., Leach A.W., Holt J., Mumford J.D. 2015. Specifying and weighting scenarios for MSE robustness trials. Col. Vol. Sci. Pap. ICCAT, 71(3): 1326-1343.

37. Di Natale A. Kell L.T., Bonhommeau S. 2015. Match and mismatch: a few thoughts about the available bluefin prediction models for the Mediterranean area. Simple Catch-At-Age and Size Analyses For Atlantic Bluefin. Col. Vol. Sci. Pap. ICCAT, 71(3): 1383-1395.

38. de la Serna J.M., Godoy D., Belda E., El Arraf S., Majuelos E., Sanchez R., Mengual J., Saber S., Muñoz P. 2015. Campaña de marcado convencional y electrónico de atún rojo realizada en el Estrecho de Gibraltar según el diseño adoptado por el programa de investigación GBYP-ICCAT y desarrollado en el "Tagging GBYP-ICCAT 4ª Fase, 2013". Col. Vol. Sci. Pap. ICCAT, 71(3): 1396-1402.

39. Cozzolino G., Pignalosa P., Lombardo F. *Withdrawn*. SCRS/2014/139. Bluefin tuna (*Thunnus thynnus*) experimental tagging activity by new applicator (SMAT) and biometric data survey by a synchronised scuba-video tape system. Malata Channel – Portoscuso, Sardinia.

40. Ortiz M., Preliminary review of bluefin tuna (*Thunnus thynnus*) size and weight measure taken with stereo video cameras at caging operations in the Mediterranean Sea in 2014. 2015. Col. Vol. Sci. Pap. ICCAT, 71(3): 1417-1425.

41. Di Natale A. 2015. Report on the use of Research Mortality Allowance by ICCAT GBYP in 2012, 2013 and 2014. 2015. Col. Vol. Sci. Pap. ICCAT, 71(3): 1426-1435.

42. Rodríguez-Marín E., Di Natale A., Quelle P., Ruiz M., Allman R., Bellodi A., Busawon D., Farley J., Garibaldi F., Ishihara T., Koob E., Lanteri L., Luque P.L., Marcone A., Megalofonou P., Milatou N., Pacicco A., Russo E., Sardenne F., Stagioni M., Tserpes G., Vittori S. *Withdrawn*. SCRS/2014/150. Report on the age calibration exchange within the Atlantic-wide Research Programme for Bluefin Tuna (ICCAT GBYP).

43. Cort J., Estruch V., Di Natale A., Abid N., De la Serna J.M. *Withdrawn*. SCRS/2014/151. Una relación talla-peso estacional para el atún rojo, *Thunnus thynnus* (L.), del Atlántico oriental y Mediterráneo.

44. Garibaldi F. 2015. Bluefin tuna (*Thunnus thynnus*) size composition in the western Ligurian Sea (Western Mediterranean) for the period 1990-2013. 2015. Col. Vol. Sci. Pap. ICCAT, 71(3): 1490-1494.

45. Vanderlaan A.S.M., Jech J.M., Weber T.C., Rzhanov Y., Lutcavage M.E. 2015. Direct assessment of juvenile bluefin tuna: integrating sonar and aerial survey results in support of fishery-independent surveys. 2015. Col. Vol. Sci. Pap. ICCAT, 71(4): 1617-1625.

46. Puncher G.N., Onar V., Yaşar Toker N., Tinti F. 2015. A multitude of Byzantine era bluefin tuna and swordfish bones uncovered in Istambul, Turkey. Col. Vol. Sci. Pap. ICCAT, 71(4): 1626-1631.

47. Quílez-Badia G., Ospina-Alvarez A., Sainz Trápaga S., Di Natale A., Abid N., Cermeño P., Tudela S. 2015. The WWF/GBYP multi-annual bluefin tuna electronic tagging programme (2008-2013): repercussions for management. Col. Vol. Sci. Pap. ICCAT, 71(4): 1789-1802.

48. Mariani A., Dell'Aquila M., Valastro M., Buzzi A., Scardi M. 2015. Conventional tagging of adult bluefin tunas (*Thunnus thynnus*) by purse-seiners in the Mediterranean. Methodological notes. Col. Vol. Sci. Pap. ICCAT, 71(4): 1832-1842.

49. ICCAT GBYP Steering Committee. 2015. Time to plan for the future of GBYP. 11 p. 2015. Col. Vol. Sci. Pap. ICCAT, 71(4): 1843-1853.

50. Anon. 2014. ICCAT Atlantic-wide Research Programme for Bluefin Tuna (GBYP), Activity Report for 2013 (last part of Phase 3 and first part of Phase 4). ICCAT Report for the biennial period 2012-2013, part II (2013), Vol. 2, Appendix 5: 293-298.

51. Rooker J.R., Arrizabalaga H., Fraile I., Secor D.H., Dettman D.L., Abid N., Addis P., Deguara S., Karakulak S.F., Kimoto A., Sakai O., Macías M., Neves dos Santos M. 2014. Crossing the line: migratory and homing behaviors of Atlantic bluefin tuna. Marine Ecology Progress Series, 504: 265-276.

52. Leach A.W., Levontin P., Kell L.T., Holt J., Mumford J.D. *In press*. Identification and prioritization of uncertainties for management of Eastern Atlantic Bluefin Tuna (*Thunnus thynnus*). Marine Policy.

53. Fraile I., Arrizabalaga H., Rooker J.R. 2014. Origin of Atlantic bluefin tuna (*Thunnus thynnus*) in the Bay of Biscay**.** ICES Journal of Marine Science; doi:10.1093/icesjms/fsu156.

54. Fraile I., Arrizabalaga H., Koelling M., Groeneveld J., Deguara S., Neves Santos M., Macías D., Addis P., Karakulak S., Dettman D.L., Rooker J.R. *In press*. The imprint of anthropogenic CO2 emissions in Atlantic bluefin tuna otoliths. Submitted to: Global and Planetary Changes: 23 p.

55. Cort J., Estruch V., Di Natale A., Abid N., De la Serna J.M., Neves dos Santos M. *In press*. On the variability of the length-weight relationship for Atlantic bluefin tuna, *Thunnus thynnus* (L.). Fishery Science & Aquaculture, 2015, 45 p.

56. Quílez-Badia G., Ospina-Alvarez A., Sainz Trápaga S., Di Natale A., Abid N., Tudela S. *In press*. Eleven consecutive years of electronic tagging on Bluefin tuna in the East Atlantic and Mediterranean: New clues on habitat use, migratory behavior and population structure. Ecology Letters (2015), 30 p.

57. Puncher G.N., Cilli E., Morales A., Onar V., Massari F., Cariani A., Tinti F. *In press*. Rediscovering our relationship with the sea: Unlocking the evolutionary history of the mighty bluefin tuna using novel paleogenetic techniques and ancient tuna remains. Mares Conference, Olão (Portugal), November 2014.

58. Die D., Johnson M. and Lauretta M. 2014. Simulating tagging of tropical tuna in the Equatorial Atlantic Ocean. Col. Vol. Sci. Pap. ICCAT, 70(6): 2710-2724.

59. USA Scientists. 2014. Bluefin Tuna Biological Sampling Program: Commercial and recreational fisheries. Col. Vol. Sci. Pap. ICCAT, 70(2): 394-395.

60. ICCAT GBYP Steering Committee. 2015. Time to plan for the future of GBYP. Col. Vol. Sci. Pap. ICCAT, 71(4): 1843-1853.

61. Pagá García A., Palma C., Di Natale A., De Bruyn P. *In press*. SCRS/2015/148. ICCAT GBYP report on additional ancient trap data recovered in Phase 4 and 5. 14 p.

Annex Ib. List of reports and scientific papers in the first part of GBYP Phase 5

List of deliverables produced within the framework of GBYP contracts and activities in the first part of Phase 5 (mid-term reports will not be included in the final copies when the final report is available; interim reports cannot be published):

1. Coordination: Steering Committee – ICCAT GBYP Steering Committee Report, Madrid, 10-12 February 2015: 4 p.
2. Data recovery, data mining and data analyses – Progress Report no. 1, 13/07/2015: Historical genetic samples collected in old times in the Eastern Mediterranean Sea, in the Marmara Sea or in the Black Sea, including the genetic analyses of these samples. University of Bologna, 5 p.
3. Anon. 2015. *In press*. SCRS/2015/012. Report of 2015 ICCAT bluefin tuna data preparatory meeting. ICCAT, Madrid, 2-6 March 2015: 61 p.
4. Aerial survey on spawning aggregations – Report, 01/04/2015: Short-term contract for the aerial survey design of the Atlantic-wide Research Programme for Bluefin Tuna (ICCAT-GBYP Phase 5 – 2015). Alnilam S.A., Madrid, 16+23+18 p.
5. Aerial survey on spawning aggregations – Report on the 2015 ICCAT GBYP Training course for the tuna aerial survey on spawning aggregations (Phase 5). Di Natale A., 1 pag + 3.
6. Aerial survey on spawning aggregations – ICCAT GBYP Aerial Survey Protocol 2015, 17 pag.
7. Aerial survey on spawning aggregations – Report, 16/06/2015: ICCAT Bluefin tuna aerial survey on spawning aggregations 03/2015, Intermediate report of surveys carried out in Area A. Grup Air Med (Spain), 16 p. + various annexes.
8. Aerial survey on spawning aggregations – Report, 10/07/2015: Bluefin tuna aerial survey on spawning aggregations 03/2015, Intermediate report of surveys carried out in Areas B, E and G. Action Air SA (France), 18 p.
9. Aerial survey on spawning aggregations – Report, 25/06/2015: Bluefin tuna aerial survey on spawning aggregations 03/2015, Intermediate report of surveys carried out in Areas C, D and F. UNIMAR (Italy), 4 p. + various annexes.
10. Aerial survey on spawning aggregations – Report, 24/07/2015: ICCAT Bluefin tuna aerial survey on spawning aggregations 03/2015, Informe final, Area A. Grup Air Med (Spain): 46 p. + various annexes.
11. Aerial survey on spawning aggregations – Report, 31/07/2015: Bluefin tuna aerial survey on spawning aggregations 03/2015, Rapport final, zones de prospection B, E and G. Action Air SA (France): 31 p. + various annexes.
12. Aerial survey on spawning aggregations – Report, 27/07/2015: Bluefin tuna aerial survey on spawning aggregations 03/2015, Final report of surveys carried out in Areas C, D and F. UNIMAR (Italy): 38 p. + various annexes.
13. Aerial survey on spawning aggregations – Report, 14 September 2015: ICCAT GBYP Phase 5 – 2015. Elaboration of 2015 data from the aerial survey on spawning aggregations. Intermediate report: 1-70.
14. Biological Studies – 20 August 2015: Short-term contract for the biological studies (ICCAT GBYP 06b/2015-2) (Phase 5). Preliminary report. AZTI on behalf of the Consortium, 10 p.
15. Tagging programme – Report, 30/06/2015: Marquage électronique de thons rouges adultes dans des madragues situées dans l'Océan Atlantique Est, dans les eaux Marocaines. Programme de marquage 2015 (ICCAT GBYP Phase 5). Rapport Succinct mise à jour. INRH, Maromadraba (Morocco), WWF-MedPO, 14 p. + various annexes.
16. Tagging programme – Report, 09/07/2015: Tagging Programme 2015. Electronic tagging of adult Bluefin tunas by purse-seiners in the eastern Mediterranean (ICCAT GBYP 05/2015, Objective A, as modified by the GBYP Steering Committee). Short Report and 1st update. University of Istanbul (Turkey) and Consorzio Unimar (Italy), 6 p. + various annexes.
17. Tagging programme – Report, 21/07/2015: Marquage électronique de thons rouges adultes dans la Madrague « Essahel » située situées dans l'Océan Atlantique Est, dans les eaux Marocaines. Programme de marquage 2015 (ICCAT GBYP Phase 5, 05/2015 objective B). Rapport Final Révisée. INRH, Maromadraba (Morocco), WWF-MedPO, 28 p. + various annexes.

18. Tagging programme – Report, 31/07/2015: Tagging Programme 2015. Electronic tagging of adult Bluefin tunas by purse-seiners in the eastern Mediterranean (ICCAT GBYP 05/2015, Objective A, as modified by the GBYP Steering Committee). Final report. University of Istanbul (Turkey) and Consorzio Unimar (Italy): 23 p. + various annexes.
19. Tagging programme – Report, 28/07/2015: Electronic tagging of adult Bluefin tunas in Sardinian traps (ICCAT GBYP 05/2015, Objective C, as modified by the GBYP Steering Committee). Final report. COMBIOMA, and Carloforte Tonnare PIAM (Italy), 31 p. + various annexes.
20. Tagging programme (complimentary activities) – Report, 30/07/2015: Experimental tagging activity of bluefin tuna to be released in the southern Tyrrhenian Sea. Final report. Federcoopesca, University of Bologna and Consorzio Unimar (Italy), 1 p. + various annexes.
21. Modelling approaches – Report, 19/06/2015. Proposed Multi-annual Workplan for the Development of Management Strategy Evaluations of Atlantic Bluefin Tuna by the International Commission for the Conservation of Atlantic Tunas (ICCAT), Joseph Powers, 7 pag. + 4.
22. Modelling approaches – Draft report, 21/09/2015 - A summary of data to inform management strategy evaluation for Atlantic bluefin tuna.. Tom Carruthers.
23. Modelling approaches – Draft report, 21/09/2015. Operating model structure and estimation framework for Atlantic bluefin management strategy evaluation. Tom Carruthers.
24. SCI-APP.5-2015 – Anon. ICCAT Atlantic-wide research programme for bluefin tuna (GBYP), Activity Report for the last part of Phase 4 and the first part of Phase 5 (2014-2015). 11 p.

List of Scientific Papers – Phase 5

1. Puncher G.N., Arrizabalaga H., Francisco Alemany F., Cariani A., Oray I.K., F. Saadet Karakulak S.F., Basilone G., Cuttitta A., Mazzola S., Tinti F., 2014, Molecular Identification of Atlantic Bluefin Tuna (*Thunnus thynnus*, Scombridae) Larvae and Development of a DNA Character-Based Identification Key for Mediterranean Scombrids. PLosONE 10(7): e0130407. doi:10.1371/journal.pone.0130407.
2. Brophy D., Haynes P., Arrizabalaga H., Fraile I., Fromentin J.M., Garibaldi F., Katavic I., Tinti F., Karakulak S., Macías D., Busawon D., Hanke A., Kimoto A., Sakai O., Deguara S., Abid N., Neves Santos M., 2015, Otolith shape variation in blue fin tuna from different regions of the North Atlantic: a possible marker of stock origin. SCRS/P/2015/004.
3. Arrizabalaga H., Fraile I., Goñi N. *et al*. 2015. Biological samples collected within the GBYP program. SCRS/P/2015/005.
4. Fraile I., Rooker J., Arrizabalaga H. *et al*. 2015. Bluefin Otolith chemistry: what we learnt with the GBYP program. SCRS/P/2015/006.
5. Rodriguez Ezpeleta N., Arrizabalaga H., Puncher G.N. *et al*. 2015. Genetic population structure of Atlantic bluefin tuna using RadSEQ. SCRS/P/2015/007.
6. Lauretta M., Goethel D., Walter J. 2015. A summary of available GBYP tagging data for consideration in upcoming benchmark assessments. SCRS/P/2015/008.
7. Cort J.L., Estruch V.D., Neves dos Santos M., Di Natale A., Abid N., de la Serna J.M. *Withdrawn*. SCRS/2015/026. On the variability of the length--weight relationship for Atlantic bluefin tuna, *Thunnus thynnus* (L.).
8. Cort J.L., Estruch V.D., Neves dos Santos M., Di Natale A., Abid N., de la Serna J.M. 2015. On the variability of the length-weight relationship for Atlantic bluefin tuna, *Thunnus thynnus* (L.). Reviews in Fishery Science and Aquacolture, 23 (1): 23-38.
9. Rodriguez-Marin E., Quelle P., Ruiz M., Luque P.L. *In press*. SCRS/2015/040. Standardized age-length key for East Atlantic and Mediterranean bluefin tuna based on otoliths readings. 10 p.
10. Serna J.M., Puncher G.N., Cariani A., Maes G.E., Van Houdt J., Herten K., Albaina A., Estonba A., Cannas R., Rodríguez-Ezpeleta N., Arrizabalaga H., Tinti F. *Withdrawn*. SCRS/2015/048. Population structure and genetic management unit delineation in the bluefin tuna using a genotyping-by-sequencing approach.

11. Puncher G.N., Cariani A., Cilli E., Massari F., Martelli P.L., Morales A., Ona V., Toker N.Y., Moens T., Tinti F. *In press*. SCRS/2015/049. Unlocking the evolutionary history of the mighty bluefin tuna using novel paleogenetic techniques and ancient tuna remains. p 10.
12. Ortiz M. *In press*. SCRS/2015/050. Update review of bluefin tuna (*Thunnus thynnus*) size and weight measures taken with stereo video cameras at caging operations in the Mediterranean sea 2014. 10 p.
13. Di Natale A. *Withdrawn*. SCRS/2015/053. Review of the ICCAT GBYP tagging activities up to phase 4.
14. Di Natale A. *In press*. SCRS/2015/143. Tentative SWOT analysis for the calibration of ICCAT GBYP aerial survey. 20 p.
15. Di Natale A., Tensek S. *In press*. SCRS/2015/144. ICCAT Atlantic-wide Research Programme for Bluefin tuna (GBYP). Activity report for the last part of Phase 4 and the first part of Phase 5 (2014-2015). 65 p.
16. Di Natale A., Tensek S., Pagá García A. 2015f. *In press*. Report on the use of Research Mortality Allowance by ICCAT GBYP up to September 2015. SCRS/2015/145: 14 p.
17. Quilez Badia G., Tensek S., Di Natale A., Tensek S., Pagá Garía, Kell L. *In press*. SCRS/2015/146. An estimate of additional variance for the ICCAT GBYP aerial survey using mini-PATs data: 12 p.
18. Di Natale A., Cañadas A., Tensek S., Vázquez Bonales J.A., Pagá García A. 2015a. *In press*. SCRS/2015/147. ICCAT GBYP aerial survey for spawning aggregations in 2015. Preliminary report: 25 p.
19. Pagá García A., Palma C., Di Natale A., Parrilla A., De Bruyn P. *In press*. SCRS/2015/148. ICCAT GBYP report on additional ancient trap data recovered in Phase 4 and 5. 14 p.
20. Di Natale A., Tensek S., Pagá García A. *In press*. SCRS/2015/149. Preliminary information about the ICCAT GBYP tagging activities in Phase 5. 25 p.
21. Di Natale A., Tensek S., Pagá García A. 2015b. *In press*. SCRS/2015/154. 2015: is the Bluefin tuna facing another 2003? 17 p.
22. Lauretta M.V., Hanke A., Di Natale A. *In press*. SCRS/2015/170. Atlantic bluefin tuna electronic tagging data summary. 17 p.
23. Carruthers T., Powers J., Lauretta M.V., Di Natale A., Kell L. *In press*. SCRS/2015/180. A summary of data to inform operating models in Management Strategy Evaluation of Atlantic Bluefin tuna. 12 p.
24. Hanke A.R., Rodriguez-Marin E. *In press*. SCRS/2015/177. Atlantic bluefin tuna data base for age and stock identification. 4 p.
25. Rodriguez-Marin E., Quelle P., Ruiz M., Busawon D., Golet W. *Withdrawn*. SCRS/2015/173. Comparison of age estimates from paired calcified structures from Atlantic bluefin tuna.
26. Carruthers T., Kimoto A., Powers J., Kell L., Butterworth D., Lauretta M., Kitakado T. *In press*. SCRS/2015/179. Structure and Estimation Framework for Atlantic Bluefin Tuna Operating Models.13 p.

Annex IIa: GBYP contracts issued in Phase 4

ICCAT GBYP CONTRACTS AND MEETINGS (PHASE 4)

ICCAT GBYP COODINATION

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013-2014	30.000,00	direct contract	*ICCAT GBYP Steering Committee - External Member*	Ph.D. Tom Polacheck, e-mail: runningtide.tom@gmail.com	21/03/2013	09/12/2014	30.000,00			X

ICCAT GBYP DATA RECOVERY

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013 - 2014	20.000,00	06/2013	*Data recovery - Genetic analyses of ancient bones* - Dep. Biol.Geol., Genet. Env. Sc. - University of Bologna - Italy	Fausto Tinti, e-mail: fausto.tinti@unibo.it	22/10/2013	10/09/2014	13.000,00	1		
		50.000,00	direct contract	*Validation and Analyses of Trade, Auction and Market data provided to GBYP* - Roberto Mielgo Bregazzi - Spain	Robetrto Mielgo Bregazzi e-mail: robertomielgo1@telefonica.net	11/11/2013	05/05/2014	27.250,00	1	1	data on excel files

ICCAT GBYP AERIAL SURVEY

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013 - 2015	9.000,00	direct contract	Aerial Survey Extended Design- Alnilam Investigación y Conservación SA - Spain	Ana Cañadas, e-mail: anacanadas@alnilam.conm.es	10/04/2013	25/04/2013	9,000.00	1		
		19.000,00		*GBYP Aerial Survey Training Course* - ICCAT	Antonio Di Natale e-mail: antonio.dinatale@iccat.int		04/06/2013	11,708,06	1		
		460000,00	03/2013	*Aerial Survey on Spawning Aggregations - Sub-area A* - Grup Air Med - Spain	Javier Hevia, e-mail: javier@grupairmed.com	17/05/2013	02/08/2013	73,625.00	1		data on excel file
			03/2013	*Aerial Survey on Spawning Aggregations - Sub-areas E and G* - Périgord Travail Aerién - France (+1 subcontract to France)	Christian Gonzaléz, e-mail: christiangonzalez@aliceadsl.fr	17/05/2013	02/08/2013	245.718,25	1		data on excel file
			03/2013	*Aerial Survey on Spawning Aggregations - Sub-areas C, D and F* - Consorzio Unimar - Italy (+ 2 subcontracts to Italy)	Adriano Mariani, e-mail: unimar@unimar.it or mariani.a@unimar.it	17/05/2013	02/08/2013	124,915.00	1		data on excel file
			03/2013	*Aerial Survey on Spawning Aggregations - Sub-area B* - Action Communication SARL - France	Alexis Giordana, e-mail: ag@actionair-environnement.com	17/05/2013	02/08/2013	47,460.00	1		data on excel file
		10.000,00	direct contract	*Aerial Survey Data Analyses - Alnilam Investigación y Conservación SA - Spain*	Ana Cañadas, e-mail: anacanadas@alnilam.conm.es	14/08/2013	20/09/2013	6,000.00	1		data on excel files
			direct contract	*Aerial Survey Further Data Analyses - Alnilam Investigación y Conservación SA - Spain*	Ana Cañadas, e-mail: anacanadas@alnilam.conm.es	16/02/201	20/09/2013	1,915,00	1		data on excel files

ICCAT GBYP TAGGING PROGRAMME

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013 - 2014	500000,00	01/2013	*GBYP Tagging Programme 2013, tagging with baitboats in the Bay of Biscay and the Straits of Gibraltar - Fundación AZTI - Spain, as leader of a Consortium including 5 Spanish Institutions (+ 3 subcontracts)*	Nicolas Goñi, e-mail: ngoni@azti.es	20/06/2013	23/12/2013	500,000.00	1		data on excel file
		485000,00	01/2013	*GBYP Tagging Programme 2013, tagging adults with purse-seine in the Tyrrhenian Sea - Consorzio Unimar - Italy, as leader of a Consortium including 3 Italian Institutions (+ 1 subcontract to Italy)*	Adriano Mariani, e-mail: unimar@unimar.it or mariani.a@unimar.it	19/04/2013	23/12/2013	148,450.00	1		data on excel file
			01/2013	*GBYP Tagging Programme 2013, tagging juveniles with purse-seine in the Adriatic Sea - Kali Tuna d.o.o. - Croatia, (+ 1 subcontract to Croatia)*	Neven Cinoti, e-mail: neven.cinoti@kali-tuna.hr	19/04/2013	23/12/2013	92,135.00	1		data on excel file
			01/2013	*GBYP Tagging Programme 2013, tagging adults in tuna traps in Sardinia - Centro di Competenza sulla Biologia Marina - Italy, as leader of a Consortium including 3 Italian Institutions*	Pierantonio Addis, e-mail: addisp@unica.it	19/04/2013	23/12/2013	90,000.00	1		data on excel file
			01/2013	*GBYP Tagging Programme 2013, tagging adults in tuna traps in Atlantic Morocco - Institut National de Recherche Haulieutique - Morocco, as leader of a Consortium including 3 Moroccan Institutions*	Noureddine Abid, e-mail: noureddine.abid65@gmail.com	19/04/2013	23/12/2013	127,812.00	1		data on excel file

ICCAT GBYP BIOLOGICAL SAMPLING AND ANALYSES

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013 - 2014	365000,00	03/2013	GBYP Biological and Genetic Sampling and Analyses 2011- Fundación AZTI - Spain, as leader of a Consortium including 13 Institutions (3 Spain, 3 Italy, 1 Croatia, 1 France, 1 Ireland, 1 Japan, 1 Malta, 1 Morocco, 1 USA (+ 7 subcontracts, 2 Italy, 1 Spain, 1 Turkey, 1 Belgium, 1 Mexico and 1 Algeria)	Haritz Arrizabalaga, e-mail: harri@azti.es	21/10/2013	12/09/2014	356.942,86	3	1	data on excel files
			03a/2014	Collection of YOY BF samples	AZT - Haritz Arrizabalaga, e-mail: harri@azti.es	06/10/2014	05/12/2014	11.000,00	1		samples
			03b/2014	Collection of YOY samples	Massimiliano Valastro, e-mail: bubuval@hotmail.com	06/10/2014	05/12/2014	4.000,00	1		samples

ICCAT GBYP MODELLING APPROACHES

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013-2014	20.000,00	04/2013	Quantitative *Risk Assessment - Support to BFT Stock Assessment* - Imperial College Consultants Ltd - UK	John Mumford, e-mail: j.mumford@imperial.ac.uk	24/05/2013	13/12/2013	18,600.00	1	1	
		60.000,00	04/2013	*Statistically based stock assessment methods* - Prof. Murdoch McAllister, Ph.D. Thomas R. Carruthers -Canada - and Prof. Marie-Pierre Etienne - France	Prof. Murdoch McAllister, e-mail: m.mcallister@fisheries.ubc.ca	24/07/2013	13/12/2013	9,500.00	1	1	
			04/2013	Development of Biological Hypotheses for the Use within MSE (no bids have been submitted)	-			-			
		25.000,00		GBYP Core Modelling Group Meeting	Antonio Di Natale e-mail: antonio.dinatale@iccat.int	December 2014		14.339,00	1		
		30.000,00	01/2014	*Support to BFT Assessment (Coordinator)* - CSIRO - Australia	Ph.D. Campbell Davies, e-mail: campbell.davies@csiro.au	24/03/2014	20/02/2015	20.150,00	2	2	
		50.000,00	02/2014	*Support to BFT Assessment* - Dr. Tom Carruthers - Canada	Thomas Robert Carruthers, e-mail: t.carruthers@fisheries.ubc.ca	23/06/2014	20/02/2105	42.984,00	1	1	

ICCAT GBYP MID-TERM REVIEW

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
4	2013	50,000.00	05/2013	*Mid-Term Review - Andrew Payne, PhD*	Andrew Payne, e-mail: j.mumford@imperial.ac.uk	05/08/2013	15/09/2013	16.500,00	1	1	
				Mid-term Review, Alain Fonteneau, PhD	Alain Fonteneau, e-mail: alain.fonteneau@ird.fr	06/08/2013	15/09/2013	11.500,00			
				Mid-term Review, Ziro Suzuki, PhD	Ziro Suzuki, e-mail: zsuzuki@affrc.go.jp	06/08/2013	15/09/2013	16.000,00			

Annex IIb: GBYP contracts issued in the first part of Phase 5

ICCAT GBYP CONTRACTS AND MEETINGS (PHASE 5)

ICCAT GBYP COODINATION

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
5	2015-2016	15.000,00	direct contract	*ICCAT GBYP Steering Committee - External Member*	Ph.D. Tom Polacheck, e-mail: runningtide.tom@gmail.com	21/06/2015	21/02/2016	15.000,00			X

ICCAT GBYP DATA RECOVERY

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
5	2015 - 2016	20.000,00	direct contract	*Data recovery - Genetic analyses of ancient bones* - Dep. Biol.Geol., Genet. Env. Sc. - University of Bologna - Italy	Fausto Tinti, e-mail: fausto.tinti@unibo.it	07/05/2015	31/01/2016	20.000,00	1		

ICCAT GBYP AERIAL SURVEY

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
5	2015	9.000,00	direct contract	Aerial Survey Extended Design- Alnilam Investigación y Conservación SA - Spain	Ana Cañadas, e-mail: anacanadas@alnilam.conm.es	27/03/2015	01/04/2015	9,000.00	1		
		15.000,00	direct contract	*GBYP Aerial Survey Training Course* - Expert support	Ana Cañadas, e-mail: anacanadas@alnilam.conm.es	26/05/2015	28/05/2015	3.200,00	1		X
			cost reimboursement	*GBYP Aerial Survey Training Course* - ICCAT	Antonio Di Natale e-mail: antonio.dinatale@iccat.int		26/05/2015	tbd	1		
		640000,00	03/2015	*Aerial Survey on Spawning Aggregations - Sub-area A* - Grup Air Med - Spain	Javier Hevia, e-mail: javier@grupairmed.com	30/06/2015	03/08/2015	107.560,00	1		data on excel file
			03/2015	*Aerial Survey on Spawning Aggregations - Sub-area B, E, G* - Action Communication SARL - France (+2 subcontracts to France	Alexis Giordana, e-mail: ag@actionair-environnement.com	26/05/2015	03/08/2015	166.826,00	1		data on excel file
			03/2015	*Aerial Survey on Spawning Aggregations - Sub-areas C, D and F* - Consorzio Unimar - Italy (+ 2 subcontracts to Italy)	Adriano Mariani, e-mail: unimar@unimar.it or mariani.a@unimar.it	17/06/2015	03/08/2015	170.604,00	1		data on excel file
		not defined	direct contract	*Aerial Survey Data Analyses - Alnilam Investigación y Conservación SA - Spain*	Ana Cañadas, e-mail: anacanadas@alnilam.conm.es	04/08/2015	21/02/2016	26.400,00	2		data on excel files

ICCAT GBYP TAGGING PROGRAMME

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
5	2015	485000,00	05/2015	*GBYP Tagging Programme 2015, tagging adults with purse-seine in the Eastern Mediterranean - University of Istanbul - Turkey - and Consorzio Unimar - Italy (+ 1 subcontract to Turkey)*	Saadet Karakulak, e-mail: karakulak@istanbul.edu.tr Adriano Mariani, e-mail: mariani.a@unimar.it	17/06/2015	31/07/2015	148,450.00	1		data on excel file
			05/2015	*GBYP Tagging Programme 2015, tagging adults in tuna traps in Atlantic Morocco - Institut National de Recherche Haulieutique - Morocco, as leader of a Consortium including 2 Moroccan Institutions and 1 International NGO*	Noureddine Abid, e-mail: noureddine.abid65@gmail.com	03/06/2015	31/07/2015	92,135.00	1		data on excel file
			05/2015	*GBYP Tagging Programme 2015, tagging adults in tuna traps in Sardinia - Centro di Competenza sulla Biologia Marina - Italy, as leader of a Consortium including 2 Italian Institutions*	Pierantonio Addis, e-mail: addisp@unica.it	08/06/2015	31/07/2015	90,000.00	1		data on excel file
	2015 - 2016	100000,00	07b/2015	*Close-kin Genetic Study*							

ICCAT GBYP BIOLOGICAL SAMPLING AND ANALYSES

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
5	2015 - 2016	tbd	06b/2015	1 - Necton S.C.a r.l. - Italy	Antonio Celona. E-mail: info@necton.it	07/07/1905	31/12/2015	28.000,00	1		samples
			06b/2015	2 - GBYP Biological Studies- Fundación AZTI - Spain, as leader of a Consortium including 14 Institutions (2 Spain, 3 Italy, 1 Croatia, 1 France, 1 Ireland, 1 Japan, 1 Malta, 1 Morocco, 1 USA, 1 Portugal, 1 Turkey (+ 6 subcontracts, 1 Italy, 1 Spain, 1 Turkey, 1 Japan, 1 Croatia and 1 USA)	Haritz Arrizabalaga, e-mail: harri@azti.es	31/01/2015	12/09/2014	314.496,00	3	1	data on excel files
		10000,00	cost reimbursement	BFT Larval meeting	Antonio Di Natale e-mail: antonio.dinatale@iccat.int				1		

ICCAT GBYP MODELLING APPROACHES

PHASE	YEAR	BUDGET €	CALL FOR TENDERS or ACTIVITY	RETAINED PROPOSAL	main contact	working schedule		COST €	DELIVERABLES		
						initial date	final date		REPORT	SCRS PAPERS	OTHERS
5	2015 - 2016	25.000,00	cost reimbursement	GBYP Core Modelling Group Meeting	Antonio Di Natale e-mail: antonio.dinatale@iccat.int	December 2015			1		
		40.000,00	direct contract	*Support to BFT Assessment (Coordinator)* - Ph.D. Joseph E. Powers (USA)	Joseph E. Powers, e-mail: jepowers@lsu.edu	21/04/2015	22/02/2016	32.544,00	2	2	
		120.000,00	direct contract	*Support to BFT Assessment* - University of British Columbia - Canada	Thomas Robert Carruthers, e-mail: t.carruthers@fisheries.ubc.ca	19/05/2015	23/02/2016	110.126,00	1	2	
		27.000,00	cost reimbursement	*Travel costs for the Coordinator and the Expert*	Antonio Di Natale e-mail: antonio.dinatale@iccat.int	21/04/2015	23/02/2016				X

Annex III: List of meetings and activities attended by GBYP coordination staff or external invited experts

No.	date	place	Meeting or activity	Motivation
1	22-26/09/2014	Madrid (SP)	SCRS BFT Species Group	Overview of the GBYP activities, other BFT subjects
2	29/09-03/10/2014	Madrid (SP)	SCRS Plenary	Overview of the GBYP activities
3	10-17/10/2014	Genova (IT)	19th Special Meeting of the Commission	Overview of the GBYP activities
4	1-4/12/2014	Madrid (SP)	SCRS - Meeting of ICCAT GBYP Core Modelling Group	Participation as member and supervision of the meeting
5	10-12/02/2015	Madrid (SP)	Meeting of the GBYP Steering Committee	Detailed overview of all GBYP activities and plans.
6	02-06/03/2015	Madrid (SP)	ICCAT SCRS Bluefin tuna data preparatory meeting	Review of available data and discussion about their use for MSE; data requested for the next meeting.
7	08/05/2015	Amsterdam (NL)	Meeting organised by WWF NL with various Universities for developing a research plan for the Bluefin tuna in the North Sea.	Overview of GBYP activities and opportunities for cooperation
8	26/05/2015	Madrid (SP)	ICCAT-GBYP Training course on Aerial Survey	Training for pilots, professional spotters and scientific observers working for the GBYP aerial survey.
9	08-09/06/2013	Favignana (IT)	Settimana delle Egadi, Tonni e Tonnare	Historical review of traps activities (nop)
10	07/07/2015	Milano (IT)	EXPO – Conference on marine food and history	Historical and recent importance of traps in providing rich proteins (nop)
11	10-12/09/2015	Isla Cristina (SP)	2015 (XV) Meeting of Tuna Trap Captains	Report about the tuna fishery in the Canary Islands in the early XX century (nop)
12	21-25/09/2015	Madrid (SP)	SCRS BFT Species Group	Overview of the GBYP activities, other BFT subjects
13	23/09/2015	Madrid	Informal meeting of the Modelling MSE members present at the SCRS meeting	Discussion about the situation and the plan
14	26/09/2015	Madrid (SP)	Meeting of the GBYP Steering Committee	Detailed overview of all GBYP activities and plans.
15	28/09-02/10/2015	Madrid (ES)	SCRS Plenary	Overview of the GBYP activities

NOTE: nop = non official participation; the meeting was attended on personal behalf and without costs for the programme.